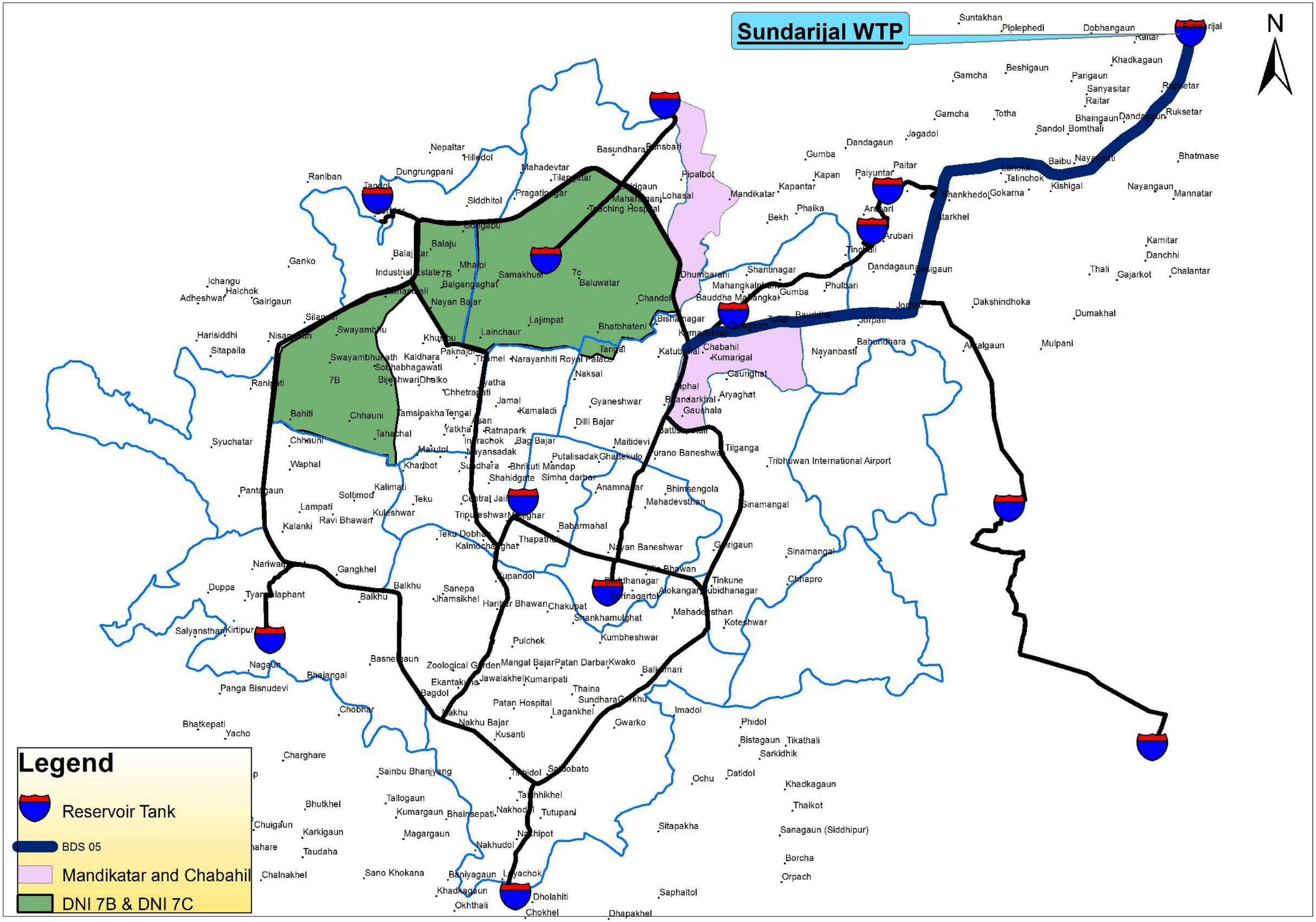
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Abbreviations

GoN	Government of Nepal
CIAMP	Capital Investment And Asset Management Program
LPCD	Liters Per Capita per Day
KUKL	Kathmandu Upatyaka Khanepani Limited
PID	Project Implementation Directorate
MWSP	Melamchi Water Supply Project
BDS	Bulk Distribution System
WTP	Water Treatment Plant
DI	Ductile Iron
O&M	Operating & Maintenance
ADB	Asian Development Bank
BS	British Standard
DIN	German Standard Organization (Deutsche Industry Norm)
ICB	International Competitive Bidding
LCB	Local Competitive Bidding
VAT	Valuated added tax

SECTION 1

PROJECT BACKGROUND AND DESCRIPTION

1.1 BACKGROUND

Kathmandu Valley is currently suffering from chronic water shortages and inefficient service delivery. To improve the present conditions of water supply and wastewater services in Kathmandu Valley, the Government of Nepal (GoN), with the assistance of several development partners, has embarked on a two-pronged improvement strategy that includes capital investments for infrastructure development, i.e., supply augmentation and system improvement and institutional reforms. In order to assist GoN in this endeavor, the Asian Development Bank (ADB) has provided loans covering both infrastructure investment and institutional reforms, namely Loan 1820-NEP: Melamchi Water Supply Project and Loans 2058/2059-NEP: Kathmandu Valley Water Services Sector Development Program.

To address the water supply challenges in the Kathmandu Valley, the government updated its ambitious capital investment and asset management program (CIAMP) in 2010, which envisages providing 135 liters per capita per day (lpcd) to the residents of Kathmandu Valley by 2025 from the current level of 45 lpcd. The plan defines two major phases for rehabilitation and expansion of the water supply and wastewater system. Phase 1 (2012-2016) focuses on rehabilitation of existing assets, development of a new water source, and initial expansion of the water distribution and wastewater system. Phase 2 (2016-2025) focuses on additional source augmentation and further expansion of the water distribution and wastewater system.

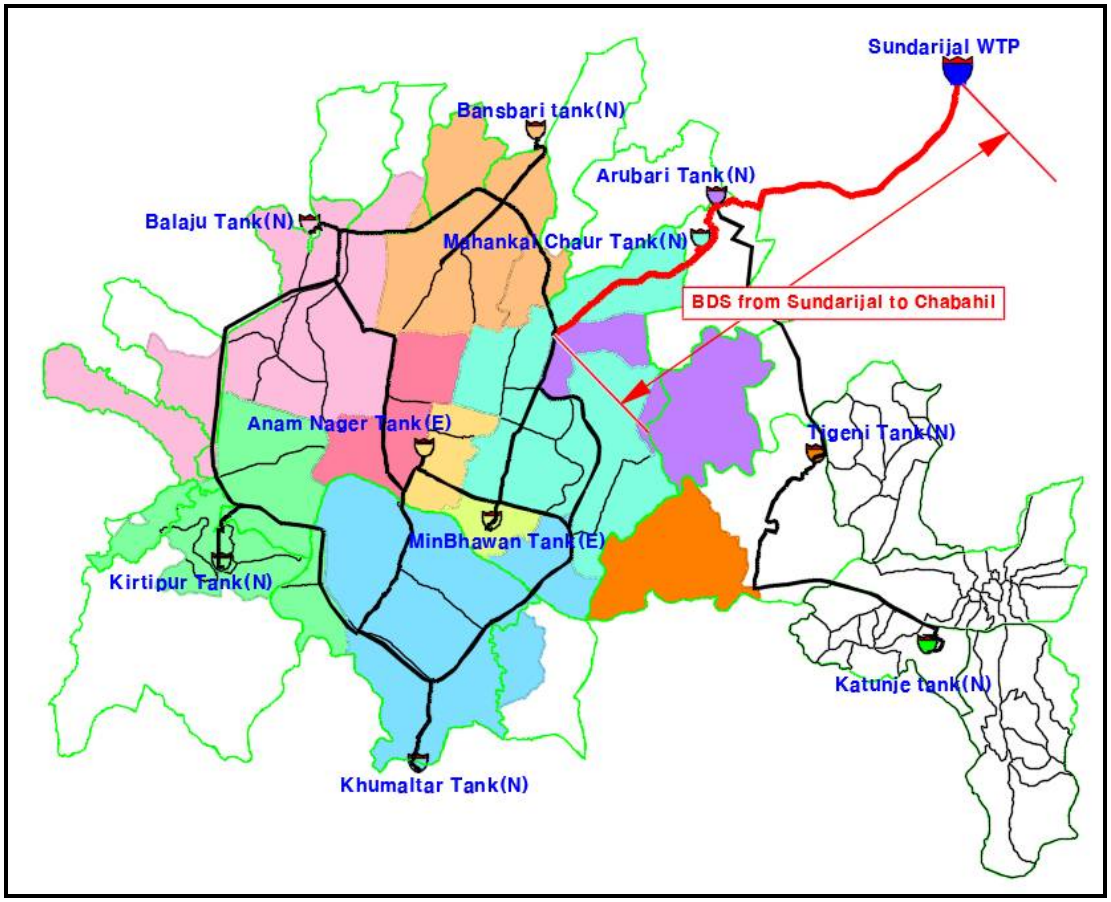
In line with Phase 1 requirements, ADB approved the original project on 16 September 2011 and it became effective on 7 February 2012. The $80 million loan complements ongoing investments to improve access, efficiency, and reliability of water supply services for the residents of Kathmandu Valley through improving the distribution system and enhancing operational and financial performance of the water utility, the Kathmandu Upatyaka Khanepani Limited (KUKL). Phase 1 is also supported by the Melamchi Water Supply Project (MWSP) and the Kathmandu Valley Wastewater Management Project. The Kathmandu Valley Wastewater Management Project will manage the wastewater generated from households receiving water from these projects. Phase 1 investment is the first step towards improving services but is still inadequate for serving the entire population of the Client's service area.

Additional financing (this project) will support the completion of Phase 1 and will start Phase 2 investments with a focus on distribution network expansion and improvement. The additional financing is in line with ADB's Nepal country partnership strategy, which supports the government's development objective of accelerated, sustainable, and inclusive economic growth.

1.2 SCOPE OF THESE DESIGN WORKS FOR BDS

- Design of remaining bulk distribution system, bidding documents preparation and procurement support for the Bulk Distribution System (BDS) from Sundarijal to Chabahil.

Figure 1.1 indicates the location of the new Bulk Distribution System that needs to be designed in this phase of design.



< Figure 1.1 : Location of BDS from Sundarijal WTP to Chabahil >

The Consultant understands and acknowledges the work to be completed under the Contract and detailed scheduling and resources has been planned for the most efficient implementation.

For the new BDS work, the Consultant reviewed master plan, related documents, current status and identified a 1400mm diameter singular BDS pipeline is under construction which was designed to carry 251 MLD treated water from Sundarijal.

According to the master plan, water from Sundarijal WTP will be transferred to service area with dual BDS pipelines and the second pipeline is under our scope of work. The second BDS line is to be designed and constructed to provide total of 542MLD of treated water to the whole service area. Out of which 32MLD water is assigned for Katunje SRT (Bhaktapur district) and remaining 510 MLD is estimated for KUKL service area of Kathmandu and Lalitpur districts.

The Consultant carried out the BDS design following the previous BDS0 design criteria. Since Bhaktapur was omitted in the master plan i.e. CIAMP report, consultant projected the population and demand and finalized the design to cover 542MLD; which was previously 510MLD.

1.3 FORMAT OF THE REPORT

The objectives of the Design Report are to ensure that all parties are aware of the scheme for which detailed designs have been prepared. The report contains technical, financial and procurement strategy details. The report is divided into the following sections:

1.3.1 Pipeline Routes

During the design report stage we have carried out further investigations to confirm the preferred route. We also considered several alternatives considering land acquisition and efficiency of the system. Details of the above topics are presented in Section 2.

1.3.2 Pipes

During Master Planning and BDS0 design and construction, the total demand was 510MLD. Since the total demand have increased to 542MLD, we expanded the nominal pipe diameter to 1600~1800mm which was planned as 1400~1600mm originally. Section 3 of this report will cover information and comparisons of pipe materials, details of bedding and backfilling considerations.

1.3.3 Pipeline Structures

Structures are required to allow a pipeline to be operated satisfactorily, to facilitate maintenance and to ensure the security of the pipeline. These range from valve chambers and washouts to thrust blocks and river crossings. The parameters that will be used for the design of these during the detailed design phase are presented in Section 4. The criteria and standards for structural design are presented in Appendix B. Geotechnical observations (from Lahmeyer/ Mott Macdonald/ Nepalconsult, 1999) are included in Appendix A.

1.3.4 Procurement Strategy

The procurement strategy for the recommended scheme is presented in Section 5. The strategy takes account of the works to be constructed, the capability of local contractors and the overall program for water supply improvements in Kathmandu Valley.

SECTION 2

PIPELINE ROUTE

2.1 INTRODUCTION

The conveyance of treated water from the clear water reservoir at Sundarijal Water Treatment Plant WTP) to various service reservoirs is necessary for the effective distribution of treated water to communities in the Greater Kathmandu Area. The Melamchi Water Supply Project is designed for ultimately improving water distribution to the entire Kathmandu Valley. This Design Report covers information of the NEW BDS line planned for water transmission to supply 542MLD targeted at year 2030. DSC05 have designed Bulk Distribution System (BDS) from Sundarijal WTP to Chabahil junction considering the existing BDS line (251MLD for Existing BDS, 291MLD for New BDS05) to transmit 542MLD efficiently to the distribution system. Ultimately, the entire distribution network system, supplying the communities, will be fed by gravity or pumping from ground level service reservoirs located within and on the perimeter of the urban area. The confirmation of the route has involved site visits and extensive consultation with PID.

2.2 CRITERIA FOR ROUTE SELECTION

The criteria used to select the pipeline route ensures that water can gravitate from the Sundarijal WTP to the service reservoirs, thus minimizing any negative social, environmental and economic impacts generated by the bulk distribution main either during its construction or operation phases. The following issues were addressed to achieve the above requirements and to ensure smooth and efficient transportation of treated water through bulk distribution mains:

- Laying of the pipe, for proposed range of diameters, is feasible.
- Ground slopes are reasonable and stable.
- Cross-drainages are minimum and do not require heavy structures.
- Right of way and working space are available along the route
- Access is available for transportation of pipes and movement of heavy vehicles.
- The routes are not excessively long.
- If possible the routes avoid built-up area, roads with congested existing infrastructure and do not encounter existing buildings and other structures.
- Number of structures requiring removal and the impact on the environment is minimized.
- Sharp changes in direction are avoided, where possible, to minimize bends.

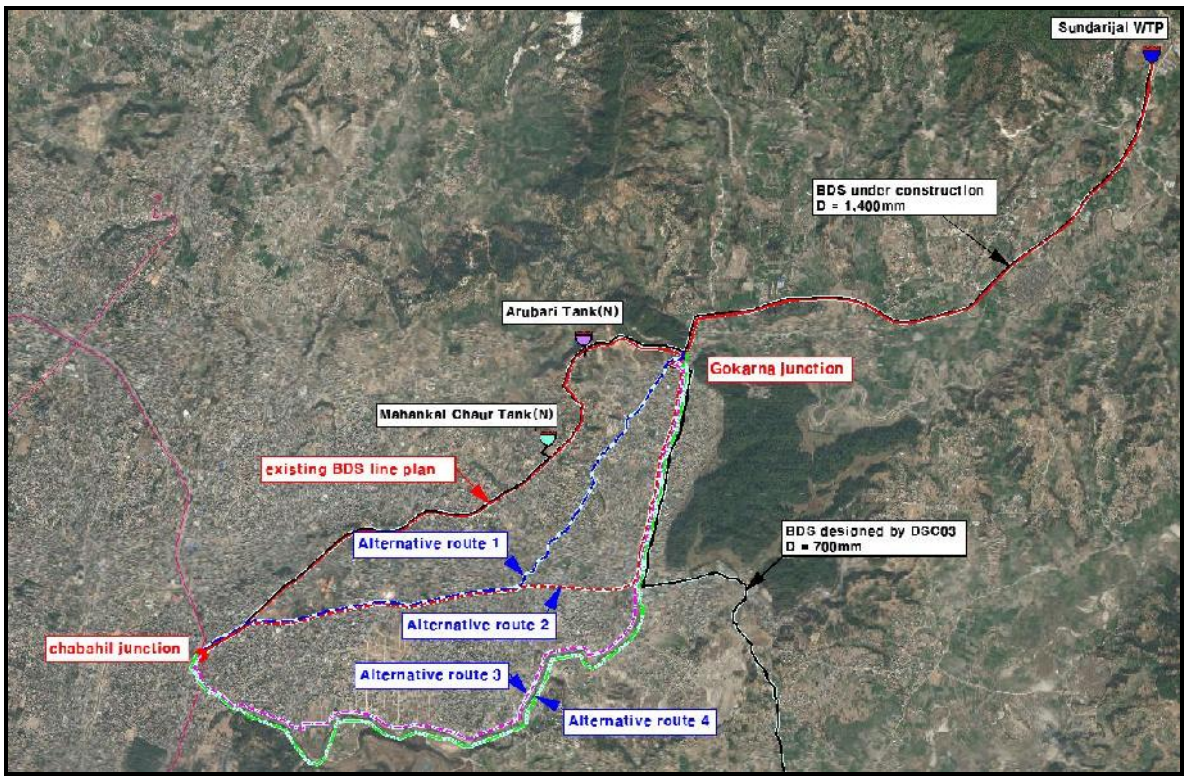
2.3 ROUTE OPTIONS

There may be four possible routes available which are technically feasible. The most appropriate and cost-effective routes are those which cause minimal environmental impact, need least maintenance and provide better facilities for future extension. The options with regards to selection of alignment routes for bulk distribution mains may be:

- alignment route along the acquired land for existing BDS line
- alignment route along existing roads and tracks
- alignment route adjacent to the existing roads and tracks
- alignment across open fields
- combination of some/all options.

2.4 ROUTE SELECTION

In order to select the pipeline route, four alternatives were selected through site investigation including the existing plan.



< Figure 2.1 : Alternative Routes of BDS >

2.4.1 Selection

Synthetically, as a result of reviewing the existing plan and alternative routes, alternative route 2 was selected. And this route selection is the confirmed result based on sufficient consultation with PID and KUKL.

Table 2.1 : Comparisons of Existing Plan and Alternative Routes (1/2)

S.N.	Items Name	Existing Plan	Alternative Route I	Alternative Route II	Alternative Route III	Alternative Route IV
		Parallel route along the Existing route	Along Hospital route	Along Bagmati corridor + Bouddha road	Along Bagmati corridor + Guheshwari road	Along Bagmati corridor + Gothatar road
1	Advantages	• Easily accessible for transportation • Less working space available • Less cost of road reinstatement • Less chances of encroachment	• Easily accessible for transportation • More working space available • Moderate cost of road reinstatement • Less chances of encroachment	• Up to Gokarna in the acquired corridor of 13.5 m wide • Better accessible for transportation • More working space available • Less cost of road reinstatement • Less chances of encroachment	• Easily accessible for transportation • More working space available • Moderate cost of road reinstatement • Less chances of encroachment	• Easily accessible for transportation • More working space available • Less cost of road reinstatement • Less chances of encroachment
2	Route Length	• D1800 : 2.54km • D1600 : 7.09km	• D1800 : 2.54km • D1600 : 7.70km	• D1800 : 2.54km • D1600 : 8.2km	• D1800 : 2.54km • D1600 : 9.74km	• D1800 : 2.54km • D1600 : 10.21km
3	Short Coming	• Chances of disturbance due to congested settlements and other utilities • Problem of accommodation of additional BDS pipe line along existing BDS route • Requirement of cost for service utility maintenance works.	• Chances of disturbance due to congested settlements and other utilities including longitudinal and lateral sewer • Requirement of cost for service utility maintenance works.	• Less chances of disturbance due to congested settlements and other utilities including longitudinal and lateral sewer • Requirement of cost for service utility maintenance works.	• Moderate chances of disturbance due to congested settlements and other utilities including longitudinal and lateral sewer • Requirement of cost for service utility maintenance works. • Limited space to bring from Mitra park to Chabahil • First phase BDS size is only 1000mm at Mitra Park	• Less chances of disturbance due to congested settlements and other utilities including longitudinal and lateral sewer • Requirement of cost for service utility maintenance works. • Two or more river crossings are necessary for the BDS pipe line
4	Civil Complaint	• Highest chances of complain for environmental issues such as dust, noise and traffic • Demand of temporary diversion facilities.	• More chances of complain for environmental issues such as dust, noise and traffic especially due to hospital area • Demand of temporary diversion facilities.	• Moderate chances of complain for environmental issues such as dust, noise and traffic • Demand of temporary diversion facilities.	• Moderate chances of complain for environmental issues such as dust, noise and traffic • Demand of temporary diversion facilities.	• Less chances of complain for environmental issues such as dust, noise and traffic • Less chances of demand of temporary diversion facilities.

S.N.	Items Name	Existing Plan	Alternative Route I	Alternative Route II	Alternative Route III	Alternative Route IV
5	Land Compensation	• No need of land and crop compensation	• No need of land and crop compensation	• No need of land and crop compensation	• No need of land and crop compensation	• No need of land and crop compensation
6	Traffic Problem	• Comparatively highest traffic problem • Stretch wise traffic diversion facilities could not be managed.	• Comparatively highest traffic problem • Stretch wise traffic diversion facilities could be managed temporarily.	• Comparatively moderate traffic problem • Stretch wise traffic diversion facilities could be easily managed.	• Comparatively less traffic problem • Stretch wise traffic diversion facilities could be easily managed.	• Comparatively less traffic problem Stretch wise traffic diversion facilities could be easily managed.
7	Economic Evaluation	• Comparatively Shorter pipe line • USD milion • Cost effective considering all other conditions such as land, crop and other utility compensation.	• Longer than existing BDS pipe line • USD 37.60 million • Less cost effective considering all other conditions such as land, crop and other utility compensation.	• Longer than Alternative-I BDS pipe line • USD 39.44 million • Cost effective considering all other conditions such as land, crop and other utility compensation.	• Longer than Alternative-II BDS pipe line • USD 45.10 million • Lesser cost effective considering all other conditions such as land, crop and other utility compensation.	• Longer than Alternative-III BDS pipe line • USD 46.82 million • No cost effective considering all other conditions such as land, crop and other utility compensation.
8	Reason for Selection	• As per master plan and CIAMP report.	• Problem of accommodation of additional BDS pipe line along existing BDS route.	• Problem of traffic and service utilities due to academic and health institution such as teaching hospital along alternative-I BDS route.	• Problem of traffic due to Bouddha road for tourist and major road to Gokarna and sankhu along alternative-II BDS route.	• Problem of traffic due to public road for jorpati and Gokarna along alternative-III BDS route.

Note:

(a) Preliminary cost estimate of BDS pipe line are done with reference to the procedures adopted by BDS05.

(b) Cost of pipe line up to 1600 and 1800 mm diameter D. I. pipes including laying is taken as per PWD of Nepal .i.e. lowest rates from fresh quotations of 3 manufacturers for pipe fittings and standard rate analysis practice of PWD of Nepal for other civil work items.

(c) Calculation of trench width, bedding materials, cradle, blanket and back filling are done according to the procedure adopted by DSC-02 and 03.

(d) Assumed quantitate of pipe accessories and line chambers according to walkover survey are;
- Eleven numbers of RCC chambers for three line valves, nine air valves and eight washout valves
- Forty one thrust blocks for horizontal bends and twenty one thrust blocks for vertical bends of 1600 mm diameter pipe
- Three thrust blocks for horizontal bends and nine thrust blocks for vertical bends of 1800 mm diameter pipe
- Three river crossing for alternative-IV BDS route

(e) Pavement reinstatement of the road consisting of sub grade, sub-base, priming and asphalt concrete work.

Table 2.2 : Comparisons of Existing Plan and Alternative Routes (2/2)

	Existing	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Accessibility	○	○	◎	○	○
Available Space	△	○	○	○	○
Road Reinstate	○	△	○	△	○
Obstacles on Route	X	X	○	△	△
O&M Cost	X	X	△	X	○
Civil Complaint	X	△	○	△	◎
Land Compensation	○	○	○	○	○
Traffic Problem	X	X	△	○	○
Estimated Cost	30 M USD	29 M USD	30.9 M USD	35 M USD	37 M USD
Recommendation			√		
◎ Best ○ Good △ Moderate X Bad					

Conclusion
- Existing : Not recommended due to existing pipeline and Social problems (Civil Complaint and accessibility)
- Alternative 1 : Not recommended due to congested settlement (hospital, utilities and sewer line)
- **Alternative 2 : Recommended due to relatively easy construction and Cost effective (Right of River Flow)**
- Alternative 3, 4 : Not recommended due to Cost of the construction

2.5 PIPE DIAMETER

2.5.1 Summary

Kathmandu Valley faces a very severe water shortage, and in order to meet the water demand of Kathmandu Valley, the Melamchi water supply project is currently under construction and design. The first master plan (TA 4893-NEP) was established in 2010 to supply Kathmandu valley water, which was later revised through a detailed review of the master plan (2776 (NEP) SF). The amount of water demand until this time was planned to supply 510MLD to the Kathmandu Valley through Sundalijal WTP, but the amount supplied from the Sundalijal WTP was determined to be 542MLD as the Bhaktapur area was included. In this design, for the design of the BDS pipeline, various studies were carried out by applying the 542MLD calculated from the final BDS master plan to supply a stable distribution of reservoir volume from the Sundalijal WTP to each reservoir.

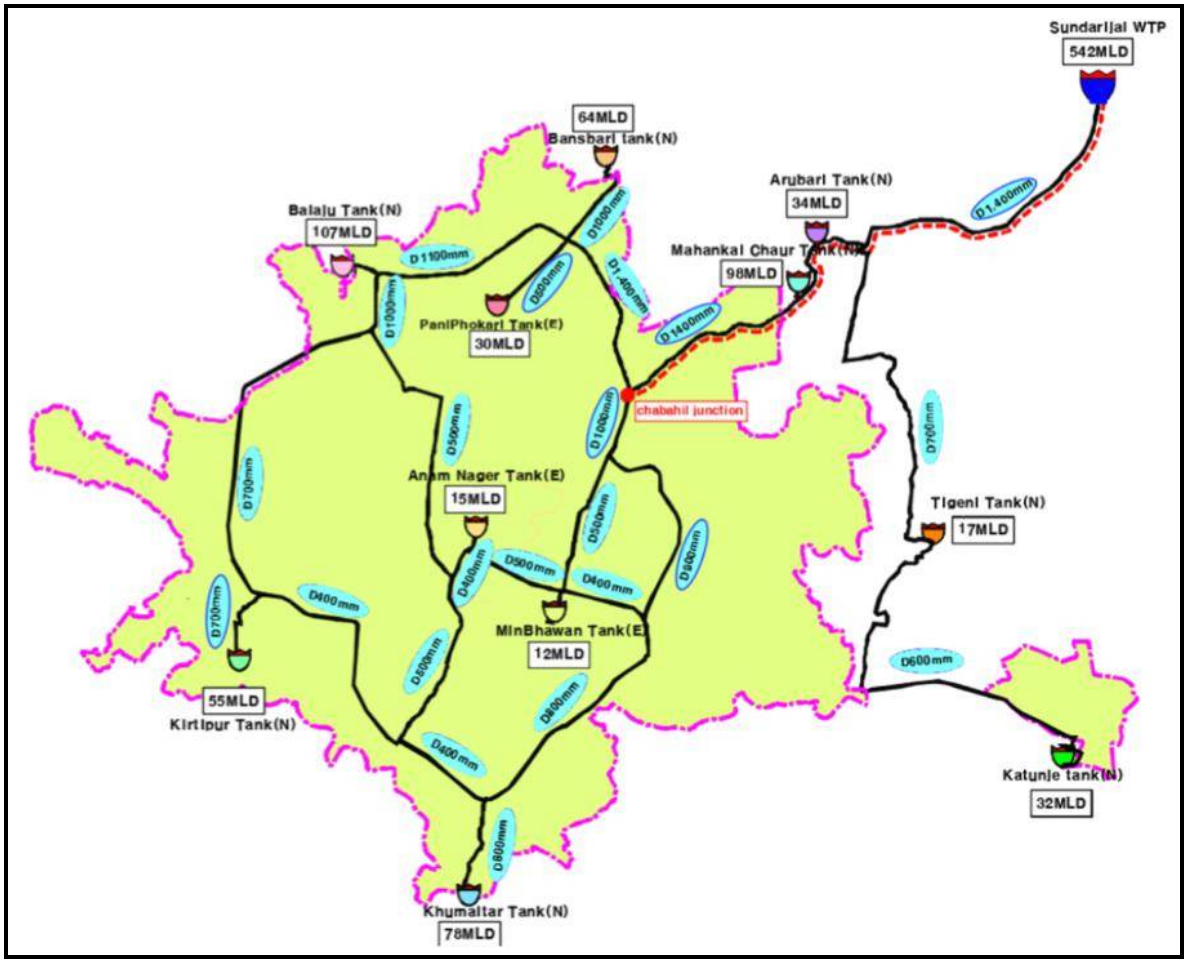
2.5.2 Review of reservoir distribution

In order to determine the diameter of the parallel pipelines to the BDS line (Sundalijal WTP to chabahil junction), which is the scope of this detail design, the master plan was reviewed. Recently, the BDS03 was determined by applying the demand amount of 542MLD including Bhaktapur area. The plan is to set the year 2030 as the target year, and the population distribution, demand and supply plan for each reservoir are as follows.

Table 2.3 : The population distribution, demand and supply plan for each reservoir

Reservoir	Population			Demand(MLD)						each reservoir supply
	2015	2025	2030	2015	2025	2030	Each reservoir distribution			
BALAJU	360,281	519,247	617,585	60.906	87.779	104.403	36.517	72.100	107.102	107
BANSBARI	192,990	298,502	368,976	32.625	50.321	62.375	19.561	41.333	63.987	64
PANIPOKHARI	102,486	153,811	172,043	17.325	24.702	29.084	10.387	20.290	29.836	30
MAHANKALCHAUR	335,262	478,016	562,798	56.676	80.809	95.141	33.981	66.375	97.600	98
ARUBARI	83,959	146,477	195,469	14.193	24.762	33.044	8.510	20.339	33.898	34
MINBHAWAN	41,855	59,677	70,261	7.076	10.088	11.878	4.243	8.286	12.185	12
ANAMNAGAR	50,519	72,030	84,806	8.540	12.177	14.336	5.120	10.002	14.707	15
KHUMALTAR	292,730	391,550	449,027	49.486	66.192	75.908	29.670	54.369	77.870	78
KIRTIPUR	167,195	260,243	324,760	27.945	43.357	54.003	16.755	35.613	55.399	55
TIGANI	51,867	81,334	100,424	8.768	13.750	16.977	5.257	11.294	17.416	17
KATUNJE	137,722	172,993	188,473	23.282	29.245	31.861	-	29	32	32
Grand Total	**1,816,866**	**2,633,880**	**3,134,622**	**283.540**	**413.937**	**497.149**	**170**	**369**	**542**	**542**

The distribution plan for each reservoir is shown in the following figure. In this plan, parallel pipe installation was examined based on this.



< Figure 2.2 : The Distribution Plan for each reservoir >

2.5.3 Additional SRT requirements

After reviewing the construction phases of SRT, we have considered the additional SRT requirements for the distribution system. The additional SRT requirements are as shown in table 2.4.

Table 2.4 : Additional SRT requirements

Sub-Zone – Reservoir	Demand in 2030(MLD)		Storage Volume, MLD (6 hour demand)								Short Fall Storage Volume (m^3)
	Other DSC	DSC 05	Usable Existing Storage		Increment Required		Land Allowed Storage	New Storage in Phase-1 Construction	New Storage in Phase-2 Construction	Short Fall Storage	
			Other DSC	CIAMP Report	Other DSC	CIAMP Report	Other DSC	Other DSC	Other DSC	CIAMP Report	DSC 05
Balaju	101.8	104.4	18.0	-	84.0	104.4	72.0	28.0	44.0	32.4	8,100
Bansbari	65.0	62.4	27.2	-	37.8	62.4	38.0	38.0	-	24.4	6,100
Panipokhari	29.1	29.1	-	-	29.1	29.1	30.0	30.0	-	-	-
Mahankal Chaur	95.1	95.1	34.0	-	61.2	95.1	62.0	31.0	31.0	33.1	8,500
Arubari	33.0	33.0	-	-	33.0	33.0	34.0	34.0	-	-	-
Min Bhawan	11.9	11.9	12.3	12.3	-	-	-	-	-	-	-
Anam Nagar	14.3	14.3	10.8	10.8	3.5	3.5	-	-	-	3.5	-
Khumaltar	75.9	75.9	-	-	75.9	75.9	76.0	38.0	38.0	-	-
Kirtipur	54.0	54.0	6.4	-	47.6	54.0	48.0	24.0	24.0	6.0	1,500
Tigeni	17.0	17.0	5.2	4.0	11.8	13.0	12.0	12.0	-	1.0	-
Sub-Total	**497.1**	**497.1**	**113.9**	**27.1**	**384.0**	**470.4**	**372.0**	**235.0**	**137.0**	**100.4**	**24,200**
Bhakatapur-Katunje (New)	32.0	32.0	8.0	8.0	24.0	24.0	24.0	24.0	-	-	-
Total	**529.1**	**529.1**	**121.9**	**35.1**	**408.0**	**494.4**	**396.0**	**259.0**	**137.0**	**100.4**	**24,200**

These SRT Short fall storage volume shall be constructed near the existing/construction phase SRTs at the same ground level. The newly constructed SRTs shall have the same operating water level of the existing/constructing SRTs.

The SRT short fall shown above are only considering 542MLD water supplied from Sundarijal WTP.

2.5.4 Apply of hydraulic criteria

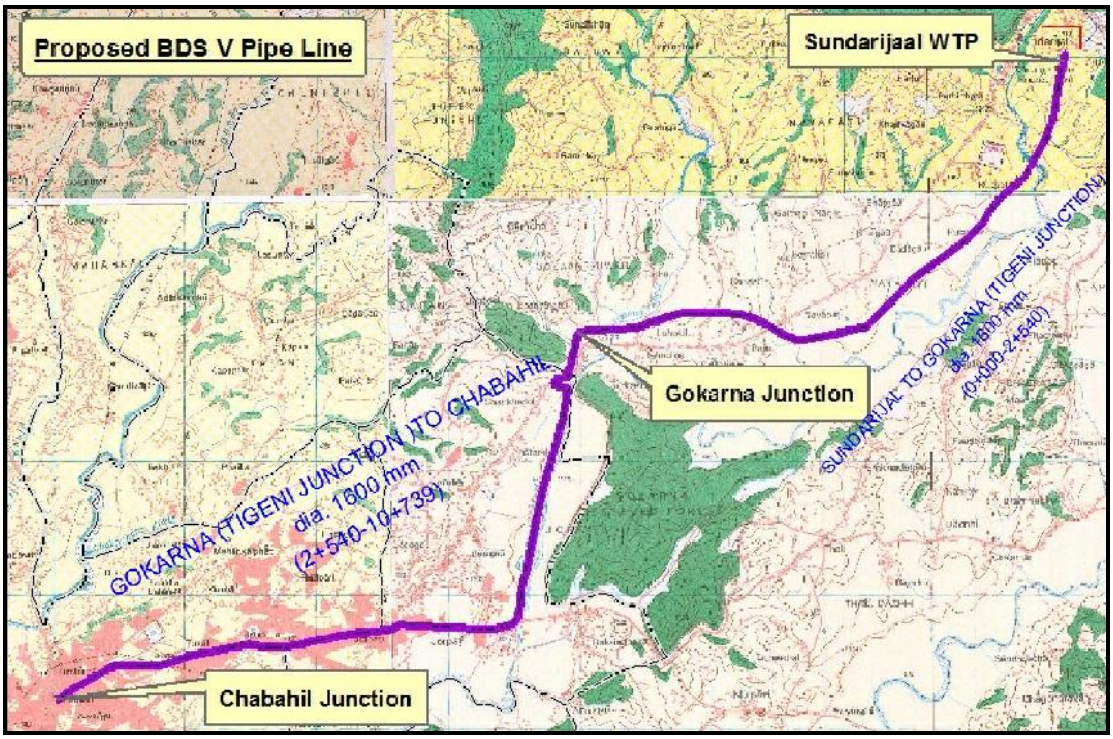
In this design, the modeling conditions and parameters applied in the DSC03 are applied for consistency with the master plan, and the contents are as follows.

1) BDS Pipe line is designed using 542MLD flow including all pipes of phase 1 and 2.
2) EPANET program is used
3) The velocity in pipe is maintained as 0.4 to 2.2 m/s
4) Pressure head at the top of reservoirs inlets is 4m or higher.
5) Hazen-William Friction Coefficient C = 130 for Ductile Iron Pipe
6) Model is designed using static pressure at Sundarijal treatment plant (2m above outlet pipe level to eliminate air vortices in the pipe) at 1397m AMSL

2.5.5 Review of pipe diameter by condition

In order to determine the diameter of the BDS pipeline, we ran EPANET program applying all the pipe routes as per the above data.

Considering that the reservoir inlet pressure is at least 4m, the core reservoir for the hydraulic calculation is Bansbari tank (N). If that reservoir inlet pressure is more than 4.0m, the treated water could be supplied stably to the other reservoir. As a result of the hydraulic review based on what is mentioned right before, the diameter of BDS pipeline was determined from D1,600 to D1,800 as shown below.



< Figure 2.3 : Pipe Diameter of BDS by condition >

2.6 LAND ACQUISITION

The pipeline route identified includes sections in roads and across fields. The land requirements for the proposed bulk distribution mains differ during the construction and operation phases.

2.6.1 Right of Way

The pipeline right of way is the corridor of land above the pipeline which is permanently dedicated to the pipeline. Therefore, no structures or roads can be constructed within the limits of the right of way without first obtaining the permission of the pipeline owner. This enables the pipeline agency to review any changes in loading on the pipeline and, if necessary, allows for inclusion of additional protective measures to prevent any damage to the pipeline from the new construction, both during and after construction. It also allows the pipeline agency to ensure that access to critical locations for operation and maintenance purposes is maintained.

The required width of the right of way is dependent on several criteria. It must be wide enough to accommodate all normal operations and maintenance activities. It must also be wide enough to allow for any emergency activities. For example, if there is a leak or rupture in the pipeline, the right of way should be wide enough to allow for the excavation and repair or replacement of the defective section of the pipeline.

Another consideration when determining the required width of the right of way is the possible inclusion of space for the future twinning of the transmission main.

For the off-road sections of the pipeline, a permanent right-of-way of width 10.5 meters has been acquired. For the sections within existing roadways, the available width of roadway right-of-way varies from 4m to 8m.

2.6.2 Working Easement and Techniques for Working in Congested Areas

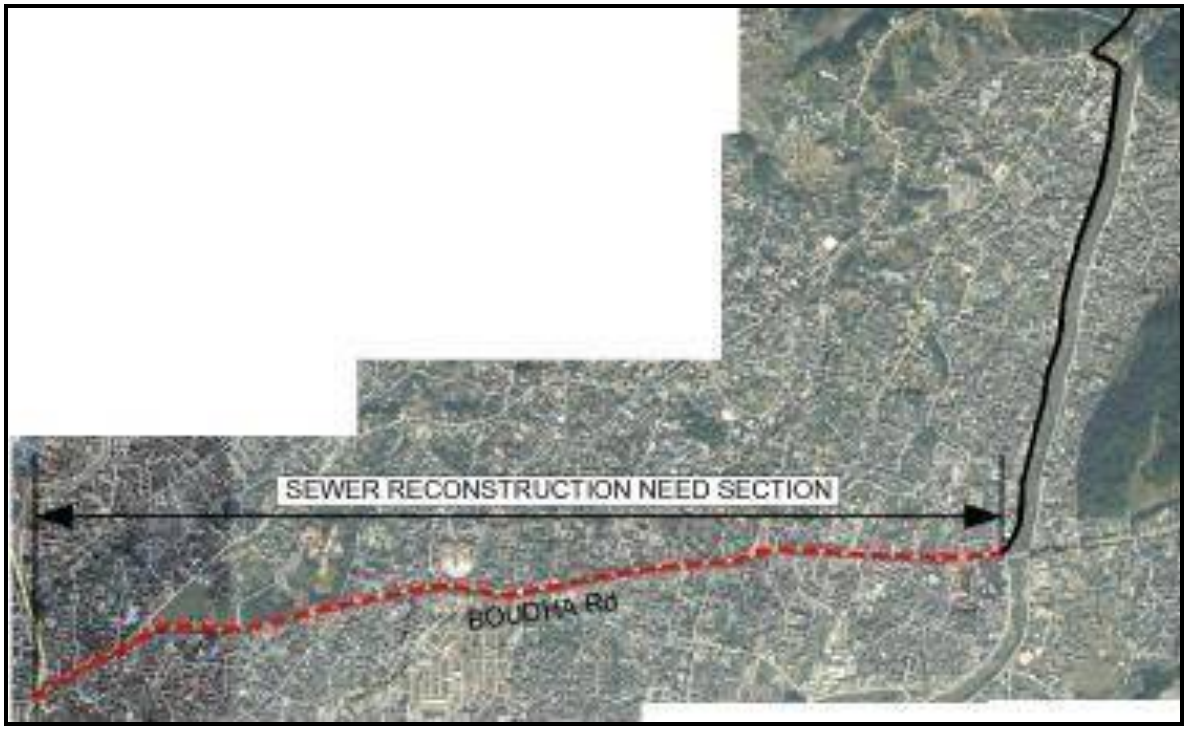
In some instances, the right of way is not wide enough to complete the initial construction efficiently and economically. In some instances, such as in built up areas, existing surface and underground structures restrict the working space available and the size and capacity of equipment which may be used for the pipeline installation.

The narrower sections will not permit traffic access along the roadway during construction, and will require the Contractor to arrange detours.

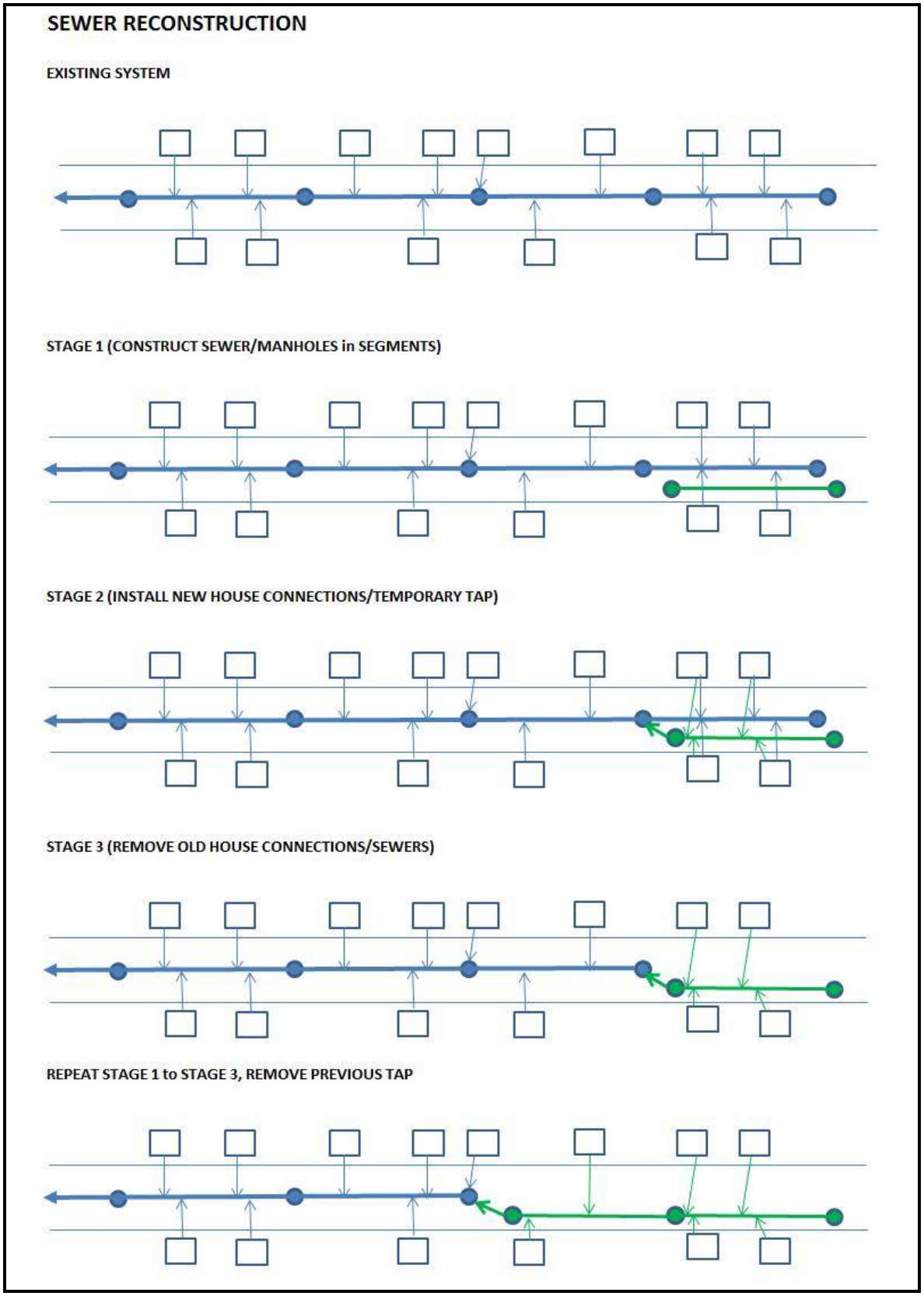
Sewer Reconstruction

The portion of the pipeline alignment within the existing roadway also contains an existing combined sewer (300mm diameter) located approximately in the middle of the road which will need to be relocated by the Contractor as part of the works. The section where the sewer pipe relocation is required is mainly along the Boudha road as shown in Figure 2.4 and Figure 2.5 illustrates how the sewer relocation will be undertaken in stages:

- The new (relocated) sewer and manholes are reconstructed in segments.
- New house connections are provided to the new segments, and a temporary tap to the downstream existing sewer is provided.
- The old house connections and sewer segments are removed.
- The new line is advanced downstream, and the process is repeated.



< Figure 2.4 : Sewer Relocation Map>



< Figure 2.5 : Sewer Relocation Procedure>

Because of the narrow width of the roadway, the sewer relocation in several areas will need to be performed prior to construction of the water pipeline.

2.7 PIPELINE POSITION

2.7.1 General

When considering the position of the pipeline one must consider the impact of the construction and operation of the pipeline on existing features and also the impact of those features on the pipeline. The most significant aspects to consider are outlined below.

2.7.2 Adjacent Construction

The pipe trench should, wherever possible, not be closer than 5 m to existing structures to avoid possible failure of foundations etc. During construction of the pipeline some construction; walls, fences etc, will be damaged and it will be the contractor's responsibility to repair or reinstate these items.

If it should prove necessary to construct the pipe trench closer to any existing structures it will be specified that the contractor must take particular care and take all measure to ensure the safety of the structure. If 5 m is not available, vertical trench with support system such as shoring will be applied to acquire the stability of ground. In unavoidable case if depth of pipe could not be maintained, pipe with concrete casing will be installed shallowly. The structure will be inspected before and after completion of the works to assess any damage.

2.7.3 Other Utilities

Other utilities generally have requirements to protect their services from damage. Detailed requirements will be determined by discussions with the concerned authorities. The general requirements are as follows:

- Power Lines: The closest a pipeline can be laid to power lines, as per Nepal Electricity Authority, is 6 m vertically and not interfering with transmission tower foundation horizontally.
- Telephone Cables: Pipelines should be laid below the telephone cables and should not interfere with the manhole structure of the cables.
- Sewers: It is preferable to install the water pipeline above sewer lines. Horizontally, water lines should be laid to avoid the sewer manhole structure and have a minimum of 3 m distance (2 m trench separation).
- Water Supply: BDS pipe is as large pipe as 1800~1600mm. Therefore, if existing water supply pipe line encounters/interferes in BDS pipe line, the existing one shall be relocated as required. In case of BDS line adjacent to the existing line, the minimum spacing between two lines must be above 50 cm. Otherwise, in case of the under 50 cm spacing, concrete casing need to be installed to protect the pipe.

2.8 LAND REQUIREMENTS

2.8.1 Trench Requirement

The excavation of the trench is, of course, necessary to install the pipe. The trench dimensions are determined by the design grade (depth) of the pipe and the soil properties.

Once the depth has been determined, the trench configuration is dependent on whether the excavation will be free standing or supported by shoring. Shored excavations for a short duration, as in a moving trench, are usually much more expensive and only used in confined areas or areas with very poor ground conditions.

The bottom width of the trench is determined by the outside diameter of the pipe plus an allowance to allow proper placement and compaction of backfill material around and under the pipe. The dimensions are given in Section 3. If the ground conditions are such that it is necessary to exceed this amount, special provisions may be required to ensure the pipe is adequately supported. This could include using a stronger class of pipe or a higher class of backfill around the pipe or both.

From the bottom of the trench it is normal for the trench wall to be vertical to 0.3 m above the crown of the pipeline. An assessment of the soil conditions must be made to confirm that this height does not exceed the safe height for a short-term unsupported face. Above this point the trench wall will be sloped back. A slope of one vertical to one horizontal is common. Depending on the soil profile's integrity this side slope may be steepened, or in the worst case, may have to be flattened. By extending the side slopes to their intersection with the ground surface, the top of trench width can be determined.

2.8.2 Trench Spoil

The trench excavation produces an equal amount of material that must be stockpiled. As this excavated material is not compacted the stockpile volume will be larger than the trench volume. As this is a significant amount of material, it is preferable to stockpile it alongside the trench rather than to haul it away and then haul it back to site for backfilling. However, this may not be possible in some of the narrower sections of the roadway alignment. The contractor may choose to use the excavated material as backfill over the pipes nearby, thus reducing the double handling and the working space required.

2.8.3 Material Storage

The pipe and other construction materials (bedding material, etc) must also be stored either along the alignment or at a designated storage site or sites. This would require additional equipment at the storage site to load and haul the material to site as needed for installation.

2.8.4 Contractor's Equipment

Depending on the type of pipe and specifically its jointing method, a certain amount of space is required along the top of the trench for the installation. Large cranes, trucks and other equipment must have access to this area to permit the pipe installation.

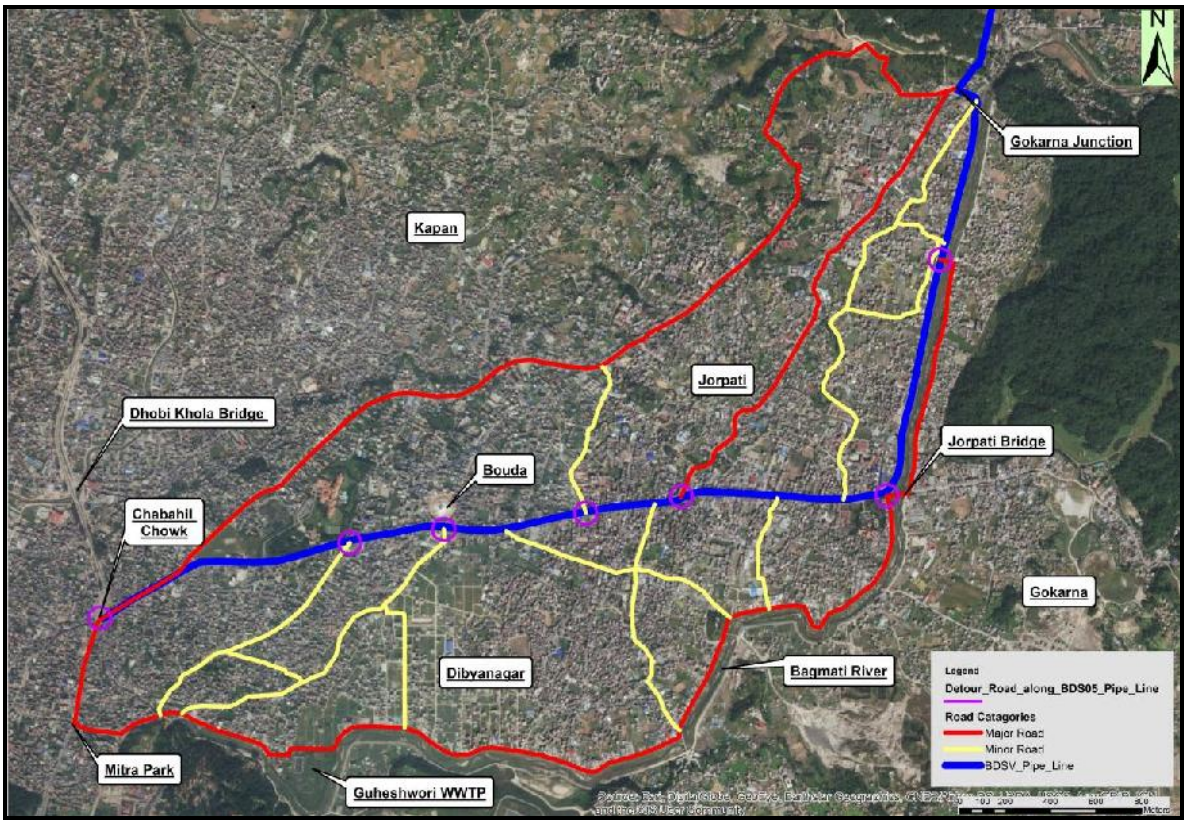
2.8.5 General Access, Detours and Traffic Management Plan

During construction of the pipeline, good general access is required to the site, and to homes and businesses along the site. The Contractor shall be required to program his work in such a way that, wherever the temporary closure of street sections to public thoroughfare cannot be avoided, the duration of traffic diversion can be kept as short as possible. No streets shall be closed and no detours shall be introduced and no traffic diverted until the Contractor's

proposals have been approved by the Engineer and the appropriate Government authorities, such as the Roads Department and Traffic Police.

BDS Construction from Sundarijal WTP to Gokarna Junction is planned on the 13m width road provided from KUKL. This road is very wide and not used as public road but only used for BDS construction and BDS maintenance. Thus, the detour plan is only planned from Gokarna Junction to Chabahil Junction.

Figures 2.6 shows one sections of the pipeline alignment which are in existing roads and will likely require detouring of ordinary traffic during construction.



< Figure 2.6 : Map of Detour plan>

Figure 2.6 indicates a heavily populated segment of the pipeline alignment in the roadway, and it will be relatively easy for the Contractor to design short detours which minimize loss of roadway access to adjacent homes and businesses. Figure 2.6 suggests above detours, however the final arrangements should be left to the Contractor to design.

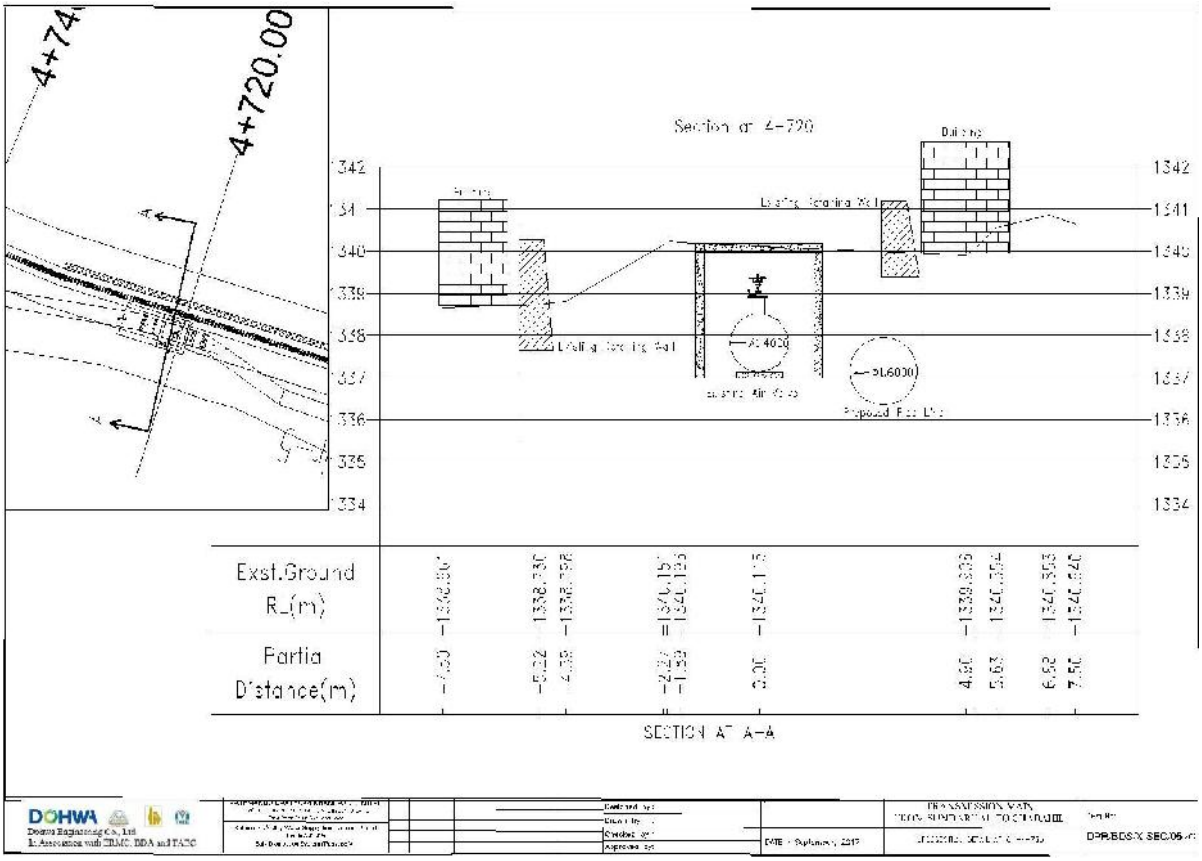
2.8.6 Laying the Pipes in the Dry

The pipes must be laid in the dry. Should the inflow of water from the surrounding soil be such that dry conditions cannot be maintained by simple pumping a well point system may be necessary. The well points may increase the working space requirements.

2.9 Crucial Points in BDS05

2.9.1 Narrow Section

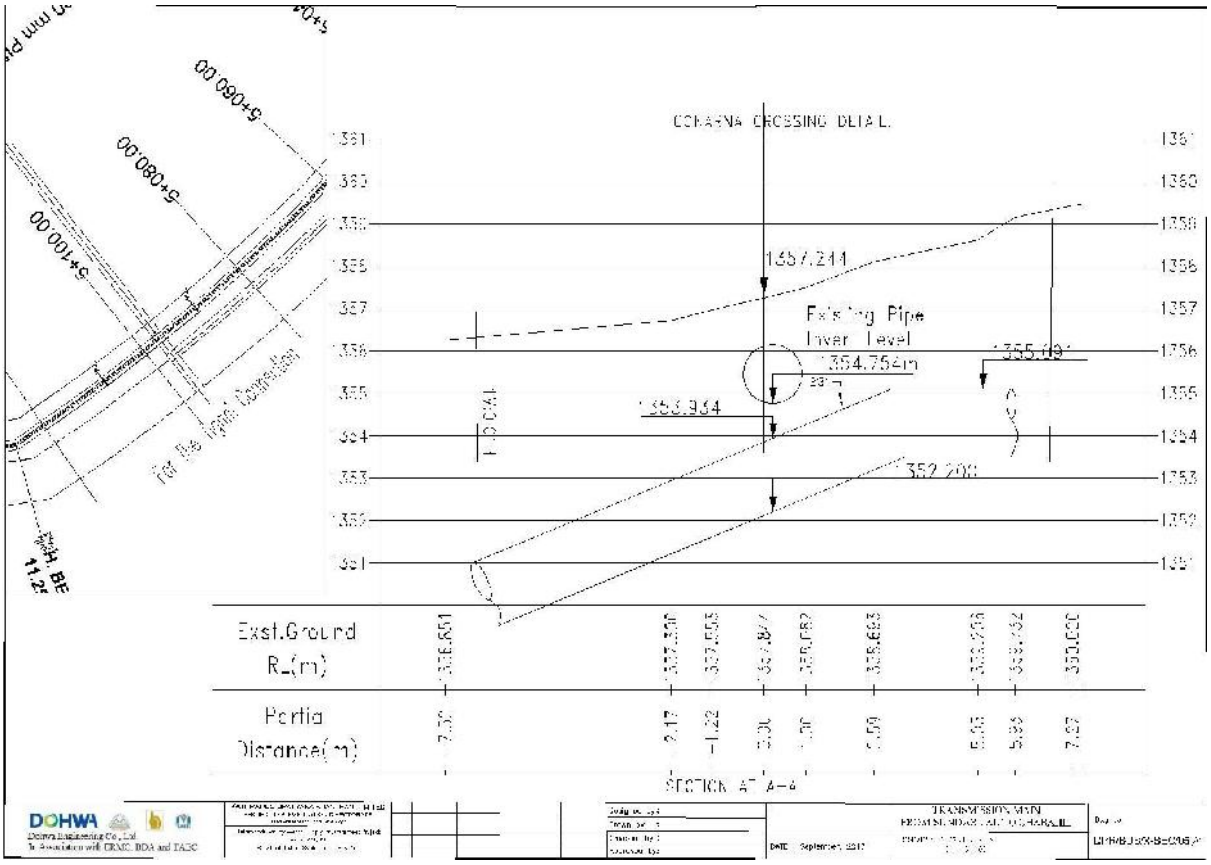
At section 4+720 of BDS design, there is a very narrow road where BDS0 is already laying. BDS05 is planned at the right side of the air chamber of BDS0. Since there is a retaining wall above the BDS05 route, the retaining wall shall be demolished during construction and reconstructed after BDS05 pipe works are finalized. See Figure 2.7 for details.



< Figure 2.7 : Drawing of Narrow Section>

2.9.2 Gokarna junction BDS Crossing

Near Gokarna junction where the chain number is 5+80, BDS05 will be crossing the existing BDS0. BDS05 is designed to go below the existing BDS0 pipe line. The distance between two BDS is planned minimum 50cm away from each other to secure stability. See Figure 2.8 for details.



< Figure 2.8 : Drawing of BDS0 and BDS05 Crossing>

SECTION 3
Ductile Iron Pipes and Fittings

Pipes and Fitting

General

Ductile iron pressure pipes and fittings shall comply with ISO 2531. All pipes shall be Class K9, socketed unless otherwise specified. All fittings shall be socketed unless specified otherwise, fittings other than tees shall be K12, tees shall be K14. The working pressure of all pipe and fittings shall be 16 bar.

Materials

The materials used in the manufacture pipes and fittings shall comply with ISO 2531.

Tests

Tests on pipes and fittings shall be carried out in accordance with ISO 2531. The Employer shall be permitted free access to the place to manufacture for the purpose of examining and witnessing the testing of pipes and fittings.

Joints

Flexible non restrained (push fit)

These shall be flexible spigot and socket joints with sockets integral with the pipes and incorporating rubber rings recommended by the manufacturer and approved by the Engineer. Elastomeric gasket components shall comply with ISO 4633.

Mechanical joints

These shall be flexible spigot and socket joints with the sockets integral with the pipes. The joint shall be sealed by compressions of a rubber ring in the socket by means of bolting. The joint shall be suitable for use on the spigot of normal push fit jointed pipe.

Restrained joints

These shall be push fit type joints and shall incorporate some means of preventing the spigot being withdrawn from the socket once the joint is made. The joint shall be able to withstand the forces imposed when testing the pipeline using an end cap fixed with the restrained joint.

Flanged Joints

These shall be as specified in Clause 3.08.1.

Puddle and Thrust Flanges

Puddle and thrust flanges shall comply with Clause 3.08.1 but remain un-drilled.

Linings

Pipes

The pipes shall be internally lined in the factory with a sulphate resisting or portland cement mortar. The thickness and the lining shall be in accordance with ISO 4179. Prior to application of the lining the internal surfaces shall be shot blast cleaned to acceptable standard. The lining shall be applied centrifugally. The cement composition shall conform to BS 4027 or BS EN 197-1.

Certain sections are amplified as follows:

No additives shall be used without the written approval of the Engineer, and shall be used strictly in accordance with the manufacturer’s recommendations.

The thickness of the lining at any one point shall not be less than the specified minimum thickness.

All linings shall have a smooth uniform surface finish.

Fittings

The fittings shall be internally lined in the factory with either a cement mortar lining as specified for pipes or an epoxy coating. The epoxy coating shall be suitable for potable water by test certificate from an international health institute, shall be abrasion resistant, and shall be subject to the approval of the Engineer. The thickness of the lining shall be not less than 0.3 mm. Prior to application of the lining the internal surfaces shall be shot blast cleaned to acceptable standard. All linings shall have a smooth uniform surface finish.

Coating

General

Unless otherwise specified, ductile iron pipes and fittings shall be zinc coated with a bitumen over coating, all in accordance with the following Specifications. Buried pipes and fittings shall also have a site or factory applied polythene sleeving. Pipe coatings shall be inspected on site and any damage or defective areas made good to the satisfaction of the Engineer.

Zinc Coating

Zinc coating shall comply with ISO 8197 and shall be applied as a spray coating. The mass of sprayed metal shall not be less than 130 g/m2 as described in Clause 5.2 of ISO 8197.

Bitumen Coating

Bitumen coating shall be of normal thickness 0.07 mm unless otherwise specified. It shall be a cold applied compound complying with the requirements of BS 3416

Type II, suitable for tropical climates, factory applied in accordance with the manufacturer's instructions.

Damaged areas of coating shall be repainted on site after removing any remaining loose coating and wire brushing and rusted areas of pipe.

Polyethylene Sleeving

Unless indicated otherwise, polyethylene sleeving shall be provided in addition to bitumen coating. Polyethylene sleeving shall comply with ISO 8180.

Site applied sleeving shall be stored under cover, out of direct sunlit, and its exposure to sunlight shall be kept to a minimum. Pipes having a factory applied sleeving must be stored in the same conditions.

Pipe Marking

In addition to the marking required to comply with ISO 2531, the pipes and fittings shall bear readable and indelible marks as follows:

A unique identification number

Spigot ends will show control marks for ease in connection.

Pipes which are gauged to allow them to be cut shall be marked by a two diametrically opposed longitudinal lines each at least 20mm wide.

Slip-on Type couplings

Slip-on type couplings shall include the following couplings:

Straight flexible couplings;

Stepped flexible couplings;

Flange adapters

Dismantling joints.

Slip-on type couplings shall be from the Viking Johnson System manufactured by the Victaulic Company or similar approved and suitable for use with ductile iron pipes manufactured to ISO 2531.

All nuts, bolts and washers used in the construction of the coupling shall be cadmium plated.

Flanges which mate with pipes, fittings and valves shall be drilled to BS EN 1092-2 (ISO 2531)

Gaskets and jointing rings shall comply with Clause 3.08.3

Gate Valves

Gate valves shall comply with BS EN 1171. All valves shall be suitable for use with potable water. Valves complying with BS 5163 are acceptable provided that they also comply with BS EN 1171.

Specific Clauses of BS EN 1171 are amplified as follows:

Types of valves

Solid with non-rising stem.

Nominal sizes

All valves shall be flanged end PN designated non-clamp type valves. Sizes as indicated in the Bill of Quantities.

Nominal Pressure

PN 16 unless otherwise indicated in the Drawings or Bill of Quantities.

Dimensions

Valves shall be Basic Series 3 as Table 3.

General

Flanged and drilled to BS EN 1092-2 (ISO 2531)

Bypasses

Gate valves used on the Contract shall not be fitted with bypasses.

Body Tapping

As specified to BS 21 (ISO/R7) fitted with bronze or gunmetal plug.

Operation

Gate valves shall be provided with cast iron handwheels or square heads for tee key operation as detailed in the Bill of Quantities.

The direction of operation shall be clockwise to close the valve.

Handwheels shall require a force not greater than 20 kg on the outer rim to operate with a balanced pressure across the valve.

Tee keys shall require a force not greater than 12 kg applied at the opposite ends of a standard key from the closed position.

Choice of Materials

Brasses shall not contain more than 5% zinc gunmetal to BS 1400 Grade LG3; aluminum bronze or nickel copper alloy may be employed for internal components. Body and wedge shall be of spheroidal or cast grey iron. The valve body and other uncoated ferrous parts shall be painted with epoxy paint 250micron thick.

Test Certificates

The Supplier shall provide a test certificate confirming that the valves have been tested in accordance with BS 5150 and stating the actual pressures and medium used in the test. In addition the Supplier shall ensure that the Purchaser has access to the manufacturer's works at all reasonable times for the purposes of inspecting the assembled valves and witnessing testing.

Butterfly Valves

Butterfly valves shall comply with BS 5155 Table 6. Double flanged long or other approved standards. Nominal pressure rating PN16 unless indicated otherwise in the Drawings or Bill of Quantities. Flanges drilled to BS EN 1092-2 (ISO 2531).

Materials shall be as follows:

Body: Ductile iron SG 400-15 to Bs 2789

Body sealing ring: gunmetal LG2C to BS 1400

Disc: SG 400-15 ductile iron to BS 2789

Seal retaining ring: bronze

Shaft: stainless steel 304 in self lubricants bushes

Internal bolts, nuts and set screws: stainless steel

Body and disc painted with epoxy 250 micron thick

Manual devices for operation shall be so geared that under the operating conditions as specified herein, the maximum force on the rim of the handwheel, crank, or other necessary for operation shall not exceed 20 kg and the maximum torque shall not exceed 5.5 kg/m. A spur, bevel, or work gear reduction unit, if required, shall be attached to the pinion shaft of the operating mechanism.

The reduction gears shall be made of steel with machined teeth and unless otherwise provided, they shall be enclosed in a cast iron or fabricated steel sealed housing with

oil seals, and shall operate in an oil bath. The pinion shaft and screw stems shall be made of alloy steel. The pinion shaft shall be provided with bronze sleeves.

The thrust bearings at each end of the pinion shaft shall have external fittings to permit lubrication with grease. The screw stem shall have a thrust bearing of the ball or roller type which can be lubricated with grease through an external fitting.

The gearbox shall indicate the position of the disc, shall be suitable for installation in a wet chamber and shall be suitable for electric actuation.

Test certificates shall be supplied with each valve.

Automatic Air Relief Valves

Design of Air Valves

Automatic air relief valves shall conform to AWWA C512 and be designed to meet the following conditions:

Discharge air during charging of the pipeline

Admit air during emptying of the pipeline, or when the pipeline pressure falls below atmospheric pressure during a surge event

Discharge air accumulated at local peaks along the pipeline under normal operating condition.

Conditions (a) and (b) shall be met by the employment of a large orifice capable of handling large volumes of air at a high flow rate, and condition (c) by a small orifice capable of discharging small quantities of air as they accumulate.

Valves with air intakes or exhaust facilities shall have approved screening arrangements to prevent the ingress of air borne sand.

Types of Air Valves

Double Acting Air Valves

These shall combine both large and small orifices within one valve. The large orifice shall be sealed by a rigid float and the chamber housing shall be designed to avoid premature closing of the valve by the air whilst being discharged.

The small orifice shall be sealed by a float at all pressures above atmospheric except when air accumulates in the valve chamber.

Single Air Valves

These include a small orifice only operating in a manner identical with the small orifice in a double acting valve.

General Specification

The nominal pressure range shall be PN 16 unless indicated otherwise in the Drawings or Bill of Quantities.

Body ends shall be flanged with raised faces and drilled BS EN 1092-2 (ISO 2531).

The materials for the valves shall be as follows:

Body cover and cowl	-	Ductile Iron SG 400-15 to BS 2789
Small orifice	-	Ductile iron with gunmetal seat
Small orifice float	-	Rubber covered or other approved
Large orifice	-	Ductile iron with rubber seat
Large float	-	Vulcanite covered or other approved

Body and other uncoated ferrous parts painted with epoxy 250 micron thick

Tests

Test certificates shall be provided with each valve showing.

Hydraulic testing to at least 1.5 x working (rated) pressure or high pressure strength test

Low head leakage tests

Small orifice testing

Large orifice discharge test

During the tests the air flow rates shall be measured by orifice plates in accordance with BS 1042. Pressures (positive and vacuum) shall be measured by Bourdon tube gauges in accordance with BS 1780, or by means of a mercury-in-glass manometers. The temperature of the flowing air shall be measured in accordance with BS 1041: Part 1 and Part 2. The barometric pressure shall also be measured.

Float Valves

General

The nominal pressure range shall be PN16 unless indicated otherwise in the Drawings or Bill of Quantities.

The float valve shall have a right angle discharge and consist of a ported globe valve (Glenfield and Kennedy Type 1048 or similar) the operation of which is controlled by float. The flow through the valve shall be controlled by the level of the float. The float shall control the movement of the piston by a direct lever system.

The materials of construction of the valve will be:

Body	Ductile Iron SG 400-15 to BS 2789
Cylinder	Ductile Iron
Fulcrum Bracket	Ductile Iron
Piston	Ductile Iron
Seal, Guides and Piston Seal Holder	Gunmetal
Face and seals	Synthetic Rubber
Liner and Pins	Bronze
Links	Mild steel cadmium plated

Lever	Mild Steel
Float	Plastic or tinned copper

Body ends shall be flanged with raised faces and drilled BS EN 1092-2 (ISO 2531).

Body and lever and other unprotected ferrous parts painted with epoxy 250 micron thick

Particular Requirements

The float valves shall comply with the following criteria.

Location	Maximum Head m	Valve Dia. mm	Maximum Flow l/s	Average Flow l/s
Mahankalchaur BPT	36	500	600	220

Tests

The body shall be tested to 1.5 times the rated pressure and the closed assembly tested to the rated pressure for leakage. Test certificates shall be supplied with each valve.

Flow Control Valve

General

Flow control valves shall be hydraulically operated pilot controlled diaphragm valve with solenoid operated closure control.

The valve shall limit the flow rate to the specified value regardless of the pressure. The valve shall be controlled by a differential pilot valve sensing the pressure differences caused by an office plate. The de-energizing of the solenoid shall cause the valve to shut tight.

The main valve shall consist of a removable Aluminum-Bronze seat and resilient rubber seal fully supported by a seal disc.

The stem will be guided at the top by a replaceable guide bearing in the valve bonnet, and at the bottom, by an Aluminum-Bronze centering device, connected to the seal disc and moving freely inside the seat.

No bottom guide bearing is permitted.

The synthetic rubber diaphragm will be fully supported, top and bottom, by rigid discs and will be connected to the stem in a way which enables fast and easy replacement on site.

No external packing gland and piston activation is permitted.

The valve will be equipped with a position indicating rod.

The pilot system shall contain a differential pilot designed to close when the controlling differential exceeds the adjustable spring setting. The pilot control is normally held open by the force of the compression on the spring above the diaphragm and it closes when the pressure acting on the underside of the diaphragm exceeds the spring setting. The pilot control system shall contain a fixed orifice. No variable orifices shall be permitted.

The orifice plate flange assembly shall be of non ferrous material.

Small diameter non ferrous pipework, valves, strainers shall be provided to allow operation of the system.

Large diameter pipework including necessary, tapers, dismounting joints etc shall be supplied to allow installation of the valve in the feed main specified. Connections to other pipework shall be flanged and drilled to BS EN 1092.2 to PN16.

All ferrous items shall be protected by an epoxy coating with a minimum 300 microns thickness.

Tests

Each pressure and flow control valve shall be tested at the manufacturer's works as follows:

Body strength: closed end test, valve open, test pressure 1.5 times working pressure

Valve element strength: open end test, valve closed, test pressure applied to inlet end of 1.5 times working pressure

Leak tightness: open and test, valve closed, test pressure of the working pressure applied to inlet end, no visible leakage permitted.

Test certificates shall be supplied with every valve.

Pressure Reducing Valve

General

Pressure reducing valves shall be hydraulically operated pilot controlled diaphragm valve of a similar design to the flow control valve.

The valve shall limit the downstream pressure to the specified value regardless of the flow. The valve shall be controlled by a differential pilot valve sensing the downstream pressure.

The main valve shall consist of a removable Aluminum-Bronze seat and resilient rubber seal fully supported by a seal disc.

The stem will be guided at the top by a replaceable guide bearing in the valve bonnet, and at the bottom, by an Aluminum-Bronze centering device, connected to the seal disc and moving freely inside the seat.

No bottom guide bearing is permitted.

The synthetic rubber diaphragm will be fully supported, top and bottom, by rigid discs and will be connected to the stem in a way which enables fast and easy replacement on site.

No external packing gland and piston activation is permitted.

The valve will be equipped with a position indicating rod.

The pilot system shall contain a differential pilot designed to close when the controlling pressure exceeds the adjustable spring setting. The pilot control is normally held open by the force of the compression on the spring above the diaphragm and it closes when the pressure acting on the underside of the diaphragm exceeds the spring setting. The pilot control system shall contain a fixed orifice. No variable orifices shall be permitted.

The orifice plate flange assembly shall be of non ferrous material.

Small diameter non ferrous pipework, valves, strainers shall be provided to allow operation of the system.

All ferrous items shall be protected by an epoxy coating with a minimum 300 microns thickness.

Particular Requirements

The pressure reducing valves shall comply with the following criteria.

Location	Control Head m	Maximum Head m	Dia. of main mm	Maximum Flow l/s	Average Flow l/s
Mahankalchaur BPT	7	36	500	600	220

The valve shall be complete any necessary pipework to allow installation in a length of 1200mm. The connections to other pipework shall be with flanges drilled to BS EN 1092-2 to PN 16.

Tests

Each pressure reducing valve shall be tested at the manufacturer's works as follows:

Body strength: closed end test, valve open, test pressure 1.5 times working pressure

Valve element strength: open end test, valve closed, test pressure applied to inlet end of 1.5 times working pressure

Leak tightness: open and test, valve closed, test pressure of the working pressure applied to inlet end, no visible leakage permitted.

Test certificates shall be supplied with every valve.

Check Valves

Check valves shall comply with BS 5153, and be suitable for use with potable water. The valve shall close using a lever weight arrangement.

Details are follows:

Nominal Pressure PN16 unless otherwise indicated in the Drawings or Bill of Quantities.

Body Flanged with flanges drilled to BS EN 1092-2 (ISO 2531).

Materials:

Body and cover plate	-	Ductile iron
Resilient Disc	-	Steel EPDM encapsulated
Hinge Pin	-	Stainless Steel

Hinge Bush	-	Copper Alloy
Lever Arm	-	Steel
Weight	-	Ductile Iron

The body, cover plate and other uncoated ferrous parts shall be painted with epoxy paint 250 microns thick.

Tests

Testing shall be in accordance with BS 5153, certificates shall be provided for every valve.

Flap Valves

Flap valves shall be circular door double hung.

The valve shall be suitable for mounting on a wall or flanged pipework thimble. Valves for flange fixing shall be suitable for flanges drilled to BS EN 1092-2 (ISO 2531).

Materials:

Frame	-	Ductile Iron BS 2789
Door	-	Ductile Iron BS 2789
Sealing faces	-	Copper Alloy
Hinge links	-	Mild Steel
Hinge brackets	-	Ductile Iron BS 2789
Hinge Pins	-	Bronze

All ferrous metal parts shall be painted with epoxy paint 250 microns thick.

Tests

Flap valves shall be tested with a head of 5 m for free operation in opening and closing and for leak tightness. A certificate shall be provided with each valve.

Penstock

Penstocks shall be of the full frame type.

The penstock shall be suitable for wall mounting with an offsetting head of 2m.

The penstock shall have adjustable wedges to accommodate wear during the life of the penstock.

Materials:

Frame	-	High Grade Cast Iron
Door	-	High Grade Cast Iron
Sealing Faces	-	Copper Alloy. The sealing face shall be fixed to the door and frame using countersunk pegs in the some material as the sealing faces.
Wedges	-	High Grade Cast Iron
Thrust housing	-	Cast Iron with low friction thrust washer and lubrication.
Door Nut	-	Gunmetal

Penstock operation shall be with a rising stem and a floor mounted headstock. The headstock shall be of cast iron and fitted with a position indicator and handwheel. The operation shall be so geared that the maximum force on the rim of the handwheel shall not exceed 20 kg when there is a head of 2 m on the penstock. Stem bearings shall be gun metal bushed.

Where headstocks are structurally mounted above penstock, then operating spindle extensions shall be used between the penstock and headstock. These shall be suitable for length adjustment during assembly and shall be fitted with universal couplings adjacent to the penstock and to the headstock. The two couplings shall be so orientated as to give a liner transmission of rotational movement between headstock and penstock stems.

Tests

Penstocks shall be tested with an offseating head of 2 m for ease of operation with the headstock and for leak tightness. A certificate shall be provided with each penstock.

Marking of Valves and Fittings

The valves and fittings shall bear readable and indelible marks as follows in the English language.

- a unique identification number
- manufacturing mark
- last two digits of year of manufacture
- nominal diameter
- nominal pressure
- confirming standards

PIPES

3.1 INTRODUCTION

Lahmeyer/ Mott Mac Donald/ Nepalconsult (1999) considered that ductile iron to be the optimal pipe material for this project. All of the BDS up to date have been constructed by applying ductile iron and are under construction. A discussion of pipe material considerations from their earlier design report follows.

3.2 ASBESTOS CEMENT

The water supply authorities in Nepal have adopted a policy of not using asbestos cement pipes; therefore their use was not considered for the bulk distribution mains.

3.3 PRESTRESSED CONCRETE NON-CYLINDER PIPE

It was not known whether prestressed concrete non-cylinder pipe had been used in Kathmandu as pressure pipes. The performance of this type of pipe in other countries has a varied track record with frequent bursts often being reported. Considering this history this type of pipe was not recommended for the bulk distribution mains.

3.4 PRESTRESSED CONCRETE CYLINDER PIPE

There are no manufacturing facilities for PCCP in Nepal. The BDS and prospects of future large diameter pipeline projects is not large enough to encourage a factory to be established in Kathmandu. The pipes do not have a significant cost advantage over other alternative: therefore they were not considered further for the bulk distribution mains.

3.5 PLASTIC

PVC-U and polyethylene (MDPE and HDPE) pipes are used in Nepal for both transmission and distribution pipelines. The size range of the pipes is limited and there is a risk of damage if the pipes are used in areas where construction will take place in future. For big size pipes, HDPE are not manufactured since its not cost effective compared to metallic pipes such as DI & Steel pipes. Joints and pressure rating for large diameter pipes are also limited. To ensure the pipeline has good structural properties, a high standard of bedding is required. Without good storage conditions plastic pipes deteriorate, and storage of materials for future repairs may be difficult. The use of plastic pipes for the bulk distribution mains would mean two types of material are used, plastic for the smaller mains, and steel or ductile iron for the larger mains. However, the smaller diameter pipes are generally required in the higher pressure sections of the BDS and plastic pipes are not particularly suited to the duty.

3.6 GLASS FIBRE REINFORCED THERMOSETTING RESIN

There are no manufacturing facilities for large diameter glass reinforced plastic (GRP) pipes in Nepal. The pipes can be manufactured for any pressure rating and may be used for large

and small diameter pipelines. They have the advantage that they are comparatively light and easy to install and they are resistant to corrosion. They are flexible pipes which require good quality bedding; they can be damaged by rough handling. The pipes do not have a significant cost advantage over other alternatives and therefore they were not considered further for the bulk distribution mains.

3.7 STEEL

3.7.1 General

There is only limited experience of the use of steel pipes in distribution systems in Nepal.

Steel pipes have the advantage that they can be designed for any pressure and this can result in cost savings. The design of the pipes for a particular pressure does limit future options unless the pipes are designed taking into account future loading. The pipes can be designed to withstand considerable longitudinal forces eliminating the need for anchor (thrust) blocks in many locations. The joints are generally welded giving little tolerance for ground movement or for making on-site adjustment to the pipeline alignment during installation.

The same companies that fabricate the pipe could weld the joints of the pipes on site. It was considered that the pipes would either have to be laid and the pipes jointed in the pipe trench or welded on the edge of the trench and then lowered/snaked into the pipe trench. Welding the joint in the trench would require a large excavation at each joint to allow access for the welder to make the joint. For the larger pipes it will take a day to make each joint. Trench sheeting would generally be required to ensure there is no danger of trench collapse whilst welding or coating the joint. The alternative of welding the pipes on the edge of the trench and then lowering/snaking them into the pipe trench was not considered practical for the following reasons:

- A larger working easement would be required than is generally available.
- A large amount of trench would need to be open to snake the pipes into position.
- The heavy lifting equipment needed to move the pipes is not available.

The pipes require a good standard of bedding to ensure deflections are not excessive.

The addition of new sections of pipeline to an existing steel system requires specialist skills in welding. The location of tees and fittings may also be limited as tees must be made in single plate and not include joints.

3.7.2 Bedding

The initial geotechnical field surveys (refer to Appendix A for the details) indicated that the native soil material would be likely to be fine-grained soil. This type of material provides very little support to flexible pipes such as steel pipes and, in order to enable the pipeline to withstand soil, vehicle and other imposed loads, a reasonable quality of bedding would be required. The recommended bedding would need to comprise of at least a cradle of graded gravel, and a blanket of native material.

3.7.3 Operation and Maintenance

General pipeline operation and maintenance will include regular inspection and operation of all valves plus periodic inspection of the route for illegal connections and visible leaks.

If a cathodic protection system is installed the requirements for operation and maintenance are greater for steel pipe than any other material. The operation of the system must be regularly monitored and periodically anodes and/or electrical components which are required to maintain the protection will require replacement. If an impressed current system is installed there will be operational costs associated with the electricity consumed to provide the pipeline protection.

3.8 DUCTILE IRON

3.8.1 General

Nepali contractors have experience of laying ductile iron pipes up to 1,400 mm diameter. Based on experience, there will be no difficulty for Nepali contractors to lay 1,600 mm ~ 1,800 mm diameter which is applied to this design, including the following topics: handling of pipes and fittings; laying; jointing; setting of valves, specials, and fittings; cutting of pipes; anchor/ thrust blocks and pedestals; internal pipe cleaning; and pipe testing. The required skills are easily learned, and the equipment for laying large diameter pipes is available locally.

The pipes are relatively strong; they can withstand large external loads with modest bedding. The majority of standard pipes and fittings can handle pressures up to 16 Bar. The flexible joint system means that earthquake movements can be accommodated. Restrained joints can be provided by most manufactures where the pipes are to withstand some longitudinal forces; however, generally thrust blocks are required. The strength of the pipes means they are less likely to be damaged than other materials.

Ductile iron pipes can be laid quicker with short lengths of trench open at any one time. This can have a positive impact on the contractor's overheads and disruption to road traffic. The system can be modified and additional facilities easily added to the pipe network.

3.8.2 Lining

The lining for ductile iron pipes will generally be cement mortar. For fittings epoxy coating may be used because it is often difficult to apply cement mortar to fittings.

3.8.3 External Coatings

The standard coating for ductile iron pipes is zinc coating of 200 g/m^2 followed by bitumen coating. This coating system is satisfactory for non-aggressive soil; however, polythene sleeving is generally provided to give additional protection.

3.8.4 Bedding

Ductile iron pipes are semi-rigid pipes and generally do not require bedding to be of as high a standard as steel pipes. It is possible to use the native material in both the cradle and blanket; however, care must be taken in the placing and compaction of the material in the cradle to

ensure that adequate support is provided and an arrangement with a small cradle in granular material may be preferred.

3.8.5 Operation and Maintenance

General pipeline operation and maintenance will include regular inspection and operation of all valves plus periodic inspection of the route for illegal connections and visible leaks.

3.9 RECOMMENDED MATERIAL

Consultant has compared Ductile Iron (DI) pipe and Steel pipe for the BDS design. The comparisons of these two materials are shown below.

Table 3.1 : Comparisons of DI and Steel

Item \ Pipe material		DI	Steel
Basic Properties	Tensile strength (kgf/mm^2)	43	41
	Elongation (%)	10 or more	18
	Hardness(Hb)	230 or less	140
	Modulus of elasticity (kgf/cm^2)	1.6×10^4~1.7×10^4	2.1×10^4
	Poissons ratio	0.28~0.29	0.3
	Impact strength(kg.m)	8~15.9	6~20
	Specific gravity	7.20	7.75
	Coefficient of thermal expansion(cm/cm^0C)	1.0×10^{-5}	1.5×10^{-5}
	flexural rigidity(kgf/cm^2)	61 or more	40
	Compression strength(kgf/cm^2)	99~340	25~20
	Maximum allowable velocity(m/sec)	5.0	6.0
weight		Heavy compared to Steel	It is about two-thirds of ductile iron
impact resistance		It has strong resistance against internal and external pressure and impact	It has high strength and very high elongation, so it is very strong against internal and external impact and very adaptable to deformation
electric insulation		It is no corrosion by electricity.	It is vulnerable to corrosion by electricity.

Item \ Pipe material	DI	Steel
Earth pressure and road load	Strong against external pressure such as vehicle load, earth pressure	It is very resistant to impact and vibration and is not destroyed by an external force which causes large deformation.
Ground Deformation (earthquake)	Separation of pipe in the joints can occur during earth quake or differential settlement, but faster repair can be done	Stronger resistance to earth quakes and differential settlements due to welding conjugation, but longer repair time required.
traffic	It is possible to shorten the construction time when applied to the city and congested section because of its excellent workability, but it is difficult to handle the pipe because it is heavy in weight.	Welding requires much construction time, which is likely to cause complaints when used in urban areas and congested areas
Constructability	• It is heavy and require separate equipment • It is possible to bend construction with short construction period and various types of pipes. • It is unnecessary to use expansion joints against temperature changes • It is easy to construct the river section and the urban congestion section.	• It is light in weight compared to cast iron pipes, but it is also heavy and require separate equipment • laying period is long Because of welded joint • It is relatively difficult to construct the water section(river) Because of the welded joint, • On-site process ability is difficult.
Constructability	• It has excellent stretch ability and on-site workability • It is easy to construct under various conditions because of various types of fittings. • It takes a lot of transportation cost because it is heavy.	• It is used for various purposes compared with other pipe materials because it is easy to produce large diameter. • In case of welding method, internal welding below D800 mm is impossible. • There is a risk of corrosion at the cut and perforated areas.

Although the Ductile Iron pipes are costly compared to steel pipes for large diameters, we selected DI pipe since it's commonly experienced by the national contractors. Ductile Iron pipe doesn't require high class welding technique and easier to repair compared to Steel pipes. Also, Steel pipe requires cathodic protection system which is relatively new to Nepal.

New system requires new imported facilities to maintain the system. From previous experiences we saw disrepair and failure of the system when applying a totally new system in Nepal. If cathodic protection fails, the life of BDS pipeline system will be reduced and will cause leakages in the system.

To minimize the issues, we have adopted DI pipe for BDS design.

3.10 PIPE BEDDING AND BACKFILL (FOR USE WITH DUCTILE IRON)

3.10.1 Definitions

Cover – The distance between the top of the pipe and ground surface. Considered the dead load, live load of the top of the pipe and buoyancy, the following are the minimum cover requirements:

D1,800 mm	1.8 m
D1,600 mm	1.5 m

For places where it can't meet the required minimum cover shall be concrete cased to acquire stability from buoyancy and external force.

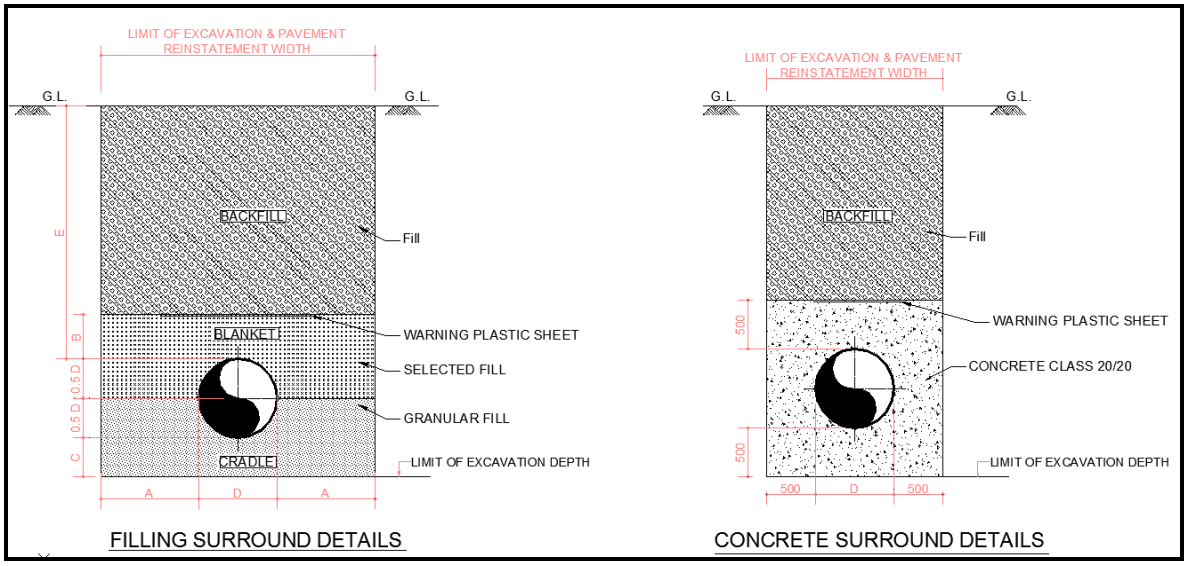
Backfill (main fill) – The approved filling material placed in a pipe trench after the pipe has been laid, bedded and surrounded by the blanket that has been compacted at the sides and over the top of the pipe.

Bedding – The material, and the operation of placing it, of the bedding cradle and blanket, up to the underside of the backfill.

Blanket – The bedding zone in which selected material is placed and compacted on or from the top of the cradle up the sides and over the top of the pipe in such a manner that the barrel of the pipe is supported continuously and firmly on the sides and protected over the top by a dense cushion of material.

Cradle – The bedding zone in which material is placed firmly and without voids under and up the sides of a pipe in such a manner that for all practical purposes the pipe cannot move or deflect.

Details of a typical pipe trench are shown as below.



< Figure 3.1 : Details of typical pipe trench >

BEDDING DIMENSIONS

PIPE DIAMETER (D)	SIDE ALLOWANCE (A)	CRADLE (C)	BLANKET (B)	COVER (E)
⩽ 500	300	150	200	SUBJECT TO AN ABSOLUTE MINIMUM OF 150m BELOW LEVEL OF ROAD FORMATION. By Calculation: 1600 mm: min. 1500 mm 1800 mm : min. 1800 mm
600-800	400	200	300	
900-1100	500	300	300	
1200-1400	800	300	300	
1500-2000	1000	300	300	

< Figure 3.2 : Bedding dimensions >

3.10.2 In Roads

Special bedding and backfill is required at road crossings for two reasons, to ensure the pipe can support the additional loads and to limit settlement of the backfill which would cause damage to the reinstated road surface.

To provide adequate support to the pipe it may be necessary to provide a graded gravel cradle and blanket, in extreme cases (very deep cover for example) it may even be necessary to encase the pipe in concrete.

Settlement of backfill should be limited by adequate compaction. It is more difficult to compact cohesive materials than granular materials therefore, in some cases, it may be necessary to replace the native backfill material with a coarser soil. The type of backfill may only be determined when the works are constructed. However the geotechnical investigations will provide information for the quantities to be estimated during detailed design and to allow the degree of compaction to be specified.

The type of bedding and backfill is also likely to change depending upon the type of road and whether the pipe is crossing the road perpendicularly or running along the road.

3.11 CONNECTING METHOD AND ACCESSORIES

3.11.1 Connecting method of Joints

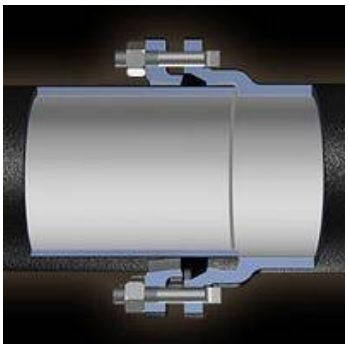
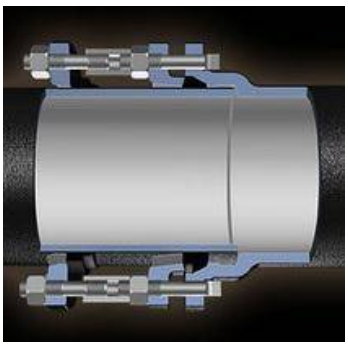
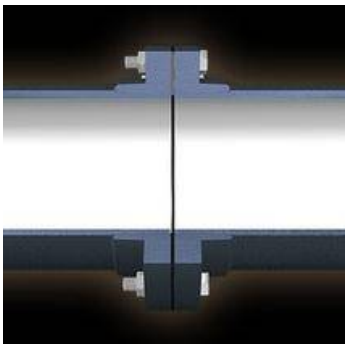
The method used for connecting the ductile iron is mechanical joint, tyton joint and so on. For the whole diameter of pipe, the mechanical joint is adopted, which has rich usage performance and is the most reliable, safest.

Table 3.2 : Comparisons of ductile iron joints

	Mechanical Joint (Flanged joints)	Tyton Joint (Push on joints)
1. Shape		
2. Connecting Method	• Tighten rubber ring by mechanical joint glands • Connection between mechanical joint glands and main body is performed by tightening the bolt at holes which is located to socket head and glands.	• Connecting method of Rubber Ring Type • After fixing the globular-shaped rubber ring into the internal groove, insert the pipe and bind it
3. Features	• Good sealing and connecting method with elasticity • Allowable deflection angle is 4° up to D300mm, 3° up to D500mm, 2° up to D700mm, and is 1.5° for over D800mm • Depth of socket is deep so that there is movability along the pipe axis direction • Flexibility of pipe is free according to the variation of temperature.	• Developed by U.S pipe company in U.S.A • Easy to connect with only one rubber ring • Allowable deflection angle of Tyton joint in the joint larger than Mechanical joint • Connecting process is simple so that pipe laying can progress quickly • Flexibility of joint is large and flexibility of pipe is free according to the variation of temperature
4. Reason for selection	• In terms of the safety, mechanical joint is definitely more guaranteed than tyton joint. Therefore, the mechanical joint is recommended as connecting method of ductile iron pipe.	

3.11.2 Type of Joints

Table 3.3 : Type of Joints

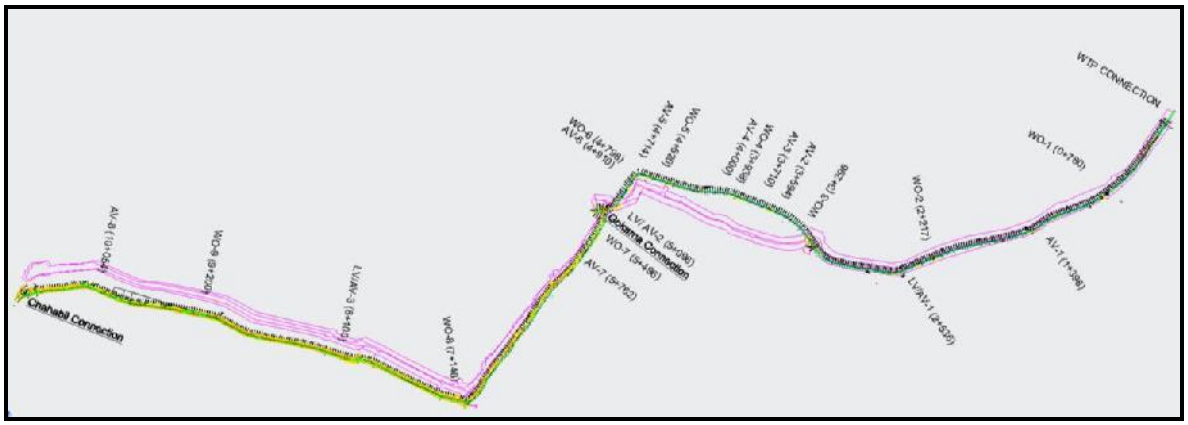
Type	Figure	Description
Mechanical joint		• Mechanical joints are the basic joint that will be used for most of the BDS pipeline
Mechanical coupling joint		• Mechanical coupling joints are used where the plain ends of two pipes are facing each other and at 200m intervals for hydraulic test and chambers.
Flange joint		• Flange joints are required where fittings shall be easily removed and attached, such as valve joints etc. Flange joints are usually located inside the chambers.

SECTION 4

PIPELINE ACCESSORIES

4.1 LOACATION

The location of the AIR VALVE, WASH OUT VALVE, and CONNECTION VALVE are planned as the details shown below;



< Figure 4.1 : Planned location of valve >

Table 4.1 : Size and number of each valve

Item	Places	Size
Line Valve Chamber	3	D1800mm : 1EA D1600mm : 2EA
Air Valve Chamber	9	Double Air Valve DN200
Wash-out Valve Chamber	8	D400mm
Connection Valve Chamber	3	D1800mm × D1400mm(Sundalizal Connection) D1600mm × D700mm (Gokarna Connection) D1600mm × D1400mm(Chabahil Connection)

4.2 CHAMBERS

Reinforced concrete valve chambers will be used for the various valves, air valves, wash-outs and bulk water meters, etc, of the BDS. The concrete chambers shall serve as housing, protection and convenient access to these pipe appurtenances.

Inside the concrete chambers necessary concrete supports shall be provided for pipes and valves at appropriate locations.

The headroom in the chamber shall be at least 1.80 m. However, the headroom could be less than 1.80 m because air valve is located at high points of pipe and in this case, for easy O&M, the chamber should be composed with consideration on the location and size of manhole cover.

Access to the chamber will be given via lockable cast iron covers with frames. The minimum horizontal dimension of the manhole should be 1.00 m. Manhole covers to be used in vehicular traffic roads shall have a bearing capacity of 400 kN. Covers for manholes in paths or in fields may be proposed for lower capacities of 250 kN or 40 kN respectively.

All valve chambers shall be equipped with step irons of cast iron or ladders of hot dip galvanized steel.

A pump sump with drain outlet shall be provided for drainage purposes. If the concrete chamber is surrounded by ground water special provisions shall be applied to prevent uplift of the structure (e.g. by increasing the concrete mass).

For ventilation of the chamber a DN 200 cast iron or galvanized standpipe with protection cap will be proposed. The protection cap should include a non-corrosive insect screen. The vent pipe will be exposed from the concrete chamber from the slab.

When the concrete chamber is within the main road, the exit point of the vent pipe will be laterally at the highest possible point of the chamber and lead to the nearest convenient outlet above ground such as foot path.

4.3 AIR VALVES

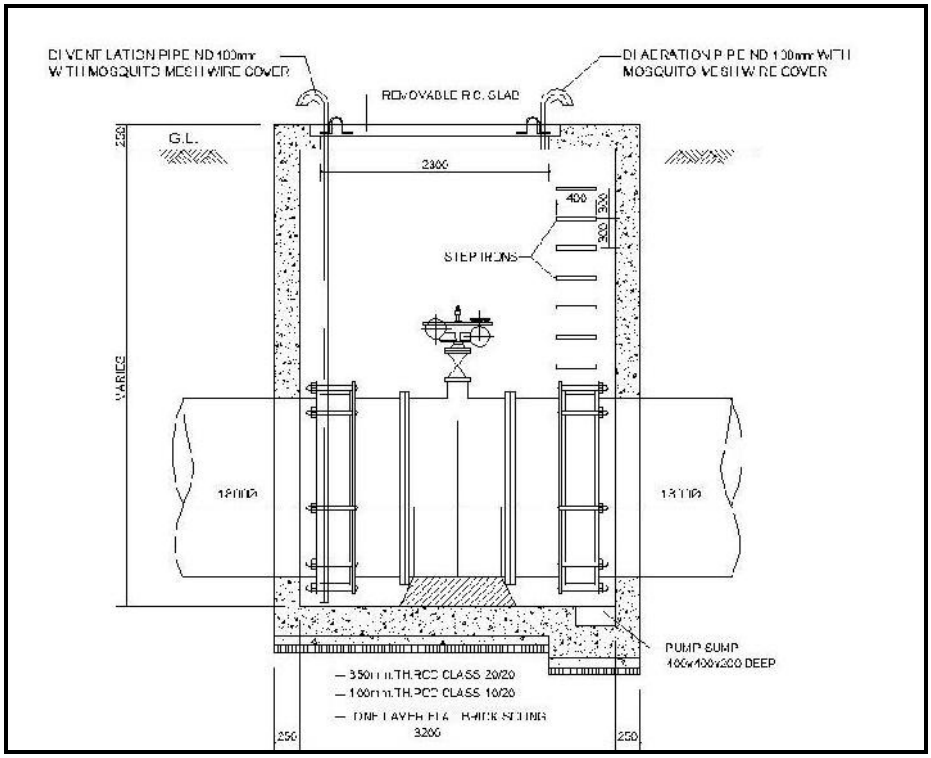
A typical arrangement of an air valve is shown in Figure 4.2. Air valves will be installed at all high points of the pipeline, in sections which form a peak with respect to the hydraulic gradient and on the downhill side of line valves. Air valves will also be installed between two line valves to make the proper time for replenishing and draining water in case that the length of pipe line is long and there is no protruded section along the profile of the pipe. If the length of pipe line is long, line valves will be installed at intervals of 1 ~ 3 km for O&M. So air valves should be close installed in front of one of higher line valve.

Air valves shall be of combined type with a larger and smaller venting orifice which permits passage of large volumes of air for vacuum breaking and venting on starting up and closing down operation and a small venting cross section for release of small volumes of air under full internal operation pressure.

Two types of air valves, namely Type A and Type B, shall be proposed for the various pipeline installations.

4.3.1 Type A

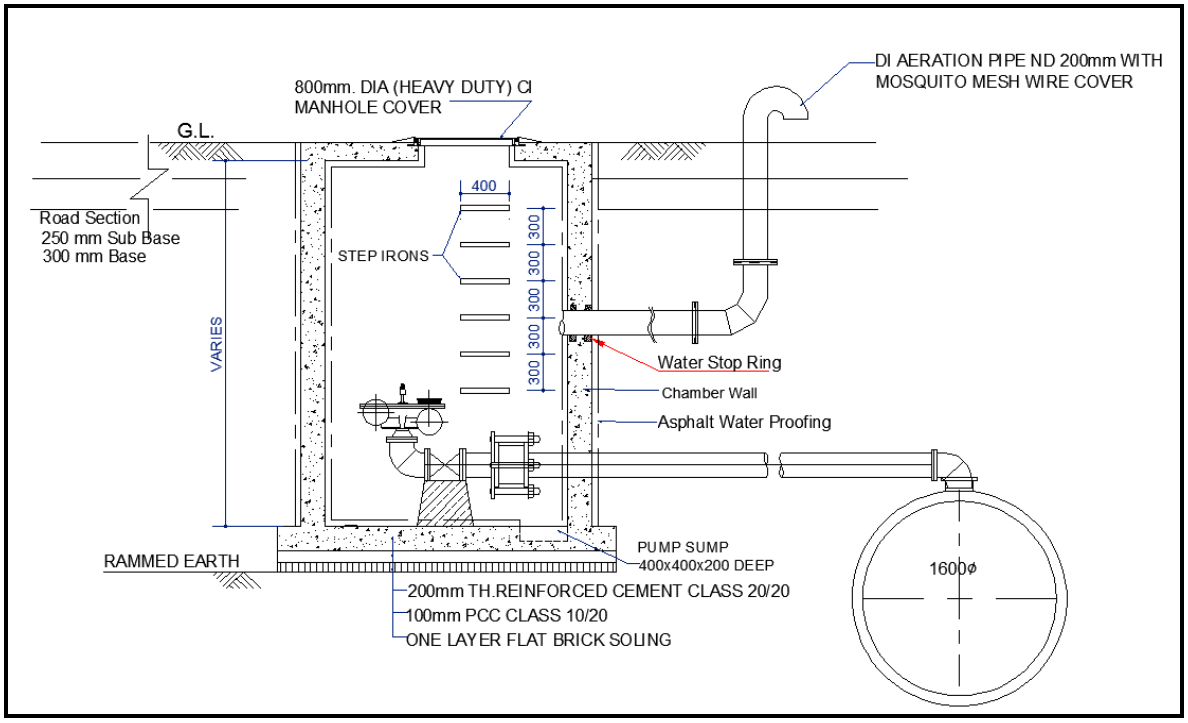
This type of air valve, which will be installed directly on the top of main pipe, is a general type which will be installed when there is no obstacle interrupting the installation of valve chamber.



< Figure 4.2 : Air valve Type A >

4.3.2 Type B

This type of air valve is included in difficult case that there is some obstacle underground or on the ground at the point of installation of air valve chamber. In this case, air pipe line, which is connected directly to the top of main pipe(BDS), will be connected to the point where air valve chamber could be easily installed and air will be released through this air pipe.



< Figure 4.3 : Air valve Type B >

A line valve shall also be installed to allow inspection and repair of the valve without shutting off the main. All valves are flanged and shall be of PN 16.

In general the following air valve types are recommended:

double air valve DN 200

4.4 LINE VALVES

A typical arrangement of a line valve is shown in Figure 4.4.

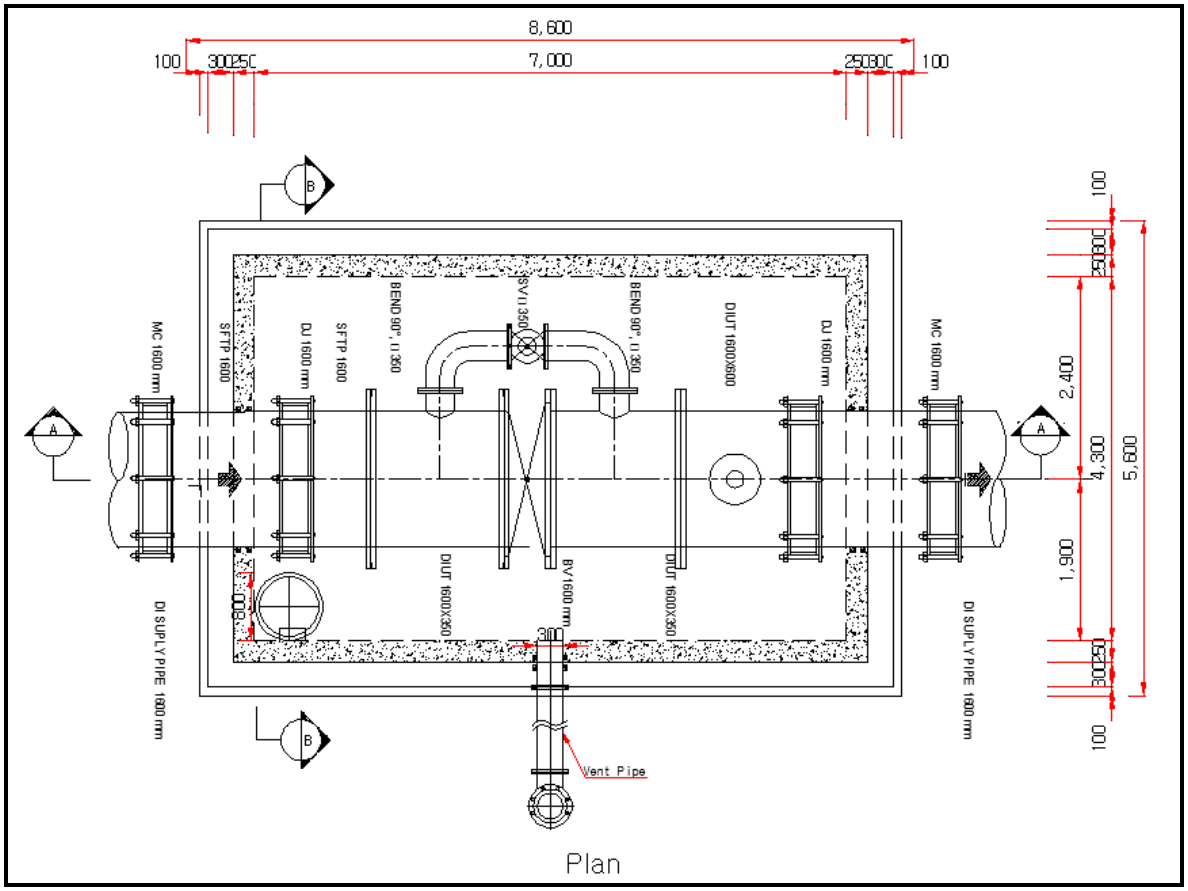
Line valves shall be provided at river crossings and at other locations where there is risk of damage to the main, they shall also be provided to allow sections of the pipeline to be drained. As we do not recommend swabbing, valves larger than DN 300 will be butterfly valves because they are more economical than gate valves and technically desirable. They are lighter and shorter and still have the hydraulic properties similar conventional GVs. Only valves less than DN 300 (e.g. for valves in valve chambers, wash-out chambers etc) shall be of gate valve type.

The valves shall be of double flange type, pressure class PN 16 and made of ductile iron protected by an epoxy coating.

All valves shall have non-rising stem, closing clockwise, provided with suitable hand wheels for easy operation. Extension spindles and surface boxes shall be installed. Extension spindles will be connected to the handwheels by stem unit couplings.

Line valves in large pipes can cause malfunction on highly pressurized sections. The by-pass valve shall be opened when the main valve is closed to disperse the pressure in the system to prevent malfunction of the line valves.

Also, an air valve shall be installed just behind the line valve to release the air cause while valves function.



< Figure 4.4 : Typical arrangement of a Line valve >

4.5 GATE VALVES

Gate valves shall comply with DIN 3352 or equivalent standards. They shall be of the short construction type so as to keep the dimensions of the concrete chambers to a minimum.

4.6 BUTTERFLY VALVES

Butterfly valves shall comply with DIN 3354 or equivalent standards. The valve discs shall be provided with an endless rubber-sealing ring and be designed as double offset on shaft with optimum hydraulic flow pattern and low coefficient.

4.7 BURST CONTROL

Major water pipelines are sometimes fitted with burst control valves. These are generally weight operated butterfly valves which close automatically by a paddle sensor if an excessive velocity is detected. These valves do require maintenance and testing which would usually require shutdown and draining of the main. This is often not carried out even in Europe. The Consultant is aware of a burst control valve failing to operate due to lack of maintenance in Glasgow, UK several years ago resulting in loss of supply to a major part of the city for several days. This type of valve is not considered appropriate for this project.

As it is recommended that the pipeline is generally buried along the whole of the pipeline route and adequate protected against corrosion, the risk of pipe bursts is minimal. Ductile iron pipes also do not generally fail catastrophically, unlike older cast iron pipes or some concrete pipes. It is therefore recommended that burst control valves are not provided.

4.8 WASH-OUTS

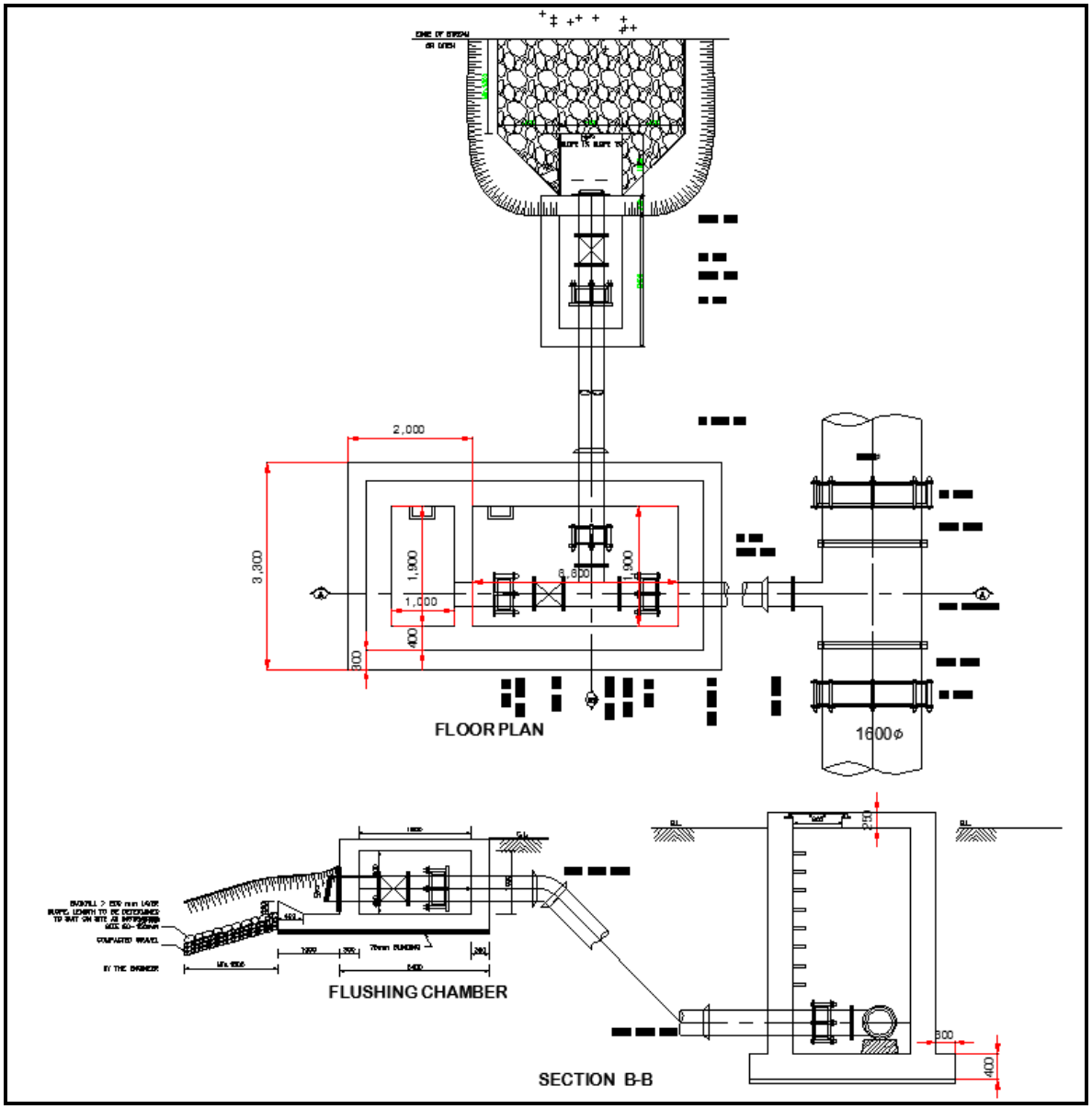
The purpose of the Wash-Out is to flush out substance such soil or sand that can be left in the pipes during construction or operation. Also, it is used to empty the pipe for maintenance and emergency drainages. Thus, all Wash-Outs shall be installed at the lowest point of the pipe to drain out everything.

There are usually limits in sizes of the Wash-Out because draining a large volume or water in a short period of time can cause impact in the system. Size of the Wash-Outs will be calculated for proper size to drain efficiently and for safety of the system.

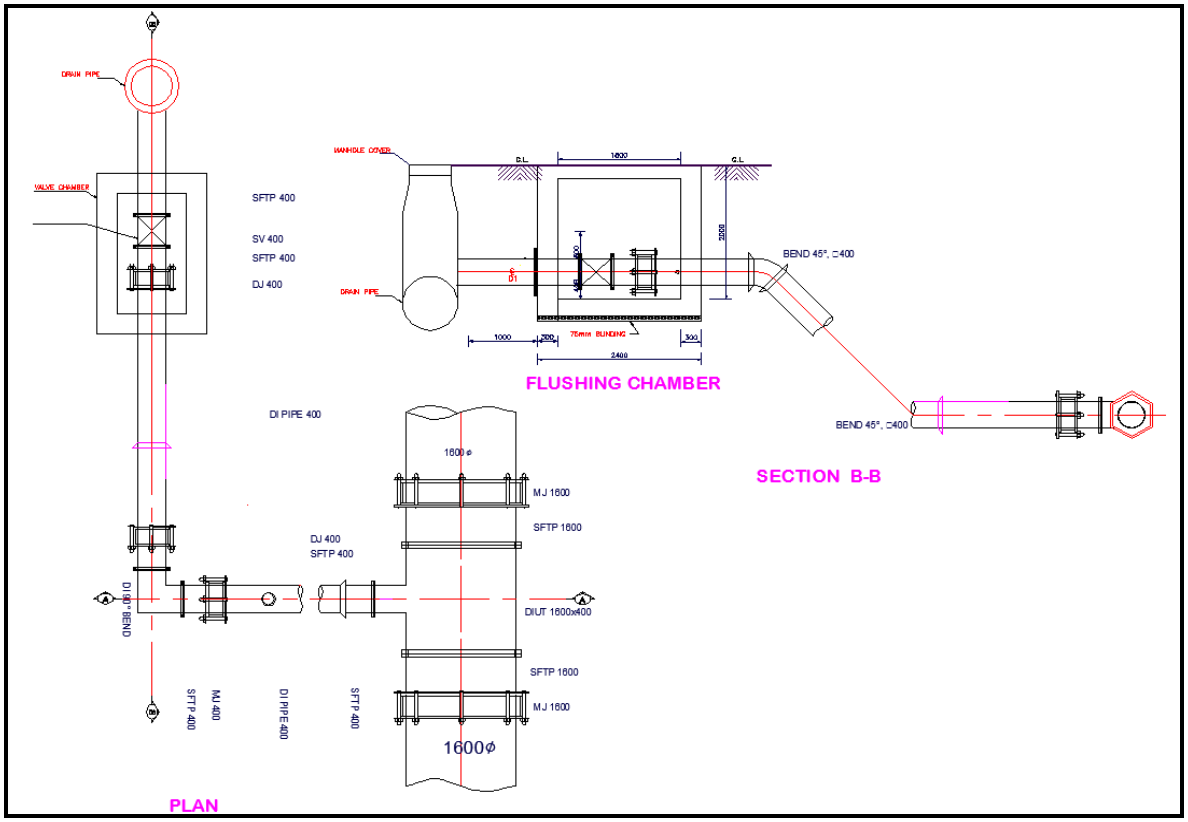
The outlet of the Wash-Out will be placed higher than the high-water level of the waterway to prevent counterflow of sewage.

4.8.1 Drainage of Wash-Out Chambers

Drainage valves are installed at the end of the Wash-Outs for operation convenience. If full drainage of the pipe is required, most of the water can be drained using the valve and then can be completely drained using the Wash-Out Chamber.



< Figure 4.5 : Drainage of Wash-Out Chambers Type A >



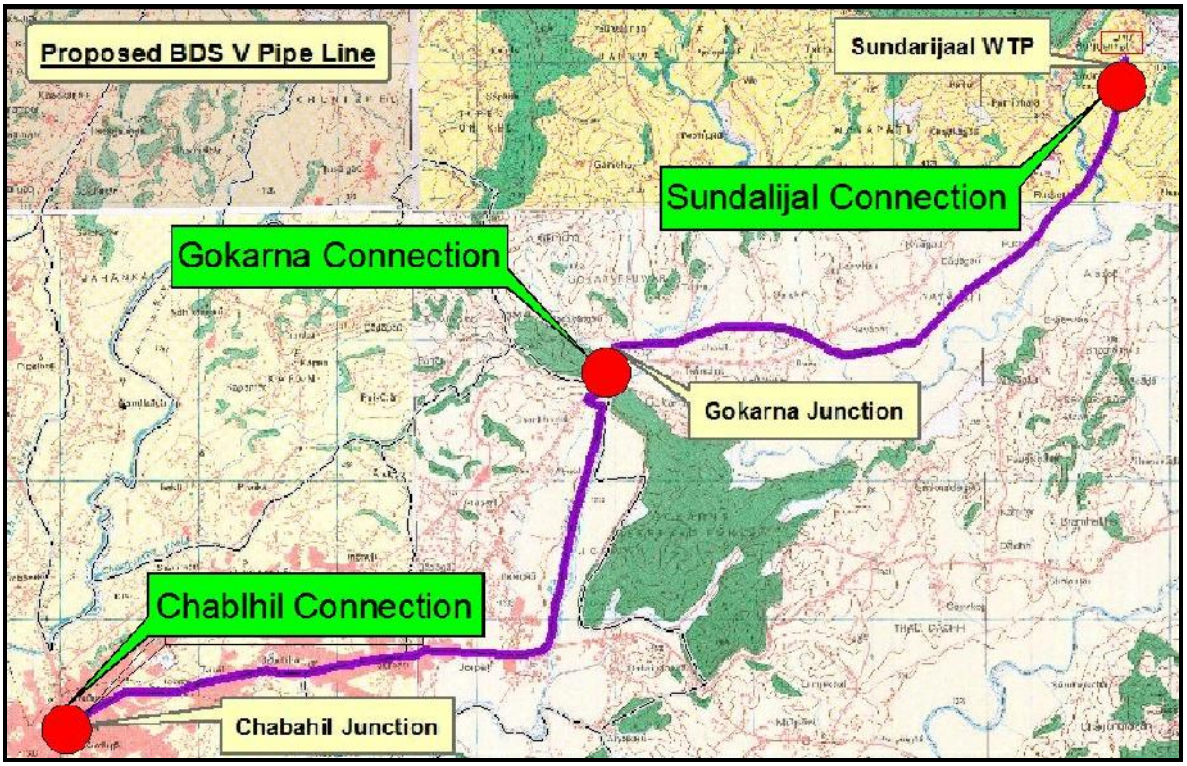
< Figure 4.6 : Drainage of Wash-Out Chambers Type B>

WO-chambers shall be provided with drain pipes leading preferably to an existing drain system, open drain channels, ditches or water ways (Type 1). Sizes of drainage facilities will vary with location. The lower end of the drain pipe should be protected against the entry of dirt, animals and the ingress of surface water by a check or flap valve.

In case drainage by gravity is not possible owing to topographical conditions, the drain water of the WO shall be discharged to a nearby concrete manhole with provision for an overflow (Type 2). From here the remaining drain water can be disposed by pumping or bailing. The same effect can be gained by connecting the WO-drain pipe to a DI stand pipe of suitable diameter. The upper end of the stand pipe above ground is furnished with a tee-piece which allows discharge of the BDS and disposal of the remaining drain water by insertion of a small submersible pump.

4.9 CONNECTION VALVE

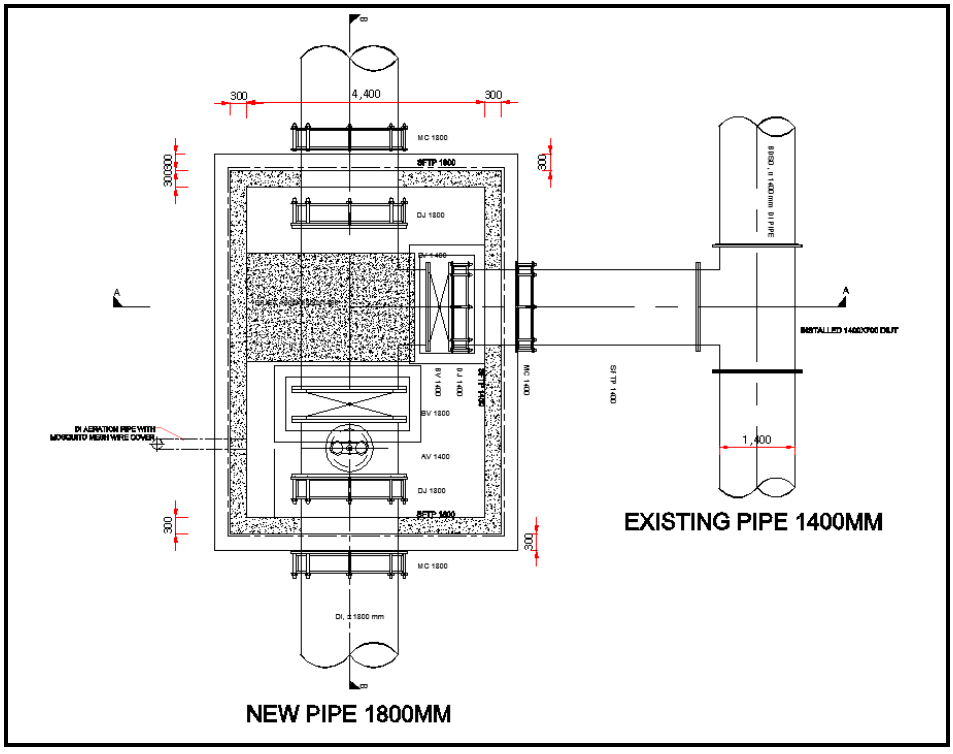
There are 3 connection points at Sundalijal, Chabahil, Gokerna for the new BDS line. Connection Valve will be installed for connection and can be used for supplementation when problem occurs to the system.



< Figure 4.7 : Location of Connection valve >

4.9.1 Sundarijal Connection

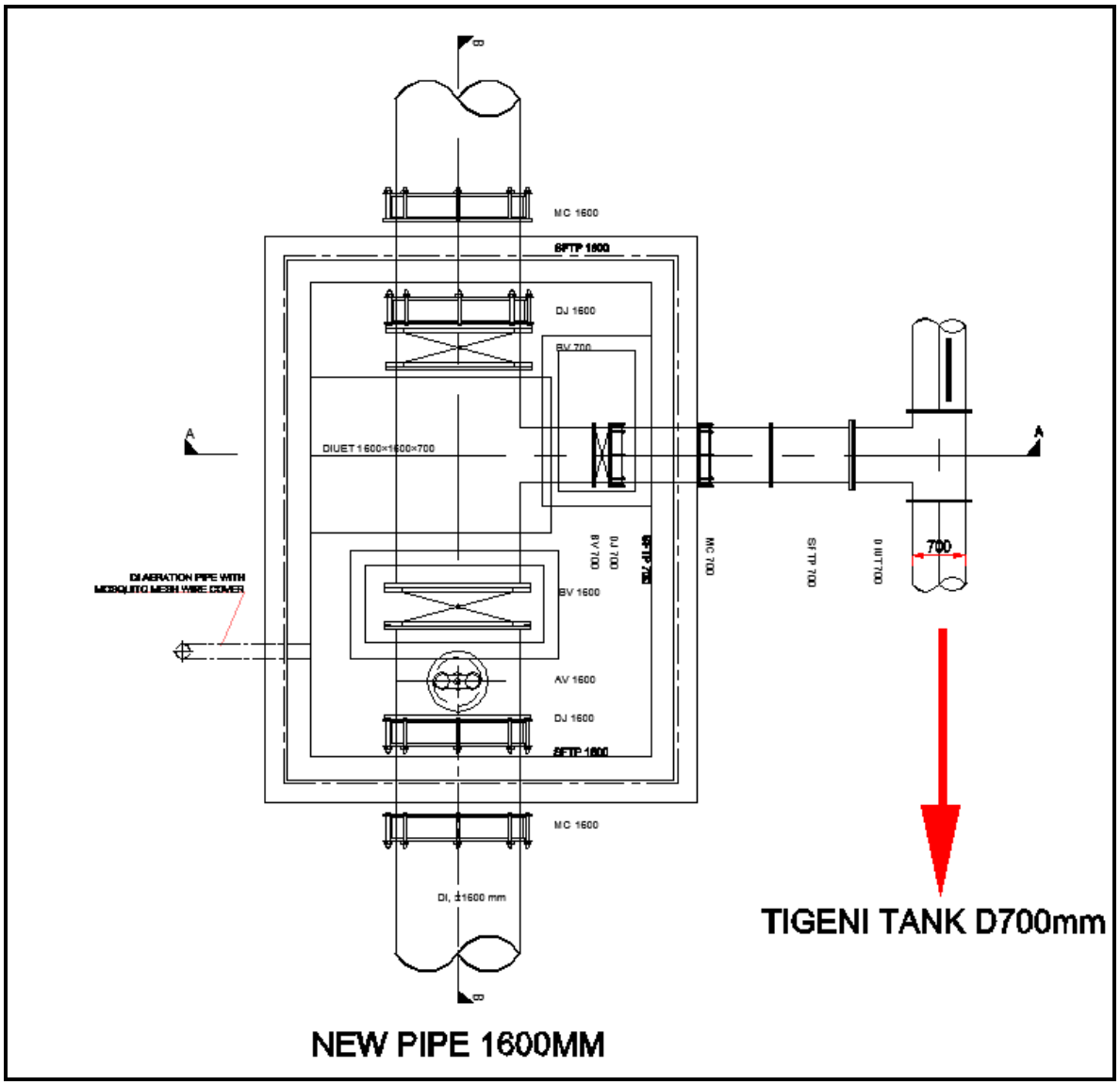
Sundarijal Connection will be connected to the 1400mm diameter BDS line. 2 valves will be installed at this connection for proper operation and maintenance. One valve will be installed in the main pipe and the other will be installed in the connection pipe.



< Figure 4.8 : Connection detail of Sundarijal Connection >

4.9.2 Gokarna Connection

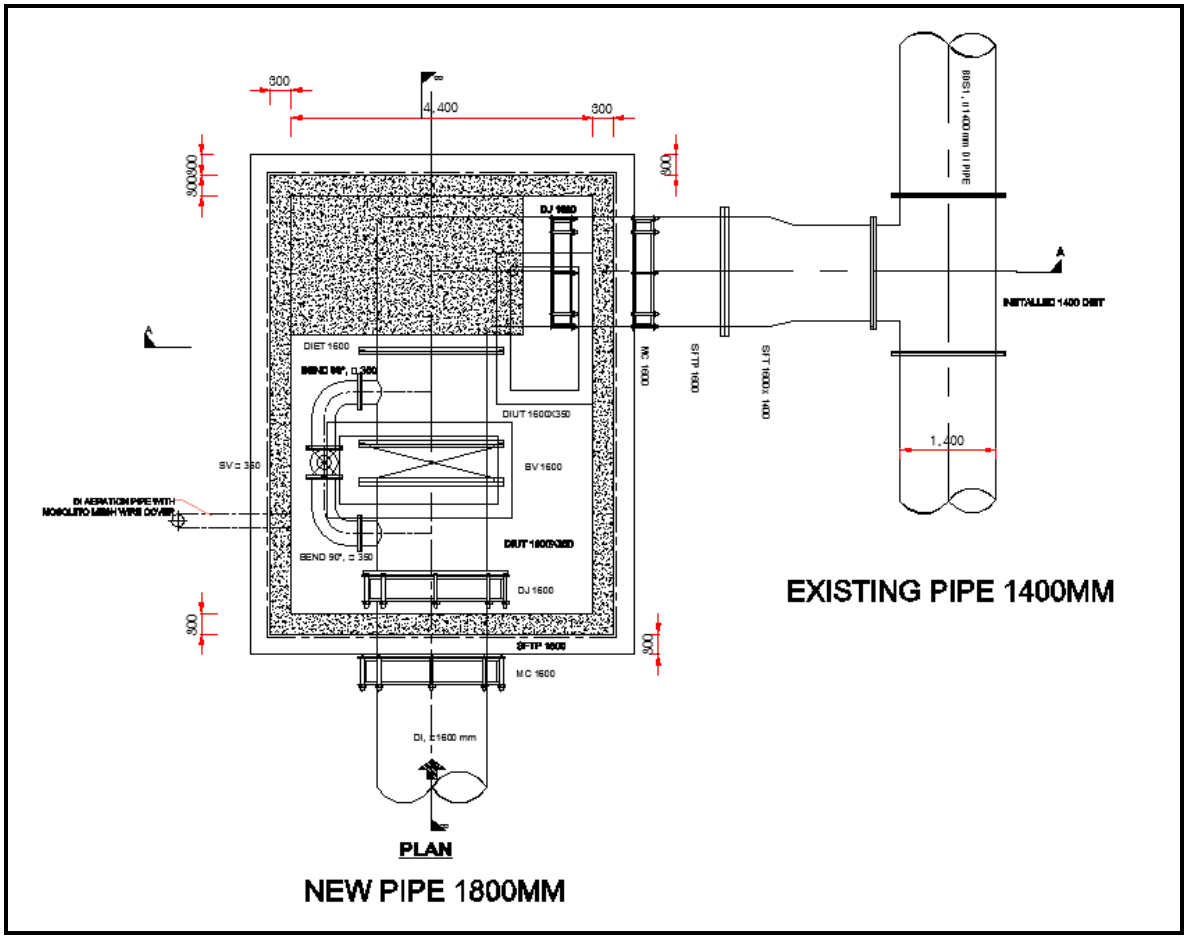
When problem occurs in the existing 1400mm diameter BDS system, water supply to the Tigeni and Katunje SRT will stop. The Gokarna connection will be connected the BDS at the 700mm diameter BDS pipe to prevent discontinuance of supply to these areas.



< Figure 4.9 : Connection detail of Gokarna Connection >

4.9.3 Chabahil Connection

Chabahil connection is the final connection with the existing BDS system. A connection valve chamber for convenience of O&M and will have the thrust block installed inside the chamber to prevent water hammer.



< Figure 4.10 : Connection detail of Chabahil Connection >

4.10 THRUST BLOCKS

In flexible non-restrained jointed pipelines (e.g. Tyton type joints or similar), forces at bends, tees, tapers, closed valves, dead ends etc must be absorbed by thrust blocks. Concrete thrust blocks take the forces from the pipeline and transmit them to the soil adjacent to the pipe trench.

Thrust blocks shall be constructed of cast-in-situ concrete. The bearing faces of the thrust blocks must be placed against undisturbed natural soil.

Thrust blocks were designed with the standard of the maximum pressure (10kgf/cm^2) and the maximum velocity (3.0m/s). Dimensioning of the thrust blocks must be dependent on the bearing capacity of the prevailing soil. For the calculation of thrust blocks, there is appendix G to refer.

In concrete chambers, thrust forces resulting from closed valves shall be absorbed by the concrete walls by means of puddle thrust flanges welded on the pipes.

4.11 PIPES ON SLOPES

Within the BDS system parts of the pipeline have to be installed on steep slopes. Considering the impact of a possible heavy earthquake, the use of an underground installation which presents a better overall stability is recommended.

The pipe alignment in the slope section has to be designed in such a way that pipe trench will cross the contour lines of the steep slope perpendicularly. In this way the trench walls will get better stability than by crossing the slope at an angle.

We propose to install the pipes underground, fixed and secured by restrained joints and concrete blocks. Depending on the pipe laying sequence, pipes have to be laid in up-hill and down-hill direction.

4.11.1 Pipe laying in an Uphill Direction

If the pipeline has to be laid up hills, on steep slopes, proposed thrust block in this design can be used to secure the pipeline on the slope.

Depending on the slope inclination, additional concrete trust blocks will be placed behind the socket part of every second or third pipe as required.

4.11.2 Pipe laying in a Downhill Direction

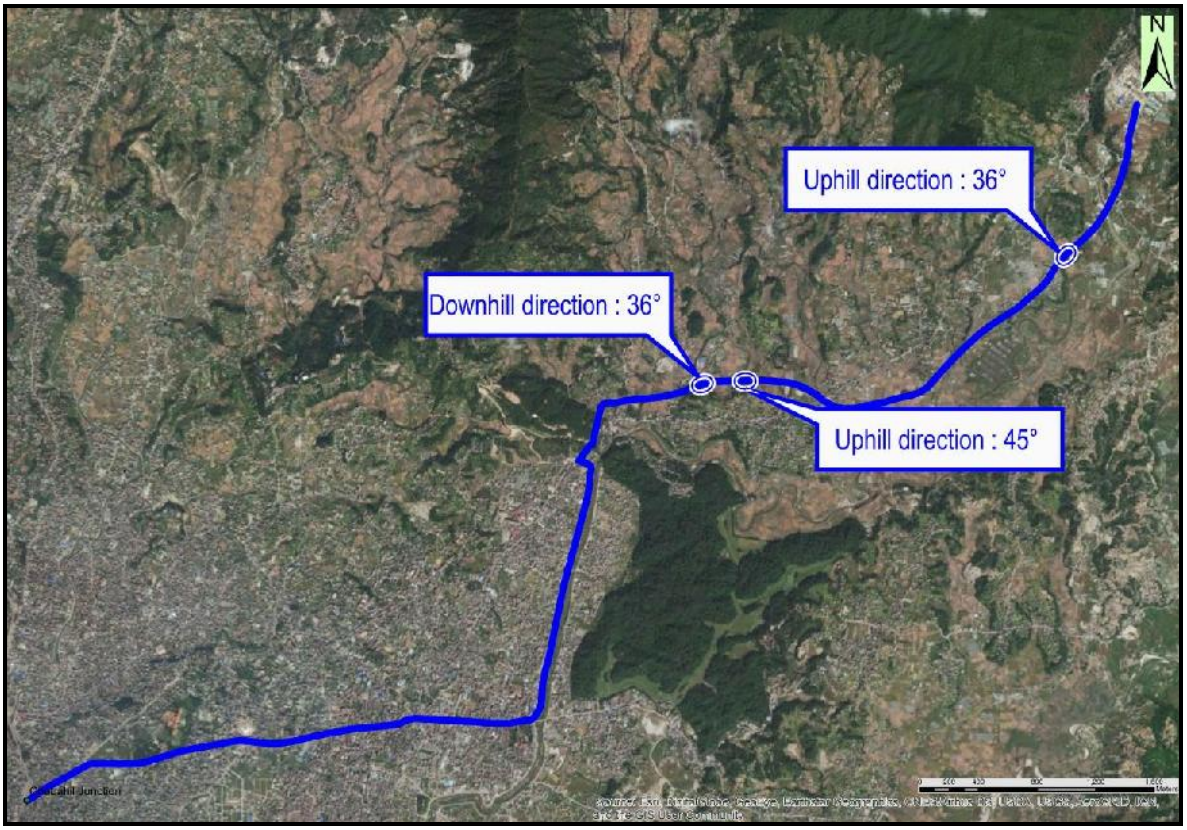
In case pipe laying works have to proceed in a downhill direction on steep slopes, restraint pipe joints will be required providing self-anchorage of the joints to prevent displacement or even separation of the pipeline. A sufficiently dimensioned concrete block, placed on upper end of the steep slope will secure the whole pipeline string.

If the pipeline at the top of the slope continues in horizontal direction and a certain number of pipes are installed with restraint joints, this concrete block can be omitted.

In general however, pipe laying in down-hill direction should be avoided considering the difficulties in installation of the pipes and the need to use restrained joints.

4.11.3 Location of Uphill and Downhill Direction

In these design, there are 3 sections of uphill and downhill direction above 30° as shown below. Those sections are considered as critical sections because the slope of each hill is quite steep. Therefore, the vertical bend of the pipe must be installed with casing of thrust block to protect the pipe.



< Figure 4.11 : Location of Uphill and Downhill Direction above 30° >

Table 4.2 : Vertical Bend of the BDS pipe

No.	Chainage	Pipe bend degree	Pipe Diameter	Remark
1	1+099	33.75°	1800	Uphill direction
	1+118	33.75°	1800	
2	3+938	45°	1600	Uphill direction
	3+944	45°	1600	
3	4+001	33.75°	1600	Downhill direction
	4+009	33.75°	1600	

4.12 PROTECTION AGAINST EROSION

After field investigation, erosion protection shall be planned by the contractors based on their judgements. Locations with steep sloop shall be specially considered such as areas shown in figure 4.11. The three method of erosion protection is shown below;

4.12.1 Surface Drainage System

The backfill area of the pipeline at steep slopes must be kept free from concentration of runoff water. Near the upper edge of the slope a reasonably dimensioned storm water ditch will be provided. If the height of the slope is more than approximately 10 m, the slope should be intersected by one or more additional ditches. The ditches will collect the storm water before more concentrated streams develop. The surface of the ditches and the intermediate slopes shall be protected by planted vegetation, as outlined below. To stabilize very steep slopes, a sequence of gabions can be installed which will provide a secure protection at the hillside part of the berm.

4.12.2 Surface Protection by Vegetation

The most adequate protection against erosion consists in planting of grass or, in special cases, in planting of small bushes. The surface to be protected will need a certain care and maintenance particularly immediately after planting of grass, but later the cultivated areas will remain safe with minimum maintenance.

Along the proposed alignment of BDS pipe line, there is the section crossing Gokarna forest, which has steep slope with vegetation.



< Figure 4.12 : Proposed alignment crossing Gokarna forest >

4.12.3 Protection by Rockfill Layers

At difficult areas, where water flows cannot be diverted easily or where traffic condition may not allow successful vegetation planting, a special protective layer may be prepared by use of rockfill material. The grain size distribution of this material will be carefully selected in accordance with the inclination and the expected water flow. Consultant is not expecting rockfill layers for erosion protection for this project but Contractors shall have detailed site investigation and make final decision.

4.13 RIVER CROSSINGS

4.13.1 General

River crossings may be made by:

- Constructing a separate pipe bridge
- Attaching the pipe to an existing bridge
- Installing the pipe on the footpath of an existing bridge
- Laying the pipe in the bed of the river in a siphon.

A pipe bridge would be vulnerable to accidents or other attacks. The structure must be above maximum flood level. Additionally, a pipe bridge would require an earthquake resisting design, which would be very expensive taking into account the high ground accelerations to be expected in the Kathmandu Valley.

Pipelines, connected to existing road bridges, are only permitted if these are connected laterally to its structure. This is of course a difficult solution since appropriate supporting structures have to be designed and incorporated to the existing bridge construction. The pipeline must not overload the structure and expansion joints would be required to accommodate movement of the bridge and pipeline.

Permanent installation on footpaths of the bridge is not allowed by the DOR.

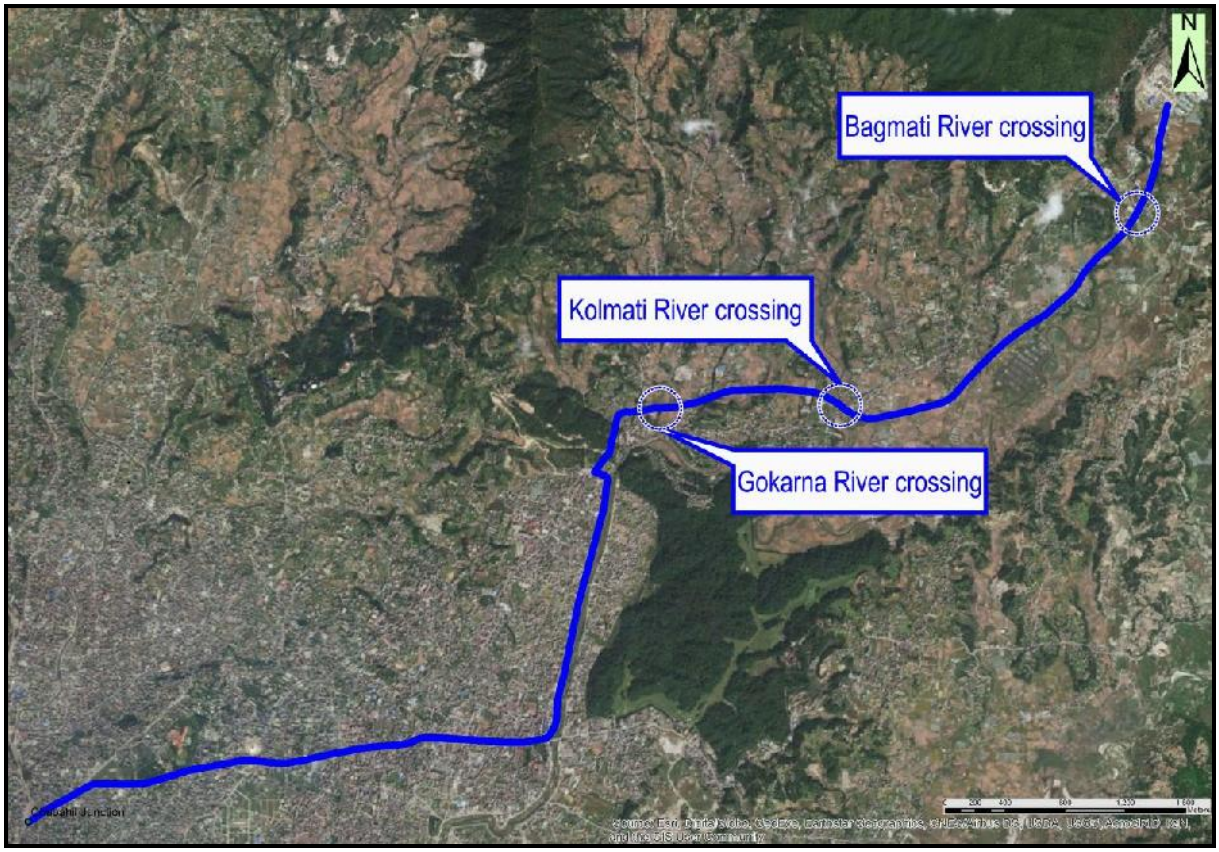
The rivers to be crossed by the BDS have a low water level and flow at the end of the dry season. This will allow the pipes to be laid in the riverbed by diverting the river water. Hence normal pipe laying practice would suffice to achieve a technically and economical sound river crossing construction.

For river crossings therefore we recommend a siphon design rather than a pipe bridge design due to safety and cost reasons.

The pipeline itself will be surrounded by reinforced concrete, on top of which an approximate 60 cm thick layer of adequately dimensioned rockfill material will be placed. The width of the layer will be in a range from 5.00 to 10.00 m as required by the specific site condition. Where the riverbed consists of solid rock, the pipe trench will be backfilled by use of concrete replacing the rockfill. The condition of the riverbed will be determined by geotechnical investigations.

The banks at both ends of a siphon crossing of rivers or small streams will be protected by the construction of gabions at the adjacent slope up to the required elevation, depending on the expected maximum water level.

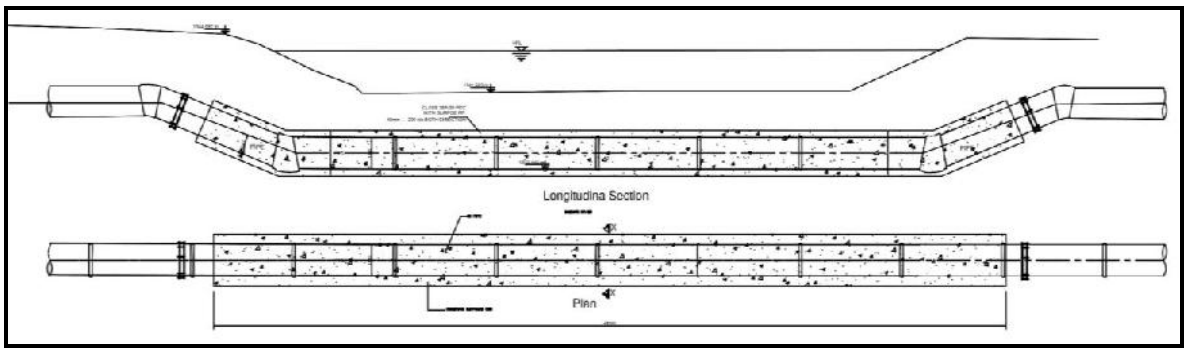
In these design, there are three river crossings along the proposed alignment as shown below;



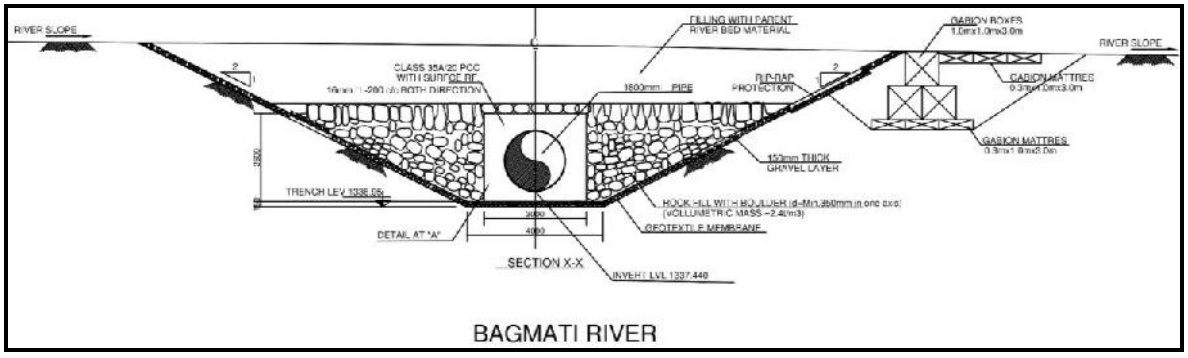
< Figure 4.13 : Location of River crossing >

4.13.2 Bagmati River crossing

The bed width of Bagmati River parallel to river crossing is 28.136 m. And the elevation of the riverbed is 1341.683 m, the elevation of riverbank is 1344.097m. The drawing of Bagmati river crossing is presented as below.



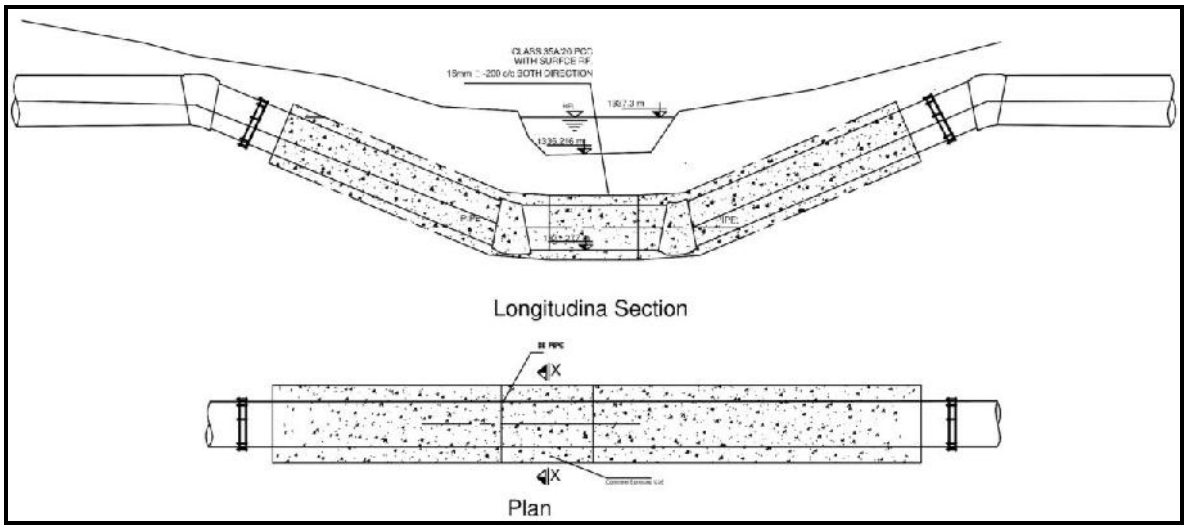
< Figure 4.14 : Profile of river crossing perpendicular to Bagmati river >



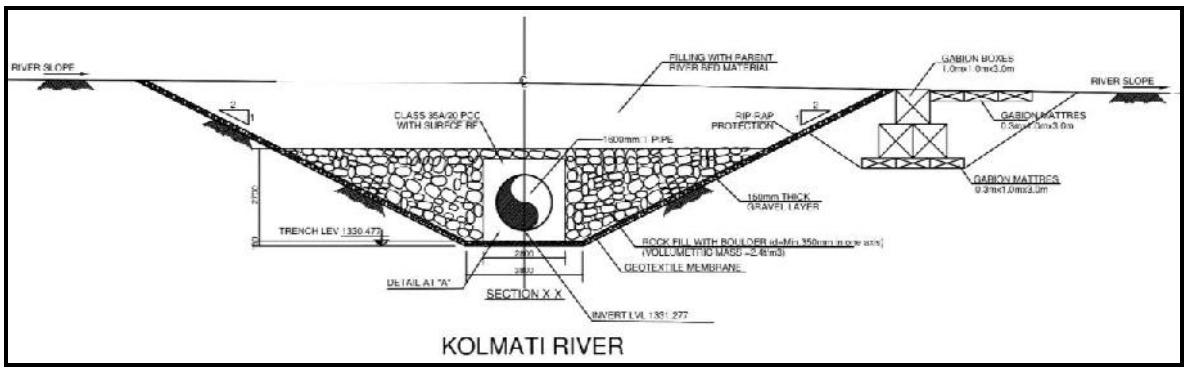
< Figure 4.15 : Cross section of river crossing parallel to Bagmati river >

4.13.3 Kolmati River crossing

The bed width of Kolmati River parallel to river crossing is 3.293 m. And the elevation of the riverbed is 1336.216 m, the elevation of riverbank is 1336.850m. The drawing of Kolmati river crossing is presented as below.



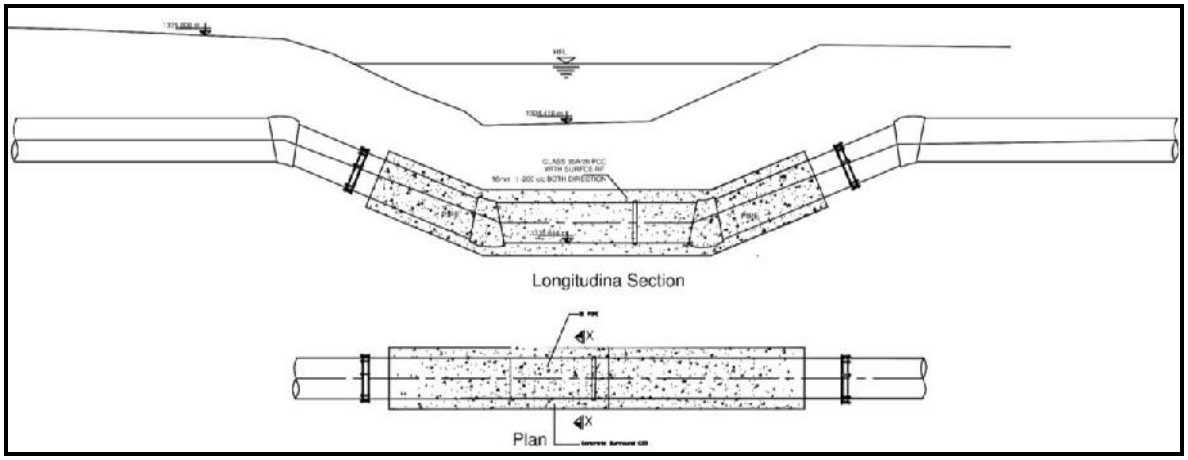
< Figure 4.16 : Profile of river crossing perpendicular to Kolmati river >



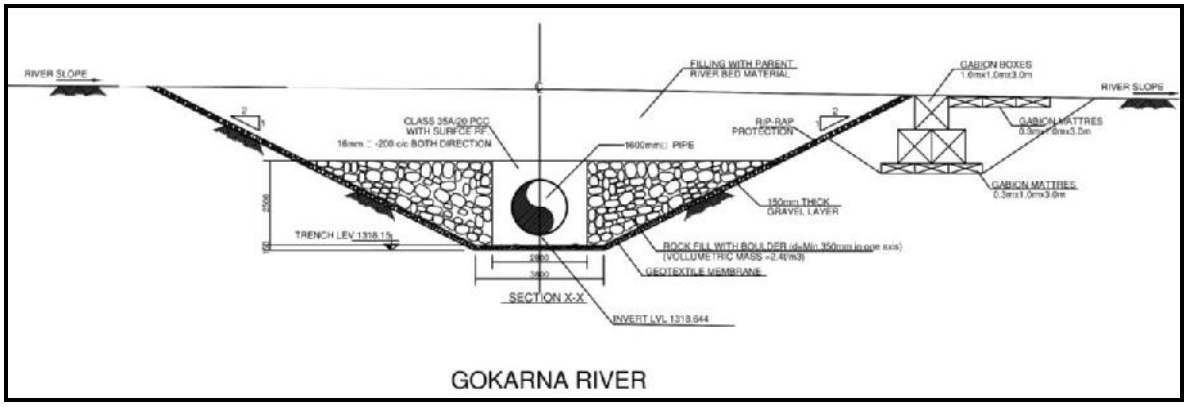
< Figure 4.17 : Cross section of river crossing parallel to Kolmati river >

4.13.4 Gokarna River crossing

The bed width of Gokarna River parallel to river crossing is 6.638 m. And the elevation of the riverbed is 1324.418 m, the elevation of riverbank is 1325.806m. The drawing of Gokarna river crossing is presented as below.



< Figure 4.18 : Profile of river crossing perpendicular to Gokarna river >



< Figure 4.19 : Cross section of river crossing parallel to Gokarna river >

4.14 ROAD WORKS

In general, all road works, road crossings and other works belonging to roads are subject to the approval of the Department of Roads in Kathmandu. They must be in conformity with the standards and special requirements of the DOR. For the approval of all road works, submittal of layouts and details and descriptions of the works to be executed are required by the DOR well in advance.

Roads generally have to be crossed perpendicular to the road axis; however, in some cases the pipeline will run along the road. It is assumed the pipes will be installed in an open trench with the temporary diversion of vehicular traffic. The precise details of the temporary diversion and traffic control will be the responsibility of the contractor subject to the approval of the Department of Roads (DOR).

The pipe trench backfill will continue up to the underside of the sub-base of the road surface. The installation of the road sub-structure and final completion of the road surface then will either be done by the DOR or the contractor. If the work is carried out by the DOR, the cost of the works will have to be prepaid by the contractor to the DOR.

It is considered environmentally and socially preferable for the contractor to reinstate the trench to a standard acceptable to the DOR, which would be specified in the contract. The method of road reinstatement will be investigated during the detailed design phase.

SECTION 5

PROCUREMENT STRATEGY

5.1 IMPLEMENTATION OPTIONS

The various options considered for the implementation of the Bulk Distribution System are as follows:

- International Supply and Construction Contract
- International Supply Contract and separate International Construction Contract
- International Supply Contract and separate Local Construction Contract

The advantages and disadvantages of each of the options are discussed in Table 5.1.

Table 5.1 : Implementation Options

Advantages	Disadvantages
International Supply and Construct Contract	
• Contractor responsible for ensuring material, pipes, valves and fittings are delivered to site to suit his program • Should encourage more international competition • Easier to supervise one contract	• Material costs approximately 50% to 65% of the total cost • Civil works contractors may be unwilling to bid due to the material costs being the majority of the contract, with their performance dependent on a supplier who will have different priorities • If the contractor fails to perform, affects the whole project • Contractor adds handling charge to cost of materials • Increased cash flow requirements for Contractor due to purchase of material
International Supply Contract and International Construction Contract	
International Supply Contract for Pipes, Valves, Fittings and Ball Valves	
• Guarantees quality and standardization of pipes, valves, fittings and ball valves • No contractor handling charge on cost of pipes, valves and fittings • Pipes can be ordered in advance of construction contract, hence reducing construction contract period and contractor's site overheads	• Employer responsible for quality and standardization of pipes, valves, fittings and ball valves • Employer responsible for ensuring pipes, valves and fittings are delivered to site to suit contractors' program • Employer to pay import duty at 1% • Increased early cash flow requirements for Employer and ADB • Employer may have to airfreight valves, fittings etc. to ensure progress of construction work

Advantages	Disadvantages
	• Requires International Inspection Services • Pipe materials must be stored for a considerable period before they are laid. Proper storage facilities must be provided by the Employer.
International Construction Contracts for Laying Pipelines	
• Contractor able to commence work as soon as mobilized hence reducing site overheads • Contractor has no risk for the delivery of the material and hence should be able to tender a lower price • Contractor able to employ local sub-contractors for the laying of ductile iron pipeline • Local and international contractors able to participate.	• Foreign contractor's increased overheads and profit paid to employ local sub-contractors • Local contractors unable to participate without forming large joint ventures, or of being joint venture partners with or sub–contractors to foreign contractors.
International Supply Contract and Local Construction Contract	
International Supply Contract for Pipes, Valves and Fittings	
• Guarantees quality and standardization of pipes, valves, fittings and ball valves • No contractor handling charge on cost of pipes, valves and fittings • Pipes can be ordered in advance of construction contract, hence reducing construction contract period and contractor's site overheads	• Employer responsible for quality and standardization of pipes, valves, fittings and ball valves • Employer responsible for ensuring pipes, valves and fittings are delivered to site to suit contractors' program • Employer to pay import duty at 1% • Increased early cash flow requirements for Employer and ADB • Employer may have to airfreight valves, fittings etc. to ensure progress of construction work • Requires International Inspection Services • Pipe materials must be stored for a considerable period before they are laid. Proper storage facilities must be provided by the Employer.
Local Construction Contract for Laying Ductile Iron Pipelines	
• Contractor able to commence work as soon as mobilized hence reducing site overheads • Contractor has no risk for the delivery of the material and hence should be able to tender a lower price • Improves local contractors' capabilities • No foreign contractor's increased overheads and profit	• Local contractors only have experience of up to 800mm diameter pipes • Local contractors would need to employ specialist sub-contractors with appropriate expertise • Local contractors do not currently have the heavy earthmoving equipment required but it is possible to purchase 2nd hand from Hong Kong or Singapore,

Advantages	Disadvantages
	or hire from India • Local contractors probably do not have adequate financial resources except through JVs of more than 2 firms • Requires additional supervision • International competition removed

5.2 PROPOSED IMPLEMENTATION METHOD

Considering the size, the relative lack of complexity, and the capabilities of regional international contractors, it is recommended that the construction of the project be accomplished by one competitively bid, qualified contractor or joint venture. The recommended approach was discussed and agreed with PID.

To follow the ADB's Procurement Guidelines it is proposed to use International Competitive Bidding which is based on Single Cover-Two Envelope model for the employer, designer, supply and construct pipeline contract. The adoption of ICB will not exclude local contractors. They can form joint ventures either with international or local contractors.

5.3 IMPLEMENTATION PROGRAM

We assume 30 months construction period. This would allow for six months for complete delivery of materials, and construction work carried out over a full construction season, allowing for possible slippage time in the delivery of pipe and fittings. This will also overcome potential problems where, with separate supply and construction contracts, the delay in the pipes allowed potential claims from the construction contractors.

5.4 POSTQUALIFICATION OF CONTRACTORS/ TENDERERS

It has been discussed and agreed with PID to perform post qualification rather than prequalification of bidders. This will further accelerate project implementation by ensuring that tender documents for the supply and construct contract will be issued in the shortest possible time. The main qualification criteria are:

- Minimum average annual construction turnover of US$ 31.75 million or equivalent NRs. calculated as total certified payments received for contracts in progress or completed, within the last 5 (five) years.

- Participation in at least one contract that has been successfully or substantially completed within the last 5 (five) years and that is similar to the proposed works, where the value of the Bidder's participation exceeds of US$ 31.75 million or equivalent NRs. The similarity of the Bidder's participation shall be based on the physical size, nature of works, complexity, methods, technology or other characteristics as described in Section 6, Employer's Requirements.

- Minimum 9 km (cumulative comprising of minimum of 1000 mm diameter within the last five (5) years, that have been successfully or are substantially completed and that are similar to the proposed works.

- Minimum 20,000 sqm (cumulative) of bituminous black topping work or 800 cum (cumulative) of bituminous asphalt concrete works in one contract within the last five (05) years, that have been successfully or are substantially completed and that are similar to the proposed work.

5.5 FORM OF TENDER

The model form of contract will be ADB's Standard Bidding Documents for Procurement of Works (without Prequalification), dated September 2010. It is based on the Master Procurement Document entitled "Bidding Document for the Procurement of Works", prepared by multilateral development banks and other public international financial institutions which reflects the majority view of these institutions. This document has the structure and the provisions of the Master Procurement Document, except where ADB-specific considerations have required a change.

The documents have been prepared in the following volumes:

Volume: I – Bidding Procedures

Section 1	Instructions to Bidders
Section 2	Bid Data Sheet
Section 3	Evaluation and Qualification Criteria
Section 4	Bidding Forms
Section 5	Eligible Countries

Volume: II – Requirements – Specifications

Section 6A	Technical Specifications

Volume: III – Requirements - Drawings

Section 6B	Drawings

Volume: IV – Conditions of Contract and Contract Forms

Section 7	General Conditions of Contract
Section 8	Particular Conditions of Contract
Section 9	Contract Forms

5.6 BILL OF QUANTITIES AND COST ESTIMATE

5.6.1 Unit Rate Analysis

The unit prices or lump sum prices were analyzed considering the following:

- Standard GON NORMS of unit price analysis and other accepted norms in recent ICB and LCB contracts in the country and elsewhere
- Market Prices/FOB prices for imported materials as pipes, accessories etc
- Wages of skilled and unskilled labor
- Construction technology
- Mobilization and demobilization cost
- Overheads and profit
- Contract tax or VAT.

Break-down into plant, materials and labor component for all unit prices was derived. Unit rates for individual items were determined on the basis of basic inputs, overheads and profit including the determination of the foreign exchange component of each element.

5.6.2 Quantity and Cost Estimates

Based on the detail design and drawings prepared, the bills of quantities have been prepared for all components of the project. Cost estimates were prepared considering the established quantity of works and unit prices. Capital cost estimates are included in Appendix I and include cost of materials, construction, and contingencies.

The cost estimates for 2nd phase SRTs for Kirtipur and Mahankal is also included. The cost estimates of SRTs are based on DSC03 drawings and estimation.

Total estimated cost of the pipeline system (including custom and excise duties, VAT, and contingencies) is approximately $17.0 Million

5.7 TENDER PERIOD AND AWARD

DSC-05 will perform the following tasks in connection with Contractor's bid:

- respond to queries, site inspections and conduct pre-bid conference
- assist the PID in the bid opening and evaluation of bids
- assist the PID in preparation of evaluation report
- assist PID in contract negotiation with Contractor

DSC-05 will prepare tender evaluation report(s), and assist with the approval of the recommendations of the tender evaluation report with the lending agency by way of answering any queries.

5.7.1 Response to Queries and Conduct Pre-Bid Conference

PID and DSC-05 will be available for clarification of any point raised. Should further investigation be required in order to respond to bidders' questions, written answers will be sent to all bidders. These answers, together with the minutes of any pre-bid conference, will form part of the Tender Documents.

5.7.2 Conduct the Bid Opening and Evaluation of Bids

The Tenders when received will be initially examined to determine their substantive responsiveness. DSC-05 places priority on ensuring that the most acceptable Tenderer is awarded the contract. Tenders will therefore be carefully evaluated to examine all risks, and to ensure that the tendered price is reasonable, that Tender programs are logical and achievable, and that proposed resources (plant, equipment, materials, and manpower) are adequate for the work.

As far as possible, rates for daywork, prolongation costs, and any possible future variations will be established prior to contract award to limit possible dispute during the contract.

In evaluating Tenders, the aim will be to award the contract to the Tenderer who can best demonstrate that the contract will be completed on time, at the most acceptable contract price and to the specified quality.

It is intended that Tender evaluation will check the following items for each Tender submitted:

- Eligibility of Tenderer
- Sufficiency of Tender
- Tender price
- Technical analysis which includes review of the Contractors' method of construction and program of works including their proposed time for completion of works
- Contractor's statement on Health & Safety; and
- Contractor's environmental statement and management plan including staff and labor resources, and plant and equipment proposed by the Contractor.

The evaluation will check that the tenders have been correctly completed and are responsive to the instructions for tendering. Any reservations and special conditions made by the Tenderers will be assessed with relation to financial implication and consideration given to their acceptance. A check will be made to confirm that the required sureties have been submitted.

Analysis of the priced bids will be divided into two phases; first to check errors in computation and secondly to evaluate the Tenders to establish:

- the arithmetically corrected Tenders
- reservations and alternative proposals and their financial implications
- other factors which cannot be expressed in money terms
- comparison with the Engineer's Estimate and assessing unbalanced rate, front loading and implication to project implementation.

A check will be carried out to confirm that the information provided at prequalification is still relevant. After the thorough evaluation and analysis of all the Tender Bids received, DSC-05, if necessary, will prepare a list of clarifications to be asked to each Tenderer and submit it to PID. DSC-05 will further evaluate all the clarification received from the Tenderers before making the final recommendations. Examination of the Tenders and their subsequent evaluation will be carried out in strict confidence.

5.7.3 Prepare Recommendations to the Client for Contract Awards

The Tender evaluation will be submitted in a report with recommendations for the preferred Tenderer. The report will include:

- Introduction
- Particulars of Tenders received
- Initial Elimination of Tenders
- Comparison of Tenders
- Conclusions
- Recommendations

This report will contain a technical as well as financial assessment of all Tenders received combined or technical and financial BER as per the process of the tender. In addition, the report will contain a series of appendices in the form of tables showing the details of the tender figures, tender totals, evaluated tender totals, records of minutes of meetings, copies of relevant correspondence with Contractors after the Tenders were received and other data as appropriate. In addition a draft Letter of Acceptance will be submitted.

5.7.4 Assist PID in Liaison with Lending Agency

The Engineer's estimated cost of the pipeline (approximately $16.7 Million) exceeds what is reported to be the available remaining funds under ADB Loan 1820-NEP (SF). However, the total estimated cost includes amounts which would not be covered under the present ADB Loan. Depending on the final evaluated bid price, DSC-05 would propose to provide the following assistance to PID:

1. Determine which portions of the evaluated bid price are covered under the terms of the ADB Loan, and which are not.

2. Review the available funding available under the ADB Loan 1820-NEP (SF) after payment of outstanding contract obligations and other amounts committed (but not yet incurred) under other contracts.

3. Assist PID to liaise with ADB regarding the shortfall of available funding under ADB Loan 1820-NEP (SF).

4. Provide any necessary backup support to ADB required to support a request for retroactive financing from upcoming Project No. 34304-NEP of the Asian Development Bank.

5.7.5 Assist PID in Contract Negotiations with Contractor

DSC-05 will assist PID with the negotiation of the contract and the formalities associated with the award, with the Client's approval and ADB's 'no objection' being sought at each stage.

On successful completion of negotiations the formalities will include preparation of formal Letters of Modification as appropriate, incorporating the prices and any other amendments to the Tender for the submission by the Client to the successful tenderer for signature. On receipt of the successful Tenderer's unqualified acceptance, the Form of Agreement will be prepared together with the Contract for signature by PID and Contractor.

Appendix A Initial Geotechnical Observations

A.1 Design

From an inspection of the sites and available information, the following observations were made.

During design of BDS system the following geotechnical problems may be encountered:

- High groundwater tables
- Unstable slopes
- Danger of erosion
- Stability of trench walls
- Low bearing capacity under foundations
- Low lateral bearing capacity in trenches
- High bedrock level
- Earthquake
- Construction materials.

A.1.1 High Groundwater Tables

The low points of the pipelines, particularly at crossings of rivers and side streams, will require the construction of scour-valve chambers. The design of these chambers shall include the required safety measures against uplift considering the different water levels and load cases. The same applies to the pipe itself near river crossings. It must be possible to evacuate the pipe or the chamber or both at regularly occurring high outside water levels.

For the improvement of uplift safety it is proposed to enlarge the foundation slab laterally, so that the weight of the surrounding backfill can be taken into account. To avoid the backfill to be eroded, rockfill material may be used from the Melamchi Tunnel muck deposit.

A.1.2 Unstable Slopes

An unstable slope has been noted at the eastern Bagmati River bank near the location of Jhamsikhel-Sanepa, which is outside of the area of the present project phase. This slope, which is composed at surface of a clayey silt, is showing considerable sliding movements, implying severe damages or destruction to several houses. The level difference at that slope is about 30 meters.

Earthquake impacts seems not to be involved in this dislocation. The possible cause of this event is actually under investigation by others. The instability was possibly influenced by scouring at river level, change in groundwater and drainage conditions and increase of additional surface loads (building construction) on a subsoil with a low shearing resistance.

The design of the new reservoirs of the Melamchi Project must avoid similar problems. Some reservoirs are foreseen to be constructed near steep slopes and at some places the underground will

consist of cohesive soils with a low shearing resistance combined with a high groundwater level. Since the results of the soil investigation are not yet available, the design shall proceed with a preliminary stability analysis on the basis of conservatively estimated soil parameters.

In any case the design should avoid layouts, where new loads will be placed near the upper edge of steep slopes.

The stability of cut slopes of a certain depth must also be analyzed in the same way, using at first estimated parameters in a preliminary calculation, in order to make sure that the intended layout will not present severe problems.

A.1.3 Danger of Erosion

Erosion problems are mainly expected at the pipelines, particularly, where rivers and side streams have to be crossed.

To prevent erosion of soil and backfill in the area of the pipeline installation, the following erosion protection measures may be applied.

(i) Surface Drainage System

The backfill area of the pipeline at steep slopes must be kept free from concentration of runoff water. Near the upper edge of the slope a reasonably dimensioned storm water ditch will be provided. If the height of the slope is more than approximately 10 m, the slope should be intersected by one or more additional ditches. The ditches will collect the storm water before more concentrated streams develop. The surface of the ditches and the intermediate slopes shall be protected by planted vegetation, as outlined below. To stabilize very steep slopes, a sequence of gabions can be installed which will provide a secure protection at the hillside part of the berm.

(ii) Surface Protection by Rockfill Layers

At difficult areas, where water flows cannot be diverted easily or where traffic condition may not allow a successful vegetation planting, a special protection layer may be prepared by use of rockfill material. Suitable rockfill material may be available from the muck deposit of the Melamchi Tunnel construction site. The grain size distribution of this material must be carefully selected in accordance with the inclination and the expected water flow.

(iii) Surface Protection by Vegetation

The most adequate protection against erosion consists in planting of grass or, in special cases, in the planting of small bushes. The surface to be protected will need a certain care and maintenance particularly immediately after planting of grass, but later the cultivated areas will remain safe with minimum maintenance.

(iv) Erosion Protection at River Crossings

For river crossings we consider a siphon design is appropriate. The pipe will be installed during the dry season in a trench excavated into the riverbed.

The pipeline itself will be surrounded by concrete, on top of which an approximate 60 cm thick layer of adequately dimensioned rockfill material will be placed. The width of the layer will be in a range between 5.00 to 10.00 meters as required by the specific site conditions. Where the river bed consists of solid rock, the pipe trench will be back filled by use of concrete, replacing the rockfill.

The banks at both ends of a siphon at crossings of rivers or of sidestreams will be protected by the construction of gabions at the adjacent slope up to the expected maximum water level.

A.1.4 Stability of Trench Walls

Where the pipe trenches will be excavated with vertical cuts deeper than 1.50 m the walls would require a temporary support for safety reasons. Near roads or places with public traffic any cut steeper inclined than 1V:1H shall be supported. Soil parameters for the dimensioning of the required support, like bulk density and shearing resistance will be available only after completion of geotechnical investigations.

A.1.5 Low Bearing Capacity under Foundations

The subsoil under some of the reservoirs may be found to have a low natural density, which is related to a low compression modulus. To avoid unacceptable settlement values and settlements differences, the design will try to reduce the new load by increasing the depth of excavation. It would also be possible to replace the uppermost layer underneath the foundation by a compacted selected fill, to achieve a more uniform load distribution underneath the structure.

The values of the soil parameters to be used for the dimensioning of the foundations will be available after having received the corresponding test results from the laboratory.

A.1.6 Low Lateral Bearing Capacity in Trenches

Anchor blocks at pipe bends and valves would need to react on the laterally located undisturbed soil to transmit the forces from the pipe to the underground without displacements.

The lateral bearing capacity of soils along the pipeline depends mainly on the soils composition, the density and the shearing resistance prevailing at the side wall of the trench. These values will be investigated in regular distances and used to establish the admissible lateral loads on the trench walls.

At some places the horizontal bearing capacity will be low, due to the presence of soft cohesive soils, or due to high temporary groundwater levels. The pipe may then be designed to be installed deeper under the ground surface; the bearing capacity generally increases with depth, due to the increase of soil volume reacting laterally and very often also due to a better soil quality at a greater depth.

A.1.7 High Bedrock Level

Near the village of Gokarna bedrock is observed to outcrop on the road, the main pipe will be installed in this location. Some additional locations with bedrock at shallow depth will be identified during execution of geotechnical investigations and finally during construction some more locations will be found.

The excavation of trenches in rock material must be carried out mechanically, e.g. by excavator, ripping dozer, hydraulic hammer in co-operation with a track drill machine and/or pneumatic hammers, because the use of explosives will almost certainly not be possible in populated areas.

The final quantities for the different excavation classes can only be estimated on the basis of the actual knowledge.

A.1.8 Earthquake

It is a well-known experience from other countries, where the frequency of heavy earthquakes is rather high, that underground structures are less affected by severe seismic events. Deformations in the underground may only be expected at active fault lines, which locally may exist in the underground of the Kathmandu Valley. Surface structures like reservoirs or retaining walls shall be dimensioned to be able to resist to additional horizontal loads in accordance to the specific earthquake acceleration, which has to be considered in connection with the corresponding return period. Stiff concrete structures will resist earthquake motions far better than steel tanks will, as they cannot be subdivided into internal compartments.

A.1.9 Construction Materials

The following construction materials will be required for the BDS:

- Concrete fine aggregates
- Concrete coarse aggregates
- Pipe bedding material
- Selected backfill for blanket
- Rockfill material
- Selected and processed rock material
- Subbase and base material

(i) Concrete Fine Aggregates

It will be investigated whether the sandy material available at local borrow areas will be suitable as excavated, or if processing will be necessary.

(ii) Concrete Coarse Aggregates

Coarse aggregates will be prepared from crushed limestone available at several quarries in the Kathmandu valley. The material from three different quarries will be tested in the laboratory.

(iii) Pipe Bedding (Cradle) Material

Good pipe bedding material would not be found easily in the Kathmandu valley. The natural sand deposits, containing either a sandy terrace material or sandy river sediments will be investigated. Also the material, which will be excavated in pipe trenches and at reservoir sites will be taken into consideration. The terrace material is estimated to contain some parts of gravel and also fine sand and some percentage of silt. The silt content in river sand is lower.

Compaction tests will show whether the material from the pipe alignment and from reservoir sites may also partly be used as bedding material.

If required, any selected granular material will be material of a granular, non-cohesive nature, free draining, a pH > 6 and the following grading.

Sieve Size (mm)	% Passing Sieve
40	100
20	80-100
5	40-100
2.5	20-80
0.6	
0.315	0-20
0.075	0-5

Where selected granular material is not required, selected fill material shall be material that has a pH > 6 and the following grading.

Sieve Size (mm)	% Passing Sieve
40	100
20	80-100
5	40-100
2.5	20-100
0.6	5-100
0.315	0-70
0.075	0-10

(iv) Selected Backfill for Blanket

It is estimated that part of the trench excavation material will be useful as selected backfill; if this is not the case, the same material as proposed for the bedding will be used for the blanket.

(v) Rockfill Material

Rock fill material will be available from the deposit of the material excavated from the Melamchi Tunnel. This rock material is estimated to be useful for erosion protection measures, and also for the replacement of unsuitable soils at foundations of structures.

(vi) Selected or processed Rock Material

Selected or processed rock material will be available at local quarries or it can be prepared from the material at the tunnel muck deposit. Selected rock material will be required for the preparation of gabions and for specific filter layers, which would need to be carefully designed in order to construct an effective and hydraulically stable and safe filter system.

(vii) Subbase and Base Materials

Subbase and base material have to be used for the reconstruction of the roads, and they will be available mainly from the local quarries.

A.2 Execution of Construction Works

The following problems shall be taken into consideration during construction of the BDS project:

- High groundwater tables
- Unstable slopes
- Danger of erosion
- Stability of trench walls
- High bedrock level

A.2.1 High Groundwater Tables

At sites with a high groundwater table, the construction works shall be carried out preferably during the dry season. If this will not be possible, the water table must be kept down by a suitable drainage system, or by an open pump system or even by a closed wellpoint system.

If the dewatering system is a permanent installation, it has to be designed by the Engineer. All other temporary systems have to be proposed by the Contractor to be approved by the Engineer.

A.2.2 Unstable Slopes

All permanent slopes which will be affected permanently by the design of the project, or which have an important influence on the safety of the project, shall be analyzed and, where necessary, submitted to an adequate design by the Engineer, in order to achieve the required safety level.

The stability of temporary slopes is the responsibility of the Contractor under the supervision of the Engineer.

A.2.3 Danger of Erosion

The work for stabilization and protection of permanent slopes will be included in the contractual scope of paid works. Temporary slopes must be protected by the contractor on his own account.

A.2.4 Stability of Trench Walls

For safety reasons all vertical trenches deeper than 1.5 m will require support, which shall be classified according to the depth. The Contractor will be responsible for stability and safety of trenches.

Appendix B Structural Design

B.1 Design Loads

B.1.1 Structures will be designed to withstand loads exerted by

- dead loads,
- live loads,
- operation loads,
- temperature loads,
- buoyancy,
- test loads,
- wind loads,
- seismic loads.

Loads will be basically in accordance with BS 6399 'Design loads for buildings' unless otherwise stated hereafter. All loads used in the design and their origin will be clearly indicated in the design calculations.

(i) Dead Loads

Dead loads include dead weight of structural components, imposed steady loads (earth and ground water pressure for instance) and equipment.

(ii) Live Loads

Live loads include stationary and/or movable loads. Following loads will be used:

• Walkways and stairs	5.0	kN/m^2
• Platform plates	5.0	kN/m^2
• Flat roofs carrying equipment	5.0	kN/m^2
• Flat roofs carrying no equipment / Tank roofs	1.0	kN/m^2

(iii) Operation Loads

Operation loads include loads generated by machinery (engines, pumps, cranes, etc), content of storage vessels, content of process vessels, etc.

Where necessary, dynamic factors and increased loads due to malfunction of equipment will be considered. When choosing dynamic factors and/or increased loads, the designer will consult the equipment manufacturer.

Safety factors in the case of equipment malfunction may be reduced to a reasonable amount in agreement with authorized contractual parties.

(iv) Temperature Loads

Thermal influences and temperatures will be considered for all structures where such influences result in higher stresses or endanger the proper function of equipment.

Temperature variation from + 0°C to 50°C will be considered in the design for the structure or structural parts and piping exposed to direct weather influences. This criterion will be considered in the design of expansion and/or contraction joints.

For empty pipes exposed to direct sun radiation a maximum temperature of 80°C will be taken into account. Due account will be taken of the effects of direct sun radiation on steel structures.

(v) Buoyancy

Under normal conditions structures will be protected from buoyancy effects by the drainage system/s. Where this is not possible for specific reasons or floods cannot be prevented, structures must be designed to withstand the uplift forces and maintain required safety against sliding and overturning.

(vi) Test Loads

Site test loads and procedures for particular equipment or parts of equipment are / will be defined in relevant regulations and/or manufacturer's instructions.

(vii) Wind Loads

Wind pressures on structures and parts of structure (cladding for example) will be calculated in accordance with 'National Building Code of India' (NBCI-Revision April 1984). Basic maximum wind pressure will be 1.25 kPa (125 kg/m^2) corresponding to a basic wind speed of 40 m/s ($p=0.006xV^2$; V in km/h, p in kg/m^2). The value of 1.25 kPa is the mean value between the 'green' and 'blue' zones shown on the figure 1A of NBCI. In typically flat areas basic maximum wind pressure of 1.50 kPa will be used.

Basic maximum wind pressures given above are applicable for the heights up to 30 m above the ground; for the heights above 30 m provisions of NBCI will be followed.

(viii) Earthquake Loads

Seismic loads on structures and parts of structure will be calculated in accordance with 'National Building Code of India' (NBCI-Revision April 1984). When determining loads due to seismic effects acting upon structures or parts of the structure, Seismic Coefficient Method will be used. Response Spectrum Method may be used when the natural periods of vibration of the structure are clearly defined.

Earthquake zone will be V; basic coefficient α_0 for Seismic Coefficient Method will be 0.08 and basic coefficient F_0 for Response Spectrum Method will be 0.40.

(ix) Permissible increase in stresses, partial factor of safety, increase in allowable bearing pressure of soil

(a) Serviceability Limit State

Whenever earthquake forces are considered along with other design forces, the permissible stresses in materials and the elastic method of design assumed may be increased by one third.

(b) Ultimate Limit State

There is no provision for the partial safety factor for seismic loads in BS 8110. When using ultimate limit state in the design of a structure or parts of a structure, a partial safety factor as quoted under 1.2.2 will be used.

For both, serviceability limit state and ultimate limit state, permissible increase in allowable bearing pressure of soil will be as specified in NBCI, Part VI Structural design, Section 2, Foundations.

B.1.2 Combination of Loads

In all combinations, earth and ground water pressure, if any, are included in the dead load.

If any of the combinations is not considered in the design calculation, the designer will point this out clearly and give a reasonable technical explanation for the omission.

In the design calculations using either ultimate limit state (ULS) or serviceability limit state (SLS) as a minimum, the following load combinations will be considered for structures and their foundations:

(i) Serviceability Limit State

(a) dead + operation + live + wind

(b) dead + wind + buoyancy (drainage malfunction)

(c) dead + test

(d) dead + earthquake

(e) dead + operation + earthquake

(ii) Ultimate Limit State

(f) 1.2 x dead + 1.2 x operation + 1.2 x live + 1.2 x wind

(g) 1.0 x dead + 1.4 x wind + 1.0 x buoyancy (drainage malfunction)

(h) 1.2 x dead + 1.2 test

(i) 1.2 x dead + 1.4 x earthquake

(j) 1.2 x dead + 1.2 x operation + 1.2 x earthquake

B.1.3 Deflection Limits

When checking the deflections of a structure, the most adverse realistic combination and arrangement of unfactored loads (SLS) will be assumed.

Deflection of members listed in the table below will not exceed the tabulated limits, unless it is proven that higher values will not be detrimental to the performance of the structure or any of its parts.

(a)	Beams	Maximum vertical deflection
	Cantilevers	Length/200
	Beams (general)	Length/300

Purlins and sheeting rails to suit the characteristics of the sheeting, roofing and ceiling materials but not more than Length/200.

(b)	Columns	Maximum horizontal deflection
	Each storey (any structural system including portal framed structures with metal cladding)	Height/300
(c)	Crane girder	Maximum vertical deflection
	Vertical deflection due to static wheel loads	Span/800
	Horizontal deflection (calculated on properties of top or bottom flange along as applicable)	Span/500

The relative lateral deflection of adjacent frames (including end frames) of sheeting clad structures will be limited in general to frame centers/250 unless higher values can be proven to have no detrimental effect on the structural performance of the sheeting.

B.2 Structural Concrete Design

B.2.1 Design Principles and Analysis

Calculations for the design of any structures will be prefaced by a statement explaining the principles of design and the type of analysis adopted. The statement will also indicate the codes of practice upon which the design is based and into which category the structure (or part of a structure) is placed for design purposes, i.e. class l, 2 or 3 as described later under ‘classification of concrete structures’.

For a superstructure framework a separate statement will be included explaining how the overall stability is maintained.

Any computer programs used in structural concrete design will be fully described, and details of input and print-out will be presented in a manner, which can be readily understood. Program manuals and any instructions to program users will be available upon request.

Where any such program cannot be proven to have been fully checked, test examples will be run upon request in order to verify the completeness and accuracy of the program.

B.2.2 Reinforced Concrete

Reinforced concrete will be designed in accordance with whichever of the following British Standard codes of Practice, is relevant:

BS 8110: 1997 Structural use of concrete, Part 1

BS 8007: 1987 Design of concrete for retaining aqueous liquids
(to be read in conjunction with BS 8110:1985)

BS 8004: Design of foundations

Plain concrete will be designed in accordance with BS 8110: Part 1.

The thickness of reinforced concrete walls and slabs designed to BS 8007 (Class 2 and 3 structures) will not be less than that derived from the following constraints:

- where walls and slabs are 'external' (i.e. bounding the outside of a water containing space so that leakage, if it ever occurred, would pass through the wall to or from foundations, drainage, collection systems or places intended to be dry and accessible), the thickness will be not less than 350 mm,
- where walls and slabs, reinforced on both faces, are 'internal' (i.e. dividing the internal space of a structure so that leakage, if it ever occurred, would pass through the walls from one water containing space to another water containing space), the thickness will not be less than 250 mm.
- the thickness will nowhere be less than the structural thickness required by the design procedures for Class 2 and 3 structures specified under 'Design methods'.

(i) Classification of Concrete Structures

This classification will be applied to the whole structure or to parts of structures where more than one case exists within the overall framework. Structures are divided into three classes as follows:

Class 1: Structures not normally subjected to hydrostatic pressure and not intended for the purpose of storage, retaining or transmission of liquids.

Class 2: Structures not used to store liquids but may be subjected to hydrostatic pressure and/or external soil pressure.

Class 3: Structures for storage or retaining of liquids.

(ii) Design Methods

Class 1 structures will be designed to BS 8110 using limit state design methods.

Class 2 structures will be designed to BS 8007 using limit state design method. A limiting design crack width of 0.2 mm will be used for the serviceability limit state of cracking.

Class 3 structures will be designed to BS 8007 using limit state design methods. Where requirements on aesthetic appearance are set (example: outside face of water tank walls) a limiting design crack width of 0.l mm otherwise 0.2 mm will be used for the serviceability limit state of cracking.

Where additional concrete beyond normal structural design needs is introduced for the purpose of gaining dead weight to counter the effects of buoyancy or increasing the friction force, it will be uniformly distributed among the sub-structure members as far as possible.

(iii) Reinforcement for Control of Temperature and Moisture Effects

Class 1 superstructures

Where a slab or wall is exposed to 'severe' exposure conditions (BS 8110 classification) the reinforcement provided to exposed face will be not less than that indicated below:

- sections up to 250 mm thick, T 12 - 200 mm c/c in each direction;
- sections 300 mm to 450 mm thick, T 16 - 200 mm c/c in each direction;
- sections 500 mm thick or greater, T 16 - 175 mm c/c in each direction.

Class 2 and 3 structures

Slabs and walls will have reinforcement calculated in accordance with BS 8007 (crack spacing/crack widths) using the following data:

fct = 1.6 MPa and 1.76 MPa for immature concrete C35 and C40 (3 days strength) respectively

fy = 250 MPa for plain round mild steel bars

fy = 460 Mpa for deformed high yield bars

fy = 415 Mpa for twisted steel bars complying with Fe415NS191-2046 requirements

$\frac{fct}{fb}$ = 1.0 for plain round mild steel bars

$\frac{fct}{fb}$ = 0.667 for deformed high yield bars

$\frac{fct}{fb}$ = 1.0 for twisted steel bars

α = 1.2×10^{-5} / °C = coefficient of thermal expansion of concrete

T_1 = fall in temperature from hydration peak to ambient.

This will be calculated allowing for the following:

(k) Estimated temperature at time of placing

(l) Cement content in the mix

(m) Size of members

(n) Formwork materials

T_2 = fall in temperature due to seasonal deviation.

(iv) Grades of Concrete

Grade of concrete will generally be in accordance with the following table:

Grade	Description
C40	Class 1, 2 and 3 structures under 'severe' exposure conditions (BS 8110)
C35	Class 1, 2 and 3 structures under 'moderate' exposure conditions (BS 8110)
C30	Class 1, 2 and 3 structures under 'mild' exposure conditions (BS 8110)
C30	Structural plain concrete for soil retaining walls
C25	Blinding concrete / Concrete fill

Pulverized-fuel ash (p.f.a.) and ground granulated blast furnace slag (g.g.b.f.s.) will not be used in the concrete mix.

(v) Reinforcement

Main reinforcement will generally be high yield deformed (Type 2) or twisted steel bars. Links to beams and columns may be plain round mild steel bars.

The following characteristic yield strengths will be used in design calculations:

- plain round mild steel bars: f_y=250 N/mm^2
- high yield deformed steel bars: f_y=460 N/mm^2
- twisted steel bars f_y=415 N/mm^2

(complying with Fe415NS191-2046 requirements)

(vi) Concrete Cover

Nominal concrete cover will be determined following BS 8110 regulations (Table 3.3) considering conditions of exposure. Concrete cover/s used will be clearly indicated in the design calculation/s and execution drawings.

Where exposed aggregate finishes are used, the reinforcement covers specified above will be increased by 10 mm concrete for a maximum aggregate size of 20 mm and 15 mm for concrete with a maximum aggregate size of 40 mm.

Where ribbed finishes are used the dimensions of the ribs will increase concrete cover and the detailed structural drawings will indicate that the specified covers are to be measured from the outermost surface of the ribs.

(vii) Bond and Lap Length

The minimum 'anchorage bond length' and 'lap length' to develop the force in the bars will be as given in Table 3.29 of BS 8110.

The lap length will be in no case less than 25 times the bar diameter plus 150 mm for bars in tension and 20 times the bar diameter plus 150 mm for bars in compression. Where lapped bars are of two different diameters the lap length will be calculated using the diameter of the smaller bar.

(viii) Waterstops and Sealing Compounds

Construction and expansion joints in Class 2 and 3 structures will incorporate internal waterstops and sealing compounds on both faces as specified in 'Joints in concrete'.

In expansion joints internal waterstops will be of central bulb type and in construction joints they will be of expansion type. Surface waterstops will be used for construction joints in exceptional cases only and will be of expansion type.

(ix) Joints in Concrete

(a) Construction joints

Construction joints are introduced for convenience in construction. Reinforcement will be fully continuous across the joint and special measures taken to achieve continuity in the concrete in accordance with the requirements of the specification for concrete structures. The position of construction joints will be clearly indicated on the drawing/s. Joint positions will be located avoiding zones of high stresses wherever possible. A central waterstop of expansion type will be used together with sealing compounds on both faces.

(b) Expansion joints

In this type of joint, concrete and reinforcement are completely discontinuous. An initial gap of approximately 20 mm between adjoining parts will be provided to accommodate the movement due to expansion or contraction of the structure. A central waterstop of bulb type will be used together with compressive joint filler and sealing compounds on both faces.

(c) Complete and partial contraction joints

Although quoted in BS 8007 this type of joint will not be used in the design of water tanks. When used in other structures complete and/or partial contraction joints will be designed following the rules of the BS code.

(x) Surface Finishes

Where necessary a detailed description of surface finish will be given on relevant formwork drawing/s.

Finishes will be generally provided as described below.

Class F.l

Surfaces against which further concrete is to be placed and surfaces to be permanently concealed by rendering, plastering, etc. No special requirements are set for this type of finish.

Class F.2

All surfaces permanently exposed to view, except where Class F.3 is required.

Surfaces either permanently in contact with stored, retained or flowing liquids and surfaces against which a membrane tanking is to be applied.

For this type of finish small blemishes caused by entrapped air or water may be expected; the surface should however be free from voids, honeycombing or other blemishes.

Class F.3, 'ribbed' and 'exposed aggregate' finishes.

Surfaces prominently exposed to public view where good appearance is of special importance. Class F.3 is also known as 'fairfaced' finish.

For this type of finish all surfaces should be true and clean. Very minor blemishes may occur with no staining or discoloration.

(xi) Drawings

Drawings will be prepared such that the details are presented in a clear, concise and unambiguous manner. Written descriptions will be as brief as possible, consistent and complete. Lettering will be legible and clear (minimum height 2.5 mm).

Special requirements associated with the design, e.g. details of chambers, sequence of construction, position and type of joints, will be described on the detailed structural drawings.

Special consideration will be given to the spacing of bars in order to ensure that the concrete can be placed and compacted without difficulties.

Reinforcement laps in slabs and walls will be staggered wherever possible.

The following scales will be used:

General arrangement drawings	1 to 100	or	1 to 50
Walls and slabs* - plans and elevations	1 to 50	or	1 to 20
Walls and slabs - sections	1 to 20		
Beams and columns - elevations	1 to 20		
Beams and columns - sections	1 to 20	or	1 to 10

Where concrete sections and/or reinforcement details are complex and liable to result in a drawing which is difficult to read, a larger scale will be adopted.

(xii) Detailing Will be as Follows:

Lines

Main reinforcement	- to be 0.6 mm thick
Concrete outline and links, etc	- to be 0.4 mm thick
Dimension lines, etc	- to be 0.2 mm thick

Note: When detailing reinforcement all bars will be indicated by full lines. Where, for clarity, bars which are detailed elsewhere are shown extending into the part of the structure being detailed (e.g. from an adjacent span of a beam, or from a support), they will be indicated by dashed lines.

Reinforcing bar notation

The following method, complying with BS 4466 'Specification for bending dimensions and scheduling of reinforcement for concrete', will be used.

(a) Elevations of walls and plans of slabs (example)

20 T 12 - 63 - 150 NF where:

20	indicates number of bars
T	indicates type of steel - see note (c) below
12	indicates diameter of bars in mm
63	indicates the bar mark
150	indicates spacing centre to centre bars in mm
NF	indicates location of bars

Use one of the following abbreviations:

EW -	each way				
NF -	near face,	FF –	far face,	EF -	each face
BF -	bottom,	TF -	top		

(b) Main reinforcement in beam and column elevations (example)

4	indicates number of bars
T	indicates type of steel - see (c) below
25	indicates diameter of bars in mm
39	indicates the bar mark

(c) Type of steel

R = round mild steel bars in the metric round range of areas (hot rolled bars complying with BS 4449)

T = high yield bars having a high bond strength, in the metric round range of areas (hot rolled bars to BS 4449 and worked bars to BS 4461).

Adequate information will be given on plans, elevations or sections for the bending dimensions of all reinforcing bars.

All reinforcing bars will be positioned in relation to concrete faces.

Basic structural dimensions will be specified on the reinforcement drawings, e.g. slab depth, wall thickness, beam length, width and depth, etc.

(xiii) Slabs

Slab plans will be drawn as viewed from above the slab and will show any grid reference and the beam and wall numbers.

A 'run' of bar reinforcement on the plan will have the limits of the run shown by short lines and one intermediate bar only shown in full. The short lines at the limits will be joined by a thin collecting line.

Provided congestion does result, the description of bar reinforcement on the plan will be written on the collecting line; otherwise the description will be written on an extension of the collecting line.

Beams

Elevations will give the full bar notation of main reinforcing bars and link reinforcement.

Cross sections will show the individual position of each reinforcing bar, its bar mark, the concrete cover and the shape of the link reinforcement.

Slab reinforcement and reinforcement in adjacent beams will only be shown on the beam details for their relationship with the reinforcing bars in the subject beam, and when shown will be indicated by dashed lines.

Columns

Elevations will give the full bar notation of main reinforcing bars and link reinforcement.

Cross sections will show the individual position of each reinforcing bar, its bar mark, the concrete cover and the shape of the link reinforcement.

B.3 Structural Steel Design

B.3.1 Design Principles and Analysis

A statement explaining the principles of design will preface calculations for the design of any structures and the type of analysis adopted. The statement will also indicate the codes of practice upon which the design is based.

For a superstructure framework a separate statement will be included explaining how the overall stability is maintained.

Any computer programs used in structural steel design will be fully described, and details of input and print-out will be presented in a manner which can be readily understood. Program manuals and any instructions to program users will be available upon request.

Where any such program cannot be proven to have been fully checked, test examples will be run upon request in order to verify the completeness and accuracy of the program.

B.3.2 Codes and Standards

Structural steelworks will be designed in accordance with the following codes / standards:

BS 5950 Specification for the use of structural steel in building

Structures, which are considered to be beyond the scope of the aforementioned standard, will be designed in accordance with:

BS 5400 Steel, concrete and composite bridges

Use of a standard or code of practice different to those specified will be separately agreed among the authorized contractual parties. The standard or code of practice agreed will be used in its entirety for the whole structure.

Isolated parts of other standards or codes of practice considered relevant, may also be implemented upon agreement among the authorized contractual parties.

B.3.3 General Principles

Structures may be designed either by the working stress approach, using unfactored loads against a working stress (generally limited to 0.7 x yield stress) as specified in the relevant standard or by the limit state method. Structures designed to the limit state methods will be designed considering the limit state which maintains appropriate safety factors to provide an adequate degree of safety and serviceability.

The structures will be designed with an additional safety of not more than 10% in order to be capable of accepting reasonable amount of extra loading due to any cause including extra services, heavier cladding, or other items that may reasonably be added during the life of the structure.

The design will take into account the need for stability of both framework and individual elements at all stages of erection works. Where temporary stabilizing measures (bracing/s for instance) are required, they will be checked for the effects of all loading conditions that may arise during erection including those due to erection equipment and its operation. Such measures will be clearly indicated on the drawings together with clear instructions about the appropriate time/stage of erection for their removal.

The design of crane beams is not a subject of these design criteria. When required, the regulations of BS 5950 will be followed.

B.3.4 Protective Coating Design

(i) Scope and Standards

This section specifies design methods for the protective coating to be applied to structural steel, metalwork and ironwork as corrosion protection systems. The systems designed as specified here will be applied as specified under Protective Coatings. Protective coatings specified elsewhere for particular works such as pipes and cladding will firstly be designed in accordance with particular requirements specified elsewhere and secondly in accordance with any requirements herein that are not over-ridden elsewhere.

This specification refers to BS 5493: 'Code of practice for the protective coating of iron and steel against corrosion'.

(ii) General Requirements

Protective coatings will be designed in accordance with BS 5493 to have a long service life generally at least 15 years to the first maintenance for metal surfaces and tank linings and 5 years to first maintenance for building structures. Protection systems will be chosen to be easily maintained in the future and to allow *in situ* re-coating where necessary using single mean/equipment.

(iii) Environment

For the purpose of system design the general environment will be assumed as specified in BS 5493 Table 3 Part 2: 'Exterior exposed polluted inland'. Structures retaining and/or transferring and/or storing water will be assumed to be exposed to the Table 3 Part 8: 'Non-saline water' environment unless otherwise agreed by authorized contractual parties.

Interior spaces in administration areas open to continuous access will be considered dry. Other locations will be assumed as damp or immersed. Protective coatings of structures or structural components or structures that are continuously or infrequently immersed will be designed for the more onerous of these two conditions concerning the protection system used.

All exterior exposed items to be coated will have a final coat of good appearance and of a color and type as agreed by authorized contractual parties.

Protection system for a structure, a group of structures or structural parts will be determined in the design phase.

(iv) Systems

Protective coating systems will generally be included in one of the following basic systems:

- galvanizing;
- galvanizing plus painting;
- multi-coat painting;
- bitumen enamel;

- others as proposed in particular design and agreed by authorized contractual parties.

Depending on necessity to protect a structure or a part of a structure, the designer will provide details of corrosion protection based on protection systems quoted above. Each item to be protected will be allocated to one of the categories below:

- trash screens, flooring, ladders, access covers and frames, step irons and other components which are inaccessible but subject to abrasion/damage;
- structural steelworks (including crane beams, monorails, crane structures and chassis), bulkhead gates, stoplogs, grappling beams, steel tanks and other large items readily accessible for maintenance;
- valves and other corrosion-susceptible items which may be buried and are not covered by the provisions of other specifications;
- other components not covered by the above quotations for which a special system may be considered to be more advantageous.

B.4 Thrust Blocks

Thrust blocks on pipelines will be designed to resist with the specified factors of safety any pulls or thrusts to which they may be subjected. Four basic load conditions must be considered:

- normal operation,
- test pressure,
- closed valve pressure with pumps running,
- earthquake including loads due to normal operation.

B.4.1 Sliding

(a) Normal operation

Where the factor of safety against sliding is not otherwise specified, it will be taken as not less than 1.5 calculated on frictional resistance at the base of the thrust/anchor block in the direction of incipient sliding.

Should it be necessary to take into account passive resistance of soil, the factor of safety against sliding will not be less than 2 even if frictional resistance is included. When using the passive soil resistance for stability calculations, an estimation of block movement will be required in order to check compatibility of the movement with the pipe joint system used.

Passive soil resistance will not be taken into account where movement cannot be permitted (rigid pipe joints for example).

(b) Test pressure

A minimum factor of safety of 1.2 on friction on sides and base of structure is required. In view of his responsibility for the Works, the Contractor may propose a higher factor of safety later on.

(c) Closed valve pressure with pumps running

A minimum factor of safety of 1.4 on friction on sides and base of structure is required.

(d) Earthquake including loads due to normal operation

A minimum factor of safety of 1.2 on friction on sides and base of structure is required.

Should passive resistance be mobilized in design of thrust block and pipelines, the factors of safety for test, closed valve pressure and earthquake conditions will be increased depending upon the relative contributions from friction and passive resistance but will not exceed the value of 2. Basis for comparison (unit measure) will be the friction component (increasing factor = total resistance/ frictional resistance).

B.4.2 Overturning

Safety factor against overturning will be minimum 3.0 for load condition (a) and minimum 1.5 for load conditions (b), (c) and (d).

B.4.3 Buoyancy

Safety factor against buoyancy will be minimum 1.1 for all load conditions.

B.5 Retaining Walls

Retaining walls will be designed to resist with the specified factors of safety any loads to which they may be subjected.

Retaining walls that are not restrained above their bases will be designed to resist not less than active earth pressure. Retaining walls that are restrained above their bases or form part of a basement will be designed for at-rest earth pressure; the co-efficient of earth pressure at rest will be taken not less than 0.5 of the vertical pressure at the point being considered.

Anchorage for retaining walls, where necessary, should be positioned outside the zone influenced by deflection or lateral displacement of the retaining wall. Connection between anchorage and retaining wall will be designed to resist the tensile stresses and all lateral or vertical stresses to which they may be subjected by settlement, earth-moving during construction or other reasons.

In addition to the specified earth pressures, retaining walls will be designed for any surcharge that may be applicable and for appropriate water pressure.

Table B.5.1: Factors of Safety for (a) Normal Condition and (d) Earthquake Will be as Shown:

	Factor of safety against:		
Loads	Sliding	Overturning	Buoyancy
(a) Normal condition	1.5	3.0	1.1
(d) Earthquake	1.2	1.5	1.1

Should it be necessary to take into account passive resistance of soil, the factor of safety against sliding will not be less than 2 for load condition (a) and 1.5 for load condition (d).

Appendix C Pipeline Structural Design

C.1 General

Water supply pipe must be the pipe having strength to endure the inner pressure and external pressure. Maximum hydrostatic pressure and water hammer pressure must be considered into inner pressure. Also, earth pressure, road weight and earthquake load must be considered into external pressure.

Ductile iron pipe applied in these design must be used with pipe thickness suitable for the standard, considering actually applied force of inner pressure, external pressure, differential settlements, earthquake load and so on. In any case, it must be above the minimum pipe thickness

Therefore, we implemented the review for the pipe thickness of the ductile iron applied in these design and the results of the review was that the pipe thickness is suitable.

	Standard	
• C25	D1,800 mm	17.7mm
• C25	D1,600 mm	19.7mm

C.2 Calculation sheets

(D = 1,600 mm)

(1) Minimum pipe thickness

$$t = \frac{D}{288}\ \text{(below 1,350mm) or}\qquad t = \frac{D + 508}{400}\ \text{(over 1,350mm)}$$

$\therefore$ t = 5.27 mm

(2) Calculation based on internal pressure

P = 10.00 kg/㎠

$$t = \frac{P \times D}{2 \times \sigma sa}$$

here, t : Pipe thickness (mm)
P : Water pressure in pipe (dynamic water pressure+water hammer pressure or highest value of static water pressure : kg/㎠)
D : Pipe thickness (mm)
σsa : Allowable stress of pipe (kg/㎠)

$\therefore$ t = 5.71 mm

(3) Calculation based on external pressure

A. Upper soil cover load

① Temporary work section (sheet pile, earth retaining wall etc in case of vertical excavation)

$Wv = \gamma s \times H$

here, Wv : Upper soil cover load (kg/㎠)
γs : Unit weight of soil (0.0018 kg/㎤)
H : Soil cover (㎝)

② General excavation section

$Wv = Cd \times \gamma s \times Bd$

here, $Cd = \frac{1 - EXP(-2K \times \mu' \times H/Bd)}{2K \times \mu'}$
γs : Unit weight of soil (0.0018 kg/㎤)
Bd : Trench width at the top of pipe (㎝)
K : Rankine earth pressure coefficient $= \frac{1 - \sin\theta}{1 + \sin\theta} =$ 0.333
μ' : Coefficient of friction of backfill soil and slope (μ' = tanθ') = 0.577
θ : Internal friction angle of backfill soil = 30 °
θ' : Internal friction angle of backfill soil and slope (generally θ – θ')

Soil cover (H)		㎝	800	600	500	350	250	150
Bd		㎝	316	316	316	316	316	316
Cd		–	1.618	1.347	1.185	0.902	0.682	0.434
Wv	Temporary work	kg/㎠	230.40	172.80	144.00	100.80	72.00	43.20
	General	kg/㎠	147.21	122.59	107.85	82.07	62.07	39.48

B. External pressure by vehicle load

$$Wt = \frac{2np \times (1 + i)}{[\, n \times L + (n-1) \times C + b + 2H\tan\theta \,] \times (\, a + 2H\tan\theta \,)}$$

here, Wt : External pressure by vehicle load (kg/㎠)
n : Number of wheels parallel to occupancy wi 2 wheels
p : The rear wheel load of truck (DB 24) = 9,000 kg
L : Center gap of the rear wheel = 175 ㎝
C : Center gap of the rear wheel between adjacent trucks = 100 ㎝
b : The rear wheel ground witch = 50 ㎝
H : Soil cover (㎝)
θ : Dispersion angle = 45 °
a : vehicle contact length = 20 ㎝
i : Factor of impact
H ≤ 1.5m i = 0.5
1.5m < H ≤ 6.5m i = 0.65 – 0.1H
H >6.5m i = 0

Soil cover (H)	㎝	800	600	500	350	250	150
i	–	0.00	0.05	0.15	0.30	0.40	0.50
Wt	kg/㎠	1.81	3.11	4.62	9.24	16.54	36.00

C. Total sum of external pressure

W = Wv + Wt

Soil cover (H)		cm	800	600	500	350	250	150
Temporary work	Wv	kg/㎠	230.40	172.80	144.00	100.80	72.00	43.20
	Wt	kg/㎠	1.81	3.11	4.62	9.24	16.54	36.00
	W	**kg/㎠**	**232.21**	**175.91**	**148.62**	**110.04**	**88.54**	**79.20**
General	Wv	kg/㎠	147.21	122.59	107.85	82.07	62.07	39.48
	Wt	kg/㎠	1.81	3.11	4.62	9.24	16.54	36.00
	W	**kg/㎠**	**149.02**	**125.70**	**112.46**	**91.31**	**78.61**	**75.48**

D. Condition of External pressure

$$P = \frac{W}{D} \times F$$

here, W : Total sum of external pressure (Wv + Wt)
D : Diameter (㎝)
F : Factor of satey = 2.0

Soil cover (H)		cm	800	600	500	350	250	150
P	Temporary work	kg/㎠	2.90	2.20	1.86	1.38	1.11	0.99
	General	kg/㎠	1.86	1.57	1.41	1.14	0.98	0.94

E. Calculation of pipe thickness (Buckling failure condition)

$$t = \frac{P^{1/2}}{3,530,000^{1/2}} \times D$$

	Pipe thickness allowance		Soil cover (㎝) 800 Required thickness	800 Application	600 Required thickness	600 Application	500 Required thickness	500 Application	350 Required thickness	350 Application	250 Required thickness	250 Application	150 Required thickness	150 Application
Temporary work	Allowance (㎜)	0	14.99	17.7	13.66	17.7	12.92	17.7	11.69	17.7	10.87	17.7	10.47	17.7
		1	15.99	17.7	14.66	17.7	13.92	17.7	12.69	17.7	11.87	17.7	11.47	17.7
General	Allowance (㎜)	0	12.93	17.7	12.22	17.7	11.77	17.7	10.98	17.7	10.45	17.7	10.31	17.7
		1	13.93	17.7	13.22	17.7	12.77	17.7	11.98	17.7	11.45	17.7	11.31	17.7

Minium pipe thickness = 5.27 ㎜
Pipe thickness based interal pressure = 5.71 ㎜

Pipe thickness = 17.7 ㎜

(4) Review of Deformation

$$\triangle X = \frac{2 \times Kx \times (Wv + Wt) \times R^4}{EI + 0.061E' \times R^3}$$

here, △X : rizontal direction deformation of p (㎝)
Kx : zontal direction strain coefficient accoring to support an 0.096
(Wv + Wt) : of total sum of external pressu 1.45 (kg/㎠)
R : The average radius of the pipe = 80 (㎝)
E : Elastic modulus of pipe = 2,100,000 (kg/㎠)
I : 2nd moment of inertia of pipe (per unit width) $= \frac{t^3}{12}$ = (0.462)
E' : Coefficient of reaction of soil = 70

Kb, Kx Coefficient table

Support angle	Kb	Kx	(0.061Kb − 0.083Kx)
60°	0.189	0.103	0.00307
90°	0.157	0.096	0.00171
120°	0.138	0.089	0.00107
180°	0.128	0.085	0.00082

△X = 3.616 (㎝)

$$\text{Strain} = \frac{\triangle X}{D} < 5\%$$

$$\therefore \text{Strain} = \frac{3.616}{160} = 2.26\% \quad \text{therfore} \quad \text{GOOD}$$

(5) Review of differential settlement

$$\sigma b = \frac{2 \times (Wv + Wt) \times Coef}{f \times z}$$

here, σb : Bending stress of bottom of pipe by external pressure (kg/㎠)

(Wv + Wt) : 50% of total sum of external pressure = 1.45 (kg/㎠)

$$Coef = \frac{Kb \times R^2 \times EI + (0.061Kb - 0.083Kx) \times E' \times R^5}{EI + 0.061E' \times R^3}$$

f : Factor of shape = 1.5

z : Section modulus of pipe (per unit wid.h) $= \frac{t^2}{6}$ = (0.522)

Kb : Bending moment coefficient of bottom of pipe according to support angle = 0.157

Coef = 426

σb = 1,578.0 (kg/㎠)

∴ Deformation = $\varepsilon = \frac{\sigma b}{E} < 0.1\%$

ε = 0.08% therefore GOOD

(6) Review of earthquake-proof

● Design condition

Outer diameter of pipe (D_C) : 1,835.4 ㎜

Pipe thickness (t) : 17.7 ㎜

Allowable strain (ε) : 0.3%

Design horizontal seismic coefficient (Kh) : 0.12

Reviewed soil cover : 150 ㎝

A. Maximum horizontal displacement at laid pipe location

$$Uh = \frac{2}{\pi^2} \times Sv \times Tg \times Kh' \times \cos\frac{\pi \times h}{2 \times Hs}$$

here, Uh : The horizontal displacement amplitude of the ground at laid pipe location (㎝)

h : Depth from ground surface to pipe center = 230 ㎝

Hs : Total ground thickness of surface layer = 1,540 ㎝

Sv : Response speed per unit magnitude (㎝/sec)

h' : Depth from pipe center to ground = 1,310 ㎝

Tg : Natural period of surface layer = $S \times \sum_{i=1}^{n} \frac{Hi}{Vsi}$

S : Coefficient according to type of soil (clayey soil:4.0, sandy soil:5.2)

Hi : Thickness of i layer

Vsi calculation according to soil condition(Assumption)

Layer	Classification according to type of soil		S	Thickness (m)	N value	Vs Calcuation	Vsi (m/sec)
1	alluvial layer	clayey soil	4.0	1.50	3	122N^0.0777	132.87
2	alluvial layer	sandy soil	5.2	3.10	4	61.8N^0.211	82.80
3	alluvial layer	sandy soil	5.2	10.80	30	61.8N^0.211	129.67
Base	alluvial layer	sandy soil		–	50	103N^0.211	235.14

Tg = 0.68 sec Sv = 80 ㎝/sec

∴ Uh = 1.29 ㎝

B. Ground deformation during earthquake

$$\varepsilon_L = \pi \times \frac{Uh}{L}$$

$$\varepsilon_B = 2\pi^2 \times \frac{D_O \times Uh}{L^2}$$

$$L\ (\text{Ground motion wavelength}) = \frac{2 \times L_1 \times L_2}{L_1 + L_2}$$

here,

$L_1 = Tg \times \underline{Vs}$

$L_2 = Tg \times Vas$

$$\underline{Vs} = \frac{\sum Hi}{\sum_{i=1}^{n} \frac{Hi}{Vsi}}$$: The average shear elastic wave velocity of the surface layer (m/sec)

Vas = Shear elastic wave velocity of the base surface (m/sec)

Hi : Thickness of i layer (m)

$\underline{Vs}$ =	114.9	m/sec	
L_1 =	78.5	m	
L_2 =	160.6	m	
L =	105.5	m	
ε_L =	0.000385	=	3.85E-04
ε_B =	0.000038	=	3.75E-05

C. Stiffness coefficient of the ground

$$K_{g1} = K_{g2} = \frac{k_0 \times r_s \times V_s^2}{g}$$

here,

K_{g1} : Stiffness coefficient of the ground in the pipe axis direction (kg/㎠)

K_{g2} : Stiffness coefficient of the ground in the direction perpendicular to the pipe axis (kg/㎠)

k_0 : Constant for the stiffness coefficient of ground per unit length in the direction perpendicular to the pipe axis and the pipe axis direction ≒ 3.0

r_s : Unit weight of soil at laid pipe location = 0.0018 kg/㎠

V_s : he shear elastic wave velocity of the surface at laid pipe location 8,280 ㎝/sec

g : Acceleration of gravity = 9.8 ㎨ = 980 $㎝/s^2$

$K_{g1} = K_{g2}$ = 377.8 kg/㎠

D. Joint deformation in the pipe axis direction due to the ground displacement

$$\varepsilon_{te} = \sqrt{(r\varepsilon_{PL}^2 + N\varepsilon_{PB}^2)}$$

$$\varepsilon_{PL} = a_1 \times \varepsilon_L = a_1 \times \frac{\pi \times Uh}{L}$$

$$\varepsilon_{PB} = a_2 \times \varepsilon_B = a_2 \times \frac{2\pi^2 \times D_O \times Uh}{L^2}$$

here

r : Coefficient by wave component ≒ 1.0

ε_{PL} : Axial change during earthquake

ε_{PB} : Axial change due to bending

a_1 : Transmission ratio of the axial strain εL in the ground to the pipe

$$a_1 = \frac{1}{1 + (\frac{2 \times \pi}{\lambda_1 \times L'})^2}$$

$$\lambda_1 = (\frac{K_{g1}}{E \times A})^{0.5} = 4.47E-04\ \text{㎝}^{-1}$$

a_2 : Transmission ratio of the bending strain εB in the ground to the pipe

$$a_2 = \frac{1}{1 + (\frac{2 \times \pi}{\lambda_2 \times L})^4}$$

$$\lambda_2 = (\frac{K_{g2}}{E \times I})^{0.25} = 2.80E-03\ \text{㎝}^{-1}$$

a_1 = 0.530

a_2 = 0.998

A : Area of pipe (㎠)

I : 2nd moment of inertia of pipe ($㎝^4$)

$$I = \frac{\pi}{64}(D_O^4 - D^4)$$

L' : External wavelength ($L' = \sqrt{2} \times L$) (㎝)

ε_{PL} = 2.04E-04

ε_{PB} = 3.74E-05

ε_{te} = 0.000214 = 0.021% < 0.3%, therefore GOOD

(D = 1,800 mm)

(1) Minimum pipe thickness

$t = \frac{D}{288}$ (below 1,350mm) or $t = \frac{D + 508}{400}$ (over 1,350mm)

$\therefore$ t = 5.77 mm

(2) Calculation based on internal pressure

P = 10.00 kg/㎠

$t = \frac{P \times D}{2 \times \sigma sa}$

here, t : Pipe thickness (mm)
P : Water pressure in pipe (dynamic water pressure+water hammer pressure or highest value of static water pressure : kg/㎠)
D : Pipe thickness (mm)
σsa : Allowable stress of pipe (kg/㎠)

$\therefore$ t = 6.43 mm

(3) Calculation based on external pressure

A. Upper soil cover load

① Temporary work section (sheet pile, earth retaining wall etc in case of vertical excavation)

$Wv = \gamma s \times H$

here, Wv : Upper soil cover load (kg/㎠)
γs : Unit weight of soil (0.0018 kg/㎠)
H : Soil cover (㎝)

② General excavation section

$Wv = Cd \times \gamma s \times Bd$

here, $Cd = \frac{1 - EXP(-2K \times \mu' \times H/Bd)}{2K \times \mu'}$
γs : Unit weight of soil (0.0018 kg/㎠)
Bd : Trench width at the top of pipe (㎝)
K : Rankine earth pressure coefficient = $\frac{1 - \sin\theta}{1 + \sin\theta}$ = 0.333
μ' : Coefficient of friction of backfill soil and slope (μ' = tanθ') = 0.577
θ : Internal friction angle of backfill soil = 30 °
θ' : Internal friction angle of backfill soil and slope (generally θ = θ')

Soil cover (H)		㎝	800	600	500	350	250	150
Bd		㎝	348	348	348	348	348	348
Cd		–	1.526	1.260	1.104	0.834	0.628	0.397
Wv	Temporary work	kg/㎠	259.20	194.40	162.00	113.40	81.00	48.60
	General	kg/㎠	172.02	142.08	124.44	94.03	70.77	44.78

B. External pressure by vehicle load

$Wt = \frac{2np \times (1 + i)}{[n \times L + (n-1) \times C + b + 2H\tan\theta] \times (a + 2H\tan\theta)}$

here, Wt : External pressure by vehicle load (kg/㎠)
n : Number of wheels parallel to occupancy wi 2 wheels
p : The rear wheel load of truck (DB-24) = 9,600 kg
L : Center gap of the rear wheel = 175 ㎝
C : Center gap of the rear wheel between adjacent trucks = 100 ㎝
b : The rear wheel ground witdh = 50 ㎝
H : Soil cover (㎝)
θ : Dispersion angle = 45 °
a : Vehicle contact length = 20 ㎝
i : Factor of impact
H ≤ 1.5m i = 0.5
1.5m < H ≤ 6.5m i = 0.65 – 0.1H
H >6.5m i = 0

Soil cover (H)	㎝	800	600	500	350	250	150
i	–	0.00	0.05	0.15	0.30	0.40	0.50
Wt	kg/㎠	2.03	3.50	5.20	10.40	18.61	40.50

C. Total sum of external pressure

$W = Wv + Wt$

Soil cover (H)		cm	800	600	500	350	250	150
Temporary work	Wv	kg/cm	259.20	194.40	162.00	113.40	81.00	48.60
	Wt	kg/cm	2.03	3.50	5.20	10.40	18.61	40.50
	W	**kg/cm**	**261.23**	**197.90**	**167.20**	**123.80**	**99.61**	**89.10**
General	Wv	kg/cm	172.02	142.08	124.14	94.03	70.77	44.78
	Wt	kg/cm	2.03	3.50	5.20	10.40	18.61	40.50
	W	**kg/cm**	**174.05**	**145.58**	**129.63**	**104.43**	**89.38**	**85.28**

D. Condition of External pressure

$$P = \frac{W}{D} \times \Gamma$$

here, W : Total sum of external pressure (Wv + Wt)
D : Diameter (cm)
Γ : Factor of satey = 2.0

Soil cover (H)		cm	800	600	500	350	250	150
P	Temporary work	kg/cm²	2.90	2.20	1.86	1.38	1.11	0.99
	General	kg/cm²	1.93	1.62	1.44	1.16	0.99	0.95

E. Calculation of pipe thickness (Buckling failure condition)

$$t = \frac{P^{1/2}}{3{,}530{,}000^{1/2}} \times D$$

	Pipe thickness allowance		Soil cover (cm)											
			800		600		500		350		250		150	
			Required thickness	Application	Required thickness	Application	Required thickness	Application	Required thickness	Application	Required thickness	Application	Required thickness	Application
Temporary work	Allowance (mm)	0	16.86	19.7	15.37	19.7	14.53	19.7	13.15	19.7	12.23	19.7	11.78	19.7
		1	17.86	19.7	16.37	19.7	15.53	19.7	14.15	19.7	13.23	19.7	12.78	19.7
General	Allowance (mm)	0	14.73	19.7	13.86	19.7	13.35	19.7	12.42	19.7	11.79	19.7	11.61	19.7
		1	15.73	19.7	14.86	19.7	14.35	19.7	13.42	19.7	12.79	19.7	12.61	19.7

Minium pipe thickness = 5.77 mm
Pipe thickness based interal pressure = 6.43 mm

Pipe thickness = 19.7 mm

(4) Review of Deformation

$$\triangle X = \frac{2 \times Kx \times (Wv + Wt) \times R^4}{EI + 0.061E' \times R^3}$$

here, △X : rizontal direction deformation of p (cm)
Kx : Horizontal direction strain coefficient accoring to support angle = 0.096
(Wv + Wt) : 50% of total sum of external pressure = 1.45 (kg/cm)
R : The average radius of the pipe = 90 (cm)
E : Elastic modulus of pipe = 2,100,000 (kg/cm²)
I : 2nd moment of inertia of pipe (per unit width) $= \frac{t^3}{12} =$ (0.637)
E' : Coefficient of reaction of soil = 70

Kb, Kx Coefficient table

Support angle	Kb	Kx	(0.061Kb − 0.083Kx)
60°	0.189	0.103	0.00307
90°	0.157	0.096	0.00171
120°	0.138	0.089	0.00107
180°	0.128	0.085	0.00082

△X = 4.108 (cm)

$$\text{Strain} = \frac{\triangle X}{D} < 5\%$$

$$\therefore \text{Strain} = \frac{4.108}{180} = 2.28\% \quad \text{therfore} \quad \text{GOOD}$$

(5) Review of differential settlement

$$\sigma b = \frac{2 \times (Wv + Wt) \times Coef}{f \times z}$$

here, σb : Bending stress of bottom of pipe by external pressure (kg/㎠)

$(Wv + Wt)$: 50% of total sum of external pressure = 1.45 (kg/㎠)

$$Coef = \frac{Kb \times R^2 \times EI + (0.061Kb - 0.083Kx) \times E' \times R^5}{EI + 0.061E' \times R^3}$$

f : Factor of shape = 1.5

z : Section modulus of pipe (per unit width) $= \frac{t^2}{6}$ = (0.647)

Kb : Bending moment coefficient of bottom of pipe according to support angle = 0.157

Coef = 532

σb = 1,590.7 (kg/㎠)

$\therefore$ Deformation = $\varepsilon = \frac{\sigma b}{E} < 0.1\%$

ε = 0.08% therefore GOOD

(6) Review of earthquake-proof

● Design condition

Outer diameter of pipe (D_O) : 1,839.4 ㎜

Pipe thickness (t) : 19.7 ㎜

Allowable strain (ε) : 0.3%

Design horizontal seismic coefficient (Kh') : 0.12

Reviewed soil cover : 150 ㎝

A. Maximum horizontal displacement at laid pipe location

$$Uh = \frac{2}{\pi^2} \times Sv \times Tg \times Kh' \times \cos\frac{\pi \times h}{2 \times Hs}$$

here, Uh : The horizontal displacement amplitude of the ground at laid pipe location (㎝)

h : Depth from ground surface to pipe center = 240 ㎝

Hs : Total ground thickness of surface layer = 1,560 ㎝

Sv : esponse speed per unit magnitu (㎝/sec)

h' : Depth from pipe center to ground = 1,320 ㎝

Tg : Natural period of surface layer = $S \times \sum_{i=1}^{n} \frac{Hi}{Vsi}$

S : Coefficient according to type of soil (clayey soil:4.0, sandy soil:5.2)

Hi : Thickness of i layer

Vsi calculation according to soil condition(Assumption)

Layer	Classification according to type of soil		S	Thickness (m)	N value	Vsi Calcuation	Vsi (m/sec)
1	alluvial layer	clayey soil	4.0	1.50	3	122N^0.0777	132.87
2	alluvial layer	sandy soil	5.2	3.30	4	61.8N^0.211	82.80
3	alluvial layer	sandy soil	5.2	10.80	30	61.8N^0.211	126.67
Base	alluvial layer	sandy soil		-	50	103N^0.211	235.14

Tg = 0.70 sec Sv = 80 ㎝/sec

$\therefore$ Uh = 1.31 ㎝

B. Ground deformation during earthquake

$$\varepsilon_L = \pi \times \frac{Uh}{L}$$

$$\varepsilon_B = 2\pi^2 \times \frac{D_C \times Uh}{L^2}$$

$$L \text{ (Ground motion wavelength)} = \frac{2 \times L_1 \times L_2}{L_1 + L_2}$$

here, $L_1 = Tg \times \underline{Vs}$

$L_2 = Tg \times Vas$

$$\underline{Vs} = \frac{\sum Hi}{\sum_{i=1}^{n} \frac{Hi}{Vsi}}$$: The average shear elastic wave velocity of the surface layer (m/sec)

Vas = Shear elastic wave velocity of the base surface (m/sec)

Hi : Thickness of i layer (m)

$\underline{Vs}$ =	114.4	m/sec	
L_1 =	79.6	m	
L_2 =	163.6	m	
L =	107.1	m	
ε_L =	0.000386	=	3.86E-04
ε_B =	0.000042	=	4.16E-05

C. Stiffness coefficient of the ground

$$K_{g1} = K_{g2} = \frac{k_g \times r_s \times V_s^2}{g}$$

here, K_{g1} : Stiffness coefficient of the ground in the pipe axis direction (kg/㎠)

K_{g2} : Stiffness coefficient of the ground in the direction perpendicular to the pipe axis (kg/㎠)

k_g : Constant for the stiffness coefficient of ground per unit length in the direction perpendicular to the pipe axis and the pipe axis direction ≒ 3.0

r_s : Unit weight of soil at laid pipe location = 0.0018 kg/㎤

V_s : he shear elastic wave velocity of the surface at laid pipe location 8,280 ㎝/sec

g : Acceleration of gravity = 9.8 ㎨ = 980 ㎝/s²

$K_{g1} = K_{g2}$ =	377.8	kg/㎠

D. Joint deformation in the pipe axis direction due to the ground displacement

$$\varepsilon_{le} = \sqrt{(r\varepsilon_{PL}^2 + N\varepsilon_{PB}^2)}$$

$$\varepsilon_{PL} = a_1 \times \varepsilon_L = a_1 \times \frac{\pi \times Uh}{L}$$

$$\varepsilon_{PB} = a_2 \times \varepsilon_B = a_2 \times \frac{2\pi^2 \times D_{(i)} \times Uh}{L^2}$$

here r : oefficient by wave component ≒ 1.0

ε_{PL} : Axial change during earthquake

ε_{PB} : Axial change due to bending

a_1 : Transmission ratio of the axial strain εL in the ground to the pipe

$$a_1 = \frac{1}{1 + \left(\frac{2 \times \pi}{\lambda_1 \times L'}\right)^2}$$

$$\lambda_1 = \left(\frac{K_{g1}}{E \times A}\right)^{0.5} = 4.00E-04 \ \text{㎝}^{-1}$$

a_2 : Transmission ratio of the bending strain εB in the ground to the pipe

$$a_2 = \frac{1}{1 + \left(\frac{2 \times \pi}{\lambda_2 \times L}\right)^4}$$

$$\lambda_2 = \left(\frac{K_{g2}}{E \times I}\right)^{0.25} = 2.49E-03 \ \text{㎝}^{-1}$$

a_1 =	0.481
a_2 =	0.997
ε_{PL} =	1.86E-04
ε_{PB} =	4.15E-05

A : Area of pipe (㎠)

I : 2nd moment of inertia of pipe (㎝⁴)

$$I = \frac{\pi}{64} (D_{(i)}^4 - D^4)$$

L' : External wavelength ($L' = \sqrt{2} \times L$) (㎝)

ε_{le} =	0.000199	=	0.020%	< 0.3%, therefore	GOOD

Appendix D Hydraulic Calculation

D.1 Hydraulic Design Criteria

In this design, the modeling conditions and parameters applied in the DSC03 are applied for consistency with the master plan, and the contents are as follows.

BDS Pipe line is designed using 542MLD flow including all pipes of phase 1 and 2.

EPANET program is used

The velocity in pipe is maintained as 0.4 to 2.2 m/s

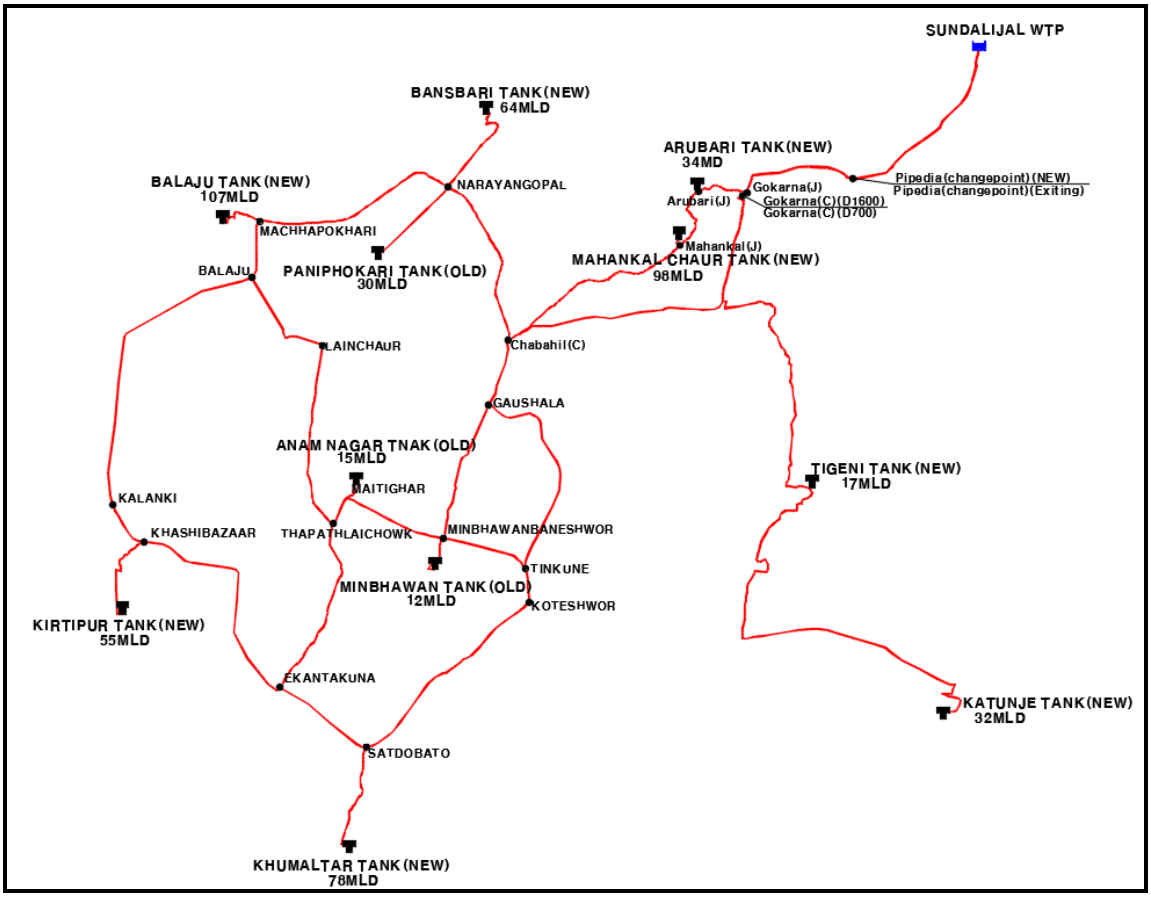
Pressure head at the top of reservoirs inlets is 4m or higher.

Hazen-William Friction Coefficient C = 130 for Ductile Iron Pipe

Model is designed using static pressure at Sundarijal treatment plant (2m above outlet pipe level to eliminate air vortices in the pipe) at 1397m AMSL

D.2 Hydraulic Calculation

The schematic drawing for hydraulic calculation is as follows



Water supply demand of each reservoir is as follows,

Table 1. The population distribution, demand and supply plan for each reservoir

Reservoir	Population			Demand(MLD)						each reservoir supply
	2015	2025	2030	2015	2025	2030	Each reservoir distribution			
BALAJU	360,281	519,247	617,585	60.906	87.779	104.403	36.517	72.100	107.102	107
BANSBARI	192,990	298,502	368,976	32.625	50.321	62.375	19.561	41.333	63.987	64
PANIPOKHARI	102,486	153,811	172,043	17.325	24.702	29.084	10.387	20.290	29.836	30
MAHANKALCHAUR	335,262	478,016	562,798	56.676	80.809	95.141	33.981	66.375	97.600	98
ARUBARI	83,959	146,477	195,469	14.193	24.762	33.044	8.510	20.339	33.898	34
MINBHAWAN	41,855	59,677	70,261	7.076	10.088	11.878	4.243	8.286	12.185	12
ANAMNAGAR	50,519	72,030	84,806	8.540	12.177	14.336	5.120	10.002	14.707	15
KHUMALTAR	292,730	391,550	449,027	49.486	66.192	75.908	29.670	54.369	77.870	78
KIRTIPUR	167,195	260,243	324,760	27.945	43.357	54.003	16.755	35.613	55.399	55
TIGANI	51,867	81,334	100,424	8.768	13.750	16.977	5.257	11.294	17.416	17
KATUNJE	137,722	172,993	188,473	23.282	29.245	31.861	-	29	32	32
Grand Total	**1,816,866**	**2,633,880**	**3,134,622**	**283.540**	**413.937**	**497.149**	**170**	**369**	**542**	**542**

As the result of calculation, the pressure of each reservoir is above 4.0m and the velocity in all pipes is from 0.4 to 2.2m/sec.

	Elevation	Demand	Head	Pressure
Node ID	m	MLD	m	m
Junc Arubari(Tank)	1379.482	34	1386.97	7.47
Junc Arubari(J)	1379.2	0	1387	7.79
Junc MahankalChaur(Tank)	1372.251	98	1385.01	12.73
Junc Mahankal(J)	1371	0	1385.41	14.38
Junc Chabahil(C)	1331.77	0	1383.82	51.94
Junc NARAYANGOPAL	1342.86	0	1378.41	35.48
Junc Bansbari(Tank)	1371.424	64	1377.1	5.67
Junc Balaju(Tank)	1345.7	107	1368.26	22.52
Junc MACHHAPOKHARI	1299.35	0	1369.77	70.28
Junc KALANKI	1293.12	0	1357.81	64.56
Junc EKANTAKUNA	1305.73	0	1363.41	57.57
Junc SATDOBATO	1331.17	0	1362.68	31.44
Junc Kumaltar(Tank)	1351.991	78	1356.51	4.51
Junc TINKUNE	1294.56	0	1374.65	79.93
Junc GAUSHALA	1321.81	0	1381.7	59.77

	Elevation	Demand	Head	Pressure
Node ID	m	MLD	m	m
Junc KOTESHWOR	1309.4	0	1372.94	63.41
Junc TIGENI(J)	1354.683	0	1372.03	17.31
Junc MINBHAWANBANESHWOR	1304.81	0	1372.57	67.62
Junc MAITIGHAR	1284.9	0	1367.72	82.65
Junc AnamNagar(Tank)	1298.285	15	1366.45	68.03
Junc THAPATHLAICHOWK	1284	0	1367.29	83.12
Junc LAINCHAUR	1305.61	0	1368.56	62.82
Junc BALAJU	1292.87	0	1369.28	76.26
Junc MinBhawan(Tank)	1305	12	1370.46	65.33
Junc Paniphokari(Tank)	1329.5	30	1369.44	39.86
Junc Gokarna(C)(D1600)	1327.435	0	1388.7	61.14
Junc KHASHIBAZAAR	1291.549	0	1355.94	64.26
Junc Katunje(Tank)	1349.664	32	1351.94	2.27
Junc Kirtipur(Tank)	1343	55	1350.75	7.73
Junc Gokarna(J)	1359.985	0	1388.57	28.52
Junc Pipedia(changepoint)(NEW)	0	0	1392.09	1389.3
Junc Tigeni(Tank)	1360	17	1371.94	11.92
Junc Pipedia(changepoint)(Exiting)	0	0	1391.06	1388.28
Junc Gokarna(C)(D700)	1327.435	0	1388.68	61.12
Resvr Sundalijal(WTP)	1395.044	542	1395.04	0

Link ID	Length m	Diameter mm	Roughness C - value	Flow MLD	Velocity m/s
Pipe Arubarijunction-Arubari(Tank)	29.48	700	130	34	1.02
Pipe Arubari(J)-Mahankal(J)	1135.51	1400	130	218.8	1.65
Pipe Mahankal(J)-Chabahil(C)	3394.245	1400	130	120.8	0.91
Pipe 43	2914.245	1400	130	253.91	1.91
Pipe 45	1760.14	1000	130	64	0.94
Pipe 52	3386.651	1100	130	159.91	1.95
Pipe 64	1938.24	800	130	78	1.8
Pipe 77	596.8598	800	130	73.78	1.7
Pipe 84	1707.51	500	130	21.31	1.26
Pipe 90	3078.61	500	130	7.52	0.44
Pipe 92	941.3	1000	130	52.91	0.78
Pipe 102	3036.75	500	130	13.83	0.82
Pipe 150	5126.69	700	130	45.39	1.37
Pipe p18	834.7	700	130	45.39	1.37
Pipe p19	3874.81	400	130	9.61	0.89
Pipe 153	1742.99	400	130	4.22	0.39
Pipe 155	3573.189	800	130	73.78	1.7
Pipe 160	1475.01	400	130	8.13	0.75
Pipe 162	486.54	400	130	6.31	0.58
Pipe 170	3591.963	900	130	81.9	1.49
Pipe 171	1095.483	1000	130	-107.09	1.58
Pipe 178	1756.69	500	130	7.52	0.44
Pipe 179	2359.49	500	130	25.19	1.48
Pipe 267	724.24	400	130	12	1.11
Pipe 273	1676.86	500	130	30	1.77
Pipe 276	287.03	400	130	15	1.38
Pipe 290	784.44	1000	130	107	1.58
Pipe Mahankaljunction-Mahankal(TANK)	146.28	900	130	98	1.78
Pipe p45	6457.89	700	130	49	1.47
Pipe p42	8095.47	600	130	32	1.31
Pipe p43	1626.85	700	130	55	1.65
Pipe 8	849.29	1400	130	252.8	1.9
Pipe Sundarijal-Gokarna(C)	2064.64	1600	130	337.74	1.94

Link ID	Length m	Diameter mm	Roughness C - value	Flow MLD	Velocity m/s
Pipe Sundarijal-Gokarna1(NEW)	3196.39	1800	130	337.74	1.54
Pipe 14	45.72	500	130	17	1
Pipe Gokarna(C)(D1600)-Chabahil(C)	5592.17	1600	130	240.2	1.38
Pipe Sundarijal-Gokarnajunction(OLD)	2013.88	1400	130	204.26	1.54
Pipe Sundarijal-Gokarna1(OLD)	3211.77	1400	130	204.26	1.54
Pipe 3	43.85	700	130	48.54	1.46

Appendix E Pipeline Design Criteria

E.1.1 General

The pipeline will be designed to provide a pipeline system which is structurally sound and is easy to operate and maintain.

E.1.2 Cover

The following will be the minimum cover:

1,800 mm	1.8m
1,600 mm	1.5 m

The pipeline will generally be designed for a minimum cover of 1500 mm and a maximum cover of 3 500 mm.

E.1.3 Gradients

In order to avoid the formation of air pockets the adopted minimum slopes are 2 $^{o}/_{oo}$ (1 in 500) for ascending and 4 $^{o}/_{oo}$ (1 in 250) for descending pipes. If the pipeline is laid on a slope greater than 20 % (1 in 5) for an above ground pipeline or 25 % (1 in 4) for a buried pipeline the anchor blocks will be provided.

E.1.4 Air Valves

Air valves will be provided at all high points of the pipeline, in sections which form a peak with respect to the hydraulic gradient and on the downhill side of isolation valves. Air valves will also be installed in long ascending or descending pipe sections at a maximum spacing of 800 m and in particular at points with significant change of pipeline gradient.

Air valves will be of combined type with a larger and smaller venting orifice which permits passage of large volumes of air for vacuum breaking and venting on starting up and closing down operation and a small venting cross section for release of small volumes of air under full internal operation pressure.

An isolation valve will also be installed to allow inspection and repair of the valve without shutting off the main. All valves are flanged and will be of PN 16.

In general the following air valve types are recommended:

For pipelines of : DN 1600 - DN 1800 double air valve DN 200

E.1.5 Washouts

Washouts will be provided at all major low points.

E.1.6 Line Valves

Line valves will be provided at river crossings and at other locations where there is risk of damage to the main, they will also be provided to allow sections of the pipeline to be drained and to allow future cross connections.

E.1.7 Thrust Blocks

Thrust blocks will be provided at all locations where thrusts are both resisted by the pipeline or other structures and there is a risk of pipeline movement.

Thrust blocks will be designed as described in Appendix B.

E.1.8 Pipeline Protection

The pipeline will be protected where there is risk of damage from excessive loads, erosion or impact. The protection will be designed on a case by case basis.

E.1.9 Drawings

Drawings will be prepared to illustrate the designs prepared and to allow a proficient contractor to construct the works.

E.1.10 Hydraulic Profile

Hydraulic profile drawings for the bulk distribution mains will show steady state and transient conditions result along the pipeline route. The drawings will be supported by calculations.

E.1.11 Pipeline Layout

Layout drawings will be drawn to scale 1: 2000 or 1: 2500.

Each drawing will consist of pipeline alignment, position of pipeline structures, road or river crossing, position of trial pits, marked chainage, alignment of power lines, surrounding houses, notification of other services, etc.

E.1.12 Longitudinal Profile Drawings

Longitudinal profile drawings may be shown on the same drawing as the pipeline layout and drawn at the same scale horizontally and a factor of ten different vertically e.g.:

Horizontal	1: 2000
Vertical	1: 200

Each drawing will show ground and invert levels along the profile, chainage, type of bedding, diameter and class of pipe, position and description of pipeline structures etc.

E.1.13 Pipeline Details

In areas where it is not possible to satisfactorily show the pipeline layout or longitudinal profile at a scale of 1:2000 of 1:2500 pipeline detail drawings will be prepared using the following scales:

Pipeline Details 1:100 or 1:50

E.1.14 Structural Details

Drawings which show structural details: thrust blocks, chambers etc will generally be shown on drawings as described in Appendix B section 2.2.11.

Appendix F Air Valve and Wash-out Valve calculation

F.1 General

In these design, the diameter of Air valve and Wash-out valve was calculated based on the relations between the amount of drainage and the amount of air suction through Air valve when Wash-out valve open.

F.2 Theory

F.2.1 Air Valve capacity calculation

(i) Determination of Air Valve diameter

(a) Design Condition

1) Flow rate : refer to hydraulic calculation

(b) Formula(by "APCO Valves Manual" p.93, APCO VALVE AND PRIMER CO.)

1) Flow rate by Pumping when discharged through pipe(Q1)

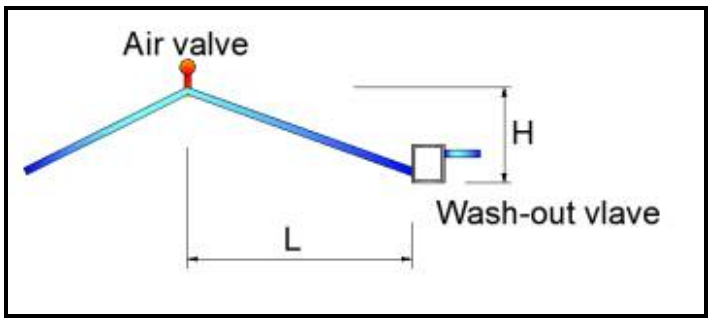
$$Q1 = \frac{Pump\ GPM}{449}$$ [CFS : f3/sec]

2) Drain flow rate by gravity(Q2)

Q2 = 0.08666×(S×d5) [CFS]

S : Slope of pipe line = H/L

d : Diameter of drain pipe [in]



(c) Determination of diameter

In this design, applied pipe diameter is 1,600mm and 1,800mm, so double orifice 200mm air valve is proposed. Therefore, air valve is determined based on synthetically reviewing proposed diameter and above formula.

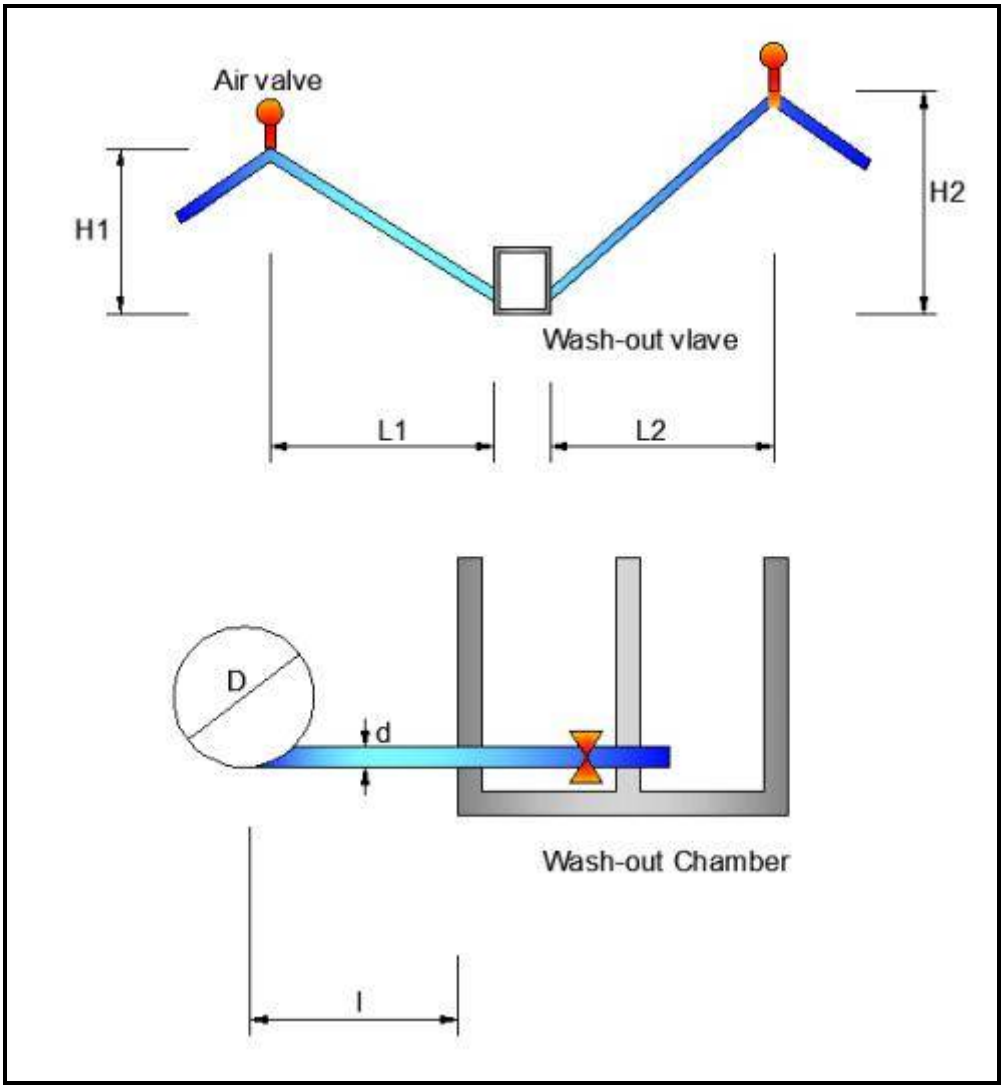
F.2.2 Wash-out Valve capacity calculation

(i) Calculation of wash-out valve diameter and Drainage time

(a) Design Condition

- Wash-out valve diameter is the diameter at which the amount of drainage can be discharged within 1 hour

- Wash-out valve diameter is recommended more than quarter of main pipe.



(b) Outflow rate through Drain Pipe

$$Q = A \cdot V = \frac{\pi \cdot d^2}{4} = \sqrt{\frac{2gH}{1.5 + f\frac{l}{d}}} \quad [m^3/sec]$$

d : Diameter of Drain Pipe(m)

ℓ : Length of Drain Pipe(m)

1.5 = fi : entrance-loss coefficient 0.5 + fo : runoff-loss coefficient 1.0

f : coefficient of frictional loss

$$f = \frac{12.7gn^2}{d^{\frac{1}{3}}} = \frac{12.7 \times 9.8 \times 0.012^2}{d^{\frac{1}{3}}}$$

n : coefficient of roughness H : Height difference between air valve and drain pipe(m)

(c) Determination of Drain pipe diameter

1) Drain flow rate

$$Qd = \frac{V'}{T} \quad [\ m^3/sec\ ]$$

Qd = Total outflow rate of LINE

V' = V1 + V2 = A1 + L1 + A2×L2

T : total T(total drainage time through Drain Pipe, min)

2) Discharge capacity of drain pipe

$$Qo = A \cdot V = \frac{\pi \cdot d^2}{4} \frac{1}{n} R^{\frac{2}{3}} I^{\frac{1}{2}} \quad [m^3/sec]$$

Qo : Discharge capacity of drain pipe(m^3/sec)

d : Diameter of drain pipe(m)

n : Coefficient of roughness of drain pipe(concrete pipe : 0.013)

R : Hydraulic radius of drain pipe(A/P)

l : Gradient of drain pipe(H/L)

3) Determination of Drain pipe diameter

Qd< Qo = OK

F.3 Calculation sheets

1) Review of Air Valve diameter(D=1,600mm~1,800mm)

Wash-out Valve Location (STA NO & E.L.)	Air Valve Location (STA NO & E.L.)	Washout pipe diameter (mm)	Washout pipe diameter (in)	L (m)	H (m)	S (H/L)	Design flow (m³/day)	Design flow (GPM)	Q1 (CFS)	Q (CFS)	Required valve diameter (in)	Required valve diameter (mm)	adoption (mm)
NO. 0 + 780.00 E.L. = 1,333.35	NO 0 + 0.00 E.L. = 1,331.44	400	15.75	780.00	58.09	0.0745	337,730	61,939	138.02	23.29	6.23	158.2	200
	NO 1 + 398.00 E.L. = 1,353.55	400	15.75	618.00	20.20	0.0327	337,730	61,939	138.02	15.43	6.23	158.2	200
NO. 2 + 217.00 E.L. = 1,332.31	NO 1 + 398.00 L.L. = 1,353.55	400	15.75	819.00	21.23	0.0259	337,730	61,939	138.02	13.73	6.23	158.2	200
	NO 2 + 536.00 E.L. = 1,337.77	400	15.75	319.00	5.45	0.0171	337,730	61,939	138.02	11.16	6.23	158.2	200
NO. 3 + 296.00 E.L. = 1,331.28	NO 2 + 536.00 L.L. = 1,337.77	400	15.75	760.00	6.49	0.0085	337,730	61,939	138.02	7.87	6.23	158.2	200
	NO 3 + 710.00 E.L. = 1,355.83	400	15.75	414.00	24.06	0.0581	337,730	61,939	138.02	20.56	6.23	158.2	200
NO. 3 + 930.00 E.L. = 1,325.81	NO 3 + 710.00 L.L. = 1,355.83	400	15.75	220.00	29.52	0.1342	337,730	61,939	138.02	31.25	6.23	158.2	200
	NO 4 + 0.00 L.L. = 1,332.12	400	15.75	70.00	6.31	0.0902	337,730	61,939	138.02	25.92	6.23	158.2	200
NO. 4 + 520.00 E.L. = 1,319.43	NO 4 + 0.00 L.L. = 1,332.12	400	15.75	520.00	12.89	0.0244	337,730	61,939	138.02	13.33	6.23	158.2	200
	NO 4 + 714.00 L.L. = 1,335.83	400	15.75	194.00	15.89	0.0819	337,730	61,939	138.02	24.42	6.23	158.2	200
NO. 4 + 796.00 E.L. = 1,324.10	NO 4 + 714.00 E.L. = 1,332.12	400	15.75	84.00	8.02	0.0955	337,730	61,939	138.02	26.36	6.23	158.2	200
	NO 4 + 910.00 E.L. = 1,338.07	400	15.75	112.00	13.97	0.1247	337,730	61,939	138.02	30.13	6.23	158.2	200
NO. 5 + 496.00 E.L. = 1,315.92	NO 4 + 910.00 E.L. = 1,338.07	400	15.75	586.00	22.15	0.0378	337,730	61,939	138.02	16.59	6.23	158.2	200
	NO 5 + 732.00 E.L. = 1,317.87	400	15.75	266.00	1.95	0.0073	337,730	61,939	138.02	7.29	6.23	158.2	200
NO. 7 + 146.00 E.L. = 1,313.02	NO 5 + 732.00 E.L. = 1,317.87	400	15.75	1,086.00	4.85	0.0035	337,730	61,939	138.02	5.05	6.23	158.2	200
	NO 8 + 100.00 E.L. = 1,328.83	400	15.75	952.00	15.81	0.017	337,730	61,939	138.02	10.99	6.23	158.2	200
NO. 9 + 200.00 E.L. = 1,321.93	NO 8 + 100.00 L.L. = 1,328.83	400	15.75	1,100.00	6.90	0.0063	337,730	61,939	138.02	6.77	6.23	158.2	200
	NO 10 + 54.00 L.L. = 1,332.37	400	15.75	854.00	10.44	0.0122	337,730	61,939	138.02	9.42	6.23	158.2	200

2) Calculation of drain time in Wash-out Valve

Wash-out Valve Location (STA NO & E.L.)	Air Valve Location (STA NO & E.L.)	d (m)	ℓ (m)	D (m)	L (m)	H (m)	A (m²)	A' (m²)	a (m²)	k (1/sec)	t (min)	Total Drainage time (min)
NO. 0 + 0.00 E.L. = 1,333.35	NO 0 + 0.00 E.L. = 1,391.44	0.40	9.00	1.80	780.00	58.09	2.54	34.[illegible]	0.13	3.33	10.79	25.28
	NO [illegible] + 936.00 E.L. = 1,353.55	0.40	9.00	1.80	6'8.00	20.20	2.54	11.42	0.13	3.33	14.49	
NO. 2 + 217.00 E.L. = 1,332.31	NO [illegible] + 936.00 E.L. = 1,353.55	0.40	9.00	1.80	8'9.00	21.23	2.54	57.57	0.13	3.33	18.73	33.13
	NO 2 + 936.00 E.L. = 1,337.77	0.40	9.00	1.80	3'9.00	5.45	2.54	148.64	0.13	3.33	14.40	
NO. 3 + 238.00 E.L. = 1,331.28	NO 2 + 556.00 E.L. = 1,337.77	0.40	9.00	1.80	760.00	6.49	2.54	297.53	0.13	3.33	31.44	38.48
	NO 3 + 710.00 E.L. = 1,355.33	0.40	9.00	1.60	4'4.00	24.06	2.01	54.59	0.13	3.33	7.04	
NO. 3 + 330.00 E.L. = 1,325.81	NO 3 + 710.00 E.L. = 1,355.33	0.40	9.00	1.60	220.00	29.52	2.01	14.95	0.13	3.33	3.38	5.70
	NO 4 + 0.00 E.L. = 1,332.12	0.40	9.00	1.60	70.00	6.31	2.01	22.28	0.13	3.33	2.32	
NO. 4 + 520.00 E.L. = 1,319.23	NO 4 + 0.00 E.L. = 1,332.12	0.40	9.00	1.60	520.00	12.89	2.01	82.37	0.13	3.33	12.17	16.23
	NO 4 + 714.00 E.L. = 1,335.33	0.40	9.00	1.60	94.00	15.89	2.01	24.54	0.13	3.33	4.06	
NO. 4 + 793.00 E.L. = 1,327.10	NO 4 + 714.00 E.L. = 1,332.12	0.40	9.00	1.60	84.00	8.02	2.01	27.05	0.13	3.33	2.47	4.97
	NO 4 + 810.00 E.L. = 1,336.07	0.40	9.00	1.60	[illegible]2.00	13.97	2.01	[illegible]6.12	0.13	3.33	2.50	
NO. 5 + 496.00 E.L. = 1,315.92	NO 4 + 810.00 E.L. = 1,336.07	0.40	9.00	1.60	586.00	22.15	2.01	55.[illegible]8	0.13	3.33	10.38	26.27
	NO 5 + 762.00 E.L. = 1,317.87	0.40	9.00	1.60	266.00	1.95	2.01	27[illegible].33	0.13	3.33	15.89	
NO. 7 + 116.00 E.L. = 1,310.02	NO 5 + 762.00 E.L. = 1,317.87	0.40	9.00	1.60	1,386.00	[illegible].85	2.01	5[illegible]7.40	0.13	3.33	52.48	72.45
	NO 8 + 100.00 E.L. = 1,328.83	0.40	9.00	1.60	952.00	15.81	2.01	121.06	0.13	3.33	19.97	
NO. 9 + 230.00 E.L. = 1,321.93	NO 8 + 100.00 E.L. = 1,328.83	0.40	9.00	1.60	1,100.00	6.90	2.01	320.78	0.13	3.33	37.93	56.94
	NO 10 + 54.00 E.L. = 1,352.37	0.40	9.00	1.60	854.00	10.77	2.01	169.70	0.13	3.33	22.04	

3) Determination of Drain pipe diameter

① Drain flow rate

$$Qd = \frac{V'}{T} \quad [\ m^3/sec\ ]$$

Qd: Total outflow rate of LINE

V' : V1+V2 = A1 x L1 + A2 x L2

T : total T (total drainage time through Drain pipe, min)

② When the main pipe is 1,800~2,400mm

Wash-out Valve Location (STA. NO & E.L)	Air Valve Location (STA. NO & E.L)	L (m)	H (m)	L' (m)	D (m)	V (m^3)	V' (m^3)	total T (min)	Qd (m^3/sec)
0 + 780.00	0 + 0.00	780.00	58.09	782.16	1.80	1990.35	3563.81	25.28	2.350
I.N.V = 1333.35	E.L = 1391.44								
	1 + 398.00	618.00	20.20	618.33	1.80	1573.46			
	F.I = 1353.55								
2 + 217.00	1 + 398.00	819.00	21.23	819.28	1.80	2084.81	2896.69	33.13	1.457
I.N.V = 1332.31	F.I = 1353.55								
	2 + 536.00	319.00	5.45	319.05	1.60	811.88			
	E.L = 1337.77								
3 + 296.00	2 + 536.00	760.00	6.49	760.03	1.80	1934.04	2767.84	38.48	1.199
I.N.V = 1331.28	E.L = 1337.77								
	3 + 710.00	414.00	24.06	414.70	1.60	833.80			
	F.I = 1355.33								
3 + 930.00	3 + 710.00	220.00	29.52	221.97	1.60	446.30	587.61	5.70	1.718
I.N.V = 1325.81	F.I = 1355.33								
	4 + 0.00	70.00	6.31	70.26	1.60	141.31			
	E.L = 1332.12								
4 + 520.00	4 + 0.00	520.00	12.69	520.15	1.60	1045.62	1437.19	16.23	1.476
I.N.V = 1319.43	E.L = 1332.12								
	4 + 714.00	194.00	15.89	194.65	1.60	391.37			
	F.I = 1335.33								
4 + 798.00	4 + 714.00	84.00	8.02	84.36	1.60	169.66	396.60	4.97	1.330
I.N.V = 1324.10	E.L = 1332.12								
	4 + 910.00	112.00	13.97	112.67	1.60	226.94			
	E.L = 1338.07								
5 + 496.00	4 + 910.00	586.00	22.15	586.42	1.60	1179.07	1713.91	26.27	1.087
I.N.V = 1315.92	E.L = 1338.07								
	5 + 762.00	266.00	1.95	266.01	1.60	534.84			
	F.I = 1317.87								
7 + 148.00	5 + 762.00	1386.00	4.65	1386.01	1.60	2786.74	4701.11	72.45	1.081
I.N.V = 1313.02	E.L = 1317.87								
	8 + 100.00	952.00	15.81	952.13	1.60	1914.37			
	E.L = 1328.83								
9 + 200.00	8 + 100.00	1100.00	6.90	1100.02	1.60	2211.72	3928.91	56.97	1.149
I.N.V = 1321.93	F.I = 1328.83								
	10 + 54.00	854.00	10.44	854.06	1.60	1717.19			
	F.I = 1332.37								

* L' = Length of pipe = $\sqrt{L^2 + H^2}$

③ Discharge capacity of drain pipe

$$Qo = A \cdot V = \frac{\pi \cdot d^2}{4} \cdot \frac{1}{n} R^{2/3} I^{1/2} \quad [\ m^3/sec\ ]$$

Qo : Discharge capacity of drain pipe(m^3/sec)
d : Diameter of drain pipe(m)
n : Coefficient of roughness of drain pipe(concrete pipe : 0.013)
R : Hydraulic radius of drain pipe(A/P)
I : Gradient of drain pipe(H/L)

Wash out Valve Location (STA. NO)			d (m)	A (m^2)	n	R (m)	L (m)	H (m)	I	V (m/sec)	Qo (m^3/sec)	Remarks
0	+	780.00	0.60	0.28	0.013	0.149	7.00	2.00	0.28571	11.56	3.236	1.38
2	+	217.00	0.60	0.28	0.013	0.149	7.00	2.00	0.28571	11.56	3.236	2.22
3	+	296.00	0.60	0.28	0.013	0.149	7.00	3.00	0.42857	14.15	3.963	3.31
3	+	930.00	0.60	0.28	0.013	0.149	7.00	2.00	0.28571	11.56	3.236	1.88
4	+	520.00	0.45	0.16	0.013	0.113	7.00	2.00	0.28571	9.61	1.538	1.04
4	+	798.00	0.45	0.16	0.013	0.113	7.00	2.00	0.28571	9.61	1.538	1.16
5	+	496.00	0.45	0.16	0.013	0.113	7.00	2.00	0.28571	9.61	1.538	1.41
7	+	148.00	0.45	0.16	0.013	0.113	7.00	2.00	0.28571	9.61	1.538	1.42
9	+	200.00	0.45	0.16	0.013	0.113	7.00	2.00	0.28571	9.61	1.538	1.34

④ Determination of Drain pipe diameter

0	+	780.00	Qd	=	2.350	<	Qo	=	3.236	OK
2	+	217.00	Qd	=	1.457	<	Qo	=	3.236	OK
3	+	296.00	Qd	=	1.199	<	Qo	=	3.963	OK
3	+	930.00	Qd	=	1.718	<	Qo	=	3.236	OK
4	+	520.00	Qd	=	1.476	<	Qo	=	1.538	OK
4	+	798.00	Qd	=	1.330	<	Qo	=	1.538	OK
5	+	496.00	Qd	=	1.087	<	Qo	=	1.538	OK
7	+	148.00	Qd	=	1.081	<	Qo	=	1.538	OK
9	+	200.00	Qd	=	1.149	<	Qo	=	1.538	OK

Appendix G Trust block calculation

G.1 General

Thrust block is required to prevent the pipe from the separation of the ductile iron joints by the force generated from the fluid at the bending pipe and prevent the pipe from the water leakage by the separation of those joints.

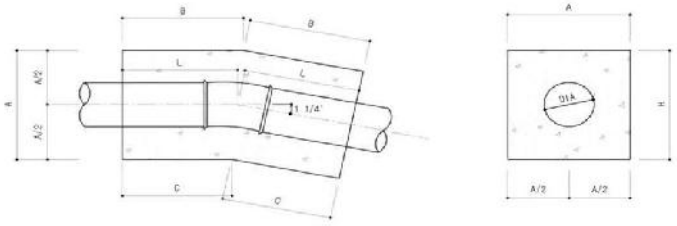
In these design, the size and thickness of thrust block were calculated considering the force generated by the fluid at the bending pipe, the weight of the block itself, the weight of the soil covering the upper part of thrust block, the friction of soil and so on.

The applied diameter in these design is D1,600mm and D1,800mm, which is large pipe. Therefore, Casing type thrust block was applied according to advantages in terms of stability and land acquisition.

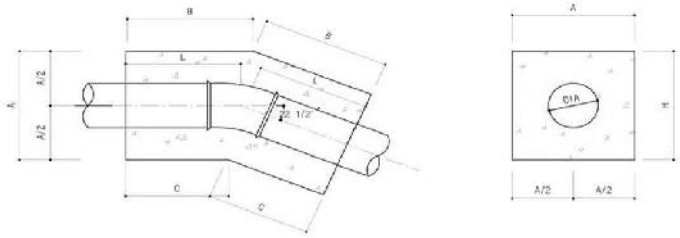
G.2 Calculation sheets

■ Horizental trust block(D1,600mm)

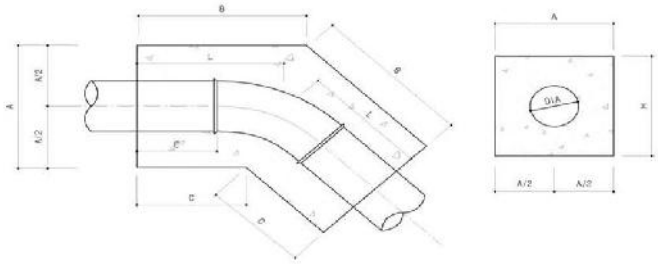
11 1/4°



22 1/2°



45°



1) dimension of trust block 138 115

Pipe Dia (mm)	Bending angle (°)	A (cm)	B (cm)	C (cm)	E (mm)	F (cm)	
1,600	11 1/4°	235	118	90	340		
1,600	22 1/2°	235	254	196	1,800		
1,600	45°	235	499	361	3,000		

Pipe Dia (mm)	Bending angle (°)	G (cm)	I (cm)	J (cm)	K (cm)	H (cm)	Weight	
							material	(kg/m)
1,600	11 1/4°	-	104	-	-	240	DI	364.0
1,600	22 1/2°	-	228	-	-	240	DI	364.0
1,600	45°	-	430	-	-	240	DI	364.0

2) calculation condition

① Maximum water pressure(P)	=	10.0	kg/cm²
② Velocity(V) : maximum velocity in pipe	=	300.00	cm/sec
③ Unit weight of soil (γ1)	=	0.0018	kg/cm³
④ Unit weight of CON'C	=	0.0023	kg/cm³
⑤ Internal friction angle of soil(φ)	=	30	°
⑥ Friction coefficient of trust block against ground(μ)	=	0.5	

㉡ Cover of trust block

Cover	H1	H2	H3	H4	H5
	150cm	200cm	300cm	400cm	500cm

3) The force acting on the bend section(R)

① The force by water pressure(R1)

$R1 = 2 \times p \times a \times \sin(\Theta/2)$

R1 : The force acting on the bend section by water pressure(kg)
p : water pressure(kg/cm²)
a : cross-section area = $\pi/4 \times D2$(cm²)
D : pipe diameter(cm)
Θ : bending degree(°)

Pipe Dia (cm)	Bending angle (°)	p (kg/cm²)	a (cm²)	Θ (°)	R1 (kg)
160.0	11 1/4°	10.00	20,106	11.25	39,414.7
160.0	22 1/2°	10.00	20,106	22.50	78,449.7
160.0	45°	10.00	20,106	45.00	153,884.7

② Centrifugal force by water(R2)

$R2 = 2 \times a \times \gamma_w \times V^2 \times \sin(\Theta/2)/g$

R2 : The centrifugal force acting on the bend section by water pressure(kg)
a : cross section area = $\pi/4 \times D^2$
D : pipe diameter(cm)
γ_w : Unit weight of water(kg/cm³) = 0.001 kg/cm³
V : velocity(cm/sec) = 300.00 cm/sec
Θ : bending degree(°)
g : acceleration of gravity(cm/sec²) = 980 cm/sec²

Pipe Dia (cm)	Bending angle (°)	a (cm²)	γ_w (kg/cm³)	V (cm/sec)	Θ (°)	g (cm/sec²)	R2 (kg)
160.0	11 1/4°	20,106	0.001	300.00	11.25	980	382.0
160.0	22 1/2°	20,106	0.001	300.00	22.50	980	720.5
160.0	45°	20,106	0.001	300.00	45.00	980	1,413.2

③ The force acting on the bend section(R)

R = R1 + R2 (kg)

Pipe Dia (cm)	Bending angle (°)	Total(R) (kg)	R1 (kg)	R2 (kg)
160.0	11 1/4°	39,796.7	39,414.7	382.0
160.0	22 1/2°	79,170.2	78,449.7	720.5
160.0	45°	155,297.9	153,884.7	1,413.2

4) Total weight per Unit Length of the trust block floor(W)

① Weight of trust block(W1)

$W1 = (A \times H - \pi/4 \times D^2) \times$ 0.0023 kg/cm³

Pipe Dia (cm)	Bending angle (°)	A (cm)	H (cm)	W1 (kg/cm)
160.0	11 1/4°	285.0	240.0	111.1
160.0	22 1/2°	285.0	240.0	111.1
160.0	45°	285.0	240.0	111.1

③ Weight of pipe(W2)
W2 = (Unit weight of pipe)

Pipe Dia (cm)	Bending angle (°)	W2 (kg/cm)
160.0	11 1/4°	8.64
160.0	22 1/2°	8.64
160.0	45°	8.64

④ Weight of water in the pipe(W3)
$W3 = \pi/4 * D^2 * \gamma_w$ (kg/cm)
D : pipe diameter(cm)
γ_w : Unit weight of water(kg/cm) = 0.001 kg/cm

Pipe Dia (cm)	Bending angle (°)	γ_w (kg/cm)	W3 (kg/cm)
160.0	11 1/4°	0.001	20.1
160.0	22 1/2°	0.001	20.1
160.0	45°	0.001	20.1

⑤ Weight of soil on the trust block(W4)
W4 = $\gamma_t * h' * A$ (kg/cm)
γ_t :Unit weight of soil = 0.0018 kg/cm
h' : Cover of trust block =

Cover	I 1	I 2	I I3	I4	I 5
	150cm	200cm	300cm	400cm	500cm

A : width of trust block(cm)

Pipe Dia (cm)	Bending angle (°)	γ_t (kg/cm)	A (cm)	W4 (kg/cm)				
h'(cm)				150	200	300	400	500
160.0	11 1/4°	0.0018	285	77.0	102.6	153.9	205.2	256.5
160.0	22 1/2°	0.0018	285	77.0	102.6	153.9	205.2	256.5
160.0	45°	0.0018	285	77.0	102.6	153.9	205.2	256.5

⑥ Total weight per Unit Length of the trust block base(W)
W = W1 + W2 + W3 +W4 (kg/cm)

- Cover 150cm

Pipe Dia (cm)	Bending angle (°)	W1 (kg/cm)	W2 (kg/cm)	W3 (kg/cm)	W4 (kg/cm)	W (kg/cm)
160.0	11 1/4°	[illegible].1	8.6	20.1	77.0	216.8
160.0	22 1/2°	[illegible].1	8.6	20.1	77.0	216.8
160.0	45°	[illegible].1	8.6	20.1	77.0	216.8

- Cover 200cm

Pipe Dia (cm)	Bending angle (°)	W1 (kg/cm)	W2 (kg/cm)	W3 (kg/cm)	W4 (kg/cm)	W (kg/cm)
160.0	11 1/4°	[illegible].1	8.6	20.1	102.6	242.4
160.0	22 1/2°	[illegible].1	8.6	20.1	102.6	242.4
160.0	45°	[illegible].1	8.6	20.1	102.6	242.4

- Cover 300cm

Pipe Dia (cm)	Bending angle (°)	W1 (kg/cm)	W2 (kg/cm)	W3 (kg/cm)	W4 (kg/cm)	W (kg/cm)
160.0	11 1/4°	[illegible].1	8.6	20.1	153.9	293.7
160.0	22 1/2°	[illegible].1	8.6	20.1	153.9	293.7
160.0	45°	[illegible].1	8.6	20.1	153.9	293.7

- Cover 400cm

Pipe Dia (cm)	Bending angle (°)	W1 (kg/cm)	W2 (kg/cm)	W3 (kg/cm)	W4 (kg/cm)	W (kg/cm)
60.0	11 1/4°	111.1	9.6	20.1	205.2	345.0
60.0	22 1/2°	111.1	9.6	20.1	205.2	345.0
60.0	45°	111.1	9.6	20.1	205.2	345.0

- Cover 500cm

Pipe Dia (cm)	Bending angle (°)	W1 (kg/cm)	W2 (kg/cm)	W3 (kg/cm)	W4 (kg/cm)	W (kg/cm)
60.0	11 1/4°	111.1	9.6	20.1	256.5	396.3
60.0	22 1/2°	111.1	9.6	20.1	256.5	396.3
60.0	45°	111.1	9.6	20.1	256.5	396.3

5) Resistant force of passive earth pressure beneath trust block (E)

$E = 1/2 * K_p * \gamma_t * [(H+h')^2 - h'^2]$

E : Resistant force of passive earth pressure beneath trust block(kg/cm)

K_p : Coefficient of passive earth pressure = $\tan^2(45-\Phi/2)$ = 3.0

γ_t : Unit weight of soil = 0.0018 kg/cm³

h : Cover of trust block =

Cover	H1	H2	H3	H4	H5
	150cm	200cm	300cm	400cm	500cm

H : height of trust block(cm)

Pipe Dia (cm)	Bending angle (°)	K_p	γ_t (kg/cm³)	H (cm)	E (kg/cm)				
h'(cm)					150	200	300	400	500
60.0	11 1/4°	3.0	0.0018	240	349.9	414.7	544.3	673.9	803.5
60.0	22 1/2°	3.0	0.0018	240	349.9	414.7	544.3	673.9	803.5
60.0	45°	3.0	0.0018	240	349.9	414.7	544.3	673.9	803.5

6) Safety review of trust block

Calculation of safety rate

$$F.S = \frac{(\mu * W + E) * \ell}{R}$$

F.S : safety rate = above 1.5

μ : Friction coefficient of trust block against ground 0.5

W : Total weight per Unit Length beneath the trust block(kg/cm)

E : passive earth pressure per unit length(kg/cm)

ℓ : Length of trust block(cm)

R : The force acting on the bend section(kg)

- Cover 150cm

Pipe Dia (cm)	Bending angle (°)	μ	W (kg/cm)	E (kg/cm)	ℓ (cm)	R (kg)	F.S	Result
60.0	11 1/4°	0.5	216.8	349.9	208	33,776.7	2.4	OK
60.0	22 1/2°	0.5	216.8	349.9	455	73,170.2	2.6	OK
60.0	45°	0.5	216.8	349.9	860	155,297.9	2.5	OK

- Cover 200cm

Pipe Dia (cm)	Bending angle (°)	μ	W (kg/cm)	E (kg/cm)	ℓ (cm)	R (kg)	F.S	Result
60.0	11 1/4°	0.5	242.4	414.7	208	33,776.7	2.8	OK
60.0	22 1/2°	0.5	242.4	414.7	455	73,170.2	3.1	OK
60.0	45°	0.5	242.4	414.7	860	155,297.9	3.0	OK

- Cover 300cm

Pipe Dia (cm)	Bending angle (°)	μ	W (kg/cm)	E (kg/cm)	ℓ (cm)	R (kg)	F.S	Result
60.0	11 1/4°	0.5	293.7	544.3	208	33,776.7	3.8	OK
60.0	22 1/2°	0.5	293.7	544.3	455	73,170.2	4.0	OK
60.0	45°	0.5	293.7	544.3	860	155,297.9	3.8	OK

– Cover 400cm

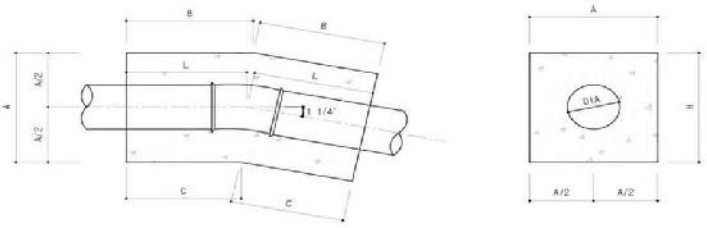
Pipe Dia (cm)	Bending angle (°)	μ	W (kg/cm)	E (kg/cm²)	λ (cm⁻¹)	R (kg)	F.S	Result
160.0	11 1/4°	0.5	345.0	673.9	208	39,776.7	4.4	OK
160.0	22 1/2°	0.5	345.0	673.9	455	79,170.2	4.9	OK
160.0	45°	0.5	345.0	673.9	860	155,297.9	4.7	OK

– Cover 500cm

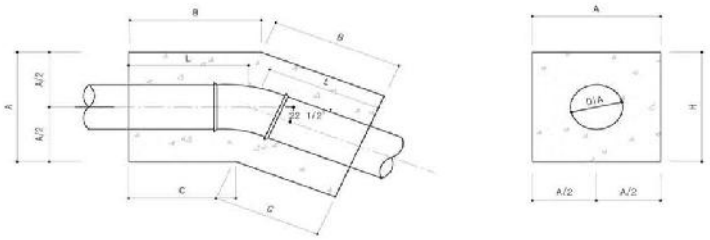
Pipe Dia (cm)	Bending angle (°)	μ	W (kg/cm)	E (kg/cm²)	λ (cm⁻¹)	R (kg)	F.S	Result
160.0	11 1/4°	0.5	398.3	809.8	208	39,776.7	5.2	OK
160.0	22 1/2°	0.5	398.3	809.8	455	79,170.2	5.8	OK
160.0	45°	0.5	398.3	809.8	860	155,297.9	5.5	OK

■ Horizental trust block(D1,800mm)

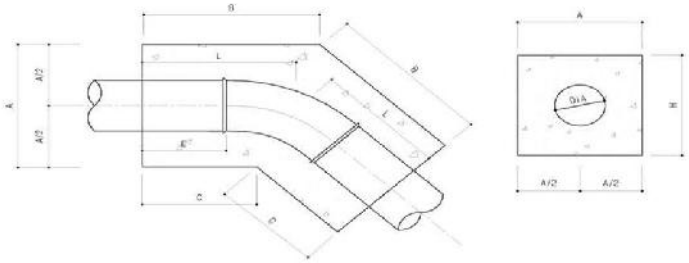
11 1/4°



22 1/2°



45°



1) dimension of trust block

Pipe Size (mm)	Bending angle (°)	A (cm)	B (cm)	C (cm)	L (mm)	L' (cm)	L'' (cm)
1,600	11 1/4°	300	150	100	470	-	-
1,600	22 1/2°	300	281	219	1,820	–	–
1,600	45°	300	542	408	4,040	-	-

Pipe Size (mm)	Bending angle (°)	G (cm)	L (cm)	ℓ (cm)	ℓ' (cm)	L' (cm)	Weight	
							material	(kg/m)
1,600	11 1/4°	-	115	-	-	255	STS	1,055.0
1,600	22 1/2°	–	250	–	–	255	STS	1,055.0
1,600	45°	-	475	-	-	255	STS	1,055.0

2) calculation condition

① Maximum water pressure(p)	=	10.0	kg/cm²
② Velocity(V) – maximum velocity in pipe	–	300.00	cm/sec
③ Unit weight of soil (γt)	=	0.0018	kg/cm³
④ Unit weight of CONC	–	0.0023	kg/cm³
⑤ Internal friction angle of soil (φ)	=	30	°
⑥ Friction coefficient of trust block against ground(μ)	=	0.5	
⑦ Cover of trust block			

Cover	H1	H2	H3	H4	H5
	150cm	200cm	300cm	400cm	500cm

3) The force acting on the bend section(R)

① The force by water pressure(R1)

$R1 = 2 \times p \times a \times \sin(\Theta/2)$

R1 : The force acting on the bend section by water pressure(kg)
p : water pressure(kg/cm²)
a : cross section area = $\pi/4 \times D2$(cm²)
D : pipe diameter(cm)
Θ : bending degree(°)

Pipe Dia (cm)	Bending angle (°)	p (kg/cm²)	a (cm²)	Θ (°)	R1 (kg)
180.0	11 1/4"	10.00	25,447	11.25	49,884.8
180.0	22 1/2"	10.00	25,447	22.50	99,289.3
180.0	45°	10.00	25,447	45.00	194,762.9

② Centrifugal force by water(R2)

$P2 = \gamma_w \times a \times V_w \times V^2 \times \sin(\Theta/2)/g$

R2 : The centrifugal force acting on the bend section by water pressure(kg)
a : cross section area = $\pi/4 \times D^2$
D : pipe diameter(cm)
Y_w : Unit weight of water(kg/cm³) = 0.001 kg/cm³
V : velocity(cm/sec) = 300.00 cm/sec
Θ : bending degree(°)
g : acceleration of gravity(cm/sec²) = 980 cm/sec²

Pipe Dia (cm)	Bending angle (°)	a (cm²)	Y_w (kg/cm³)	V (cm/sec)	Θ (°)	g (cm/sec²)	R2 (kg)
180.0	11 1/4"	25,447	0.001	300.00	11.25	980	458.1
180.0	22 1/2"	25,447	0.001	300.00	22.50	980	911.8
180.0	45°	25,447	0.001	300.00	45.00	980	1,788.6

③ The force acting on the bend section(R)

R = R1 + R2 (kg)

Pipe Dia (cm)	Bending angle (°)	Total(R) (kg)	R1 (kg)	R2 (kg)
180.0	11 1/4"	50,342.9	49,884.8	458.1
180.0	22 1/2"	100,201.1	99,289.3	911.8
180.0	45°	196,551.5	194,762.9	1,788.6

4) Total weight per Unit Length of the trust block floor(W)

① Weight of trust block(W1)

$W = (A \times l - \pi/4 \times D^2) \times$ 0.0023 kg/cm³

Pipe Dia (cm)	Bending angle (°)	A (cm)	l (cm)	W1 (kg/cm)
180.0	11 1/4"	200.0	255.0	58.8
180.0	22 1/2"	300.0	255.0	117.4
180.0	45°	300.0	255.0	117.4

③ Weight of pipe(W2)
W2 = (Unit weight of pipe)

Pipe Dia (cm)	Bending angle (°)	W2 (kg/cm)
150.0	11 1/4°	10.55
150.0	22 1/2°	10.55
150.0	45°	10.55

④ Weight of water in the pipe(W3)
$W3 = \pi/4 \times D^2 \times Y_w$ (kg/cm)
D : pipe diameter (cm)
Y_w : Unit weigth of water(kg/cm³) = 0.001 kg/cm³

Pipe Dia (cm)	Bending angle (°)	Y_w (kg/cm³)	W3 (kg/cm)
150.0	11 1/4°	0.001	25.4
150.0	22 1/2°	0.001	25.4
150.0	45°	0.001	25.4

⑤ Weight of soil on the thrust block(W4)
$W4 = Y_1 \times h \times A$ (kg/cm)
Y_1 :Unit weight of soil = 0.0018 kg/cm³
h : Cover of trust block =

Cover	H1	H2	H3	H4	H5
	150cm	200cm	300cm	400cm	500cm

A : width of trust block(cm)

Pipe Dia (cm)	Bending angle (°)	Y_1 (kg/cm³)	A (cm)	W4 (kg/cm)				
h (cm)				150	200	300	400	500
150.0	11 1/4°	0.0018	200	54.0	72.0	108.0	144.0	180.0
150.0	22 1/2°	0.0018	300	81.0	108.0	162.0	216.0	270.0
150.0	45°	0.0018	300	81.0	108.0	162.0	216.0	270.0

⑥ Total weight per Unit Length of the trust block base(W)
W = W1 + W2 + W3 +W4 (kg/cm)

- Cover 150cm

Pipe Dia (cm)	Bending angle (°)	W1 (kg/cm)	W2 (kg/cm)	W3 (kg/cm)	W4 (kg/cm)	W (kg/cm)
150.0	11 1/4°	58.8	10.6	25.4	54.0	148.8
150.0	22 1/2°	117.4	10.6	25.4	81.0	234.4
150.0	45°	117.4	10.6	25.4	81.0	234.4

- Cover 200cm

Pipe Dia (cm)	Bending angle (°)	W1 (kg/cm)	W2 (kg/cm)	W3 (kg/cm)	W4 (kg/cm)	W (kg/cm)
150.0	11 1/4°	58.8	10.6	25.4	72.0	166.8
150.0	22 1/2°	117.4	10.6	25.4	108.0	261.4
150.0	45°	117.4	10.6	25.4	108.0	261.4

- Cover 300cm

Pipe Dia (cm)	Bending angle (°)	W1 (kg/cm)	W2 (kg/cm)	W3 (kg/cm)	W4 (kg/cm)	W (kg/cm)
150.0	11 1/4°	58.8	10.6	25.4	108.0	202.8
150.0	22 1/2°	117.4	10.6	25.4	162.0	315.4
150.0	45°	117.4	10.6	25.4	162.0	315.4

– Cover 400cm

Pipe Dia (cm)	Bending angle (°)	W1 (kg/cm)	W2 (kg/cm)	W3 (kg/cm)	W4 (kg/cm)	W (kg/cm)
180.0	11 1/4°	58.8	10.6	25.4	144.0	238.8
180.0	22 1/2°	117.4	10.6	25.4	216.0	369.4
180.0	45°	117.4	10.6	25.4	216.0	369.4

Cover 500cm

Pipe Dia (cm)	Bending angle (°)	W1 (kg/cm)	W2 (kg/cm)	W3 (kg/cm)	W4 (kg/cm)	W (kg/cm)
180.0	11 1/4°	58.8	10.6	25.4	180.0	274.8
180.0	22 1/2°	117.4	10.6	25.4	270.0	423.4
180.0	45°	117.4	10.6	25.4	270.0	423.4

5) Resistant force of passive earth pressure beneath trust block (E)

$E = 1/2 * K_p * Y_t * [(H+h)^2 - h^2]$

E : Resistant force of passive earth pressure beneath trust block(kg/cm)

K_p : Coefficient of passive earth pressure = $\tan^2(45+\Phi/2)$ = 3.0

Y_t : Unit weight of soil = 0.0018 kg/cm³

h : Cover of trust block =

Cover	H1	H2	H3	H4	H5
	150cm	200cm	300cm	400cm	500cm

H : height of trust block(cm)

Pipe Dia (cm)	Bending angle (°)	K_p	Y_t (kg/cm³)	H (cm)	E (kg/cm)				
h (cm)					150	200	300	400	500
180.0	11 1/4°	3.0	0.0018	255	382.1	451.0	588.7	726.4	864.1
180.0	22 1/2°	3.0	0.0018	255	382.1	451.0	588.7	726.4	864.1
180.0	45°	3.0	0.0018	255	382.1	451.0	588.7	726.4	864.1

6) Safety review of trust block

Calculation of safety rate

$$F.S = \frac{(\mu \times W - E) \times \ell}{R}$$

F.S : safety rate = above 1.5

μ : friction coefficient of trust block against ground 0.5

W : Total weight per Unit Length beneath the trust block(kg/cm)

E : passive earth pressure per unit length(kg/cm)

ℓ : length of trust block(cm)

R : The force acting on the bend section(kg)

Cover 150cm

Pipe Dia (cm)	Bending angle (°)	μ	W (kg/cm)	E (kg/cm)	ℓ (cm)	R (kg)	F.S	Result
180.0	11 1/4°	0.5	148.8	382.1	230	50,342.9	2.1	OK
180.0	22 1/2°	0.5	234.4	382.1	500	100,201.1	2.5	OK
180.0	45°	0.5	234.4	382.1	950	196,551.5	2.4	OK

Cover 200cm

Pipe Dia (cm)	Bending angle (°)	μ	W (kg/cm)	E (kg/cm)	ℓ (cm)	R (kg)	F.S	Result
180.0	11 1/4°	0.5	166.8	451.0	230	50,342.9	2.1	OK
180.0	22 1/2°	0.5	261.4	451.0	500	100,201.1	2.9	OK
180.0	45°	0.5	261.4	451.0	950	196,551.5	2.8	OK

– Cover 300cm

Pipe Dia (cm)	Bending angle (°)	μ	W (kg/cm)	E (kg/cm)	ℓ (cm)	R (kg)	F.S	Result
180.0	11 1/4°	0.5	202.8	588.7	230	50,342.9	3.2	OK
180.0	22 1/2°	0.5	315.4	588.7	500	100,201.1	3.7	OK
180.0	45°	0.5	315.4	588.7	950	196,551.5	3.6	OK

- Cover 400cm

Pipe Dia (cm)	Bending angle (°)	μ	W (kg/cm)	F (kg/cm)	ℓ (cm)	R (kg)	F.S	Result
180.0	11 1/4°	0.5	238.9	726.4	230	50,342.9	3.9	OK
180.0	22 1/2°	0.5	369.4	726.4	500	100,201.1	4.5	OK
180.0	45°	0.5	369.4	726.4	950	196,551.5	4.7	OK

- Cover 500cm

Pipe Dia (cm)	Bending angle (°)	μ	W (kg/cm)	F (kg/cm)	ℓ (cm)	R (kg)	F.S	Result
180.0	11 1/4°	0.5	274.9	864.1	230	50,342.9	4.8	OK
180.0	22 1/2°	0.5	423.4	864.1	500	100,201.1	5.4	OK
180.0	45°	0.5	423.4	864.1	950	196,551.5	5.9	OK

■ Vertical trust block(D1,600mm)

1) dimension of trust block

Pipe Dia (mm)	Bending angle (°)	A (cm)	B (cm)	C (cm)	F (mm)	F' (cm)	E (cm)
1,600	11 1/4°	222	127	99	43	-	-
1,600	22 1/2°	227	227	171	104	-	-
1,600	11 1/4°+22 1/2°	285	240	216	182	193	198
1,600	45°	265	353	248	195	-	-
1,600	11 1/4°~45°	285	437	412	357	430	231
1,600	22 1/2°~45°	300	573	590	477	600	248

Pipe Dia (mm)	Bending angle (°)	G (cm)	I (cm)	ℓ (cm)	ι (cm)	I (cm)	Weight	
							meterial	(kg/m)
1,600	11 1/4°	20	110	-	-	222	DI	884.0
1,600	22 1/2°	40	209	-	-	247	DI	884.0
1,600	11 1/4°+22 1/2°	118	-	310	253	240	DI	884.0
1,600	45°	50	298	-	-	270	DI	884.0
1,600	11 1/4°~45°	89	-	597	479	240	DI	884.0
1,600	22 1/2°~45°	74	-	661	543	270	DI	884.0

2) calculation condition

① Maximum water pressure(p)	=	10.0	kg/cm
② Velocity(V) = maximum velocity in pipe	=	300.00	cm/sec
③ Unit weight of soil (γt)	=	0.0018	kg/cm
④ Unit weight of CON'C	=	0.0023	kg/cm
⑤ Internal friction angle of soil(φ)	=	30	°
⑥ Friction coefficient of trust block against ground(μ)	=	0.6	

⑦ Cover of trust block

Cover	l1	l2	l3	l4	l5
	150cm	200cm	300cm	400cm	500cm

3) The force acting on the bend section(R)

① The force by water pressure(R1)

R1 = 2×p×a×sin(θ/2)

R1 : The force acting on the bend section by water pressure(kg)

p : water pressure(kg/cm²)

a : cross-section area = π/4×D2(cm)

D : pipe diameter(cm)

θ : bending degree(°)

Pipe Dia (cm)	Bending angle (°)	p (kg/cm²)	a (cm²)	θ (°)	R1 (kg)
160.0	11 1/4°	10.00	20,106	11.25	39,414.7
160.0	22 1/2°	10.00	20,106	22.50	78,448.7
160.0	11 1/4°+22 1/2°	10.00	20,106	33.75	116,729.3
160.0	45°	10.00	20,106	45.00	153,664.7
160.0	11 1/4°~45°	10.00	20,106	56.25	189,555.1
160.0	22 1/2°~45°	10.00	20,106	67.50	223,406.9

② Centrifugal force by water(R2)

R2 = 2×a×Y_w×V²×sin(θ/2)/g

R2 : The centrifugal force acting on the bend section by water pressure(kg)

a : cross-section area = π/4×D²

D : pipe diameter(cm)

Y_w : Unit weight of water(kg/cm³) = 0.001 kg/cm³

V : velocity(cm/sec) = 300.00 cm/sec
θ : bending degree(°)
g : acceleration of gravity(cm/sec²) = 980 cm/sec²

Pipe Dia. (cm)	Bending angle (°)	a (cm)	γ_w (kg/cm)	V (cm/sec)	θ (°)	g (cm/sec²)	R2 (kg)
60.0	11 1/4°	20,106	0.001	300.00	11.25	980	362.0
60.0	22 1/2°	20,106	0.001	300.00	22.50	980	720.5
60.0	11 1/4°~22 1/2°	20,106	0.001	300.00	33.75	980	1,072.0
60.0	45°	20,106	0.001	300.00	45.00	980	1,413.2
60.0	11 1/4°+45°	20,106	0.001	300.00	56.25	980	1,740.8
60.0	22 1/2°+45°	20,106	0.001	300.00	67.50	980	2,051.7

③ The force acting on the bend section(R)
R = R1 + R2 (kg)

Pipe Dia. (cm)	Bending angle (°)	Total(R) (kg)	R1 (kg)	R2 (kg)
60.0	11 1/4°	39,776.7	39,414.7	362.0
60.0	22 1/2°	79,170.2	78,449.7	720.5
60.0	11 1/4°~22 1/2°	117,601.3	116,529.3	1,072.0
60.0	45°	155,297.9	153,884.7	1,413.2
60.0	11 1/4°+45°	191,298.9	189,558.1	1,740.8
60.0	22 1/2°+45°	225,457.6	223,405.9	2,051.7

④ The horizontal component force(Rh) and the vertical component force(Rv) of R
Rh = R * sin(θ/2) (kg)
Rv = R * cos(θ/2)

Pipe Dia. (cm)	Bending angle (°)	R (kg)	θ (°)	Rh (kg)	Rv (kg)
60.0	11 1/4°	39,776.7	11.25	3,898.8	39,585.2
60.0	22 1/2°	79,170.2	22.50	15,445.3	77,649.0
60.0	11 1/4°~22 1/2°	117,601.3	33.75	34,195.9	112,428.8
60.0	45°	155,297.9	45.00	59,428.9	143,476.6
60.0	11 1/4°+45°	191,298.9	56.25	90,177.7	168,710.6
60.0	22 1/2°+45°	225,457.6	67.50	125,257.5	187,481.1

4) Total weight per Unit Length of the trust block floor(W)

① Weight of trust block(W1)
W1 = (A*H - π/4*D²) * 0.0023 kg/cm³

Pipe Dia. (cm)	Bending angle (°)	A (cm)	H (cm)	W (kg/cm)
60.0	11 1/4°	222.0	222.0	67.1
60.0	22 1/2°	227.0	247.0	82.7
60.0	11 1/4°~22 1/2°	285.0	240.0	101.1
60.0	45°	265.0	270.0	118.3
60.0	11 1/4°+45°	285.0	240.0	101.1
60.0	22 1/2°+45°	300.0	270.0	140.1

② Weight of pipe(W2)
W2 = (Unit weight of pipe)

Pipe Dia. (cm)	Bending angle (°)	W2 (kg/cm)
60.0	11 1/4°	3.64
60.0	22 1/2°	3.64
60.0	11 1/4°~22 1/2°	3.64
60.0	45°	3.64
60.0	11 1/4°+45°	3.64
60.0	22 1/2°+45°	3.64

③ Weight of water in the pipe(W3)

$W3 = \pi/4 \times D^2 \times \gamma_w$ (kg/cm)

D : pipe diameter(cm)

γ_w : Unit weigth of water(kg/cm³) = 0.001 kg/cm³

Pipe Dia (cm)	Bending angle (°)	γ_w (kg/cm³)	W3 (kg/cm)
180.0	11 1/4°	0.001	20.1
180.0	22 1/2°	0.001	20.1
180.0	11 1/4°+22 1/2°	0.001	20.1
180.0	45°	0.001	20.1
180.0	11 1/4°-45°	0.001	20.1
180.0	22 1/2°-45°	0.001	20.1

② Weight of soil on the trust block(W4)

$W4 = \gamma_t \times h \times A$ (kg/cm)

γ_t : Unit weight of soil = 0.0018 kg/cm³

h' : Cover of trust block =

Cover	H1	H2	H3	H4	H5
	150cm	200cm	300cm	400cm	500cm

A : width of trust block(cm)

Pipe Dia (cm)	Bending angle (°)	γ_t (kg/cm³)	A (cm)	W4 (kg/cm)				
h'(cm)				150	200	300	400	500
180.0	11 1/4°	0.0018	222	59.8	79.9	119.9	159.8	199.8
180.0	22 1/2°	0.0018	227	61.3	81.7	122.6	163.4	204.3
180.0	11 1/4°+22 1/2°	0.0018	285	77.0	102.6	153.9	205.2	256.5
180.0	45°	0.0018	265	71.6	95.4	143.1	190.8	238.5
180.0	11 1/4°-45°	0.0018	285	77.0	102.6	153.9	205.2	256.5
180.0	22 1/2°-45°	0.0018	300	81.0	108.0	162.0	216.0	270.0

③ Total weight per Unit Length of the trust block pace(W)

W = W1 + W2 + W3 +W4 (kg/cm)

- Cover 150cm

Pipe Dia (cm)	Bending angle (°)	W1 (kg/cm)	W2 (kg/cm)	W3 (kg/cm)	W4 (kg/cm)	W (kg/cm)
180.0	11 1/4°	67.1	8.6	20.1	59.9	155.7
180.0	22 1/2°	82.7	8.6	20.1	61.3	172.7
180.0	11 1/4°+22 1/2°	107.1	8.6	20.1	77.0	216.8
180.0	45°	98.3	8.6	20.1	71.6	218.6
180.0	11 1/4°-45°	107.1	8.6	20.1	77.0	216.8
180.0	22 1/2°-45°	140.1	8.6	20.1	81.0	249.8

- Cover 200cm

Pipe Dia (cm)	Bending angle (°)	W1 (kg/cm)	W2 (kg/cm)	W3 (kg/cm)	W4 (kg/cm)	W (kg/cm)
180.0	11 1/4°	67.1	8.6	20.1	79.9	175.7
180.0	22 1/2°	82.7	8.6	20.1	81.7	193.1
180.0	11 1/4°+22 1/2°	107.1	8.6	20.1	102.6	249.4
180.0	45°	98.3	8.6	20.1	95.4	242.4
180.0	11 1/4°-45°	107.1	8.6	20.1	102.6	242.4
180.0	22 1/2°-45°	140.1	8.6	20.1	108.0	276.8

- Cover 300cm

Pipe Dia (cm)	Bending angle (°)	W1 (kg/cm)	W2 (kg/cm)	W3 (kg/cm)	W4 (kg/cm)	W (kg/cm)
180.0	11 1/4°	67.1	8.6	20.1	119.9	215.7
180.0	22 1/2°	82.7	8.6	20.1	122.6	234.0
180.0	11 1/4°+22 1/2°	107.1	8.6	20.1	153.9	289.7
180.0	45°	98.3	8.6	20.1	143.1	280.1
180.0	11 1/4°-45°	107.1	8.6	20.1	153.9	289.7
180.0	22 1/2°-45°	140.1	8.6	20.1	162.0	330.8

- Cover 400cm

Pipe Dia (cm)	Bending angle (°)	W1 (kg/cm)	W2 (kg/cm)	W3 (kg/cm)	W4 (kg/cm)	W (kg/cm)
160.0	11 1/4°	67.1	8.6	20.1	159.6	255.6
160.0	22 1/2°	82.7	8.6	20.1	160.4	274.8
160.0	11 1/4°+22 1/2°	99.1	8.6	20.1	205.2	345.0
160.0	45°	118.3	8.6	20.1	190.8	337.8
160.0	11 1/2°+45°	99.1	8.6	20.1	205.2	345.0
160.0	22 1/2°+45°	140.1	8.6	20.1	216.0	384.8

Cover 500cm

Pipe Dia (cm)	Bending angle (°)	W1 (kg/cm)	W2 (kg/cm)	W3 (kg/cm)	W4 (kg/cm)	W (kg/cm)
160.0	11 1/4°	67.1	8.6	20.1	199.5	295.6
160.0	22 1/2°	82.7	8.6	20.1	204.3	315.7
160.0	11 1/4°+22 1/2°	99.1	8.6	20.1	256.5	396.3
160.0	45°	118.3	8.6	20.1	238.5	385.5
160.0	11 1/2°+45°	99.1	8.6	20.1	256.5	396.3
160.0	22 1/2°+45°	140.1	8.6	20.1	270.0	438.8

5) Resistant force of passive soil pressure beneath trust block (E)

$E = 1/2 * K_p * \gamma_s * [(H+h)^2 - h^2] * A$

여기서, E : Resistant force of passive soil pressure beneath trust block(kg)

K_p : Coefficient of passive earth pressure = $\tan^2(45-\Phi/2)$ = 3.0

γ_s : Unit weihth of soil = 0.0018 kg/㎤

h : Cover of trust block =

Cover	l1	l2	l3	l4	l5
	150cm	200cm	300cm	400cm	500cm

H : Height of trust block(cm)

A : Wicth of trust block(cm)

Pipe Dia (cm)	Bending angle (°)	K_p	γ (kg/㎤)	l (cm)	A (cm)
160.0	11 1/4°	3.0	0.0018	222	222
160.0	22 1/2°	3.0	0.0018	247	227
160.0	11 1/4°+22 1/2°	3.0	0.0018	240	286
160.0	45°	3.0	0.0018	270	265
160.0	11 1/2°+45°	3.0	0.0018	270	285
160.0	22 1/2°+45°	3.0	0.0018	270	300

Pipe Dia (cm)	Bending angle (°)	E (kg/cm)				
h (cm)		150	200	300	400	500
160.0	11 1/4°	69,460.9	82,767.5	109,380.9	135,994.3	162,607.6
160.0	22 1/2°	82,308.3	97,948.9	129,224.2	160,501.5	188,778.7
160.0	11 1/4°+22 1/2°	99,727.2	118,195.2	156,131.2	192,067.2	229,003.2
160.0	45°	110,115.5	129,437.0	169,071.0	208,708.0	248,345.0
160.0	11 1/2°+45°	99,727.2	118,195.2	156,131.2	192,067.2	229,003.2
0.0	22 1/2°+45°	124,659.0	146,529.0	190,269.0	234,009.0	277,749.0

5) Resistant force of positive earth pressure beside trust block(F)

$F = 1/2 * K_a * \gamma_s * [(H+h)^2 - h^2] * 2(A+\ell)$

F : Resistant force of positive earth pressure beside trust block(kg)

K_a : Coefficient of positive earth pressure = $\tan^2(45-\Phi/2)$ = 0.333

γ_s : Unit weihth of soil = 0.0018 kg/㎤

h : Cover of trust block =

Cover	l1	l2	l3	l4	l5
	150cm	200cm	300cm	400cm	500cm

H : Height of trust block(cm)

A : Wicth of trust block(cm)

ℓ : Length of trust block(cm)

Pipe Dia. (cm)	Bending angle (°)	K_a	Y_1 (kg/cm²)	H (cm)	A (cm)	ℓ (cm)
160.0	11 1/4°	0.333	0.0018	222	222	220
160.0	22 1/2°	0.333	0.0018	247	227	404
160.0	11 1/4°+22 1/2°	0.333	0.0018	240	285	620
160.0	45°	0.333	0.0018	270	265	596
160.0	11 1/4°–45°	0.333	0.0018	240	265	1,194
160.0	22 1/2°–45°	0.333	0.0018	270	300	1,322

Pipe Dia. (cm)	Bending angle (°)	F (kg/cm)				
h'(cm)		150	200	300	400	500
160.0	11 1/4°	30,701.7	36,583.3	48,346.4	60,109.5	71,872.6
160.0	22 1/2°	51,101.1	60,443.2	79,127.3	97,811.5	116,495.6
160.0	11 1/4°+22 1/2°	70,302.4	83,321.4	109,359.3	135,397.3	161,435.2
160.0	45°	79,403.7	93,334.2	121,195.1	149,056.1	176,917.0
160.0	11 1/4°–45°	114,892.3	136,185.3	178,720.9	221,273.5	263,826.1
0.0	22 1/2°–45°	149,625.7	176,975.8	229,676.1	280,376.3	333,376.6

F) Safety review of trust block

① **Safe rate of horizontal component**

$$F.S = \frac{\mu * (W * \ell + Rv) + F}{Rh}$$

F.S : safety rate = above 1.5

μ : friction coefficient of trust block against = 0.6

W : Total weight per Unit Length of the trust block (kg/cm)

ℓ : Length of trust block(cm)

F : Resistant force of passive earth pressure beneath trust block(kg)

Rv : Vertical component acting on the bend(kg)

Rh : Horizental component acting on the bend(kg)

- Cover 150cm

Pipe Dia. (cm)	Bending angle (°)	μ	W (kg/cm)	F (kg/cm)	ℓ (cm)	Rv (kg)	Rh (kg)	F.S	Result
160.0	11 1/4°	0.6	155.7	69,460.9	220	38,586.2	3,598.8	**17.1**	OK
160.0	22 1/2°	0.6	172.7	82,808.3	404	77,649.0	16,445.3	**5.1**	OK
160.0	11 1/4°+22 1/2°	0.6	216.6	99,727.2	620	112,729.8	34,198.9	**3.2**	OK
160.0	45°	0.6	218.6	110,115.6	596	143,476.6	59,429.9	**1.7**	OK
160.0	11 1/4°–45°	0.6	216.6	99,727.2	1,194	168,710.6	90,177.7	**1.6**	OK
160.0	22 1/2°–45°	0.6	249.6	124,659.0	1,322	187,461.1	125,257.6	**1.6**	OK

- Cover 200cm

Pipe Dia. (cm)	Bending angle (°)	μ	W (kg/cm)	F (kg/cm)	ℓ (cm)	Rv (kg)	Rh (kg)	F.S	Result
160.0	11 1/4°	0.6	175.7	82,767.5	220	38,586.2	3,598.8	**21.1**	OK
160.0	22 1/2°	0.6	190.1	97,946.9	404	77,649.0	16,445.3	**6.4**	OK
160.0	11 1/4°+22 1/2°	0.6	242.4	118,195.2	620	112,729.8	34,198.9	**4.0**	OK
160.0	45°	0.6	242.4	129,434.0	596	143,476.6	59,429.9	**2.2**	OK
160.0	11 1/4°–45°	0.6	242.4	118,195.2	1,194	168,710.6	90,177.7	**2.0**	OK
160.0	22 1/2°–45°	0.6	276.6	146,529.0	1,322	187,461.1	125,257.6	**1.9**	OK

- Cover 300cm

Pipe Dia. (cm)	Bending angle (°)	μ	W (kg/cm)	F (kg/cm)	ℓ (cm)	Rv (kg)	Rh (kg)	F.S	Result
160.0	11 1/4°	0.6	215.7	109,380.9	220	38,586.2	3,598.8	**29.1**	OK
160.0	22 1/2°	0.6	234.0	128,224.2	404	77,649.0	16,445.3	**8.8**	OK
160.0	11 1/4°+22 1/2°	0.6	293.7	155,181.2	620	112,729.8	34,198.9	**5.6**	OK
160.0	45°	0.6	290.1	168,071.0	596	143,476.6	59,429.9	**3.1**	OK
160.0	11 1/4°–45°	0.6	293.7	155,181.2	1,194	168,710.6	90,177.7	**2.7**	OK
160.0	22 1/2°–45°	0.6	330.6	190,269.0	1,322	187,461.1	125,257.6	**2.5**	OK

- Cover 400cm

Pipe Dia (cm)	Bending angle (°)	μ	W (kg/cm)	F (kg/cm²)	ℓ (cm)	Rv (kg)	Rh (kg)	F.S	Result
160.0	11 1/4°	0.5	255.6	185,994.0	220	39,595.2	3,898.8	37.0	OK
160.0	22 1/2°	0.5	277.8	168,501.6	404	77,649.0	15,445.3	11.3	OK
160.0	11 1/4°+22 1/2°	0.5	345.0	192,067.2	620	112,728.8	34,195.9	7.1	OK
160.0	45°	0.5	337.8	206,708.0	596	143,476.6	59,429.9	4.0	OK
160.0	11 1/4°+45°	0.5	375.0	192,067.2	1,194	168,710.6	90,177.7	3.5	OK
160.0	22 1/2°+45°	0.5	387.8	231,009.0	1,322	187,461.1	125,257.5	3.2	OK

- Cover 500cm

Pipe Dia (cm)	Bending angle (°)	μ	W (kg/cm)	F (kg/cm²)	ℓ (cm)	Rv (kg)	Rh (kg)	F.S	Result
160.0	11 1/4°	0.5	295.6	162,607.6	220	39,595.2	3,898.8	45.0	OK
160.0	22 1/2°	0.5	315.7	188,778.7	404	77,649.0	15,445.3	13.8	OK
160.0	11 1/4°+22 1/2°	0.5	396.3	229,003.2	620	112,728.8	34,195.9	8.6	OK
160.0	45°	0.5	385.5	245,345.0	596	143,476.6	59,429.9	4.9	OK
160.0	11 1/4°+45°	0.5	396.3	229,003.2	1,194	168,710.6	90,177.7	4.2	OK
160.0	22 1/2°+45°	0.5	438.8	277,749.0	1,322	187,461.1	125,257.5	3.8	OK

② Safe rate of vertical component

$$F.S = \frac{(W + \ell) - F}{Rv}$$

F.S : safety rate = above 1.5

W : Total weight per Unit Length beneath the trust block(kg/cm)

F : Resistant force of positive earth pressure bes dc trust block(kg)

ℓ : Length of trust block(cm)

Rv : Vertical component acting on the ben(kg)

Cover 150cm

Pipe Dia (cm)	Bending angle (°)	W (kg/cm)	F (kg/cm)	ℓ (cm)	Rv (kg)	F.S	Result
160.0	11 1/4°	155.7	30,701.7	220	39,595.2	1.6	OK
160.0	22 1/2°	172.7	51,101.1	404	77,649.0	1.6	OK
160.0	11 1/4°+22 1/2°	216.8	70,309.4	620	112,728.8	1.8	OK
160.0	45°	218.6	79,403.7	596	143,476.6	1.5	OK
160.0	11 1/4°+45°	216.8	114,892.0	1,194	168,710.6	2.2	OK
160.0	22 1/2°+45°	279.8	149,825.7	1,322	187,461.1	2.6	OK

Cover 200cm

Pipe Dia (cm)	Bending angle (°)	W (kg/cm)	F (kg/cm)	ℓ (cm)	Rv (kg)	F.S	Result
160.0	11 1/4°	175.7	36,583.3	220	39,595.2	1.9	OK
160.0	22 1/2°	193.1	60,443.2	404	77,649.0	1.8	OK
160.0	11 1/4°+22 1/2°	242.4	83,821.4	620	112,728.8	2.1	OK
160.0	45°	242.4	93,334.2	596	143,476.6	1.7	OK
160.0	11 1/4°+45°	242.4	138,168.3	1,194	168,710.6	2.5	OK
160.0	22 1/2°+45°	276.8	175,976.8	1,322	187,461.1	2.9	OK

Cover 300cm

Pipe Dia (cm)	Bending angle (°)	W (kg/cm)	F (kg/cm)	ℓ (cm)	Rv (kg)	F.S	Result
160.0	11 1/4°	215.7	48,346.4	220	39,595.2	2.4	OK
160.0	22 1/2°	234.0	79,127.3	404	77,649.0	2.2	OK
160.0	11 1/4°+22 1/2°	293.7	109,368.3	620	112,728.8	2.6	OK
160.0	45°	290.1	121,195.1	596	143,476.6	2.0	OK
160.0	11 1/4°+45°	293.7	178,720.9	1,194	168,710.6	3.1	OK
160.0	22 1/2°+45°	330.8	228,376.1	1,322	187,461.1	3.6	OK

Cover 400cm

Pipe Dia (cm)	Bending angle (°)	W (kg/cm)	F (kg/cm)	ℓ (cm)	Fv (kg)	F.S	Result
160.0	11 1/4°	266.8	60,139.5	220	39,585.2	2.9	OK
160.0	22 1/2°	274.8	97,811.5	404	77,649.0	2.7	OK
160.0	11 1/4°+22 1/2°	345.0	135,397.3	620	112,728.8	3.1	OK
160.0	45°	337.8	149,056.1	596	143,476.6	2.4	OK
160.0	11 1/4°+45°	346.0	221,273.5	1,194	168,710.6	3.8	OK
160.0	22 1/2°+45°	384.8	280,976.3	1,322	197,461.7	4.2	OK

Cover 600cm

Pipe Dia (cm)	Bending angle (°)	W (kg/cm)	F (kg/cm)	ℓ (cm)	Fv (kg)	F.S	Result
160.0	11 1/4°	296.8	71,872.6	220	39,585.2	3.5	OK
160.0	22 1/2°	316.7	116,496.8	404	77,649.0	3.1	OK
160.0	11 1/4°+22 1/2°	398.3	161,735.2	620	112,728.8	3.6	OK
160.0	45°	385.5	176,917.0	596	143,476.6	2.8	OK
160.0	11 1/4°+45°	396.3	263,826.1	1,194	168,710.6	4.4	OK
160.0	22 1/2°+45°	439.8	333,376.8	1,322	197,461.7	4.9	OK

■ Vertical trust block(D1,800mm)

1) dimension of trust block

Pipe Dia (mm)	Bending angle (°)	A (cm)	B (cm)	C (cm)	D (mm)	E (cm)	F (cm)
1,800	11 1/4°	245	132	98	43	–	–
1,800	22 1/2°	245	247	183	122	–	–
1,800	11 1/4°–22 1/2°	300	282	255	201	230	201
1,800	45°	300	409	293	248	–	–
1,800	11 1/4°–45°	350	494	467	412	436	235
1,800	22 1/2°–45°	380	637	589	544	577	282

Pipe Dia (mm)	Bending angle (°)	G (cm)	L (cm)	I (cm)	J (cm)	H (cm)	Weight	
							material	(kg/m)
1,800	11 1/4°	20	110	–	–	245	D	582.0
1,800	22 1/2°	40	220	–	–	270	D	582.0
1,800	11 1/4°–22 1/2°	114	–	349	239	255	D	582.0
1,800	45°	50	351	–	–	280	D	582.0
1,800	11 1/4°–45°	84	–	705	587	255	D	582.0
1,800	22 1/2°–45°	68	–	701	607	280	D	582.0

2) calculation condition

① Maximum water pressure(p)	=	10.0	kg/cm²
② Velocity(V) = maximum velocity in pipe	=	300.00	cm/sec
③ Unit weight of soil (Yt)	=	0.0018	kg/cm³
④ Unit weight of CON'C	=	0.0023	kg/cm³
⑤ Internal friction angle of soil (φ)	=	30	°
⑥ Friction coefficient of trust block against ground(μ)	=	0.6	

⑦ Cover of trust block

Cover	H1	H2	H3	H4	H5
	150cm	200cm	300cm	400cm	500cm

3) The force acting on the bend section(R)

① The force by water pressure(R1)

$R1 = 2*p*a*\sin(\Theta/2)$

R1 : The force acting on the bend section by water pressure(kg)

p : water pressure(kg/cm²)

a : cross-section area = $\pi/4*D2$(cm²)

D : pipe diameter(cm)

Θ : bending degree(°)

Pipe Dia (cm)	Bending angle (°)	p (kg/cm²)	a (cm²)	Θ (°)	R1 (kg)
180.0	11 1/4°	10.00	25,447	11.25	49,884.8
180.0	22 1/2°	10.00	25,447	22.50	99,299.3
180.0	11 1/4°–22 1/2°	10.00	25,447	33.75	147,737.5
180.0	45°	10.00	25,447	45.00	194,762.9
180.0	11 1/4°–45°	10.00	25,447	56.25	239,912.7
180.0	22 1/2°–45°	10.00	25,447	67.50	282,751.9

② Centrifugal force by water(R2)

$R2 = 2*a*Y_w*V^2*\sin(\Theta/2)/g$

R2 : The centrifugal force acting on the bend section by water pressure(kg)

a : cross-section area = $\pi/4*D^2$

D : pipe diameter(cm)
Y_w : Unit weight of water(kg/cm³) = 0.001 kg/cm³
V : velocity(cm/sec) = 300.00 cm/sec
θ : bending degree(°)
g : acceleration of gravity(cm/sec²) = 980 cm/sec²

Pipe Dia (cm)	Bending angle (°)	A (cm²)	Y_w (kg/cm³)	V (cm/sec)	θ (°)	g (cm/sec²)	P2 (kg)
180.0	11 1/4°	25,447	0.001	300.00	11.25	980	458.1
180.0	22 1/2°	25,447	0.001	300.00	22.50	980	916.3
180.0	11 1/4°+22 1/2°	25,447	0.001	300.00	33.75	980	1,356.8
180.0	45°	25,447	0.001	300.00	45.00	980	1,788.6
180.0	11 1/4°+45°	25,447	0.001	300.00	56.25	980	2,203.3
180.0	22 1/2°+45°	25,447	0.001	300.00	67.50	980	2,596.7

① The force acting on the bend section(R)
R = P1 + R2 (kg)

Pipe Dia (cm)	Bending angle (°)	Total(R) (kg)	P1 (kg)	P2 (kg)
180.0	11 1/4°	50,342.9	49,884.8	458.1
180.0	22 1/2°	100,201.1	99,269.3	916.3
180.0	11 1/4°+22 1/2°	149,094.3	147,737.5	1,356.8
180.0	45°	196,551.5	194,762.9	1,788.6
180.0	11 1/4°+45°	242,116.0	239,912.7	2,203.3
180.0	22 1/2°+45°	285,048.6	282,451.9	2,596.7

② The horizontal component force(Rh) and the vertical component force(Rv) of R
Rh = R × sin(θ/2) (kg)
Rv = R × cos(θ/2)

Pipe Dia (cm)	Bending angle (°)	R (kg)	θ °	Rh (kg)	Rv (kg)
180.0	11 1/4°	50,342.9	11.25	4,994.5	50,100.5
180.0	22 1/2°	100,201.1	22.50	19,548.3	98,275.5
180.0	11 1/4°+22 1/2°	149,094.3	33.75	43,279.8	142,674.3
180.0	45°	196,551.5	45.00	75,217.0	181,589.9
180.0	11 1/4°+45°	242,116.0	56.25	114,739.7	213,527.2
180.0	22 1/2°+45°	285,048.6	67.50	158,501.2	237,258.7

4) Total weight per Unit Length of the trust block floor(W)
① Weight of trust block(W1)
W1 = (A×H − π/4×D²) × 0.0023 kg/cm³

Pipe Dia (cm)	Bending angle (°)	A (cm)	H (cm)	W1 (kg/cm)
180.0	11 1/4°	245.0	245.0	79.5
180.0	22 1/2°	245.0	270.0	90.6
180.0	11 1/4°+22 1/2°	300.0	255.0	117.4
180.0	45°	300.0	280.0	134.7
180.0	11 1/4°+45°	350.0	255.0	146.7
180.0	22 1/2°+45°	380.0	280.0	186.2

② Weight of pipe(W2)
W2 = (Unit weight of pipe)

Pipe Dia (cm)	Bending angle (°)	W2 (kg/cm)
180.0	11 1/4°	5.82
180.0	22 1/2°	5.82
180.0	11 1/4°+22 1/2°	5.82
180.0	45°	5.82
180.0	11 1/4°+45°	5.82
180.0	22 1/2°+45°	5.82

③ Weight of water in the pipe(W3)

$W3 = \pi/4 \times D^2 \times \gamma_w$ (kg/cm)

D : pipe diameter(cm)

γ_w : Unit weight of water(kg/cm³) = 0.001 kg/cm³

Pipe Dia (cm)	Bending angle (°)	γ_w (kg/cm³)	W3 (kg/cm)
180.0	11 1/4°	0.001	25.4
180.0	22 1/2°	0.001	25.4
180.0	11 1/4°+22 1/2°	0.001	25.4
180.0	45°	0.001	25.4
180.0	11 1/4°+45°	0.001	25.4
180.0	22 1/2°+45°	0.001	25.4

④ Weight of soil on the trust block(W4)

$W4 = \gamma_t \times h \times A$ (kg/cm)

γ_t : Unit weight of soil = 0.0018 kg/cm³

H : Cover of cus. block =

Cover	H1	H2	H3	H4	H5
	150cm	200cm	300cm	400cm	500cm

A : width to trust block(cm)

Pipe Dia (cm)	Bending angle (°)	γ (kg/cm³)	A (cm)	W4 (kg/cm)				
h(cm)				150	200	300	400	500
180.0	11 1/4°	0.0018	245	66.2	88.2	132.3	176.4	220.5
180.0	22 1/2°	0.0018	245	66.2	88.2	132.3	176.4	220.5
180.0	11 1/4°+22 1/2°	0.0018	300	81.0	108.0	162.0	216.0	270.0
180.0	45°	0.0018	300	81.0	108.0	162.0	216.0	270.0
180.0	11 1/4°+45°	0.0018	350	94.5	126.0	189.0	252.0	315.0
180.0	22 1/2°+45°	0.0018	380	102.6	136.8	205.2	273.6	342.0

⑤ Total weight per Unit Length of the trust block base(W)

$W = W1 + W2 + W3 + W4$ (kg/cm)

- Cover 150cm

Pipe Dia (cm)	Bending angle (°)	W1 (kg/cm)	W2 (kg/cm)	W3 (kg/cm)	W4 (kg/cm)	W (kg/cm)
180.0	11 1/4°	79.5	5.9	25.4	66.2	176.9
180.0	22 1/2°	93.6	5.9	25.4	66.2	191.0
180.0	11 1/4°+22 1/2°	117.4	5.9	25.4	81.0	229.6
180.0	45°	134.7	5.9	25.4	81.0	246.9
180.0	11 1/4°+45°	146.7	5.9	25.4	94.5	272.4
180.0	22 1/2°+45°	166.2	5.9	25.4	102.6	300.0

- Cover 200cm

Pipe Dia (cm)	Bending angle (°)	W1 (kg/cm)	W2 (kg/cm)	W3 (kg/cm)	W4 (kg/cm)	W (kg/cm)
180.0	11 1/4°	79.5	5.9	25.4	88.2	198.9
180.0	22 1/2°	93.6	5.9	25.4	88.2	213.0
180.0	11 1/4°+22 1/2°	117.4	5.9	25.4	108.0	256.6
180.0	45°	134.7	5.9	25.4	108.0	273.9
180.0	11 1/4°+45°	146.7	5.9	25.4	126.0	303.9
180.0	22 1/2°+45°	166.2	5.9	25.4	136.8	334.2

- Cover 300cm

Pipe Dia (cm)	Bending angle (°)	W1 (kg/cm)	W2 (kg/cm)	W3 (kg/cm)	W4 (kg/cm)	W (kg/cm)
180.0	11 1/4°	79.5	5.9	25.4	132.3	243.0
180.0	22 1/2°	93.6	5.9	25.4	132.3	257.1
180.0	11 1/4°+22 1/2°	117.4	5.9	25.4	162.0	310.6
180.0	45°	134.7	5.9	25.4	162.0	327.9
180.0	11 1/4°+45°	146.7	5.9	25.4	189.0	368.9
180.0	22 1/2°+45°	166.2	5.9	25.4	205.2	422.6

– Cover 400cm

Pipe Dia. (cm)	Bending angle (°)	W1 (kg/cm)	W2 (kg/cm)	W3 (kg/cm)	W4 (kg/cm)	W (kg/cm)
180.0	11 1/4°	79.5	5.8	25.4	176.4	287.1
180.0	22 1/2°	93.6	5.8	25.4	176.4	301.2
180.0	11 1/4°~22 1/2°	117.4	5.8	25.4	216.0	364.6
180.0	45°	134.7	5.8	25.4	216.0	381.9
180.0	11 1/4°~45°	146.7	5.8	25.4	252.0	429.9
180.0	22 1/2°~45°	166.2	5.8	25.4	273.6	491.0

– Cover 500cm

Pipe Dia. (cm)	Bending angle (°)	W1 (kg/cm)	W2 (kg/cm)	W3 (kg/cm)	W4 (kg/cm)	W (kg/cm)
180.0	11 1/4°	79.5	5.8	25.4	220.5	331.2
180.0	22 1/2°	93.6	5.8	25.4	220.5	345.3
180.0	11 1/4°~22 1/2°	117.4	5.8	25.4	270.0	418.6
180.0	45°	134.7	5.8	25.4	270.0	435.9
180.0	11 1/4°~45°	146.7	5.8	25.4	315.0	492.8
180.0	22 1/2°~45°	166.2	5.8	25.4	342.0	559.4

5) Resistant force of passive soil pressure beneath trust block (E)

$E = 1/2 * K_p * Y_t * [(H1+h')^2 - h'^2] * A$

여기서, E : Resistant force of passive soil pressure beneath trust block(kg)

K_p : Coefficient of passive earth pressure $= \tan^2(45-\Phi/2) =$ 3.0

Y_t : Unit weight of soil = 0.0018 kg/㎤

h' : Cover of trust block =

Cover	H1	H2	H3	H4	H5
	150cm	200cm	300cm	400cm	500cm

H : Height of trust block(cm)

A : Width of trust block(cm)

Pipe Dia. (cm)	Bending angle (°)	K_p	Y_t (kg/㎤)	H (cm)	A (cm)
180.0	11 1/4°	3.0	0.0018	245	245
180.0	22 1/2°	3.0	0.0018	270	245
180.0	11 1/4°~22 1/2°	3.0	0.0018	255	300
180.0	45°	3.0	0.0018	280	300
180.0	11 1/4°~45°	3.0	0.0018	255	350
180.0	22 1/2°~45°	3.0	0.0018	280	380

Pipe Dia. (cm)	Bending angle (°)	E (kg/cm)				
h (cm)		150	200	300	400	500
180.0	11 1/4°	88,328.8	104,533.5	138,947.0	169,360.5	201,774.0
180.0	22 1/2°	101,804.9	119,685.4	155,386.4	191,107.4	226,828.4
180.0	11 1/4°~22 1/2°	114,635.3	135,290.3	176,600.3	217,910.3	259,220.3
180.0	45°	131,544.0	154,224.0	199,584.0	244,944.0	290,304.0
180.0	11 1/4°~45°	138,741.0	157,838.6	206,033.6	254,228.6	302,423.6
0.0	22 1/2°~45°	166,692.4	195,350.4	252,806.4	310,262.4	367,718.4

6) Resistant force of positive earth pressure beside trust block(F)

$F = 1/2 * Ka * Y_t * [(H+h')^2 - h'^2] * 2(A+\ell)$

F : Resistant force of positive earth pressure beside trust block(kg)

K_p : Coefficient of positive earth pressure = $\tan^2(45-\Phi/2) =$ 0.333

Y_t : Unit weight of soil = 0.0018 kg/㎤

h' : Cover of trust block =

Cover	H1	H2	H3	H4	H5
	150cm	200cm	300cm	400cm	500cm

H : Height of trust block(cm)

A : Width of trust block(cm)

ℓ : Length of trust block(cm)

Pipe Dia (cm)	Bending angle (°)	K_a	γ_1 (kg/cm³)	H (cm)	A (cm)	ℓ (cm)
180.0	11 1/4°	0.333	0.0018	245	245	220
180.0	22 1/2°	0.333	0.0018	270	245	440
180.0	11 1/4°+22 1/2°	0.333	0.0018	255	300	698
180.0	45°	0.333	0.0018	280	300	702
180.0	11 1/4°+45°	0.333	0.0018	255	350	1,410
180.0	22 1/2°+45°	0.333	0.0018	280	350	1,462

Pipe Dia (cm)	Bending angle (°)	F (kg/cm)				
h'(cm)		150	200	300	400	500
180.0	11 1/4°	37,278.2	44,044.9	57,702.2	71,359.5	85,016.9
180.0	22 1/2°	63,189.6	74,276.8	96,447.4	118,618.2	140,791.0
180.0	11 1/4°+22 1/2°	84,660.4	99,914.8	130,422.8	160,931.7	191,439.3
180.0	45°	97,535.3	114,351.7	147,984.6	181,617.4	215,250.3
180.0	11 1/4°+45°	149,300.9	176,902.0	230,004.2	283,606.3	337,208.5
0.0	22 1/2°+45°	179,305.0	210,919.6	272,049.0	333,878.3	395,707.6

7) Safety review of trust block

① Safe rate of horizontal component

$$F.S = \frac{\mu \times (W \times \ell - Rv) - E}{Rh}$$

F.S : safety rate = above 1.5

μ : friction coefficient of trust block against = 0.6

W : Total weight per Unit Length of the trust block (soil)(kg/cm)

ℓ : Length of trust block(cm)

E : Passive earth pressure beneath trust block(kg)

Rv : Vertical component acting on the bend(kg)

Rh : Horizental component acting on the bend(kg)

- Cover 150cm

Pipe Dia (cm)	Bending angle (°)	μ	W (kg/cm)	E (kg/cm)	ℓ (cm)	Rv (kg)	Rh (kg)	F.S	Result
180.0	11 1/4°	0.5	176.9	88,326.6	220	50,100.5	4,934.5	**16.8**	OK
180.0	22 1/2°	0.5	191.0	101,804.9	440	98,275.8	19,548.3	**4.8**	OK
180.0	11 1/4°+22 1/2°	0.5	229.6	114,605.3	698	142,674.3	43,279.8	**2.9**	OK
180.0	45°	0.5	276.9	131,544.3	702	181,589.9	75,217.0	**1.7**	OK
180.0	11 1/4°+45°	0.5	272.4	133,741.1	1,410	213,527.2	114,132.7	**1.9**	OK
180.0	22 1/2°+45°	0.5	320.0	166,622.4	1,462	237,258.7	158,531.2	**1.8**	OK

- Cover 200cm

Pipe Dia (cm)	Bending angle (°)	μ	W (kg/cm)	E (kg/cm)	ℓ (cm)	Rv (kg)	Rh (kg)	F.S	Result
180.0	11 1/4°	0.5	198.9	104,533.5	220	50,100.5	4,934.5	**20.5**	OK
180.0	22 1/2°	0.5	213.0	119,665.4	440	98,275.8	19,548.3	**6.0**	OK
180.0	11 1/4°+22 1/2°	0.5	256.6	135,290.3	698	142,674.3	43,279.8	**3.5**	OK
180.0	45°	0.5	273.9	154,224.0	702	181,589.9	75,217.0	**2.1**	OK
180.0	11 1/4°+45°	0.5	303.9	157,608.6	1,410	213,527.2	114,132.7	**2.3**	OK
180.0	22 1/2°+45°	0.5	357.2	195,360.4	1,462	237,258.7	158,531.2	**2.1**	OK

- Cover 300cm

Pipe Dia (cm)	Bending angle (°)	μ	W (kg/cm)	E (kg/cm)	ℓ (cm)	Rv (kg)	Rh (kg)	F.S	Result
180.0	11 1/4°	0.5	243.0	136,947.3	220	50,100.5	4,934.5	**28.1**	OK
180.0	22 1/2°	0.5	257.1	155,386.4	440	98,275.8	19,548.3	**8.3**	OK
180.0	11 1/4°+22 1/2°	0.5	310.6	176,600.3	698	142,674.3	43,279.8	**4.9**	OK
180.0	45°	0.5	327.9	199,584.0	702	181,589.9	75,217.0	**3.0**	OK
180.0	11 1/4°+45°	0.5	366.9	206,038.6	1,410	213,527.2	114,132.7	**3.1**	OK
180.0	22 1/2°+45°	0.5	422.6	252,506.4	1,462	237,258.7	158,531.2	**2.8**	OK

– Cover 400cm

Pipe Dia (cm)	Bending angle (°)	δ	W (kg/cm)	E (kg/cm)	ℓ (cm)	Pv (kg)	Ph (kg)	F.S	Result
180.0	11 1/4°	0.5	287.1	189,360.5	220	50,100.5	4,934.5	**35.6**	OK
180.0	22 1/2°	0.5	301.2	191,107.4	440	98,275.8	19,548.3	**10.7**	OK
180.0	11 1/4°+22 1/2°	0.5	364.6	217,910.3	698	142,674.3	43,279.8	**6.3**	OK
180.0	45°	0.5	381.9	244,944.0	702	181,589.9	75,217.0	**3.8**	OK
180.0	11 1/4°+45°	0.5	429.9	254,228.6	1,410	213,527.2	114,132.7	**3.9**	OK
180.0	22 1/2°+45°	0.5	491.0	310,262.4	1,462	237,258.7	158,631.2	**3.5**	OK

– Cover 500cm

Pipe Dia (cm)	Bending angle (°)	δ	W (kg/cm)	F (kg/cm)	ℓ (cm)	Pv (kg)	Ph (kg)	F.S	Result
180.0	11 1/4°	0.5	331.2	201,774.0	220	50,100.5	4,934.5	**43.2**	OK
180.0	22 1/2°	0.5	345.3	226,628.4	440	98,275.8	19,548.3	**13.0**	OK
180.0	11 1/4°+22 1/2°	0.5	418.6	259,220.3	698	142,674.3	43,279.8	**7.7**	OK
180.0	45°	0.5	435.9	290,304.0	702	181,589.9	75,217.0	**4.7**	OK
180.0	11 1/4°+45°	0.5	492.9	302,423.6	1,410	213,527.2	114,132.7	**4.8**	OK
180.0	22 1/2°+45°	0.5	559.4	367,778.4	1,462	237,258.7	158,631.2	**4.2**	OK

② Safe rate of vertical component

$$F.S = \frac{(W + \ell) + F}{Pv}$$

F.S : safety rate = above 1.5

W : Total weight per Unit Length beneath the trust block(kg/cm)

F : Resistant force of positive earth pressure beside trust block(kg)

ℓ : Length of trust block(cm)

Pv : Vertical component acting on the bend(kg)

Cover 150cm

Pipe Dia (cm)	Bending angle (°)	W (kg/cm)	F (kg/cm)	ℓ (cm)	Pv (kg)	F.S	Result
180.0	11 1/4°	176.9	97,216.2	220	50,100.5	**1.5**	OK
180.0	22 1/2°	181.0	83,188.8	440	98,275.8	**1.5**	OK
180.0	11 1/4°+22 1/2°	229.6	84,660.4	698	142,674.3	**1.7**	OK
180.0	45°	246.9	97,535.3	702	181,589.9	**1.5**	OK
180.0	11 1/4°+45°	272.4	149,300.9	1,410	213,527.2	**2.5**	OK
180.0	22 1/2°+45°	320.0	179,305.0	1,462	237,258.7	**2.7**	OK

Cover 200cm

Pipe Dia (cm)	Bending angle (°)	W (kg/cm)	F (kg/cm)	ℓ (cm)	Pv (kg)	F.S	Result
180.0	11 1/4°	196.9	44,044.9	220	50,100.5	**1.8**	OK
180.0	22 1/2°	218.0	74,275.8	440	98,275.8	**1.7**	OK
180.0	11 1/4°+22 1/2°	266.6	99,914.6	698	142,674.3	**2.0**	OK
180.0	45°	273.9	114,351.7	702	181,589.9	**1.7**	OK
180.0	11 1/4°+45°	303.9	176,902.0	1,410	213,527.2	**2.8**	OK
180.0	22 1/2°+45°	354.2	210,919.6	1,462	237,258.7	**3.1**	OK

Cover 300cm

Pipe Dia (cm)	Bending angle (°)	W (kg/cm)	F (kg/cm)	ℓ (cm)	Pv (kg)	F.S	Result
180.0	11 1/4°	243.0	57,709.2	220	50,100.5	**2.2**	OK
180.0	22 1/2°	257.1	96,447.4	440	98,275.8	**2.1**	OK
180.0	11 1/4°+22 1/2°	310.6	130,422.8	698	142,674.3	**2.4**	OK
180.0	45°	327.9	147,984.6	702	181,589.9	**2.1**	OK
180.0	11 1/4°+45°	386.9	230,004.2	1,410	213,527.2	**3.5**	OK
180.0	22 1/2°+45°	422.6	272,048.0	1,462	237,258.7	**3.8**	OK

Cover 400cm

Pipe Dia (cm)	Bending angle (°)	W (kg/cm)	F (kg/cm²)	ℓ (cm)	Fv (kg)	F.S	Result
180.0	11 1/4°	287.1	71,3e8.5	220	50,100.5	2.7	OK
180.0	22 1/2°	331.2	118,619.9	440	98,275.8	2.6	OK
180.0	11 1/4°+22 1/2°	364.6	160,931.1	698	142,874.3	2.9	OK
180.0	45°	391.9	181,617.4	702	181,589.9	2.5	OK
180.0	11 1/4°+45°	429.9	283,506.3	1,410	213,527.2	4.2	OK
180.0	22 1/2°+45°	491.0	333,875.3	1,462	237,258.7	4.4	OK

Cover 500cm

Pipe Dia (cm)	Bending angle (°)	W (kg/cm)	F (kg/cm²)	ℓ (cm)	Fv (kg)	F.S	Result
180.0	11 1/4°	331.2	85,0?6.9	220	50,100.5	3.2	OK
180.0	22 1/2°	345.3	140,791.0	440	98,275.8	3.0	OK
180.0	11 1/4°+22 1/2°	418.8	191,439.3	698	142,874.3	3.4	OK
180.0	45°	435.9	215,250.3	702	181,589.9	2.9	OK
180.0	11 1/4°+45°	499.9	337,608.5	1,410	213,527.2	4.8	OK
180.0	22 1/2°+45°	559.4	395,707.6	1,462	237,258.7	5.1	OK

Appendix H Pipe Buoyancy stability review

H.1 General

Pipe is vulnerable to buoyancy when the pipe is empty under construction or before commissioning. Due to the situation as previously stated, accident related to buoyancy occurs frequently. Therefore, in these design, we reviewed the buoyancy affecting the pipe to acquire the stability about the buoyancy when the pipe is empty, which also influences the determination of the minimum soil cover. Based on the results of the review, the minimum soil cover was applied to the calculation in these design.

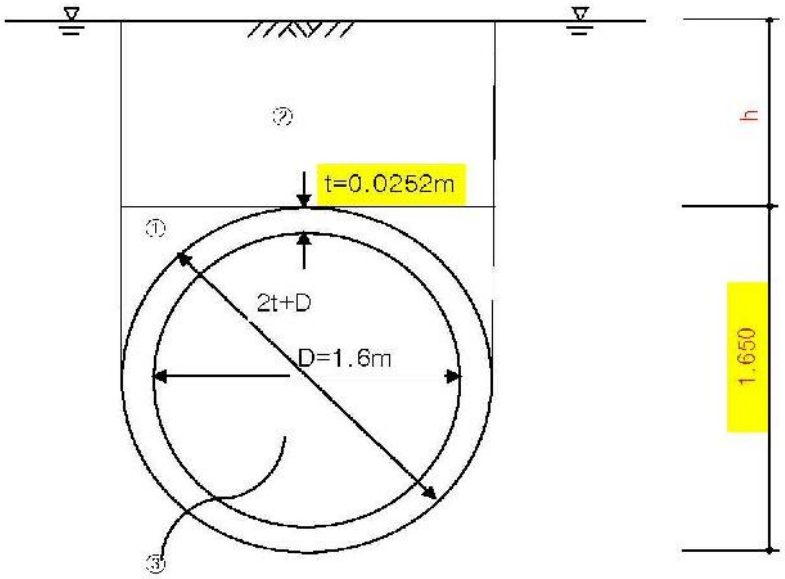
H.2 Calculation sheets

1.1 buoyancy stability review(D1600mm)

1) unit weight of soils (unit:kN/m³)

item(soils)	unit weight	item	unit weight
dampness	17.50	water	10.00
saturation	19.00		

2) overview diagram



3) vertical load

(1) weight of pipe = 8.640 kN/m

(2) the Surface load of pipe

① (0.825 ² − 1/8 x π x 1.650 ²)

x 2 EA x 19.000 = 5.553 kN/m

② 1.650 x - x 19.000 = 31.358 h kN/m

Σ 5.553 + 31.358 x h kN/m

∴ vertical load = 14.193 + 31.358 x - kN/m

4) buoyancy stability review

① (0.825 ^{2} − 1/16 x π x 1.650 ^{2})
x 2 EA x 10.300 − 2.923 kN/m

② 1.650 x [illegible] x 10.000 − 16.504 kN/m

③ 1/4 x π x 1.650 ^{2} x 10.300 − 21.393 kN/m

Σ 24.316 + 16.504 x [illegible] kN/m

5) cover height for buoyancy stability

vertical load / buoyancy > 1.25

(14.193 + 21.358 x h) / (24.316 − 16.504 x h) > 1.25

∴ h > 1.510 m

6) buoyancy stability review result

safety factor	buoyancy (KN/m)	vertical load(KN/m)			review result(m)	application(m)
		계	weight of pipe	weigth of soil		
Fs=1.20	49.241	61.551	8.640	52.911	1.510	1.50

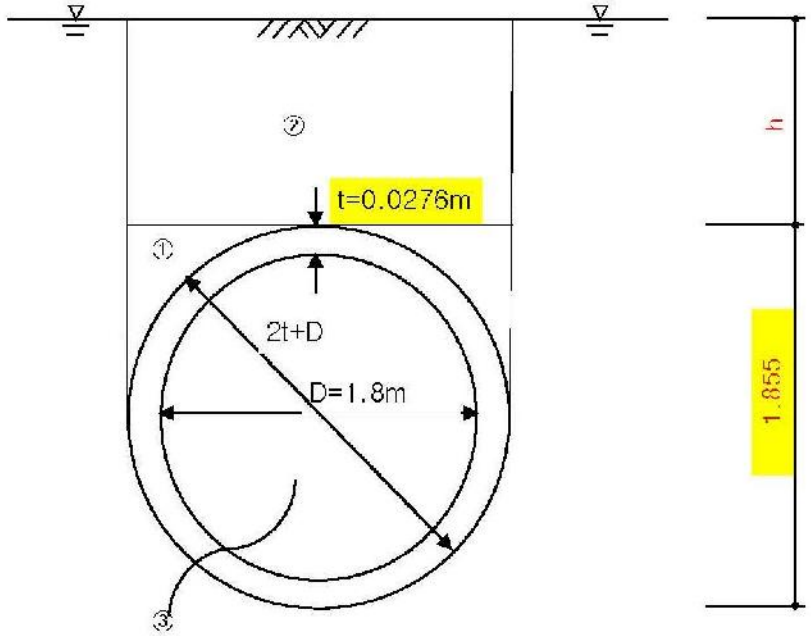
1.1 buoyancy stability review(D1800mm)

1) unit weight of soils

(unit:kN/㎥)

item(soils)	unit weight	item	unit weight
cohesness	17.50	water	10.00
saturation	19.00		

2) overview diagram



3) vertical load

(1) weight of pipe = 10.549 kN/m

(2) the Surface load of pipe

① (0.928 ² − 1/16 x π x 1.855 ²)

x 2 EA x 19.000 = 7.017 kN/m

② 1.855 x η x 19.000 = 35.249 η kN/m

Σ 7.017 + 35.249 x η kN/m

∴ vertical load = 17.566 + 35.249 x h kN/m

4) buoyancy stability review

①	(	0.928	^{2}	−	1/16	x	π	x	1.855	^{2}	)				−	3.693	kN/m
	x	2 LA	x	10.000													
②	1.855	x	h	x	10.000										=	18.552	x kN/m
③	1/4	x	π	x	1.855	^{2}	x	10.000							−	27.032	kN/m
												Σ	30.725	+	18.552	x	kN/m

5) cover height for buoyancy stability

vertical load / buoyancy > 1.25

(17.566 + 35.249 x h) / (30.725 + 18.552 x h) > 1.25

∴ h > 1.728 m

6) buoyancy stability review result

safety factor	buoyancy (KN/m)	vertical load(KN/m)			review result(m)	application(m)
		계	weight of pipe	weigth of soil		
Fs=1.20	62.786	78.483	10.549	67.934	1.728	1.80

Appendix I Preparation of the Engineer's Cost Estimates

Summary of Bill of Quantities (Sundarijal-Chabil Connection Chamber)
KUKL/BDS/05 (Ch-0+000-10+740)

Part No.	Work No.	Description of Works	Amount (NRs.)
A		**Preliminary, Provisional and General Work**	
	A1	Preliminary and General Work	97,715,914.85
	A21	Provisional Work	45,200,000.00
B		**Civil Works**	
	B1	Site Clearance, Earthwork, Sand Filling, Shoring and Other Earth Material Related Works	547,704,220.86
	B2	Brickwork	15,446,874.08
	B3	Concrete Related Work	72,064,740.84
	B4	Surface Finishing Work	2,892,421.75
	B5	Reinstatement and Pavement Work	88,599,927.90
	B6	Metal Related Work	1,360,568.50
	B7	Miscellaneous Works	136,642.90
C		**Pipe line, Pipe Fitting and Other Pipe Line Related Works**	
	C1	Pipe Supply, laying and jointing works	1,758,645,750.00
	C2	Supply and Installation of Pipe Fittings, Valves and Appurtenances	336,222,854.00
	C3	Hydrostatic Testing and Disinfection Work	11,671,042.00
D	D1	Dayworks	427,875.00
		Sub Total	**2,978,088,832.68**
		Price Contingencies @ 10%	297,808,883.27
		Physical Contingencies @10%	297,808,883.27
		Sub total	**3,573,706,599.22**
		VAT @ 13%	464,581,857.90
		Total estimated Cost (Grand Total)	**4,038,288,457.12**

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ABBREVIATIONS

ADB	Asian Development Bank
AV	Air Valve
BDS	Bulk Distribution System
BLS	Base line station
BM	Bulkmeter
BPC	Butwal Power Company
BS	British Standard
CAN	Contractor's Association of Nepal
CBP	Capacity Building Partnership
CIP	Carriage and Insurance Paid
DDU	Delivery Duty Unpaid
DIN	German Standard Organization (Deutsche Industry Norm)
FH	Fire Hydrant
FIDIC	Federation Internationale des Ingenieurs Conseils
ICB	International Competitive Bidding
ICM	Indian Corporation Mission
IDA	International Development Agency
ISO	International Standard Organization
IV	Isolation Valve
KUKL	Kathmandu Upatyaka Khanepani Limited
LCB	Local Competitive Bidding
MDD	Maximum dry density
MT	Metric ton
MWSP	Melamchi Water Supply Project

OMC	Optimum moisture content
PAF	Project affected families
PAP	Project affected people
PBM	Permanent bench marks
PID	Project Implementation Directorate
PRV	Pressure Reducing Valve
SPT	Standard penetration test
TBM	Temporary bench marks
TOR	Terms of References
UFW	Unaccounted- For-Water
UWSSRP	Urban Water Supply and Sewerage Rehabilitation Project
WSSA	Water Supply and Sanitation Area
WV	Washout Valve
VAT	Value added tax

SALIENT DESIGN FEATURES

Sl. No.	Particulars	
1	Country	Nepal
2	Capital City	Kathmandu
3	Name of the Project	Kathmandu Valley Water Supply Improvement Project (KVWSIP)
4	Source of Finance	ADB Loan 3255-NEP
5	Implementing Agency	KUKL, PID, Kathmandu assisted by DSMC
6	Executing Agency	Ministry of Water Supply
7	Operation & Maintenance	KUKL, Kathmandu
8	Scope	Providing Distribution Network Improvement to DNI area -7B (DNI Zones A, B, C, F, K)
9	Area Covered (Ha)	DNI area - 7B: 569.20 Ha
10	Municipal Wards Covered	13,14, 15 & 16
11	Population served (for DNI-7B)	Initial Design Year (2015): 96,934 Design Year Population (2025): 128,792 Intermediate Design Year (2030): 171,119 Ultimate Design Year (2045): 332,090
12	Service Reservoirs	DNI area–7B (DNI Zones - A,B,C,F & K) served by Balaju & Kirtipur
13	Number of House Service Connections (HSCs)-nos.	DNI area-7B (DNI zones - A,B,C,F & K): 25,782 Nos
14	Total Water Demand (lps)	DNI area-7B (DNI zones- A,B,C,F & K): 1110.901
15	Pipe Length (m)	DNI area-7B (DNI zones - A,B,C,F & K): 241462m HDD: 51332m
16	Isolation Valves (nos.)	DNI area-7B (DNI zones - A,B,C,F & K): 334
17	Bulk meters (nos.)	DNI area-7B (DNI zones - A,B,C,F & K): 20

Sl. No.	Particulars	
18	Fire Hydrant (nos.)	DNI area-7B (DNI zones - A,B,C,F & K): 136
19	Air Valve (nos.)	DNI area-7B (DNI zones - A,B,C,F & K): 73
20	Washout Valve (nos.)	DNI area-7B (DNI zones - A,B,C,F & K): 48
21	Minimum Node Pressure (m)	DNI area-7B (DNI zones - A,B,C,F & K): 10-50
22	Pressure Reducing Valve (nos.)	DNI area-7B (DNI zones - A,B,C,F & K): 18
23	Number of District Metered Area (DMA's)/service Areas	DNI area-7B (DNI zones - A,B,C,F & K: 18
23	**Pumping Arrangement (for DNI zones B, & A 1.10, elevated areas)**	
23.1	DNI zones covered by Pumping	Zones DNI 7B & (A 1.10) ***We were instructed by the KUKL not to design A1.10. However, we had made a provision of an outlet to area A-1.10 (by pumping arrangement) with a demand of 155lps.***
23.2	Number of Pumps	8 Nos.
23.3	Type of Pump	Centrifugal Horizontal Split type & Submersible
23.4	Standby Arrangement	5 (working) + 1 (standby) & 2 No of Submersible
23.5	Discharge Capacity of each Pump	30700 m^3/day
23.6	Pumping Head	42 m
23.7	Diameter and Length of Pumping Main	500mm dia
23.8	Pump Capacity	Each of 75 HP

Sl. No.	Particulars	
23.9	Service Reservoir	Balaju
23.10	Total Water Demand (lps)	DNI Zone A: 308.26 DNI Zone B: 249.953 DNI Zone C: 250.058 DNI Zone F : 141.69 DNI Zone K: 160.94
23.11	Number of District Metered Area (DMA's)/service areas	DNI 7B: 18 ***DNI Zone A 1.10: Not designed (as per KUKL instruction)***

1

Introduction

1.1 General Background

Nestled in the lap of Himalayas, Nepal is a small and beautiful country spreading over a geographical area of 147,181 sq. km. The population of Nepal is recorded 26.4 million (Census 2011). The urbanization rate is lower at 16% in comparison with its South Asian counter parts. The capital city Kathmandu is the largest urban centre and has been experiencing rapid urban growth in recent years. The last decade experienced a growth of 7% which is one of the highest in the urbanising world.

The Kathmandu valley is spread over an area of 900 sq. km, and comprises five municipalities and is home to about 30% of the country's urban population.

The rapid increase in population -affected both by natural growth and in- migration has increased the demand for infrastructure services, housing, and for other amenities in Kathmandu Valley. The infrastructure development, on the other hand, has not been up to the requirement. These are resulted in large gap in service delivery, especially in basic services like water supply, sewerage and power supply. Lack of operational wastewater system facilities converted the holy Bagmati River into a highly polluted river.

The project was developed using lessons from previous ADB interventions. An important lesson from earlier projects was to give importance to rehabilitation of networks along with creation of assets. Accordingly, the project will focus on reducing non-revenue water (NRW) and improving the existing network. To drive efficiencies and introduce best practices, the project will utilize the District Metering Areas (DMA) approach for distribution network improvement (DNI) and non-revenue water (NRW) reduction. With the completion of Melamchi tunnel, Kathmandu Valley will receive an additional 170 million litres per day (MLD) upon completion of stage one while the current average availability is only 100 MLD against a demand of 367 MLD for 2014-15. The project will adopt contracts with adequate provisions to monitor NRW reduction, introduce asset management plan, and develop geographical information system (GIS) to maximize benefits.

The expected impact of the project is sustainable water supply services for residents of Kathmandu Valley covered under the scope. The expected outcome is improved access, efficiency, and reliability of water supply services to the residents of Kathmandu Valley including poor women and men. The project will prioritize underserved areas and poor sections of the population in Kathmandu Valley. The project will further enhance capacities of the urban areas to attract investments, increase productivity and create enabling environment for higher economic

growth. Piped water through individual household connection will relieve women of the drudgery of managing water, thereby giving them more time for social and economically productive activities.

1.2 Current Project Objective and Scope –DSC-03 Objective of the Assignment

The objective of the proposed consultancy services for Design, Management and Supervision Consultants is to:

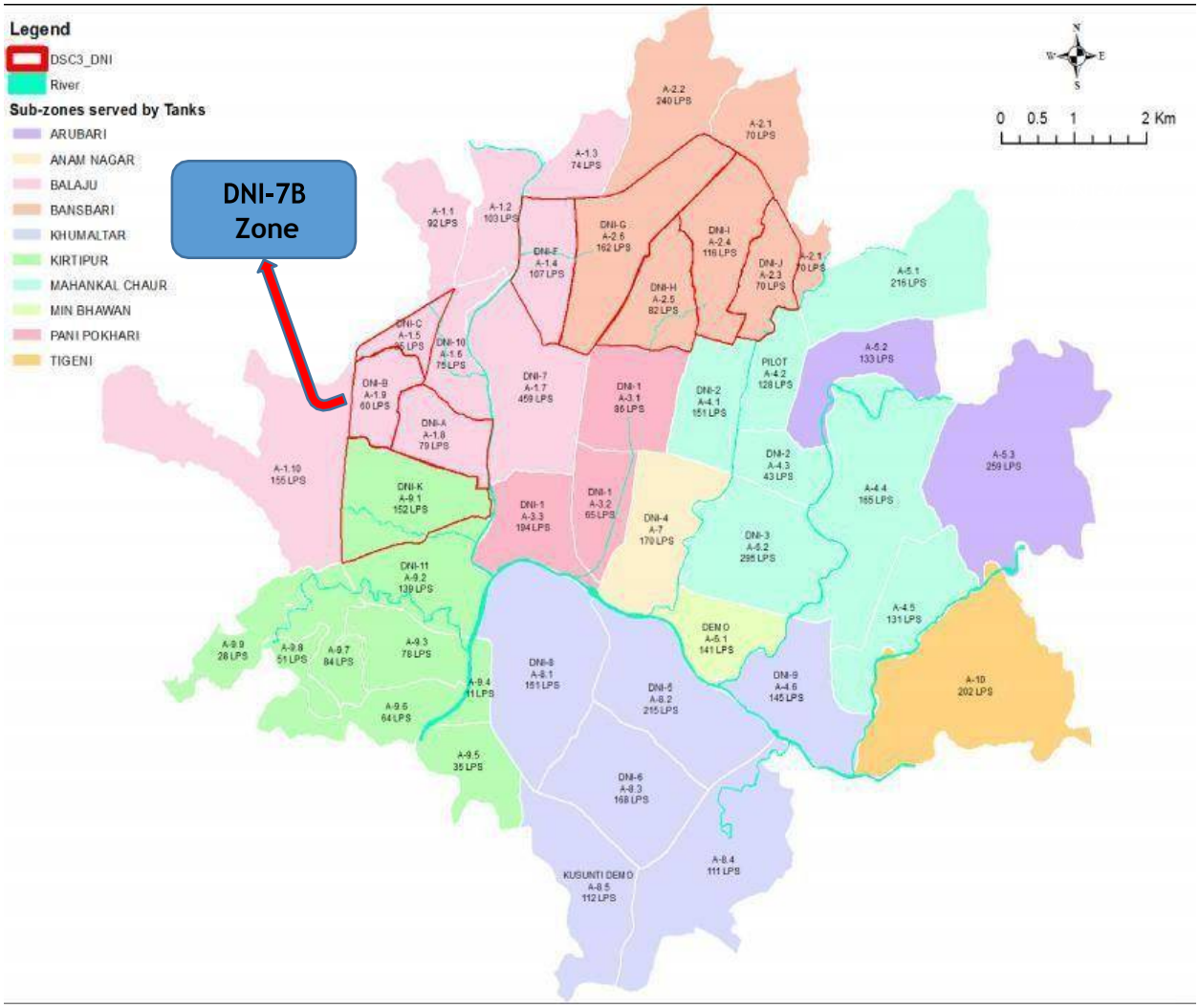
- Carry out detailed design of distribution network improvement of remaining areas of Kathmandu Metro (7B) Area and Kathmandu North-East Region.

Scope of services

- Review of preliminary design and preparation of base maps, manuals, guidelines and commissioning plans.
- Surveys, studies and investigations.
- Detailed Engineering Design and Bid Document preparation.
- Social, Environmental, Archaeological, Occupational health & safety, Community participation and Gender issues during the detailed design phase.

This report presents the detail design of distribution network improvement of new **7B DNI areas**; where **DNI-7B Area** comprises of four **DNI Zones** namely DNI-A (A1.8), DNI-B (A1.9), DNI–C (A1.5), DNI-K (A9.1) & DNI–F (A1.4).

Figure 1.1: Demarcation of 7B Areas (Comprising of DNI Zones-A, B, C, F, & K) boundary



1.3 Scope of –DSC-05

The design was fully undertaken by DSC03 but has been reviewed and updated by DSC05. DSC05 could only review within the information submitted by DSC03 and have improved the design with minimum changes.

For secondary mains, HDD method will be applied as per client's request in the possible areas. Detailed design shall be undertaken by the consultant for Primary mains, Secondary mains and Pumping Related facilities.

This report is based on DSC03 report and revised by DSC05 for several items.

1.4 Institutional Arrangement

Following are the key agencies involved in the project implementation.

(i) **Executing Agency**: The Ministry of Urban Development (MoUD) is the executing agency responsible for overall strategic planning, guidance and management of the project and for ensuring compliance with loan covenants.

(ii) **Implementing Agency:** KUKL, the asset operator and service provider, through its existing Project Implementation Directorate (PID), is the implementing agency responsible for (i) project planning, implementation, monitoring and supervision, (ii) reporting to KUKL Board of Directors, MoUD and ADB, and (iii) coordination of all activities in the project. PID is staffed with sufficient number of experienced professionals headed by Project Director, who is a Joint Secretary level GON officer. PID is supported by the following consultants:

(iii) **Project Steering Committee (PSC):** Chaired by the Secretary, MoUD, has been established to provide policy guidance, accomplish reform measures, oversee project implementation and ensure cooperation of all agencies involved in the project.

(iv) **Design, Supervision and Management Consultant (DSC-3)**: To support PID in project management, engineering design, construction supervision, procurement of goods and services, institutional development and capacity building.

(v) **Community Awareness and Participation Consultant (CAPC)**: Towards assisting in community awareness and participation within project area.

Continuation to signing of loan by Government of Nepal with Asian Development Bank, through a competitive bidding process CDM Smith Inc. in association with TAEC Consult P. Ltd. and Integrated Consultants Pvt. Ltd. (ICON) is appointed as Design, Supervision and Management Consultant (DSC)

3) For this Loan No. 2776 (NEP) SF project.

Structure of the Report

Section 1: Introduction: Project background with objectives and scope of study

Section 2: Existing Water Supply Scenario in Kathmandu

Section 3: Population projection and Water demand

Section 4: Topographical survey

Section 5: Design Standards and Approach

Section 6: Proposed Distribution Network Improvement

Section 7: Project cost

Section 8: Operation and Maintenance Plan

Section 9: Institutional strengthening and Training

Section 10: Procurement Strategy

2

Existing Water Supply Scenario -Kathmandu

Water is Nepal's largest available natural resources with over 6,000 rivers having a combined length of 45,000 km. Still the access to water supply is limited. The water supply system in Kathmandu Valley is dependent partly on ground water and partly on surface water sources. In all, at present water is drawn from 31 surface sources and 75 deep tube wells (54 operational) located in different parts of the valley. The total water production from these sources put together is about 100 MLD (dry season) to 150 MLD (monsoon). These sources supply water to 21 Water Treatment Plants (WTPs) with a total treatment capacity of 85 MLD. The treated water is fed into 44 service reservoirs, from where water is supplied through 1,240km of distribution lines, over 165,000 consumer connections and 1,200 public stand posts to about 2 million consumers.

The water supply system suffers both from partial coverage (only 70% of the total 2.8 million population covered) and inadequate supply (100 to 150 MLD production as against an estimated demand of 190 MLD at consumer end). Added to this is the old water supply system with aging old and profusely leaking pipes resulting in high water losses (estimated at 45%). Besides, there are numerous illegal and unauthorized multiple connection, resulting in a large portion of unaccounted for water (UFW).

Under the water shortage conditions, KUKL (the agency responsible for water supply in Kathmandu Valley) has applied a rationing system whereby water is allowed to flow to different sections of the metropolitan/urban area in rotation. The control system developed by KUKL is complex to implement as it requires KUKL staff to operate with over 1000 valves for distribution. The result is an inequitable distribution of water, particularly as the areas close to the water sources are very difficult to isolate. While some parts of the city have an abundance of water and enjoy 24-hour supply, a large share of the population only receives water for a few hours every 2-5days and even then, the pressure is low and the quality is poor. As most areas receive intermittent supply with low pressure, use of pumps to suck water and bypassing of water meters are believed to be quite common techniques used by the consumers. People in many areas often receive one-hour supply in every fourth day only.

The outdated system with old design, ad-hoc development on need basis and old and damaged pipes has given rise to contamination of treated water. Water quality at the consumers end is far less than desired and it is a common practice to treat or boil water for potable use. While the basic cost of piped water in Kathmandu may be cheap, the other direct and indirect costs associated with its use seem very high. The mushrooming of firms supplying the household level water purification systems in Kathmandu is an indication of growing water quality concerns among the general public – a recentsurvey report states that there are about 64 water vendors in Kathmandu.

Besides, there is sprawling private water supply market supplying treated water at a rate of Rs. 5-10 per 20 liters to the consumers. Around 60% of the households in Kathmandu either boil water or use some form of water purification devices to attain quality water for drinking use. Also, an estimated 20% of the households depend on packaged water supply. On an average, the current "water cost" is around Rs.350-500 per month per household. Besides the exorbitant costs associated with these alternative strategies, there is no assurance of quality.

The typical/specific problems exhibited in entire Kathmandu distribution network and as well in the 7B areas are as follows:

- Little equity in water supply; some properties get very good supply with good pressure for 6-7 hours, while others get only 1 to 2 hours supply every fourth or fifth day with very poor pressure;
- Very high-water leakage and losses in the area.
- No control mechanism for isolating the service area for maintenance;
- Multiple house connections to a trunk water supply main;
- Old and undersized water distribution mains;
- No operational fire hydrants;
- Long, multiple house connection pipe work;
- Areas of poor water supply service;
- Many non-operational consumer meters.

Many of such households also have secondary water sources like hand pumps, dug well or other such facilities to supplement their daily requirements. In addition, same households also supplement their drinking water requirements through the use of private tankers and bottled water.

3

Population Projection & Water Demand

3.1 General

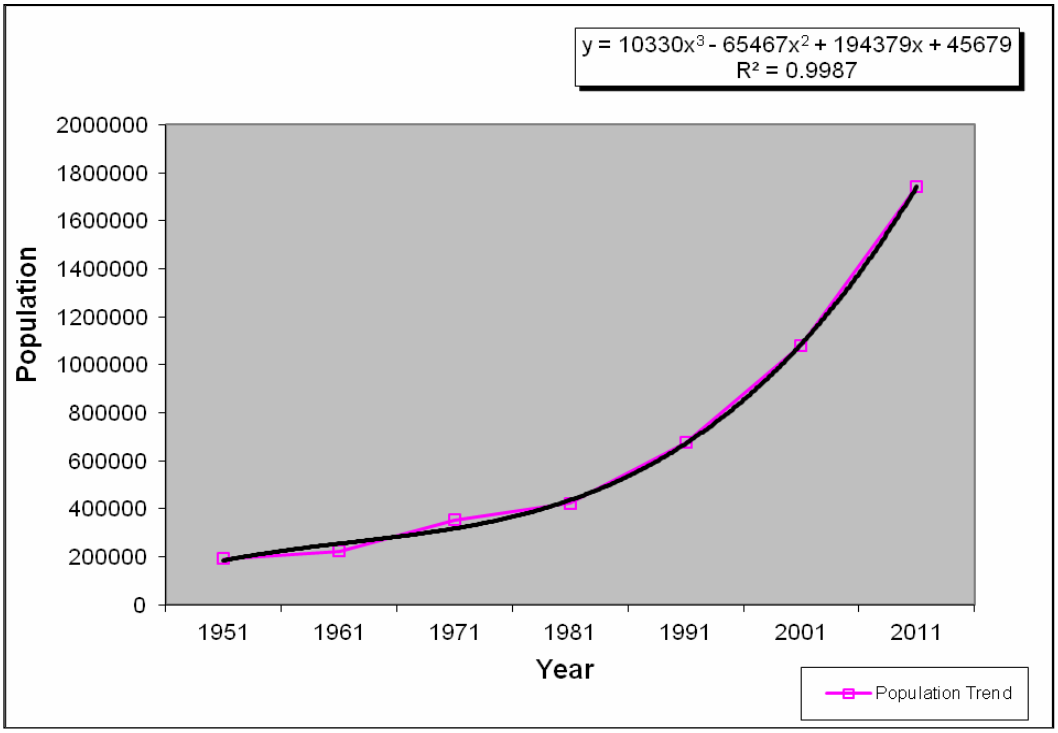
A critical factor in the design of a water supply system is the estimation of water demand which again directly depends on the ultimate population. Design population projection finds its base upon the historic census population, the present population and its expected rate of growth. Demographic methods for projecting population include numerical methods like Arithmetic increase, Incremental increase, Geometric increase, Exponential, Polynomial logarithmic and Power series. The best fitting among these is generally used in projecting population for water supply schemes.

For projecting population for Kathmandu Metro Zone historic population figures from years 1951 to 2011 were collected from the country's census website for the various urban and village bodies comprising the zone and was analysed using the above methods. On doing a regression analysis, ***a third order polynomial appeared to be representing the historic data best and the same is adopted for projecting to future.***

Another critical factor is the design period adopted. Generally, the civil components such as source and pipe networks are designed considering the demand for a period of 30 years, water treatment plants for 15 or 30 years (based on the difference in capacities and its economics), storage and electromechanical components for 15 years. ***Accordingly, 2015 is proposed as Base Design Year, 2030 as Intermediate Design Year and 2045 as Ultimate Design Year.***

*Figure 3.1***,** shows the population growth over last seven decades on the best fitting curve; that is a third order polynomial.

Figure 3.1: Polynomial Third Order Curve of Historic Population Growth



Adopting above regression model based on third order polynomial, the population projection pertaining to **Kathmandu Metro Water Supply Zone (Zone A)** is projected in **Table 3.1** for the desired years in the tables below for Base Year, Intermediate and Ultimate Year respectively.

Table 3.1: Design Population for Base, Intermediate and Ultimate Years (Kathmandu Metro Water Supply Zone)

Year	Permanent Population	Temporary Population	Total Design Population
2015 – Base Year	16,77,258	5,03,179	21,80,437
2030-Intermediate Year	29,40,836	8,82,250	38,23,086
2045 – Ultimate Year	50,48,782	15,14,636	65,63,418

Accordingly, based on trend line method the population projection was made for the **DNI Zones covered under 7B DNI areas** are furnished in the below **Table 3.2**

Table 3.2: Design Population for Base, Intermediate and Ultimate Years (DNI 7B & 7C areas)

DNI Zones	Area	Projected Population		
	(Ha)	Base Year - 2015	Intermediate Year - 2030	Ultimate Design Year -2045
DNI-A (A-1.8)	109.61	23498	39446	61430
DNI-B (A-1.9)	85.15	17776	29839	46470
DNI-C (A-1.5)	50.01	10439	17524	27291
DNI-F (A-1.4)	122.55	31739	53281	82975
DNI-K (A-9.1)	201.88	45211	75895	118193
TOTAL				

The details of Area, Ward no. and Zones, HSCs covered by 7B & 7C DNIareas are furnished in the below **Table 3.3**

Table 3.3 Details of Area, ward no. and HSCs covered by 7B & 7C DNI Areas

DNI area	DNI Zones	Area covered (Ha)	Municipal Ward no. covered	Population served- 2015	House Service Connections (HSCs) - (Nos.)
7B	DNI-A (A1.8)	109.61	15	31,739	6,348
	DNI-B (A1.9)	85.15	15	10,439	2,088
	DNI-C (A1.5)	50.01	15	23,498	4,700
	DNI-F (A1.4)	122.55	16	17,776	3,555
	DNI-K (A9.1)	201.88	13	45,211	9,042
Total					

3.2 Estimation of Water Demand

It is considered that the Project area will be serviced from the Melamchi Project with a target of 510 MLD. The planning horizon and design is based on this available water resource and the ultimate population projection. Also the available water resource of 510 MLD corresponds to the population projection slightly beyond 2030 following review and updating of the various projections with total population serviced in the project area of about 3.8 million.

Therefore, DSC 3 Team suggests adopting a flat rate of supply at 135 lpcd (1) for permanent population and 40 lpcd for the temporary (floating) population **including 15% UFW (Un-accounted for water) and Fire Demand**.

3.3 Fire Fighting Demand (*)

It is usual to provide for firefighting demand as a coincident draft on the distribution system along with the normal supply to the consumers as assumed. A provision in Kiloliters per day based on the formula $100\sqrt{P}$ where p = population in thousands may be adopted for communities larger than 50,000. It is desirable that one third of the firefighting requirements form part of the service storage.

Below **Table 3.4** indicates Fire demand calculations in each of the DNI Sub- Zones.

Table 3.4 Fire Fighting Demand

DNI's	Projected Population Design Year -2030	Fire Demand = 100*√p	
		KLD	MLD
DNI-A	39446	19861.02	0.020
DNI-B	29839	17273.97	0.017
DNI-C	17524	13237.82	0.013
DNI-K	75895	27549.05	0.028
DNI-F	53281	23082.68	0.023

Below **Table 3.5** indicates population projections and water demand calculations in each of the DNI Sub-Zones.

Table 3.5 Population Projection and Water Demand

DNI Zones	Area	Population			Demand (MLD) (@135 lpcd + 40 lpcd + 15% UFW)			Water Demand Design for 510 MLD (2)		Served by Reservoir
	(Ha)	2015	2030	2045	2015	2030	2045	MLD	LPS	
7B-DNI area										
DNI-A (A-1.8)	109.61	23498	39446	61430	3.93	6.59	10.26	6.84	79.18	BALAJU
DNI-B (A-1.9)	85.15	17776	29839	46470	2.97	4.98	7.76	5.17	59.89	BALAJU
DNI-C (A-1.5)	50.01	10439	17524	27291	1.74	2.93	4.56	3.04	35.17	BALAJU
DNI-F (A-1.4)	122.55	31739	53281	82975	5.30	8.90	13.86	9.24	106.94	BALAJU
DNI-K (A-9.1)	201.88	45211	75895	118193	7.55	12.68	19.75	13.16	152.33	KIRTIPUR
TOTAL	**1234.58**	**256459**	**430520**	**670456**	**42.83**	**71.91**	**112.00**	**74.66**	**864.13**	

(1) **Note:** The Figure include requirement of water for commercial, institutional and minor industries. ***Source: Manual on Water Supply and Treatment-Central Public Health and Environmental Engineering Organization (CPHEEO), Ministry of Urban development, New Delhi, India.***

(2) **Note:** *We calculated the demands for design years 2015, 2030 and 2045 and as the projected total demand of 510 MLD is between the design years 2030 and 2045, we had interpolated the demand for each DNI sub-zone for 510 MLD.*

(*) *Source: Manual on Water Supply and Treatment-Central Public Health and Environmental Engineering Organization (CPHEEO), Ministry of Urban development, New Delhi, India.*

4

Topographical Survey

4.1 Topographic Survey for Distribution Lines:

Detailed topographical survey work was conducted for new 7B & 7C DNI Zones. The survey using Electronic Total Station covered extraction of features which included boundaries, topographical and contours. Later the agency re- produced the survey drawings in required format for further design by DSC 3.

As part of above survey along the major roads, control points were established. Survey work commenced by establishing bench mark as available by geodetic survey branch under Government of Nepal. The survey data stored in total station was later transferred for further processing using AutoCAD.

The survey was to be undertaken with within a tolerance of ±5cm or size of the Boundary Marker whichever is coarser.

Note:

Currently the topographical survey has been carried out only on main roads (only 30%). The levels of intermediate roads have been obtained by interpolating with the levels surveyed on main roads.

After awarding the contract, the Contractor should carry out 100% topographical survey to verify the correctness of the levels adopted in the design and the refinement of the hydraulic model is necessary. The Contractor should also carry out the soil investigation wherever necessary and should submit a report.

5

Design Standards and Approach

5.1 General

Primary design parameters are established for commencing the engineer designs. These parameters are largely based on the guidelines specified in Central Public Health and Environmental Engineering Organization (CPHEEO)
– Manual on Water Supply and Treatment, Government of India, choice of technology and service level and as well have been discussed with PID, KUKL and finalized. For the present and future purposes, the following basic design parameters are discussed in the following sections.

5.2 Design Period

Distribution network has been designed to meet demand for the year 2030.

5.3 Population

Projection of population for thirty-year period (2015-2045) has been considered as explained in the previous chapter.

5.4 Per-Capita Demand

A per-capita demand of 135 lpcd for permanent population and 40 lpcd for temporary (floating) population including UFW at 15% and Fire Demand.

5.5 Peak Factor

A peak demand factor of 1.5 has been adopted in the design.

5.6 Residual Head

Hydraulic analysis and sizing of pipes has been performed to ensure a residual pressure of minimum 1 bar (10m) and 5 bar (50m). (This has been updated from DSC05 since HDPE pipe class has been increased to PN10)

5.7 Velocity

As far as possible it was attempted to restrict the flow velocities in distribution pipelines between 0.5m/s and 2.0m/s.

5.8 Allowable Head loss

Head loss of 10m/km has been limited in the distribution network.

5.9 Loss coefficient: Hazen William "C" values

The 'C' value of 110 for DI and 130 for HDPE pipes have been adopted in the design.

5.10 Nodal Demand

Proportional nodal demand distribution (by area) using "Thiessen" Polygon has been adopted in the design.

5.11 District Metered Area (DMA)

In practice, there will always be a significant variation in size of DMA due to the layout of the existing infrastructure and the need to optimize pressure management. DMAs are often sized by the number of properties, where typically a property is supplied by a single customer connection.

Henceforth, DNI's is divided into District Metered Area (DMA) with an average households ranging from 500 to 3,000 for each DMA. In our Design average of 1,500 Households have been considered. **(Or)** shall be based on topography of the service area. ***Ref: International Water Association (IWA) Guidelines, February2007, Version 1.***

5.12 Design and Size of Mains

Pipe DN400 mm Ø and larger have been designated as Primary Mains and pipe smaller than DN400 mm Ø designated as Secondary and Tertiary Mains (based on flow).

5.13 Pipe material

Selection of pipe material has been performed considering the following parameters:

- Hazen-Williams Coefficient
- Ability to withstand Internal / External pressure
- Ease in handling and lowering of pipes
- Corrosion Resistance
- Pipe jointing materials
- Trouble-free maintenance & operation should be ensured
- Availability of specials and fittings

However, finally the selection of pipe materials were discussed with the Client PID, KUKL and agreed as follows:

- HDPE pipe with electro-fusion fittings will be used for distribution lines smaller than DN 150mm, and for service connections.
- DI pipe will be used for mains DN 150mm and larger than DN 150mm.
- HDPE Pipe size increments, as per availability of materials in the market.
  Eg: HDPE pipe of DN75, DN90, DN 110, per IS 4984 as secondary and tertiary mains, and DI pipe as per ISO 2531 as primary mains.
- HDD method will be applied to secondary mains of size between 150mm to 300mm in possible areas. If applying HDD, HDPE can be used for secondary mains up to 300mm. (updated by DSC05)

5.14 Piping layout

- Minimize dead ends by looping of all mains.
- Dual mains are being provided in all roads greater than 7-meter width, and as needed to hydraulically isolate each sub-DMA.
- DSC-03 staff visited several locations in the field to assess the practicality of placing dual mains between every sub-DMA, which will allow complete hydraulic separation of each sub-DMA and also allow for permanent meter installations at the inlet(s) to each sub-DMA.
- Many of the streets between sub-DMAs are quite narrow and also contain sewers which zigzag from one side of the street to another. For these reasons, it will usually not be possible to place dual water mains in such streets while maintaining an adequate separation distance from these sewers. Therefore, when unavoidable (the majority of such cases are unavoidable), we will design such dual mains to be placed in a common trench with an appropriate nominal amount of separation (e.g., 300 mm clear separation). Such dual mains will provide the desired hydraulic isolation of sub-DMAs, but will still necessitate extending service laterals across the street (which would have been avoided had it been possible to place one main on either side of the street).
- Where dead - end main occurs, it shall be provided washout for flushing purposes.
- Flushing device shall not be directly connected to the sewer – Where dead-end mains occur, they shall be provided with a fire hydrant if flow and pressure are sufficient or with an approved flushing hydrant

  or blow-off for flushing purposes. It is recommended that all water quality problem areas in the distribution systems be flushed at least twice each year. No flushing device shall be directly connected to any sewer.

5.15 Testing & Commissioning

The pipelines shall be tested and commissioned using the procedure and methodology as per relevant IS/ISO standards & latest amendments.

5.16 Valves & Appurtenances:

Isolation valve locations shall be based on the following considerations:

- Limiting the number of customers (100 to 150) that will be out of service. Limiting the number (3 to 5) of fire hydrants out of service
- Limiting the time, (2 hours) takes to drain a pipe segment
- Limiting the number of customers (100 to 150) impacted by future system modifications
- Limiting future construction within major streets or intersections
- Avoiding excessive number of valves thus reducing initial cost
- Shall be located at major or critical street intersections
- Line valves at primary mains shall be spaced not more than 1km (or) shall be based on site condition

Air valve locations:

- At the highest point in respective distribution network
- In special locations (such as near district meters)
- Limited to primary mains except in exceptional cases

Fire Hydrant Locations:

- Shall be located at major or critical intersections
- Maximum coverage approximately 5 Hectares per hydrant
- Maximum spacing approximately 250 meters
- Minimum tapping size shall be at 200mm Ø for commercial FH and 150mm Ø for residential FH.

Electromagnetic Flow Meters

It is proposed to install electromagnetic bulk flow meters, each at every inlet pipe of respective service reservoirs.

Bulk Meters – It is proposed to install at every inlet to each DMA's.

Scour Valves/Wash out Valves

Scour valves are located at selected low-points and at appropriate locations to facilitate water and silt removal from the system in cleaning and maintenance operations.

Thrust & Anchor Blocks

Thrust block prevents pipe movement when a pressure system is activated and pressurized. Thrust blocking is required at all points of change of direction in the pipe line. Most blocking is done where a fitting, valve, or hydrant is installed. There may be times when side blocking is necessary because of curvature occurring without the use of fittings. Usually good compacted backfill will provide the necessary anchor for side thrust. Concrete blocking is the most commonly recommended method of blocking. Concrete is placed directly on the fitting against the line of thrust. The concrete must also pour against undisturbed earth. The size of the blocking will vary with the size of pipe, working pressure exerted, type of fitting, degree of flow direction change, and the soil conditions.

Anchor Blocks are provided wherever the pipe is being laid where the nature of ground is steep in nature and wherever the pipeline crosses the rivers/valley in order to hold the pipe and to avoid the dislocation of pipe from the alignment.

5.17 Joint Restraint

A properly designed, restrained pipeline uses the bearing strength and frictional resistance of the soil to turn the pipeline into a thrust block. The same basic parameters required to determine the size of a thrust block are used to determine the amount of pipe that must be restrained to resist thrust forces underground. These parameters are pipe size, pipe type, test pressure, fitting type, trench type, depth of bury, soil type, and safety factor.

Using joint restraints opens possibilities that are not available with thrust blocks. When construction is required in congested underground areas it is next to impossible to pour thrust blocks without interfering with other utilities. Also, the use of thrust blocks in congested areas poses a problem when construction or maintenance of a different utility occurs in close proximity to the thrust block. Because the bearing area of a restrained pipeline is not concentrated in a small area, excavations in close proximity do not pose the danger that could be experienced with thrust blocks.

5.18 Thrust Restraint for DNI Works

In flexible non-restrained jointed pipelines (e.g. Tyton type joints or similar), forces at bends, tees, tapers, closed valves, dead ends etc. will generally be absorbed by thrust blocks. Concrete thrust blocks take the forces from the pipeline and transmit them to the soil adjacent to the pipe trench. Thrust blocks shall be constructed of cast-in-place concrete. The bearing faces of the thrust blocks will be placed against undisturbed natural soil. Thrust forces and siting of anchor blocks will conform with the field test pressure of the pipeline. Dimensioning of the thrust blocks must be dependent on the bearing capacity of the prevailing soil.

5.19 Pressure Reducing Valve (PRV) Chambers

PRV chambers have been provided for the distribution network of all DNIs. They are necessary in order to maintain a constant delivery of acceptable service pressure which should not be more than the required max head of 4 bars - regardless of varying high inlet pressure.

5.20 Bulk Meters and Other Valve Chambers

Supply of water to the DNI areas will be from primary mains fed from the respective reservoirs. In order to enhance water auditing, bulk meter chambers will be provided. These chambers comprise of control valves (Sluice Valve) and other necessary appurtenances to control water from the transmission main and isolating distribution blocks from maintenance purposes. Each bulk meter will be well equipped with flow sensor & data loggers to record flow rate for analysis and record keeping. Similarly, other valve chambers have been provided to isolate parts of the distribution system for maintenance or in case of damage.

5.21 Pressure Test Point Chambers

Pressure test point chambers have been provided for each DMA at maximum and minimum pressure level.

5.22 Air Valve Chambers

Air valve chambers with drain pipes and sluice valves have been provided along the primary and secondary main alignments. The air valves are double orifice (with ball/gate valve isolation).

5.23 Water Revenue Meters

Dry dial volumetric rotary piston type water revenue meter for all house connections are proposed. These household water meters have 15mm, 20mm and 25mm Nominal Diameter and have been recommended for useelsewhere in Kathmandu.

5.24 House Service Connections

All house service connections shall be of non-metallic pipe in order to reduce leakage at the service connection points.

5.25 Chambers

All chambers are M 20 Grade RCC Chamber. All the chambers have been designed for heavy traffic load (heaviest axle load of 8 ton) and limiting cracking width philosophy assuming other design parameter such as depth of pipe, location of ground water table, soil characteristic, etc.

5.26 River Crossings

River crossings may be made by:

- Constructing a separate pipe bridge
- Attaching the pipe to an existing bridge
- Installing the pipe on the footpath of an existing bridge
- Laying the pipe in the bed of the river in a siphon.

A pipe bridge would be vulnerable to accidents or other attacks. The structure must be above maximum flood level. Additionally, a pipe bridge would require an earthquake resisting design, which would be very expensive taking into account the high ground accelerations to be expected in the Kathmandu Valley. Pipelines, connected to existing road bridges, are only permitted if these are connected laterally to its structure. This is of course a difficult solution since appropriate supporting structures have to be designed and incorporated to the existing bridge construction. The pipeline must not overload the structure and expansion joints would be required to accommodate movement of the bridge and pipeline.

Permanent installation on footpaths of the bridge is not allowed by the DOR. The rivers to be crossed by the BDS have a low water level and flow at the end of the dry season. This will allow the pipes to be laid in the riverbed by diverting the river water. Hence normal pipe laying practice would suffice to achieve a technically and economical sound river crossing construction.

For river crossings therefore we recommend a siphon design rather than a pipe bridge design due to safety and cost reasons. The pipeline itself will be surrounded by reinforced concrete.

5.27 Road Works

All road works, road crossings and other works belonging to roads are subject to the approval of the Department of Roads and relevant municipal entities. For the approval of all road works, submittal of layouts and details and descriptions of the works to be executed are required by these entities in advance of the works.

Roads generally have to be crossed perpendicular to the road axis; however, in some cases the pipeline will run along the road. It is assumed the pipes will be installed in an open trench with the temporary diversion of vehicular traffic. The precise details of the temporary diversion and traffic control will be the responsibility of the contractor.

The pipe trench backfill will continue up to the underside of the sub-base of the road surface. The installation of the road sub-structure and final completion of the road surface then will be done by the contractor.

5.28 Pump House & Reservoir Tank

Most of the areas of DNI Sub-zones B, C & A 1.10 are located at high elevation areas due to which they are not able to get water by gravity from Balaju reservoir. Hence, pump house with 3 centrifugal pump sets 2 (W) +1 (S) will be constructed nearby Muslim Graveyard located in DNI C to pump water from Graveyard to the reservoir tank; located near Swayambhu Stupa. Each pump has been designed with the discharge capacity of 190lps. The proposed RCC sump (circular shape) of 400 m^3 capacity near Muslim Graveyard and RCC reservoir (circular shape) of 200 m^3 capacity and at Swayambhu stupa.

5.29 Guard House

Guard House shall be constructed for the reservoir tank area along with the construction of inspection chamber of toilet, septic tank and soak pit.

5.30 Surface Drain

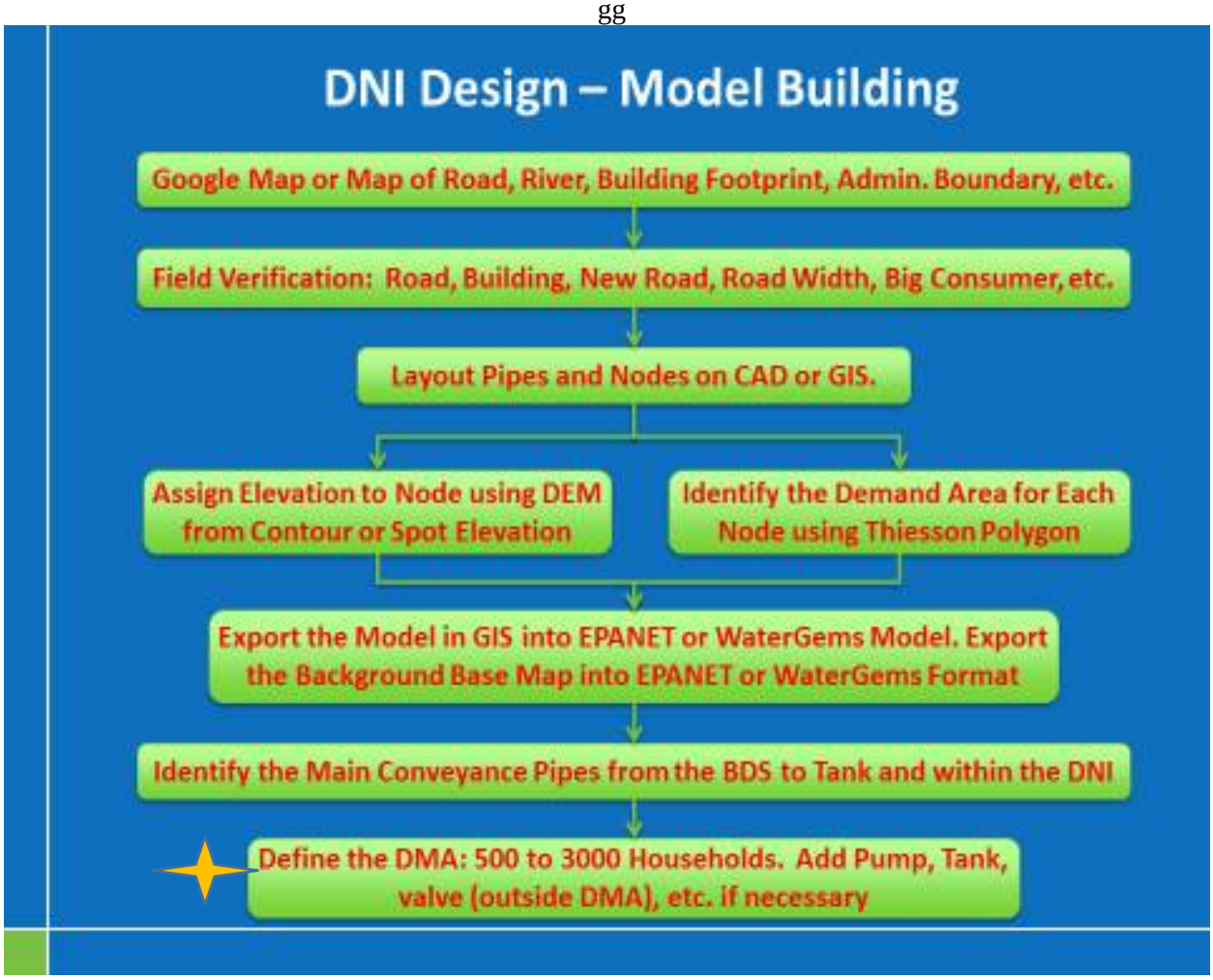
Tick type concrete surface drain will be constructed both sides for the roads having width more than 7 m while for the roads having width from 4 to 7 m drain will be constructed only single side. However, there is no provision of such type of drain for roads with width less than 4 m. Similarly, brick masonry wall shall be constructed at the back of tick drain.

Catch pit shall also be constructed for every 100 m of the drain in a staggered manner.

5.31 Design Approach

Fig 5.1 DNI Design – Model Building

gg



Source: International Water Association (IWA), Guidance notes. However based on the geography considered 1500 Households (average) for defining DMA's.

Fig 5.2 DNI Design – Model Optimization

Fig 5.3 Demonstration of DNI's Model Development

Fig 5.4 Base Map

Fig 5.5 Pipes & Nodes

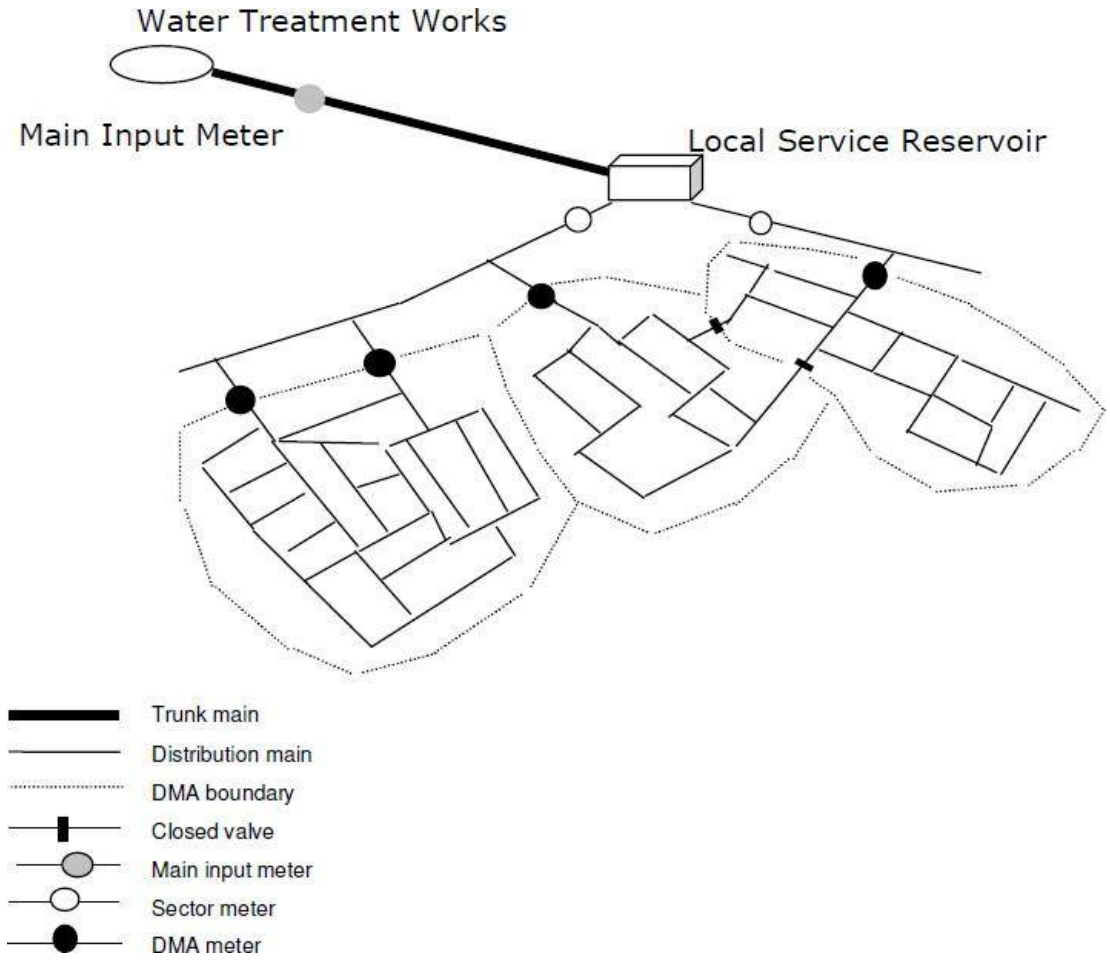
Fig 5.6 Thiesson Polygon to Allocate Demand

Fig 5.7 DEM – Data Elevation Model – All Zones

Fig 5.8 Typical DEM – Data Elevation Model – A-1.8 (DNI-A)

Fig 5.9 EPANET Model of Zone A-1.8 (DNI-A)

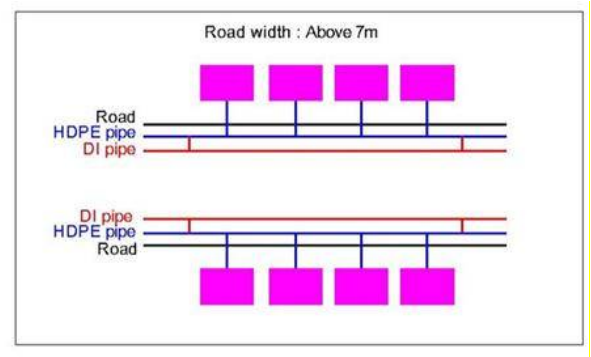
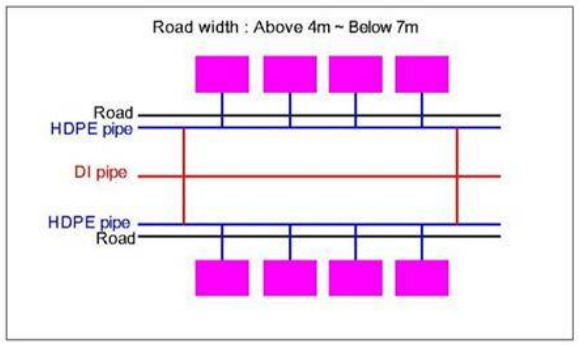
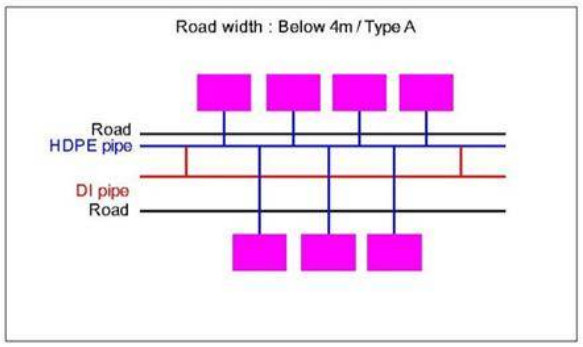
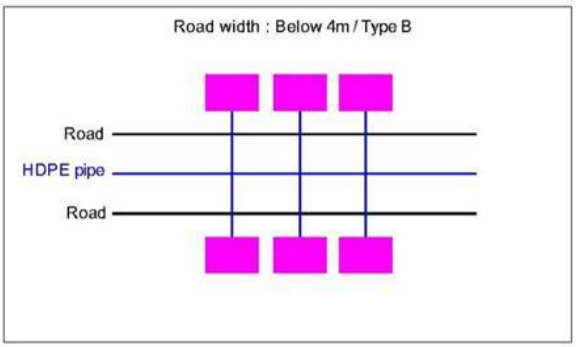
5.32 Design of District Meter Area (DMA)



- DMA Design
    - Supply via single main (preferable) or multiple feeds
    - Isolate area with adjacent DMA's (i.e., no flow into adjacent DMAs).
    - Cascade into an adjacent DMA (to be avoided if at all possible)
    - Minimum variation in ground level across the DMA
    - 500-1500 households.
- Monitor/locate/Control leakage
- Manage pressure
- Minimize utilities inside DMA

- Pump
- Water Tank
- Isolated valves, PRVs

5.33 Reticulation Pipes

	Two DI pipes are purposed in roads with 7m width or above since most DMA zones are divided by large roads. We have minimized two DI pipes lying where DMA zones are not overlapping, but it's based on consideration of fire hydrants and other facilities.
	One DI pipe is purposed in roads with 4~7m width, but for unavoidable DMA zone overlapping, two DI pipes are purposed.
	For narrow roads below 4m width will have DI pipe only when it's necessary for stable pressure control.
	Where DI pipe is not necessary for pressure control, HDPE pipe is purposed as tertiary main for house connections.

To avoid many households, connect directly to the DI pipe, the HDPE reticulation pipes are used to layout parallel with the DI pipes.

The objectives of adding the HDPE 75mm, 90mm or 110mm reticulation pipes are:

- Reduce number of household connection to the DI pipe
- Convert the DI pipe into the transmission pipe
- The additional reticulation pipe will become the distribution pipe and easily for household connection.

The sizing of Isolation valve, Air Valve, Washout Valve & Fire Hydrants is specified in the below **Table: 5.1**

Table 5.1: Sizing of Valves

Sizing of Valves				
Pipe Dia (mm)	Isolation Valve	Air Valve	Washout Valve	Fire Hydrant
75	50	-	50	-
90	80	50.00	-	100
110	100	50.00	-	100
150	150	50.00	-	100
200	200	50.00	-	100
250	250	50.00	-	100
300	300	50.00	-	100
350	250	80.00	-	100
400	300	80.00	-	100
450	-	80.00	-	-
500	-	100.00	-	-
600	-	100.00	-	-
700	-	150.00	-	-
800	-	150.00	-	-
900	-	150.00	-	-
1000	-	200.00	-	-

6

Proposed Distribution Network Improvement

6.1 General

This report presents the detail design of distribution network of new **7B DNI area**. Where **DNI-7B area** comprises of five **DNI Zones** namely DNI- A(A1.8), DNI-B(A1.9), DNI–C(A1.5), DNI–F(A1.4) & DNI-K(A9.1).

The hydraulic design of water distribution network has been done in following stages.

- Demarcating the pressure zones or supply zones.
- Sizing of Distribution lines.

Hence, considering the topography of Kathmandu Metro Area and Kathmandu North-east Region, the zonal plan for DNI 7B & 7C is done based on contours and pressure points helping in operating the system with defined pressures and ease of regulated supply. The capacities of reservoirs to cater to intermediate requirement are ensured in all zones.

6.2 Proposed DNI Zones under 7B DNI area

6.2.1 DNI Zone - A (A 1.8), B (A 1.9), C (A 1.5) & DNI-F (A 1.4)

These DNI Zones mainly comprises of the western area (from Kanti Path to Ring Road) which includes the older settlements of KMC. It covers complete area of Ward Number 15 & 16. The area of this zone would be served by Balaju Reservoir ***(DNI -A & DNI-F by gravity and DNI- B & C by Pumping)***.

6.2.2 DNI Zone - K (A 9.1)

This DNI Zone mainly comprises of southern area of Chhauni and Tahachaal, Bafal, Himalayan Height and Kalimati. It covers complete area of Ward Number 13. The area of this zone would be served by gravity from Kirtipur Reservoir.

6.3 The Hydraulic Design of each DNI Zone have been described below:

6.3.1 Design of DNI Zone - A (A 1.8)

The DNI-A model has been designed and the model features are prepared accordingly. DNI-A has been designed using the inner diameter (66.8mm, 80.4mm and 98.6mm) for HDPE PE100-PN10 pipes and the diameters (150mm, 200mm, 300mm, 400mm, 800mm, 900mm & 1000mm) for DI pipes. After optimizing the pipe diameters for HDPE & DI pipes, all 419 demand nodes have pressure head between 20m and 40m. The demarcation of DNI-A Boundary shown in **Figure 6.1** and DNI-A Design Model at Peak Demand (7.00) is shown in **Figure 6.2**

The details of DNI-A/Pipe material & length/Bulk Meter, Isolation Valves, PRVs/PRVs with Set pressure/Location of Air Valve, Washout Valve & Fire hydrants are shown in the **Tables 6.1/6.2/6.3/6.4/6.5** respectively.

Figure 6.1: Demarcation of DNI-A Boundary

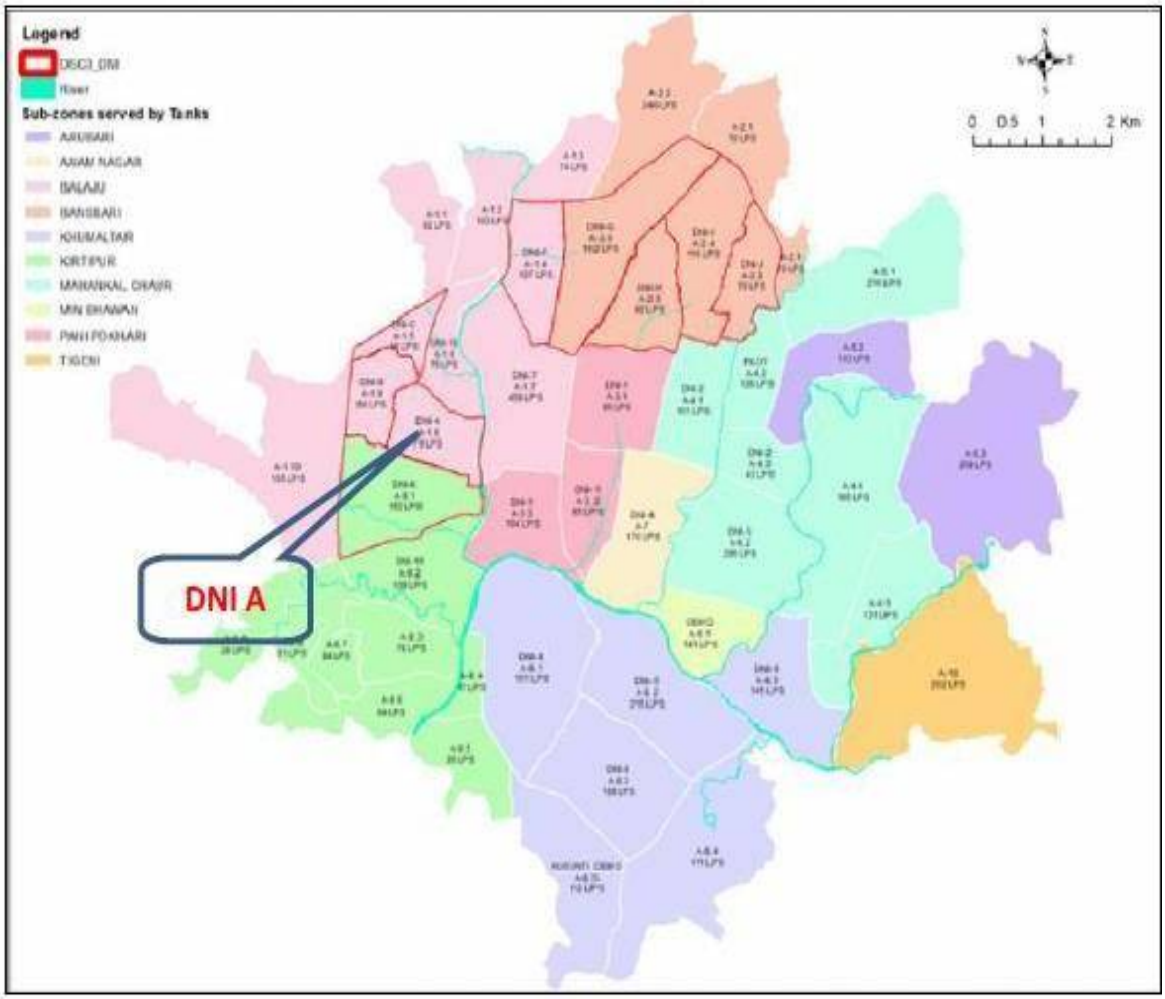


Table 6.1: Design of DNI Zone - A

Description	
Reservoir	Balaju
Outlet Elevation of the Reservoir (m)	1339.70
Total Demand (LPS)	79.18
Total number of nodes	419
Total Number of Pipes	566
Total Length of Pipes	32,533
Number of PRVs	3
Number of Pumps	0
At Peak Time (7:00) - Only for HDPE Pipes within DNI	
Number of Nodes have Pressure < 5m	0
Number of Nodes have Pressure [5m,10m]	0
Number of Nodes have Pressure [20m,40m]	419
Number of Nodes have Pressure [40m,50m]	0
Number of Nodes have Pressure [50m,60m]	0
Number of Nodes have Pressure > 60m	0
At Lowest Demand Time (1:00) - Only for HDPE pipes within DNI	
Number of Nodes have Pressure < 5m	0
Number of Nodes have Pressure [5m,10m]	0
Number of Nodes have Pressure [20m,40m]	419
Number of Nodes have Pressure [40m,50m]	0
Number of Nodes have Pressure [50m,60m]	0
Number of Nodes have Pressure > 60m	0

Table 6.2: Details of Pipe material and length

Pipe Length of DNI-A (m)	
Reservoir	Balaju
Pipe Diameter (mm)	Length (m)
HDPE PIPE-PE 100, PN6	
66.80 (75)	10,961.50
80.40 (90)	7,832
98.60 (110)	5,720
DI PIPE	
150	3,712.50
200	330
Grand Total	28,556

Table 6.3: Details of Bulk Meter/Isolation Valve/PRV's

LOCATION OF BM/IV/PRV FOR DNI_A									
DNI	DMA	# Bulk Meter	Size of BM	# Isolation Valve	Size of IV	# PRV	Size of PRV	From_Junc	To_Junc
A	1	1	250	3	250	1	250	83	23
A	2	1	150	3	150	1	150	46	40
A	3	1	150	3	150	1	150	54	41
A	3	1	150	3	150			83	47
A	mainline	1	400	3	400	0	0	54	41

Table 6.4: Details of PRV's with Set Pressure

DNI	DMA	# PRV	Size of PRV	Set pressure (m)	From_Junc	To_Junc
A	1	1	250	22	83	23
A	2	1	150	40	46	40
A	3	1	150	40	54	41

Table 6.5: Details of location of Air Valve/Washout Valve/Fire Hydrant

LOCATION OF AV/ WV/FH FOR DNI_A				
DNI	# Air Valve	# Wash out Valve	# Fire Hydrant	
	Provide at Junction	Provide at Junction	Provide at Junction	On pipe dia (mm)
A	Balaju_08	A087	A003	150 DI PIPE
	Balaju_12	A093	A007	150 DI PIPE
	A306	A228	A010	150 DI PIPE
	A390	A405	A012	150 DI PIPE
	A394	A115	A021	110 HDPE PIPE
	A200	A077	A177	110 HDPE PIPE
	A001	A124	A190	110 HDPE PIPE
	A009	A148	A194	110 HDPE PIPE
	A014	A065	A218	150 DI PIPE
	A012	A061	A232	200 DI PIPE
	A234	A044	A089	200 DI PIPE
	A316	A049	A088	150 DI PIPE
	A375	A140	A002	150 DI PIPE
	A177	A030	A080	110 HDPE PIPE
		A027	A051	110 HDPE PIPE
		A159	A142	110 HDPE PIPE
		A185	A151	110 HDPE PIPE
		A180	A174	110 HDPE PIPE
		A188	A157	110 HDPE PIPE
		A192	A393	150 DI PIPE
		A183	A389	150 DI PIPE
		A018	A425	150 DI PIPE
		A222	A353	110 HDPE PIPE
		A086	A365	110 HDPE PIPE
		A111	A387	90 HDPE PIPE
		A199	A425	150 DI PIPE
		A249	A284	150 DI PIPE
		A340	A265	150 DI PIPE
		A290	A250	90 HDPE PIPE
			A319	110 HDPE PIPE

Figure 6.2: Sub-Zone DNI-A Design Model at Peak Demand (7.00)

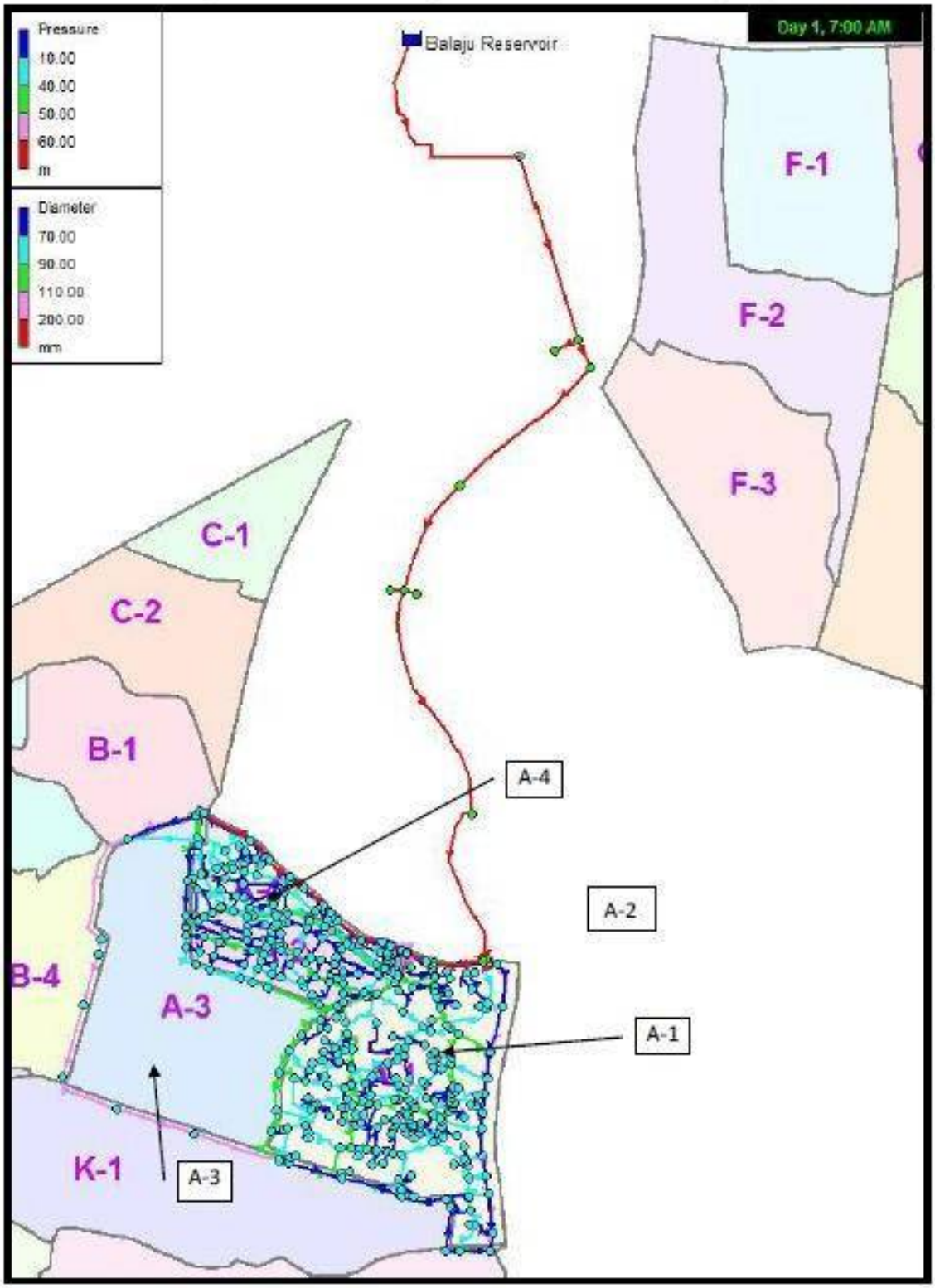


Table 6.6.Details of Pipe Design for DNI A (at peak time 7.00)

Link ID	Length	Diameter	Roughness	Material	Flow	Velocity	Unit Headloss	Friction Factor
	m	mm			LPS	m/s	m/km	
Pipe A003_A002	148.47	150	110		-5.6	0.32	1.23	0.036
Pipe A003_A004	79.38	150	110	DI	7.58	0.43	2.16	0.035
Pipe A004_A005	47.57	150	110	DI	7.58	0.43	2.16	0.035
Pipe A005_A006	62.54	150	110	DI	7.58	0.43	2.16	0.035
Pipe A006_A007	46.23	150	110	DI	7.58	0.43	2.16	0.035
Pipe A008_A007	82.58	150	110	DI	-2.31	0.13	0.24	0.041
Pipe A009_A008	63.11	150	110	DI	-0.99	0.06	0.05	0.046
Pipe A009_A010	56.57	150	110	DI	0.99	0.06	0.05	0.047
Pipe A010_A011	115.78	150	110	DI	0.99	0.06	0.05	0.047
Pipe A010_A024	63.71	62.2	130	HDPE-PE 100 PN10	0.02	0.01	0	0.048
Pipe A011_A012	56.45	150	110	DI	0.99	0.06	0.05	0.047
Pipe A011_A017	72.31	64.2	130	HDPE-PE 100 PN10	0.09	0.03	0.02	0.044
Pipe A013_A012	93.92	150	110	DI	-0.99	0.06	0.05	0.046
Pipe A013_A014	41.03	150	110	DI	0.99	0.06	0.05	0.047
Pipe A013_A017	100.7	62.2	130	HDPE-PE 100 PN10	-0.16	0.05	0.09	0.04
Pipe A014_A020	138.14	150	110	DI	0.99	0.06	0.05	0.046
Pipe A016_A019	44.91719	62.2	130	HDPE-PE 100 PN10	-1.14	0.38	3.47	0.03
Pipe A017_A016	0.993031	62.2	130	HDPE-PE 100 PN10	-0.34	0.11	0.45	0.043
Pipe A018_A016	16.74543	64.2	130	HDPE-PE 100 PN10	-0.58	0.18	0.84	0.033
Pipe A019_A023	39.64331	62.2	130	HDPE-PE 100 PN10	-1.15	0.38	3.53	0.03
Pipe A020_A019	77.35	64.2	130	HDPE-PE 100 PN10	0.45	0.14	0.53	0.034
Pipe A020_A021	21.41	150	110	DI	0.99	0.06	0.06	0.052
Pipe A022_A021	7.854126	150	110	DI	-0.99	0.06	0.04	0.035
Pipe A023_A024	3.357573	62.2	130	HDPE-PE 100 PN10	-0.96	0.32	2.53	0.031
Pipe A024_A025	56.06628	62.2	130	HDPE-PE 100 PN10	-1.25	0.41	4.07	0.03
Pipe A025_A009	51.35	62.2	130	HDPE-PE 100	-1.07	0.35	3.07	0.03

				PN10				
Pipe A026_A025	38.25092	62.2	130	HDPE-PE 100 PN10	0.67	0.22	1.29	0.032
Pipe A026_A027	41.64955	64.2	130	HDPE-PE 100 PN10	0.96	0.3	2.17	0.031
Pipe A028_A008	50.08	62.2	130	HDPE-PE 100 PN10	-3.38	1.11	25.83	0.025
Pipe A028_A026	16.68822	62.2	130	HDPE-PE 100 PN10	1.87	0.61	8.6	0.028
Pipe A029_A028	11.25	62.2	130	HDPE-PE 100 PN10	-1.38	0.46	4.93	0.029
Pipe A029_A030	42.84	64.2	130	HDPE-PE 100 PN10	0.46	0.14	0.54	0.034
Pipe A029_A037	101.47	62.2	130	HDPE-PE 100 PN10	1.21	0.4	3.85	0.03
Pipe A031_A022	139.26	150	110	DI	-0.47	0.03	0.01	0.053
Pipe A032_A031	20.58	62.2	130	HDPE-PE 100 PN10	-3.82	1.26	32.33	0.025
Pipe A032_A033	45.21076	64.2	130	HDPE-PE 100 PN10	0.58	0.18	0.85	0.033
Pipe A034_A032	31.50226	62.2	130	HDPE-PE 100 PN10	-2.91	0.96	19.6	0.026
Pipe A034_A035	39.83801	64.2	130	HDPE-PE 100 PN10	0.98	0.3	2.23	0.031
Pipe A036_A034	76.40337	62.2	130	HDPE-PE 100 PN10	-1.37	0.45	4.84	0.029
Pipe A036_A172	25.18429	62.2	130	HDPE-PE 100 PN10	0.31	0.1	0.3	0.036
Pipe A037_A038	6.59957	62.2	130	HDPE-PE 100 PN10	1.14	0.38	3.47	0.03
Pipe A037_A045	62.42937	64.2	130	HDPE-PE 100 PN10	0.14	0.04	0.06	0.042
Pipe A038_A036	105.7047	62.2	130	HDPE-PE 100 PN10	-0.5	0.16	0.74	0.034
Pipe A038_A039	49.67734	62.2	130	HDPE-PE 100 PN10	1.06	0.35	3	0.03
Pipe A039_A040	20.84981	64.2	130	HDPE-PE 100 PN10	0.36	0.11	0.34	0.036

Pipe A039_A041	31.44541	64.2	130	HDPE-PE 100 PN10	0.52	0.16	0.68	0.034
Pipe A041_A042	32.59834	64.2	130	HDPE-PE 100 PN10	0.19	0.06	0.11	0.04
Pipe A041_A043	21.62529	64.2	130	HDPE-PE 100 PN10	0.22	0.07	0.14	0.039
Pipe A043_A044	33.55719	64.2	130	HDPE-PE 100 PN10	0.12	0.04	0.05	0.043
Pipe A046_A037	23.42847	62.2	130	HDPE-PE 100 PN10	0.22	0.07	0.17	0.038
Pipe A046_A047	20.56	64.2	130	HDPE-PE 100 PN10	0.25	0.08	0.18	0.037
Pipe A048_A046	24.04131	62.2	130	HDPE-PE 100 PN10	0.37	0.12	0.43	0.035
Pipe A048_A049	54.43	64.2	130	HDPE-PE 100 PN10	0.41	0.13	0.45	0.035
Pipe A050_A007	120.53	62.2	130	HDPE-PE 100 PN10	-1.81	0.6	8.13	0.028
Pipe A050_A048	19.12297	62.2	130	HDPE-PE 100 PN10	0.55	0.18	0.9	0.033
Pipe A051_A050	8.445273	62.2	130	HDPE-PE 100 PN10	0.67	0.22	1.29	0.032
Pipe A052_A051	33.75	62.2	130	HDPE-PE 100 PN10	-1.1	0.36	3.22	0.03
Pipe A052_A053	49.89439	64.2	130	HDPE-PE 100 PN10	0.42	0.13	0.48	0.035
Pipe A054_A052	14.72998	62.2	130	HDPE-PE 100 PN10	-0.49	0.16	0.73	0.034
Pipe A054_A055	11.01668	64.2	130	HDPE-PE 100 PN10	0.08	0.02	0.03	0.056
Pipe A054_A135	61.78	62.2	130	HDPE-PE 100 PN10	-0.16	0.05	0.09	0.04
Pipe A056_A054	9.148506	62.2	130	HDPE-PE 100 PN10	-0.51	0.17	0.76	0.033
Pipe A056_A057	13.33055	64.2	130	HDPE-PE 100 PN10	0.12	0.04	0.06	0.05
Pipe A058_A056	9.705373	62.2	130	HDPE-PE 100 PN10	-0.34	0.11	0.37	0.036

Pipe A058_A059	84.31807	62.2	130	HDPE-PE 100 PN10	-1.39	0.46	4.98	0.029
Pipe A059_A005	28.77	62.2	130	HDPE-PE 100 PN10	-0.92	0.3	2.33	0.031
Pipe A059_A060	34.60726	64.2	130	HDPE-PE 100 PN10	-0.78	0.24	1.45	0.032
Pipe A060_A006	38.35	62.2	130	HDPE-PE 100 PN10	-1.19	0.39	3.76	0.03
Pipe A060_A061	19.76105	64.2	130	HDPE-PE 100 PN10	0.24	0.07	0.16	0.037
Pipe A062_A058	6.348429	62.2	130	HDPE-PE 100 PN10	-1.69	0.55	7.13	0.028
Pipe A062_A063	51.25276	64.2	130	HDPE-PE 100 PN10	0.31	0.1	0.26	0.036
Pipe A064_A062	13.64884	62.2	130	HDPE-PE 100 PN10	-1.3	0.43	4.43	0.029
Pipe A064_A065	77.79194	64.2	130	HDPE-PE 100 PN10	0.27	0.08	0.2	0.037
Pipe A066_A064	12.5036	62.2	130	HDPE-PE 100 PN10	-0.94	0.31	2.4	0.031
Pipe A066_A067	11.12264	64.2	130	HDPE-PE 100 PN10	0.09	0.03	0.03	0.043
Pipe A068_A066	11.66183	62.2	130	HDPE-PE 100 PN10	-0.73	0.24	1.53	0.032
Pipe A068_A069	16.00341	64.2	130	HDPE-PE 100 PN10	0.37	0.12	0.37	0.035
Pipe A070_A004	113.89	62.2	130	HDPE-PE 100 PN10	-1.51	0.5	5.79	0.029
Pipe A070_A068	66.52938	62.2	130	HDPE-PE 100 PN10	-0.13	0.04	0.06	0.04
Pipe A070_A071	4.823156	62.2	130	HDPE-PE 100 PN10	1.24	0.41	4.07	0.03
Pipe A071_A072	18.37758	62.2	130	HDPE-PE 100 PN10	0.55	0.18	0.88	0.033
Pipe A071_A132	37.5912	62.2	130	HDPE-PE 100 PN10	0.56	0.18	0.91	0.033
Pipe A072_A073	49.8187	62.2	130	HDPE-PE 100 PN10	0.73	0.24	1.5	0.032

Pipe A072_A078	71.8326	62.2	130	HDPE-PE 100 PN10	-0.71	0.24	1.45	0.032
Pipe A073_A074	15.30429	64.2	130	HDPE-PE 100 PN10	0.19	0.06	0.11	0.039
Pipe A073_A075	9.109063	64.2	130	HDPE-PE 100 PN10	0.45	0.14	0.52	0.034
Pipe A075_A076	11.48791	64.2	130	HDPE-PE 100 PN10	0.15	0.05	0.06	0.038
Pipe A075_A077	9.305356	64.2	130	HDPE-PE 100 PN10	0.25	0.08	0.18	0.037
Pipe A078_A003	112.68	62.2	130	HDPE-PE 100 PN10	-2.52	0.83	15.02	0.027
Pipe A078_A079	27.64192	62.2	130	HDPE-PE 100 PN10	0.9	0.3	2.23	0.031
Pipe A080_A079	19.17	62.2	130	HDPE-PE 100 PN10	-1.8	0.59	8	0.028
Pipe A080_A081	125.7383	62.2	130	HDPE-PE 100 PN10	0.52	0.17	0.81	0.034
Pipe A080_A105	58.69116	62.2	130	HDPE-PE 100 PN10	0.96	0.32	2.52	0.031
Pipe A081_A082	22.03077	64.2	130	HDPE-PE 100 PN10	0.47	0.15	0.57	0.034
Pipe A083_A081	18.43361	62.2	130	HDPE-PE 100 PN10	0.59	0.2	1.03	0.033
Pipe A083_A085	63.50375	64.2	130	HDPE-PE 100 PN10	1.4	0.43	4.33	0.029
Pipe A084_A083	1.517219	62.2	130	HDPE-PE 100 PN10	2.06	0.68	10.3	0.027
Pipe A085_A086	51.09277	64.2	130	HDPE-PE 100 PN10	0.43	0.13	0.49	0.035
Pipe A085_A087	55.17342	64.2	130	HDPE-PE 100 PN10	0.38	0.12	0.38	0.035
Pipe A088_A001	28.92	150	110	DI	5.6	0.32	1.23	0.036
Pipe A088_A084	125.56	62.2	130	HDPE-PE 100 PN10	1.53	0.5	5.93	0.029
Pipe A088_A089	165.32	150	110	DI	-10.14	0.57	3.7	0.033
Pipe A089_A091	25.16	150	110	DI	-10.14	0.57	3.7	0.033

Pipe A090_A089	13.3	62.2	130	HDPE-PE 100 PN10	-1	0.33	2.72	0.03
Pipe A090_A091	31.88	62.2	130	HDPE-PE 100 PN10	-0.64	0.21	1.19	0.033
Pipe A091_A232	61.54	150	110	DI	-10.14	0.57	3.7	0.033
Pipe A092_A090	10.91144	62.2	130	HDPE-PE 100 PN10	-1.57	0.52	6.26	0.029
Pipe A092_A093	72.47341	64.2	130	HDPE-PE 100 PN10	0.38	0.12	0.39	0.035
Pipe A094_A092	12.22125	62.2	130	HDPE-PE 100 PN10	-1.1	0.36	3.23	0.03
Pipe A094_A229	116.31	62.2	130	HDPE-PE 100 PN10	-1.28	0.42	4.3	0.029
Pipe A095_A094	3.863164	62.2	130	HDPE-PE 100 PN10	-2.31	0.76	12.71	0.027
Pipe A095_A096	41.31588	64.2	130	HDPE-PE 100 PN10	0.24	0.07	0.17	0.038
Pipe A097_A095	29.78441	62.2	130	HDPE-PE 100 PN10	-1.91	0.63	8.93	0.028
Pipe A097_A400	65.66911	64.2	130	HDPE-PE 100 PN10	0.63	0.19	0.98	0.033
Pipe A099_A097	2.709848	62.2	130	HDPE-PE 100 PN10	-1.13	0.37	3.41	0.03
Pipe A099_A100	52.98969	64.2	130	HDPE-PE 100 PN10	0.28	0.09	0.22	0.037
Pipe A101_A099	14.01129	62.2	130	HDPE-PE 100 PN10	-0.77	0.25	1.68	0.032
Pipe A101_A102	35.0444	64.2	130	HDPE-PE 100 PN10	0.14	0.04	0.06	0.04
Pipe A103_A101	20.62981	62.2	130	HDPE-PE 100 PN10	-0.46	0.15	0.65	0.034
Pipe A103_A104	39.78412	64.2	130	HDPE-PE 100 PN10	0.24	0.08	0.17	0.038
Pipe A105_A103	29.20389	62.2	130	HDPE-PE 100 PN10	0.07	0.02	0.02	0.042
Pipe A105_A405	49.28619	64.2	130	HDPE-PE 100 PN10	0.56	0.17	0.79	0.033

Pipe A107_A079	63.12386	62.2	130	HDPE-PE 100 PN10	-0.61	0.2	1.09	0.033
Pipe A107_A108	39.26	64.2	130	HDPE-PE 100 PN10	0.4	0.12	0.43	0.035
Pipe A109_A107	27.83711	62.2	130	HDPE-PE 100 PN10	-0.3	0.1	0.28	0.036
Pipe A109_A110	53.9031	62.2	130	HDPE-PE 100 PN10	2.44	0.8	14.13	0.027
Pipe A110_A111	51.249	64.2	130	HDPE-PE 100 PN10	0.35	0.11	0.34	0.036
Pipe A110_A112	8.474371	62.2	130	HDPE-PE 100 PN10	1.79	0.59	7.96	0.028
Pipe A112_A113	45.66743	64.2	130	HDPE-PE 100 PN10	0.66	0.2	1.09	0.033
Pipe A112_A114	19.64576	62.2	130	HDPE-PE 100 PN10	1.02	0.33	2.8	0.03
Pipe A114_A115	118.4581	64.2	130	HDPE-PE 100 PN10	1.08	0.33	2.69	0.03
Pipe A114_A116	27.75503	62.2	130	HDPE-PE 100 PN10	-0.23	0.08	0.18	0.038
Pipe A116_A117	26.48569	62.2	130	HDPE-PE 100 PN10	-0.96	0.32	2.52	0.031
Pipe A117_A118	30.37446	64.2	130	HDPE-PE 100 PN10	0.27	0.08	0.2	0.037
Pipe A117_A119	30.98663	62.2	130	HDPE-PE 100 PN10	-1.45	0.48	5.4	0.029
Pipe A119_A120	55.19281	64.2	130	HDPE-PE 100 PN10	0.34	0.1	0.31	0.036
Pipe A119_A121	44.78189	62.2	130	HDPE-PE 100 PN10	-2.33	0.77	12.98	0.027
Pipe A121_A122	9.723108	62.2	130	HDPE-PE 100 PN10	-1.12	0.37	3.34	0.03
Pipe A122_A123	74.93792	64.2	130	HDPE-PE 100 PN10	-0.24	0.07	0.16	0.038
Pipe A122_A149	12.36389	62.2	130	HDPE-PE 100 PN10	-1.07	0.35	3.06	0.03
Pipe A123_A124	23.83258	64.2	130	HDPE-PE 100 PN10	0.21	0.06	0.12	0.038

Pipe A123_A125	37.32	62.2	130	HDPE-PE 100 PN10	-0.63	0.21	1.15	0.033
Pipe A125_A126	35.99	62.2	130	HDPE-PE 100 PN10	2.35	0.77	13.19	0.027
Pipe A126_A137	41.57518	62.2	130	HDPE-PE 100 PN10	0.59	0.19	1.03	0.033
Pipe A127_A126	17.30746	62.2	130	HDPE-PE 100 PN10	-1.57	0.52	6.28	0.029
Pipe A127_A128	32.59687	64.2	130	HDPE-PE 100 PN10	0.08	0.03	0.02	0.043
Pipe A129_A127	9.921231	62.2	130	HDPE-PE 100 PN10	-1.39	0.46	5.01	0.029
Pipe A129_A130	86.36	62.2	130	HDPE-PE 100 PN10	0.5	0.16	0.75	0.034
Pipe A130_A131	8.875761	64.2	130	HDPE-PE 100 PN10	0.26	0.08	0.18	0.037
Pipe A132_A130	68.86365	62.2	130	HDPE-PE 100 PN10	0.05	0.02	0.01	0.055
Pipe A132_A133	22.22803	64.2	130	HDPE-PE 100 PN10	0.2	0.06	0.12	0.04
Pipe A134_A129	52.12501	62.2	130	HDPE-PE 100 PN10	-1.23	0.41	3.99	0.03
Pipe A134_A135	4.442566	62.2	130	HDPE-PE 100 PN10	0.92	0.3	2.31	0.031
Pipe A134_A136	41.40345	64.2	130	HDPE-PE 100 PN10	0.15	0.05	0.07	0.041
Pipe A135_A051	27.29118	62.2	130	HDPE-PE 100 PN10	0.79	0.26	1.75	0.032
Pipe A137_A138	8.967432	64.2	130	HDPE-PE 100 PN10	0.03	0.01	0	0
Pipe A137_A139	31.88914	62.2	130	HDPE-PE 100 PN10	0.41	0.13	0.52	0.035
Pipe A140_A139	32.25801	64.2	130	HDPE-PE 100 PN10	-0.27	0.08	0.2	0.037
Pipe A141_A139	30.21214	64.2	130	HDPE-PE 100 PN10	-0.12	0.04	0.04	0.042
Pipe A142_A125	11.13705	62.2	130	HDPE-PE 100 PN10	2.5	0.82	14.77	0.027

Pipe A142_A147	73.24627	62.2	130	HDPE-PE 100 PN10	-1.71	0.56	7.32	0.028
Pipe A143_A142	56.30178	62.2	130	HDPE-PE 100 PN10	1.11	0.36	3.27	0.03
Pipe A144_A143	24.12061	62.2	130	HDPE-PE 100 PN10	3.09	1.02	21.9	0.026
Pipe A144_A145	38.2694	64.2	130	HDPE-PE 100 PN10	0.21	0.07	0.13	0.039
Pipe A144_A146	2.742274	62.2	130	HDPE-PE 100 PN10	-3.38	1.11	25.89	0.025
Pipe A146_A147	25.56788	62.2	130	HDPE-PE 100 PN10	1.99	0.65	9.66	0.028
Pipe A146_A154	17.6176	62.2	130	HDPE-PE 100 PN10	-5.42	1.78	61.95	0.024
Pipe A147_A148	50.61	64.2	130	HDPE-PE 100 PN10	0.26	0.08	0.2	0.038
Pipe A149_A147	58.79	64.2	130	HDPE-PE 100 PN10	-0.36	0.11	0.34	0.036
Pipe A149_A150	71.28	62.2	130	HDPE-PE 100 PN10	-0.92	0.3	2.31	0.031
Pipe A152_A151	20.77207	62.2	130	HDPE-PE 100 PN10	-0.47	0.15	0.66	0.034
Pipe A152_A153	36.32022	64.2	130	HDPE-PE 100 PN10	0.21	0.07	0.13	0.038
Pipe A154_A151	61.00858	62.2	130	HDPE-PE 100 PN10	0.53	0.18	0.85	0.033
Pipe A155_A154	35.13992	62.2	130	HDPE-PE 100 PN10	-3.14	1.03	22.57	0.026
Pipe A155_A156	31.24187	64.2	130	HDPE-PE 100 PN10	0.18	0.05	0.1	0.041
Pipe A157_A155	20.15666	62.2	130	HDPE-PE 100 PN10	-2.83	0.93	18.64	0.026
Pipe A158_A157	64.60505	62.2	130	HDPE-PE 100 PN10	-2.22	0.73	11.88	0.027
Pipe A158_A159	20.89848	64.2	130	HDPE-PE 100 PN10	0.23	0.07	0.16	0.038
Pipe A160_A157	13.37995	62.2	130	HDPE-PE 100 PN10	-0.51	0.17	0.79	0.034

Pipe A160_A161	41.2603	64.2	130	HDPE-PE 100 PN10	0.45	0.14	0.53	0.034
Pipe A162_A158	68.79829	62.2	130	HDPE-PE 100 PN10	-1.65	0.54	6.84	0.028
Pipe A162_A174	34.87821	62.2	130	HDPE-PE 100 PN10	0.16	0.05	0.09	0.042
Pipe A163_A162	25.38956	62.2	130	HDPE-PE 100 PN10	-1.2	0.39	3.77	0.03
Pipe A163_A164	23.61425	64.2	130	HDPE-PE 100 PN10	0.27	0.08	0.2	0.037
Pipe A165_A143	141.1815	64.2	130	HDPE-PE 100 PN10	-1.67	0.51	5.98	0.028
Pipe A165_A163	19.96762	62.2	130	HDPE-PE 100 PN10	-0.75	0.25	1.58	0.032
Pipe A166_A165	26.67836	62.2	130	HDPE-PE 100 PN10	-2.18	0.72	11.5	0.027
Pipe A167_A166	73.33607	64.2	130	HDPE-PE 100 PN10	-0.39	0.12	0.41	0.035
Pipe A168_A166	4.976568	62.2	130	HDPE-PE 100 PN10	-1.64	0.54	6.79	0.028
Pipe A168_A169	45.25448	64.2	130	HDPE-PE 100 PN10	0.69	0.21	1.16	0.032
Pipe A170_A168	32.02844	62.2	130	HDPE-PE 100 PN10	-0.78	0.26	1.71	0.032
Pipe A170_A171	35.11571	64.2	130	HDPE-PE 100 PN10	0.38	0.12	0.39	0.035
Pipe A172_A170	19.34921	62.2	130	HDPE-PE 100 PN10	-0.2	0.07	0.13	0.037
Pipe A172_A173	61.33134	64.2	130	HDPE-PE 100 PN10	0.29	0.09	0.24	0.037
Pipe A174_A178	109.5562	62.2	130	HDPE-PE 100 PN10	1.37	0.45	4.87	0.029
Pipe A175_A174	73.80019	62.2	130	HDPE-PE 100 PN10	2.15	0.71	11.21	0.027
Pipe A176_A175	24.75346	64.2	130	HDPE-PE 100 PN10	-0.51	0.16	0.66	0.034
Pipe A177_A031	190.53	150	110	DI	5.14	0.29	1.05	0.037
Pipe A177_A175	21.31	62.2	130	HDPE-	3.25	1.07	24.04	0.026

				PE 100 PN10				
Pipe A178_A179	15.69755	64.2	130	HDPE-PE 100 PN10	0.67	0.21	1.11	0.032
Pipe A178_A180	21.84499	64.2	130	HDPE-PE 100 PN10	0.41	0.13	0.44	0.035
Pipe A181_A177	169.5209	150	110	DI	10.02	0.57	3.62	0.033
Pipe A181_A190	31.48	150	110	DI	-10.02	0.57	3.62	0.033
Pipe A182_A181	16.32	64.2	130	HDPE-PE 100 PN10	-0.74	0.23	1.31	0.032
Pipe A182_A183	17.80607	64.2	130	HDPE-PE 100 PN10	0.79	0.24	1.49	0.032
Pipe A182_A415	89.0139	64.2	130	HDPE-PE 100 PN10	-0.28	0.09	0.22	0.037
Pipe A184_A185	45.36446	64.2	130	HDPE-PE 100 PN10	0.51	0.16	0.66	0.034
Pipe A184_A186	9.157096	62.2	130	HDPE-PE 100 PN10	-1.38	0.45	4.89	0.029
Pipe A186_A160	77.89384	64.2	130	HDPE-PE 100 PN10	0.19	0.06	0.1	0.039
Pipe A187_A186	7.296628	64.2	130	HDPE-PE 100 PN10	1.77	0.55	6.73	0.028
Pipe A187_A188	29.78369	64.2	130	HDPE-PE 100 PN10	0.51	0.16	0.66	0.034
Pipe A189_A187	13.20611	62.2	130	HDPE-PE 100 PN10	2.31	0.76	12.8	0.027
Pipe A189_A195	104.772	64.2	130	HDPE-PE 100 PN10	-2.02	0.62	8.52	0.028
Pipe A430_A319	86.9	62.2	130	HDPE-PE 100 PN10	0.07	0.02	0.02	0.043
Pipe A190_A191	126.58	62.2	130	HDPE-PE 100 PN10	-0.62	0.21	1.13	0.033
Pipe A191_A192	38.26973	64.2	130	HDPE-PE 100 PN10	0.34	0.1	0.31	0.036
Pipe A191_A193	71.2	62.2	130	HDPE-PE 100 PN10	-1.39	0.46	4.95	0.029
Pipe A193_A189	103.1457	64.2	130	HDPE-PE 100 PN10	0.63	0.19	0.98	0.033

Pipe A193_A194	116.51	62.2	130	HDPE-PE 100 PN10	-2.43	0.8	14.06	0.027
Pipe A195_A194	57.25	62.2	130	HDPE-PE 100 PN10	-2.5	0.82	14.8	0.027
Pipe A196_A195	35.51783	62.2	130	HDPE-PE 100 PN10	0.13	0.04	0.07	0.042
Pipe A196_A197	38.29879	64.2	130	HDPE-PE 100 PN10	-0.65	0.2	1.05	0.033
Pipe A197_A198	1.448801	62.2	130	HDPE-PE 100 PN10	-1.28	0.42	4.21	0.029
Pipe A198_A199	20.96969	64.2	130	HDPE-PE 100 PN10	0.35	0.11	0.33	0.035
Pipe A198_A200	88.17437	62.2	130	HDPE-PE 100 PN10	-1.82	0.6	8.2	0.028
Pipe A200_A194	72.67	62.2	130	HDPE-PE 100 PN10	-0.6	0.2	1.04	0.033
Pipe A200_A221	61.82441	62.2	130	HDPE-PE 100 PN10	-1.64	0.54	6.75	0.028
Pipe A201_A197	47.36287	62.2	130	HDPE-PE 100 PN10	-0.51	0.17	0.79	0.034
Pipe A201_A202	30.20363	64.2	130	HDPE-PE 100 PN10	0.34	0.1	0.32	0.036
Pipe A202_A152	53.10687	62.2	130	HDPE-PE 100 PN10	0.04	0.01	0.01	0.045
Pipe A202_A196	68.50006	62.2	130	HDPE-PE 100 PN10	-0.17	0.05	0.1	0.04
Pipe A203_A201	60.42498	62.2	130	HDPE-PE 100 PN10	0.17	0.06	0.1	0.04
Pipe A203_A205	48.995	64.2	130	HDPE-PE 100 PN10	0.23	0.07	0.16	0.038
Pipe A204_A203	2.254369	62.2	130	HDPE-PE 100 PN10	0.63	0.21	1.12	0.032
Pipe A204_A210	40.93509	64.2	130	HDPE-PE 100 PN10	-0.3	0.09	0.25	0.037
Pipe A206_A204	21.67936	62.2	130	HDPE-PE 100 PN10	0.42	0.14	0.54	0.035
Pipe A206_A207	44.92974	64.2	130	HDPE-PE 100 PN10	0.29	0.09	0.23	0.037

Pipe A208_A206	23.38508	62.2	130	HDPE-PE 100 PN10	0.83	0.27	1.93	0.031
Pipe A208_A209	34.11671	64.2	130	HDPE-PE 100 PN10	0.3	0.09	0.25	0.037
Pipe A208_A216	56.99506	62.2	130	HDPE-PE 100 PN10	-1.32	0.44	4.55	0.029
Pipe A210_A212	52.6369	62.2	130	HDPE-PE 100 PN10	-1.1	0.36	3.21	0.03
Pipe A211_A121	91.5	62.2	130	HDPE-PE 100 PN10	1.53	0.5	5.98	0.029
Pipe A211_A210	10.06866	62.2	130	HDPE-PE 100 PN10	-0.5	0.16	0.74	0.033
Pipe A212_A215	47.16811	62.2	130	HDPE-PE 100 PN10	-0.98	0.32	2.59	0.031
Pipe A213_A212	20.40363	62.2	130	HDPE-PE 100 PN10	0.75	0.25	1.6	0.032
Pipe A213_A214	10.95413	64.2	130	HDPE-PE 100 PN10	0.11	0.04	0.04	0.041
Pipe A215_A213	39.8859	64.2	130	HDPE-PE 100 PN10	0.98	0.3	2.25	0.031
Pipe A215_A216	1.273951	62.2	130	HDPE-PE 100 PN10	-2.23	0.73	11.92	0.027
Pipe A216_A217	33.7996	62.2	130	HDPE-PE 100 PN10	-3.73	1.23	30.99	0.025
Pipe A217_A218	57.41	62.2	130	HDPE-PE 100 PN10	-4.21	1.39	38.78	0.025
Pipe A217_A225	143.47	62.2	130	HDPE-PE 100 PN10	0.56	0.19	0.93	0.033
Pipe A219_A218	15.13	62.2	130	HDPE-PE 100 PN10	-3.29	1.08	24.6	0.026
Pipe A219_A220	33.36534	64.2	130	HDPE-PE 100 PN10	0.27	0.08	0.2	0.037
Pipe A221_A222	64.34214	64.2	130	HDPE-PE 100 PN10	0.24	0.08	0.17	0.038
Pipe A221_A223	74.23677	62.2	130	HDPE-PE 100 PN10	-2.14	0.7	11.08	0.027
Pipe A223_A219	67.95994	62.2	130	HDPE-PE 100 PN10	-2.78	0.91	17.96	0.026

Pipe A223_A224	33.52073	64.2	130	HDPE-PE 100 PN10	0.25	0.08	0.17	0.037
Pipe A225_A218	93.83	62.2	130	HDPE-PE 100 PN10	-2.99	0.98	20.6	0.026
Pipe A226_A225	15.58	62.2	130	HDPE-PE 100 PN10	-3.38	1.11	25.87	0.025
Pipe A226_A227	99.33	62.2	130	HDPE-PE 100 PN10	3.49	1.15	27.47	0.025
Pipe A227_A109	74.77232	62.2	130	HDPE-PE 100 PN10	2.55	0.84	15.33	0.027
Pipe A227_A228	101.15	64.2	130	HDPE-PE 100 PN10	0.44	0.14	0.51	0.035
Pipe A229_A226	100.62	62.2	130	HDPE-PE 100 PN10	-2.45	0.81	14.24	0.027
Pipe A230_A233	66.76	64.2	130	HDPE-PE 100 PN10	0.1	0.03	0.03	0.042
Pipe A231_A116	69.22762	64.2	130	HDPE-PE 100 PN10	-0.38	0.12	0.38	0.035
Pipe A232_A229	68.11	62.2	130	HDPE-PE 100 PN10	-1.09	0.36	3.19	0.03
Pipe A233_A242	18.80351	64.2	130	HDPE-PE 100 PN10	0.03	0.01	0	0
Pipe A234_A327	187.01	62.2	130	HDPE-PE 100 PN10	-0.67	0.22	1.28	0.032
Pipe A235_A234	21.62	62.2	130	HDPE-PE 100 PN10	-0.58	0.19	0.99	0.033
Pipe A235_A236	65.74218	62.2	130	HDPE-PE 100 PN10	0.52	0.17	0.81	0.034
Pipe A235_A420	55.60535	62.2	130	HDPE-PE 100 PN10	-0.15	0.05	0.08	0.04
Pipe A236_A237	29.48465	62.2	130	HDPE-PE 100 PN10	0.58	0.19	0.98	0.033
Pipe A236_A331	53.49727	62.2	130	HDPE-PE 100 PN10	-0.27	0.09	0.24	0.037
Pipe A237_A238	75.2531	62.2	130	HDPE-PE 100 PN10	-0.13	0.04	0.06	0.041
Pipe A238_A341	28.73665	62.2	130	HDPE-PE 100 PN10	0.38	0.13	0.46	0.035

Pipe A239_A238	82.08	62.2	130	HDPE-PE 100 PN10	0.72	0.24	1.48	0.032
Pipe A239_A343	39.36	62.2	130	HDPE-PE 100 PN10	0.42	0.14	0.54	0.035
Pipe A240_A241	33.66	64.2	130	HDPE-PE 100 PN10	0.18	0.05	0.09	0.039
Pipe A241_A242	34.95522	64.2	130	HDPE-PE 100 PN10	0	0	0	0
Pipe A241_A243	14.5001	64.2	130	HDPE-PE 100 PN10	0.03	0.01	0.01	0.134
Pipe A242_A246	15.46961	62.2	130	HDPE-PE 100 PN10	-0.06	0.02	0.01	0.027
Pipe A243_A244	7.08555	64.2	130	HDPE-PE 100 PN10	0.03	0.01	0	0
Pipe A245_A243	10.12327	64.2	130	HDPE-PE 100 PN10	0.04	0.01	0.01	0.155
Pipe A246_A245	25.04731	64.2	130	HDPE-PE 100 PN10	0.05	0.02	0.01	0.027
Pipe A246_A247	10.14622	62.2	130	HDPE-PE 100 PN10	-0.18	0.06	0.12	0.039
Pipe A247_A248	25.56226	64.2	130	HDPE-PE 100 PN10	0.13	0.04	0.05	0.039
Pipe A248_A245	12.29552	64.2	130	HDPE-PE 100 PN10	0.03	0.01	0	0
Pipe A248_A249	15.44574	64.2	130	HDPE-PE 100 PN10	0.03	0.01	0.01	0.107
Pipe A250_A247	28.99557	62.2	130	HDPE-PE 100 PN10	0.4	0.13	0.5	0.035
Pipe A251_A250	37.592	62.2	130	HDPE-PE 100 PN10	0.22	0.07	0.17	0.038
Pipe A251_A257	67.43212	64.2	130	HDPE-PE 100 PN10	-0.54	0.17	0.73	0.034
Pipe A252_A251	1.550395	62.2	130	HDPE-PE 100 PN10	-0.17	0.06	0.1	0.038
Pipe A253_A252	25.27109	64.2	130	HDPE-PE 100 PN10	-0.23	0.07	0.15	0.038
Pipe A254_A253	7.004819	64.2	130	HDPE-PE 100 PN10	-0.03	0.01	0	0

Pipe A255_A253	16.17	64.2	130	HDPE-PE 100 PN10	-0.14	0.04	0.06	0.038
Pipe A256_A252	34.36	62.2	130	HDPE-PE 100 PN10	0.15	0.05	0.08	0.04
Pipe A257_A258	14.94	62.2	130	HDPE-PE 100 PN10	-0.39	0.13	0.48	0.035
Pipe A257_A259	25.76449	62.2	130	HDPE-PE 100 PN10	-0.43	0.14	0.58	0.035
Pipe A259_A250	94.05778	62.2	130	HDPE-PE 100 PN10	0.5	0.16	0.75	0.034
Pipe A259_A260	74.60538	62.2	130	HDPE-PE 100 PN10	-1.16	0.38	3.57	0.03
Pipe A260_A261	31.68	62.2	130	HDPE-PE 100 PN10	-0.11	0.04	0.04	0.04
Pipe A260_A264	27.50969	62.2	130	HDPE-PE 100 PN10	-1.32	0.43	4.5	0.029
Pipe A262_A263	17.78	62.2	130	HDPE-PE 100 PN10	-0.75	0.25	1.57	0.032
Pipe A263_A266	44.742	64.2	130	HDPE-PE 100 PN10	-0.62	0.19	0.95	0.033
Pipe A264_A263	20.78253	62.2	130	HDPE-PE 100 PN10	0.26	0.09	0.22	0.037
Pipe A264_A268	48.59985	62.2	130	HDPE-PE 100 PN10	-1.75	0.58	7.64	0.028
Pipe A265_A269	123.12	150	110	DI	5.73	0.32	1.28	0.036
Pipe A266_A265	17.83	62.2	130	HDPE-PE 100 PN10	0.52	0.17	0.82	0.034
Pipe A267_A266	9.252065	62.2	130	HDPE-PE 100 PN10	1.4	0.46	5.07	0.029
Pipe A267_A272	110.3675	62.2	130	HDPE-PE 100 PN10	0.37	0.12	0.44	0.035
Pipe A268_A267	27.48784	62.2	130	HDPE-PE 100 PN10	2.07	0.68	10.43	0.027
Pipe A268_A273	77.60227	62.2	130	HDPE-PE 100 PN10	1.22	0.4	3.9	0.03
Pipe A269_A270	4.52	62.2	130	HDPE-PE 100 PN10	0.71	0.23	1.45	0.032
Pipe A269_A284	103.37	150	110	DI	5.73	0.32	1.29	0.036

Pipe A270_A271	35.00434	62.2	130	HDPE-PE 100 PN10	0.25	0.08	0.2	0.037
Pipe A270_A286	105.4337	62.2	130	HDPE-PE 100 PN10	0.13	0.04	0.07	0.041
Pipe A271_A297	125.7508	64.2	130	HDPE-PE 100 PN10	0.2	0.06	0.12	0.039
Pipe A272_A271	4.927602	62.2	130	HDPE-PE 100 PN10	0.47	0.16	0.66	0.034
Pipe A273_A272	62.71199	64.2	130	HDPE-PE 100 PN10	0.44	0.14	0.51	0.035
Pipe A273_A276	33.36962	62.2	130	HDPE-PE 100 PN10	0.56	0.19	0.94	0.033
Pipe A274_A271	29.95955	64.2	130	HDPE-PE 100 PN10	-0.31	0.09	0.26	0.036
Pipe A275_A274	25.90233	62.2	130	HDPE-PE 100 PN10	0.08	0.03	0.02	0.04
Pipe A275_A278	74.4379	64.2	130	HDPE-PE 100 PN10	0	0	0	0
Pipe A276_A275	26.23195	62.2	130	HDPE-PE 100 PN10	0.36	0.12	0.41	0.036
Pipe A276_A279	67.0252	62.2	130	HDPE-PE 100 PN10	0.06	0.02	0.01	0.045
Pipe A277_A274	96.99157	64.2	130	HDPE-PE 100 PN10	0.03	0.01	0	0.057
Pipe A277_A297	42.50559	64.2	130	HDPE-PE 100 PN10	0.25	0.08	0.18	0.038
Pipe A278_A277	37.68557	62.2	130	HDPE-PE 100 PN10	0.05	0.02	0.01	0.037
Pipe A279_A278	23.38501	62.2	130	HDPE-PE 100 PN10	0.36	0.12	0.42	0.036
Pipe A280_A277	24.47251	64.2	130	HDPE-PE 100 PN10	0.55	0.17	0.77	0.033
Pipe A281_A279	63.00819	62.2	130	HDPE-PE 100 PN10	0.54	0.18	0.86	0.033
Pipe A281_A280	45.60266	64.2	130	HDPE-PE 100 PN10	0.63	0.2	1	0.033
Pipe A282_A280	50.33665	64.2	130	HDPE-PE 100 PN10	0.19	0.06	0.11	0.038

Pipe A283_A281	32.56761	62.2	130	HDPE-PE 100 PN10	1.55	0.51	6.08	0.029
Pipe A283_A282	57.87355	62.2	130	HDPE-PE 100 PN10	1.25	0.41	4.11	0.03
Pipe A284_A285	23.66	62.2	130	HDPE-PE 100 PN10	2.03	0.67	10.05	0.027
Pipe A285_A286	36.87876	62.2	130	HDPE-PE 100 PN10	0.76	0.25	1.63	0.032
Pipe A150_A151	2.38	62.2	130	HDPE-PE 100 PN10	0.05	0.02	0	0
Pipe A211_A150	46.87	62.2	130	HDPE-PE 100 PN10	0.22	0.07	0.16	0.039
Pipe A285_A287	23.17709	64.2	130	HDPE-PE 100 PN10	1.03	0.32	2.43	0.03
Pipe A286_A295	38.13401	62.2	130	HDPE-PE 100 PN10	0.38	0.12	0.44	0.035
Pipe A287_A288	36.22293	64.2	130	HDPE-PE 100 PN10	0.18	0.06	0.1	0.039
Pipe A287_A289	34.63685	64.2	130	HDPE-PE 100 PN10	0.64	0.2	1.01	0.033
Pipe A289_A290	27.87555	64.2	130	HDPE-PE 100 PN10	0.44	0.13	0.5	0.034
Pipe A289_A293	57.03306	64.2	130	HDPE-PE 100 PN10	-0.01	0	0	0
Pipe A292_A291	107.98	62.2	130	HDPE-PE 100 PN10	-0.57	0.19	0.95	0.033
Pipe A292_A301	82.72238	62.2	130	HDPE-PE 100 PN10	0.02	0.01	0	0.066
Pipe A293_A292	48.68914	62.2	130	HDPE-PE 100 PN10	0.17	0.06	0.1	0.039
Pipe A293_A294	10.59629	62.2	130	HDPE-PE 100 PN10	-0.34	0.11	0.37	0.036
Pipe A295_A294	35.01611	62.2	130	HDPE-PE 100 PN10	0.3	0.1	0.29	0.037
Pipe A296_A295	31.1967	64.2	130	HDPE-PE 100 PN10	0.09	0.03	0.02	0.042
Pipe A296_A299	55.66018	64.2	130	HDPE-PE 100 PN10	0	0	0	1.988

Pipe A297_A296	5.024987	64.2	130	HDPE-PE 100 PN10	0.23	0.07	0.18	0.044
Pipe A298_A294	21.34465	62.2	130	HDPE-PE 100 PN10	0.16	0.05	0.1	0.041
Pipe A298_A410	30.636	62.2	130	HDPE-PE 100 PN10	0.02	0.01	0	0.117
Pipe A299_A282	35.68195	64.2	130	HDPE-PE 100 PN10	-0.61	0.19	0.92	0.033
Pipe A299_A298	30.06121	64.2	130	HDPE-PE 100 PN10	0.33	0.1	0.3	0.036
Pipe A300_A301	76.53	64.2	130	HDPE-PE 100 PN10	0.13	0.04	0.06	0.042
Pipe A301_A302	102.0365	64.2	130	HDPE-PE 100 PN10	-0.31	0.1	0.27	0.036
Pipe A303_A304	3.180005	62.2	130	HDPE-PE 100 PN10	0.27	0.09	0.23	0.036
Pipe A304_A307	29.30333	62.2	130	HDPE-PE 100 PN10	-0.42	0.14	0.53	0.035
Pipe A305_A304	83.95	62.2	130	HDPE-PE 100 PN10	-0.48	0.16	0.69	0.034
Pipe A306_A389	382.26	150	110	DI	1.41	0.08	0.09	0.044
Pipe A306_A425	226.29	150	110	DI	-3.61	0.2	0.55	0.039
Pipe A307_A308	17.89	62.2	130	HDPE-PE 100 PN10	-0.37	0.12	0.42	0.035
Pipe A308_A305	132.32	150	110	DI	-4.57	0.26	0.85	0.037
Pipe A309_A307	37.1054	64.2	130	HDPE-PE 100 PN10	0.32	0.1	0.29	0.036
Pipe A310_A309	80.56244	64.2	130	HDPE-PE 100 PN10	0.6	0.19	0.9	0.033
Pipe A310_A311	28.82745	64.2	130	HDPE-PE 100 PN10	0.31	0.09	0.26	0.036
Pipe A312_A303	115.0188	62.2	130	HDPE-PE 100 PN10	0.37	0.12	0.43	0.035
Pipe A312_A313	26.84323	62.2	130	HDPE-PE 100 PN10	-0.14	0.05	0.07	0.039
Pipe A313_A309	83.0001	64.2	130	HDPE-PE 100 PN10	0.34	0.11	0.32	0.036
Pipe A314_A310	14.41136	62.2	130	HDPE-PE 100	1.14	0.38	3.48	0.03

				PN10				
Pipe A314_A313	49.26592	62.2	130	HDPE-PE 100 PN10	0.84	0.28	1.96	0.031
Pipe A315_A308	145.16	150	110	DI	-4.57	0.26	0.85	0.037
Pipe A315_A314	43.48	62.2	130	HDPE-PE 100 PN10	2.02	0.66	9.91	0.028
Pipe A316_A317	42.54	62.2	130	HDPE-PE 100 PN10	2.21	0.73	11.78	0.027
Pipe A317_A318	21.88305	62.2	130	HDPE-PE 100 PN10	1.18	0.39	3.69	0.03
Pipe A317_A379	94.09782	64.2	130	HDPE-PE 100 PN10	0.87	0.27	1.79	0.031
Pipe A318_A430	56.61	62.2	130	HDPE-PE 100 PN10	0.51	0.17	0.79	0.034
Pipe A318_A321	141.6203	64.2	130	HDPE-PE 100 PN10	0.43	0.13	0.49	0.035
Pipe A319_A324	88.87027	62.2	130	HDPE-PE 100 PN10	-0.54	0.18	0.87	0.033
Pipe A320_A319	27.77267	62.2	130	HDPE-PE 100 PN10	-0.43	0.14	0.56	0.035
Pipe A321_A320	22.7587	62.2	130	HDPE-PE 100 PN10	-0.32	0.11	0.33	0.036
Pipe A322_A321	19.05993	62.2	130	HDPE-PE 100 PN10	-0.53	0.17	0.83	0.034
Pipe A323_A322	3.519229	62.2	130	HDPE-PE 100 PN10	-0.37	0.12	0.42	0.035
Pipe A323_A379	71.12341	64.2	130	HDPE-PE 100 PN10	0.08	0.02	0.02	0.044
Pipe A324_A325	35.69495	62.2	130	HDPE-PE 100 PN10	-1.27	0.42	4.18	0.029
Pipe A325_A326	71.93582	62.2	130	HDPE-PE 100 PN10	-2.48	0.82	14.6	0.027
Pipe A326_A352	25.64999	62.2	130	HDPE-PE 100 PN10	4.24	1.4	39.36	0.025
Pipe A327_A326	131.9824	62.2	130	HDPE-PE 100 PN10	-2.07	0.68	10.43	0.027
Pipe A328_A327	19.54813	62.2	130	HDPE-PE 100 PN10	-1.17	0.38	3.59	0.03

Pipe A329_A328	30.89992	62.2	130	HDPE-PE 100 PN10	-1.36	0.45	4.76	0.029
Pipe A330_A329	2.845931	62.2	130	HDPE-PE 100 PN10	-0.84	0.28	1.99	0.031
Pipe A331_A330	140.6509	64.2	130	HDPE-PE 100 PN10	-0.46	0.14	0.55	0.034
Pipe A332_A330	20.50481	64.2	130	HDPE-PE 100 PN10	-0.28	0.09	0.23	0.037
Pipe A332_A333	38.39792	64.2	130	HDPE-PE 100 PN10	0.52	0.16	0.69	0.034
Pipe A332_A344	41.48848	64.2	130	HDPE-PE 100 PN10	-0.42	0.13	0.46	0.035
Pipe A333_A334	23.2621	64.2	130	HDPE-PE 100 PN10	0.1	0.03	0.03	0.042
Pipe A333_A335	18.12575	64.2	130	HDPE-PE 100 PN10	0.26	0.08	0.19	0.038
Pipe A335_A346	44.14465	62.2	130	HDPE-PE 100 PN10	-0.61	0.2	1.09	0.033
Pipe A336_A335	41.93149	62.2	130	HDPE-PE 100 PN10	-0.9	0.3	2.24	0.031
Pipe A336_A337	1.459871	62.2	130	HDPE-PE 100 PN10	0.84	0.28	2.04	0.032
Pipe A337_A338	26.44696	62.2	130	HDPE-PE 100 PN10	0.86	0.28	2.03	0.031
Pipe A337_A342	68.00825	62.2	130	HDPE-PE 100 PN10	-0.11	0.03	0.04	0.044
Pipe A338_A339	11.37296	64.2	130	HDPE-PE 100 PN10	0.24	0.07	0.16	0.037
Pipe A338_A340	47.51327	64.2	130	HDPE-PE 100 PN10	0.52	0.16	0.68	0.034
Pipe A341_A336	26.72746	62.2	130	HDPE-PE 100 PN10	0.06	0.02	0.01	0.035
Pipe A341_A342	63.00359	64.2	130	HDPE-PE 100 PN10	0.04	0.01	0	0.038
Pipe A342_A237	17.8497	62.2	130	HDPE-PE 100 PN10	-0.4	0.13	0.51	0.035
Pipe A343_A335	65.95406	64.2	130	HDPE-PE 100 PN10	0.33	0.1	0.3	0.036

Pipe A343_A348	38.82213	62.2	130	HDPE-PE 100 PN10	-0.57	0.19	0.96	0.033
Pipe A344_A345	32.57107	64.2	130	HDPE-PE 100 PN10	-0.85	0.26	1.71	0.031
Pipe A344_A346	54.42074	64.2	130	HDPE-PE 100 PN10	0.08	0.03	0.02	0.042
Pipe A345_A349	70.55468	64.2	130	HDPE-PE 100 PN10	-0.84	0.26	1.68	0.031
Pipe A346_A347	1.88836	62.2	130	HDPE-PE 100 PN10	-0.71	0.23	1.42	0.032
Pipe A348_A347	38.96876	64.2	130	HDPE-PE 100 PN10	0.24	0.07	0.16	0.038
Pipe A348_A370	15.06104	62.2	130	HDPE-PE 100 PN10	-1.2	0.39	3.78	0.03
Pipe A349_A328	69.6651	64.2	130	HDPE-PE 100 PN10	0.44	0.14	0.52	0.035
Pipe A349_A351	54.01804	64.2	130	HDPE-PE 100 PN10	-1.73	0.54	6.42	0.028
Pipe A350_A345	24.15442	62.2	130	HDPE-PE 100 PN10	0.31	0.1	0.31	0.036
Pipe A350_A347	53.10535	62.2	130	HDPE-PE 100 PN10	0.63	0.21	1.16	0.033
Pipe A352_A351	2.226553	62.2	130	HDPE-PE 100 PN10	3.29	1.08	24.53	0.026
Pipe A352_A354	60.62994	64.2	130	HDPE-PE 100 PN10	0.83	0.25	1.63	0.032
Pipe A353_A350	42.56936	62.2	130	HDPE-PE 100 PN10	1.21	0.4	3.85	0.03
Pipe A353_A351	75.89282	62.2	130	HDPE-PE 100 PN10	-1.21	0.4	3.87	0.03
Pipe A354_A325	26.21052	64.2	130	HDPE-PE 100 PN10	-0.97	0.3	2.2	0.031
Pipe A355_A354	22.57333	64.2	130	HDPE-PE 100 PN10	-1.53	0.47	5.08	0.029
Pipe A356_A355	30.01763	64.2	130	HDPE-PE 100 PN10	-1.06	0.33	2.57	0.03
Pipe A356_A357	39.55784	64.2	130	HDPE-PE 100 PN10	0.59	0.18	0.88	0.033

Pipe A356_A361	30.48538	64.2	130	HDPE-PE 100 PN10	0.22	0.07	0.14	0.039
Pipe A357_A353	44.42472	62.2	130	HDPE-PE 100 PN10	0.41	0.14	0.53	0.035
Pipe A358_A357	10.50886	62.2	130	HDPE-PE 100 PN10	-0.01	0	0	0
Pipe A358_A363	31.98538	62.2	130	HDPE-PE 100 PN10	-0.4	0.13	0.5	0.035
Pipe A359_A324	29.1757	64.2	130	HDPE-PE 100 PN10	-0.62	0.19	0.97	0.033
Pipe A359_A355	14.27146	64.2	130	HDPE-PE 100 PN10	-0.37	0.11	0.36	0.035
Pipe A359_A360	32.99793	64.2	130	HDPE-PE 100 PN10	0.88	0.27	1.84	0.031
Pipe A360_A320	55.13184	64.2	130	HDPE-PE 100 PN10	0.15	0.05	0.07	0.041
Pipe A361_A360	30.64656	64.2	130	HDPE-PE 100 PN10	-0.44	0.14	0.51	0.035
Pipe A362_A322	67.96457	64.2	130	HDPE-PE 100 PN10	-0.03	0.01	0	0.057
Pipe A362_A361	17.49215	64.2	130	HDPE-PE 100 PN10	-0.51	0.16	0.68	0.034
Pipe A363_A362	4.042624	62.2	130	HDPE-PE 100 PN10	-0.45	0.15	0.59	0.033
Pipe A363_A364	21.5963	62.2	130	HDPE-PE 100 PN10	-0.03	0.01	0	0
Pipe A364_A323	61.58061	64.2	130	HDPE-PE 100 PN10	-0.07	0.02	0.02	0.046
Pipe A364_A365	25.6479	62.2	130	HDPE-PE 100 PN10	-0.14	0.05	0.07	0.042
Pipe A365_A366	20.35317	62.2	130	HDPE-PE 100 PN10	-0.7	0.23	1.39	0.032
Pipe A365_A376	37.18951	62.2	130	HDPE-PE 100 PN10	0.4	0.13	0.49	0.035
Pipe A366_A367	43.34678	64.2	130	HDPE-PE 100 PN10	-0.01	0	0	0
Pipe A366_A373	24.73868	64.2	130	HDPE-PE 100 PN10	-0.86	0.26	1.74	0.031

Pipe A367_A368	53.11661	64.2	130	HDPE-PE 100 PN10	0.62	0.19	0.95	0.033
Pipe A367_A372	24.98039	64.2	130	HDPE-PE 100 PN10	-0.89	0.27	1.86	0.031
Pipe A368_A358	13.38954	62.2	130	HDPE-PE 100 PN10	-0.32	0.11	0.32	0.036
Pipe A369_A368	53.20215	62.2	130	HDPE-PE 100 PN10	-0.75	0.25	1.57	0.032
Pipe A370_A369	61.27515	62.2	130	HDPE-PE 100 PN10	-0.75	0.25	1.59	0.032
Pipe A370_A371	65.85271	62.2	130	HDPE-PE 100 PN10	-0.79	0.26	1.74	0.032
Pipe A371_A369	49.43726	64.2	130	HDPE-PE 100 PN10	0.36	0.11	0.35	0.036
Pipe A372_A371	28.8433	64.2	130	HDPE-PE 100 PN10	1.62	0.5	5.67	0.029
Pipe A373_A372	46.11198	62.2	130	HDPE-PE 100 PN10	-0.14	0.05	0.07	0.04
Pipe A374_A239	171.09	62.2	130	HDPE-PE 100 PN10	1.66	0.55	6.91	0.028
Pipe A374_A372	43.81563	62.2	130	HDPE-PE 100 PN10	2.86	0.94	18.96	0.026
Pipe A375_A373	44.70949	62.2	130	HDPE-PE 100 PN10	0.96	0.32	2.5	0.031
Pipe A375_A374	49.43197	62.2	130	HDPE-PE 100 PN10	-2.49	0.82	14.61	0.027
Pipe A375_A378	40.7	62.2	130	HDPE-PE 100 PN10	1.29	0.42	4.33	0.029
Pipe A377_A376	51.70977	64.2	130	HDPE-PE 100 PN10	-0.2	0.06	0.12	0.039
Pipe A378_A377	43.03937	62.2	130	HDPE-PE 100 PN10	0.49	0.16	0.73	0.034
Pipe A378_A383	95.71043	62.2	130	HDPE-PE 100 PN10	0.36	0.12	0.4	0.035
Pipe A379_A380	23.91626	64.2	130	HDPE-PE 100 PN10	0.46	0.14	0.56	0.035
Pipe A380_A376	92.68228	62.2	130	HDPE-PE 100 PN10	0.09	0.03	0.03	0.043

Pipe A380_A381	12.84165	62.2	130	HDPE-PE 100 PN10	0.05	0.02	0.01	0.046
Pipe A381_A382	46.8401	64.2	130	HDPE-PE 100 PN10	0.36	0.11	0.34	0.036
Pipe A381_A384	45.47941	62.2	130	HDPE-PE 100 PN10	-0.51	0.17	0.78	0.034
Pipe A382_A377	95.98664	64.2	130	HDPE-PE 100 PN10	-0.16	0.05	0.08	0.04
Pipe A383_A382	43.52105	64.2	130	HDPE-PE 100 PN10	-0.03	0.01	0	0.038
Pipe A383_A386	44.67951	62.2	130	HDPE-PE 100 PN10	-0.22	0.07	0.16	0.038
Pipe A384_A387	57.35155	64.2	130	HDPE-PE 100 PN10	-1.26	0.39	3.56	0.03
Pipe A385_A384	47.08869	64.2	130	HDPE-PE 100 PN10	-0.33	0.1	0.29	0.036
Pipe A386_A385	42.54545	62.2	130	HDPE-PE 100 PN10	-0.49	0.16	0.72	0.034
Pipe A387_A316	24.03	62.2	130	HDPE-PE 100 PN10	-2.82	0.93	18.45	0.026
Pipe A387_A388	36.32305	62.2	130	HDPE-PE 100 PN10	1.43	0.47	5.23	0.029
Pipe A388_A385	45.48401	64.2	130	HDPE-PE 100 PN10	0.49	0.15	0.62	0.034
Pipe A388_A386	61.36165	62.2	130	HDPE-PE 100 PN10	0.57	0.19	0.96	0.033
Pipe A389_A390	49.13987	150	110	DI	0.6	0.03	0.02	0.053
Pipe A390_A391	158.4236	150	110	DI	0.12	0.01	0	0.06
Pipe A392_A391	229.9918	150	110	DI	1.01	0.06	0.05	0.047
Pipe A393_A392	191.3796	150	110	DI	1.53	0.09	0.11	0.044
Pipe A393_A394	252.4672	150	110	DI	-2.82	0.16	0.35	0.04
Pipe A394_A500	266.85	150	110	DI	-4.15	0.24	0.71	0.038
Pipe A395_A306	218.05	62.2	130	HDPE-PE 100 PN10	-0.68	0.22	1.32	0.032
Pipe A410_A302	40.50596	62.2	130	HDPE-PE 100 PN10	-0.36	0.12	0.41	0.036
Pipe A415_A184	107.8815	64.2	130	HDPE-PE 100 PN10	-0.71	0.22	1.24	0.032
Pipe A420_A329	135.078	64.2	130	HDPE-	-0.32	0.1	0.28	0.036

				PE 100 PN10				
Pipe A300_A305	93.8	150	110	DI	1.26	0.07	0.08	0.044
Pipe A001_A002	139.95	150	110	DI	5.6	0.32	1.23	0.036
Pipe A002_A084	48.85	62.2	130	HDPE-PE 100 PN10	0.91	0.3	2.29	0.031
Pipe A300_A291R	173.15	64.2	130	HDPE-PE 100 PN10	-0.47	0.14	0.57	0.034
Pipe A291_A284R	71.63	64.2	130	HDPE-PE 100 PN10	-1.19	0.37	3.23	0.03
Pipe A284_A269	103.04	64.2	130	HDPE-PE 100 PN10	1.1	0.34	2.76	0.03
Pipe A269_A265	122.73	64.2	130	HDPE-PE 100 PN10	0.26	0.08	0.19	0.037
Pipe A265_A262R	47.16	64.2	130	HDPE-PE 100 PN10	0.7	0.22	1.19	0.032
Pipe A262_A261	21.14	64.2	130	HDPE-PE 100 PN10	1.39	0.43	4.25	0.029
Pipe A261_A258R	93.96	64.2	130	HDPE-PE 100 PN10	1.14	0.35	2.94	0.03
Pipe A258_A256R	61.26	64.2	130	HDPE-PE 100 PN10	0.59	0.18	0.88	0.033
Pipe A256_A255	29.62	64.2	130	HDPE-PE 100 PN10	0.31	0.09	0.26	0.036
Pipe A255_A240R	35.2	64.2	130	HDPE-PE 100 PN10	0.39	0.12	0.4	0.035
Pipe A240_A230R	18.79	64.2	130	HDPE-PE 100 PN10	0.13	0.04	0.06	0.044
Pipe A232_A091	60.6	64.2	130	HDPE-PE 100 PN10	0.99	0.31	2.27	0.031
Pipe A091_A089	25.54	64.2	130	HDPE-PE 100 PN10	0.15	0.05	0.07	0.039
Pipe A089_A088	165.41	64.2	130	HDPE-PE 100 PN10	-0.91	0.28	1.94	0.031
Pipe A088_A001R	28.04	64.2	130	HDPE-PE 100 PN10	1.9	0.59	7.63	0.028
Pipe A001_A002R	138.49	64.2	130	HDPE-PE 100 PN10	1.15	0.36	3.02	0.03
Pipe A002_A003	148.52	64.2	130	HDPE-	-0.81	0.25	1.58	0.032

				PE 100 PN10				
Pipe A003_A004R	77.75	64.2	130	HDPE-PE 100 PN10	2.66	0.82	14.16	0.027
Pipe A004_A005R	47.85	64.2	130	HDPE-PE 100 PN10	0.35	0.11	0.32	0.036
Pipe A005_A006R	62.5	64.2	130	HDPE-PE 100 PN10	-0.93	0.29	2.04	0.031
Pipe A006_A007R	46.5	64.2	130	HDPE-PE 100 PN10	-2.53	0.78	12.94	0.027
Pipe A007_A008	81.35	64.2	130	HDPE-PE 100 PN10	0.28	0.09	0.23	0.037
Pipe A008_A009	62.02	64.2	130	HDPE-PE 100 PN10	3.32	1.03	21.43	0.026
Pipe A009_A010R	57.11	64.2	130	HDPE-PE 100 PN10	1.78	0.55	6.75	0.028
Pipe A013_A014R	39.93	64.2	130	HDPE-PE 100 PN10	-0.47	0.15	0.58	0.034
Pipe A020_A021R	23.15	64.2	130	HDPE-PE 100 PN10	-1.59	0.49	5.5	0.029
Pipe A022_A031	148.13	64.2	130	HDPE-PE 100 PN10	-2.34	0.72	11.23	0.027
Pipe A031_A177	190.12	64.2	130	HDPE-PE 100 PN10	-0.65	0.2	1.06	0.033
Pipe A177_A181	169.33	64.2	130	HDPE-PE 100 PN10	0.83	0.26	1.64	0.032
Pipe A181_A190R	30.74	64.2	130	HDPE-PE 100 PN10	-0.05	0.01	0.01	0.057
Pipe A010_A011R	115.24	64.2	130	HDPE-PE 100 PN10	1.07	0.33	2.63	0.03
Pipe A011_A012R	55.37	64.2	130	HDPE-PE 100 PN10	0.31	0.1	0.27	0.036
Pipe A014_A020R	136.99	64.2	130	HDPE-PE 100 PN10	-0.74	0.23	1.34	0.032
Pipe A021_A023	65.58	64.2	130	HDPE-PE 100 PN10	0.4	0.12	0.43	0.035
Pipe A012_A013	92.44	64.2	130	HDPE-PE 100 PN10	-0.12	0.04	0.05	0.042

Pipe A305_A308	125.86	64.2	130	HDPE-PE 100 PN10	-0.5	0.15	0.64	0.034
Pipe A308_A315	141.6	64.2	130	HDPE-PE 100 PN10	-1.33	0.41	3.93	0.029
Pipe A425_A395	67.87	62.2	130	HDPE-PE 100 PN10	0.17	0.06	0.1	0.039
Pipe A306_A425R	222.14	64.2	130	HDPE-PE 100 PN10	0.72	0.22	1.27	0.032
Pipe BALAJU_RES_Balaju_1_01	708.12	1000	110	DI	924.8	1.18	1.53	0.022
Pipe Balaju_1_01_Balaju_1_02	587.16	1000	110	DI	924.8	1.18	1.53	0.022
Pipe Balaju_1_02_DNI-10A	76.13	350	110	DI	26.94	0.28	0.36	0.032
Pipe Balaju_1_02_Balaju_1_03	92.42	900	110	DI	897.9	1.41	2.42	0.021
Pipe Balaju_1_03_Balaju_1_04	535.67	900	110	DI	897.9	1.41	2.42	0.021
Pipe Balaju_1_04_Balaju_1_05	370.27	900	110	DI	897.9	1.41	2.42	0.021
Pipe Balaju_1_05_DNI-10B	41.47	400	110	DI	87.99	0.7	1.7	0.027
Pipe Balaju_1_05_DNI-7	40.26	800	110	DI	689	1.37	2.63	0.022
Pipe Balaju_1_06_Balaju_1_07	510.85	400	110	DI	120.9	0.96	3.07	0.026
Pipe Balaju_1_05_Balaju_1_06	744.93	400	110	DI	120.9	0.96	3.07	0.026
Pipe Balaju_1_08_Balaju_12	238.67	400	110	DI	120.9	0.96	3.06	0.026
Pipe Balaju_12_A234	68.92	150	110	DI	-5.73	0.32	1.28	0.036
Pipe Balaju_1_07_Balaju_1_08	7.02	300	110	DI	120.9	1.71	12.44	0.025
Pipe 1	0.83	150	110	DI	4.54	0.26	0.9	0.04
Pipe 2	313.72	150	110	DI	-10.02	0.57	3.62	0.033
Pipe 3	315.74	150	110	DI	-16.39	0.93	8.99	0.031
Pipe 4	96.44	150	110	DI	10.14	0.57	3.7	0.033
Pipe 6	3.2	150	110	DI	6.37	0.36	1.53	0.035
Pipe 7	1.16	150	110	DI	31.73	1.8	30.54	0.028
Pipe 8	1.62	150	110	DI	5.27	0.3	1.1	0.037
Pipe 9	84.87	150	110	DI	5.73	0.32	1.29	0.036
Pipe 10	222.77	150	110	DI	-5.73	0.32	1.29	0.036
Pipe 11	248.37	150	110	DI	1.26	0.07	0.08	0.045
Pipe 14	279.85	150	110	DI	-2.59	0.15	0.3	0.04
Pipe 15	282.87	150	110	DI	-4.57	0.26	0.85	0.037
Pipe 16	320.68	150	110	DI	-7.83	0.44	2.29	0.034
Pipe 17	320.78	150	110	DI	-13.51	0.76	6.29	0.032

Pipe 19	365.72	150	110	DI	-3.97	0.22	0.65	0.038
Pipe 20	265.56	150	110	DI	-11.31	0.64	4.52	0.033
Pipe 21	271.3	150	110	DI	-11.31	0.64	4.52	0.033
Pipe 22	118.78	62.2	130	HDPE-PE 100 PN10	-0.9	0.3	2.22	0.031
Pipe 23	206.79	150	110	DI	1.26	0.07	0.08	0.045
Pipe 24	208.18	150	110	DI	-4.57	0.26	0.85	0.037
Pipe 25	2.8	400	110	DI	120.9	0.96	3.08	0.026
Pipe 26	68.52	400	110	DI	120.9	0.96	3.06	0.026
Pipe 27	280.5	350	110	DI	82.53	0.86	2.9	0.027
Pipe 28	370.51	150	110	DI	-3.61	0.2	0.55	0.039
Pipe 29	370.46	150	110	DI	-3.61	0.2	0.55	0.038
Pipe 30	273.49	150	110	DI	-3.61	0.2	0.55	0.039
Pipe 31	261.56	150	110	DI	4.15	0.24	0.71	0.038
Pipe 32	312.49	150	110	DI	4.15	0.24	0.71	0.038
Pipe 36	68.61	150	110	DI	10.14	0.57	3.7	0.033
Pipe 37	1.68	150	110	DI	8.94	0.51	2.92	0.034
Pipe 38	1.28	150	110	DI	5.24	0.3	1.05	0.035
Pipe 39	1.4	150	110	DI	8.54	0.48	2.66	0.033
Pipe 41	3.6	62.2	130	HDPE-PE 100 PN10	-3.48	1.15	27.24	0.025
Pipe 42	2.05	150	110	DI	7.34	0.42	2.03	0.035
Pipe 43	3.8	400	110	DI	107.3	0.85	2.47	0.027
Pipe 45	1.37	150	110	DI	2.21	0.12	0.22	0.041
Pipe 13	1.23	150	110	DI	4.48	0.25	0.73	0.033
Pipe 33	2.47	150	110	DI	3.85	0.22	0.6	0.037
Pipe 34	3.31	62.2	130	HDPE-PE 100 PN10	0.37	0.12	0.4	0.034
Pipe 35	1.48	150	110	DI	5.61	0.32	1.21	0.035
Pipe 40	108.89	150	110	DI	-26.65	1.51	22.12	0.029
Pipe 46	142.67	62.2	130	HDPE-PE 100 PN10	0.55	0.18	0.89	0.033
Pipe 47	61.4	62.2	130	HDPE-PE 100 PN10	-1.25	0.41	4.08	0.03
Pipe 48	103.25	62.2	130	HDPE-PE 100 PN10	-1.65	0.54	6.86	0.028
Pipe 49	97.39	62.2	130	HDPE-PE 100 PN10	-2.09	0.69	10.62	0.027
Pipe 50	265.33	150	110	DI	11.58	0.66	4.73	0.032
Pipe 51	140.92	150	110	DI	11.58	0.66	4.73	0.032

Pipe 52	1.06	150	110	DI	16.51	0.93	9.13	0.031
Pipe 53	1.43	62.2	130	HDPE-PE 100 PN10	4.54	1.49	44.65	0.024
Pipe 54	1.56	62.2	130	HDPE-PE 100 PN10	0.38	0.12	0.48	0.037
Pipe 55	1.3	150	110	DI	-1.98	0.11	0.23	0.054
Pipe 56	1.69	62.2	130	HDPE-PE 100 PN10	1.36	0.45	4.84	0.03
Pipe 57	1.34	62.2	130	HDPE-PE 100 PN10	6.71	2.21	91.96	0.023
Pipe 59	0.44	62.2	130	HDPE-PE 100 PN10	7.66	2.52	117.71	0.023
Pipe 60	0.52	62.2	130	HDPE-PE 100 PN10	6.72	2.21	92.16	0.023
Pipe 61	58.15	62.2	130	HDPE-PE 100 PN10	3.73	1.23	30.94	0.025
Pipe 62	171.96	62.2	130	HDPE-PE 100 PN10	3.16	1.04	22.85	0.026
Pipe 63	46.64	62.2	130	HDPE-PE 100 PN10	1.63	0.54	6.69	0.028
Pipe 64	98.33	62.2	130	HDPE-PE 100 PN10	0.71	0.23	1.44	0.032
Pipe 65	3.9	62.2	130	HDPE-PE 100 PN10	0.45	0.15	0.61	0.034
Pipe 66	86.23	62.2	130	HDPE-PE 100 PN10	0.09	0.03	0.03	0.045
Pipe 67	64.9	62.2	130	HDPE-PE 100 PN10	-0.54	0.18	0.86	0.033
Pipe 68	56.46	62.2	130	HDPE-PE 100 PN10	-1.04	0.34	2.89	0.03
Pipe 69	30.34	62.2	130	HDPE-PE 100 PN10	-1.19	0.39	3.76	0.03
Pipe 70	8.44	62.2	130	HDPE-PE 100 PN10	-2.29	0.75	12.59	0.027
Pipe 71	23.76	62.2	130	HDPE-PE 100 PN10	-0.48	0.16	0.7	0.034
Pipe 72	24.62	62.2	130	HDPE-PE 100 PN10	-0.89	0.29	2.19	0.031

Pipe 73	119.62	62.2	130	HDPE-PE 100 PN10	-1.15	0.38	3.49	0.03
Pipe 74	60.31	62.2	130	HDPE-PE 100 PN10	-1.78	0.58	7.85	0.028
Pipe 75	1.49	150	110	DI	1.32	0.07	0	0
Pipe 76	1.36	150	110	DI	2.08	0.12	0.22	0.046
Pipe 77	1.28	150	110	DI	7.29	0.41	2.09	0.036
Pipe 78	267	150	110	DI	-8.05	0.46	2.41	0.034
Pipe 79	248.07	150	110	DI	-8.05	0.46	2.41	0.034
Pipe 80	129.7	150	110	DI	-17.35	0.98	9.99	0.031
Pipe 81	229.7	150	110	DI	-17.35	0.98	9.99	0.031
Pipe 82	1.31	150	110	DI	9.29	0.53	3.18	0.034
Pipe 83	1.64	150	110	DI	4.87	0.28	0.91	0.035
Pipe 84	58.42	150	110	DI	7.77	0.44	2.26	0.034
Valve 5	#N/A	150	#N/A		13.57	0.77	0.81	0
Valve 12	#N/A	150	#N/A		24.82	1.4	0.63	0
Valve 18	#N/A	250	#N/A		74.76	1.52	4.95	0

Table 6.7.Details of Pressure for DNI A (at peak time 7.00)

Node ID	Elevation	Base Demand	**Peak Demand (LPS)**	Head	Pressure
	m	LPS	LPS	m	m
Junc A001	1285.791	0	0	1320.7	34.87
Junc A002	1283.954	0	0	1320.5	36.54
Junc A003	1283.113	0	0	1320.3	37.2
Junc A004	1282.072	0	0	1320.1	38.07
Junc A005	1281.849	0	0	1320	38.19
Junc A006	1281.831	0	0	1319.9	38.07
Junc A007	1281.722	0	0	1319.8	38.08
Junc A008	1281.347	0	0	1319.8	38.43
Junc A009	1281.148	0	0	1319.8	38.63
Junc A010	1281.353	0	0	1319.8	38.42
Junc A011	1281.546	0	0	1319.8	38.22
Junc A012	1284.293	0	0	1319.8	35.47
Junc A013	1283.753	0	0	1319.8	36.01
Junc A014	1286.099	0	0	1319.8	33.66
Junc A016	1285.044	0.147334	0.22	1317.8	32.71
Junc A017	1285.02	0.182021	0.27	1317.8	32.74
Junc A018	1285.48	0.384798	0.58	1317.8	32.26
Junc A019	1285.346	0.309862	0.46	1317.9	32.57
Junc A020	1287.94	0	0	1319.8	31.81
Junc A021	1288.23	0	0	1319.8	31.52
Junc A022	1287.66	0.348855	0.52	1319.8	32.09

Junc A023	1284.599	0.140189	0.21	1318.1	33.46
Junc A024	1284.568	0.206096	0.31	1318.1	33.5
Junc A025	1283.432	0.32893	0.49	1318.3	34.86
Junc A026	1283.014	0.154915	0.23	1318.3	35.33
Junc A027	1284.281	0.642545	0.96	1318.3	33.97
Junc A028	1282.905	0.087162	0.13	1318.5	35.58
Junc A029	1283.137	0.115954	0.17	1318.4	35.29
Junc A030	1283.214	0.303416	0.46	1319.3	36.07
Junc A031	1292.99	0	0	1319.8	26.76
Junc A032	1293.37	0.214452	0.32	1319.1	25.71
Junc A033	1291.44	0.388013	0.58	1319	27.6
Junc A034	1290.325	0.375962	0.56	1318.5	28.14
Junc A035	1288.908	0.652862	0.98	1318.4	29.47
Junc A036	1294.72	0.37719	0.57	1318.1	23.37
Junc A037	1285.71	0.096903	0.15	1318	32.33
Junc A038	1285.71	0.389106	0.58	1318	32.31
Junc A039	1285.977	0.12256	0.18	1317.9	31.89
Junc A040	1286.393	0.237497	0.36	1317.9	31.47
Junc A041	1286.089	0.071021	0.11	1317.9	31.76
Junc A042	1288.899	0.126233	0.19	1317.8	28.94
Junc A043	1286.009	0.066016	0.1	1317.8	31.83
Junc A044	1290.227	0.081566	0.12	1317.8	27.61
Junc A045	1285.793	0.095284	0.14	1318	32.24
Junc A046	1285.33	0.099974	0.15	1318	32.71
Junc A047	1284.851	0.169369	0.25	1318.9	34.03
Junc A048	1285.88	0.118079	0.18	1318.1	32.17
Junc A049	1283.986	0.274615	0.41	1318.8	34.83
Junc A050	1285.85	0.081355	0.12	1318.1	32.22
Junc A051	1285.28	0.078264	0.12	1318.1	32.8
Junc A052	1284.6	0.122171	0.18	1318.6	34
Junc A053	1284.027	0.283112	0.42	1318.6	34.55
Junc A054	1284.55	0.039824	0.06	1318.6	34.04
Junc A055	1284.422	0.05341	0.08	1318.6	34.17
Junc A056	1284.55	0.030985	0.05	1318.6	34.04
Junc A057	1284.403	0.081336	0.12	1318.6	34.18
Junc A058	1284.68	0.029662	0.04	1318.6	33.9
Junc A059	1282.431	0.205013	0.31	1319	36.57
Junc A060	1282.613	0.120625	0.18	1319.1	36.44
Junc A061	1283.793	0.157726	0.24	1319.1	35.26
Junc A062	1284.68	0.04793	0.07	1318.5	33.86
Junc A063	1284.851	0.205721	0.31	1318.5	33.67
Junc A064	1284.53	0.065974	0.1	1318.5	33.95
Junc A065	1285.132	0.178781	0.27	1318.5	33.33
Junc A066	1284.73	0.075935	0.11	1318.5	33.72

Junc A067	1284.573	0.060425	0.09	1318.5	33.87
Junc A068	1284.57	0.156604	0.23	1318.4	33.86
Junc A069	1284.398	0.24865	0.37	1318.4	34.03
Junc A070	1285.13	0.260168	0.39	1318.4	33.3
Junc A071	1285.02	0.094292	0.14	1318.4	33.39
Junc A072	1284.96	0.355334	0.53	1318.4	33.43
Junc A073	1285.208	0.058419	0.09	1318.3	33.11
Junc A074	1285.195	0.127595	0.19	1318.3	33.12
Junc A075	1285.222	0.031216	0.05	1318.3	33.09
Junc A076	1285.259	0.099391	0.15	1318.3	33.05
Junc A077	1285.236	0.168194	0.25	1318.3	33.07
Junc A078	1285.29	0.604905	0.91	1318.5	33.2
Junc A079	1285.59	0.19263	0.29	1318.4	32.84
Junc A080	1285.75	0.208716	0.31	1320	34.27
Junc A081	1285.148	0.429763	0.64	1319.9	34.77
Junc A082	1285.861	0.313587	0.47	1319.9	34.05
Junc A083	1285.405	0.042045	0.06	1319.9	34.53
Junc A084	1285.41	0.25576	0.38	1320	34.54
Junc A085	1286.706	0.394003	0.59	1319.7	32.96
Junc A086	1286.909	0.287478	0.43	1319.6	32.73
Junc A087	1286.987	0.251749	0.38	1319.6	32.66
Junc A088	1286.247	0	0	1320.7	34.45
Junc A089	1288.44	0.038871	0.06	1320.4	31.94
Junc A090	1288.4	0.048919	0.07	1320.3	31.94
Junc A091	1289.45	0.127653	0.19	1320.4	30.93
Junc A092	1287.81	0.062168	0.09	1320.3	32.46
Junc A093	1288.426	0.252827	0.38	1320.3	31.82
Junc A094	1287.5	0.051458	0.08	1320.2	32.73
Junc A095	1287.5	0.107927	0.16	1320.2	32.69
Junc A096	1287.466	0.159742	0.24	1320.2	32.71
Junc A097	1287.19	0.098608	0.15	1319.9	32.73
Junc A099	1287.18	0.050129	0.08	1319.9	32.73
Junc A100	1287.237	0.187534	0.28	1319.9	32.66
Junc A101	1287.36	0.110246	0.17	1319.9	32.53
Junc A102	1287.42	0.096646	0.14	1319.9	32.46
Junc A103	1286.93	0.195346	0.29	1319.9	32.94
Junc A104	1287.452	0.16269	0.24	1319.9	32.41
Junc A105	1286.94	0.217918	0.33	1319.9	32.93
Junc A107	1285.471	0.210095	0.32	1318.4	32.89
Junc A108	1285.54	0.269052	0.4	1320.4	34.87
Junc A109	1285.722	0.270818	0.41	1318.4	32.63
Junc A110	1286.521	0.197215	0.3	1317.6	31.07
Junc A111	1285.364	0.236557	0.35	1317.6	32.21
Junc A112	1286.713	0.073489	0.11	1317.5	30.81

Junc A113	1286.57	0.441935	0.66	1317.5	30.91
Junc A114	1287.818	0.111453	0.17	1317.5	29.65
Junc A115	1290.37	0.721791	1.08	1317.2	26.78
Junc A116	1290.459	0.234106	0.35	1317.5	27.02
Junc A117	1291.699	0.147583	0.22	1317.5	25.84
Junc A118	1288.535	0.178343	0.27	1317.5	29
Junc A119	1291.462	0.361794	0.54	1317.7	26.25
Junc A120	1288.86	0.224543	0.34	1317.7	28.83
Junc A121	1288.658	0.215874	0.32	1318.3	29.63
Junc A122	1287.647	0.121394	0.18	1318.3	30.68
Junc A123	1286.8	0.124327	0.19	1318.3	31.54
Junc A124	1286.088	0.138181	0.21	1318.3	32.25
Junc A125	1286.38	0.098074	0.15	1319	32.6
Junc A126	1286.08	0.12302	0.18	1318.5	32.43
Junc A127	1285.75	0.064717	0.1	1318.4	32.65
Junc A128	1285.85	0.055779	0.08	1318.4	32.55
Junc A129	1285.53	0.10711	0.16	1318.4	32.82
Junc A130	1285.345	0.195409	0.29	1318.4	33.03
Junc A131	1285.227	0.171946	0.26	1318.4	33.14
Junc A132	1285.17	0.203302	0.3	1318.4	33.2
Junc A133	1285.169	0.133064	0.2	1318.4	33.2
Junc A134	1285.48	0.108356	0.16	1318.1	32.66
Junc A135	1285.83	0.086425	0.13	1318.1	32.3
Junc A136	1285.802	0.101765	0.15	1318.1	32.33
Junc A137	1286.02	0.105022	0.16	1318.5	32.44
Junc A138	1285.991	0.017045	0.03	1318.5	32.47
Junc A139	1290.073	0.017045	0.03	1318.5	28.37
Junc A140	1297.778	0.177341	0.27	1318.4	20.66
Junc A141	1298.712	0.078403	0.12	1318.4	19.73
Junc A142	1286.42	0.213876	0.32	1319.1	32.72
Junc A143	1288.402	0.211388	0.32	1319.3	30.93
Junc A144	1288.28	0.05235	0.08	1319.9	31.58
Junc A145	1295.888	0.141905	0.21	1319.9	23.96
Junc A146	1288.28	0.033135	0.05	1319.9	31.65
Junc A147	1287.51	0.184524	0.28	1319.7	32.17
Junc A148	1288.05	0.175053	0.26	1318.4	30.32
Junc A149	1287.869	0.138441	0.21	1318.4	30.49
Junc A150	1291.626	0.108789	0.16	1321	29.34
Junc A151	1291.128	0.081419	0.12	1321	29.84
Junc A152	1292.278	0.194143	0.29	1321	28.68
Junc A153	1289.34	0.14209	0.21	1321	31.61
Junc A154	1288.24	0.129084	0.19	1321	32.78
Junc A155	1288.84	0.089247	0.13	1320.2	31.39
Junc A156	1298.744	0.117112	0.18	1320.2	21.48

Junc A157	1289.11	0.064539	0.1	1319.9	30.74
Junc A158	1304.101	0.225743	0.34	1319.1	14.98
Junc A159	1300.913	0.156527	0.23	1319.1	18.17
Junc A160	1289.42	0.165947	0.25	1319.8	30.42
Junc A161	1297.831	0.301071	0.45	1319.8	21.99
Junc A162	1301.84	0.195947	0.29	1318.6	16.77
Junc A163	1301.69	0.119134	0.18	1318.5	16.83
Junc A164	1297.635	0.179867	0.27	1318.5	20.88
Junc A165	1301.69	0.153915	0.23	1318.5	16.79
Junc A166	1301.7	0.097917	0.15	1318.2	16.48
Junc A167	1299.197	0.262828	0.39	1318.2	18.95
Junc A168	1301.19	0.115121	0.17	1318.1	16.95
Junc A169	1295.161	0.459532	0.69	1318.1	22.93
Junc A170	1300.17	0.132753	0.2	1318.1	17.92
Junc A171	1299.393	0.25474	0.38	1318.1	18.68
Junc A172	1297.11	0.14052	0.21	1318.1	20.98
Junc A173	1299.152	0.196014	0.29	1318.1	18.92
Junc A174	1301.81	0.626858	0.94	1318.6	16.8
Junc A175	1302.17	0.394989	0.59	1319.4	17.27
Junc A176	1302.093	0.336932	0.51	1319.4	17.33
Junc A177	1303.18	0	0	1320	16.77
Junc A178	1301.849	0.195903	0.29	1318.1	16.23
Junc A179	1302.338	0.447576	0.67	1318.1	15.72
Junc A180	1301.086	0.271762	0.41	1318.1	16.98
Junc A181	1304.33	0	0	1320.6	16.23
Junc A182	1304.12	0.152104	0.23	1319.7	15.53
Junc A183	1303.964	0.525531	0.79	1319.6	15.66
Junc A184	1292.912	0.106575	0.16	1319.8	26.89
Junc A185	1292.057	0.338145	0.51	1319.8	27.72
Junc A186	1291.76	0.139974	0.21	1319.9	28.09
Junc A187	1291.76	0.022102	0.03	1319.9	28.14
Junc A188	1291.83	0.337629	0.51	1319.9	28.05
Junc A189	1292.356	0.221799	0.33	1320.1	27.71
Junc A430	1302.01	0.05	0.08	1326.5	24.47
Junc A190	1304.4	0	0	1320.7	16.28
Junc A191	1303.5	0.282902	0.42	1319.8	16.31
Junc A192	1302.199	0.224776	0.34	1319.8	17.6
Junc A193	1303.93	0.280136	0.42	1320.2	16.24
Junc A194	1303.88	0.555869	0.83	1321.8	17.93
Junc A195	1296.54	0.41293	0.62	1321	24.42
Junc A196	1294.532	0.234324	0.35	1321	26.43
Junc A197	1301.501	0.078231	0.12	1321	19.5
Junc A198	1301.551	0.122047	0.18	1321	19.46
Junc A199	1303.006	0.235104	0.35	1321	17.99

Junc A200	1304.65	0.276027	0.41	1321.7	17.08
Junc A201	1299.45	0.230419	0.35	1321	21.51
Junc A202	1294.184	0.312045	0.47	1321	26.77
Junc A203	1298.501	0.149229	0.22	1321	22.47
Junc A204	1298.51	0.060795	0.09	1321	22.46
Junc A205	1301.75	0.155251	0.23	1321	19.21
Junc A206	1298.553	0.083929	0.13	1321	22.43
Junc A207	1301.449	0.190764	0.29	1321	19.52
Junc A208	1298.862	0.129796	0.19	1321	22.17
Junc A209	1299.956	0.198524	0.3	1321	21.07
Junc A210	1297.199	0.198716	0.3	1321	23.78
Junc A211	1296.903	0.187896	0.28	1321	24.07
Junc A212	1296.726	0.420953	0.63	1321.2	24.43
Junc A213	1297.165	0.078358	0.12	1321.2	24.02
Junc A214	1297.676	0.076043	0.11	1321.2	23.51
Junc A215	1297.707	0.181768	0.27	1321.3	23.57
Junc A216	1297.754	0.115349	0.17	1321.3	23.53
Junc A217	1300.655	0.320569	0.48	1322.3	21.68
Junc A218	1302.65	0.107391	0.16	1324.6	21.91
Junc A219	1302.11	0.16406	0.25	1324.2	22.08
Junc A220	1302.843	0.179055	0.27	1324.2	21.34
Junc A221	1304.565	0.172547	0.26	1322.2	17.58
Junc A222	1303.752	0.162516	0.24	1322.1	18.38
Junc A223	1304.04	0.26033	0.39	1323	18.93
Junc A224	1301.953	0.164878	0.25	1323	21.01
Junc A225	1296.66	0.1143	0.17	1322.6	25.97
Junc A226	1296.82	0.178816	0.27	1322.2	25.41
Junc A227	1286.303	0.62891	0.94	1319.5	33.2
Junc A228	1286.513	0.292996	0.44	1321.1	34.57
Junc A229	1289.78	0.048296	0.07	1320.7	30.95
Junc A230	1290.25	0.020366	0.03	1328	37.78
Junc A231	1286.938	0.252817	0.38	1317.5	30.51
Junc A232	1290.25	0.070306	0.11	1320.5	30.27
Junc A233	1289.61	0.047055	0.07	1328	38.42
Junc A234	1289.78	0.056731	0.09	1326.1	36.36
Junc A235	1290.63	0.142421	0.21	1326.1	35.49
Junc A236	1296.82	0.144282	0.22	1326.1	29.25
Junc A237	1297.06	0.200948	0.3	1326	28.98
Junc A238	1301.9	0.139897	0.21	1326	24.14
Junc A239	1303.84	0.347186	0.52	1326.2	22.33
Junc A240	1290.57	0.053641	0.08	1328	37.46
Junc A241	1289.33	0.09446	0.14	1328	38.7
Junc A242	1289.81	0.063789	0.1	1328	38.22
Junc A243	1289.33	0.02736	0.04	1328	38.7

Junc A244	1289.449	0.017439	0.03	1328	38.58
Junc A245	1289.28	0.033561	0.05	1328	38.75
Junc A246	1290.09	0.044624	0.07	1328	37.94
Junc A247	1290.38	0.054965	0.08	1328	37.65
Junc A248	1289.051	0.044616	0.07	1328	38.97
Junc A249	1289.822	0.022937	0.03	1328	38.2
Junc A250	1290.67	0.21625	0.32	1328	37.37
Junc A251	1289.522	0.096276	0.14	1328.1	38.53
Junc A252	1289.598	0.06128	0.09	1328.1	38.45
Junc A253	1290.595	0.042686	0.06	1328	37.45
Junc A254	1290.203	0.01756	0.03	1328	37.84
Junc A255	1291.527	0.038742	0.06	1328	36.52
Junc A256	1290.862	0.08888	0.13	1328.1	37.19
Junc A257	1291.312	0.190528	0.29	1328.1	36.79
Junc A258	1292.495	0.102272	0.15	1328.1	35.61
Junc A259	1292.01	0.152405	0.23	1328.1	36.1
Junc A260	1292.84	0.175649	0.26	1328.4	35.54
Junc A261	1294.343	0.093381	0.14	1328.4	34.04
Junc A262	1293.933	0.037689	0.06	1328.5	34.54
Junc A263	1293.99	0.088662	0.13	1328.5	34.51
Junc A264	1293.16	0.116253	0.17	1328.5	35.34
Junc A265	1296.369	0.06	0.09	1328.5	32.16
Junc A266	1295.43	0.175402	0.26	1328.5	33.11
Junc A267	1294.907	0.195722	0.29	1328.6	33.68
Junc A268	1293.54	0.13385	0.2	1328.9	35.33
Junc A269	1300.994	0.081984	0.12	1328.6	27.56
Junc A270	1300.994	0.219994	0.33	1328.5	27.55
Junc A271	1297.823	0.140539	0.21	1328.5	30.71
Junc A272	1297.681	0.226318	0.34	1328.5	30.86
Junc A273	1294.89	0.143765	0.22	1328.6	33.68
Junc A274	1297.976	0.276109	0.41	1328.5	30.55
Junc A275	1296.96	0.187276	0.28	1328.5	31.57
Junc A276	1296.97	0.097738	0.15	1328.5	31.57
Junc A277	1304.291	0.216323	0.32	1328.5	24.24
Junc A278	1299.17	0.209217	0.31	1328.5	29.36
Junc A279	1298.78	0.15494	0.23	1328.5	29.76
Junc A280	1303.879	0.184134	0.28	1328.6	24.67
Junc A281	1300.45	0.249966	0.37	1328.6	28.14
Junc A282	1304.334	0.301761	0.45	1328.6	24.22
Junc A283	1301.52	0.099632	0.15	1328.8	27.27
Junc A284	1307.68	0.102194	0.15	1328.8	21.15
Junc A285	1305.823	0.162115	0.24	1328.6	22.77
Junc A286	1306.055	0.347061	0.52	1328.5	22.48
Junc A287	1307.422	0.137354	0.21	1328.5	21.12

Junc A288	1308.05	0.121157	0.18	1328.5	20.49
Junc A289	1309.542	0.138709	0.21	1328.5	18.96
Junc A290	1310.154	0.291255	0.44	1328.5	18.34
Junc A291	1310.027	0.10558	0.16	1328.6	18.58
Junc A292	1310.122	0.479237	0.72	1328.5	18.38
Junc A293	1309.929	0.108137	0.16	1328.5	18.58
Junc A294	1309.259	0.084431	0.13	1328.5	19.25
Junc A295	1307.614	0.107819	0.16	1328.5	20.91
Junc A296	1306.833	0.09905	0.15	1328.5	21.69
Junc A297	1306.71	0.147384	0.22	1328.5	21.81
Junc A298	1309.419	0.097509	0.15	1328.5	19.09
Junc A299	1307.717	0.18091	0.27	1328.5	20.8
Junc A300	1311.83	0.222886	0.33	1328.5	16.67
Junc A301	1310.48	0.308165	0.46	1328.5	18.02
Junc A302	1308.08	0.152029	0.23	1328.5	20.45
Junc A303	1307.32	0.066645	0.1	1326.4	19.11
Junc A304	1307.32	0.14114	0.21	1326.4	19.11
Junc A305	1310.18	0	0	1328.8	18.63
Junc A306	1316.03	0.537669	0.81	1328.8	12.76
Junc A307	1307.806	0.18318	0.27	1326.5	18.64
Junc A308	1309.08	0.309493	0.46	1326.5	17.37
Junc A309	1304.933	0.412534	0.62	1326.5	21.52
Junc A310	1302.95	0.15669	0.24	1326.5	23.58
Junc A311	1304.14	0.205013	0.31	1326.5	22.38
Junc A312	1302.01	0.093318	0.14	1326.5	24.47
Junc A313	1302.13	0.236156	0.35	1326.5	24.35
Junc A314	1303.19	0.02048	0.03	1326.6	23.39
Junc A315	1308.68	0.090137	0.14	1327	18.33
Junc A316	1308.68	0.022063	0.03	1327.1	18.43
Junc A317	1303.19	0.107598	0.16	1326.6	23.42
Junc A318	1302.52	0.158783	0.24	1326.5	24.01
Junc A319	1299.69	0.122772	0.18	1326.5	26.79
Junc A320	1299.26	0.171534	0.26	1326.5	27.21
Junc A321	1300.188	0.150622	0.23	1326.5	26.27
Junc A322	1305.19	0.0852	0.13	1326.4	21.25
Junc A323	1306.919	0.145016	0.22	1326.4	19.52
Junc A324	1295.8	0.06578	0.1	1326.6	30.76
Junc A325	1294.89	0.164172	0.25	1326.7	31.82
Junc A326	1294.31	0.091039	0.14	1327.8	33.45
Junc A327	1292.21	0.159689	0.24	1326.4	34.17
Junc A328	1292.75	0.169409	0.25	1326.3	33.56
Junc A329	1300.299	0.127338	0.19	1326.2	25.87
Junc A330	1300.479	0.066505	0.1	1326.2	25.68
Junc A331	1294.166	0.124137	0.19	1326.1	31.92

Junc A332	1301.526	0.12129	0.18	1326.2	24.63
Junc A333	1302.783	0.110908	0.17	1326.1	23.34
Junc A334	1302.164	0.066793	0.1	1326.1	23.96
Junc A335	1303.065	0.196302	0.29	1326.1	23.06
Junc A336	1301.848	0.079975	0.12	1326	24.18
Junc A337	1301.887	0.062102	0.09	1326	24.14
Junc A338	1301.329	0.066887	0.1	1326	24.64
Junc A339	1301.04	0.158578	0.24	1326	24.93
Junc A340	1300.621	0.344776	0.52	1325.9	25.32
Junc A341	1301.407	0.188347	0.28	1326	24.62
Junc A342	1297.4	0.226125	0.34	1326	28.63
Junc A343	1304.366	0.439828	0.66	1326.1	21.78
Junc A344	1302.524	0.23113	0.35	1326.2	23.65
Junc A345	1303.727	0.20054	0.3	1326.2	22.5
Junc A346	1304.081	0.121673	0.18	1326.2	22.09
Junc A347	1304.075	0.108811	0.16	1326.2	22.1
Junc A348	1304.832	0.256057	0.38	1326.2	21.35
Junc A349	1301.999	0.298475	0.45	1326.4	24.35
Junc A350	1303.986	0.17659	0.26	1326.2	22.25
Junc A351	1301.379	0.228209	0.34	1326.7	25.32
Junc A352	1300.506	0.087495	0.13	1326.8	26.24
Junc A353	1306.212	0.277958	0.42	1326.4	20.19
Junc A354	1304.39	0.181092	0.27	1326.7	22.26
Junc A355	1303.793	0.065514	0.1	1326.5	22.74
Junc A356	1305.625	0.16429	0.25	1326.5	20.83
Junc A357	1307.398	0.111333	0.17	1326.4	19.03
Junc A358	1307.381	0.062043	0.09	1326.4	19.04
Junc A359	1302.614	0.07596	0.11	1326.5	23.92
Junc A360	1300.57	0.194072	0.29	1326.5	25.9
Junc A361	1304.164	0.096652	0.14	1326.5	22.29
Junc A362	1305.669	0.067442	0.1	1326.4	20.77
Junc A363	1305.969	0.045939	0.07	1326.4	20.47
Junc A364	1307.205	0.12381	0.19	1326.4	19.23
Junc A365	1307.284	0.10891	0.16	1326.4	19.16
Junc A366	1307.369	0.111219	0.17	1326.5	19.1
Junc A367	1307.906	0.173837	0.26	1326.5	18.56
Junc A368	1307.66	0.128046	0.19	1326.4	18.76
Junc A369	1306.339	0.234068	0.35	1326.3	20
Junc A370	1304.851	0.22867	0.34	1326.2	21.39
Junc A371	1306.319	0.316298	0.47	1326.4	20.03
Junc A372	1307.334	0.138979	0.21	1326.5	19.18
Junc A373	1307.47	0.164579	0.25	1326.5	19.04
Junc A374	1306.8	0.220261	0.33	1327.4	20.55
Junc A375	1307.38	0.158392	0.24	1326.6	19.25

Junc A376	1307.892	0.194608	0.29	1326.4	18.53
Junc A377	1307.955	0.353753	0.53	1326.4	18.46
Junc A378	1307.83	0.293129	0.44	1326.5	18.62
Junc A379	1304.035	0.321319	0.48	1326.4	22.4
Junc A380	1307.766	0.211838	0.32	1326.4	18.66
Junc A381	1307.655	0.13825	0.21	1326.4	18.77
Junc A382	1308.178	0.32028	0.48	1326.4	18.23
Junc A383	1308.43	0.407072	0.61	1326.4	17.98
Junc A384	1307.472	0.280218	0.42	1326.5	18.99
Junc A385	1308.501	0.218008	0.33	1326.5	17.95
Junc A386	1308.78	0.562325	0.84	1326.4	17.64
Junc A387	1309.47	0.088017	0.13	1326.7	17.2
Junc A388	1309.39	0.244847	0.37	1326.5	17.09
Junc A389	1313.07	0.534137	0.8	1328.8	15.68
Junc A390	1312.77	0.322824	0.48	1328.8	15.98
Junc A391	1313.44	0.752881	1.13	1328.8	15.31
Junc A392	1312.79	0.350032	0.53	1328.8	15.97
Junc A393	1310.07	0.85718	1.29	1328.8	18.71
Junc A394	1306.58	0.889002	1.33	1328.9	22.29
Junc A395	1310.66	0.564783	0.85	1328.5	17.84
Junc A400	1286.723	0.418631	0.63	1319.9	33.13
Junc A405	1286.841	0.373807	0.56	1319.8	32.99
Junc A410	1308.977	0.253835	0.38	1328.5	19.53
Junc A415	1302.193	0.287167	0.43	1319.7	17.48
Junc A420	1295.102	0.111831	0.17	1326.1	31.02
Junc A425	1311.64	0.369131	0.55	1328.5	16.86
Junc A500	1304.4	0	0	1329.1	24.66
Junc Balaju_12	1290.25	0	0	1330.6	40.39
Junc Balaju_1_01	1320	0	0	1338.6	18.62
Junc Balaju_1_02	1291	0	0	1337.7	46.72
Junc DNI-10A	1290	17.96	26.94	1337.7	47.69
Junc Balaju_1_03	1295.37	0	0	1337.5	42.13
Junc Balaju_1_04	1292.36	0	0	1336.2	43.84
Junc Balaju_1_05	1291	0	0	1335.3	44.3
Junc DNI-10B	1291	58.66	87.99	1335.2	44.23
Junc DNI-7	1291	459.3	688.95	1335.2	44.2
Junc Balaju_1_06	1285.8	0	0	1333	47.22
Junc Balaju_1_07	1285.5	0	0	1331.5	45.96

Junc Balaju_1_08	1285.5	0	0	1331.4	45.87
Junc A501	1290	0	0	1330.6	40.63
Junc 1	1286.247	0.138502	0.21	1320.7	34.45
Junc 2	1285.791	0.498958	0.75	1320.5	34.69
Junc 3	1283.954	0.701001	1.05	1320.1	36.11
Junc 4	1283.113	1.021395	1.53	1320.2	37.07
Junc 5	1282.072	0.534566	0.8	1319.1	37.01
Junc 6	1281.849	0.23803	0.36	1319.1	37.22
Junc 7	1281.831	0.267999	0.4	1319.2	37.37
Junc 8	1281.722	0.429723	0.64	1319.8	38.08
Junc 9	1281.347	0.392206	0.59	1319.8	38.43
Junc 10	1281.148	0.314029	0.47	1318.5	37.3
Junc 11	1281.353	0.458139	0.69	1318.1	36.71
Junc 12	1281.546	0.446078	0.67	1317.8	36.21
Junc 13	1284.293	0.290621	0.44	1317.8	33.45
Junc 14	1283.753	0.33938	0.51	1317.8	34
Junc 15	1286.099	0.18	0.27	1317.8	31.67
Junc 16	1287.94	0.265147	0.4	1318	30.02
Junc 17	1288.23	0.230904	0.35	1318.1	29.85
Junc 18	1292.99	0.071946	0.11	1319.8	26.76
Junc 19	1303.18	0.094293	0.14	1320	16.77
Junc 20	1304.33	0.093062	0.14	1319.7	15.34
Junc 21	1304.4	0.384295	0.58	1319.7	15.27
Junc 22	1303.88	0	0	1321.8	17.93
Junc 23	1302.65	0	0	1324.7	22
Junc 24	1290.25	0	0	1321.6	31.38
Junc 25	1288.44	0	0	1321.3	32.87
Junc 26	1289.45	0	0	1321.4	31.95
Junc 27	1290.862	0	0	1329.4	38.55
Junc 28	1296.369	0	0	1329.1	32.76
Junc 29	1307.68	0	0	1328.8	21.15
Junc 30	1300.994	0	0	1329	27.97
Junc 31	1290	0	0	1329.5	39.52
Junc 32	1311.83	0	0	1328.8	16.99
Junc 33	1310.18	0.650197	0.98	1326.4	16.19
Junc 34	1309.08	0	0	1327.2	18.16
Junc 36	1302.01	0	0	1328.8	26.78
Junc 37	1302.01	0	0	1327.5	25.51
Junc 38	1293.54	0	0	1328.9	35.33
Junc 39	1294.31	0	0	1327.8	33.45
Junc 40	1289.61	0	0	1329.6	40
Junc 41	1289.78	0	0	1329.8	40
Junc 42	1308.68	0	0	1327.1	18.43
Junc 43	1307.83	0	0	1327.4	19.52

Junc 44	1303.84	0	0	1328.6	24.71
Junc 45	1310.18	0	0	1327.4	17.17
Junc 46	1289.61	0	0	1330.4	40.81
Junc 47	1303.84	0	0	1329.5	25.62
Junc 48	1311.64	0	0	1328.9	17.27
Junc 49	1308.68	0	0	1329.1	20.43
Junc 50	1307.83	0	0	1329.3	21.48
Junc 51	1303.88	0	0	1329.3	25.4
Junc 53	1289.61	0	0	1321.9	32.27
Junc 54	1289.61	0	0	1330.4	40.8
Junc 56	1316.03	0	0	1328.8	12.76
Junc 35	1296.82	0	0	1322.2	25.42
Junc 52	1296.82	0	0	1322.2	25.35
Junc 55	1285.59	0	0	1321	35.39
Junc 57	1285.59	0	0	1320.2	34.58
Junc 58	1285.471	0	0	1320.4	34.95
Junc 59	1286.303	0	0	1321.1	34.83
Junc 60	1283.113	0	0	1320.3	37.19
Junc 61	1296.82	0	0	1322.2	25.41
Junc 62	1283.113	1.021395	1.53	1320.3	37.2
Junc 63	1281.347	0.392206	0.59	1319.8	38.43
Junc 64	1283.137	0.115954	0.17	1319.3	36.17
Junc 65	1285.33	0	0	1318.9	33.56
Junc 66	1285.88	0	0	1318.8	32.96
Junc 67	1285.85	0	0	1318.8	32.97
Junc 68	1285.28	0	0	1318.7	33.43
Junc 69	1285.83	0	0	1318.6	32.77
Junc 70	1285.53	0	0	1318.4	32.91
Junc 71	1286.38	0	0	1318.4	32
Junc 72	1287.51	0	0	1318.4	30.87
Junc 73	1287.51	0	0	1318.4	30.87
Junc 74	1291.626	0	0	1318.5	26.9
Junc 75	1296.903	0	0	1318.8	21.94
Junc 76	1300.655	0	0	1322.8	22.11
Junc 77	1302.65	0	0	1324.6	21.92
Junc 78	1302.65	0	0	1324.6	21.96
Junc 79	1285.83	0	0	1320.4	34.6
Junc 80	1281.347	0	0	1319.8	38.43
Junc 81	1287.51	0	0	1321	33.51
Junc 82	1297.199	0	0	1322.3	25.12
Junc 83	1302.65	0	0	1329.6	26.95
Resvr BALAJU_RES	1339.7	#N/A	-924.79	1339.7	0

6.3.2 Design of DNI Zone - B (A 1.9)

The DNI-B model has been designed and the model features are prepared accordingly. DNI-B has been designed using the inside diameters (66.8mm, 80.4mm and 98.6mm) for HDPE PE100-PN6 pipes and the diameters (150mm, 200mm, 300mm, 400mm, 450mm, 500mm, 550mm & 600mm) for DI pipes. After optimizing the pipe diameters for HDPE & DI pipes, all 289 demand nodes have pressure head between 20m and 40m and 3 demand nodes have pressure very close to 10m.

The demarcation of DNI-B Boundary shown in **Figure 6.3** and DNI-B Design Model at Peak Demand (7.00) is shown in **Figure 6.4.**

The details of DNI-B/Pipe material & length/Bulk Meter, Isolation Valves, PRVs/PRVs with Set pressure/Location of Air Valve, Washout Valve & Fire hydrants are shown in the **Tables 6.6/6.7/6.8/6.9/6.10** respectively.

Figure 6.3: Demarcation of DNI Zone - B Boundary

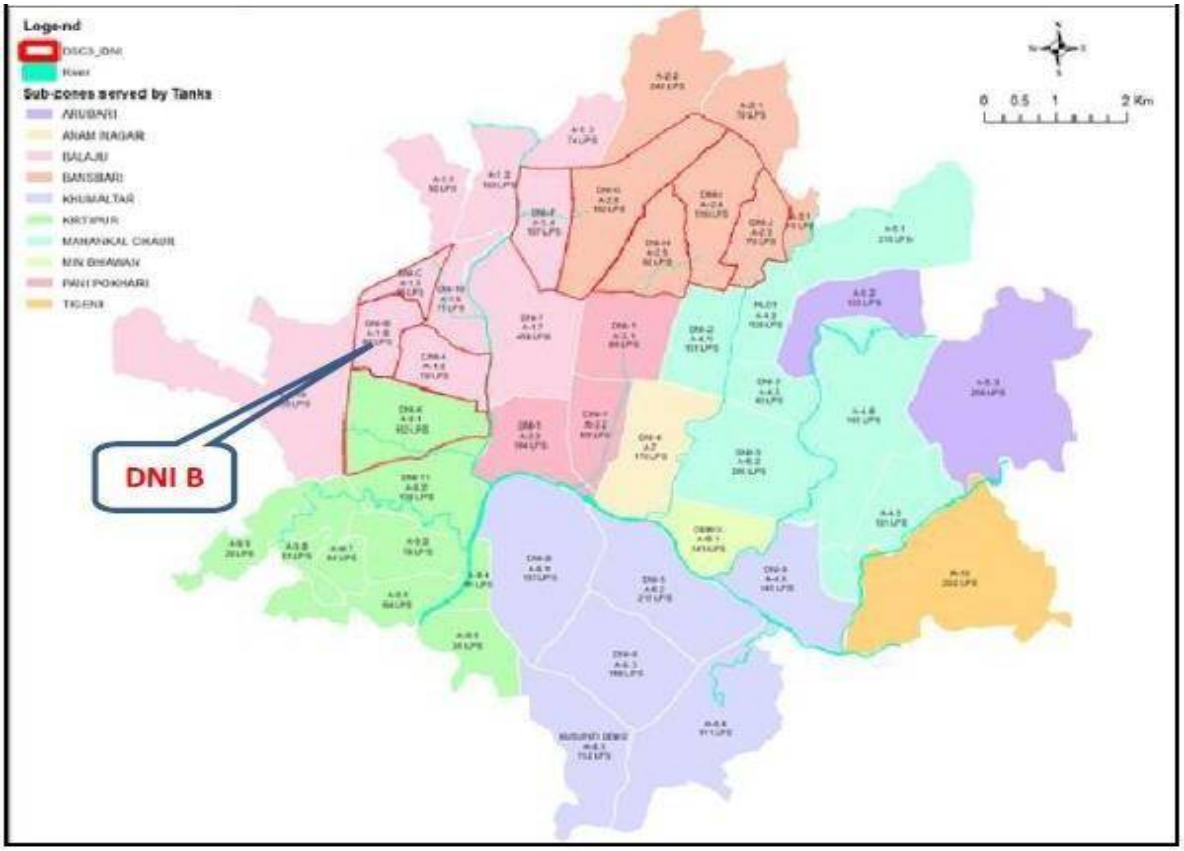


Table 6.8: Design of DNI Zone - B

Description	
Reservoir	Balaju
Outlet Elevation of the Reservoir (m)	1339.70
Total Demand (LPS)	59.89
Total number of nodes	292
Total Number of Pipes	356
Total Length of Pipes	23,576
Number of PRVs	3
Number of Pumps	1
At Peak Time (7:00) - Only for HDPE pipes within DNI	
Number of Nodes have Pressure < 5m	0
Number of Nodes have Pressure [5m,10m]	3
Number of Nodes have Pressure [20m,40m]	289
Number of Nodes have Pressure [40m,50m]	0
Number of Nodes have Pressure [50m,60m]	0
Number of Nodes have Pressure > 60m	0
At Lowest Demand Time (1:00) - Only for HDPE pipes within DNI	
Number of Nodes have Pressure < 5m	0
Number of Nodes have Pressure [5m,10m]	3
Number of Nodes have Pressure [20m,40m]	289
Number of Nodes have Pressure [40m,50m]	0
Number of Nodes have Pressure [50m,60m]	0
Number of Nodes have Pressure > 60m	0

Table 6.9: Details of Pipe material and length

Pipe Length of DNI-B (m)	
Reservoir	Balaju
Pipe Diameter (mm)	Length (m)
HDPE PIPE-PE100, PN6	
66.80 (75)	8,272
80.40 (90)	4,598
98.60 (110)	5,560.50
DI PIPE	
150	1,886.50
Total	20.317.00

Table 6.10: Details of Bulk Meter/Isolation Valve/PRV's

DNI	DMA	# Bulk Meter	Size of BM	# Isolation Valve	Size of IV	# PRV	Size of PRV	From_Junc	To_Junc
B	1	1	200	3	200	1	200	1	9
B	2	1	200	3	200	1	200	1	34
B	3	1	200	3	200	1	150	1	10
B	4	1	150	3	200			36	B303
B	mainline	1	300	3	300	0	0	DNI_B	35

Table 6.11: Details of PRV's with Set Pressure

DNI	DMA	# PRV	Size of PRV	Set Pressure (m)	From_Junc	To_Junc
B	1	1	200	29	1	9
B	2	1	200	22	1	34
B	3	1	200	32	1	10

Table 6.12: Details of location of Air Valve/Washout Valve/Fire Hydrant

LOCATION OF AV/IV/WV/FH FOR DNI_B				
DNI	# Air Valve	# Wash out Valve	# Fire Hydrant	
	Provide at Junction	Provide at Junction	Provide at Junction	On pipe dia (mm)
B	At Stupa	B032	B234	150 DI PIPE
	At Tank Out	B045	B029	150 DI PIPE
	DNI-B	B210	B218	150 DI PIPE
	B219	B167	B002	150 DI PIPE
	B039	B197	B270	150 DI PIPE
	B002	B229	B008	110 HDPE PIPE
	B270	B222	B011	110 HDPE PIPE
	B007	B237	B013	150 DI PIPE
	B274	B242	B014	150 DI PIPE
	B310	B063	B019	110 HDPE PIPE
	B021	B079	B021	150 DI PIPE
	B241	B076	B022	150 DI PIPE
		B080	B241	150 DI PIPE
		B097	B186	110 HDPE PIPE
		B107	B287	110 HDPE PIPE
		B112	B165	110 HDPE PIPE
		B118	B143	110 HDPE PIPE
		B146	B147	110 HDPE PIPE
		B190	B122	110 HDPE PIPE
		B262	B277	110 HDPE PIPE
		B192	B094	110 HDPE PIPE

Figure 6.4: DNI Zone - B Design Model at Peak Demand at 7.00 AM

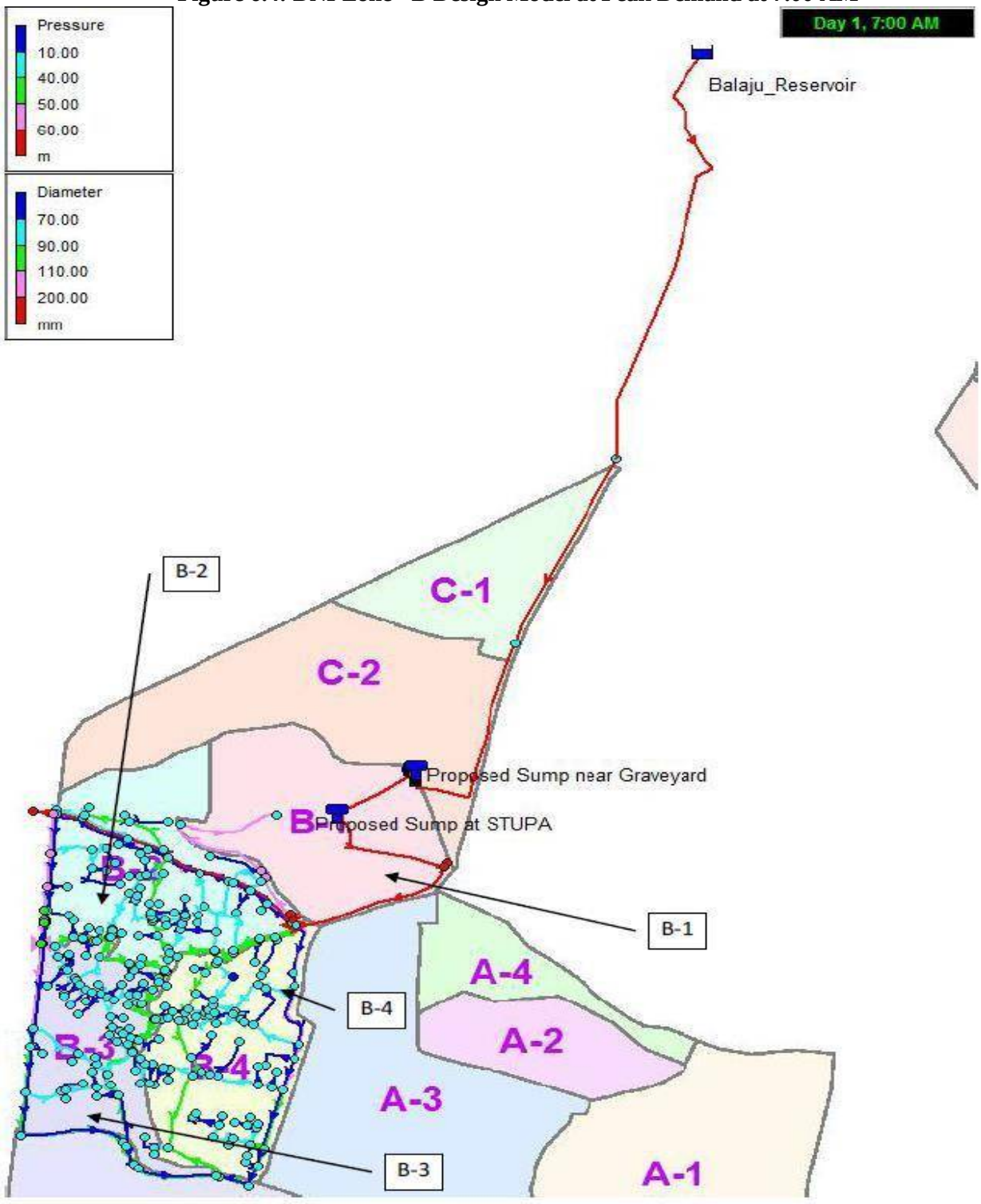


Table 6.13: Design of DNI B

Link ID	Length	Diameter	Materials	Roughness	Flow	Velocity	Unit Headloss	Friction Factor
	m	mm			LPS	m/s	m/km	
Pipe B001-B035	64.97	62.2	HDPE-PE 100 PN 9	130	-2.7	1	16.5	0
Pipe B004-B005	42.82	62.2	HDPE-PE 100 PN 10	130	0.91	0	2.28	0
Pipe B008-B007	236.27	62.2	HDPE-PE 100 PN 10	130	-1.6	1	6.34	0
Pipe B008-B009	51.46	62.2	HDPE-PE 100 PN 10	130	-0.6	0	1.13	0
Pipe B009-B010	33.55048	62.2	HDPE-PE 100 PN 10	130	0.91	0	2.25	0
Pipe B011-B009	130.0876	62.2	HDPE-PE 100 PN 10	130	1.92	1	9.1	0
Pipe B012-B011	124.3511	62.2	HDPE-PE 100 PN 10	130	-2.4	1	14.1	0
Pipe B013-B012	258.9	62.2	HDPE-PE 100 PN 10	130	-1.6	1	6.28	0
Pipe B014-B094	158.99	62.2	HDPE-PE 100 PN 10	130	1.4	0	5.07	0
Pipe B016-B017	34.03	62.2	HDPE-PE 100 PN 10	130	0.34	0	0.36	0
Pipe B023-B020	104.35	62.2	HDPE-PE 100 PN 10	130	0.43	0	0.57	0
Pipe B027-B026	22.43528	150	DI	110	-0.4	0	0.01	0
Pipe B027-B029	235.2994	150	DI	110	0.25	0	0	0.1
Pipe B028-B232	128.7306	62.2	HDPE-PE 100 PN 10	130	-0.1	0	0.06	0
Pipe B029-B030	250.68	150	DI	110	0.13	0	0	0.1
Pipe B033-B031	114.8206	62.2	HDPE-PE 100 PN 10	130	-2	1	10.1	0
Pipe B033-B032	61.57369	62.2	HDPE-PE 100 PN 10	130	0.13	0	0.06	0
Pipe B034-B033	22.2324	62.2	HDPE-PE 100 PN 10	130	-0.1	0	0.06	0
Pipe B035-B031	216.6075	62.2	HDPE-PE 100 PN 10	130	-1.9	1	9.05	0
Pipe B035-B036	6.367488	62.2	HDPE-PE 100 PN 10	130	-1.3	0	4.42	0
Pipe B036-B033	111.3819	62.2	HDPE-PE 100 PN 10	130	-1.7	1	6.9	0
Pipe B036-B037	25.99384	62.2	HDPE-PE 100 PN 10	130	0.13	0	0.06	0
Pipe B039-B040	29.91433	62.2	HDPE-PE 100 PN 10	130	2.82	1	18.4	0
Pipe B040-B041	45.13987	62.2	HDPE-PE 100 PN 10	130	0.31	0	0.31	0
Pipe B040-B042	38.99799	62.2	HDPE-PE 100 PN 10	130	2.16	1	11.3	0
Pipe B042-B003	103.49	62.2	HDPE-PE 100 PN 10	130	-0.1	0	0.02	0

Pipe B042-B043	49.72544	62.2	HDPE-PE 100 PN 10	130	1.51	1	5.8	0
Pipe B043-B044	36.50996	62.2	HDPE-PE 100 PN 10	130	0.38	0	0.45	0
Pipe B043-B045	84.03739	62.2	HDPE-PE 100 PN 10	130	0.53	0	0.83	0
Pipe B046-B007	31.91	62.2	HDPE-PE 100 PN 10	130	2.17	1	11.3	0
Pipe B046-B174	49.82	62.2	HDPE-PE 100 PN 10	130	2.68	1	16.9	0
Pipe B047-B046	33.15	62.2	HDPE-PE 100 PN 10	130	-3.6	1	29.1	0
Pipe B047-B048	24.09216	62.2	HDPE-PE 100 PN 10	130	0.1	0	0.04	0
Pipe B049-B047	37.32224	62.2	HDPE-PE 100 PN 10	130	-3.2	1	22.9	0
Pipe B049-B051	5.529987	62.2	HDPE-PE 100 PN 10	130	2.87	1	19	0
Pipe B050-B049	39.46407	62.2	HDPE-PE 100 PN 10	130	-0.1	0	0.06	0
Pipe B051-B052	64.89604	62.2	HDPE-PE 100 PN 10	130	0.97	0	2.55	0
Pipe B053-B051	27.1775	62.2	HDPE-PE 100 PN 10	130	-1.7	1	7.58	0
Pipe B053-B054	51.02717	62.2	HDPE-PE 100 PN 10	130	0.19	0	0.13	0
Pipe B055-B053	8.416321	62.2	HDPE-PE 100 PN 10	130	-1.4	0	4.97	0
Pipe B055-B056	14.114	62.2	HDPE-PE 100 PN 10	130	1.52	1	5.86	0
Pipe B056-B057	49.22856	62.2	HDPE-PE 100 PN 10	130	0.24	0	0.19	0
Pipe B056-B058	21.04332	62.2	HDPE-PE 100 PN 10	130	1.14	0	3.47	0
Pipe B058-B059	56.75531	62.2	HDPE-PE 100 PN 10	130	0.37	0	0.43	0
Pipe B058-B060	17.16415	62.2	HDPE-PE 100 PN 10	130	0.65	0	1.22	0
Pipe B060-B061	22.33186	62.2	HDPE-PE 100 PN 10	130	0.29	0	0.27	0
Pipe B060-B244	32.43275	62.2	HDPE-PE 100 PN 10	130	0.27	0	0.24	0
Pipe B061-B062	25.48605	62.2	HDPE-PE 100 PN 10	130	0.35	0	0.4	0
Pipe B061-B063	81.81423	62.2	HDPE-PE 100 PN 10	130	0.78	0	1.71	0
Pipe B061-B064	19.58222	62.2	HDPE-PE 100 PN 10	130	-1	0	2.56	0
Pipe B064-B065	51.29968	62.2	HDPE-PE 100 PN 10	130	0.28	0	0.26	0
Pipe B066-B064	20.30651	62.2	HDPE-PE 100 PN 10	130	1.43	0	5.26	0
Pipe B066-B067	46.2987	62.2	HDPE-PE 100 PN 10	130	-1.4	0	4.8	0
Pipe B066-B151	37.69695	62.2	HDPE-PE 100 PN 10	130	-0.2	0	0.2	0

Pipe B067-B068	30.62158	62.2	HDPE-PE 100 PN 10	130	0.21	0	0.16	0
Pipe B067-B069	31.56686	62.2	HDPE-PE 100 PN 10	130	-1.9	1	9.05	0
Pipe B069-B070	20.58935	62.2	HDPE-PE 100 PN 10	130	0.07	0	0.01	0
Pipe B069-B071	22.83684	62.2	HDPE-PE 100 PN 10	130	-2.1	1	11.1	0
Pipe B071-B072	26.53502	62.2	HDPE-PE 100 PN 10	130	-2.5	1	15.2	0
Pipe B072-B073	27.64063	62.2	HDPE-PE 100 PN 10	130	0.06	0	0.01	0
Pipe B072-B074	45.85	62.2	HDPE-PE 100 PN 10	130	-2.8	1	18.7	0
Pipe B074-B075	34.58	62.2	HDPE-PE 100 PN 10	130	2.73	1	17.4	0
Pipe B074-B080	95.26	62.2	HDPE-PE 100 PN 10	130	3.21	1	23.5	0
Pipe B075-B077	12.79	62.2	HDPE-PE 100 PN 10	130	0.39	0	0.47	0
Pipe B075-B147	77.09	62.2	HDPE-PE 100 PN 10	130	2.13	1	11	0
Pipe B077-B078	22.52874	62.2	HDPE-PE 100 PN 10	130	0.12	0	0.05	0
Pipe B077-B079	25.29543	62.2	HDPE-PE 100 PN 10	130	0.2	0	0.14	0
Pipe B080-B091	37.4	62.2	HDPE-PE 100 PN 10	130	2.5	1	14.8	0
Pipe B081-B080	38.65	62.2	HDPE-PE 100 PN 10	130	-0.4	0	0.46	0
Pipe B081-B082	18.67768	62.2	HDPE-PE 100 PN 10	130	0.34	0	0.36	0
Pipe B081-B083	52.77386	62.2	HDPE-PE 100 PN 10	130	-0.1	0	0.06	0
Pipe B083-B008	135.75	62.2	HDPE-PE 100 PN 10	130	-1.3	0	4.22	0
Pipe B083-B084	25.16614	62.2	HDPE-PE 100 PN 10	130	0.52	0	0.8	0
Pipe B085-B011	85.03654	62.2	HDPE-PE 100 PN 10	130	-3.3	1	24.6	0
Pipe B085-B086	24.40093	62.2	HDPE-PE 100 PN 10	130	1.34	0	4.67	0
Pipe B087-B085	9.917433	62.2	HDPE-PE 100 PN 10	130	-1.5	1	5.85	0
Pipe B087-B088	48.7925	62.2	HDPE-PE 100 PN 10	130	0.33	0	0.34	0
Pipe B089-B087	76.0502	62.2	HDPE-PE 100 PN 10	130	-0.9	0	2.27	0
Pipe B089-B091	36.0804	62.2	HDPE-PE 100 PN 10	130	0.53	0	0.83	0
Pipe B090-B089	45.26086	62.2	HDPE-PE 100 PN 10	130	-0.2	0	0.15	0
Pipe B091-B092	35.08	62.2	HDPE-PE 100 PN 10	130	2.77	1	17.8	0
Pipe B092-B013	140.84	62.2	HDPE-PE 100 PN 10	130	1.03	0	2.87	0

Pipe B092-B093	51.94	62.2	HDPE-PE 100 PN 10	130	0.84	0	1.95	0
Pipe B094-B095	33.15037	62.2	HDPE-PE 100 PN 10	130	2.18	1	11.5	0
Pipe B094-B122	214.26	62.2	HDPE-PE 100 PN 10	130	-1.9	1	9.26	0
Pipe B095-B096	20.17151	62.2	HDPE-PE 100 PN 10	130	0.98	0	2.63	0
Pipe B095-B097	36.71518	62.2	HDPE-PE 100 PN 10	130	1	0	2.7	0
Pipe B098-B018	34.94	150	HDPE-PE 100 PN 10	130	-5.6	0	0.92	0
Pipe B098-B099	29.39318	62.2	HDPE-PE 100 PN 10	130	0.18	0	0.12	0
Pipe B098-B108	51.96817	62.2	HDPE-PE 100 PN 10	130	1.45	0	5.42	0
Pipe B100-B098	46.8092	62.2	HDPE-PE 100 PN 10	130	-3.8	1	31.6	0
Pipe B100-B101	19.74592	62.2	HDPE-PE 100 PN 10	130	0.4	0	0.49	0
Pipe B100-B102	48.23516	62.2	HDPE-PE 100 PN 10	130	3.15	1	22.7	0
Pipe B102-B103	36.26858	62.2	HDPE-PE 100 PN 10	130	2.41	1	13.8	0
Pipe B103-B104	28.83127	62.2	HDPE-PE 100 PN 10	130	0.62	0	1.11	0
Pipe B103-B105	65.36933	62.2	HDPE-PE 100 PN 10	130	1.54	1	6.04	0
Pipe B105-B106	5.058523	62.2	HDPE-PE 100 PN 10	130	0.65	0	1.24	0
Pipe B105-B107	14.60624	62.2	HDPE-PE 100 PN 10	130	0.63	0	1.14	0
Pipe B108-B109	11.73199	62.2	HDPE-PE 100 PN 10	130	0.34	0	0.38	0
Pipe B108-B110	23.18084	62.2	HDPE-PE 100 PN 10	130	0.89	0	2.2	0
Pipe B110-B111	24.89862	62.2	HDPE-PE 100 PN 10	130	0.51	0	0.77	0
Pipe B110-B112	32.82555	62.2	HDPE-PE 100 PN 10	130	0.23	0	0.18	0
Pipe B113-B019	31.26	62.2	HDPE-PE 100 PN 10	130	0.57	0	0.95	0
Pipe B113-B114	47.29014	62.2	HDPE-PE 100 PN 10	130	0.35	0	0.38	0
Pipe B115-B113	35.51234	62.2	HDPE-PE 100 PN 10	130	1.26	0	4.18	0
Pipe B115-B116	49.24497	62.2	HDPE-PE 100 PN 10	130	0.49	0	0.73	0
Pipe B117-B115	96.79065	62.2	HDPE-PE 100 PN 10	130	2.44	1	14.1	0
Pipe B118-B117	108.1231	62.2	HDPE-PE 100 PN 10	130	-0.9	0	1.99	0
Pipe B119-B117	20.61077	62.2	HDPE-PE 100 PN 10	130	4.16	1	37.9	0
Pipe B121-B119	22.21155	62.2	HDPE-PE 100 PN 10	130	4.51	1	44	0

Pipe B122-B121	16.82	62.2	HDPE-PE 100 PN 10	130	5.49	2	63.5	0
Pipe B123-B122	57.51	62.2	HDPE-PE 100 PN 10	130	2.46	1	14.4	0
Pipe B123-B124	30.32	62.2	HDPE-PE 100 PN 10	130	0.45	0	0.6	0
Pipe B125-B126	51.53	62.2	HDPE-PE 100 PN 10	130	-1.2	0	3.54	0
Pipe B126-B128	11.85581	62.2	HDPE-PE 100 PN 10	130	-1.7	1	6.93	0
Pipe B127-B125	27.84	62.2	HDPE-PE 100 PN 10	130	2.19	1	11.6	0
Pipe B127-B128	56.84712	62.2	HDPE-PE 100 PN 10	130	0.59	0	1.02	0
Pipe B128-B130	22.62047	62.2	HDPE-PE 100 PN 10	130	-1.3	0	4.59	0
Pipe B129-B127	20.63651	62.2	HDPE-PE 100 PN 10	130	3.01	1	20.9	0
Pipe B130-B129	53.59613	62.2	HDPE-PE 100 PN 10	130	-1.7	1	7.19	0
Pipe B131-B129	17.76327	62.2	HDPE-PE 100 PN 10	130	4.81	2	49.7	0
Pipe B131-B132	34.32684	62.2	HDPE-PE 100 PN 10	130	0.33	0	0.36	0
Pipe B133-B021	126.27	62.2	HDPE-PE 100 PN 10	130	-2.2	1	11.4	0
Pipe B134-B022	76.93	62.2	HDPE-PE 100 PN 10	130	-0.2	0	0.13	0
Pipe B134-B133	107.3668	62.2	HDPE-PE 100 PN 10	130	-0.6	0	0.94	0
Pipe B135-B134	25	62.2	HDPE-PE 100 PN 10	130	0	0	0	0
Pipe B136-B135	100.03	62.2	HDPE-PE 100 PN 10	130	0.5	0	0.74	0
Pipe B136-B138	28.05638	62.2	HDPE-PE 100 PN 10	130	0.03	0	0.01	0.1
Pipe B137-B136	6.380659	62.2	HDPE-PE 100 PN 10	130	-0.2	0	0.19	0
Pipe B137-B138	26.5562	62.2	HDPE-PE 100 PN 10	130	-0.1	0	0.04	0
Pipe B138-B139	5.953868	62.2	HDPE-PE 100 PN 10	130	-0.3	0	0.2	0
Pipe B139-B133	25.20937	62.2	HDPE-PE 100 PN 10	130	-0.6	0	1	0
Pipe B140-B137	46.08781	62.2	HDPE-PE 100 PN 10	130	-0.2	0	0.13	0
Pipe B140-B139	63.25548	62.2	HDPE-PE 100 PN 10	130	-0.2	0	0.13	0
Pipe B141-B140	59.92784	62.2	HDPE-PE 100 PN 10	130	-0.1	0	0.06	0
Pipe B141-B142	21.44564	62.2	HDPE-PE 100 PN 10	130	0.11	0	0.05	0
Pipe B143-B141	25.60534	62.2	HDPE-PE 100 PN 10	130	0.3	0	0.28	0
Pipe B143-B176	23.63848	62.2	HDPE-PE 100 PN 10	130	-1.2	0	3.58	0

Pipe B144-B143	10.47	62.2	HDPE-PE 100 PN 10	130	-0.7	0	1.52	0
Pipe B144-B250	108.21	62.2	HDPE-PE 100 PN 10	130	0.56	0	0.93	0
Pipe B145-B146	39.71	62.2	HDPE-PE 100 PN 10	130	0.3	0	0.3	0
Pipe B148-B147	66.06	62.2	HDPE-PE 100 PN 10	130	-1.8	1	8.08	0
Pipe B148-B149	4.48	62.2	HDPE-PE 100 PN 10	130	0.78	0	1.69	0
Pipe B149-B150	25.36148	62.2	HDPE-PE 100 PN 10	130	0.15	0	0.08	0
Pipe B149-B151	29.31468	62.2	HDPE-PE 100 PN 10	130	0.56	0	0.93	0
Pipe B151-B152	49.68726	62.2	HDPE-PE 100 PN 10	130	0.19	0	0.12	0
Pipe B153-B148	52.5	62.2	HDPE-PE 100 PN 10	130	-0.8	0	1.84	0
Pipe B153-B154	37.68255	62.2	HDPE-PE 100 PN 10	130	0.13	0	0.07	0
Pipe B157-B158	63.48	62.2	HDPE-PE 100 PN 10	130	0.1	0	0.04	0
Pipe B159-B157	25.83	62.2	HDPE-PE 100 PN 10	130	-0.3	0	0.21	0
Pipe B159-B160	58.99	62.2	HDPE-PE 100 PN 10	130	-0	0	0.01	0.1
Pipe B160-B162	26.74	62.2	HDPE-PE 100 PN 10	130	-0.2	0	0.13	0
Pipe B162-B163	34.10681	62.2	HDPE-PE 100 PN 10	130	0.19	0	0.12	0
Pipe B162-B164	77.89	62.2	HDPE-PE 100 PN 10	130	-0.8	0	1.61	0
Pipe B164-B055	90.86	62.2	HDPE-PE 100 PN 10	130	0.25	0	0.2	0
Pipe B165-B164	61.38	62.2	HDPE-PE 100 PN 10	130	1.5	0	5.72	0
Pipe B166-B167	24.58332	62.2	HDPE-PE 100 PN 10	130	0.49	0	0.73	0
Pipe B168-B165	38.04	62.2	HDPE-PE 100 PN 10	130	1.72	1	7.38	0
Pipe B170-B168	8.15	62.2	HDPE-PE 100 PN 10	130	1.85	1	8.45	0
Pipe B170-B171	51.51	62.2	HDPE-PE 100 PN 10	130	0.29	0	0.28	0
Pipe B172-B170	25.59	62.2	HDPE-PE 100 PN 10	130	2.24	1	12.1	0
Pipe B174-B172	22.53	62.2	HDPE-PE 100 PN 10	130	2.39	1	13.6	0
Pipe B176-B177	28.89931	62.2	HDPE-PE 100 PN 10	130	0.14	0	0.07	0
Pipe B176-B178	14.24728	62.2	HDPE-PE 100 PN 10	130	-1.4	0	4.92	0
Pipe B178-B179	47.23638	62.2	HDPE-PE 100 PN 10	130	-0.3	0	0.26	0
Pipe B178-B187	46.47459	62.2	HDPE-PE 100 PN 10	130	-1.3	0	4.47	0

Pipe B179-B180	5.917384	62.2	HDPE-PE 100 PN 10	130	-0.4	0	0.4	0
Pipe B180-B181	13.06354	62.2	HDPE-PE 100 PN 10	130	0.06	0	0.01	0
Pipe B180-B182	10.60623	62.2	HDPE-PE 100 PN 10	130	-0.5	0	0.63	0
Pipe B182-B183	15.9024	62.2	HDPE-PE 100 PN 10	130	0.1	0	0.04	0
Pipe B182-B184	17.73726	62.2	HDPE-PE 100 PN 10	130	-0.6	0	1.17	0
Pipe B184-B136	55.65629	62.2	HDPE-PE 100 PN 10	130	1.14	0	3.46	0
Pipe B184-B185	95.44	62.2	HDPE-PE 100 PN 10	130	-1.9	1	8.69	0
Pipe B187-B188	49.8112	62.2	HDPE-PE 100 PN 10	130	0.4	0	0.5	0
Pipe B187-B189	64.69769	62.2	HDPE-PE 100 PN 10	130	-2.2	1	11.7	0
Pipe B189-B190	31.94	62.2	HDPE-PE 100 PN 10	130	0.45	0	0.62	0
Pipe B191-B192	28.07	62.2	HDPE-PE 100 PN 10	130	0.38	0	0.46	0
Pipe B193-B191	13.78	62.2	HDPE-PE 100 PN 10	130	1.17	0	3.63	0
Pipe B195-B224	67	62.2	HDPE-PE 100 PN 10	130	1.54	1	6.06	0
Pipe B196-B195	45.6	62.2	HDPE-PE 100 PN 10	130	-2.2	1	11.5	0
Pipe B196-B197	42.85	62.2	HDPE-PE 100 PN 10	130	0.39	0	0.48	0
Pipe B196-B198	44.55	62.2	HDPE-PE 100 PN 10	130	1.49	0	5.64	0
Pipe B198-B200	29.71	62.2	HDPE-PE 100 PN 10	130	-0.3	0	0.31	0
Pipe B199-B198	7.19	62.2	HDPE-PE 100 PN 10	130	-1.6	1	6.79	0
Pipe B200-B227	49.96	62.2	HDPE-PE 100 PN 10	130	-1.1	0	3.37	0
Pipe B201-B199	7.12	62.2	HDPE-PE 100 PN 10	130	0.04	0	0	0
Pipe B201-B200	42.05	62.2	HDPE-PE 100 PN 10	130	-0.7	0	1.38	0
Pipe B202-B201	12.31	62.2	HDPE-PE 100 PN 10	130	-0.6	0	0.93	0
Pipe B202-B203	58.44	62.2	HDPE-PE 100 PN 10	130	0.2	0	0.13	0
Pipe B204-B202	24.46	62.2	HDPE-PE 100 PN 10	130	-0.2	0	0.13	0
Pipe B204-B205	21.71	62.2	HDPE-PE 100 PN 10	130	0.29	0	0.27	0
Pipe B204-B217	92.08	62.2	HDPE-PE 100 PN 10	130	-0.3	0	0.35	0
Pipe B206-B199	68.29509	62.2	HDPE-PE 100 PN 10	130	-1.6	1	6.58	0
Pipe B206-B209	13.36	62.2	HDPE-PE 100 PN 10	130	1.23	0	3.95	0

Pipe B208-B209	18.76	62.2	HDPE-PE 100 PN 10	130	-1	0	2.44	0
Pipe B209-B210	24.13	62.2	HDPE-PE 100 PN 10	130	0.21	0	0.15	0
Pipe B211-B208	53.53996	62.2	HDPE-PE 100 PN 10	130	1.06	0	3	0
Pipe B211-B212	28.7931	62.2	HDPE-PE 100 PN 10	130	0.23	0	0.17	0
Pipe B211-B213	15.82455	62.2	HDPE-PE 100 PN 10	130	-1.4	0	5.13	0
Pipe B213-B217	39.00736	62.2	HDPE-PE 100 PN 10	130	-1.8	1	8.29	0
Pipe B214-B213	40.34504	62.2	HDPE-PE 100 PN 10	130	-0.2	0	0.18	0
Pipe B215-B216	29.69	62.2	HDPE-PE 100 PN 10	130	0.21	0	0.16	0
Pipe B217-B218	51.33	62.2	HDPE-PE 100 PN 10	130	-2.7	1	17.1	0
Pipe B218-B215	53.78	150	DI	110	-2.4	0	0.25	0
Pipe B220-B219	100.55	62.2	HDPE-PE 100 PN 10	130	-0.8	0	1.76	0
Pipe B221-B220	31.79315	62.2	HDPE-PE 100 PN 10	130	-1	0	2.57	0
Pipe B221-B222	20.45103	62.2	HDPE-PE 100 PN 10	130	0.29	0	0.28	0
Pipe B223-B220	78.54534	62.2	HDPE-PE 100 PN 10	130	0.77	0	1.66	0
Pipe B224-B223	87.60468	62.2	HDPE-PE 100 PN 10	130	-0.4	0	0.49	0
Pipe B224-B225	15.68353	62.2	HDPE-PE 100 PN 10	130	1.6	1	6.46	0
Pipe B225-B226	36.43029	62.2	HDPE-PE 100 PN 10	130	0.15	0	0.09	0
Pipe B225-B227	19.45464	62.2	HDPE-PE 100 PN 10	130	1.35	0	4.72	0
Pipe B227-B228	4.650181	62.2	HDPE-PE 100 PN 10	130	0.17	0	0.1	0
Pipe B228-B221	31.8479	62.2	HDPE-PE 100 PN 10	130	-0.5	0	0.75	0
Pipe B228-B229	47.55402	62.2	HDPE-PE 100 PN 10	130	0.56	0	0.93	0
Pipe B231-B232	92.81	62.2	HDPE-PE 100 PN 10	130	-0	0	0	0
Pipe B233-B237	67.63	62.2	HDPE-PE 100 PN 10	130	0.77	0	1.67	0
Pipe B234-B235	25.87	62.2	HDPE-PE 100 PN 10	130	0.48	0	0.68	0
Pipe B238-B239	64.27	62.2	HDPE-PE 100 PN 10	130	-0.7	0	1.48	0
Pipe B241-B240	63.61	62.2	HDPE-PE 100 PN 10	130	-0.2	0	0.18	0
Pipe B242-B006	58.53	62.2	HDPE-PE 100 PN 10	130	-0.5	0	0.75	0
Pipe B250-B120	81.122	62.2	HDPE-PE 100 PN 10	130	0.61	0	1.1	0
Pipe B250-B121	50.64247	62.2	HDPE-PE	130	-0.8	0	1.61	0

			100 PN 10					
Pipe B001-B002	15.56	62.2	HDPE-PE 100 PN 10	130	2.12	1	10.9	0
Pipe B240-B262	91.41	62.2	HDPE-PE 100 PN 10	130	0	0	0	0
Pipe B135-B263	26.27	62.2	HDPE-PE 100 PN 10	130	0	0	0	0
Pipe B208-B261	112.91	62.2	HDPE-PE 100 PN 10	130	1.7	1	7.23	0
Pipe B166-B264	12.75	62.2	HDPE-PE 100 PN 10	130	-1.7	1	7.24	0
Pipe B145-B268	14.83	62.2	HDPE-PE 100 PN 10	130	0	0	0	0
Pipe B194-B186	32.89	62.2	HDPE-PE 100 PN 10	130	-1.7	1	7.38	0
Pipe B236-B186	52.78	62.2	HDPE-PE 100 PN 10	130	-3	1	20.7	0
Pipe B236-B239	72.16	62.2	HDPE-PE 100 PN 10	130	2.48	1	14.5	0
Pipe B239-B240	39.04	62.2	HDPE-PE 100 PN 10	130	1.11	0	3.29	0
Pipe B194-B193	111.75	62.2	HDPE-PE 100 PN 10	130	1.25	0	4.1	0
Pipe B272-B273	22.39	62.2	HDPE-PE 100 PN 10	130	0	0	0	0
Pipe B271-B272	36.74	62.2	HDPE-PE 100 PN 10	130	0.62	0	1.11	0
Pipe B271-B191	34.58	62.2	HDPE-PE 100 PN 10	130	-0.6	0	1.11	0
Pipe B267-B269	12.55	62.2	HDPE-PE 100 PN 10	130	1.69	1	7.12	0
Pipe B131-B276	29.32	62.2	HDPE-PE 100 PN 10	130	-5.3	2	60.3	0
Pipe B076-B278	60.33	62.2	HDPE-PE 100 PN 10	130	-0.6	0	1.12	0
Pipe B276-B278	32.19	62.2	HDPE-PE 100 PN 10	130	0.5	0	0.76	0
Pipe B278-B279	77.44	62.2	HDPE-PE 100 PN 10	130	-0.1	0	0.05	0
Pipe B145-B279	15.43	62.2	HDPE-PE 100 PN 10	130	-0.5	0	0.74	0
Pipe B279-B280	65.45	62.2	HDPE-PE 100 PN 10	130	-0.6	0	1.11	0
Pipe B272-B280	75.81	62.2	HDPE-PE 100 PN 10	130	0.62	0	1.11	0
Pipe B153-B157	36.69	62.2	HDPE-PE 100 PN 10	130	0.48	0	0.69	0
Pipe B024-B281	60.1	62.2	HDPE-PE 100 PN 10	130	1.79	1	7.95	0
Pipe B281-B282	35.9	62.2	HDPE-PE 100 PN 10	130	1.79	1	7.95	0
Pipe B282-B283	71.44	62.2	HDPE-PE 100 PN 10	130	1.79	1	7.95	0
Pipe B230-B283	219.58	62.2	HDPE-PE 100 PN 10	130	-0.9	0	2.4	0
Pipe B283-B284	49.43	62.2	HDPE-PE	130	0.85	0	2.01	0

			100 PN 10					
Pipe B284-B285	30.07	62.2	HDPE-PE 100 PN 10	130	0.85	0	2.01	0
Pipe B223-B285	54.41	62.2	HDPE-PE 100 PN 10	130	-1.8	1	8.02	0
Pipe B285-B286	116.33	62.2	HDPE-PE 100 PN 10	130	-1	0	2.44	0
Pipe B195-B286	10.25	62.2	HDPE-PE 100 PN 10	130	-4	1	34.9	0
Pipe B286-B287	48.97	62.2	HDPE-PE 100 PN 10	130	2.22	1	11.8	0
Pipe B287-B288	60.97	62.2	HDPE-PE 100 PN 10	130	2.22	1	11.8	0
Pipe B161-B288	16.52	62.2	HDPE-PE 100 PN 10	130	-0.3	0	0.37	0
Pipe B288-B289	27.01	62.2	HDPE-PE 100 PN 10	130	1.88	1	8.68	0
Pipe B289-B291	72.43	62.2	HDPE-PE 100 PN 10	130	1.88	1	8.69	0
Pipe B291-B290	62.02	62.2	HDPE-PE 100 PN 10	130	1.88	1	8.68	0
Pipe B166-B290	5.24	62.2	HDPE-PE 100 PN 10	130	1.07	0	3.07	0
Pipe B290-B292	38.33	62.2	HDPE-PE 100 PN 10	130	2.95	1	20.1	0
Pipe B292-B169	27.32	62.2	HDPE-PE 100 PN 10	130	0.43	0	0.57	0
Pipe B292-B293	33.42	62.2	HDPE-PE 100 PN 10	130	2.52	1	15	0
Pipe B173-B293	29.99	62.2	HDPE-PE 100 PN 10	130	-0.3	0	0.34	0
Pipe B293-B294	24.36	62.2	HDPE-PE 100 PN 10	130	2.19	1	11.6	0
Pipe B294-B295	52.72	62.2	HDPE-PE 100 PN 10	130	1.81	1	8.11	0
Pipe B294-B175	46.95	62.2	HDPE-PE 100 PN 10	130	0.38	0	0.46	0
Pipe B295-B270	28.34	62.2	HDPE-PE 100 PN 10	130	1.81	1	8.11	0
Pipe B185-B186	56.48	62.2	HDPE-PE 100 PN 10	130	-2.5	1	14.9	0
Pipe B186-B189	35.93	62.2	HDPE-PE 100 PN 10	130	3.01	1	20.8	0
Pipe B264-B261	6.49	62.2	HDPE-PE 100 PN 10	130	-1.7	1	7.22	0
Pipe B303-B026	121.28	150	DI	110	0.51	0	0.01	0.1
Pipe B024-B234	84.12	62.2	HDPE-PE 100 PN 10	130	2.72	1	17.3	0
Pipe B234-B233	55.02	62.2	HDPE-PE 100 PN 10	130	1.69	1	7.11	0
Pipe B233-B231	48.8	62.2	HDPE-PE 100 PN 10	130	0.25	0	0.21	0
Pipe B231-B230	8.73	62.2	HDPE-PE 100 PN 10	130	-0.1	0	0.02	0
Pipe B230-	77.05	62.2	HDPE-PE 100 PN 10	130	0.3	0	0.28	0

B219R								
Pipe B219-B218R	89.97	62.2	HDPE-PE 100 PN 10	130	-1.3	0	4.29	0
Pipe B218-B215R	53.28	62.2	HDPE-PE 100 PN 10	130	4.2	1	38.5	0
Pipe B215-B039R	73.83	62.2	HDPE-PE 100 PN 10	130	3.72	1	30.9	0
Pipe B039-B038	26.4	62.2	HDPE-PE 100 PN 10	130	0.57	0	0.96	0
Pipe B038-B002	187.49	62.2	HDPE-PE 100 PN 10	130	0.22	0	0.16	0
Pipe B002-B003	111.15	62.2	HDPE-PE 100 PN 10	130	1.84	1	8.39	0
Pipe B003-B004	92.19	62.2	HDPE-PE 100 PN 10	130	0.77	0	1.69	0
Pipe B004-B006	68.88	62.2	HDPE-PE 100 PN 10	130	-0.7	0	1.32	0
Pipe B006-B265R	26.46	62.2	HDPE-PE 100 PN 10	130	-1.8	1	8.11	0
Pipe B265-B266R	11.05	62.2	HDPE-PE 100 PN 10	130	-1.8	1	8.11	0
Pipe B266-B270R	56.26	62.2	HDPE-PE 100 PN 10	130	-1.8	1	8.11	0
Pipe B267-B274R	57.37	62.2	HDPE-PE 100 PN 10	130	-1.7	1	7.12	0
Pipe B310-B269	195.63	62.2	HDPE-PE 100 PN 10	130	-1.7	1	7.12	0
Pipe B015-B014R	70.97	62.2	HDPE-PE 100 PN 10	130	-2.5	1	14.9	0
Pipe B241-B260	148.83	62.2	HDPE-PE 100 PN 10	130	-0.8	0	1.91	0
Pipe B260-B022R	37.21	62.2	HDPE-PE 100 PN 10	130	-0.8	0	1.9	0
Pipe B022-B021R	187.61	62.2	HDPE-PE 100 PN 10	130	-1.8	1	8.14	0
Pipe B021-B023	43.98	62.2	HDPE-PE 100 PN 10	130	4.5	1	43.9	0
Pipe B023-B019	92.07	62.2	HDPE-PE 100 PN 10	130	3.75	1	31.2	0
Pipe B019-B018R	172.75	62.2	HDPE-PE 100 PN 10	130	4.03	1	35.8	0
Pipe B018-B016R	49.65	62.2	HDPE-PE 100 PN 10	130	-1.8	1	7.97	0
Pipe B016-B015R	59.38	62.2	HDPE-PE 100 PN 10	130	-2.3	1	12.8	0
Pipe B232-B233	37.57	62.2	HDPE-PE 100 PN 10	130	-0.3	0	0.27	0
Pipe B125-B123	17.3	62.2	HDPE-PE 100 PN 10	130	3.15	1	22.7	0
Pipe Tank_Out-DNI_B	411.54	500	DI	110	322	2	6.36	0
Pipe Pump_Out-STUPA	215.76	700	DI	110	685	2	4.99	0

Pipe Balaju_Reservoir-B304	1248.37	600	DI	110	0	0	0	0
Pipe B304-B305	573.78	600	DI	110	0	0	0	0
Pipe B305-Graveyard	635.57	600	DI	110	0	0	0	0
Pipe B296-To_A1.10	49.93	400	DI	110	233	2	10.3	0
Pipe DNI_B-B296	683.05	450	DI	110	233	1	5.8	0
Pipe STUPA-Tank_Out	342.29	550	DI	110	375	2	5.28	0
Pipe DNI_B-B303	26.98	150	DI	110	0.51	0	0.02	0.1
Pipe B218-B031	28.06	62.2	HDPE-PE 100 PN 10	130	4.42	1	42.4	0
Pipe Tank_Out-DNI_C	14.05	200	DI	110	52.5	2	19.1	0
Pipe B013-B274	11.44	62.2	HDPE-PE 100 PN 10	130	1.69	1	7.13	0
Pipe 1	222.31	200	DI	110	31.9	1	7.6	0
Pipe 2	195.05	200	DI	110	31.9	1	7.6	0
Pipe 3	226.49	150	DI	110	16.2	1	8.79	0
Pipe 4	222.34	150	DI	110	-9.5	1	3.27	0
Pipe 5	4.19	300	DI	110	89.9	1	7.21	0
Pipe 6	146.46	150	DI	110	-9.5	1	3.27	0
Pipe 7	194.34	150	DI	110	-5.7	0	1.26	0
Pipe 8	162.56	150	DI	110	2.35	0	0.25	0
Pipe 9	163.12	150	DI	110	14.6	1	7.27	0
Pipe 10	240.23	150	DI	110	2.35	0	0.25	0
Pipe 11	210.02	150	DI	110	14.6	1	7.27	0
Pipe 13	368.48	150	DI	110	-2.4	0	0.25	0
Pipe 14	194.33	150	DI	110	2.35	0	0.25	0
Pipe 15	26.95	150	DI	110	2.35	0	0.25	0
Pipe 16	70.4	150	DI	110	2.35	0	0.25	0
Pipe 17	364.47	150	DI	110	-11	1	4.1	0
Pipe 18	1.23	150	DI	110	8.66	0	2.66	0
Pipe 19	49.32	150	DI	110	2.35	0	0.25	0
Pipe 20	1.44	150	DI	110	7.14	0	1.96	0
Pipe 21	377.71	150	DI	110	13.5	1	6.3	0
Pipe 22	136.14	150	DI	110	3.44	0	0.5	0
Pipe 23	359.95	150	DI	110	3.44	0	0.5	0
Pipe 24	381.62	150	DI	110	-2.9	0	0.36	0
Pipe 25	378	150	DI	110	-3.4	0	0.5	0
Pipe 26	377.8	62.2	HDPE-PE 100 PN 10	130	3.11	1	22.1	0
Pipe 27	174.77	150	DI	110	2.89	0	0.36	0
Pipe 28	175.49	150	DI	110	5.66	0	1.26	0

Pipe 29	177.61	62.2	HDPE-PE 100 PN 10	130	-0.5	0	0.76	0
Pipe 30	0.88	150	DI	110	14.4	1	6.93	0
Pipe 31	1.41	150	DI	110	9.05	1	3.06	0
Pipe 32	290.61	150	DI	110	-17	1	9.92	0
Pipe 33	289.16	150	DI	110	5.66	0	1.26	0
Pipe 37	278.57	150	DI	110	2.89	0	0.36	0
Pipe 38	387.31	150	DI	110	2.89	0	0.36	0
Pipe 39	420.29	150	DI	110	-5.9	0	1.35	0
Pipe 40	2.56	150	DI	110	4.76	0	0.93	0
Pipe 41	1.93	150	DI	110	10.5	1	4.01	0
Pipe 42	4.67	150	DI	110	9.29	1	3.16	0
Pipe 43	3.89	150	DI	110	9.1	1	3.02	0
Pipe 44	32.65	150	DI	110	5.89	0	1.35	0
Pipe 45	1.56	150	DI	110	8.72	0	2.86	0
Pipe 46	3.13	150	DI	110	8.78	1	2.81	0
Pipe 48	1.31	300	DI	110	89.4	1	7.04	0
Pipe 49	3.18	150	DI	110	0.51	0	0	0
Pipe 36	2.52	200	DI	110	31.9	1	7.56	0
Pump Pump	#N/A	#N/A		#N/A	685	0	-84.1	0
Valve 12	#N/A	200		#N/A	27.8	1	33.9	0
Valve 34	#N/A	200		#N/A	29.7	1	30.9	0
Valve 35	#N/A	200		#N/A	31.9	1	40.9	0

Table 6.13a.Details of Pressure for DNI B

Node ID	Elevation	Base Demand	Demand	Head	Pressure
	m	LPS	LPS	m	m
Junc B001	1333.277	0.358	0.54	1350.92	17.6
Junc B002	1332.963	0.329	0.49	1350.75	17.8
Junc B003	1329.744	0.663	0.99	1349.81	20.1
Junc B004	1330.099	0.362	0.54	1349.66	19.6
Junc B005	1329.987	0.607	0.91	1349.56	19.6
Junc B006	1330.647	0.421	0.63	1349.75	19.1
Junc B007	1329.283	0.389	0.58	1343.36	14.1
Junc B008	1312.466	0.623	0.93	1341.86	29.4
Junc B009	1307.557	0.264	0.4	1341.92	34.4
Junc B010	1307.299	0.604	0.91	1341.84	34.5
Junc B011	1303.393	0.752	1.13	1343.1	39.7
Junc B012	1302.73	0.576	0.86	1341.35	38.6
Junc B013	1299.14	0.615	0.92	1339.72	40.6
Junc B014	1313.84	0.4	0.6	1348.45	34.6
Junc B015	1312.73	0.132	0.2	1347.4	34.7
Junc B016	1313.3	0.119	0.18	1346.64	33.3

Junc B017	1314.125	0.226	0.34	1346.63	32.5
Junc B018	1313.36	0.121	0.18	1346.25	32.9
Junc B019	1313.43	0.189	0.28	1352.43	39
Junc B020	1314.786	0.287	0.43	1355.24	40.5
Junc B021	1312.77	0.533	0.8	1357.23	44.5
Junc B022	1318.87	0.527	0.79	1355.71	36.8
Junc B023	1312.98	0.218	0.33	1355.3	42.3
Junc B024	1326.26	0.165	0.25	1356.63	30.4
Junc DNI_B	1327.63	0	0	1390.56	62.9
Junc B026	1336.05	0.085	0.13	1390.53	54.5
Junc B027	1337.16	0.085	0.13	1390.53	53.4
Junc B028	1334.532	0.085	0.13	1354.76	20.2
Junc B029	1358.41	0.085	0.13	1390.53	32.1
Junc B030	1375.82	0.085	0.13	1390.53	14.7
Junc B031	1328.97	0.306	0.46	1353.95	25
Junc B032	1339.61	0.085	0.13	1352.78	13.2
Junc B033	1334.576	0.085	0.13	1352.78	18.2
Junc B034	1339.869	0.085	0.13	1352.78	12.9
Junc B035	1333.01	0.381	0.57	1351.99	19
Junc B036	1332.92	0.149	0.22	1352.02	19.1
Junc B037	1333.394	0.085	0.13	1352.01	18.6
Junc B038	1328.26	0.234	0.35	1350.78	22.5
Junc B039	1327.19	0.222	0.33	1350.8	23.6
Junc B040	1326.64	0.233	0.35	1350.25	23.6
Junc B041	1326.094	0.207	0.31	1350.24	24.1
Junc B042	1327.03	0.481	0.72	1349.81	22.8
Junc B043	1327.244	0.4	0.6	1349.52	22.3
Junc B044	1326.923	0.254	0.38	1349.51	22.6
Junc B045	1323.751	0.352	0.53	1349.45	25.7
Junc B046	1328.15	0.177	0.27	1343.72	15.6
Junc B047	1327.34	0.224	0.34	1342.76	15.4
Junc B048	1327.3	0.065	0.1	1342.75	15.5
Junc B049	1326.75	0.116	0.17	1341.9	15.2
Junc B050	1327.3	0.088	0.13	1341.9	14.6
Junc B051	1325.45	0.102	0.15	1341.79	16.3
Junc B052	1321.371	0.645	0.97	1341.63	20.3
Junc B053	1323.31	0.112	0.17	1341.59	18.3
Junc B054	1319.503	0.126	0.19	1341.58	22.1
Junc B055	1322.32	0.078	0.12	1341.55	19.2
Junc B056	1321.24	0.089	0.13	1341.46	20.2
Junc B057	1318.78	0.16	0.24	1341.45	22.7
Junc B058	1319.41	0.08	0.12	1341.39	22
Junc B059	1315.769	0.248	0.37	1341.37	25.6
Junc B060	1318.02	0.061	0.09	1341.37	23.4

Junc B061	1313.44	0.083	0.12	1341.36	27.9
Junc B062	1314.74	0.236	0.35	1341.35	26.6
Junc B063	1314.145	0.52	0.78	1341.22	27.1
Junc B064	1312.53	0.119	0.18	1341.41	28.9
Junc B065	1314.422	0.189	0.28	1341.4	27
Junc B066	1311.78	0.116	0.17	1341.52	29.7
Junc B067	1310.713	0.229	0.34	1341.74	31
Junc B068	1311.84	0.142	0.21	1341.74	29.9
Junc B069	1309.284	0.1	0.15	1342.03	32.7
Junc B070	1309.874	0.045	0.07	1342.03	32.2
Junc B071	1308.942	0.27	0.41	1342.28	33.3
Junc B072	1309.309	0.162	0.24	1342.68	33.4
Junc B073	1310.348	0.038	0.06	1342.68	32.3
Junc B074	1312.21	0.174	0.26	1343.54	31.3
Junc B075	1313.03	0.144	0.22	1342.94	29.9
Junc B076	1320.546	0.415	0.62	1356.57	36
Junc B077	1313.03	0.045	0.07	1342.94	29.9
Junc B078	1311.58	0.078	0.12	1342.93	31.4
Junc B079	1312.423	0.136	0.2	1342.93	30.5
Junc B080	1308.12	0.218	0.33	1341.3	33.2
Junc B081	1307.12	0.122	0.18	1341.29	34.2
Junc B082	1307.23	0.224	0.34	1341.28	34.1
Junc B083	1306.12	0.411	0.62	1341.29	35.2
Junc B084	1306.131	0.346	0.52	1341.27	35.1
Junc B085	1303.923	0.29	0.44	1341.01	37.1
Junc B086	1303.361	0.895	1.34	1340.9	37.5
Junc B087	1304.124	0.185	0.28	1340.95	36.8
Junc B088	1305.076	0.218	0.33	1340.94	35.9
Junc B089	1305.45	0.116	0.17	1340.78	35.3
Junc B090	1306.23	0.139	0.21	1340.77	34.5
Junc B091	1306.77	0.176	0.26	1340.75	34
Junc B092	1306.89	0.598	0.9	1340.12	33.2
Junc B093	1304.841	0.558	0.84	1340.02	35.2
Junc B094	1319.98	0.775	1.16	1336.94	17
Junc B095	1315.872	0.134	0.2	1336.56	20.7
Junc B096	1313.091	0.656	0.98	1336.51	23.4
Junc B097	1315.04	0.666	1	1336.46	21.4
Junc B098	1314.632	0.155	0.23	1346.22	31.6
Junc B099	1314.429	0.122	0.18	1346.21	31.8
Junc B100	1317.08	0.145	0.22	1344.74	27.7
Junc B101	1317.292	0.265	0.4	1344.73	27.4
Junc B102	1319.034	0.497	0.75	1343.64	24.6
Junc B103	1319.243	0.166	0.25	1343.14	23.9
Junc B104	1319.776	0.412	0.62	1343.11	23.3

Junc B105	1321.493	0.177	0.27	1342.75	21.3
Junc B106	1321.625	0.434	0.65	1342.74	21.1
Junc B107	1321.755	0.417	0.63	1342.73	21
Junc B108	1314.806	0.144	0.22	1345.93	31.1
Junc B109	1314.822	0.23	0.34	1345.93	31.1
Junc B110	1315.93	0.105	0.16	1345.88	30
Junc B111	1315.882	0.338	0.51	1345.86	30
Junc B112	1318.261	0.153	0.23	1345.88	27.6
Junc B113	1314.89	0.232	0.35	1352.46	37.6
Junc B114	1313.965	0.232	0.35	1352.44	38.5
Junc B115	1316.09	0.456	0.68	1352.61	36.5
Junc B116	1315.583	0.329	0.49	1352.57	37
Junc B117	1322.19	0.58	0.87	1353.97	31.8
Junc B118	1323.925	0.564	0.85	1353.76	29.8
Junc B119	1325.49	0.233	0.35	1354.76	29.3
Junc B120	1334.068	0.41	0.61	1355.56	21.5
Junc B121	1323.97	0.153	0.23	1355.73	31.8
Junc B122	1323.5	0.346	0.52	1338.93	15.4
Junc B123	1322.523	0.161	0.24	1339.75	17.2
Junc B124	1321.623	0.297	0.45	1339.73	18.1
Junc B125	1321.118	0.134	0.2	1340.14	19
Junc B126	1318.568	0.337	0.51	1340.33	21.8
Junc B127	1318.311	0.152	0.23	1340.47	22.2
Junc B128	1317.291	0.174	0.26	1340.41	23.1
Junc B129	1315.323	0.071	0.11	1340.9	25.6
Junc B130	1314.339	0.242	0.36	1340.51	26.2
Junc B131	1314.346	0.13	0.19	1341.78	27.4
Junc B132	1312.176	0.222	0.33	1341.77	29.6
Junc B133	1322.94	0.682	1.02	1355.8	32.9
Junc B134	1336.142	0.508	0.76	1355.7	19.6
Junc B135	1340.451	0.329	0.49	1355.7	15.3
Junc B136	1335.053	0.262	0.39	1355.77	20.7
Junc B137	1335.014	0.087	0.13	1355.77	20.8
Junc B138	1330.893	0.114	0.17	1355.77	24.9
Junc B139	1329.984	0.096	0.14	1355.77	25.8
Junc B140	1337.296	0.171	0.26	1355.76	18.5
Junc B141	1326.46	0.212	0.32	1355.76	29.3
Junc B142	1326.4	0.074	0.11	1355.76	29.4
Junc B143	1325.68	0.088	0.13	1355.77	30.1
Junc B144	1321.21	0.115	0.17	1355.75	34.5
Junc B145	1317.3	0.13	0.19	1356.63	39.3
Junc B146	1314.923	0.202	0.3	1356.62	41.7
Junc B147	1316.66	0.215	0.32	1342.1	25.4
Junc B148	1312.8	0.145	0.22	1341.56	28.8

Junc B149	1312.8	0.039	0.06	1341.55	28.8
Junc B150	1312.296	0.103	0.15	1341.55	29.3
Junc B151	1311.54	0.088	0.13	1341.53	30
Junc B152	1312.32	0.125	0.19	1341.52	29.2
Junc B153	1311.957	0.134	0.2	1341.47	29.5
Junc B154	1311.86	0.089	0.13	1341.46	29.6
Junc B157	1312.687	0.087	0.13	1341.44	28.8
Junc B158	1313.627	0.064	0.1	1341.44	27.8
Junc B159	1314.011	0.194	0.29	1341.44	27.4
Junc B160	1313.397	0.104	0.16	1341.44	28
Junc B161	1314.284	0.227	0.34	1354.11	39.8
Junc B162	1315.223	0.248	0.37	1341.44	26.2
Junc B163	1313.964	0.124	0.19	1341.43	27.5
Junc B164	1321.938	0.332	0.5	1341.56	19.6
Junc B165	1321.801	0.147	0.22	1341.92	20.1
Junc B166	1321.603	0.09	0.14	1352.73	31.1
Junc B167	1319.643	0.328	0.49	1352.72	33.1
Junc B168	1324.079	0.087	0.13	1342.2	18.1
Junc B169	1324.794	0.287	0.43	1351.93	27.1
Junc B170	1324.648	0.067	0.1	1342.27	17.6
Junc B171	1324.371	0.194	0.29	1342.25	17.9
Junc B172	1326.579	0.098	0.15	1342.57	16
Junc B173	1326.261	0.218	0.33	1351.44	25.2
Junc B174	1327.056	0.198	0.3	1342.88	15.8
Junc B175	1327.778	0.256	0.38	1351.15	23.4
Junc B176	1325.92	0.052	0.08	1355.85	29.9
Junc B177	1319.77	0.093	0.14	1355.85	36.1
Junc B178	1326.77	0.142	0.21	1355.92	29.2
Junc B179	1331.226	0.053	0.08	1355.93	24.7
Junc B180	1331.731	0.026	0.04	1355.94	24.2
Junc B181	1334.933	0.037	0.06	1355.94	21
Junc B182	1332.973	0.052	0.08	1355.94	23
Junc B183	1335.801	0.067	0.1	1355.94	20.1
Junc B184	1335.554	0.067	0.1	1355.96	20.4
Junc B185	1340.837	0.42	0.63	1356.79	16
Junc B186	1330.24	0.193	0.29	1357.63	27.4
Junc B187	1328.76	0.325	0.49	1356.13	27.4
Junc B188	1336.427	0.267	0.4	1356.11	19.7
Junc B189	1330.41	0.238	0.36	1356.88	26.5
Junc B190	1323.175	0.302	0.45	1356.86	33.7
Junc B191	1315.144	0.114	0.17	1356.88	41.7
Junc B192	1319.269	0.255	0.38	1356.87	37.6
Junc B193	1316.05	0.054	0.08	1356.93	40.9
Junc B194	1326.35	0.311	0.47	1357.39	31

Junc B195	1316.219	0.163	0.24	1355.06	38.8
Junc B196	1315.732	0.205	0.31	1354.54	38.8
Junc B197	1316.952	0.261	0.39	1354.52	37.6
Junc B198	1315.97	0.102	0.15	1354.29	38.3
Junc B199	1316.202	0.042	0.06	1354.24	38
Junc B200	1317.415	0.081	0.12	1354.3	36.9
Junc B201	1316.51	0.065	0.1	1354.24	37.7
Junc B202	1317.073	0.113	0.17	1354.23	37.2
Junc B203	1319.546	0.131	0.2	1354.22	34.7
Junc B204	1318.086	0.157	0.24	1354.22	36.1
Junc B205	1317.499	0.193	0.29	1354.22	36.7
Junc B206	1320.51	0.259	0.39	1353.79	33.3
Junc B208	1321.964	0.203	0.3	1353.69	31.7
Junc B209	1320.64	0.047	0.07	1353.74	33.1
Junc B210	1320.954	0.14	0.21	1353.73	32.8
Junc B211	1321.582	0.086	0.13	1353.85	32.3
Junc B212	1323.648	0.15	0.23	1353.85	30.2
Junc B213	1321.2	0.124	0.19	1353.93	32.7
Junc B214	1322.846	0.155	0.23	1353.93	31.1
Junc B215	1328.21	0.173	0.26	1353.08	24.9
Junc B216	1323.824	0.143	0.21	1353.08	29.3
Junc B217	1319.956	0.363	0.54	1354.26	34.3
Junc B218	1329.22	0.316	0.47	1355.13	25.9
Junc B219	1330.05	0.524	0.79	1354.75	24.7
Junc B220	1326.818	0.391	0.59	1354.57	27.8
Junc B221	1324.92	0.122	0.18	1354.49	29.6
Junc B222	1324.37	0.193	0.29	1354.48	30.1
Junc B223	1325.996	0.422	0.63	1354.7	28.7
Junc B224	1320.922	0.227	0.34	1354.66	33.7
Junc B225	1321.244	0.066	0.1	1354.56	33.3
Junc B226	1317.354	0.101	0.15	1354.55	37.2
Junc B227	1322.035	0.039	0.06	1354.47	32.4
Junc B228	1322.227	0.069	0.1	1354.46	32.2
Junc B229	1323.796	0.375	0.56	1354.42	30.6
Junc B230	1329.56	0.38	0.57	1354.77	25.2
Junc B231	1329.47	0.236	0.35	1354.77	25.3
Junc B232	1329.14	0.085	0.13	1354.77	25.6
Junc B233	1328.96	0.253	0.38	1354.78	25.8
Junc B234	1329.21	0.376	0.56	1355.17	26
Junc B235	1328.342	0.317	0.48	1355.15	26.8
Junc B236	1329.37	0.348	0.52	1356.54	27.2
Junc B237	1327.125	0.513	0.77	1354.67	27.5
Junc B238	1338.297	0.482	0.72	1355.4	17.1
Junc B239	1328.12	0.429	0.64	1355.49	27.4

Junc B240	1327.16	0.586	0.88	1355.36	28.2
Junc B241	1326.15	0.706	1.06	1355.35	29.2
Junc B242	1328.663	0.332	0.5	1349.71	21
Junc B244	1316.541	0.181	0.27	1341.36	24.8
Junc B250	1326.38	0.469	0.7	1355.65	29.3
Junc B260	1318.08	0	0	1355.64	37.6
Junc B261	1322.408	0	0	1352.87	30.5
Junc B262	1338.575	0	0	1355.36	16.8
Junc B263	1340.147	0	0	1355.7	15.6
Junc B264	1322.107	0	0	1352.83	30.7
Junc B265	1330.439	0	0	1349.96	19.5
Junc B266	1329.367	0	0	1350.05	20.7
Junc B267	1301.66	0	0	1339.23	37.6
Junc B268	1318.9	0	0	1356.63	37.7
Junc B269	1303.16	0	0	1339.14	36
Junc B270	1329.283	0	0	1350.51	21.2
Junc B271	1314	0	0	1356.84	42.8
Junc B272	1312.519	0	0	1356.8	44.3
Junc B273	1312.245	0	0	1356.8	44.6
Junc B274	1299.33	0	0	1339.64	40.3
Junc B276	1312.21	0	0	1343.55	31.3
Junc B278	1313.03	0	0	1356.64	43.6
Junc B279	1316.66	0	0	1356.65	40
Junc B280	1312.8	0	0	1356.72	43.9
Junc B281	1327.16	0	0	1356.15	29
Junc B282	1328.12	0	0	1355.86	27.7
Junc B283	1329.37	0	0	1355.3	25.9
Junc B284	1329.93	0	0	1355.2	25.3
Junc B285	1326.33	0	0	1355.14	28.8
Junc B286	1316.069	0	0	1355.42	39.4
Junc B287	1314.059	0	0	1354.84	40.8
Junc B288	1313.417	0	0	1354.12	40.7
Junc B289	1315.271	0	0	1353.89	38.6
Junc B291	1321.796	0	0	1353.26	31.5
Junc B290	1321.731	0	0	1352.72	31
Junc B292	1324.088	0	0	1351.95	27.9
Junc B293	1326.538	0	0	1351.45	24.9
Junc B294	1327.018	0	0	1351.17	24.2
Junc B295	1328.15	0	0	1350.74	22.6
Junc B296	1332.517	0	0	1386.61	54.1
Junc B303	1328.1	0	0	1390.53	62.4
Junc Pump_Out	1313.681	0	0	1396.07	82.4
Junc B304	1299.72	0	0	1339.7	40
Junc B305	1294	0	0	1339.7	45.7

Junc To_A1.10	1320.31	155	232.5	1386.09	65.8
Junc DNI_C	1311.827	35	52.5	1392.91	81.1
Junc Tank_Out	1311	0	0	1393.18	82.2
Junc B310	1313	0.188	0.28	1337.75	24.8
Junc 1	1327.63	0	0	1390.53	62.9
Junc 2	1330.24	0	0	1347.94	17.7
Junc 3	1314.059	0	0	1346.46	32.4
Junc 4	1314.059	0	0	1355.41	41.4
Junc 5	1314.059	0	0	1357.4	43.3
Junc 6	1314.059	0	0	1346.44	32.4
Junc 7	1329.93	0	0	1355.9	26
Junc 8	1330.24	0	0	1357.64	27.4
Junc 9	1327.63	1.894	2.84	1356.63	29
Junc 10	1327.63	0	0	1359.63	32
Junc 11	1321.938	0	0	1355.37	33.4
Junc 12	1321.938	0	0	1345.25	23.3
Junc 13	1329.283	0	0	1355.31	26
Junc 14	1329.283	0	0	1343.68	14.4
Junc 15	1332.963	0	0	1355.22	22.3
Junc 16	1328.26	0	0	1355.17	26.9
Junc 17	1327.19	0	0	1355.17	28
Junc 18	1328.21	0	0	1355.15	26.9
Junc 19	1329.22	0	0	1355.14	25.9
Junc 20	1316.069	0	0	1355.42	39.4
Junc 21	1312.77	0.533	0.8	1357.25	44.5
Junc 22	1313.84	0	0	1357	43.2
Junc 23	1313.84	0	0	1343.35	29.5
Junc 24	1313.43	0	0	1357.18	43.8
Junc 25	1323.5	0	0	1343.49	20
Junc 26	1323.5	0	0	1356.81	33.3
Junc 27	1323.5	0	0	1356.8	33.3
Junc 28	1312.21	0	0	1343.55	31.3
Junc 29	1312.21	0	0	1357.03	44.8
Junc 30	1312.21	0	0	1356.67	44.5
Junc 31	1303.393	0	0	1343.11	39.7
Junc 32	1299.14	0	0	1343.25	44.1
Junc 33	1328.15	0	0	1343.72	15.6
Junc 34	1327.63	0	0	1349.63	22
Junc 35	1327.63	0	0	1390.53	62.9
Junc 36	1327.63	0	0	1390.53	62.9
Resvr Balaju_Reservoir	1339.7	#N/A	0	1339.7	0
Tank Graveyard	1307	#N/A	-685.22	1312	5
Tank STUPA	1390	#N/A	310.29	1394.99	4.99

6.3.3 Design of DNI Zone - C (A 1.5)

The DNI-C model has been designed and the model features are prepared accordingly. DNI-C has been designed using the inside diameters (66.8mm, 80.4mm and 98.6mm) for HDPE PE100-PN6 pipes and the diameters (150mm, 200mm, 400mm, 500mm, 550mm & 600mm) for DI pipes. After optimizing the pipe diameters for HDPE & DI pipes, all 172 demand nodes have pressure head between 20m and 40m and 3 demand nodes have pressure above 40m.

The demarcation of DNI-C Boundary shown in **Figure 6.5** and DNI-C Design Model at Peak Demand (7.00) is shown in **Figure 6.6.**

The details of DNI-C/Pipe material & length/Bulk Meter, Isolation Valves, PRVs/PRVs with Set pressure/Location of Air Valve, Washout Valve & Fire hydrants are shown in the **Tables 6.11/6.12/6.13/6.14/6.15** respectively.

Figure 6.5: Demarcation of DNI Zone - C Boundary

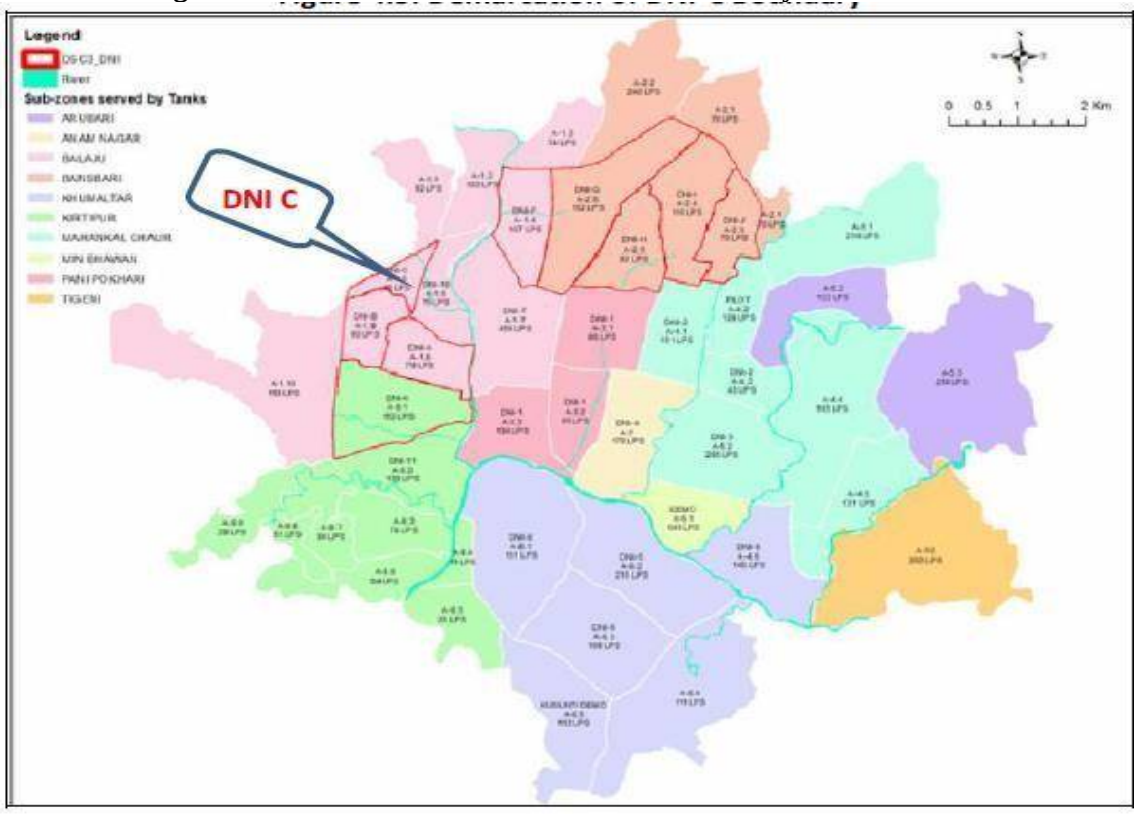


Table 6.14: Design of DNI Zone - C

Description	
Reservoir	Balaju
Outlet Elevation of the Reservoir (m)	1339.70
Total Demand (LPS)	35.17
Total number of nodes	175
Total Number of Pipes	256
Total Length of Pipes	18,803
Number of PRVs	2
Number of Pumps	1
At Peak Time (7:00) - Only for HDPE pipes within DNI	
Number of Nodes have Pressure < 5m	0
Number of Nodes have Pressure [5m,10m]	0
Number of Nodes have Pressure [20m,40m]	172
Number of Nodes have Pressure [40m,50m]	3
Number of Nodes have Pressure [50m,60m]	0
Number of Nodes have Pressure > 60m	0
At Lowest Demand Time (1:00) - Only for HDPE pipes within DNI	
Number of Nodes have Pressure < 5m	0
Number of Nodes have Pressure [5m,10m]	0
Number of Nodes have Pressure [20m,40m]	172
Number of Nodes have Pressure [40m,50m]	3
Number of Nodes have Pressure [50m,60m]	0
Number of Nodes have Pressure > 60m	0

Table 6.15: Details of Pipe material and length

Pipe Length of DNI-C (m)	
Reservoir	Balaju
Pipe Diameter (mm)	Length (m)
HDPE PIPE-PE100, PN6	
66.80 (75)	8,200.50
80.40 (90)	2,161.50
98.60 (110)	3,663.00
DI PIPE	
150	2,156.00
Grand Total	16,181.00

Table 6.16: Details of Bulk Meter/Isolation Valve/PRV's

LOCATION OF BM/IV/PRV FOR DNI_C									
DNI	DMA	# Bulk Meter	Size of BM	# Isolation Valve	Size of IV	# PRV	Size of PRV	From_Junc	To_Junc
C	1	1	150	3	150	1	150	C180	DNI_C
C	2	1	200	3	200	1	200	DNI_C	34
C	Mainline	1	500	3	500	0	0	TANK_OUT	DNI_B

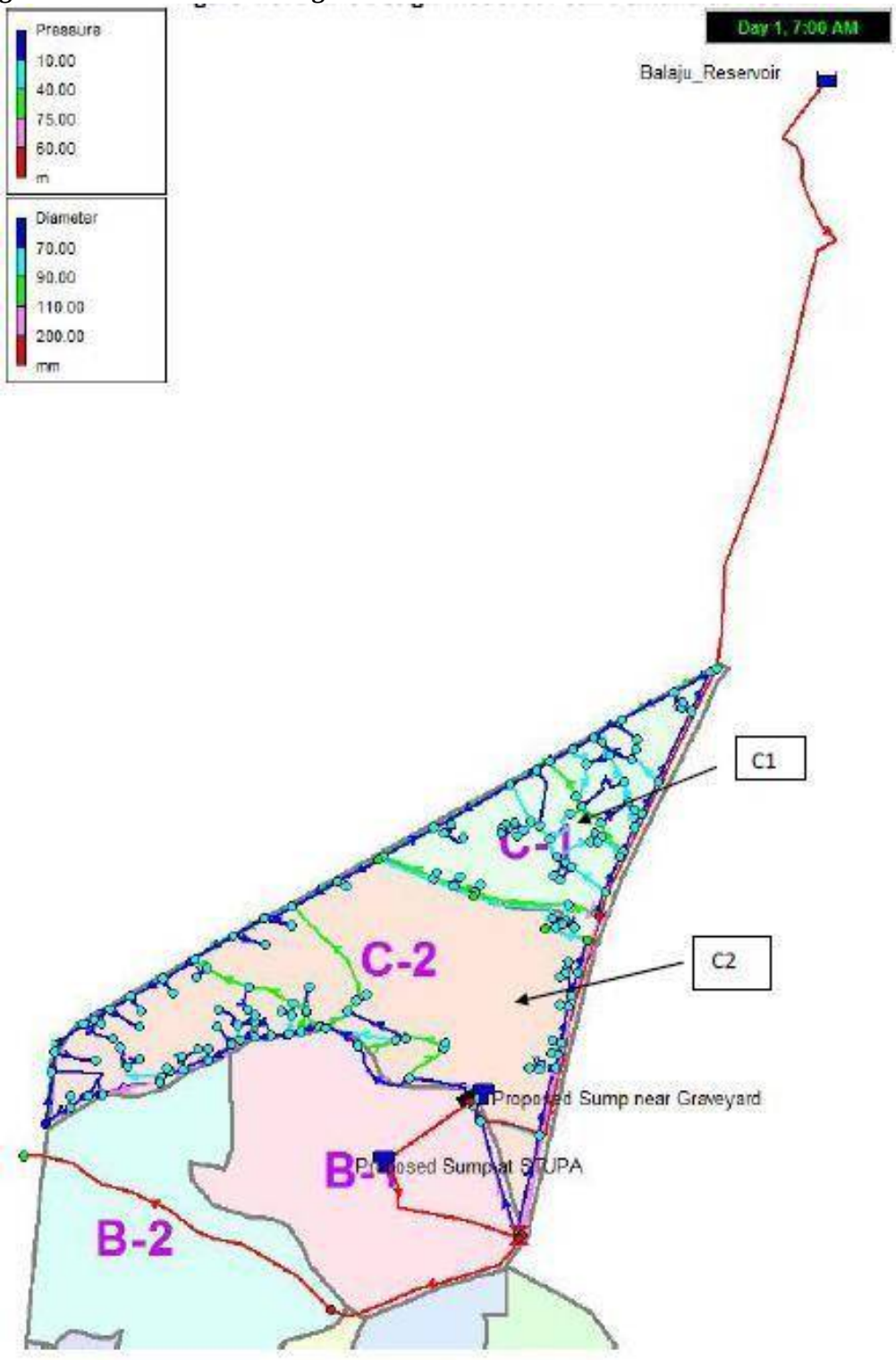
Table 6.17: Details of PRV's with Set Pressure

DNI	DMA	# PRV	Size of PRV	Set Pressure (m)	From_Junc	To_Junc
C	1	1	150	23	C180	DNI_C
C	2	1	200	40	DNI_C	34

Table 6.18: Details of location of Air Valve/Washout Valve/Fire Hydrant

LOCATION OF AV/IV/WV/FH FOR DNI_C				
DNI	# Air Valve	# Wash out Valve	# Fire Hydrant	
	Provide at Junction	Provide at Junction	Provide at Junction	On pipe dia (mm)
C	C001	C067	C001	150 DI PIPE
	C045	C036	C017	150 DI PIPE
	C203	C011	C051	150 DI PIPE
	At Stupa	C007	C082	150 DI PIPE
	At Tankout	C004	C086	110 HDPE PIPE
	C098	C057	C092	110 HDPE PIPE
	C103	C106	C203	110 HDPE PIPE
	C138	C073	C200	110 HDPE PIPE
	C158	C117	C058	110 HDPE PIPE
		C132	C052	110 HDPE PIPE
		C125	C068	110 HDPE PIPE
		C085	C027	110 HDPE PIPE
		C157	C008	110 HDPE PIPE
		C147	C071	110 HDPE PIPE
		C061	C152	110 HDPE PIPE
			C142	110 HDPE PIPE
			C138	110 HDPE PIPE
			C133	150 DI PIPE
			C118	150 DI PIPE
			C101	150 DI PIPE
			C078	150 DI PIPE
			C038	90 HDPE PIPE
			C023	110 HDPE PIPE
			C010	90 HDPE PIPE

Figure 6.6: DNI Zone - C Design Model at Peak Demand at 7.00 AM



Most of the areas within DNI-B, DNI-C and DNI A-1.10 zones are located in the high elevation areas (the highest elevation of 1339.7m, except the temple) which are not able to get water by gravity from Balaju reservoir (discharge elevation of 1,390m), therefore, it needs pump to raise the water head to supply for these areas. **Tables:**

6.16 & 6.17 provide the hydraulic configuration of the pumps and water tanks to supply water for DNI-B, DNI-C and DNI A-1.10.

Table 6.19: Pump Head Parameters

Proposed Sump (nearby Muslim Graveyard) to Proposed Reservoir at Swayambhu (STUPA)		
Ground level of pumping site (sump) near Muslim Graveyard (Masjid)	1312.00	m
Elevation of pipe inlet at Swayambhu STUPA	1390.00	m
Static Head	**78.00**	**m**
Residual Head	5.00	m
Discharge required -Q (lps)	**375.00**	**lps**
Total pipe length from proposed sump at (Muslim Graveyard) to proposed Reservoir at Swayambhu-STUPA	250.00	m
Provide DI pipe	700.00	mm
Head loss in pipe	0.41	m
Add 10% Special Losses	0.15	m
Station Losses	1.50	m
Pumping Head	**85.06**	**m**
Rounding off (Pumping Head)	**100.00**	**m**
Velocity in pipe	0.97	m/sec
Water Horse Power (r*Q*H/75)	390.00	HP
Assume efficiency of the motors and pumps as 90% and 70 % , the Breaking Horse Power (BHP) of the pump sets	619.05	BHP
Provide pumps of total capacity	**700.00**	**HP**
Provide three pump of each capacity	**350**	**HP**
Two pump will work at a time and third is standby 2(W) + 1(S)		
The discharge of each pump 190 lps with total pumping head 100m		

Table 6.20: Water Tank Storage requirements

Water Storage Calculation for proposed Sump& Reservoir at (Muslim Graveyard & Swayambhu-STUPA)		
Total Demand required for sub-zone DNI-B	59.89	lps
Total Demand required for sub-zone DNI-C	35.17	lps
Total Demand required for sub-zone A 1.10	155.47	lps
Total Demand required for Sub-zones DNI-B,C & A 1.10	**250.53**	**lps**
Peak Factor	1.50	
Peak Demand (Quantity)	375.80	lps
Say	**375.00**	**lps**
Quantity (Q)	**0.375**	**m^3/s**
Considering Detention time	18	hrs
	1080	sec
Volume =Quantity x Detention Time (V=Q*T)	405	m^3
Volume of the water required to store at proposed sump nearby Muslim Graveyard	**400**	**m^3**
Volume of the water required to store at proposed reservoir at Swayambhu-STUPA (based on the availability of Area)	**200**	**m^3**

It proposed the water sump nearby Graveyard **(see Callout Box 1 in map below)** receives water by gravity from Balaju reservoir. The existing water tank supplies water to the temple and presently it is no longer working since earthquake in April 2015 **(see Callout box 2 in map below).** Each pump with a capacity of 190 **lps** (2 working and 1 standby) will be used to pump the water from this sump at Graveyard to the Stupa water tank **(see Callout box 3 in map below).** It is proposed to have centrifugal pump sets - 3 Nos (Horizontal Split Type) where 2 (W) +1 (S) will be housed at pump house which will be constructed near Graveyard.

Figure: 6.7: Details of Area required for Water Storage and location of Proposed Pump House



Below are the model results of water depth of the Graveyard sump, pump and Stupa tank:

Figure: 6.8 Graph Showing Water Head at Graveyard sump

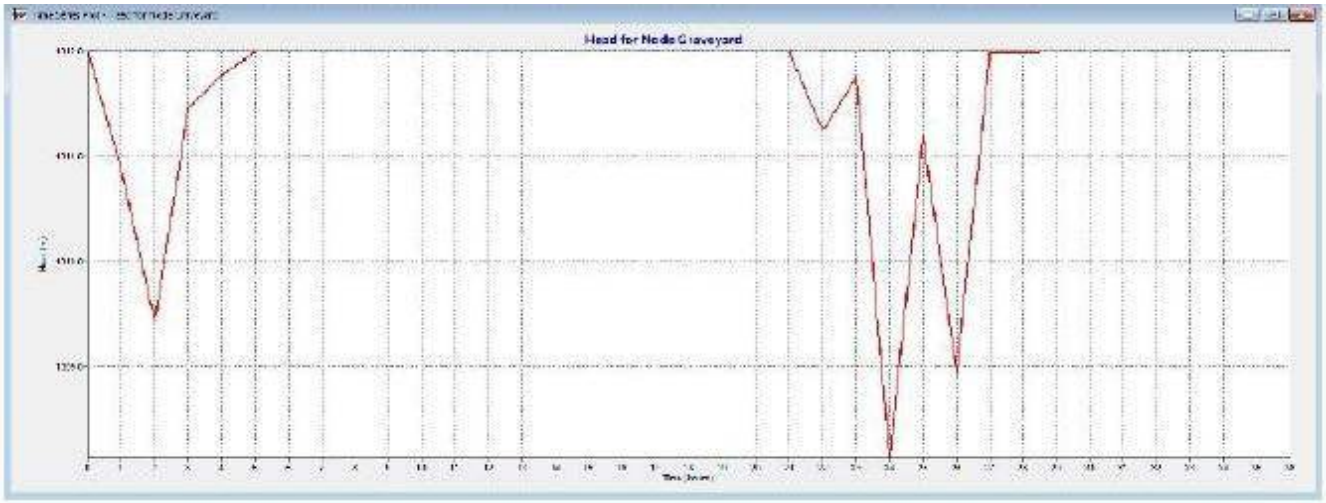


Figure 6.9: Graph Showing Pump flow

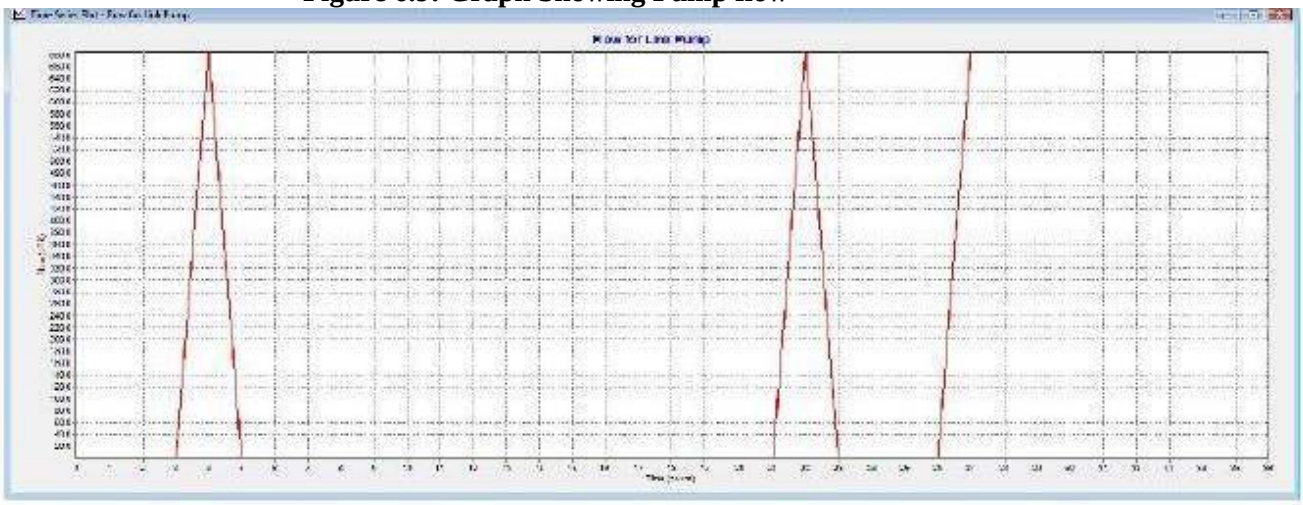


Figure 6.10: Water head at Stupa Tank

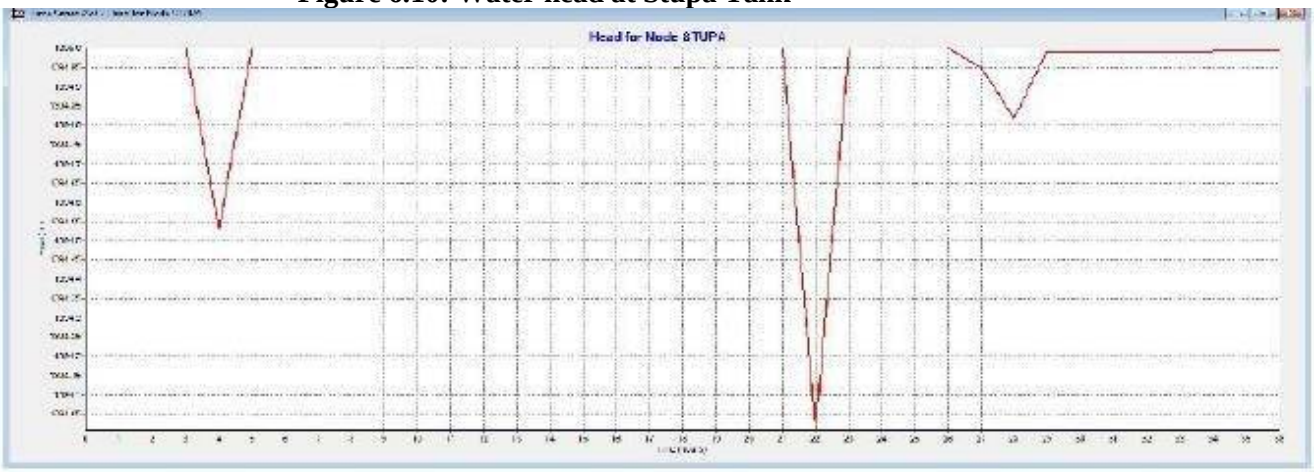


Table 6.21.Details of Pipe for DNI C

Link ID	Length	Diameter	Roughness	Material	Flow	Velocity	Unit Headloss	Friction Factor
	m	mm			LPS	m/s	m/km	
Pipe C099-C100	79.08	62.2	130	HDPE-PE 100 PN10	-0.4	0.13	0.49	0.035
Pipe C096-C095	8.5127	62.2	130	HDPE-PE 100 PN10	-0.05	0.02	0.02	0.091
Pipe C095-C097	11.65	62.2	130	HDPE-PE 100 PN10	0.32	0.11	0.34	0.037
Pipe C094-C095	24.06	62.2	130	HDPE-PE 100 PN10	0.42	0.14	0.54	0.035
Pipe C093-C092	52.81	62.2	130	HDPE-PE 100 PN10	-1.16	0.38	3.58	0.03
Pipe C090-C091	16.86	62.2	130	HDPE-PE 100 PN10	0.88	0.29	2.15	0.031
Pipe C088-C089	16.72	62.2	130	HDPE-PE 100 PN10	0.59	0.19	1.01	0.033
Pipe C086-C087	16.83	62.2	130	HDPE-PE 100 PN10	0.14	0.05	0.07	0.038

Pipe C084-C160	7.6782	62.2	130	HDPE-PE 100 PN10	0.25	0.08	0.21	0.037
Pipe C084-C085	22.712	62.2	130	HDPE-PE 100 PN10	1.19	0.39	3.75	0.03
Pipe C083-C084	29.04	62.2	130	HDPE-PE 100 PN10	2.37	0.78	13.37	0.027
Pipe C082-C081	118.68	62.2	130	HDPE-PE 100 PN10	-1.63	0.54	6.72	0.028
Pipe C079-C080	16.38	80.4	130	HDPE-PE 100 PN10	0.92	0.18	0.66	0.032
Pipe C077-C076	8.759	62.2	130	HDPE-PE 100 PN10	-0.57	0.19	0.97	0.033
Pipe C076-C078	97.19	62.2	130	HDPE-PE 100 PN10	2.15	0.71	11.22	0.027
Pipe C076-C075	79.203	62.2	130	HDPE-PE 100 PN10	-3.38	1.11	25.78	0.025
Pipe C075-C100	19.294	62.2	130	HDPE-PE 100 PN10	-1.7	0.56	7.23	0.028
Pipe C075-C074	127.56	62.2	130	HDPE-PE 100 PN10	-1.89	0.62	8.83	0.028
Pipe C074-C101	63.31	62.2	130	HDPE-PE 100 PN10	-2.99	0.98	20.55	0.026
Pipe C072-C074	25.959	62.2	130	HDPE-PE 100 PN10	-0.7	0.23	1.4	0.032
Pipe C072-C073	23.468	62.2	130	HDPE-PE 100 PN10	0.57	0.19	0.95	0.033
Pipe C071-C072	243.87	62.2	130	HDPE-PE 100 PN10	0.23	0.08	0.18	0.038
Pipe C070-C069	23.6	62.2	130	HDPE-PE 100 PN10	-0.39	0.13	0.46	0.035
Pipe C069-C071	101.87	150	110	DI	7.13	0.4	1.92	0.035
Pipe C068-C062	112.32	62.2	130	HDPE-PE 100 PN10	1.95	0.64	9.31	0.028
Pipe C065-C067	40.022	62.2	130	HDPE-PE 100 PN10	0.51	0.17	0.78	0.034
Pipe C065-C066	24.556	62.2	130	HDPE-PE 100 PN10	0.42	0.14	0.53	0.035
Pipe C064-C068	116.87	150	110	DI	-2.15	0.12	0.21	0.042
Pipe C064-C065	23.02	62.2	130	HDPE-PE 100 PN10	1.17	0.38	3.59	0.03
Pipe C062-C063	10.416	62.2	130	HDPE-PE 100 PN10	0.38	0.12	0.46	0.036
Pipe C062-C060	43.615	62.2	130	HDPE-PE 100 PN10	1.27	0.42	4.23	0.029
Pipe C060-C061	20.29	62.2	130	HDPE-PE 100 PN10	0.28	0.09	0.26	0.036
Pipe C060-C058	40.73	62.2	130	HDPE-PE 100 PN10	0.79	0.26	1.74	0.032
Pipe C058-C059	20.33	62.2	130	HDPE-PE 100 PN10	0.79	0.26	1.73	0.032
Pipe C058-C052	190.76	62.2	130	HDPE-PE 100 PN10	-0.42	0.14	0.55	0.035
Pipe C055-C057	16.93	62.2	130	HDPE-PE 100 PN10	0.79	0.26	1.76	0.032
Pipe C055-C056	21.811	62.2	130	HDPE-PE 100 PN10	0.66	0.22	1.26	0.033

Pipe C053-C055	8.0751	62.2	130	HDPE-PE 100 PN10	1.5	0.49	5.75	0.029
Pipe C053-C054	22.71	62.2	130	HDPE-PE 100 PN10	0.31	0.1	0.3	0.036
Pipe C052-C053	33.633	62.2	130	HDPE-PE 100 PN10	1.87	0.62	8.65	0.028
Pipe C052-C051	60.7	62.2	130	HDPE-PE 100 PN10	-2.61	0.86	16.03	0.026
Pipe C051-C050	48.82	150	110	DI	12.76	0.72	5.65	0.032
Pipe C050-C045	76.2	150	110	DI	5.01	0.28	1	0.037
Pipe C048-C050	83.75	62.2	130	HDPE-PE 100 PN10	-2.14	0.7	11.04	0.027
Pipe C048-C049	33.539	62.2	130	HDPE-PE 100 PN10	0.2	0.07	0.14	0.039
Pipe C047-C046	33.91	62.2	130	HDPE-PE 100 PN10	-0.54	0.18	0.86	0.033
Pipe C046-C048	13.287	62.2	130	HDPE-PE 100 PN10	-1.64	0.54	6.79	0.028
Pipe C045-C020	8.59	150	110	DI	5.01	0.28	1	0.037
Pipe C043-C045	58.51	62.2	130	HDPE-PE 100 PN10	-0.18	0.06	0.12	0.039
Pipe C043-C044	12.91	62.2	130	HDPE-PE 100 PN10	0.12	0.04	0.06	0.044
Pipe C041-C043	14.821	62.2	130	HDPE-PE 100 PN10	0.07	0.02	0.02	0.04
Pipe C041-C042	17.714	62.2	130	HDPE-PE 100 PN10	0.09	0.03	0.03	0.039
Pipe C040-C046	20.571	62.2	130	HDPE-PE 100 PN10	-1	0.33	2.69	0.03
Pipe C040-C041	73.749	62.2	130	HDPE-PE 100 PN10	0.41	0.13	0.52	0.035
Pipe C040-C039	88.82	62.2	130	HDPE-PE 100 PN10	0.34	0.11	0.37	0.036
Pipe C037-C038	34.634	62.2	130	HDPE-PE 100 PN10	0.32	0.1	0.32	0.036
Pipe C037-C028	19.554	62.2	130	HDPE-PE 100 PN10	0.55	0.18	0.9	0.033
Pipe C034-C036	4.4864	62.2	130	HDPE-PE 100 PN10	0.3	0.1	0.3	0.037
Pipe C034-C035	6.9084	62.2	130	HDPE-PE 100 PN10	0.22	0.07	0.17	0.039
Pipe C032-C034	12.709	62.2	130	HDPE-PE 100 PN10	0.54	0.18	0.88	0.033
Pipe C032-C033	7.4021	62.2	130	HDPE-PE 100 PN10	0.16	0.05	0.1	0.042
Pipe C031-C032	25.559	62.2	130	HDPE-PE 100 PN10	0.74	0.24	1.54	0.032
Pipe C029-C031	15.379	62.2	130	HDPE-PE 100 PN10	1.14	0.38	3.45	0.03
Pipe C029-C030	23.302	62.2	130	HDPE-PE 100 PN10	0.15	0.05	0.08	0.04
Pipe C028-C029	22.32	62.2	130	HDPE-PE 100 PN10	1.38	0.45	4.93	0.029
Pipe C028-C027	84.93	62.2	130	HDPE-PE 100 PN10	-1.08	0.35	3.1	0.03

Pipe C027-C064	175.27	150	110	DI	-2.15	0.12	0.21	0.042
Pipe C026-C037	120.87	62.2	130	HDPE-PE 100 PN10	1.11	0.37	3.28	0.03
Pipe C026-C027	58.86	150	110	DI	-2.15	0.12	0.21	0.042
Pipe C025-C026	32.26	150	110	DI	-2.15	0.12	0.21	0.041
Pipe C025-C024	88.86	62.2	130	HDPE-PE 100 PN10	-1.06	0.35	3.01	0.03
Pipe C024-C023	25.164	62.2	130	HDPE-PE 100 PN10	-0.8	0.26	1.79	0.032
Pipe C023-C021	48.918	62.2	130	HDPE-PE 100 PN10	-0.63	0.21	1.15	0.033
Pipe C022-C021	70.002	62.2	130	HDPE-PE 100 PN10	-0.05	0.02	0.01	0.051
Pipe C022-C019	51.01	62.2	130	HDPE-PE 100 PN10	-0.41	0.14	0.53	0.035
Pipe C021-C020	74.58	62.2	130	HDPE-PE 100 PN10	-0.97	0.32	2.55	0.031
Pipe C020-C019	56.38	150	110	DI	5.01	0.28	1	0.037
Pipe C019-C017	28.42	150	110	DI	5.01	0.28	1	0.037
Pipe C017-C018	16.27	62.2	130	HDPE-PE 100 PN10	0.11	0.04	0.05	0.04
Pipe C017-C012	73.49	150	110	DI	5.01	0.28	1	0.037
Pipe C016-C023	98.672	62.2	130	HDPE-PE 100 PN10	0.4	0.13	0.51	0.035
Pipe C016-C022	43.203	62.2	130	HDPE-PE 100 PN10	-0.19	0.06	0.12	0.038
Pipe C015-C016	61.582	62.2	130	HDPE-PE 100 PN10	0.63	0.21	1.16	0.033
Pipe C014-C024	67.212	62.2	130	HDPE-PE 100 PN10	0.7	0.23	1.41	0.032
Pipe C014-C015	48.862	62.2	130	HDPE-PE 100 PN10	-0.72	0.24	1.48	0.032
Pipe C013-C025	51.42	150	110	DI	-2.15	0.12	0.21	0.041
Pipe C013-C014	46.75	62.2	130	HDPE-PE 100 PN10	0.37	0.12	0.43	0.035
Pipe C012-C005	156.28	150	110	DI	5.01	0.28	1	0.037
Pipe C010-C012	70.2	62.2	130	HDPE-PE 100 PN10	0.57	0.19	0.95	0.033
Pipe C010-C011	21.877	62.2	130	HDPE-PE 100 PN10	0.26	0.09	0.22	0.036
Pipe C009-C015	29.154	62.2	130	HDPE-PE 100 PN10	1.61	0.53	6.55	0.028
Pipe C009-C010	66.921	62.2	130	HDPE-PE 100 PN10	1.05	0.35	2.99	0.03
Pipe C008-C013	46.86	150	110	DI	-2.15	0.12	0.21	0.042
Pipe C008-C009	19.97	62.2	130	HDPE-PE 100 PN10	2.84	0.94	18.74	0.026
Pipe C006-C008	65.07	150	110	DI	5.01	0.28	1	0.037
Pipe C006-C007	56.73	62.2	130	HDPE-PE 100 PN10	0.52	0.17	0.82	0.034
Pipe C005-C001	86.12	150	110	DI	5.01	0.28	1	0.037
Pipe C004-C003	10.208	62.2	130	HDPE-PE 100 PN10	-0.14	0.05	0.07	0.04

Pipe C003-C005	24.38	62.2	130	HDPE-PE 100 PN10	-0.22	0.07	0.16	0.037
Pipe C002-C006	119.43	150	110	DI	5.01	0.28	1	0.037
Pipe C002-C003	33.629	62.2	130	HDPE-PE 100 PN10	0.29	0.1	0.28	0.037
Pipe C001-C002	83.28	150	110	DI	5.01	0.28	1	0.037
Pipe C165-C100	144.34	62.2	130	HDPE-PE 100 PN10	2.22	0.73	11.9	0.027
Pipe C159-C158	57.53	62.2	130	HDPE-PE 100 PN10	-0.99	0.33	2.67	0.031
Pipe C158-C071	64.98	150	110	DI	-7.13	0.4	1.92	0.035
Pipe C156-C158	72.48	150	110	DI	-7.13	0.4	1.92	0.035
Pipe C156-C157	65.8	62.2	130	HDPE-PE 100 PN10	0.69	0.23	1.35	0.032
Pipe C155-C154	44.501	62.2	130	HDPE-PE 100 PN10	-0.19	0.06	0.12	0.039
Pipe C154-C107	92.487	62.2	130	HDPE-PE 100 PN10	-0.11	0.04	0.05	0.043
Pipe C153-C170	27.067	62.2	130	HDPE-PE 100 PN10	0.33	0.11	0.34	0.036
Pipe C153-C154	93.446	62.2	130	HDPE-PE 100 PN10	0.78	0.26	1.72	0.032
Pipe C152-C156	94.05	150	110	DI	-7.13	0.4	1.92	0.035
Pipe C152-C153	26.03	62.2	130	HDPE-PE 100 PN10	1.5	0.49	5.73	0.029
Pipe C152-C150	74.22	150	110	DI	0.62	0.03	0.02	0.049
Pipe C151-C150	33.67	62.2	130	HDPE-PE 100 PN10	-0.58	0.19	0.97	0.033
Pipe C148-C149	34.34	62.2	130	HDPE-PE 100 PN10	0.32	0.11	0.33	0.036
Pipe C146-C147	66.4	62.2	130	HDPE-PE 100 PN10	0.45	0.15	0.61	0.034
Pipe C144-C145	18.03	62.2	130	HDPE-PE 100 PN10	0.15	0.05	0.08	0.041
Pipe C142-C143	69.81	62.2	130	HDPE-PE 100 PN10	0.21	0.07	0.16	0.039
Pipe C141-C140	83.91	62.2	130	HDPE-PE 100 PN10	-0.52	0.17	0.8	0.034
Pipe C139-C135	149.13	62.2	130	HDPE-PE 100 PN10	0.02	0.01	0	0.038
Pipe C136-C137	22.57	62.2	130	HDPE-PE 100 PN10	0.3	0.1	0.29	0.036
Pipe C131-C130	26.361	62.2	130	HDPE-PE 100 PN10	-0.31	0.1	0.3	0.036
Pipe C130-C132	42.079	62.2	130	HDPE-PE 100 PN10	0.2	0.07	0.14	0.038
Pipe C130-C129	88.36	62.2	130	HDPE-PE 100 PN10	-0.89	0.29	2.18	0.031
Pipe C127-C128	7.05	62.2	130	HDPE-PE 100 PN10	0.16	0.05	0.08	0.038
Pipe C124-C126	4.1043	62.2	130	HDPE-PE 100 PN10	0.3	0.1	0.29	0.036
Pipe C124-C125	35.235	62.2	130	HDPE-PE 100 PN10	0.29	0.09	0.27	0.037

Pipe C123-C124	22.74	62.2	130	HDPE-PE 100 PN10	0.65	0.21	1.22	0.033
Pipe C121-C122	20.78	62.2	130	HDPE-PE 100 PN10	0.14	0.05	0.07	0.042
Pipe C119-C120	45.77	62.2	130	HDPE-PE 100 PN10	0.31	0.1	0.32	0.036
Pipe C118-C116	28.98	62.2	130	HDPE-PE 100 PN10	-0.32	0.11	0.33	0.036
Pipe C116-C117	48.967	62.2	130	HDPE-PE 100 PN10	0.46	0.15	0.66	0.034
Pipe C116-C114	36.054	62.2	130	HDPE-PE 100 PN10	-0.94	0.31	2.43	0.031
Pipe C115-C114	12.025	62.2	130	HDPE-PE 100 PN10	-0.13	0.04	0.06	0.044
Pipe C114-C113	7.959	62.2	130	HDPE-PE 100 PN10	-1.13	0.37	3.37	0.03
Pipe C113-C112	23.91	62.2	130	HDPE-PE 100 PN10	-0.1	0.03	0.04	0.046
Pipe C113-C111	51.99	62.2	130	HDPE-PE 100 PN10	-1.1	0.36	3.21	0.03
Pipe C108-C110	36.69	62.2	130	HDPE-PE 100 PN10	0.66	0.22	1.26	0.032
Pipe C108-C109	21.208	62.2	130	HDPE-PE 100 PN10	0.24	0.08	0.2	0.038
Pipe C107-C108	24.709	62.2	130	HDPE-PE 100 PN10	1	0.33	2.72	0.031
Pipe C107-C104	32.157	62.2	130	HDPE-PE 100 PN10	-1.17	0.39	3.64	0.03
Pipe C106-C105	45.688	62.2	130	HDPE-PE 100 PN10	-1.06	0.35	3.03	0.03
Pipe C105-C104	5.1581	62.2	130	HDPE-PE 100 PN10	0.95	0.31	2.45	0.031
Pipe C105-C102	44.28	62.2	130	HDPE-PE 100 PN10	-2.16	0.71	11.28	0.027
Pipe C104-C103	38.1	62.2	130	HDPE-PE 100 PN10	-0.31	0.1	0.3	0.036
Pipe C001-C002R	81.17	62.2	130	HDPE-PE 100 PN10	-0.16	0.05	0.1	0.04
Pipe C002-C006R	119.57	62.2	130	HDPE-PE 100 PN10	-0.85	0.28	2	0.031
Pipe C006-C008R	64.23	62.2	130	HDPE-PE 100 PN10	-1.78	0.59	7.9	0.028
Pipe C008-C013R	47.27	62.2	130	HDPE-PE 100 PN10	2.34	0.77	13.06	0.027
Pipe C013-C025R	51.74	62.2	130	HDPE-PE 100 PN10	1.72	0.57	7.38	0.028
Pipe C025-C026R	31.71	62.2	130	HDPE-PE 100 PN10	2.47	0.81	14.47	0.027
Pipe C026-C027R	58.92	62.2	130	HDPE-PE 100 PN10	0.97	0.32	2.56	0.031
Pipe C027-C064R	174.73	62.2	130	HDPE-PE 100 PN10	-0.71	0.23	1.44	0.032
Pipe C064-C068R	116.15	62.2	130	HDPE-PE 100 PN10	-2.29	0.75	12.55	0.027

Pipe C069-C071R	102.07	62.2	130	HDPE-PE 100 PN10	0.69	0.23	1.37	0.032
Pipe C071-C158	64.98	62.2	130	HDPE-PE 100 PN10	-0.02	0.01	0	0.043
Pipe C158-C156	71.07	62.2	130	HDPE-PE 100 PN10	-1.32	0.43	4.51	0.029
Pipe C156-C152	94.27	62.2	130	HDPE-PE 100 PN10	-2.48	0.82	14.59	0.027
Pipe C152-C150R	75.94	62.2	130	HDPE-PE 100 PN10	2.27	0.75	12.31	0.027
Pipe C150-C148R	73.65	62.2	130	HDPE-PE 100 PN10	1.35	0.45	4.73	0.029
Pipe C148-C146R	48.59	62.2	130	HDPE-PE 100 PN10	0.76	0.25	1.64	0.032
Pipe C146-C144	36.76	62.2	130	HDPE-PE 100 PN10	0.08	0.03	0.03	0.046
Pipe C144-C142	21.24	62.2	130	HDPE-PE 100 PN10	-0.17	0.06	0.11	0.04
Pipe C142-C140	83.11	62.2	130	HDPE-PE 100 PN10	-0.72	0.24	1.46	0.032
Pipe C140-C139	39.37	62.2	130	HDPE-PE 100 PN10	-1.59	0.52	6.37	0.028
Pipe C139-C138	102.39	62.2	130	HDPE-PE 100 PN10	-1.98	0.65	9.55	0.028
Pipe C138-C136R	59.06	62.2	130	HDPE-PE 100 PN10	2.16	0.71	11.26	0.027
Pipe C136-C135R	42.5	62.2	130	HDPE-PE 100 PN10	1.72	0.56	7.36	0.028
Pipe C135-C134R	27.71	62.2	130	HDPE-PE 100 PN10	1.56	0.51	6.18	0.029
Pipe C134-C133	116.2	62.2	130	HDPE-PE 100 PN10	1.29	0.43	4.35	0.029
Pipe C133-C129R	15.46	62.2	130	HDPE-PE 100 PN10	1.11	0.36	3.26	0.03
Pipe C129-C127R	18.43	62.2	130	HDPE-PE 100 PN10	0.12	0.04	0.05	0.04
Pipe C127-C123	29.39	62.2	130	HDPE-PE 100 PN10	-0.1	0.03	0.04	0.042
Pipe C119-C118R	18.76	62.2	130	HDPE-PE 100 PN10	-1.51	0.5	5.79	0.029
Pipe C118-C112	30.36	62.2	130	HDPE-PE 100 PN10	-1.25	0.41	4.11	0.03
Pipe C112-C111	31.65	62.2	130	HDPE-PE 100 PN10	-1.43	0.47	5.23	0.029
Pipe C111-C110	37.59	62.2	130	HDPE-PE 100 PN10	-2.64	0.87	16.39	0.026
Pipe C110-C103	23.23	62.2	130	HDPE-PE 100 PN10	-2.07	0.68	10.42	0.027
Pipe C103-C102	36.6	62.2	130	HDPE-PE 100 PN10	-2.4	0.79	13.68	0.027
Pipe C102-C101R	4.93	62.2	130	HDPE-PE 100 PN10	8.65	2.85	147.14	0.022
Pipe C101-C165R	8.62	62.2	130	HDPE-PE 100 PN10	5.62	1.85	66.25	0.024

Pipe C165-C099R	74.01	62.2	130	HDPE-PE 100 PN10	3.23	1.06	23.73	0.026
Pipe C099-C078	152.08	62.2	130	HDPE-PE 100 PN10	3.04	1	21.26	0.026
Pipe C078-C079	151.97	62.2	130	HDPE-PE 100 PN10	4.4	1.45	42.08	0.025
Pipe C079-C081	34.27	62.2	130	HDPE-PE 100 PN10	3.4	1.12	26.16	0.025
Pipe C081-C098R	234.85	62.2	130	HDPE-PE 100 PN10	1.02	0.34	2.83	0.03
Pipe C098-C082R	196.64	62.2	130	HDPE-PE 100 PN10	0.47	0.16	0.67	0.034
Pipe C082-C083	136.28	62.2	130	HDPE-PE 100 PN10	0.82	0.27	1.87	0.031
Pipe C083-C086	28.2	62.2	130	HDPE-PE 100 PN10	-2.47	0.81	14.45	0.027
Pipe C086-C088	26.17	62.2	130	HDPE-PE 100 PN10	-3.54	1.16	28.07	0.025
Pipe C088-C090	71.68	62.2	130	HDPE-PE 100 PN10	-4.2	1.38	38.53	0.025
Pipe C090-C092	24.68	62.2	130	HDPE-PE 100 PN10	-5.17	1.7	56.77	0.024
Pipe C092-C094R	46.73	62.2	130	HDPE-PE 100 PN10	-6.44	2.12	85.2	0.023
Pipe C051-C050R	47.74	62.2	130	HDPE-PE 100 PN10	-2.81	0.93	18.37	0.026
Pipe C050-C045R	75.87	62.2	130	HDPE-PE 100 PN10	2.48	0.82	14.52	0.027
Pipe C020-C019R	56.97	62.2	130	HDPE-PE 100 PN10	1.03	0.34	2.88	0.03
Pipe C019-C017R	28.08	62.2	130	HDPE-PE 100 PN10	0.45	0.15	0.63	0.034
Pipe C017-C012R	72.88	62.2	130	HDPE-PE 100 PN10	0.28	0.09	0.26	0.037
Pipe C012-C005R	156.15	62.2	130	HDPE-PE 100 PN10	0.49	0.16	0.71	0.034
Pipe C005-C001R	83.69	62.2	130	HDPE-PE 100 PN10	0.08	0.03	0.03	0.042
Pipe C119-C121R	56.7	62.2	130	HDPE-PE 100 PN10	1.07	0.35	3.08	0.03
Pipe C121-C123R	54.37	62.2	130	HDPE-PE 100 PN10	0.84	0.28	1.97	0.031
Pipe C069-C200R	95.49	150	110	DI	-7.13	0.4	1.92	0.035
Pipe C069-C200	94.2	62.2	130	HDPE-PE 100 PN10	-1.49	0.49	5.69	0.029
Pipe C200-C201	199.8	62.2	130	HDPE-PE 100 PN10	-1.49	0.49	5.69	0.029
Pipe C201-C202	202.61	62.2	130	HDPE-PE 100 PN10	-1.49	0.49	5.69	0.029
Pipe C203-C094	69.3	62.2	130	HDPE-PE 100 PN10	6.94	2.28	97.88	0.023
Pipe C202-C203	86.38	62.2	130	HDPE-PE 100	-1.49	0.49	5.69	0.029

				PN10				
Pipe STUPA-Tank_Out	345.83	550	110	DI	375.09	1.58	5.29	0.023
Pipe Balaju_Reservoir-C204	1286.7	600	110	DI	708.11	2.5	11.23	0.021
Pipe Pump_Out-STUPA	208.16	700	110	DI	0	0	0	0
Pipe Graveyard-C205	641.94	600	110	DI	-708.11	2.5	11.23	0.021
Pipe C205-C204	538.73	600	110	DI	-708.11	2.5	11.23	0.021
Pipe Tank_Out-DNI_B	420.57	500	110	DI	322.33	1.64	6.35	0.023
Pipe DNI_B-To_A-1.10	704.19	400	110	DI	232.5	1.85	10.29	0.024
Pipe C180-C190	656.5	150	110	DI	20.18	1.14	13.22	0.03
Pipe Tank_Out-DNI_C	3.32	200	110	DI	52.75	1.68	19.32	0.027
Pipe 1	196.59	150	110	DI	-7.42	0.42	2.07	0.035
Pipe 2	251.22	150	110	DI	-7.42	0.42	2.07	0.035
Pipe 3	8.5	62.2	130	HDPE-PE 100 PN10	2.12	0.7	10.84	0.027
Pipe 4	1.18	150	110	DI	7.16	0.4	1.89	0.034
Pipe 5	1.17	150	110	DI	7.75	0.44	2.16	0.033
Pipe 6	180.06	150	110	DI	0.62	0.03	0.02	0.05
Pipe 7	228.37	150	110	DI	0.62	0.03	0.02	0.05
Pipe 8	266.17	150	110	DI	-3.74	0.21	0.58	0.038
Pipe 9	204.41	150	110	DI	-3.74	0.21	0.58	0.038
Pipe 10	130.58	150	110	DI	-3.74	0.21	0.58	0.038
Pipe 11	3.62	150	110	DI	4.36	0.25	0.78	0.038
Pipe 12	2.61	150	110	DI	3.26	0.18	0.46	0.04
Pipe 13	237.43	150	110	DI	17.01	0.96	9.64	0.031
Pipe 14	183.64	150	110	DI	-17.01	0.96	9.64	0.031
Pipe 15	238.48	150	110	DI	-17.01	0.96	9.64	0.031
Pipe 16	291.84	150	110	DI	7.13	0.4	1.92	0.035
Pipe 17	201.38	150	110	DI	7.13	0.4	1.92	0.035
Pipe 18	403.82	150	110	DI	15.56	0.88	8.17	0.031
Pipe 19	198.66	150	110	DI	15.56	0.88	8.17	0.031
Pipe 20	2.94	150	110	DI	13.27	0.75	6.07	0.032
Pipe 21	2.61	150	110	DI	3.26	0.18	0.46	0.04
Pipe 22	4.38	150	110	DI	8.43	0.48	2.62	0.034
Pipe 23	4.79	150	110	DI	20.18	1.14	13.24	0.03
Pipe 25	1.75	150	110	DI	5.27	0.3	1.11	0.037
Pump Pump	#N/A	#N/A	#N/A		0	0	-200	0
Valve C_PRV1	#N/A	200	#N/A		32.57	1.04	41.57	0
Valve 24	#N/A	150	#N/A		20.18	1.14	59.11	0

Table 6.22.Details of Pressure for DNI C

Node ID	Elevation	Base Demand	Demand	Head	Pressure
	m	LPS	LPS	m	m
Junc C001	1298.7	0.166	0.25	1323.47	24.75
Junc C002	1298.2	0.261	0.39	1323.48	25.24
Junc C003	1298.3	0.246	0.37	1323.47	25.16
Junc C004	1298.6	0.095	0.14	1323.47	24.9
Junc C005	1298.7	0.122	0.18	1323.47	24.77
Junc C006	1299.3	0.274	0.41	1323.72	24.4
Junc C007	1298.4	0.349	0.52	1323.67	25.28
Junc C008	1294.4	0.127	0.19	1324.22	29.82
Junc C009	1294.7	0.118	0.18	1323.85	29.19
Junc C010	1297.9	0.151	0.23	1323.65	25.79
Junc C011	1298	0.173	0.26	1323.64	25.63
Junc C012	1296.9	0.242	0.36	1323.58	26.7
Junc C013	1295.4	0.165	0.25	1323.61	28.25
Junc C014	1294	0.261	0.39	1323.59	29.59
Junc C015	1295.8	0.171	0.26	1323.66	27.87
Junc C016	1295.1	0.28	0.42	1323.59	28.54
Junc C017	1294.7	0.04	0.06	1323.6	28.91
Junc C018	1294	0.076	0.11	1323.6	29.59
Junc C019	1293.8	0.112	0.17	1323.62	29.84
Junc C020	1293.3	0.075	0.11	1323.78	30.46
Junc C021	1294	0.19	0.28	1323.59	29.59
Junc C022	1294.9	0.183	0.27	1323.59	28.74
Junc C023	1294	0.157	0.24	1323.54	29.54
Junc C024	1294	0.295	0.44	1323.49	29.49
Junc C025	1294.5	0.203	0.3	1323.22	28.69
Junc C026	1294.2	0.262	0.39	1322.77	28.6
Junc C027	1294.4	0.404	0.61	1322.61	28.17
Junc C028	1294.3	0.165	0.25	1322.35	28.03
Junc C029	1294.5	0.058	0.09	1322.24	27.75
Junc C030	1294.6	0.102	0.15	1322.24	27.67
Junc C031	1295.1	0.27	0.41	1322.19	27.12
Junc C032	1295.4	0.019	0.03	1322.15	26.74
Junc C033	1295.5	0.109	0.16	1322.15	26.65
Junc C034	1295.5	0.014	0.02	1322.14	26.6
Junc C035	1295.6	0.149	0.22	1322.14	26.51
Junc C036	1295.6	0.2	0.3	1322.14	26.55
Junc C037	1294.5	0.159	0.24	1322.37	27.85
Junc C038	1293.8	0.212	0.32	1322.36	28.54
Junc C039	1294	0.227	0.34	1323.87	29.87
Junc C040	1293.7	0.165	0.25	1323.91	30.18
Junc C041	1294	0.166	0.25	1323.87	29.87

Junc C042	1294	0.057	0.09	1323.87	29.87
Junc C043	1294	0.092	0.14	1323.87	29.87
Junc C044	1294	0.081	0.12	1323.87	29.87
Junc C045	1293.3	0.118	0.18	1323.88	30.55
Junc C046	1293.4	0.07	0.1	1323.96	30.53
Junc C047	1294.2	0.36	0.54	1323.93	29.71
Junc C048	1293.4	0.194	0.29	1324.05	30.63
Junc C049	1294	0.135	0.2	1324.05	30.05
Junc C050	1293.7	0.217	0.33	1324.98	31.26
Junc C051	1294.2	0.133	0.2	1324.1	29.86
Junc C052	1293	0.213	0.32	1323.13	30.13
Junc C053	1294	0.042	0.06	1322.84	28.81
Junc C054	1294.2	0.204	0.31	1322.83	28.64
Junc C055	1295.3	0.033	0.05	1322.79	27.49
Junc C056	1295.2	0.441	0.66	1322.76	27.53
Junc C057	1298.2	0.528	0.79	1322.76	24.59
Junc C058	1297.5	0.282	0.42	1323.02	25.54
Junc C059	1295	0.524	0.79	1322.99	28.03
Junc C060	1296.2	0.135	0.2	1323.09	26.86
Junc C061	1295.9	0.188	0.28	1323.09	27.17
Junc C062	1296.9	0.198	0.3	1323.28	26.33
Junc C063	1296.8	0.253	0.38	1323.27	26.48
Junc C064	1295.5	0.275	0.41	1322.87	27.34
Junc C065	1297.2	0.157	0.24	1322.78	25.56
Junc C066	1295.4	0.278	0.42	1322.77	27.41
Junc C067	1296.3	0.342	0.51	1322.75	26.5
Junc C068	1297.9	0.69	1.03	1324.32	26.38
Junc C069	1302.6	0.277	0.42	1343.28	40.68
Junc C070	1305.3	0.257	0.39	1343.27	37.97
Junc C071	1308.6	0.325	0.49	1343.14	34.54
Junc C072	1304	0.242	0.36	1343.1	39.1
Junc C073	1304	0.379	0.57	1343.08	39.08
Junc C074	1307	0.262	0.39	1343.13	36.13
Junc C075	1304	0.144	0.22	1342.01	38.01
Junc C076	1310.5	0.434	0.65	1339.97	29.52
Junc C077	1309	0.381	0.57	1339.96	30.97
Junc C078	1314.1	0.532	0.8	1338.88	24.79
Junc C079	1313.7	0.05	0.08	1332.48	18.83
Junc C080	1312.7	0.614	0.92	1332.47	19.73
Junc C081	1312.5	0.497	0.75	1331.58	19.12
Junc C082	1311.9	0.858	1.29	1330.79	18.87
Junc C083	1310.5	0.614	0.92	1330.53	19.99
Junc C084	1312	0.614	0.92	1330.14	18.14
Junc C085	1312	0.795	1.19	1330.06	18.06

Junc C086	1310.5	0.614	0.92	1330.94	20.43
Junc C087	1312	0.096	0.14	1330.94	18.94
Junc C088	1310.3	0.047	0.07	1331.67	21.34
Junc C089	1311.8	0.393	0.59	1331.66	19.88
Junc C090	1309.6	0.063	0.09	1334.44	24.79
Junc C091	1310.6	0.588	0.88	1334.4	23.82
Junc C092	1309	0.07	0.1	1335.84	26.88
Junc C093	1310	0.775	1.16	1335.65	25.65
Junc C094	1306.5	0.054	0.08	1339.82	33.33
Junc C095	1309.7	0.033	0.05	1339.8	30.09
Junc C096	1310	0.031	0.05	1339.8	29.8
Junc C097	1308.4	0.216	0.32	1339.8	31.43
Junc C098	1311.5	0.368	0.55	1330.92	19.38
Junc C099	1315	0.39	0.58	1342.11	27.08
Junc C100	1304	0.084	0.13	1342.15	38.15
Junc C101	1318.2	0.026	0.04	1344.44	26.19
Junc C102	1318.2	0.042	0.06	1345.16	26.92
Junc C103	1322.1	0.013	0.02	1344.66	22.54
Junc C104	1316.5	0.053	0.08	1344.65	28.16
Junc C105	1316.5	0.103	0.15	1344.66	28.18
Junc C106	1317.8	0.708	1.06	1344.52	26.72
Junc C107	1320	0.041	0.06	1344.53	24.53
Junc C108	1318.7	0.065	0.1	1344.46	25.79
Junc C109	1320	0.161	0.24	1344.46	24.46
Junc C110	1319.4	0.059	0.09	1344.42	24.99
Junc C111	1321.6	0.081	0.12	1343.8	22.24
Junc C112	1320.7	0.047	0.07	1343.64	22.98
Junc C113	1320.3	0.049	0.07	1343.64	23.37
Junc C114	1320.3	0.038	0.06	1343.61	23.34
Junc C115	1320.4	0.084	0.13	1343.61	23.21
Junc C116	1320	0.105	0.16	1343.52	23.52
Junc C117	1322	0.31	0.46	1343.49	21.49
Junc C118	1320.5	0.044	0.07	1343.51	23.02
Junc C119	1320.7	0.08	0.12	1343.4	22.67
Junc C120	1322	0.21	0.31	1343.39	21.39
Junc C121	1320.8	0.061	0.09	1343.23	22.48
Junc C122	1321.2	0.092	0.14	1343.23	21.98
Junc C123	1322.7	0.063	0.09	1343.12	20.39
Junc C124	1321.9	0.042	0.06	1343.09	21.23
Junc C125	1321.2	0.192	0.29	1343.08	21.84
Junc C126	1321.9	0.2	0.3	1343.09	21.23
Junc C127	1322.6	0.037	0.06	1343.12	20.47
Junc C128	1322	0.106	0.16	1343.12	21.09
Junc C129	1323.2	0.066	0.1	1343.12	19.93

Junc C130	1324.3	0.251	0.38	1342.93	18.62
Junc C131	1326	0.207	0.31	1342.92	16.92
Junc C132	1326	0.135	0.2	1342.92	16.92
Junc C133	1323.4	0.124	0.19	1343.17	19.82
Junc C134	1327.2	0.18	0.27	1343.68	16.49
Junc C135	1326.2	0.115	0.17	1343.85	17.62
Junc C136	1328	0.095	0.14	1344.16	16.18
Junc C137	1327.6	0.2	0.3	1344.15	16.51
Junc C138	1330.4	0.148	0.22	1344.83	14.46
Junc C139	1322.1	0.247	0.37	1343.85	21.76
Junc C140	1322.9	0.236	0.35	1343.6	20.66
Junc C141	1326	0.344	0.52	1343.53	17.53
Junc C142	1323.2	0.221	0.33	1343.47	20.23
Junc C143	1326	0.143	0.21	1343.46	17.46
Junc C144	1323.2	0.07	0.1	1343.47	20.3
Junc C145	1326	0.1	0.15	1343.47	17.47
Junc C146	1321.6	0.156	0.23	1343.47	21.86
Junc C147	1326	0.297	0.45	1343.43	17.43
Junc C148	1320.8	0.179	0.27	1343.55	22.77
Junc C149	1325.4	0.214	0.32	1343.54	18.14
Junc C150	1319	0.225	0.34	1343.9	24.95
Junc C151	1322	0.384	0.58	1343.87	21.87
Junc C152	1316.4	0.174	0.26	1344.84	28.42
Junc C153	1319.7	0.261	0.39	1344.69	25.01
Junc C154	1321.5	0.47	0.7	1344.53	23.06
Junc C155	1321.2	0.125	0.19	1344.52	23.29
Junc C156	1310.1	0.318	0.48	1343.46	33.35
Junc C157	1318.3	0.459	0.69	1343.37	25.11
Junc C158	1306.7	0.2	0.3	1343.14	36.47
Junc C159	1309.5	0.662	0.99	1342.99	33.49
Junc C160	1312	0.17	0.25	1330.14	18.14
Junc C165	1317.1	0.112	0.17	1343.86	26.72
Junc C170	1320	0.218	0.33	1344.68	24.68
Junc C200	1298.3	0	0	1343.82	45.47
Junc C201	1297.5	0	0	1344.96	47.48
Junc C202	1298.2	0	0	1346.11	47.94
Junc C203	1297.2	0	0	1346.6	49.41
Junc DNI_C	1311.8	0	0	1393.11	81.28
Junc C204	1298.8	0	0	1325.25	26.48
Junc C205	1294	0	0	1319.2	25.2
Junc Pump_Out	1312.7	0	0	1511.99	199.28
Junc DNI_B	1329.2	59.89	89.83	1390.5	61.31
Junc To_A-1.10	1329.2	155	232.5	1383.25	54.06
Junc C180	1311	0	0	1334	23

Junc C190	1294	0	0	1325.32	31.32
Junc Tank_Out	1311	0	0	1393.17	82.17
Junc 1	1298.7	0	0	1324.49	25.77
Junc 2	1298.2	0	0	1324.41	26.17
Junc 3	1299.3	0	0	1324.29	24.98
Junc 4	1294.4	0	0	1324.23	29.82
Junc 5	1295.4	0	0	1324.24	28.88
Junc 6	1294.5	0	0	1324.25	29.71
Junc 7	1294.2	0	0	1324.25	30.08
Junc 8	1294.4	0	0	1324.27	29.82
Junc 9	1295.5	0	0	1324.3	28.78
Junc 10	1297.9	0	0	1324.33	26.38
Junc 11	1297.5	0	0	1324.73	27.25
Junc 12	1294.2	0	0	1325.26	31.02
Junc 13	1293.7	0	0	1324.98	31.26
Junc 14	1293.3	0	0	1324.9	31.58
Junc 15	1293.3	0	0	1324.89	31.57
Junc 16	1293.8	0	0	1324.84	31.05
Junc 17	1294.7	0	0	1324.81	30.12
Junc 18	1296.9	0	0	1324.74	27.85
Junc 19	1298.7	0	0	1324.58	25.88
Junc 20	1298.3	0	0	1345.66	47.32
Junc 21	1302.6	0	0	1345.48	42.88
Junc 22	1308.6	0	0	1345.28	36.68
Junc 23	1306.7	0	0	1345.16	38.49
Junc 24	1310.1	0	0	1345.02	34.91
Junc 25	1316.4	0	0	1344.84	28.42
Junc 26	1319	0	0	1344.84	25.89
Junc 29	1330.4	0	0	1344.83	14.46
Junc 30	1323.2	0	0	1344.98	21.79
Junc 31	1320.7	0	0	1345.1	24.45
Junc 32	1318.2	0	0	1345.18	26.94
Junc 27	1323.2	0	0	1344.83	21.59
Junc 33	1314.1	0	0	1347.47	33.38
Junc 34	1311.5	0	0	1351.54	40
Junc 35	1312.5	0	0	1349.24	36.77
Junc 36	1311.9	0	0	1349.91	37.99
Junc 37	1297.2	0	0	1346.61	49.43
Junc 38	1297.5	0	0	1346.05	48.57
Resvr Balaju_Reservoir	1339.7	#N/A	-708.11	1339.7	0
Tank Graveyard	1307	#N/A	708.11	1311.99	4.99
Tank STUPA	1390	#N/A	-375.09	1395	5

6.3.4 Design of DNI Zone - K (A 9.1)

The DNI-K model has been designed and the model features are prepared accordingly. DNI-K has been designed using inside diameters (66.8mm, 80.4mm and 98.6mm) for HDPE PE100-PN6 pipes and the diameters (150mm, 200mm, 250mm & 300mm) for DI pipes. After optimizing the pipe diameters for HDPE & DI pipes, all 821 demand nodes have pressure head between 20m and 40m and 44 demand nodes have pressure between 5m & 10m.

The demarcation of DNI-K Boundary shown in **Figure 6.11** and DNI-K Design Model at Peak Demand (7.00) is shown in **Figure 6.12.**

The details of DNI-K/Pipe material & length/Bulk Meter, Isolation Valves, PRVs/PRVs with Set pressure/Location of Air Valve, Washout Valve & Fire hydrants are shown in the **Tables 6.18/6.19/6.20/6.21/6.22** respectively.

Figure 6.11: Demarcation of Sub-Zone DNI-K Boundary

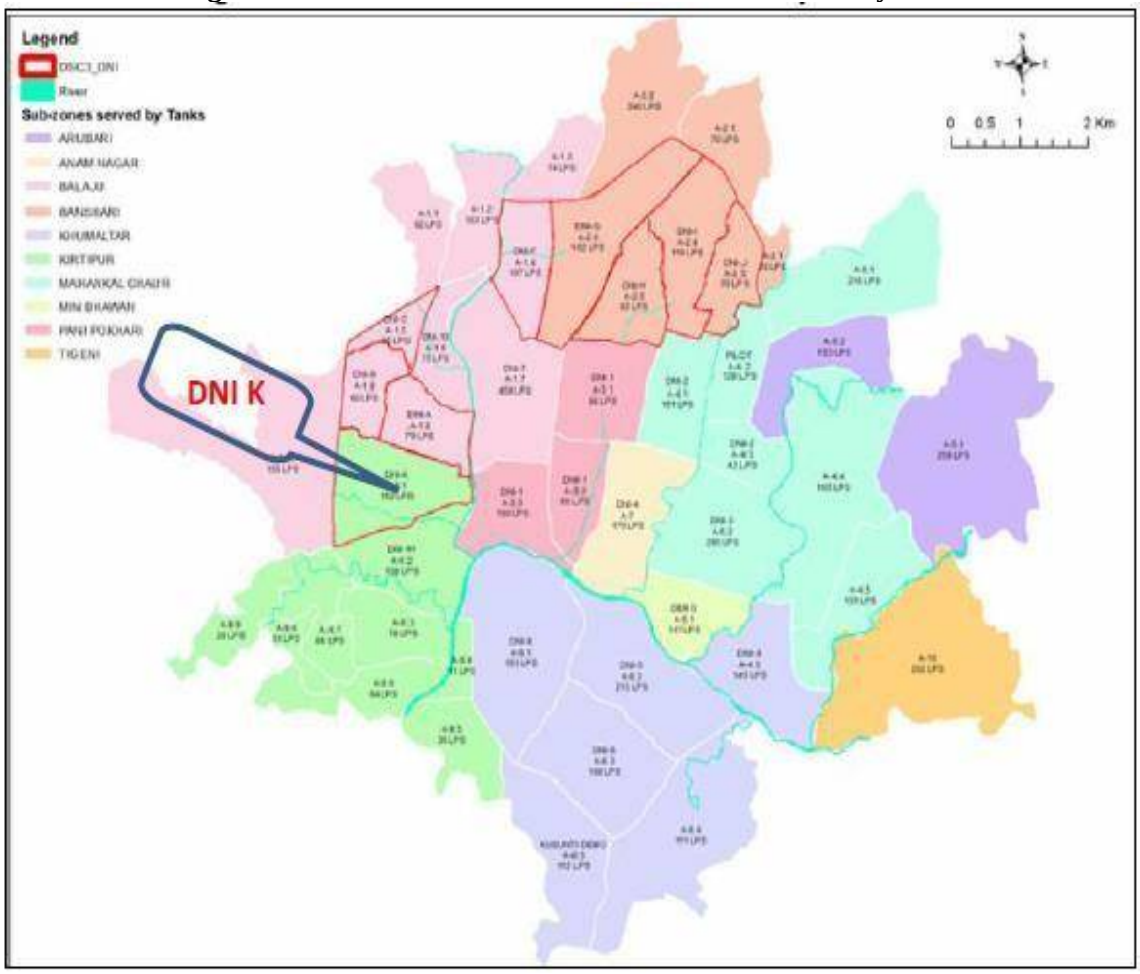


Table 6.23: Design of DNI Zone - K

Description	
Reservoir	Kirtipur
Outlet Elevation of the Reservoir (m)	1338.50
Total Demand (LPS)	152.33
Total number of nodes	865
Total Number of Pipes	1077
Total Length of Pipes	62,886
Number of PRVs	4
Number of Pumps	0
At Peak Time (7:00) - Only for HDPE pipes within DNI	
Number of Nodes have Pressure < 5m	0
Number of Nodes have Pressure [5m,10m]	44
Number of Nodes have Pressure [20m,40m]	821
Number of Nodes have Pressure [40m,50m]	0
Number of Nodes have Pressure [50m,60m]	0
Number of Nodes have Pressure > 60m	0
At Lowest Demand Time (1:00) - Only for HDPE pipes within DNI	
Number of Nodes have Pressure < 5m	0
Number of Nodes have Pressure [5m,10m]	2
Number of Nodes have Pressure [20m,40m]	863
Number of Nodes have Pressure [40m,50m]	0
Number of Nodes have Pressure [50m,60m]	0
Number of Nodes have Pressure > 60m	0

Table 6.24: Details of Pipe material and length

Pipe Length of DNI-K (m)	
Reservoir	Kirtipur
Pipe Diameter (mm)	Length (m)
HDPE PIPE-PE100, PN6	
66.80 (75)	26,411.00
80.40 (90)	14,866.50
98.60 (110)	12,760.00
DI PIPE	
150	4,994
200	1,952.50
250	682
300	1,089
Grand Total	62,755

Table 6.25: Details of Bulk Meter/Isolation Valve/PRV's

LOCATION OF BM/IV/PRV FOR DNI_K									
DNI	DMA	# Bulk Meter	Size of BM	# Isolation Valve	Size of IV	# PRV	Size of PRV	From_Junc	To_Junc
K	1	1	250	3	250	1	250	K888	43
K	2	1	250	3	250	1	250	K888	147
K	3	1	200	3	200	1	200	K872	62
K	4	1	300	3	300	1	300	86	81
K	5	1	250	3	300	1	250	85	75
K	mainline	1	600	3	6			KRITIPUR_02	KRITIPUR_04

Table 6.26: Details of PRV's with Set Pressure

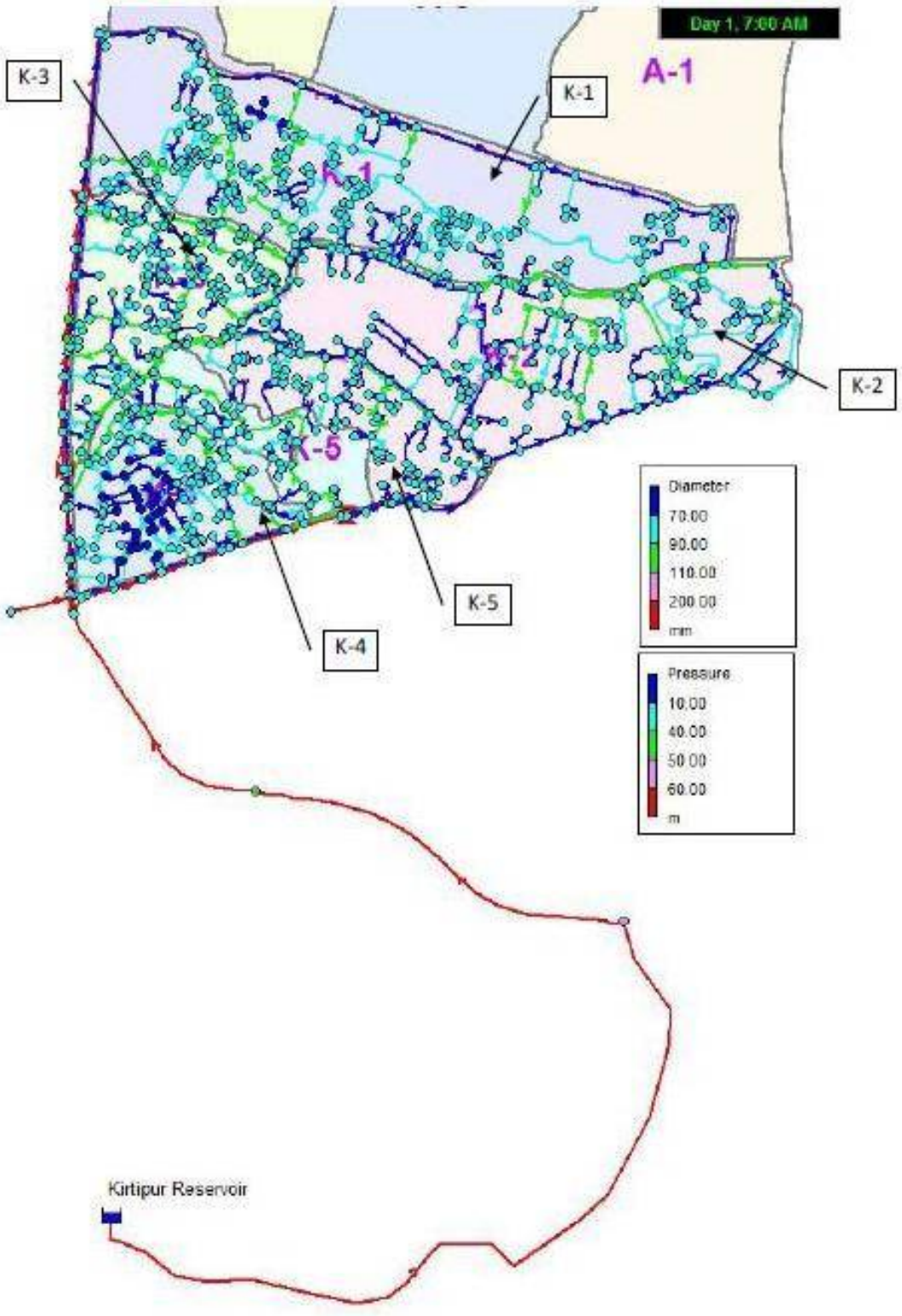
DNI	DMA	# PRV	Size of PRV	Set Pressure (m)	From_Junc	To_Junc
K	1	1	250	22	K888	43
K	2	1	250	22	K888	147
K	3	1	200	33	K872	62
K	4	1	300	18	86	81
K	5	1	300	27	85	75

Table 6.27: Details of location of Air Valve/Washout Valve/Fire Hydrant

LOCATION OF AV/IV/WV/FH FOR DNI_K				
DNI	# Air Valve	# Wash out Valve	# Fire Hydrant	
	Provide at Junction	Provide at Junction	Provide at Junction	On pipe dia (mm)
K	K779	K518	K066	150 DI PIPE
	K685	K795	K137	150 DI PIPE
	K604	K437	K276	150 DI PIPE
	K887	K534	K729	150 DI PIPE
	K567	K529	K758	150 DI PIPE
	K484	K789	K778	150 DI PIPE
	K550	K021	K685	150 DI PIPE
	K025	K030	K624	150 DI PIPE
	K001	K813	K589	150 DI PIPE
	K524	K041	K571	150 DI PIPE
	K871	K073	K323	150 DI PIPE
	K864	K173	K481	150 DI PIPE
		K134	K492	150 DI PIPE
		K151	K551	150 DI PIPE
		K234	K553	150 DI PIPE
		K168	K530	150 DI PIPE
		K160	K424	150 DI PIPE
		K735	K372	150 DI PIPE
		K895	K025	150 DI PIPE
		K264	K006	150 DI PIPE
		K289	K417	150 DI PIPE
		K301	K376	150 DI PIPE
		K580	K248	150 DI PIPE

		K570	K255	150 DI PIPE
		K655	K819	150 DI PIPE
		K760	K306	150 DI PIPE
		K565	K031	110 HDPE PIPE
		K508	K052	110 HDPE PIPE
		K487	K178	110 HDPE PIPE
		K467	K080	110 HDPE PIPE
		K326	K024	110 HDPE PIPE
		K472	K055	110 HDPE PIPE
		K487	K104	110 HDPE PIPE
		K544	K171	110 HDPE PIPE
		K800	K863	110 HDPE PIPE
		K414	K620	110 HDPE PIPE
		K422	K709	110 HDPE PIPE
		K315	K608	110 HDPE PIPE
			K597	110 HDPE PIPE
			K497	110 HDPE PIPE
			K460	110 HDPE PIPE
			K451	110 HDPE PIPE
			K440	110 HDPE PIPE

Figure 6.12: DNI Zone - K Design Model at Peak Demand at 7.00 AM



6.28.Details of Pipe for DNI K

Link ID	Length	Diameter	Roughness	Flow	Velocity	Unit Headloss	Friction Factor
	m	mm		LPS	m/s	m/km	
Pipe K663-K664	36.786	62.2	130	0.91	0.3	2.25	0.031
Pipe K663-K662	49.422	62.2	130	-0.37	0.12	0.43	0.035
Pipe K662-K666	8.411	62.2	130	-0.46	0.15	0.64	0.034
Pipe K661-K662	66.457	62.2	130	0.15	0.05	0.08	0.04
Pipe K660-K661	43.237	62.2	130	0.49	0.16	0.73	0.034
Pipe K660-K659	59.25	62.2	130	-0.81	0.27	1.83	0.031
Pipe K659-K658	60.654	62.2	130	-0.46	0.15	0.64	0.034
Pipe K658-K657	49.91	62.2	130	-1.08	0.36	3.14	0.03
Pipe K657-K685	89.52	62.2	130	0.63	0.21	1.16	0.033
Pipe K657-K649	26.48	62.2	130	1.86	0.61	8.51	0.028
Pipe K654-K656	24.984	62.2	130	0.12	0.04	0.05	0.042
Pipe K654-K655	19.956	62.2	130	0.05	0.02	0.01	0.039
Pipe K651-K653	31.831	62.2	130	0.09	0.03	0.03	0.043
Pipe K651-K652	7.8936	62.2	130	0.1	0.03	0.04	0.041
Pipe K650-K654	8.8219	62.2	130	0.2	0.07	0.15	0.041
Pipe K650-K651	16.559	62.2	130	0.26	0.09	0.23	0.038
Pipe K649-K650	45.392	62.2	130	0.55	0.18	0.89	0.033
Pipe K646-K648	35.499	62.2	130	0.29	0.1	0.28	0.037
Pipe K645-K649	62.295	62.2	130	-1.18	0.39	3.7	0.03
Pipe K645-K647	47.584	62.2	130	0.22	0.07	0.17	0.038
Pipe K644-K643	21.873	62.2	130	-0.22	0.07	0.16	0.039
Pipe K643-K664	23.219	62.2	130	-1.71	0.56	7.29	0.028
Pipe K643-K641	17.612	62.2	130	1.41	0.47	5.15	0.029
Pipe K641-K642	35.509	62.2	130	0.05	0.02	0.01	0.045
Pipe K639-K641	20.195	62.2	130	-1.29	0.42	4.34	0.029
Pipe K639-K640	24.249	62.2	130	0.09	0.03	0.03	0.038
Pipe K639-K636	16.226	62.2	130	1.14	0.37	3.44	0.03
Pipe K638-K637	13.125	62.2	130	-0.05	0.02	0.01	0.052
Pipe K637-K631	15.785	62.2	130	0.78	0.26	1.72	0.032
Pipe K636-K637	32.293	62.2	130	0.91	0.3	2.28	0.031
Pipe K636-K634	107.04	62.2	130	0.06	0.02	0.01	0.046
Pipe K634-K635	18.7	62.2	130	0.21	0.07	0.15	0.038
Pipe K634-K625	18.636	62.2	130	-0.29	0.1	0.28	0.037
Pipe K632-K633	14.398	62.2	130	0.15	0.05	0.08	0.042
Pipe K632-K610	48.05	62.2	130	0.54	0.18	0.85	0.033
Pipe K631-K632	29.384	62.2	130	0.76	0.25	1.61	0.032
Pipe K629-K631	45.182	62.2	130	0.13	0.04	0.07	0.042
Pipe K629-K630	21.926	62.2	130	0.26	0.08	0.22	0.037
Pipe K627-K628	17.834	62.2	130	0.17	0.06	0.1	0.04
Pipe K627-K607	76.872	62.2	130	-0.22	0.07	0.16	0.038

Pipe K626-K629	9.0046	62.2	130	0.47	0.16	0.68	0.034
Pipe K626-K627	23.651	62.2	130	0.15	0.05	0.08	0.04
Pipe K625-K626	63.52	62.2	130	0.73	0.24	1.5	0.032
Pipe K624-K625	89.808	62.2	130	1.38	0.46	4.95	0.029
Pipe K623-K711	57.857	62.2	130	0.36	0.12	0.41	0.035
Pipe K623-K622	102.51	62.2	130	-1.1	0.36	3.23	0.03
Pipe K622-K796	35	62.2	130	-1.39	0.46	5	0.029
Pipe K620-K619	13.078	62.2	130	1.13	0.37	3.4	0.03
Pipe K619-K621	28.753	62.2	130	0.37	0.12	0.43	0.035
Pipe K619-K612	38.324	62.2	130	0.65	0.22	1.23	0.032
Pipe K617-K618	23.915	62.2	130	0.17	0.06	0.11	0.04
Pipe K617-K601	19.904	62.2	130	-1.03	0.34	2.87	0.03
Pipe K616-K615	35.166	62.2	130	-0.42	0.14	0.55	0.035
Pipe K615-K617	26.174	62.2	130	-0.78	0.26	1.7	0.032
Pipe K613-K615	50.476	62.2	130	-0.18	0.06	0.11	0.04
Pipe K613-K614	32.398	62.2	130	0.21	0.07	0.15	0.038
Pipe K612-K613	105.44	62.2	130	0.36	0.12	0.41	0.036
Pipe K608-K610	82.8	62.2	130	-0.07	0.02	0.02	0.046
Pipe K608-K609	32.52	62.2	130	0.47	0.15	0.66	0.034
Pipe K608-K607	83.157	62.2	130	-0.68	0.22	1.32	0.032
Pipe K607-K606	30.07	62.2	130	-1.41	0.47	5.14	0.029
Pipe K606-K605	12.63	62.2	130	-1.63	0.54	6.72	0.028
Pipe K605-K604	73.28	62.2	130	-2.13	0.7	10.99	0.027
Pipe K602-K603	23.551	62.2	130	2.17	0.72	11.4	0.027
Pipe K601-K620	159.35	62.2	130	-0.23	0.08	0.18	0.038
Pipe K598-K600	23.369	62.2	130	0.46	0.15	0.65	0.034
Pipe K598-K599	18.279	62.2	130	0.11	0.04	0.05	0.046
Pipe K597-K601	71.24	62.2	130	1.21	0.4	3.87	0.03
Pipe K597-K598	27.315	62.2	130	0.66	0.22	1.25	0.032
Pipe K596-K597	71.034	62.2	130	2.3	0.76	12.66	0.027
Pipe K595-K596	37.671	62.2	130	3.01	0.99	20.86	0.026
Pipe K593-K595	6.0288	62.2	130	1.46	0.48	5.43	0.029
Pipe K593-K594	25.341	62.2	130	0.3	0.1	0.29	0.036
Pipe K591-K593	62.741	62.2	130	1.91	0.63	8.93	0.028
Pipe K591-K592	42.055	62.2	130	1.05	0.35	2.95	0.03
Pipe K590-K591	34.6	62.2	130	3.3	1.09	24.66	0.026
Pipe K587-K589	59.07	62.2	130	-2.77	0.91	17.85	0.026
Pipe K587-K588	71.24	62.2	130	0.63	0.21	1.14	0.033
Pipe K585-K587	14.54	62.2	130	-1.97	0.65	9.55	0.028
Pipe K585-K586	24.317	62.2	130	0.21	0.07	0.14	0.038
Pipe K583-K585	49.173	62.2	130	-1.7	0.56	7.25	0.028
Pipe K583-K584	32.614	62.2	130	0.14	0.05	0.07	0.041
Pipe K577-K580	29.435	62.2	130	0.14	0.05	0.07	0.038
Pipe K577-K579	39.576	62.2	130	0.09	0.03	0.03	0.044

Pipe K576-K578	30.718	62.2	130	0.18	0.06	0.11	0.039
Pipe K576-K577	15.527	62.2	130	0.38	0.13	0.46	0.035
Pipe K574-K581	45.06	62.2	130	0.15	0.05	0.08	0.041
Pipe K574-K575	45.199	62.2	130	0.24	0.08	0.19	0.038
Pipe K573-K576	24.291	62.2	130	0.64	0.21	1.19	0.033
Pipe K573-K574	9.6302	62.2	130	0.48	0.16	0.7	0.034
Pipe K572-K582	20.978	62.2	130	0.39	0.13	0.48	0.035
Pipe K572-K573	34.089	62.2	130	1.19	0.39	3.75	0.03
Pipe K571-K583	45.114	62.2	130	-1.43	0.47	5.27	0.029
Pipe K571-K572	37.778	62.2	130	1.7	0.56	7.24	0.028
Pipe K568-K570	53.871	62.2	130	0.56	0.18	0.92	0.033
Pipe K568-K569	19.438	62.2	130	0.18	0.06	0.11	0.038
Pipe K567-K571	245.93	150	110	-13.22	0.75	6.05	0.032
Pipe K567-K568	53.4	62.2	130	0.96	0.32	2.53	0.031
Pipe K564-K566	29.778	62.2	130	0.21	0.07	0.14	0.039
Pipe K564-K565	52.123	62.2	130	0.6	0.2	1.07	0.033
Pipe K563-K564	44.998	62.2	130	0.98	0.32	2.62	0.031
Pipe K563-K561	21.367	62.2	130	-1.66	0.55	6.93	0.028
Pipe K561-K562	66.684	62.2	130	0.5	0.17	0.76	0.034
Pipe K561-K560	34.997	62.2	130	-0.15	0.05	0.08	0.039
Pipe K560-K552	55.767	62.2	130	-1.5	0.49	5.76	0.029
Pipe K558-K560	86.905	62.2	130	-0.86	0.28	2.03	0.031
Pipe K558-K559	13.053	62.2	130	0.38	0.12	0.44	0.035
Pipe K556-K557	24.531	62.2	130	0.47	0.15	0.67	0.034
Pipe K556-K512	15.744	62.2	130	0.05	0.02	0.01	0.044
Pipe K555-K558	112.88	62.2	130	-0.03	0.01	0	0.041
Pipe K555-K556	8.4714	62.2	130	0.57	0.19	0.95	0.033
Pipe K554-K555	36.467	62.2	130	0.66	0.22	1.26	0.032
Pipe K554-K553	212.35	62.2	130	-0.49	0.16	0.73	0.034
Pipe K554-K513	76.084	62.2	130	-0.44	0.14	0.59	0.034
Pipe K552-K550	27.6	62.2	130	-2.86	0.94	18.92	0.026
Pipe K551-K561	53.878	62.2	130	2.23	0.73	11.99	0.027
Pipe K551-K540	230.53	62.2	130	-0.45	0.15	0.63	0.034
Pipe K550-K551	18.239	62.2	130	2.13	0.7	10.99	0.027
Pipe K549-K543	20.98	62.2	130	0.71	0.23	1.44	0.032
Pipe K546-K547	24.948	62.2	130	0.38	0.13	0.46	0.035
Pipe K544-K543	52.486	62.2	130	-0.55	0.18	0.89	0.033
Pipe K543-K542	99.279	62.2	130	-0.24	0.08	0.19	0.038
Pipe K540-K538	92.938	62.2	130	-0.86	0.28	2.03	0.031
Pipe K538-K539	66.847	62.2	130	0.68	0.22	1.32	0.032
Pipe K535-K537	8.1679	62.2	130	0.85	0.28	1.99	0.031
Pipe K535-K536	14.353	62.2	130	0.14	0.05	0.07	0.04
Pipe K533-K535	57.3	62.2	130	1.24	0.41	4.02	0.03
Pipe K533-K534	16.896	62.2	130	0.24	0.08	0.19	0.038

Pipe K531-K533	32.143	62.2	130	1.62	0.53	6.63	0.028
Pipe K531-K532	29.01	62.2	130	0.25	0.08	0.21	0.037
Pipe K530-K531	27.73	62.2	130	2.15	0.71	11.15	0.027
Pipe K530-K526	116.98	62.2	130	1.39	0.46	4.97	0.029
Pipe K527-K529	30.57	62.2	130	0.32	0.1	0.32	0.036
Pipe K527-K528	19.758	62.2	130	0.28	0.09	0.25	0.036
Pipe K526-K527	19.772	62.2	130	0.75	0.25	1.6	0.032
Pipe K526-K525	32.969	62.2	130	0.52	0.17	0.79	0.034
Pipe K525-K524	150.33	62.2	130	0.42	0.14	0.54	0.035
Pipe K524-K522	64.074	62.2	130	-0.32	0.11	0.33	0.036
Pipe K522-K523	57.025	62.2	130	0.47	0.16	0.67	0.034
Pipe K522-K514	176.8	62.2	130	-1.04	0.34	2.9	0.03
Pipe K519-K521	28.355	62.2	130	0.24	0.08	0.19	0.037
Pipe K519-K520	25.467	62.2	130	1.17	0.38	3.59	0.03
Pipe K517-K519	37.924	62.2	130	1.55	0.51	6.07	0.029
Pipe K517-K518	111.1	62.2	130	0.55	0.18	0.89	0.033
Pipe K516-K517	30.64	62.2	130	2.4	0.79	13.67	0.027
Pipe K516-K514	56.613	62.2	130	-0.15	0.05	0.08	0.04
Pipe K515-K788	48.643	62.2	130	1.84	0.61	8.37	0.028
Pipe K515-K444	104.51	62.2	130	0.06	0.02	0.01	0.05
Pipe K514-K515	231.04	62.2	130	2.03	0.67	10.09	0.027
Pipe K513-K503	17.743	62.2	130	-1.51	0.5	5.79	0.029
Pipe K512-K513	73.259	62.2	130	-0.69	0.23	1.35	0.032
Pipe K512-K509	71.121	62.2	130	0.52	0.17	0.81	0.034
Pipe K511-K510	22.629	62.2	130	-0.1	0.03	0.04	0.045
Pipe K510-K563	221.14	62.2	130	-0.47	0.16	0.68	0.034
Pipe K510-K506	78.637	62.2	130	-0.06	0.02	0.02	0.046
Pipe K509-K504	35.198	62.2	130	-1.04	0.34	2.9	0.03
Pipe K506-K509	11.105	62.2	130	-1.39	0.46	5.01	0.029
Pipe K506-K508	47.692	62.2	130	0.64	0.21	1.18	0.033
Pipe K506-K507	36.463	62.2	130	0.45	0.15	0.62	0.034
Pipe K504-K505	19.331	62.2	130	0.2	0.07	0.13	0.037
Pipe K504-K502	29.279	62.2	130	-1.37	0.45	4.87	0.029
Pipe K503-K830	60	62.2	130	-2.11	0.7	10.82	0.027
Pipe K502-K503	50.684	62.2	130	-0.3	0.1	0.29	0.037
Pipe K502-K501	175.94	62.2	130	-1.29	0.43	4.35	0.029
Pipe K501-K495	59.72	62.2	130	-0.63	0.21	1.15	0.033
Pipe K500-K498	27.996	62.2	130	1.03	0.34	2.85	0.03
Pipe K500-K467	44.18	62.2	130	1.15	0.38	3.49	0.03
Pipe K498-K499	38.212	62.2	130	0.33	0.11	0.35	0.036
Pipe K498-K497	164.06	62.2	130	0.14	0.05	0.07	0.041
Pipe K497-K501	32.89	62.2	130	0.81	0.27	1.83	0.031
Pipe K497-K495	60.847	62.2	130	-0.12	0.04	0.05	0.041
Pipe K495-K496	26.528	62.2	130	0.14	0.05	0.07	0.04

Pipe K495-K493	17.116	62.2	130	-0.41	0.13	0.51	0.035
Pipe K493-K822	44.558	62.2	130	-0.67	0.22	1.28	0.032
Pipe K493-K494	31.963	62.2	130	0.1	0.03	0.04	0.041
Pipe K492-K538	14.23	62.2	130	1.69	0.56	7.19	0.028
Pipe K492-K490	61.052	62.2	130	2.54	0.84	15.23	0.027
Pipe K490-K491	22.499	62.2	130	0.16	0.05	0.09	0.04
Pipe K490-K488	36.426	62.2	130	2.25	0.74	12.18	0.027
Pipe K488-K489	69.101	62.2	130	0.16	0.05	0.09	0.04
Pipe K488-K484	63.109	62.2	130	1.85	0.61	8.44	0.028
Pipe K485-K487	99.489	62.2	130	0.75	0.25	1.58	0.032
Pipe K485-K486	50.197	62.2	130	0.26	0.09	0.23	0.037
Pipe K484-K485	90.078	62.2	130	1.88	0.62	8.75	0.028
Pipe K484-K482	91.077	62.2	130	-0.52	0.17	0.81	0.034
Pipe K482-K483	37.796	62.2	130	0.68	0.22	1.32	0.032
Pipe K481-K482	66.62	62.2	130	1.47	0.48	5.54	0.029
Pipe K481-K479	35.38	62.2	130	0.1	0.03	0.04	0.046
Pipe K479-K480	48.85	62.2	130	0.52	0.17	0.81	0.034
Pipe K479-K477	151.37	62.2	130	-0.8	0.26	1.79	0.032
Pipe K477-K478	63.209	62.2	130	0.73	0.24	1.53	0.032
Pipe K477-K321	92.76	62.2	130	-2.03	0.67	10.02	0.027
Pipe K476-K481	81.589	62.2	130	1.75	0.58	7.63	0.028
Pipe K476-K460	137.4	62.2	130	-0.64	0.21	1.18	0.033
Pipe K475-K476	36.287	62.2	130	1.72	0.57	7.39	0.028
Pipe K474-K475	37.924	62.2	130	1.97	0.65	9.47	0.028
Pipe K473-K455	112.54	150	110	15.99	0.9	8.59	0.031
Pipe K471-K472	52.594	62.2	130	0.59	0.2	1.03	0.033
Pipe K470-K471	44.706	62.2	130	-1.1	0.36	3.22	0.03
Pipe K470-K451	111.08	62.2	130	-1.18	0.39	3.68	0.03
Pipe K469-K468	67.137	62.2	130	-0.35	0.11	0.39	0.036
Pipe K468-K470	69.527	62.2	130	-1.76	0.58	7.67	0.028
Pipe K468-K423	28.218	62.2	130	0.96	0.32	2.5	0.031
Pipe K465-K467	145.05	62.2	130	-1.15	0.38	3.52	0.03
Pipe K465-K466	56.435	62.2	130	0.49	0.16	0.74	0.034
Pipe K464-K463	74.059	62.2	130	-0.24	0.08	0.19	0.038
Pipe K463-K465	23.138	62.2	130	-0.14	0.05	0.08	0.044
Pipe K463-K462	42.111	62.2	130	-0.44	0.14	0.59	0.035
Pipe K462-K460	8.7412	62.2	130	0.09	0.03	0.03	0.048
Pipe K461-K475	138.01	62.2	130	0.14	0.05	0.07	0.041
Pipe K461-K457	46.183	62.2	130	-1.53	0.5	5.97	0.029
Pipe K460-K461	39.37	62.2	130	-1.05	0.34	2.95	0.03
Pipe K459-K462	74.698	62.2	130	0.72	0.24	1.49	0.032
Pipe K459-K458	76.747	62.2	130	-1.23	0.41	3.98	0.03
Pipe K458-K457	50.5	62.2	130	0.4	0.13	0.49	0.035
Pipe K457-K456	53.496	62.2	130	-1.52	0.5	5.89	0.029

Pipe K456-K474	112.32	62.2	130	0.89	0.29	2.16	0.031
Pipe K455-K449	105.79	150	110	9.35	0.53	3.18	0.033
Pipe K454-K453	43.576	62.2	130	-0.47	0.15	0.67	0.034
Pipe K453-K451	46.733	62.2	130	1.49	0.49	5.66	0.029
Pipe K451-K452	71.286	62.2	130	0.48	0.16	0.71	0.034
Pipe K450-K453	106.76	62.2	130	-0.36	0.12	0.42	0.035
Pipe K450-K451	123.95	62.2	130	0.8	0.26	1.77	0.032
Pipe K448-K467	157.32	62.2	130	0.9	0.3	2.24	0.031
Pipe K448-K449	66.37	150	110	-9.08	0.51	3.01	0.034
Pipe K446-K448	50.19	62.2	130	-2.28	0.75	12.41	0.027
Pipe K446-K447	39.551	62.2	130	0.16	0.05	0.09	0.039
Pipe K445-K444	63.939	62.2	130	-0.76	0.25	1.62	0.032
Pipe K444-K433	86.32	62.2	130	-1.05	0.35	2.96	0.03
Pipe K443-K442	75.466	62.2	130	-0.39	0.13	0.48	0.035
Pipe K442-K446	97.121	62.2	130	-1.84	0.61	8.41	0.028
Pipe K442-K440	40.89	62.2	130	1.06	0.35	3.04	0.03
Pipe K440-K441	79.917	62.2	130	0.78	0.26	1.69	0.032
Pipe K439-K438	31.15	62.2	130	1.37	0.45	4.84	0.029
Pipe K439-K436	93.472	62.2	130	-2.5	0.82	14.73	0.027
Pipe K437-K439	22.997	62.2	130	-0.66	0.22	1.24	0.032
Pipe K436-K530	292.7	62.2	130	-1.12	0.37	3.33	0.03
Pipe K436-K434	94.983	62.2	130	-2.25	0.74	12.16	0.027
Pipe K434-K435	67.99	62.2	130	1.15	0.38	3.48	0.03
Pipe K433-K431	38.34	62.2	130	-0.39	0.13	0.48	0.035
Pipe K433-K410	139.49	62.2	130	-0.88	0.29	2.12	0.031
Pipe K431-K432	35.673	62.2	130	0.38	0.13	0.45	0.035
Pipe K430-K429	84.508	62.2	130	-0.35	0.12	0.39	0.036
Pipe K429-K431	32.382	62.2	130	1.01	0.33	2.77	0.03
Pipe K429-K428	49.487	62.2	130	-1.67	0.55	6.99	0.028
Pipe K428-K426	69.46	62.2	130	-2.42	0.8	13.87	0.027
Pipe K426-K427	24.03	62.2	130	0.26	0.09	0.23	0.037
Pipe K426-K425	43.58	62.2	130	-2.98	0.98	20.47	0.026
Pipe K425-K516	406.71	62.2	130	0.44	0.14	0.58	0.034
Pipe K424-K434	21.81	62.2	130	3.66	1.2	29.94	0.025
Pipe K424-K425	154.57	62.2	130	1.37	0.45	4.87	0.029
Pipe K423-K319	188.95	62.2	130	-1.73	0.57	7.5	0.028
Pipe K422-K419	44.024	62.2	130	-0.34	0.11	0.36	0.036
Pipe K421-K418	36.41	62.2	130	-0.27	0.09	0.24	0.037
Pipe K420-K419	29.714	62.2	130	-0.26	0.09	0.23	0.037
Pipe K419-K418	41.599	62.2	130	-0.75	0.25	1.6	0.032
Pipe K418-K417	50.054	62.2	130	-1.33	0.44	4.6	0.029
Pipe K417-K423	28.507	62.2	130	-2.47	0.81	14.45	0.027
Pipe K417-K416	116.62	62.2	130	0.85	0.28	2.02	0.031
Pipe K416-K415	121.01	62.2	130	-0.95	0.31	2.45	0.031

Pipe K415-K440	78.04	62.2	130	-0.03	0.01	0	0.057
Pipe K415-K412	21.46	62.2	130	3.03	1	21.15	0.026
Pipe K413-K416	54.503	62.2	130	-1.28	0.42	4.3	0.029
Pipe K413-K414	66.853	62.2	130	0.92	0.3	2.33	0.031
Pipe K412-K413	92.321	62.2	130	0.53	0.17	0.83	0.034
Pipe K411-K410	31.985	62.2	130	-0.35	0.12	0.4	0.036
Pipe K410-K393	47.993	62.2	130	-1.8	0.59	8.04	0.028
Pipe K408-K428	44.719	62.2	130	-0.49	0.16	0.74	0.034
Pipe K408-K409	32.543	62.2	130	0.22	0.07	0.16	0.038
Pipe K406-K408	52.228	62.2	130	0.42	0.14	0.55	0.035
Pipe K406-K407	20.336	62.2	130	0.13	0.04	0.07	0.041
Pipe K405-K406	12.946	62.2	130	1.1	0.36	3.22	0.03
Pipe K405-K404	22.149	62.2	130	-0.81	0.27	1.83	0.031
Pipe K404-K400	13.425	62.2	130	-0.58	0.19	0.99	0.033
Pipe K404-K397	57.286	62.2	130	-0.3	0.1	0.29	0.037
Pipe K403-K402	10.351	62.2	130	1.71	0.56	7.28	0.028
Pipe K402-K405	42.836	62.2	130	0.73	0.24	1.52	0.032
Pipe K401-K402	27.26	62.2	130	0.18	0.06	0.11	0.04
Pipe K401-K388	44.749	62.2	130	-0.83	0.27	1.92	0.031
Pipe K400-K401	13.931	62.2	130	-0.59	0.19	1.01	0.033
Pipe K400-K398	43.278	62.2	130	-0.05	0.02	0.01	0.055
Pipe K398-K399	25.244	62.2	130	0.13	0.04	0.06	0.041
Pipe K397-K398	10.12	62.2	130	0.28	0.09	0.26	0.037
Pipe K397-K395	10.909	62.2	130	-0.62	0.2	1.11	0.033
Pipe K395-K396	31.208	62.2	130	0.28	0.09	0.26	0.037
Pipe K394-K395	41.393	62.2	130	0.99	0.33	2.67	0.031
Pipe K394-K386	47.256	62.2	130	-1.09	0.36	3.17	0.03
Pipe K393-K394	67.496	62.2	130	0.22	0.07	0.17	0.038
Pipe K392-K403	7.158	62.2	130	1.4	0.46	5.07	0.029
Pipe K391-K403	22.492	62.2	130	0.44	0.14	0.59	0.035
Pipe K391-K392	21.147	62.2	130	-0.61	0.2	1.09	0.033
Pipe K389-K391	20.846	62.2	130	-0.06	0.02	0.01	0.053
Pipe K389-K391R	20.846	62.2	130	-0.06	0.02	0.01	0.053
Pipe K389-K390	12.689	62.2	130	0.17	0.05	0.09	0.038
Pipe K388-K389	10.931	62.2	130	0.1	0.03	0.04	0.047
Pipe K386-K388	66.736	62.2	130	0.99	0.32	2.63	0.031
Pipe K386-K387	31.997	62.2	130	0.29	0.1	0.27	0.036
Pipe K386-K385	73.093	62.2	130	-2.67	0.88	16.73	0.026
Pipe K385-K393	70.206	62.2	130	2.9	0.95	19.39	0.026
Pipe K385-K382	39.281	62.2	130	2.34	0.77	13.07	0.027
Pipe K384-K382	139.93	62.2	130	-0.31	0.1	0.31	0.036
Pipe K382-K381	9.2951	62.2	130	1.69	0.56	7.19	0.028
Pipe K381-K383	132.92	62.2	130	0.12	0.04	0.06	0.041
Pipe K381-K379	23.129	62.2	130	1.37	0.45	4.86	0.029

Pipe K379-K380	97.458	62.2	130	0.26	0.09	0.23	0.037
Pipe K379-K378	12.802	62.2	130	0.95	0.31	2.49	0.031
Pipe K378-K791	33.686	62.2	130	1.98	0.65	9.56	0.028
Pipe K378-K350	121.97	62.2	130	-1.15	0.38	3.53	0.03
Pipe K377-K376	74.162	62.2	130	-0.85	0.28	2.01	0.031
Pipe K376-K412	297.21	62.2	130	-2.07	0.68	10.39	0.027
Pipe K376-K374	62.43	62.2	130	0.83	0.27	1.94	0.031
Pipe K374-K375	65.335	62.2	130	0.52	0.17	0.8	0.034
Pipe K373-K816	11.301	62.2	130	0.49	0.16	0.72	0.034
Pipe K373-K091	43.816	62.2	130	-0.77	0.25	1.67	0.032
Pipe K372-K424	343.85	62.2	130	0.31	0.1	0.32	0.036
Pipe K372-K373	94.828	62.2	130	-0.21	0.07	0.14	0.038
Pipe K371-K372	107.43	62.2	130	1.03	0.34	2.83	0.03
Pipe K371-K370	45.477	62.2	130	1.83	0.6	8.31	0.028
Pipe K370-K392	172.32	62.2	130	2.5	0.82	14.83	0.027
Pipe K370-K368	90.645	62.2	130	0.98	0.32	2.61	0.031
Pipe K368-K369	20.638	62.2	130	0.31	0.1	0.3	0.036
Pipe K368-K366	15.923	62.2	130	0.44	0.15	0.59	0.034
Pipe K366-K367	26.271	62.2	130	0.06	0.02	0.02	0.052
Pipe K366-K361	21.333	62.2	130	0.31	0.1	0.31	0.037
Pipe K364-K365	20.091	62.2	130	0.19	0.06	0.12	0.037
Pipe K362-K364	74.592	62.2	130	-0.77	0.25	1.68	0.032
Pipe K362-K363	24.839	62.2	130	0.28	0.09	0.26	0.036
Pipe K361-K362	40.344	62.2	130	-0.18	0.06	0.12	0.039
Pipe K359-K361	24.671	62.2	130	-0.39	0.13	0.47	0.035
Pipe K359-K360	18.627	62.2	130	0.21	0.07	0.14	0.037
Pipe K356-K358	6.8029	62.2	130	0.05	0.02	0	0
Pipe K356-K357	12.943	62.2	130	0.31	0.1	0.3	0.036
Pipe K355-K359	37.036	62.2	130	-0.06	0.02	0.01	0.041
Pipe K355-K356	19.361	62.2	130	0.4	0.13	0.5	0.035
Pipe K353-K355	43.786	62.2	130	0.45	0.15	0.63	0.034
Pipe K353-K354	24.436	62.2	130	0.23	0.08	0.18	0.038
Pipe K351-K353	29.97	62.2	130	0.81	0.27	1.83	0.032
Pipe K351-K352	56.57	62.2	130	0.24	0.08	0.19	0.038
Pipe K350-K351	16.69	62.2	130	0.93	0.31	2.38	0.031
Pipe K349-K348	67.448	62.2	130	-0.8	0.26	1.78	0.032
Pipe K348-K374	46.444	62.2	130	0	0	0	0
Pipe K348-K330	116.17	62.2	130	-1.11	0.37	3.28	0.03
Pipe K347-K350	93.13	62.2	130	1.03	0.34	2.84	0.03
Pipe K347-K346	49.158	62.2	130	0.29	0.1	0.27	0.037
Pipe K344-K347	14.627	62.2	130	1.52	0.5	5.88	0.029
Pipe K344-K345	31.511	62.2	130	0.13	0.04	0.07	0.041
Pipe K343-K341	74.979	62.2	130	-0.23	0.07	0.17	0.038
Pipe K341-K343	74.979	62.2	130	0.23	0.07	0.17	0.038

Pipe K341-K340	5.0268	62.2	130	-0.55	0.18	0.89	0.033
Pipe K340-K342	22.792	62.2	130	0.13	0.04	0.07	0.041
Pipe K340-K339	54.788	62.2	130	-0.85	0.28	2	0.031
Pipe K339-K080	85.586	62.2	130	-1.29	0.42	4.32	0.029
Pipe K338-K336	19.495	62.2	130	-0.15	0.05	0.08	0.039
Pipe K336-K337	21.259	62.2	130	0.31	0.1	0.3	0.036
Pipe K336-K334	104.49	62.2	130	-0.6	0.2	1.05	0.033
Pipe K334-K335	25.725	62.2	130	0.27	0.09	0.24	0.037
Pipe K334-K332	60.059	62.2	130	-1.2	0.4	3.81	0.03
Pipe K333-K344	19.39	62.2	130	1.72	0.57	7.4	0.028
Pipe K332-K339	62.152	62.2	130	-0.05	0.01	0.01	0.053
Pipe K332-K333	49.61	62.2	130	-1.49	0.49	5.69	0.029
Pipe K330-K331	34.93	62.2	130	0.32	0.11	0.33	0.036
Pipe K330-K329	23.43	62.2	130	-1.53	0.5	5.98	0.029
Pipe K329-K327	58.47	62.2	130	-1.6	0.53	6.43	0.028
Pipe K327-K328	23.683	62.2	130	0.82	0.27	1.86	0.031
Pipe K327-K235	71.657	62.2	130	-2.6	0.85	15.85	0.026
Pipe K325-K324	17.009	62.2	130	-0.26	0.09	0.23	0.037
Pipe K324-K326	79.614	62.2	130	0.86	0.28	2.06	0.031
Pipe K322-K323	69.5	62.2	130	-3.29	1.08	24.53	0.026
Pipe K322-K317	63.83	62.2	130	3.08	1.01	21.76	0.026
Pipe K321-K320	74.61	62.2	130	1.86	0.61	8.55	0.028
Pipe K320-K324	59.945	62.2	130	1.54	0.51	6.02	0.029
Pipe K320-K319	44.439	62.2	130	0.13	0.04	0.06	0.043
Pipe K319-K312	35.193	62.2	130	2.42	0.8	13.93	0.027
Pipe K317-K318	70.909	62.2	130	0.38	0.13	0.46	0.035
Pipe K317-K308	79.603	62.2	130	2.53	0.83	15.1	0.027
Pipe K313-K316	24.797	62.2	130	0.32	0.11	0.33	0.036
Pipe K313-K315	30.091	62.2	130	0.08	0.02	0.02	0.049
Pipe K313-K314	16.571	62.2	130	0.11	0.03	0.04	0.046
Pipe K312-K313	93.208	62.2	130	0.78	0.26	1.7	0.032
Pipe K310-K309	64.271	62.2	130	-0.56	0.18	0.92	0.033
Pipe K309-K311	114.49	62.2	130	0.21	0.07	0.15	0.039
Pipe K308-K309	40.263	62.2	130	1.3	0.43	4.42	0.029
Pipe K307-K800	203.02	62.2	130	1.55	0.51	6.1	0.029
Pipe K307-K798	30.753	62.2	130	-2.63	0.87	16.24	0.026
Pipe K307-K797	54.206	62.2	130	0.2	0.07	0.14	0.039
Pipe K306-K819	154.05	62.2	130	2.36	0.78	13.27	0.027
Pipe K306-K312	143.01	62.2	130	-1.27	0.42	4.21	0.029
Pipe K305-K308	83.533	62.2	130	-0.67	0.22	1.28	0.032
Pipe K305-K290	60.517	62.2	130	-0.05	0.02	0.01	0.052
Pipe K304-K305	39.61	62.2	130	-0.54	0.18	0.85	0.033
Pipe K304-K302	23.408	62.2	130	0.11	0.03	0.04	0.045
Pipe K303-K304	14.623	62.2	130	-0.24	0.08	0.19	0.039

Pipe K301-K299	14.281	62.2	130	-0.38	0.12	0.44	0.035
Pipe K299-K300	28.121	62.2	130	0.35	0.12	0.4	0.036
Pipe K299-K297	7.3815	62.2	130	-0.76	0.25	1.65	0.032
Pipe K297-K298	10.334	62.2	130	0.29	0.1	0.27	0.036
Pipe K297-K295	52.503	62.2	130	-1.16	0.38	3.54	0.03
Pipe K295-K296	45.599	62.2	130	0.64	0.21	1.2	0.033
Pipe K295-K293	55.711	62.2	130	-2.12	0.7	10.9	0.027
Pipe K293-K294	14.117	62.2	130	0.26	0.08	0.22	0.038
Pipe K291-K293	55.892	62.2	130	2.57	0.85	15.57	0.027
Pipe K291-K292	32.819	62.2	130	0.25	0.08	0.2	0.037
Pipe K290-K291	49.164	62.2	130	3.01	0.99	20.85	0.026
Pipe K289-K287	21.964	62.2	130	-0.42	0.14	0.54	0.035
Pipe K288-K287	27.723	62.2	130	-0.22	0.07	0.16	0.037
Pipe K287-K285	58.019	62.2	130	-0.87	0.28	2.07	0.031
Pipe K285-K286	61.258	62.2	130	0.31	0.1	0.31	0.036
Pipe K285-K284	40.36	62.2	130	-1.42	0.47	5.16	0.029
Pipe K284-K272	68.81	62.2	130	-1.62	0.53	6.6	0.028
Pipe K283-K281	17.94	62.2	130	0.09	0.03	0.03	0.043
Pipe K281-K282	40.62	62.2	130	0.22	0.07	0.17	0.038
Pipe K280-K283	37.565	62.2	130	0.3	0.1	0.28	0.036
Pipe K280-K281	32.73	62.2	130	0.33	0.11	0.34	0.036
Pipe K279-K290	102.36	62.2	130	3.79	1.25	31.94	0.025
Pipe K279-K280	34.734	62.2	130	0.89	0.29	2.17	0.031
Pipe K277-K279	23.45	62.2	130	-3.9	1.28	33.68	0.025
Pipe K275-K276	24.327	62.2	130	0.21	0.07	0.15	0.038
Pipe K275-K255	33.344	62.2	130	-0.42	0.14	0.54	0.035
Pipe K274-K275	77.297	62.2	130	0.06	0.02	0.01	0.043
Pipe K273-K277	78.36	62.2	130	-3.62	1.19	29.29	0.025
Pipe K273-K258	101.1	62.2	130	0.26	0.09	0.23	0.037
Pipe K272-K273	55.003	62.2	130	-3.09	1.02	21.88	0.026
Pipe K271-K284	95.23	62.2	130	0.22	0.07	0.16	0.038
Pipe K269-K272	58.93	62.2	130	-1.04	0.34	2.9	0.03
Pipe K269-K271	117.78	62.2	130	0.91	0.3	2.28	0.031
Pipe K269-K270	12.154	62.2	130	0.14	0.05	0.07	0.04
Pipe K268-K267	16.262	62.2	130	-0.2	0.07	0.14	0.039
Pipe K267-K269	29.097	62.2	130	0.33	0.11	0.34	0.036
Pipe K266-K265	13.586	62.2	130	-0.05	0.02	0.01	0.043
Pipe K265-K267	37.142	62.2	130	0.71	0.23	1.45	0.032
Pipe K263-K265	25.043	62.2	130	0.99	0.33	2.66	0.03
Pipe K263-K264	108.04	62.2	130	0.65	0.21	1.22	0.032
Pipe K261-K263	25.325	62.2	130	2.09	0.69	10.65	0.027
Pipe K261-K262	21.237	62.2	130	0.04	0.01	0.01	0.055
Pipe K259-K261	13.842	62.2	130	2.24	0.74	12.1	0.027
Pipe K259-K260	21.451	62.2	130	0.13	0.04	0.07	0.044

Pipe K258-K259	55.07	62.2	130	2.45	0.81	14.23	0.027
Pipe K258-K256	34.48	62.2	130	-2.29	0.75	12.53	0.027
Pipe K256-K257	39.879	62.2	130	0.18	0.06	0.11	0.039
Pipe K255-K252	74.426	62.2	130	-1.11	0.36	3.27	0.03
Pipe K254-K253	18.735	62.2	130	-0.53	0.18	0.84	0.033
Pipe K253-K255	47.268	62.2	130	-0.6	0.2	1.04	0.033
Pipe K250-K252	44.653	62.2	130	-1.38	0.45	4.92	0.029
Pipe K250-K251	27.156	62.2	130	0.21	0.07	0.14	0.038
Pipe K250-K249	22.052	62.2	130	1.01	0.33	2.77	0.03
Pipe K249-K253	67.748	62.2	130	0.22	0.07	0.17	0.038
Pipe K249-K235	39.392	62.2	130	0.44	0.14	0.59	0.035
Pipe K248-K252	98.55	62.2	130	2.83	0.93	18.55	0.026
Pipe K247-K246	22.099	62.2	130	3.78	1.24	31.75	0.025
Pipe K246-K256	120.3	62.2	130	2.65	0.87	16.49	0.026
Pipe K246-K240	62.971	62.2	130	0.87	0.29	2.09	0.031
Pipe K244-K243	9.1092	62.2	130	-0.12	0.04	0.05	0.038
Pipe K243-K245	36.52	62.2	130	0.31	0.1	0.31	0.036
Pipe K242-K241	10.412	62.2	130	-0.07	0.02	0.03	0.058
Pipe K241-K243	10.109	62.2	130	0.56	0.18	0.93	0.033
Pipe K240-K241	15.294	62.2	130	0.68	0.22	1.32	0.032
Pipe K240-K237	29.302	62.2	130	-0.01	0	0	0
Pipe K238-K239	75.467	62.2	130	0.54	0.18	0.85	0.034
Pipe K237-K238	38.789	62.2	130	1.25	0.41	4.06	0.03
Pipe K237-K236	90.235	62.2	130	-1.62	0.53	6.61	0.028
Pipe K236-K247	62.119	62.2	130	-1.2	0.4	3.82	0.03
Pipe K235-K248	154	62.2	130	-2.41	0.79	13.84	0.027
Pipe K233-K232	23.966	62.2	130	-0.09	0.03	0.03	0.046
Pipe K232-K234	48.005	62.2	130	0.23	0.08	0.18	0.038
Pipe K232-K219	82.163	62.2	130	-0.61	0.2	1.07	0.033
Pipe K231-K229	38.664	62.2	130	-0.09	0.03	0.03	0.042
Pipe K230-K220	66.079	62.2	130	-0.36	0.12	0.42	0.035
Pipe K229-K171	8.59	62.2	130	-1.4	0.46	5.04	0.029
Pipe K227-K229	19.868	62.2	130	-1.24	0.41	4.06	0.03
Pipe K227-K228	23.221	62.2	130	0.17	0.05	0.1	0.039
Pipe K225-K227	38.69	62.2	130	-0.98	0.32	2.59	0.031
Pipe K225-K226	29.439	62.2	130	0.2	0.06	0.14	0.04
Pipe K223-K225	17.313	62.2	130	-0.67	0.22	1.3	0.032
Pipe K223-K224	22.433	62.2	130	0.2	0.07	0.15	0.039
Pipe K221-K223	14.451	62.2	130	-0.42	0.14	0.55	0.035
Pipe K221-K222	24.085	62.2	130	0.18	0.06	0.11	0.038
Pipe K220-K221	14.366	62.2	130	-0.2	0.07	0.13	0.038
Pipe K220-K219	7.6659	150	130	-0.22	0.01	0	0
Pipe K219-K218	79.931	62.2	130	-1.12	0.37	3.34	0.03
Pipe K218-K216	36.441	62.2	130	0.32	0.11	0.33	0.036

Pipe K217-K216	13.554	62.2	130	-0.2	0.07	0.14	0.039
Pipe K216-K214	26.57	62.2	130	0.07	0.02	0.02	0.052
Pipe K215-K214	8.681	62.2	130	-0.15	0.05	0.07	0.035
Pipe K214-K212	112.92	62.2	130	-0.2	0.07	0.14	0.039
Pipe K212-K213	18.667	62.2	130	0.19	0.06	0.13	0.038
Pipe K211-K787	70.49	62.2	130	-0.78	0.26	1.69	0.032
Pipe K211-K208	26.98	62.2	130	0.57	0.19	0.95	0.033
Pipe K210-K207	38.233	62.2	130	-0.11	0.03	0.04	0.043
Pipe K208-K209	10.85	62.2	130	0.12	0.04	0.05	0.042
Pipe K208-K207	8.9866	62.2	130	0.39	0.13	0.48	0.035
Pipe K207-K205	23.002	62.2	130	0.24	0.08	0.2	0.039
Pipe K205-K206	27.328	62.2	130	0.09	0.03	0.03	0.04
Pipe K205-K203	22.724	62.2	130	0.02	0.01	0	0
Pipe K203-K204	20.12	62.2	130	0.09	0.03	0.03	0.045
Pipe K203-K201	35.205	62.2	130	-0.23	0.08	0.18	0.038
Pipe K201-K202	18.595	62.2	130	0.12	0.04	0.05	0.039
Pipe K201-K199	35.646	62.2	130	-0.42	0.14	0.53	0.035
Pipe K199-K200	29.085	62.2	130	0.27	0.09	0.24	0.037
Pipe K199-K198	78.841	62.2	130	-0.85	0.28	2.01	0.031
Pipe K198-K177	63.48	62.2	130	-0.89	0.29	2.16	0.031
Pipe K197-K211	101.25	62.2	130	0	0	0	0
Pipe K196-K333	41.35	62.2	130	-1.25	0.41	4.09	0.03
Pipe K194-K196	99.28	62.2	130	-1.09	0.36	3.18	0.03
Pipe K194-K195	50.708	62.2	130	0.4	0.13	0.5	0.035
Pipe K192-K197	100.04	62.2	130	0.15	0.05	0.08	0.04
Pipe K192-K193	41.409	62.2	130	0.15	0.05	0.08	0.04
Pipe K191-K190	21.328	62.2	130	-0.25	0.08	0.2	0.037
Pipe K190-K194	44.847	62.2	130	-0.47	0.16	0.68	0.034
Pipe K188-K192	58.087	62.2	130	0.46	0.15	0.65	0.034
Pipe K188-K189	15.693	62.2	130	0.2	0.07	0.14	0.039
Pipe K187-K198	67.386	62.2	130	0.33	0.11	0.35	0.036
Pipe K187-K188	78.245	62.2	130	0.76	0.25	1.63	0.032
Pipe K182-K184	15.106	62.2	130	0.13	0.04	0.06	0.039
Pipe K182-K183	16.164	62.2	130	0.32	0.11	0.34	0.036
Pipe K181-K186	14.145	62.2	130	0.13	0.04	0.05	0.037
Pipe K181-K185	5.32	62.2	130	0.06	0.02	0	0
Pipe K181-K180	15.294	62.2	130	-0.21	0.07	0.16	0.039
Pipe K180-K179	30.307	62.2	130	0.09	0.03	0.03	0.041
Pipe K179-K182	35.263	62.2	130	0.53	0.17	0.84	0.034
Pipe K179-K178	62.95	62.2	130	-0.65	0.22	1.23	0.033
Pipe K178-K786	51.485	62.2	130	-0.81	0.27	1.82	0.031
Pipe K178-K190	76.385	62.2	130	-0.12	0.04	0.05	0.041
Pipe K177-K176	13.22	62.2	130	-1.23	0.41	3.99	0.03
Pipe K176-K187	33.94	62.2	130	1.25	0.41	4.07	0.03

Pipe K176-K175	93.88	62.2	130	1.29	0.42	4.32	0.029
Pipe K175-K172	4.6052	62.2	130	-0.66	0.22	1.26	0.032
Pipe K172-K173	30.925	62.2	130	0.17	0.06	0.1	0.04
Pipe K171-K169	32.053	62.2	130	0.93	0.3	2.34	0.031
Pipe K169-K170	66.81	62.2	130	0.25	0.08	0.21	0.037
Pipe K169-K165	67.569	62.2	130	0.37	0.12	0.43	0.035
Pipe K167-K168	72.11	62.2	130	0.32	0.1	0.32	0.036
Pipe K165-K166	110.2	62.2	130	0.18	0.06	0.11	0.039
Pipe K163-K165	29.597	62.2	130	0.12	0.04	0.06	0.043
Pipe K163-K164	46.139	62.2	130	0.3	0.1	0.29	0.037
Pipe K161-K167	4.2083	62.2	130	-0.79	0.26	1.73	0.031
Pipe K161-K163	31.255	62.2	130	0.61	0.2	1.07	0.033
Pipe K161-K162	22.528	62.2	130	0.1	0.03	0.04	0.048
Pipe K160-K158	102.49	62.2	130	-0.39	0.13	0.47	0.035
Pipe K159-K158	26.89	62.2	130	-0.26	0.09	0.22	0.037
Pipe K158-K157	59.65	62.2	130	-0.98	0.32	2.61	0.031
Pipe K157-K212	35.66	62.2	130	0.77	0.25	1.66	0.032
Pipe K157-K156	26.56	62.2	130	1.13	0.37	3.4	0.03
Pipe K156-K167	22.256	62.2	130	0.85	0.28	1.99	0.031
Pipe K155-K154	25.674	62.2	130	-0.13	0.04	0.06	0.039
Pipe K154-K156	52.36	62.2	130	-0.14	0.05	0.07	0.041
Pipe K154-K152	30.683	62.2	130	-0.19	0.06	0.12	0.04
Pipe K152-K153	48.257	62.2	130	0.23	0.08	0.18	0.038
Pipe K149-K151	41.732	62.2	130	0.3	0.1	0.3	0.036
Pipe K149-K150	17.618	62.2	130	0.16	0.05	0.09	0.039
Pipe K148-K152	65.46	62.2	130	0.67	0.22	1.28	0.032
Pipe K148-K149	54.797	62.2	130	0.67	0.22	1.3	0.032
Pipe K147-K145	83.24	62.2	130	-0.41	0.13	0.51	0.035
Pipe K145-K148	14.462	62.2	130	1.59	0.52	6.39	0.029
Pipe K145-K146	75.928	62.2	130	0.42	0.14	0.54	0.035
Pipe K145-K142	78.429	62.2	130	-2.77	0.91	17.9	0.026
Pipe K142-K143	53.048	62.2	130	0.55	0.18	0.88	0.033
Pipe K141-K144	15.333	62.2	130	0.17	0.06	0.11	0.04
Pipe K141-K142	31.684	62.2	130	3.67	1.21	30.1	0.025
Pipe K140-K141	28.725	62.2	130	3.94	1.3	34.36	0.025
Pipe K140-K138	125.37	62.2	130	2.78	0.92	18.03	0.026
Pipe K138-K139	66.378	62.2	130	0.65	0.21	1.21	0.033
Pipe K138-K137	71.21	62.2	130	1.71	0.56	7.35	0.028
Pipe K137-K135	121.8	62.2	130	1.77	0.58	7.79	0.028
Pipe K136-K132	55.59	62.2	130	0.42	0.14	0.54	0.035
Pipe K136-K106	36.642	62.2	130	-0.22	0.07	0.16	0.038
Pipe K135-K136	48.265	62.2	130	0.49	0.16	0.71	0.034
Pipe K135-K133	34.118	62.2	130	0.74	0.24	1.56	0.032
Pipe K133-K134	13.78	62.2	130	0.28	0.09	0.25	0.037

Pipe K133-K132	24.474	62.2	130	0.38	0.12	0.44	0.035
Pipe K132-K130	29.421	62.2	130	0.63	0.21	1.15	0.033
Pipe K131-K107	32.913	62.2	130	-0.12	0.04	0.06	0.043
Pipe K130-K131	31.599	62.2	130	0.19	0.06	0.12	0.039
Pipe K128-K129	20.251	62.2	130	0.26	0.08	0.22	0.038
Pipe K128-K115	30.964	62.2	130	-0.23	0.08	0.18	0.038
Pipe K127-K131	46.622	62.2	130	-0.1	0.03	0.04	0.042
Pipe K127-K128	15.679	62.2	130	0.1	0.03	0.04	0.04
Pipe K126-K130	12.749	62.2	130	-0.36	0.12	0.41	0.035
Pipe K126-K127	19.429	62.2	130	0.08	0.03	0.02	0.043
Pipe K125-K126	38.109	62.2	130	-0.2	0.07	0.14	0.039
Pipe K125-K121	24.511	62.2	130	0.28	0.09	0.26	0.037
Pipe K123-K122	12.5	62.2	130	-0.17	0.06	0.1	0.037
Pipe K122-K124	23.031	62.2	130	0.13	0.04	0.06	0.041
Pipe K121-K122	7.6633	62.2	130	0.35	0.11	0.39	0.036
Pipe K121-K117	36.371	62.2	130	-0.12	0.04	0.05	0.042
Pipe K118-K120	7.2209	62.2	130	0.12	0.04	0.04	0.034
Pipe K118-K119	12.239	62.2	130	0.05	0.02	0	0
Pipe K118-K117	6.6705	62.2	130	-0.19	0.06	0.13	0.044
Pipe K117-K116	26.74	62.2	130	-0.36	0.12	0.41	0.036
Pipe K116-K125	37.28	62.2	130	0.23	0.07	0.18	0.038
Pipe K115-K116	2.8731	62.2	130	0.65	0.21	1.19	0.032
Pipe K114-K171	20.487	62.2	130	-1.61	0.53	6.52	0.028
Pipe K114-K115	73.417	62.2	130	0.99	0.33	2.66	0.031
Pipe K112-K114	43.05	62.2	130	-0.42	0.14	0.54	0.035
Pipe K112-K113	40	62.2	130	0.11	0.04	0.04	0.041
Pipe K111-K112	21.958	62.2	130	-0.25	0.08	0.2	0.038
Pipe K110-K177	38.15	62.2	130	-1.06	0.35	3.04	0.03
Pipe K110-K111	9.1983	62.2	130	0.36	0.12	0.4	0.036
Pipe K109-K111	21.183	62.2	130	-0.54	0.18	0.86	0.034
Pipe K109-K110	20.516	62.2	130	-0.61	0.2	1.07	0.033
Pipe K108-K172	23.238	62.2	130	0.92	0.3	2.32	0.031
Pipe K108-K109	73.286	62.2	130	-0.87	0.29	2.11	0.031
Pipe K107-K108	21.851	62.2	130	0.24	0.08	0.18	0.037
Pipe K106-K104	16.127	62.2	130	0.84	0.28	1.96	0.031
Pipe K104-K107	49.635	62.2	130	0.52	0.17	0.8	0.034
Pipe K103-K106	6.8241	62.2	130	1.11	0.37	3.29	0.03
Pipe K103-K105	19.051	62.2	130	0.13	0.04	0.05	0.039
Pipe K100-K102	26.836	62.2	130	0.07	0.02	0.02	0.05
Pipe K100-K101	38.077	62.2	130	0.19	0.06	0.12	0.039
Pipe K099-K103	30.022	62.2	130	1.28	0.42	4.29	0.029
Pipe K099-K100	24.965	62.2	130	0.43	0.14	0.56	0.035
Pipe K097-K137	106.75	62.2	130	0.71	0.23	1.43	0.032
Pipe K097-K096	69.976	62.2	130	1.86	0.61	8.51	0.028

Pipe K096-K099	44.029	62.2	130	1.88	0.62	8.7	0.028
Pipe K096-K095	9.0393	62.2	130	-0.4	0.13	0.49	0.035
Pipe K095-K098	69.608	62.2	130	0.12	0.04	0.05	0.042
Pipe K094-K097	12.561	62.2	130	-4.31	1.42	40.55	0.025
Pipe K094-K095	70.297	62.2	130	0.63	0.21	1.16	0.033
Pipe K093-K371	143.38	74.8	130	-1.33	0.3	1.87	0.03
Pipe K092-K364	48.144	62.2	130	1.34	0.44	4.65	0.029
Pipe K092-K093	57.053	74.8	130	-0.34	0.08	0.15	0.037
Pipe K091-K818	48.586	62.2	130	0.7	0.23	1.39	0.032
Pipe K090-K092	93.043	74.8	130	1.7	0.39	2.96	0.029
Pipe K087-K089	21.583	62.2	130	0.18	0.06	0.11	0.038
Pipe K087-K088	13.675	62.2	130	0.3	0.1	0.28	0.036
Pipe K086-K783	62.62	74.8	130	-0.25	0.06	0.08	0.038
Pipe K086-K087	17.665	62.2	130	0.54	0.18	0.87	0.034
Pipe K083-K085	17.176	62.2	130	0.11	0.04	0.04	0.04
Pipe K083-K084	14.911	62.2	130	0.13	0.04	0.06	0.038
Pipe K082-K086	43.27	74.8	130	0.42	0.1	0.22	0.035
Pipe K082-K083	26.922	62.2	130	0.33	0.11	0.35	0.036
Pipe K080-K082	64.802	74.8	130	0.94	0.21	0.98	0.032
Pipe K080-K081	16.908	62.2	130	0.26	0.09	0.23	0.037
Pipe K078-K080	45.04	62.2	130	-0.05	0.02	0.01	0.055
Pipe K078-K079	34.261	62.2	130	0.31	0.1	0.3	0.036
Pipe K076-K180	21.815	62.2	130	0.37	0.12	0.44	0.035
Pipe K075-K078	16.26	62.2	130	0.4	0.13	0.5	0.035
Pipe K075-K077	22.046	62.2	130	0.24	0.08	0.19	0.037
Pipe K074-K076	54.4	62.2	130	2.46	0.81	14.32	0.027
Pipe K074-K075	45.66	62.2	130	0.75	0.25	1.57	0.032
Pipe K072-K076	4.9325	62.2	130	-2.02	0.66	9.93	0.028
Pipe K072-K073	78.547	62.2	130	0.47	0.15	0.67	0.034
Pipe K070-K072	70.444	62.2	130	-1.22	0.4	3.89	0.03
Pipe K070-K071	32.194	62.2	130	0.25	0.08	0.2	0.037
Pipe K067-K069	71.128	62.2	130	-1.62	0.53	6.65	0.028
Pipe K067-K068	20.151	62.2	130	0.15	0.05	0.09	0.043
Pipe K066-K069	87.963	62.2	130	-1.64	0.54	6.76	0.028
Pipe K064-K067	42.643	62.2	130	-1.19	0.39	3.72	0.03
Pipe K064-K065	35.914	62.2	130	0.23	0.08	0.17	0.037
Pipe K062-K064	51.987	62.2	130	-0.69	0.23	1.37	0.032
Pipe K062-K063	29.279	62.2	130	0.16	0.05	0.09	0.041
Pipe K061-K782	89.834	62.2	130	0.56	0.18	0.92	0.033
Pipe K061-K062	33.237	62.2	130	-0.36	0.12	0.41	0.036
Pipe K059-K061	27.365	62.2	130	0.67	0.22	1.29	0.032
Pipe K059-K060	17.85	62.2	130	1	0.33	2.69	0.031
Pipe K058-K785	54.557	62.2	130	0.15	0.05	0.08	0.04
Pipe K058-K056	55.14	62.2	130	-1.42	0.47	5.17	0.029

Pipe K056-K174	49.58	62.2	130	1.21	0.4	3.85	0.03
Pipe K055-K059	59.32	62.2	130	0.8	0.26	1.78	0.032
Pipe K055-K058	19.93	62.2	130	-1.07	0.35	3.07	0.03
Pipe K055-K057	26.929	62.2	130	0.12	0.04	0.06	0.046
Pipe K054-K055	52.58	62.2	130	-1.35	0.44	4.7	0.029
Pipe K054-K052	37.108	62.2	130	0.44	0.15	0.59	0.034
Pipe K053-K056	97.7	62.2	130	-1.93	0.64	9.17	0.028
Pipe K052-K053	34.497	62.2	130	-0.52	0.17	0.81	0.034
Pipe K051-K052	16.913	62.2	130	-0.78	0.26	1.72	0.032
Pipe K050-K051	17.183	62.2	130	-0.31	0.1	0.32	0.037
Pipe K049-K053	19.593	62.2	130	-1.03	0.34	2.87	0.03
Pipe K049-K050	32.041	62.2	130	0.24	0.08	0.2	0.038
Pipe K048-K049	14.045	62.2	130	-0.68	0.22	1.31	0.032
Pipe K048-K047	38.938	62.2	130	0.2	0.07	0.14	0.038
Pipe K047-K050	35.796	62.2	130	-0.4	0.13	0.49	0.035
Pipe K046-K048	15.161	62.2	130	-0.4	0.13	0.49	0.035
Pipe K044-K046	17.893	62.2	130	-0.17	0.06	0.11	0.041
Pipe K044-K045	8.5769	62.2	130	0.09	0.03	0.03	0.044
Pipe K043-K046	21.468	62.2	130	-0.16	0.05	0.1	0.041
Pipe K043-K044	10.107	62.2	130	-0.06	0.02	0.01	0.049
Pipe K042-K054	97.117	62.2	130	-0.59	0.19	1.01	0.033
Pipe K042-K051	94.748	62.2	130	-0.4	0.13	0.49	0.035
Pipe K040-K042	39.53	62.2	130	-0.31	0.1	0.31	0.036
Pipe K040-K041	34.289	62.2	130	0.21	0.07	0.15	0.039
Pipe K037-K039	5.9914	62.2	130	0.05	0.02	0	0
Pipe K037-K038	14.301	62.2	130	0.18	0.06	0.11	0.038
Pipe K036-K040	20.912	62.2	130	0.04	0.01	0	0
Pipe K036-K037	26.886	62.2	130	0.29	0.09	0.27	0.037
Pipe K035-K047	71.204	62.2	130	-0.38	0.13	0.46	0.035
Pipe K035-K036	6.3592	62.2	130	0.4	0.13	0.51	0.036
Pipe K033-K035	29.146	62.2	130	0.07	0.02	0.02	0.044
Pipe K033-K034	17.215	62.2	130	0.22	0.07	0.16	0.039
Pipe K032-K070	29.772	62.2	130	-0.72	0.24	1.49	0.032
Pipe K032-K043	11.403	62.2	130	-0.19	0.06	0.12	0.037
Pipe K032-K033	49.333	62.2	130	0.42	0.14	0.54	0.035
Pipe K031-K074	88.35	62.2	130	1	0.33	2.71	0.031
Pipe K031-K032	95.79	62.2	130	-0.38	0.12	0.45	0.035
Pipe K029-K031	17.797	62.2	130	1.25	0.41	4.1	0.03
Pipe K029-K030	40.995	62.2	130	0.42	0.14	0.53	0.035
Pipe K027-K029	15.66	62.2	130	1.72	0.57	7.42	0.028
Pipe K027-K028	14.71	62.2	130	0.08	0.03	0.03	0.051
Pipe K025-K091	199.13	62.2	130	1.92	0.63	9.06	0.028
Pipe K025-K024	110.55	74.8	130	3.46	0.79	10.95	0.026
Pipe K024-K090	49.583	74.8	130	2.84	0.65	7.61	0.027

Pipe K022-K024	15.353	74.8	130	-0.29	0.07	0.12	0.039
Pipe K022-K023	33.91	62.2	130	0.26	0.09	0.22	0.037
Pipe K019-K022	66.884	74.8	130	0.29	0.07	0.11	0.037
Pipe K019-K021	35.952	62.2	130	0.84	0.28	1.97	0.031
Pipe K019-K020	33.12	62.2	130	0.29	0.1	0.28	0.036
Pipe K018-K784	42.91	74.8	130	1.92	0.44	3.7	0.028
Pipe K018-K027	11.92	62.2	130	1.77	0.58	7.79	0.028
Pipe K016-K018	8.69	62.2	130	-0.03	0.01	0	0
Pipe K016-K017	14.32	62.2	130	0.1	0.03	0.03	0.033
Pipe K014-K016	24.77	62.2	130	0.04	0.01	0.01	0.042
Pipe K014-K015	21.72	62.2	130	0.13	0.04	0.06	0.042
Pipe K012-K014	12.84	62.2	130	0.1	0.03	0.03	0.043
Pipe K012-K013	17.945	62.2	130	0.16	0.05	0.09	0.04
Pipe K010-K012	31.753	62.2	130	0.3	0.1	0.29	0.036
Pipe K010-K011	20.467	62.2	130	0.38	0.12	0.45	0.035
Pipe K008-K010	15.72	62.2	130	0.78	0.26	1.7	0.032
Pipe K008-K009	11.37	62.2	130	0.21	0.07	0.16	0.038
Pipe K007-K025	252.28	62.2	130	-1.07	0.35	3.06	0.03
Pipe K007-K008	53.351	62.2	130	0.88	0.29	2.15	0.031
Pipe K006-K812	56.236	62.2	130	3.03	1	21.06	0.026
Pipe K005-K026	13.72	62.2	130	0.54	0.18	0.87	0.034
Pipe K005-K006	45.936	62.2	130	1.05	0.35	2.99	0.03
Pipe K004-K811	27.776	62.2	130	1.38	0.45	4.89	0.029
Pipe K004-K005	130.44	62.2	130	1.65	0.54	6.87	0.028
Pipe K002-K004	134.92	62.2	130	3.25	1.07	24.04	0.026
Pipe K002-K003	33.904	62.2	130	2.09	0.69	10.64	0.027
Pipe K001-K066	358.52	62.2	130	1.11	0.37	3.3	0.03
Pipe K001-K002	15.813	62.2	130	5.52	1.82	63.99	0.024
Pipe K830-K500	34.77	62.2	130	-2.11	0.7	10.82	0.027
Pipe K802-K804	30	62.2	130	0.34	0.11	0.36	0.036
Pipe K815-K813	63	62.2	130	0.19	0.06	0.13	0.039
Pipe Kirtipur_Tank-Kirtipur01	2500	1000	110	482.83	0.61	0.46	0.024
Pipe Kirtipur04-TO_A9.9	200	200	110	42.45	1.35	12.91	0.028
Pipe Kirtipur02-Kirtipur04	780	600	110	274.26	0.97	1.94	0.024
Pipe Kirtipur01-Kirtipur02	1135.3	600	110	274.26	0.97	1.94	0.024
Pipe K822-K823	209.53	62.2	130	0.48	0.16	0.68	0.034
Pipe K822-K492	25.991	62.2	130	-0.91	0.3	2.27	0.031
Pipe K819-K824	49.229	62.2	130	0.62	0.2	1.11	0.033
Pipe K818-K093	62.409	62.2	130	-0.3	0.1	0.28	0.037
Pipe K816-K818	59.257	62.2	130	-0.27	0.09	0.23	0.037
Pipe K816-K817	58.556	62.2	130	0.44	0.14	0.58	0.035

Pipe K812-K814	85.385	62.2	130	1.7	0.56	7.2	0.028
Pipe K812-K815	30	62.2	130	0.49	0.16	0.71	0.034
Pipe K810-K809	22.652	62.2	130	0.26	0.09	0.23	0.037
Pipe K810-K807	62.479	62.2	130	-0.85	0.28	1.99	0.031
Pipe K808-K810	39.108	62.2	130	-0.4	0.13	0.48	0.035
Pipe K807-K806	37.508	62.2	130	0.89	0.29	2.19	0.031
Pipe K807-K796	29.108	62.2	130	-1.92	0.63	9.03	0.028
Pipe K806-K808	63.836	62.2	130	0.57	0.19	0.96	0.033
Pipe K806-K612	42.594	62.2	130	0	0	0	0
Pipe K805-K611	71.09	62.2	130	-0.06	0.02	0.01	0.046
Pipe K802-K803	19.83	62.2	130	0.26	0.08	0.23	0.039
Pipe K801-K805	64.21	62.2	130	0.22	0.07	0.17	0.038
Pipe K801-K802	20.75	62.2	130	0.72	0.24	1.48	0.032
Pipe K801-K709	59.17	62.2	130	-1.14	0.37	3.45	0.03
Pipe K798-K799	189.5	62.2	130	0.69	0.23	1.36	0.032
Pipe K798-K306	85.27	62.2	130	-4.06	1.34	36.2	0.025
Pipe K796-K620	41.241	62.2	130	1.56	0.51	6.14	0.029
Pipe K793-K795	37.503	62.2	130	0.54	0.18	0.85	0.033
Pipe K793-K794	83.644	62.2	130	0.34	0.11	0.37	0.036
Pipe K791-K793	76.814	62.2	130	1.16	0.38	3.58	0.03
Pipe K791-K792	71.983	62.2	130	0.43	0.14	0.57	0.035
Pipe K788-K790	22.434	62.2	130	0.37	0.12	0.42	0.035
Pipe K788-K789	27.969	62.2	130	1.19	0.39	3.76	0.03
Pipe K787-K218	66.62	62.2	130	-1.03	0.34	2.88	0.03
Pipe K786-K174	96.48	62.2	130	-1	0.33	2.72	0.03
Pipe K850-K104	61.74	62.2	130	-0.15	0.05	0.08	0.041
Pipe K784-K019	41.525	74.8	130	1.7	0.39	2.94	0.029
Pipe K783-K090	26.049	74.8	130	-0.39	0.09	0.19	0.036
Pipe K782-K066	52.172	62.2	130	-1.22	0.4	3.91	0.03
Pipe K781-K780	83.693	62.2	130	-0.63	0.21	1.15	0.033
Pipe K781-K685	58.395	62.2	130	0.34	0.11	0.37	0.036
Pipe K780-K779	76.163	62.2	130	-1.65	0.54	6.84	0.028
Pipe K779-K778	39.74	62.2	130	-1.85	0.61	8.45	0.028
Pipe K777-K780	11.324	62.2	130	-0.93	0.31	2.37	0.031
Pipe K777-K769	68.346	62.2	130	0.55	0.18	0.89	0.033
Pipe K776-K777	38.211	62.2	130	0.4	0.13	0.49	0.035
Pipe K775-K778	63.3	62.2	130	-2.2	0.72	11.64	0.027
Pipe K775-K776	82.802	62.2	130	0.74	0.24	1.55	0.032
Pipe K773-K774	23.843	62.2	130	0.09	0.03	0.03	0.043
Pipe K773-K694	25.94	62.2	130	0.28	0.09	0.25	0.037
Pipe K771-K773	19.637	62.2	130	0.5	0.16	0.74	0.034
Pipe K771-K772	29.292	62.2	130	0.26	0.09	0.22	0.037
Pipe K770-K777	72.939	62.2	130	-0.56	0.19	0.94	0.033
Pipe K770-K771	37.422	62.2	130	0.87	0.29	2.11	0.031

Pipe K769-K770	9.6096	62.2	130	0.52	0.17	0.81	0.034
Pipe K768-K769	67.998	62.2	130	0.22	0.07	0.16	0.038
Pipe K767-K775	37.2	62.2	130	-1.18	0.39	3.7	0.03
Pipe K767-K768	69.43	62.2	130	0.53	0.18	0.84	0.033
Pipe K766-K695	40.534	62.2	130	-0.3	0.1	0.29	0.036
Pipe K765-K766	33.48	62.2	130	-0.06	0.02	0.02	0.05
Pipe K763-K764	41.177	62.2	130	0.29	0.09	0.27	0.037
Pipe K763-K762	37.922	62.2	130	0.05	0.02	0.01	0.048
Pipe K762-K765	34.565	62.2	130	0.12	0.04	0.06	0.042
Pipe K761-K762	55.375	62.2	130	0.39	0.13	0.46	0.035
Pipe K759-K761	41.356	62.2	130	0.64	0.21	1.19	0.033
Pipe K759-K760	27.004	62.2	130	0.17	0.05	0.1	0.041
Pipe K758-K767	61.09	62.2	130	-0.48	0.16	0.69	0.034
Pipe K758-K759	31.312	62.2	130	1.03	0.34	2.88	0.03
Pipe K758-K754	87.69	62.2	130	-0.82	0.27	1.89	0.031
Pipe K757-K699	86.376	62.2	130	-0.2	0.07	0.14	0.039
Pipe K756-K757	30.676	62.2	130	0.62	0.2	1.11	0.033
Pipe K755-K763	8.1698	62.2	130	0.53	0.17	0.82	0.033
Pipe K755-K756	16.797	62.2	130	0.5	0.16	0.74	0.034
Pipe K754-K755	96.84	62.2	130	1.12	0.37	3.34	0.03
Pipe K754-K753	49.27	62.2	130	-2.39	0.79	13.56	0.027
Pipe K753-K752	97.74	62.2	130	2.04	0.67	10.1	0.027
Pipe K752-K748	57.555	62.2	130	0.68	0.22	1.31	0.032
Pipe K751-K750	23.138	62.2	130	-0.13	0.04	0.06	0.039
Pipe K750-K752	26.699	62.2	130	-1.07	0.35	3.05	0.03
Pipe K749-K750	59.631	62.2	130	-0.78	0.26	1.72	0.032
Pipe K748-K757	61.901	62.2	130	-0.36	0.12	0.4	0.035
Pipe K748-K701	52.109	62.2	130	-0.02	0.01	0	0
Pipe K747-K748	57.098	62.2	130	-0.71	0.23	1.45	0.032
Pipe K746-K747	56.369	62.2	130	-0.58	0.19	0.98	0.033
Pipe K745-K749	68.366	62.2	130	-0.52	0.17	0.81	0.034
Pipe K745-K746	53.054	62.2	130	-0.39	0.13	0.48	0.035
Pipe K744-K745	37.372	62.2	130	-0.63	0.21	1.14	0.033
Pipe K742-K741	5.05	62.2	130	-0.85	0.28	2	0.031
Pipe K741-K744	7.4438	62.2	130	-1.06	0.35	3	0.03
Pipe K741-K743	27.24	62.2	130	0.19	0.06	0.11	0.038
Pipe K738-K739	93.04	62.2	130	0.85	0.28	2	0.031
Pipe K737-K738	35.93	62.2	130	0.95	0.31	2.46	0.031
Pipe K736-K737	65.356	62.2	130	1.06	0.35	3.03	0.03
Pipe K735-K734	52.958	62.2	130	-0.51	0.17	0.77	0.034
Pipe K734-K733	25.172	62.2	130	-1.29	0.43	4.35	0.029
Pipe K733-K732	34.96	62.2	130	-1.12	0.37	3.33	0.03
Pipe K733-K728	80.591	62.2	130	-0.33	0.11	0.35	0.036
Pipe K732-K730	107.2	62.2	130	-1.22	0.4	3.89	0.03

Pipe K732-K729	60.11	62.2	130	-0.12	0.04	0.05	0.041
Pipe K731-K736	73.36	62.2	130	1.38	0.45	4.92	0.029
Pipe K730-K729	105.17	62.2	130	1.22	0.4	3.93	0.03
Pipe K729-K728	50.83	62.2	130	0.8	0.26	1.8	0.031
Pipe K728-K727	106.71	62.2	130	0.12	0.04	0.06	0.042
Pipe K727-K726	68.895	62.2	130	-1.4	0.46	5.05	0.029
Pipe K725-K820	27.221	62.2	130	0.28	0.09	0.26	0.037
Pipe K725-K724	23.015	62.2	130	-3.19	1.05	23.22	0.026
Pipe K724-K821	25.203	62.2	130	0.14	0.04	0.06	0.04
Pipe K724-K140	56.635	62.2	130	-3.43	1.13	26.54	0.025
Pipe K723-K722	57.035	62.2	130	-0.51	0.17	0.79	0.034
Pipe K723-K721	38.535	62.2	130	-0.21	0.07	0.15	0.038
Pipe K722-K726	125.04	62.2	130	-1.29	0.42	4.34	0.029
Pipe K721-K722	43.109	62.2	130	-0.55	0.18	0.9	0.033
Pipe K721-K720	58.14	62.2	130	0.09	0.03	0.03	0.042
Pipe K720-K719	14.25	62.2	130	-0.51	0.17	0.78	0.034
Pipe K720-K717	70.296	62.2	130	0.28	0.09	0.25	0.037
Pipe K719-K727	65.007	62.2	130	-1.14	0.38	3.45	0.03
Pipe K719-K718	73.544	62.2	130	0.34	0.11	0.37	0.036
Pipe K718-K717	28.586	62.2	130	0.11	0.04	0.05	0.042
Pipe K717-K716	45.808	62.2	130	0.21	0.07	0.15	0.038
Pipe K716-K723	28.502	62.2	130	-0.49	0.16	0.72	0.034
Pipe K715-K716	22.138	62.2	130	-0.56	0.18	0.93	0.033
Pipe K714-K740	28.05	62.2	130	-0.31	0.1	0.31	0.036
Pipe K713-K714	34.67	62.2	130	-0.15	0.05	0.08	0.04
Pipe K712-K713	15.12	62.2	130	-0.39	0.13	0.46	0.035
Pipe K711-K712	63.227	62.2	130	0.08	0.03	0.03	0.045
Pipe K710-K711	61.373	62.2	130	0.33	0.11	0.34	0.036
Pipe K710-K623	65.771	62.2	130	-0.1	0.03	0.04	0.043
Pipe K708-K742	47.52	62.2	130	-0.7	0.23	1.4	0.032
Pipe K708-K709	83.27	62.2	130	1.34	0.44	4.68	0.029
Pipe K707-K708	23.68	62.2	130	1.04	0.34	2.94	0.03
Pipe K707-K706	65.04	62.2	130	-0.55	0.18	0.9	0.033
Pipe K706-K744	37.099	62.2	130	0.51	0.17	0.78	0.034
Pipe K704-K706	37.67	62.2	130	1.25	0.41	4.09	0.03
Pipe K704-K705	58.846	62.2	130	0.15	0.05	0.08	0.041
Pipe K703-K704	4.8406	62.2	130	1.47	0.48	5.53	0.029
Pipe K703-K676	28.01	62.2	130	1.43	0.47	5.28	0.029
Pipe K702-K703	55.145	62.2	130	-0.19	0.06	0.13	0.039
Pipe K702-K674	90.16	62.2	130	0.68	0.22	1.32	0.032
Pipe K701-K702	42.95	62.2	130	0.16	0.05	0.09	0.039
Pipe K701-K700	2.8551	62.2	130	-0.32	0.11	0.36	0.04
Pipe K700-K671	112.22	62.2	130	0.57	0.19	0.94	0.033
Pipe K699-K700	43.822	62.2	130	0.52	0.17	0.8	0.034

Pipe K698-K699	25.021	62.2	130	0.98	0.32	2.61	0.031
Pipe K698-K697	11.09	62.2	130	0.74	0.24	1.56	0.032
Pipe K697-K756	98.151	62.2	130	0.28	0.09	0.26	0.037
Pipe K697-K696	25.094	62.2	130	0.33	0.11	0.35	0.036
Pipe K696-K695	72.556	62.2	130	0.06	0.02	0.02	0.047
Pipe K696-K681	26.608	62.2	130	0.11	0.04	0.04	0.044
Pipe K694-K695	43.31	62.2	130	0.38	0.12	0.45	0.035
Pipe K691-K693	30	62.2	130	0.15	0.05	0.08	0.04
Pipe K691-K692	9.7889	62.2	130	0.1	0.03	0.03	0.034
Pipe K691-K690	1.9474	62.2	130	-0.29	0.1	0.31	0.041
Pipe K690-K689	71.285	62.2	130	-0.35	0.12	0.39	0.036
Pipe K689-K658	26.795	62.2	130	-0.45	0.15	0.62	0.034
Pipe K688-K694	42.64	62.2	130	0.27	0.09	0.25	0.037
Pipe K688-K689	38.114	62.2	130	0.12	0.04	0.05	0.044
Pipe K686-K688	29.37	62.2	130	0.54	0.18	0.87	0.033
Pipe K686-K687	18.607	62.2	130	0.16	0.05	0.1	0.041
Pipe K685-K686	21.296	62.2	130	0.84	0.28	1.96	0.031
Pipe K684-K698	33.93	62.2	130	-1.39	0.46	4.98	0.029
Pipe K684-K683	32.303	62.2	130	0.47	0.16	0.68	0.034
Pipe K683-K669	62.015	62.2	130	0.56	0.18	0.93	0.033
Pipe K682-K683	4.5795	62.2	130	0.2	0.06	0.13	0.038
Pipe K681-K682	31.36	62.2	130	0.57	0.19	0.97	0.033
Pipe K680-K679	33.539	62.2	130	-0.86	0.28	2.04	0.031
Pipe K680-K668	50.062	62.2	130	0.2	0.07	0.14	0.039
Pipe K679-K682	38.019	62.2	130	-0.31	0.1	0.31	0.036
Pipe K678-K681	29.63	62.2	130	-0.01	0	0	0
Pipe K678-K679	20.61	62.2	130	0.65	0.21	1.22	0.033
Pipe K678-K677	30.827	62.2	130	-0.06	0.02	0.01	0.042
Pipe K677-K690	34.911	62.2	130	0.03	0.01	0	0.043
Pipe K677-K659	26.758	62.2	130	-0.25	0.08	0.2	0.037
Pipe K676-K707	56.347	62.2	130	0.76	0.25	1.62	0.032
Pipe K675-K676	8.6725	62.2	130	-0.54	0.18	0.88	0.034
Pipe K675-K674	37.879	62.2	130	0.05	0.02	0.01	0.048
Pipe K674-K673	19.401	62.2	130	0.49	0.16	0.73	0.034
Pipe K673-K675	52.739	62.2	130	-0.29	0.1	0.28	0.036
Pipe K672-K673	37.133	62.2	130	-0.56	0.18	0.91	0.033
Pipe K672-K670	52.037	62.2	130	-0.64	0.21	1.18	0.033
Pipe K671-K684	48.074	62.2	130	-0.68	0.22	1.32	0.032
Pipe K670-K671	2.5679	62.2	130	-1.07	0.35	3.01	0.03
Pipe K670-K669	30.518	62.2	130	0.29	0.1	0.28	0.037
Pipe K669-K668	21.081	62.2	130	0.69	0.23	1.38	0.032
Pipe K668-K667	15.809	62.2	130	0.78	0.26	1.71	0.032
Pipe K667-K663	23.945	62.2	130	0.63	0.21	1.14	0.033
Pipe K666-K667	38.352	62.2	130	-0.06	0.02	0.02	0.049

Pipe K666-K665	36.848	62.2	130	-0.5	0.17	0.76	0.034
Pipe K665-K680	7.7352	62.2	130	-0.55	0.18	0.89	0.033
Pipe K665-K660	76.751	62.2	130	-0.11	0.04	0.05	0.043
Pipe K664-K672	46.088	62.2	130	-0.95	0.31	2.45	0.031
Pipe K571-K567	209.98	62.2	130	-0.43	0.14	0.57	0.035
Pipe K541-K542	64.69	62.2	130	1.03	0.34	2.86	0.03
Pipe K542-K545	41.421	62.2	130	0.43	0.14	0.56	0.035
Pipe K545-K546	90.446	62.2	130	0.14	0.05	0.07	0.041
Pipe K546-K548	169.14	62.2	130	-0.45	0.15	0.61	0.034
Pipe K541-K549	107.12	62.2	130	0.76	0.25	1.63	0.032
Pipe K549-K548	149.67	62.2	130	-0.36	0.12	0.41	0.036
Pipe K007-K006	40.99	62.2	130	2.16	0.71	11.27	0.027
Pipe Kirtipur_05-Kirtipur_06	348.28	300	110	95.13	1.35	7.98	0.026
Pipe Kirtipur_06-Kirtipur_07	422.55	300	110	95.13	1.35	7.98	0.026
Pipe Kirtipur04-Kirtipur_01	56.76	350	110	109.85	1.14	4.92	0.026
Pipe K860-Kirtipur_04	135.63	350	110	73.99	0.77	2.37	0.027
Pipe Kirtipur04-Kirtipur_05	47.88	300	110	95.13	1.35	7.99	0.026
Pipe K274-K861	74.73	62.2	130	-0.31	0.1	0.32	0.036
Pipe K819-K861R	38.27	62.2	130	1.41	0.46	5.09	0.029
Pipe K861-K278	54.47	62.2	130	1.09	0.36	3.19	0.03
Pipe K862-K863	53.97	62.2	130	0.99	0.32	2.64	0.031
Pipe K236-K863	102.33	62.2	130	-0.99	0.32	2.64	0.031
Pipe Kirtipur_01-K864	94.75	350	110	109.85	1.14	4.92	0.026
Pipe K864-K865	148.63	350	110	109.85	1.14	4.92	0.026
Pipe K866-K867	11.28	350	110	109.85	1.14	4.92	0.026
Pipe K860-K873	108.54	350	110	-73.99	0.77	2.37	0.027
Pipe K873-K872	195.86	350	110	-73.99	0.77	2.37	0.027
Pipe K872-K871	56.16	350	110	-109.85	1.14	4.92	0.026
Pipe K871-K870	107.85	350	110	-109.85	1.14	4.92	0.026
Pipe K870-K869	106.26	350	110	-109.85	1.14	4.92	0.026
Pipe K869-K868	51.33	350	110	-109.85	1.14	4.92	0.026
Pipe K868-K867	106.51	350	110	-109.85	1.14	4.92	0.026
Pipe K595-K603	80.86	62.2	130	-1.68	0.55	7.08	0.028
Pipe K865-K874	48.83	350	110	109.85	1.14	4.92	0.026
Pipe K874-K866	45.44	350	110	109.85	1.14	4.92	0.026
Pipe K238-K875	71.06	62.2	130	0.1	0.03	0.04	0.044
Pipe K603-K877	96.09	62.2	130	0.17	0.05	0.1	0.04
Pipe K596-K878	112.99	62.2	130	0.07	0.02	0.02	0.044
Pipe K611-K610	18.63	62.2	130	-0.19	0.06	0.12	0.038
Pipe K740-K884	87.6	62.2	130	0.05	0.02	0.01	0.047

Pipe K712-K883	93.18	62.2	130	0.13	0.04	0.07	0.041
Pipe K710-K882	20.8	62.2	130	-0.57	0.19	0.97	0.033
Pipe K808-K882	69.43	62.2	130	0.64	0.21	1.19	0.033
Pipe K808-K881	33.5	62.2	130	0.06	0.02	0.02	0.049
Pipe K806-K880	37.61	62.2	130	0.09	0.03	0.04	0.047
Pipe K612-K879	35.18	62.2	130	0.04	0.01	0.01	0.049
Pipe K602-K885	52.99	74.8	130	0.11	0.03	0.02	0.043
Pipe K602-K590	106.27	74.8	130	-2.43	0.55	5.69	0.027
Pipe K740-K886	42.32	62.2	130	-0.56	0.19	0.94	0.033
Pipe K589-K887	62.5	62.2	130	-3.16	1.04	22.8	0.026
Pipe Kirtipur_07-K888	4.62	300	110	95.13	1.35	7.99	0.026
Pipe K753-K731	45.72	62.2	110	0.16	0.05	0.13	0.055
Pipe 1	46.77	300	110	26.83	0.38	0.77	0.031
Pipe 2	9.5	62.2	130	-0.63	0.21	1.16	0.032
Pipe 3	304.93	150	110	12.11	0.69	5.14	0.032
Pipe 4	303.59	150	110	12.11	0.69	5.14	0.032
Pipe 5	274.09	150	110	7.12	0.4	1.92	0.035
Pipe 6	163.2	62.2	130	0.56	0.18	0.91	0.033
Pipe 7	321.44	150	110	-7.9	0.45	2.33	0.034
Pipe 9	4.05	62.2	130	0	0	0	0
Pipe 10	148.75	62.2	130	0	0	0	0
Pipe 11	2.89	62.2	130	-1.04	0.34	2.94	0.031
Pipe 12	35.56	150	110	8.96	0.51	2.94	0.034
Pipe 13	2.94	150	110	-1.06	0.06	0.05	0.042
Pipe 16	6.09	62.2	130	-0.31	0.1	0.32	0.038
Pipe 19	18.78	150	110	7.9	0.45	2.33	0.034
Pipe 23	66.24	62.2	130	0.43	0.14	0.56	0.035
Pipe 24	39.24	62.2	130	-0.25	0.08	0.21	0.037
Pipe 25	68.02	62.2	130	-0.82	0.27	1.86	0.031
Pipe 27	60.99	62.2	130	0.98	0.32	2.62	0.031
Pipe 28	32.34	62.2	130	0.41	0.13	0.52	0.035
Pipe 29	59.8	62.2	130	-0.24	0.08	0.19	0.038
Pipe 30	3.21	200	110	13.6	0.43	1.58	0.033
Pipe 31	1.08	62.2	130	2.91	0.96	19.57	0.026
Pipe 32	0.88	62.2	130	1.87	0.62	8.63	0.028
Pipe 33	109.96	62.2	130	-1.05	0.35	2.97	0.03
Pipe 34	136.6	200	110	-8.82	0.28	0.7	0.035
Pipe 36	38.05	62.2	130	0.46	0.15	0.64	0.034
Pipe 37	122.4	62.2	130	-1.27	0.42	4.21	0.029
Pipe 38	26.6	62.2	130	0.83	0.27	1.91	0.031
Pipe 39	348.74	200	110	17.35	0.55	2.46	0.032
Pipe 41	4.13	200	110	4.22	0.13	0.18	0.039
Pipe 42	1.87	150	110	-1.38	0.08	0.08	0.038
Pipe 43	2.62	150	110	2.63	0.15	0.28	0.038

Pipe 44	4.01	150	110	1.86	0.11	0.15	0.039
Pipe 45	3.62	150	110	1.81	0.1	0.16	0.046
Pipe 46	174.55	150	110	3.67	0.21	0.56	0.038
Pipe 47	277.48	200	110	3.74	0.12	0.14	0.04
Pipe 48	2.95	150	110	3.74	0.21	0.61	0.04
Pipe 49	303.72	200	110	5.26	0.17	0.27	0.038
Pipe 50	4.18	200	110	4.92	0.16	0.21	0.034
Pipe 51	3.26	150	110	5.94	0.34	1.37	0.036
Pipe 52	3.59	150	110	5	0.28	0.99	0.037
Pipe 54	124.28	200	110	8.67	0.28	0.68	0.035
Pipe 55	60.19	62.2	130	-0.99	0.32	2.64	0.031
Pipe 56	2.45	62.2	130	-0.15	0.05	0.12	0.062
Pipe 57	3.96	150	110	-3.23	0.18	0.45	0.04
Pipe 58	230.35	250	110	60.62	1.23	8.42	0.027
Pipe 59	246.13	250	110	60.62	1.23	8.42	0.027
Pipe 60	2.42	62.2	130	-0.55	0.18	0.92	0.035
Pipe 61	31.19	62.2	130	1.68	0.55	7.09	0.028
Pipe 62	233.59	150	110	13.22	0.75	6.05	0.032
Pipe 63	2.46	150	110	21.29	1.2	14.58	0.03
Pipe 64	116.44	150	110	8.15	0.46	2.47	0.034
Pipe 65	340.8	150	110	8.15	0.46	2.47	0.034
Pipe 67	392.02	150	110	-0.5	0.03	0.01	0.052
Pipe 68	283.72	150	110	5.53	0.31	1.2	0.036
Pipe 69	1.85	150	110	16.72	0.95	9.33	0.031
Pipe 70	118.76	150	110	12.43	0.7	5.39	0.032
Pipe 71	437.1	150	110	8.2	0.46	2.5	0.034
Pipe 72	553.01	150	110	2.67	0.15	0.31	0.04
Pipe 73	1.65	150	110	4.29	0.24	0.81	0.041
Pipe 74	283.29	150	110	-16.72	0.95	9.34	0.031
Pipe 75	414.03	150	110	13.81	0.78	6.55	0.032
Pipe 76	54.52	62.2	130	1.05	0.34	2.95	0.03
Pipe 77	59.26	62.2	130	0.92	0.3	2.31	0.031
Pipe 78	214.37	150	110	2.6	0.15	0.3	0.04
Pipe 79	289.31	150	110	-2.59	0.15	0.29	0.04
Pipe 80	241.72	150	110	-0.23	0.01	0	0.054
Pipe 81	49.71	62.2	130	-1.91	0.63	9	0.028
Pipe 82	77.3	62.2	130	1.85	0.61	8.48	0.028
Pipe 83	73.79	62.2	130	0.01	0	0	0.193
Pipe 84	169.82	62.2	130	-1.11	0.37	3.3	0.03
Pipe 85	274.35	150	110	-0.23	0.01	0	0.057
Pipe 86	245.96	150	110	-6.1	0.35	1.44	0.036
Pipe 87	321.93	150	110	6.44	0.36	1.6	0.035
Pipe 88	530.23	150	110	0.96	0.05	0.05	0.047
Pipe 89	14.82	62.2	130	-2.86	0.94	18.92	0.026

Pipe 90	5.17	150	110	-11.91	0.67	4.98	0.032
Pipe 91	430.5	150	110	-11.91	0.67	4.98	0.032
Pipe 92	433.54	150	110	13.28	0.75	6.09	0.032
Pipe 93	34.37	62.2	130	-3.55	1.17	28.35	0.025
Pipe 95	4.29	150	110	10.41	0.59	3.89	0.033
Pipe 96	568.35	150	110	-2.59	0.15	0.29	0.04
Pipe 97	127.48	150	110	-1.08	0.06	0.06	0.046
Pipe 98	612.79	150	110	-0.72	0.04	0.03	0.049
Pipe 99	562.52	150	110	-6.9	0.39	1.81	0.035
Pipe 100	450.5	150	110	-0.72	0.04	0.03	0.049
Pipe 101	238.14	150	110	-2.54	0.14	0.28	0.041
Pipe 103	160.12	150	110	2.7	0.15	0.32	0.04
Pipe 104	309.3	150	110	2.7	0.15	0.32	0.04
Pipe 105	253.99	150	110	3.27	0.19	0.46	0.039
Pipe 106	144.78	150	110	-2.7	0.15	0.32	0.04
Pipe 107	3.92	150	110	5.07	0.29	1.03	0.037
Pipe 108	3.51	150	110	0.9	0.05	0.04	0.048
Pipe 109	17.46	150	110	2.13	0.12	0.2	0.042
Pipe 111	1.57	150	110	1.81	0.1	0.09	0.026
Pipe 112	315.5	150	110	-2.54	0.14	0.28	0.041
Pipe 113	408.66	150	110	-7.36	0.42	2.04	0.035
Pipe 116	346.5	150	110	-13.38	0.76	6.18	0.032
Pipe 117	806.01	150	110	-6.74	0.38	1.74	0.035
Pipe 118	363.56	150	110	-6.44	0.36	1.6	0.035
Pipe 119	381.03	150	110	-13.15	0.74	5.99	0.032
Pipe 120	2.86	150	110	13.93	0.79	6.66	0.032
Pipe 121	18.21	62.2	130	-1.15	0.38	3.53	0.03
Pipe 122	282.34	62.2	130	-1.39	0.46	4.99	0.029
Pipe 123	158.99	62.2	130	0.31	0.1	0.32	0.036
Pipe 124	161.1	150	110	19.36	1.1	12.25	0.03
Pipe 125	306.86	150	110	7.94	0.45	2.35	0.034
Pipe 126	204.92	150	110	1.08	0.06	0.06	0.046
Pipe 127	152.41	150	110	1.08	0.06	0.06	0.046
Pipe 128	752.99	350	110	73.99	0.77	2.37	0.027
Pipe 129	599.3	300	110	32.75	0.46	1.11	0.03
Pipe 130	202.33	150	110	16.26	0.92	8.86	0.031
Pipe 131	199.26	150	110	13.83	0.78	6.57	0.032
Pipe 132	36.23	62.2	130	-1.54	0.51	6	0.029
Pipe 133	111.67	62.2	130	-1.54	0.51	6	0.029
Pipe 134	105.93	62.2	130	1.47	0.48	5.5	0.029
Pipe 135	106.01	150	110	-7.93	0.45	2.34	0.034
Pipe 136	112.24	150	110	-13.83	0.78	6.57	0.032
Pipe 137	13.18	62.2	130	1.9	0.62	8.86	0.028
Pipe 138	200.67	62.2	130	0.1	0.03	0.04	0.043

Pipe 139	112.53	62.2	130	-1.99	0.66	9.72	0.028
Pipe 140	105.8	62.2	130	1.57	0.52	6.26	0.029
Pipe 141	65.7	62.2	130	-0.67	0.22	1.29	0.032
Pipe 142	65.98	150	110	7.93	0.45	2.34	0.034
Pipe 143	64.27	62.2	130	-0.62	0.2	1.12	0.033
Pipe 144	195.7	150	110	6.4	0.36	1.58	0.035
Pipe 145	286.93	250	110	60.62	1.23	8.42	0.027
Pipe 147	3.16	200	110	32.98	1.05	8.1	0.029
Pipe 148	33.16	62.2	130	-2.9	0.95	19.44	0.026
Pipe 149	39.75	62.2	130	2.71	0.89	17.13	0.026
Pipe 150	28.27	62.2	130	0.9	0.3	2.24	0.031
Pipe 151	33.24	62.2	130	-2.09	0.69	10.59	0.027
Pipe 152	2.07	150	110	5.9	0.33	1.29	0.034
Pipe 153	1.87	150	110	6.28	0.36	1.51	0.035
Pipe 154	106.66	150	110	5.4	0.31	1.15	0.036
Pipe 158	124.21	150	110	9.11	0.52	3.03	0.034
Pipe 159	1.35	150	110	6.51	0.37	1.54	0.034
Pipe 160	1.21	150	110	5.02	0.28	0.98	0.036
Pipe 161	2.51	150	110	5.07	0.29	1.01	0.036
Pipe 162	1.29	150	110	4.23	0.24	0.81	0.042
Pipe 164	2.58	150	110	-11.42	0.65	4.61	0.033
Pipe 167	3.65	150	110	5.26	0.3	1.1	0.037
Pipe 168	42.72	150	110	-0.96	0.05	0.05	0.046
Pipe 173	3.13	150	110	7.18	0.41	1.95	0.035
Pipe 174	135	150	110	6.1	0.35	1.44	0.036
Pipe 175	1.72	150	110	2.83	0.16	0.35	0.04
Pipe 176	218.52	150	110	-6.1	0.35	1.44	0.036
Pipe 177	1.18	150	110	5.87	0.33	1.26	0.034
Pipe 178	1.57	150	110	5.49	0.31	1.14	0.035
Pipe 179	4.39	150	110	6.71	0.38	1.7	0.035
Pipe 8	2.14	150	110	8.66	0.49	2.71	0.033
Pipe 15	1000	150	110	2.18	0.12	0.21	0.042
Pipe 17	1000	150	110	1.53	0.09	0.11	0.044
Pipe 18	1000	150	110	4.31	0.24	0.76	0.038
Pipe 20	2.7	150	110	2.03	0.11	0.22	0.049
Pipe 21	1.56	62.2	130	0.81	0.27	1.81	0.031
Pipe 22	2.18	150	130	3.4	0.19	0.34	0.027
Pipe 26	410.82	150	110	-2.18	0.12	0.21	0.042
Pipe 35	327.38	62.2	130	-0.44	0.14	0.59	0.034
Pipe 66	404.71	150	110	13.93	0.79	6.66	0.032
Pipe 115	93.26	62.2	130	2.31	0.76	12.75	0.027
Pipe 156	33.6	62.2	130	2.69	0.88	16.91	0.026
Pipe 157	18.28	62.2	130	2.61	0.86	15.97	0.026
Pipe 163	24.2	62.2	130	2.5	0.82	14.81	0.027

Pipe 166	62.47	62.2	130	2.37	0.78	13.43	0.027
Pipe 169	58.16	62.2	130	2.16	0.71	11.27	0.027
Pipe 170	2.18	150	110	-5.21	0.29	1.02	0.035
Pipe 182	48.36	62.2	130	0.55	0.18	0.89	0.033
Pipe 183	167.35	62.2	130	0.23	0.08	0.18	0.038
Pipe 184	1.59	150	110	2.41	0.14	0.28	0.045
Pipe 185	1.61	150	110	1.32	0.07	0.09	0.049
Pipe 186	214.84	150	110	2.78	0.16	0.34	0.04
Pipe 187	61.2	62.2	130	0.23	0.07	0.17	0.038
Pipe 188	69.03	62.2	130	0.11	0.04	0.05	0.042
Pipe 189	14.89	62.2	130	-0.77	0.25	1.67	0.032
Pipe 190	0.85	150	110	-2.61	0.15	0.35	0.047
Pipe 191	1.06	150	110	2.02	0.11	0.28	0.063
Pipe 192	145.32	150	110	1.24	0.07	0.08	0.045
Pipe 193	1.88	150	110	1.4	0.08	0.08	0.037
Pipe 194	1.46	150	110	2.63	0.15	0.31	0.041
Pipe 204	111.06	150	110	-6.74	0.38	1.74	0.035
Pipe 205	2.85	150	110	5.67	0.32	1.25	0.036
Pipe 208	3.56	150	110	4.82	0.27	0.92	0.036
Pipe 209	198.2	150	110	-7.94	0.45	2.35	0.034
Pipe 210	1.66	150	110	8.66	0.49	2.78	0.034
Pipe 211	106.16	150	110	-4.95	0.28	0.98	0.037
Pipe 212	2.45	150	110	2.77	0.16	0.3	0.036
Pipe 213	134.18	150	110	10.15	0.57	3.71	0.033
Pipe 214	2.29	150	110	3.78	0.21	0.58	0.038
Pipe 215	259.35	150	110	-14.16	0.8	6.86	0.031
Pipe 216	4.69	150	110	7.42	0.42	2.06	0.034
Pipe 217	2.92	150	110	8.29	0.47	2.55	0.034
Pipe 218	0.76	150	110	3.57	0.2	0.59	0.042
Pipe 219	1.2	150	110	3.12	0.18	0.37	0.035
Pipe 220	27.77	62.2	130	1.31	0.43	4.45	0.029
Pipe 221	61.47	62.2	130	0.2	0.07	0.14	0.039
Pipe 222	151.31	150	110	-1.48	0.08	0.1	0.044
Pipe 223	61.5	62.2	130	0.83	0.27	1.93	0.031
Pipe 224	199.75	62.2	130	-0.61	0.2	1.07	0.033
Pipe 225	198.95	150	110	1.48	0.08	0.1	0.044
Pipe 226	0.99	150	110	2.72	0.15	0.3	0.037
Pipe 227	1.09	150	110	2.46	0.14	0.27	0.041
Pipe 228	1.17	150	110	3.7	0.21	0.64	0.043
Pipe 229	3.25	200	110	27.64	0.88	5.82	0.029
Pipe 230	1.96	150	110	0.31	0.02	0	0
Pipe 231	2.05	150	110	3.9	0.22	0.58	0.035
Pipe 232	422.66	150	110	7.21	0.41	1.96	0.035
Pipe 233	1.61	150	110	2.56	0.15	0.37	0.052

Pipe 234	1.81	150	110	2.69	0.15	0.33	0.042
Pipe 235	59.6	62.2	130	1.66	0.54	6.89	0.028
Pipe 236	42.21	150	110	7.21	0.41	1.97	0.035
Pipe 237	2.33	150	110	-0.63	0.04	0.06	0.147
Pipe 238	413.44	62.2	130	0.74	0.24	1.56	0.032
Pipe 239	467.18	150	110	3.44	0.19	0.5	0.039
Pipe 240	1.84	150	110	4.4	0.25	0.81	0.038
Pipe 241	3.19	150	110	6.02	0.34	1.4	0.035
Pipe 114	3.46	150	110	3.19	0.18	0.43	0.039
Pipe 146	3.53	150	110	1.81	0.1	0.17	0.047
Pipe 155	1.36	150	110	-13.22	0.75	6.02	0.032
Pipe 165	1.72	150	110	5.53	0.31	1.21	0.036
Valve 102	#N/A	250	#N/A	34.51	0.7	1	0
Valve 40	#N/A	250	#N/A	60.62	1.23	1	0
Valve 53	#N/A	200	#N/A	35.85	1.14	8.67	0
Valve 94	#N/A	300	#N/A	32.75	0.46	0.03	0
Valve 110	#N/A	250	#N/A	41.25	0.84	0	0

Table 6.29.Details of Pressure for DNI K

Node ID	Elevation	Base Demand	Demand	Head	Pressure
	m	LPS	LPS	m	m
Junc K830	1288.9	0	0	1316.48	27.56
Junc Kirtipur01	1285	139.05	208.58	1337.35	52.35
Junc TO_A9.9	1318	28.3	42.45	1331.06	13.06
Junc Kirtipur04	1314	0	0	1333.64	19.64
Junc Kirtipur02	1290	0	0	1335.15	45.15
Junc K824	1289.2	0.4127	0.62	1313.12	23.88
Junc K823	1282.1	0.3169	0.48	1316.63	34.53
Junc K822	1282.5	0.1634	0.25	1316.84	34.32
Junc K821	1287.7	0.0906	0.14	1319.35	31.63
Junc K820	1287	0.1869	0.28	1318.81	31.8
Junc K819	1288.4	0.2221	0.33	1313.17	24.75
Junc K818	1310.1	0.4847	0.73	1323.05	12.98
Junc K817	1308.7	0.2913	0.44	1323.01	14.32
Junc K816	1309.7	0.2157	0.32	1323.04	13.39
Junc K815	1293.1	0.1971	0.3	1317.93	24.81
Junc K814	1292.3	1.1307	1.7	1317.34	25
Junc K813	1294.7	0.1268	0.19	1317.93	23.19
Junc K812	1291.6	0.564	0.85	1317.96	26.34
Junc K811	1299.5	0.9177	1.38	1320.04	20.53
Junc K810	1286.8	0.1245	0.19	1322.51	35.72
Junc K809	1287.4	0.1761	0.26	1322.51	35.08
Junc K808	1298.5	0.1728	0.26	1322.49	23.95

Junc K807	1293.2	0.1201	0.18	1322.64	29.42
Junc K806	1299.9	0.1553	0.23	1322.56	22.62
Junc K805	1306.1	0.1858	0.28	1331.55	25.5
Junc K804	1302.8	0.2237	0.34	1331.52	28.72
Junc K803	1314.5	0.1711	0.26	1331.52	17.07
Junc K802	1308.5	0.0883	0.13	1331.53	23.06
Junc K801	1304	0.1276	0.19	1331.56	27.52
Junc K800	1292.7	1.0334	1.55	1310.39	17.68
Junc K799	1291.7	0.4595	0.69	1311.87	20.13
Junc K798	1288.5	0.4908	0.74	1312.13	23.63
Junc K797	1288.5	0.1344	0.2	1311.62	23.07
Junc K796	1289.5	0.0852	0.13	1322.9	33.4
Junc K795	1291.3	0.3575	0.54	1321.5	30.23
Junc K794	1291.2	0.2284	0.34	1321.5	30.3
Junc K793	1291	0.1889	0.28	1321.53	30.51
Junc K792	1290.8	0.2886	0.43	1321.77	31
Junc K791	1291.6	0.2544	0.38	1321.81	30.16
Junc K790	1293.3	0.2467	0.37	1320.14	26.8
Junc K789	1300.6	0.7961	1.19	1320.04	19.48
Junc K788	1293.4	0.1833	0.27	1320.15	26.71
Junc K787	1293	0.1729	0.26	1317.17	24.17
Junc K786	1297.3	0.1317	0.2	1322.89	25.62
Junc K785	1294.1	0.1033	0.15	1316.22	22.09
Junc K784	1304	0.1521	0.23	1323.84	19.84
Junc K783	1305.6	0.093	0.14	1323.33	17.73
Junc K782	1299.4	1.1859	1.78	1315.94	16.55
Junc K781	1318.6	0.1926	0.29	1332.65	14.03
Junc K780	1314.7	0.0588	0.09	1332.75	18.06
Junc K779	1311.6	0.1335	0.2	1333.27	21.71
Junc K778	1314	0.1168	0.18	1333.6	19.57
Junc K777	1316	0.1437	0.22	1332.72	16.69
Junc K776	1320.7	0.2285	0.34	1332.74	12.02
Junc K775	1317	0.1837	0.28	1332.87	15.87
Junc K774	1324.9	0.0605	0.09	1332.56	7.61
Junc K773	1325.5	0.0866	0.13	1332.56	7.02
Junc K772	1322.7	0.1742	0.26	1332.57	9.91
Junc K771	1325	0.0777	0.12	1332.57	7.52
Junc K770	1324	0.1404	0.21	1332.65	8.65
Junc K769	1324.4	0.1651	0.25	1332.66	8.28
Junc K768	1323.3	0.2092	0.31	1332.67	9.34
Junc K767	1318.8	0.1138	0.17	1332.73	13.91
Junc K766	1323.4	0.1563	0.23	1332.52	9.08
Junc K765	1322.5	0.1245	0.19	1332.52	10.05
Junc K764	1323.1	0.1913	0.29	1332.51	9.45

Junc K763	1322.7	0.1248	0.19	1332.52	9.82
Junc K762	1317.7	0.2097	0.31	1332.52	14.83
Junc K761	1319.5	0.1713	0.26	1332.55	13.03
Junc K760	1320.4	0.1107	0.17	1332.59	12.24
Junc K759	1319.5	0.1504	0.23	1332.6	13.08
Junc K758	1314.5	0.1797	0.27	1332.69	18.23
Junc K757	1323.1	0.3071	0.46	1332.48	9.39
Junc K756	1322.8	0.1081	0.16	1332.52	9.68
Junc K755	1322.7	0.0642	0.1	1332.53	9.79
Junc K754	1305.8	0.2944	0.44	1332.85	27.1
Junc K753	1304.4	0.2251	0.34	1333.52	29.17
Junc K752	1303.1	0.1948	0.29	1332.53	29.44
Junc K751	1311.8	0.0863	0.13	1332.45	20.67
Junc K750	1305.2	0.1026	0.15	1332.45	27.3
Junc K749	1304.9	0.1757	0.26	1332.35	27.46
Junc K748	1323.1	0.226	0.34	1332.46	9.31
Junc K747	1315.4	0.0897	0.13	1332.38	16.97
Junc K746	1317.4	0.1232	0.18	1332.32	14.88
Junc K745	1296.8	0.1919	0.29	1332.29	35.5
Junc K744	1299.9	0.0549	0.08	1332.25	32.37
Junc K743	1294.1	0.1237	0.19	1332.23	38.12
Junc K742	1297	0.0992	0.15	1332.22	35.19
Junc K741	1298	0.0133	0.02	1332.23	34.25
Junc K740	1292.1	0.1367	0.21	1317.82	25.72
Junc K739	1293.8	0.143	0.21	1317.87	24.11
Junc K738	1300.3	0.0664	0.1	1318.05	17.76
Junc K737	1301.6	0.0754	0.11	1318.14	16.5
Junc K736	1299.6	0.2121	0.32	1318.34	18.78
Junc K735	1301.1	0.3379	0.51	1318.02	16.96
Junc K734	1300.6	0.153	0.23	1318.06	17.48
Junc K733	1302.4	0.103	0.15	1318.17	15.74
Junc K732	1301.7	0.1447	0.22	1318.28	16.59
Junc K731	1302.4	0.1071	0.16	1333.52	31.14
Junc K730	1302.4	0.126	0.19	1318.7	16.32
Junc K729	1302.6	0.2005	0.3	1318.29	15.65
Junc K728	1300.5	0.2337	0.35	1318.19	17.73
Junc K727	1291.7	0.2565	0.38	1318.19	26.49
Junc K726	1287.9	0.1117	0.17	1318.54	30.68
Junc K725	1288.1	0.0361	0.05	1318.82	30.73
Junc K724	1287.6	0.0685	0.1	1319.35	31.72
Junc K723	1292.9	0.1564	0.23	1317.95	25.1
Junc K722	1290.4	0.1497	0.22	1317.99	27.6
Junc K721	1292	0.1643	0.25	1317.96	25.95
Junc K720	1294.1	0.2194	0.33	1317.95	23.83

Junc K719	1296.6	0.1923	0.29	1317.96	21.36
Junc K718	1297.5	0.1527	0.23	1317.94	20.49
Junc K717	1296	0.117	0.18	1317.94	21.9
Junc K716	1290.5	0.0947	0.14	1317.93	27.4
Junc K715	1290.2	0.0381	0.06	1317.91	27.75
Junc K714	1290	0.1071	0.16	1317.81	27.77
Junc K713	1286.4	0.1088	0.16	1322.38	35.94
Junc K712	1286	0.224	0.34	1322.37	36.39
Junc K711	1285.7	0.4043	0.61	1322.37	36.66
Junc K710	1287.9	0.232	0.35	1322.39	34.51
Junc K709	1294.2	0.1368	0.21	1331.76	37.52
Junc K708	1293.7	0.2676	0.4	1332.15	38.46
Junc K707	1300.2	0.1754	0.26	1332.22	32.05
Junc K706	1310.3	0.1243	0.19	1332.28	21.97
Junc K705	1317.6	0.098	0.15	1332.43	14.82
Junc K704	1312.4	0.052	0.08	1332.43	20.02
Junc K703	1313.6	0.096	0.14	1332.46	18.89
Junc K702	1324.4	0.2362	0.35	1332.45	8.02
Junc K701	1324.2	0.0928	0.14	1332.46	8.24
Junc K700	1324.2	0.1323	0.2	1332.46	8.23
Junc K699	1324.3	0.175	0.26	1332.49	8.23
Junc K698	1324.2	0.0611	0.09	1332.56	8.4
Junc K697	1324.1	0.0852	0.13	1332.54	8.49
Junc K696	1324.6	0.1077	0.16	1332.53	7.93
Junc K695	1324	0.0953	0.14	1332.53	8.55
Junc K694	1325.2	0.114	0.17	1332.55	7.3
Junc K693	1325.7	0.0993	0.15	1332.53	6.81
Junc K692	1323.6	0.0671	0.1	1332.53	8.96
Junc K691	1325.5	0.0279	0.04	1332.53	7.03
Junc K690	1325.5	0.0612	0.09	1332.53	7.05
Junc K689	1322.9	0.1475	0.22	1332.56	9.65
Junc K688	1324	0.0991	0.15	1332.56	8.55
Junc K687	1324.2	0.1082	0.16	1332.59	8.4
Junc K686	1322.3	0.0917	0.14	1332.59	10.3
Junc K685	1320.1	0.0877	0.13	1332.63	12.54
Junc K684	1325.8	0.1601	0.24	1332.39	6.56
Junc K683	1325.2	0.0708	0.11	1332.37	7.14
Junc K682	1325.1	0.0467	0.07	1332.37	7.28
Junc K681	1325.7	0.0636	0.1	1332.53	6.87
Junc K680	1323.2	0.0733	0.11	1332.29	9.1
Junc K679	1323.9	0.0661	0.1	1332.36	8.44
Junc K678	1324.4	0.0499	0.07	1332.53	8.12
Junc K677	1323.3	0.0994	0.15	1332.53	9.22
Junc K676	1319	0.0927	0.14	1332.31	13.34

Junc K675	1316.9	0.1292	0.19	1332.31	15.43
Junc K674	1324	0.1578	0.24	1332.31	8.29
Junc K673	1323.5	0.1534	0.23	1332.29	8.8
Junc K672	1322.5	0.1647	0.25	1332.26	9.73
Junc K671	1325.4	0.1169	0.18	1332.33	6.95
Junc K670	1325.4	0.0906	0.14	1332.32	6.97
Junc K669	1323.9	0.106	0.16	1332.31	8.37
Junc K668	1323	0.077	0.12	1332.28	9.3
Junc K667	1322.2	0.0643	0.1	1332.25	10.09
Junc K666	1322.2	0.0699	0.1	1332.25	10.07
Junc K665	1322.9	0.102	0.15	1332.28	9.35
Junc K664	1320.5	0.098	0.15	1332.14	11.63
Junc K663	1321	0.0595	0.09	1332.23	11.21
Junc K662	1322.1	0.1605	0.24	1332.25	10.18
Junc K661	1320.7	0.2257	0.34	1332.25	11.6
Junc K660	1322.4	0.139	0.21	1332.29	9.89
Junc K659	1323.1	0.1418	0.21	1332.54	9.46
Junc K658	1322.5	0.1151	0.17	1332.58	10.1
Junc K657	1319.3	0.105	0.16	1332.73	13.47
Junc K656	1322.5	0.0799	0.12	1332.45	9.97
Junc K655	1322.3	0.0309	0.05	1332.45	10.18
Junc K654	1322.1	0.0257	0.04	1332.45	10.34
Junc K653	1322.1	0.0616	0.09	1332.45	10.32
Junc K652	1321.5	0.0678	0.1	1332.45	10.92
Junc K651	1321.8	0.0462	0.07	1332.45	10.68
Junc K650	1322.1	0.0531	0.08	1332.45	10.32
Junc K649	1319.4	0.0824	0.12	1332.49	13.07
Junc K648	1317.1	0.1933	0.29	1332.2	15.12
Junc K647	1319.9	0.1492	0.22	1332.26	12.37
Junc K646	1317.2	0.0548	0.08	1332.21	15.02
Junc K645	1318.2	0.0871	0.13	1332.26	14.1
Junc K644	1319.3	0.1449	0.22	1331.97	12.68
Junc K643	1319.2	0.0504	0.08	1331.97	12.77
Junc K642	1317.4	0.0306	0.05	1331.88	14.5
Junc K641	1319	0.0528	0.08	1331.88	12.84
Junc K640	1320.3	0.0633	0.09	1331.8	11.49
Junc K639	1319.2	0.0375	0.06	1331.8	12.64
Junc K638	1317.7	0.0332	0.05	1331.67	13.98
Junc K637	1317.8	0.0535	0.08	1331.67	13.9
Junc K636	1319.1	0.1143	0.17	1331.74	12.66
Junc K635	1318.9	0.1415	0.21	1331.74	12.83
Junc K634	1318.3	0.0908	0.14	1331.74	13.4
Junc K633	1316.6	0.0997	0.15	1331.59	14.96
Junc K632	1316.9	0.0464	0.07	1331.59	14.72

Junc K631	1317.1	0.1058	0.16	1331.64	14.5
Junc K630	1318.2	0.1705	0.26	1331.64	13.49
Junc K629	1317	0.0568	0.09	1331.64	14.61
Junc K628	1314.6	0.1122	0.17	1331.65	17.05
Junc K627	1315.1	0.1302	0.2	1331.65	16.5
Junc K626	1317	0.0725	0.11	1331.65	14.67
Junc K625	1317.3	0.2426	0.36	1331.74	14.42
Junc K624	1315.7	0.2286	0.34	1332.19	16.47
Junc K623	1285.8	0.4232	0.63	1322.39	36.56
Junc K622	1288.6	0.1959	0.29	1322.73	34.16
Junc K621	1295.5	0.2484	0.37	1322.59	27.13
Junc K620	1290.3	0.1306	0.2	1322.65	32.33
Junc K619	1294.3	0.0698	0.1	1322.6	28.3
Junc K618	1297	0.1155	0.17	1322.56	25.54
Junc K617	1294.3	0.0545	0.08	1322.56	28.22
Junc K616	1286.1	0.2803	0.42	1322.5	36.38
Junc K615	1292.5	0.1203	0.18	1322.52	30.04
Junc K614	1299.2	0.1392	0.21	1322.51	23.32
Junc K613	1296.5	0.2199	0.33	1322.51	25.99
Junc K612	1300.6	0.1631	0.24	1322.56	21.99
Junc K611	1304.9	0.0882	0.13	1331.55	26.64
Junc K610	1306.5	0.188	0.28	1331.55	25.08
Junc K609	1307.9	0.3131	0.47	1331.53	23.6
Junc K608	1312.5	0.1829	0.27	1331.55	19.02
Junc K607	1312.2	0.345	0.52	1331.66	19.45
Junc K606	1310.1	0.1479	0.22	1331.81	21.69
Junc K605	1310.9	0.3309	0.5	1331.9	21.02
Junc K604	1312.1	0.2279	0.34	1332.7	20.6
Junc K603	1310.3	0.218	0.33	1325.15	14.89
Junc K602	1310.2	0.0933	0.14	1325.42	15.27
Junc K601	1293.6	0.2724	0.41	1322.62	29
Junc K600	1303.1	0.3077	0.46	1322.85	19.77
Junc K599	1298.5	0.0726	0.11	1322.86	24.33
Junc K598	1299.2	0.0591	0.09	1322.86	23.67
Junc K597	1299.2	0.2853	0.43	1322.9	23.71
Junc K596	1299.6	0.4254	0.64	1323.79	24.16
Junc K595	1297.9	0.0845	0.13	1324.58	26.71
Junc K594	1304.9	0.199	0.3	1324.61	19.67
Junc K593	1297.9	0.0993	0.15	1324.61	26.74
Junc K592	1296.9	0.6991	1.05	1325.05	28.13
Junc K591	1303	0.229	0.34	1325.17	22.19
Junc K590	1304.2	0.1428	0.21	1326.03	21.85
Junc K589	1299.8	0.2604	0.39	1324.6	24.8
Junc K588	1290.4	0.418	0.63	1323.47	33.05

Junc K587	1296.4	0.112	0.17	1323.55	27.1
Junc K586	1295.1	0.1368	0.21	1323.41	28.29
Junc K585	1295.5	0.044	0.07	1323.41	27.87
Junc K584	1293.1	0.094	0.14	1323.05	29.99
Junc K583	1293.1	0.0857	0.13	1323.05	29.91
Junc K582	1283.8	0.2612	0.39	1322.53	38.69
Junc K581	1284.3	0.0979	0.15	1322.4	38.06
Junc K580	1282.2	0.0929	0.14	1322.38	40.2
Junc K579	1282.4	0.0587	0.09	1322.38	39.95
Junc K578	1283.8	0.119	0.18	1322.38	38.55
Junc K577	1286	0.1037	0.16	1322.38	36.34
Junc K576	1286.5	0.0536	0.08	1322.39	35.85
Junc K575	1284.3	0.1598	0.24	1322.4	38.1
Junc K574	1285.1	0.0625	0.09	1322.41	37.3
Junc K573	1286.6	0.0469	0.07	1322.41	35.84
Junc K572	1287.6	0.0784	0.12	1322.54	34.96
Junc K571	1291.2	0.1085	0.16	1322.82	31.61
Junc K570	1284.3	0.3725	0.56	1322.75	38.46
Junc K569	1283.7	0.1231	0.18	1322.8	39.15
Junc K568	1283.8	0.1463	0.22	1322.8	39.04
Junc K567	1282.6	0.1922	0.29	1322.94	40.29
Junc K566	1281.5	0.1372	0.21	1315.55	34.05
Junc K565	1281.9	0.4025	0.6	1315.49	33.59
Junc K564	1281.6	0.1149	0.17	1315.55	33.91
Junc K563	1281.3	0.1382	0.21	1315.67	34.38
Junc K562	1281	0.3363	0.5	1315.77	34.75
Junc K561	1281.2	0.1434	0.22	1315.82	34.62
Junc K560	1281.4	0.3324	0.5	1315.82	34.39
Junc K559	1281.9	0.253	0.38	1315.64	33.75
Junc K558	1281.9	0.2964	0.44	1315.64	33.72
Junc K557	1283	0.3136	0.47	1315.62	32.59
Junc K556	1285.7	0.0321	0.05	1315.63	29.95
Junc K555	1285.6	0.0852	0.13	1315.64	30
Junc K554	1287.2	0.1794	0.27	1315.69	28.48
Junc K553	1284.3	0.28421	0.43	1315.84	31.55
Junc K552	1280.7	0.20433	0.31	1316.14	35.4
Junc K551	1280.9	0.2337	0.35	1316.46	35.56
Junc K550	1280.5	0.0523	0.08	1316.66	36.16
Junc K549	1280.6	0.2733	0.41	1316.6	36.01
Junc K548	1280.5	0.0632	0.09	1316.67	36.17
Junc K547	1279.9	0.2559	0.38	1316.55	36.69
Junc K546	1279.4	0.1328	0.2	1316.56	37.2
Junc K545	1282	0.1915	0.29	1316.57	34.6
Junc K544	1280.8	0.3647	0.55	1316.53	35.76

Junc K543	1280.7	0.2693	0.4	1316.57	35.88
Junc K542	1281.4	0.2445	0.37	1316.59	35.21
Junc K541	1281.1	0.2249	0.34	1316.78	35.63
Junc K540	1281.1	0.2683	0.4	1316.61	35.49
Junc K539	1281.3	0.4533	0.68	1316.71	35.36
Junc K538	1282.9	0.1055	0.16	1316.79	33.9
Junc K537	1288.9	0.5636	0.85	1322.27	33.4
Junc K536	1288.5	0.095	0.14	1322.29	33.75
Junc K535	1289	0.1662	0.25	1322.29	33.32
Junc K534	1289.8	0.159	0.24	1322.52	32.7
Junc K533	1289.7	0.0978	0.15	1322.52	32.84
Junc K532	1289.4	0.1669	0.25	1322.73	33.31
Junc K531	1290.2	0.1832	0.27	1322.73	32.55
Junc K530	1295	0.1112	0.17	1323.04	28.09
Junc K529	1287	0.211	0.32	1322.42	35.47
Junc K528	1287.1	0.1849	0.28	1322.42	35.36
Junc K527	1287.6	0.1051	0.16	1322.43	34.8
Junc K526	1288.5	0.0798	0.12	1322.46	34.01
Junc K525	1287.7	0.0644	0.1	1322.43	34.75
Junc K524	1286	0.4963	0.74	1322.35	36.31
Junc K523	1287	0.3146	0.47	1322.34	35.29
Junc K522	1286.8	0.1615	0.24	1322.37	35.55
Junc K521	1289	0.1624	0.24	1321.82	32.79
Junc K520	1288.7	0.7773	1.17	1321.74	33.05
Junc K519	1288.9	0.0909	0.14	1321.83	32.98
Junc K518	1287.7	0.3652	0.55	1321.96	34.24
Junc K517	1290.3	0.203	0.3	1322.06	31.74
Junc K516	1290	0.3942	0.59	1322.88	32.93
Junc K515	1290.5	0.0925	0.14	1320.56	30.09
Junc K514	1288.9	0.2487	0.37	1322.89	33.97
Junc K513	1288.5	0.2532	0.38	1315.73	27.23
Junc K512	1285.8	0.1435	0.22	1315.63	29.81
Junc K511	1282.4	0.0664	0.1	1315.52	33.15
Junc K510	1283.1	0.289	0.43	1315.52	32.4
Junc K509	1283.1	0.1117	0.17	1315.58	32.44
Junc K508	1282.4	0.426	0.64	1315.46	33.04
Junc K507	1286	0.3016	0.45	1315.5	29.55
Junc K506	1283	0.1613	0.24	1315.52	32.49
Junc K505	1287	0.1333	0.2	1315.68	28.72
Junc K504	1286.2	0.0894	0.13	1315.68	29.44
Junc K503	1288.1	0.2052	0.31	1315.84	27.71
Junc K502	1287.5	0.144	0.22	1315.82	28.36
Junc K501	1284.9	0.0991	0.15	1316.59	31.67
Junc K500	1289.8	0.1915	0.29	1316.86	27.04

Junc K499	1289.9	0.2223	0.33	1316.77	26.91
Junc K498	1289.7	0.3695	0.55	1316.78	27.11
Junc K497	1286.5	0.1749	0.26	1316.77	30.24
Junc K496	1285.3	0.0959	0.14	1316.77	31.44
Junc K495	1284	0.0943	0.14	1316.77	32.73
Junc K494	1285.1	0.0678	0.1	1316.78	31.7
Junc K493	1283.7	0.1049	0.16	1316.78	33.1
Junc K492	1283.3	0.0797	0.12	1316.9	33.61
Junc K491	1284.5	0.1081	0.16	1315.96	31.45
Junc K490	1284.4	0.0844	0.13	1315.97	31.62
Junc K489	1285.9	0.1048	0.16	1315.52	29.6
Junc K488	1285.1	0.1652	0.25	1315.52	30.44
Junc K487	1287.3	0.4986	0.75	1314.04	26.72
Junc K486	1286.1	0.1746	0.26	1314.19	28.04
Junc K485	1287.4	0.583	0.87	1314.2	26.83
Junc K484	1285.8	0.3241	0.49	1314.99	29.2
Junc K483	1286.3	0.4525	0.68	1315.01	28.75
Junc K482	1285.4	0.1807	0.27	1315.06	29.63
Junc K481	1284.1	0.1851	0.28	1315.43	31.37
Junc K480	1286.7	0.3479	0.52	1315.71	28.99
Junc K479	1283.7	0.2506	0.38	1315.75	32.07
Junc K478	1285.3	0.4892	0.73	1315.92	30.6
Junc K477	1283.2	0.3286	0.49	1316.02	32.8
Junc K476	1287.5	0.4064	0.61	1316.06	28.53
Junc K475	1288	0.2592	0.39	1316.32	28.31
Junc K474	1289	0.3039	0.46	1316.68	27.65
Junc K473	1289.4	0.1801	0.27	1317.82	28.44
Junc K472	1287.9	0.3954	0.59	1315.58	27.68
Junc K471	1289.7	0.1374	0.21	1315.64	25.97
Junc K470	1290	0.3494	0.52	1315.49	25.52
Junc K469	1290.7	0.2324	0.35	1314.94	24.24
Junc K468	1290.3	0.2994	0.45	1314.96	24.69
Junc K467	1290	0.5989	0.9	1316.71	26.74
Junc K466	1289.7	0.3298	0.49	1316.15	26.43
Junc K465	1288.7	0.3446	0.52	1316.2	27.46
Junc K464	1289.8	0.1578	0.24	1316.18	26.38
Junc K463	1288.9	0.23	0.34	1316.19	27.31
Junc K462	1288.6	0.1295	0.19	1316.22	27.57
Junc K461	1289.9	0.2284	0.34	1316.33	26.43
Junc K460	1288.4	0.3319	0.5	1316.22	27.85
Junc K459	1289.6	0.3385	0.51	1316.33	26.76
Junc K458	1290.2	0.3065	0.46	1316.64	26.42
Junc K457	1290.6	0.2571	0.39	1316.61	26.01
Junc K456	1290.7	0.3281	0.49	1316.93	26.26

Junc K455	1291.3	0.2445	0.37	1316.85	25.54
Junc K454	1291.7	0.3136	0.47	1316.14	24.44
Junc K453	1291.5	0.2564	0.38	1316.17	24.63
Junc K452	1290.5	0.3227	0.48	1315.85	25.31
Junc K451	1291.8	0.4138	0.62	1315.9	24.14
Junc K450	1291.2	0.3127	0.47	1316.12	24.97
Junc K449	1291	0.1799	0.27	1316.52	25.51
Junc K448	1290.6	0	0	1316.32	25.7
Junc K447	1291.1	0.1075	0.16	1315.48	24.37
Junc K446	1290.8	0.18	0.27	1315.48	24.63
Junc K445	1291	0.5064	0.76	1320.45	29.49
Junc K444	1291.1	0.2309	0.35	1320.55	29.44
Junc K443	1291.2	0.2625	0.39	1314.63	23.43
Junc K442	1291.5	0.2573	0.39	1314.66	23.18
Junc K441	1290.9	0.5176	0.78	1314.4	23.5
Junc K440	1291.8	0.1735	0.26	1314.54	22.74
Junc K439	1304.1	0.3146	0.47	1320.69	16.6
Junc K438	1302.4	0.9125	1.37	1320.54	18.12
Junc K437	1304.2	0.4369	0.66	1320.66	16.49
Junc K436	1303.8	0.5826	0.87	1322.07	18.32
Junc K435	1305	0.7642	1.15	1322.98	17.98
Junc K434	1304.5	0.1758	0.26	1323.22	18.71
Junc K433	1292	0.1468	0.22	1320.81	28.79
Junc K432	1291.6	0.2533	0.38	1320.81	29.24
Junc K431	1291.9	0.1601	0.24	1320.83	28.89
Junc K430	1296.1	0.2346	0.35	1320.89	24.8
Junc K429	1292.1	0.2037	0.31	1320.92	28.8
Junc K428	1296.5	0.1676	0.25	1321.26	24.77
Junc K427	1303.3	0.1754	0.26	1322.22	18.91
Junc K426	1303.7	0.2015	0.3	1322.23	18.57
Junc K425	1304.8	0.6536	0.98	1323.12	18.36
Junc K424	1304.7	0.8702	1.31	1323.87	19.2
Junc K423	1290.1	0.1471	0.22	1314.89	24.83
Junc K422	1288	0.2237	0.34	1314.17	26.17
Junc K421	1288.9	0.1802	0.27	1314.24	25.32
Junc K420	1289.4	0.1736	0.26	1314.17	24.8
Junc K419	1289.2	0.1048	0.16	1314.18	24.99
Junc K418	1289.1	0.2052	0.31	1314.25	25.11
Junc K417	1290.5	0.1898	0.28	1314.48	23.94
Junc K416	1290.7	0.3453	0.52	1314.24	23.55
Junc K415	1291.8	0.2385	0.36	1314.54	22.7
Junc K414	1289.8	0.6153	0.92	1313.85	24.06
Junc K413	1290.4	0.5914	0.89	1314.01	23.61
Junc K412	1292.1	0.2938	0.44	1314.08	22.02

Junc K411	1293	0.2351	0.35	1321.09	28.1
Junc K410	1292.2	0.3802	0.57	1321.11	28.9
Junc K409	1296.4	0.1464	0.22	1321.23	24.85
Junc K408	1302	0.4645	0.7	1321.23	19.24
Junc K407	1302.3	0.0894	0.13	1321.26	18.94
Junc K406	1302.5	0.3625	0.54	1321.26	18.81
Junc K405	1302.9	0.295	0.44	1321.3	18.4
Junc K404	1302.9	0.0449	0.07	1321.34	18.45
Junc K403	1304.2	0.0896	0.13	1321.44	17.2
Junc K402	1304.1	0.7669	1.15	1321.37	17.24
Junc K401	1301.6	0.046	0.07	1321.37	19.82
Junc K400	1301.9	0.0392	0.06	1321.36	19.43
Junc K399	1294.9	0.0852	0.13	1321.35	26.49
Junc K398	1296.8	0.0688	0.1	1321.36	24.54
Junc K397	1296.6	0.0233	0.03	1321.36	24.76
Junc K396	1296.6	0.1883	0.28	1321.36	24.81
Junc K395	1296.1	0.0622	0.09	1321.37	25.26
Junc K394	1294.2	0.2114	0.32	1321.48	27.26
Junc K393	1292.2	0.5836	0.88	1321.49	29.29
Junc K392	1303.5	0.3267	0.49	1321.48	18.01
Junc K391	1300.2	0.0425	0.06	1321.46	21.24
Junc K390	1295.1	0.1112	0.17	1321.45	26.38
Junc K389	1295.7	0.0284	0.04	1321.46	25.75
Junc K388	1294.4	0.0377	0.06	1321.46	27.1
Junc K387	1292.9	0.1943	0.29	1321.62	28.68
Junc K386	1292.3	0.2046	0.31	1321.63	29.35
Junc K385	1292.7	0.5034	0.76	1322.85	30.15
Junc K384	1292.6	0.2053	0.31	1322.3	29.71
Junc K383	1292.5	0.0831	0.12	1322.27	29.78
Junc K382	1293.4	0.2258	0.34	1322.34	28.92
Junc K381	1293.2	0.1307	0.2	1322.27	29.08
Junc K380	1291.7	0.1743	0.26	1322.14	30.39
Junc K379	1293.2	0.1044	0.16	1322.16	28.94
Junc K378	1293.2	0.0885	0.13	1322.13	28.93
Junc K377	1292.8	0.5686	0.85	1310.85	18.02
Junc K376	1293.4	0.2534	0.38	1311	17.6
Junc K375	1293.3	0.3454	0.52	1310.82	17.53
Junc K374	1293.6	0.2107	0.32	1310.88	17.23
Junc K373	1309.3	0.0487	0.07	1323.05	13.77
Junc K372	1308	0.8203	1.23	1323.04	15.02
Junc K371	1308.4	0.9881	1.48	1323.34	14.93
Junc K370	1306.1	0.5677	0.85	1322.96	16.83
Junc K369	1299.2	0.204	0.31	1322.72	23.55
Junc K368	1293.8	0.1556	0.23	1322.73	28.96

Junc K367	1300.3	0.0405	0.06	1322.72	22.45
Junc K366	1293.5	0.0465	0.07	1322.72	29.18
Junc K365	1305.1	0.126	0.19	1322.84	17.73
Junc K364	1302.2	0.2516	0.38	1322.84	20.63
Junc K363	1304	0.1881	0.28	1322.71	18.67
Junc K362	1294.6	0.2044	0.31	1322.71	28.12
Junc K361	1293.3	0.0708	0.11	1322.71	29.37
Junc K360	1293.4	0.139	0.21	1322.7	29.34
Junc K359	1292.8	0.0815	0.12	1322.7	29.86
Junc K358	1293.1	0.0308	0.05	1322.69	29.54
Junc K357	1293.4	0.2038	0.31	1322.68	29.26
Junc K356	1293.1	0.032	0.05	1322.69	29.58
Junc K355	1292.6	0.0744	0.11	1322.7	30.08
Junc K354	1292.9	0.1562	0.23	1322.72	29.87
Junc K353	1292.3	0.081	0.12	1322.73	30.39
Junc K352	1292.1	0.1579	0.24	1322.61	30.5
Junc K351	1293.4	0.0835	0.13	1322.78	29.39
Junc K350	1293.4	0.0616	0.09	1322.82	29.43
Junc K349	1294.3	0.5313	0.8	1310.76	16.5
Junc K348	1294.3	0.2086	0.31	1310.88	16.58
Junc K347	1294.9	0.1356	0.2	1323.08	28.15
Junc K346	1293.4	0.193	0.29	1323.07	29.64
Junc K345	1294.1	0.0897	0.13	1323.17	29.06
Junc K344	1295.3	0.0444	0.07	1323.17	27.83
Junc K343	1294.3	0.3027	0.45	1322.91	28.61
Junc K342	1294.4	0.0898	0.13	1322.92	28.48
Junc K341	1294.3	0.0654	0.1	1322.92	28.63
Junc K340	1294.3	0.1082	0.16	1322.92	28.62
Junc K339	1296.2	0.262	0.39	1323.03	26.85
Junc K338	1295.2	0.0996	0.15	1322.69	27.49
Junc K337	1295.7	0.2039	0.31	1322.69	27.03
Junc K336	1294.7	0.0971	0.15	1322.69	27.98
Junc K335	1294.1	0.1792	0.27	1322.8	28.72
Junc K334	1293.9	0.2217	0.33	1322.8	28.91
Junc K333	1295.6	0.123	0.18	1323.31	27.7
Junc K332	1295.4	0.2243	0.34	1323.03	27.65
Junc K331	1295.5	0.213	0.32	1311.25	15.75
Junc K330	1296.1	0.0697	0.1	1311.26	15.16
Junc K329	1296	0.0413	0.06	1311.4	15.38
Junc K328	1295.6	0.5444	0.82	1311.73	16.15
Junc K327	1295.6	0.123	0.18	1311.77	16.14
Junc K326	1286.2	0.5748	0.86	1315.79	29.54
Junc K325	1287.4	0.1756	0.26	1315.95	28.54
Junc K324	1286.7	0.2757	0.41	1315.95	29.24

Junc K323	1283.6	0.0685	0.1	1323.16	39.51
Junc K322	1285.2	0.1371	0.21	1321.45	36.25
Junc 102	1283.1	0	0	1316.97	33.89
Junc K320	1285.3	0.1306	0.2	1316.31	31.04
Junc K319	1286.2	0.1324	0.2	1316.31	30.11
Junc K318	1284.1	0.2557	0.38	1320.03	35.95
Junc K317	1286.6	0.112	0.17	1320.06	33.47
Junc K316	1289.4	0.2148	0.32	1315.65	26.22
Junc K315	1289.4	0.0505	0.08	1315.66	26.28
Junc K314	1288.6	0.0701	0.11	1315.66	27.06
Junc K313	1289.2	0.1835	0.28	1315.66	26.47
Junc K312	1286.5	0.2498	0.37	1315.82	29.31
Junc K311	1282	0.1373	0.21	1318.67	36.63
Junc K310	1283	0.3717	0.56	1318.62	35.58
Junc K309	1282.6	0.3599	0.54	1318.68	36.11
Junc K308	1286.6	0.3735	0.56	1318.86	32.22
Junc K307	1289.1	0.5863	0.88	1311.63	22.57
Junc K306	1286.8	0.2581	0.39	1315.21	28.37
Junc K305	1286.8	0.1172	0.18	1318.76	31.91
Junc K304	1285.9	0.1292	0.19	1318.72	32.79
Junc K303	1285.5	0.158	0.24	1318.72	33.18
Junc K302	1285.4	0.0706	0.11	1318.72	33.29
Junc K301	1282.5	0.2513	0.38	1316.05	33.54
Junc K300	1282.2	0.2365	0.35	1316.04	33.85
Junc K299	1282.5	0.0216	0.03	1316.05	33.6
Junc K298	1282.7	0.1951	0.29	1316.06	33.36
Junc K297	1282.5	0.0659	0.1	1316.07	33.58
Junc K296	1283	0.4292	0.64	1316.2	33.21
Junc K295	1283.5	0.2147	0.32	1316.25	32.75
Junc K294	1284.2	0.1709	0.26	1316.86	32.67
Junc K293	1284.5	0.1298	0.19	1316.86	32.34
Junc K292	1285.4	0.166	0.25	1317.72	32.36
Junc K291	1285.5	0.1266	0.19	1317.73	32.24
Junc K290	1287.3	0.4892	0.73	1318.76	31.49
Junc K289	1283.7	0.2799	0.42	1316.94	33.22
Junc K288	1283.7	0.147	0.22	1316.95	33.26
Junc K287	1283.6	0.1498	0.22	1316.95	33.36
Junc K286	1284.3	0.2075	0.31	1317.06	32.71
Junc K285	1284.6	0.1596	0.24	1317.07	32.52
Junc K284	1284.5	0.2791	0.42	1317.28	32.74
Junc K283	1286	0.1348	0.2	1321.94	35.98
Junc K282	1284.8	0.1494	0.22	1321.93	37.09
Junc K281	1286	0.1313	0.2	1321.94	35.98
Junc K280	1287	0.1762	0.26	1321.95	34.93

Junc K279	1288.4	0.051	0.08	1322.03	33.6
Junc K278	1290.4	0.7291	1.09	1312.8	22.44
Junc K277	1288.6	0.1892	0.28	1321.24	32.64
Junc K276	1289.9	0.1384	0.21	1312.95	23.05
Junc K275	1289.9	0.1788	0.27	1312.95	23.09
Junc K274	1289.4	0.1724	0.26	1312.95	23.59
Junc K273	1289.2	0.1753	0.26	1318.94	29.75
Junc K272	1286.7	0.2894	0.43	1317.74	31.08
Junc K271	1283.6	0.4637	0.7	1317.3	33.67
Junc K270	1285.6	0.0962	0.14	1317.57	32
Junc K269	1284.8	0.2073	0.31	1317.57	32.78
Junc K268	1286.2	0.1331	0.2	1317.57	31.39
Junc K267	1285.2	0.1237	0.19	1317.58	32.41
Junc K266	1285.6	0.0356	0.05	1317.63	32.07
Junc K265	1285.3	0.1502	0.23	1317.63	32.35
Junc K264	1285.9	0.4343	0.65	1317.56	31.68
Junc K263	1284.5	0.3007	0.45	1317.7	33.23
Junc K262	1285.9	0.0253	0.04	1317.97	32.03
Junc K261	1285.6	0.0745	0.11	1317.97	32.34
Junc K260	1286.9	0.0891	0.13	1318.13	31.27
Junc K259	1286.6	0.0484	0.07	1318.13	31.53
Junc K258	1290	0.067	0.1	1318.92	28.91
Junc K257	1286.8	0.1195	0.18	1319.35	32.51
Junc K256	1289.8	0.1244	0.19	1319.35	29.55
Junc K255	1289.6	0.0597	0.09	1312.97	23.39
Junc K254	1291.8	0.3564	0.53	1312.9	21.11
Junc K253	1292	0.1897	0.28	1312.92	20.94
Junc K252	1290	0.2264	0.34	1313.21	23.2
Junc K251	1291.6	0.1378	0.21	1312.99	21.43
Junc K250	1292.5	0.1064	0.16	1312.99	20.53
Junc K249	1294.4	0.2354	0.35	1312.93	18.57
Junc K248	1289.4	0.0112	0.02	1315.04	25.61
Junc K247	1289.7	0.0276	0.04	1322.04	32.34
Junc K246	1289.9	0.1703	0.26	1321.33	31.47
Junc K245	1287.4	0.2088	0.31	1321.16	33.78
Junc K244	1287	0.0804	0.12	1321.17	34.2
Junc K243	1287.2	0.0836	0.13	1321.17	33.98
Junc K242	1287.1	0.0497	0.07	1321.18	34.12
Junc K241	1287.2	0.0309	0.05	1321.18	33.95
Junc K240	1287.5	0.1307	0.2	1321.2	33.72
Junc K239	1281.5	0.3568	0.54	1320.98	39.47
Junc K238	1286.5	0.4083	0.61	1321.04	34.55
Junc K237	1286.9	0.2453	0.37	1321.2	34.26
Junc K236	1289.7	0.3808	0.57	1321.8	32.14

Junc K235	1294.4	0.1706	0.26	1312.91	18.53
Junc K234	1292.7	0.1559	0.23	1317	24.31
Junc K233	1293.2	0.0579	0.09	1317.01	23.82
Junc K232	1292.8	0.191	0.29	1317.01	24.17
Junc K231	1294.3	0.0607	0.09	1317.31	22.99
Junc K230	1291	0.243	0.36	1317.07	26.1
Junc K229	1293.7	0.0427	0.06	1317.31	23.57
Junc K228	1293.6	0.1106	0.17	1317.23	23.6
Junc K227	1293.4	0.0683	0.1	1317.23	23.86
Junc K226	1292.8	0.1314	0.2	1317.12	24.29
Junc K225	1292.6	0.0715	0.11	1317.13	24.49
Junc K224	1292.1	0.1366	0.2	1317.1	24.99
Junc K223	1292.3	0.0318	0.05	1317.11	24.83
Junc K222	1292.2	0.1178	0.18	1317.09	24.92
Junc K221	1292	0.0289	0.04	1317.1	25.14
Junc K220	1291.8	0.0337	0.05	1317.1	25.33
Junc K219	1291.7	0.198	0.3	1317.1	25.41
Junc K218	1291.1	0.2402	0.36	1317.36	26.29
Junc K217	1290.2	0.1358	0.2	1317.35	27.14
Junc K216	1289.8	0.0303	0.05	1317.35	27.59
Junc K215	1290.2	0.0993	0.15	1317.35	27.2
Junc K214	1290	0.0802	0.12	1317.35	27.33
Junc K213	1288.4	0.1294	0.19	1317.36	28.95
Junc K212	1288.9	0.2496	0.37	1317.37	28.51
Junc K211	1294.7	0.1342	0.2	1317.05	22.39
Junc K210	1293.4	0.0706	0.11	1317.02	23.59
Junc K209	1296.2	0.0807	0.12	1317.03	20.84
Junc K208	1295.7	0.037	0.06	1317.03	21.37
Junc K207	1295.4	0.0306	0.05	1317.02	21.66
Junc K206	1294	0.0585	0.09	1317.02	23.06
Junc K205	1295.1	0.0919	0.14	1317.02	21.91
Junc K204	1294.1	0.0575	0.09	1317.02	22.87
Junc K203	1295	0.1078	0.16	1317.02	22.01
Junc K202	1293.9	0.0785	0.12	1317.02	23.12
Junc K201	1294.6	0.0441	0.07	1317.02	22.39
Junc K200	1294.2	0.1788	0.27	1317.04	22.83
Junc K199	1295	0.1122	0.17	1317.04	22.05
Junc K198	1295.8	0.2439	0.37	1317.2	21.45
Junc K197	1296	0.0999	0.15	1317.05	21.04
Junc K196	1296	0.1059	0.16	1323.14	27.13
Junc K195	1296.1	0.2679	0.4	1322.8	26.74
Junc K194	1296.1	0.1445	0.22	1322.83	26.72
Junc K193	1295.3	0.0976	0.15	1317.06	21.79
Junc K192	1296.1	0.1143	0.17	1317.06	20.99

Junc K191	1296.3	0.1647	0.25	1322.79	26.5
Junc K190	1296.1	0.0728	0.11	1322.8	26.69
Junc K189	1296.4	0.1357	0.2	1317.09	20.7
Junc K188	1296.4	0.0628	0.09	1317.1	20.71
Junc K187	1297.9	0.1018	0.15	1317.22	19.37
Junc K186	1297.3	0.0841	0.13	1322.71	25.38
Junc K185	1297.2	0.0407	0.06	1322.71	25.5
Junc K184	1297	0.0867	0.13	1322.68	25.69
Junc K183	1296.8	0.2165	0.32	1322.68	25.93
Junc K182	1297	0.0511	0.08	1322.69	25.71
Junc K181	1297.3	0.0172	0.03	1322.71	25.4
Junc K180	1297.6	0.0466	0.07	1322.72	25.13
Junc K179	1297.6	0.1418	0.21	1322.72	25.09
Junc K178	1297.3	0.1788	0.27	1322.79	25.47
Junc K177	1297	0.112	0.17	1317.31	20.35
Junc K176	1297.3	0.0624	0.09	1317.36	20.1
Junc K175	1295.7	0.0243	0.04	1316.96	21.26
Junc K174	1295.7	0.1376	0.21	1323.15	27.45
Junc K173	1295.5	0.1126	0.17	1316.96	21.44
Junc K172	1295.5	0.0597	0.09	1316.96	21.46
Junc K171	1293.7	0.0616	0.09	1317.35	23.62
Junc K170	1292.2	0.1671	0.25	1317.26	25.1
Junc K169	1293	0.202	0.3	1317.28	24.26
Junc K168	1289.5	0.2122	0.32	1317.36	27.88
Junc K167	1288.6	0.0367	0.06	1317.29	28.72
Junc K166	1289.7	0.1193	0.18	1317.23	27.51
Junc K165	1291	0.2091	0.31	1317.25	26.25
Junc K164	1289.7	0.199	0.3	1317.24	27.49
Junc K163	1289.7	0.1247	0.19	1317.25	27.59
Junc K162	1288.4	0.0642	0.1	1317.28	28.91
Junc K161	1288.7	0.0589	0.09	1317.28	28.59
Junc K160	1286.9	0.2595	0.39	1317.22	30.33
Junc K159	1287.1	0.174	0.26	1317.26	30.11
Junc K158	1286.9	0.2204	0.33	1317.27	30.42
Junc K157	1288.1	0.1962	0.29	1317.42	29.32
Junc K156	1287.9	0.0964	0.14	1317.33	29.45
Junc K155	1288.1	0.0858	0.13	1317.33	29.22
Junc K154	1287.5	0.1313	0.2	1317.33	29.85
Junc K153	1288.7	0.1548	0.23	1317.33	28.6
Junc K152	1287.6	0.1656	0.25	1317.33	29.76
Junc K151	1289.3	0.2028	0.3	1317.33	27.99
Junc K150	1288.6	0.1089	0.16	1317.34	28.7
Junc K149	1288.4	0.1364	0.2	1317.35	28.95
Junc K148	1287.8	0.1673	0.25	1317.42	29.6

Junc K147	1288.6	0.272	0.41	1317.47	28.91
Junc K146	1289.3	0.2798	0.42	1317.47	28.21
Junc K145	1287.6	0.2373	0.36	1317.51	29.95
Junc K144	1287.8	0.1162	0.17	1319.87	32.11
Junc K143	1288.4	0.3639	0.55	1318.87	30.49
Junc K142	1287	0.2351	0.35	1318.91	31.9
Junc K141	1287.5	0.0653	0.1	1319.87	32.4
Junc K140	1287.9	0.1668	0.25	1320.85	32.98
Junc K139	1289.3	0.4315	0.65	1318.51	29.19
Junc K138	1289.6	0.2817	0.42	1318.59	29.01
Junc K137	1292.1	0.4357	0.65	1318.07	25.92
Junc K136	1294	0.1893	0.28	1317.09	23.12
Junc K135	1291.9	0.3609	0.54	1317.12	25.19
Junc K134	1292.1	0.1841	0.28	1317.06	24.94
Junc K133	1292.5	0.06	0.09	1317.07	24.53
Junc K132	1293.2	0.1099	0.16	1317.06	23.86
Junc K131	1294.1	0.1413	0.21	1317.02	22.95
Junc K130	1293.1	0.0527	0.08	1317.02	23.94
Junc K129	1293.1	0.1713	0.26	1317.01	23.9
Junc K128	1292.5	0.0535	0.08	1317.02	24.56
Junc K127	1292.4	0.0508	0.08	1317.02	24.59
Junc K126	1292.7	0.0538	0.08	1317.02	24.33
Junc K125	1292	0.1002	0.15	1317.01	25.04
Junc K124	1290.4	0.0891	0.13	1317	26.57
Junc K123	1290.6	0.1136	0.17	1317	26.41
Junc K122	1290.9	0.0286	0.04	1317	26.07
Junc K121	1291.2	0.0349	0.05	1317.01	25.83
Junc K120	1291.9	0.0784	0.12	1317.01	25.09
Junc K119	1292.2	0.0331	0.05	1317.01	24.84
Junc K118	1292	0.0126	0.02	1317.01	25.02
Junc K117	1292.2	0.0354	0.05	1317.01	24.84
Junc K116	1292.3	0.042	0.06	1317.02	24.74
Junc K115	1292.3	0.0712	0.11	1317.02	24.73
Junc K114	1294.1	0.1343	0.2	1317.22	23.14
Junc K113	1294.5	0.0742	0.11	1317.34	22.88
Junc K112	1294.7	0.1137	0.17	1317.19	22.49
Junc K111	1295.5	0.0433	0.06	1317.19	21.68
Junc K110	1295.9	0.0674	0.1	1317.19	21.3
Junc K109	1295.3	0.1803	0.27	1317.17	21.85
Junc K108	1295	0.1265	0.19	1317.02	22.03
Junc K107	1294.8	0.1044	0.16	1317.02	22.17
Junc K106	1295	0.0372	0.06	1317.09	22.06
Junc K105	1294.9	0.084	0.13	1317.11	22.26
Junc K104	1295	0.115	0.17	1317.06	22.01

Junc K103	1294.8	0.0298	0.04	1317.12	22.27
Junc K102	1294.7	0.0472	0.07	1317.23	22.51
Junc K101	1293.5	0.1248	0.19	1317.23	23.7
Junc K100	1294.4	0.1131	0.17	1317.23	22.81
Junc K099	1294.2	0.1127	0.17	1317.24	23.05
Junc K098	1293.2	0.0797	0.12	1317.63	24.39
Junc K097	1292.5	0.205	0.31	1318.22	25.67
Junc K096	1294.1	0.2489	0.37	1317.63	23.54
Junc K095	1294.1	0.0776	0.12	1317.63	23.48
Junc K094	1293	0.0835	0.13	1317.71	24.71
Junc K093	1310.2	0.462	0.69	1323.07	12.92
Junc K092	1308.9	0.4706	0.71	1323.06	14.16
Junc K091	1310.1	0.2997	0.45	1323.12	13.05
Junc K090	1308.3	0.4969	0.75	1323.34	15.03
Junc K089	1296.2	0.121	0.18	1323.31	27.13
Junc K088	1295.7	0.1987	0.3	1323.31	27.61
Junc K087	1295.8	0.0394	0.06	1323.31	27.56
Junc K086	1295.6	0.09	0.14	1323.33	27.73
Junc K085	1294.7	0.074	0.11	1323.33	28.6
Junc K084	1295	0.0886	0.13	1323.33	28.32
Junc K083	1294.8	0.0578	0.09	1323.33	28.51
Junc K082	1295.2	0.1231	0.18	1323.34	28.15
Junc K081	1295.4	0.1751	0.26	1323.4	27.99
Junc K080	1295.7	0.1516	0.23	1323.4	27.69
Junc K079	1296.4	0.2043	0.31	1323.39	26.97
Junc K078	1296.7	0.0995	0.15	1323.4	26.66
Junc K077	1297.1	0.1597	0.24	1323.41	26.31
Junc K076	1297.6	0.0457	0.07	1322.73	25.15
Junc K075	1297	0.0684	0.1	1323.41	26.4
Junc K074	1297.1	0.1696	0.25	1323.48	26.35
Junc K073	1297.8	0.3134	0.47	1322.62	24.86
Junc K072	1297.6	0.2202	0.33	1322.68	25.12
Junc K071	1297	0.1654	0.25	1322.4	25.42
Junc K070	1296.2	0.1626	0.24	1322.4	26.25
Junc K069	1294.3	0.1937	0.29	1316.74	22.4
Junc K068	1293.9	0.1018	0.15	1316.26	22.33
Junc K067	1295.1	0.1902	0.29	1316.27	21.13
Junc K066	1297.8	0.2799	0.42	1316.14	18.33
Junc K065	1292.7	0.1526	0.23	1316.1	23.43
Junc K064	1294.9	0.1761	0.26	1316.11	21.25
Junc K063	1292	0.1056	0.16	1316.03	24.01
Junc K062	1293.6	0.1176	0.18	1316.04	22.41
Junc K061	1295.6	0.3128	0.47	1316.02	20.39
Junc K060	1292.8	0.6648	1	1322.64	29.79

Junc K059	1293.2	0.0845	0.13	1316.06	22.9
Junc K058	1292.1	0.1287	0.19	1316.23	24.13
Junc K057	1291.5	0.0775	0.12	1316.16	24.69
Junc K056	1295.6	0.3293	0.49	1316.51	20.88
Junc K055	1291.4	0.1052	0.16	1316.16	24.79
Junc K054	1291.7	0.213	0.32	1322.44	30.71
Junc K053	1293.4	0.2531	0.38	1322.44	29.04
Junc K052	1292.5	0.1192	0.18	1322.42	29.92
Junc K051	1292.6	0.049	0.07	1322.39	29.76
Junc K050	1292.8	0.105	0.16	1322.38	29.62
Junc K049	1293.6	0.0738	0.11	1322.39	28.81
Junc K048	1293.7	0.0496	0.07	1322.37	28.66
Junc K047	1293.6	0.1458	0.22	1322.36	28.8
Junc K046	1294.1	0.0412	0.06	1322.36	28.26
Junc K045	1294.5	0.0626	0.09	1322.36	27.88
Junc K044	1294.8	0.0143	0.02	1322.36	27.58
Junc K043	1295.5	0.0222	0.03	1322.36	26.9
Junc K042	1294.1	0.4478	0.67	1322.34	28.28
Junc K041	1295.7	0.1375	0.21	1322.32	26.66
Junc K040	1295.8	0.0947	0.14	1322.33	26.5
Junc K039	1297.6	0.0357	0.05	1322.32	24.75
Junc K038	1299	0.1232	0.18	1322.32	23.27
Junc K037	1297.9	0.0317	0.05	1322.32	24.45
Junc K036	1296.8	0.0527	0.08	1322.33	25.55
Junc K035	1297	0.0375	0.06	1322.33	25.38
Junc K034	1296.6	0.1444	0.22	1322.33	25.7
Junc K033	1296.4	0.0877	0.13	1322.33	25.9
Junc K032	1296.3	0.0749	0.11	1322.36	26.08
Junc K031	1298.6	0.1669	0.25	1323.72	25.15
Junc K030	1297.7	0.2774	0.42	1323.77	26.11
Junc K029	1299.4	0.0379	0.06	1323.79	24.42
Junc K028	1299.8	0.0544	0.08	1321.75	21.96
Junc K027	1300.1	0.0311	0.05	1323.91	23.76
Junc K026	1297.4	0.3591	0.54	1319.27	21.86
Junc K025	1313.2	0.6494	0.97	1324.93	11.7
Junc K024	1312	0.2175	0.33	1323.72	11.74
Junc K023	1307.2	0.1727	0.26	1323.71	16.5
Junc K022	1312.6	0.2147	0.32	1323.71	11.07
Junc K021	1313.6	0.5627	0.84	1323.65	10.02
Junc K020	1313.8	0.1961	0.29	1323.71	9.92
Junc K019	1313.9	0.1784	0.27	1323.72	9.8
Junc K018	1301.8	0.0341	0.05	1324	22.19
Junc K017	1300.7	0.0691	0.1	1321.45	20.76
Junc K016	1302.5	0.0469	0.07	1324	21.49

Junc K015	1302.2	0.0861	0.13	1321.1	18.91
Junc K014	1303.2	0.0366	0.05	1324	20.77
Junc K013	1305.3	0.1069	0.16	1324	18.67
Junc K012	1303.2	0.0287	0.04	1324	20.84
Junc K011	1306.2	0.2532	0.38	1324	17.78
Junc K010	1303.3	0.066	0.1	1324.01	20.75
Junc K009	1302.2	0.1431	0.21	1320.26	18.09
Junc K008	1303.4	0.0711	0.11	1324.04	20.64
Junc K007	1303.1	0.1233	0.18	1324.15	21.02
Junc K006	1301.2	0.1247	0.19	1319.14	17.97
Junc K005	1299.6	0.0399	0.06	1319.28	19.7
Junc K004	1299.1	0.148	0.22	1320.17	21.03
Junc K003	1302.5	1.396	2.09	1323.06	20.58
Junc K002	1303.2	0.114	0.17	1323.42	20.24
Junc K001	1303.2	0.0524	0.08	1324.43	21.23
Junc K889	1282	0.08586	0.13	1315.98	33.98
Junc K850	1294.1	0.1	0.15	1317.06	22.95
Junc Kirtipur_04	1295	0	0	1328.5	33.51
Junc Kirtipur_01	1313.1	0	0	1333.36	20.26
Junc Kirtipur_05	1310.9	0	0	1333.26	22.38
Junc Kirtipur_06	1319.4	0	0	1330.48	11.05
Junc Kirtipur_07	1304.1	0	0	1327.1	23.04
Junc K860	1292.5	0	0	1328.82	36.27
Junc K861	1288.6	0	0	1312.98	24.38
Junc K862	1286.9	0	0	1322.21	35.36
Junc K863	1288.1	0	0	1322.07	33.97
Junc K864	1318.8	0	0	1332.89	14.07
Junc K865	1305.8	0	0	1332.16	26.41
Junc K866	1302.4	0	0	1331.7	29.33
Junc K867	1302.4	0	0	1331.64	29.27
Junc K868	1302.6	0	0	1331.12	28.49
Junc K869	1300.5	0	0	1330.87	30.4
Junc K870	1291.7	0	0	1330.35	38.65
Junc K871	1287.6	0	0	1329.82	42.18
Junc K872	1287.9	0	0	1329.54	41.67
Junc K873	1292.1	0	0	1329.08	36.93
Junc K874	1304.4	0	0	1331.92	27.57
Junc K875	1288.6	0.0653	0.1	1321.04	32.48
Junc K877	1310.9	0.1103	0.17	1325.14	14.26
Junc K878	1310.1	0.049	0.07	1323.79	13.67
Junc K879	1304.9	0.0294	0.04	1322.56	17.64
Junc K880	1306.1	0.0619	0.09	1322.55	16.5
Junc K881	1304	0.0425	0.06	1322.49	18.45
Junc K882	1294.2	0.0456	0.07	1322.41	28.17

Junc K883	1293.7	0.0892	0.13	1322.36	28.67
Junc K884	1297	0.033	0.05	1317.82	20.79
Junc K885	1312.1	0.0759	0.11	1325.42	13.31
Junc K886	1293.8	0.0476	0.07	1317.86	24.1
Junc K887	1304.2	0.049	0.07	1326.03	21.86
Junc K888	1304.1	0	0	1327.07	23
Junc 1	1293.6	0	0	1324.46	30.85
Junc 2	1304.2	0	0	1326.03	21.86
Junc 3	1289.5	0	0	1322.9	33.41
Junc 4	1286.4	0	0	1322.38	35.94
Junc 5	1285.8	0	0	1322.37	36.53
Junc 6	1285.8	0	0	1322.37	36.53
Junc 7	1286.4	0.0362	0.05	1322.37	35.94
Junc 8	1290.2	0	0	1317.91	27.75
Junc 9	1292.1	0	0	1317.95	25.85
Junc 11	1292.1	0	0	1317.82	25.71
Junc 14	1313.6	0	0	1332.46	18.89
Junc 15	1324.4	0	0	1332.42	7.99
Junc 16	1324.2	0	0	1332.43	8.2
Junc 17	1324.2	0	0	1332.56	8.4
Junc 18	1325.7	0	0	1332.4	6.74
Junc 19	1324.4	0	0	1332.38	7.97
Junc 20	1323.1	0	0	1332.39	9.31
Junc 21	1324.2	0	0	1332.56	8.4
Junc 22	1319.3	0	0	1332.75	13.48
Junc 23	1319.3	0	0	1332.72	13.46
Junc 24	1319.3	0	0	1332.74	13.48
Junc 25	1314	0	0	1333.6	19.57
Junc 26	1302.4	0	0	1318.7	16.32
Junc 27	1302.4	0	0	1318.7	16.32
Junc 28	1313.6	0	0	1332.46	18.89
Junc 29	1312.1	0	0	1332.71	20.6
Junc 30	1304.4	0.2251	0.34	1333.52	29.17
Junc 31	1323.3	0.0994	0.15	1332.64	9.33
Junc 32	1286.4	0	0	1317.8	31.37
Junc 33	1286.4	0	0	1317.8	31.37
Junc 34	1291.2	0	0	1324.13	32.92
Junc 35	1289.7	0	0	1322.04	32.34
Junc 36	1289.7	0	0	1315.04	25.35
Junc 37	1288.4	0	0	1315.22	26.79
Junc 38	1288.4	0	0	1322.03	33.61
Junc 39	1286.2	0	0	1322.87	36.67
Junc 40	1283.6	0	0	1323.17	39.52
Junc 41	1291.2	0	0	1324.65	33.45

Junc 43	1304.1	0	0	1326.07	22
Junc 44	1286.2	0	0	1316.31	30.11
Junc K321	1283.1	0.267	0.4	1316.95	33.88
Junc 46	1283.1	0	0	1316.95	33.88
Junc 47	1284.1	0	0	1319.62	35.55
Junc 48	1284.1	0	0	1316.78	32.71
Junc 49	1289.7	0	0	1317.36	27.67
Junc 50	1296	0	0	1315.13	19.11
Junc 51	1296	0	0	1323.32	27.3
Junc 52	1296	0	0	1317.36	21.35
Junc 53	1295.6	0.3293	0.49	1322.69	27.05
Junc 54	1295.6	0.3293	0.49	1323.34	27.71
Junc 55	1297.8	0	0	1323.25	25.43
Junc 56	1291.4	0	0	1323.34	31.96
Junc 57	1291.4	0	0	1317.68	26.3
Junc 58	1293.2	0.0845	0.13	1322.69	29.53
Junc 59	1297.8	0	0	1318.03	20.22
Junc 60	1297.8	0	0	1323.86	26.04
Junc 61	1302.4	0	0	1318.73	16.35
Junc 62	1287.9	0.1668	0.25	1320.87	33
Junc 63	1291.8	0	0	1315.3	23.46
Junc 64	1291.8	0	0	1322.88	31.04
Junc 65	1293.4	0	0	1323.32	29.94
Junc 66	1290	0	0	1316.86	26.9
Junc 67	1290	0	0	1322.89	32.93
Junc 68	1286	0	0	1322.96	36.91
Junc 69	1284.3	0	0	1316.71	32.42
Junc 70	1288.1	0	0	1316.81	28.68
Junc 71	1280.5	0	0	1316.67	36.17
Junc 72	1295	0	0	1323.04	28.09
Junc 73	1304.7	0	0	1323.88	19.21
Junc 74	1308	0	0	1323.54	15.52
Junc 75	1303.1	0	0	1326.72	23.59
Junc 76	1303.2	0	0	1324.44	21.24
Junc 77	1306.1	0	0	1324.03	17.9
Junc 78	1293.4	0	0	1322.62	29.24
Junc 79	1293.4	0	0	1322.56	29.17
Junc 80	1293.4	0	0	1323.32	29.94
Junc 81	1308	0	0	1326.02	18
Junc 82	1308	0	0	1323.98	15.96
Junc 83	1306.1	0	0	1324.05	17.92
Junc 84	1293.3	0	0	1323.33	29.99
Junc 85	1303.1	0	0	1326.72	23.59
Junc 86	1308	0	0	1326.05	18.03

Junc 87	1284.1	0	0	1315.75	31.68
Junc 88	1284.1	0	0	1319.61	35.54
Junc 89	1289.4	0	0	1315.76	26.38
Junc 90	1289.4	0	0	1318.31	28.93
Junc 91	1289.4	0	0	1316.9	27.52
Junc 92	1291	0	0	1316.19	25.19
Junc 93	1291	0	0	1317.32	26.32
Junc 94	1291	0	0	1316.99	25.99
Junc 95	1291.3	0	0	1316.85	25.53
Junc 96	1291.3	0	0	1317.57	26.26
Junc 97	1291.3	0	0	1317.57	26.26
Junc 98	1290.6	0	0	1317.06	26.45
Junc 99	1290.6	0	0	1317.17	26.56
Junc 100	1290.6	0.3823	0.57	1316.1	25.49
Junc 101	1283.1	0	0	1322.05	38.98
Junc 103	1284.1	0	0	1319.64	35.57
Junc 104	1283.3	0.0797	0.12	1316.9	33.62
Junc 105	1288.1	0	0	1317.43	29.32
Junc 106	1295.6	0	0	1323.32	27.7
Junc 107	1292.5	0	0	1318.23	25.68
Junc 108	1297.3	0	0	1317.36	20.1
Junc 10	1295.6	0	0	1323.32	27.7
Junc 45	1297.1	0	0	1323.51	26.37
Junc 109	1297.1	0	0	1323.5	26.37
Junc 110	1298.6	0	0	1322.32	23.75
Junc 111	1300.1	0	0	1321.75	21.6
Junc 112	1302.5	0	0	1321.46	18.94
Junc 113	1303.2	0	0	1321.1	17.86
Junc 114	1303.4	0	0	1320.26	16.85
Junc 115	1303.1	0	0	1319.6	16.47
Junc 116	1295.6	0	0	1323.31	27.7
Junc 117	1303.1	0	0	1326.7	23.57
Junc 118	1293.7	0	0	1317.35	23.62
Junc 119	1293.7	0	0	1317.35	23.62
Junc 120	1288.6	0	0	1317.38	28.81
Junc 121	1288.1	0	0	1317.42	29.32
Junc 122	1288.1	0	0	1317.42	29.32
Junc 123	1297	0	0	1317.34	20.38
Junc 124	1294.7	0	0	1317.34	22.64
Junc 125	1297.3	0	0	1317.36	20.1
Junc 126	1297.3	0	0	1317.36	20.1
Junc 133	1303.7	0	0	1323.2	19.55
Junc 134	1308.4	0	0	1323.34	14.93
Junc 135	1292.7	0	0	1322.86	30.16

Junc 136	1295.7	0	0	1323.4	27.69
Junc 137	1301.8	0	0	1324	22.19
Junc 138	1313.2	0	0	1324.94	11.71
Junc 139	1283.3	0.0797	0.12	1316.9	33.61
Junc 140	1283.3	0.0797	0.12	1316.9	33.61
Junc 141	1282.5	0	0	1316.77	34.26
Junc 142	1286.5	0	0	1316.88	30.35
Junc 143	1286.5	0	0	1316.65	30.12
Junc 144	1284	0	0	1316.65	32.61
Junc 145	1289.8	0	0	1316.86	27.04
Junc 146	1289.8	0	0	1316.86	27.04
Junc 147	1304.1	0	0	1326.07	22
Junc 148	1306.1	0	0	1324.03	17.91
Junc 149	1306.1	0	0	1324.03	17.91
Junc 152	1288.9	0	0	1322.89	33.97
Junc 153	1288.9	0	0	1322.89	33.97
Junc 155	1290	0	0	1322.48	32.52
Junc 156	1304.8	0	0	1323.12	18.36
Junc 157	1304.8	0	0	1323.12	18.36
Junc 12	1283.6	0	0	1323.16	39.52
Resvr Kirtipur_Tank	1338.5	#N/A	-482.83	1338.5	0

6.3.5 Design of DNI Zone - F (A 1.4)

The DNI-F model has been designed and the model features are prepared accordingly. DNI-F has been designed using inside diameters (66.8mm, 80.4mm and 98.6mm) for HDPE PE100-PN6 pipes and the diameters (150mm, 200mm & 250mm) for DI pipes. After optimizing the pipe diameters for HDPE & DI pipes, all 815 demand nodes have pressure head between 20m & 40m and 03 demand nodes have pressure between 40m & 50m.

The demarcation of DNI-F Boundary shown in **Figure 6.13** and DNI-F Design Model at Peak Demand (7.00) is shown in **Figure 6.14**

The details of DNI-F/Pipe material & length/Bulk Meter, Isolation Valves, PRVs/Location of Air Valve, Washout Valve & Fire hydrants are shown in the **Tables 6.23/6.24/6.25/6.26** respectively.

Figure 6.13: Demarcation of DNI Zone - F Boundary

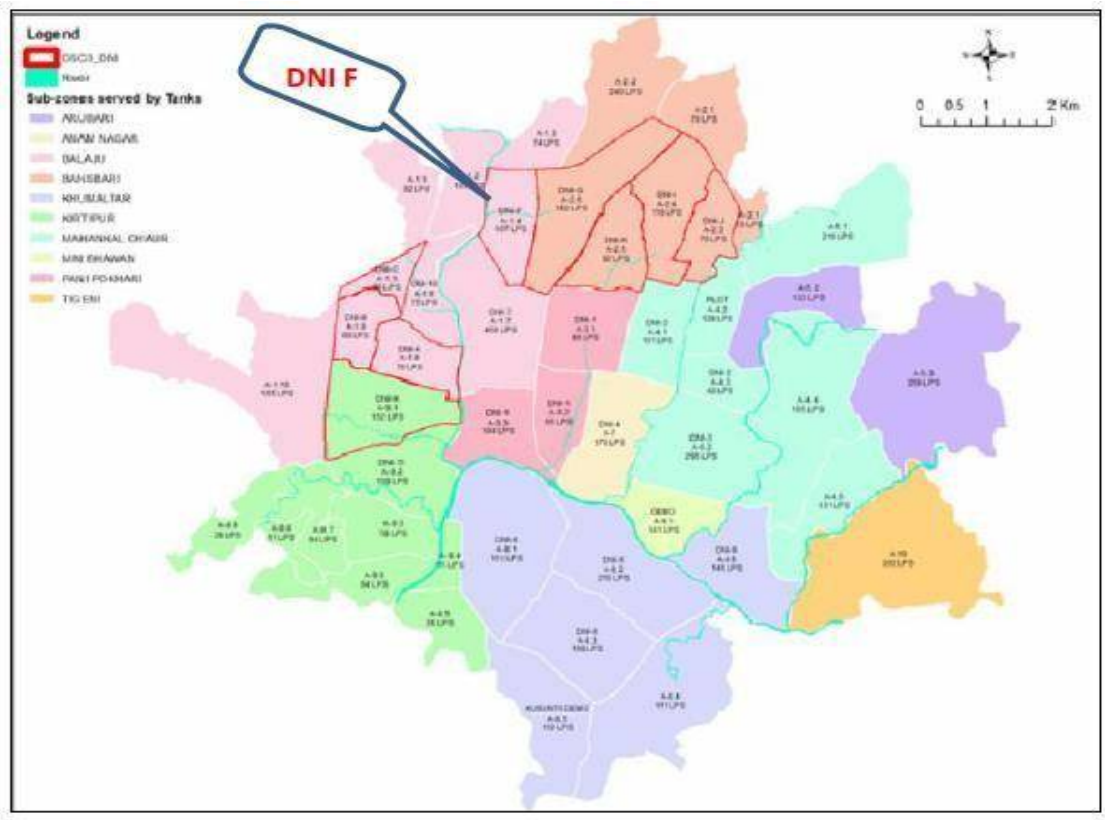


Table 6.30: Design of DNI Zone - F

Description	
Reservoir	Balaju
Outlet Elevation of the Reservoir (m)	1339.70
Total Demand (LPS)	106.94
Total number of nodes	818
Total Number of Pipes	1030
Total Length of Pipes	47,754
Number of PRVs	0
Number of Pumps	0
At Peak Time (7:00) - Only for HDPE pipes within DNI	
Number of Nodes have Pressure < 5m	0
Number of Nodes have Pressure [5m,10m]	0
Number of Nodes have Pressure [20m,40m]	815
Number of Nodes have Pressure [40m,50m]	3
Number of Nodes have Pressure [50m,60m]	0
Number of Nodes have Pressure > 60m	0
At Lowest Demand Time (1:00) - Only for HDPE pipes within DNI	
Number of Nodes have Pressure < 5m	0
Number of Nodes have Pressure [5m,10m]	0
Number of Nodes have Pressure [20m,40m]	694
Number of Nodes have Pressure [40m,50m]	124
Number of Nodes have Pressure [50m,60m]	0
Number of Nodes have Pressure > 60m	0

Table 6.31: Details of Pipe material and length

Pipe Length of DNI-F (m)	
Reservoir	Balaju
Pipe Diameter (mm)	Length (m)
HDPE PIPE-PE100, PN6	
66.80 (75)	15,438.50
80.40 (90)	8,261.00
98.60 (110)	8,299.50
DI PIPE	
150	3,993
200	819.50
250	49.50
Grand Total	36,861

Table 6.32: Details of Bulk Meter/Isolation Valve/PRV's

LOCATION OF BM/IV/PRV FOR DNI_F									
DNI	DMA	# Bulk Meter	Size of BM	# Isolation Valve	Size of IV	# PRV	Size of PRV	From_Junc	To_Junc
F	1	1	400	3	400	1	400	A1.4	146
F	2	1	250	3	250	1	250	146	147
F	3	1	200	3	200	1	200	BALAJU_10	90
F	Mainline	1	400	3	400	1	400	BALAJU_11	145

Table 6.33: Details of PRV's with Set Pressure

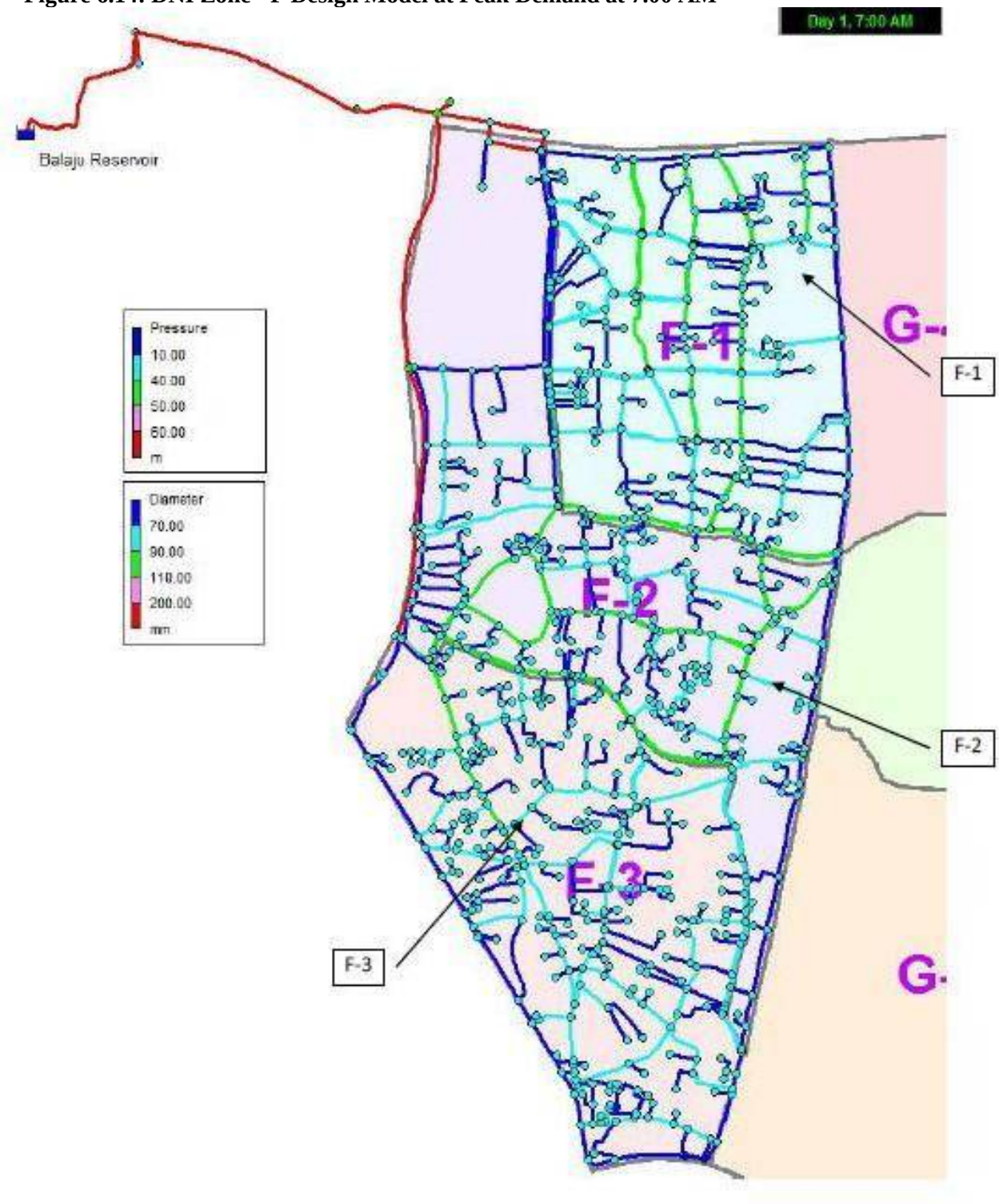
DNI	DMA	# PRV	Size of PRV	Set Pressure (m)	From_Junc	To_Junc
F	1	1	250	40	146	147
F	2	1	200	25	BALAJU_10	90
F	3	1	200	30	BALAJU_11	145

Table 6.34: Details of location of Air Valve/ Washout Valve/Fire Hydrant

LOCATION OF AV/IV/WV/FH FOR DNI_F				
DNI	# Air Valve	# Wash out Valve	# Fire Hydrant	
	Provide at Junction	Provide at Junction	Provide at Junction	On pipe dia (mm)
	A1.4	F260	Balaju_13	150 DI PIPE
	Balaju_14	F261	F055	150 DI PIPE
	F820	F278	F002	150 DI PIPE
	F338	F458	F048	150 DI PIPE
	F347	F571	F299	150 DI PIPE
	F350	F563	F820	150 DI PIPE
	F354	F313	F324	150 DI PIPE
	F367	F590	F337	150 DI PIPE
	F026	F336	F343	150 DI PIPE
	F014	F692	F346	150 DI PIPE
	F011	F679	F350	150 DI PIPE
	F171	F770	F354	150 DI PIPE
	F146	F655	F359	150 DI PIPE
	F298	F634	F362	150 DI PIPE
	F500	F420	F032B	150 DI PIPE
F	F532	F409	F367	150 DI PIPE
	F369	F389	F028	150 DI PIPE
	F473	F226	F025	150 DI PIPE
	F302	F245	F013	150 DI PIPE
	F626	F220	F007	150 DI PIPE
		F197	F176	110 HDPE PIPE
		F138	F169	110 HDPE PIPE
		F174	F805	110 HDPE PIPE
		F019	F159	110 HDPE PIPE
		F104	F047	150 DI PIPE
			F463	110 HDPE PIPE
			F542	110 HDPE PIPE
			F621	110 HDPE PIPE
			F726	90 HDPE PIPE
			F717	90 HDPE PIPE
			F583	110 HDPE PIPE
			F432	110 HDPE PIPE
			F039	110 HDPE PIPE
			F124	110 HDPE PIPE

F	Provide at Junction	Provide at Junction	Provide at Junction	On pipe dia (mm)
			F096	110 HDPE PIPE
			F192	90 HDPE PIPE
			F208	90 HDPE PIPE
			F436	90 HDPE PIPE
			F572	90 HDPE PIPE
			F580	90 HDPE PIPE
			F629	90 HDPE PIPE
			F727	90 HDPE PIPE
			F686	90 HDPE PIPE
			F654	90 HDPE PIPE
			F611	90 HDPE PIPE
			F390	90 HDPE PIPE
			F153	90 HDPE PIPE
			F134	90 HDPE PIPE

Figure 6.14: DNI Zone - F Design Model at Peak Demand at 7.00 AM



6.35.Details of Pipe for DNI F

Link ID	Length	Diameter	Roughness	Flow	Velocity	Unit Headloss	Friction Factor
	m	mm		LPS	m/s	m/km	
Pipe F004_F006	27.14	150	110	24.72	1.4	19.26	0.029
Pipe F007_F008	95.87	150	110	21.94	1.24	15.43	0.029
Pipe F007_F070	133.583	62.2	130	2.07	0.68	10.46	0.027
Pipe F008_F075	14.23	62.2	130	1.87	0.61	8.62	0.028
Pipe F009_F076	101.23	62.2	130	1.22	0.4	3.89	0.03
Pipe F010_F009	53.77	150	110	-10.23	0.58	3.76	0.033
Pipe F011_F012	162.05	150	110	10.23	0.58	3.76	0.033
Pipe F012_F016	15.54	62.2	130	2.01	0.66	9.9	0.028
Pipe F013_F012	43.13	150	110	-6.75	0.38	1.74	0.035
Pipe F014_F013	46.22	150	110	-6.75	0.38	1.74	0.035
Pipe F015_F014	47.71	62.2	130	-0.13	0.04	0.06	0.042
Pipe F015_F018	35.4349	62.2	130	1.36	0.45	4.78	0.029
Pipe F016_F015	30.6567	62.2	130	1.48	0.49	5.63	0.029
Pipe F016_F017	16.0224	62.2	130	0.42	0.14	0.54	0.034
Pipe F018_F019	80.8747	62.2	130	0.46	0.15	0.65	0.034
Pipe F018_F021	19.0995	62.2	130	0.71	0.23	1.44	0.032
Pipe F021_F020	25.9785	62.2	130	0.26	0.09	0.23	0.037
Pipe F021_F105	60.0036	62.2	130	1.15	0.38	3.49	0.03
Pipe F022_F014	60.17	150	110	-6.75	0.38	1.74	0.035
Pipe F022_F021	45.55	62.2	130	0.88	0.29	2.12	0.031
Pipe F023_F022	44.73	150	110	-6.75	0.38	1.74	0.035
Pipe F023_F025	30.55	150	110	6.75	0.38	1.74	0.035
Pipe F024_F023	22.56	62.2	130	-0.18	0.06	0.12	0.039
Pipe F025_F105	59.88	62.2	130	1.5	0.49	5.7	0.029
Pipe F026_F025	163.36	150	110	-2.64	0.15	0.31	0.04
Pipe F026_F027	154	150	110	2.64	0.15	0.31	0.04
Pipe F026_F134	109.83	62.2	130	1.44	0.47	5.29	0.029
Pipe F028_F029	52.03	150	110	2.64	0.15	0.31	0.04
Pipe F029_F030	43.83	150	110	-2.77	0.16	0.33	0.04
Pipe F030_F152	87.03	62.2	130	1.17	0.39	3.62	0.03
Pipe F031_F030	37.81	150	110	2.77	0.16	0.33	0.04
Pipe F031_F032	102.97	150	110	-2.77	0.16	0.33	0.04
Pipe F032_F033	133.29	62.2	130	0.07	0.02	0.02	0.045
Pipe F032_F369	38.1	150	110	3.45	0.2	0.5	0.039
Pipe F033_F246	30.94	62.2	130	0.39	0.13	0.47	0.035
Pipe F033_F036	31.8	62.2	130	-0.41	0.13	0.51	0.035
Pipe F034_F382	36.9907	62.2	130	1.3	0.43	4.43	0.029
Pipe F035_F042	36.571	62.2	130	1.74	0.57	7.53	0.028
Pipe F035_F051	1.23304	62.2	130	-4.05	1.33	36.09	0.025
Pipe F036_F247	41.3626	62.2	130	0.19	0.06	0.13	0.039
Pipe F037_F036	25.8149	62.2	130	0.71	0.23	1.45	0.032

Pipe F037_F248	37.3391	62.2	130	0.14	0.05	0.07	0.04
Pipe F038_F037	48.9493	62.2	130	1.07	0.35	3.06	0.03
Pipe F038_F039	2.12222	62.2	130	-0.97	0.32	2.52	0.03
Pipe F039_F234	62.4692	62.2	130	-0.26	0.09	0.22	0.037
Pipe F040_F783	30.2643	62.2	130	0.3	0.1	0.29	0.037
Pipe F040_F835	119.517	62.2	130	1.01	0.33	2.77	0.03
Pipe F041_F039	36.18	62.2	130	0.78	0.26	1.69	0.032
Pipe F041_F815	39.61	62.2	130	0.28	0.09	0.26	0.037
Pipe F042_F040	99.0887	62.2	130	1.39	0.46	5.01	0.029
Pipe F043_F041	100.13	62.2	130	0.04	0.01	0.01	0.049
Pipe F043_F251	16.9035	62.2	130	0.94	0.31	2.4	0.031
Pipe F044_F045	18.0866	62.2	130	1.38	0.45	4.92	0.029
Pipe F044_F051	57.8312	62.2	130	-1.76	0.58	7.74	0.028
Pipe F044_F253	51.0653	62.2	130	0.16	0.05	0.09	0.041
Pipe F045_F046	41.9001	62.2	130	0.89	0.29	2.16	0.031
Pipe F045_F254	23.2757	62.2	130	0.2	0.07	0.13	0.038
Pipe F046_F043	139.171	62.2	130	1.04	0.34	2.92	0.03
Pipe F046_F225	131.74	62.2	130	0.68	0.22	1.31	0.032
Pipe F047_F048	255.25	62.2	130	0.39	0.13	0.47	0.035
Pipe F047_F255	33.3	150	110	-19.44	1.1	12.34	0.03
Pipe F048_F049	18.95	62.2	110	-2.65	0.87	22.46	0.036
Pipe F048_F275	24.64	150	110	12.75	0.72	5.64	0.032
Pipe F049_F050	148.97	150	110	-12.75	0.72	5.65	0.032
Pipe F050_F776	34.77	62.2	130	-0.62	0.2	1.11	0.033
Pipe F051_F436	74.5294	62.2	130	2.4	0.79	13.72	0.027
Pipe F052_F776	138.3	62.2	130	1.9	0.63	8.88	0.028
Pipe F052_F800	53.62	150	110	17.11	0.97	9.74	0.031
Pipe F053_F052	53.86	150	110	17.11	0.97	9.74	0.031
Pipe F053_F223	135.31	62.2	130	1.2	0.4	3.81	0.03
Pipe F054_F053	43.04	150	110	17.11	0.97	9.74	0.031
Pipe F054_F222	101.36	62.2	130	0.98	0.32	2.62	0.031
Pipe F055_F054	94.59	150	110	17.11	0.97	9.74	0.031
Pipe F055_F224	146.661	150	110	23.12	1.31	17.01	0.029
Pipe F056_F055	337.023	200	110	47.33	1.51	15.79	0.027
Pipe F056_F059	27.1	62.2	130	0.15	0.05	0.09	0.041
Pipe F057_F058	30.13	62.2	130	0.42	0.14	0.54	0.035
Pipe F057_F782	14.76	150	110	23.33	1.32	17.29	0.029
Pipe F061_F062	2.20736	150	110	18.69	1.06	11.46	0.03
Pipe F061_F063	50.34	62.2	130	2.6	0.86	15.91	0.026
Pipe F062_F067	117.56	62.2	130	1.94	0.64	9.23	0.028
Pipe F062_F188	38.1261	150	110	18.69	1.06	11.47	0.03
Pipe F063_F064	34.8711	62.2	130	0.37	0.12	0.43	0.035
Pipe F063_F065	20.9643	62.2	130	2.01	0.66	9.88	0.028
Pipe F065_F066	42.1918	62.2	130	0.42	0.14	0.54	0.035
Pipe F065_F069	103.064	62.2	130	1.39	0.46	4.97	0.029

Pipe F067_F068	27.8486	62.2	130	0.24	0.08	0.19	0.037
Pipe F067_F797	63.9634	62.2	130	1.47	0.49	5.55	0.029
Pipe F069_F006	135.2	62.2	130	0.38	0.12	0.45	0.035
Pipe F069_F797	2.25458	62.2	130	0.83	0.27	1.91	0.031
Pipe F070_F071	2.18807	62.2	130	0.27	0.09	0.27	0.041
Pipe F070_F072	31.988	62.2	130	1.66	0.55	6.89	0.028
Pipe F071_F175	108.772	62.2	130	-1.14	0.38	3.47	0.03
Pipe F072_F073	79.6402	62.2	130	0.08	0.03	0.02	0.047
Pipe F072_F095	62.3539	62.2	130	1.15	0.38	3.48	0.03
Pipe F073_F074	27.9301	62.2	130	0.18	0.06	0.11	0.038
Pipe F073_F075	51.7441	62.2	130	-0.69	0.23	1.37	0.032
Pipe F075_F074	31	62.2	130	0.93	0.31	2.38	0.031
Pipe F076_F077	89.9365	62.2	130	0.9	0.3	2.22	0.031
Pipe F077_F079	6.83753	62.2	130	1.17	0.39	3.63	0.03
Pipe F078_F088	26.1338	62.2	130	1.3	0.43	4.39	0.029
Pipe F079_F080	21.4448	62.2	130	0.17	0.06	0.1	0.041
Pipe F081_F078	10.9592	62.2	130	1.42	0.47	5.19	0.029
Pipe F081_F085	30.7144	62.2	130	0.18	0.06	0.12	0.041
Pipe F082_F010	99.2397	62.2	130	0.61	0.2	1.09	0.033
Pipe F082_F079	5.75337	62.2	130	-0.99	0.33	2.66	0.031
Pipe F083_F082	32.3641	62.2	130	-0.36	0.12	0.41	0.035
Pipe F084_F078	25.6987	62.2	130	-0.07	0.02	0.02	0.047
Pipe F086_F011	89.2655	62.2	130	-2.21	0.73	11.76	0.027
Pipe F086_F081	12.2883	62.2	130	1.62	0.53	6.61	0.028
Pipe F087_F086	46.6024	62.2	130	-0.39	0.13	0.48	0.035
Pipe F088_F089	30.6541	62.2	130	0.22	0.07	0.16	0.038
Pipe F088_F099	46.711	62.2	130	0.85	0.28	2.01	0.031
Pipe F090_F077	64.3417	62.2	130	0.31	0.1	0.31	0.036
Pipe F091_F090	6.44475	62.2	130	0.49	0.16	0.74	0.035
Pipe F092_F076	51.7874	62.2	130	0.12	0.04	0.05	0.043
Pipe F092_F093	5.41402	62.2	130	-0.43	0.14	0.58	0.035
Pipe F093_F091	105.927	62.2	130	0.78	0.26	1.71	0.032
Pipe F093_F094	2.16793	62.2	130	-1.23	0.4	3.91	0.029
Pipe F094_F097	20.9062	62.2	130	1.54	0.51	6.04	0.029
Pipe F095_F074	114.979	62.2	130	-0.81	0.27	1.84	0.031
Pipe F095_F096	2.13432	62.2	130	-1.75	0.58	7.6	0.028
Pipe F096_F071	95.52	62.2	130	-1.3	0.43	4.4	0.029
Pipe F097_F172	80.758	62.2	130	0.76	0.25	1.64	0.032
Pipe F098_F091	2.13632	62.2	130	-0.28	0.09	0.28	0.04
Pipe F098_F094	105.617	62.2	130	-0.8	0.26	1.8	0.032
Pipe F099_F109	64.9878	62.2	130	1.83	0.6	8.25	0.028
Pipe F100_F099	15.0402	62.2	130	1	0.33	2.71	0.03
Pipe F100_F101	32.5367	62.2	130	0.27	0.09	0.24	0.037
Pipe F102_F100	60.0687	62.2	130	1.46	0.48	5.48	0.029
Pipe F102_F103	25.5773	62.2	130	0.21	0.07	0.15	0.039
Pipe F105_F777	11.7506	62.2	130	2.51	0.83	14.88	0.027

Pipe F106_F097	99.3024	62.2	130	-0.68	0.22	1.31	0.032
Pipe F106_F098	23.1592	62.2	130	-1.03	0.34	2.87	0.03
Pipe F107_F106	15.3081	62.2	130	-1.56	0.51	6.19	0.029
Pipe F107_F108	60.6593	62.2	130	0.36	0.12	0.41	0.035
Pipe F109_F110	44.8925	62.2	130	0.77	0.25	1.66	0.032
Pipe F109_F113	33.1699	62.2	130	0.93	0.31	2.39	0.031
Pipe F111_F107	35.0829	62.2	130	-1.05	0.34	2.94	0.03
Pipe F111_F112	51.0358	62.2	130	0.31	0.1	0.31	0.036
Pipe F113_F114	20.9853	62.2	130	0.25	0.08	0.21	0.037
Pipe F113_F129	85.2585	62.2	130	0.55	0.18	0.9	0.033
Pipe F115_F111	47.7263	62.2	130	-0.62	0.21	1.13	0.033
Pipe F115_F116	51.3564	62.2	130	0.35	0.11	0.38	0.036
Pipe F117_F115	17.108	62.2	130	-0.14	0.05	0.07	0.039
Pipe F117_F118	105.5	62.2	130	-0.5	0.16	0.74	0.034
Pipe F118_F119	18.98	62.2	130	0.42	0.14	0.53	0.035
Pipe F119_F120	20.915	62.2	130	0.16	0.05	0.09	0.042
Pipe F119_F121	43.42	62.2	130	0.43	0.14	0.57	0.035
Pipe F119_F122	22.273	62.2	130	0.38	0.13	0.45	0.035
Pipe F122_F123	23.89	62.2	130	0.21	0.07	0.15	0.038
Pipe F122_F124	37.7818	62.2	130	0.24	0.08	0.2	0.038
Pipe F124_F125	2.56175	62.2	130	-0.38	0.13	0.46	0.036
Pipe F124_F139	89.465	62.2	130	0.5	0.16	0.75	0.034
Pipe F124_F167	80.57	62.2	130	0	0	0	0
Pipe F125_F161	125.49	62.2	130	0.49	0.16	0.71	0.034
Pipe F126_F168	76.7036	62.2	130	-0.28	0.09	0.26	0.037
Pipe F128_F117	29.3459	62.2	130	-0.45	0.15	0.61	0.034
Pipe F128_F127	50.8546	62.2	130	0.36	0.12	0.4	0.036
Pipe F129_F130	40.4218	62.2	130	0.47	0.16	0.68	0.034
Pipe F129_F140	43.128	62.2	130	-0.12	0.04	0.05	0.042
Pipe F130_F131	25.4796	62.2	130	0.26	0.09	0.23	0.037
Pipe F130_F132	13.7121	62.2	130	0.06	0.02	0.01	0.04
Pipe F134_F133	7.41803	62.2	130	0.04	0.01	0	0
Pipe F134_F135	22.0626	62.2	130	1	0.33	2.73	0.03
Pipe F135_F136	21.3799	62.2	130	0.32	0.11	0.33	0.037
Pipe F135_F137	29.405	62.2	130	0.61	0.2	1.09	0.033
Pipe F137_F140	65.731	62.2	130	-0.7	0.23	1.4	0.032
Pipe F138_F137	58.0582	62.2	130	-0.87	0.29	2.09	0.031
Pipe F139_F128	56.0567	62.2	130	0.07	0.02	0.02	0.042
Pipe F139_F141	2.52837	62.2	130	0.24	0.08	0.18	0.034
Pipe F140_F144	62.0478	62.2	130	-1.01	0.33	2.74	0.03
Pipe F141_F125	88.8445	62.2	130	-0.51	0.17	0.78	0.034
Pipe F142_F141	52.1081	62.2	130	-0.65	0.21	1.21	0.033
Pipe F142_F143	41.0787	62.2	130	0.46	0.15	0.63	0.034
Pipe F144_F145	39.2925	62.2	130	0.72	0.24	1.47	0.032
Pipe F144_F146	59.8269	62.2	130	-1.94	0.64	9.25	0.028
Pipe F146_F149	115.87	62.2	130	-0.85	0.28	1.99	0.031

Pipe F146_F155	29.1137	62.2	130	-1.38	0.45	4.91	0.029
Pipe F147_F142	70.7388	62.2	130	0.01	0	0	0
Pipe F147_F148	1.37057	62.2	130	0.37	0.12	0.43	0.036
Pipe F147_F161	77.0804	62.2	130	-0.42	0.14	0.55	0.035
Pipe F148_F239	64.4455	62.2	130	0.39	0.13	0.46	0.035
Pipe F149_F029	78.15	62.2	130	-1.8	0.59	8.03	0.028
Pipe F149_F150	48.0097	62.2	130	0.11	0.04	0.05	0.043
Pipe F150_F027	58.52	62.2	130	1.02	0.33	2.79	0.03
Pipe F150_F028	45.2488	62.2	130	-1.54	0.51	6.04	0.029
Pipe F151_F149	32.8323	62.2	130	-0.27	0.09	0.24	0.037
Pipe F151_F152	5.25689	62.2	130	-0.42	0.14	0.54	0.035
Pipe F151_F155	107.513	62.2	130	0.5	0.16	0.74	0.034
Pipe F152_F153	31.0106	62.2	130	0.47	0.15	0.66	0.034
Pipe F153_F242	24.9377	62.2	130	0.06	0.02	0.02	0.055
Pipe F153_F778	63.8411	62.2	130	0.09	0.03	0.03	0.045
Pipe F154_F240	22.6849	62.2	130	-0.89	0.29	2.18	0.031
Pipe F155_F154	20.2933	62.2	130	-1.03	0.34	2.87	0.03
Pipe F157_F158	16.4986	62.2	130	0.14	0.05	0.07	0.043
Pipe F157_F779	22.5128	62.2	130	0.32	0.1	0.32	0.037
Pipe F159_F162	2.327	62.2	130	-0.07	0.02	0	0
Pipe F159_F781	82.4089	62.2	130	-0.11	0.04	0.05	0.043
Pipe F161_F157	32.5036	62.2	130	0.62	0.2	1.1	0.033
Pipe F161_F159	3.74474	62.2	130	-0.07	0.02	0.04	0.084
Pipe F161_F810	68.9	62.2	130	0.37	0.12	0.42	0.035
Pipe F162_F810	62.7703	62.2	130	0.56	0.18	0.92	0.033
Pipe F163_F162	19.4378	62.2	130	-0.31	0.1	0.31	0.036
Pipe F164_F163	20.6772	62.2	130	-0.19	0.06	0.13	0.039
Pipe F165_F159	28.6502	62.2	130	-0.09	0.03	0.03	0.046
Pipe F165_F207	111.452	62.2	130	0.12	0.04	0.05	0.041
Pipe F167_F168	2.96837	62.2	130	0.26	0.09	0.25	0.041
Pipe F168_F169	3.09028	62.2	130	-0.04	0.01	0	0
Pipe F169_F170	2.51758	62.2	130	1.09	0.36	3.19	0.03
Pipe F169_F199	105.518	62.2	130	-1.16	0.38	3.57	0.03
Pipe F170_F165	132.322	62.2	130	0.52	0.17	0.8	0.034
Pipe F171_F167	132.082	62.2	130	0.52	0.17	0.8	0.034
Pipe F171_F172	87.98	62.2	130	-0.51	0.17	0.77	0.034
Pipe F172_F118	47.9826	62.2	130	1.17	0.38	3.59	0.03
Pipe F173_F096	34.59	62.2	130	0.49	0.16	0.73	0.034
Pipe F173_F174	31.1727	62.2	130	0.49	0.16	0.72	0.034
Pipe F173_F805	61.2	62.2	130	-1.19	0.39	3.73	0.03
Pipe F176_F175	2.86952	62.2	130	2.78	0.91	17.95	0.026
Pipe F176_F797	108.533	62.2	130	-2.05	0.67	10.21	0.027
Pipe F177_F176	34.3207	62.2	130	0.9	0.3	2.22	0.031
Pipe F178_F177	2.61417	62.2	130	-1.2	0.39	3.76	0.029
Pipe F179_F178	42.7593	62.2	130	-1.13	0.37	3.37	0.03
Pipe F180_F179	116.62	62.2	130	0	0	0	0

Pipe F180_F189	49.89	150	110	18.39	1.04	11.13	0.03
Pipe F181_F180	15.0428	150	110	18.39	1.04	11.14	0.03
Pipe F181_F184	26.68	62.2	130	0.38	0.13	0.46	0.035
Pipe F182_F181	12.6462	150	110	18.39	1.04	11.13	0.03
Pipe F182_F183	17	62.2	130	0.18	0.06	0.11	0.04
Pipe F183_F184	9.36417	62.2	130	-0.22	0.07	0.16	0.038
Pipe F183_F186	72.7947	62.2	130	0.05	0.02	0.01	0.054
Pipe F184_F185	70.7399	62.2	130	-0.07	0.02	0.02	0.043
Pipe F185_F179	51.4324	62.2	130	-0.59	0.2	1.04	0.033
Pipe F186_F185	11.8866	62.2	130	-0.31	0.1	0.31	0.036
Pipe F187_F182	105.241	150	110	18.39	1.04	11.13	0.03
Pipe F187_F186	68.63	62.2	130	-0.08	0.03	0.03	0.044
Pipe F188_F177	174.72	62.2	130	2.23	0.74	11.99	0.027
Pipe F188_F187	2.33468	150	110	18.39	1.04	11.09	0.03
Pipe F189_F190	3.79	62.2	110	3.46	1.14	36.68	0.035
Pipe F189_F191	81.59	62.2	130	0.41	0.13	0.51	0.035
Pipe F190_F192	109.76	62.2	130	2.03	0.67	10.09	0.027
Pipe F190_F200	79.77	150	110	13.22	0.75	6.04	0.032
Pipe F191_F178	65.0994	62.2	130	0.06	0.02	0.01	0.042
Pipe F192_F193	22.0448	62.2	130	1.29	0.42	4.31	0.029
Pipe F192_F780	60.8538	62.2	130	0.55	0.18	0.91	0.033
Pipe F193_F194	40.5323	62.2	130	0.26	0.09	0.23	0.037
Pipe F195_F193	12.5965	62.2	130	-0.92	0.3	2.34	0.031
Pipe F195_F196	31	62.2	130	0.41	0.14	0.52	0.035
Pipe F195_F197	65.7538	62.2	130	0.3	0.1	0.29	0.036
Pipe F199_F198	48.7551	62.2	130	0.39	0.13	0.47	0.035
Pipe F199_F200	80.77	62.2	130	-1.65	0.54	6.82	0.028
Pipe F200_F201	3.95	62.2	110	4.38	1.44	56.78	0.033
Pipe F201_F202	55.2695	62.2	130	1.9	0.62	8.88	0.028
Pipe F202_F203	36.5392	62.2	130	1.23	0.41	4	0.03
Pipe F202_F218	37.3033	62.2	130	0.5	0.17	0.76	0.034
Pipe F203_F204	47.7306	62.2	130	0.84	0.28	1.95	0.031
Pipe F203_F210	58.2705	62.2	130	0.25	0.08	0.21	0.037
Pipe F204_F170	46.7182	62.2	130	-0.36	0.12	0.4	0.035
Pipe F205_F204	39.2847	62.2	130	-0.9	0.3	2.24	0.031
Pipe F205_F206	37.388	62.2	130	0.48	0.16	0.69	0.034
Pipe F207_F205	52.5786	62.2	130	-0.15	0.05	0.08	0.04
Pipe F207_F208	1.48826	62.2	130	0.06	0.02	0	0
Pipe F208_F163	119.381	62.2	130	-0.03	0.01	0	0.04
Pipe F208_F209	38.2704	62.2	130	-0.84	0.28	1.97	0.031
Pipe F209_F269	8.72687	62.2	130	-0.09	0.03	0.03	0.048
Pipe F210_F209	46.0518	62.2	130	0.88	0.29	2.12	0.031
Pipe F211_F210	37.559	62.2	130	0.87	0.29	2.1	0.031
Pipe F212_F211	46.9619	62.2	130	0.14	0.05	0.07	0.042
Pipe F212_F213	11.1388	62.2	130	-0.98	0.32	2.62	0.031
Pipe F213_F214	48.1302	62.2	130	0.19	0.06	0.12	0.039

Pipe F213_F215	14.0537	62.2	130	-1.31	0.43	4.47	0.029
Pipe F214_F211	11.1324	62.2	130	0.93	0.31	2.38	0.031
Pipe F215_F216	13.4226	62.2	130	-2.01	0.66	9.83	0.028
Pipe F215_F218	49.6128	62.2	130	0.55	0.18	0.88	0.033
Pipe F216_F201	26.116	62.2	130	-2.35	0.77	13.14	0.027
Pipe F217_F216	39.1122	62.2	130	-0.13	0.04	0.06	0.039
Pipe F218_F214	13.9796	62.2	130	0.8	0.26	1.78	0.032
Pipe F218_F221	12.1837	62.2	130	0.21	0.07	0.16	0.041
Pipe F221_F219	22.0054	62.2	130	0.07	0.02	0.02	0.044
Pipe F221_F220	14.9795	62.2	130	0.06	0.02	0.01	0.033
Pipe F223_F224	136.26	62.2	130	-1.52	0.5	5.85	0.029
Pipe F224_F255	78.1357	150	110	19.44	1.1	12.34	0.03
Pipe F225_F212	49.2783	62.2	130	-0.52	0.17	0.8	0.034
Pipe F227_F226	17.1266	62.2	130	0.57	0.19	0.95	0.033
Pipe F228_F208	105.057	62.2	130	-0.51	0.17	0.77	0.034
Pipe F229_F227	50.6444	62.2	130	0.08	0.03	0.03	0.045
Pipe F229_F230	27.1491	62.2	130	0.2	0.07	0.14	0.039
Pipe F229_F231	65.6465	62.2	130	-0.44	0.14	0.59	0.034
Pipe F231_F233	33.2132	62.2	130	-0.01	0	0	0
Pipe F234_F233	63.96	62.2	130	-0.43	0.14	0.57	0.035
Pipe F234_F239	42.6387	62.2	130	-0.01	0	0	0.18
Pipe F235_F237	34.8233	62.2	130	-0.24	0.08	0.2	0.038
Pipe F237_F233	18.3747	62.2	130	0.17	0.05	0.1	0.04
Pipe F238_F239	52.5855	62.2	130	-0.24	0.08	0.2	0.038
Pipe F240_F241	23.2552	62.2	130	0.77	0.25	1.66	0.032
Pipe F241_F242	64.86	62.2	130	0.18	0.06	0.12	0.039
Pipe F242_F031	115.32	62.2	130	-1.02	0.34	2.83	0.03
Pipe F242_F243	45.5361	62.2	130	0.93	0.31	2.35	0.031
Pipe F243_F244	23.5706	62.2	130	0.6	0.2	1.06	0.033
Pipe F243_F245	23.4008	62.2	130	0.15	0.05	0.08	0.043
Pipe F250_F038	41.7766	62.2	130	-2	0.66	9.73	0.028
Pipe F250_F240	62.6674	62.2	130	1.72	0.57	7.4	0.028
Pipe F250_F249	28.0828	62.2	130	0.14	0.05	0.07	0.041
Pipe F251_F227	28.8987	62.2	130	0.67	0.22	1.29	0.032
Pipe F251_F252	23.2528	62.2	130	0.17	0.06	0.1	0.039
Pipe F256_F255	71.8	62.2	130	-2.12	0.7	10.91	0.027
Pipe F256_F257	51.9493	62.2	130	0.55	0.18	0.9	0.033
Pipe F258_F256	48.1978	62.2	130	-1.06	0.35	3.03	0.03
Pipe F258_F259	30.4578	62.2	130	0.3	0.1	0.29	0.037
Pipe F260_F258	40.868	62.2	130	-0.52	0.17	0.8	0.034
Pipe F261_F262	53.7489	62.2	130	-0.34	0.11	0.37	0.036
Pipe F262_F049	35.03	62.2	130	0.78	0.26	1.71	0.032
Pipe F262_F264	70.1101	62.2	130	-1.46	0.48	5.48	0.029
Pipe F264_F263	35.2579	62.2	130	0.26	0.09	0.22	0.037
Pipe F265_F266	56.0045	62.2	130	-0.23	0.07	0.17	0.038
Pipe F266_F264	35.1404	62.2	130	2.22	0.73	11.88	0.027

Pipe F267_F266	9.63829	62.2	130	2.66	0.87	16.54	0.026
Pipe F267_F268	28.5988	62.2	130	0.2	0.06	0.14	0.039
Pipe F269_F225	72.6313	62.2	130	-0.83	0.27	1.93	0.031
Pipe F269_F270	17.0366	62.2	130	0.57	0.19	0.97	0.033
Pipe F271_F035	23.1511	62.2	130	-2.26	0.74	12.27	0.027
Pipe F271_F042	45.9273	62.2	130	-0.24	0.08	0.19	0.038
Pipe F271_F437	19.1923	62.2	130	2.42	0.8	13.9	0.027
Pipe F273_F272	54.2129	62.2	130	0.21	0.07	0.15	0.039
Pipe F273_F274	43.9169	62.2	130	0.2	0.07	0.14	0.038
Pipe F275_F277	69.77	62.2	130	1.16	0.38	3.59	0.03
Pipe F275_F282	40.33	150	110	12.75	0.72	5.65	0.032
Pipe F277_F276	25.258	62.2	130	0.23	0.08	0.18	0.038
Pipe F277_F785	27.7195	62.2	130	0.73	0.24	1.52	0.032
Pipe F280_F279	61.1565	62.2	130	0.25	0.08	0.21	0.037
Pipe F281_F280	27.4168	62.2	130	0.14	0.05	0.08	0.041
Pipe F281_F282	70.32	62.2	130	-0.5	0.17	0.76	0.034
Pipe F281_F284	24.4729	62.2	130	0.13	0.04	0.06	0.041
Pipe F282_F283	28.53	150	110	12.75	0.72	5.64	0.032
Pipe F283_F786	26.02	150	110	12.75	0.72	5.65	0.032
Pipe F284_F283	85.68	62.2	130	0.03	0.01	0.01	0.049
Pipe F285_F284	18.9517	62.2	130	-0.02	0.01	0	0
Pipe F285_F286	23.8209	62.2	130	0.64	0.21	1.19	0.033
Pipe F286_F289	35.3577	62.2	130	0.43	0.14	0.56	0.035
Pipe F286_F786	80.38	62.2	130	0.07	0.02	0.02	0.046
Pipe F287_F288	20.8399	62.2	130	0.22	0.07	0.16	0.039
Pipe F287_F293	48.8833	62.2	130	-1.33	0.44	4.58	0.029
Pipe F287_F840	18.5897	62.2	130	1.04	0.34	2.91	0.03
Pipe F289_F290	71.53	62.2	130	-0.05	0.02	0.01	0.048
Pipe F289_F291	17.8977	62.2	130	0.32	0.11	0.32	0.036
Pipe F290_F299	44.32	150	110	12.75	0.72	5.64	0.032
Pipe F291_F292	30.4189	62.2	130	0.23	0.08	0.18	0.038
Pipe F291_F298	49.68	62.2	130	0.04	0.01	0.01	0.053
Pipe F294_F787	32.53	62.2	130	2.11	0.69	10.77	0.027
Pipe F295_F294	26.5389	62.2	130	2.15	0.71	11.21	0.027
Pipe F295_F296	25.8197	62.2	130	0.11	0.04	0.05	0.045
Pipe F297_F295	19.9441	62.2	130	2.38	0.78	13.46	0.027
Pipe F297_F300	13.41	62.2	130	2.68	0.88	16.79	0.026
Pipe F299_F298	59	62.2	130	0.04	0.01	0.01	0.067
Pipe F300_F301	18.4598	62.2	130	0.23	0.08	0.18	0.038
Pipe F300_F302	63.71	62.2	130	2.35	0.77	13.14	0.027
Pipe F302_F303	32.2471	62.2	130	0.25	0.08	0.21	0.038
Pipe F302_F304	69.6595	62.2	130	1.92	0.63	9.03	0.028
Pipe F304_F305	31.4899	62.2	130	2.55	0.84	15.34	0.027
Pipe F304_F306	26.6629	62.2	130	-0.92	0.3	2.31	0.031
Pipe F305_F562	23.0352	62.2	130	0.08	0.03	0.03	0.042
Pipe F307_F306	34.15	62.2	130	-0.89	0.29	2.17	0.031

Pipe F307_F308	23.3268	62.2	130	0.25	0.08	0.2	0.037
Pipe F307_F309	32.9685	62.2	130	0.43	0.14	0.58	0.035
Pipe F309_F310	15.7829	62.2	130	0.08	0.03	0.02	0.034
Pipe F309_F311	17.4922	62.2	130	0.3	0.1	0.29	0.036
Pipe F311_F312	21.4836	62.2	130	0.15	0.05	0.08	0.04
Pipe F311_F313	16.0975	62.2	130	0.09	0.03	0.03	0.042
Pipe F314_F315	25.97	62.2	130	0.26	0.08	0.22	0.037
Pipe F314_F316	14.54	150	110	17.23	0.98	9.88	0.031
Pipe F314_F820	57	150	110	-17.23	0.98	9.87	0.031
Pipe F316_F317	40.16	62.2	130	0.22	0.07	0.17	0.039
Pipe F318_F316	158.4	150	110	-17.23	0.98	9.87	0.031
Pipe F319_F318	29.04	62.2	130	-1.63	0.54	6.68	0.028
Pipe F319_F321	63.7167	62.2	130	1	0.33	2.7	0.031
Pipe F320_F319	32.5842	62.2	130	-0.35	0.12	0.39	0.036
Pipe F320_F790	17.4807	62.2	130	0.12	0.04	0.05	0.041
Pipe F321_F322	19.9288	62.2	130	0.11	0.04	0.04	0.041
Pipe F321_F323	76.602	62.2	130	0.53	0.17	0.83	0.034
Pipe F324_F318	23.82	150	110	-17.23	0.98	9.87	0.031
Pipe F325_F320	27.8045	62.2	130	-0.14	0.05	0.07	0.042
Pipe F325_F324	38.26	62.2	130	-1.88	0.62	8.74	0.028
Pipe F326_F324	59.74	150	110	-12.17	0.69	5.18	0.032
Pipe F327_F326	20.84	62.2	130	-0.34	0.11	0.36	0.036
Pipe F327_F328	18.8424	62.2	130	0.11	0.04	0.04	0.038
Pipe F329_F327	13.3574	62.2	130	-0.17	0.05	0.09	0.036
Pipe F330_F326	80.07	150	110	-12.17	0.69	5.18	0.032
Pipe F331_F332	11.4601	62.2	130	-0.14	0.05	0.06	0.035
Pipe F332_F330	15.54	62.2	130	-1.65	0.54	6.84	0.028
Pipe F333_F332	19.4409	62.2	130	-1.45	0.48	5.39	0.029
Pipe F334_F333	66.1173	62.2	130	-0.31	0.1	0.3	0.036
Pipe F335_F333	14.4852	62.2	130	-1.05	0.35	2.98	0.03
Pipe F335_F336	20.6591	62.2	130	0.16	0.05	0.09	0.041
Pipe F337_F330	27.17	150	110	-10.54	0.6	3.97	0.033
Pipe F338_F337	17.27	150	110	-10.54	0.6	3.97	0.033
Pipe F338_F339	33.21	62.2	130	0.21	0.07	0.15	0.039
Pipe F338_F340	3.45	150	110	10.54	0.6	3.97	0.033
Pipe F340_F341	31.07	62.2	130	0.39	0.13	0.48	0.035
Pipe F340_F342	134.12	150	110	10.54	0.6	3.97	0.033
Pipe F342_F343	49.96	150	110	10.54	0.6	3.97	0.033
Pipe F342_F796	158.72	62.2	130	0.3	0.1	0.29	0.037
Pipe F343_F344	103.84	150	110	10.54	0.6	3.97	0.033
Pipe F343_F794	13.19	62.2	130	-0.73	0.24	1.53	0.032

Pipe F344_F345	43.51	150	110	10.54	0.6	3.97	0.033
Pipe F345_F346	56.4	150	110	6.1	0.34	1.44	0.036
Pipe F346_F347	65.82	150	110	5.97	0.34	1.39	0.036
Pipe F347_F688	16.5	62.2	130	0.41	0.13	0.51	0.035
Pipe F348_F347	52.64	150	110	-5.97	0.34	1.39	0.036
Pipe F349_F348	127.66	150	110	-5.97	0.34	1.39	0.036
Pipe F349_F350	36.77	150	110	5.97	0.34	1.39	0.036
Pipe F349_F683	50.0585	62.2	130	0.19	0.06	0.13	0.039
Pipe F351_F677	32.1859	62.2	130	0.36	0.12	0.4	0.035
Pipe F351_F792	90.41	150	110	-4.01	0.23	0.66	0.038
Pipe F352_F351	10.07	150	110	-4.01	0.23	0.67	0.038
Pipe F352_F678	89.77	62.2	130	1.45	0.48	5.42	0.029
Pipe F353_F352	29.43	150	110	-4.01	0.23	0.67	0.038
Pipe F354_F353	41.37	150	110	-4.01	0.23	0.66	0.038
Pipe F354_F672	75.8727	62.2	130	1.84	0.61	8.41	0.028
Pipe F355_F356	42.23	150	110	-0.57	0.03	0.02	0.06
Pipe F355_F666	113.313	62.2	130	1.34	0.44	4.67	0.029
Pipe F356_F357	58.63	150	110	-0.57	0.03	0.02	0.05
Pipe F356_F671	35.21	62.2	130	0.16	0.05	0.09	0.041
Pipe F357_F358	122.17	150	110	-0.57	0.03	0.02	0.048
Pipe F357_F666	43.03	62.2	130	-0.02	0.01	0	0
Pipe F358_F359	95.66	150	110	-0.57	0.03	0.02	0.053
Pipe F358_F649	29.38	62.2	130	0.11	0.04	0.05	0.041
Pipe F359_F360	149.71	150	110	-0.57	0.03	0.02	0.05
Pipe F359_F641	80.45	62.2	130	-0.3	0.1	0.29	0.037
Pipe F360_F504	27.94	62.2	130	0.4	0.13	0.5	0.035
Pipe F361_F360	22.25	150	110	0.57	0.03	0.02	0.057
Pipe F361_F502	22.96	62.2	130	0.76	0.25	1.63	0.032
Pipe F362_F361	46.87	150	110	0.57	0.03	0.02	0.045
Pipe F362_F484	130.6	62.2	130	-0.2	0.07	0.14	0.039
Pipe F363_F362	10.75	150	110	0.57	0.03	0.03	0.078
Pipe F363_F483	38.22	62.2	130	0.32	0.11	0.33	0.036
Pipe F364_F363	9.79	150	110	0.57	0.03	0.02	0.043
Pipe F364_F365	76.6	150	110	-0.57	0.03	0.02	0.049
Pipe F364_F482	21.25	62.2	130	0.17	0.06	0.1	0.038
Pipe F365_F366	48.44	150	110	-0.57	0.03	0.02	0.052
Pipe F366_F479	14.96	62.2	130	0.39	0.13	0.47	0.035
Pipe F367_F366	66.1	150	110	0.57	0.03	0.02	0.051
Pipe F367_F375	65.69	62.2	130	0.54	0.18	0.85	0.034
Pipe F368_F367	105.87	150	110	3.45	0.2	0.5	0.039
Pipe F369_F368	22.57	150	110	3.45	0.2	0.5	0.039
Pipe F369_F370	27.2705	62.2	130	0.37	0.12	0.43	0.035
Pipe F370_F368	17.49	62.2	130	-0.25	0.08	0.22	0.038
Pipe F370_F371	89.9992	62.2	130	0.42	0.14	0.54	0.035
Pipe F371_F372	21.0836	62.2	130	0.34	0.11	0.37	0.036
Pipe F371_F373	16.9115	62.2	130	-0.05	0.02	0.01	0.047

Pipe F374_F373	11.43	62.2	130	-0.1	0.03	0.04	0.045
Pipe F374_F375	32.01	62.2	130	0.14	0.05	0.07	0.042
Pipe F375_F376	31.8756	62.2	130	0.47	0.15	0.66	0.034
Pipe F378_F825	21.0089	62.2	130	-0.03	0.01	0.01	0.08
Pipe F379_F373	58.286	62.2	130	0.17	0.06	0.11	0.04
Pipe F379_F380	28.255	62.2	130	0.3	0.1	0.29	0.037
Pipe F379_F382	38.1253	62.2	130	-0.63	0.21	1.15	0.033
Pipe F382_F381	83.0335	62.2	130	0.47	0.15	0.67	0.034
Pipe F384_F383	33.0553	62.2	130	0.22	0.07	0.17	0.037
Pipe F384_F385	57.2868	62.2	130	1.05	0.34	2.95	0.03
Pipe F385_F378	44.4009	62.2	130	0.45	0.15	0.61	0.034
Pipe F385_F386	49.1863	62.2	130	0.45	0.15	0.61	0.034
Pipe F387_F378	142.874	62.2	130	-0.27	0.09	0.23	0.037
Pipe F387_F388	4.93326	62.2	130	-0.2	0.07	0.12	0.034
Pipe F388_F389	26.1334	62.2	130	0.24	0.08	0.19	0.038
Pipe F390_F388	36.6563	62.2	130	0.55	0.18	0.89	0.033
Pipe F390_F391	23.8516	62.2	130	0.18	0.06	0.11	0.04
Pipe F392_F387	20.2375	62.2	130	-0.35	0.11	0.38	0.036
Pipe F392_F393	49.0621	62.2	130	0.49	0.16	0.73	0.034
Pipe F392_F394	62.6286	62.2	130	-0.47	0.16	0.67	0.034
Pipe F394_F396	94.2649	62.2	130	-0.31	0.1	0.31	0.036
Pipe F394_F430	86.4386	62.2	130	-0.38	0.13	0.46	0.035
Pipe F395_F399	69.8446	62.2	130	-2.35	0.77	13.19	0.027
Pipe F397_F374	61.81	62.2	130	0.15	0.05	0.08	0.04
Pipe F397_F398	3.55	62.2	130	-0.21	0.07	0.17	0.044
Pipe F399_F477	45.9989	62.2	130	1.74	0.57	7.53	0.028
Pipe F400_F395	56.9196	62.2	130	-1.14	0.38	3.47	0.03
Pipe F400_F401	30.1563	62.2	130	0.25	0.08	0.21	0.037
Pipe F403_F400	21.6759	62.2	130	-0.71	0.23	1.42	0.032
Pipe F403_F402	7.29427	62.2	130	0.05	0.02	0.02	0.078
Pipe F403_F404	16.1067	62.2	130	0.58	0.19	0.98	0.033
Pipe F404_F405	14.6453	62.2	130	0.05	0.02	0.01	0.05
Pipe F404_F406	20.289	62.2	130	0.48	0.16	0.7	0.034
Pipe F406_F407	10.3885	62.2	130	0.1	0.03	0.04	0.048
Pipe F406_F408	11.3628	62.2	130	0.34	0.11	0.37	0.036
Pipe F408_F410	44.8742	62.2	130	0.11	0.04	0.05	0.042
Pipe F409_F408	30.2212	62.2	130	-0.11	0.04	0.04	0.042
Pipe F410_F411	22.6224	62.2	130	0.2	0.07	0.14	0.038
Pipe F410_F412	9.65239	62.2	130	-0.18	0.06	0.11	0.037
Pipe F412_F414	18.9596	62.2	130	-0.11	0.04	0.05	0.045
Pipe F414_F413	23.4194	62.2	130	0.1	0.03	0.04	0.044
Pipe F414_F415	25.4345	62.2	130	-0.35	0.12	0.39	0.036
Pipe F415_F416	15.351	62.2	130	0.45	0.15	0.61	0.034
Pipe F415_F517	44.9284	62.2	130	-0.93	0.3	2.35	0.031
Pipe F416_F412	22.8674	62.2	130	0.13	0.04	0.07	0.043
Pipe F416_F417	14.877	62.2	130	0.24	0.08	0.2	0.039

Pipe F417_F418	6.74315	62.2	130	0.17	0.06	0.09	0.033
Pipe F417_F419	65.9722	62.2	130	0.01	0	0	0
Pipe F419_F420	25.3933	62.2	130	0.2	0.07	0.14	0.038
Pipe F419_F421	17.1846	62.2	130	-0.31	0.1	0.3	0.037
Pipe F421_F422	30.2742	62.2	130	0.14	0.05	0.07	0.041
Pipe F421_F424	11.1021	62.2	130	-0.52	0.17	0.8	0.034
Pipe TO_A-1.4	92.14	300	110	103.4	1.46	9.31	0.026
Pipe 5	33.3	400	110	110.7	0.88	2.6	0.026
Pipe South_A-1.4	151.18	600	110	271.2	0.96	1.9	0.024
Pipe A-1.2_South	430	600	110	271.2	0.96	1.9	0.024
Pipe TO_A-1.2	100	500	110	153.9	0.78	1.61	0.026
Pipe BalaljuRes_A-1.2	367	800	110	425.1	0.85	1.08	0.024
Pipe F001_F850	82.3681	62.2	130	1.07	0.35	3.05	0.03
Pipe F630_F629A	98.5	62.2	130	0.74	0.24	1.54	0.032
Pipe F423_F424	38.7162	62.2	130	-0.34	0.11	0.38	0.036
Pipe F424_F425	41.1186	62.2	130	-0.93	0.31	2.39	0.031
Pipe F425_F426	38.0845	62.2	130	-0.51	0.17	0.77	0.034
Pipe F425_F429	7.4044	62.2	130	-0.55	0.18	0.88	0.033
Pipe F426_F395	56.7226	62.2	130	-0.89	0.29	2.18	0.031
Pipe F426_F427	27.3234	62.2	130	0.15	0.05	0.08	0.041
Pipe F429_F428	31.2918	62.2	130	0.21	0.07	0.15	0.038
Pipe F429_F473	66.4978	62.2	130	-0.79	0.26	1.76	0.032
Pipe F430_F431	14.6027	62.2	130	0.26	0.08	0.22	0.038
Pipe F432_F430	39.238	62.2	130	0.73	0.24	1.49	0.032
Pipe F432_F433	30.631	62.2	130	-0.69	0.23	1.37	0.032
Pipe F433_F434	12.2094	62.2	130	0.27	0.09	0.23	0.035
Pipe F435_F390	91.44	62.2	130	1.13	0.37	3.38	0.03
Pipe F435_F433	51.18	62.2	130	1.11	0.36	3.28	0.03
Pipe F435_F437	67.61	62.2	130	-1.7	0.56	7.21	0.028
Pipe F436_F435	35.33	62.2	130	0.78	0.26	1.71	0.032
Pipe F437_F438	33.4484	62.2	130	0.6	0.2	1.05	0.033
Pipe F438_F439	19.3881	62.2	130	0.34	0.11	0.36	0.035
Pipe F438_F440	16.4417	62.2	130	0.09	0.03	0.03	0.035
Pipe F441_F436	22.8501	62.2	130	-1.43	0.47	5.24	0.029
Pipe F441_F442	28.6814	62.2	130	0.17	0.06	0.1	0.039
Pipe F443_F273	29.4894	62.2	130	0.55	0.18	0.91	0.033
Pipe F443_F441	46.4121	62.2	130	-1.05	0.34	2.95	0.03
Pipe F443_F470	84.9612	62.2	130	0.06	0.02	0.01	0.047
Pipe F444_F443	86.2697	62.2	130	-0.03	0.01	0	0.045
Pipe F444_F462	79.0829	62.2	130	-0.47	0.15	0.66	0.034
Pipe F445_F444	8.11393	62.2	130	-0.4	0.13	0.5	0.036
Pipe F445_F446	15.7188	62.2	130	-0.12	0.04	0.06	0.047
Pipe F445_F456	34.6447	62.2	130	0.44	0.14	0.58	0.034
Pipe F446_F447	30.5709	62.2	130	0.28	0.09	0.25	0.037
Pipe F449_F446	28.5299	62.2	130	0.47	0.16	0.67	0.034

Pipe F449_F448	15.3468	62.2	130	0.05	0.02	0.01	0.038
Pipe F450_F047	69.0708	62.2	130	-1.91	0.63	8.93	0.028
Pipe F450_F449	15.1111	62.2	130	0.66	0.22	1.27	0.032
Pipe F450_F451	7.28028	62.2	130	1.06	0.35	3.01	0.03
Pipe F451_F452	28.3278	62.2	130	0.2	0.07	0.14	0.038
Pipe F451_F454	8.11497	62.2	130	0.83	0.27	1.93	0.031
Pipe F454_F453	18.2233	62.2	130	0.07	0.02	0.02	0.037
Pipe F456_F454	14.5477	62.2	130	-0.73	0.24	1.51	0.032
Pipe F456_F455	20.2028	62.2	130	0.04	0.01	0.01	0.046
Pipe F457_F285	118.396	62.2	130	0.67	0.22	1.29	0.032
Pipe F457_F456	23.7381	62.2	130	-1.05	0.35	2.98	0.03
Pipe F457_F458	29.1928	62.2	130	0.27	0.09	0.23	0.037
Pipe F459_F460	28.5856	62.2	130	0.15	0.05	0.08	0.039
Pipe F459_F461	60.11	62.2	130	0.66	0.22	1.26	0.032
Pipe F461_F544	25.2746	62.2	130	-0.03	0.01	0.01	0.055
Pipe F462_F463	2.35	62.2	130	1.85	0.61	8.49	0.028
Pipe F462_F470	79.8684	62.2	130	0.47	0.15	0.66	0.034
Pipe F463_F461	76.431	62.2	130	-0.9	0.3	2.25	0.031
Pipe F464_F463	10.9976	62.2	130	-2.71	0.89	17.13	0.026
Pipe F464_F465	18.5425	62.2	130	0.17	0.05	0.1	0.039
Pipe F464_F466	12.5776	62.2	130	2.48	0.82	14.52	0.027
Pipe F466_F467	49.1286	62.2	130	0.17	0.06	0.1	0.04
Pipe F468_F466	10.0631	62.2	130	-2.21	0.73	11.73	0.027
Pipe F468_F469	51.7772	62.2	130	0.18	0.06	0.11	0.04
Pipe F468_F471	57.5239	62.2	130	1.74	0.57	7.56	0.028
Pipe F470_F432	66.2212	62.2	130	0.23	0.08	0.18	0.038
Pipe F471_F472	42.3167	62.2	130	0.32	0.11	0.33	0.036
Pipe F471_F473	36.3864	62.2	130	1.22	0.4	3.94	0.03
Pipe F473_F474	134.111	62.2	130	0.22	0.07	0.17	0.038
Pipe F474_F518	21.49	62.2	130	-0.05	0.02	0.01	0.03
Pipe F475_F474	5.9744	62.2	130	-0.14	0.05	0.07	0.044
Pipe F477_F476	22.5168	62.2	130	0.24	0.08	0.2	0.037
Pipe F478_F398	46.84	62.2	130	-2.56	0.84	15.47	0.027
Pipe F478_F492	40.468	62.2	130	1.75	0.57	7.61	0.028
Pipe F480_F365	25.52	62.2	130	-0.06	0.02	0.02	0.052
Pipe F480_F478	111.921	62.2	130	-0.56	0.18	0.92	0.033
Pipe F480_F481	12.811	62.2	130	0.36	0.12	0.42	0.036
Pipe F485_F484	19.0613	62.2	130	-0.12	0.04	0.05	0.046
Pipe F485_F486	20.6462	62.2	130	0.13	0.04	0.06	0.038
Pipe F485_F487	8.82551	62.2	130	-0.04	0.01	0.02	0.14
Pipe F487_F488	26.5811	62.2	130	0.15	0.05	0.08	0.043
Pipe F487_F490	35.2873	62.2	130	-0.23	0.08	0.18	0.037
Pipe F489_F477	124.98	62.2	130	-1.42	0.47	5.15	0.029
Pipe F489_F498	27.3581	62.2	130	0.75	0.25	1.59	0.032
Pipe F490_F491	29.0893	62.2	130	0.34	0.11	0.36	0.036
Pipe F492_F490	72.8204	62.2	130	0.85	0.28	2	0.031

Pipe F492_F493	27.9668	62.2	130	0.55	0.18	0.88	0.033
Pipe F495_F489	63.4389	62.2	130	-0.54	0.18	0.85	0.033
Pipe F495_F494	21.0035	62.2	130	0.22	0.07	0.17	0.039
Pipe F496_F495	17.4318	62.2	130	-0.06	0.02	0.02	0.054
Pipe F498_F497	50.9626	62.2	130	0.24	0.08	0.19	0.038
Pipe F498_F500	7.20964	62.2	130	0.49	0.16	0.7	0.034
Pipe F500_F499	29.8281	62.2	130	0.24	0.08	0.2	0.038
Pipe F501_F502	36.6245	62.2	130	-0.24	0.08	0.18	0.037
Pipe F502_F503	42.7517	62.2	130	0.4	0.13	0.5	0.035
Pipe F505_F513	199.96	62.2	130	-0.64	0.21	1.18	0.033
Pipe F506_F505	158.627	62.2	130	0.11	0.04	0.04	0.042
Pipe F506_F632	55.8326	62.2	130	0.76	0.25	1.64	0.032
Pipe F507_F506	18.6171	62.2	130	1.68	0.55	7.05	0.028
Pipe F508_F507	3.33	62.2	130	-2.36	0.78	13.32	0.027
Pipe F508_F509	22.1329	62.2	130	0.91	0.3	2.28	0.031
Pipe F510_F507	90.1902	62.2	130	-0.04	0.01	0.01	0.053
Pipe F510_F513	40.27	62.2	130	-0.94	0.31	2.42	0.031
Pipe F510_F845	64.2142	62.2	130	0.65	0.21	1.2	0.033
Pipe F511_F509	80.4131	62.2	130	0.77	0.25	1.67	0.032
Pipe F511_F512	25.9005	62.2	130	0.22	0.07	0.17	0.038
Pipe F513_F514	6.84	62.2	130	-1.72	0.57	7.38	0.028
Pipe F514_F511	30.65	62.2	130	1.1	0.36	3.2	0.03
Pipe F515_F514	33.32	62.2	130	1.03	0.34	2.86	0.03
Pipe F515_F516	21.05	62.2	130	0.25	0.08	0.21	0.037
Pipe F515_F519	87.4	62.2	130	-1.34	0.44	4.68	0.029
Pipe F517_F500	207.1	62.2	130	-0.21	0.07	0.15	0.039
Pipe F517_F518	48.1	62.2	130	-0.85	0.28	1.99	0.031
Pipe F519_F520	20.95	62.2	130	0.08	0.03	0.03	0.053
Pipe F519_F523	45.7	62.2	130	-1.65	0.54	6.85	0.028
Pipe F521_F518	74.85	62.2	130	1.08	0.36	3.14	0.03
Pipe F521_F522	66.26	62.2	130	0.31	0.1	0.31	0.036
Pipe F523_F524	50.326	62.2	130	0.65	0.21	1.21	0.033
Pipe F523_F528	8.32947	62.2	130	-2.34	0.77	13.06	0.027
Pipe F524_F525	37.941	62.2	130	0.22	0.07	0.16	0.039
Pipe F524_F526	35.7326	62.2	130	0.22	0.07	0.17	0.038
Pipe F528_F529	15.9195	62.2	130	0.13	0.04	0.06	0.039
Pipe F528_F532	10.8196	62.2	130	-2.49	0.82	14.66	0.027
Pipe F530_F521	26.6	62.2	130	1.54	0.51	5.99	0.029
Pipe F530_F531	41.9758	62.2	130	0.16	0.05	0.1	0.04
Pipe F530_F533	7.40242	62.2	130	-1.73	0.57	7.5	0.028
Pipe F532_F527	108.524	62.2	130	0.17	0.06	0.1	0.04
Pipe F532_F535	37.8789	62.2	130	-1.51	0.5	5.81	0.029
Pipe F533_F534	38.41	62.2	130	0.18	0.06	0.11	0.04
Pipe F535_F536	40.8575	62.2	130	0.04	0.01	0.01	0.062
Pipe F535_F542	43.95	62.2	130	-1.75	0.58	7.66	0.028
Pipe F538_F537	17.1686	62.2	130	0.17	0.05	0.1	0.039

Pipe F538_F573	11.4648	62.2	130	0.17	0.06	0.1	0.041
Pipe F539_F538	8.24612	62.2	130	0.35	0.11	0.38	0.035
Pipe F539_F540	10.8544	62.2	130	0.1	0.03	0.04	0.047
Pipe F541_F539	25.9597	62.2	130	0.49	0.16	0.73	0.034
Pipe F541_F542	51.4	62.2	130	-2.42	0.8	13.95	0.027
Pipe F543_F533	83.55	62.2	130	2	0.66	9.79	0.028
Pipe F544_F543	19.1	62.2	130	-0.32	0.11	0.33	0.036
Pipe F544_F545	21.1275	62.2	130	0.15	0.05	0.08	0.042
Pipe F546_F542	67.9	62.2	130	1.56	0.51	6.18	0.029
Pipe F546_F547	20.5623	62.2	130	0.25	0.08	0.21	0.038
Pipe F548_F543	99.42	62.2	130	1.02	0.33	2.79	0.03
Pipe F548_F549	39.9386	62.2	130	0.13	0.04	0.06	0.043
Pipe F550_F293	32.8506	62.2	130	-1.46	0.48	5.44	0.029
Pipe F550_F548	19.5652	62.2	130	1.3	0.43	4.4	0.029
Pipe F550_F551	15.3697	62.2	130	0.13	0.04	0.06	0.041
Pipe F553_F555	31.1194	62.2	130	-0.22	0.07	0.17	0.038
Pipe F555_F554	16.409	62.2	130	0.13	0.04	0.05	0.037
Pipe F556_F555	27.9948	62.2	130	0.5	0.16	0.74	0.034
Pipe F556_F557	18.1099	62.2	130	0.09	0.03	0.03	0.049
Pipe F558_F556	27.2472	62.2	130	0.72	0.24	1.47	0.032
Pipe F558_F559	5.76555	62.2	130	1.2	0.39	3.77	0.03
Pipe F558_F561	56.68	62.2	130	-2.03	0.67	10	0.027
Pipe F559_F572	32.2831	62.2	130	0.67	0.22	1.28	0.032
Pipe F561_F305	7.55	62.2	130	-2.39	0.79	13.64	0.027
Pipe F561_F560	22.97	62.2	130	0.24	0.08	0.19	0.037
Pipe F565_F563	13.0039	62.2	130	0.23	0.08	0.18	0.037
Pipe F565_F564	9.58805	62.2	130	0.05	0.02	0	0
Pipe F567_F565	22.7776	62.2	130	0.32	0.11	0.33	0.036
Pipe F567_F566	10.9813	62.2	130	0.06	0.02	0.01	0.046
Pipe F568_F306	22.9778	62.2	130	-3.52	1.16	27.88	0.025
Pipe F568_F567	19.071	62.2	130	0.42	0.14	0.54	0.035
Pipe F568_F569	10.6951	62.2	130	3	0.99	20.75	0.026
Pipe F569_F570	25.7748	62.2	130	0.13	0.04	0.06	0.042
Pipe F571_F559	72.1693	62.2	130	-0.34	0.11	0.36	0.036
Pipe F572_F541	37.9968	62.2	130	-1.81	0.59	8.1	0.028
Pipe F574_F572	46.7592	62.2	130	-2.26	0.74	12.22	0.027
Pipe F574_F575	8.08811	62.2	130	0.16	0.05	0.09	0.043
Pipe F576_F574	16.4883	62.2	130	-2	0.66	9.81	0.028
Pipe F576_F577	31.4857	62.2	130	0.27	0.09	0.23	0.037
Pipe F576_F578	69.6915	62.2	130	1.51	0.5	5.79	0.029
Pipe F578_F579	18.4111	62.2	130	0.2	0.07	0.14	0.038
Pipe F580_F578	10.547	62.2	130	-1.11	0.36	3.27	0.03
Pipe F580_F601	45.0411	62.2	130	0.57	0.19	0.97	0.033
Pipe F580_F602	67.7556	62.2	130	0.27	0.09	0.24	0.037
Pipe F581_F569	35.5923	62.2	130	-2.74	0.9	17.48	0.026
Pipe F581_F582	32.5	62.2	130	0.09	0.03	0.03	0.044

Pipe F581_F583	21.0521	62.2	130	2.56	0.84	15.4	0.027
Pipe F583_F584	59.1072	62.2	130	0.37	0.12	0.44	0.035
Pipe F583_F585	19.0657	62.2	130	2.05	0.67	10.19	0.027
Pipe F585_F586	33.86	62.2	130	0.37	0.12	0.44	0.036
Pipe F585_F788	44.1052	62.2	130	1.86	0.61	8.53	0.028
Pipe F586_F587	18.4554	62.2	130	0.08	0.03	0.02	0.042
Pipe F586_F588	11.4405	62.2	130	0.2	0.07	0.13	0.037
Pipe F588_F589	17.7217	62.2	130	0.06	0.02	0.02	0.062
Pipe F588_F590	16.9811	62.2	130	0.1	0.03	0.04	0.043
Pipe F591_F325	19.5857	62.2	130	-1.91	0.63	8.94	0.028
Pipe F591_F592	12.0131	62.2	130	0.08	0.03	0.02	0.043
Pipe F591_F593	52.3877	62.2	130	1.74	0.57	7.55	0.028
Pipe F593_F594	18.4671	62.2	130	0.12	0.04	0.06	0.043
Pipe F596_F595	50.53	62.2	130	0.11	0.04	0.05	0.044
Pipe F596_F619	22.2003	62.2	130	1.13	0.37	3.39	0.03
Pipe F597_F596	26.5266	62.2	130	1.27	0.42	4.22	0.029
Pipe F597_F598	21.0522	62.2	130	0.36	0.12	0.41	0.035
Pipe F597_F788	14.4061	62.2	130	-1.72	0.57	7.39	0.028
Pipe F598_F599	62.7051	62.2	130	0.23	0.08	0.18	0.038
Pipe F598_F601	46.1604	62.2	130	-0.1	0.03	0.04	0.043
Pipe F601_F600	33.2001	62.2	130	0.23	0.08	0.18	0.038
Pipe F602_F603	54.5483	62.2	130	-0.98	0.32	2.59	0.031
Pipe F602_F605	39.0659	62.2	130	0.87	0.29	2.08	0.031
Pipe F603_F509	35.8841	62.2	130	-1.46	0.48	5.47	0.029
Pipe F603_F604	37.2436	62.2	130	0.28	0.09	0.25	0.036
Pipe F605_F606	48.0844	62.2	130	0.27	0.09	0.24	0.037
Pipe F605_F607	46.0473	62.2	130	0.26	0.08	0.22	0.038
Pipe F609_F508	15.8317	62.2	130	-1.39	0.46	5	0.029
Pipe F609_F608	30.7532	62.2	130	0.15	0.05	0.08	0.04
Pipe F609_F610	14.7945	62.2	130	1.15	0.38	3.52	0.03
Pipe F610_F791	62.7791	62.2	130	0.2	0.07	0.14	0.039
Pipe F611_F506	56.218	62.2	130	-0.54	0.18	0.87	0.033
Pipe F611_F612	23.1828	62.2	130	0.34	0.11	0.37	0.036
Pipe F613_F610	30.5625	62.2	130	-0.91	0.3	2.28	0.031
Pipe F613_F617	59.4	62.2	130	0.89	0.29	2.19	0.031
Pipe F613_F630	18.3416	62.2	130	-0.08	0.03	0.03	0.055
Pipe F615_F614	17.591	62.2	130	0.15	0.05	0.08	0.039
Pipe F615_F616	16.8092	62.2	130	0.21	0.07	0.15	0.038
Pipe F617_F615	14.063	62.2	130	0.4	0.13	0.51	0.035
Pipe F617_F618	58.3885	62.2	130	0.25	0.08	0.21	0.037
Pipe F619_F620	29.471	62.2	130	0.07	0.02	0.02	0.048
Pipe F619_F621	12.8105	62.2	130	0.98	0.32	2.63	0.031
Pipe F621_F626	9.50562	62.2	130	0.95	0.31	2.46	0.031
Pipe F622_F593	41.8894	62.2	130	-1.46	0.48	5.49	0.029
Pipe F622_F621	22.12	62.2	130	1.15	0.38	3.5	0.03
Pipe F623_F622	62.124	62.2	130	-0.19	0.06	0.12	0.039

Pipe F625_F624	31.1942	62.2	130	0.21	0.07	0.15	0.038
Pipe F625_F774	26.8802	62.2	130	-1.38	0.46	4.94	0.029
Pipe F626_F625	20.83	62.2	130	-1.1	0.36	3.22	0.03
Pipe F626_F758	103.397	62.2	130	1.68	0.55	7.08	0.028
Pipe F627_F626	32.4549	62.2	130	0.81	0.27	1.82	0.032
Pipe F628_F627	37.0347	62.2	130	-0.33	0.11	0.34	0.036
Pipe F629_F627	52.2913	62.2	130	1.34	0.44	4.63	0.029
Pipe F631_F611	41.2372	62.2	130	-0.14	0.05	0.07	0.041
Pipe F631_F632	98.7989	62.2	130	0.36	0.12	0.4	0.036
Pipe F631_F766	79.5423	62.2	130	-0.48	0.16	0.7	0.034
Pipe F632_F633	24.6632	62.2	130	0.45	0.15	0.61	0.034
Pipe F632_F634	20.4686	62.2	130	0.31	0.1	0.3	0.036
Pipe F636_F505	88.5838	62.2	130	-1.62	0.53	6.63	0.028
Pipe F636_F635	47.5203	62.2	130	0.62	0.2	1.12	0.033
Pipe F638_F636	58.61	62.2	130	-0.23	0.07	0.18	0.038
Pipe F638_F637	15.82	62.2	130	0.23	0.08	0.18	0.038
Pipe F640_F638	33.27	62.2	130	0.4	0.13	0.5	0.035
Pipe F640_F639	44.15	62.2	130	0.43	0.14	0.56	0.035
Pipe F640_F642	30.14	62.2	130	-0.99	0.33	2.68	0.031
Pipe F641_F484	214.85	62.2	130	0.41	0.14	0.53	0.035
Pipe F642_F643	39.6941	62.2	130	0.22	0.07	0.16	0.039
Pipe F644_F641	48.3828	62.2	130	0.84	0.28	1.95	0.031
Pipe F645_F644	14.9481	62.2	130	-0.22	0.07	0.17	0.039
Pipe F646_F642	32.8134	62.2	130	1.33	0.44	4.58	0.029
Pipe F646_F647	34.6153	62.2	130	0.12	0.04	0.05	0.041
Pipe F646_F648	19.759	62.2	130	-1.51	0.5	5.83	0.029
Pipe F648_F665	27.8584	62.2	130	2.08	0.69	10.55	0.027
Pipe F651_F648	36.2547	62.2	130	-1.71	0.56	7.31	0.028
Pipe F651_F650	10.0466	62.2	130	0.06	0.02	0.01	0.05
Pipe F653_F651	49.4615	62.2	130	-1.56	0.51	6.17	0.029
Pipe F653_F652	26.7299	62.2	130	0.31	0.1	0.3	0.036
Pipe F654_F653	9.28832	62.2	130	-1.15	0.38	3.49	0.03
Pipe F655_F654	23.5391	62.2	130	-0.18	0.06	0.11	0.039
Pipe F657_F654	26.5623	62.2	130	-0.89	0.29	2.2	0.031
Pipe F657_F656	17.3962	62.2	130	0.12	0.04	0.05	0.039
Pipe F658_F657	53.4187	62.2	130	-0.59	0.2	1.03	0.033
Pipe F658_F659	47.3371	62.2	130	0.25	0.08	0.21	0.038
Pipe F660_F658	12.6844	62.2	130	-0.14	0.05	0.08	0.044
Pipe F661_F660	64.1694	62.2	130	0.63	0.21	1.14	0.033
Pipe F661_F662	59.9507	62.2	130	-1.28	0.42	4.29	0.029
Pipe F662_F663	49.8595	62.2	130	0.23	0.08	0.18	0.038
Pipe F665_F662	11.3133	62.2	130	1.82	0.6	8.24	0.028
Pipe F665_F664	31.4395	62.2	130	0.15	0.05	0.08	0.04
Pipe F666_F644	145.605	62.2	130	1.11	0.37	3.3	0.03
Pipe F667_F661	55.4212	62.2	130	-0.26	0.09	0.23	0.038
Pipe F667_F668	8.69417	62.2	130	-0.5	0.17	0.77	0.034

Pipe F667_F719	75.8707	62.2	130	0.65	0.21	1.22	0.033
Pipe F668_F670	30.6354	62.2	130	0.35	0.12	0.4	0.036
Pipe F668_F672	8.99224	62.2	130	-0.89	0.29	2.18	0.031
Pipe F675_F353	18.8642	62.2	130	-0.48	0.16	0.71	0.034
Pipe F675_F674	25.5581	62.2	130	0.3	0.1	0.29	0.036
Pipe F676_F675	15.2344	62.2	130	-0.1	0.03	0.04	0.042
Pipe F678_F679	40.0943	62.2	130	0.34	0.11	0.38	0.036
Pipe F680_F678	25.8889	62.2	130	-0.86	0.28	2.05	0.031
Pipe F680_F681	49.1343	62.2	130	0.39	0.13	0.48	0.035
Pipe F682_F350	37.5185	62.2	130	-0.03	0.01	0	0.049
Pipe F683_F682	45.6953	62.2	130	-0.22	0.07	0.17	0.039
Pipe F683_F684	27.846	62.2	130	0.12	0.04	0.05	0.04
Pipe F684_F685	19.4135	62.2	130	0.23	0.08	0.18	0.038
Pipe F686_F684	46.5496	62.2	130	0.38	0.12	0.44	0.035
Pipe F686_F687	28.7791	62.2	130	0.15	0.05	0.08	0.04
Pipe F688_F348	43.71	62.2	130	0.34	0.11	0.37	0.036
Pipe F689_F686	23.8941	62.2	130	0.84	0.28	1.95	0.031
Pipe F690_F688	72.0612	62.2	130	0.14	0.05	0.08	0.041
Pipe F690_F689	35.8325	62.2	130	0.42	0.14	0.55	0.035
Pipe F690_F697	17.4918	62.2	130	-0.76	0.25	1.63	0.032
Pipe F691_F689	7.94892	62.2	130	0.61	0.2	1.09	0.033
Pipe F693_F691	41.1975	62.2	130	0.26	0.09	0.23	0.037
Pipe F693_F692	21.0877	62.2	130	0.13	0.04	0.06	0.04
Pipe F694_F693	34.8615	62.2	130	0.53	0.18	0.85	0.033
Pipe F694_F695	34.2289	62.2	130	0.27	0.09	0.24	0.037
Pipe F695_F691	48.7002	62.2	130	0.45	0.15	0.63	0.034
Pipe F695_F696	6.54724	62.2	130	0.08	0.03	0.02	0.044
Pipe F695_F697	27.1939	62.2	130	-0.32	0.11	0.33	0.036
Pipe F697_F698	9.63158	62.2	130	-1.17	0.39	3.63	0.03
Pipe F698_F699	12.9732	62.2	130	0.06	0.02	0.01	0.04
Pipe F698_F700	13.5709	62.2	130	-1.29	0.42	4.34	0.029
Pipe F700_F346	22.16	62.2	130	-0.5	0.17	0.75	0.034
Pipe F700_F701	33.9902	62.2	130	-0.89	0.29	2.19	0.031
Pipe F701_F702	26.5157	62.2	130	-1.15	0.38	3.51	0.03
Pipe F701_F705	39.1939	62.2	130	0.12	0.04	0.05	0.04
Pipe F702_F345	12.3	62.2	130	-2.4	0.79	13.67	0.027
Pipe F702_F705	26.4209	62.2	130	1.17	0.38	3.61	0.03
Pipe F703_F345	17.15	62.2	130	-3.69	1.22	30.42	0.025
Pipe F703_F704	26.1075	62.2	130	0.06	0.02	0.02	0.05
Pipe F705_F707	33.3247	62.2	130	1.18	0.39	3.7	0.03
Pipe F707_F706	10.1928	62.2	130	0.07	0.02	0.01	0.037
Pipe F707_F708	9.7896	62.2	130	1.01	0.33	2.78	0.031
Pipe F708_F694	7.53028	62.2	130	0.89	0.29	2.19	0.031
Pipe F708_F709	6.87634	62.2	130	0.11	0.04	0.04	0.04
Pipe F710_F703	7.66132	62.2	130	-3.59	1.18	28.83	0.025
Pipe F711_F344	21.74	62.2	130	0.36	0.12	0.4	0.035

Pipe F711_F710	13.848	62.2	130	-2.15	0.71	11.19	0.027
Pipe F713_F711	15.9454	62.2	130	-2.1	0.69	10.71	0.027
Pipe F713_F712	19.9751	62.2	130	0.34	0.11	0.36	0.036
Pipe F713_F714	6.02	62.2	130	1.73	0.57	7.47	0.028
Pipe F714_F715	36.61	62.2	130	0.25	0.08	0.21	0.037
Pipe F714_F725	80.66	62.2	130	1.54	0.51	6.03	0.029
Pipe F717_F680	75.0969	62.2	130	-0.12	0.04	0.05	0.042
Pipe F717_F718	24.2792	62.2	130	-0.53	0.18	0.85	0.033
Pipe F717_F793	100.779	62.2	130	-0.8	0.26	1.77	0.032
Pipe F718_F672	83.0104	62.2	130	-0.72	0.24	1.48	0.032
Pipe F718_F719	49.3774	62.2	130	-0.14	0.05	0.07	0.041
Pipe F719_F660	44.2029	62.2	130	-0.49	0.16	0.72	0.034
Pipe F719_F744	76.0598	62.2	130	0.75	0.25	1.59	0.032
Pipe F720_F717	67.0309	62.2	130	-1.12	0.37	3.32	0.03
Pipe F720_F721	23.0363	62.2	130	0.22	0.07	0.17	0.039
Pipe F724_F722	68.0863	62.2	130	0.42	0.14	0.53	0.035
Pipe F724_F723	81.7708	62.2	130	0.33	0.11	0.35	0.036
Pipe F724_F727	66.87	62.2	130	-1.28	0.42	4.25	0.029
Pipe F725_F726	25.64	62.2	130	1.07	0.35	3.07	0.03
Pipe F726_F727	35.35	62.2	130	0.79	0.26	1.76	0.032
Pipe F726_F733	56.93	62.2	130	0	0	0	0
Pipe F727_F732	30.6158	62.2	130	-0.71	0.23	1.44	0.032
Pipe F728_F720	28.2723	62.2	130	-0.62	0.2	1.12	0.033
Pipe F728_F729	11.2105	62.2	130	0.13	0.04	0.07	0.047
Pipe F730_F728	56.4615	62.2	130	-0.32	0.11	0.34	0.036
Pipe F730_F731	18.0281	62.2	130	0.18	0.06	0.12	0.04
Pipe F732_F730	42.3997	62.2	130	0.09	0.03	0.03	0.044
Pipe F733_F732	21.59	62.2	130	0.77	0.25	1.67	0.032
Pipe F733_F734	31.79	62.2	130	0.38	0.12	0.44	0.035
Pipe F733_F736	34.18	62.2	130	-0.91	0.3	2.26	0.031
Pipe F736_F735	34.59	62.2	130	0.45	0.15	0.62	0.034
Pipe F737_F732	31.6157	62.2	130	0.93	0.31	2.39	0.031
Pipe F737_F738	22.0137	62.2	130	0.11	0.04	0.05	0.042
Pipe F739_F737	10.884	62.2	130	1.11	0.37	3.3	0.03
Pipe F739_F740	29.5	62.2	130	0.14	0.05	0.07	0.039
Pipe F741_F739	15.596	62.2	130	1.17	0.38	3.62	0.03
Pipe F741_F742	97.0199	62.2	130	0	0	0	0
Pipe F741_F747	23.097	62.2	130	-1.35	0.44	4.69	0.029
Pipe F742_F745	61.2204	62.2	130	0.22	0.07	0.16	0.038
Pipe F744_F742	14.2269	62.2	130	0.4	0.13	0.49	0.035
Pipe F744_F743	15.0244	62.2	130	0.25	0.08	0.21	0.038
Pipe F747_F746	101.141	62.2	130	0.38	0.13	0.45	0.035
Pipe F750_F747	17.0016	62.2	130	1.86	0.61	8.55	0.028
Pipe F750_F748	41.846	62.2	130	0.35	0.12	0.39	0.036
Pipe F750_F751	29.89	62.2	130	0.12	0.04	0.06	0.045
Pipe F752_F736	34.4095	62.2	130	1.07	0.35	3.05	0.03

Pipe F752_F753	29.7553	62.2	130	0.13	0.04	0.06	0.041
Pipe F752_F754	11.4727	62.2	130	-1.3	0.43	4.42	0.029
Pipe F754_F757	18.0451	62.2	130	-1.36	0.45	4.8	0.029
Pipe F755_F754	28.1	62.2	130	-0.2	0.06	0.13	0.039
Pipe F757_F756	35.9224	62.2	130	0.13	0.04	0.06	0.042
Pipe F757_F758	4.50488	62.2	130	-1.54	0.51	6.05	0.029
Pipe F758_F759	19.95	62.2	130	0.17	0.06	0.1	0.04
Pipe F760_F750	12.5755	62.2	130	2.28	0.75	12.49	0.027
Pipe F760_F763	38.59	62.2	130	0.51	0.17	0.78	0.034
Pipe F762_F760	3.97577	62.2	130	2.32	0.76	12.84	0.027
Pipe F762_F761	23.2383	62.2	130	0.12	0.04	0.05	0.042
Pipe F762_F766	43.9121	62.2	130	-2.53	0.83	15.08	0.027
Pipe F763_F764	17.2917	62.2	130	0.17	0.06	0.1	0.038
Pipe F763_F765	29.0773	62.2	130	0.25	0.08	0.21	0.037
Pipe F766_F768	38.6363	62.2	130	1.82	0.6	8.21	0.028
Pipe F768_F767	24.032	62.2	130	0.19	0.06	0.12	0.039
Pipe F768_F769	26.2468	62.2	130	1.38	0.45	4.93	0.029
Pipe F769_F772	27.1546	62.2	130	0.48	0.16	0.69	0.034
Pipe F769_F773	47.9472	62.2	130	0.64	0.21	1.2	0.033
Pipe F772_F770	24.2587	62.2	130	0.26	0.09	0.22	0.037
Pipe F772_F771	13.8558	62.2	130	0.08	0.03	0.02	0.04
Pipe F774_F335	81.5162	62.2	130	-0.79	0.26	1.75	0.032
Pipe F774_F337	157.94	62.2	130	-0.83	0.27	1.91	0.031
Pipe F776_F223	64.1998	62.2	130	-2.24	0.74	12.01	0.027
Pipe F776_F267	31.2726	62.2	130	2.97	0.98	20.27	0.026
Pipe F777_F102	14.0404	62.2	130	1.85	0.61	8.44	0.028
Pipe F777_F104	20.8948	62.2	130	0.61	0.2	1.09	0.033
Pipe F778_F154	11.2565	62.2	130	0.2	0.07	0.13	0.036
Pipe F778_F241	24.6822	62.2	130	-0.34	0.11	0.37	0.036
Pipe F779_F148	22.8727	62.2	130	0.05	0.02	0.01	0.05
Pipe F779_F156	21.0215	62.2	130	0.12	0.04	0.05	0.038
Pipe F780_F171	5.99477	62.2	130	0.32	0.1	0.32	0.036
Pipe F780_F775	12.451	62.2	130	0.23	0.07	0.17	0.037
Pipe F781_F126	43.2123	62.2	130	-0.86	0.28	2.07	0.031
Pipe F781_F166	31.0618	62.2	130	0.41	0.13	0.52	0.035
Pipe F782_F060	31.64	62.2	130	0.26	0.09	0.23	0.037
Pipe F782_F061	40.5815	150	110	23.33	1.32	17.3	0.029
Pipe F784_F377	31.0825	62.2	130	0.36	0.12	0.4	0.036
Pipe F784_F396	29.216	62.2	130	-0.59	0.19	1.02	0.033
Pipe F784_F825	42.5672	62.2	130	0.06	0.02	0.01	0.044
Pipe F785_F278	28.8104	62.2	130	0.34	0.11	0.37	0.035
Pipe F785_F280	10.0356	62.2	130	0.28	0.09	0.25	0.037
Pipe F786_F290	26.69	150	110	12.75	0.72	5.65	0.032
Pipe F787_F546	57.11	62.2	130	1.98	0.65	9.57	0.028
Pipe F787_F552	19.92	62.2	130	0.09	0.03	0.03	0.042
Pipe F788_F789	35.55	62.2	130	0.13	0.04	0.06	0.043

Pipe F792_F350	42.14	150	110	-5.97	0.34	1.39	0.036
Pipe F792_F682	12.1438	62.2	130	0.44	0.15	0.59	0.034
Pipe F793_F710	101.221	62.2	130	-1.39	0.46	4.97	0.029
Pipe F793_F716	34.9213	62.2	130	0.28	0.09	0.26	0.037
Pipe F794_F725	65.02	62.2	130	-1.13	0.37	3.38	0.03
Pipe F794_F795	7.758	62.2	130	0.21	0.07	0.15	0.04
Pipe F800_F050	143.34	150	110	12.75	0.72	5.65	0.032
Pipe F805_F175	92.6973	62.2	130	-1.52	0.5	5.88	0.029
Pipe F810_F237	3.9932	62.2	130	0.46	0.15	0.63	0.034
Pipe F815_F232	23.9354	62.2	130	0.14	0.05	0.07	0.041
Pipe F835_F034	3.11	62.2	130	-0.39	0.13	0.48	0.036
Pipe F835_F384	10.2227	62.2	130	1.36	0.45	4.8	0.029
Pipe F840_F459	77.1696	62.2	130	0.98	0.32	2.6	0.031
Pipe F002_F001	95.5776	200	110	-47.33	1.51	15.79	0.027
Pipe F002_F056	50.8346	200	110	47.33	1.51	15.79	0.027
Pipe F003_F004	139.5	150	110	24.72	1.4	19.26	0.029
Pipe F003_F057	36.1	150	110	23.33	1.32	17.29	0.029
Pipe F004_F005	18.96	62.2	130	0.47	0.16	0.68	0.034
Pipe 1	137.84	62.2	130	3.01	0.99	20.88	0.026
Pipe 6	26.32	62.2	130	2.11	0.69	10.75	0.027
Pipe 8	94.04	62.2	130	2.54	0.83	15.17	0.027
Pipe 10	52.78	62.2	130	2.43	0.8	14.05	0.027
Pipe 12	159.91	62.2	130	0.03	0.01	0	0.045
Pipe 13	42.65	62.2	130	1.26	0.42	4.16	0.029
Pipe 14	45.64	62.2	130	1.09	0.36	3.2	0.03
Pipe 15	60.06	62.2	130	0.78	0.26	1.71	0.032
Pipe 16	44.66	62.2	130	-0.27	0.09	0.24	0.037
Pipe 17	30.58	62.2	130	-0.52	0.17	0.81	0.033
Pipe 18	163.4	62.2	130	1.65	0.54	6.82	0.028
Pipe 19	142.89	62.2	130	-0.72	0.24	1.45	0.032
Pipe 21	52.09	62.2	130	-1.65	0.54	6.84	0.028
Pipe 22	43.67	62.2	130	1.7	0.56	7.26	0.028
Pipe 23	37.86	62.2	130	0.28	0.09	0.26	0.037
Pipe 24	100.37	62.2	130	-1.22	0.4	3.88	0.03
Pipe 2	40.6688	62.2	130	0.82	0.27	1.88	0.031
Pipe 3	23	62.2	130	0.33	0.11	0.34	0.035
Pipe 4	105.86	62.2	130	-0.04	0.01	0.01	0.046
Pipe 25	65.99	62.2	130	1.94	0.64	9.24	0.028
Pipe 26	48.62	62.2	130	1.46	0.48	5.46	0.029
Pipe 27	76.77	62.2	130	1.29	0.42	4.33	0.029
Pipe 28	9.77	62.2	130	1.03	0.34	2.86	0.03
Pipe 29	10.8	62.2	130	0.69	0.23	1.34	0.032
Pipe 30	46.58	62.2	130	0.79	0.26	1.75	0.032
Pipe 31	22.15	62.2	130	-0.04	0.01	0.01	0.048
Pipe 32	149.6	62.2	130	-0.67	0.22	1.28	0.032

Pipe 33	95.83	62.2	130	-0.84	0.28	1.97	0.031
Pipe 34	121.89	62.2	130	-1.12	0.37	3.36	0.03
Pipe 35	58.51	62.2	130	-1.31	0.43	4.46	0.029
Pipe 36	42.09	62.2	130	-1.59	0.52	6.39	0.028
Pipe 38	40.38	62.2	130	1.34	0.44	4.64	0.029
Pipe 39	28.85	62.2	130	0.79	0.26	1.75	0.032
Pipe 40	8.88	62.2	130	-0.71	0.23	1.42	0.032
Pipe 41	89.9592	62.2	130	-1.2	0.39	3.77	0.03
Pipe 42	38.3935	62.2	130	0.23	0.08	0.18	0.037
Pipe 43	36.6938	62.2	130	0.1	0.03	0.04	0.044
Pipe 44	128.16	62.2	130	-0.38	0.12	0.45	0.035
Pipe 45	51.32	62.2	130	-0.39	0.13	0.48	0.035
Pipe 46	65.34	62.2	130	-0.87	0.29	2.08	0.031
Pipe 47	56.13	62.2	130	-1.49	0.49	5.68	0.029
Pipe 48	41.62	62.2	130	0.18	0.06	0.11	0.039
Pipe 49	104.03	62.2	130	0.48	0.16	0.7	0.034
Pipe 50	49.8	62.2	130	1.16	0.38	3.55	0.03
Pipe 51	133.94	62.2	130	0.44	0.15	0.6	0.034
Pipe 53	17.5	62.2	130	-0.25	0.08	0.2	0.038
Pipe 54	27.05	62.2	130	-1.15	0.38	3.53	0.03
Pipe 55	80.1	62.2	130	-1.22	0.4	3.91	0.03
Pipe 56	59.37	62.2	130	-1.66	0.55	6.92	0.028
Pipe 57	24.45	62.2	130	1.41	0.46	5.13	0.029
Pipe 58	157.63	62.2	130	-0.37	0.12	0.43	0.035
Pipe 59	12.59	62.2	130	-0.65	0.21	1.22	0.033
Pipe 60	56.68	62.2	130	-1.03	0.34	2.86	0.03
Pipe 62	41.13	62.2	130	-0.22	0.07	0.16	0.038
Pipe 63	26.59	62.2	130	-0.46	0.15	0.65	0.034
Pipe 64	26.19	62.2	130	-0.62	0.21	1.13	0.033
Pipe 65	27.84	62.2	130	-0.84	0.28	1.98	0.031
Pipe 66	40.03	62.2	130	-1.54	0.51	5.99	0.029
Pipe 67	24.89	62.2	130	-2.9	0.95	19.47	0.026
Pipe 69	147.97	62.2	130	-2.12	0.7	10.92	0.027
Pipe 70	143.13	62.2	130	-2.19	0.72	11.52	0.027
Pipe 71	50.62	62.2	130	1.74	0.57	7.54	0.028
Pipe 72	53.2	62.2	130	-0.61	0.2	1.09	0.033
Pipe 74	87.89	62.2	130	-3.37	1.11	25.62	0.025
Pipe 75	51.49	62.2	130	-0.4	0.13	0.49	0.035
Pipe 76	36.11	62.2	130	3.17	1.04	22.93	0.026
Pipe 77	14.69	62.2	130	2.62	0.86	16.15	0.026
Pipe 78	40.84	62.2	130	2.3	0.76	12.61	0.027
Pipe 79	338.78	62.2	130	-0.61	0.2	1.07	0.033
Pipe 81	38.29	62.2	130	2.01	0.66	9.84	0.028
Pipe 83	105.25	62.2	130	-0.1	0.03	0.04	0.043
Pipe 84	12.85	62.2	130	-0.56	0.18	0.93	0.033
Pipe 85	15.04	62.2	130	-1.02	0.34	2.82	0.03

Pipe 86	50.36	62.2	130	-1.18	0.39	3.7	0.03
Pipe 88	77.04	62.2	130	1.31	0.43	4.46	0.029
Pipe 7	129	62.2	130	-0.44	0.15	0.59	0.034
Pipe 11	71.04	150	110	17.23	0.98	9.87	0.031
Pipe 20	9.24	150	110	17.23	0.98	9.86	0.031
Pipe 37	95	150	110	17.23	0.98	9.87	0.031
Pipe 52	69.71	62.2	130	1.26	0.41	4.16	0.029
Pipe 61	109.13	62.2	130	1.26	0.41	4.16	0.029
Pipe 68	96.39	200	110	54.55	1.74	20.54	0.027
Pipe 80	29.89	200	110	48.81	1.55	16.72	0.027
Pipe 82	32.97	200	110	54.55	1.74	20.54	0.027
Pipe 87	465.59	250	110	57.11	1.16	7.54	0.027
Pipe 89	295.24	250	110	57.11	1.16	7.54	0.027
Pipe 90	198.91	250	110	57.11	1.16	7.54	0.027
Pipe 92	64.56	150	110	39.88	2.26	46.69	0.027
Pipe 93	119.33	62.2	130	-1.09	0.36	3.17	0.03
Pipe 94	80.43	62.2	130	1.02	0.34	2.82	0.03
Pipe 95	68.13	62.2	130	-1.26	0.41	4.15	0.029
Pipe 96	146.25	62.2	130	2.68	0.88	16.84	0.026
Pipe 97	78.3	62.2	130	4.4	1.45	42.04	0.025
Pipe 98	32.15	62.2	130	1.71	0.56	7.33	0.028
Pipe 9	43.64	62.2	130	2.09	0.69	10.56	0.027
Pipe 73	10.42	62.2	130	1.26	0.41	4.16	0.029
Pipe 91	0.98	200	110	39.88	1.27	11.54	0.028
Pipe 105	48.52	150	110	16.85	0.95	9.46	0.031
Pipe 106	32.56	150	110	16.85	0.95	9.47	0.031
Pipe 107	57.22	150	110	16.85	0.95	9.46	0.031
Pipe 108	67.39	150	110	16.85	0.95	9.47	0.031
Pipe 109	43.58	150	110	14.12	0.8	6.83	0.031
Pipe 110	37.99	150	110	14.12	0.8	6.83	0.031
Pipe 111	19.12	150	110	12.94	0.73	5.81	0.032
Pipe 112	44.95	150	110	12.94	0.73	5.81	0.032
Pipe 113	88.25	150	110	12.94	0.73	5.81	0.032
Pipe 114	32.12	150	110	12.94	0.73	5.81	0.032
Pipe 115	2.2	150	110	12.94	0.73	5.82	0.032
Pipe 116	200.3	150	110	6.03	0.34	1.41	0.036
Pipe 117	96.52	150	110	4.63	0.26	0.86	0.037
Pipe 118	58.54	150	110	4.63	0.26	0.86	0.037
Pipe 119	33.46	150	110	4.63	0.26	0.87	0.037
Pipe 120	30.09	150	110	4.63	0.26	0.87	0.037
Pipe 121	32.68	150	110	4.63	0.26	0.86	0.037
Pipe 122	19.98	150	110	4.63	0.26	0.87	0.037
Pipe 123	39.58	150	110	-0.76	0.04	0.03	0.054
Pipe 124	59.28	150	110	-0.76	0.04	0.03	0.048
Pipe 125	56.56	150	110	-0.76	0.04	0.03	0.046
Pipe 126	17.73	150	110	-0.76	0.04	0.03	0.053

Pipe 127	76.79	150	110	-0.76	0.04	0.03	0.049
Pipe 129	1.22	150	110	23.03	1.3	16.83	0.029
Pipe 130	0.61	150	110	2.72	0.15	0.24	0.03
Pipe 132	0.72	150	110	1.63	0.09	0	0
Pipe 133	0.51	150	110	1.18	0.07	0	0
Pipe 134	0.29	150	110	6.91	0.39	2.05	0.04
Pipe 135	0.59	150	110	1.4	0.08	0	0
Pipe 136	0.69	150	110	5.39	0.3	1.08	0.034
Pipe 137	1.15	150	110	3.25	0.18	0.52	0.045
Pipe 138	0.93	150	110	1.96	0.11	0.16	0.038
Pipe 139	1.51	150	110	7.64	0.43	2.17	0.034
Pipe 140	1.37	150	110	6.51	0.37	1.63	0.035
Pipe 142	1.97	62.2	130	2.37	0.78	13.37	0.027
Pipe 143	1.97	62.2	130	2.76	0.91	17.75	0.026
Pipe 144	133.08	150	110	-4.54	0.26	0.83	0.037
Pipe 145	57.79	150	110	-4.54	0.26	0.83	0.037
Pipe 146	49.27	150	110	-4.54	0.26	0.83	0.037
Pipe 147	38.83	150	110	-6.82	0.39	1.77	0.035
Pipe 148	100.69	150	110	-6.6	0.37	1.67	0.035
Pipe 149	142.56	150	110	-6.6	0.37	1.67	0.035
Pipe 150	133.63	150	110	-8.45	0.48	2.64	0.034
Pipe 151	49.14	150	110	-8.45	0.48	2.64	0.034
Pipe 152	25.19	150	110	-8.45	0.48	2.64	0.034
Pipe 153	42.14	150	110	-8.45	0.48	2.64	0.034
Pipe 154	0.6	150	110	2.78	0.16	0.25	0.029
Pipe 157	2.21	62.2	130	4.19	1.38	38.32	0.025
Pipe 158	1.37	150	110	4.64	0.26	0.87	0.037
Pipe 159	1.8	150	110	0.3	0.02	0	0
Pipe 160	0.94	150	110	5.17	0.29	1.11	0.038
Pipe 161	1.98	150	110	4.76	0.27	0.9	0.037
Pipe 162	0.52	150	110	1.85	0.1	0.29	0.077
Pipe 163	0.59	150	110	2.28	0.13	0.25	0.045
Pipe 164	47.39	150	110	19.44	1.1	12.35	0.03
Pipe 165	18.17	150	110	19.44	1.1	12.34	0.03
Pipe 166	57.99	150	110	19.44	1.1	12.35	0.03
Pipe 167	38.03	150	110	11.1	0.63	4.37	0.033
Pipe 168	99.16	150	110	11.1	0.63	4.37	0.033
Pipe 169	124.79	150	110	11.1	0.63	4.37	0.033
Pipe 170	140.15	150	110	3.83	0.22	0.61	0.038
Pipe 171	123.09	150	110	-2.47	0.14	0.27	0.041
Pipe 172	145.62	150	110	-2.47	0.14	0.27	0.041
Pipe 173	49.27	150	110	-2.47	0.14	0.27	0.04
Pipe 174	214.84	150	110	-2.47	0.14	0.27	0.041
Pipe 175	15.45	150	110	-2.47	0.14	0.27	0.041
Pipe 176	206.05	150	110	-2.47	0.14	0.27	0.041
Pipe 177	47.36	150	110	-2.47	0.14	0.27	0.041

Pipe 178	73.92	150	110	-2.47	0.14	0.27	0.041
Pipe 179	33.34	150	110	-2.47	0.14	0.27	0.04
Pipe 180	83.58	150	110	-2.47	0.14	0.27	0.041
Pipe 181	100.46	150	110	-9.93	0.56	3.56	0.033
Pipe 182	52.03	150	110	-9.93	0.56	3.56	0.033
Pipe 183	111.87	150	110	-12.75	0.72	5.65	0.032
Pipe 184	17.91	150	110	-12.75	0.72	5.65	0.032
Pipe 101	0.49	150	110	8.34	0.47	2.43	0.032
Pipe 102	3.16	150	110	3.67	0.21	0.57	0.039
Pipe 103	2.19	150	110	-21.53	1.22	14.88	0.03
Pipe 104	1.76	150	110	-24.22	1.37	18.6	0.029
Pipe 185	0.51	150	110	7.27	0.41	2.04	0.036
Pipe 186	9.08	250	110	57.11	1.16	7.54	0.027
Pipe 190	0.22	150	110	3.04	0.17	0	0
Pipe 192	1.46	150	110	4.36	0.25	0.82	0.039
Pipe 193	0.71	150	110	2.81	0.16	0.42	0.049
Pipe 194	1.05	150	110	0.38	0.02	0	0
Pipe 195	0.86	150	110	2.88	0.16	0.35	0.038
Pipe 198	128.37	150	110	4.08	0.23	0.69	0.038
Pipe 189	0.71	150	110	-29.83	1.69	27.25	0.028
Pipe 191	0.77	150	110	11.7	0.66	4.83	0.032
Pipe 196	161.38	150	110	8.27	0.47	2.53	0.034
Pipe 197	1.47	150	110	3.62	0.21	0.61	0.043
Pipe 202	1.56	150	110	-3.66	0.21	0.57	0.039
Pipe 203	101.78	150	110	8.3	0.47	2.55	0.034
Pipe 204	0.9	150	110	0.59	0.03	0	0
Pipe 205	0.95	150	110	1.5	0.08	0	0
Pipe 206	0.91	62.2	130	1.57	0.52	6.21	0.029
Pipe 207	0.95	62.2	130	0.56	0.19	0.94	0.033
Pipe 208	129.6	150	110	6.21	0.35	1.49	0.036
Pipe 209	68.27	62.2	130	0.99	0.33	2.67	0.031
Pipe 210	1.33	62.2	130	0.21	0.07	0.11	0.03
Pipe 211	22.31	62.2	130	0.35	0.12	0.39	0.035
Pipe 212	40.06	62.2	130	0.15	0.05	0.08	0.042
Pipe 213	2.28	62.2	130	1.06	0.35	3	0.03
Pipe 214	2.25	62.2	130	0.98	0.32	2.65	0.031
Pipe 215	0.55	150	110	-0.21	0.01	0	0
Pipe 216	158.51	150	110	2.05	0.12	0.19	0.042
Pipe 217	0.49	62.2	130	1.32	0.43	4.56	0.03
Pipe 218	0.56	62.2	130	0.52	0.17	0.8	0.033
Pipe 220	18.66	62.2	130	0.37	0.12	0.42	0.036
Pipe 221	33.72	62.2	130	-0.07	0.02	0.02	0.046

Pipe 222	39.85	62.2	130	-0.56	0.19	0.93	0.033
Pipe 223	0.88	150	110	4.11	0.23	0.68	0.037
Pipe 224	1.41	150	110	1.77	0.1	0.11	0.031
Pipe 225	1.01	62.2	130	1.76	0.58	7.66	0.028
Pipe 226	206.61	150	110	5.13	0.29	1.05	0.037
Pipe 229	0.81	62.2	130	1	0.33	2.76	0.031
Pipe 230	370.46	150	110	-2.91	0.16	0.37	0.04
Pipe 231	1.29	62.2	130	0.95	0.31	2.42	0.03
Pipe 232	128.39	150	110	-5.76	0.33	1.3	0.036
Pipe 233	0.5	62.2	130	0.73	0.24	1.49	0.032
Pipe 234	0.58	62.2	130	2.43	0.8	14.11	0.027
Pipe 235	0.46	150	110	7.46	0.42	1.94	0.032
Pipe 236	44.33	62.2	130	-0.29	0.1	0.28	0.037
Pipe 237	0.8	62.2	130	5.09	1.67	55.07	0.024
Pipe 238	172.11	150	110	16.68	0.94	9.3	0.031
Pipe 239	1.64	62.2	130	4.55	1.5	44.74	0.024
Pipe 240	1.89	62.2	130	2.3	0.76	12.6	0.027
Pipe 241	2.13	150	110	-0.15	0.01	0	0
Pipe 243	229.04	150	110	9.84	0.56	3.5	0.033
Pipe 244	71.28	62.2	130	1.41	0.46	5.11	0.029
Pipe 245	40.22	62.2	130	1.32	0.43	4.52	0.029
Pipe 246	43.77	62.2	130	0.95	0.31	2.45	0.031
Pipe 247	41.66	62.2	130	0.82	0.27	1.87	0.031
Pipe 248	31.94	62.2	130	0.71	0.23	1.44	0.032
Pipe 249	278.25	150	110	9.69	0.55	3.4	0.033
Pipe 250	164.15	150	110	3.2	0.18	0.44	0.039
Pipe 251	10.97	62.2	130	2.01	0.66	9.86	0.028
Pipe 252	103.13	62.2	130	3.11	1.02	22.11	0.026
Pipe 253	23.07	62.2	130	2.94	0.97	19.91	0.026
Pipe 254	46.49	62.2	130	2.74	0.9	17.53	0.026
Pipe 255	34.77	62.2	130	2.29	0.75	12.56	0.027
Pipe 256	60.18	62.2	130	1.91	0.63	9.01	0.028
Pipe 259	24.27	62.2	130	1.91	0.63	9.01	0.028
Pipe 260	80.13	62.2	130	0.79	0.26	1.74	0.032
Pipe 261	21.66	62.2	130	0.54	0.18	0.86	0.034
Pipe 262	37.32	62.2	130	0.18	0.06	0.11	0.039
Pipe 263	2.52	150	110	13.74	0.78	6.5	0.032
Pipe 264	226.72	150	110	6.49	0.37	1.62	0.035
Pipe 265	44.42	62.2	130	0.78	0.26	1.69	0.032
Pipe 266	56.39	62.2	130	0.63	0.21	1.16	0.033
Pipe 267	12.64	62.2	130	-0.51	0.17	0.78	0.034
Pipe 268	2.21	62.2	130	5.26	1.73	58.59	0.024
Pipe 269	1.09	62.2	130	2.11	0.69	10.79	0.027
Pipe 270	161.08	150	110	-0.88	0.05	0.04	0.048
Pipe 271	1.14	62.2	130	1.77	0.58	7.83	0.028
Pipe 272	2.53	62.2	130	0.18	0.06	0.12	0.04

Pipe 273	2.16	150	110	6.03	0.34	1.45	0.037
Pipe 274	137.93	150	110	-5.01	0.28	1	0.037
Pipe 199	1.22	150	110	5.4	0.31	1.22	0.038
Pipe 200	1.5	150	110	-2.24	0.13	0.3	0.055
Pipe 201	1.39	150	110	0.93	0.05	0	0
Pipe 227	1.04	150	110	4.22	0.24	0.72	0.037
Pipe 228	1.15	150	110	2.89	0.16	0.39	0.043
Pipe 276	0.43	150	110	3.49	0.2	0.35	0.026
Pipe 277	59.86	12	100	0	0.04	0.6	0.089
Pipe 278	0.77	150	110	5.07	0.29	0.97	0.035
Pipe 279	0.94	62.2	130	3.83	1.26	32.62	0.025
Pipe 280	0.9	62.2	130	-0.4	0.13	0.5	0.035
Pipe 128	1	62.2	130	5.15	1.69	56.26	0.024
Valve 99	#N/A	200	#N/A	54.55	1.74	13.34	0
Valve 100	#N/A	200	#N/A	48.81	1.55	8.34	0
Valve 187	#N/A	400	#N/A	160.5	1.28	0	0
Valve 188	#N/A	250	#N/A	57.11	1.16	2.2	0

Table 6.36.Details of Pressure for DNI F

Node ID	**Elevation**	**Base Demand**	**Demand**	**Head**	**Pressure**
	m	**LPS**	**LPS**	**m**	**m**
	Elevation	Base Demand	Demand	Head	Pressure
Node ID	m	LPS	LPS	m	m
Junc A-1.2	1312.5	102.6	153.9	1339	26.64
Junc A-1.3	1296	73.8	110.7	1338	42.12
Junc A-1.4	1296	0	0	1338	42.2
Junc TO_South	1297.1	0	0	1338	41.39
Junc TO_A-1.2	1312.5	0	0	1339	26.81
Junc F850	1300	0.7109	1.07	1328	28.25
Junc F001	1300	0.2743	0.41	1329	28.5
Junc F002	1297.67	0	0	1327	29.32
Junc F003	1297.67	0.2158	0.32	1321	23.65
Junc F004	1299.85	0.2887	0.43	1318	18.59
Junc F005	1299.38	0.3165	0.47	1318	19.05
Junc F006	1299.75	0.0799	0.12	1318	18.41
Junc F007	1299.01	0.3595	0.54	1318	19.06
Junc F008	1298.79	0.1793	0.27	1317	17.86
Junc F009	1298.79	0.1217	0.18	1317	17.83
Junc F010	1298.38	0.1894	0.28	1316	17.49
Junc F011	1298.38	0.3504	0.53	1316	17.46
Junc F012	1298.93	0.1591	0.24	1316	16.91
Junc F013	1300.06	0.1113	0.17	1316	15.61
Junc F014	1301.36	0.1245	0.19	1316	14.16
Junc F015	1298.61	0.1674	0.25	1316	16.91
Junc F016	1298.93	0.0718	0.11	1316	16.76

Junc F017	1298.8	0.2808	0.42	1316	16.88
Junc F018	1298.21	0.122	0.18	1315	17.13
Junc F019	1299.08	0.3092	0.46	1315	16.22
Junc F020	1297.62	0.1763	0.26	1315	17.69
Junc F021	1298.36	0.1188	0.18	1315	16.96
Junc F022	1300.09	0.1149	0.17	1315	15.32
Junc F023	1299.65	0.0472	0.07	1315	15.77
Junc F024	1298.52	0.1231	0.18	1315	16.91
Junc F025	1299.01	0.2939	0.44	1315	16.44
Junc F026	1298.24	0.6175	0.93	1314	16.1
Junc F027	1298.8	0.2009	0.3	1315	15.75
Junc F028	1298.89	0.0713	0.11	1315	16.1
Junc F029	1298.73	0.1682	0.25	1315	16.61
Junc F030	1299.49	0.1664	0.25	1315	15.53
Junc F031	1299.13	0.3169	0.48	1315	15.88
Junc F032	1300.24	0.323	0.48	1315	15.16
Junc F033	1298.16	0.0616	0.09	1315	17.24
Junc F034	1298.09	0.0076	0.01	1314	16.23
Junc F035	1296.17	0.0357	0.05	1315	19.25
Junc F036	1297.93	0.078	0.12	1315	17.48
Junc F037	1297.78	0.1414	0.21	1315	17.67
Junc F038	1297.37	0.1232	0.18	1316	18.23
Junc F039	1297.37	0.0444	0.07	1316	18.23
Junc F040	1297.11	0.0563	0.08	1315	17.55
Junc F041	1297.19	0.1709	0.26	1316	18.48
Junc F042	1296.89	0.0699	0.1	1315	18.26
Junc F043	1296.52	0.0412	0.06	1316	19.15
Junc F044	1295.92	0.1498	0.22	1315	19.11
Junc F045	1295.75	0.196	0.29	1315	19.18
Junc F046	1296.13	0.0906	0.14	1316	19.95
Junc F047	1296.18	0.203	0.3	1315	18.66
Junc F048	1293.96	0.0936	0.14	1315	20.76
Junc F049	1292.63	0.1686	0.25	1315	22.52
Junc F050	1291.84	0.4527	0.68	1317	24.93
Junc F051	1296.26	0.0837	0.13	1315	19.21
Junc F052	1295.98	0.3013	0.45	1318	22.05
Junc F053	1295.95	0.1808	0.27	1318	22.13
Junc F054	1295.85	0.1987	0.3	1319	22.7
Junc F055	1295.99	0	0	1321	24.87
Junc F056	1297.15	0	0	1326	29.04
Junc F057	1297.19	0	0	1321	23.51
Junc F058	1297.12	0.2783	0.42	1320	23.36
Junc F059	1297.1	0.1031	0.15	1320	23.33
Junc F060	1297.4	0.174	0.26	1320	22.85
Junc F061	1296.81	0	0	1320	22.93
Junc F062	1296.81	0	0	1320	22.91

Junc F063	1297.28	0.1457	0.22	1319	21.66
Junc F064	1297.8	0.2478	0.37	1319	21.12
Junc F065	1297.35	0.1384	0.21	1319	21.38
Junc F066	1296.78	0.2779	0.42	1319	21.93
Junc F067	1296.53	0.149	0.22	1319	22.05
Junc F068	1296.82	0.1607	0.24	1319	21.75
Junc F069	1296.97	0.1189	0.18	1318	21.25
Junc F070	1297.22	0.0963	0.14	1317	19.46
Junc F071	1297.25	0.0775	0.12	1317	19.43
Junc F072	1296.86	0.2892	0.43	1316	19.6
Junc F073	1298.23	0.3903	0.59	1316	18.23
Junc F074	1298.74	0.2019	0.3	1316	17.71
Junc F075	1298.71	0.1627	0.24	1317	17.82
Junc F076	1298.25	0.292	0.44	1316	17.98
Junc F077	1297.74	0.0225	0.03	1316	18.28
Junc F078	1297.74	0.0319	0.05	1315	16.91
Junc F079	1297.95	0.0091	0.01	1316	18.05
Junc F080	1298.04	0.1125	0.17	1316	17.96
Junc F081	1297.89	0.0141	0.02	1315	16.83
Junc F082	1298.05	0.0115	0.02	1316	17.94
Junc F083	1298.31	0.2405	0.36	1316	17.67
Junc F084	1297.85	0.0498	0.07	1315	16.8
Junc F085	1297.74	0.1193	0.18	1315	16.96
Junc F086	1298.01	0.132	0.2	1315	16.79
Junc F087	1299.08	0.2617	0.39	1315	15.69
Junc F088	1298.01	0.1522	0.23	1315	16.53
Junc F089	1298.04	0.1447	0.22	1315	16.5
Junc F090	1298.24	0.1204	0.18	1316	17.81
Junc F091	1297.9	0.0064	0.01	1316	18.15
Junc F092	1298.54	0.2072	0.31	1316	17.69
Junc F093	1297.94	0.0122	0.02	1316	18.29
Junc F094	1297.94	0.0344	0.05	1316	18.3
Junc F095	1297.95	0.0336	0.05	1316	18.29
Junc F096	1298.59	0.0301	0.05	1316	17.67
Junc F097	1298.19	0.0698	0.1	1316	17.93
Junc F098	1298.56	0.0322	0.05	1316	17.49
Junc F099	1298.56	0.0184	0.03	1314	15.88
Junc F100	1298.52	0.1294	0.19	1314	15.97
Junc F101	1297.9	0.1787	0.27	1314	16.58
Junc F102	1298.39	0.1194	0.18	1315	16.42
Junc F103	1297.89	0.1367	0.21	1315	16.92
Junc F104	1298.44	0.4084	0.61	1315	16.47
Junc F105	1298.47	0.0885	0.13	1315	16.64
Junc F106	1297.87	0.0965	0.14	1316	18.11
Junc F107	1298.05	0.1047	0.16	1316	17.84
Junc F108	1298.1	0.2399	0.36	1316	17.77

Junc F109	1298.62	0.0817	0.12	1314	15.29
Junc F110	1298.64	0.5124	0.77	1314	15.19
Junc F111	1298.43	0.0745	0.11	1316	17.36
Junc F112	1298.02	0.207	0.31	1316	17.75
Junc F113	1298.06	0.085	0.13	1314	15.77
Junc F114	1298.85	0.1699	0.25	1314	14.98
Junc F115	1298.51	0.0902	0.14	1316	17.22
Junc F116	1297.85	0.2311	0.35	1316	17.86
Junc F117	1297.67	0.1289	0.19	1316	18.06
Junc F118	1298.2	0.1676	0.25	1316	17.61
Junc F119	1297.25	0.0559	0.08	1316	18.55
Junc F120	1297.74	0.1047	0.16	1316	18.05
Junc F121	1296.8	0.288	0.43	1316	18.97
Junc F122	1297.01	0.0912	0.14	1316	18.78
Junc F123	1297	0.1396	0.21	1316	18.79
Junc F124	1296.91	0.0848	0.13	1316	18.88
Junc F125	1296.86	0.1248	0.19	1316	18.92
Junc F126	1296.91	0.0832	0.12	1316	18.88
Junc F127	1297.67	0.2385	0.36	1316	18.03
Junc F128	1297.69	0.106	0.16	1316	18.03
Junc F129	1297.43	0.1305	0.2	1314	16.33
Junc F130	1297.29	0.1049	0.16	1314	16.44
Junc F131	1297.45	0.1747	0.26	1314	16.27
Junc F132	1297.26	0.037	0.06	1314	16.47
Junc F133	1297.36	0.0253	0.04	1314	16.4
Junc F134	1297.36	0.2621	0.39	1314	16.4
Junc F135	1297.19	0.0491	0.07	1314	16.51
Junc F136	1297.22	0.2135	0.32	1314	16.47
Junc F137	1297.15	0.2953	0.44	1314	16.52
Junc F138	1297.63	0.5797	0.87	1314	15.91
Junc F139	1297.02	0.1254	0.19	1316	18.69
Junc F140	1297.02	0.1248	0.19	1314	16.73
Junc F141	1297.02	0.0695	0.1	1316	18.69
Junc F142	1297.49	0.1312	0.2	1316	18.16
Junc F143	1297.06	0.305	0.46	1316	18.56
Junc F144	1297.49	0.144	0.22	1314	16.43
Junc F145	1297.36	0.4792	0.72	1314	16.51
Junc F146	1296.77	0.1888	0.28	1314	17.71
Junc F147	1296.77	0.0341	0.05	1316	18.88
Junc F148	1296.77	0.0235	0.04	1316	18.88
Junc F149	1297.35	0.3795	0.57	1315	17.36
Junc F150	1298.15	0.4247	0.64	1315	16.56
Junc F151	1297.27	0.1291	0.19	1315	17.43
Junc F152	1297.28	0.1902	0.29	1315	17.42
Junc F153	1297.15	0.2132	0.32	1315	17.53
Junc F154	1297.11	0.0404	0.06	1315	17.58

Junc F155	1296.77	0.1002	0.15	1315	17.86
Junc F156	1296.96	0.0804	0.12	1316	18.69
Junc F157	1296.38	0.1091	0.16	1316	19.27
Junc F158	1296.48	0.0916	0.14	1316	19.18
Junc F159	1296.49	0.0629	0.09	1316	19.21
Junc F161	1296.23	0.0898	0.13	1316	19.46
Junc F162	1296.49	0.0222	0.03	1316	19.21
Junc F163	1296.25	0.0546	0.08	1316	19.44
Junc F164	1296.14	0.1295	0.19	1316	19.54
Junc F165	1296.2	0.3258	0.49	1316	19.49
Junc F166	1296.39	0.2717	0.41	1316	19.29
Junc F167	1296.57	0.1706	0.26	1316	19.23
Junc F168	1296.37	0.0152	0.02	1316	19.43
Junc F169	1296.37	0.0173	0.03	1316	19.43
Junc F170	1296.37	0.1451	0.22	1316	19.43
Junc F171	1296.16	0.2046	0.31	1316	19.75
Junc F172	1297.21	0.1247	0.19	1316	18.78
Junc F173	1298.11	0.1393	0.21	1316	18.18
Junc F174	1297.35	0.3249	0.49	1316	18.91
Junc F175	1296.19	0.0781	0.12	1317	20.87
Junc F176	1296.19	0.1111	0.17	1317	20.92
Junc F177	1296.32	0.0905	0.14	1317	20.86
Junc F178	1296.16	0.0863	0.13	1317	21.02
Junc F179	1296.17	0.3534	0.53	1317	20.86
Junc F180	1296.46	0	0	1318	21.31
Junc F181	1296.74	0	0	1318	21.2
Junc F182	1296.74	0	0	1318	21.34
Junc F183	1296.43	0.234	0.35	1317	20.54
Junc F184	1296.6	0.1605	0.24	1317	20.38
Junc F185	1296.38	0.1396	0.21	1317	20.6
Junc F186	1296.32	0.1842	0.28	1317	20.65
Junc F187	1296.78	0	0	1319	22.48
Junc F188	1296.78	0	0	1319	22.5
Junc F189	1295.98	0.0833	0.12	1317	21.24
Junc F190	1295.98	0.0752	0.11	1317	21.1
Junc F191	1296.4	0.2346	0.35	1317	20.78
Junc F192	1296.06	0.1296	0.19	1316	19.91
Junc F193	1296.48	0.0659	0.1	1316	19.4
Junc F194	1296.64	0.1754	0.26	1316	19.23
Junc F195	1296.41	0.1411	0.21	1316	19.44
Junc F196	1296.4	0.2735	0.41	1316	19.43
Junc F197	1296.03	0.2012	0.3	1316	19.8
Junc F198	1296.33	0.2586	0.39	1316	19.84
Junc F199	1296.22	0.0651	0.1	1316	19.97
Junc F200	1295.93	0.0314	0.05	1317	20.81
Junc F201	1296.17	0.0883	0.13	1317	20.34

Junc F202	1296.13	0.1067	0.16	1316	19.89
Junc F203	1296.64	0.0952	0.14	1316	19.23
Junc F204	1296.57	0.1966	0.29	1316	19.21
Junc F205	1296.34	0.1798	0.27	1316	19.36
Junc F206	1296.21	0.3198	0.48	1316	19.45
Junc F207	1296.03	0.1371	0.21	1316	19.66
Junc F208	1296.03	0.2879	0.43	1316	19.66
Junc F209	1296.14	0.0829	0.12	1316	19.63
Junc F210	1296.34	0.1658	0.25	1316	19.52
Junc F211	1296.05	0.1306	0.2	1316	19.89
Junc F212	1296.3	0.2172	0.33	1316	19.65
Junc F213	1296.3	0.0934	0.14	1316	19.68
Junc F214	1296.09	0.0359	0.05	1316	19.88
Junc F215	1295.94	0.1002	0.15	1316	20.09
Junc F216	1295.86	0.1373	0.21	1316	20.31
Junc F217	1296.07	0.0882	0.13	1316	20.1
Junc F218	1296.14	0.0303	0.05	1316	19.85
Junc F219	1296.15	0.048	0.07	1316	19.84
Junc F220	1296.02	0.0389	0.06	1316	19.97
Junc F221	1296.07	0.0524	0.08	1316	19.92
Junc F222	1295.2	0.6544	0.98	1318	23.09
Junc F223	1294.82	0.3216	0.48	1318	22.75
Junc F224	1295.74	0	0	1318	22.64
Junc F225	1295.27	0.2413	0.36	1316	20.64
Junc F226	1296.17	0.3782	0.57	1316	19.41
Junc F227	1296.32	0.1225	0.18	1316	19.27
Junc F228	1296.64	0.3377	0.51	1316	18.97
Junc F229	1296.82	0.1034	0.16	1316	18.78
Junc F230	1296.68	0.1347	0.2	1316	18.91
Junc F231	1297.26	0.088	0.13	1316	18.38
Junc F232	1296.57	0.0956	0.14	1316	19.09
Junc F233	1296.39	0.1051	0.16	1316	19.25
Junc F234	1297.29	0.1247	0.19	1316	18.33
Junc F235	1296.5	0.1606	0.24	1316	19.13
Junc F237	1296.42	0.0358	0.05	1316	19.21
Junc F238	1296.62	0.1627	0.24	1316	18.99
Junc F239	1297.17	0.0846	0.13	1316	18.45
Junc F240	1297.17	0.0407	0.06	1315	17.56
Junc F241	1297.27	0.1613	0.24	1315	17.42
Junc F242	1297.38	0.2283	0.34	1315	17.31
Junc F243	1298.01	0.1181	0.18	1315	16.56
Junc F244	1298.2	0.4021	0.6	1315	16.35
Junc F245	1298.25	0.0978	0.15	1315	16.33
Junc F246	1298.24	0.2578	0.39	1315	17.14
Junc F247	1298.02	0.1265	0.19	1315	17.39
Junc F248	1297.77	0.0949	0.14	1315	17.68

Junc F249	1297.38	0.095	0.14	1315	17.81
Junc F250	1297.53	0.0885	0.13	1315	17.67
Junc F251	1296.49	0.0649	0.1	1316	19.14
Junc F252	1297.01	0.114	0.17	1316	18.62
Junc F253	1296.51	0.1056	0.16	1315	18.5
Junc F254	1296.2	0.1332	0.2	1315	18.73
Junc F255	1296.23	0	0	1317	21.18
Junc F256	1295.17	0.3389	0.51	1314	19.12
Junc F257	1295.33	0.3678	0.55	1314	18.92
Junc F258	1294.72	0.1635	0.25	1314	19.43
Junc F259	1294.89	0.1987	0.3	1314	19.25
Junc F260	1294.45	0.3465	0.52	1314	19.66
Junc F261	1291.98	0.2272	0.34	1315	23.2
Junc F262	1291.06	0.2277	0.34	1315	24.15
Junc F263	1293.27	0.1732	0.26	1316	22.31
Junc F264	1292.69	0.3331	0.5	1316	22.9
Junc F265	1294.48	0.1501	0.23	1316	21.52
Junc F266	1293.47	0.1387	0.21	1316	22.53
Junc F267	1293.69	0.0754	0.11	1316	22.48
Junc F268	1294.41	0.1313	0.2	1316	21.76
Junc F269	1295.73	0.1128	0.17	1316	20.04
Junc F270	1295.54	0.3826	0.57	1316	20.21
Junc F271	1295.94	0.0538	0.08	1315	19.2
Junc F272	1295.89	0.1375	0.21	1314	18.26
Junc F273	1296.6	0.0977	0.15	1314	17.57
Junc F274	1297.02	0.1345	0.2	1314	17.13
Junc F275	1293.62	0.1346	0.2	1314	20.61
Junc F276	1294.19	0.1527	0.23	1314	19.8
Junc F277	1294.34	0.1363	0.2	1314	19.65
Junc F278	1291.05	0.2277	0.34	1314	22.88
Junc F279	1293.85	0.1688	0.25	1314	20.08
Junc F280	1294.73	0.1123	0.17	1314	19.21
Junc F281	1294.9	0.1525	0.23	1314	19.04
Junc F282	1293.83	0.1263	0.19	1314	20.16
Junc F283	1293.7	0.1697	0.25	1314	20.24
Junc F284	1295.36	0.0502	0.08	1314	18.59
Junc F285	1295.43	0.0307	0.05	1314	18.52
Junc F286	1294.75	0.0973	0.15	1314	19.16
Junc F287	1294.71	0.0492	0.07	1315	20.02
Junc F288	1295.06	0.1447	0.22	1315	19.66
Junc F289	1294.74	0.1043	0.16	1314	19.16
Junc F290	1293.41	0.1307	0.2	1314	20.49
Junc F291	1294.36	0.029	0.04	1314	19.53
Junc F292	1293.71	0.1546	0.23	1314	20.17
Junc F293	1294.36	0.0181	0.03	1315	20.6
Junc F294	1294.36	0.0312	0.05	1325	30.68

Junc F295	1294.78	0.078	0.12	1325	30.56
Junc F296	1294.55	0.0714	0.11	1325	30.78
Junc F297	1294.38	0.0201	0.03	1326	31.22
Junc F298	1294.38	0.053	0.08	1314	19.51
Junc F299	1293.48	0.1219	0.18	1314	20.41
Junc F300	1294.05	0.0683	0.1	1325	31.33
Junc F301	1294.2	0.1534	0.23	1325	31.18
Junc F302	1294.82	0.1181	0.18	1325	29.72
Junc F303	1294.15	0.1683	0.25	1325	30.38
Junc F304	1293.43	0.1895	0.28	1324	30.49
Junc F305	1293.29	0.0482	0.07	1323	30.14
Junc F306	1293.43	0.0726	0.11	1324	30.55
Junc F307	1293.22	0.1379	0.21	1324	30.73
Junc F308	1292.97	0.1635	0.25	1324	30.97
Junc F309	1293.35	0.0369	0.06	1324	30.58
Junc F310	1293.19	0.0531	0.08	1324	30.74
Junc F311	1293.54	0.0446	0.07	1324	30.39
Junc F312	1293.31	0.0975	0.15	1324	30.62
Junc F313	1293.69	0.0573	0.09	1324	30.24
Junc F314	1293.64	0.0818	0.12	1324	30.77
Junc F315	1293.92	0.1716	0.26	1324	30.49
Junc F316	1293.76	0.0371	0.06	1324	30.65
Junc F317	1293.62	0.1489	0.22	1324	30.77
Junc F318	1292.65	0.1035	0.16	1324	31.68
Junc F319	1292.85	0.1849	0.28	1324	31.29
Junc F320	1292.65	0.061	0.09	1324	31.47
Junc F321	1292.78	0.2396	0.36	1324	31.18
Junc F322	1292.67	0.0738	0.11	1324	31.3
Junc F323	1293.28	0.3521	0.53	1324	30.62
Junc F324	1292.29	0.0738	0.11	1324	32.17
Junc F325	1292.65	0.0791	0.12	1324	31.47
Junc F326	1291.88	0.0697	0.1	1324	32.17
Junc F327	1292.14	0.0407	0.06	1324	31.9
Junc F328	1292.57	0.0725	0.11	1324	31.47
Junc F329	1292.14	0.1109	0.17	1324	31.9
Junc F330	1291.7	0.0311	0.05	1324	32.03
Junc F331	1291.92	0.0958	0.14	1324	31.71
Junc F332	1291.96	0.0363	0.05	1324	31.67
Junc F333	1291.98	0.0588	0.09	1324	31.54
Junc F334	1292.11	0.2049	0.31	1324	31.39
Junc F335	1292.05	0.0702	0.11	1323	31.43
Junc F336	1291.98	0.1067	0.16	1323	31.5
Junc F337	1291.34	0.0524	0.08	1324	32.3
Junc F338	1291.5	0.0268	0.04	1324	32.14
Junc F339	1291.35	0.1381	0.21	1324	32.28
Junc F340	1291.5	0.0343	0.05	1318	26.39

Junc F341	1291.35	0.2615	0.39	1318	26.52
Junc F342	1291.66	0.2788	0.42	1318	26.31
Junc F343	1292.45	0.0391	0.06	1318	25.7
Junc F344	1293.19	0.0361	0.05	1318	25.03
Junc F345	1293.64	0.0391	0.06	1322	28.57
Junc F346	1295.21	0.0823	0.12	1322	26.69
Junc F347	1301.64	0.0429	0.06	1322	20.12
Junc F348	1307.02	0.2385	0.36	1322	14.71
Junc F349	1308.24	0.1929	0.29	1322	13.43
Junc F350	1308.6	0.0688	0.1	1322	13.08
Junc F351	1297.45	0.0875	0.13	1321	23.89
Junc F352	1296.87	0.0278	0.04	1321	24.46
Junc F353	1296.75	0.0426	0.06	1321	24.63
Junc F354	1295.52	0.0465	0.07	1322	26.05
Junc F355	1295.37	0.0725	0.11	1314	18.77
Junc F356	1295.24	0.084	0.13	1314	18.63
Junc F357	1294.5	0.1366	0.2	1314	19.11
Junc F358	1294.98	0.1122	0.17	1313	18.23
Junc F359	1295.48	0.3159	0.47	1313	17.53
Junc F360	1296.11	0.151	0.23	1313	16.72
Junc F361	1296.35	0.0471	0.07	1313	16.48
Junc F362	1296.47	0.0647	0.1	1313	16.44
Junc F363	1296.68	0.016	0.02	1313	16.24
Junc F364	1296.68	0.0587	0.09	1313	16.26
Junc F365	1296.89	0.0744	0.11	1313	16.39
Junc F366	1297.58	0.0607	0.09	1314	15.97
Junc F367	1298.24	0.2392	0.36	1314	15.92
Junc F368	1297.76	0.0779	0.12	1314	16.4
Junc F369	1298.43	0.0806	0.12	1314	15.74
Junc F370	1298.43	0.1369	0.21	1314	15.73
Junc F371	1297.72	0.0839	0.13	1314	16.38
Junc F372	1297.82	0.227	0.34	1314	16.27
Junc F373	1298.11	0.0204	0.03	1314	15.99
Junc F374	1298.2	0.0734	0.11	1314	15.9
Junc F375	1297.76	0.1371	0.21	1314	16.34
Junc F376	1297.45	0.3119	0.47	1314	16.63
Junc F377	1297.38	0.2367	0.36	1314	16.68
Junc F378	1296.49	0.1419	0.21	1314	17.58
Junc F379	1297.83	0.1059	0.16	1314	16.28
Junc F380	1297.45	0.1983	0.3	1314	16.65
Junc F381	1297.27	0.313	0.47	1314	16.82
Junc F382	1297.35	0.1354	0.2	1314	16.81
Junc F383	1297.17	0.1497	0.22	1314	17.1
Junc F384	1298.09	0.0599	0.09	1314	16.19
Junc F385	1297.83	0.1017	0.15	1314	16.28
Junc F386	1297.47	0.2981	0.45	1314	16.61

Junc F387	1296.42	0.0803	0.12	1314	17.63
Junc F388	1296.42	0.0712	0.11	1314	17.63
Junc F389	1296.59	0.1606	0.24	1314	17.45
Junc F390	1296.61	0.268	0.4	1314	17.47
Junc F391	1296.71	0.1183	0.18	1314	17.36
Junc F392	1296.28	0.2169	0.33	1314	17.75
Junc F393	1296.62	0.3294	0.49	1314	17.38
Junc F394	1295.91	0.1502	0.23	1314	18.17
Junc F395	1296.35	0.2128	0.32	1313	16.84
Junc F396	1296.64	0.0204	0.03	1314	17.46
Junc F397	1297.19	0.0395	0.06	1314	16.92
Junc F398	1297.19	0.0805	0.12	1314	16.92
Junc F399	1296.64	0.0858	0.13	1314	17.46
Junc F400	1295.8	0.1242	0.19	1313	17.19
Junc F401	1295.55	0.1673	0.25	1313	17.44
Junc F402	1295.36	0.0361	0.05	1313	17.6
Junc F403	1295.47	0.0493	0.07	1313	17.49
Junc F404	1295.35	0.0332	0.05	1313	17.59
Junc F405	1295.57	0.032	0.05	1313	17.37
Junc F406	1295.05	0.0285	0.04	1313	17.87
Junc F407	1294.97	0.0667	0.1	1313	17.95
Junc F408	1294.87	0.0776	0.12	1313	18.05
Junc F409	1295.11	0.0728	0.11	1313	17.81
Junc F410	1294.4	0.0622	0.09	1313	18.52
Junc F411	1294.77	0.1341	0.2	1313	18.15
Junc F412	1294.27	0.0375	0.06	1313	18.65
Junc F413	1294.29	0.066	0.1	1313	18.63
Junc F414	1294.19	0.0966	0.14	1313	18.73
Junc F415	1294.05	0.0834	0.13	1313	18.88
Junc F416	1294.05	0.0509	0.08	1313	18.88
Junc F417	1293.95	0.0417	0.06	1313	18.97
Junc F418	1293.92	0.1151	0.17	1313	19
Junc F419	1294.62	0.0725	0.11	1313	18.3
Junc F420	1294.6	0.1357	0.2	1313	18.32
Junc F421	1294.9	0.0459	0.07	1313	18.03
Junc F422	1295.13	0.0952	0.14	1313	17.8
Junc F423	1294.33	0.229	0.34	1313	18.59
Junc F424	1295.04	0.0488	0.07	1313	17.9
Junc F425	1295.76	0.0816	0.12	1313	17.28
Junc F426	1295.69	0.1539	0.23	1313	17.38
Junc F427	1295.37	0.1004	0.15	1313	17.69
Junc F428	1295.18	0.1412	0.21	1313	17.86
Junc F429	1295.73	0.0212	0.03	1313	17.31
Junc F430	1295.47	0.0553	0.08	1314	18.65
Junc F431	1296.07	0.1721	0.26	1314	18.04
Junc F432	1295.05	0.1346	0.2	1314	19.13

Junc F433	1295.66	0.0955	0.14	1314	18.56
Junc F434	1295.56	0.1815	0.27	1314	18.66
Junc F435	1295.46	0.1613	0.24	1314	18.93
Junc F436	1295.49	0.1282	0.19	1314	18.96
Junc F437	1295.82	0.0807	0.12	1315	19.06
Junc F438	1296.5	0.1124	0.17	1315	18.34
Junc F439	1296.94	0.2258	0.34	1315	17.9
Junc F440	1296.35	0.0621	0.09	1315	18.48
Junc F441	1295.78	0.1391	0.21	1314	18.55
Junc F442	1295.42	0.1151	0.17	1314	18.9
Junc F443	1296.36	0.2706	0.41	1314	17.83
Junc F444	1297.27	0.0664	0.1	1314	16.92
Junc F445	1297.39	0.0498	0.07	1314	16.79
Junc F446	1297.47	0.0518	0.08	1314	16.72
Junc F447	1297.04	0.1852	0.28	1314	17.14
Junc F448	1297.17	0.0357	0.05	1314	17.04
Junc F449	1296.16	0.092	0.14	1314	18.04
Junc F450	1296.07	0.1237	0.19	1314	18.15
Junc F451	1296.23	0.0155	0.02	1314	17.98
Junc F452	1292.54	0.1339	0.2	1314	21.66
Junc F453	1293.81	0.047	0.07	1314	20.38
Junc F454	1295.94	0.0199	0.03	1314	18.25
Junc F455	1290.09	0.0283	0.04	1314	24.08
Junc F456	1296.38	0.049	0.07	1314	17.78
Junc F457	1296.23	0.0785	0.12	1314	17.86
Junc F458	1284.66	0.1774	0.27	1314	29.43
Junc F459	1296.12	0.1075	0.16	1314	18.35
Junc F460	1294.97	0.1033	0.15	1314	19.51
Junc F461	1296.1	0.0549	0.08	1314	18.3
Junc F462	1296.47	0.0449	0.07	1314	17.77
Junc F463	1296.47	0.0278	0.04	1314	17.75
Junc F464	1296.42	0.0436	0.07	1314	17.62
Junc F465	1295.97	0.1112	0.17	1314	18.07
Junc F466	1295.19	0.0665	0.1	1314	18.67
Junc F467	1296.03	0.1132	0.17	1314	17.81
Junc F468	1294.99	0.19	0.28	1314	18.75
Junc F469	1294.98	0.1204	0.18	1314	18.74
Junc F470	1295.07	0.1936	0.29	1314	19.12
Junc F471	1294.93	0.1308	0.2	1313	18.37
Junc F472	1294.15	0.2141	0.32	1313	19.14
Junc F473	1294.87	0.139	0.21	1313	18.28
Junc F474	1293.69	0.0907	0.14	1313	19.45
Junc F475	1293.69	0.0919	0.14	1313	19.45
Junc F476	1296.37	0.1632	0.24	1314	17.39
Junc F477	1296.56	0.0516	0.08	1314	17.2
Junc F478	1296.56	0.1723	0.26	1313	16.83

Junc F479	1297.11	0.259	0.39	1314	16.43
Junc F480	1296.45	0.1714	0.26	1313	16.83
Junc F481	1296.35	0.2419	0.36	1313	16.92
Junc F482	1296.09	0.1131	0.17	1313	16.86
Junc F483	1296.03	0.2136	0.32	1313	16.87
Junc F484	1295.75	0.0651	0.1	1313	17.17
Junc F485	1296.05	0.0146	0.02	1313	16.87
Junc F486	1295.4	0.0868	0.13	1313	17.52
Junc F487	1295.96	0.0324	0.05	1313	16.97
Junc F488	1295.69	0.0991	0.15	1313	17.23
Junc F489	1295.77	0.0873	0.13	1313	17.35
Junc F490	1296.2	0.1835	0.28	1313	16.73
Junc F491	1296.54	0.2264	0.34	1313	16.38
Junc F492	1296.23	0.2341	0.35	1313	16.85
Junc F493	1296.27	0.3644	0.55	1313	16.78
Junc F494	1294.6	0.1486	0.22	1313	18.46
Junc F495	1294.88	0.1684	0.25	1313	18.18
Junc F496	1294.46	0.0397	0.06	1313	18.6
Junc F497	1294.91	0.1587	0.24	1313	18.16
Junc F498	1295.96	0.0171	0.03	1313	17.12
Junc F499	1295.04	0.1621	0.24	1313	18.03
Junc F500	1296.05	0.0238	0.04	1313	17.02
Junc F501	1295.79	0.1568	0.24	1313	16.99
Junc F502	1296.17	0.0817	0.12	1313	16.62
Junc F503	1295.87	0.2682	0.4	1313	16.9
Junc F504	1295.96	0.2668	0.4	1313	16.85
Junc F505	1294.63	0.3514	0.53	1322	27.17
Junc F506	1292.91	0.1756	0.26	1322	28.89
Junc F507	1293.4	0.0356	0.05	1322	28.53
Junc F508	1293.17	0.0387	0.06	1322	28.73
Junc F509	1293.05	0.1481	0.22	1322	28.8
Junc F510	1293.86	0.2218	0.33	1322	28.07
Junc F511	1293.94	0.0685	0.1	1322	28.04
Junc F512	1293.61	0.1477	0.22	1322	28.36
Junc F513	1294.23	0.093	0.14	1322	27.8
Junc F514	1294.42	0.0777	0.12	1322	27.66
Junc F515	1294.28	0.0398	0.06	1322	27.89
Junc F516	1294.15	0.1693	0.25	1322	28.02
Junc F517	1294.28	0.086	0.13	1313	18.76
Junc F518	1293.86	0.1232	0.18	1313	19.28
Junc F519	1294.47	0.1523	0.23	1323	28.12
Junc F520	1294.47	0.052	0.08	1323	28.11
Junc F521	1293.83	0.0941	0.14	1313	19.54
Junc F522	1293.87	0.2069	0.31	1313	19.48
Junc F523	1293.67	0.0287	0.04	1323	29.22
Junc F524	1293.99	0.138	0.21	1323	28.85

Junc F525	1294.43	0.1434	0.22	1323	28.4
Junc F526	1293.87	0.1496	0.22	1323	28.96
Junc F527	1293.69	0.1147	0.17	1323	29.47
Junc F528	1293.72	0.0146	0.02	1323	29.29
Junc F529	1293.75	0.0852	0.13	1323	29.25
Junc F530	1293.49	0.023	0.03	1314	20.04
Junc F531	1294.28	0.1098	0.16	1314	19.24
Junc F532	1293.49	0.0181	0.03	1323	29.67
Junc F533	1293.51	0.0596	0.09	1314	20.08
Junc F534	1294.97	0.119	0.18	1314	18.61
Junc F535	1293.66	0.1318	0.2	1323	29.72
Junc F536	1293.83	0.0297	0.04	1323	29.55
Junc F537	1293.87	0.1105	0.17	1323	29.11
Junc F538	1293.82	0.0096	0.01	1323	29.16
Junc F539	1293.8	0.0289	0.04	1323	29.18
Junc F540	1293.81	0.0662	0.1	1323	29.17
Junc F541	1293.73	0.0836	0.13	1323	29.27
Junc F542	1293.66	0.0729	0.11	1324	30.07
Junc F543	1293.68	0.0699	0.1	1314	20.73
Junc F544	1293.51	0.0907	0.14	1314	20.89
Junc F545	1294.02	0.1002	0.15	1314	20.37
Junc F546	1293.92	0.1114	0.17	1324	30.22
Junc F547	1293.72	0.1658	0.25	1324	30.41
Junc F548	1294.1	0.103	0.15	1315	20.59
Junc F549	1294.46	0.0862	0.13	1315	20.23
Junc F550	1294.28	0.0208	0.03	1315	20.5
Junc F551	1294.16	0.084	0.13	1315	20.62
Junc F552	1294.18	0.0594	0.09	1325	30.51
Junc F553	1293.96	0.1487	0.22	1323	28.74
Junc F554	1293.59	0.086	0.13	1323	29.11
Junc F555	1293.52	0.0964	0.14	1323	29.18
Junc F556	1293.54	0.0912	0.14	1323	29.18
Junc F557	1293.68	0.0577	0.09	1323	29.04
Junc F558	1293.63	0.0734	0.11	1323	29.13
Junc F559	1293.62	0.1257	0.19	1323	29.11
Junc F560	1293.57	0.1604	0.24	1323	29.75
Junc F561	1293.3	0.086	0.13	1323	30.03
Junc F562	1293.16	0.0557	0.08	1323	30.27
Junc F563	1293.5	0.1565	0.23	1323	29.82
Junc F564	1293.39	0.0331	0.05	1323	29.93
Junc F565	1293.45	0.0252	0.04	1323	29.86
Junc F566	1293.13	0.0386	0.06	1323	30.19
Junc F567	1292.95	0.0241	0.04	1323	30.37
Junc F568	1292.87	0.0686	0.1	1323	30.47
Junc F569	1292.86	0.0897	0.13	1323	30.25
Junc F570	1293.37	0.0873	0.13	1323	29.74

Junc F571	1293.06	0.2257	0.34	1323	29.65
Junc F572	1293.71	0.1455	0.22	1323	28.99
Junc F573	1293.81	0.1123	0.17	1323	29.17
Junc F574	1293.2	0.0643	0.1	1322	28.93
Junc F575	1293.26	0.104	0.16	1322	28.86
Junc F576	1293.07	0.1539	0.23	1322	28.89
Junc F577	1293.42	0.1769	0.27	1322	28.53
Junc F578	1292.86	0.1321	0.2	1322	28.7
Junc F579	1292.65	0.1342	0.2	1322	28.9
Junc F580	1292.82	0.1782	0.27	1322	28.71
Junc F581	1292.6	0.1202	0.18	1322	29.89
Junc F582	1292.6	0.0601	0.09	1324	31.06
Junc F583	1292.54	0.0922	0.14	1322	29.63
Junc F584	1292.54	0.2487	0.37	1322	29.6
Junc F585	1292.39	0.1251	0.19	1322	29.58
Junc F586	1292.45	0.0604	0.09	1323	31.01
Junc F587	1292.57	0.0538	0.08	1323	30.89
Junc F588	1292.46	0.0328	0.05	1323	31
Junc F589	1292.57	0.0368	0.06	1323	30.89
Junc F590	1292.47	0.064	0.1	1323	30.99
Junc F591	1292.54	0.0568	0.09	1324	31.41
Junc F592	1292.54	0.054	0.08	1324	31.41
Junc F593	1292.08	0.1022	0.15	1324	31.47
Junc F594	1292.29	0.0812	0.12	1324	31.26
Junc F595	1292.13	0.0734	0.11	1323	31.16
Junc F596	1292.07	0.0951	0.14	1321	29.3
Junc F597	1292.24	0.0568	0.09	1321	29.25
Junc F598	1292.19	0.1553	0.23	1321	29.29
Junc F599	1292.04	0.1527	0.23	1321	29.42
Junc F600	1292.44	0.1538	0.23	1321	29.04
Junc F601	1292.5	0.1624	0.24	1321	28.98
Junc F602	1293.03	0.2515	0.38	1322	28.48
Junc F603	1293.02	0.138	0.21	1322	28.64
Junc F604	1293.34	0.1846	0.28	1322	28.3
Junc F605	1293.32	0.2271	0.34	1321	28.11
Junc F606	1293.66	0.1797	0.27	1321	27.76
Junc F607	1293.76	0.1711	0.26	1321	27.66
Junc F608	1292.8	0.0988	0.15	1322	29.01
Junc F609	1293.36	0.0602	0.09	1322	28.46
Junc F610	1292.75	0.028	0.04	1322	29.01
Junc F611	1292.78	0.0448	0.07	1322	28.98
Junc F612	1292.64	0.2252	0.34	1322	29.1
Junc F613	1293.17	0.0677	0.1	1322	28.52
Junc F614	1292.57	0.0989	0.15	1322	28.99
Junc F615	1292.57	0.0283	0.04	1322	28.99
Junc F616	1292.56	0.1413	0.21	1322	29

Junc F617	1292.45	0.1587	0.24	1322	29.12
Junc F618	1292.41	0.1672	0.25	1322	29.14
Junc F619	1292.06	0.0507	0.08	1321	29.24
Junc F620	1291.93	0.0459	0.07	1321	29.37
Junc F621	1292.41	0.024	0.04	1321	28.86
Junc F622	1292.22	0.0842	0.13	1323	31.11
Junc F623	1292.17	0.1265	0.19	1323	31.15
Junc F624	1292.27	0.1428	0.21	1323	30.94
Junc F625	1292.41	0.047	0.07	1323	30.8
Junc F626	1292.06	0.0499	0.07	1321	29.19
Junc F627	1292.28	0.1353	0.2	1321	29.03
Junc F628	1292.84	0.2172	0.33	1321	28.45
Junc F629	1292.65	0.3273	0.49	1322	28.89
Junc F630	1292.71	0.135	0.2	1322	28.99
Junc F631	1292.71	0.177	0.27	1322	29.04
Junc F632	1293.43	0.2429	0.36	1322	28.28
Junc F633	1293.71	0.2985	0.45	1322	27.98
Junc F634	1293.4	0.2039	0.31	1322	28.31
Junc F635	1294.23	0.4137	0.62	1321	26.92
Junc F636	1294.9	0.517	0.78	1321	26.31
Junc F637	1294.19	0.1539	0.23	1321	27
Junc F638	1294.6	0.2652	0.4	1321	26.59
Junc F639	1294.04	0.2858	0.43	1321	27.15
Junc F640	1294.71	0.1085	0.16	1321	26.5
Junc F641	1294.71	0.0833	0.12	1313	18.33
Junc F642	1295	0.0797	0.12	1321	26.29
Junc F643	1294.46	0.1436	0.22	1321	26.83
Junc F644	1294.35	0.0374	0.06	1313	18.79
Junc F645	1294.78	0.1469	0.22	1313	18.35
Junc F646	1294.55	0.0443	0.07	1321	26.9
Junc F647	1294.18	0.079	0.12	1321	27.26
Junc F648	1294.18	0.0542	0.08	1322	27.38
Junc F649	1294.4	0.0744	0.11	1313	18.81
Junc F650	1294.08	0.0386	0.06	1321	27.22
Junc F651	1294.01	0.0607	0.09	1321	27.29
Junc F652	1294.28	0.2036	0.31	1321	26.7
Junc F653	1294.07	0.0722	0.11	1321	26.92
Junc F654	1294.08	0.0512	0.08	1321	26.87
Junc F655	1294.11	0.117	0.18	1321	26.84
Junc F656	1294.28	0.0811	0.12	1321	26.61
Junc F657	1294.28	0.1195	0.18	1321	26.62
Junc F658	1294.4	0.1324	0.2	1321	26.44
Junc F659	1294.19	0.1673	0.25	1321	26.64
Junc F660	1294.39	0.1881	0.28	1321	26.45
Junc F661	1294.91	0.2641	0.4	1321	26.01
Junc F662	1294.28	0.2062	0.31	1321	26.89

Junc F663	1294.18	0.154	0.23	1321	26.98
Junc F664	1294.16	0.1006	0.15	1321	27.1
Junc F665	1294.31	0.0733	0.11	1321	26.96
Junc F666	1294.13	0.1403	0.21	1314	19.48
Junc F667	1294.02	0.0748	0.11	1321	26.88
Junc F668	1293.71	0.0237	0.04	1321	27.2
Junc F670	1293.35	0.2356	0.35	1321	27.55
Junc F671	1294.05	0.1036	0.16	1314	19.82
Junc F672	1293.71	0.1554	0.23	1321	27.22
Junc F674	1293.4	0.1985	0.3	1321	27.96
Junc F675	1295.83	0.0569	0.09	1321	25.54
Junc F676	1296.4	0.0679	0.1	1321	24.96
Junc F677	1296.59	0.2386	0.36	1321	24.74
Junc F678	1293.59	0.1656	0.25	1321	27.25
Junc F679	1293.99	0.2299	0.34	1321	26.84
Junc F680	1293.32	0.2331	0.35	1321	27.47
Junc F681	1292.83	0.2615	0.39	1321	27.94
Junc F682	1304.25	0.1672	0.25	1322	17.43
Junc F683	1307.63	0.1976	0.3	1322	14.04
Junc F684	1307.76	0.1741	0.26	1322	13.9
Junc F685	1306.77	0.155	0.23	1322	14.89
Junc F686	1302.33	0.2062	0.31	1322	19.35
Junc F687	1294.19	0.1014	0.15	1322	27.49
Junc F688	1300.8	0.1409	0.21	1322	20.95
Junc F689	1302.37	0.1292	0.19	1322	19.36
Junc F690	1301.09	0.1277	0.19	1322	20.66
Junc F691	1298.74	0.0729	0.11	1322	23
Junc F692	1293.5	0.0846	0.13	1322	28.25
Junc F693	1293.24	0.0955	0.14	1322	28.51
Junc F694	1293.45	0.0567	0.09	1322	28.33
Junc F695	1294.37	0.0432	0.06	1322	27.41
Junc F696	1294.2	0.0507	0.08	1322	27.57
Junc F697	1296.88	0.061	0.09	1322	24.9
Junc F698	1295.47	0.0401	0.06	1322	26.35
Junc F699	1294.72	0.0377	0.06	1322	27.1
Junc F700	1295.61	0.0692	0.1	1322	26.27
Junc F701	1294.41	0.0914	0.14	1322	27.53
Junc F702	1294.05	0.052	0.08	1322	27.99
Junc F703	1293.43	0.0297	0.04	1322	28.26
Junc F704	1293.31	0.0414	0.06	1322	28.38
Junc F705	1293.31	0.0714	0.11	1322	28.63
Junc F706	1293.55	0.0443	0.07	1322	28.27
Junc F707	1293.25	0.0687	0.1	1322	28.57
Junc F708	1293.3	0.0077	0.01	1322	28.5
Junc F709	1293.13	0.0735	0.11	1322	28.67
Junc F710	1293.49	0.0298	0.04	1321	27.98

Junc F711	1292.96	0.0338	0.05	1321	28.35
Junc F712	1292.69	0.2234	0.34	1321	28.45
Junc F713	1292.83	0.0242	0.04	1321	28.31
Junc F714	1292.66	0.1266	0.19	1321	28.44
Junc F715	1292.81	0.1666	0.25	1318	25.43
Junc F716	1293.15	0.1871	0.28	1321	27.81
Junc F717	1292.58	0.222	0.33	1321	28.21
Junc F718	1292.92	0.2182	0.33	1321	27.89
Junc F719	1293.14	0.1641	0.25	1321	27.67
Junc F720	1292.82	0.1848	0.28	1321	27.74
Junc F721	1292.95	0.1462	0.22	1321	27.61
Junc F722	1292.22	0.2775	0.42	1320	27.93
Junc F723	1292.23	0.2199	0.33	1320	27.93
Junc F724	1293.12	0.3532	0.53	1320	27.07
Junc F725	1293.12	0.3132	0.47	1321	27.49
Junc F726	1293.69	0.185	0.28	1321	26.84
Junc F727	1292.99	0.1518	0.23	1320	27.48
Junc F728	1292.9	0.113	0.17	1321	27.63
Junc F729	1292.96	0.0838	0.13	1321	27.57
Junc F730	1293.26	0.1537	0.23	1321	27.25
Junc F731	1293.19	0.1196	0.18	1321	27.32
Junc F732	1293.74	0.0929	0.14	1321	26.77
Junc F733	1293.45	0.0881	0.13	1320	26.72
Junc F734	1292.99	0.251	0.38	1319	26.15
Junc F735	1293.12	0.3011	0.45	1320	26.44
Junc F736	1293.83	0.1065	0.16	1320	26.42
Junc F737	1293.34	0.0438	0.07	1321	27.25
Junc F738	1293.3	0.0751	0.11	1321	27.29
Junc F739	1293.06	0.037	0.06	1321	27.57
Junc F740	1293.71	0.0955	0.14	1320	26.35
Junc F741	1292.98	0.1173	0.18	1321	27.7
Junc F742	1293.72	0.1195	0.18	1321	26.96
Junc F743	1293.32	0.165	0.25	1321	27.36
Junc F744	1293.27	0.0725	0.11	1321	27.41
Junc F745	1293.48	0.145	0.22	1321	27.19
Junc F746	1294.41	0.2543	0.38	1321	26.34
Junc F747	1293.14	0.0893	0.13	1321	27.65
Junc F748	1294.21	0.2359	0.35	1321	26.71
Junc F750	1293.5	0.0455	0.07	1321	27.44
Junc F751	1293.52	0.0817	0.12	1320	26.47
Junc F752	1294.74	0.072	0.11	1320	25.61
Junc F753	1294.14	0.0859	0.13	1320	26.2
Junc F754	1293.59	0.0388	0.06	1320	26.81
Junc F755	1293.75	0.1302	0.2	1320	26.64
Junc F756	1293.57	0.0862	0.13	1320	26.91
Junc F757	1293.68	0.0327	0.05	1320	26.81

Junc F758	1293.68	0.0934	0.14	1321	26.83
Junc F759	1293.69	0.1139	0.17	1321	27.17
Junc F760	1293.77	0.0231	0.03	1321	27.33
Junc F761	1294.31	0.0779	0.12	1321	26.84
Junc F762	1293.74	0.0624	0.09	1321	27.4
Junc F763	1293.61	0.0537	0.08	1320	26.34
Junc F764	1293.76	0.1164	0.17	1320	26.19
Junc F765	1293.58	0.1697	0.25	1320	26.36
Junc F766	1294.1	0.2847	0.43	1322	27.7
Junc F767	1294.12	0.1265	0.19	1321	27.36
Junc F768	1293.83	0.1657	0.25	1321	27.66
Junc F769	1293.9	0.1747	0.26	1321	27.46
Junc F770	1294.31	0.1731	0.26	1321	27.02
Junc F771	1294.1	0.0518	0.08	1321	27.24
Junc F772	1294.02	0.0928	0.14	1321	27.32
Junc F773	1293.73	0.429	0.64	1321	27.57
Junc F774	1292.34	0.1558	0.23	1323	30.99
Junc F775	1296.47	0.1515	0.23	1316	19.44
Junc F776	1294.4	0.3672	0.55	1317	22.4
Junc F777	1298.39	0.0331	0.05	1315	16.55
Junc F778	1297.15	0.1506	0.23	1315	17.53
Junc F779	1296.68	0.0934	0.14	1316	18.97
Junc F780	1296.19	0.0062	0.01	1316	19.73
Junc F781	1296.56	0.2325	0.35	1316	19.14
Junc F782	1297.15	0	0	1320	23.29
Junc F783	1296.91	0.1987	0.3	1315	17.74
Junc F784	1298.43	0.1166	0.17	1314	15.65
Junc F785	1294.77	0.0745	0.11	1314	19.17
Junc F786	1293.55	0.1537	0.23	1314	20.36
Junc F787	1294.28	0.0269	0.04	1325	30.41
Junc F788	1292.2	0.093	0.14	1322	29.39
Junc F789	1292.27	0.0852	0.13	1323	31.1
Junc F790	1292.64	0.0794	0.12	1324	31.48
Junc F791	1292.72	0.1335	0.2	1322	29.04
Junc F792	1304.16	0.0564	0.08	1322	17.53
Junc F793	1292.69	0.2083	0.31	1321	28.27
Junc F794	1292.37	0.1238	0.19	1318	25.8
Junc F795	1292.37	0.1378	0.21	1318	25.8
Junc F796	1292.69	0.1979	0.3	1318	25.24
Junc F797	1297.22	0.1713	0.26	1318	21
Junc F800	1296.17	0.2918	0.44	1318	22.25
Junc F805	1297.19	0.2209	0.33	1317	19.32
Junc F810	1296.21	0.0666	0.1	1316	19.43
Junc F815	1297.26	0.0498	0.07	1316	18.4
Junc F820	1295.75	0	0	1327	31.22
Junc F825	1298.11	0.0187	0.03	1314	15.97

Junc F835	1298.05	0.0235	0.04	1314	16.28
Junc F840	1295.43	0.0398	0.06	1315	19.25
Junc F845	1294.04	0.4302	0.65	1322	27.82
Junc F032B	1299.54	0	0	1314	14.7
Junc F161A	1296.51	0	0	1316	19.19
Junc F299C	1292.73	0	0	1328	35.18
Junc F299B	1292.62	0	0	1328	35.37
Junc Balaju_10	1299	0	0	1337	38.34
Junc Balaju_11	1300.35	0	0	1322	21.67
Junc Balaju_13	1294	0	0	1332	38.49
Junc Balaju_14	1292.63	0	0	1330	37.63
Junc Balaju_15	1293.48	0	0	1329	35.28
Junc Balaju_12	1293.45	0	0	1329	35.23
Junc F860	1290	0	0	1322	31.92
Junc 1	1293.45	0	0	1329	35.25
Junc 2	1292.62	0	0	1325	32.46
Junc 3	1292.73	0	0	1325	32.31
Junc 4	1295.75	0.1538	0.23	1325	28.83
Junc 5	1293.64	0	0	1326	32.76
Junc 6	1293.76	0	0	1326	32.5
Junc 7	1292.65	0	0	1325	32.05
Junc 8	1292.29	0	0	1324	32.17
Junc 9	1291.88	0	0	1324	32.27
Junc 10	1291.7	0	0	1324	32.03
Junc 11	1291.34	0	0	1324	32.29
Junc 12	1291.5	0	0	1324	32.06
Junc 13	1291.5	0	0	1324	32.05
Junc 14	1291.66	0	0	1323	31.35
Junc 15	1292.45	0	0	1323	30.37
Junc 16	1293.19	0	0	1322	29.22
Junc 17	1293.64	0	0	1322	28.57
Junc 18	1295.21	0.0823	0.12	1322	26.93
Junc 19	1301.64	0	0	1322	20.4
Junc 20	1307.02	0	0	1322	14.95
Junc 21	1308.24	0	0	1322	13.55
Junc 22	1308.6	0	0	1322	13.14
Junc 23	1304.16	0	0	1322	17.53
Junc 24	1297.45	0	0	1322	24.17
Junc 25	1296.87	0	0	1322	24.75
Junc 26	1296.75	0	0	1322	24.84
Junc 27	1294.38	0	0	1326	31.29
Junc 28	1294.36	0	0	1325	30.85
Junc 29	1293.92	0	0	1324	30.44
Junc 30	1294.28	0	0	1325	30.62
Junc 31	1293.66	0	0	1324	30.07
Junc 32	1293.66	0	0	1323	29.76

Junc 33	1293.49	0	0	1323	29.67
Junc 34	1293.67	0	0	1323	29.38
Junc 35	1294.47	0	0	1323	28.33
Junc 36	1294.28	0	0	1322	28
Junc 37	1294.42	0	0	1322	27.67
Junc 38	1294.23	0	0	1322	27.85
Junc 39	1294.63	0	0	1322	27.17
Junc 40	1294.9	0	0	1322	26.81
Junc 41	1294.71	0	0	1322	26.92
Junc 42	1294.6	0	0	1322	27.06
Junc 43	1295	0	0	1322	26.6
Junc 44	1294.55	0	0	1322	27.03
Junc 45	1294.18	0	0	1322	27.38
Junc 46	1294.28	0	0	1322	27.28
Junc 47	1294.91	0	0	1322	26.66
Junc 48	1293.71	0	0	1322	27.85
Junc 49	1294.02	0	0	1322	27.55
Junc 50	1295.52	0	0	1322	26.05
Junc 51	1293.45	0	0	1325	31.92
Junc 52	1297.67	0	0	1321	23.67
Junc 53	1297.67	0	0	1321	23.65
Junc 54	1297.19	0.0862	0.13	1320	23.3
Junc 55	1297.15	0.0449	0.07	1320	23.11
Junc 56	1296.81	0.0971	0.15	1320	22.93
Junc 57	1299.85	0	0	1319	18.81
Junc 58	1299.75	0	0	1318	18.39
Junc 59	1298.79	0	0	1317	17.87
Junc 60	1298.38	0	0	1316	18.07
Junc 61	1298.93	0	0	1316	16.91
Junc 62	1300.06	0	0	1316	15.71
Junc 63	1301.36	0	0	1316	14.33
Junc 64	1300.09	0	0	1316	15.49
Junc 65	1299.65	0	0	1316	15.85
Junc 66	1299.01	0	0	1315	16.44
Junc 67	1298.24	0	0	1315	17.17
Junc 68	1298.89	0	0	1315	16.47
Junc 69	1298.73	0	0	1315	16.61
Junc 70	1299.49	0	0	1315	15.87
Junc 71	1299.13	0	0	1315	16.23
Junc 72	1300.24	0	0	1315	15.16
Junc 73	1298.16	0	0	1316	17.35
Junc 74	1297.78	0	0	1316	17.78
Junc 75	1297.37	0	0	1316	18.23
Junc 76	1297.19	0	0	1316	18.48
Junc 77	1296.52	0	0	1316	19.32
Junc 78	1296.13	0	0	1316	19.95

Junc 79	1295.27	0	0	1316	21.16
Junc 80	1296.3	0	0	1317	20.26
Junc 81	1295.94	0	0	1317	20.68
Junc 82	1295.93	0	0	1317	20.81
Junc 83	1295.98	0	0	1317	21.24
Junc 84	1296.46	0.1085	0.16	1317	20.57
Junc 85	1296.74	0.0527	0.08	1317	20.25
Junc 86	1296.74	0.1828	0.27	1317	20.24
Junc 87	1296.78	0.1242	0.19	1317	20.19
Junc 88	1296.78	0.0463	0.07	1319	22.5
Junc 89	1296.81	0.16	0.24	1320	22.85
Junc 91	1297.67	0.2649	0.4	1320	22.74
Junc 92	1297.15	0.0364	0.05	1320	23.29
Junc 93	1295.99	0.3014	0.45	1321	24.81
Junc 94	1295.99	0	0	1321	24.84
Junc 95	1295.74	0.2945	0.44	1318	22.63
Junc 96	1296.23	0.3743	0.56	1315	18.85
Junc 97	1296.18	0	0	1317	20.81
Junc 98	1295.75	0	0	1316	20.66
Junc 99	1295.92	0	0	1316	20.27
Junc 100	1296.26	0	0	1315	19.21
Junc 101	1296.89	0	0	1315	18.41
Junc 102	1297.11	0	0	1315	17.76
Junc 103	1298.05	0	0	1314	16.28
Junc 104	1299.54	0	0	1314	14.7
Junc 105	1298.43	0	0	1314	15.79
Junc 106	1297.76	0	0	1314	16.45
Junc 107	1298.24	0	0	1314	15.92
Junc 108	1297.58	0	0	1314	16.57
Junc 109	1296.89	0	0	1314	17.27
Junc 110	1296.68	0	0	1314	17.47
Junc 111	1296.68	0	0	1314	17.47
Junc 112	1296.47	0	0	1314	17.68
Junc 113	1296.35	0	0	1314	17.8
Junc 114	1296.11	0	0	1314	18.04
Junc 115	1295.48	0	0	1314	18.67
Junc 116	1294.98	0	0	1314	19.17
Junc 117	1294.5	0	0	1314	19.64
Junc 118	1295.24	0	0	1314	18.9
Junc 119	1295.37	0	0	1314	18.77
Junc 120	1294.13	0	0	1314	20.04
Junc 121	1294.35	0	0	1314	19.87
Junc 122	1294.71	0	0	1314	19.52
Junc 123	1295.75	0	0	1314	18.53
Junc 124	1296.05	0	0	1314	18.24
Junc 125	1294.28	0	0	1314	20.06

Junc 126	1293.86	0	0	1314	20.5
Junc 127	1293.83	0	0	1314	20.55
Junc 128	1293.51	0	0	1314	20.88
Junc 129	1293.68	0	0	1314	20.73
Junc 130	1294.1	0	0	1315	20.67
Junc 131	1294.36	0	0	1315	20.6
Junc 132	1293.48	0	0	1316	22.1
Junc 133	1293.41	0	0	1316	22.43
Junc 134	1293.55	0	0	1316	22.44
Junc 135	1293.7	0	0	1316	22.43
Junc 136	1293.83	0	0	1316	22.46
Junc 137	1293.62	0	0	1317	22.9
Junc 138	1293.96	0	0	1317	22.7
Junc 139	1292.63	0	0	1317	24.13
Junc 140	1291.84	0	0	1318	25.77
Junc 141	1296.17	0	0	1318	22.25
Junc 142	1295.98	0	0	1319	22.95
Junc 143	1295.95	0	0	1319	23.51
Junc 144	1295.85	0	0	1320	24.03
Junc 90	1299	0	0	1324	25
Junc 145	1299	0	0	1329	30
Junc 146	1296	0	0	1338	42.2
Junc 147	1296	0	0	1336	40
Junc 149	1296.86	0	0	1316	18.93
Junc 148	1298.79	0	0	1317	17.86
Junc 151	1297.94	0	0	1316	18.3
Junc 152	1297.21	0	0	1316	18.78
Junc 153	1297.21	0	0	1316	18.78
Junc 154	1297.25	0	0	1316	18.55
Junc 155	1297.01	0	0	1316	18.78
Junc 156	1296.49	0	0	1316	19.21
Junc 157	1297.19	0	0	1316	18.48
Junc 158	1297.19	0	0	1316	18.48
Junc 159	1296.21	0	0	1316	19.46
Junc 160	1296.39	0	0	1316	19.27
Junc 161	1298.05	0	0	1314	16.28
Junc 162	1297.19	0	0	1314	16.92
Junc 163	1296.47	0	0	1314	17.77
Junc 164	1296.1	0	0	1314	18.3
Junc 165	1293.68	0	0	1314	20.73
Junc 166	1293.68	0	0	1314	20.73
Junc 167	1294.38	0	0	1326	31.27
Junc 168	1293.43	0	0	1324	30.6
Junc 169	1293.43	0	0	1324	30.62
Junc 170	1292.41	0	0	1323	30.84
Junc 171	1292.41	0	0	1323	30.84

Junc 172	1292.6	0	0	1324	31.06
Junc 173	1292.39	0	0	1323	31.09
Junc 174	1292.2	0	0	1323	31.17
Junc 175	1292.07	0	0	1323	31.22
Junc 176	1293.69	0	0	1322	28.61
Junc 177	1293.64	0	0	1322	28.59
Junc 178	1292.06	0	0	1323	31.08
Junc 179	1293.68	0	0	1321	27.18
Junc 180	1293.59	0	0	1320	26.81
Junc 181	1293.83	0	0	1320	25.76
Junc 182	1293.45	0	0	1319	25.7
Junc 183	1293.69	0	0	1319	24.91
Junc 184	1293.12	0	0	1318	25.27
Junc 185	1292.66	0	0	1318	25.59
Junc 186	1292.96	0	0	1318	25.27
Junc 187	1293.64	0	0	1318	24.58
Junc 188	1290	0	0	1322	31.94
Junc 189	1293.74	0	0	1320	26.39
Junc 190	1293.06	0	0	1320	27
Junc 191	1293.5	0	0	1320	26.49
Junc 192	1293.77	0	0	1320	26.21
Junc 193	1293.17	0	0	1322	28.77
Junc 194	1294.42	0	0	1322	27.66
Junc 195	1294.42	0	0	1322	27.66
Junc 150	1297.19	0	0	1314	16.92
Junc 196	1293.69	0	0	1320	26.47
Junc 197	1299.75	0	0	1318	18.39
Junc 198	1296.91	0	0	1316	18.9
Resvr BALAJU_RES	1339.7	#N/A	-425.07	1340	0

6.3.6 Pipe Abstract

Table 6.37: Abstract of Pipe Length of DNI 7B area

Description of Works	Unit	Quantity
Supply of all materials and laying/installation of **spigot and socket DI pipes** with necessary rubber gaskets including storing properly, loading the pipes at store, delivery to site, unload, distribute, multiple handling, cutting, jointing,dewatering, successful sectional presure and leakage testing, including cost of water and cost of all testing arrangements/ equipments, supply and installation of PE sleeving, non detectable warning tape at specified levels as shown in the drawing and all other associated works to complete with all lead and lift (Technical specifications :clause 6.4).		
600 mm diameter DI Pipe of Class C30 as per ISO 2531 or equivalent	m	2,939.00
500 mm diameter DI Pipe of Class C30 as per ISO 2531 or equivalent	m	910.00
450 mm diameter DI Pipe of Class C30 as per ISO 2531 or equivalent	m	682.00
400 mm diameter DI Pipe of Class C30 as per ISO 2531 or equivalent	m	346.50
350 mm diameter DI Pipe of Class C40 as per ISO 2531 or equivalent	m	2,403.00
300 mm diameter DI Pipe of Class C40 as per ISO 2531 or equivalent	m	395.50
250 mm diameter DI Pipe of Class C40 as per ISO 2531 or equivalent	m	50.00
200 mm diameter DI Pipe of Class C40 as per ISO 2531 or equivalent	m	158.50
150 mm diameter DI Pipe of Class C40 as per ISO 2531 or equivalent	m	818.50
Supply HDPE pipe PE 100 PN 10 and installation/laying with Electro Fusion joint excluding necessary pipe fittings (e.g. EF coupler, Tee, Bend, Reducer, Cap etc.) as per instruction of engineer including storing in proper location, loading the pipes & fittings at store, deliver to site, unload, distribute, multiple handling, cutting, fusion jointing, dewatering, successful sectional pressure and leakege testing, including cost of water and cost of all testing arrangements/equipments,supply and installation of detectable warning tape at specified level as shown in the drawing and all other associated works to complete and drawing with all lead and lift (Technical specification :clause 6.5)		-
140mm diameter HDPE pipe	m	100.00
125mm diameter HDPE pipe	m	200.00
110mm diameter HDPE pipe	m	6,752.00
90mm diameter HDPE pipe	m	5,971.00
75mm diameter HDPE pipe	m	150,959.80
Supply laying and jointing of 16 mm PE pipe PE 100 PN 16 (for demo Baneshower And Kusunti)	m	3,200.00
Supply HDPE pipe PE 100 PN 10 and Installation/laying with **Butt Fusion joint and Electro-fusion Joint excluding pipe fittings to be used for HDD and open cut procedures** as per instruction of engineer including storing in proper location, loading the pipes & fittings at store, deliver to site, unload, distribute, multiple handling, cutting, fusion jointing, dewatering, successful sectional pressure and leakege testing, including cost of water and cost of all testing arrangements/equipments,supply and installation of detectable warning tape at specified level as shown in the drawing and all other associated works to complete and drawing with all lead and lift (Technical specification :clause 6.5)		-
Dia 400mm	m	500.00
Dia 315mm	m	874.65
Dia 280mm	m	1,818.60
Dia 225mm	m	2,609.25
Dia 160mm	m	60,675.96

Table 6.38: Abstract

S N	Description	Unit	Quantity	Remarks
1	Electricity and Electromechanocal Works	-	-	
1.1	Pump	No.	5.00	
1.2	Transformer	No.	1.00	
2	Gen Set	No.	1.00	
3	Isolation Valve	No.	334.00	
4	Bulk Water Meter	No.	20.00	
5	Fire Hydrant	No.	136.00	
6	Air Valve	No.	73.00	
7	Washout	No.	48.00	
8	PRV	No.	18.00	
9	DMA	No.	18.00	

7

Project Cost

7.1 Basis of Costing

The unit prices or lump sum prices were analysed considering the following:

- Standard GON norms of unit price analysis and other accepted norms in recent ICB and LCB contracts in the country and elsewhere
- Market Prices/FOB prices for imported materials as pipes, accessories etc.
- Wages of skilled and unskilled labor
- Construction technology
- Mobilization and demobilization cost
- Overheads and profit
- Contract tax or VAT

Break-down into plant, materials and labor component for all unit prices was derived. Unit rates for individual items were determined on basic inputs, overheads and profit including the determination of the foreign exchange component of each element.

Table 7.1: Cost Estimate for DNI-7B area

Summary of Abstract of Quantities

Part No.	Work No.	Description of Works	Amount (NRs.)	Remarks
A		**Preliminary, Provisional and General Work**		
	A1	Preliminary and General Work	36,690,000.00	
	A2	Provisional Work	101,200,000.00	
		Sub total A	**137,890,000.00**	
B		**Civil Works**		
	B1	Site Clearance, Earthwork, Sand Filling, Shoring and Other Earth Material Related Works	230,983,451.66	
	B2	Brickwork	38,794,616.73	
	B3	Concrete Related Work	91,019,774.59	
	B4	Surface Finishing Work	2,393,253.54	
	B5	Reinstatement and Pavement Work	369,831,957.50	
	B6	Metal Related Work	1,803,938.00	
	B7	Other Building and Electric Work	1,701,266.92	
	B8	Miscellaneous Works	9,109,140.75	
	B9	HDD Work	178,476,096.75	
		Sub total B	**924,113,496.44**	
C		**Pipe line, Pipe Fitting and Other Pipe Line Related Works**		
	C1	Pipe Supply, laying and jointing works	380,385,817.38	
	C2	Supply and Installation of Pipe Fittings, Valves and Appurtenances	516,135,070.00	
	C3	Hydrostatic Testing and Disinfection Work	34,811,971.35	
		Sub total C	**931,332,858.73**	
D		**Days Works**		
	D1	Supply of Pipes, Fittings and Accessories for Operation & Maintenance	50,355,185.72	
	D2	Supply of labours and equipments and construction materials	3,181,150.00	
		Sub total D	**53,536,335.72**	
E		**Electrical and Electromechanical Works**		
	E1	Electromechanical Works	26,322,994.24	
	E2	Electrical Works	33,735,325.38	
		Sub total E	**60,058,319.62**	
		Sub Total A,B,C,D & E	**2,106,931,010.51**	
		Price contingencies @ 10%	210,693,101.05	
		Physical contingencies @ 10%	210,693,101.05	
		Sub total	**2,528,317,212.61**	
		VAT @ 13%	328,681,237.64	
		Total estimated Cost (Grand Total)	**2,856,998,450.25**	

8

Operation and Maintenance Plan

8.1 General

A well-designed Operation and Maintenance (O&M) Plan for a water supply system is critical to ensure that the design intent is conveyed in daily operation resulting in maximum benefit to the residents at the minimum possible level of investment. Proper implementation of the O&M plan results in low maintenance cost and ensures longer service life of all system components.

The critical issues to be taken care of in the development of an O&M Plan will be the maintenance of equipment, pipelines, valves & other appurtenances and the system of providing house service connections.

8.2 Proposed Maintenance System

8.2.1 Preventive Maintenance

The preventive maintenance of a water distribution system is a set of activities that shall be performed on a regular basis.

Preventive maintenance may increase the initial project cost marginally, but will result in an economical maintenance of the system over the project life. Specifically, in the internal water distribution system, preventive maintenance will increase the life of water mains and appurtenances, which in turn will assure regular and uninterrupted water supply to consumers.

The water distribution system is usually one of the most expensive components of a water supply system and its proper maintenance will reflect on the functioning of the system and its associated service life. The KMC has an advantage on this water supply project with respect to O&M, since no major electrical and mechanical equipment's are installed in the system and electric power is apparently not relied on.

Maintenance issues in pipelines will differ from place to place depending on the conditions encountered. Selection of suitable pipe material and periodical maintenance is essential to ensure protected water supply at the most economical rate with minimum breakdowns, which will ultimately manifest itself as consumer satisfaction. The points to be considered while planning are enumerated below:

- Periodic inspection of mechanical / electrical equipment such as pumps and motors installed at the WTP, valves, capacitors, voltage stabilizer etc. shall be done for trouble-free operation and optimum performance
- Materials of superior quality shall be procured for replacements
- Newly laid mains shall be regularly tested

- Precautionary measures against corrosion shall be performed
- Leak detection surveys shall be performed from time to time.
- Ducts shall be provided across streets to permit easy laying of additional mains, if required
- Provisions of stubs (short length mains) shall be made to accommodate a group of ferrule connections
- Equipment like submersible dewatering pumps, pipe cutting machines, cutting machines, pipe detectors, leak detectors, lighting sets, spare valves etc. shall be arranged for O&M.
- Preparation of 'ward manuals' with details of mains, valves, hydrants, etc. within a ward or zone shall be done.
- Emergency labor teams to work on Sunday and holidays to attend emergency works shall be available.
- Liaison with custodians of other utilities for proper work co-ordination and reduced interference shall be taken care.
- Adequate staff training shall be arranged from time to time.
- A system of information dissemination to consumers on possible disruption in supply shall be established.

8.2.2 Breakdown / Emergency Maintenance

In case of damage (burst) resulting on a main, the following operational sequence shall be adopted:

- Labor workforce (skilled & unskilled) shall be mobilized and required materials shall be assimilated and the team shall be directed to the breakdown site.
- Main control stations / senior officers concerned with maintenance of water distribution shall be informed of the situation and the progress monitored.
- The concerned control office shall be intimated to isolate the damaged main and alternative supply arrangements (if possible tankers) for water supply to the localities affected shall be pressed into action.
- Utilities such as Roads, Electricity & Telephones shall be informed of the breakdown and requested to be present at site to ensure coordination.
- The local traffic police shall be informed to ensure proper traffic regulation.
- Isolation of the water main by closing sluice valves on all sides shall be done if the pipe is damaged severely.

8.2.3 Maintenance of Appurtenances

The objective of installing appurtenances on water pipelines is to permit control of water supply, protect the pipelines and assist with periodical cleaning. Normally installed appurtenances are described below.

- **Sluice valves**

Sluice valves are required to control and regulate water supply and shall be provided at suitable locations considering the length of pipeline and take off branches. Defects normally reported on the sluice valves are the following:

- **Gland leaks:** Gland leaks can be rectified by replacing the hemp packing when noticeable leaks are observed.
- **Spindle damage:** Unequal application of pressure results in damage to the spindle, which can be avoided by training valve operators to operate the valve in accordance with manufacturer's recommendations on tightening pressure. It is necessary to have spare spindles for the full range of valves to ensure replacement in the shortest possible time frame
- **Partial valve closure:** Debris accumulated in the valve seat and around spindle heads causes this problem and can be removed by opening the top cover of the sluice valves. Round out of spindle heads are a direct consequence of wear and tear and this can be reduced by using specially prepared caps

It is a recommended practice to provide a name plate on the valve chamber or near the curb edge detailing sluice valves with location, size and direction of opening. This will reduce the complaints regarding sluice valves getting buried during road construction and/or trench backfill. When possible, sluice valves shall be installed along pavements. Sluice valves in roads where there is intense traffic shall be provided with heavy-duty covers with markings of pipeline alignment to avoid intentional or accidental damage.

8.2.4 Scour Valves

Scour valves are normally provided at the bottom of pipelines (normally horizontal) and operated to flush and dewater the mains.

8.2.5 Air Valves

Air valves are provided on the top of pipelines where there is an acute horizontal / vertical direction changes.

8.2.6 Quality of Materials

The water supply system will work without (or with very minimal) interruption if the procured materials such as pipes and appurtenances are of standard quality. It is therefore necessary to use standard materials of approved make and establish procedures right from procurement of materials to installation, testing and commissioning.

The pipes procured shall be subjected to hydraulic pressure tests as specified in IS: 1536-1967. If the testing facility does not exist, a manufacturer's test certificate shall be obtained and filed for reference. Manufacturers shall test pipes in the presence of the representative of KUKL and submit a test certificate while delivering the pipes.

Valves, hydrants and other appurtenances shall be tested prior to installation. It is recommended to invest more in procuring good quality materials rather than purchasing inferior materials and then incur high maintenance expenditure.

8.2.7 Maintenance of Service Reservoirs

The important aspects to be considered in the maintenance of service reservoir are:

- **Measurement of inflows / outflows:** Supply and Discharge flows or at least discharge flows shall be measured to ensure the losses. Water level indicators and flow indicators / recorders shall be in working condition.
- **Structural leakage:** All structural damages and leak shall be promptly repaired.
- **External Pollution:** Manhole openings, ventilation shafts and overflow pipes shall be adequately protected and checked periodically to prevent any contaminant infiltration.
- General cleanliness in and around the service reservoirs shall be maintained and observed.
- A garden around the service reservoir can be provided, wherever possible, for aesthetic reasons.
- A program to clean the service reservoir at least twice in a year shall be undertaken. Such cleaning process shall be performed during non-supply times or a facility to by-pass the water supply shall be in place.
- Appropriate safety measures to prevent entry of unauthorized persons shall be provided.
- All guide and hand railings shall be maintained in a safe and firm condition.

8.2.8 Maintenance of Bulk Distribution System

Conveyance and water distribution are items that involve substantial expenditure in a large water supply scheme. For effective maintenance, the entire water distribution system shall be divided into zones served preferably from a minimum number of service reservoirs. Operation and Maintenance of the water distribution system shall be entrusted to at least a Junior Engineer who shall be the authorised official of the controlling authority to receive and deal with complaints. Appropriate registers shall be maintained to record complaints and track follow up action to ensure that the complaint is addressed. He shall be provided with sufficient funds to face an emergency. If the complaint is such that it cannot be dealt with at his level, the Junior Engineer shall promptly refer the matter to a higher authority and also intimate the action taken to the complaint. Frequent vigilance checks in areas receiving maximum complaints shall be made as an essential part of the supervisory staff's daily schedule of duties.

8.2.9 Annual O&M Cost

It is envisioned and recommended that KUKL will be responsible for Maintenance and Operation of the entire water supply system. However, it may also be possible for KUKL to privatize the O&M through a fixed cost contract and supervise the maintenance.

9

Institutional Strengthening & Training

9.1 General

Good Organisation set-up is a prerequisite for efficient maintenance of a water supply system. A local body with a good organisational set-up and definite tasks assigned to its employees will have minimum maintenance problems. The existing Organisation set-up in KUKL is very small, considering the future improvements to the water supply system of Kathmandu City.

9.2 Present Institutional Set-up & Restructuring

The institutional framework for urban development was created in early 1990's with the establishment of the Ministry of Housing and Physical Planning (now under newly formed Ministry of Urban Development - MoUD), Nepal Water Supply Corporation (NWSC), Urban Development Training Centre, and town development committees in each municipality. The Town Development Fund was established in the mid-1990s as a source of urban finance. Several Government Ministries, departments and other agencies are involved in the management of the water supply sector and related activities. Major institutions involved and responsible for development and management of water supply services in the Kathmandu Valley are:

- **Ministry of Urban Development** (**MoUD)** is responsible for formulating national level policies and programs and guiding sector activities to meet objectives and targets.

- **Department of Water Supply and Sewerage (DWSS)** is the lead agency in the sector and is responsible for water supply services in rural areas and small urban centers.

- **Nepal Water Supply Corporation (NWSC)** is a semi-autonomous corporation responsible for water supply and sewerage in major urban centres outside of Kathmandu Valley.

- **Kathmandu Valley Water Supply Management Board (KVWSMB)** is an autonomous body established under WSMB Act (2006) and responsible for water supply and sewerage services in Kathmandu Valley.

- **Water Supply Tariff Fixation Commission (WSTFC)** is an autonomous body responsible for economic regulation of water supply and wastewater services and to fix the tariff.

- **Kathmandu Upatyaka Khanepani Limited (KUKL)** was set up in 2008 under a Public Private Partnership (PPP) model under the Companies Act for operation and maintenance of water supply system in Kathmandu Valley under lease and license (30 year) from KVWSMB.

9.3 Training for Water Supply Personnel

9.3.1 Introduction

Recruitment of trained engineering personnel for management of water works is an important issue confronting organisation like Public Health Engineering Department, Municipalities and Industries possessing their own waterworks. Of equal importance is the problem of keeping such personnel technically updated. Special efforts to impart in-service training or continuing professional education should go along with employment of such personnel.

In view of the rapidly changing pace of science and technology, individuals initially educated in traditional disciplines in engineering and employed in the waterworks industry should obtain additional training, if they are to continue performing their technical duties effectively. Formal academic education may not equip an employee to cope indefinitely with challenges posed.

Necessity of Training

A valuable resource in a waterworks utility is the personnel. Their proficiency directly influences quality of service and overall economy. Creative, hard- working and well-trained employees capable of achieving high standards of performance enhance the status of a utility company with resultant additional benefits such as the following:

- Increased efficiency of operation with advanced knowledge of operational practice;
- Overall economy by virtue of expanded skilled operation and maintenance;
- Improvement in quality of treated water;
- Improved public relations; and
- Improved public health conditions due to supply of water of superior quality closely controlled by trained laboratory staff.

In recent years, there has been an increased realisation of importance of maintaining specialised operating personnel and attention has also been focussed on the need for training employees at different levels. Training cannot end with just one course. To be effective, it has to be a continuous process. Each employee should be trained year after year through employment. In this town, due to lack of training both for the field staff as well as the Engineers; the maintenance system is found to be not satisfactory. It is therefore necessary that periodical intensive training be given to the operating staff with the following areas of focus:

- Interaction with consumers
- Need for providing potable water supply
- Description and application details of instruments and other accessories required for maintenance work
- Need for proper maintenance of the same and monitoring how each activity shall be operated upon / performed.
- During emergency break down, how system has to be restore within a minimum breakdown period.
- Training and field visits to other project sites to get firsthand information about proper maintenance procedures.
- Maintaining of records and necessary field documents regarding Operation and Maintenance (O&M) of various units in the water supply scheme and periodical interaction with higher authorities for effective follow up action.

9.3.2 Training Requirements

The existing water supply scheme was constructed by KUKL. The headworks, Sundarijal Water Treatment Plant, existing service reservoirs and internal water distribution system are being maintained by the KUKL. Though most of them are qualified for the O&M of water supply schemes, they are not trained to handle and properly operate and maintain the electrical and mechanical equipment in water treatment plant. This results in frequent failure of starters and other electrical equipment like switches and control panel. At the time when KUKL employs its own staff for O&M, the staff needs training for proper O&M of the equipment and the proposed water supply scheme.

9.3.3 Training Plan

The operating staff of KUKL shall to be trained in the following:

- Basic principle of various machineries working
- Basic Knowledge in the working of motor, starters, circuit breakers & switches.
- Purpose of various types of valves – Sluice valve and Scour valve etc.
- Valve operations at headworks and in the gravity main.
- Preventive maintenance of electrical and mechanical equipment
- Attending to minor repairs, major repairs – procedure to be followed
- Various types of pipes and pipe materials – pressure ratings
- Log books – maintenance & upkeep of records
- Importance of keeping good health and hygiene
- Management of crises in the Operation & Maintenance

10

Procurement Strategy

10.1 Implementation Options

The Proposed improvement works under 7B DNI areas have been divided into Contract Package 5.

Contract Package 5: DNI Zone - A, B, C & K.

The various options considered for the implementation of the Distribution Network Improvement System are as follows:

- International Supply and Construction Contract
- International Supply Contract and separate International Construction Contract
- International Supply Contract and separate Local Construction Contract

10.2 Proposed Implementation Method

Considering the size, the relative lack of complexity, and the capabilities of available international contractors, it is recommended that the construction of the project be accomplished by one competitively bid, qualified contractor or joint venture. The recommended approach was discussed and agreed with PID.

To follow the ADB's Procurement Guidelines it is proposed to use International Competitive Bidding for the supply and construct pipeline contract. The adoption of ICB will not exclude local contractors. They can form joint ventures either with international or local contractors.

10.3 Construction Period

A 30-month construction period is proposed.

10.4 Post Qualification of Contractors/Tenderers

It has been discussed and agreed with PID to perform post qualification rather than prequalification of bidders. This will further accelerate project implementation by ensuring that tender documents for the supply and construction contract will be issued in the shortest possible time.

10.5 Form of Tender

The model form of contract will be ADB's Standard Bidding Documents for Procurement of Works (without Prequalification), dated September 2010. International Competitive Bidding will be conducted in accordance with ADB's Single-Stage, Two-envelope Bidding procedure. It is

based on the Master Procurement Document entitled "Bidding Document for the Procurement of Works", prepared by multilateral development banks and other public international financial institutions which reflects the majority view of these institutions. This document has the structure and the provisions of the Master Procurement Document, except where ADB-specific considerations have required a change.

The documents have been prepared in the following volumes:

Volume: I – Bidding Procedures Section
1: Instructions to Bidders Section 2: Bid
Data Sheet
Section 3: Evaluation and Qualification Criteria Section 4:
Bidding Forms (including BOQ) Section 5: Eligible
Countries

Volume: II – Requirements – Specifications
Section 6A: Technical Specifications

Volume: III – Requirements - Drawings
Section 6B: Drawings

Volume: IV – Conditions of Contract and Contract Forms
Section 7: General Conditions of Contract Section 8:
Particular Conditions of Contract Section 9: Contract
Forms

By referring the above bid documents, other documents have been prepared and submitted separately.

10.6 Quantity and Cost Estimates

Based on the detail design and drawings prepared, the bills of quantities have been prepared for all components of the project. Cost estimates were prepared considering the established quantity of works and unit prices.

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ABBREVIATIONS

ADB	Asian Development Bank
AV	Air Valve
BDS	Bulk Distribution System
BLS	Base line station
BM	Bulkmeter
BPC	Butwal Power Company
BS	British Standard
CAN	Contractor's Association of Nepal
CBP	Capacity Building Partnership
CIP	Carriage and Insurance Paid
DDU	Delivery Duty Unpaid
DIN	German Standard Organization (Deutsche Industry Norm)
FH	Fire Hydrant
FIDIC	Federation Internationale des Ingenieurs Conseils
ICB	International Competitive Bidding
ICM	Indian Corporation Mission
IDA	International Development Agency
ISO	International Standard Organization
IV	Isolation Valve
KUKL	Kathmandu Upatyaka Khanepani Limited
LCB	Local Competitive Bidding
MDD	Maximum dry density
MT	Metric ton
MWSP	Melamchi Water Supply Project
OMC	Optimum moisture content
PAF	Project affected families

PAP	Project affected people
PBM	Permanent bench marks
PID	Project Implementation Directorate
PRV	Pressure Reducing Valve
SPT	Standard penetration test
TBM	Temporary bench marks
TOR	Terms of References
UFW	Unaccounted- For-Water
UWSSRP	Urban Water Supply and Sewerage Rehabilitation Project
WSSA	Water Supply and Sanitation Area
WV	Washout Valve
VAT	Value added tax

SALIENT DESIGN FEATURES

Sl. No.	Particulars	
1	Country	Nepal
2	Capital City	Kathmandu
3	Name of the Project	Kathmandu Valley Water Supply Improvement Project (KVWSIP)
4	Source of Finance	ADB Loan 2776-NEP
5	Implementing Agency	KUKL, PID, Kathmandu assisted by DSMC
6	Executing Agency	The Ministry of Urban development (MoUD)
7	Operation & Maintenance	KUKL, Kathmandu
8	Scope	Providing Distribution Network Improvement to DNI -7C (DNI Zones G, H, I, J)
9	Area Covered (Ha)	DNI area - 7C: 455.20 Ha
10	Municipal Wards Covered	2, 3, 4, 16 & 26
11	Population served (for DNI- 7C)	Initial Design Year (2015): 1,27,796 Intermediate Design Year (2030): 2,14,535 Ultimate Design Year (2045): 3,34,097
12	Service Reservoirs	DNI area–7C (DNI Zones - G,H,I & J) served by Bansbari
13	Number of House Service Connections (HSCs)-nos.	DNI area-7C (DNI zones - G,H,I & J): 27,974
14	Total Water Demand (lps)	DNI area-7C (DNI zones- G,H,I & J): 430.62
15	Pipe Length (m)	DNI area-7C (DNI zones - G,H,I & J): 262,164.55
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20	Washout Valve (nos.)	DNI area-7C (DNI zones - G,H,I & J): 150
21	Minimum Node Pressure (m)	DNI area-7C (DNI zones - G,H,I & J): 10-50
22	Pressure Reducing Valve (nos.)	DNI area-7C (DNI zones - G,H,I & J): 19
23	Number of District Metered Area (DMA's)/service areas	DNI area-7C (DNI zones - G,H,I & J: 18

1

INTRODUCTION

1.1 General Background

Nestled in the lap of Himalayas, Nepal is a small and beautiful country spreading over a geographical area of 147,181 sq. km. The population of Nepal is recorded 26.4 million (Census 2011). The urbanization rate is lower at 16% in comparison with its South Asian counter parts. The capital city Kathmandu is the largest urban centre and has been experiencing rapid urban growth in recent years. The last decade experienced a growth of 7% which is one of the highest in the urbanising world.

The Kathmandu valley is spread over an area of 900 sq. km, and comprises five municipalities and is home to about 30% of the country's urban population.

The rapid increase in population -affected both by natural growth and in- migration has increased the demand for infrastructure services, housing, and for other amenities in Kathmandu Valley. The infrastructure development, on the other hand, has not been up to the requirement. These are resulted in large gap in service delivery, especially in basic services like water supply, sewerage and power supply. Lack of operational wastewater system facilities converted the holy Bagmati River into a highly polluted river.

The project was developed using lessons from previous ADB interventions. An important lesson from earlier projects was to give importance to rehabilitation of networks along with creation of assets. Accordingly, the project will focus on reducing non-revenue water (NRW) and improving the existing network. To drive efficiencies and introduce best practices, the project will utilize the District Metering Areas (DMA) approach for distribution network improvement (DNI) and non-revenue water (NRW) reduction. With the completion of Melamchi tunnel, Kathmandu Valley will receive an additional 170 million litres per day (MLD) upon completion of stage one while the current average availability is only 100 MLD against a demand of 367 MLD for 2014-15. The project will adopt contracts with adequate provisions to monitor NRW reduction, introduce asset management plan, and develop geographical information system (GIS) to maximize benefits.

The expected impact of the project is sustainable water supply services for residents of Kathmandu Valley covered under the scope. The expected outcome is improved access, efficiency, and reliability of water supply services to the residents of Kathmandu Valley including poor women and men. The project will prioritize underserved areas and poor sections of the

population in Kathmandu Valley. The project will further enhance capacities of the urban areas to attract investments, increase productivity and create enabling environment for higher economic growth. Piped water through individual household connection will relieve women of the drudgery of managing water, thereby giving them more time for social and economically productive activities.

1.2 Current Project Objective and Scope –DSC-03 Objective of the Assignment

The objective of the proposed consultancy services for Design, Management and Supervision Consultants is to:

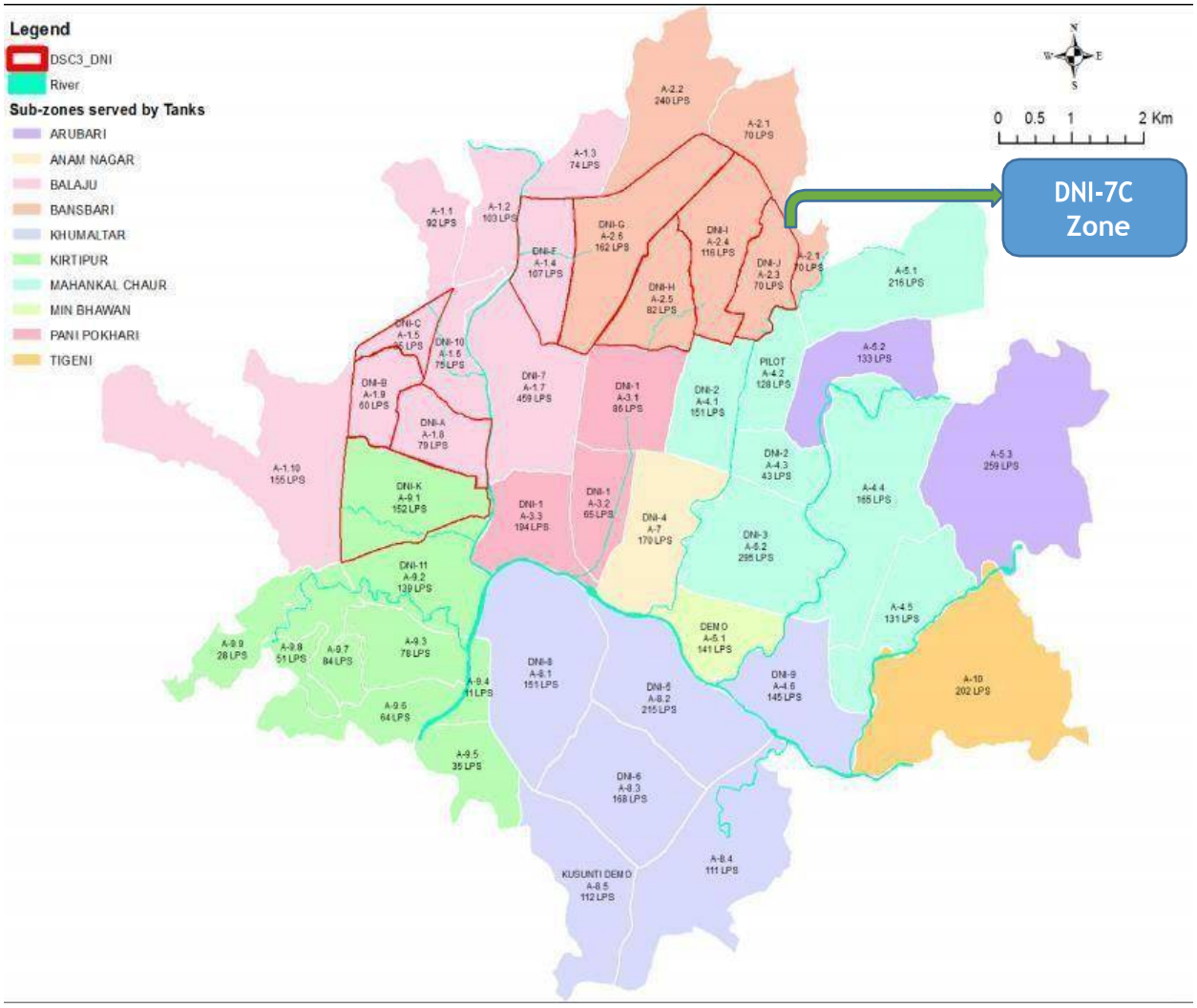
- Carry out detailed design of distribution network improvement of remaining areas of Kathmandu Metro (7B & 7C) Area and Kathmandu North-East Region.

Scope of services

- Review of preliminary design and preparation of base maps, manuals, guidelines and commissioning plans.
- Surveys, studies and investigations.
- Detailed Engineering Design and Bid Document preparation.
- Social, Environmental, Archaeological, Occupational health & safety, Community participation and Gender issues during the detailed design phase.

This report presents the detail design of distribution network improvement of **7C DNI area**. Where **DNI-7C Area** comprises of **5 DNI Zones** namely: DNI–G (A2.6), DNI– H (A2.5), DNI–I (A2.4) & DNI–J (A2.3).

Figure 1.1: Demarcation of 7C DNI Areas (Comprising of DNI Zones- G, H, I & J) boundary



1.3 Scope of –DSC-05

The design was fully undertaken by DSC03 but has been reviewed and updated by DSC05. DSC05 could only review within the information submitted by DSC03 and have improved the design with minimum changes.

For secondary mains, HDD method will be applied as per client's request in the possible areas. Detailed design shall be undertaken by the consultant for Primary mains, Secondary mains and Pumping Related facilities.

This report is based on DSC03 report and revised by DSC05 for several items.

1.4 Institutional Arrangement

Following are the key agencies involved in the project implementation.

(i) **Executing Agency**: The Ministry of Urban Development (MoUD) is the executing agency responsible for overall strategic planning, guidance and management of the project and for ensuring compliance with loan covenants.

(ii) **Implementing Agency:** KUKL, the asset operator and service provider, through its existing Project Implementation Directorate (PID), is the implementing agency responsible for (i) project planning, implementation, monitoring and supervision, (ii) reporting to KUKL Board of Directors, MoUD and ADB, and (iii) coordination of all activities in the project. PID is staffed with sufficient number of experienced professionals headed by Project Director, who is a Joint Secretary level GON officer. PID is supported by the following consultants:

(iii) **Project Steering Committee (PSC):** Chaired by the Secretary, MoUD, has been established to provide policy guidance, accomplish reform measures, oversee project implementation and ensure cooperation of all agencies involved in the project.

(iv) **Design, Supervision and Management Consultant (DSC-3)**: To support PID in project management, engineering design, construction supervision, procurement of goods and services, institutional development and capacity building.

(v) **Community Awareness and Participation Consultant (CAPC)**: Towards assisting in community awareness and participation within project area.

Continuation to signing of loan by Government of Nepal with Asian Development Bank, through a competitive bidding process CDM Smith Inc. in association with TAEC Consult P. Ltd. and Integrated Consultants Pvt. Ltd. (ICON) is appointed as Design, Supervision and Management Consultant (DSC

3) For this loan no. 2776 (NEP) SF project.

Structure of the Report

Section 1: Introduction: Project background with objectives and scope of study

Section 2: Existing Water Supply Scenario in Kathmandu

Section 3: Population projection and Water demand

Section 4: Topographical survey

Section 5: Design Standards and Approach

Section 6: Proposed Distribution Network Improvement

Section 7: Project cost

Section 8: Operation and Maintenance Plan

Section 9: Institutional strengthening and Training

Section 10: Procurement Strategy

2

Existing Water Supply Scenario –Kathmandu

2.1 General

Water is Nepal's largest available natural resources with over 6,000 rivers having a combined length of 45,000 km. Still the access to water supply is limited. The water supply system in Kathmandu Valley is dependent partly on ground water and partly on surface water sources. In all, at present water is drawn from 31 surface sources and 75 deep tube wells (54 operational) located in different parts of the valley. The total water production from these sources put together is about 100 MLD (dry season) to 150 MLD (monsoon). These sources supply water to 21 Water Treatment Plants (WTPs) with a total treatment capacity of 85 MLD. The treated water is fed into 44 service reservoirs, from where water is supplied through 1,240km of distribution lines, over 165,000 consumer connections and 1,200 public stand posts to about 2 million consumers.

The water supply system suffers both from partial coverage (only 70% of the total 2.8 million population covered) and inadequate supply (100 to 150 MLD production as against an estimated demand of 190 MLD at consumer end). Added to this is the old water supply system with aging old and profusely leaking pipes resulting in high water losses (estimated at 45%). Besides, there are numerous illegal and unauthorized multiple connection, resulting in a large portion of unaccounted for water (UFW).

Under the water shortage conditions, KUKL (the agency responsible for water supply in Kathmandu Valley) has applied a rationing system whereby water is allowed to flow to different sections of the metropolitan/urban area in rotation. The control system developed by KUKL is complex to implement as it requires KUKL staff to operate with over 1000 valves for distribution. The result is an inequitable distribution of water, particularly as the areas close to the water sources are very difficult to isolate. While some parts of the city have an abundance of water and enjoy 24-hour supply, a large share of the population only receives water for a few hours every 2-5days and even then, the pressure is low and the quality is poor. As most areas receive intermittent supply with low pressure, use of pumps to suck water and bypassing of water meters are believed to be quite common techniques used by the consumers. People in many areas often receive one-hour supply in every fourth day only.

The outdated system with old design, ad-hoc development on need basis and old and damaged pipes has given rise to contamination of treated water. Water quality at the consumers end is far less than desired and it is a common practice to treat or boil water for potable use. While the basic cost of piped water in Kathmandu may be cheap, the other direct and indirect costs associated with its use seem very high. The mushrooming of firms supplying the household level water

purification systems in Kathmandu is an indication of growing water quality concerns among the general public – a recent survey report states that there are about 64 water vendors in Kathmandu.

Besides, there is sprawling private water supply market supplying treated water at a rate of Rs. 5-10 per 20 liters to the consumers. Around 60% of the households in Kathmandu either boil water or use some form of water purification devices to attain quality water for drinking use. Also, an estimated 20% of the households depend on packaged water supply. On an average, the current "water cost" is around Rs.350-500 per month per household. Besides the exorbitant costs associated with these alternative strategies, there is no assurance of quality.

The typical/specific problems exhibited in entire Kathmandu distribution network and as well in the 7C area are as follows:

- Little equity in water supply; some properties get very good supply with good pressure for 6-7 hours, while others get only 1 to 2 hours supply every fourth or fifth day with very poor pressure;
- Very high-water leakage and losses in the area.
- No control mechanism for isolating the service area for maintenance;
- Multiple house connections to a trunk water supply main;
- Old and undersized water distribution mains;
- No operational fire hydrants;
- Long, multiple house connection pipe work;
- Areas of poor water supply service;
- Many non-operational consumer meters.

Many of such households also have secondary water sources like hand pumps, dug well or other such facilities to supplement their daily requirements. In addition, same households also supplement their drinking water requirements through the use of private tankers and bottled water.

3

Population Projection & Water Demand

3.1 General

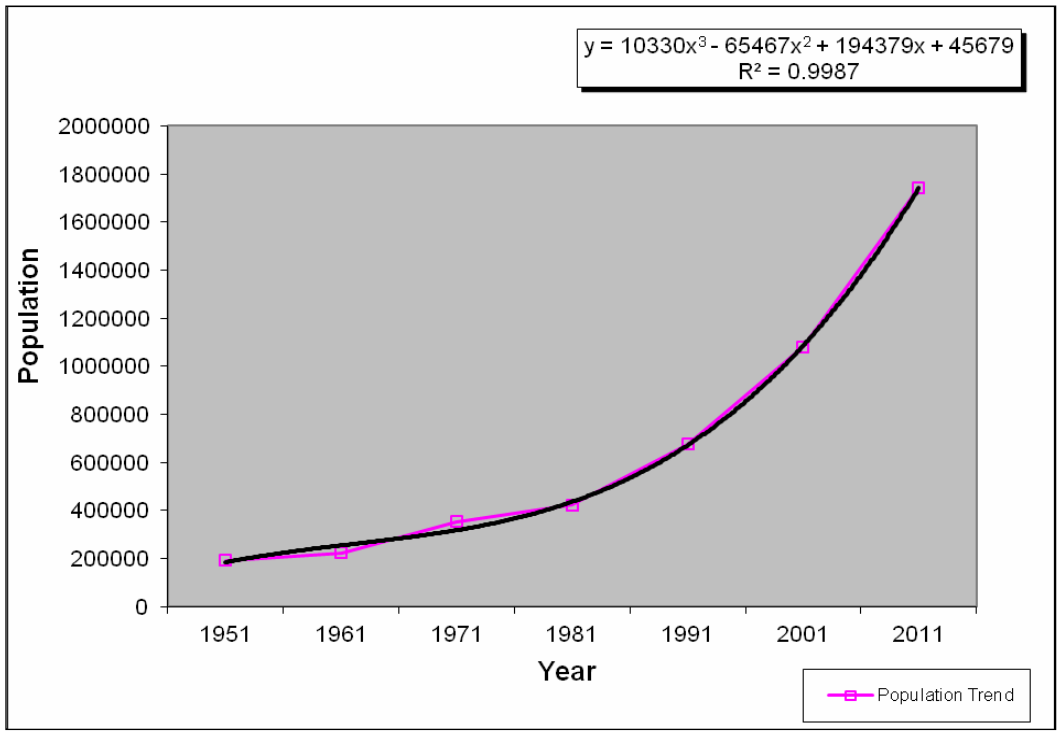
A critical factor in the design of a water supply system is the estimation of water demand which again directly depends on the ultimate population. Design population projection finds its base upon the historic census population, the present population and its expected rate of growth. Demographic methods for projecting population include numerical methods like Arithmetic increase, Incremental increase, Geometric increase, Exponential, Polynomial logarithmic and Power series. The best fitting among these is generally used in projecting population for water supply schemes.

For projecting population for Kathmandu Metro Zone historic population figures from years 1951 to 2011 were collected from the country's census website for the various urban and village bodies comprising the zone and was analysed using the above methods. On doing a regression analysis, ***a third order polynomial appeared to be representing the historic data best and the same is adopted for projecting to future.***

Another critical factor is the design period adopted. Generally, the civil components such as source and pipe networks are designed considering the demand for a period of 30 years, water treatment plants for 15 or 30 years (based on the difference in capacities and its economics), storage and electromechanical components for 15 years. ***Accordingly, 2015 is proposed as Base Design Year, 2030 as Intermediate Design Year and 2045 as Ultimate Design Year.***

Figure 3.1 shows the population growth over last seven decades on the best fitting curve; that is a third order polynomial.

Figure 3.1: Polynomial Third Order Curve of Historic Population Growth



Adopting above regression model based on third order polynomial, the population projection pertaining to **Kathmandu Metro Water Supply Zone (Zone A)** is projected in ***Table 3.1*** for the desired years in the tables below for Base Year, Intermediate and Ultimate Year respectively.

Table 3.1: Design Population for Base, Intermediate and Ultimate Years (Kathmandu Metro Water Supply Zone)

Year	Permanent Population	Temporary Population	Total Design Population
2015 – Base Year	16,77,258	5,03,179	21,80,437
2030-Intermediate Year	29,40,836	8,82,250	38,23,086
2045 – Ultimate Year	50,48,782	15,14,636	65,63,418

Accordingly, based on trend line method the population projection was made for the **DNI Zones covered under 7C DNI area** are furnished in the below **Table 3.2**

Table 3.2: Design Population for Base, Intermediate and Ultimate Years (DNI 7C area)

DNI Zones	Area (Ha)	Projected Population		
		Base Year - 2015	Intermediate Year - 2030	Ultimate Design Year -2045
DNI-G (A-2.6)	250.36	48151	80833	125882
DNI-H (A-2.5)	134.44	24327	40839	63598
DNI-I (A-2.4)	178.97	34482	57885	90145
DNI-J (A-2.3)	101.61	20836	34978	54472
TOTAL	**455.20**	**1,27,796**	**2,14,535**	**3,34,097**

The details of Area, Ward no. and Zones, HSCs covered by 7C DNI area are furnished in the below **Table 3.3**

Table 3.3 Details of Area, ward no. and HSCs covered by 7C DNI Area

DNI area	DNI Zones	Area covered (Ha)	Municipal Ward no. covered	Population served- 2015	House Service Connections (HSCs) - (Nos.)
7C	DNI-G (A2.6)	250.36	3	20,836	4,167
	DNI-H (A2.5)	134.44	3	34,482	6,896
	DNI-I (A2.4)	178.97	3	24,327	4,865
	DNI-J (A2.3)	101.61	4	48,151	9,630
	Total	**455.20**		**1,27,796**	**25,558**

3.2 Estimation of Water Demand

It is considered that the Project area will be serviced from the Melamchi Project with a target of 510 MLD. The planning horizon and design is based on this available water resource and the ultimate population projection. Also the available water resource of 510 MLD corresponds to the population projection slightly beyond 2030 following review and updating of the various projections with total population serviced in the project area of about 3.8 million.

Therefore, DSC 3 Team suggests adopting a flat rate of supply at 135 lpcd (1) for permanent population and 40 lpcd for the temporary (floating) population **including 15% UFW (Un-accounted for water) and Fire Demand**.

3.3 Fire Fighting Demand (*)

It is usual to provide for firefighting demand as a coincident draft on the distribution system along with the normal supply to the consumers as assumed. A provision in Kiloliters per day based on the formula $100\sqrt{P}$ where p = population in thousands may be adopted for communities larger than 50,000. It is desirable that one third of the firefighting requirements form part of the service storage.

Below **Table 3.4** indicates Fire demand calculations in each of the DNI Sub- Zones.

Table 3.4 Fire Fighting Demand

DNI's	Projected Population Design Year -2030	Fire Demand = $100*\sqrt{p}$	
		KLD	MLD
DNI-G	80833	28431.14	0.028
DNI-H	40839	20208.66	0.020
DNI-I	57885	24059.30	0.024
DNI-J	34978	18702.41	0.019

Below **Table 3.5** indicates population projections and water demand calculations in each of the DNI Sub-Zones.

Table 3.5 Population Projection and Water Demand

DNI Zones	Area	Population			Demand (MLD) (@135 lpcd +0.30x 40 lpcd) x 15% UFW			Water Demand Design for 510 MLD (2)		Served by Reservoir
	(Ha)	2015	2030	2045	2015	2030	2045	MLD	LPS	
7C-DNI area										
DNI-G (A-2.6)	250.36	48151	80833	125882	8.04	13.50	21.03	14.02	162.25	BANSBARI
DNI-H (A-2.5)	134.44	24327	40839	63598	4.06	6.82	10.62	7.08	81.97	BANSBARI
DNI-I (A-2.4)	178.97	34482	57885	90145	5.76	9.67	15.06	10.04	116.19	BANSBARI
DNI-J (A-2.3)	101.61	20836	34978	54472	3.48	5.84	9.10	6.07	70.21	BANSBARI
TOTAL	**455.20**	**127796**	**214535**	**334097**	**21.34**	**35.83**	**55.81**	**37.21**	**430.62**	

(1) **Note:** The Figure include requirement of water for commercial, institutional and minor industries. ***Source: Manual on Water Supply and Treatment-Central Public Health and Environmental Engineering Organization (CPHEEO), Ministry of Urban development, New Delhi, India.***

(2) **Note:** *We calculated the demands for design years 2015, 2030 and 2045 and as the projected total demand of 510 MLD is between the design years 2030 and 2045, we had interpolated the demand for each DNI sub-zone for 510 MLD.*

(*) *Source: Manual on Water Supply and Treatment-Central Public Health and Environmental Engineering Organization (CPHEEO), Ministry of Urban development, New Delhi, India.*

4

Topographical Survey

4.1 Topographic Survey for Distribution Lines:

Detailed topographical survey work was conducted for new 7C DNI Zone. The survey using Electronic Total Station covered extraction of features which included boundaries, topographical and contours. Later the agency re- produced the survey drawings in required format for further design by DSC 3.

As part of above survey along the major roads, control points were established. Survey work commenced by establishing bench mark as available by geodetic survey branch under Government of Nepal. The survey data stored in total station was later transferred for further processing using AutoCAD.

The survey was to be undertaken with within a tolerance of ±5cm or size of the Boundary Marker whichever is coarser.

Note:

Currently the topographical survey has been carried out only on main roads (only 30%). The levels of intermediate roads have been obtained by interpolating with the levels surveyed on main roads.

After awarding the contract, the Contractor should carry out 100% topographical survey to verify the correctness of the levels adopted in the design and the refinement of the hydraulic model is necessary. The Contractor should also carry out the soil investigation wherever necessary and should submit a report.

5

Design Standards and Approach

5.1 General

Primary design parameters are established for commencing the engineer designs. These parameters are largely based on the guidelines specified in Central Public Health and Environmental Engineering Organization (CPHEEO)
– Manual on Water Supply and Treatment, Government of India, choice of technology and service level and as well have been discussed with PID, KUKL and finalized. For the present and future purposes, the following basic design parameters are discussed in the following sections.

5.2 Design Period

Distribution network has been designed to meet demand for the year 2030.

5.3 Population

Projection of population for thirty-year period (2015-2045) has been considered as explained in the previous chapter.

5.4 Per-Capita Demand

A per-capita demand of 135 lpcd for permanent population and 40 lpcd for temporary (floating) population including UFW at 15% and Fire Demand is adopted.

5.5 Peak Factor

A peak demand factor of 1.5 has been adopted in the design.

5.6 Residual Head

Hydraulic analysis and sizing of pipes has been performed to ensure a residual pressure of minimum 1 bar (10m) and 5 bar (50m). *(This has been updated from DSC05 since HDPE pipe class has been increased to PN10)*

5.7 Velocity

As far as possible it was attempted to restrict the flow velocities in distribution pipelines between 0.5m/s and 2.0m/s.

5.8 Allowable Head loss

Head loss of 10m/km has been limited in the distribution network.

5.9 Loss coefficient: Hazen William "C" values

The 'C' value of 110 for DI and 130 for HDPE pipes have been adopted in the design.

5.10 Nodal Demand

Proportional nodal demand distribution (by area) using "Thiessen" Polygon has been adopted in the design.

5.11 District Metered Area (DMA)

In practice, there will always be a significant variation in size of DMA due to the layout of the existing infrastructure and the need to optimize pressure management. DMAs are often sized by the number of properties, where typically a property is supplied by a single customer connection.

Henceforth, DNI's is divided into District Metered Area (DMA) with an average households ranging from 500 to 3,000 for each DMA. In our Design average of 1,500 Households have been considered. **(Or)** shall be based on topography of the service area. ***Ref: International Water Association (IWA) Guidelines, February2007, Version 1.***

5.12 Design and Size of Mains

Pipe DN400 mm Ø and larger have been designated as Primary Mains and pipe smaller than DN400 mm Ø designated as Secondary and Tertiary Mains (based on flow).

5.13 Pipe material

Selection of pipe material has been performed considering the following parameters:

- Hazen-Williams Coefficient
- Ability to withstand Internal / External pressure
- Ease in handling and lowering of pipes
- Corrosion Resistance
- Pipe jointing materials
- Trouble-free maintenance & operation should be ensured
- Availability of specials and fittings

However, finally the selection of pipe materials were discussed with the Client PID, KUKL and agreed as follows:

- HDPE pipe with electro-fusion fittings will be used for distribution lines smaller than DN 150mm, and for service connections.
- DI pipe will be used for mains DN 150mm and larger than DN 150mm.
- HDPE Pipe size increments, as per availability of materials in the market.
  Eg: HDPE pipe of DN75, DN90, DN 110, per IS 4984 as secondary and tertiary mains, and DI pipe as per ISO 2531 as primary mains.
- HDD method will be applied to secondary mains of size between 150mm to 300mm in possible areas. If applying HDD, HDPE can be used for secondary mains up to 300mm. (updated by DSC05)

5.14 Piping layout

- Minimize dead ends by looping of all mains.
- Dual mains are being provided in all roads greater than 7-meter width, and as needed to hydraulically isolate each sub-DMA.
- DSC-03 staff visited several locations in the field to assess the practicality of placing dual mains between every sub-DMA, which will allow complete hydraulic separation of each sub-DMA and also allow for permanent meter installations at the inlet(s) to each sub-DMA.
- Many of the streets between sub-DMAs are quite narrow and also contain sewers which zigzag from one side of the street to another. For these reasons, it will usually not be possible to place dual water mains in such streets while maintaining an adequate separation distance from these sewers. Therefore, when unavoidable (the majority of such cases are unavoidable), we will design such dual mains to be placed in a common trench with an appropriate nominal amount of separation (e.g., 300 mm clear separation). Such dual mains will provide the desired hydraulic isolation of sub-DMAs, but will still necessitate extending service laterals across the street (which would have been avoided had it been possible to place one main on either side of the street).
- Where dead - end main occurs, it shall be provided washout for flushing purposes.
- Flushing device shall not be directly connected to the sewer – Where dead-end mains occur, they shall be provided with a fire hydrant if flow and pressure are sufficient or with an approved flushing hydrant

  or blow-off for flushing purposes. It is recommended that all water quality problem areas in the distribution systems be flushed at least twice each year. No flushing device shall be directly connected to any sewer.

5.15 Testing & Commissioning

The pipelines shall be tested and commissioned using the procedure and methodology as per relevant IS/ISO standards & latest amendments.

5.16 Valves & Appurtenances:

Isolation valve locations shall be based on the following considerations:

- Limiting the number of customers (100 to 150) that will be out of service. Limiting the number (3 to 5) of fire hydrants out of service
- Limiting the time, (2 hours) takes to drain a pipe segment
- Limiting the number of customers (100 to 150) impacted by future system modifications
- Limiting future construction within major streets or intersections
- Avoiding excessive number of valves thus reducing initial cost
- Shall be located at major or critical street intersections
- Line valves at primary mains shall be spaced not more than 1km (or) shall be based on site condition

Air valve locations:

- At the highest point in respective distribution network
- In special locations (such as near district meters)
- Limited to primary mains except in exceptional cases

Fire Hydrant Locations:

- Shall be located at major or critical intersections
- Maximum coverage approximately 5 Hectares per hydrant
- Maximum spacing approximately 250 meters
- Minimum tapping size shall be at 200mm Ø for commercial FH and 150mm Ø for residential FH.

Electromagnetic Flow Meters

It is proposed to install electromagnetic bulk flow meters, each at every inlet pipe of respective service reservoirs.

Bulk Meters – It is proposed to install at every inlet to each DMA's.
Scour Valves/Wash out Valves
Scour valves are located at selected low-points and at appropriate locations to facilitate water and silt removal from the system in cleaning and maintenance operations.

Thrust & Anchor Blocks

Thrust block prevents pipe movement when a pressure system is activated and pressurized. Thrust blocking is required at all points of change of direction in the pipe line. Most blocking is done where a fitting, valve, or hydrant is installed. There may be times when side blocking is necessary because of curvature occurring without the use of fittings. Usually good compacted backfill will provide the necessary anchor for side thrust. Concrete blocking is the most commonly recommended method of blocking. Concrete is placed directly on the fitting against the line of thrust. The concrete must also pour against undisturbed earth. The size of the blocking will vary with the size of pipe, working pressure exerted, type of fitting, degree of flow direction change, and the soil conditions.

Anchor Blocks are provided wherever the pipe is being laid where the nature of ground is steep in nature and wherever the pipeline crosses the rivers/valley in order to hold the pipe and to avoid the dislocation of pipe from the alignment.

5.17 Joint Restraint

A properly designed, restrained pipeline uses the bearing strength and frictional resistance of the soil to turn the pipeline into a thrust block. The same basic parameters required to determine the size of a thrust block are used to determine the amount of pipe that must be restrained to resist thrust forces underground. These parameters are pipe size, pipe type, test pressure, fitting type, trench type, depth of bury, soil type, and safety factor.

Using joint restraints opens possibilities that are not available with thrust blocks. When construction is required in congested underground areas it is next to impossible to pour thrust blocks without interfering with other utilities. Also, the use of thrust blocks in congested areas poses a problem when construction or maintenance of a different utility occurs in close proximity to the thrust block. Because the bearing area of a restrained pipeline is not concentrated in a small area, excavations in close proximity do not pose the danger that could be experienced with thrust blocks.

5.18 Thrust Restraint for DNI Works

In flexible non-restrained jointed pipelines (e.g. Tyton type joints or similar), forces at bends, tees, tapers, closed valves, dead ends etc. will generally be absorbed by thrust blocks. Concrete thrust blocks take the forces from the pipeline and transmit them to the soil adjacent to the pipe trench. Thrust blocks shall be constructed of cast-in-place concrete. The bearing faces of the thrust blocks will be placed against undisturbed natural soil. Thrust forces and siting of anchor blocks will conform with the field test pressure of the pipeline. Dimensioning of the thrust blocks must be dependent on the bearing capacity of the prevailing soil.

5.19 Pressure Reducing Valve (PRV) Chambers

PRV chambers have been provided for the distribution network of all DNIs. They are necessary in order to maintain a constant delivery of acceptable service pressure which should not be more than the required max head of 4 bars - regardless of varying high inlet pressure.

5.20 Bulk Meters and Other Valve Chambers

Supply of water to the DNI areas will be from primary mains fed from the respective reservoirs. In order to enhance water auditing, bulk meter chambers will be provided. These chambers comprise of control valves (Sluice Valve) and other necessary appurtenances to control water from the transmission main and isolating distribution blocks from maintenance purposes. Each bulk meter will be well equipped with flow sensor & data loggers to record flow rate for analysis and record keeping. Similarly, other valve chambers have been provided to isolate parts of the distribution system for maintenance or in case of damage.

5.21 Pressure Test Point Chambers

Pressure test point chambers have been provided for each DMA at maximum and minimum pressure level.

5.22 Air Valve Chambers

Air valve chambers with drain pipes and sluice valves have been provided along the primary and secondary main alignments. The air valves are double orifice (with ball/gate valve isolation).

5.23 Water Revenue Meters

Dry dial volumetric rotary piston type water revenue meter for all house connections are proposed. These household water meters have 15mm, 20mm and 25mm Nominal Diameter and have been recommended for use elsewhere in Kathmandu.

5.24 House Service Connections

All house service connections shall be of non-metallic pipe in order to reduce leakage at the service connection points.

5.25 Chambers

All chambers are M 20 Grade RCC Chamber. All the chambers have been designed for heavy traffic load (heaviest axle load of 8 ton) and limiting cracking width philosophy assuming other design parameter such as depth of pipe, location of ground water table, soil characteristic, etc.

5.26 River Crossings

River crossings may be made by:

- Constructing a separate pipe bridge
- Attaching the pipe to an existing bridge
- Installing the pipe on the footpath of an existing bridge
- Laying the pipe in the bed of the river in a siphon.

A pipe bridge would be vulnerable to accidents or other attacks. The structure must be above maximum flood level. Additionally, a pipe bridge would require an earthquake resisting design, which would be very expensive taking into account the high ground accelerations to be expected in the Kathmandu Valley. Pipelines, connected to existing road bridges, are only permitted if these are connected laterally to its structure. This is of course a difficult solution since appropriate supporting structures have to be designed and incorporated to the existing bridge construction. The pipeline must not overload the structure and expansion joints would be required to accommodate movement of the bridge and pipeline.

Permanent installation on footpaths of the bridge is not allowed by the DOR. The rivers to be crossed by the BDS have a low water level and flow at the end of the dry season. This will allow the pipes to be laid in the riverbed by diverting the river water. Hence normal pipe laying practice would suffice to achieve a technically and economical sound river crossing construction.
For river crossings therefore we recommend a siphon design rather than a pipe bridge design due to safety and cost reasons. The pipeline itself will be surrounded by reinforced concrete.

5.27 Road Works

All road works, road crossings and other works belonging to roads are subject to the approval of the Department of Roads and relevant municipal entities. For the approval of all road works, submittal of layouts and details and descriptions of the works to be executed are required by these entities in advance of the works.
Roads generally have to be crossed perpendicular to the road axis; however, in some cases the pipeline will run along the road. It is assumed the pipes will be installed in an open trench with the temporary diversion of vehicular traffic. The precise details of the temporary diversion and traffic control will be the responsibility of the contractor.

The pipe trench backfill will continue up to the underside of the sub-base of the road surface. The installation of the road sub-structure and final completion of the road surface then will be done by the contractor.

5.28 Guard House

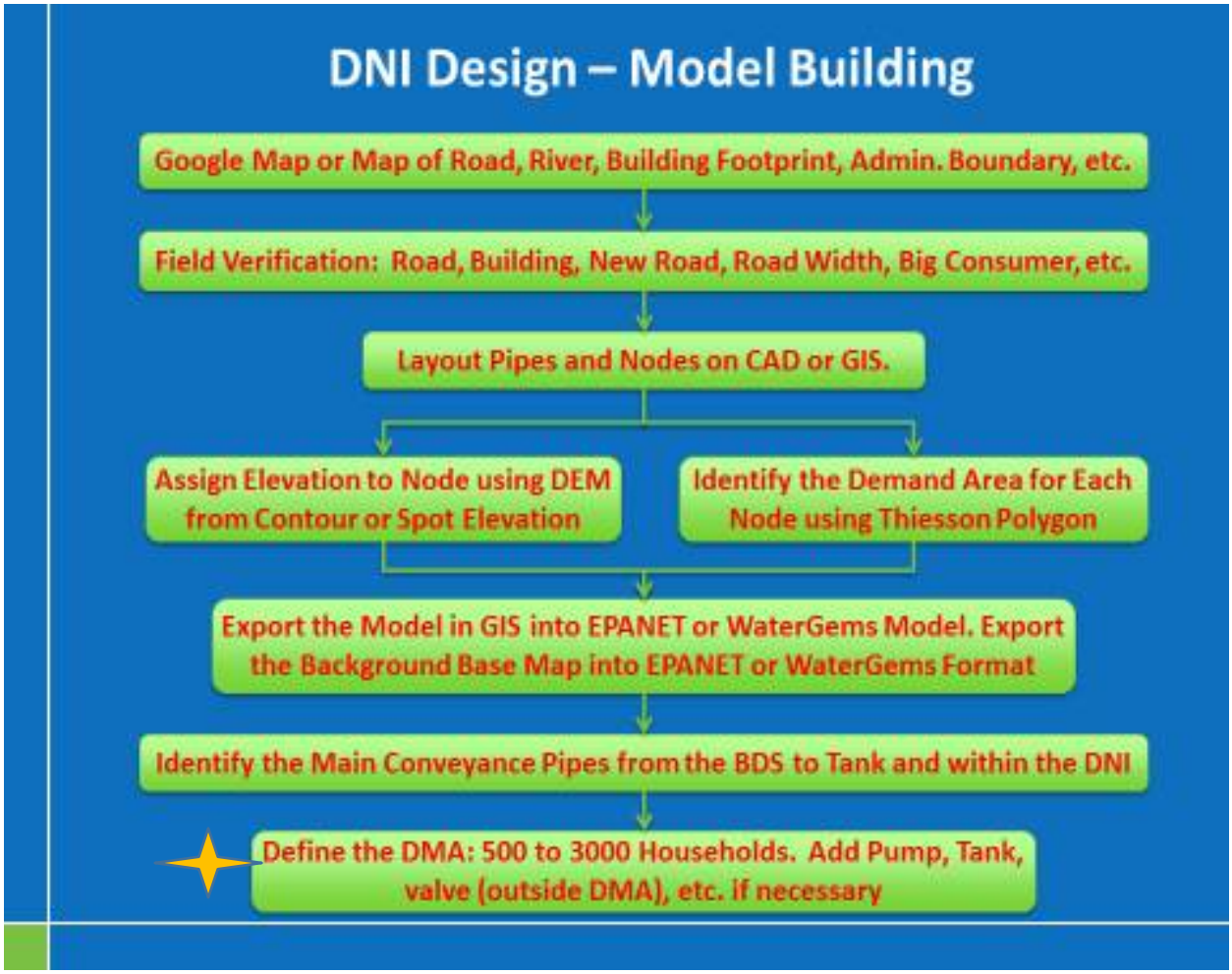
Guard House shall be constructed for the reservoir tank area along with the construction of inspection chamber of toilet, septic tank and soak pit.

5.29 Surface Drain

Tick type concrete surface drain will be constructed both sides for the roads having width more than 7 m while for the roads having width from 4 to 7 m drain will be constructed only single side. However, there is no provision of such type of drain for roads with width less than 4 m. Similarly, brick masonry wall shall be constructed at the back of tick drain.
Catch pit shall also be constructed for every 100 m of the drain in a staggered manner.

5.30 Design Approach

Fig 5.1 DNI Design – Model Building



Source: International Water Association (IWA), Guidance notes. However based on the geography considered 1500 Households (average) for defining DMA's.

Fig 5.2 DNI Design – Model Optimization

Fig 5.3 Demonstration of DNI's Model Development

Fig 5.4 Base Map

Fig 5.5 Pipes & Nodes

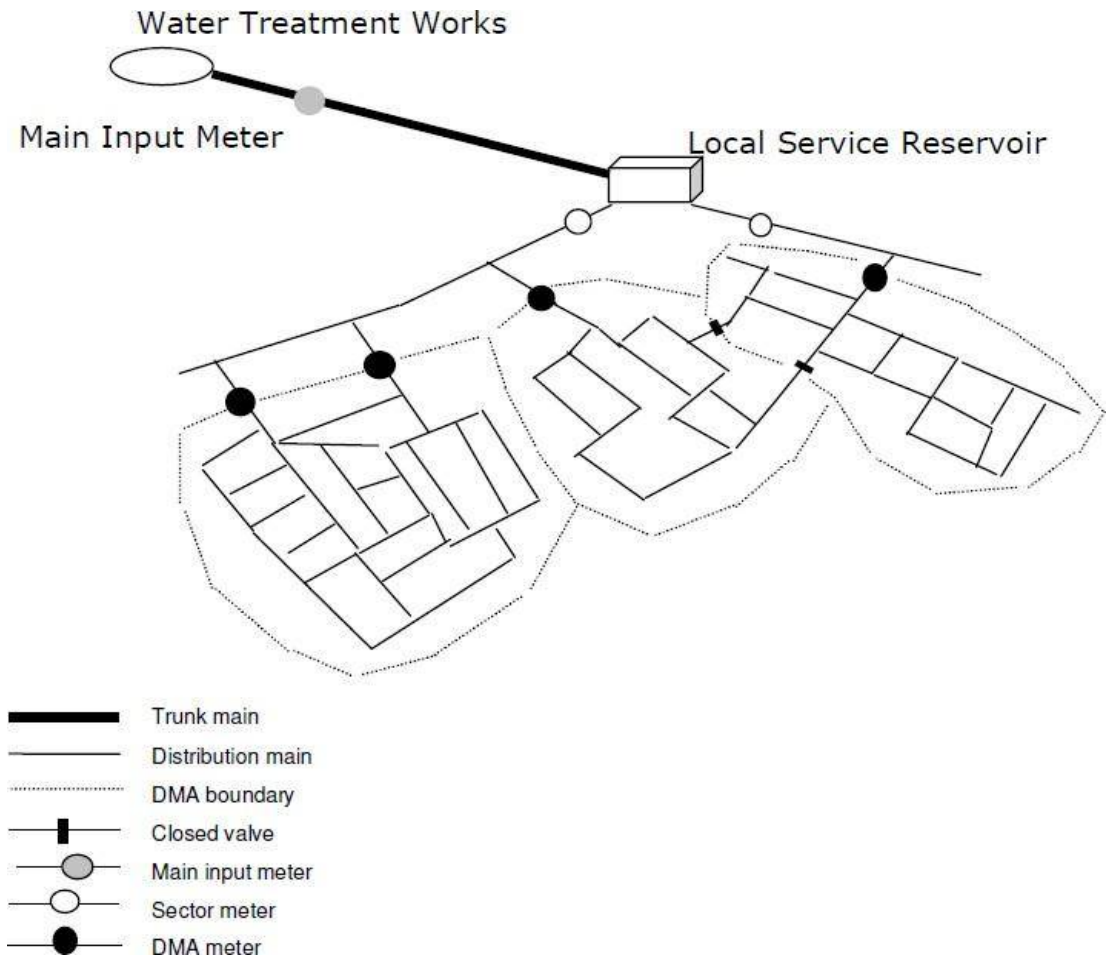
Fig 5.6 Thiesson Polygon to Allocate Demand

Fig 5.7 DEM – Data Elevation Model – All Zones

Fig 5.8 Typical DEM – Data Elevation Model – A-1.8 (DNI-A)

Fig 5.9 EPANET Model of Zone A-1.8 (DNI-A)

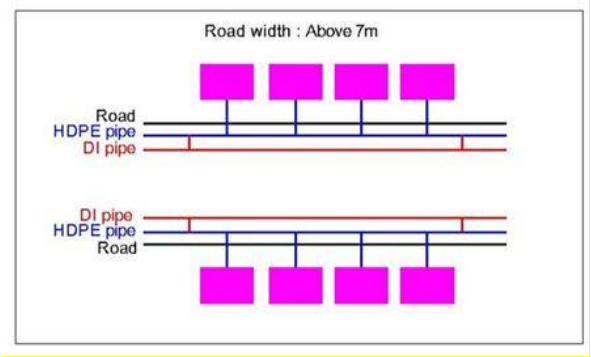
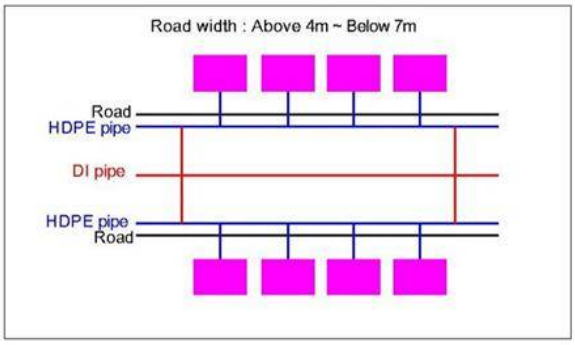
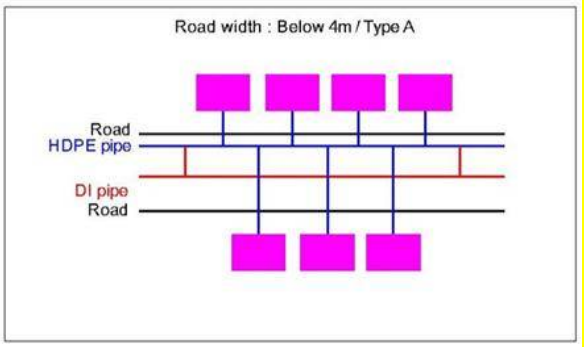
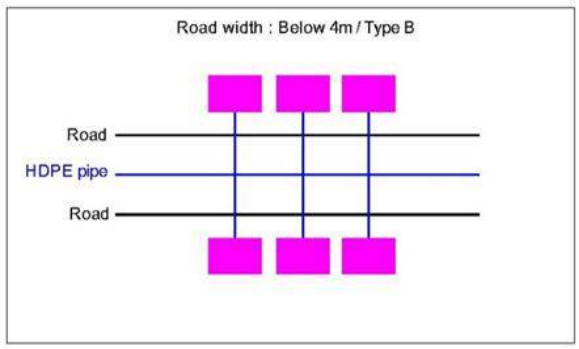
Fig 5.10 Design of District Meter Area (DMA)



- DMA Design
    - Supply via single main (preferable) or multiple feeds
    - Isolate area with adjacent DMA's (i.e., no flow into adjacent DMAs).
    - Cascade into an adjacent DMA (to be avoided if at all possible)
    - Minimum variation in ground level across the DMA
    - 500-1500 households.
- Monitor/locate/Control leakage
- Manage pressure
- Minimize utilities inside DMA

- Water Tank
- Isolated valves, PRVs

Fig 5.11 Reticulation Pipes

	Two DI pipes are purposed in roads with 7m width or above since most DMA zones are divided by large roads. We have minimized two DI pipes lying where DMA zones are not overlapping, but it's based on consideration of fire hydrants and other facilities.
	One DI pipe is purposed in roads with 4~7m width, but for unavoidable DMA zone overlapping, two DI pipes are purposed.
	For narrow roads below 4m width will have DI pipe only when it's necessary for stable pressure control.
	Where DI pipe is not necessary for pressure control, HDPE pipe is purposed as tertiary main for house connections.

To avoid many households, connect directly to the DI pipe, the HDPE reticulation pipes are used to layout parallel with the DI pipes.

The objectives of adding the HDPE 75mm, 90mm or 110mm reticulation pipes are:

- Reduce number of household connection to the DI pipe
- Convert the DI pipe into the transmission pipe
- The additional reticulation pipe will become the distribution pipe and easily for household connection.

The sizing of Isolation valve, Air Valve, Washout Valve & Fire Hydrants is specified in the below **Table: 5.1**

Table 5.1: Sizing of Valves

Sizing of Valves				
Pipe Dia (mm)	Isolation Valve	Air Valve	Washout Valve	Fire Hydrant
75	50	-	50	-
90	80	50.00	-	100
110	100	50.00	-	100
150	150	50.00	-	100
200	200	50.00	-	100
250	250	50.00	-	100
300	300	50.00	-	100
350	250	80.00	-	100
400	300	80.00	-	100
450	-	80.00	-	-
500	-	100.00	-	-
600	-	100.00	-	-
700	-	150.00	-	-
800	-	150.00	-	-
900	-	150.00	-	-
1000	-	200.00	-	-

6

Proposed Distribution Network Improvement

6.1 General

This report presents the detail design of distribution network of new **7C DNI area**. Where **DNI-7C area** comprises of four **DNI Zones** namely: DNI–G (A2.6), DNI– H (A2.5), DNI–I (A2.4) & DNI–J (A2.3).

The hydraulic design of water distribution network has been done in following stages.

- Demarcating the pressure zones or supply zones.
- Sizing of Distribution lines.

Hence, considering the topography of Kathmandu Metro Area and Kathmandu North-east Region, the zonal plan for DNI 7C is done based on contours and pressure points helping in operating the system with defined pressures and ease of regulated supply. The capacities of reservoirs to cater to intermediate requirement are ensured in all zones.

6.2.3 DNI Zone - G (A 2.6), H (A 2.5), I (A 2.4) & J (A 2.3)

This DNI Zone is bounded by Galkopakha-Gongabu-Ring Road as west boundary, Dhapasi VDC and ward no. 3 and 4 of KMC as northern boundary, Dhobi Khola as the eastern boundary and northern road of Old Palace as the southern boundary. It covers complete area of Ward Number 3 & 4. The area of this zone would be served by gravity from Bansbari Reservoir.

6.3 The Hydraulic Design of each DNI Zone have been described below:

6.3.1 Design of DNI Zone - G (A 2.6)

The DNI-G model has been designed and the model features are prepared accordingly. DNI-G has been designed using inside diameters (66.8mm, 80.4mm and 98.6mm) for HDPE PE100-PN6 pipes and the diameters (150mm, 200mm, 250mm & 300mm) for DI pipes. After optimizing the pipe diameters for HDPE & DI pipes, all 921 demand nodes have pressure head between 20m & 40m and 31 demand nodes have pressure between 40m & 50m.

The demarcation of DNI-G boundary is shown in **Figure 6.1** and DNI-G Design Model at Peak Demand (7.00) is shown in **Figure 6.2.**

The details of DNI-G/Pipe material & length/Bulk Meter, Isolation Valves, PRVs/PRVs with Set pressure/Location of Air Valve, Washout Valve & Fire hydrants are shown in the **Tables 6.1/6.2/6.3/6.4/6.5** respectively.

Figure 6.1: Demarcation of DNI-G Zone Boundary

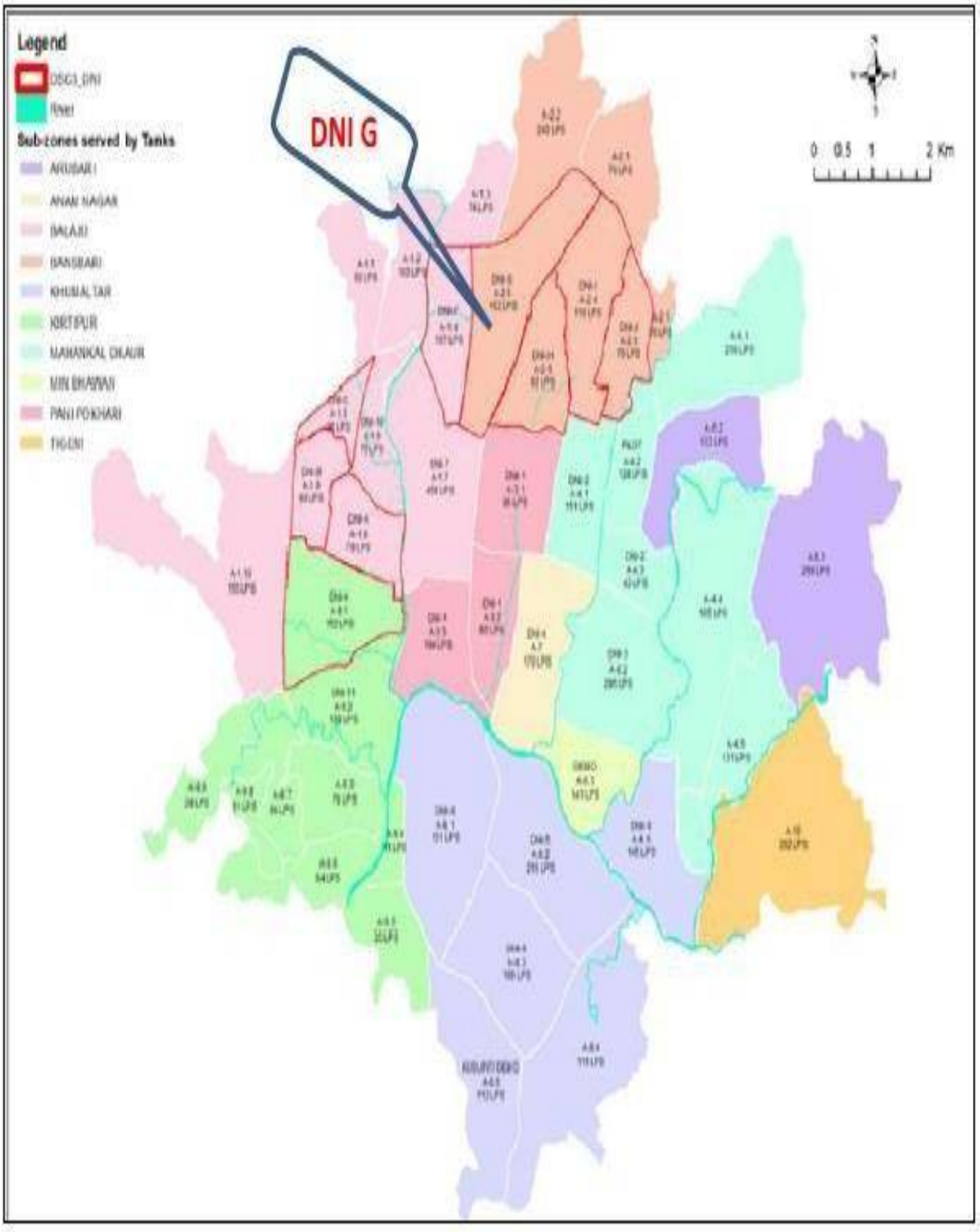


Table 6.1: Design of DNI Zone - G

Description	
Reservoir	Bansbari
Outlet Elevation of the Reservoir (m)	1374.40
Total Demand (LPS)	162.25
Total number of nodes	952
Total Number of Pipes	1186
Total Length of Pipes	70,195
Number of PRVs	07
Number of Pumps	0
At Peak Time (7:00) - Only for HDPE pipes within DNI	
Number of Nodes have Pressure < 5m	0
Number of Nodes have Pressure [5m,10m]	0
Number of Nodes have Pressure [20m,40m]	921
Number of Nodes have Pressure [40m,50m]	31
Number of Nodes have Pressure [50m,60m]	0
Number of Nodes have Pressure > 60m	0
At Lowest Demand Time (1:00) - Only for HDPE pipes within DNI	
Number of Nodes have Pressure < 5m	0
Number of Nodes have Pressure [5m,10m]	0
Number of Nodes have Pressure [20m,40m]	882
Number of Nodes have Pressure [40m,50m]	70
Number of Nodes have Pressure [50m,60m]	0
Number of Nodes have Pressure > 60m	0

Table 6.2: Details of Pipe material and length

Pipe Length of DNI-G (m)	
Reservoir	Bansbari
Pipe Diameter (mm)	Length (m)
HDPE PIPE-PE100, PN6	
66.80 (75)	28,182
80.40 (90)	21,741.50
98.60 (110)	12,600.50
DI PIPE	
150	6,022.50
200	1,664.50
250	16.50
300	11
Grand Total	70,218.50

Table 6.3: Details of Bulk Meter/Isolation Valve/PRV's

LOCATION OF BM/IV/PRV FOR DNI_G									
DNI	DMA	# Bulk Meter	Size of BM	# Isolation Valve	Size of IV	# PRV	Size of PRV	From_Junc	To_Junc
G	1	1	300	3	300	1	300	BANSBARI4	BANSBARI5
G	2	1	250	3	250	1	250	BANSBARI7	G733
G	3	1	250	3	250	1	250	BANSBARI9	G267
G	4	1	200	3	200	1	200	BANSBARI11	124
G	5	1	150	3	150	1	150	BANSBARI12	G561
G	6	1	150	3	150	1	150	BANSBARI12	197

Table 6.4: Details of PRV's with Set Pressure

DNI	DMA	# PRV	Size of PRV	Set pressure (m)	From_Junc	To_Junc
G	1	1	300	15	BANSBARI4	BANSBARI5
G	2	1	250	20	BANSBARI7	G733
G	3	1	250	30	BANSBARI9	G267
G	4	1	200	32	BANSBARI11	124
G	5	1	150	25	BANSBARI12	G561
G	6	1	150	23	BANSBARI12	197

Table 6.5: Details of location of Air Valve/Washout Valve/Fire Hydrant

LOCATION OF AV/IV/WV/FH FOR DNI_G				
DNI	# Air Valve	# Wash out Valve	# Fire Hydrant	
	Provide at Junction	Provide at Junction	Provide at Junction	On pipe dia (mm)
G	Bansbari5	G763	Bansbari5	200 DI PIPE
	G562	G786	G666	150 DI PIPE
	G691	G662	G679	150 DI PIPE
	G590	G697	G683	150 DI PIPE
	G532	G710	G707	150 DI PIPE
	G531	G724	G562	150 DI PIPE
	G486	G610	G590	150 DI PIPE
	G831	G559	G532	150 DI PIPE
	G732	G414	G772	150 DI PIPE
	G266	G508	G792	150 DI PIPE
	G039	G518	G490	150 DI PIPE
	G103	G806	G486	150 DI PIPE
	G006	G491	G215	110 HDPE PIPE
		G311	G006	110 HDPE PIPE
		G354	G116	110 HDPE PIPE
		G239	G107	110 HDPE PIPE
		G928	G178	150 DI PIPE
		G202	G039	150 DI PIPE
		G159	G053	150 DI PIPE
		G962	G267	150 DI PIPE
		G923	G377	150 DI PIPE
		G269	G035	150 DI PIPE
		G849	G402	150 DI PIPE
		G452	G733	150 DI PIPE

G	Provide at Junction	Provide at Junction	Provide at Junction	On pipe dia (mm)
		G559	G728	150 DI PIPE
		G710	G736	150 DI PIPE
		G662	G777	110 HDPE PIPE
			G602	90 HDPE PIPE
			G583	90 HDPE PIPE
			G416	110 HDPE PIPE
			G430	90 HDPE PIPE
			G504	110 HDPE PIPE
			G480	110 HDPE PIPE
			G304	110 HDPE PIPE
			G260	110 HDPE PIPE
			G218	110 HDPE PIPE
			G226	110 HDPE PIPE
			G899	110 HDPE PIPE
			G010	110 HDPE PIPE
			G181	110 HDPE PIPE
			G984	110 HDPE PIPE
			G457	110 HDPE PIPE
			G410	110 HDPE PIPE
			G648	90 HDPE PIPE
			G628	90 HDPE PIPE
			G832	90 HDPE PIPE
			G615	90 HDPE PIPE
			G977	90 HDPE PIPE
			G015	90 HDPE PIPE
			G308	90 HDPE PIPE
			G250	90 HDPE PIPE
			G218	90 HDPE PIPE
			G152	90 HDPE PIPE

Figure 6.2: DNI Zone - G Design Model at Peak Demand at 7.00 AM

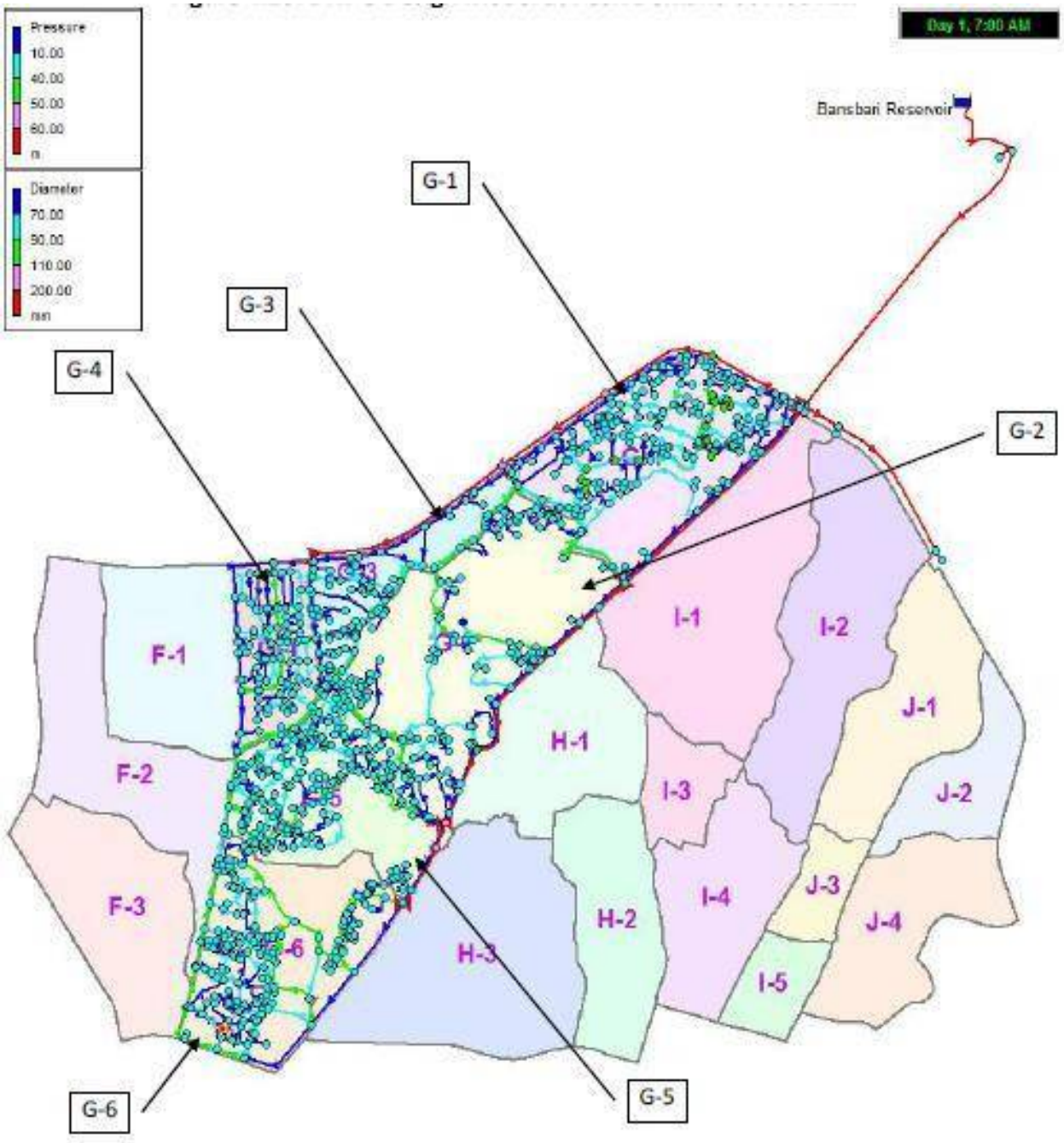


Table 6.6.Details of Pipe Design for DNI G (at peak time 7.00)

Link ID	Length	Diameter	Roughness	Material	Flow	Velocity	Unit Headloss	Friction Factor
	m	mm			LPS	m/s	m/km	
Pipe G003_G963	53.22	62.2	130	HDPE-PE 100 PN10	-0.27	0.09	0.24	0.037
Pipe G004_G132	31.03	62.2	130	HDPE-PE 100 PN10	-0.33	0.11	0.35	0.036
Pipe G005_G009	10.47	62.2	130	HDPE-PE 100 PN10	0.21	0.07	0.16	0.041
Pipe G005_G175	81.25	62.2	130	HDPE-PE 100 PN10	1.18	0.39	3.69	0.03
Pipe G006_G120	52.64	62.2	130	HDPE-PE 100 PN10	-0.87	0.29	2.11	0.031
Pipe G007_G316	13.75	62.2	130	HDPE-PE 100 PN10	-0.08	0.03	0.02	0.034
Pipe G008_G111	18.62	62.2	130	HDPE-PE 100 PN10	-0.6	0.2	1.06	0.033
Pipe G010_G014	131.6	62.2	130	HDPE-PE 100 PN10	-0.79	0.26	1.75	0.032
Pipe G010_G942	46.25	62.2	130	HDPE-PE 100 PN10	0.23	0.08	0.18	0.038
Pipe G011_G924	33.21	62.2	130	HDPE-PE 100 PN10	1.26	0.41	4.15	0.029
Pipe G014_G213	38.39	62.2	130	HDPE-PE 100 PN10	-0.74	0.24	1.54	0.032
Pipe G015_G324	62.72	62.2	130	HDPE-PE 100 PN10	-1.39	0.46	4.95	0.029
Pipe G017_G060	34.8	62.2	130	HDPE-PE 100 PN10	0.37	0.12	0.42	0.035
Pipe G019_G071	28.68	62.2	130	HDPE-PE 100 PN10	-0.25	0.08	0.2	0.037
Pipe G019_G766	111.5	62.2	130	HDPE-PE 100 PN10	0.15	0.05	0.08	0.04
Pipe G020_G071	14.17	62.2	130	HDPE-PE 100 PN10	0.29	0.1	0.28	0.037
Pipe G020_G787	33.41	62.2	130	HDPE-PE 100 PN10	-0.47	0.15	0.66	0.034
Pipe G021_G770	134	62.2	130	HDPE-PE 100 PN10	0.6	0.2	1.07	0.033
Pipe G022_G021	29.86	62.2	130	HDPE-PE 100 PN10	-0.66	0.22	1.26	0.032
Pipe G023_G809	57.25	62.2	130	HDPE-PE 100 PN10	-0.56	0.18	0.93	0.033
Pipe G023_G881	78.2	62.2	130	HDPE-PE 100 PN10	-0.07	0.02	0.02	0.051
Pipe G026_G803	79.15	62.2	130	HDPE-PE 100 PN10	-0.62	0.2	1.1	0.033
Pipe G027_G026	35.63	62.2	130	HDPE-PE 100 PN10	-0.33	0.11	0.35	0.036
Pipe G027_G812	85.42	62.2	130	HDPE-PE 100 PN10	0.37	0.12	0.42	0.035
Pipe G028_G813	76.84	62.2	130	HDPE-PE 100 PN10	-0.46	0.15	0.65	0.034

Pipe G028_G879	35.57	62.2	130	HDPE-PE 100 PN10	-0.47	0.15	0.66	0.034
Pipe G029_G091	48.41	62.2	130	HDPE-PE 100 PN10	0.13	0.04	0.06	0.041
Pipe G029_G278	58.59	62.2	130	HDPE-PE 100 PN10	-2.65	0.87	16.46	0.026
Pipe G031_G094	156.4	62.2	130	HDPE-PE 100 PN10	-1.26	0.41	4.12	0.03
Pipe G031_G849	48.78	62.2	130	HDPE-PE 100 PN10	0.4	0.13	0.5	0.035
Pipe G035_G036	107.7	150	110	DI	-11.75	0.66	4.86	0.032
Pipe G036_G037	52.45	62.2	130	HDPE-PE 100 PN10	0.1	0.03	0.04	0.045
Pipe G038_G053	57.51	150	110	DI	2.34	0.13	0.24	0.041
Pipe G038_G920	23.49	62.2	130	HDPE-PE 100 PN10	2.64	0.87	16.36	0.026
Pipe G039_G178	266	150	110	DI	17.97	1.02	10.67	0.03
Pipe G039_G929	98.05	62.2	130	HDPE-PE 100 PN10	1.22	0.4	3.88	0.03
Pipe G046_G005	30.28	62.2	130	HDPE-PE 100 PN10	1.51	0.5	5.81	0.029
Pipe G046_G962	63.49	62.2	130	HDPE-PE 100 PN10	0.43	0.14	0.57	0.034
Pipe G051_G011	64.24	62.2	130	HDPE-PE 100 PN10	3.01	0.99	20.85	0.026
Pipe G051_G012	63.86	62.2	130	HDPE-PE 100 PN10	0.87	0.29	2.1	0.031
Pipe G053_G051	75.93	62.2	130	HDPE-PE 100 PN10	4.36	1.43	41.29	0.025
Pipe G054_G901	19.27	62.2	130	HDPE-PE 100 PN10	0.38	0.12	0.44	0.035
Pipe G054_G904	39.19	62.2	130	HDPE-PE 100 PN10	-2.91	0.96	19.58	0.026
Pipe G061_G062	25.46	62.2	130	HDPE-PE 100 PN10	1.03	0.34	2.85	0.03
Pipe G061_G771	277.7	150	110	DI	-6.62	0.37	1.68	0.035
Pipe G062_G019	44.93	62.2	130	HDPE-PE 100 PN10	0.35	0.12	0.39	0.036
Pipe G065_G066	29.9	62.2	130	HDPE-PE 100 PN10	-0.48	0.16	0.69	0.034
Pipe G065_G787	1.992	62.2	130	HDPE-PE 100 PN10	0.64	0.21	1.2	0.032
Pipe G066_G791	79.74	62.2	130	HDPE-PE 100 PN10	0.16	0.05	0.09	0.04
Pipe G069_G070	29.69	62.2	130	HDPE-PE 100 PN10	-0.47	0.16	0.68	0.034
Pipe G069_G796	51.25	62.2	130	HDPE-PE 100 PN10	-0.27	0.09	0.24	0.037
Pipe G070_G797	51	62.2	130	HDPE-PE 100 PN10	-0.14	0.05	0.07	0.04
Pipe G070_G799	30.63	62.2	130	HDPE-PE 100 PN10	-0.47	0.16	0.68	0.034
Pipe G071_G078	84.42	62.2	130	HDPE-PE 100 PN10	-0.22	0.07	0.17	0.038

Pipe G073_G807	49.23	62.2	130	HDPE-PE 100 PN10	0.44	0.15	0.6	0.034
Pipe G074_G075	31.96	62.2	130	HDPE-PE 100 PN10	0.9	0.3	2.24	0.031
Pipe G074_G810	18.6	62.2	130	HDPE-PE 100 PN10	0.94	0.31	2.44	0.031
Pipe G075_G808	95.59	62.2	130	HDPE-PE 100 PN10	0.31	0.1	0.3	0.036
Pipe G075_G883	89.39	62.2	130	HDPE-PE 100 PN10	0.28	0.09	0.25	0.037
Pipe G076_G875	18.04	62.2	130	HDPE-PE 100 PN10	-0.23	0.08	0.18	0.037
Pipe G078_G790	14.66	62.2	130	HDPE-PE 100 PN10	-0.54	0.18	0.85	0.034
Pipe G079_G078	13.07	62.2	130	HDPE-PE 100 PN10	-0.15	0.05	0.08	0.04
Pipe G080_G495	151.2	62.2	130	HDPE-PE 100 PN10	-0.93	0.31	2.37	0.031
Pipe G081_G025	23.72	62.2	130	HDPE-PE 100 PN10	0.28	0.09	0.26	0.037
Pipe G082_G802	151	62.2	130	HDPE-PE 100 PN10	-0.28	0.09	0.27	0.037
Pipe G086_G089	2.47	62.2	130	HDPE-PE 100 PN10	0.56	0.19	0.96	0.034
Pipe G086_G728	109.1	150	110	DI	14.86	0.84	7.51	0.031
Pipe G087_G742	112.3	62.2	130	HDPE-PE 100 PN10	-1.32	0.43	4.51	0.029
Pipe G087_G776	57.06	62.2	130	HDPE-PE 100 PN10	1.85	0.61	8.47	0.028
Pipe G089_G828	13.68	62.2	130	HDPE-PE 100 PN10	0.11	0.04	0.04	0.04
Pipe G089_G829	35.45	62.2	130	HDPE-PE 100 PN10	0.4	0.13	0.5	0.035
Pipe G091_G030	33.55	62.2	130	HDPE-PE 100 PN10	0.32	0.11	0.34	0.036
Pipe G091_G031	85.52	62.2	130	HDPE-PE 100 PN10	-0.54	0.18	0.87	0.033
Pipe G094_G266	37.29	150	110	DI	11.75	0.66	4.86	0.032
Pipe G094_G376	92.27	150	110	DI	-11.75	0.66	4.86	0.032
Pipe G096_G034	41.72	62.2	130	HDPE-PE 100 PN10	2.65	0.87	16.48	0.026
Pipe G096_G733	234.9	200	110	DI	-35.66	1.14	9.35	0.028
Pipe G101_G003	3.697	62.2	130	HDPE-PE 100 PN10	-0.06	0.02	0	0
Pipe G101_G004	3.477	62.2	130	HDPE-PE 100 PN10	-0.4	0.13	0.47	0.034
Pipe G103_G046	72.67	62.2	130	HDPE-PE 100 PN10	2.09	0.69	10.57	0.027
Pipe G103_G107	2.52	62.2	130	HDPE-PE 100 PN10	-3.59	1.18	28.88	0.025
Pipe G107_G130	58.43	62.2	130	HDPE-PE 100 PN10	2.13	0.7	11.01	0.027
Pipe G111_G115	120.8	62.2	130	HDPE-PE 100 PN10	-0.33	0.11	0.34	0.036

Pipe G115_G004	160.1	62.2	130	HDPE-PE 100 PN10	0.22	0.07	0.17	0.038
Pipe G116_G115	3.524	62.2	130	HDPE-PE 100 PN10	0.69	0.23	1.35	0.032
Pipe G116_G119	156.4	62.2	130	HDPE-PE 100 PN10	-0.99	0.33	2.68	0.031
Pipe G117_G116	12.45	62.2	130	HDPE-PE 100 PN10	-0.13	0.04	0.06	0.041
Pipe G117_G136	52.63	62.2	130	HDPE-PE 100 PN10	0.66	0.22	1.27	0.032
Pipe G118_G120	96.15	62.2	130	HDPE-PE 100 PN10	1.94	0.64	9.27	0.028
Pipe G119_G118	3.68	62.2	130	HDPE-PE 100 PN10	3.3	1.09	24.79	0.026
Pipe G120_G121	29.3	62.2	130	HDPE-PE 100 PN10	0.95	0.31	2.47	0.031
Pipe G121_G122	25.03	62.2	130	HDPE-PE 100 PN10	0.66	0.22	1.25	0.032
Pipe G121_G950	20.69	62.2	130	HDPE-PE 100 PN10	0.12	0.04	0.05	0.042
Pipe G122_G123	36.77	62.2	130	HDPE-PE 100 PN10	0.35	0.11	0.38	0.036
Pipe G123_G946	15.74	62.2	130	HDPE-PE 100 PN10	0.14	0.05	0.08	0.042
Pipe G123_G952	10.89	62.2	130	HDPE-PE 100 PN10	0.07	0.02	0.01	0.032
Pipe G124_G006	58.46	62.2	130	HDPE-PE 100 PN10	-0.37	0.12	0.43	0.035
Pipe G124_G948	51.15	62.2	130	HDPE-PE 100 PN10	-0.32	0.11	0.34	0.036
Pipe G125_G124	35.92	62.2	130	HDPE-PE 100 PN10	-0.4	0.13	0.5	0.035
Pipe G125_G945	18.89	62.2	130	HDPE-PE 100 PN10	0.09	0.03	0.03	0.047
Pipe G126_G125	33.4	62.2	130	HDPE-PE 100 PN10	-0.1	0.03	0.04	0.044
Pipe G126_G949	36.05	62.2	130	HDPE-PE 100 PN10	-0.67	0.22	1.29	0.032
Pipe G127_G126	19.41	62.2	130	HDPE-PE 100 PN10	-0.58	0.19	0.98	0.033
Pipe G127_G944	19.06	62.2	130	HDPE-PE 100 PN10	0.13	0.04	0.06	0.041
Pipe G128_G127	35.59	62.2	130	HDPE-PE 100 PN10	-0.34	0.11	0.37	0.035
Pipe G128_G163	57.7	62.2	130	HDPE-PE 100 PN10	-1.1	0.36	3.25	0.03
Pipe G129_G107	117.2	62.2	130	HDPE-PE 100 PN10	-1.59	0.52	6.41	0.028
Pipe G129_G111	132.7	62.2	130	HDPE-PE 100 PN10	0.48	0.16	0.69	0.034
Pipe G130_G141	90.72	62.2	130	HDPE-PE 100 PN10	0.76	0.25	1.62	0.032
Pipe G131_G130	42.75	62.2	130	HDPE-PE 100 PN10	-1.17	0.38	3.6	0.03
Pipe G131_G133	59.66	62.2	130	HDPE-PE 100 PN10	0.35	0.12	0.39	0.036

Pipe G132_G129	50.31	62.2	130	HDPE-PE 100 PN10	-0.68	0.22	1.32	0.032
Pipe G132_G963	45.65	62.2	130	HDPE-PE 100 PN10	-0.03	0.01	0	0.046
Pipe G133_G134	56.98	62.2	130	HDPE-PE 100 PN10	0.24	0.08	0.2	0.037
Pipe G133_G139	20.33	62.2	130	HDPE-PE 100 PN10	-0.11	0.04	0.04	0.042
Pipe G134_G003	33.22	62.2	130	HDPE-PE 100 PN10	-0.11	0.04	0.05	0.042
Pipe G135_G134	6.705	62.2	130	HDPE-PE 100 PN10	-0.18	0.06	0.11	0.039
Pipe G135_G964	54.37	62.2	130	HDPE-PE 100 PN10	-0.25	0.08	0.21	0.037
Pipe G136_G101	96.44	62.2	130	HDPE-PE 100 PN10	-0.33	0.11	0.35	0.036
Pipe G136_G137	49.34	62.2	130	HDPE-PE 100 PN10	0.41	0.13	0.51	0.035
Pipe G138_G135	87.36	62.2	130	HDPE-PE 100 PN10	-0.25	0.08	0.21	0.037
Pipe G139_G140	40.01	62.2	130	HDPE-PE 100 PN10	-0.25	0.08	0.21	0.038
Pipe G140_G144	56.72	62.2	130	HDPE-PE 100 PN10	0.2	0.07	0.14	0.039
Pipe G141_G140	20.13	62.2	130	HDPE-PE 100 PN10	0.61	0.2	1.07	0.033
Pipe G142_G174	79.4	62.2	130	HDPE-PE 100 PN10	-0.49	0.16	0.71	0.034
Pipe G143_G146	20.55	62.2	130	HDPE-PE 100 PN10	-0.27	0.09	0.25	0.037
Pipe G143_G964	11.49	62.2	130	HDPE-PE 100 PN10	0.19	0.06	0.13	0.039
Pipe G144_G139	49.47	62.2	130	HDPE-PE 100 PN10	0.02	0.01	0	0.088
Pipe G144_G143	2.468	62.2	130	HDPE-PE 100 PN10	0.12	0.04	0.06	0.048
Pipe G145_G153	85.01	62.2	130	HDPE-PE 100 PN10	-1.37	0.45	4.85	0.029
Pipe G145_G965	24.89	62.2	130	HDPE-PE 100 PN10	0.21	0.07	0.16	0.039
Pipe G146_G148	39.59	62.2	130	HDPE-PE 100 PN10	0.66	0.22	1.25	0.032
Pipe G146_G150	13.5	62.2	130	HDPE-PE 100 PN10	-0.99	0.33	2.66	0.031
Pipe G148_G147	10.66	62.2	130	HDPE-PE 100 PN10	0.19	0.06	0.13	0.041
Pipe G148_G149	59.1	62.2	130	HDPE-PE 100 PN10	0.35	0.11	0.39	0.036
Pipe G150_G151	55.88	62.2	130	HDPE-PE 100 PN10	0.25	0.08	0.21	0.038
Pipe G150_G152	73.13	62.2	130	HDPE-PE 100 PN10	-1.41	0.46	5.09	0.029
Pipe G152_G153	5.28	62.2	130	HDPE-PE 100 PN10	5.24	1.72	58.07	0.024
Pipe G152_G155	62.95	62.2	130	HDPE-PE 100 PN10	0.69	0.23	1.37	0.032

Pipe G153_G164	115.2	62.2	130	HDPE-PE 100 PN10	1.42	0.47	5.17	0.029
Pipe G154_G153	7.492	62.2	130	HDPE-PE 100 PN10	-2.16	0.71	11.24	0.027
Pipe G154_G156	82.69	62.2	130	HDPE-PE 100 PN10	0.51	0.17	0.79	0.034
Pipe G155_G117	169.2	62.2	130	HDPE-PE 100 PN10	0.8	0.26	1.8	0.032
Pipe G155_G158	89.81	62.2	130	HDPE-PE 100 PN10	-0.31	0.1	0.31	0.036
Pipe G156_G118	94.75	62.2	130	HDPE-PE 100 PN10	-1.25	0.41	4.08	0.03
Pipe G156_G160	36.13	62.2	130	HDPE-PE 100 PN10	1.59	0.52	6.4	0.028
Pipe G158_G119	34.64	62.2	130	HDPE-PE 100 PN10	-0.96	0.32	2.51	0.031
Pipe G158_G157	36.84	62.2	130	HDPE-PE 100 PN10	0.29	0.1	0.28	0.037
Pipe G160_G159	19.3	62.2	130	HDPE-PE 100 PN10	0.23	0.08	0.19	0.038
Pipe G161_G160	69.12	62.2	130	HDPE-PE 100 PN10	-1.13	0.37	3.41	0.03
Pipe G162_G154	102.3	62.2	130	HDPE-PE 100 PN10	-1.41	0.46	5.11	0.029
Pipe G162_G955	9.383	62.2	130	HDPE-PE 100 PN10	0.5	0.16	0.73	0.034
Pipe G163_G162	25.14	62.2	130	HDPE-PE 100 PN10	-0.82	0.27	1.86	0.031
Pipe G163_G164	85.08	62.2	130	HDPE-PE 100 PN10	-0.48	0.16	0.69	0.034
Pipe G164_G165	53.26	62.2	130	HDPE-PE 100 PN10	0.62	0.2	1.1	0.033
Pipe G165_G166	22.18	62.2	130	HDPE-PE 100 PN10	0.36	0.12	0.41	0.036
Pipe G165_G167	26.18	62.2	130	HDPE-PE 100 PN10	0.05	0.02	0.01	0.051
Pipe G167_G168	33.22	62.2	130	HDPE-PE 100 PN10	-0.21	0.07	0.15	0.038
Pipe G167_G180	33.62	62.2	130	HDPE-PE 100 PN10	0.33	0.11	0.36	0.036
Pipe G168_G167	33.22	62.2	130	HDPE-PE 100 PN10	0.21	0.07	0.15	0.038
Pipe G168_G169	22.61	62.2	130	HDPE-PE 100 PN10	-0.59	0.19	1.02	0.033
Pipe G169_G170	23.37	62.2	130	HDPE-PE 100 PN10	0.15	0.05	0.08	0.04
Pipe G169_G171	39.54	62.2	130	HDPE-PE 100 PN10	-0.82	0.27	1.86	0.031
Pipe G170_G180	42.2	62.2	130	HDPE-PE 100 PN10	0.55	0.18	0.9	0.033
Pipe G171_G176	15.46	62.2	130	HDPE-PE 100 PN10	-0.58	0.19	0.98	0.033
Pipe G173_G171	33.9	62.2	130	HDPE-PE 100 PN10	0.32	0.1	0.32	0.036
Pipe G173_G172	12.46	62.2	130	HDPE-PE 100 PN10	0.11	0.04	0.05	0.046

Pipe G174_G145	16.44	62.2	130	HDPE-PE 100 PN10	-1.14	0.37	3.44	0.03
Pipe G174_G173	63.53	62.2	130	HDPE-PE 100 PN10	0.63	0.21	1.15	0.033
Pipe G175_G177	36.69	62.2	130	HDPE-PE 100 PN10	0.69	0.23	1.38	0.032
Pipe G176_G142	26.6	62.2	130	HDPE-PE 100 PN10	-0.38	0.13	0.45	0.035
Pipe G176_G175	6.32	62.2	130	HDPE-PE 100 PN10	-0.25	0.08	0.21	0.037
Pipe G177_G170	23.22	62.2	130	HDPE-PE 100 PN10	0.8	0.26	1.79	0.032
Pipe G178_G103	334.9	150	110	DI	17.97	1.02	10.67	0.03
Pipe G178_G177	182.2	62.2	130	HDPE-PE 100 PN10	0.61	0.2	1.09	0.033
Pipe G179_G178	96.14	62.2	130	HDPE-PE 100 PN10	-0.9	0.3	2.23	0.031
Pipe G180_G181	18.83	62.2	130	HDPE-PE 100 PN10	0.52	0.17	0.8	0.034
Pipe G181_G182	99	62.2	130	HDPE-PE 100 PN10	0.47	0.16	0.67	0.034
Pipe G181_G935	144.3	62.2	130	HDPE-PE 100 PN10	-0.42	0.14	0.55	0.035
Pipe G182_G961	105.8	62.2	130	HDPE-PE 100 PN10	-1.72	0.57	7.38	0.028
Pipe G183_G182	21.13	62.2	130	HDPE-PE 100 PN10	-1.29	0.43	4.36	0.029
Pipe G183_G184	17.37	62.2	130	HDPE-PE 100 PN10	0.1	0.03	0.04	0.051
Pipe G186_G183	20.16	62.2	130	HDPE-PE 100 PN10	-1.13	0.37	3.4	0.03
Pipe G186_G185	15.46	62.2	130	HDPE-PE 100 PN10	0.33	0.11	0.35	0.036
Pipe G187_G186	39.89	62.2	130	HDPE-PE 100 PN10	-0.72	0.24	1.47	0.032
Pipe G187_G188	25.23	62.2	130	HDPE-PE 100 PN10	0.19	0.06	0.12	0.038
Pipe G190_G189	18.13	62.2	130	HDPE-PE 100 PN10	0.09	0.03	0.03	0.05
Pipe G190_G191	17.86	62.2	130	HDPE-PE 100 PN10	0.09	0.03	0.03	0.051
Pipe G192_G187	46.76	62.2	130	HDPE-PE 100 PN10	-0.41	0.14	0.53	0.035
Pipe G192_G957	15.85	62.2	130	HDPE-PE 100 PN10	0.1	0.03	0.04	0.042
Pipe G193_G190	20.63	62.2	130	HDPE-PE 100 PN10	0.23	0.08	0.17	0.037
Pipe G193_G192	24.1	62.2	130	HDPE-PE 100 PN10	-0.2	0.07	0.14	0.038
Pipe G194_G128	34.26	62.2	130	HDPE-PE 100 PN10	-1.31	0.43	4.44	0.029
Pipe G194_G193	28.66	62.2	130	HDPE-PE 100 PN10	0.11	0.04	0.05	0.042
Pipe G195_G194	17.17	62.2	130	HDPE-PE 100 PN10	-1.07	0.35	3.08	0.03

Pipe G195_G197	111.4	62.2	130	HDPE-PE 100 PN10	0.28	0.09	0.26	0.037
Pipe G196_G195	114	62.2	130	HDPE-PE 100 PN10	-0.28	0.09	0.26	0.037
Pipe G197_G196	7.165	62.2	130	HDPE-PE 100 PN10	0.03	0.01	0	0
Pipe G198_G199	27.05	62.2	130	HDPE-PE 100 PN10	-0.39	0.13	0.47	0.035
Pipe G199_G200	56.39	62.2	130	HDPE-PE 100 PN10	-0.57	0.19	0.95	0.033
Pipe G200_G201	58.31	62.2	130	HDPE-PE 100 PN10	-1.28	0.42	4.26	0.029
Pipe G201_G006	101.7	62.2	130	HDPE-PE 100 PN10	-0.24	0.08	0.2	0.038
Pipe G202_G200	23.21	62.2	130	HDPE-PE 100 PN10	-0.35	0.11	0.38	0.036
Pipe G203_G197	53.23	62.2	130	HDPE-PE 100 PN10	0.01	0	0	0.186
Pipe G203_G199	108.4	62.2	130	HDPE-PE 100 PN10	0.17	0.06	0.1	0.04
Pipe G204_G203	44.61	62.2	130	HDPE-PE 100 PN10	0.44	0.14	0.58	0.035
Pipe G204_G213	66.6	62.2	130	HDPE-PE 100 PN10	-1.25	0.41	4.07	0.03
Pipe G206_G941	12.26	62.2	130	HDPE-PE 100 PN10	-0.35	0.11	0.39	0.036
Pipe G207_G201	136.1	62.2	130	HDPE-PE 100 PN10	1.42	0.47	5.21	0.029
Pipe G207_G208	31.22	62.2	130	HDPE-PE 100 PN10	0.35	0.12	0.39	0.036
Pipe G208_G209	28.27	62.2	130	HDPE-PE 100 PN10	0.09	0.03	0.03	0.043
Pipe G208_G211	15.85	62.2	130	HDPE-PE 100 PN10	0.13	0.04	0.07	0.043
Pipe G211_G210	13.18	62.2	130	HDPE-PE 100 PN10	0.06	0.02	0.01	0.033
Pipe G212_G211	10.16	62.2	130	HDPE-PE 100 PN10	-0.04	0.01	0.01	0.09
Pipe G213_G214	16.62	62.2	130	HDPE-PE 100 PN10	-2.12	0.7	10.93	0.027
Pipe G214_G215	40.31	62.2	130	HDPE-PE 100 PN10	-3.24	1.07	23.91	0.026
Pipe G214_G217	71.46	62.2	130	HDPE-PE 100 PN10	0.93	0.31	2.37	0.031
Pipe G215_G939	26.37	62.2	130	HDPE-PE 100 PN10	2.06	0.68	10.3	0.027
Pipe G216_G014	53.61	62.2	130	HDPE-PE 100 PN10	0.55	0.18	0.9	0.033
Pipe G216_G220	25.66	62.2	130	HDPE-PE 100 PN10	-0.15	0.05	0.08	0.041
Pipe G217_G216	20.88	62.2	130	HDPE-PE 100 PN10	0.61	0.2	1.1	0.033
Pipe G218_G243	40.16	62.2	130	HDPE-PE 100 PN10	0.44	0.14	0.58	0.035
Pipe G219_G218	2.987	62.2	130	HDPE-PE 100 PN10	0.8	0.26	1.79	0.032

Pipe G219_G222	11.42	62.2	130	HDPE-PE 100 PN10	-1.12	0.37	3.32	0.03
Pipe G220_G219	3.813	62.2	130	HDPE-PE 100 PN10	-0.31	0.1	0.31	0.036
Pipe G220_G221	20.49	62.2	130	HDPE-PE 100 PN10	0.1	0.03	0.04	0.048
Pipe G222_G223	77.72	62.2	130	HDPE-PE 100 PN10	-1.14	0.38	3.47	0.03
Pipe G223_G224	17.81	62.2	130	HDPE-PE 100 PN10	0.21	0.07	0.15	0.039
Pipe G223_G337	4.821	62.2	130	HDPE-PE 100 PN10	-1.41	0.46	5.09	0.029
Pipe G225_G226	23.56	62.2	130	HDPE-PE 100 PN10	-0.92	0.3	2.33	0.031
Pipe G226_G227	17.27	62.2	130	HDPE-PE 100 PN10	-0.4	0.13	0.51	0.035
Pipe G226_G229	40.88	62.2	130	HDPE-PE 100 PN10	-0.66	0.22	1.24	0.032
Pipe G227_G225	30.74	62.2	130	HDPE-PE 100 PN10	0.86	0.28	2.07	0.031
Pipe G227_G228	68.56	62.2	130	HDPE-PE 100 PN10	-1.47	0.49	5.55	0.029
Pipe G229_G230	22.11	62.2	130	HDPE-PE 100 PN10	-0.98	0.32	2.61	0.031
Pipe G229_G339	10.29	62.2	130	HDPE-PE 100 PN10	0.22	0.07	0.16	0.038
Pipe G230_G231	39.34	62.2	130	HDPE-PE 100 PN10	0.35	0.12	0.39	0.036
Pipe G230_G343	22.98	62.2	130	HDPE-PE 100 PN10	0.26	0.09	0.23	0.038
Pipe G231_G233	36.29	62.2	130	HDPE-PE 100 PN10	1.28	0.42	4.28	0.029
Pipe G232_G234	23.11	62.2	130	HDPE-PE 100 PN10	2.2	0.72	11.69	0.027
Pipe G232_G894	93.21	62.2	130	HDPE-PE 100 PN10	-0.8	0.26	1.78	0.032
Pipe G233_G232	38.62	62.2	130	HDPE-PE 100 PN10	0.76	0.25	1.64	0.032
Pipe G233_G891	40	62.2	130	HDPE-PE 100 PN10	0.36	0.12	0.41	0.035
Pipe G234_G235	22.15	62.2	130	HDPE-PE 100 PN10	1.02	0.33	2.79	0.03
Pipe G234_G257	56.71	62.2	130	HDPE-PE 100 PN10	1.07	0.35	3.09	0.03
Pipe G235_G236	40.4	62.2	130	HDPE-PE 100 PN10	0.23	0.07	0.17	0.038
Pipe G235_G237	55.84	62.2	130	HDPE-PE 100 PN10	0.61	0.2	1.1	0.033
Pipe G237_G238	19.93	62.2	130	HDPE-PE 100 PN10	0.19	0.06	0.13	0.039
Pipe G237_G936	37.76	62.2	130	HDPE-PE 100 PN10	0.25	0.08	0.21	0.037
Pipe G239_G218	42.44	62.2	130	HDPE-PE 100 PN10	-0.28	0.09	0.26	0.037
Pipe G242_G240	19.92	62.2	130	HDPE-PE 100 PN10	0.08	0.03	0.03	0.052

Pipe G242_G241	17.13	62.2	130	HDPE-PE 100 PN10	0.06	0.02	0.02	0.05
Pipe G243_G242	15.79	62.2	130	HDPE-PE 100 PN10	0.2	0.07	0.13	0.038
Pipe G243_G245	70.28	62.2	130	HDPE-PE 100 PN10	0.14	0.05	0.07	0.041
Pipe G245_G246	9.241	62.2	130	HDPE-PE 100 PN10	0.89	0.29	2.17	0.031
Pipe G245_G257	14.53	62.2	130	HDPE-PE 100 PN10	-0.83	0.27	1.91	0.031
Pipe G246_G244	48.63	62.2	130	HDPE-PE 100 PN10	0.15	0.05	0.08	0.039
Pipe G247_G246	36.59	62.2	130	HDPE-PE 100 PN10	-0.61	0.2	1.07	0.033
Pipe G247_G248	55.95	62.2	130	HDPE-PE 100 PN10	0.66	0.22	1.27	0.032
Pipe G248_G249	37.75	62.2	130	HDPE-PE 100 PN10	0.26	0.09	0.22	0.038
Pipe G248_G967	8.942	62.2	130	HDPE-PE 100 PN10	0.26	0.09	0.22	0.035
Pipe G249_G250	106.8	62.2	130	HDPE-PE 100 PN10	-0.02	0.01	0	0.061
Pipe G249_G253	48.48	62.2	130	HDPE-PE 100 PN10	-0.07	0.02	0.02	0.045
Pipe G250_G251	47.15	62.2	130	HDPE-PE 100 PN10	0.19	0.06	0.12	0.039
Pipe G250_G261	125.3	62.2	130	HDPE-PE 100 PN10	-0.59	0.2	1.03	0.033
Pipe G251_G252	21.3	62.2	130	HDPE-PE 100 PN10	0.17	0.06	0.1	0.039
Pipe G251_G262	87.56	62.2	130	HDPE-PE 100 PN10	-0.3	0.1	0.29	0.037
Pipe G252_G253	42.82	62.2	130	HDPE-PE 100 PN10	-0.25	0.08	0.2	0.037
Pipe G252_G360	24.26	62.2	130	HDPE-PE 100 PN10	0.28	0.09	0.26	0.037
Pipe G253_G254	17.74	62.2	130	HDPE-PE 100 PN10	-0.45	0.15	0.62	0.035
Pipe G254_G333	22.22	62.2	130	HDPE-PE 100 PN10	0.28	0.09	0.25	0.038
Pipe G255_G247	13	62.2	130	HDPE-PE 100 PN10	0.19	0.06	0.11	0.036
Pipe G255_G254	37.32	62.2	130	HDPE-PE 100 PN10	0.82	0.27	1.87	0.031
Pipe G256_G017	93.83	62.2	130	HDPE-PE 100 PN10	-1.07	0.35	3.09	0.03
Pipe G256_G255	25.88	62.2	130	HDPE-PE 100 PN10	1.1	0.36	3.25	0.03
Pipe G257_G256	10.02	62.2	130	HDPE-PE 100 PN10	0.19	0.06	0.12	0.037
Pipe G258_G017	3.618	62.2	130	HDPE-PE 100 PN10	1.5	0.49	5.76	0.029
Pipe G258_G018	17.22	62.2	130	HDPE-PE 100 PN10	0.24	0.08	0.2	0.038
Pipe G259_G258	44.91	62.2	130	HDPE-PE 100 PN10	1.91	0.63	8.93	0.028

Pipe G259_G260	44.11	62.2	130	HDPE-PE 100 PN10	-1.62	0.53	6.61	0.028
Pipe G260_G332	32.64	62.2	130	HDPE-PE 100 PN10	-4.15	1.37	37.83	0.025
Pipe G261_G260	81.05	62.2	130	HDPE-PE 100 PN10	-2.32	0.76	12.82	0.027
Pipe G262_G261	35.94	62.2	130	HDPE-PE 100 PN10	-1.07	0.35	3.06	0.03
Pipe G262_G263	38.64	62.2	130	HDPE-PE 100 PN10	0.32	0.1	0.32	0.036
Pipe G264_G038	190.5	150	110	DI	2.34	0.13	0.24	0.041
Pipe G265_G264	1.946	150	110	DI	3.91	0.22	0.61	0.037
Pipe G266_G270	72.64	62.2	130	HDPE-PE 100 PN10	2.1	0.69	10.68	0.027
Pipe G267_G265	101	150	110	DI	3.87	0.22	0.62	0.038
Pipe G268_G267	82.43	200	110	DI	-32.7	1.04	7.96	0.029
Pipe G268_G269	53.9	62.2	130	HDPE-PE 100 PN10	0.67	0.22	1.28	0.032
Pipe G270_G276	161.7	62.2	130	HDPE-PE 100 PN10	0.83	0.27	1.93	0.031
Pipe G271_G268	76.98	200	110	DI	-32.7	1.04	7.96	0.029
Pipe G272_G271	53.17	62.2	130	HDPE-PE 100 PN10	-2.85	0.94	18.77	0.026
Pipe G272_G273	15.19	62.2	130	HDPE-PE 100 PN10	0.17	0.06	0.1	0.038
Pipe G272_G283	113.6	62.2	130	HDPE-PE 100 PN10	2.26	0.74	12.22	0.027
Pipe G274_G271	85.92	150	110	DI	-16.2	0.92	8.8	0.031
Pipe G274_G852	20.84	150	110	DI	16.2	0.92	8.8	0.031
Pipe G275_G270	156.2	62.2	130	HDPE-PE 100 PN10	-0.81	0.26	1.81	0.032
Pipe G275_G276	31.35	62.2	130	HDPE-PE 100 PN10	0.57	0.19	0.95	0.033
Pipe G276_G851	25.24	62.2	130	HDPE-PE 100 PN10	1.35	0.44	4.7	0.029
Pipe G277_G274	61.58	62.2	130	HDPE-PE 100 PN10	-0.25	0.08	0.22	0.037
Pipe G278_G383	115.9	62.2	130	HDPE-PE 100 PN10	-1.58	0.52	6.33	0.029
Pipe G279_G280	56.54	62.2	130	HDPE-PE 100 PN10	2.99	0.98	20.58	0.026
Pipe G279_G458	186	62.2	130	HDPE-PE 100 PN10	1.95	0.64	9.32	0.028
Pipe G280_G281	4.46	62.2	130	HDPE-PE 100 PN10	1.05	0.34	2.94	0.03
Pipe G281_G282	35.4	62.2	130	HDPE-PE 100 PN10	1.01	0.33	2.73	0.03
Pipe G282_G295	38.46	62.2	130	HDPE-PE 100 PN10	1.94	0.64	9.22	0.028
Pipe G283_G282	39.73	62.2	130	HDPE-PE 100 PN10	1.08	0.36	3.13	0.03
Pipe G283_G284	26.24	62.2	130	HDPE-PE 100 PN10	0.57	0.19	0.96	0.033
Pipe G284_G285	20.86	62.2	130	HDPE-PE 100	0.32	0.1	0.32	0.036

				PN10				
Pipe G284_G286	21.26	62.2	130	HDPE-PE 100 PN10	0.18	0.06	0.11	0.04
Pipe G286_G281	33.86	62.2	130	HDPE-PE 100 PN10	0.02	0.01	0	0
Pipe G286_G287	9.762	62.2	130	HDPE-PE 100 PN10	0.1	0.03	0.03	0.036
Pipe G288_G280	23.2	62.2	130	HDPE-PE 100 PN10	-1.84	0.61	8.36	0.028
Pipe G288_G289	16.14	62.2	130	HDPE-PE 100 PN10	0.21	0.07	0.15	0.039
Pipe G289_G290	12.73	62.2	130	HDPE-PE 100 PN10	0.09	0.03	0.02	0.036
Pipe G289_G291	8.096	62.2	130	HDPE-PE 100 PN10	0.09	0.03	0.04	0.052
Pipe G292_G288	30.02	62.2	130	HDPE-PE 100 PN10	-1.55	0.51	6.11	0.029
Pipe G292_G293	50.67	62.2	130	HDPE-PE 100 PN10	0.37	0.12	0.43	0.035
Pipe G294_G292	34.9	62.2	130	HDPE-PE 100 PN10	-1.02	0.33	2.79	0.03
Pipe G294_G297	36.45	62.2	130	HDPE-PE 100 PN10	1.09	0.36	3.19	0.03
Pipe G295_G294	44.36	62.2	130	HDPE-PE 100 PN10	0.27	0.09	0.24	0.037
Pipe G295_G296	22.1	62.2	130	HDPE-PE 100 PN10	1.5	0.49	5.72	0.029
Pipe G296_G303	38.14	62.2	130	HDPE-PE 100 PN10	1.2	0.39	3.79	0.03
Pipe G297_G296	68.89	62.2	130	HDPE-PE 100 PN10	-0.03	0.01	0	0.044
Pipe G299_G298	29	62.2	130	HDPE-PE 100 PN10	0.16	0.05	0.09	0.041
Pipe G299_G457	79.27	62.2	130	HDPE-PE 100 PN10	-0.11	0.04	0.05	0.041
Pipe G300_G297	36.31	62.2	130	HDPE-PE 100 PN10	-0.93	0.31	2.37	0.031
Pipe G300_G299	24.14	62.2	130	HDPE-PE 100 PN10	0.19	0.06	0.13	0.039
Pipe G301_G300	69.16	62.2	130	HDPE-PE 100 PN10	-0.59	0.19	1.02	0.033
Pipe G301_G302	10.61	62.2	130	HDPE-PE 100 PN10	0.88	0.29	2.12	0.031
Pipe G302_G305	5.725	62.2	130	HDPE-PE 100 PN10	1.59	0.52	6.45	0.029
Pipe G303_G301	24.62	62.2	130	HDPE-PE 100 PN10	0.41	0.13	0.51	0.035
Pipe G303_G304	23.7	62.2	130	HDPE-PE 100 PN10	0.5	0.17	0.75	0.034
Pipe G304_G302	11.05	62.2	130	HDPE-PE 100 PN10	0.74	0.24	1.55	0.032
Pipe G305_G306	34.44	62.2	130	HDPE-PE 100 PN10	0.35	0.12	0.39	0.035
Pipe G305_G307	49.4	62.2	130	HDPE-PE 100 PN10	1.15	0.38	3.5	0.03

Pipe G307_G309	26.22	62.2	130	HDPE-PE 100 PN10	0.17	0.06	0.1	0.039
Pipe G308_G307	4.12	62.2	130	HDPE-PE 100 PN10	-1.34	0.44	4.66	0.029
Pipe G308_G461	39.92	62.2	130	HDPE-PE 100 PN10	-0.04	0.01	0.01	0.057
Pipe G310_G308	98.77	62.2	130	HDPE-PE 100 PN10	-1.22	0.4	3.91	0.03
Pipe G312_G310	11.79	62.2	130	HDPE-PE 100 PN10	-1.03	0.34	2.84	0.03
Pipe G312_G311	29.23	62.2	130	HDPE-PE 100 PN10	0.26	0.09	0.23	0.038
Pipe G313_G312	7.957	62.2	130	HDPE-PE 100 PN10	-0.73	0.24	1.52	0.032
Pipe G313_G888	17.74	62.2	130	HDPE-PE 100 PN10	0.47	0.16	0.68	0.034
Pipe G314_G315	19.42	62.2	130	HDPE-PE 100 PN10	-0.11	0.04	0.05	0.042
Pipe G315_G476	42.77	62.2	130	HDPE-PE 100 PN10	0.13	0.04	0.06	0.041
Pipe G316_G890	9.423	62.2	130	HDPE-PE 100 PN10	0.15	0.05	0.08	0.038
Pipe G317_G316	29.89	62.2	130	HDPE-PE 100 PN10	0.29	0.09	0.27	0.037
Pipe G318_G317	22.3	62.2	130	HDPE-PE 100 PN10	-0.09	0.03	0.03	0.045
Pipe G319_G317	9.964	62.2	130	HDPE-PE 100 PN10	0.44	0.14	0.58	0.034
Pipe G319_G478	32.28	62.2	130	HDPE-PE 100 PN10	-0.08	0.03	0.03	0.045
Pipe G320_G319	25.61	62.2	130	HDPE-PE 100 PN10	0.41	0.14	0.52	0.035
Pipe G320_G322	52.76	62.2	130	HDPE-PE 100 PN10	-0.56	0.18	0.92	0.033
Pipe G321_G320	1.793	62.2	130	HDPE-PE 100 PN10	-0.07	0.02	0	0
Pipe G322_G310	97.67	62.2	130	HDPE-PE 100 PN10	0.13	0.04	0.07	0.042
Pipe G322_G323	43.7	62.2	130	HDPE-PE 100 PN10	0.34	0.11	0.37	0.036
Pipe G322_G324	61.48	62.2	130	HDPE-PE 100 PN10	-0.89	0.29	2.19	0.031
Pipe G324_G358	65.36	62.2	130	HDPE-PE 100 PN10	0.78	0.26	1.71	0.032
Pipe G326_G015	46.41	62.2	130	HDPE-PE 100 PN10	0.97	0.32	2.55	0.031
Pipe G326_G325	30.41	62.2	130	HDPE-PE 100 PN10	0.35	0.12	0.39	0.035
Pipe G327_G326	36.33	62.2	130	HDPE-PE 100 PN10	1.51	0.5	5.83	0.029
Pipe G327_G328	40.12	62.2	130	HDPE-PE 100 PN10	0.21	0.07	0.15	0.038
Pipe G327_G329	29.82	62.2	130	HDPE-PE 100 PN10	0.34	0.11	0.36	0.036
Pipe G330_G327	35.77	62.2	130	HDPE-PE 100 PN10	2.19	0.72	11.57	0.027

Pipe G331_G330	30.35	62.2	130	HDPE-PE 100 PN10	-0.13	0.04	0.06	0.041
Pipe G332_G330	23.38	62.2	130	HDPE-PE 100 PN10	2.45	0.81	14.21	0.027
Pipe G334_G217	10	62.2	130	HDPE-PE 100 PN10	-0.11	0.04	0.04	0.042
Pipe G335_G336	17.32	62.2	130	HDPE-PE 100 PN10	-0.35	0.11	0.38	0.035
Pipe G337_G225	24.7	62.2	130	HDPE-PE 100 PN10	-1.65	0.54	6.88	0.028
Pipe G337_G338	10.24	62.2	130	HDPE-PE 100 PN10	0.21	0.07	0.15	0.037
Pipe G340_G228	67.45	62.2	130	HDPE-PE 100 PN10	1.81	0.59	8.09	0.028
Pipe G340_G230	94.27	62.2	130	HDPE-PE 100 PN10	0.73	0.24	1.52	0.032
Pipe G341_G340	12.41	62.2	130	HDPE-PE 100 PN10	-0.87	0.29	2.11	0.031
Pipe G341_G342	27.14	62.2	130	HDPE-PE 100 PN10	1.26	0.41	4.13	0.029
Pipe G342_G346	35.38	62.2	130	HDPE-PE 100 PN10	0.86	0.28	2.03	0.031
Pipe G343_G342	84.12	62.2	130	HDPE-PE 100 PN10	-0.19	0.06	0.12	0.039
Pipe G343_G344	13.52	62.2	130	HDPE-PE 100 PN10	0.14	0.05	0.07	0.04
Pipe G345_G343	11.64	62.2	130	HDPE-PE 100 PN10	-0.21	0.07	0.15	0.037
Pipe G346_G347	15.17	62.2	130	HDPE-PE 100 PN10	0.19	0.06	0.14	0.041
Pipe G346_G348	33.26	62.2	130	HDPE-PE 100 PN10	0.53	0.17	0.84	0.034
Pipe G348_G349	15.96	62.2	130	HDPE-PE 100 PN10	0.18	0.06	0.1	0.037
Pipe G348_G350	27.12	62.2	130	HDPE-PE 100 PN10	0.25	0.08	0.21	0.037
Pipe G350_G351	38	62.2	130	HDPE-PE 100 PN10	-0.28	0.09	0.25	0.037
Pipe G350_G483	33.35	62.2	130	HDPE-PE 100 PN10	0.35	0.12	0.4	0.036
Pipe G351_G352	15.8	62.2	130	HDPE-PE 100 PN10	-0.06	0.02	0.02	0.053
Pipe G352_G353	13.08	62.2	130	HDPE-PE 100 PN10	0.3	0.1	0.31	0.037
Pipe G352_G356	19.45	62.2	130	HDPE-PE 100 PN10	-0.42	0.14	0.53	0.034
Pipe G353_G354	7.526	62.2	130	HDPE-PE 100 PN10	0.13	0.04	0.06	0.04
Pipe G353_G355	10.4	62.2	130	HDPE-PE 100 PN10	0.16	0.05	0.09	0.04
Pipe G356_G351	34.8	62.2	130	HDPE-PE 100 PN10	0.31	0.1	0.3	0.036
Pipe G356_G357	3.14	62.2	130	HDPE-PE 100 PN10	-0.78	0.26	1.75	0.032
Pipe G357_G358	42.12	62.2	130	HDPE-PE 100 PN10	-0.61	0.2	1.1	0.033

Pipe G357_G359	69.17	62.2	130	HDPE-PE 100 PN10	-0.32	0.11	0.34	0.036
Pipe G358_G231	112.3	62.2	130	HDPE-PE 100 PN10	-0.19	0.06	0.12	0.039
Pipe G359_G324	33.73	62.2	130	HDPE-PE 100 PN10	-1.23	0.41	3.99	0.03
Pipe G359_G481	40.6	62.2	130	HDPE-PE 100 PN10	0.63	0.21	1.13	0.033
Pipe G361_G332	69.64	62.2	130	HDPE-PE 100 PN10	-1.16	0.38	3.56	0.03
Pipe G361_G362	13.22	62.2	130	HDPE-PE 100 PN10	0.72	0.24	1.49	0.032
Pipe G362_G304	53.67	62.2	130	HDPE-PE 100 PN10	0.34	0.11	0.37	0.036
Pipe G362_G363	13.4	62.2	130	HDPE-PE 100 PN10	0.16	0.05	0.1	0.044
Pipe G365_G371	14.5	62.2	130	HDPE-PE 100 PN10	1.34	0.44	4.63	0.029
Pipe G366_G365	1.71	62.2	130	HDPE-PE 100 PN10	-0.96	0.32	2.52	0.031
Pipe G367_G366	33.12	62.2	130	HDPE-PE 100 PN10	-0.71	0.23	1.45	0.032
Pipe G367_G368	17.44	62.2	130	HDPE-PE 100 PN10	0.06	0.02	0.02	0.062
Pipe G369_G367	28.64	62.2	130	HDPE-PE 100 PN10	-0.51	0.17	0.79	0.034
Pipe G370_G366	42.42	62.2	130	HDPE-PE 100 PN10	-0.2	0.06	0.13	0.038
Pipe G371_G364	42.27	62.2	130	HDPE-PE 100 PN10	0.87	0.29	2.09	0.031
Pipe G371_G372	16.76	62.2	130	HDPE-PE 100 PN10	0.4	0.13	0.5	0.034
Pipe G373_G377	153.4	150	110	DI	-11.75	0.66	4.86	0.032
Pipe G374_G373	71.24	62.2	130	HDPE-PE 100 PN10	-0.52	0.17	0.81	0.034
Pipe G376_G373	28.16	150	110	DI	-11.75	0.66	4.86	0.032
Pipe G376_G375	48.64	62.2	130	HDPE-PE 100 PN10	0.46	0.15	0.64	0.034
Pipe G377_G848	3.686	150	110	DI	-11.75	0.66	4.84	0.032
Pipe G378_G377	26.14	62.2	130	HDPE-PE 100 PN10	0.42	0.14	0.55	0.034
Pipe G378_G379	13.52	62.2	130	HDPE-PE 100 PN10	0.37	0.12	0.42	0.035
Pipe G380_G381	44.41	62.2	130	HDPE-PE 100 PN10	0.76	0.25	1.62	0.032
Pipe G381_G378	140.1	62.2	130	HDPE-PE 100 PN10	0.95	0.31	2.47	0.031
Pipe G381_G387	41.45	62.2	130	HDPE-PE 100 PN10	-0.59	0.19	1.01	0.033
Pipe G382_G380	132.1	62.2	130	HDPE-PE 100 PN10	3.07	1.01	21.6	0.026
Pipe G382_G456	147.8	62.2	130	HDPE-PE 100 PN10	1.97	0.65	9.52	0.028
Pipe G383_G382	5.501	62.2	130	HDPE-PE 100 PN10	-2.89	0.95	19.29	0.026

Pipe G383_G384	26.14	62.2	130	HDPE-PE 100 PN10	1.14	0.38	3.46	0.03
Pipe G384_G386	34.17	62.2	130	HDPE-PE 100 PN10	0.36	0.12	0.4	0.036
Pipe G385_G384	12.45	62.2	130	HDPE-PE 100 PN10	-0.64	0.21	1.18	0.033
Pipe G387_G029	100.4	62.2	130	HDPE-PE 100 PN10	-2.11	0.69	10.75	0.027
Pipe G388_G391	42.46	62.2	130	HDPE-PE 100 PN10	-0.56	0.19	0.94	0.033
Pipe G389_G387	48.39	62.2	130	HDPE-PE 100 PN10	-1.19	0.39	3.74	0.03
Pipe G390_G389	16.08	62.2	130	HDPE-PE 100 PN10	-0.18	0.06	0.11	0.039
Pipe G391_G389	3.539	62.2	130	HDPE-PE 100 PN10	-0.9	0.3	2.23	0.031
Pipe G391_G392	15.62	62.2	130	HDPE-PE 100 PN10	0.29	0.1	0.27	0.036
Pipe G393_G095	79.78	62.2	130	HDPE-PE 100 PN10	0.66	0.22	1.24	0.032
Pipe G393_G394	9.006	62.2	130	HDPE-PE 100 PN10	0.98	0.32	2.61	0.03
Pipe G395_G396	23.31	62.2	130	HDPE-PE 100 PN10	0.35	0.12	0.4	0.035
Pipe G395_G836	156.7	62.2	130	HDPE-PE 100 PN10	2.38	0.78	13.5	0.027
Pipe G396_G397	6.375	62.2	130	HDPE-PE 100 PN10	0.06	0.02	0.02	0.078
Pipe G396_G398	10.78	62.2	130	HDPE-PE 100 PN10	0.27	0.09	0.23	0.037
Pipe G400_G403	37.93	62.2	130	HDPE-PE 100 PN10	1.46	0.48	5.46	0.029
Pipe G400_G835	41.45	62.2	130	HDPE-PE 100 PN10	0.43	0.14	0.57	0.035
Pipe G401_G402	53.62	62.2	130	HDPE-PE 100 PN10	-3	0.99	20.72	0.026
Pipe G402_G096	165.6	200	110	DI	-35.66	1.14	9.35	0.028
Pipe G402_G838	52.46	150	110	DI	11.75	0.66	4.86	0.032
Pipe G403_G395	53.33	62.2	130	HDPE-PE 100 PN10	3.05	1	21.33	0.026
Pipe G403_G401	67.42	62.2	130	HDPE-PE 100 PN10	-1.89	0.62	8.83	0.028
Pipe G404_G400	156.8	62.2	130	HDPE-PE 100 PN10	-1.93	0.64	9.17	0.028
Pipe G404_G405	84.89	62.2	130	HDPE-PE 100 PN10	1.08	0.35	3.1	0.03
Pipe G406_G404	30.24	62.2	130	HDPE-PE 100 PN10	-1.07	0.35	3.08	0.03
Pipe G406_G407	39.93	62.2	130	HDPE-PE 100 PN10	0.21	0.07	0.15	0.038
Pipe G407_G408	20.91	62.2	130	HDPE-PE 100 PN10	0.46	0.15	0.64	0.034
Pipe G407_G410	96.45	62.2	130	HDPE-PE 100 PN10	-0.52	0.17	0.82	0.034
Pipe G409_G411	112.8	62.2	130	HDPE-PE 100	0.86	0.28	2.04	0.031

				PN10				
Pipe G409_G415	154.1	62.2	130	HDPE-PE 100 PN10	1.02	0.33	2.8	0.03
Pipe G410_G976	143.4	62.2	130	HDPE-PE 100 PN10	3.39	1.12	25.98	0.025
Pipe G413_G412	35.08	62.2	130	HDPE-PE 100 PN10	0.17	0.05	0.09	0.039
Pipe G413_G414	47.79	62.2	130	HDPE-PE 100 PN10	1.51	0.5	5.81	0.029
Pipe G415_G413	41.16	62.2	130	HDPE-PE 100 PN10	1.96	0.65	9.43	0.028
Pipe G416_G415	54.67	62.2	130	HDPE-PE 100 PN10	1.35	0.45	4.74	0.029
Pipe G416_G421	306.3	62.2	130	HDPE-PE 100 PN10	1.18	0.39	3.69	0.03
Pipe G417_G563	490.3	62.2	130	HDPE-PE 100 PN10	-1.54	0.51	6	0.029
Pipe G417_G590	155.4	62.2	130	HDPE-PE 100 PN10	-0.11	0.04	0.05	0.042
Pipe G418_G417	46.97	62.2	130	HDPE-PE 100 PN10	-1.02	0.34	2.8	0.03
Pipe G419_G544	60.55	62.2	130	HDPE-PE 100 PN10	-1.24	0.41	4.05	0.03
Pipe G420_G419	36	62.2	130	HDPE-PE 100 PN10	-1.07	0.35	3.06	0.03
Pipe G421_G425	19.53	62.2	130	HDPE-PE 100 PN10	0.66	0.22	1.24	0.033
Pipe G423_G421	26.28	62.2	130	HDPE-PE 100 PN10	-0.4	0.13	0.5	0.035
Pipe G423_G422	10.32	62.2	130	HDPE-PE 100 PN10	0.18	0.06	0.1	0.036
Pipe G424_G423	11.52	62.2	130	HDPE-PE 100 PN10	-0.17	0.06	0.1	0.039
Pipe G425_G426	68.41	62.2	130	HDPE-PE 100 PN10	0.45	0.15	0.63	0.034
Pipe G425_G779	262.3	62.2	130	HDPE-PE 100 PN10	0.09	0.03	0.03	0.043
Pipe G427_G512	25	62.2	130	HDPE-PE 100 PN10	0.16	0.05	0.09	0.038
Pipe G427_G513	45.28	62.2	130	HDPE-PE 100 PN10	-2.4	0.79	13.71	0.027
Pipe G428_G427	22.43	62.2	130	HDPE-PE 100 PN10	-2.07	0.68	10.36	0.027
Pipe G428_G511	24.55	62.2	130	HDPE-PE 100 PN10	0.12	0.04	0.05	0.041
Pipe G429_G428	31.14	62.2	130	HDPE-PE 100 PN10	-1.84	0.61	8.38	0.028
Pipe G430_G429	16.78	62.2	130	HDPE-PE 100 PN10	-1.6	0.53	6.46	0.028
Pipe G430_G433	62.6	62.2	130	HDPE-PE 100 PN10	0.17	0.06	0.11	0.04
Pipe G431_G429	54.06	62.2	130	HDPE-PE 100 PN10	-0.11	0.04	0.05	0.043
Pipe G433_G432	30.96	62.2	130	HDPE-PE 100 PN10	0.17	0.05	0.1	0.04

Pipe G433_G434	39.05	62.2	130	HDPE-PE 100 PN10	-0.16	0.05	0.09	0.041
Pipe G434_G435	48.04	62.2	130	HDPE-PE 100 PN10	-0.52	0.17	0.8	0.034
Pipe G434_G871	10.61	62.2	130	HDPE-PE 100 PN10	0.17	0.06	0.11	0.042
Pipe G435_G438	60.85	150	110	DI	-6.08	0.34	1.44	0.036
Pipe G436_G437	4.194	62.2	130	HDPE-PE 100 PN10	-3.08	1.01	21.75	0.026
Pipe G436_G523	191.9	62.2	130	HDPE-PE 100 PN10	0.6	0.2	1.04	0.033
Pipe G437_G445	194.2	62.2	130	HDPE-PE 100 PN10	1.43	0.47	5.25	0.029
Pipe G437_G805	37.86	62.2	130	HDPE-PE 100 PN10	2.93	0.96	19.76	0.026
Pipe G438_G443	62.97	150	110	DI	-6.08	0.34	1.44	0.036
Pipe G439_G438	43.44	62.2	130	HDPE-PE 100 PN10	-0.47	0.16	0.67	0.034
Pipe G439_G441	37.53	62.2	130	HDPE-PE 100 PN10	0.19	0.06	0.13	0.039
Pipe G440_G439	14.04	62.2	130	HDPE-PE 100 PN10	-0.12	0.04	0.06	0.047
Pipe G443_G503	85.12	150	110	DI	-6.08	0.34	1.43	0.036
Pipe G443_G872	33.47	62.2	130	HDPE-PE 100 PN10	0.29	0.09	0.27	0.037
Pipe G444_G509	148.3	62.2	130	HDPE-PE 100 PN10	-0.39	0.13	0.47	0.035
Pipe G444_G867	19.65	62.2	130	HDPE-PE 100 PN10	0.16	0.05	0.09	0.04
Pipe G445_G502	73.28	62.2	130	HDPE-PE 100 PN10	0.74	0.24	1.54	0.032
Pipe G446_G447	21.96	62.2	130	HDPE-PE 100 PN10	0.38	0.13	0.46	0.036
Pipe G446_G866	58.18	62.2	130	HDPE-PE 100 PN10	0.22	0.07	0.17	0.038
Pipe G447_G504	60.02	62.2	130	HDPE-PE 100 PN10	0.36	0.12	0.41	0.035
Pipe G448_G780	13.54	62.2	130	HDPE-PE 100 PN10	0.84	0.28	1.96	0.031
Pipe G450_G446	36.37	62.2	130	HDPE-PE 100 PN10	0.71	0.23	1.42	0.032
Pipe G450_G449	24.65	62.2	130	HDPE-PE 100 PN10	0.1	0.03	0.04	0.048
Pipe G451_G448	63.36	62.2	130	HDPE-PE 100 PN10	-2.62	0.86	16.12	0.026
Pipe G451_G452	30.22	62.2	130	HDPE-PE 100 PN10	0.11	0.04	0.05	0.043
Pipe G453_G450	19.38	62.2	130	HDPE-PE 100 PN10	0.87	0.28	2.07	0.031
Pipe G453_G455	41.77	62.2	130	HDPE-PE 100 PN10	-2.17	0.72	11.39	0.027
Pipe G454_G451	37.49	62.2	130	HDPE-PE 100 PN10	-2.47	0.81	14.42	0.027
Pipe G455_G464	89.66	62.2	130	HDPE-PE 100 PN10	0.85	0.28	2.01	0.031

Pipe G456_G454	108.5	62.2	130	HDPE-PE 100 PN10	0.11	0.03	0.04	0.043
Pipe G456_G854	187.2	62.2	130	HDPE-PE 100 PN10	1.39	0.46	4.98	0.029
Pipe G457_G455	127.2	62.2	130	HDPE-PE 100 PN10	0.5	0.17	0.76	0.034
Pipe G458_G457	39.4	62.2	130	HDPE-PE 100 PN10	1	0.33	2.7	0.031
Pipe G459_G458	46.13	62.2	130	HDPE-PE 100 PN10	-0.22	0.07	0.16	0.038
Pipe G460_G461	79.35	62.2	130	HDPE-PE 100 PN10	-0.22	0.07	0.16	0.039
Pipe G461_G462	19.4	62.2	130	HDPE-PE 100 PN10	-0.22	0.07	0.17	0.038
Pipe G462_G016	62.66	62.2	130	HDPE-PE 100 PN10	0.28	0.09	0.25	0.037
Pipe G462_G463	6.666	62.2	130	HDPE-PE 100 PN10	-0.3	0.1	0.29	0.037
Pipe G463_G464	26.62	62.2	130	HDPE-PE 100 PN10	-0.56	0.18	0.91	0.033
Pipe G464_G465	20.57	62.2	130	HDPE-PE 100 PN10	0.1	0.03	0.04	0.043
Pipe G466_G453	29.26	62.2	130	HDPE-PE 100 PN10	-1.24	0.41	4.03	0.03
Pipe G466_G467	24.41	62.2	130	HDPE-PE 100 PN10	0.67	0.22	1.28	0.032
Pipe G467_G468	22.66	62.2	130	HDPE-PE 100 PN10	0.09	0.03	0.03	0.045
Pipe G467_G469	28.75	62.2	130	HDPE-PE 100 PN10	0.51	0.17	0.77	0.034
Pipe G469_G470	24.84	62.2	130	HDPE-PE 100 PN10	0.14	0.05	0.07	0.038
Pipe G469_G471	43.9	62.2	130	HDPE-PE 100 PN10	0.19	0.06	0.13	0.038
Pipe G471_G472	29.96	62.2	130	HDPE-PE 100 PN10	0.14	0.05	0.07	0.043
Pipe G471_G473	14.02	62.2	130	HDPE-PE 100 PN10	-0.07	0.02	0.01	0.028
Pipe G473_G313	79.24	62.2	130	HDPE-PE 100 PN10	-0.2	0.07	0.14	0.039
Pipe G474_G466	85.11	62.2	130	HDPE-PE 100 PN10	-0.48	0.16	0.68	0.034
Pipe G474_G473	49.49	62.2	130	HDPE-PE 100 PN10	0.04	0.01	0.01	0.067
Pipe G475_G474	25.23	62.2	130	HDPE-PE 100 PN10	-0.23	0.08	0.18	0.038
Pipe G476_G475	44.24	62.2	130	HDPE-PE 100 PN10	-0.13	0.04	0.06	0.041
Pipe G476_G477	14.97	62.2	130	HDPE-PE 100 PN10	0.08	0.03	0.03	0.054
Pipe G478_G475	83.46	62.2	130	HDPE-PE 100 PN10	0.14	0.05	0.07	0.04
Pipe G478_G479	9.306	62.2	130	HDPE-PE 100 PN10	-0.36	0.12	0.42	0.036
Pipe G479_G480	31.36	62.2	130	HDPE-PE 100 PN10	-0.26	0.09	0.23	0.037

Pipe G480_G321	29.33	62.2	130	HDPE-PE 100 PN10	-0.11	0.04	0.05	0.044
Pipe G480_G782	32.2	62.2	130	HDPE-PE 100 PN10	-0.26	0.09	0.23	0.038
Pipe G481_G321	48.13	62.2	130	HDPE-PE 100 PN10	0.12	0.04	0.05	0.042
Pipe G482_G481	58.65	62.2	130	HDPE-PE 100 PN10	-0.26	0.08	0.22	0.037
Pipe G482_G782	54.24	62.2	130	HDPE-PE 100 PN10	-0.3	0.1	0.3	0.036
Pipe G483_G482	75.34	62.2	130	HDPE-PE 100 PN10	-0.11	0.04	0.05	0.043
Pipe G483_G484	11.88	62.2	130	HDPE-PE 100 PN10	0.16	0.05	0.09	0.037
Pipe G485_G341	134.3	62.2	130	HDPE-PE 100 PN10	0.43	0.14	0.58	0.035
Pipe G486_G487	71.63	150	110	DI	2.46	0.14	0.27	0.041
Pipe G487_G489	159.7	150	110	DI	2.46	0.14	0.27	0.041
Pipe G488_G487	70.28	62.2	130	HDPE-PE 100 PN10	-0.54	0.18	0.86	0.033
Pipe G489_G490	5.82	150	110	DI	-6.62	0.37	1.69	0.035
Pipe G489_G494	67.48	62.2	130	HDPE-PE 100 PN10	2.15	0.71	11.15	0.027
Pipe G490_G875	38.71	150	110	DI	-6.62	0.37	1.68	0.035
Pipe G492_G081	32.43	62.2	130	HDPE-PE 100 PN10	0.17	0.06	0.1	0.039
Pipe G492_G491	45.27	62.2	130	HDPE-PE 100 PN10	0.44	0.14	0.58	0.034
Pipe G493_G492	32.87	62.2	130	HDPE-PE 100 PN10	0.89	0.29	2.2	0.031
Pipe G493_G496	86.6	62.2	130	HDPE-PE 100 PN10	0.27	0.09	0.24	0.037
Pipe G494_G082	97.2	62.2	130	HDPE-PE 100 PN10	0.59	0.19	1.01	0.033
Pipe G494_G493	32.35	62.2	130	HDPE-PE 100 PN10	1.42	0.47	5.19	0.029
Pipe G495_G074	27.99	62.2	130	HDPE-PE 100 PN10	1.96	0.64	9.41	0.028
Pipe G495_G490	71.14	62.2	130	HDPE-PE 100 PN10	-3.01	0.99	20.83	0.026
Pipe G496_G497	32.16	62.2	130	HDPE-PE 100 PN10	0.54	0.18	0.88	0.033
Pipe G497_G081	74.79	62.2	130	HDPE-PE 100 PN10	0.33	0.11	0.35	0.036
Pipe G497_G498	17.51	62.2	130	HDPE-PE 100 PN10	0.73	0.24	1.5	0.032
Pipe G498_G884	20.64	62.2	130	HDPE-PE 100 PN10	0.48	0.16	0.68	0.034
Pipe G499_G498	21.71	62.2	130	HDPE-PE 100 PN10	-0.17	0.06	0.1	0.038
Pipe G501_G497	41.91	62.2	130	HDPE-PE 100 PN10	0.63	0.21	1.15	0.033
Pipe G501_G880	26.8	62.2	130	HDPE-PE 100 PN10	-0.62	0.2	1.11	0.033

Pipe G502_G501	86.89	62.2	130	HDPE-PE 100 PN10	0.24	0.08	0.2	0.038
Pipe G502_G781	149.5	62.2	130	HDPE-PE 100 PN10	0.1	0.03	0.03	0.043
Pipe G503_G444	56.26	62.2	130	HDPE-PE 100 PN10	-0.16	0.05	0.09	0.04
Pipe G504_G479	171.3	62.2	130	HDPE-PE 100 PN10	0.28	0.09	0.26	0.037
Pipe G507_G506	22.87	62.2	130	HDPE-PE 100 PN10	0.08	0.03	0.03	0.041
Pipe G507_G508	21.76	62.2	130	HDPE-PE 100 PN10	0.1	0.03	0.03	0.041
Pipe G509_G430	52.1	62.2	130	HDPE-PE 100 PN10	-1.14	0.37	3.44	0.03
Pipe G509_G510	34.38	62.2	130	HDPE-PE 100 PN10	0.19	0.06	0.13	0.038
Pipe G513_G420	75.15	62.2	130	HDPE-PE 100 PN10	-0.68	0.23	1.34	0.032
Pipe G513_G514	250.1	62.2	130	HDPE-PE 100 PN10	-2	0.66	9.77	0.028
Pipe G514_G521	63.83	150	110	DI	-6.08	0.34	1.44	0.036
Pipe G515_G517	95.92	62.2	130	HDPE-PE 100 PN10	-0.64	0.21	1.19	0.033
Pipe G516_G519	14.12	62.2	130	HDPE-PE 100 PN10	0.19	0.06	0.13	0.04
Pipe G517_G516	8.629	62.2	130	HDPE-PE 100 PN10	-1.19	0.39	3.71	0.03
Pipe G517_G518	40.49	62.2	130	HDPE-PE 100 PN10	0.38	0.12	0.45	0.035
Pipe G520_G435	89.02	150	110	DI	-6.08	0.34	1.43	0.036
Pipe G520_G516	22.27	62.2	130	HDPE-PE 100 PN10	1.4	0.46	5.07	0.029
Pipe G521_G520	23.24	150	110	DI	-6.08	0.34	1.43	0.036
Pipe G522_G521	16.79	62.2	130	HDPE-PE 100 PN10	-0.23	0.08	0.17	0.036
Pipe G523_G524	31.11	62.2	130	HDPE-PE 100 PN10	2.78	0.91	17.94	0.026
Pipe G523_G531	108.6	62.2	130	HDPE-PE 100 PN10	-2.33	0.77	13	0.027
Pipe G524_G774	80.41	62.2	130	HDPE-PE 100 PN10	1.32	0.43	4.51	0.029
Pipe G524_G775	67.2	62.2	130	HDPE-PE 100 PN10	0.98	0.32	2.6	0.031
Pipe G525_G514	63.55	150	110	DI	2.9	0.16	0.37	0.04
Pipe G525_G526	72.05	62.2	130	HDPE-PE 100 PN10	0.95	0.31	2.46	0.031
Pipe G526_G527	26.24	62.2	130	HDPE-PE 100 PN10	0.48	0.16	0.69	0.034
Pipe G526_G528	37.31	62.2	130	HDPE-PE 100 PN10	0.3	0.1	0.29	0.037
Pipe G530_G525	29.53	150	110	DI	2.9	0.16	0.36	0.04
Pipe G530_G529	66.96	62.2	130	HDPE-PE 100 PN10	0.51	0.17	0.77	0.034
Pipe G531_G772	149.6	150	110	DI	6.62	0.37	1.68	0.035

Pipe G532_G530	29.72	150	110	DI	2.9	0.16	0.37	0.04
Pipe G534_G532	142.8	150	110	DI	2.9	0.16	0.36	0.04
Pipe G534_G533	51.01	62.2	130	HDPE-PE 100 PN10	0.31	0.1	0.31	0.036
Pipe G535_G534	28.25	150	110	DI	2.9	0.16	0.36	0.04
Pipe G535_G536	37.04	62.2	130	HDPE-PE 100 PN10	2.28	0.75	12.41	0.027
Pipe G536_G537	66.79	62.2	130	HDPE-PE 100 PN10	0.99	0.33	2.66	0.031
Pipe G537_G536	66.79	62.2	130	HDPE-PE 100 PN10	-0.99	0.33	2.66	0.031
Pipe G538_G537	2.183	62.2	130	HDPE-PE 100 PN10	-1.81	0.6	8.18	0.028
Pipe G538_G539	35	62.2	130	HDPE-PE 100 PN10	0.9	0.3	2.22	0.031
Pipe G538_G868	28.87	62.2	130	HDPE-PE 100 PN10	0.8	0.26	1.78	0.032
Pipe G539_G540	42.46	62.2	130	HDPE-PE 100 PN10	0.45	0.15	0.62	0.034
Pipe G539_G541	16.79	62.2	130	HDPE-PE 100 PN10	0.27	0.09	0.23	0.036
Pipe G539_G542	30.5	62.2	130	HDPE-PE 100 PN10	0.06	0.02	0.01	0.041
Pipe G543_G420	44.6	62.2	130	HDPE-PE 100 PN10	-0.2	0.06	0.13	0.039
Pipe G544_G418	79.96	62.2	130	HDPE-PE 100 PN10	-2.05	0.68	10.25	0.027
Pipe G544_G545	27.35	62.2	130	HDPE-PE 100 PN10	0.5	0.16	0.75	0.034
Pipe G546_G416	132.1	62.2	130	HDPE-PE 100 PN10	-1.3	0.43	4.38	0.029
Pipe G547_G546_A	54.91	62.2	130	HDPE-PE 100 PN10	-0.01	0	0	0.157
Pipe G547_G546_B	54.91	62.2	130	HDPE-PE 100 PN10	-0.01	0	0	0.157
Pipe G548_G547	72.8	62.2	130	HDPE-PE 100 PN10	1.05	0.35	2.96	0.03
Pipe G548_G549	69.01	62.2	130	HDPE-PE 100 PN10	1.23	0.41	3.97	0.03
Pipe G550_G548	20.98	62.2	130	HDPE-PE 100 PN10	2.71	0.89	17.12	0.026
Pipe G551_G550	52.18	62.2	130	HDPE-PE 100 PN10	-0.15	0.05	0.08	0.041
Pipe G553_G550	13.89	62.2	130	HDPE-PE 100 PN10	3.03	1	21.12	0.026
Pipe G553_G552	56.15	62.2	130	HDPE-PE 100 PN10	0.15	0.05	0.08	0.04
Pipe G554_G553	9.321	62.2	130	HDPE-PE 100 PN10	3.27	1.08	24.3	0.026
Pipe G554_G555	54.19	62.2	130	HDPE-PE 100 PN10	2.57	0.85	15.58	0.027
Pipe G555_G556	17.63	62.2	130	HDPE-PE 100 PN10	2.06	0.68	10.32	0.027
Pipe G556_G557	43.9	62.2	130	HDPE-PE 100 PN10	1.75	0.58	7.62	0.028

Pipe G556_G560	57.05	62.2	130	HDPE-PE 100 PN10	0.06	0.02	0.02	0.049
Pipe G557_G558	28.63	62.2	130	HDPE-PE 100 PN10	0.17	0.06	0.1	0.039
Pipe G557_G559	56.99	62.2	130	HDPE-PE 100 PN10	1.4	0.46	5.07	0.029
Pipe G561_G594	156	150	110	DI	10.25	0.58	3.77	0.033
Pipe G563_G561	59.01	62.2	130	HDPE-PE 100 PN10	-1.77	0.58	7.83	0.028
Pipe G564_G554	165.4	62.2	130	HDPE-PE 100 PN10	1.26	0.41	4.13	0.03
Pipe G565_G595	52.39	62.2	130	HDPE-PE 100 PN10	1	0.33	2.69	0.031
Pipe G566_G564	118.8	62.2	130	HDPE-PE 100 PN10	1.46	0.48	5.46	0.029
Pipe G566_G575	74.13	62.2	130	HDPE-PE 100 PN10	-0.54	0.18	0.86	0.033
Pipe G567_G569	38.67	62.2	130	HDPE-PE 100 PN10	0.17	0.05	0.1	0.041
Pipe G567_G570	28.79	62.2	130	HDPE-PE 100 PN10	-0.77	0.25	1.68	0.032
Pipe G568_G567	42.62	62.2	130	HDPE-PE 100 PN10	-0.29	0.09	0.27	0.037
Pipe G570_G566	43.53	62.2	130	HDPE-PE 100 PN10	-1.12	0.37	3.34	0.03
Pipe G570_G571	53.12	62.2	130	HDPE-PE 100 PN10	0.13	0.04	0.06	0.04
Pipe G573_G572	37.58	62.2	130	HDPE-PE 100 PN10	0.03	0.01	0	0.044
Pipe G573_G578	35.64	62.2	130	HDPE-PE 100 PN10	1.18	0.39	3.67	0.03
Pipe G574_G573	11.65	62.2	130	HDPE-PE 100 PN10	1.3	0.43	4.37	0.029
Pipe G574_G576	35.45	62.2	130	HDPE-PE 100 PN10	0.1	0.03	0.03	0.039
Pipe G575_G574	6.234	62.2	130	HDPE-PE 100 PN10	1.45	0.48	5.4	0.029
Pipe G575_G587	123.7	62.2	130	HDPE-PE 100 PN10	-2.2	0.72	11.63	0.027
Pipe G578_G577	13.58	62.2	130	HDPE-PE 100 PN10	0.07	0.02	0.02	0.05
Pipe G578_G579	59.89	62.2	130	HDPE-PE 100 PN10	0.98	0.32	2.6	0.031
Pipe G580_G581	78.21	62.2	130	HDPE-PE 100 PN10	0.54	0.18	0.87	0.033
Pipe G580_G986	102.2	62.2	130	HDPE-PE 100 PN10	-0.22	0.07	0.16	0.038
Pipe G582_G588	4.189	62.2	130	HDPE-PE 100 PN10	-1.83	0.6	8.35	0.028
Pipe G583_G608	71.51	62.2	130	HDPE-PE 100 PN10	0.39	0.13	0.47	0.035
Pipe G584_G565	244.6	62.2	130	HDPE-PE 100 PN10	1.65	0.54	6.82	0.028
Pipe G585_G583	24.12	62.2	130	HDPE-PE 100 PN10	-2.6	0.86	15.91	0.026

Pipe G585_G586	40.33	62.2	130	HDPE-PE 100 PN10	0.32	0.11	0.33	0.036
Pipe G587_G580	13.63	62.2	130	HDPE-PE 100 PN10	-2.25	0.74	12.2	0.027
Pipe G588_G585	54.8	62.2	130	HDPE-PE 100 PN10	-1.94	0.64	9.24	0.028
Pipe G589_G418	136.6	62.2	130	HDPE-PE 100 PN10	1.98	0.65	9.57	0.028
Pipe G589_G535	91.44	150	110	DI	2.9	0.16	0.36	0.04
Pipe G590_G589	199.5	150	110	DI	10.25	0.58	3.77	0.033
Pipe G591_G592	73.22	62.2	130	HDPE-PE 100 PN10	0.54	0.18	0.88	0.033
Pipe G591_G980	76.84	150	110	DI	10.25	0.58	3.77	0.033
Pipe G594_G591	47.35	150	110	DI	10.25	0.58	3.78	0.033
Pipe G594_G593	11.24	62.2	130	HDPE-PE 100 PN10	0.15	0.05	0.08	0.039
Pipe G595_G562	22.66	62.2	130	HDPE-PE 100 PN10	0.41	0.13	0.52	0.035
Pipe G596_G562	49.49	150	110	DI	-0.07	0	0	0
Pipe G596_G595	57.38	62.2	130	HDPE-PE 100 PN10	-0.38	0.13	0.45	0.035
Pipe G598_G596	101.1	150	110	DI	-0.07	0	0	0
Pipe G598_G597	65.04	62.2	130	HDPE-PE 100 PN10	0.68	0.22	1.33	0.032
Pipe G599_G565	214.5	62.2	130	HDPE-PE 100 PN10	0.01	0	0	0.1
Pipe G600_G609	135.7	62.2	130	HDPE-PE 100 PN10	-1.17	0.39	3.62	0.03
Pipe G600_G727	67.03	62.2	130	HDPE-PE 100 PN10	0.81	0.27	1.85	0.031
Pipe G601_G720	89.28	62.2	130	HDPE-PE 100 PN10	1.46	0.48	5.48	0.029
Pipe G603_G602	45.53	62.2	130	HDPE-PE 100 PN10	-0.63	0.21	1.15	0.033
Pipe G603_G604	20.78	62.2	130	HDPE-PE 100 PN10	0.33	0.11	0.35	0.036
Pipe G604_G605	35.07	62.2	130	HDPE-PE 100 PN10	0.13	0.04	0.06	0.041
Pipe G606_G604	32.01	62.2	130	HDPE-PE 100 PN10	-0.08	0.03	0.02	0.044
Pipe G606_G607	36.52	62.2	130	HDPE-PE 100 PN10	0.24	0.08	0.19	0.037
Pipe G608_G603	62.84	62.2	130	HDPE-PE 100 PN10	-0.01	0	0	0
Pipe G608_G606	27.61	62.2	130	HDPE-PE 100 PN10	0.3	0.1	0.29	0.037
Pipe G609_G610	61.11	62.2	130	HDPE-PE 100 PN10	0.54	0.18	0.88	0.033
Pipe G609_G611	56.21	62.2	130	HDPE-PE 100 PN10	-1.88	0.62	8.7	0.028
Pipe G611_G584	19.31	62.2	130	HDPE-PE 100 PN10	-2.22	0.73	11.87	0.027
Pipe G611_G833	30.35	62.2	130	HDPE-PE 100 PN10	0.22	0.07	0.17	0.038

Pipe G612_G582	150.1	62.2	130	HDPE-PE 100 PN10	-0.4	0.13	0.49	0.035
Pipe G612_G613	74.04	62.2	130	HDPE-PE 100 PN10	0.18	0.06	0.11	0.039
Pipe G613_G614	27.4	62.2	130	HDPE-PE 100 PN10	0.3	0.1	0.29	0.036
Pipe G615_G612	59.41	62.2	130	HDPE-PE 100 PN10	0.41	0.14	0.52	0.035
Pipe G615_G613	88.31	62.2	130	HDPE-PE 100 PN10	0.38	0.12	0.44	0.035
Pipe G616_G615	28.06	62.2	130	HDPE-PE 100 PN10	1.08	0.35	3.09	0.03
Pipe G616_G618	17.69	62.2	130	HDPE-PE 100 PN10	0.67	0.22	1.29	0.032
Pipe G618_G617	30.84	62.2	130	HDPE-PE 100 PN10	0.36	0.12	0.41	0.035
Pipe G618_G619	20.96	62.2	130	HDPE-PE 100 PN10	0.24	0.08	0.19	0.037
Pipe G620_G601	108	62.2	130	HDPE-PE 100 PN10	-1.51	0.5	5.83	0.029
Pipe G621_G602	116.8	62.2	130	HDPE-PE 100 PN10	-1.24	0.41	4.03	0.03
Pipe G622_G616	25.39	62.2	130	HDPE-PE 100 PN10	1.86	0.61	8.57	0.028
Pipe G622_G621	116.9	62.2	130	HDPE-PE 100 PN10	-0.8	0.26	1.79	0.032
Pipe G623_G622	23.67	62.2	130	HDPE-PE 100 PN10	1.17	0.39	3.62	0.03
Pipe G623_G832	85.46	62.2	130	HDPE-PE 100 PN10	-0.71	0.23	1.45	0.032
Pipe G624_G620	95.54	62.2	130	HDPE-PE 100 PN10	-0.26	0.09	0.22	0.037
Pipe G625_G626	28.63	62.2	130	HDPE-PE 100 PN10	0.15	0.05	0.08	0.041
Pipe G625_G721	70.58	62.2	130	HDPE-PE 100 PN10	1.39	0.46	5	0.029
Pipe G627_G625	42.22	62.2	130	HDPE-PE 100 PN10	1.78	0.59	7.86	0.028
Pipe G628_G627	4.079	62.2	130	HDPE-PE 100 PN10	1.34	0.44	4.63	0.029
Pipe G628_G717	73.68	62.2	130	HDPE-PE 100 PN10	-0.88	0.29	2.13	0.031
Pipe G629_G624	42.3	62.2	130	HDPE-PE 100 PN10	-0.75	0.25	1.6	0.032
Pipe G629_G630	29.85	62.2	130	HDPE-PE 100 PN10	1.3	0.43	4.41	0.029
Pipe G630_G631	25	62.2	130	HDPE-PE 100 PN10	0.4	0.13	0.48	0.035
Pipe G630_G636	59.32	62.2	130	HDPE-PE 100 PN10	0.73	0.24	1.51	0.032
Pipe G632_G638	9.252	62.2	130	HDPE-PE 100 PN10	1.11	0.37	3.28	0.03
Pipe G633_G632	72.59	62.2	130	HDPE-PE 100 PN10	0.79	0.26	1.74	0.032
Pipe G633_G634	86.1	62.2	130	HDPE-PE 100 PN10	-0.38	0.13	0.45	0.035

Pipe G634_G635	30.48	62.2	130	HDPE-PE 100 PN10	-0.46	0.15	0.63	0.034
Pipe G635_G620	116.4	62.2	130	HDPE-PE 100 PN10	-0.95	0.31	2.46	0.031
Pipe G636_G633	29.32	62.2	130	HDPE-PE 100 PN10	0.64	0.21	1.2	0.033
Pipe G636_G635	91	62.2	130	HDPE-PE 100 PN10	-0.28	0.09	0.26	0.037
Pipe G638_G639	14.87	62.2	130	HDPE-PE 100 PN10	0.42	0.14	0.55	0.035
Pipe G638_G641	31.69	62.2	130	HDPE-PE 100 PN10	0.63	0.21	1.14	0.033
Pipe G639_G637	32.22	62.2	130	HDPE-PE 100 PN10	0.22	0.07	0.17	0.038
Pipe G639_G640	16.6	62.2	130	HDPE-PE 100 PN10	0.1	0.03	0.04	0.047
Pipe G642_G634	170.8	62.2	130	HDPE-PE 100 PN10	0.52	0.17	0.8	0.034
Pipe G642_G826	27.76	62.2	130	HDPE-PE 100 PN10	1.47	0.49	5.55	0.029
Pipe G643_G644	3.81	62.2	130	HDPE-PE 100 PN10	-0.14	0.05	0.08	0.045
Pipe G643_G648	55.65	62.2	130	HDPE-PE 100 PN10	1.17	0.39	3.62	0.03
Pipe G644_G629	140.1	62.2	130	HDPE-PE 100 PN10	0.74	0.24	1.54	0.032
Pipe G645_G628	215.1	62.2	130	HDPE-PE 100 PN10	0.5	0.16	0.74	0.034
Pipe G645_G646	37.46	62.2	130	HDPE-PE 100 PN10	0.31	0.1	0.31	0.036
Pipe G647_G645	28.42	62.2	130	HDPE-PE 100 PN10	1.02	0.34	2.8	0.03
Pipe G648_G647	5.514	62.2	130	HDPE-PE 100 PN10	1.08	0.35	3.1	0.03
Pipe G648_G649	45.95	62.2	130	HDPE-PE 100 PN10	-0.03	0.01	0.01	0.06
Pipe G649_G699	92.8	62.2	130	HDPE-PE 100 PN10	-0.18	0.06	0.11	0.039
Pipe G649_G821	32.49	62.2	130	HDPE-PE 100 PN10	-0.21	0.07	0.16	0.038
Pipe G650_G651	38.68	62.2	130	HDPE-PE 100 PN10	-0.99	0.33	2.68	0.031
Pipe G650_G652	47.61	62.2	130	HDPE-PE 100 PN10	0.28	0.09	0.26	0.037
Pipe G651_G653	37.07	62.2	130	HDPE-PE 100 PN10	0.21	0.07	0.14	0.039
Pipe G654_G651	28.05	62.2	130	HDPE-PE 100 PN10	1.45	0.48	5.4	0.029
Pipe G654_G655	30.19	62.2	130	HDPE-PE 100 PN10	0.19	0.06	0.12	0.038
Pipe G656_G654	45.25	62.2	130	HDPE-PE 100 PN10	1.86	0.61	8.55	0.028
Pipe G656_G777	93.42	62.2	130	HDPE-PE 100 PN10	-0.91	0.3	2.28	0.031
Pipe G657_G087	103.2	62.2	130	HDPE-PE 100 PN10	0.93	0.3	2.34	0.031

Pipe G658_G661	23.16	62.2	130	HDPE-PE 100 PN10	-0.26	0.08	0.22	0.038
Pipe G659_G657	24.93	62.2	130	HDPE-PE 100 PN10	0.51	0.17	0.77	0.034
Pipe G660_G659	58.93	62.2	130	HDPE-PE 100 PN10	0.76	0.25	1.61	0.032
Pipe G660_G661	18.07	62.2	130	HDPE-PE 100 PN10	1.17	0.39	3.62	0.03
Pipe G660_G663	112.8	62.2	130	HDPE-PE 100 PN10	-2.11	0.69	10.78	0.027
Pipe G661_G657	42.9	62.2	130	HDPE-PE 100 PN10	0.63	0.21	1.14	0.033
Pipe G661_G662	9.931	62.2	130	HDPE-PE 100 PN10	0.23	0.08	0.19	0.04
Pipe G664_G663	13.61	62.2	130	HDPE-PE 100 PN10	2.91	0.96	19.54	0.026
Pipe G664_G665	9.153	62.2	130	HDPE-PE 100 PN10	0.27	0.09	0.24	0.038
Pipe G664_G666	68.98	62.2	130	HDPE-PE 100 PN10	-3.24	1.07	23.94	0.026
Pipe G666_G667	76.55	150	110	DI	21.09	1.19	14.34	0.03
Pipe G667_G668	13.59	150	110	DI	21.09	1.19	14.35	0.03
Pipe G668_G670	38.36	62.2	130	HDPE-PE 100 PN10	0.17	0.06	0.1	0.039
Pipe G668_G673	27.4	150	110	DI	21.09	1.19	14.35	0.03
Pipe G669_G667	22.57	62.2	130	HDPE-PE 100 PN10	-0.13	0.04	0.07	0.043
Pipe G671_G672	36.82	62.2	130	HDPE-PE 100 PN10	-0.08	0.03	0.03	0.049
Pipe G672_G679	69.96	150	110	DI	21.09	1.19	14.35	0.03
Pipe G673_G672	26.82	150	110	DI	21.09	1.19	14.34	0.03
Pipe G673_G674	18.61	62.2	130	HDPE-PE 100 PN10	0.1	0.03	0.03	0.038
Pipe G676_G675	32.76	62.2	130	HDPE-PE 100 PN10	0.14	0.05	0.07	0.04
Pipe G676_G677	32.28	62.2	130	HDPE-PE 100 PN10	0.54	0.18	0.86	0.033
Pipe G677_G659	52.39	62.2	130	HDPE-PE 100 PN10	0.01	0	0	0
Pipe G677_G678	62.14	62.2	130	HDPE-PE 100 PN10	0.23	0.08	0.18	0.038
Pipe G679_G676	44.45	62.2	130	HDPE-PE 100 PN10	0.81	0.27	1.81	0.032
Pipe G680_G764	22.48	62.2	130	HDPE-PE 100 PN10	1.61	0.53	6.54	0.028
Pipe G681_G680	39.17	150	110	DI	-8.38	0.47	2.6	0.034
Pipe G682_G681	54.52	150	110	DI	-8.38	0.47	2.6	0.034
Pipe G682_G683	2.67	150	110	DI	8.38	0.47	2.62	0.034
Pipe G683_G684	29.42	150	110	DI	8.38	0.47	2.6	0.034
Pipe G684_G691	106.7	150	110	DI	8.38	0.47	2.6	0.034
Pipe G685_G683	24.71	62.2	130	HDPE-PE 100 PN10	-0.97	0.32	2.54	0.031
Pipe G685_G684	33.17	62.2	130	HDPE-PE 100	0.56	0.19	0.94	0.033

				PN10				
Pipe G686_G681	76.64	62.2	130	HDPE-PE 100 PN10	-1.48	0.49	5.61	0.029
Pipe G686_G682	48.33	62.2	130	HDPE-PE 100 PN10	0.42	0.14	0.55	0.035
Pipe G687_G685	43.09	62.2	130	HDPE-PE 100 PN10	-0.29	0.09	0.27	0.037
Pipe G687_G689	85.31	62.2	130	HDPE-PE 100 PN10	0.32	0.11	0.33	0.036
Pipe G688_G687	11.58	62.2	130	HDPE-PE 100 PN10	0.15	0.05	0.08	0.038
Pipe G688_G690	45.39	62.2	130	HDPE-PE 100 PN10	0.25	0.08	0.21	0.037
Pipe G691_G694	52.38	150	110	DI	8.38	0.47	2.6	0.034
Pipe G692_G691	65.65	62.2	130	HDPE-PE 100 PN10	-0.19	0.06	0.12	0.039
Pipe G693_G705	52.18	150	110	DI	8.38	0.47	2.6	0.034
Pipe G694_G693	7.41	150	110	DI	8.38	0.47	2.59	0.034
Pipe G695_G693	19.32	62.2	130	HDPE-PE 100 PN10	-0.13	0.04	0.06	0.043
Pipe G696_G694	51.49	62.2	130	HDPE-PE 100 PN10	-0.78	0.26	1.72	0.032
Pipe G696_G697	26.6	62.2	130	HDPE-PE 100 PN10	0.19	0.06	0.13	0.039
Pipe G698_G696	42.24	62.2	130	HDPE-PE 100 PN10	-0.43	0.14	0.58	0.035
Pipe G699_G686	63.96	62.2	130	HDPE-PE 100 PN10	-0.88	0.29	2.12	0.031
Pipe G699_G700	40.84	62.2	130	HDPE-PE 100 PN10	0.37	0.12	0.42	0.035
Pipe G701_G647	102.6	62.2	130	HDPE-PE 100 PN10	0.13	0.04	0.07	0.041
Pipe G701_G823	40.84	62.2	130	HDPE-PE 100 PN10	0.33	0.11	0.35	0.036
Pipe G702_G688	217	62.2	130	HDPE-PE 100 PN10	0.51	0.17	0.78	0.034
Pipe G702_G703	37.1	62.2	130	HDPE-PE 100 PN10	-0.24	0.08	0.18	0.038
Pipe G703_G704	36.75	62.2	130	HDPE-PE 100 PN10	0.21	0.07	0.15	0.039
Pipe G703_G705	54.11	62.2	130	HDPE-PE 100 PN10	-0.71	0.23	1.43	0.032
Pipe G705_G707	101.9	150	110	DI	8.38	0.47	2.6	0.034
Pipe G706_G716	78.88	62.2	130	HDPE-PE 100 PN10	1.87	0.61	8.61	0.028
Pipe G706_G726	250.7	150	110	DI	-0.07	0	0	0.1
Pipe G707_G706	4.546	150	110	DI	-0.07	0	0	0
Pipe G707_G708	21.41	62.2	130	HDPE-PE 100 PN10	3.22	1.06	23.55	0.026
Pipe G708_G702	97.1	62.2	130	HDPE-PE 100 PN10	0.42	0.14	0.55	0.035
Pipe G708_G709	3.352	62.2	130	HDPE-PE 100 PN10	2.73	0.9	17.36	0.026
Pipe G709_G824	31.73	62.2	130	HDPE-PE 100	1.14	0.38	3.47	0.03

				PN10				
Pipe G711_G710	20.73	62.2	130	HDPE-PE 100 PN10	0.12	0.04	0.05	0.038
Pipe G711_G717	37.73	62.2	130	HDPE-PE 100 PN10	-0.51	0.17	0.77	0.034
Pipe G712_G627	27.77	62.2	130	HDPE-PE 100 PN10	0.57	0.19	0.95	0.033
Pipe G712_G713	53.22	62.2	130	HDPE-PE 100 PN10	0.14	0.05	0.07	0.041
Pipe G715_G712	20.99	62.2	130	HDPE-PE 100 PN10	0.82	0.27	1.88	0.031
Pipe G715_G714	65.26	62.2	130	HDPE-PE 100 PN10	0.44	0.14	0.58	0.034
Pipe G716_G715	31.21	62.2	130	HDPE-PE 100 PN10	1.36	0.45	4.8	0.029
Pipe G716_G718	38.22	62.2	130	HDPE-PE 100 PN10	0.4	0.13	0.5	0.035
Pipe G717_G709	50.65	62.2	130	HDPE-PE 100 PN10	-1.48	0.49	5.57	0.029
Pipe G719_G711	44.85	62.2	130	HDPE-PE 100 PN10	-0.26	0.08	0.22	0.037
Pipe G720_G088	67.43	62.2	130	HDPE-PE 100 PN10	0.48	0.16	0.7	0.034
Pipe G720_G624	108.3	62.2	130	HDPE-PE 100 PN10	0.73	0.24	1.5	0.032
Pipe G721_G722	16.93	62.2	130	HDPE-PE 100 PN10	0.7	0.23	1.42	0.032
Pipe G721_G725	43.34	62.2	130	HDPE-PE 100 PN10	0.59	0.19	1.01	0.033
Pipe G722_G599	53.41	62.2	130	HDPE-PE 100 PN10	0.32	0.11	0.33	0.036
Pipe G722_G723	31.76	62.2	130	HDPE-PE 100 PN10	0.17	0.06	0.1	0.039
Pipe G725_G724	36.56	62.2	130	HDPE-PE 100 PN10	0.49	0.16	0.73	0.034
Pipe G725_G726	128.8	62.2	130	HDPE-PE 100 PN10	-0.1	0.03	0.04	0.043
Pipe G726_G598	75.12	150	110	DI	-0.07	0	0	0
Pipe G728_G731	264.3	150	110	DI	8.66	0.49	2.76	0.034
Pipe G729_G623	224.1	62.2	130	HDPE-PE 100 PN10	1.08	0.35	3.11	0.03
Pipe G729_G728	133.1	62.2	130	HDPE-PE 100 PN10	-2.61	0.86	16.03	0.026
Pipe G730_G729	26.94	62.2	130	HDPE-PE 100 PN10	-0.6	0.2	1.06	0.033
Pipe G731_G732	121.5	150	110	DI	8.66	0.49	2.76	0.034
Pipe G731_G973	32.82	62.2	130	HDPE-PE 100 PN10	1.47	0.49	5.55	0.029
Pipe G732_G974	20.08	62.2	130	HDPE-PE 100 PN10	0.21	0.07	0.15	0.037
Pipe G734_G733	71.28	62.2	130	HDPE-PE 100 PN10	-2.26	0.74	12.24	0.027
Pipe G734_G735	42.69	62.2	130	HDPE-PE 100 PN10	1.45	0.48	5.37	0.029

Pipe G736_G737	68.78	62.2	130	HDPE-PE 100 PN10	1.62	0.53	6.6	0.028
Pipe G736_G831	151.3	150	110	DI	14.86	0.84	7.51	0.031
Pipe G737_G738	22.49	62.2	130	HDPE-PE 100 PN10	1.08	0.36	3.12	0.03
Pipe G737_G815	12.56	62.2	130	HDPE-PE 100 PN10	0.43	0.14	0.58	0.035
Pipe G738_G968	15.31	62.2	130	HDPE-PE 100 PN10	1.82	0.6	8.24	0.028
Pipe G741_G744	73.1	62.2	130	HDPE-PE 100 PN10	2.12	0.7	10.87	0.027
Pipe G742_G741	1.813	62.2	130	HDPE-PE 100 PN10	0.56	0.18	0.99	0.036
Pipe G743_G744	2.466	62.2	130	HDPE-PE 100 PN10	-1.46	0.48	5.43	0.029
Pipe G743_G746	36.2	62.2	130	HDPE-PE 100 PN10	0.29	0.1	0.28	0.037
Pipe G744_G745	19.07	62.2	130	HDPE-PE 100 PN10	0.49	0.16	0.73	0.034
Pipe G747_G743	57.59	62.2	130	HDPE-PE 100 PN10	-1.09	0.36	3.18	0.03
Pipe G748_G742	28.04	62.2	130	HDPE-PE 100 PN10	1.94	0.64	9.25	0.028
Pipe G749_G738	37.27	62.2	130	HDPE-PE 100 PN10	0.87	0.29	2.1	0.031
Pipe G749_G748	29.31	62.2	130	HDPE-PE 100 PN10	0.85	0.28	2	0.031
Pipe G750_G749	90.39	62.2	130	HDPE-PE 100 PN10	1.89	0.62	8.81	0.028
Pipe G750_G751	70.29	62.2	130	HDPE-PE 100 PN10	0.12	0.04	0.06	0.042
Pipe G751_G752	17.63	62.2	130	HDPE-PE 100 PN10	0.12	0.04	0.05	0.039
Pipe G751_G753	26.96	62.2	130	HDPE-PE 100 PN10	-0.21	0.07	0.15	0.039
Pipe G753_G736	28.55	150	110	DI	14.86	0.84	7.5	0.031
Pipe G754_G753	156	200	110	DI	14.86	0.47	1.85	0.032
Pipe G755_G754	7.62	62.2	130	HDPE-PE 100 PN10	-4.22	1.39	38.93	0.025
Pipe G755_G762	93.26	62.2	130	HDPE-PE 100 PN10	0.82	0.27	1.88	0.031
Pipe G756_G750	37.81	62.2	130	HDPE-PE 100 PN10	2.5	0.82	14.75	0.027
Pipe G756_G755	82.73	62.2	130	HDPE-PE 100 PN10	-3.02	0.99	20.98	0.026
Pipe G756_G760	128.2	62.2	130	HDPE-PE 100 PN10	-1.93	0.63	9.14	0.028
Pipe G757_G756	25.15	62.2	130	HDPE-PE 100 PN10	-2.14	0.7	11.06	0.027
Pipe G757_G758	15.09	62.2	130	HDPE-PE 100 PN10	0.22	0.07	0.16	0.038
Pipe G759_G663	64.13	62.2	130	HDPE-PE 100 PN10	-0.54	0.18	0.86	0.033
Pipe G759_G757	47.83	62.2	130	HDPE-PE 100 PN10	-1.8	0.59	8	0.028

Pipe G759_G783	39.16	62.2	130	HDPE-PE 100 PN10	2.1	0.69	10.67	0.027
Pipe G760_G666	60.84	200	110	DI	28.57	0.91	6.2	0.029
Pipe G761_G760	35.18	200	110	DI	28.57	0.91	6.2	0.029
Pipe G762_G761	33.8	200	110	DI	28.57	0.91	6.2	0.029
Pipe G763_G761	49.79	62.2	130	HDPE-PE 100 PN10	-0.42	0.14	0.53	0.035
Pipe G764_G656	198.1	62.2	130	HDPE-PE 100 PN10	1.33	0.44	4.6	0.029
Pipe G764_G765	20.6	62.2	130	HDPE-PE 100 PN10	0.2	0.07	0.14	0.039
Pipe G766_G062	90.02	62.2	130	HDPE-PE 100 PN10	-0.3	0.1	0.29	0.036
Pipe G767_G020	135.6	62.2	130	HDPE-PE 100 PN10	0.02	0.01	0	0.065
Pipe G767_G766	30.03	62.2	130	HDPE-PE 100 PN10	0.46	0.15	0.63	0.034
Pipe G768_G065	135	62.2	130	HDPE-PE 100 PN10	0.34	0.11	0.36	0.036
Pipe G768_G767	33.73	62.2	130	HDPE-PE 100 PN10	0.89	0.29	2.18	0.031
Pipe G769_G066	134.7	62.2	130	HDPE-PE 100 PN10	0.77	0.25	1.68	0.032
Pipe G769_G768	31.35	62.2	130	HDPE-PE 100 PN10	1.58	0.52	6.31	0.029
Pipe G770_G772	40.1	62.2	130	HDPE-PE 100 PN10	1.24	0.41	4.02	0.03
Pipe G771_G769	39.79	62.2	130	HDPE-PE 100 PN10	2.53	0.83	15.12	0.027
Pipe G771_G772	5.35	150	110	DI	-6.62	0.37	1.67	0.035
Pipe G773_G022	133.9	62.2	130	HDPE-PE 100 PN10	-0.35	0.12	0.4	0.036
Pipe G773_G770	29.77	62.2	130	HDPE-PE 100 PN10	0.79	0.26	1.75	0.032
Pipe G774_G022	137.2	62.2	130	HDPE-PE 100 PN10	-0.03	0.01	0.01	0.053
Pipe G774_G773	32	62.2	130	HDPE-PE 100 PN10	0.76	0.25	1.64	0.032
Pipe G775_G796	36.93	62.2	130	HDPE-PE 100 PN10	0.12	0.04	0.05	0.043
Pipe G776_G747	20.55	62.2	130	HDPE-PE 100 PN10	0.22	0.07	0.16	0.038
Pipe G776_G816	19.01	62.2	130	HDPE-PE 100 PN10	0.24	0.08	0.2	0.038
Pipe G777_G643	170.9	62.2	130	HDPE-PE 100 PN10	1.22	0.4	3.89	0.03
Pipe G777_G778	3.163	62.2	130	HDPE-PE 100 PN10	3.55	1.17	28.18	0.025
Pipe G778_G642	66.56	62.2	130	HDPE-PE 100 PN10	2.34	0.77	13.09	0.027
Pipe G778_G644	171.9	62.2	130	HDPE-PE 100 PN10	1.12	0.37	3.34	0.03
Pipe G779_G507	50	62.2	130	HDPE-PE 100 PN10	0.41	0.13	0.51	0.035

Pipe G780_G505	27.14	62.2	130	HDPE-PE 100 PN10	0.1	0.03	0.04	0.046
Pipe G780_G779	41.76	62.2	130	HDPE-PE 100 PN10	0.65	0.21	1.21	0.033
Pipe G781_G486	195.1	62.2	130	HDPE-PE 100 PN10	-0.29	0.09	0.27	0.037
Pipe G782_G485	187.6	62.2	130	HDPE-PE 100 PN10	-0.74	0.24	1.54	0.032
Pipe G783_G784	12.45	62.2	130	HDPE-PE 100 PN10	0.2	0.07	0.13	0.037
Pipe G783_G785	16.98	62.2	130	HDPE-PE 100 PN10	1.83	0.6	8.26	0.028
Pipe G785_G748	42.31	62.2	130	HDPE-PE 100 PN10	1.33	0.44	4.58	0.029
Pipe G785_G786	33.87	62.2	130	HDPE-PE 100 PN10	0.32	0.11	0.33	0.036
Pipe G788_G021	4.281	62.2	130	HDPE-PE 100 PN10	1.43	0.47	5.21	0.029
Pipe G789_G069	38.48	62.2	130	HDPE-PE 100 PN10	-0.54	0.18	0.87	0.033
Pipe G789_G775	52.87	62.2	130	HDPE-PE 100 PN10	-0.55	0.18	0.9	0.033
Pipe G789_G788	29.94	62.2	130	HDPE-PE 100 PN10	0.99	0.33	2.66	0.031
Pipe G790_G023	59.01	62.2	130	HDPE-PE 100 PN10	-0.34	0.11	0.36	0.036
Pipe G790_G787	78.84	62.2	130	HDPE-PE 100 PN10	0.03	0.01	0.01	0.053
Pipe G790_G791	32.72	62.2	130	HDPE-PE 100 PN10	-0.38	0.13	0.46	0.035
Pipe G791_G080	114.9	62.2	130	HDPE-PE 100 PN10	-0.43	0.14	0.58	0.035
Pipe G792_G061	126.3	150	110	DI	-6.62	0.37	1.68	0.035
Pipe G793_G794	29.68	62.2	130	HDPE-PE 100 PN10	0.07	0.02	0.02	0.043
Pipe G793_G878	3.674	150	110	DI	-6.62	0.37	1.66	0.035
Pipe G796_G797	29.94	62.2	130	HDPE-PE 100 PN10	-0.35	0.11	0.38	0.036
Pipe G797_G800	31.35	62.2	130	HDPE-PE 100 PN10	-0.69	0.23	1.37	0.032
Pipe G799_G800	50.99	62.2	130	HDPE-PE 100 PN10	-0.41	0.13	0.51	0.035
Pipe G799_G801	30.35	62.2	130	HDPE-PE 100 PN10	-0.22	0.07	0.17	0.039
Pipe G800_G804	29.54	62.2	130	HDPE-PE 100 PN10	-1.29	0.42	4.31	0.029
Pipe G982_G788	130	62.2	130	HDPE-PE 100 PN10	0.54	0.18	0.86	0.033
Pipe G802_G027	79.26	62.2	130	HDPE-PE 100 PN10	0.37	0.12	0.43	0.035
Pipe G802_G803	36.74	62.2	130	HDPE-PE 100 PN10	-0.8	0.26	1.77	0.032
Pipe G804_G436	55.08	62.2	130	HDPE-PE 100 PN10	-2.4	0.79	13.65	0.027
Pipe G804_G801	51.18	62.2	130	HDPE-PE 100	1.04	0.34	2.89	0.03

				PN10				
Pipe G805_G803	33.69	62.2	130	HDPE-PE 100 PN10	1.6	0.53	6.46	0.028
Pipe G805_G813	83.49	62.2	130	HDPE-PE 100 PN10	1.12	0.37	3.35	0.03
Pipe G807_G806	27.67	62.2	130	HDPE-PE 100 PN10	0.21	0.07	0.16	0.039
Pipe G808_G080	28.76	62.2	130	HDPE-PE 100 PN10	-0.24	0.08	0.19	0.038
Pipe G809_G808	2.137	62.2	130	HDPE-PE 100 PN10	-0.42	0.14	0.56	0.036
Pipe G810_G073_A	41.43	62.2	130	HDPE-PE 100 PN10	0.39	0.13	0.47	0.035
Pipe G810_G073_B	41.43	62.2	130	HDPE-PE 100 PN10	0.39	0.13	0.47	0.035
Pipe G811_G496	52.76	62.2	130	HDPE-PE 100 PN10	0.57	0.19	0.96	0.033
Pipe G811_G812	10.02	62.2	130	HDPE-PE 100 PN10	-0.78	0.26	1.71	0.032
Pipe G812_G082	26.58	62.2	130	HDPE-PE 100 PN10	-0.54	0.18	0.85	0.033
Pipe G813_G879	83.28	62.2	130	HDPE-PE 100 PN10	0.31	0.1	0.31	0.036
Pipe G814_G740	14.65	62.2	130	HDPE-PE 100 PN10	0.03	0.01	0	0
Pipe G816_G817	5.913	62.2	130	HDPE-PE 100 PN10	0.06	0.02	0.03	0.087
Pipe G816_G819	6.855	62.2	130	HDPE-PE 100 PN10	0.17	0.05	0.11	0.045
Pipe G819_G818	4.104	62.2	130	HDPE-PE 100 PN10	0.03	0.01	0	0
Pipe G819_G820	3.075	62.2	130	HDPE-PE 100 PN10	0.12	0.04	0.05	0.037
Pipe G821_G650	4.712	62.2	130	HDPE-PE 100 PN10	-0.63	0.21	1.14	0.033
Pipe G821_G822	6.134	62.2	130	HDPE-PE 100 PN10	0.37	0.12	0.44	0.036
Pipe G824_G701	67.03	62.2	130	HDPE-PE 100 PN10	0.66	0.22	1.24	0.032
Pipe G824_G825	32.47	62.2	130	HDPE-PE 100 PN10	0.21	0.07	0.16	0.038
Pipe G826_G632	76.62	62.2	130	HDPE-PE 100 PN10	0.83	0.27	1.93	0.031
Pipe G826_G827	9.998	62.2	130	HDPE-PE 100 PN10	0.39	0.13	0.48	0.035
Pipe G830_G831	22.41	62.2	130	HDPE-PE 100 PN10	-0.48	0.16	0.7	0.034
Pipe G831_G086	48.76	150	110	DI	14.86	0.84	7.5	0.031
Pipe G832_G621	95.93	62.2	130	HDPE-PE 100 PN10	0	0	0	0
Pipe G832_G747	242.3	62.2	130	HDPE-PE 100 PN10	-1.14	0.37	3.43	0.03
Pipe G834_G406	44.32	62.2	130	HDPE-PE 100 PN10	-0.65	0.21	1.21	0.033
Pipe G836_G035	226.7	62.2	130	HDPE-PE 100	0.14	0.05	0.07	0.041

				PN10				
Pipe G836_G837	35.63	62.2	130	HDPE-PE 100 PN10	0.95	0.31	2.46	0.031
Pipe G838_G036	52	150	110	DI	11.75	0.66	4.85	0.032
Pipe G838_G840	19.89	62.2	130	HDPE-PE 100 PN10	-0.54	0.18	0.86	0.033
Pipe G840_G842	18.48	62.2	130	HDPE-PE 100 PN10	-0.67	0.22	1.3	0.032
Pipe G840_G846	15.79	62.2	130	HDPE-PE 100 PN10	0.09	0.03	0.03	0.041
Pipe G842_G401	18.06	62.2	130	HDPE-PE 100 PN10	-0.82	0.27	1.89	0.031
Pipe G842_G844	13.16	62.2	130	HDPE-PE 100 PN10	0.09	0.03	0.02	0.03
Pipe G848_G393	91.31	62.2	130	HDPE-PE 100 PN10	2.13	0.7	11.02	0.027
Pipe G848_G969	183.2	150	110	DI	-11.75	0.66	4.86	0.032
Pipe G851_G278	23.2	62.2	130	HDPE-PE 100 PN10	1.16	0.38	3.59	0.03
Pipe G851_G850	14.96	62.2	130	HDPE-PE 100 PN10	0.15	0.05	0.08	0.039
Pipe G852_G279	40.81	150	110	DI	16.2	0.92	8.8	0.031
Pipe G852_G853	12.57	62.2	130	HDPE-PE 100 PN10	0.13	0.04	0.06	0.041
Pipe G854_G855	60.99	62.2	130	HDPE-PE 100 PN10	0.48	0.16	0.71	0.034
Pipe G854_G856	36	62.2	130	HDPE-PE 100 PN10	-0.32	0.11	0.33	0.036
Pipe G856_G857	27.33	62.2	130	HDPE-PE 100 PN10	0.31	0.1	0.31	0.036
Pipe G856_G858	25.98	62.2	130	HDPE-PE 100 PN10	-0.8	0.26	1.8	0.032
Pipe G858_G859	15.59	62.2	130	HDPE-PE 100 PN10	0.08	0.02	0.03	0.056
Pipe G858_G860	14.25	62.2	130	HDPE-PE 100 PN10	-0.93	0.31	2.38	0.031
Pipe G860_G861	32.01	62.2	130	HDPE-PE 100 PN10	0.58	0.19	0.98	0.033
Pipe G860_G865	29.09	62.2	130	HDPE-PE 100 PN10	-1.59	0.52	6.35	0.029
Pipe G862_G864	17.84	62.2	130	HDPE-PE 100 PN10	0.24	0.08	0.2	0.038
Pipe G863_G862	17.47	62.2	130	HDPE-PE 100 PN10	-0.36	0.12	0.41	0.036
Pipe G865_G454	44.87	62.2	130	HDPE-PE 100 PN10	-2.48	0.81	14.51	0.027
Pipe G865_G862	34.84	62.2	130	HDPE-PE 100 PN10	0.75	0.25	1.59	0.032
Pipe G868_G869	69.7	62.2	130	HDPE-PE 100 PN10	0.35	0.12	0.39	0.036
Pipe G868_G966	16.13	62.2	130	HDPE-PE 100 PN10	0.07	0.02	0.02	0.039
Pipe G869_G419	16.81	62.2	130	HDPE-PE 100 PN10	0.09	0.03	0.04	0.048

Pipe G869_G870	11.63	62.2	130	HDPE-PE 100 PN10	0.17	0.06	0.1	0.039
Pipe G872_G442	9.399	62.2	130	HDPE-PE 100 PN10	0.1	0.03	0.03	0.035
Pipe G872_G873	15.81	62.2	130	HDPE-PE 100 PN10	0.13	0.04	0.06	0.038
Pipe G874_G781	25.64	62.2	130	HDPE-PE 100 PN10	-0.32	0.1	0.33	0.037
Pipe G875_G877	111.3	150	110	DI	-6.62	0.37	1.68	0.035
Pipe G877_G793	36.48	150	110	DI	-6.62	0.37	1.68	0.035
Pipe G877_G876	30.64	62.2	130	HDPE-PE 100 PN10	0.2	0.07	0.14	0.039
Pipe G878_G792	48.22	150	110	DI	-6.62	0.37	1.68	0.035
Pipe G878_G795	56.3	62.2	130	HDPE-PE 100 PN10	0.22	0.07	0.16	0.038
Pipe G879_G445	49.19	62.2	130	HDPE-PE 100 PN10	-0.48	0.16	0.7	0.034
Pipe G880_G028	34.16	62.2	130	HDPE-PE 100 PN10	-0.66	0.22	1.24	0.032
Pipe G880_G811	27.19	62.2	130	HDPE-PE 100 PN10	-0.12	0.04	0.05	0.04
Pipe G881_G792	71.04	62.2	130	HDPE-PE 100 PN10	-0.53	0.18	0.84	0.033
Pipe G881_G882	14.85	62.2	130	HDPE-PE 100 PN10	0.28	0.09	0.25	0.037
Pipe G883_G807	7.851	62.2	130	HDPE-PE 100 PN10	-0.11	0.04	0.06	0.05
Pipe G883_G809	29.71	62.2	130	HDPE-PE 100 PN10	0.27	0.09	0.24	0.037
Pipe G884_G500	21.58	62.2	130	HDPE-PE 100 PN10	0.17	0.05	0.1	0.039
Pipe G884_G885	8.711	62.2	130	HDPE-PE 100 PN10	0.24	0.08	0.19	0.038
Pipe G886_G463	40.74	62.2	130	HDPE-PE 100 PN10	-0.18	0.06	0.11	0.039
Pipe G888_G315	10.91	62.2	130	HDPE-PE 100 PN10	0.3	0.1	0.29	0.036
Pipe G888_G889	14.03	62.2	130	HDPE-PE 100 PN10	0.13	0.04	0.06	0.039
Pipe G892_G015	30.47	62.2	130	HDPE-PE 100 PN10	-2.12	0.7	10.93	0.027
Pipe G892_G259	119.9	62.2	130	HDPE-PE 100 PN10	0.58	0.19	0.98	0.033
Pipe G894_G892	45.2	62.2	130	HDPE-PE 100 PN10	-1.27	0.42	4.23	0.029
Pipe G894_G896	11.22	62.2	130	HDPE-PE 100 PN10	0.27	0.09	0.24	0.036
Pipe G898_G361	27.27	62.2	130	HDPE-PE 100 PN10	-0.1	0.03	0.04	0.045
Pipe G899_G985	46.46	62.2	130	HDPE-PE 100 PN10	-0.73	0.24	1.52	0.032
Pipe G900_G054	29.57	62.2	130	HDPE-PE 100 PN10	-2.39	0.79	13.58	0.027
Pipe G900_G899	57.9	62.2	130	HDPE-PE 100 PN10	1.74	0.57	7.54	0.028

Pipe G901_G902	5.078	62.2	130	HDPE-PE 100 PN10	0.08	0.03	0.03	0.05
Pipe G901_G903	6.092	62.2	130	HDPE-PE 100 PN10	0.27	0.09	0.24	0.037
Pipe G904_G905	41.24	62.2	130	HDPE-PE 100 PN10	1.18	0.39	3.66	0.03
Pipe G904_G912	64.05	62.2	130	HDPE-PE 100 PN10	-4.41	1.45	42.23	0.024
Pipe G905_G906	23.14	62.2	130	HDPE-PE 100 PN10	0.63	0.21	1.16	0.033
Pipe G905_G907	9.48	62.2	130	HDPE-PE 100 PN10	0.46	0.15	0.63	0.034
Pipe G907_G908	8.905	62.2	130	HDPE-PE 100 PN10	0.03	0.01	0	0
Pipe G907_G909	11.12	62.2	130	HDPE-PE 100 PN10	0.39	0.13	0.48	0.035
Pipe G909_G910	8.501	62.2	130	HDPE-PE 100 PN10	0.02	0.01	0	0
Pipe G909_G911	9.521	62.2	130	HDPE-PE 100 PN10	0.35	0.12	0.39	0.035
Pipe G912_G913	33.42	62.2	130	HDPE-PE 100 PN10	0.05	0.02	0.01	0.056
Pipe G912_G914	18.2	62.2	130	HDPE-PE 100 PN10	-4.82	1.59	49.78	0.024
Pipe G914_G918	27.17	62.2	130	HDPE-PE 100 PN10	0.12	0.04	0.06	0.043
Pipe G915_G914	37.41	62.2	130	HDPE-PE 100 PN10	-0.64	0.21	1.18	0.033
Pipe G915_G917	10.43	62.2	130	HDPE-PE 100 PN10	0.05	0.01	0.01	0.079
Pipe G916_G915	15.52	62.2	130	HDPE-PE 100 PN10	-0.5	0.16	0.74	0.034
Pipe G918_G919	33.24	62.2	130	HDPE-PE 100 PN10	0.37	0.12	0.42	0.035
Pipe G984_G922	43	62.2	130	HDPE-PE 100 PN10	-1.33	0.44	4.57	0.029
Pipe G920_G365	31.6	62.2	130	HDPE-PE 100 PN10	2.33	0.77	12.96	0.027
Pipe G920_G921	15.43	62.2	130	HDPE-PE 100 PN10	0.22	0.07	0.17	0.039
Pipe G922_G011	4.969	62.2	130	HDPE-PE 100 PN10	-1.61	0.53	6.56	0.028
Pipe G923_G922	41.29	62.2	130	HDPE-PE 100 PN10	-0.2	0.07	0.14	0.039
Pipe G924_G925	8.64	62.2	130	HDPE-PE 100 PN10	0.54	0.18	0.88	0.033
Pipe G925_G927	10.62	62.2	130	HDPE-PE 100 PN10	0.17	0.06	0.1	0.037
Pipe G925_G928	45.25	62.2	130	HDPE-PE 100 PN10	0.29	0.1	0.27	0.036
Pipe G926_G924	10.84	62.2	130	HDPE-PE 100 PN10	-0.63	0.21	1.14	0.033
Pipe G929_G900	18.24	62.2	130	HDPE-PE 100 PN10	-0.52	0.17	0.8	0.034
Pipe G930_G929	32.17	62.2	130	HDPE-PE 100 PN10	-1.56	0.51	6.2	0.029

Pipe G930_G931	15.83	62.2	130	HDPE-PE 100 PN10	0.1	0.03	0.05	0.05
Pipe G932_G930	16.44	62.2	130	HDPE-PE 100 PN10	-1.32	0.43	4.53	0.029
Pipe G932_G933	16.12	62.2	130	HDPE-PE 100 PN10	0.55	0.18	0.88	0.033
Pipe G934_G932	7.514	62.2	130	HDPE-PE 100 PN10	-0.71	0.23	1.43	0.032
Pipe G935_G179	9.963	62.2	130	HDPE-PE 100 PN10	0.02	0.01	0	0
Pipe G935_G899	190.7	62.2	130	HDPE-PE 100 PN10	-1.58	0.52	6.33	0.029
Pipe G936_G222	31.99	62.2	130	HDPE-PE 100 PN10	0.02	0.01	0	0
Pipe G936_G937	20.43	62.2	130	HDPE-PE 100 PN10	0.15	0.05	0.08	0.041
Pipe G938_G010	167.7	62.2	130	HDPE-PE 100 PN10	2.58	0.85	15.62	0.027
Pipe G939_G207	18.33	62.2	130	HDPE-PE 100 PN10	1.95	0.64	9.36	0.028
Pipe G939_G940	17.68	62.2	130	HDPE-PE 100 PN10	0.07	0.02	0.02	0.044
Pipe G941_G204	34.34	62.2	130	HDPE-PE 100 PN10	-0.63	0.21	1.15	0.033
Pipe G941_G205	22.33	62.2	130	HDPE-PE 100 PN10	0.18	0.06	0.11	0.039
Pipe G942_G196	7.034	62.2	130	HDPE-PE 100 PN10	-0.12	0.04	0.04	0.035
Pipe G942_G943	18.32	62.2	130	HDPE-PE 100 PN10	0.28	0.09	0.26	0.037
Pipe G946_G947	10.79	62.2	130	HDPE-PE 100 PN10	0.06	0.02	0.01	0.045
Pipe G946_G948	11.48	62.2	130	HDPE-PE 100 PN10	0.05	0.02	0	0
Pipe G947_G954	5.746	62.2	130	HDPE-PE 100 PN10	0.02	0.01	0	0
Pipe G948_G949	28.8	62.2	130	HDPE-PE 100 PN10	-0.33	0.11	0.35	0.036
Pipe G949_G161	44.63	62.2	130	HDPE-PE 100 PN10	-1.11	0.37	3.29	0.03
Pipe G951_G122	30.3	62.2	130	HDPE-PE 100 PN10	-0.11	0.04	0.05	0.045
Pipe G953_G947	6.45	62.2	130	HDPE-PE 100 PN10	-0.02	0.01	0	0
Pipe G955_G161	26.68	62.2	130	HDPE-PE 100 PN10	0.16	0.05	0.09	0.039
Pipe G955_G956	10.87	62.2	130	HDPE-PE 100 PN10	0.28	0.09	0.26	0.037
Pipe G958_G959	13.26	62.2	130	HDPE-PE 100 PN10	0.47	0.16	0.67	0.034
Pipe G958_G960	17.78	62.2	130	HDPE-PE 100 PN10	0.07	0.02	0.02	0.039
Pipe G961_G938	78.73	62.2	130	HDPE-PE 100 PN10	-2.89	0.95	19.28	0.026
Pipe G961_G958	22	62.2	130	HDPE-PE 100 PN10	0.59	0.2	1.03	0.033

Pipe G963_G131	22.39	62.2	130	HDPE-PE 100 PN10	-0.55	0.18	0.91	0.033
Pipe G964_G143	11.49	62.2	130	HDPE-PE 100 PN10	-0.19	0.06	0.13	0.039
Pipe G968_G739	16.02	62.2	130	HDPE-PE 100 PN10	0.04	0.01	0.01	0.074
Pipe G814_G741	15	62.2	130	HDPE-PE 100 PN10	1.65	0.54	6.85	0.028
Pipe G969_G035	85.86	150	110	DI	-11.75	0.66	4.86	0.032
Pipe G969_G971	38.75	62.2	130	HDPE-PE 100 PN10	1.22	0.4	3.88	0.03
Pipe G974_G582	235.2	62.2	130	HDPE-PE 100 PN10	-0.63	0.21	1.15	0.033
Pipe G974_G975	38.61	62.2	130	HDPE-PE 100 PN10	0.62	0.2	1.1	0.033
Pipe G976_G977	37.64	62.2	130	HDPE-PE 100 PN10	1.95	0.64	9.32	0.028
Pipe G976_G978	20.65	62.2	130	HDPE-PE 100 PN10	1.05	0.34	2.94	0.03
Pipe G977_G380	239.7	62.2	130	HDPE-PE 100 PN10	0.06	0.02	0.01	0.047
Pipe G977_G979	20.27	62.2	130	HDPE-PE 100 PN10	0.35	0.11	0.38	0.036
Pipe G980_G590	109.6	150	110	DI	10.25	0.58	3.77	0.033
Pipe G980_G981	21.8	62.2	130	HDPE-PE 100 PN10	0.83	0.27	1.94	0.031
Pipe G982_G983	3.559	62.2	130	HDPE-PE 100 PN10	0.11	0.04	0.04	0.039
Pipe G984_G049	9.768	62.2	130	HDPE-PE 100 PN10	0.08	0.03	0.02	0.028
Pipe G985_G938	114.5	62.2	130	HDPE-PE 100 PN10	-1.75	0.58	7.64	0.028
Pipe G986_G734	194.5	62.2	130	HDPE-PE 100 PN10	-2.28	0.75	12.49	0.027
Pipe 1	470	1000	110	DI	704.25	0.9	0.92	0.023
Pipe 2	50	500	110	DI	104.7	0.53	0.79	0.027
Pipe 3	1300	900	110	DI	599.55	0.94	1.14	0.023
Pipe 4	40.9	200	110	DI	28.57	0.91	6.2	0.029
Pipe 5	80.51	200	110	DI	23.11	0.74	4.19	0.03
Pipe 6	625.9	400	110	DI	105.3	0.84	2.37	0.027
Pipe 7	47.12	300	110	DI	105.3	1.49	9.64	0.026
Pipe 8	50	300	110	DI	61.98	0.88	3.61	0.028
Pipe 9	978.5	600	110	DI	283.18	1	2.06	0.024
Pipe G399_G395	17	62.2	130	HDPE-PE 100 PN10	2.95	0.97	20.1	0.026
Pipe G918_G984	80	62.2	130	HDPE-PE 100 PN10	-0.74	0.24	1.57	0.032
Pipe G814_G968	1.7	62.2	130	HDPE-PE 100 PN10	-1.72	0.57	7.44	0.028
Pipe G983_G802	30	62.2	130	HDPE-PE 100 PN10	-0.28	0.09	0.26	0.037
Pipe 10	30	62.2	130	HDPE-PE 100 PN10	-0.75	0.25	1.59	0.032

Pipe G039_G053	324	150	110	DI	-17.97	1.02	10.67	0.03
Pipe 12	33.66	62.2	130	HDPE-PE 100 PN10	1.73	0.57	7.48	0.028
Pipe 13	35.54	62.2	130	HDPE-PE 100 PN10	1.21	0.4	3.86	0.03
Pipe 14	61.24	62.2	130	HDPE-PE 100 PN10	-0.91	0.3	2.29	0.031
Pipe 15	76.36	62.2	130	HDPE-PE 100 PN10	2.96	0.97	20.22	0.026
Pipe 16	13.73	62.2	130	HDPE-PE 100 PN10	2.66	0.88	16.62	0.026
Pipe 17	27.4	62.2	130	HDPE-PE 100 PN10	2.4	0.79	13.73	0.027
Pipe 18	26.21	62.2	130	HDPE-PE 100 PN10	2.2	0.73	11.7	0.027
Pipe 19	70.93	62.2	130	HDPE-PE 100 PN10	1.96	0.64	9.38	0.028
Pipe 21	39.56	62.2	130	HDPE-PE 100 PN10	3.58	1.18	28.67	0.025
Pipe 22	54.25	62.2	130	HDPE-PE 100 PN10	1.85	0.61	8.42	0.028
Pipe 24	28.71	62.2	130	HDPE-PE 100 PN10	1.11	0.36	3.27	0.03
Pipe 25	107.7	62.2	130	HDPE-PE 100 PN10	1.36	0.45	4.8	0.029
Pipe 28	52.4	62.2	130	HDPE-PE 100 PN10	-0.23	0.08	0.18	0.038
Pipe 29	102.2	62.2	130	HDPE-PE 100 PN10	-1.34	0.44	4.63	0.029
Pipe 31	250.1	62.2	130	HDPE-PE 100 PN10	1.6	0.53	6.47	0.028
Pipe 32	76.45	62.2	130	HDPE-PE 100 PN10	0.98	0.32	2.62	0.031
Pipe 33	101.1	62.2	130	HDPE-PE 100 PN10	-0.3	0.1	0.3	0.037
Pipe 34	49.25	62.2	130	HDPE-PE 100 PN10	-0.3	0.1	0.29	0.036
Pipe 36	157.1	62.2	130	HDPE-PE 100 PN10	2.7	0.89	16.99	0.026
Pipe 37	47.08	62.2	130	HDPE-PE 100 PN10	2.06	0.68	10.35	0.027
Pipe 38	78.01	62.2	130	HDPE-PE 100 PN10	1.08	0.35	3.11	0.03
Pipe 39	110.1	62.2	130	HDPE-PE 100 PN10	-0.1	0.03	0.04	0.042
Pipe 40	198.8	62.2	130	HDPE-PE 100 PN10	-1.52	0.5	5.87	0.029
Pipe 41	93.99	62.2	130	HDPE-PE 100 PN10	2.73	0.9	17.41	0.026
Pipe 42	28.41	62.2	130	HDPE-PE 100 PN10	0.12	0.04	0.05	0.043
Pipe 43	144.4	62.2	130	HDPE-PE 100 PN10	-0.52	0.17	0.82	0.034
Pipe 45	149.3	62.2	130	HDPE-PE 100 PN10	2.73	0.9	17.41	0.026

Pipe 47	272.7	62.2	130	HDPE-PE 100 PN10	1.04	0.34	2.91	0.03
Pipe 48	127.7	62.2	130	HDPE-PE 100 PN10	-0.24	0.08	0.2	0.038
Pipe 49	48.22	62.2	130	HDPE-PE 100 PN10	-1.12	0.37	3.36	0.03
Pipe 51	35.91	62.2	130	HDPE-PE 100 PN10	-1.54	0.51	6.02	0.029
Pipe 52	111.5	62.2	130	HDPE-PE 100 PN10	-1.88	0.62	8.72	0.028
Pipe 53	38.8	62.2	130	HDPE-PE 100 PN10	-2.24	0.74	12.02	0.027
Pipe 55	162.1	62.2	130	HDPE-PE 100 PN10	1.39	0.46	4.99	0.029
Pipe 56	69.41	62.2	130	HDPE-PE 100 PN10	0.48	0.16	0.69	0.034
Pipe 76	329.4	62.2	130	HDPE-PE 100 PN10	1.12	0.37	3.33	0.03
Pipe 77	265.4	62.2	130	HDPE-PE 100 PN10	-1.64	0.54	6.77	0.028
Pipe 78	323.2	62.2	130	HDPE-PE 100 PN10	-3.57	1.18	28.59	0.025
Pipe 80	191.5	62.2	130	HDPE-PE 100 PN10	-1.02	0.33	2.78	0.03
Pipe 82	102.1	62.2	130	HDPE-PE 100 PN10	-0.45	0.15	0.61	0.034
Pipe 84	37.61	62.2	130	HDPE-PE 100 PN10	4.33	1.43	40.91	0.025
Pipe 85	92.39	62.2	130	HDPE-PE 100 PN10	2.62	0.86	16.06	0.026
Pipe 87	153.7	62.2	130	HDPE-PE 100 PN10	1.06	0.35	3.04	0.03
Pipe 89	220.4	62.2	130	HDPE-PE 100 PN10	-1.09	0.36	3.17	0.03
Pipe 90	87.84	62.2	130	HDPE-PE 100 PN10	-2.74	0.9	17.48	0.026
Pipe 91	109.1	62.2	130	HDPE-PE 100 PN10	-3.28	1.08	24.37	0.026
Pipe 92	50.79	62.2	130	HDPE-PE 100 PN10	-3.6	1.18	28.98	0.025
Pipe 93	51.98	62.2	130	HDPE-PE 100 PN10	-3.16	1.04	22.82	0.026
Pipe 94	164.9	62.2	130	HDPE-PE 100 PN10	0.55	0.18	0.91	0.033
Pipe 95	236.1	62.2	130	HDPE-PE 100 PN10	-2.66	0.88	16.58	0.026
Pipe 97	121.4	62.2	130	HDPE-PE 100 PN10	-0.29	0.1	0.27	0.037
Pipe 98	263.2	62.2	130	HDPE-PE 100 PN10	-2.33	0.77	12.97	0.027
Pipe 99	111.4	62.2	130	HDPE-PE 100 PN10	0.83	0.27	1.93	0.031
Pipe 100	47.77	62.2	130	HDPE-PE 100 PN10	0.22	0.07	0.17	0.039
Pipe 101	151.7	62.2	130	HDPE-PE 100 PN10	-0.48	0.16	0.7	0.034

Pipe 102	28.26	62.2	130	HDPE-PE 100 PN10	-2.28	0.75	12.41	0.027
Pipe 103	156.1	62.2	130	HDPE-PE 100 PN10	-2.66	0.88	16.59	0.026
Pipe 104	117	62.2	130	HDPE-PE 100 PN10	1.24	0.41	4.03	0.03
Pipe 105	29.67	62.2	130	HDPE-PE 100 PN10	-0.77	0.25	1.67	0.032
Pipe 106	29.69	62.2	130	HDPE-PE 100 PN10	-1.5	0.49	5.7	0.029
Pipe 107	64.73	62.2	130	HDPE-PE 100 PN10	-2.78	0.91	17.97	0.026
Pipe 108	63.95	62.2	130	HDPE-PE 100 PN10	3.9	1.28	33.73	0.025
Pipe 109	23.16	62.2	130	HDPE-PE 100 PN10	3.51	1.16	27.75	0.025
Pipe 110	89.16	62.2	130	HDPE-PE 100 PN10	1.95	0.64	9.33	0.028
Pipe 111	61.07	62.2	130	HDPE-PE 100 PN10	1.25	0.41	4.11	0.03
Pipe 112	63.01	62.2	130	HDPE-PE 100 PN10	0.47	0.15	0.66	0.034
Pipe 113	84.86	62.2	130	HDPE-PE 100 PN10	-0.1	0.03	0.04	0.042
Pipe 23	3.55	62.2	130	HDPE-PE 100 PN10	-4.25	1.4	39.45	0.025
Pipe 27	80	62.2	130	HDPE-PE 100 PN10	0	0	0	0
Pipe 35	20	62.2	130	HDPE-PE 100 PN10	0	0	0	0
Pipe 69	13.88	400	110	DI	94.9	0.76	1.96	0.027
Pipe 71	393	250	110	DI	43.22	0.88	4.5	0.028
Pipe 74	471.3	250	110	DI	43.22	0.88	4.5	0.028
Pipe 75	473.6	250	110	DI	43.22	0.88	4.5	0.028
Pipe 81	810	150	110	DI	21.97	1.24	15.48	0.029
Pipe 86	143.1	550	110	DI	222.63	0.94	2.01	0.025
Pipe 88	529.2	400	110	DI	153.09	1.22	4.75	0.025
Pipe 96	312.3	400	110	DI	153.09	1.22	4.75	0.025
Pipe 116	254.4	200	110	DI	48.97	1.56	16.82	0.027
Pipe 117	253.6	400	110	DI	153.09	1.22	4.75	0.025
Pipe 120	99.46	62.2	130	HDPE-PE 100 PN10	0.49	0.16	0.73	0.034
Pipe 46	102.5	300	110	DI	113.54	1.61	11.08	0.025
Pipe 58	154.1	500	110	DI	159.48	0.81	1.73	0.026
Pipe 59	33.66	250	110	DI	54.18	1.1	6.84	0.028
Pipe 60	79.05	62.2	130	HDPE-PE 100 PN10	2.27	0.75	12.4	0.027
Pipe 61	78.06	62.2	130	HDPE-PE 100 PN10	1.2	0.39	3.78	0.03
Pipe 62	85.14	62.2	130	HDPE-PE 100 PN10	2.05	0.67	10.21	0.027
Pipe 63	20.65	62.2	130	HDPE-PE 100	1.64	0.54	6.75	0.028

				PN10				
Pipe 64	40.42	62.2	130	HDPE-PE 100 PN10	1.49	0.49	5.66	0.029
Pipe 26	52.61	62.2	130	HDPE-PE 100 PN10	0.93	0.31	2.37	0.031
Pipe 11	20.19	150	110	DI	8.58	0.49	2.71	0.034
Pipe 66	310.3	150	110	DI	8.58	0.49	2.71	0.034
Pipe 67	64	150	110	DI	8.58	0.49	2.71	0.034
Pipe 68	26.2	150	110	DI	8.58	0.49	2.72	0.034
Pipe 70	253.6	150	110	DI	0.07	0	0	0.099
Pipe 72	74.95	150	110	DI	0.07	0	0	0
Pipe 73	7.33	150	110	DI	-8.38	0.47	2.6	0.034
Pipe 114	1.07	150	110	DI	8.25	0.47	2.5	0.034
Pipe 115	1.56	150	110	DI	8.45	0.48	2.67	0.034
Pipe 118	4.17	62.2	130	HDPE-PE 100 PN10	-3.67	1.21	30.12	0.025
Pipe 119	2.6	62.2	130	HDPE-PE 100 PN10	-2.14	0.7	11.05	0.027
Pipe 121	3.61	62.2	130	HDPE-PE 100 PN10	-5.27	1.74	58.87	0.024
Pipe 122	2.46	150	110	DI	6.21	0.35	1.45	0.035
Pipe 123	2.26	62.2	130	HDPE-PE 100 PN10	3.99	1.31	35.17	0.025
Pipe 124	1.46	150	110	DI	-8.5	0.48	2.65	0.034
Pipe 125	70.28	150	110	DI	19.52	1.1	12.43	0.03
Pipe 126	246.7	150	110	DI	17.27	0.98	9.91	0.031
Pipe 127	171.6	150	110	DI	14.02	0.79	6.73	0.032
Pipe 128	76.25	150	110	DI	14.02	0.79	6.73	0.032
Pipe 129	122.2	150	110	DI	11.3	0.64	4.52	0.033
Pipe 130	172.5	150	110	DI	11.3	0.64	4.52	0.033
Pipe 131	44.62	150	110	DI	6.55	0.37	1.64	0.035
Pipe 132	75.83	150	110	DI	6.55	0.37	1.65	0.035
Pipe 133	186.8	150	110	DI	6.55	0.37	1.65	0.035
Pipe 134	307.2	150	110	DI	6.56	0.37	1.65	0.035
Pipe 135	154.3	150	110	DI	6.56	0.37	1.65	0.035
Pipe 136	142	150	110	DI	6.56	0.37	1.65	0.035
Pipe 137	54.88	150	110	DI	6.56	0.37	1.65	0.035
Pipe 138	66.65	150	110	DI	3.08	0.17	0.41	0.039
Pipe 139	37.98	150	110	DI	3.08	0.17	0.4	0.039
Pipe 140	109.7	150	110	DI	3.08	0.17	0.41	0.039
Pipe 141	149.4	150	110	DI	3.08	0.17	0.41	0.039
Pipe 142	124	150	110	DI	-5.21	0.3	1.08	0.036
Pipe 143	48.9	150	110	DI	-5.21	0.3	1.08	0.036
Pipe 144	171.8	150	110	DI	-5.21	0.3	1.08	0.036
Pipe 145	71.98	150	110	DI	-5.21	0.3	1.08	0.037
Pipe 146	28.33	62.2	130	HDPE-PE 100 PN10	1.88	0.62	8.73	0.028

Pipe 147	4.45	62.2	130	HDPE-PE 100 PN10	1.23	0.41	4.01	0.03
Pipe 148	1.66	150	110	DI	-5.37	0.3	1.17	0.037
Pipe 149	1.1	150	110	DI	2.25	0.13	0.27	0.049
Pipe 150	1.31	150	110	DI	3.26	0.18	0.45	0.039
Pipe 151	1.78	150	110	DI	2.71	0.15	0.33	0.042
Pipe 152	1.24	150	110	DI	4.75	0.27	0.96	0.039
Pipe 153	1.7	150	110	DI	-0.01	0	0	0
Pipe 154	1.15	150	110	DI	3.48	0.2	0.52	0.039
Pipe 155	1.32	150	110	DI	8.29	0.47	2.59	0.035
Pipe 156	0.96	150	110	DI	6.54	0.37	1.71	0.037
Pipe 157	57.93	150	110	DI	6.08	0.34	1.43	0.036
Pipe 158	175.3	150	110	DI	6.08	0.34	1.44	0.036
Pipe 159	120.5	150	110	DI	6.08	0.34	1.44	0.036
Pipe 160	54.34	150	110	DI	6.08	0.34	1.44	0.036
Pipe 161	132.3	150	110	DI	6.08	0.34	1.44	0.036
Pipe 162	47.5	150	110	DI	6.08	0.34	1.44	0.036
Pipe 163	47.1	150	110	DI	6.08	0.34	1.43	0.036
Pipe 164	79.66	150	110	DI	6.08	0.34	1.43	0.036
Pipe 165	60.83	150	110	DI	6.08	0.34	1.44	0.036
Pipe 166	36.37	150	110	DI	6.08	0.34	1.44	0.036
Pipe 167	76.1	150	110	DI	6.08	0.34	1.44	0.036
Pipe 168	115.7	150	110	DI	6.08	0.34	1.43	0.036
Pipe 169	53.23	150	110	DI	6.08	0.34	1.43	0.036
Pipe 170	205.7	150	110	DI	6.08	0.34	1.44	0.036
Pipe 171	1.9	150	110	DI	4.91	0.28	0.94	0.036
Pipe 172	2.24	150	110	DI	7.35	0.42	2.06	0.035
Pipe 173	0.92	150	110	DI	8.99	0.51	2.91	0.033
Pipe 174	1.7	150	110	DI	2.97	0.17	0.35	0.036
Pipe 175	185.1	150	110	DI	12.57	0.71	5.5	0.032
Pipe 176	39.34	150	110	DI	12.57	0.71	5.5	0.032
Pipe 177	127.4	150	110	DI	12.57	0.71	5.5	0.032
Pipe 178	42.2	150	110	DI	3.77	0.21	0.59	0.038
Pipe 179	19.46	150	110	DI	3.77	0.21	0.59	0.038
Pipe 180	36.91	150	110	DI	3.77	0.21	0.59	0.038
Pipe 181	23.74	150	110	DI	3.77	0.21	0.59	0.038
Pipe 182	60.4	150	110	DI	3.77	0.21	0.59	0.038
Pipe 183	175.9	150	110	DI	3.77	0.21	0.59	0.038
Pipe 184	30.49	150	110	DI	3.77	0.21	0.6	0.039
Pipe 185	31.18	150	110	DI	3.77	0.21	0.59	0.038
Pipe 186	193	150	110	DI	3.77	0.21	0.59	0.038
Pipe 187	135.2	150	110	DI	2.48	0.14	0.27	0.041
Pipe 188	13.81	150	110	DI	2.48	0.14	0.27	0.04
Pipe 189	68.41	150	110	DI	-4.03	0.23	0.67	0.038

Pipe 190	3.47	150	110	DI	8.44	0.48	2.66	0.034
Pipe 191	118.3	150	110	DI	4.49	0.25	0.82	0.037
Pipe 192	132.7	150	110	DI	4.49	0.25	0.82	0.037
Pipe 193	153.7	150	110	DI	4.49	0.25	0.82	0.037
Pipe 194	157.1	150	110	DI	4.49	0.25	0.82	0.037
Pipe 195	97.94	150	110	DI	-2.46	0.14	0.27	0.041
Pipe 196	52.21	150	110	DI	-2.46	0.14	0.27	0.041
Pipe 197	101.8	150	110	DI	-2.46	0.14	0.27	0.041
Pipe 198	136.4	150	110	DI	-2.46	0.14	0.27	0.041
Pipe 199	17.96	150	110	DI	-2.46	0.14	0.27	0.04
Pipe 200	27.79	150	110	DI	-2.46	0.14	0.27	0.041
Pipe 202	2	150	110	DI	5.34	0.3	1.12	0.036
Pipe 203	5.05	62.2	130	HDPE-PE 100 PN10	-3.77	1.24	31.68	0.025
Pipe 204	4.23	62.2	130	HDPE-PE 100 PN10	-1.43	0.47	5.24	0.029
Pipe 205	5.63	62.2	130	HDPE-PE 100 PN10	-5.32	1.75	59.87	0.024
Pipe 206	199.9	150	110	DI	-2.46	0.14	0.27	0.041
Pipe 207	158.3	150	110	DI	-2.46	0.14	0.27	0.041
Pipe 208	75.69	150	110	DI	-2.46	0.14	0.27	0.041
Pipe 209	196.8	150	110	DI	-2.46	0.14	0.27	0.041
Pipe 210	197.4	150	110	DI	-10.01	0.57	3.61	0.033
Pipe 211	111.9	150	110	DI	-10.01	0.57	3.61	0.033
Pipe 212	3.32	150	110	DI	7.55	0.43	2.11	0.034
Pipe 213	1.16	150	110	DI	9.09	0.51	3.08	0.034
Pipe 214	0.77	150	110	DI	16.5	0.93	9.08	0.031
Pipe 215	1.76	150	110	DI	13.48	0.76	6.26	0.032
Pipe 216	1.56	150	110	DI	6.96	0.39	1.81	0.034
Pipe 217	1.14	150	110	DI	1.29	0.07	0	0
Pipe 218	1.25	150	110	DI	23.92	1.35	18.1	0.029
Pipe 57	3.74	150	110	DI	-21.09	1.19	14.33	0.03
Pipe 83	3.58	62.2	130	HDPE-PE 100 PN10	-1.03	0.34	2.87	0.03
Pipe 220	0.82	150	110	DI	-12.71	0.72	5.63	0.032
Pipe 221	322.9	150	110	DI	8.47	0.48	2.65	0.034
Pipe 222	2.8	62.2	130	HDPE-PE 100 PN10	-1.31	0.43	4.52	0.03
Pipe 223	2.73	62.2	130	HDPE-PE 100 PN10	5.96	1.96	73.87	0.023
Pipe 224	2.26	62.2	130	HDPE-PE 100 PN10	3.05	1	21.34	0.026
Pipe 225	184.1	150	110	DI	1.46	0.08	0.1	0.044
Pipe 226	0.94	62.2	130	HDPE-PE 100 PN10	3.23	1.06	23.75	0.026
Pipe 227	1.06	62.2	130	HDPE-PE 100 PN10	2.05	0.67	10.25	0.028
Pipe 228	562	150	110	DI	-3.82	0.22	0.61	0.038

Pipe 229	0.56	62.2	130	HDPE-PE 100 PN10	-6.45	2.12	85.58	0.023
Pipe 230	156.5	150	110	DI	16.91	0.96	9.53	0.031
Pipe 231	4.27	62.2	130	HDPE-PE 100 PN10	1.73	0.57	7.46	0.028
Pipe 232	336.3	150	110	DI	10.7	0.61	4.08	0.033
Pipe 233	0.4	62.2	130	HDPE-PE 100 PN10	-1.29	0.43	4.09	0.028
Pipe 234	0.43	62.2	130	HDPE-PE 100 PN10	3.42	1.13	26.3	0.025
Pipe 235	214.2	150	110	DI	4.72	0.27	0.9	0.037
Pipe 236	216.1	62.2	130	HDPE-PE 100 PN10	0.11	0.04	0.05	0.043
Pipe 237	2.62	62.2	130	HDPE-PE 100 PN10	3.28	1.08	24.43	0.026
Pipe 238	182.3	62.2	130	HDPE-PE 100 PN10	-0.65	0.21	1.22	0.033
Pipe 239	157.8	62.2	130	HDPE-PE 100 PN10	-1.73	0.57	7.44	0.028
Pipe 240	1.29	62.2	130	HDPE-PE 100 PN10	1.73	0.57	7.5	0.028
Pipe 241	1.25	62.2	130	HDPE-PE 100 PN10	4.49	1.48	43.7	0.024
Pipe 242	1.31	62.2	130	HDPE-PE 100 PN10	5.46	1.8	62.83	0.024
Pipe 243	1.48	150	110	DI	-2.46	0.14	0.3	0.046
Pipe 244	238.7	150	110	DI	-8.42	0.48	2.62	0.034
Pipe 245	185.2	150	110	DI	-8.42	0.48	2.62	0.034
Pipe 246	458.7	150	110	DI	-16.69	0.94	9.3	0.031
Pipe 247	297.5	150	110	DI	-22.55	1.28	16.25	0.029
Pipe 248	2.55	150	110	DI	5.87	0.33	1.34	0.036
Pipe 249	3.71	150	110	DI	8.26	0.47	2.57	0.035
Pipe 250	2.53	62.2	130	HDPE-PE 100 PN10	3.95	1.3	34.41	0.025
Pipe 251	153.9	150	110	DI	5.94	0.34	1.37	0.036
Pipe 252	1.74	62.2	130	HDPE-PE 100 PN10	2.21	0.73	11.72	0.027
Pipe 253	190.8	150	110	DI	5.94	0.34	1.37	0.036
Pipe 254	1.18	62.2	130	HDPE-PE 100 PN10	-2.15	0.71	11.23	0.027
Pipe 255	200.6	150	110	DI	-1.5	0.09	0.11	0.044
Pipe 256	0.87	62.2	130	HDPE-PE 100 PN10	5.5	1.81	63.64	0.024
Pipe 257	560.7	150	110	DI	12.2	0.69	5.2	0.032
Pipe 258	1.97	150	110	DI	8.17	0.46	2.49	0.034
Pipe 259	1.72	62.2	130	HDPE-PE 100 PN10	-0.26	0.09	0.17	0.029
Pipe 260	1.59	62.2	130	HDPE-PE 100 PN10	-0.26	0.09	0.19	0.031
Pipe 261	450.5	150	110	DI	4.03	0.23	0.67	0.038
Pipe 263	547.9	150	110	DI	4.03	0.23	0.67	0.038

Pipe 264	1.09	150	110	DI	8.8	0.5	2.87	0.034
Pipe 265	1.41	62.2	130	HDPE-PE 100 PN10	-0.5	0.17	0.74	0.033
Pipe 266	0.69	62.2	130	HDPE-PE 100 PN10	-0.23	0.08	0.22	0.046
Pipe 267	0.72	62.2	130	HDPE-PE 100 PN10	3.22	1.06	23.56	0.026
Pipe 268	183.3	150	110	DI	5.35	0.3	1.13	0.036
Pipe 269	122.1	62.2	130	HDPE-PE 100 PN10	0.73	0.24	1.52	0.032
Pipe 270	18.98	62.2	130	HDPE-PE 100 PN10	0.46	0.15	0.64	0.034
Pipe 271	41.93	62.2	130	HDPE-PE 100 PN10	0.24	0.08	0.2	0.038
Pipe 272	1.79	150	110	DI	6.51	0.37	1.66	0.036
Pipe 273	1.01	62.2	130	HDPE-PE 100 PN10	1.79	0.59	7.96	0.028
Pipe 274	0.93	62.2	130	HDPE-PE 100 PN10	3.64	1.2	29.61	0.025
Pipe 278	99.85	62.2	130	HDPE-PE 100 PN10	1.83	0.6	8.28	0.028
Pipe 279	113.6	62.2	130	HDPE-PE 100 PN10	0.85	0.28	1.99	0.031
Pipe 280	5.35	62.2	130	HDPE-PE 100 PN10	-1.36	0.45	4.76	0.029
Pipe 281	2.68	62.2	130	HDPE-PE 100 PN10	-2.37	0.78	13.44	0.027
Pipe 282	2.07	62.2	130	HDPE-PE 100 PN10	3.22	1.06	23.73	0.026
Pipe 283	329	150	110	DI	1.08	0.06	0.06	0.046
Pipe 284	260.6	150	110	DI	-4.51	0.26	0.83	0.037
Pipe 285	182.8	62.2	130	HDPE-PE 100 PN10	-1.28	0.42	4.27	0.029
Pipe 286	61.02	62.2	130	HDPE-PE 100 PN10	-0.29	0.1	0.28	0.037
Pipe 287	199.9	62.2	130	HDPE-PE 100 PN10	-0.64	0.21	1.17	0.033
Pipe 288	2.09	150	110	DI	3.63	0.21	0.57	0.04
Pipe 65	1.02	150	110	DI	7.48	0.42	2.04	0.034
Pipe 201	1.78	150	110	DI	2.34	0.13	0.25	0.042
Pipe 262	57.32	62.2	130	HDPE-PE 100 PN10	-1.82	0.6	8.24	0.028
Pipe 275	26.11	150	110	DI	21.97	1.24	15.48	0.029
Valve 20	#N/A	150	#N/A		21.25	1.2	29.26	0
Valve 44	#N/A	250	#N/A		39.55	0.81	26.69	0
Valve 50	#N/A	200	#N/A		48.97	1.56	20.05	0
Valve 30	#N/A	300	#N/A		51.68	0.73	13.01	0
Valve 219	#N/A	250	#N/A		60.55	1.23	17.85	0
Valve 79	#N/A	150	#N/A		21.97	1.24	33.44	0

Table 6.7.Details of Pressure for DNI G (at peak time 7.00)

Node ID	Elevation	Base	Peak	Head	Pressure

		Demand	Demand		
	m	LPS	LPS	m	m
Junc G003	1304	0.0614	0.09	1328.72	24.8
Junc G004	1304	0.1055	0.16	1328.73	24.8
Junc G005	1308	0.0822	0.12	1328.62	20.35
Junc G006	1295	0.1735	0.26	1328.1	33.29
Junc G007	1302	0.0561	0.08	1333.1	31.32
Junc G008	1308	0.4025	0.6	1328.69	21.15
Junc G009	1308	0.1375	0.21	1328.62	20.5
Junc G010	1309	2.09	3.13	1327.79	18.78
Junc G011	1312	0.0928	0.14	1335.04	23.31
Junc G012	1310	0.581	0.87	1336.24	26.07
Junc G014	1301	0.3354	0.5	1328.02	27.21
Junc G015	1302	0.153	0.23	1333.02	31.1
Junc G016	1303	0.1848	0.28	1333.58	30.27
Junc G017	1302	0.0395	0.06	1332.14	29.77
Junc G018	1303	0.1629	0.24	1332.16	29.52
Junc G019	1301	0.2978	0.45	1316.4	15.6
Junc G020	1301	0.1285	0.19	1316.41	15.55
Junc G021	1299	0.1075	0.16	1317.75	18.41
Junc G022	1300	0.1813	0.27	1317.71	18.09
Junc G023	1299	0.1936	0.29	1316.46	17.47
Junc G025	1300	0.1866	0.28	1317.69	17.3
Junc G026	1300	0.1912	0.29	1317.87	17.97
Junc G027	1299	0.2226	0.33	1317.86	18.53
Junc G028	1300	0.1812	0.27	1317.85	17.57
Junc G029	1317	0.2746	0.41	1342.75	25.28
Junc G030	1315	0.2163	0.32	1342.73	27.41
Junc G031	1314	0.2087	0.31	1342.82	28.91
Junc G034	1332	1.7685	2.65	1348.01	16.19
Junc G035	1329	0	0	1347.84	18.39
Junc G036	1331	0	0	1348.36	17.86
Junc G037	1331	0.0644	0.1	1346.14	14.95
Junc G038	1307	0	0	1338.18	30.99
Junc G039	1310	0.4773	0.72	1330.27	20.57
Junc G046	1307	0.0955	0.14	1328.8	21.34
Junc G049	1312	0.0518	0.08	1334.81	22.82
Junc G051	1310	0.315	0.47	1336.37	26.56
Junc G053	1308	0.3445	0.52	1339.51	31.99
Junc G054	1312	0.0979	0.15	1330.3	18.16
Junc G060	1302	0.2452	0.37	1332.13	30.31
Junc G061	1300	0	0	1319.32	19.64
Junc G062	1301	0.2505	0.38	1316.42	15.75
Junc G065	1300	0.1138	0.17	1316.44	16.1

Junc G066	1299	0.0894	0.13	1316.46	17.13
Junc G069	1300	0.1336	0.2	1317.89	18.13
Junc G070	1300	0.0958	0.14	1317.91	18.04
Junc G071	1301	0.1801	0.27	1316.41	15.52
Junc G073	1299	0.2219	0.33	1316.55	17.09
Junc G074	1299	0.0743	0.11	1316.61	17.76
Junc G075	1299	0.2127	0.32	1316.54	17.66
Junc G076	1299	0.1566	0.23	1317.89	19.14
Junc G078	1300	0.1088	0.16	1316.42	16.57
Junc G079	1300	0.1002	0.15	1316.42	16.68
Junc G080	1299	0.1719	0.26	1316.52	17.73
Junc G081	1300	0.1491	0.22	1317.7	17.49
Junc G082	1299	0.2242	0.34	1317.84	19.05
Junc G086	1337	0	0	1357.1	20.58
Junc G087	1322	0.2606	0.39	1354.89	33.01
Junc G088	1317	0.3202	0.48	1353.5	36.19
Junc G089	1337	0.0327	0.05	1356.06	19.42
Junc G091	1316	0.2335	0.35	1342.75	27.21
Junc G094	1310	0	0	1345.19	35.54
Junc G095	1325	0.4383	0.66	1340.14	14.76
Junc G096	1332	0	0	1350.42	18.7
Junc G101	1304	0.0839	0.13	1328.72	24.8
Junc G103	1307	0.2587	0.39	1329.57	22.39
Junc G107	1307	0.1472	0.22	1329.55	22.79
Junc G111	1307	0.1354	0.2	1328.71	21.5
Junc G115	1297	0.0935	0.14	1328.75	31.48
Junc G116	1297	0.1158	0.17	1328.76	31.3
Junc G117	1297	0.1775	0.27	1328.76	31.78
Junc G118	1295	0.0745	0.11	1329.1	34.16
Junc G119	1295	0.1302	0.2	1329.18	34.24
Junc G120	1295	0.0786	0.12	1328.21	33.47
Junc G121	1294	0.1183	0.18	1328.13	33.7
Junc G122	1295	0.1332	0.2	1328.1	33.27
Junc G123	1295	0.0898	0.13	1328.09	32.97
Junc G124	1295	0.1955	0.29	1328.07	33.03
Junc G125	1295	0.1461	0.22	1328.05	32.63
Junc G126	1297	0.1255	0.19	1328.05	31.41
Junc G127	1298	0.0697	0.1	1328.03	30.53
Junc G128	1307	0.0933	0.14	1328.02	20.82
Junc G129	1307	0.2903	0.44	1328.8	22.16
Junc G130	1307	0.1391	0.21	1328.91	21.87
Junc G131	1307	0.1746	0.26	1328.76	21.87
Junc G132	1305	0.2501	0.38	1328.74	23.72
Junc G133	1306	0.1436	0.22	1328.73	22.39

Junc G134	1304	0.1206	0.18	1328.72	24.98
Junc G135	1304	0.1179	0.18	1328.72	25.02
Junc G136	1299	0.3936	0.59	1328.69	29.31
Junc G137	1298	0.2718	0.41	1328.66	30.42
Junc G138	1298	0.1691	0.25	1328.7	30.25
Junc G139	1306	0.1067	0.16	1328.73	22.56
Junc G140	1307	0.1026	0.15	1328.74	21.32
Junc G141	1308	0.0997	0.15	1328.76	20.84
Junc G142	1308	0.0708	0.11	1328.34	20.72
Junc G143	1303	0.0049	0.01	1328.73	25.56
Junc G144	1303	0.0442	0.07	1328.73	25.56
Junc G145	1301	0.0136	0.02	1328.45	27.1
Junc G146	1301	0.0385	0.06	1328.74	27.71
Junc G147	1299	0.1234	0.19	1328.69	29.21
Junc G148	1299	0.0831	0.12	1328.69	29.4
Junc G149	1297	0.2324	0.35	1328.67	31.22
Junc G150	1301	0.1096	0.16	1328.78	28.08
Junc G151	1298	0.1681	0.25	1328.76	31.23
Junc G152	1298	0.0731	0.11	1329.15	30.68
Junc G153	1298	0.1945	0.29	1328.86	30.39
Junc G154	1298	0.1547	0.23	1328.78	30.43
Junc G155	1296	0.1339	0.2	1329.06	32.98
Junc G156	1296	0.1136	0.17	1328.71	33.15
Junc G157	1296	0.1943	0.29	1329.08	33.36
Junc G158	1295	0.2391	0.36	1329.09	33.77
Junc G159	1295	0.1555	0.23	1328.48	33.46
Junc G160	1295	0.1504	0.23	1328.48	33.92
Junc G161	1295	0.1218	0.18	1328.24	32.84
Junc G162	1299	0.0639	0.1	1328.25	29.58
Junc G163	1304	0.1293	0.19	1328.21	24.24
Junc G164	1307	0.2147	0.32	1328.27	20.85
Junc G165	1309	0.1377	0.21	1328.21	19.62
Junc G166	1305	0.2395	0.36	1328.2	23.26
Junc G167	1308	0.0891	0.13	1328.21	19.97
Junc G168	1307	0.1154	0.17	1328.21	21.18
Junc G169	1308	0.0484	0.07	1328.23	19.83
Junc G170	1310	0.2672	0.4	1328.23	18.38
Junc G171	1308	0.0524	0.08	1328.31	19.87
Junc G172	1306	0.072	0.11	1328.32	22.11
Junc G173	1305	0.1354	0.2	1328.32	22.91
Junc G174	1303	0.0138	0.02	1328.39	25.3
Junc G175	1308	0.1564	0.23	1328.32	19.97
Junc G176	1308	0.0375	0.06	1328.32	19.97
Junc G177	1310	0.3378	0.51	1328.27	18.66

Junc G178	1309	0.8299	1.24	1328.47	19.49
Junc G179	1310	0.6142	0.92	1328.26	17.97
Junc G180	1311	0.2461	0.37	1328.19	17.46
Junc G181	1311	0.3115	0.47	1328.18	16.99
Junc G182	1313	0.5984	0.9	1328.11	14.92
Junc G183	1312	0.0446	0.07	1328.02	15.89
Junc G184	1310	0.0647	0.1	1328.02	17.68
Junc G185	1312	0.22	0.33	1327.95	15.5
Junc G186	1312	0.0538	0.08	1327.95	15.93
Junc G187	1312	0.0781	0.12	1327.89	16.39
Junc G188	1310	0.1246	0.19	1327.89	18.27
Junc G189	1311	0.0575	0.09	1327.86	16.5
Junc G190	1312	0.0378	0.06	1327.86	16.22
Junc G191	1311	0.0572	0.09	1327.86	17.06
Junc G192	1312	0.077	0.12	1327.87	15.57
Junc G193	1312	0.055	0.08	1327.87	16.04
Junc G194	1312	0.0816	0.12	1327.87	16.28
Junc G195	1312	0.339	0.51	1327.81	16.1
Junc G196	1309	0.1297	0.19	1327.78	19.17
Junc G197	1309	0.1776	0.27	1327.78	18.9
Junc G198	1304	0.2609	0.39	1327.76	23.62
Junc G199	1297	0.2309	0.35	1327.77	30.76
Junc G200	1295	0.2416	0.36	1327.83	32.36
Junc G201	1295	0.2585	0.39	1328.08	32.59
Junc G202	1296	0.2323	0.35	1327.82	32.13
Junc G203	1298	0.1677	0.25	1327.78	29.35
Junc G204	1298	0.1213	0.18	1327.81	29.89
Junc G205	1297	0.121	0.18	1327.77	30.67
Junc G206	1297	0.2327	0.35	1327.77	30.54
Junc G207	1296	0.1191	0.18	1328.78	32.82
Junc G208	1298	0.0862	0.13	1328.77	30.72
Junc G209	1298	0.061	0.09	1328.77	30.38
Junc G210	1299	0.0412	0.06	1328.77	30.06
Junc G211	1299	0.0179	0.03	1328.77	29.92
Junc G212	1299	0.0285	0.04	1328.77	29.59
Junc G213	1299	0.0919	0.14	1328.08	28.77
Junc G214	1298	0.1252	0.19	1328.26	29.95
Junc G215	1297	0.1089	0.16	1329.23	32.6
Junc G216	1302	0.04	0.06	1328.07	25.87
Junc G217	1301	0.1384	0.21	1328.09	27.14
Junc G218	1302	0.0526	0.08	1331.86	29.97
Junc G219	1302	0.004	0.01	1331.86	30.04
Junc G220	1302	0.0405	0.06	1331.86	29.96
Junc G221	1301	0.0677	0.1	1331.86	30.77

Junc G222	1301	0.032	0.05	1331.9	30.46
Junc G223	1299	0.0376	0.06	1332.17	32.74
Junc G224	1300	0.1396	0.21	1332.17	32.53
Junc G225	1300	0.0886	0.13	1332.36	32.34
Junc G226	1300	0.092	0.14	1332.42	32.39
Junc G227	1300	0.1371	0.21	1332.43	32.61
Junc G228	1298	0.2212	0.33	1332.81	34.94
Junc G229	1300	0.0721	0.11	1332.47	32.63
Junc G230	1300	0.0818	0.12	1333.23	33.44
Junc G231	1300	0.11	0.17	1333.21	32.94
Junc G232	1301	0.1368	0.21	1332.33	31.35
Junc G233	1300	0.1035	0.16	1332.39	31.92
Junc G234	1301	0.0749	0.11	1332.03	31.09
Junc G235	1301	0.1182	0.18	1331.97	31.02
Junc G236	1301	0.1509	0.23	1331.96	31.43
Junc G237	1301	0.1125	0.17	1331.91	30.9
Junc G238	1301	0.1275	0.19	1331.91	31.2
Junc G239	1303	0.1892	0.28	1331.85	29.09
Junc G240	1302	0.0538	0.08	1331.83	29.45
Junc G241	1302	0.0417	0.06	1331.83	29.58
Junc G242	1302	0.0366	0.05	1331.83	30.01
Junc G243	1301	0.0635	0.1	1331.83	30.39
Junc G244	1302	0.1006	0.15	1331.8	29.83
Junc G245	1302	0.0549	0.08	1331.83	30.06
Junc G246	1302	0.0875	0.13	1331.81	29.93
Junc G247	1302	0.0875	0.13	1331.77	29.29
Junc G248	1303	0.0933	0.14	1331.7	28.94
Junc G249	1304	0.2294	0.34	1331.69	27.42
Junc G250	1307	0.2618	0.39	1331.69	24.9
Junc G251	1304	0.2067	0.31	1331.68	27.54
Junc G252	1304	0.0922	0.14	1331.68	27.82
Junc G253	1303	0.0894	0.13	1331.69	28.53
Junc G254	1303	0.0625	0.09	1331.7	28.6
Junc G255	1302	0.0634	0.1	1331.77	29.38
Junc G256	1302	0.1072	0.16	1331.85	29.88
Junc G257	1302	0.0371	0.06	1331.86	29.97
Junc G258	1302	0.107	0.16	1332.16	29.78
Junc G259	1303	0.1933	0.29	1332.57	29.82
Junc G260	1303	0.1465	0.22	1332.86	29.66
Junc G261	1304	0.4346	0.65	1331.82	27.39
Junc G262	1304	0.3031	0.45	1331.71	27.28
Junc G263	1304	0.2103	0.32	1331.7	27.83
Junc G264	1309	0.3705	0.56	1338.23	29.22
Junc G265	1309	0.2731	0.41	1338.23	29.3

Junc G266	1309	0	0	1345	35.67
Junc G267	1308	0	0	1338.29	30
Junc G268	1312	0.2736	0.41	1337.31	25.3
Junc G269	1312	0.4444	0.67	1337.24	24.92
Junc G270	1312	0.3059	0.46	1344.23	32.36
Junc G271	1313	0.4071	0.61	1336.96	24.01
Junc G272	1314	0.2784	0.42	1335.96	21.99
Junc G273	1314	0.1142	0.17	1335.96	21.85
Junc G274	1315	0.1042	0.16	1336.09	20.89
Junc G275	1314	0.1579	0.24	1343.94	29.46
Junc G276	1315	0.0373	0.06	1343.91	28.72
Junc G277	1315	0.1696	0.25	1336.08	21.02
Junc G278	1317	0.0637	0.1	1343.71	26.83
Junc G279	1314	0	0	1335.72	21.57
Junc G280	1318	0.0688	0.1	1334.56	16.48
Junc G281	1318	0.0426	0.06	1334.55	16.46
Junc G282	1317	0.099	0.15	1334.45	17.74
Junc G283	1321	0.4023	0.6	1334.57	13.62
Junc G284	1319	0.0514	0.08	1334.55	15.97
Junc G285	1317	0.2108	0.32	1334.54	17.43
Junc G286	1317	0.0395	0.06	1334.55	17.41
Junc G287	1316	0.0648	0.1	1334.55	18.29
Junc G288	1313	0.0535	0.08	1334.36	21.73
Junc G289	1311	0.0216	0.03	1334.36	22.96
Junc G290	1308	0.057	0.09	1334.36	26.7
Junc G291	1311	0.0593	0.09	1334.36	23.51
Junc G292	1305	0.1106	0.17	1334.18	29.63
Junc G293	1304	0.2456	0.37	1334.16	29.88
Junc G294	1305	0.1302	0.2	1334.08	29.02
Junc G295	1316	0.1136	0.17	1334.09	17.67
Junc G296	1317	0.1769	0.27	1333.97	17.11
Junc G297	1302	0.1294	0.19	1333.97	31.95
Junc G298	1303	0.1036	0.16	1333.88	30.45
Junc G299	1303	0.0995	0.15	1333.88	31.2
Junc G300	1302	0.0987	0.15	1333.88	32.09
Junc G301	1304	0.0805	0.12	1333.81	29.41
Junc G302	1304	0.0138	0.02	1333.79	30
Junc G303	1315	0.1942	0.29	1333.82	19.3
Junc G304	1309	0.0675	0.1	1333.81	25.18
Junc G305	1304	0.0608	0.09	1333.75	30.19
Junc G306	1302	0.2365	0.35	1333.74	31.33
Junc G307	1301	0.0524	0.08	1333.58	32.55
Junc G308	1301	0.1058	0.16	1333.56	32.58
Junc G309	1301	0.1148	0.17	1333.58	32.42

Junc G310	1302	0.2164	0.32	1333.17	31.4
Junc G311	1300	0.1766	0.26	1333.13	32.76
Junc G312	1301	0.0225	0.03	1333.14	32.57
Junc G313	1301	0.0356	0.05	1333.13	32.51
Junc G314	1301	0.0738	0.11	1333.11	32
Junc G315	1301	0.0385	0.06	1333.11	32.26
Junc G316	1302	0.0318	0.05	1333.1	31.35
Junc G317	1301	0.0416	0.06	1333.11	31.63
Junc G318	1301	0.0612	0.09	1333.11	31.87
Junc G319	1301	0.0361	0.05	1333.12	31.8
Junc G320	1302	0.0511	0.08	1333.13	31.43
Junc G321	1302	0.0467	0.07	1333.13	31.43
Junc G322	1302	0.1351	0.2	1333.18	31.35
Junc G323	1302	0.2286	0.34	1333.33	31.38
Junc G324	1301	0.2114	0.32	1333.31	32.07
Junc G325	1302	0.234	0.35	1333.12	31.05
Junc G326	1302	0.1285	0.19	1333.13	31
Junc G327	1302	0.0896	0.13	1333.35	31.14
Junc G328	1302	0.1392	0.21	1333.34	31.22
Junc G329	1302	0.2237	0.34	1333.34	31.07
Junc G330	1303	0.0832	0.12	1333.76	31.09
Junc G331	1303	0.0881	0.13	1333.76	30.34
Junc G332	1304	0.2722	0.41	1334.09	30.2
Junc G333	1303	0.1836	0.28	1331.7	28.64
Junc G334	1301	0.0727	0.11	1328.09	27.34
Junc G335	1297	0.2313	0.35	1329.23	32.23
Junc G336	1297	0.0983	0.15	1329.24	32.05
Junc G337	1299	0.0226	0.03	1332.19	32.82
Junc G338	1299	0.1407	0.21	1332.19	33.07
Junc G339	1300	0.1444	0.22	1332.47	32.76
Junc G340	1298	0.1263	0.19	1333.37	35.12
Junc G341	1298	0.0334	0.05	1333.35	35.12
Junc G342	1299	0.1429	0.21	1333.24	34.6
Junc G343	1300	0.0624	0.09	1333.22	33.51
Junc G344	1300	0.0912	0.14	1333.22	33.34
Junc G345	1300	0.1432	0.21	1333.22	33.55
Junc G346	1299	0.0882	0.13	1333.16	34.52
Junc G347	1299	0.1299	0.19	1333.16	34.39
Junc G348	1299	0.0662	0.1	1333.14	33.9
Junc G349	1299	0.1172	0.18	1333.13	34.21
Junc G350	1300	0.1193	0.18	1333.13	33.42
Junc G351	1300	0.0618	0.09	1333.14	33.46
Junc G352	1300	0.0322	0.05	1333.14	33.36
Junc G353	1300	0.0133	0.02	1333.14	33.52

Junc G354	1300	0.0863	0.13	1333.14	33.6
Junc G355	1300	0.1035	0.16	1333.13	33.48
Junc G356	1300	0.0394	0.06	1333.15	33.06
Junc G357	1300	0.1034	0.16	1333.16	33.02
Junc G358	1301	0.2352	0.35	1333.2	32.43
Junc G359	1301	0.189	0.28	1333.18	32.12
Junc G360	1304	0.1892	0.28	1331.67	27.63
Junc G361	1309	0.2241	0.34	1333.84	24.78
Junc G362	1310	0.1501	0.23	1333.83	23.36
Junc G363	1304	0.1069	0.16	1333.82	30.05
Junc G364	1312	0.5802	0.87	1336.74	25.03
Junc G365	1309	0.0216	0.03	1336.9	27.88
Junc G366	1309	0.0343	0.05	1336.9	27.85
Junc G367	1310	0.097	0.15	1336.85	26.52
Junc G368	1310	0.037	0.06	1336.85	26.91
Junc G369	1312	0.342	0.51	1336.83	25.22
Junc G370	1311	0.1305	0.2	1336.89	25.79
Junc G371	1309	0.0414	0.06	1336.83	27.51
Junc G372	1309	0.2687	0.4	1336.82	28.01
Junc G373	1314	0	0	1345.77	31.29
Junc G374	1316	0.3479	0.52	1341.68	26.16
Junc G375	1313	0.3044	0.46	1341.95	29.2
Junc G376	1313	0	0	1345.63	33.11
Junc G377	1324	0	0	1346.52	22.17
Junc G378	1325	0.1064	0.16	1341.28	16.51
Junc G379	1325	0.2446	0.37	1341.28	16.73
Junc G380	1315	1.5783	2.37	1341.7	26.27
Junc G381	1319	0.2616	0.39	1341.63	22.93
Junc G382	1309	0.2417	0.36	1344.55	35.19
Junc G383	1310	0.1102	0.17	1344.45	34.86
Junc G384	1310	0.1005	0.15	1344.36	34.11
Junc G385	1310	0.4242	0.64	1344.34	34.18
Junc G386	1312	0.2368	0.36	1344.34	32.25
Junc G387	1315	0.2186	0.33	1341.67	26.36
Junc G388	1319	0.3766	0.56	1341.44	22.92
Junc G389	1324	0.0772	0.12	1341.49	17.52
Junc G390	1325	0.1193	0.18	1341.49	16.73
Junc G391	1324	0.028	0.04	1341.48	17.19
Junc G392	1325	0.1931	0.29	1341.48	16.2
Junc G393	1327	0.3296	0.49	1340.24	13.54
Junc G394	1327	0.6549	0.98	1340.22	13.51
Junc G395	1332	0.1444	0.22	1345.61	14.06
Junc G396	1331	0.0183	0.03	1345.61	14.27
Junc G397	1331	0.0387	0.06	1345.61	14.31

Junc G398	1331	0.1794	0.27	1345.6	14.32
Junc G399	1332	0.0643	0.1	1345.96	14.36
Junc G400	1332	0.4412	0.66	1347.3	15.29
Junc G401	1331	0.1906	0.29	1347.69	16.69
Junc G402	1331	0	0	1348.87	18.33
Junc G403	1332	0.2034	0.31	1347.09	15.46
Junc G404	1332	0.5742	0.86	1345.86	13.96
Junc G405	1334	0.718	1.08	1345.91	12.39
Junc G406	1331	0.1413	0.21	1345.77	14.35
Junc G407	1329	0.1851	0.28	1345.76	16.41
Junc G408	1327	0.3063	0.46	1345.75	19.1
Junc G409	1323	0.333	0.5	1345.95	22.51
Junc G410	1323	0.295	0.44	1345.84	22.64
Junc G411	1322	0.5725	0.86	1345.72	24.15
Junc G412	1320	0.1101	0.17	1345.13	25.33
Junc G413	1313	0.1909	0.29	1345.13	32.11
Junc G414	1310	1.0071	1.51	1344.85	34.7
Junc G415	1317	0.2724	0.41	1345.52	28.94
Junc G416	1311	0.5139	0.77	1345.78	35.07
Junc G417	1308	0.4189	0.63	1333.77	25.33
Junc G418	1308	0.6285	0.94	1333.64	25.43
Junc G419	1307	0.1772	0.27	1332.57	25.36
Junc G420	1307	0.1246	0.19	1332.46	25.47
Junc G421	1307	0.084	0.13	1344.66	37.47
Junc G422	1308	0.1189	0.18	1344.64	36.65
Junc G423	1308	0.0326	0.05	1344.65	36.62
Junc G424	1308	0.1149	0.17	1344.64	36.8
Junc G425	1307	0.0713	0.11	1344.63	37.32
Junc G426	1307	0.3033	0.45	1344.59	37.53
Junc G427	1307	0.1154	0.17	1331.74	24.88
Junc G428	1307	0.0676	0.1	1331.51	24.89
Junc G429	1307	0.0874	0.13	1331.25	24.74
Junc G430	1306	0.1909	0.29	1331.14	24.91
Junc G431	1305	0.0742	0.11	1331.24	26.3
Junc G432	1306	0.1103	0.17	1331.13	25.58
Junc G433	1304	0.1118	0.17	1331.13	26.83
Junc G434	1303	0.1237	0.19	1331.14	28.15
Junc G435	1301	0	0	1335.06	33.7
Junc G436	1301	0.0583	0.09	1318.83	17.47
Junc G437	1301	0.0759	0.11	1318.92	17.59
Junc G438	1301	0	0	1335.15	34.01
Junc G439	1303	0.1026	0.15	1330.89	28.14
Junc G440	1303	0.0826	0.12	1330.89	27.65
Junc G441	1304	0.1293	0.19	1330.89	27.08

Junc G442	1303	0.0672	0.1	1330.87	27.69
Junc G443	1301	0	0	1335.24	33.89
Junc G444	1304	0.0468	0.07	1330.89	26.53
Junc G445	1303	0.1396	0.21	1317.9	14.84
Junc G446	1304	0.0684	0.1	1333.2	29.45
Junc G447	1304	0.0121	0.02	1333.19	28.94
Junc G448	1304	0.014	0.02	1344.7	40.45
Junc G449	1303	0.0661	0.1	1333.25	29.86
Junc G450	1304	0.0393	0.06	1333.25	29.41
Junc G451	1304	0.0269	0.04	1343.68	39.84
Junc G452	1304	0.0755	0.11	1343.68	40.11
Junc G453	1304	0.0445	0.07	1333.29	29.36
Junc G454	1304	0.0645	0.1	1343.14	39.46
Junc G455	1304	0.1286	0.19	1333.77	30.13
Junc G456	1306	0.3176	0.48	1343.15	37.6
Junc G457	1306	0.2553	0.38	1333.88	28.03
Junc G458	1308	0.4878	0.73	1333.99	26.48
Junc G459	1304	0.1459	0.22	1333.98	29.53
Junc G460	1304	0.1439	0.22	1333.57	29.88
Junc G461	1301	0.1243	0.19	1333.56	32.45
Junc G462	1302	0.0496	0.07	1333.56	32.02
Junc G463	1302	0.0535	0.08	1333.56	31.87
Junc G464	1303	0.1323	0.2	1333.59	30.94
Junc G465	1302	0.0649	0.1	1333.59	31.22
Junc G466	1303	0.0658	0.1	1333.17	30.07
Junc G467	1303	0.0466	0.07	1333.14	30.24
Junc G468	1303	0.0607	0.09	1333.14	30.37
Junc G469	1302	0.1161	0.17	1333.12	30.75
Junc G470	1303	0.0928	0.14	1333.12	30.47
Junc G471	1302	0.0784	0.12	1333.12	31
Junc G472	1303	0.0931	0.14	1333.11	30.42
Junc G473	1302	0.1175	0.18	1333.12	30.87
Junc G474	1302	0.1387	0.21	1333.12	31.11
Junc G475	1302	0.1631	0.24	1333.11	31.54
Junc G476	1302	0.1212	0.18	1333.11	31.27
Junc G477	1301	0.0525	0.08	1333.11	31.69
Junc G478	1302	0.0878	0.13	1333.12	31.55
Junc G479	1301	0.123	0.18	1333.12	31.65
Junc G480	1302	0.0739	0.11	1333.13	31.49
Junc G481	1301	0.1701	0.26	1333.13	31.66
Junc G482	1301	0.2979	0.45	1333.12	32.15
Junc G483	1300	0.2014	0.3	1333.12	33.15
Junc G484	1300	0.1086	0.16	1333.12	33.2
Junc G485	1300	0.0751	0.11	1333.43	32.93

Junc G486	1300	0.1279	0.19	1317.84	17.41
Junc G487	1299	0	0	1318.74	19.68
Junc G488	1301	0.3583	0.54	1317.83	17.27
Junc G489	1299	0	0	1318.7	19.83
Junc G490	1299	0	0	1318.71	19.93
Junc G491	1300	0.291	0.44	1317.68	17.98
Junc G492	1299	0.1902	0.29	1317.7	18.26
Junc G493	1299	0.1718	0.26	1317.78	18.48
Junc G494	1299	0.0922	0.14	1317.94	18.94
Junc G495	1299	0.0801	0.12	1316.88	17.87
Junc G496	1300	0.1997	0.3	1317.75	18.17
Junc G497	1300	0.0767	0.12	1317.73	17.54
Junc G498	1301	0.0498	0.07	1317.7	17.15
Junc G499	1301	0.1163	0.17	1317.7	17.18
Junc G500	1301	0.111	0.17	1317.68	16.74
Junc G501	1300	0.1539	0.23	1317.77	17.44
Junc G502	1302	0.2651	0.4	1317.79	15.44
Junc G503	1302	0	0	1335.36	32.89
Junc G504	1303	0.056	0.08	1333.17	30.39
Junc G505	1304	0.0689	0.1	1344.67	40.9
Junc G506	1304	0.0562	0.08	1344.6	40.75
Junc G507	1304	0.1511	0.23	1344.6	40.54
Junc G508	1304	0.0644	0.1	1344.6	40.73
Junc G509	1306	0.3716	0.56	1330.96	25.21
Junc G510	1305	0.128	0.19	1330.96	26.41
Junc G511	1307	0.0818	0.12	1331.51	24.39
Junc G512	1308	0.1085	0.16	1331.74	23.7
Junc G513	1308	0.1891	0.28	1332.36	24.76
Junc G514	1301	0	0	1334.81	33.64
Junc G515	1306	0.4277	0.64	1331.75	26.15
Junc G516	1302	0.0192	0.03	1331.89	29.94
Junc G517	1302	0.1101	0.17	1331.86	29.6
Junc G518	1303	0.253	0.38	1331.84	28.54
Junc G519	1302	0.1257	0.19	1331.89	30.05
Junc G520	1301	0	0	1334.93	33.76
Junc G521	1301	0	0	1334.9	33.49
Junc G522	1302	0.1522	0.23	1332.65	30.76
Junc G523	1301	0.1017	0.15	1318.63	17.46
Junc G524	1300	0.3218	0.48	1318.08	17.72
Junc G525	1302	0	0	1334.83	33.28
Junc G526	1301	0.116	0.17	1333.46	32.13
Junc G527	1302	0.3191	0.48	1333.45	31.67
Junc G528	1302	0.1981	0.3	1333.45	31.44
Junc G529	1301	0.3371	0.51	1333.42	32.3

Junc G530	1301	0	0	1334.84	33.52
Junc G531	1302	0.1824	0.27	1320.05	18.48
Junc G532	1302	0	0	1334.85	33.14
Junc G533	1302	0.2077	0.31	1333.29	31.13
Junc G534	1302	0	0	1334.9	32.91
Junc G535	1303	0	0	1334.92	32.3
Junc G536	1302	0.1955	0.29	1332.85	30.41
Junc G537	1304	0.1136	0.17	1332.67	28.93
Junc G538	1304	0.0765	0.11	1332.65	28.87
Junc G539	1304	0.0773	0.12	1332.57	28.16
Junc G540	1304	0.302	0.45	1332.55	28.98
Junc G541	1305	0.1783	0.27	1332.57	27.66
Junc G542	1305	0.0421	0.06	1332.57	27.53
Junc G543	1306	0.1316	0.2	1332.46	26.81
Junc G544	1308	0.2063	0.31	1332.82	25.16
Junc G545	1306	0.3331	0.5	1332.8	26.57
Junc G546	1310	0.8459	1.27	1345.2	35.6
Junc G547	1311	0.7177	1.08	1345.2	34.63
Junc G548	1311	0.2852	0.43	1345.42	34.54
Junc G549	1311	0.8205	1.23	1345.14	34.03
Junc G550	1311	0.1166	0.17	1345.77	34.61
Junc G551	1311	0.1003	0.15	1345.77	34.79
Junc G552	1311	0.102	0.15	1346.06	34.76
Junc G553	1311	0.057	0.09	1346.07	35.1
Junc G554	1311	0.1085	0.16	1346.29	35.26
Junc G555	1312	0.3421	0.51	1345.45	33.43
Junc G556	1312	0.1675	0.25	1345.27	33.44
Junc G557	1311	0.1149	0.17	1344.93	33.62
Junc G558	1311	0.1152	0.17	1344.93	33.78
Junc G559	1311	0.9357	1.4	1344.64	33.56
Junc G560	1311	0.0401	0.06	1345.27	34
Junc G561	1312	0	0	1337.17	25
Junc G562	1312	0	0	1354.08	41.88
Junc G563	1313	0.1587	0.24	1336.71	23.88
Junc G564	1310	0.1369	0.21	1346.98	37.14
Junc G565	1312	0.4389	0.66	1352.33	39.84
Junc G566	1310	0.4462	0.67	1347.63	37.56
Junc G567	1311	0.2136	0.32	1347.43	36.7
Junc G568	1311	0.1914	0.29	1347.42	36.06
Junc G569	1310	0.1106	0.17	1347.43	37.14
Junc G570	1310	0.146	0.22	1347.48	37.33
Junc G571	1311	0.0854	0.13	1347.48	36.45
Junc G572	1312	0.0213	0.03	1347.61	35.79
Junc G573	1314	0.0563	0.08	1347.61	33.23

Junc G574	1313	0.0377	0.06	1347.66	34.75
Junc G575	1313	0.1397	0.21	1347.69	34.79
Junc G576	1319	0.0656	0.1	1347.66	28.25
Junc G577	1313	0.0471	0.07	1347.47	34.43
Junc G578	1315	0.0863	0.13	1347.47	32.42
Junc G579	1313	0.6528	0.98	1347.32	34.35
Junc G580	1334	0.4522	0.68	1349.3	15.34
Junc G581	1331	0.36	0.54	1349.23	18.07
Junc G582	1334	0.5396	0.81	1353.1	19.2
Junc G583	1323	0.0366	0.05	1354.03	30.94
Junc G584	1322	0.0823	0.12	1354	31.8
Junc G585	1328	0.2267	0.34	1353.64	25.83
Junc G586	1327	0.2146	0.32	1353.63	26.33
Junc G587	1334	0.0381	0.06	1349.13	15.23
Junc G588	1334	0.0703	0.11	1353.14	19.23
Junc G589	1303	0	0	1334.95	32.11
Junc G590	1307	0	0	1335.7	28.51
Junc G591	1309	0	0	1336.41	27.86
Junc G592	1310	0.3632	0.54	1333.95	23.68
Junc G593	1309	0.101	0.15	1334.5	25.99
Junc G594	1309	0	0	1336.58	27.87
Junc G595	1313	0.1388	0.21	1352.19	39.12
Junc G596	1313	0	0	1354.08	41.42
Junc G597	1313	0.4551	0.68	1352.04	38.74
Junc G598	1313	0	0	1354.08	41.48
Junc G599	1315	0.2105	0.32	1352.33	37.25
Junc G600	1315	0.2381	0.36	1352.79	37.52
Junc G601	1316	0.1708	0.26	1354.03	37.8
Junc G602	1316	0.1183	0.18	1354.05	37.81
Junc G603	1316	0.1952	0.29	1353.99	37.81
Junc G604	1316	0.0803	0.12	1353.99	37.55
Junc G605	1330	0.0885	0.13	1353.98	24.15
Junc G606	1317	0.0895	0.13	1353.98	36.58
Junc G607	1324	0.1604	0.24	1353.98	29.52
Junc G608	1317	0.0673	0.1	1353.99	36.63
Junc G609	1317	0.1092	0.16	1353.28	35.92
Junc G610	1311	0.363	0.54	1353.22	41.81
Junc G611	1321	0.0818	0.12	1353.77	32.46
Junc G612	1331	0.4198	0.63	1353.03	22.42
Junc G613	1330	0.1671	0.25	1353.02	23.12
Junc G614	1331	0.2009	0.3	1353.01	22.26
Junc G615	1333	0.1929	0.29	1353.06	20.21
Junc G616	1334	0.0787	0.12	1353.15	19.18
Junc G617	1333	0.24	0.36	1353.11	20.06

Junc G618	1334	0.0465	0.07	1353.12	19.49
Junc G619	1334	0.1602	0.24	1353.12	18.78
Junc G620	1319	0.2031	0.3	1353.4	34.75
Junc G621	1319	0.2902	0.44	1353.57	34.92
Junc G622	1335	0.0723	0.11	1353.36	18.4
Junc G623	1336	0.4136	0.62	1353.45	17.52
Junc G624	1316	0.1551	0.23	1353.38	37.25
Junc G625	1315	0.1591	0.24	1352.72	37.3
Junc G626	1316	0.0981	0.15	1352.72	37.06
Junc G627	1317	0.0853	0.13	1353.05	36.24
Junc G628	1317	0.0255	0.04	1353.07	36.25
Junc G629	1317	0.1274	0.19	1353.31	36.15
Junc G630	1317	0.1177	0.18	1353.18	35.99
Junc G631	1317	0.2636	0.4	1353.17	35.96
Junc G632	1320	0.3411	0.51	1352.93	32.76
Junc G633	1319	0.1573	0.24	1353.06	34.07
Junc G634	1319	0.3966	0.59	1353.1	33.91
Junc G635	1319	0.1402	0.21	1353.12	33.76
Junc G636	1318	0.2442	0.37	1353.09	34.96
Junc G637	1318	0.1499	0.22	1352.89	34.76
Junc G638	1320	0.0403	0.06	1352.9	32.88
Junc G639	1319	0.063	0.09	1352.89	33.79
Junc G640	1319	0.0695	0.1	1352.89	33.68
Junc G641	1320	0.4173	0.63	1352.87	32.86
Junc G642	1321	0.2334	0.35	1353.23	32.46
Junc G643	1320	0.1241	0.19	1353.53	33.45
Junc G644	1320	0.1616	0.24	1353.53	33.45
Junc G645	1320	0.141	0.21	1353.23	33.24
Junc G646	1320	0.207	0.31	1353.22	33.39
Junc G647	1321	0.1272	0.19	1353.31	32.32
Junc G648	1321	0.0862	0.13	1353.33	32.33
Junc G649	1322	0.237	0.36	1353.33	31.29
Junc G650	1321	0.0582	0.09	1353.34	31.99
Junc G651	1322	0.1675	0.25	1353.44	31.9
Junc G652	1322	0.1863	0.28	1353.33	31.1
Junc G653	1322	0.1371	0.21	1353.44	31.21
Junc G654	1322	0.1491	0.22	1353.59	31.99
Junc G655	1322	0.1242	0.19	1353.59	31.5
Junc G656	1322	0.2542	0.38	1353.98	32.02
Junc G657	1323	0.1393	0.21	1355.13	32.54
Junc G658	1322	0.1721	0.26	1355.18	32.89
Junc G659	1323	0.1759	0.26	1355.15	32.11
Junc G660	1323	0.1214	0.18	1355.25	32.36
Junc G661	1322	0.0333	0.05	1355.18	33.1

Junc G662	1322	0.1566	0.23	1355.18	33.19
Junc G663	1340	0.1745	0.26	1356.46	16.49
Junc G664	1335	0.0453	0.07	1356.73	22.07
Junc G665	1332	0.1795	0.27	1356.73	25.22
Junc G666	1338	0	0	1358.38	20.59
Junc G667	1327	0	0	1357.29	30.78
Junc G668	1326	0	0	1357.09	30.8
Junc G669	1326	0.0875	0.13	1356.84	30.75
Junc G670	1326	0.1145	0.17	1356.61	30.87
Junc G671	1325	0.0539	0.08	1355.93	31.2
Junc G672	1325	0	0	1356.31	31.32
Junc G673	1325	0	0	1356.7	31.4
Junc G674	1325	0.0651	0.1	1356.23	30.99
Junc G675	1325	0.0924	0.14	1355.18	30.63
Junc G676	1324	0.0848	0.13	1355.18	31.35
Junc G677	1324	0.1967	0.3	1355.15	31.52
Junc G678	1325	0.1537	0.23	1355.14	30.49
Junc G679	1324	0	0	1355.31	30.85
Junc G680	1324	0	0	1355.24	31.03
Junc G681	1325	0	0	1355.14	30.2
Junc G682	1326	0	0	1354.99	29.01
Junc G683	1326	0	0	1354.99	29.01
Junc G684	1326	0	0	1354.91	28.71
Junc G685	1326	0.0773	0.12	1353.36	27.78
Junc G686	1326	0.1227	0.18	1353.47	27.53
Junc G687	1325	0.0773	0.12	1353.35	27.85
Junc G688	1325	0.0736	0.11	1353.35	28.53
Junc G689	1324	0.2144	0.32	1353.32	29.26
Junc G690	1324	0.1665	0.25	1353.34	28.87
Junc G691	1319	0	0	1354.63	35.24
Junc G692	1324	0.1237	0.19	1352.8	29.05
Junc G693	1322	0	0	1354.48	32.68
Junc G694	1322	0	0	1354.5	32.42
Junc G695	1322	0.0846	0.13	1353.59	31.87
Junc G696	1323	0.1043	0.16	1352.6	29.89
Junc G697	1323	0.1282	0.19	1352.59	29.28
Junc G698	1322	0.2896	0.43	1352.57	30.1
Junc G699	1323	0.2222	0.33	1353.34	30.08
Junc G700	1323	0.2444	0.37	1353.32	29.92
Junc G701	1320	0.1254	0.19	1353.32	33.2
Junc G702	1320	0.0983	0.15	1353.52	33.4
Junc G703	1320	0.1763	0.26	1353.52	33.14
Junc G704	1322	0.1394	0.21	1353.52	31.8
Junc G705	1320	0	0	1354.34	34.64

Junc G706	1318	0	0	1354.08	36.05
Junc G707	1318	0	0	1354.08	36.04
Junc G708	1318	0.0427	0.06	1353.57	35.77
Junc G709	1318	0.0713	0.11	1353.51	35.87
Junc G710	1316	0.0818	0.12	1353.2	36.96
Junc G711	1317	0.0863	0.13	1353.2	36.47
Junc G712	1316	0.0727	0.11	1353.08	37.09
Junc G713	1315	0.0948	0.14	1353.08	37.64
Junc G714	1315	0.2901	0.44	1353.08	37.9
Junc G715	1316	0.0706	0.11	1353.12	36.79
Junc G716	1317	0.0699	0.1	1353.27	36.63
Junc G717	1317	0.061	0.09	1353.23	36.59
Junc G718	1315	0.2675	0.4	1353.25	37.89
Junc G719	1317	0.1701	0.26	1353.19	36.01
Junc G720	1316	0.1712	0.26	1353.54	38.02
Junc G721	1315	0.0676	0.1	1352.37	37.09
Junc G722	1315	0.1413	0.21	1352.35	37.53
Junc G723	1315	0.1121	0.17	1352.34	37.8
Junc G724	1314	0.3283	0.49	1352.3	38.05
Junc G725	1314	0.1285	0.19	1352.33	37.98
Junc G726	1314	0	0	1354.08	40.39
Junc G727	1314	0.542	0.81	1352.66	38.3
Junc G728	1335	0	0	1356.28	21.03
Junc G729	1337	0.6221	0.93	1354.15	16.8
Junc G730	1338	0.4012	0.6	1354.12	16.55
Junc G731	1333	0	0	1355.55	22.44
Junc G732	1333	0.0525	0.08	1355.22	22.6
Junc G733	1333	0	0	1352.61	20
Junc G734	1332	0.5151	0.77	1351.74	19.81
Junc G735	1332	0.965	1.45	1351.51	19.32
Junc G736	1341	0	0	1358.6	17.25
Junc G737	1342	0.071	0.11	1355.71	13.49
Junc G738	1342	0.0853	0.13	1355.64	13.95
Junc G739	1342	0.025	0.04	1355.51	13.53
Junc G740	1341	0.0219	0.03	1355.5	14.63
Junc G741	1336	0.0601	0.09	1355.4	18.92
Junc G742	1336	0.0444	0.07	1355.4	19.06
Junc G743	1323	0.0512	0.08	1354.59	31.36
Junc G744	1323	0.1111	0.17	1354.6	31.16
Junc G745	1323	0.3285	0.49	1354.59	32.02
Junc G746	1325	0.1939	0.29	1354.58	29.15
Junc G747	1321	0.1134	0.17	1354.41	32.94
Junc G748	1335	0.1567	0.24	1355.66	21.07
Junc G749	1342	0.1138	0.17	1355.72	13.7

Junc G750	1343	0.3235	0.49	1356.51	13.53
Junc G751	1342	0.1384	0.21	1356.51	14.94
Junc G752	1342	0.0804	0.12	1356.51	14.84
Junc G753	1342	0	0	1358.82	17.05
Junc G754	1344	0	0	1359.11	15
Junc G755	1344	0.2511	0.38	1358.81	14.74
Junc G756	1344	0.2097	0.31	1357.07	13.31
Junc G757	1344	0.0836	0.13	1356.79	12.74
Junc G758	1344	0.1448	0.22	1356.79	12.57
Junc G759	1339	0.1574	0.24	1356.41	17.87
Junc G760	1344	0	0	1358.76	14.29
Junc G761	1344	0	0	1358.98	14.59
Junc G762	1345	0	0	1359.19	14.39
Junc G763	1344	0.2774	0.42	1358.35	14.15
Junc G764	1325	0.0504	0.08	1354.89	30.38
Junc G765	1324	0.1359	0.2	1354.89	30.92
Junc G766	1300	0.6054	0.91	1316.4	16.4
Junc G767	1300	0.2755	0.41	1316.41	16.41
Junc G768	1300	0.2339	0.35	1316.49	16.87
Junc G769	1300	0.1199	0.18	1316.69	17.07
Junc G770	1300	0.1049	0.16	1317.61	17.99
Junc G771	1300	0.1343	0.2	1317.29	16.86
Junc G772	1300	0.1306	0.2	1317.45	17.02
Junc G773	1300	0.2171	0.33	1317.66	17.69
Junc G774	1300	0.3923	0.59	1317.71	17.53
Junc G775	1300	0.2056	0.31	1317.9	17.4
Junc G776	1322	0.0545	0.08	1354.41	32.82
Junc G777	1321	0.1927	0.29	1354.19	32.73
Junc G778	1321	0.0546	0.08	1354.11	32.64
Junc G779	1305	0.2224	0.33	1344.63	40.05
Junc G780	1305	0.0604	0.09	1344.68	39.91
Junc G781	1301	0.0429	0.06	1317.79	16.41
Junc G782	1301	0.1163	0.17	1333.14	31.69
Junc G783	1338	0.046	0.07	1355.99	17.64
Junc G784	1342	0.1335	0.2	1355.99	14.26
Junc G785	1332	0.1203	0.18	1355.85	23.92
Junc G786	1328	0.2128	0.32	1355.84	27.92
Junc G787	1300	0.1407	0.21	1316.44	16.1
Junc G788	1299	0.0681	0.1	1317.77	18.43
Junc G789	1300	0.068	0.1	1317.85	18.19
Junc G790	1300	0.0996	0.15	1316.44	16.82
Junc G791	1299	0.1415	0.21	1316.45	17
Junc G792	1300	0	0	1319.11	19.45
Junc G793	1299	0	0	1319.02	19.94

Junc G794	1300	0.0482	0.07	1316.7	17.01
Junc G795	1300	0.1453	0.22	1316.67	16.92
Junc G796	1300	0.129	0.19	1317.9	17.46
Junc G797	1300	0.1374	0.21	1317.91	17.51
Junc G799	1300	0.1026	0.15	1317.93	18.26
Junc G800	1300	0.1249	0.19	1317.95	17.62
Junc G801	1299	0.0428	0.06	1317.93	18.47
Junc G802	1300	0.0933	0.14	1317.89	17.93
Junc G803	1300	0.1247	0.19	1317.96	17.74
Junc G804	1300	0.0491	0.07	1318.08	17.85
Junc G805	1300	0.1361	0.2	1318.18	17.72
Junc G806	1299	0.1413	0.21	1316.51	17.06
Junc G807	1299	0.0781	0.12	1316.52	17.27
Junc G808	1299	0.0847	0.13	1316.51	17.48
Junc G809	1299	0.0835	0.13	1316.51	17.47
Junc G810	1299	0.1134	0.17	1316.57	17.75
Junc G811	1300	0.0586	0.09	1317.81	18.03
Junc G812	1299	0.083	0.12	1317.82	18.35
Junc G813	1300	0.2311	0.35	1317.9	17.45
Junc G814	1341	0.0272	0.04	1355.5	14.85
Junc G815	1341	0.2877	0.43	1355.7	14.34
Junc G816	1322	0.0133	0.02	1354.41	32.46
Junc G817	1322	0.038	0.06	1354.41	32.48
Junc G818	1322	0.0205	0.03	1354.4	32.35
Junc G819	1322	0.0088	0.01	1354.4	32.38
Junc G820	1322	0.0807	0.12	1354.4	32.34
Junc G821	1321	0.03	0.05	1353.33	32.04
Junc G822	1321	0.2459	0.37	1353.33	32.06
Junc G823	1319	0.2228	0.33	1353.3	34.45
Junc G824	1320	0.1821	0.27	1353.4	33.78
Junc G825	1318	0.1429	0.21	1353.4	35.22
Junc G826	1321	0.1653	0.25	1353.08	32.47
Junc G827	1321	0.2623	0.39	1353.08	32.52
Junc G828	1337	0.0734	0.11	1356.06	18.84
Junc G829	1337	0.2695	0.4	1356.04	19.43
Junc G830	1338	0.323	0.48	1356.04	18.12
Junc G831	1338	0	0	1357.47	19.69
Junc G832	1319	0.2855	0.43	1353.57	34.43
Junc G833	1317	0.1475	0.22	1353.76	36.34
Junc G834	1331	0.4315	0.65	1345.72	15.2
Junc G835	1332	0.2878	0.43	1347.28	15.49
Junc G836	1330	0.8617	1.29	1343.5	13.46
Junc G837	1330	0.6325	0.95	1343.41	13.32
Junc G838	1331	0	0	1348.62	17.65

Junc G840	1331	0.0295	0.04	1347.63	16.78
Junc G842	1331	0.0384	0.06	1347.65	16.73
Junc G844	1331	0.0616	0.09	1347.65	16.66
Junc G846	1331	0.0586	0.09	1347.63	16.67
Junc G848	1324	0	0	1346.53	22.19
Junc G849	1314	0.2671	0.4	1342.8	28.91
Junc G850	1316	0.1009	0.15	1343.79	28.19
Junc G851	1316	0.0203	0.03	1343.8	28.01
Junc G852	1316	0.0133	0.02	1335.95	20.07
Junc G853	1316	0.0854	0.13	1335.95	20.07
Junc G854	1306	0.8204	1.23	1342.21	36.42
Junc G855	1317	0.3228	0.48	1342.17	25.23
Junc G856	1305	0.1107	0.17	1342.22	37.33
Junc G857	1306	0.2081	0.31	1342.22	36.71
Junc G858	1304	0.0368	0.06	1342.27	38.24
Junc G859	1304	0.0506	0.08	1342.27	38.19
Junc G860	1304	0.0504	0.08	1342.3	38.75
Junc G861	1303	0.384	0.58	1342.27	38.8
Junc G862	1303	0.0976	0.15	1342.43	39.52
Junc G863	1303	0.2394	0.36	1342.43	39.4
Junc G864	1304	0.1627	0.24	1342.43	38.56
Junc G865	1303	0.094	0.14	1342.49	39.27
Junc G866	1303	0.1484	0.22	1333.19	30.25
Junc G867	1306	0.1062	0.16	1330.89	24.9
Junc G868	1304	0.2482	0.37	1332.6	28.22
Junc G869	1307	0.0605	0.09	1332.57	25.46
Junc G870	1307	0.114	0.17	1332.57	25.39
Junc G871	1303	0.1153	0.17	1331.13	28.24
Junc G872	1303	0.0381	0.06	1330.87	28.11
Junc G873	1303	0.0859	0.13	1330.87	28.13
Junc G874	1301	0.2112	0.32	1317.78	16.34
Junc G875	1299	0	0	1318.77	20.06
Junc G876	1300	0.1327	0.2	1316.92	17.18
Junc G877	1299	0	0	1318.96	20.06
Junc G878	1299	0	0	1319.03	19.94
Junc G879	1301	0.2199	0.33	1317.87	16.37
Junc G880	1301	0.1052	0.16	1317.8	17.17
Junc G881	1301	0.1282	0.19	1316.46	15.78
Junc G882	1301	0.1836	0.28	1316.46	15.74
Junc G883	1299	0.0817	0.12	1316.52	17.23
Junc G884	1301	0.0498	0.07	1317.69	16.7
Junc G885	1301	0.1579	0.24	1317.68	16.52
Junc G886	1301	0.1171	0.18	1333.56	32.17
Junc G888	1301	0.0256	0.04	1333.11	32.36

Junc G889	1301	0.0899	0.13	1333.11	32.16
Junc G890	1302	0.1026	0.15	1333.1	31.33
Junc G891	1301	0.2404	0.36	1332.37	31.7
Junc G892	1302	0.1836	0.28	1332.68	31.01
Junc G894	1301	0.1344	0.2	1332.49	31.25
Junc G896	1301	0.1829	0.27	1332.49	31.11
Junc G898	1303	0.0653	0.1	1333.84	30.7
Junc G899	1312	0.5917	0.89	1329.47	16.97
Junc G900	1312	0.0883	0.13	1329.9	17.74
Junc G901	1312	0.015	0.02	1330.3	18.61
Junc G902	1312	0.0543	0.08	1330.3	18.62
Junc G903	1312	0.1809	0.27	1330.29	18.75
Junc G904	1312	0.2132	0.32	1331.07	18.87
Junc G905	1312	0.058	0.09	1330.92	19.34
Junc G906	1311	0.4228	0.63	1330.89	19.78
Junc G907	1312	0.022	0.03	1330.91	19.35
Junc G908	1312	0.0211	0.03	1330.91	19.36
Junc G909	1311	0.0112	0.02	1330.91	19.57
Junc G910	1311	0.0134	0.02	1330.91	19.57
Junc G911	1311	0.2363	0.35	1330.91	19.76
Junc G912	1312	0.2382	0.36	1333.78	21.57
Junc G913	1312	0.0346	0.05	1333.78	22.18
Junc G914	1312	0.1921	0.29	1334.68	22.51
Junc G915	1311	0.0645	0.1	1334.64	23.15
Junc G916	1311	0.3307	0.5	1334.63	23.44
Junc G917	1312	0.03	0.05	1334.64	23.13
Junc G918	1312	0.3355	0.5	1334.68	22.56
Junc G919	1312	0.2439	0.37	1334.67	22.88
Junc G920	1308	0.0592	0.09	1337.31	28.99
Junc G921	1309	0.1493	0.22	1337.31	28.6
Junc G922	1312	0.0553	0.08	1335	23.15
Junc G923	1311	0.135	0.2	1335	24
Junc G924	1312	0.0601	0.09	1334.9	22.49
Junc G925	1312	0.0543	0.08	1334.89	22.56
Junc G926	1313	0.4174	0.63	1334.88	22.35
Junc G927	1312	0.1145	0.17	1334.89	22.45
Junc G928	1311	0.1937	0.29	1334.88	23.77
Junc G929	1312	0.1119	0.17	1329.89	17.98
Junc G930	1312	0.094	0.14	1329.69	18.13
Junc G931	1312	0.0686	0.1	1329.69	17.92
Junc G932	1311	0.0442	0.07	1329.61	18.19
Junc G933	1312	0.3634	0.55	1329.6	18
Junc G934	1311	0.4729	0.71	1329.6	18.26
Junc G935	1311	0.7596	1.14	1328.26	17.69

Junc G936	1301	0.056	0.08	1331.9	31.03
Junc G937	1301	0.0986	0.15	1331.9	31.11
Junc G938	1314	0.6981	1.05	1330.41	16.22
Junc G939	1296	0.0253	0.04	1328.96	33.07
Junc G940	1297	0.0436	0.07	1328.95	32.43
Junc G941	1297	0.0664	0.1	1327.77	30.59
Junc G942	1308	0.043	0.06	1327.78	20.06
Junc G943	1307	0.1885	0.28	1327.78	21.27
Junc G944	1297	0.0873	0.13	1328.03	31.05
Junc G945	1295	0.0578	0.09	1328.05	32.75
Junc G946	1295	0.0242	0.04	1328.09	32.92
Junc G947	1295	0.0105	0.02	1328.09	32.85
Junc G948	1295	0.0389	0.06	1328.09	32.87
Junc G949	1295	0.0712	0.11	1328.1	32.65
Junc G950	1295	0.0779	0.12	1328.13	33.39
Junc G951	1295	0.074	0.11	1328.1	33.13
Junc G952	1295	0.0464	0.07	1328.09	32.89
Junc G953	1295	0.0124	0.02	1328.09	32.88
Junc G954	1295	0.0162	0.02	1328.09	32.83
Junc G955	1297	0.035	0.05	1328.25	31.34
Junc G956	1297	0.1886	0.28	1328.24	31.6
Junc G957	1313	0.0666	0.1	1327.87	15.26
Junc G958	1313	0.0339	0.05	1328.87	15.71
Junc G959	1313	0.3149	0.47	1328.86	15.59
Junc G960	1313	0.0464	0.07	1328.87	15.98
Junc G961	1313	0.3837	0.58	1328.89	15.67
Junc G962	1308	0.2879	0.43	1328.76	20.59
Junc G963	1307	0.171	0.26	1328.74	21.89
Junc G964	1304	0.0883	0.13	1328.73	24.83
Junc G965	1301	0.1415	0.21	1328.44	27.68
Junc G966	1305	0.0484	0.07	1332.6	27.99
Junc G967	1303	0.1759	0.26	1331.7	28.75
Junc G968	1341	0.0417	0.06	1355.51	14.68
Junc G969	1328	0	0	1347.42	19.07
Junc G971	1328	0.8101	1.22	1341.8	13.56
Junc G973	1333	0.9827	1.47	1352.69	20.08
Junc G974	1332	0.1506	0.23	1352.83	20.59
Junc G975	1333	0.4101	0.62	1352.79	19.83
Junc G976	1323	0.2642	0.4	1342.05	19.33
Junc G977	1325	1.031	1.55	1341.7	16.27
Junc G978	1322	0.6968	1.05	1341.99	20.35
Junc G979	1322	0.2313	0.35	1341.69	19.97
Junc G980	1309	0	0	1336.12	27.39
Junc G981	1309	0.5565	0.83	1333.73	24.85

Junc G982	1299	0.0686	0.1	1317.89	18.88
Junc G983	1300	0.0725	0.11	1317.88	18.13
Junc G984	1312	0.3365	0.5	1334.81	22.6
Junc G985	1313	0.6809	1.02	1329.54	16.13
Junc G986	1334	1.3788	2.07	1349.31	15.53
Junc Bansbari1	1356	0	0	1373.97	17.97
Junc TO_A-2.1	1356	69.8	104.7	1373.93	17.93
Junc Bansbari2	1345	0	0	1372.48	27.97
Junc Bansbari3	1333	0	0	1370.73	37.28
Junc To_A-2.3	1332	70.2	105.3	1370.27	38.27
Junc To_A-2.4	1345	41.32	61.98	1372.3	27.68
Junc To_A-2.5	1332	46.36	69.54	1370.18	38.36
Junc G228B	1297	0	0	1332.81	35.58
Junc G228C	1297	0	0	1329.24	32.01
Junc Bansbari4	1345	0	0	1372.45	27.89
Junc Bansbari6	1322	0	0	1370.68	48.22
Junc Bansbari8	1315	0	0	1368.56	53.17
Junc Bansbari12	1310	0	0	1366.43	56.44
Junc Bansbari13	1301	0	0	1320.45	19.08
Junc Bansbari5	1344	0	0	1359.44	15
Junc Bansbari7	1333	0	0	1370.46	37.82
Junc Bansbari14	1330	0	0	1368.97	38.66
Junc Bansbari15	1324	0	0	1366.46	42.87
Junc Bansbari9	1308	0	0	1364.98	56.69
Junc Bansbari11	1307	0	0	1359.57	52.28
Junc Bansbari18	1302	0.1	0.15	1331.86	29.87
Junc Bansbari19	1307	0	0	1338.17	30.88
Junc Bansbari10	1309	43.05	64.57	1363.84	54.87
Junc Bansbari20	1342	0	0	1372.21	30.21
Junc I308	1341	36.12	54.18	1371.98	30.98
Junc 1	1344	0.0851	0.13	1359.1	15
Junc 2	1342	0.1192	0.18	1356.51	14.74
Junc 3	1341	0.1166	0.17	1356.16	14.81
Junc 4	1338	0.1478	0.22	1356.06	18.28
Junc 5	1337	0.031	0.05	1356.06	19.54
Junc 6	1335	0.2865	0.43	1356.28	21.03
Junc 7	1333	0.3771	0.57	1352.87	19.75
Junc 8	1333	0.0525	0.08	1352.83	20.22
Junc 9	1332	0	0	1355.16	22.92
Junc 10	1334	0	0	1354.32	20.42
Junc 11	1328	0	0	1354.15	26.34
Junc 12	1322	0	0	1354.08	31.88
Junc 13	1312	0	0	1354.08	41.59
Junc 14	1312	0.0732	0.11	1352.17	39.98

Junc 15	1313	0.2514	0.38	1352.16	39.5
Junc 16	1313	0.401	0.6	1352.13	39.53
Junc 17	1314	0.3468	0.52	1352.33	38.64
Junc 18	1318	0.1365	0.2	1353.95	35.92
Junc 19	1318	0.1503	0.23	1354.07	36.03
Junc 20	1320	0.263	0.39	1353.6	33.9
Junc 21	1322	0.071	0.11	1353.59	31.8
Junc 22	1322	0.0984	0.15	1352.68	30.61
Junc 23	1319	0.1637	0.25	1352.81	33.42
Junc 24	1326	0.2068	0.31	1353.33	27.12
Junc 25	1326	0.0445	0.07	1353.42	27.44
Junc 26	1326	0.085	0.13	1353.45	27.47
Junc 27	1325	0.1656	0.25	1353.91	28.97
Junc 28	1324	0.0577	0.09	1355.04	30.83
Junc 29	1324	0.0776	0.12	1355.26	30.8
Junc 30	1325	0.1118	0.17	1355.93	30.94
Junc 31	1325	0.0673	0.1	1356.23	30.94
Junc 32	1326	0.0587	0.09	1356.61	30.32
Junc 33	1327	0.1114	0.17	1356.84	30.33
Junc 34	1338	0.2419	0.36	1358.38	20.59
Junc 35	1344	0.1301	0.2	1358.24	13.77
Junc 36	1344	0.0693	0.1	1358.38	13.99
Junc 37	1345	0.2198	0.33	1358.63	13.83
Junc 38	1333	0.3005	0.45	1352.61	20
Junc 39	1332	0	0	1351.74	19.81
Junc 40	1334	0	0	1349.3	15.34
Junc 41	1313	0	0	1348.14	35.24
Junc 42	1310	0	0	1347.63	37.57
Junc 43	1310	0	0	1347.08	37.24
Junc 44	1311	0	0	1346.3	35.26
Junc 45	1311	0	0	1346.22	35.35
Junc 46	1311	0	0	1346.1	35.53
Junc 47	1311	0	0	1345.79	35.09
Junc 48	1307	0	0	1345.28	38.1
Junc 49	1306	0	0	1345.03	38.8
Junc 50	1305	0	0	1344.79	40.22
Junc 51	1304	0	0	1344.7	40.45
Junc 52	1304	0	0	1344.68	40.83
Junc 53	1304	0	0	1344.66	40.98
Junc 54	1306	0	0	1344.62	39.07
Junc 55	1309	0	0	1344.56	35.2
Junc 56	1317	0	0	1344.69	27.81
Junc 57	1315	0	0	1344.74	29.54
Junc 58	1312	0	0	1344.93	33.06

Junc 59	1309	0.0691	0.1	1345	35.67
Junc 60	1310	0.3087	0.46	1343.46	33.82
Junc 61	1313	0.1848	0.28	1341.98	29.46
Junc 62	1314	0.1972	0.3	1341.73	27.26
Junc 63	1324	0.1706	0.26	1341.27	16.92
Junc 64	1324	0.1252	0.19	1341.25	16.9
Junc 65	1328	0.2889	0.43	1341.95	13.6
Junc 66	1329	0.4521	0.68	1343.48	14.04
Junc 67	1331	0.1497	0.22	1346.14	15.64
Junc 68	1331	0.0694	0.1	1347.61	16.65
Junc 69	1331	0.191	0.29	1348.8	18.25
Junc 70	1332	0.3754	0.56	1348.7	16.98
Junc 71	1312	0.293	0.44	1337.17	25
Junc 72	1313	0	0	1337.09	24.26
Junc 73	1311	0	0	1336.84	25.8
Junc 74	1311	0	0	1336.67	26.1
Junc 75	1310	0	0	1336.59	26.99
Junc 76	1311	0	0	1336.4	25.69
Junc 77	1308	0	0	1336.33	27.89
Junc 78	1308	0	0	1336.26	28.06
Junc 79	1308	0	0	1336.15	28.49
Junc 80	1307	0	0	1336.06	28.85
Junc 81	1307	0	0	1336.01	29.02
Junc 82	1308	0	0	1335.9	28.3
Junc 83	1306	0	0	1335.73	29.51
Junc 84	1306	0	0	1335.66	29.9
Junc 85	1302	0.0367	0.06	1330.88	28.42
Junc 86	1301	0.1906	0.29	1330.88	29.54
Junc 87	1301	0.2078	0.31	1330.92	29.79
Junc 88	1301	0.1205	0.18	1331.17	29.82
Junc 89	1301	0.1071	0.16	1332.01	30.83
Junc 90	1301	0.1077	0.16	1332.65	31.24
Junc 91	1301	0.2018	0.3	1334.81	33.64
Junc 92	1302	0.2222	0.33	1333.64	32.09
Junc 93	1301	0.1476	0.22	1333.47	32.15
Junc 94	1302	0.1636	0.25	1333.42	31.71
Junc 95	1302	0.2191	0.33	1333.31	31.31
Junc 96	1303	0.2266	0.34	1333.31	30.7
Junc 97	1303	0.7487	1.12	1334.94	32.11
Junc 98	1307	0.8746	1.31	1333.78	26.58
Junc 99	1309	0.2274	0.34	1333.77	25.05
Junc 100	1309	0.2932	0.44	1334.01	25.47
Junc 101	1309	0.3214	0.48	1334.5	25.79
Junc 103	1308	0.1688	0.25	1338.29	30

Junc 104	1312	0	0	1337.63	25.62
Junc 105	1313	0	0	1337.02	24.07
Junc 106	1315	0	0	1336.27	21.07
Junc 107	1316	0	0	1336.08	20.2
Junc 108	1314	0.1197	0.18	1335.72	21.56
Junc 109	1308	0	0	1334.71	27.2
Junc 110	1306	0	0	1334.49	28.64
Junc 111	1304	0	0	1333.79	30.15
Junc 112	1304	0	0	1333.76	29.83
Junc 113	1304	0	0	1333.75	29.91
Junc 114	1304	0	0	1333.73	29.98
Junc 115	1304	0	0	1333.72	29.46
Junc 116	1303	0	0	1333.68	30.91
Junc 117	1301	0	0	1333.58	32.1
Junc 118	1302	0	0	1333.56	31.92
Junc 119	1301	0	0	1333.54	32.1
Junc 120	1300	0	0	1333.43	32.93
Junc 121	1298	0	0	1333.39	35.16
Junc 122	1298	0	0	1333.38	35.13
Junc 123	1298	0	0	1333.43	35.56
Junc 124	1308	0	0	1339.52	32
Junc 125	1310	0	0	1336.06	26.36
Junc 126	1309	0	0	1333.22	24.24
Junc 127	1307	0	0	1329.65	22.47
Junc 128	1307	0	0	1329.55	22.91
Junc 129	1307	0	0	1329.45	22.24
Junc 130	1297	0	0	1329.32	31.87
Junc 131	1295	0	0	1329.19	34.26
Junc 132	1295	0	0	1329.22	34.48
Junc 133	1295	0	0	1329.23	34.42
Junc 134	1295	0	0	1329.26	33.78
Junc 135	1296	0	0	1329.3	33.34
Junc 136	1296	0	0	1329.3	33.42
Junc 137	1297	0	0	1329.31	32.69
Junc 139	1302	0	0	1320.05	18.48
Junc 140	1300	0	0	1319.8	19.37
Junc 141	1300	0	0	1319.79	19.36
Junc 142	1300	0.1701	0.26	1316.49	16.82
Junc 143	1300	0.232	0.35	1316.52	16.86
Junc 144	1299	0.0596	0.09	1316.68	17.6
Junc 145	1299	0.0246	0.04	1316.7	17.62
Junc 146	1299	0.0942	0.14	1316.92	18.02
Junc 147	1299	0.0808	0.12	1317.89	19.17
Junc 148	1299	0.0514	0.08	1318.36	19.58

Junc 149	1299	0.1491	0.22	1318.7	19.82
Junc 150	1299	0.2512	0.38	1317.89	18.83
Junc 151	1300	0	0	1318.76	18.34
Junc 152	1301	0	0	1318.81	17.44
Junc 153	1302	0	0	1318.86	16.5
Junc 154	1303	0	0	1318.88	15.81
Junc 155	1301	0	0	1318.93	17.6
Junc 156	1301	0	0	1319.64	18.47
Junc 102	1324	0	0	1355.25	31.04
Junc 157	1324	0	0	1355.26	31.05
Junc 158	1321	0	0	1354.4	32.93
Junc 159	1322	0	0	1354.07	31.88
Junc 160	1316	0	0	1354.06	37.82
Junc 161	1331	0	0	1348.85	18.3
Junc 162	1332	0	0	1347.36	15.35
Junc 163	1323	0	0	1345.98	22.78
Junc 164	1311	0	0	1345.79	35.09
Junc 165	1311	0	0	1345.79	35.08
Junc 166	1323	0	0	1345.78	22.58
Junc 167	1332	0	0	1346.17	14.27
Junc 168	1332	0	0	1347.35	15.34
Junc 169	1297	0	0	1329.31	32.69
Junc 170	1309	0	0	1329.93	20.93
Junc 171	1314	0	0	1330.42	16.23
Junc 172	1312	0	0	1334.69	22.51
Junc 173	1307	0	0	1329.64	22.46
Junc 174	1308	0	0	1329.43	21.51
Junc 175	1298	0	0	1329.17	30.7
Junc 176	1295	0	0	1329.19	34.25
Junc 177	1313	0	0	1337.01	24.07
Junc 178	1304	0	0	1334.1	30.2
Junc 179	1303	0	0	1331.7	28.94
Junc 180	1303	0	0	1331.7	28.94
Junc 181	1303	0	0	1333.8	31.04
Junc 182	1304	0	0	1333.78	30.15
Junc 183	1304	0	0	1333.78	30.15
Junc 184	1301	0	0	1333.58	32.6
Junc 185	1302	0	0	1333.6	32.06
Junc 186	1301	0	0	1333.59	32.48
Junc 188	1301	0	0	1332.3	31.33
Junc 189	1298	0	0	1333.38	35.13
Junc 190	1298	0	0	1333.35	35.1
Junc 191	1300	0	0	1332.53	32.74
Junc 192	1301	0	0	1333.36	32.12

Junc 193	1301	0	0	1333.33	32.08
Junc 194	1300	0	0	1332.54	32.27
Junc 195	1302	0	0	1333.34	31.52
Junc 138	1307	0.1313	0.2	1337.69	30.5
Junc 196	1307	0.3445	0.52	1338.17	30.88
Junc 197	1310	0	0	1332.99	23
Resvr Bansbari	1374	#N/A	-704.25	1374.4	0

6.3.2 Design of DNI Zone - H (A 2.5)

The DNI-H model has been designed and the model features are prepared accordingly. DNI-H has been designed using inside diameters (66.8mm, 80.4mm and 98.6mm) for HDPE PE100-PN6 pipes and the diameters (150mm, 200mm & 250mm) for DI pipes. After optimizing the pipe diameters for HDPE & DI pipes, all 552 demand nodes have pressure head between 20m & 40m and 03 demand nodes have pressure between 40m & 50m.

The demarcation of DNI-H Boundary is shown in **Figure 6.3** and DNI-H Design Model at Peak Demand (7.00) is shown in **Figure 6.4.**

The details of DNI-H/Pipe material & length/Bulk Meter, Isolation Valves, PRVs/PRVs with Set pressure/Location of Air Valve, Washout Valve & Fire hydrants are shown in the **Tables 6.8/6.9/6.10/6.11/6.12** respectively.

Figure 6.3: Demarcation of DNI zone - H Boundary

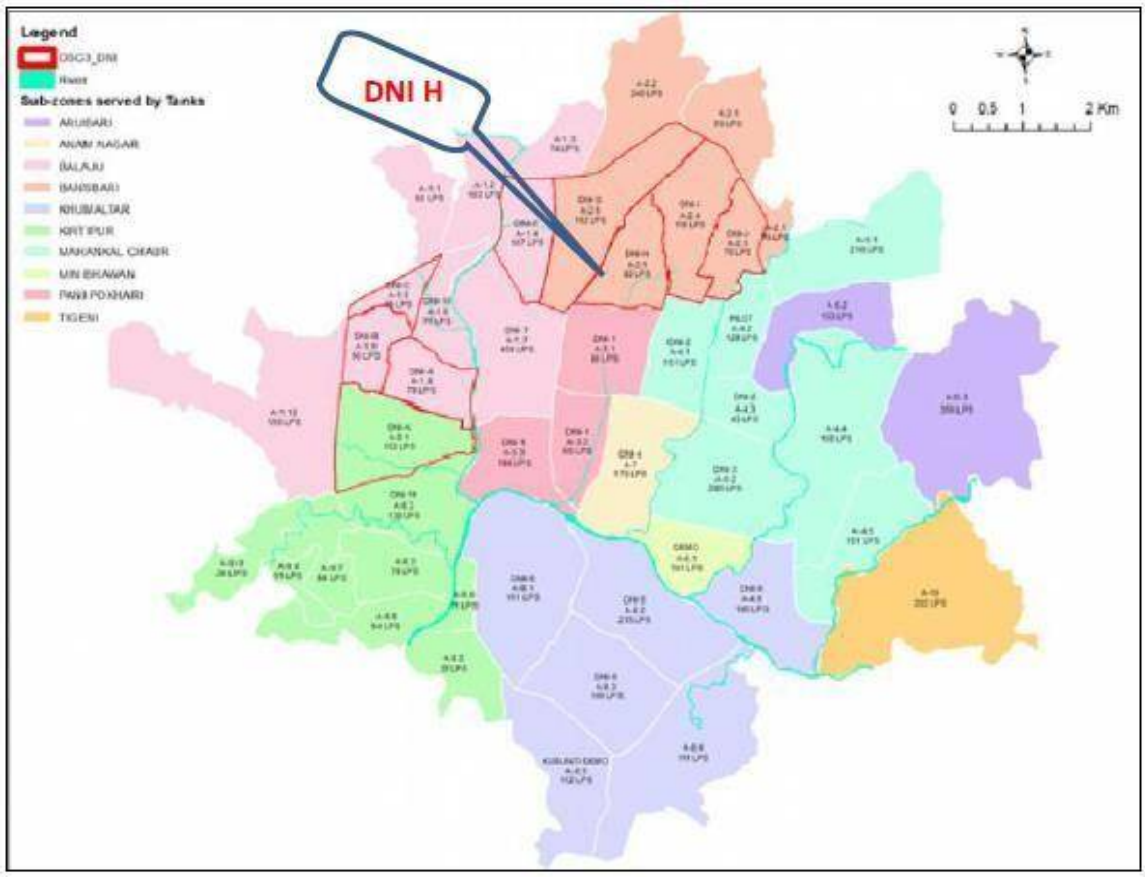


Table 6.8: Design of DNI Zone - H

Description	
Reservoir	Bansbari
Outlet Elevation of the Reservoir (m)	1374.40
Total Demand (LPS)	81.97
Total number of nodes	555
Total Number of Pipes	674
Total Length of Pipes	42,152
Number of PRVs	03
Number of Pumps	0
At Peak Time (7:00) - Only for HDPE pipes within DNI	
Number of Nodes have Pressure < 5m	0
Number of Nodes have Pressure [5m,10m]	0
Number of Nodes have Pressure [20m,40m]	552
Number of Nodes have Pressure [40m,50m]	03
Number of Nodes have Pressure [50m,60m]	0
Number of Nodes have Pressure > 60m	0
At Lowest Demand Time (1:00) - Only for HDPE pipes within DNI	
Number of Nodes have Pressure < 5m	0
Number of Nodes have Pressure [5m,10m]	0
Number of Nodes have Pressure [20m,40m]	544
Number of Nodes have Pressure [40m,50m]	08
Number of Nodes have Pressure [50m,60m]	0
Number of Nodes have Pressure > 60m	0

Table 6.9: Details of Pipe material and length

Pipe Length of DNI-H (m)	
Reservoir	Bansbari
Pipe Diameter (mm)	Length (m)
HDPE PIPE-PE100, PN6	
66.80 (75)	19,618.50
80.40 (90)	13.552
98.60 (110)	918.50
DI PIPE	
150	4,796
200	819.50
250	16.50
Grand Total	39,721

Table 6.10: Details of Bulk Meter/Isolation Valve/PRV's

LOCATION OF BM/IV/PRV FOR DNI_H									
DNI	DMA	# Bulk Meter	Size of BM	# Isolation Valve	Size of IV	# PRV	Size of PRV	From_Junc	To_Junc
H	1	1	250	3	250	1	250	1	H001
H	2	1	150	3	150	1	150	BANSBARI26	H119
H	3	1	250	3	250	1	250	BANSBARI0	H014

Table 6.11: Details of PRV's with Set Pressure

DNI	DMA	# PRV	Size of PRV	Set pressure (m)	From_Junc	To_Junc
H	1	1	250	18	1	H001
H	2	1	150	30	BANSBARI26	H119
H	3	1	250	30	BANSBARI0	H014

Table 6.12: Details of location of Air Valve/Washout Valve/Fire Hydrant

LOCATION OF AV/IV/WV/FH FOR DNI_H				
DNI	# Air Valve	# Wash out Valve	# Fire Hydrant	
	Provide at Junction	Provide at Junction	Provide at Junction	On pipe dia (mm)
H	H001	H034	H001	150 DI PIPE
	H006	H064	H005	150 DI PIPE
	H013	H052	H009	150 DI PIPE
	H014	H081	H014	150 DI PIPE
	H200	H094	H195	150 DI PIPE
	H449	H111	H198	150 DI PIPE
	H207	H090	H449	150 DI PIPE
	H232	H602	H205	150 DI PIPE
	H216	H191	H208	150 DI PIPE
	H219	H146	H232	150 DI PIPE
	H223	H331	H214	150 DI PIPE
	H119	H339	H218	150 DI PIPE
	H047	H416	H220	150 DI PIPE
	H031	H436	H223	150 DI PIPE
	H114	H445	H604	150 DI PIPE
	H105	H403	H041	150 DI PIPE
	H091	H396	H015	150 DI PIPE
	H153	H315	H105	110 HDPE PIPE
	H145	H470	H091	110 HDPE PIPE
	H132	H488	H156	110 HDPE PIPE
		H517	H137	150 DI PIPE
		H522	H151	150 DI PIPE
		H118	H237	90 HDPE PIPE
		H272	H380	90 HDPE PIPE
			H433	90 HDPE PIPE
			H508	90 HDPE PIPE
			H174	90 HDPE PIPE
			H056	90 HDPE PIPE
			H020	90 HDPE PIPE

Figure 6.4: DNI Zone - H Design Model at Peak Demand at 7.00 AM

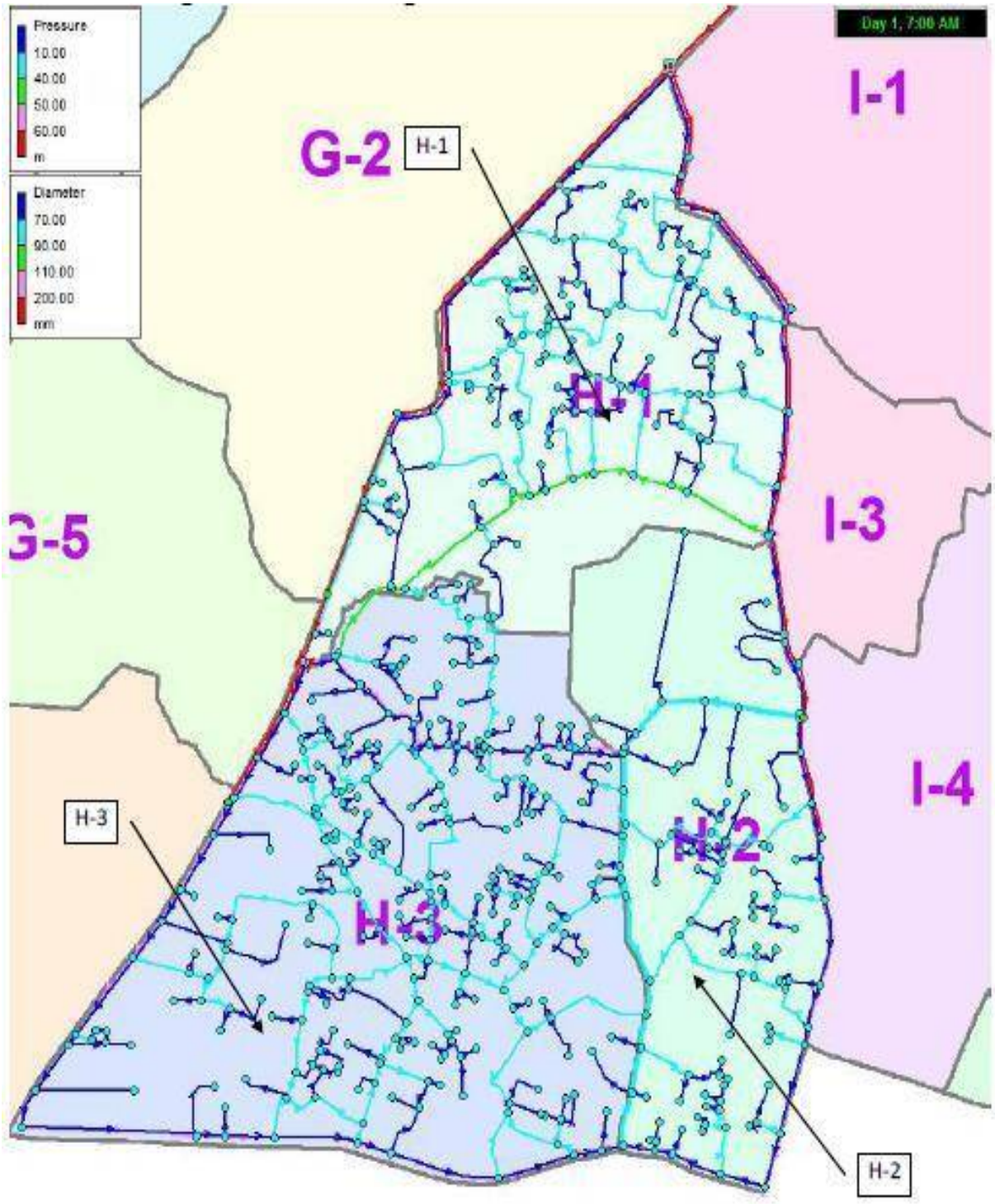


Table 6.13.Details of Pipe Design for DNI H (at peak time 7.00)

Link ID	Length	Diameter	Roughness	Material	Flow	Velocity	Unit Headloss	Friction Factor
	m	mm			LPS	m/s	m/km	
Pipe H328_H329	60.81822	62.2	130	HDPE-PE 100 PN9	0.33	0.11	0.35	0.036
Pipe H328_H147	63.99	62.2	130	HDPE-PE 100 PN10	-2.55	0.84	15.33	0.027
Pipe H326_H328	31.54672	62.2	130	HDPE-PE 100 PN10	-2.03	0.67	10.03	0.027
Pipe H326_H327	20.39199	62.2	130	HDPE-PE 100 PN10	0.11	0.04	0.04	0.041
Pipe H325_H322	104.73	62.2	130	HDPE-PE 100 PN10	-0.3	0.1	0.29	0.036
Pipe H323_H326	23.69105	62.2	130	HDPE-PE 100 PN10	-1.77	0.58	7.81	0.028
Pipe H323_H324	50.20357	62.2	130	HDPE-PE 100 PN10	0.27	0.09	0.25	0.037
Pipe H323_H322	7.73071	62.2	130	HDPE-PE 100 PN10	1.41	0.46	5.1	0.029
Pipe H322_H320	87.71335	62.2	130	HDPE-PE 100 PN10	1.06	0.35	3.02	0.03
Pipe H320_H321	28.6	62.2	130	HDPE-PE 100 PN10	0.28	0.09	0.25	0.037
Pipe H320_H319	29.92727	62.2	130	HDPE-PE 100 PN10	0.88	0.29	2.15	0.031
Pipe H319_H318	12.82336	62.2	130	HDPE-PE 100 PN10	2.14	0.7	11.07	0.027
Pipe H318_H385	26.49089	62.2	130	HDPE-PE 100 PN10	1.07	0.35	3.06	0.03
Pipe H318_H316	19.22	62.2	130	HDPE-PE 100 PN10	3.14	1.03	22.48	0.026
Pipe H316_H317	24.51841	62.2	130	HDPE-PE 100 PN10	0.07	0.02	0.02	0.037
Pipe H316_H290	57.17098	62.2	130	HDPE-PE 100 PN10	2.93	0.97	19.87	0.026
Pipe H312_H311	27.17765	62.2	130	HDPE-PE 100 PN10	-0.09	0.03	0.03	0.047
Pipe H311_H314	46.30715	62.2	130	HDPE-PE 100 PN10	0.25	0.08	0.21	0.037
Pipe H311_H313	34.06609	62.2	130	HDPE-PE 100 PN10	0.13	0.04	0.07	0.043
Pipe H310_H311	38.29472	62.2	130	HDPE-PE 100 PN10	0.65	0.21	1.22	0.033
Pipe H310_H309	96.72237	62.2	130	HDPE-PE 100 PN10	0.75	0.25	1.61	0.032
Pipe H310_H209	34.28	62.2	130	HDPE-PE 100 PN10	-1.75	0.58	7.66	0.028
Pipe H309_H306	14.5028	62.2	130	HDPE-PE 100 PN10	1.3	0.43	4.37	0.029
Pipe H309_H208	113.97	62.2	130	HDPE-PE 100 PN10	-0.99	0.32	2.64	0.031
Pipe H306_H308	56.99954	62.2	130	HDPE-PE 100 PN10	0.17	0.06	0.1	0.04

Pipe H306_H307	55.27867	62.2	130	HDPE-PE 100 PN10	0.36	0.12	0.4	0.035
Pipe H305_H306	115.9636	62.2	130	HDPE-PE 100 PN10	-0.43	0.14	0.57	0.035
Pipe H305_H303	46.41534	62.2	130	HDPE-PE 100 PN10	0.55	0.18	0.88	0.033
Pipe H305_H300	45.21058	62.2	130	HDPE-PE 100 PN10	-0.55	0.18	0.91	0.033
Pipe H303_H304	66.79428	62.2	130	HDPE-PE 100 PN10	0.37	0.12	0.42	0.035
Pipe H303_H302	29.42759	62.2	130	HDPE-PE 100 PN10	0.25	0.08	0.2	0.037
Pipe H303_H237	163.3318	62.2	130	HDPE-PE 100 PN10	-0.44	0.14	0.59	0.034
Pipe H300_H301	28.45625	62.2	130	HDPE-PE 100 PN10	0.14	0.05	0.07	0.04
Pipe H300_H299	32.82642	62.2	130	HDPE-PE 100 PN10	-0.91	0.3	2.27	0.031
Pipe H299_H284	51.70272	62.2	130	HDPE-PE 100 PN10	0.35	0.12	0.39	0.036
Pipe H296_H298	28.56409	62.2	130	HDPE-PE 100 PN10	0.24	0.08	0.19	0.038
Pipe H296_H297	18.5335	62.2	130	HDPE-PE 100 PN10	0.16	0.05	0.09	0.038
Pipe H295_H382	71.06	62.2	130	HDPE-PE 100 PN10	-1.69	0.56	7.16	0.028
Pipe H295_H299	71.08372	62.2	130	HDPE-PE 100 PN10	1.45	0.48	5.4	0.029
Pipe H295_H296	33.45366	62.2	130	HDPE-PE 100 PN10	0.53	0.18	0.84	0.033
Pipe H293_H295	58.84211	62.2	130	HDPE-PE 100 PN10	0.55	0.18	0.89	0.033
Pipe H293_H294	46.66196	62.2	130	HDPE-PE 100 PN10	0.16	0.05	0.09	0.041
Pipe H292_H293	5.856306	62.2	130	HDPE-PE 100 PN10	0.82	0.27	1.88	0.032
Pipe H292_H289	18.72122	62.2	130	HDPE-PE 100 PN10	0.58	0.19	0.99	0.033
Pipe H290_H292	15.95676	62.2	130	HDPE-PE 100 PN10	1.43	0.47	5.27	0.029
Pipe H290_H291	40.22886	62.2	130	HDPE-PE 100 PN10	0.17	0.06	0.11	0.041
Pipe H290_H289	26.41906	62.2	130	HDPE-PE 100 PN10	1.21	0.4	3.88	0.03
Pipe H289_H287	28.78375	62.2	130	HDPE-PE 100 PN10	1.7	0.56	7.19	0.028
Pipe H287_H288	34.2172	62.2	130	HDPE-PE 100 PN10	0.14	0.04	0.07	0.04
Pipe H287_H285	15.16411	62.2	130	HDPE-PE 100 PN10	1.48	0.49	5.61	0.029
Pipe H285_H286	29.31214	62.2	130	HDPE-PE 100 PN10	0.18	0.06	0.11	0.039
Pipe H285_H284	41.84709	62.2	130	HDPE-PE 100 PN10	1.19	0.39	3.75	0.03
Pipe	40.55443	62.2	130	HDPE-PE	1.3	0.43	4.41	0.029

H284_H283				100 PN10				
Pipe H283_H268	69.66914	62.2	130	HDPE-PE 100 PN10	0.09	0.03	0.03	0.043
Pipe H282_H280	49.00208	62.2	130	HDPE-PE 100 PN10	-0.47	0.15	0.66	0.034
Pipe H280_H281	46.48217	62.2	130	HDPE-PE 100 PN10	0.49	0.16	0.72	0.034
Pipe H279_H283	37.8719	62.2	130	HDPE-PE 100 PN10	-0.96	0.32	2.52	0.031
Pipe H279_H280	22.71487	62.2	130	HDPE-PE 100 PN10	1.11	0.37	3.3	0.03
Pipe H277_H279	26.04434	62.2	130	HDPE-PE 100 PN10	0.26	0.09	0.22	0.037
Pipe H277_H278	32.06097	62.2	130	HDPE-PE 100 PN10	0.15	0.05	0.08	0.039
Pipe H275_H277	59.77485	62.2	130	HDPE-PE 100 PN10	0.59	0.19	1.01	0.033
Pipe H275_H276	22.72329	62.2	130	HDPE-PE 100 PN10	0.13	0.04	0.07	0.043
Pipe H271_H274	36.35411	62.2	130	HDPE-PE 100 PN10	0.11	0.04	0.05	0.042
Pipe H271_H273	23.00756	62.2	130	HDPE-PE 100 PN10	0.16	0.05	0.09	0.039
Pipe H271_H272	14.30732	62.2	130	HDPE-PE 100 PN10	0.07	0.02	0.02	0.05
Pipe H269_H271	36.94412	62.2	130	HDPE-PE 100 PN10	0.41	0.14	0.53	0.035
Pipe H269_H270	15.3542	62.2	130	HDPE-PE 100 PN10	0.09	0.03	0.03	0.038
Pipe H268_H269	21.71437	62.2	130	HDPE-PE 100 PN10	0.57	0.19	0.97	0.033
Pipe H268_H266	15.61137	62.2	130	HDPE-PE 100 PN10	-0.58	0.19	0.98	0.033
Pipe H266_H267	43.01809	62.2	130	HDPE-PE 100 PN10	0.1	0.03	0.04	0.043
Pipe H266_H264	12.98239	62.2	130	HDPE-PE 100 PN10	-0.73	0.24	1.51	0.032
Pipe H264_H265	63.61358	62.2	130	HDPE-PE 100 PN10	0.17	0.06	0.1	0.04
Pipe H264_H262	26.23573	62.2	130	HDPE-PE 100 PN10	-0.98	0.32	2.62	0.031
Pipe H262_H263	23.00374	62.2	130	HDPE-PE 100 PN10	0.21	0.07	0.15	0.037
Pipe H262_H260	9.616696	62.2	130	HDPE-PE 100 PN10	-1.25	0.41	4.12	0.03
Pipe H260_H261	41.99033	62.2	130	HDPE-PE 100 PN10	0.22	0.07	0.16	0.038
Pipe H259_H141	38.55736	62.2	130	HDPE-PE 100 PN10	-0.19	0.06	0.12	0.039
Pipe H256_H257	30.38129	62.2	130	HDPE-PE 100 PN10	0.3	0.1	0.28	0.037
Pipe H256_H254	30.28576	62.2	130	HDPE-PE 100 PN10	2.56	0.84	15.45	0.027
Pipe H254_H255	69.83679	62.2	130	HDPE-PE 100 PN10	0.12	0.04	0.06	0.042

Pipe H254_H252	22.64785	62.2	130	HDPE-PE 100 PN10	2.34	0.77	13.05	0.027
Pipe H252_H253	39.00914	62.2	130	HDPE-PE 100 PN10	0.08	0.03	0.03	0.045
Pipe H252_H250	26.70481	62.2	130	HDPE-PE 100 PN10	2.14	0.7	11.08	0.027
Pipe H250_H251	35.57472	62.2	130	HDPE-PE 100 PN10	0.14	0.05	0.07	0.041
Pipe H250_H249	44.10977	62.2	130	HDPE-PE 100 PN10	1.81	0.59	8.09	0.028
Pipe H249_H260	78.71999	62.2	130	HDPE-PE 100 PN10	1.66	0.54	6.89	0.028
Pipe H249_H243	105.2113	62.2	130	HDPE-PE 100 PN10	-0.2	0.07	0.14	0.039
Pipe H245_H247	36.66085	62.2	130	HDPE-PE 100 PN10	0.31	0.1	0.31	0.036
Pipe H245_H246	34.60921	62.2	130	HDPE-PE 100 PN10	0.16	0.05	0.09	0.039
Pipe H244_H245	50.86669	62.2	130	HDPE-PE 100 PN10	0.69	0.23	1.36	0.032
Pipe H244_H124	56.63	62.2	130	HDPE-PE 100 PN10	-3.33	1.1	25.19	0.026
Pipe H243_H244	72.68936	62.2	130	HDPE-PE 100 PN10	-2.26	0.74	12.25	0.027
Pipe H243_H241	46.14032	62.2	130	HDPE-PE 100 PN10	1.82	0.6	8.18	0.028
Pipe H241_H242	35.60521	62.2	130	HDPE-PE 100 PN10	0.28	0.09	0.25	0.037
Pipe H241_H239	20.53079	62.2	130	HDPE-PE 100 PN10	1.37	0.45	4.86	0.029
Pipe H240_H239	38.29777	62.2	130	HDPE-PE 100 PN10	-0.07	0.02	0.02	0.039
Pipe H239_H238	28.89379	62.2	130	HDPE-PE 100 PN10	1.18	0.39	3.68	0.03
Pipe H238_H275	52.8036	62.2	130	HDPE-PE 100 PN10	1	0.33	2.72	0.03
Pipe H237_H238	188.8131	62.2	130	HDPE-PE 100 PN10	0.2	0.06	0.13	0.039
Pipe H235_H237	53.10196	62.2	130	HDPE-PE 100 PN10	1.1	0.36	3.23	0.03
Pipe H235_H236	50.7725	62.2	130	HDPE-PE 100 PN10	0.49	0.16	0.73	0.034
Pipe H235_H233	74.6177	62.2	130	HDPE-PE 100 PN10	-1.77	0.58	7.83	0.028
Pipe H233_H234	91.97296	62.2	130	HDPE-PE 100 PN10	0.36	0.12	0.4	0.036
Pipe H232_H233	83.22	62.2	130	HDPE-PE 100 PN10	2.35	0.77	13.2	0.027
Pipe H231_H211	53.89981	150	110	DI	-0.3	0.02	0.01	0.057
Pipe H230_H492	24.57669	62.2	130	HDPE-PE 100 PN10	0.25	0.08	0.21	0.037
Pipe H230_H231	85.77	62.2	130	HDPE-PE 100 PN10	-1.83	0.6	8.29	0.028
Pipe	73.18435	62.2	130	HDPE-PE	-1.47	0.48	5.5	0.029

H229_H230				100 PN10				
Pipe H228_H229	105.3773	62.2	130	HDPE-PE 100 PN10	-0.01	0	0	0
Pipe H227_H518	66.58136	62.2	130	HDPE-PE 100 PN10	2.3	0.76	12.61	0.027
Pipe H227_H228	250.6837	62.2	130	HDPE-PE 100 PN10	1.4	0.46	5.05	0.029
Pipe H226_H227	115.8032	62.2	130	HDPE-PE 100 PN10	-0.2	0.07	0.14	0.039
Pipe H226_H225	156.5243	62.2	130	HDPE-PE 100 PN10	-0.31	0.1	0.3	0.036
Pipe H224_H225	57.86269	62.2	130	HDPE-PE 100 PN10	1.06	0.35	3.04	0.03
Pipe H224_H223	106.45	62.2	130	HDPE-PE 100 PN10	-1.77	0.58	7.82	0.028
Pipe H223_H222	54.09	150	110	DI	10.31	0.58	3.81	0.033
Pipe H222_H514	134.6	62.2	130	HDPE-PE 100 PN10	0.44	0.15	0.6	0.034
Pipe H222_H221	82.59	150	110	DI	10.31	0.58	3.81	0.033
Pipe H221_H509	108.8	62.2	130	HDPE-PE 100 PN10	2.06	0.68	10.31	0.027
Pipe H220_H221	86.35692	150	110	DI	-7.2	0.41	1.96	0.035
Pipe H219_H220	66.93732	150	110	DI	-7.2	0.41	1.96	0.035
Pipe H218_H219	134.1371	150	110	DI	-7.2	0.41	1.96	0.035
Pipe H217_H480	81.78	62.2	130	HDPE-PE 100 PN10	0.76	0.25	1.64	0.032
Pipe H217_H218	67.8488	150	110	DI	-2.73	0.15	0.33	0.04
Pipe H217_H216	31.17918	150	110	DI	2.73	0.15	0.32	0.04
Pipe H216_H477	61.51	62.2	130	HDPE-PE 100 PN10	0.6	0.2	1.04	0.033
Pipe H216_H215	144.4011	150	110	DI	2.73	0.15	0.33	0.04
Pipe H215_H475	45.42	62.2	130	HDPE-PE 100 PN10	0.93	0.31	2.38	0.031
Pipe H215_H214	87.99	150	110	DI	2.73	0.15	0.33	0.04
Pipe H213_H214	80.18	150	110	DI	-0.3	0.02	0.01	0.058
Pipe H212_H213	85.8258	150	110	DI	-0.3	0.02	0.01	0.054
Pipe H211_H456	14.72	62.2	130	HDPE-PE 100 PN10	0.35	0.11	0.37	0.035
Pipe H211_H212	32.54702	150	110	DI	-0.3	0.02	0	0.047
Pipe H210_H315	60.83	62.2	130	HDPE-PE 100 PN10	0.36	0.12	0.4	0.035
Pipe H210_H232	34.35	150	110	DI	-1.06	0.06	0.06	0.046

Pipe H209_H210	47.97383	150	110	DI	-1.06	0.06	0.06	0.046
Pipe H208_H209	135.2311	150	110	DI	-1.06	0.06	0.06	0.046
Pipe H207_H208	189.0735	150	110	DI	-1.06	0.06	0.06	0.046
Pipe H207_H206	58.62561	150	110	DI	1.06	0.06	0.06	0.048
Pipe H205_H206	144.14	150	110	DI	3.48	0.2	0.51	0.039
Pipe H204_H205	84.89	150	110	DI	6.59	0.37	1.66	0.035
Pipe H203_H449	300.67	150	110	DI	-6.59	0.37	1.66	0.035
Pipe H203_H204	48.49986	150	110	DI	6.59	0.37	1.66	0.035
Pipe H202_H450	171.63	62.2	130	HDPE-PE 100 PN10	1.48	0.49	5.57	0.029
Pipe H202_H201	90.10335	150	110	DI	-10.68	0.6	4.07	0.033
Pipe H201_H451	109.74	62.2	130	HDPE-PE 100 PN10	0.65	0.21	1.21	0.033
Pipe H200_H452	32.46	62.2	130	HDPE-PE 100 PN10	0.88	0.29	2.14	0.031
Pipe H200_H201	19.65502	150	110	DI	10.68	0.6	4.07	0.033
Pipe H199_H424	102.21	62.2	130	HDPE-PE 100 PN10	1.65	0.54	6.86	0.028
Pipe H199_H200	157.988	150	110	DI	10.68	0.6	4.07	0.033
Pipe H198_H422	120.76	62.2	130	HDPE-PE 100 PN10	3.01	0.99	20.89	0.026
Pipe H198_H199	74.73701	150	110	DI	10.68	0.6	4.07	0.033
Pipe H197_H198	60.8084	150	110	DI	18.4	1.04	11.14	0.03
Pipe H196_H365	121.28	62.2	130	HDPE-PE 100 PN10	0.91	0.3	2.29	0.031
Pipe H196_H195	66.63078	150	110	DI	-18.4	1.04	11.14	0.03
Pipe H195_H343	148.88	62.2	130	HDPE-PE 100 PN10	1.59	0.52	6.41	0.028
Pipe H194_H358	82.58	62.2	130	HDPE-PE 100 PN10	0.19	0.06	0.12	0.039
Pipe H194_H195	76.68143	150	110	DI	18.4	1.04	11.14	0.03
Pipe H193_H194	81.81732	150	110	DI	18.4	1.04	11.14	0.03
Pipe H192_H152	98.82	62.2	130	HDPE-PE 100 PN10	-0.29	0.09	0.27	0.037
Pipe H187_H190	47.91004	62.2	130	HDPE-PE 100 PN10	0.18	0.06	0.11	0.039
Pipe H187_H189	16.78039	62.2	130	HDPE-PE 100 PN10	0.1	0.03	0.04	0.048
Pipe	39.22014	62.2	130	HDPE-PE	0.25	0.08	0.21	0.038

H187_H188				100 PN10				
Pipe H185_H186	37.54982	62.2	130	HDPE-PE 100 PN10	0.42	0.14	0.55	0.035
Pipe H183_H185	39.45	62.2	130	HDPE-PE 100 PN10	4.04	1.33	35.92	0.025
Pipe H183_H184	38.31	62.2	130	HDPE-PE 100 PN10	0.45	0.15	0.62	0.034
Pipe H182_H183	164.54	62.2	130	HDPE-PE 100 PN10	-0.66	0.22	1.24	0.032
Pipe H182_H180	50.58	62.2	130	HDPE-PE 100 PN10	2.38	0.78	13.53	0.027
Pipe H180_H181	44.87041	62.2	130	HDPE-PE 100 PN10	0.31	0.1	0.32	0.036
Pipe H180_H178	40.9094	62.2	130	HDPE-PE 100 PN10	1.72	0.57	7.39	0.028
Pipe H178_H179	31.02404	62.2	130	HDPE-PE 100 PN10	0.32	0.11	0.33	0.036
Pipe H178_H177	37.32269	62.2	130	HDPE-PE 100 PN10	1.26	0.42	4.16	0.029
Pipe H177_H187	32.04787	62.2	130	HDPE-PE 100 PN10	0.63	0.21	1.16	0.033
Pipe H177_H176	31.48203	62.2	130	HDPE-PE 100 PN10	0.49	0.16	0.72	0.034
Pipe H176_H185	163.31	62.2	130	HDPE-PE 100 PN10	-3.31	1.09	24.79	0.026
Pipe H175_H174	42.56386	62.2	130	HDPE-PE 100 PN10	-0.15	0.05	0.08	0.04
Pipe H174_H176	65.44367	62.2	130	HDPE-PE 100 PN10	-3.58	1.18	28.74	0.025
Pipe H172_H174	53.14673	62.2	130	HDPE-PE 100 PN10	-3.22	1.06	23.58	0.026
Pipe H172_H173	51.01538	62.2	130	HDPE-PE 100 PN10	0.21	0.07	0.15	0.039
Pipe H170_H172	63.02282	62.2	130	HDPE-PE 100 PN10	-2.68	0.88	16.76	0.026
Pipe H170_H171	45.28383	62.2	130	HDPE-PE 100 PN10	0.29	0.09	0.27	0.037
Pipe H170_H137	22.36	62.2	130	HDPE-PE 100 PN10	2.25	0.74	12.11	0.027
Pipe H169_H164	72.30697	62.2	130	HDPE-PE 100 PN10	-0.39	0.13	0.47	0.035
Pipe H168_H167	12.80957	62.2	130	HDPE-PE 100 PN10	-0.16	0.05	0.09	0.042
Pipe H167_H165	14.24707	62.2	130	HDPE-PE 100 PN10	-0.21	0.07	0.16	0.039
Pipe H165_H166	13.9097	62.2	130	HDPE-PE 100 PN10	0.12	0.04	0.05	0.041
Pipe H165_H164	28.07067	62.2	130	HDPE-PE 100 PN10	-0.4	0.13	0.5	0.035
Pipe H164_H191	77.53208	62.2	130	HDPE-PE 100 PN10	0.2	0.06	0.13	0.039
Pipe H164_H154	67.96	62.2	130	HDPE-PE 100 PN10	-1.33	0.44	4.61	0.029
Pipe H162_H160	25.11275	62.2	130	HDPE-PE 100 PN10	-0.4	0.13	0.49	0.035

Pipe H160_H161	18.88676	62.2	130	HDPE-PE 100 PN10	0.15	0.05	0.08	0.038
Pipe H158_H157	50.19738	62.2	130	HDPE-PE 100 PN10	-0.65	0.21	1.23	0.033
Pipe H156_H182	27.15	62.2	130	HDPE-PE 100 PN10	-1.06	0.35	3.01	0.03
Pipe H156_H157	190.45	62.2	130	HDPE-PE 100 PN10	0.58	0.19	0.99	0.033
Pipe H154_H156	145.39	62.2	130	HDPE-PE 100 PN10	-0.85	0.28	1.99	0.031
Pipe H152_H153	61.37	150	110	DI	-25.17	1.42	19.91	0.029
Pipe H151_H152	66.99	150	110	DI	-25.17	1.42	19.91	0.029
Pipe H149_H151	50.34	150	110	DI	-25.17	1.42	19.91	0.029
Pipe H149_H150	97.74	62.2	130	HDPE-PE 100 PN10	0.25	0.08	0.21	0.038
Pipe H148_H149	46.68	150	110	DI	-25.17	1.42	19.91	0.029
Pipe H148_H147	7.01	150	110	DI	21.56	1.22	14.95	0.03
Pipe H145_H147	31.59	150	110	DI	-11.83	0.67	4.92	0.032
Pipe H145_H146	30.41	62.2	130	HDPE-PE 100 PN10	0.1	0.03	0.04	0.045
Pipe H143_H145	33.85	150	110	DI	-11.83	0.67	4.92	0.032
Pipe H143_H144	55.83	62.2	130	HDPE-PE 100 PN10	0.13	0.04	0.06	0.042
Pipe H141_H143	17.27	150	110	DI	-11.83	0.67	4.91	0.032
Pipe H141_H142	36.73	62.2	130	HDPE-PE 100 PN10	0.14	0.05	0.06	0.039
Pipe H139_H141	38.32	150	110	DI	-11.83	0.67	4.92	0.032
Pipe H139_H140	19.53	62.2	130	HDPE-PE 100 PN10	0.06	0.02	0.02	0.043
Pipe H138_H258	25.52	62.2	130	HDPE-PE 100 PN10	0.18	0.06	0.12	0.04
Pipe H138_H139	6.7	150	110	DI	-11.83	0.67	4.91	0.032
Pipe H137_H138	8.91	150	110	DI	-11.83	0.67	4.93	0.032
Pipe H137_H136	9.93	150	110	DI	14.75	0.83	7.39	0.031
Pipe H136_H256	74.37	62.2	130	HDPE-PE 100 PN10	3.01	0.99	20.85	0.026
Pipe H134_H136	64.34	150	110	DI	-8.62	0.49	2.74	0.034
Pipe H134_H135	16.55	62.2	130	HDPE-PE 100 PN10	0.1	0.03	0.04	0.048
Pipe H132_H134	18.31	150	110	DI	-8.62	0.49	2.73	0.034
Pipe	45.16	62.2	130	HDPE-PE	0.15	0.05	0.08	0.04

H132_H133				100 PN10				
Pipe H130_H132	37.57	150	110	DI	-8.62	0.49	2.74	0.034
Pipe H130_H131	31.71	62.2	130	HDPE-PE 100 PN10	0.2	0.06	0.13	0.038
Pipe H129_H128	35.27	62.2	130	HDPE-PE 100 PN10	-0.2	0.07	0.14	0.039
Pipe H128_H130	17.02	150	110	DI	-8.62	0.49	2.74	0.034
Pipe H127_H248	86.83	62.2	130	HDPE-PE 100 PN10	0.15	0.05	0.09	0.04
Pipe H127_H128	10.72	150	110	DI	-8.62	0.49	2.73	0.034
Pipe H125_H127	18.54	150	110	DI	-8.62	0.49	2.74	0.034
Pipe H125_H126	21.89	62.2	130	HDPE-PE 100 PN10	0.11	0.04	0.05	0.044
Pipe H124_H125	65.28	150	110	DI	-8.62	0.49	2.74	0.034
Pipe H122_H123	69.74133	62.2	130	HDPE-PE 100 PN10	0.34	0.11	0.36	0.036
Pipe H120_H121	266.1947	62.2	130	HDPE-PE 100 PN10	0.67	0.22	1.27	0.032
Pipe H119_H120	238.54	62.2	130	HDPE-PE 100 PN10	0.47	0.15	0.66	0.034
Pipe H118_H117	47.63779	62.2	130	HDPE-PE 100 PN10	-0.16	0.05	0.09	0.04
Pipe H116_H115	123.54	62.2	130	HDPE-PE 100 PN10	-0.33	0.11	0.35	0.036
Pipe H114_H113	74.82601	150	110	DI	-6.75	0.38	1.74	0.035
Pipe H112_H113	166.01	62.2	130	HDPE-PE 100 PN10	-0.29	0.09	0.27	0.037
Pipe H112_H048	75.66326	62.2	130	HDPE-PE 100 PN10	-1.01	0.33	2.78	0.03
Pipe H110_H111	42.78493	62.2	130	HDPE-PE 100 PN10	0.47	0.15	0.66	0.034
Pipe H110_H049	52.96906	62.2	130	HDPE-PE 100 PN10	-0.81	0.27	1.84	0.031
Pipe H109_H112	15.14306	62.2	130	HDPE-PE 100 PN10	-0.86	0.28	2.03	0.031
Pipe H109_H110	38.57286	62.2	130	HDPE-PE 100 PN10	-0.08	0.03	0.02	0.041
Pipe H109_H108	44.7422	62.2	130	HDPE-PE 100 PN10	0.78	0.26	1.7	0.032
Pipe H108_H107	47.25927	62.2	130	HDPE-PE 100 PN10	0.14	0.04	0.07	0.042
Pipe H108_H106	60.02475	62.2	130	HDPE-PE 100 PN10	0.16	0.05	0.09	0.04
Pipe H107_H114	155.06	62.2	130	HDPE-PE 100 PN10	-0.4	0.13	0.49	0.035
Pipe H107_H106	29.88898	62.2	130	HDPE-PE 100 PN10	0.14	0.05	0.07	0.04
Pipe H106_H105	66.52291	62.2	130	HDPE-PE 100 PN10	-0.14	0.05	0.07	0.041

Pipe H103_H104	26.22925	62.2	130	HDPE-PE 100 PN10	0.19	0.06	0.13	0.04
Pipe H103_H101	28.58593	62.2	130	HDPE-PE 100 PN10	0.31	0.1	0.31	0.036
Pipe H101_H102	22.96638	62.2	130	HDPE-PE 100 PN10	0.07	0.02	0.03	0.057
Pipe H100_H101	26.29348	62.2	130	HDPE-PE 100 PN10	-0.11	0.03	0.05	0.046
Pipe H100_H099	94.81162	62.2	130	HDPE-PE 100 PN10	-0.04	0.01	0.01	0.05
Pipe H099_H105	67.52481	62.2	130	HDPE-PE 100 PN10	0.1	0.03	0.04	0.042
Pipe H096_H098	21.66822	62.2	130	HDPE-PE 100 PN10	0.21	0.07	0.16	0.04
Pipe H096_H097	30.724	62.2	130	HDPE-PE 100 PN10	0.15	0.05	0.09	0.041
Pipe H095_H099	37.04483	62.2	130	HDPE-PE 100 PN10	-1.19	0.39	3.75	0.03
Pipe H095_H096	84.53711	62.2	130	HDPE-PE 100 PN10	0.52	0.17	0.81	0.034
Pipe H095_H093	51.49825	62.2	130	HDPE-PE 100 PN10	0.52	0.17	0.8	0.034
Pipe H094_H093	41.20284	62.2	130	HDPE-PE 100 PN10	-0.25	0.08	0.2	0.038
Pipe H092_H093	27.94357	62.2	130	HDPE-PE 100 PN10	-0.17	0.06	0.1	0.041
Pipe H092_H080	114.2523	62.2	130	HDPE-PE 100 PN10	-0.84	0.28	1.97	0.031
Pipe H091_H183	83.78	62.2	130	HDPE-PE 100 PN10	0.27	0.09	0.24	0.037
Pipe H091_H092	30.10144	62.2	130	HDPE-PE 100 PN10	-0.77	0.25	1.66	0.032
Pipe H089_H091	31.1698	62.2	130	HDPE-PE 100 PN10	-0.27	0.09	0.24	0.037
Pipe H089_H090	32.74116	62.2	130	HDPE-PE 100 PN10	0.36	0.12	0.42	0.036
Pipe H086_H088	56.54923	62.2	130	HDPE-PE 100 PN10	0.4	0.13	0.49	0.035
Pipe H086_H087	18.08059	62.2	130	HDPE-PE 100 PN10	0.15	0.05	0.08	0.041
Pipe H084_H086	38.45086	62.2	130	HDPE-PE 100 PN10	0.64	0.21	1.19	0.033
Pipe H084_H085	7.579583	62.2	130	HDPE-PE 100 PN10	0.17	0.06	0.1	0.038
Pipe H082_H083	23.92532	62.2	130	HDPE-PE 100 PN10	0.18	0.06	0.12	0.04
Pipe H082_H006	79.84	62.2	130	HDPE-PE 100 PN10	-0.96	0.32	2.53	0.031
Pipe H080_H081	15.48639	62.2	130	HDPE-PE 100 PN10	0.2	0.06	0.13	0.04
Pipe H078_H077	37.75	62.2	130	HDPE-PE 100 PN10	-0.43	0.14	0.58	0.035
Pipe H077_H082	42.94308	62.2	130	HDPE-PE 100 PN10	-0.49	0.16	0.73	0.034
Pipe	128.385	62.2	130	HDPE-PE	1.26	0.42	4.17	0.029

H077_H080				100 PN10				
Pipe H074_H076	16.87679	62.2	130	HDPE-PE 100 PN10	0.13	0.04	0.06	0.042
Pipe H074_H075	11.5912	62.2	130	HDPE-PE 100 PN10	0.18	0.06	0.12	0.04
Pipe H073_H074	31.56843	62.2	130	HDPE-PE 100 PN10	0.36	0.12	0.4	0.035
Pipe H073_H005	75.53	62.2	130	HDPE-PE 100 PN10	-0.8	0.26	1.8	0.032
Pipe H071_H073	14.99007	62.2	130	HDPE-PE 100 PN10	-0.21	0.07	0.15	0.038
Pipe H071_H072	41.66866	62.2	130	HDPE-PE 100 PN10	0.14	0.05	0.07	0.04
Pipe H070_H077	21.4724	62.2	130	HDPE-PE 100 PN10	0.93	0.31	2.36	0.031
Pipe H070_H071	105.41	62.2	130	HDPE-PE 100 PN10	0.09	0.03	0.03	0.044
Pipe H068_H069	31.10843	62.2	130	HDPE-PE 100 PN10	0.13	0.04	0.06	0.042
Pipe H067_H025	107.5457	62.2	130	HDPE-PE 100 PN10	-0.3	0.1	0.28	0.036
Pipe H066_H068	69.78929	62.2	130	HDPE-PE 100 PN10	-0.6	0.2	1.05	0.033
Pipe H066_H067	26.93548	62.2	130	HDPE-PE 100 PN10	0.14	0.05	0.07	0.039
Pipe H063_H065	44.91291	62.2	130	HDPE-PE 100 PN10	0.18	0.06	0.11	0.039
Pipe H063_H064	19.71993	62.2	130	HDPE-PE 100 PN10	0.11	0.04	0.04	0.036
Pipe H062_H066	104.6089	62.2	130	HDPE-PE 100 PN10	-0.21	0.07	0.15	0.038
Pipe H062_H063	12.81422	62.2	130	HDPE-PE 100 PN10	0.38	0.12	0.45	0.036
Pipe H061_H070	31.45916	62.2	130	HDPE-PE 100 PN10	1.08	0.36	3.12	0.03
Pipe H061_H062	20.47	62.2	130	HDPE-PE 100 PN10	0.23	0.08	0.18	0.038
Pipe H059_H061	34.32725	62.2	130	HDPE-PE 100 PN10	-1.81	0.59	8.09	0.028
Pipe H059_H060	16.67322	62.2	130	HDPE-PE 100 PN10	0.24	0.08	0.19	0.038
Pipe H058_H057	30.27	62.2	130	HDPE-PE 100 PN10	-0.25	0.08	0.21	0.038
Pipe H057_H059	39.05761	62.2	130	HDPE-PE 100 PN10	-1.46	0.48	5.47	0.029
Pipe H056_H103	37.6648	62.2	130	HDPE-PE 100 PN10	0.61	0.2	1.1	0.033
Pipe H056_H057	40.95839	62.2	130	HDPE-PE 100 PN10	-1.31	0.43	4.48	0.029
Pipe H054_H056	42.8037	62.2	130	HDPE-PE 100 PN10	-0.48	0.16	0.69	0.034
Pipe H054_H055	70.02	62.2	130	HDPE-PE 100 PN10	0.37	0.12	0.42	0.035
Pipe H053_H100	65.74479	62.2	130	HDPE-PE 100 PN10	0.28	0.09	0.26	0.037

Pipe H053_H054	18.95204	62.2	130	HDPE-PE 100 PN10	-0.28	0.09	0.25	0.037
Pipe H053_H051	18.48551	62.2	130	HDPE-PE 100 PN10	-0.14	0.05	0.08	0.044
Pipe H051_H052	55.77	62.2	130	HDPE-PE 100 PN10	0.39	0.13	0.47	0.035
Pipe H050_H105	130.6573	62.2	130	HDPE-PE 100 PN10	0.26	0.08	0.22	0.037
Pipe H050_H051	24.19645	62.2	130	HDPE-PE 100 PN10	0.32	0.1	0.33	0.036
Pipe H049_H050	76.81211	62.2	130	HDPE-PE 100 PN10	0.83	0.27	1.91	0.031
Pipe H048_H049	15.68909	62.2	130	HDPE-PE 100 PN10	1.92	0.63	9.08	0.028
Pipe H048_H044	21.24408	62.2	130	HDPE-PE 100 PN10	-3.04	1	21.25	0.026
Pipe H047_H113	119.3341	150	110	DI	6.75	0.38	1.74	0.035
Pipe H047_H045	81.91	62.2	130	HDPE-PE 100 PN10	0.69	0.23	1.35	0.032
Pipe H045_H046	42.94	62.2	130	HDPE-PE 100 PN10	0.24	0.08	0.19	0.037
Pipe H044_H045	55.34606	62.2	130	HDPE-PE 100 PN10	-0.2	0.06	0.13	0.039
Pipe H042_H044	43.23	62.2	130	HDPE-PE 100 PN10	-0.11	0.04	0.05	0.042
Pipe H042_H043	13.60622	62.2	130	HDPE-PE 100 PN10	0.32	0.1	0.33	0.037
Pipe H041_H047	140.3726	150	110	DI	13.82	0.78	6.56	0.032
Pipe H039_H041	54.22	62.2	130	HDPE-PE 100 PN10	-1.2	0.39	3.77	0.03
Pipe H039_H040	56.1399	62.2	130	HDPE-PE 100 PN10	0.42	0.14	0.55	0.035
Pipe H038_H037	31.79953	62.2	130	HDPE-PE 100 PN10	-0.43	0.14	0.58	0.034
Pipe H037_H039	33.4762	62.2	130	HDPE-PE 100 PN10	-0.41	0.14	0.53	0.035
Pipe H036_H042	119.8133	62.2	130	HDPE-PE 100 PN10	0.36	0.12	0.41	0.035
Pipe H036_H037	62.3078	62.2	130	HDPE-PE 100 PN10	0.3	0.1	0.29	0.036
Pipe H033_H035	38.57935	62.2	130	HDPE-PE 100 PN10	0.1	0.03	0.04	0.047
Pipe H033_H034	31.45833	62.2	130	HDPE-PE 100 PN10	0.24	0.08	0.2	0.038
Pipe H032_H033	99.91	62.2	130	HDPE-PE 100 PN10	0.54	0.18	0.87	0.033
Pipe H032_H031	62.35978	150	110	DI	18.19	1.03	10.91	0.03
Pipe H031_H041	202.2788	150	110	DI	13.82	0.78	6.56	0.032
Pipe H030_H029	30.98747	62.2	130	HDPE-PE 100 PN10	-0.13	0.04	0.07	0.043
Pipe	65.03	62.2	130	HDPE-PE	-3.15	1.04	22.69	0.026

H029_H031				100 PN10				
Pipe H028_H036	26.71136	62.2	130	HDPE-PE 100 PN10	0.94	0.31	2.41	0.031
Pipe H028_H029	45.52998	62.2	130	HDPE-PE 100 PN10	-2.68	0.88	16.78	0.026
Pipe H027_H079	85.86916	62.2	130	HDPE-PE 100 PN10	0.57	0.19	0.95	0.033
Pipe H027_H028	4.950984	62.2	130	HDPE-PE 100 PN10	-1.66	0.55	6.94	0.028
Pipe H026_H025	29.18156	62.2	130	HDPE-PE 100 PN10	-0.1	0.03	0.04	0.042
Pipe H025_H027	20.74474	62.2	130	HDPE-PE 100 PN10	-1.02	0.34	2.8	0.03
Pipe H024_H067	86.44912	62.2	130	HDPE-PE 100 PN10	0.03	0.01	0.01	0.053
Pipe H024_H025	102.5325	62.2	130	HDPE-PE 100 PN10	-0.3	0.1	0.29	0.036
Pipe H021_H023	33.02863	62.2	130	HDPE-PE 100 PN10	0.25	0.08	0.22	0.038
Pipe H021_H022	16.43104	62.2	130	HDPE-PE 100 PN10	0.4	0.13	0.48	0.035
Pipe H020_H024	20.64777	62.2	130	HDPE-PE 100 PN10	0.09	0.03	0.03	0.037
Pipe H020_H021	67.15097	62.2	130	HDPE-PE 100 PN10	0.87	0.28	2.07	0.031
Pipe H019_H068	70.43204	62.2	130	HDPE-PE 100 PN10	1.08	0.35	3.1	0.03
Pipe H019_H020	67.79759	62.2	130	HDPE-PE 100 PN10	1.29	0.42	4.31	0.029
Pipe H018_H019	33.30391	62.2	130	HDPE-PE 100 PN10	2.73	0.9	17.41	0.026
Pipe H016_H018	80.15112	62.2	130	HDPE-PE 100 PN10	2.53	0.83	15.12	0.027
Pipe H016_H017	61.50979	62.2	130	HDPE-PE 100 PN10	0.53	0.18	0.84	0.033
Pipe H015_H032	41.29935	150	110	DI	18.19	1.03	10.91	0.03
Pipe H014_H193	85.09	200	110	DI	29.4	0.94	6.54	0.029
Pipe H014_H153	52.51	200	110	DI	28.51	0.91	6.18	0.029
Pipe H013_H155	22.76888	62.2	130	HDPE-PE 100 PN10	0.53	0.18	0.85	0.034
Pipe H012_H163	57.99462	62.2	130	HDPE-PE 100 PN10	0.55	0.18	0.88	0.033
Pipe H012_H013	213.6244	62.2	130	HDPE-PE 100 PN10	-0.93	0.31	2.39	0.031
Pipe H011_H160	39.28023	62.2	130	HDPE-PE 100 PN10	0.65	0.21	1.2	0.033
Pipe H011_H012	11.46073	62.2	130	HDPE-PE 100 PN10	-0.12	0.04	0.05	0.04
Pipe H010_H159	16.42927	62.2	130	HDPE-PE 100 PN10	0.1	0.03	0.04	0.042
Pipe H010_H011	35.3655	62.2	130	HDPE-PE 100 PN10	0.59	0.19	1.01	0.033

Pipe H009_H157	54.11	62.2	130	HDPE-PE 100 PN10	0.31	0.1	0.31	0.036
Pipe H009_H010	70.89	62.2	130	HDPE-PE 100 PN10	0.77	0.25	1.66	0.032
Pipe H009_H008	91.09487	150	110	DI	-6.36	0.36	1.56	0.035
Pipe H008_H089	227.22	62.2	130	HDPE-PE 100 PN10	0.36	0.12	0.41	0.035
Pipe H007_H084	37.08	62.2	130	HDPE-PE 100 PN10	0.94	0.31	2.4	0.031
Pipe H007_H008	50.18056	150	110	DI	6.36	0.36	1.55	0.035
Pipe H006_H007	13.13498	150	110	DI	6.36	0.36	1.56	0.036
Pipe H005_H006	164.19	150	110	DI	13.82	0.78	6.56	0.032
Pipe H004_H018	76.23	62.2	130	HDPE-PE 100 PN10	0.56	0.19	0.94	0.033
Pipe H004_H005	113.8298	150	110	DI	13.82	0.78	6.56	0.032
Pipe H003_H016	18.66	62.2	130	HDPE-PE 100 PN10	3.32	1.09	25.04	0.026
Pipe H003_H004	101.7942	150	110	DI	13.82	0.78	6.56	0.032
Pipe H002_H015	176.32	62.2	130	HDPE-PE 100 PN10	-0.01	0	0	0.192
Pipe H002_H003	46.77199	150	110	DI	18.07	1.02	10.78	0.03
Pipe H001_H015	175.05	150	110	DI	18.19	1.03	10.91	0.03
Pipe H001_H002	217.89	150	110	DI	18.07	1.02	10.78	0.03
Pipe 9	963.65	600	110	DI	330.32	1.17	2.74	0.024
Pipe 8	22.8	300	110	DI	61.98	0.88	3.61	0.028
Pipe 7	50	300	110	DI	105.3	1.49	9.64	0.026
Pipe 6	618	400	110	DI	105.3	0.84	2.37	0.027
Pipe 3	1300	900	110	DI	795.23	1.25	1.93	0.022
Pipe 2	50	500	110	DI	104.7	0.53	0.79	0.027
Pipe 1	470	1000	110	DI	899.93	1.15	1.45	0.022
Pipe H527_H220	42.97	62.2	130	HDPE-PE 100 PN10	-0.33	0.11	0.34	0.036
Pipe H526_H197	27.2	62.2	130	HDPE-PE 100 PN10	-0.37	0.12	0.43	0.035
Pipe H525_H225	110.8246	62.2	130	HDPE-PE 100 PN10	-0.48	0.16	0.68	0.034
Pipe H524_H226	88.63509	62.2	130	HDPE-PE 100 PN10	-0.34	0.11	0.37	0.036
Pipe H522_H521	48.26549	62.2	130	HDPE-PE 100 PN10	-0.35	0.12	0.39	0.036
Pipe H521_H523	29.52574	62.2	130	HDPE-PE 100 PN10	0.15	0.05	0.08	0.041
Pipe H520_H521	25.97101	62.2	130	HDPE-PE 100 PN10	0.63	0.21	1.16	0.033

Pipe H519_H520	68.66353	62.2	130	HDPE-PE 100 PN10	0.58	0.19	0.99	0.033
Pipe H518_H519	24.57992	62.2	130	HDPE-PE 100 PN10	1.63	0.54	6.7	0.028
Pipe H518_H517	59.27493	62.2	130	HDPE-PE 100 PN10	0.43	0.14	0.55	0.035
Pipe H515_H519	45.12874	62.2	130	HDPE-PE 100 PN10	-0.77	0.25	1.68	0.032
Pipe H515_H516	21.30789	62.2	130	HDPE-PE 100 PN10	0.14	0.05	0.07	0.041
Pipe H513_H224	119.8665	62.2	130	HDPE-PE 100 PN10	-0.5	0.16	0.75	0.034
Pipe H511_H520	27.27603	62.2	130	HDPE-PE 100 PN10	0.17	0.06	0.1	0.039
Pipe H511_H512	79.10872	62.2	130	HDPE-PE 100 PN10	0.41	0.14	0.52	0.035
Pipe H509_H510	11.36499	62.2	130	HDPE-PE 100 PN10	0.17	0.06	0.1	0.04
Pipe H509_H508	66.44042	62.2	130	HDPE-PE 100 PN10	1.66	0.55	6.92	0.028
Pipe H508_H511	5.888194	62.2	130	HDPE-PE 100 PN10	0.71	0.23	1.42	0.032
Pipe H506_H508	17.41661	62.2	130	HDPE-PE 100 PN10	-0.9	0.3	2.22	0.031
Pipe H506_H507	25.77199	62.2	130	HDPE-PE 100 PN10	0.08	0.03	0.02	0.044
Pipe H505_H515	52.96514	62.2	130	HDPE-PE 100 PN10	-0.53	0.18	0.85	0.034
Pipe H505_H506	15.63584	62.2	130	HDPE-PE 100 PN10	-0.75	0.25	1.59	0.032
Pipe H504_H503	37.00866	62.2	130	HDPE-PE 100 PN10	-0.23	0.07	0.17	0.038
Pipe H503_H505	25.40245	62.2	130	HDPE-PE 100 PN10	-1.19	0.39	3.71	0.03
Pipe H503_H494	80.12513	62.2	130	HDPE-PE 100 PN10	0.7	0.23	1.4	0.032
Pipe H501_H502	53.61934	62.2	130	HDPE-PE 100 PN10	0.23	0.08	0.17	0.038
Pipe H501_H219	84.39	62.2	130	HDPE-PE 100 PN10	-1.39	0.46	4.99	0.029
Pipe H500_H499	46.98022	62.2	130	HDPE-PE 100 PN10	-0.43	0.14	0.58	0.035
Pipe H499_H501	28.07481	62.2	130	HDPE-PE 100 PN10	-0.92	0.3	2.3	0.031
Pipe H499_H497	34.1568	62.2	130	HDPE-PE 100 PN10	0.33	0.11	0.34	0.036
Pipe H498_H497	18.36575	62.2	130	HDPE-PE 100 PN10	-0.14	0.05	0.07	0.039
Pipe H497_H496	15.87074	62.2	130	HDPE-PE 100 PN10	0.11	0.04	0.04	0.037
Pipe H495_H494	76.01804	62.2	130	HDPE-PE 100 PN10	-0.18	0.06	0.12	0.04
Pipe H494_H493	28.66409	62.2	130	HDPE-PE 100 PN10	0.14	0.05	0.07	0.043
Pipe	89.41141	62.2	130	HDPE-PE	-0.5	0.16	0.75	0.034

H493_H228				100 PN10				
Pipe H491_H490	97.53703	62.2	130	HDPE-PE 100 PN10	-0.67	0.22	1.3	0.032
Pipe H490_H493	121.2101	62.2	130	HDPE-PE 100 PN10	-0.06	0.02	0.01	0.045
Pipe H487_H489	34.17776	62.2	130	HDPE-PE 100 PN10	0.14	0.05	0.07	0.04
Pipe H487_H488	14.26613	62.2	130	HDPE-PE 100 PN10	0.38	0.13	0.46	0.035
Pipe H484_H487	41.02577	62.2	130	HDPE-PE 100 PN10	0.61	0.2	1.1	0.033
Pipe H484_H486	35.50503	62.2	130	HDPE-PE 100 PN10	0.22	0.07	0.16	0.039
Pipe H484_H485	13.41525	62.2	130	HDPE-PE 100 PN10	0.12	0.04	0.06	0.046
Pipe H484_H483	33.68819	62.2	130	HDPE-PE 100 PN10	-1.04	0.34	2.91	0.03
Pipe H483_H490	24.531	62.2	130	HDPE-PE 100 PN10	0.95	0.31	2.46	0.031
Pipe H481_H482	15.96794	62.2	130	HDPE-PE 100 PN10	0.12	0.04	0.06	0.044
Pipe H481_H218	54.71	62.2	130	HDPE-PE 100 PN10	-1.91	0.63	8.95	0.028
Pipe H480_H483	55.51986	62.2	130	HDPE-PE 100 PN10	2.2	0.72	11.68	0.027
Pipe H480_H481	13.9906	62.2	130	HDPE-PE 100 PN10	-1.62	0.53	6.62	0.028
Pipe H479_H477	9.93677	62.2	130	HDPE-PE 100 PN10	-0.26	0.08	0.22	0.039
Pipe H477_H478	12.42645	62.2	130	HDPE-PE 100 PN10	0.26	0.09	0.24	0.039
Pipe H475_H476	60.35776	62.2	130	HDPE-PE 100 PN10	0.51	0.17	0.77	0.034
Pipe H475_H474	14.25695	62.2	130	HDPE-PE 100 PN10	0.24	0.08	0.2	0.039
Pipe H473_H471	24.65902	62.2	130	HDPE-PE 100 PN10	-0.26	0.08	0.22	0.037
Pipe H472_H471	16.16069	62.2	130	HDPE-PE 100 PN10	-0.15	0.05	0.08	0.039
Pipe H471_H469	53.56551	62.2	130	HDPE-PE 100 PN10	-0.5	0.16	0.75	0.034
Pipe H470_H469	42.07327	62.2	130	HDPE-PE 100 PN10	-0.2	0.07	0.14	0.039
Pipe H469_H229	89.79137	62.2	130	HDPE-PE 100 PN10	-1.16	0.38	3.55	0.03
Pipe H466_H468	24.43654	62.2	130	HDPE-PE 100 PN10	0.08	0.03	0.03	0.053
Pipe H466_H467	29.95449	62.2	130	HDPE-PE 100 PN10	0.1	0.03	0.04	0.047
Pipe H464_H466	14.49306	62.2	130	HDPE-PE 100 PN10	0.28	0.09	0.25	0.035
Pipe H464_H465	22.97109	62.2	130	HDPE-PE 100 PN10	0.05	0.02	0.01	0.026
Pipe H461_H463	17.6573	62.2	130	HDPE-PE 100 PN10	0.08	0.03	0.02	0.032

Pipe H461_H462	12.5618	62.2	130	HDPE-PE 100 PN10	0.17	0.06	0.11	0.039
Pipe H460_H464	28.29802	62.2	130	HDPE-PE 100 PN10	0.4	0.13	0.5	0.035
Pipe H460_H461	36.04918	62.2	130	HDPE-PE 100 PN10	0.3	0.1	0.3	0.037
Pipe H460_H213	79.94	62.2	130	HDPE-PE 100 PN10	-0.9	0.3	2.24	0.031
Pipe H459_H212	42.26	62.2	130	HDPE-PE 100 PN10	-0.15	0.05	0.08	0.039
Pipe H456_H458	31.46304	62.2	130	HDPE-PE 100 PN10	0.17	0.06	0.11	0.04
Pipe H456_H457	10.17315	62.2	130	HDPE-PE 100 PN10	0.11	0.04	0.06	0.051
Pipe H454_H455	17.14175	62.2	130	HDPE-PE 100 PN10	-0.12	0.04	0.05	0.04
Pipe H453_H454	20.06727	62.2	130	HDPE-PE 100 PN10	0.2	0.07	0.13	0.038
Pipe H452_H455	23.25049	62.2	130	HDPE-PE 100 PN10	0.34	0.11	0.36	0.036
Pipe H452_H453	15.41324	62.2	130	HDPE-PE 100 PN10	0.37	0.12	0.42	0.036
Pipe H449_H202	66.13	150	110	DI	-10.68	0.6	4.07	0.033
Pipe H448_H203	105.81	62.2	130	HDPE-PE 100 PN10	-0.65	0.21	1.22	0.033
Pipe H447_H204	44.95	62.2	130	HDPE-PE 100 PN10	-0.3	0.1	0.29	0.036
Pipe H446_H401	92.29054	62.2	130	HDPE-PE 100 PN10	-0.29	0.1	0.27	0.037
Pipe H445_H444	76.39	62.2	130	HDPE-PE 100 PN10	-0.53	0.17	0.83	0.034
Pipe H444_H446	62.91	62.2	130	HDPE-PE 100 PN10	0.52	0.17	0.82	0.034
Pipe H444_H437	43.82	62.2	130	HDPE-PE 100 PN10	0.67	0.22	1.29	0.032
Pipe H444_H205	73.62	62.2	130	HDPE-PE 100 PN10	-1.56	0.51	6.17	0.029
Pipe H442_H443	37.45265	62.2	130	HDPE-PE 100 PN10	0.19	0.06	0.13	0.039
Pipe H442_H441	42.28212	62.2	130	HDPE-PE 100 PN10	0.11	0.03	0.04	0.042
Pipe H439_H446	44.76656	62.2	130	HDPE-PE 100 PN10	-0.36	0.12	0.42	0.036
Pipe H439_H440	26.32034	62.2	130	HDPE-PE 100 PN10	0.11	0.04	0.05	0.042
Pipe H438_H442	25.80671	62.2	130	HDPE-PE 100 PN10	0.46	0.15	0.63	0.034
Pipe H438_H439	20.27823	62.2	130	HDPE-PE 100 PN10	-0.16	0.05	0.09	0.038
Pipe H437_H438	31.49973	62.2	130	HDPE-PE 100 PN10	0.4	0.13	0.5	0.035
Pipe H437_H435	81.39207	62.2	130	HDPE-PE 100 PN10	-0.06	0.02	0.01	0.046
Pipe	54.16	62.2	130	HDPE-PE	-0.4	0.13	0.5	0.035

H436_H435				100 PN10				
Pipe H433_H435	46.40319	62.2	130	HDPE-PE 100 PN10	0.34	0.11	0.38	0.036
Pipe H433_H434	35.89505	62.2	130	HDPE-PE 100 PN10	0.18	0.06	0.11	0.04
Pipe H432_H433	9.97978	62.2	130	HDPE-PE 100 PN10	0.68	0.22	1.31	0.032
Pipe H432_H411	175.4934	62.2	130	HDPE-PE 100 PN10	1.19	0.39	3.76	0.03
Pipe H429_H431	54.94684	62.2	130	HDPE-PE 100 PN10	0.47	0.15	0.66	0.034
Pipe H429_H430	38.81236	62.2	130	HDPE-PE 100 PN10	0.57	0.19	0.95	0.033
Pipe H428_H427	47.01515	62.2	130	HDPE-PE 100 PN10	-0.65	0.21	1.23	0.033
Pipe H427_H429	51.03505	62.2	130	HDPE-PE 100 PN10	1.33	0.44	4.57	0.029
Pipe H427_H426	37.66207	62.2	130	HDPE-PE 100 PN10	-2.23	0.74	11.99	0.027
Pipe H426_H423	54.70331	62.2	130	HDPE-PE 100 PN10	-1.37	0.45	4.83	0.029
Pipe H425_H424	33.46135	62.2	130	HDPE-PE 100 PN10	-0.32	0.11	0.33	0.036
Pipe H424_H426	33.93867	62.2	130	HDPE-PE 100 PN10	1.09	0.36	3.17	0.03
Pipe H423_H419	108.3367	62.2	130	HDPE-PE 100 PN10	0.55	0.18	0.89	0.033
Pipe H422_H423	10.91193	62.2	130	HDPE-PE 100 PN10	2.19	0.72	11.59	0.027
Pipe H422_H420	36.62522	62.2	130	HDPE-PE 100 PN10	0.63	0.21	1.13	0.033
Pipe H420_H421	25.38602	62.2	130	HDPE-PE 100 PN10	0.3	0.1	0.29	0.037
Pipe H420_H417	139.8231	62.2	130	HDPE-PE 100 PN10	-0.12	0.04	0.05	0.041
Pipe H417_H418	23.43537	62.2	130	HDPE-PE 100 PN10	0.17	0.06	0.1	0.038
Pipe H417_H415	77.73238	62.2	130	HDPE-PE 100 PN10	-0.41	0.13	0.52	0.035
Pipe H415_H416	44.37017	62.2	130	HDPE-PE 100 PN10	0.29	0.1	0.28	0.036
Pipe H415_H414	50.17	62.2	130	HDPE-PE 100 PN10	-0.97	0.32	2.58	0.031
Pipe H414_H432	39.92859	62.2	130	HDPE-PE 100 PN10	2.09	0.69	10.63	0.027
Pipe H413_H412	17.25234	62.2	130	HDPE-PE 100 PN10	-0.3	0.1	0.3	0.037
Pipe H412_H414	32.07002	62.2	130	HDPE-PE 100 PN10	-2.03	0.67	10.04	0.027
Pipe H412_H380	101.4059	62.2	130	HDPE-PE 100 PN10	1.46	0.48	5.44	0.029
Pipe H411_H387	40.77112	62.2	130	HDPE-PE 100 PN10	0.63	0.21	1.14	0.033
Pipe H408_H410	19.25723	62.2	130	HDPE-PE 100 PN10	0.12	0.04	0.05	0.039

Pipe H408_H409	9.87067	62.2	130	HDPE-PE 100 PN10	0.13	0.04	0.06	0.043
Pipe H407_H411	29.58748	62.2	130	HDPE-PE 100 PN10	-0.31	0.1	0.31	0.036
Pipe H407_H408	14.17691	62.2	130	HDPE-PE 100 PN10	0.28	0.09	0.26	0.038
Pipe H405_H407	41.59719	62.2	130	HDPE-PE 100 PN10	0.16	0.05	0.09	0.04
Pipe H405_H406	61.0899	62.2	130	HDPE-PE 100 PN10	0.28	0.09	0.27	0.037
Pipe H404_H405	8.1705	62.2	130	HDPE-PE 100 PN10	0.58	0.19	0.98	0.033
Pipe H402_H404	31.1039	62.2	130	HDPE-PE 100 PN10	1.36	0.45	4.8	0.029
Pipe H402_H403	30.8127	62.2	130	HDPE-PE 100 PN10	0.24	0.08	0.18	0.037
Pipe H402_H401	67.2877	62.2	130	HDPE-PE 100 PN10	-1.74	0.57	7.51	0.028
Pipe H401_H206	32.01	62.2	130	HDPE-PE 100 PN10	-2.34	0.77	13.04	0.027
Pipe H400_H404	87.87943	62.2	130	HDPE-PE 100 PN10	-0.65	0.21	1.23	0.032
Pipe H400_H399	20.30069	62.2	130	HDPE-PE 100 PN10	0.16	0.05	0.09	0.041
Pipe H398_H400	66.48808	62.2	130	HDPE-PE 100 PN10	-0.3	0.1	0.3	0.036
Pipe H397_H207	96.01	62.2	130	HDPE-PE 100 PN10	-0.57	0.19	0.97	0.033
Pipe H396_H394	61.15112	62.2	130	HDPE-PE 100 PN10	-0.63	0.21	1.14	0.033
Pipe H394_H395	29.36596	62.2	130	HDPE-PE 100 PN10	0.42	0.14	0.55	0.034
Pipe H391_H393	25.01719	62.2	130	HDPE-PE 100 PN10	0.13	0.04	0.06	0.042
Pipe H391_H392	11.78313	62.2	130	HDPE-PE 100 PN10	0.1	0.03	0.04	0.043
Pipe H390_H394	29.88126	62.2	130	HDPE-PE 100 PN10	1.2	0.4	3.81	0.03
Pipe H390_H391	24.00802	62.2	130	HDPE-PE 100 PN10	0.27	0.09	0.24	0.037
Pipe H388_H390	12.70592	62.2	130	HDPE-PE 100 PN10	1.53	0.5	5.93	0.029
Pipe H388_H389	15.96552	62.2	130	HDPE-PE 100 PN10	0.13	0.04	0.07	0.045
Pipe H387_H388	73.29266	62.2	130	HDPE-PE 100 PN10	1.75	0.58	7.67	0.028
Pipe H386_H385	56.27923	62.2	130	HDPE-PE 100 PN10	-0.14	0.04	0.07	0.042
Pipe H385_H383	31.38	62.2	130	HDPE-PE 100 PN10	0.82	0.27	1.89	0.031
Pipe H383_H384	41.75723	62.2	130	HDPE-PE 100 PN10	0.15	0.05	0.08	0.039
Pipe H382_H383	38.36	62.2	130	HDPE-PE 100 PN10	-0.54	0.18	0.87	0.033
Pipe	48.68	62.2	130	HDPE-PE	0.72	0.24	1.48	0.032

H382_H381				100 PN10				
Pipe H381_H387	34.86299	62.2	130	HDPE-PE 100 PN10	1.39	0.46	4.98	0.029
Pipe H380_H382	42.36	62.2	130	HDPE-PE 100 PN10	0.28	0.09	0.26	0.037
Pipe H380_H381	35.20826	62.2	130	HDPE-PE 100 PN10	0.93	0.31	2.36	0.031
Pipe H380_H378	61.17	62.2	130	HDPE-PE 100 PN10	-0.02	0.01	0	0.108
Pipe H378_H379	31.84202	62.2	130	HDPE-PE 100 PN10	0.32	0.11	0.33	0.036
Pipe H378_H374	71.07574	62.2	130	HDPE-PE 100 PN10	-0.56	0.18	0.92	0.033
Pipe H375_H377	50.08864	62.2	130	HDPE-PE 100 PN10	0.33	0.11	0.35	0.036
Pipe H375_H376	26.47818	62.2	130	HDPE-PE 100 PN10	0.06	0.02	0.02	0.053
Pipe H374_H375	43.09513	62.2	130	HDPE-PE 100 PN10	0.57	0.19	0.95	0.033
Pipe H374_H372	38.97778	62.2	130	HDPE-PE 100 PN10	-1.44	0.47	5.32	0.029
Pipe H372_H373	31.74296	62.2	130	HDPE-PE 100 PN10	0.08	0.03	0.03	0.047
Pipe H372_H370	15.92248	62.2	130	HDPE-PE 100 PN10	-1.63	0.54	6.72	0.028
Pipe H370_H371	37.91479	62.2	130	HDPE-PE 100 PN10	0.16	0.05	0.09	0.041
Pipe H370_H366	43.05495	62.2	130	HDPE-PE 100 PN10	-1.88	0.62	8.72	0.028
Pipe H367_H369	11.74145	62.2	130	HDPE-PE 100 PN10	0.09	0.03	0.04	0.053
Pipe H367_H368	9.171624	62.2	130	HDPE-PE 100 PN10	0.05	0.02	0.02	0.074
Pipe H366_H367	9.251444	62.2	130	HDPE-PE 100 PN10	0.16	0.05	0.1	0.04
Pipe H363_H364	37.36903	62.2	130	HDPE-PE 100 PN10	0.08	0.03	0.03	0.047
Pipe H363_H193	54.8	62.2	130	HDPE-PE 100 PN10	-4.19	1.38	38.51	0.025
Pipe H360_H362	36.48429	62.2	130	HDPE-PE 100 PN10	0.18	0.06	0.11	0.039
Pipe H360_H361	30.7298	62.2	130	HDPE-PE 100 PN10	0.05	0.02	0.01	0.038
Pipe H359_H363	16.47405	62.2	130	HDPE-PE 100 PN10	-3.94	1.3	34.35	0.025
Pipe H359_H360	50.18757	62.2	130	HDPE-PE 100 PN10	0.33	0.11	0.36	0.036
Pipe H357_H356	17.79419	62.2	130	HDPE-PE 100 PN10	-0.25	0.08	0.21	0.036
Pipe H356_H359	46.80373	62.2	130	HDPE-PE 100 PN10	-3.52	1.16	27.82	0.025
Pipe H356_H344	48.25173	62.2	130	HDPE-PE 100 PN10	3.17	1.04	22.9	0.026
Pipe H354_H151	82.64	62.2	130	HDPE-PE 100 PN10	-0.17	0.06	0.11	0.039

Pipe H351_H353	47.91989	62.2	130	HDPE-PE 100 PN10	0.13	0.04	0.06	0.04
Pipe H351_H352	18.80957	62.2	130	HDPE-PE 100 PN10	0.07	0.02	0.02	0.037
Pipe H350_H351	39.97617	62.2	130	HDPE-PE 100 PN10	0.33	0.11	0.35	0.036
Pipe H350_H346	16.59935	62.2	130	HDPE-PE 100 PN10	-0.27	0.09	0.25	0.038
Pipe H350_H332	33.26786	62.2	130	HDPE-PE 100 PN10	-0.12	0.04	0.06	0.042
Pipe H347_H349	23.27557	62.2	130	HDPE-PE 100 PN10	0.09	0.03	0.03	0.045
Pipe H347_H348	26.27408	62.2	130	HDPE-PE 100 PN10	0.08	0.02	0.02	0.045
Pipe H346_H347	18.99493	62.2	130	HDPE-PE 100 PN10	0.25	0.08	0.2	0.038
Pipe H346_H345	7.889001	62.2	130	HDPE-PE 100 PN10	-0.56	0.18	0.92	0.033
Pipe H345_H355	52.61991	62.2	130	HDPE-PE 100 PN10	0.13	0.04	0.07	0.042
Pipe H345_H344	43.09373	62.2	130	HDPE-PE 100 PN10	-0.79	0.26	1.74	0.032
Pipe H344_H343	8.853804	62.2	130	HDPE-PE 100 PN10	2.22	0.73	11.88	0.027
Pipe H343_H342	4.849186	62.2	130	HDPE-PE 100 PN10	3.66	1.2	29.89	0.025
Pipe H342_H366	40.153	62.2	130	HDPE-PE 100 PN10	2.24	0.74	12.08	0.027
Pipe H342_H340	79.07741	62.2	130	HDPE-PE 100 PN10	1.33	0.44	4.6	0.029
Pipe H340_H341	48.68484	62.2	130	HDPE-PE 100 PN10	0.21	0.07	0.15	0.039
Pipe H340_H336	33.56784	62.2	130	HDPE-PE 100 PN10	1.02	0.34	2.83	0.03
Pipe H337_H339	12.75719	62.2	130	HDPE-PE 100 PN10	0.2	0.06	0.13	0.038
Pipe H337_H338	9.561321	62.2	130	HDPE-PE 100 PN10	0.07	0.02	0.02	0.033
Pipe H336_H337	17.94853	62.2	130	HDPE-PE 100 PN10	0.29	0.1	0.28	0.037
Pipe H336_H335	50.32546	62.2	130	HDPE-PE 100 PN10	0.58	0.19	0.98	0.033
Pipe H335_H333	41.92728	62.2	130	HDPE-PE 100 PN10	1.61	0.53	6.53	0.028
Pipe H335_H332	155.1101	62.2	130	HDPE-PE 100 PN10	-1.29	0.42	4.34	0.029
Pipe H333_H334	40.77629	62.2	130	HDPE-PE 100 PN10	0.19	0.06	0.12	0.038
Pipe H333_H319	24.40605	62.2	130	HDPE-PE 100 PN10	1.3	0.43	4.4	0.029
Pipe H332_H330	25.83099	62.2	130	HDPE-PE 100 PN10	-1.57	0.52	6.24	0.029
Pipe H330_H331	34.80065	62.2	130	HDPE-PE 100 PN10	0.16	0.05	0.09	0.04
Pipe	81.57	62.2	130	HDPE-PE	-1.95	0.64	9.29	0.028

H330_H148				100 PN10				
Pipe 44	101.9727	150	110	DI	-18.4	1.04	11.14	0.03
Pipe 10	167.23	62.2	130	HDPE-PE 100 PN10	2.49	0.82	14.65	0.027
Pipe 11	49.62	62.2	130	HDPE-PE 100 PN10	1.8	0.59	8.03	0.028
Pipe 12	65.33	62.2	130	HDPE-PE 100 PN10	1.05	0.35	2.96	0.03
Pipe 13	207.87	62.2	130	HDPE-PE 100 PN10	2.04	0.67	10.11	0.027
Pipe 14	141.34	62.2	130	HDPE-PE 100 PN10	0.6	0.2	1.05	0.033
Pipe 15	120.3	62.2	130	HDPE-PE 100 PN10	1.55	0.51	6.11	0.029
Pipe 16	74.55	62.2	130	HDPE-PE 100 PN10	0.6	0.2	1.05	0.033
Pipe 21	54.55	62.2	130	HDPE-PE 100 PN10	1.67	0.55	7	0.028
Pipe 22	83.39	62.2	130	HDPE-PE 100 PN10	0.77	0.25	1.66	0.032
Pipe 23	86.87	62.2	130	HDPE-PE 100 PN10	1.56	0.51	6.2	0.029
Pipe 24	67.29	62.2	130	HDPE-PE 100 PN10	1.04	0.34	2.92	0.03
Pipe 25	138.14	62.2	130	HDPE-PE 100 PN10	-0.66	0.22	1.24	0.032
Pipe 26	67.87	62.2	130	HDPE-PE 100 PN10	1.62	0.53	6.61	0.028
Pipe 27	31.66	62.2	130	HDPE-PE 100 PN10	0.68	0.22	1.34	0.032
Pipe 28	144.54	62.2	130	HDPE-PE 100 PN10	-0.12	0.04	0.05	0.042
Pipe 29	87.94	62.2	130	HDPE-PE 100 PN10	-1.28	0.42	4.27	0.029
Pipe 30	78.15	62.2	130	HDPE-PE 100 PN10	0.94	0.31	2.41	0.031
Pipe 31	86.18	62.2	130	HDPE-PE 100 PN10	-0.27	0.09	0.24	0.037
Pipe 32	32.77	62.2	130	HDPE-PE 100 PN10	-0.57	0.19	0.95	0.033
Pipe 33	54.4	62.2	130	HDPE-PE 100 PN10	-0.96	0.31	2.49	0.031
Pipe 35	33.9	62.2	130	HDPE-PE 100 PN10	2.94	0.97	19.99	0.026
Pipe 36	48.72	62.2	130	HDPE-PE 100 PN10	2.43	0.8	14.06	0.027
Pipe 37	134.83	62.2	130	HDPE-PE 100 PN10	0.54	0.18	0.86	0.033
Pipe 38	190.04	62.2	130	HDPE-PE 100 PN10	-1.19	0.39	3.74	0.03
Pipe 39	58.72	62.2	130	HDPE-PE 100 PN10	-2.3	0.76	12.64	0.027
Pipe 40	143.75	62.2	130	HDPE-PE 100 PN10	-0.38	0.12	0.44	0.035
Pipe 41	83.37	62.2	130	HDPE-PE 100 PN10	0.65	0.21	1.22	0.033
Pipe 42	48.4	62.2	130	HDPE-PE 100 PN10	0.13	0.04	0.06	0.041
Pipe 43	299.62	62.2	130	HDPE-PE 100 PN10	-1.01	0.33	2.76	0.03

Pipe 45	63	62.2	130	HDPE-PE 100 PN10	2.72	0.9	17.3	0.026
Pipe 46	90.19	62.2	130	HDPE-PE 100 PN10	0.59	0.19	1.02	0.033
Pipe 47	19.08	62.2	130	HDPE-PE 100 PN10	-0.38	0.13	0.45	0.035
Pipe 48	158.26	62.2	130	HDPE-PE 100 PN10	-1.34	0.44	4.65	0.029
Pipe 49	74.81	62.2	130	HDPE-PE 100 PN10	-3.54	1.16	28.13	0.025
Pipe 50	60.51	62.2	130	HDPE-PE 100 PN10	0.83	0.27	1.94	0.031
Pipe 51	102.86	62.2	130	HDPE-PE 100 PN10	0.28	0.09	0.26	0.037
Pipe 52	67.35	62.2	130	HDPE-PE 100 PN10	-1.14	0.37	3.43	0.03
Pipe 53	75.18	62.2	130	HDPE-PE 100 PN10	-3.17	1.04	22.97	0.026
Pipe 54	81.56	62.2	130	HDPE-PE 100 PN10	-3.71	1.22	30.74	0.025
Pipe 55	85.57	62.2	130	HDPE-PE 100 PN10	2.85	0.94	18.86	0.026
Pipe 61	100.17	62.2	130	HDPE-PE 100 PN10	-1.38	0.45	4.92	0.029
Pipe 62	54.94	62.2	130	HDPE-PE 100 PN10	-2.22	0.73	11.91	0.027
Pipe 63	12.51	62.2	130	HDPE-PE 100 PN10	-3.27	1.08	24.28	0.026
Pipe 64	162.13	62.2	130	HDPE-PE 100 PN10	-0.36	0.12	0.41	0.035
Pipe 65	114.64	62.2	130	HDPE-PE 100 PN10	-1.69	0.56	7.16	0.028
Pipe 66	100.61	62.2	130	HDPE-PE 100 PN10	-2.61	0.86	15.97	0.026
Pipe 67	48.04	62.2	130	HDPE-PE 100 PN10	-1.84	0.61	8.38	0.028
Pipe 68	208.77	62.2	130	HDPE-PE 100 PN10	-2.21	0.73	11.73	0.027
Pipe 79	34.91	62.2	130	HDPE-PE 100 PN10	-1.4	0.46	5.06	0.029
Pipe 18	64.8	62.2	130	HDPE-PE 100 PN10	-0.55	0.18	0.88	0.033
Pipe 69	18.51	62.2	130	HDPE-PE 100 PN10	-0.67	0.22	1.28	0.033
Pipe 70	10.47	62.2	130	HDPE-PE 100 PN10	-0.9	0.3	2.25	0.031
Pipe 71	16.04	62.2	130	HDPE-PE 100 PN10	-0.98	0.32	2.59	0.031
Pipe 72	36.39	62.2	130	HDPE-PE 100 PN10	-1.06	0.35	3.02	0.03
Pipe 73	18.93	62.2	130	HDPE-PE 100 PN10	-1.15	0.38	3.5	0.03
Pipe 74	64.57	62.2	130	HDPE-PE 100 PN10	-1.37	0.45	4.84	0.029
Pipe 75	9.72	62.2	130	HDPE-PE 100 PN10	1.62	0.53	6.61	0.028
Pipe 76	8.61	62.2	130	HDPE-PE 100 PN10	1.62	0.53	6.57	0.028
Pipe 77	6.39	62.2	130	HDPE-PE 100 PN10	1.41	0.46	5.15	0.029

Pipe 80	38.04	62.2	130	HDPE-PE 100 PN10	1.36	0.45	4.78	0.029
Pipe 81	17.36	62.2	130	HDPE-PE 100 PN10	1.08	0.36	3.12	0.03
Pipe 82	33.74	62.2	130	HDPE-PE 100 PN10	0.98	0.32	2.6	0.031
Pipe 83	28.7	62.2	130	HDPE-PE 100 PN10	0.86	0.28	2.03	0.031
Pipe 84	7.13	62.2	130	HDPE-PE 100 PN10	-2.71	0.89	17.2	0.026
Pipe 85	43.37	62.2	130	HDPE-PE 100 PN10	-1.2	0.39	3.78	0.03
Pipe 86	48.97	62.2	130	HDPE-PE 100 PN10	-1.35	0.45	4.74	0.029
Pipe 87	67.92	62.2	130	HDPE-PE 100 PN10	-1.8	0.59	8.06	0.028
Pipe 88	60.77	62.2	130	HDPE-PE 100 PN10	-2.46	0.81	14.3	0.027
Pipe 89	50.54	62.2	130	HDPE-PE 100 PN10	-2.63	0.87	16.28	0.026
Pipe 34	67.4	62.2	130	HDPE-PE 100 PN10	-0.65	0.21	1.22	0.033
Pipe 78	16.86	400	110	DI	243.45	1.94	11.2	0.023
Pipe 92	166.05	550	110	DI	269.77	1.14	2.87	0.024
Pipe 93	773.42	400	110	DI	146.44	1.17	4.37	0.025
Pipe 94	307.16	400	110	DI	146.44	1.17	4.37	0.025
Pipe 95	114.25	400	110	DI	106.88	0.85	2.44	0.026
Pipe 96	253.23	250	110	DI	48.97	1	5.67	0.028
Pipe 97	333.07	300	110	DI	81.67	1.16	6.02	0.027
Pipe 98	164.03	300	110	DI	81.67	1.16	6.02	0.027
Pipe 99	194.3	300	110	DI	81.67	1.16	6.02	0.027
Pipe 100	213.53	300	110	DI	81.67	1.16	6.02	0.027
Pipe 101	82.82	300	110	DI	81.67	1.16	6.02	0.027
Pipe 102	195.03	250	110	DI	58.12	1.18	7.79	0.027
Pipe 103	150.24	300	110	DI	81.67	1.16	6.02	0.027
Pipe 104	4.86	62.2	110	DI	0.67	0.22	1.75	0.044
Pipe 105	2.89	150	110	DI	13.94	0.79	6.64	0.031
Pipe 106	155.94	62.2	130	HDPE-PE 100 PN10	1.35	0.44	4.73	0.029
Pipe 107	121.14	62.2	130	HDPE-PE 100 PN10	0.69	0.23	1.36	0.032
Pipe 4	31.72	250	110	DI	54.18	1.1	6.84	0.028
Pipe 5	162.56	500	110	DI	159.48	0.81	1.73	0.026
Pipe 20	4.89	400	110	DI	-188.09	1.5	8.28	0.029
Pipe 57	2.19	150	110	DI	5.39	0.3	1.09	0.034
Pipe 58	154.93	150	110	DI	6.75	0.38	1.74	0.035
Pipe 59	96.7	150	110	DI	6.75	0.38	1.74	0.035
Pipe 60	67.7	150	110	DI	6.75	0.38	1.74	0.035
Pipe 90	116.48	150	110	DI	5.24	0.3	1.09	0.036
Pipe 91	29.79	150	110	DI	5.24	0.3	1.09	0.036
Pipe 108	81.47	150	110	DI	5.24	0.3	1.09	0.036
Pipe 109	165.2	150	110	DI	-3.94	0.22	0.64	0.038
Pipe 110	26.75	150	110	DI	-3.94	0.22	0.65	0.038

Pipe 111	147.23	150	110	DI	-3.94	0.22	0.64	0.038
Pipe 112	56.23	150	110	DI	-3.94	0.22	0.64	0.038
Pipe 113	272.51	150	110	DI	-6.36	0.36	1.56	0.035
Pipe 114	104.29	150	110	DI	-6.36	0.36	1.56	0.035
Pipe 115	1.94	150	110	DI	7.06	0.4	1.84	0.034
Pipe 116	1.47	150	110	DI	1.51	0.09	0.1	0.041
Pipe 117	251.09	62.2	130	HDPE-PE 100 PN10	-0.82	0.27	1.89	0.031
Pipe 120	132.37	150	110	DI	6.45	0.36	1.6	0.035
Pipe 121	95.71	150	110	DI	6.45	0.36	1.6	0.035
Pipe 122	194.97	150	110	DI	6.45	0.36	1.6	0.035
Pipe 123	132.64	150	110	DI	6.45	0.36	1.6	0.035
Pipe 124	83.65	150	110	DI	6.45	0.36	1.6	0.035
Pipe 126	0.84	150	110	DI	4.54	0.26	0.71	0.032
Pipe 127	2.31	150	110	DI	2.83	0.16	0.32	0.037
Pipe 128	0.88	150	110	DI	5.39	0.3	1.18	0.037
Pipe 129	2.96	150	110	DI	4.1	0.23	0.65	0.036
Pipe 130	2.15	150	110	DI	7.72	0.44	2.22	0.034
Pipe 132	1.4	150	110	DI	2.43	0.14	0.32	0.049
Pipe 134	87.18	150	110	DI	-2.58	0.15	0.29	0.04
Pipe 135	73.29	150	110	DI	-2.58	0.15	0.29	0.04
Pipe 136	105.33	150	110	DI	-2.58	0.15	0.29	0.041
Pipe 137	143.6	150	110	DI	-2.58	0.15	0.29	0.04
Pipe 138	114.63	150	110	DI	-2.58	0.15	0.29	0.04
Pipe 139	115.67	150	110	DI	-6.76	0.38	1.75	0.035
Pipe 140	99.84	150	110	DI	-8.26	0.47	2.53	0.034
Pipe 141	131.63	150	110	DI	-8.26	0.47	2.53	0.034
Pipe 142	107.99	150	110	DI	-8.26	0.47	2.52	0.034
Pipe 143	2.61	150	110	DI	3.63	0.21	0.57	0.04
Pipe 144	12.22	62.2	130	HDPE-PE 100 PN10	-0.97	0.32	2.56	0.031
Pipe 145	0.68	150	110	DI	2.88	0.16	0.44	0.049
Pipe 163	449.53	150	110	DI	9.73	0.55	3.43	0.033
Pipe 131	0.41	62.2	130	HDPE-PE 100 PN10	0.01	0	0	0
Pipe 146	0.35	62.2	130	HDPE-PE 100 PN10	2.77	0.91	17.86	0.026
Pipe 147	135.35	150	110	DI	4.31	0.24	0.76	0.038
Pipe 149	78.52	62.2	130	HDPE-PE 100 PN10	0.59	0.19	1.03	0.033
Pipe 150	57.22	62.2	130	HDPE-PE 100 PN10	0.35	0.12	0.38	0.036
Pipe 151	0.73	62.2	130	HDPE-PE 100 PN10	-0.25	0.08	0.2	0.036
Pipe 152	1	62.2	130	HDPE-PE 100 PN10	3.07	1.01	21.58	0.026
Pipe 153	137.66	62.2	130	HDPE-PE 100 PN10	0.49	0.16	0.71	0.034
Pipe 154	43.4	62.2	130	HDPE-PE 100 PN10	0.1	0.03	0.04	0.043
Pipe 155	180.44	150	110	DI	0.99	0.06	0.05	0.047

Pipe 158	0.58	62.2	130	HDPE-PE 100 PN10	-4.23	1.39	39.26	0.025
Pipe 159	0.67	62.2	130	HDPE-PE 100 PN10	0.07	0.02	0	0
Pipe 160	1.42	150	110	DI	-7.47	0.42	2.1	0.035
Pipe 161	122.37	62.2	130	HDPE-PE 100 PN10	0.43	0.14	0.56	0.035
Pipe 162	21.79	62.2	130	HDPE-PE 100 PN10	-0.01	0	0	0
Pipe 164	83.53	62.2	130	HDPE-PE 100 PN10	-0.27	0.09	0.24	0.037
Pipe 165	73.28	62.2	130	HDPE-PE 100 PN10	-0.52	0.17	0.8	0.034
Pipe 166	38.15	62.2	130	HDPE-PE 100 PN10	0.09	0.03	0.04	0.044
Pipe 167	158.84	150	110	DI	0.99	0.06	0.05	0.047
Pipe 168	2.55	62.2	130	HDPE-PE 100 PN10	0.85	0.28	1.98	0.031
Pipe 169	2.22	62.2	130	HDPE-PE 100 PN10	2.97	0.98	20.38	0.026
Pipe 170	178.95	150	110	DI	-2.83	0.16	0.35	0.04
Pipe 173	28.72	62.2	130	HDPE-PE 100 PN10	-0.76	0.25	1.64	0.032
Pipe 174	16.13	62.2	130	HDPE-PE 100 PN10	-0.96	0.32	2.51	0.031
Pipe 175	36.46	62.2	130	HDPE-PE 100 PN10	-1.16	0.38	3.55	0.03
Pipe 176	93.07	62.2	130	HDPE-PE 100 PN10	-1.3	0.43	4.42	0.029
Pipe 177	15.06	62.2	130	HDPE-PE 100 PN10	-1.99	0.65	9.67	0.028
Pipe 178	36.85	62.2	130	HDPE-PE 100 PN10	-2.05	0.68	10.25	0.027
Pipe 179	18.31	62.2	130	HDPE-PE 100 PN10	-2.19	0.72	11.57	0.027
Pipe 180	33.89	62.2	130	HDPE-PE 100 PN10	-2.32	0.76	12.87	0.027
Pipe 183	127.8	62.2	130	HDPE-PE 100 PN10	0.86	0.28	2.04	0.031
Pipe 184	1.17	62.2	130	HDPE-PE 100 PN10	0.01	0	0	0
Pipe 185	1.7	62.2	130	HDPE-PE 100 PN10	0.66	0.22	1.23	0.032
Pipe 186	158.25	150	110	DI	9.08	0.51	3.01	0.034
Pipe 187	89.97	150	110	DI	5.54	0.31	1.21	0.036
Pipe 188	1.93	62.2	130	HDPE-PE 100 PN10	1	0.33	2.7	0.031
Pipe 189	1.81	62.2	130	HDPE-PE 100 PN10	4.54	1.49	44.57	0.024
Pipe 190	115.79	62.2	130	HDPE-PE 100 PN10	1.22	0.4	3.89	0.03
Pipe 191	43.36	62.2	130	HDPE-PE 100 PN10	0.94	0.31	2.41	0.031
Pipe 192	0.77	62.2	130	HDPE-PE 100 PN10	-1.15	0.38	3.48	0.029
Pipe 193	0.79	62.2	130	HDPE-PE 100 PN10	2.37	0.78	13.38	0.027
Pipe 194	0.8	150	110	DI	3.11	0.18	0.37	0.035

Pipe 195	298.08	150	110	DI	-0.42	0.02	0.01	0.053
Pipe 196	187.32	150	110	DI	-5.54	0.31	1.21	0.036
Pipe 197	74.21	62.2	130	HDPE-PE 100 PN10	-0.5	0.17	0.76	0.034
Pipe 198	120.54	62.2	130	HDPE-PE 100 PN10	-0.03	0.01	0	0.043
Pipe 199	104.18	62.2	130	HDPE-PE 100 PN10	-0.43	0.14	0.56	0.035
Pipe 200	1.77	62.2	130	HDPE-PE 100 PN10	-0.84	0.28	1.93	0.031
Pipe 201	1.7	62.2	130	HDPE-PE 100 PN10	4.28	1.41	39.92	0.025
Pipe 202	145.14	62.2	130	HDPE-PE 100 PN10	-0.56	0.18	0.92	0.033
Pipe 203	1.37	150	110	DI	4.25	0.24	0.76	0.039
Pipe 204	1.94	150	110	DI	4.38	0.25	0.77	0.037
Pipe 205	26.41	62.2	130	HDPE-PE 100 PN10	-0.36	0.12	0.4	0.035
Pipe 206	1.77	150	110	DI	4.46	0.25	0.84	0.039
Pipe 133	291.57	150	110	DI	1.35	0.08	0.09	0.044
Pipe 207	4.04	150	110	DI	1.35	0.08	0.07	0.037
Pipe 208	1.89	150	110	DI	1.49	0.08	0.08	0.033
Pipe 209	11.19	62.2	130	HDPE-PE 100 PN10	-3.16	1.04	22.76	0.026
Pipe 210	164.29	62.2	130	HDPE-PE 100 PN10	-3.51	1.16	27.73	0.025
Pipe 211	2.22	150	110	DI	-3.34	0.19	0.47	0.039
Pipe 212	180.54	62.2	130	HDPE-PE 100 PN10	2.67	0.88	16.68	0.026
Pipe 213	77.71	62.2	130	HDPE-PE 100 PN10	2.42	0.8	13.9	0.027
Pipe 214	2.27	150	110	DI	-0.65	0.04	0.07	0.142
Pipe 215	65.24	62.2	130	HDPE-PE 100 PN10	-0.65	0.21	1.23	0.032
Pipe 218	41.14	62.2	130	HDPE-PE 100 PN10	-0.54	0.18	0.87	0.033
Pipe 219	92.28	62.2	130	HDPE-PE 100 PN10	2.34	0.77	13.07	0.027
Pipe 220	1.23	150	110	DI	3.61	0.2	0.6	0.043
Pipe 221	1.63	150	110	DI	11	0.62	4.29	0.033
Pipe 118	45.18	62.2	130	HDPE-PE 100 PN10	-1.59	0.52	6.39	0.028
Pipe 119	2.03	150	110	DI	6.36	0.36	1.54	0.035
Pipe 156	1.98	150	110	DI	2.41	0.14	0.23	0.036
Pipe 157	1.36	62.2	130	HDPE-PE 100 PN10	1.23	0.41	3.94	0.029
Pipe 171	1.4	62.2	130	HDPE-PE 100 PN10	7.95	2.62	125.76	0.022
Pipe 172	2.12	150	110	DI	3.11	0.18	0.42	0.04
Pipe 181	1.58	150	110	DI	10.68	0.6	4.05	0.033
Pipe 182	1.45	150	110	DI	4.19	0.24	0.72	0.038
Pipe 216	0.87	150	110	DI	-2.92	0.17	0.51	0.055
Pipe 217	0.45	150	110	DI	6.13	0.35	1.32	0.032
Valve 56	#N/A	250	#N/A		57.91	1.18	24.08	0

Valve 19	#N/A	250	#N/A		41.65	0.85	17.88	0
Valve 17	#N/A	150	#N/A		23.55	1.33	23.25	0

Table 6.14.Details of Pressure for DNI H (at peak time 7.00)

Node ID	Elevation	Base Demand	**Peak Demand (LPS)**	Head	Pressure
	m	LPS	LPS	m	m
Junc To_A-2.5	1332.17	0	0	1368.09	35.92
Junc To_A-2.4	1344	41.32	61.98	1371.12	27.12
Junc To_A-2.3	1332	70.2	105.3	1368.98	36.98
Junc Bansbari3	1333.45	0	0	1369.46	36.01
Junc Bansbari2	1344	0	0	1371.21	27.21
Junc TO_A-2.1	1356	69.8	104.7	1373.68	17.68
Junc Bansbari1	1356	0	0	1373.72	17.72
Junc H527	1307.72	0.217086	0.33	1336.9	29.18
Junc H526	1309.025	0.247772	0.37	1333.96	24.93
Junc H525	1305.96	0.316853	0.48	1336.89	30.93
Junc H524	1305.748	0.227817	0.34	1336.89	31.14
Junc H523	1306.476	0.099685	0.15	1335.83	29.35
Junc H522	1305.535	0.233611	0.35	1335.81	30.28
Junc H521	1305.926	0.088328	0.13	1335.83	29.91
Junc H520	1305.341	0.079336	0.12	1335.86	30.52
Junc H519	1304.195	0.183868	0.28	1335.93	31.74
Junc H518	1303.475	0.15849	0.24	1336.1	32.62
Junc H517	1302.491	0.283674	0.43	1336.06	33.57
Junc H516	1303.618	0.092118	0.14	1335.85	32.24
Junc H515	1303.973	0.067657	0.1	1335.86	31.88
Junc H514	1307.539	0.29451	0.44	1337.51	29.97
Junc H513	1306.737	0.333155	0.5	1337.05	30.32
Junc H512	1306.932	0.273763	0.41	1335.82	28.89
Junc H511	1305.565	0.084709	0.13	1335.87	30.3
Junc H510	1306.819	0.11487	0.17	1336.33	29.51
Junc H509	1306.685	0.150979	0.23	1336.33	29.65
Junc H508	1305.33	0.035924	0.05	1335.87	30.54
Junc H507	1304.768	0.051224	0.08	1335.83	31.07
Junc H506	1304.638	0.047875	0.07	1335.84	31.2
Junc H505	1303.996	0.065155	0.1	1335.81	31.81
Junc H504	1303.398	0.150904	0.23	1335.71	32.31
Junc H503	1303.733	0.173076	0.26	1335.72	31.98
Junc H502	1306.127	0.152149	0.23	1336.29	30.16
Junc H501	1305.85	0.165884	0.25	1336.3	30.45
Junc H500	1305.249	0.288741	0.43	1336.21	30.96
Junc H499	1305.319	0.103539	0.16	1336.23	30.91
Junc H498	1305.525	0.09642	0.14	1336.22	30.7

Junc H497	1305.447	0.049682	0.07	1336.22	30.77
Junc H496	1305.311	0.071661	0.11	1336.22	30.91
Junc H495	1305.044	0.122038	0.18	1335.59	30.55
Junc H494	1303.357	0.252959	0.38	1335.6	32.25
Junc H493	1303.399	0.387045	0.58	1335.6	32.2
Junc H492	1305.814	0.169404	0.25	1336.07	30.25
Junc H491	1307.919	0.448823	0.67	1335.47	27.55
Junc H490	1304.985	0.223094	0.33	1335.6	30.61
Junc H489	1304.725	0.093062	0.14	1335.51	30.79
Junc H488	1304.252	0.256033	0.38	1335.51	31.26
Junc H487	1304.621	0.06034	0.09	1335.52	30.9
Junc H486	1305.53	0.145328	0.22	1335.56	30.03
Junc H485	1305.405	0.077859	0.12	1335.56	30.16
Junc H484	1305.625	0.06112	0.09	1335.56	29.94
Junc H483	1305.352	0.141354	0.21	1335.66	30.31
Junc H482	1306.052	0.079607	0.12	1336.4	30.35
Junc H481	1306.432	0.112157	0.17	1336.4	29.97
Junc H480	1306.585	0.120071	0.18	1336.31	29.72
Junc H479	1308.952	0.170893	0.26	1336.33	27.38
Junc H478	1308.824	0.176405	0.26	1336.33	27.51
Junc H477	1309.015	0.049676	0.07	1336.34	27.32
Junc H476	1308.765	0.337875	0.51	1336.25	27.49
Junc H475	1308.672	0.124712	0.19	1336.3	27.63
Junc H474	1308.493	0.158872	0.24	1336.3	27.8
Junc H473	1307.89	0.171476	0.26	1335.31	27.42
Junc H472	1307.808	0.102881	0.15	1335.31	27.5
Junc H471	1307.698	0.059175	0.09	1335.31	27.61
Junc H470	1306.801	0.133726	0.2	1335.34	28.54
Junc H469	1306.953	0.303959	0.46	1335.35	28.4
Junc H468	1307.792	0.053506	0.08	1336.4	28.61
Junc H467	1307.412	0.069235	0.1	1336.4	28.99
Junc H466	1307.791	0.063943	0.1	1336.4	28.61
Junc H465	1307.59	0.035455	0.05	1336.4	28.81
Junc H464	1307.79	0.045199	0.07	1336.4	28.61
Junc H463	1307.422	0.051464	0.08	1336.41	28.98
Junc H462	1307.562	0.116385	0.17	1336.41	28.84
Junc H461	1307.625	0.034017	0.05	1336.41	28.78
Junc H460	1307.855	0.132593	0.2	1336.42	28.56
Junc H459	1307.014	0.102229	0.15	1336.61	29.6
Junc H458	1306.309	0.116461	0.17	1336.64	30.33
Junc H457	1305.092	0.076177	0.11	1336.64	31.55
Junc H456	1305.585	0.038509	0.06	1336.64	31.06
Junc H455	1310.847	0.142515	0.21	1331.17	20.32
Junc H454	1311.383	0.214309	0.32	1331.17	19.78
Junc H453	1311.553	0.110763	0.17	1331.17	19.62
Junc H452	1311.419	0.120049	0.18	1331.18	19.76
Junc H451	1309.422	0.430762	0.65	1331.11	21.68

Junc H450	1308.52	0.984306	1.48	1330.37	21.85
Junc H449	1308	0	0	1332.42	24.42
Junc H448	1306.397	0.432701	0.65	1331.46	25.07
Junc H447	1305.977	0.199531	0.3	1331.58	25.61
Junc H446	1301.268	0.299209	0.45	1331.18	29.92
Junc H445	1305.848	0.353106	0.53	1331.58	25.73
Junc H444	1304.535	0.244751	0.37	1331.24	26.7
Junc H443	1299.693	0.129966	0.19	1331.14	31.45
Junc H442	1299.786	0.103494	0.16	1331.15	31.36
Junc H441	1299.519	0.07073	0.11	1331.15	31.63
Junc H440	1299.929	0.073508	0.11	1331.16	31.23
Junc H439	1301.616	0.061839	0.09	1331.17	29.55
Junc H438	1302.145	0.070308	0.11	1331.16	29.02
Junc H437	1304.345	0.219061	0.33	1331.18	26.83
Junc H436	1306.463	0.267968	0.4	1331.61	25.15
Junc H435	1302.986	0.188792	0.28	1331.18	28.19
Junc H434	1301.051	0.117873	0.18	1331.19	30.14
Junc H433	1304.122	0.105525	0.16	1331.2	27.08
Junc H432	1304.281	0.147325	0.22	1331.21	26.93
Junc H431	1306.856	0.310115	0.47	1330.45	23.6
Junc H430	1307.388	0.378583	0.57	1330.45	23.06
Junc H429	1307.628	0.195633	0.29	1330.49	22.86
Junc H428	1308.982	0.434508	0.65	1330.66	21.68
Junc H427	1308.388	0.170235	0.26	1330.72	22.33
Junc H426	1308.495	0.148422	0.22	1331.17	22.68
Junc H425	1309.168	0.213405	0.32	1331.27	22.1
Junc H424	1309.097	0.162391	0.24	1331.28	22.18
Junc H423	1308.117	0.184835	0.28	1331.44	23.32
Junc H422	1308.108	0.130706	0.2	1331.56	23.46
Junc H421	1308.591	0.200021	0.3	1331.52	22.92
Junc H420	1308.162	0.296994	0.45	1331.52	23.36
Junc H419	1306.795	0.365861	0.55	1331.34	24.55
Junc H418	1306.402	0.112343	0.17	1331.53	25.13
Junc H417	1306.428	0.079559	0.12	1331.53	25.1
Junc H416	1306.309	0.194891	0.29	1331.56	25.25
Junc H415	1305.692	0.181961	0.27	1331.57	25.88
Junc H414	1303.164	0.10424	0.16	1331.64	28.47
Junc H413	1301.58	0.203064	0.3	1331.31	29.73
Junc H412	1302.908	0.178529	0.27	1331.31	28.41
Junc H411	1298.988	0.170758	0.26	1330.55	31.56
Junc H410	1298.824	0.082843	0.12	1330.54	31.71
Junc H409	1298.937	0.083892	0.13	1330.54	31.6
Junc H408	1298.932	0.020302	0.03	1330.54	31.61
Junc H407	1299.023	0.127481	0.19	1330.54	31.52
Junc H406	1299.486	0.189796	0.28	1330.53	31.04
Junc H405	1299.085	0.091118	0.14	1330.55	31.46
Junc H404	1299.076	0.085738	0.13	1330.55	31.48

Junc H403	1299.201	0.156704	0.24	1330.7	31.5
Junc H402	1299.06	0.091687	0.14	1330.7	31.64
Junc H401	1298.728	0.207952	0.31	1331.21	32.48
Junc H400	1298.515	0.129538	0.19	1330.45	31.93
Junc H399	1298.385	0.104237	0.16	1330.44	32.06
Junc H398	1298.831	0.201709	0.3	1330.43	31.6
Junc H397	1298.487	0.383218	0.57	1330.79	32.3
Junc H396	1298.109	0.419049	0.63	1329.68	31.57
Junc H395	1298.129	0.281947	0.42	1329.74	31.61
Junc H394	1298.298	0.100814	0.15	1329.75	31.46
Junc H393	1298.626	0.08423	0.13	1329.86	31.23
Junc H392	1298.475	0.066577	0.1	1329.86	31.39
Junc H391	1298.467	0.030346	0.05	1329.86	31.4
Junc H390	1298.452	0.034021	0.05	1329.87	31.42
Junc H389	1298.452	0.085165	0.13	1329.94	31.49
Junc H388	1298.523	0.067444	0.1	1329.94	31.42
Junc H387	1298.965	0.173979	0.26	1330.51	31.54
Junc H386	1301.521	0.090171	0.14	1331.96	30.44
Junc H385	1300.612	0.074694	0.11	1331.96	31.35
Junc H384	1301.16	0.102723	0.15	1331.9	30.74
Junc H383	1300.447	0.083743	0.13	1331.9	31.46
Junc H382	1300.373	0.140565	0.21	1330.75	30.38
Junc H381	1299.953	0.173135	0.26	1330.68	30.73
Junc H380	1301.044	0.164236	0.25	1330.76	29.72
Junc H379	1305.306	0.213118	0.32	1331.82	26.52
Junc H378	1303.993	0.149388	0.22	1331.83	27.84
Junc H377	1306.593	0.220079	0.33	1331.84	25.25
Junc H376	1306.459	0.040062	0.06	1331.86	25.4
Junc H375	1306.301	0.119411	0.18	1331.86	25.56
Junc H374	1305.639	0.207219	0.31	1331.9	26.26
Junc H373	1304.453	0.054843	0.08	1332.11	27.65
Junc H372	1305.71	0.07461	0.11	1332.11	26.4
Junc H371	1306.479	0.107168	0.16	1332.21	25.73
Junc H370	1305.78	0.057796	0.09	1332.21	26.43
Junc H369	1304.868	0.060019	0.09	1332.59	27.72
Junc H368	1305.188	0.033169	0.05	1332.59	27.4
Junc H367	1305.437	0.016294	0.02	1332.59	27.15
Junc H366	1305.9	0.13115	0.2	1332.59	26.69
Junc H365	1307.859	0.608476	0.91	1333.67	25.81
Junc H364	1308.48	0.054791	0.08	1336.3	27.82
Junc H363	1307.88	0.112565	0.17	1336.3	28.42
Junc H362	1308.535	0.12119	0.18	1335.71	27.17
Junc H361	1306.636	0.035957	0.05	1335.71	29.08
Junc H360	1307.532	0.065389	0.1	1335.71	28.18
Junc H359	1307.88	0.060457	0.09	1335.73	27.85
Junc H358	1306.91	0.125262	0.19	1335.89	28.98
Junc H357	1306.534	0.169997	0.25	1334.43	27.89

Junc H356	1306.13	0.063611	0.1	1334.43	28.3
Junc H355	1306.029	0.087927	0.13	1333.25	27.22
Junc H354	1307.187	0.116118	0.17	1334.55	27.36
Junc H353	1306.116	0.088197	0.13	1333.22	27.1
Junc H352	1306.141	0.046315	0.07	1333.22	27.08
Junc H351	1305.292	0.087324	0.13	1333.22	27.93
Junc H350	1304.706	0.044363	0.07	1333.24	28.53
Junc H349	1304.421	0.059727	0.09	1333.24	28.82
Junc H348	1304.457	0.05016	0.08	1333.24	28.78
Junc H347	1304.572	0.054818	0.08	1333.24	28.67
Junc H346	1304.876	0.026548	0.04	1333.24	28.37
Junc H345	1305.036	0.063678	0.1	1333.25	28.21
Junc H344	1305.911	0.104044	0.16	1333.32	27.41
Junc H343	1305.944	0.106235	0.16	1333.22	27.27
Junc H342	1305.802	0.055697	0.08	1333.07	27.27
Junc H341	1303.993	0.138413	0.21	1332.7	28.71
Junc H340	1304.141	0.066594	0.1	1332.71	28.57
Junc H339	1303.04	0.130257	0.2	1332.61	29.57
Junc H338	1303.504	0.048725	0.07	1332.61	29.11
Junc H337	1303.293	0.017389	0.03	1332.61	29.32
Junc H336	1303.487	0.099906	0.15	1332.62	29.13
Junc H335	1302.157	0.174082	0.26	1332.57	30.41
Junc H334	1301.591	0.1274	0.19	1332.29	30.7
Junc H333	1301.309	0.078248	0.12	1332.29	30.98
Junc H332	1304.519	0.102988	0.15	1333.24	28.72
Junc H331	1305.802	0.103369	0.16	1333.4	27.6
Junc H330	1304.598	0.148003	0.22	1333.4	28.8
Junc H329	1302.941	0.220549	0.33	1333.03	30.09
Junc H328	1303.226	0.12806	0.19	1333.06	29.83
Junc H327	1302.379	0.073027	0.11	1332.74	30.36
Junc H326	1302.436	0.097114	0.15	1332.74	30.3
Junc H325	1301.758	0.200063	0.3	1332.48	30.72
Junc H324	1302.264	0.182977	0.27	1332.54	30.28
Junc H323	1301.842	0.060275	0.09	1332.55	30.71
Junc H322	1301.656	0.225487	0.34	1332.51	30.86
Junc H321	1300.716	0.185425	0.28	1332.05	31.34
Junc H320	1301.134	0.118599	0.18	1332.25	31.12
Junc H319	1300.893	0.030176	0.05	1332.18	31.29
Junc H318	1300.788	0.047734	0.07	1332.04	31.25
Junc H317	1300.717	0.04947	0.07	1331.52	30.81
Junc H316	1300.416	0.085552	0.13	1331.53	31.11
Junc H315	1300.137	0.238703	0.36	1330.95	30.81
Junc H314	1301.722	0.167482	0.25	1329.97	28.25
Junc H313	1301.248	0.087646	0.13	1329.98	28.73
Junc H312	1300.133	0.059027	0.09	1329.98	29.85
Junc H311	1300.419	0.120005	0.18	1329.98	29.56
Junc H310	1299.661	0.232071	0.35	1330.03	30.37

Junc H309	1299.4	0.297382	0.45	1329.87	30.47
Junc H308	1300.185	0.114441	0.17	1329.8	29.62
Junc H307	1300.605	0.237942	0.36	1329.79	29.18
Junc H306	1299.624	0.224935	0.34	1329.81	30.18
Junc H305	1298.576	0.291998	0.44	1329.74	31.17
Junc H304	1302.117	0.243482	0.37	1329.67	27.56
Junc H303	1300.306	0.248226	0.37	1329.7	29.4
Junc H302	1299.601	0.165124	0.25	1329.7	30.09
Junc H301	1299.463	0.09226	0.14	1329.78	30.32
Junc H300	1298.061	0.144867	0.22	1329.78	31.72
Junc H299	1297.668	0.128454	0.19	1329.86	32.19
Junc H298	1298.187	0.157902	0.24	1330.21	32.02
Junc H297	1298.577	0.107751	0.16	1330.21	31.64
Junc H296	1298.65	0.089084	0.13	1330.21	31.56
Junc H295	1299.038	0.169135	0.25	1330.24	31.2
Junc H294	1300.146	0.104873	0.16	1330.29	30.14
Junc H293	1299.013	0.075862	0.11	1330.29	31.28
Junc H292	1299.037	0.024191	0.04	1330.31	31.27
Junc H291	1299.718	0.11465	0.17	1330.39	30.67
Junc H290	1299.105	0.076718	0.12	1330.39	31.28
Junc H289	1298.643	0.064433	0.1	1330.29	31.64
Junc H288	1299.258	0.090048	0.14	1330.08	30.82
Junc H287	1298.618	0.051633	0.08	1330.08	31.46
Junc H286	1297.991	0.12014	0.18	1329.99	32
Junc H285	1298.519	0.072914	0.11	1329.99	31.48
Junc H284	1298.621	0.16124	0.24	1329.84	31.22
Junc H283	1299.478	0.167472	0.25	1329.66	30.18
Junc H282	1300.46	0.311626	0.47	1329.46	29
Junc H281	1300.672	0.326481	0.49	1329.45	28.78
Junc H280	1300.532	0.102983	0.15	1329.49	28.96
Junc H279	1300.32	0.073925	0.11	1329.56	29.24
Junc H278	1300.677	0.100137	0.15	1329.57	28.89
Junc H277	1300.901	0.117972	0.18	1329.57	28.67
Junc H276	1301.724	0.087803	0.13	1329.63	27.9
Junc H275	1301.551	0.189817	0.28	1329.63	28.08
Junc H274	1299.421	0.072886	0.11	1329.61	30.19
Junc H273	1300.471	0.108061	0.16	1329.61	29.14
Junc H272	1300.108	0.045743	0.07	1329.62	29.51
Junc H271	1300.104	0.049503	0.07	1329.62	29.51
Junc H270	1299.825	0.061863	0.09	1329.64	29.81
Junc H269	1300.114	0.042973	0.06	1329.64	29.52
Junc H268	1300.168	0.064125	0.1	1329.66	29.49
Junc H267	1300.642	0.066507	0.1	1329.67	29.03
Junc H266	1300.437	0.034582	0.05	1329.67	29.23
Junc H265	1300.772	0.112178	0.17	1329.69	28.91
Junc H264	1300.694	0.055899	0.08	1329.69	29
Junc H263	1301.534	0.141521	0.21	1329.76	28.22

Junc H262	1301.27	0.038711	0.06	1329.76	28.49
Junc H261	1301.314	0.146502	0.22	1329.79	28.48
Junc H260	1301.489	0.121541	0.18	1329.8	28.31
Junc H259	1303.916	0.126643	0.19	1332.97	29.05
Junc H258	1303.783	0.123189	0.18	1333.18	29.4
Junc H257	1302.036	0.196736	0.3	1331.75	29.71
Junc H256	1302.216	0.103363	0.16	1331.76	29.54
Junc H255	1301.962	0.082592	0.12	1331.29	29.32
Junc H254	1303.256	0.065847	0.1	1331.29	28.03
Junc H253	1302.025	0.054832	0.08	1330.99	28.97
Junc H252	1303.119	0.07673	0.12	1330.99	27.88
Junc H251	1302.032	0.09275	0.14	1330.7	28.66
Junc H250	1302.936	0.130355	0.2	1330.7	27.76
Junc H249	1302.579	0.23497	0.35	1330.34	27.76
Junc H248	1302.212	0.103105	0.15	1332.75	30.54
Junc H247	1302.589	0.207913	0.31	1331.17	28.58
Junc H246	1302.991	0.107688	0.16	1331.18	28.18
Junc H245	1302.803	0.144704	0.22	1331.18	28.38
Junc H244	1304.5	0.256085	0.38	1331.25	26.75
Junc H243	1303.145	0.161188	0.24	1330.36	27.21
Junc H242	1302.097	0.185284	0.28	1329.97	27.87
Junc H241	1302.516	0.11097	0.17	1329.98	27.46
Junc H240	1301.873	0.049806	0.07	1329.88	28.01
Junc H239	1302.301	0.078339	0.12	1329.88	27.58
Junc H238	1301.857	0.248482	0.37	1329.77	27.92
Junc H237	1305.658	0.308659	0.46	1329.8	24.14
Junc H236	1304.164	0.328271	0.49	1329.93	25.77
Junc H235	1299.661	0.121659	0.18	1329.97	30.31
Junc H234	1303.493	0.238356	0.36	1330.52	27.02
Junc H233	1299.661	0.147076	0.22	1330.55	30.89
Junc H232	1304.281	0.062218	0.09	1331.65	27.37
Junc H231	1304.213	0	0	1336.78	32.57
Junc H230	1305.593	0.073162	0.11	1336.07	30.48
Junc H229	1306.115	0.197612	0.3	1335.67	29.55
Junc H228	1299.661	0.609179	0.91	1335.67	36.01
Junc H227	1303.313	0.192283	0.29	1336.94	33.62
Junc H226	1304.345	0.110095	0.17	1336.92	32.57
Junc H225	1307.385	0.189404	0.28	1336.97	29.58
Junc H224	1307.572	0.139398	0.21	1337.14	29.57
Junc H223	1307.996	0	0	1337.98	29.98
Junc H222	1308.284	0	0	1337.77	29.49
Junc H221	1308.295	0	0	1337.46	29.16
Junc H220	1308.708	0	0	1337.29	28.58
Junc H219	1306.255	0	0	1337.16	30.9
Junc H218	1309.133	0	0	1336.89	27.76
Junc H217	1310.543	0	0	1336.87	26.33
Junc H216	1309.902	0	0	1336.86	26.96

Junc H215	1309.319	0	0	1336.81	27.49
Junc H214	1308.639	0	0	1336.78	28.15
Junc H213	1307.788	0	0	1336.78	29
Junc H212	1306.751	0	0	1336.78	30.03
Junc H211	1306.298	0	0	1336.78	30.49
Junc H210	1304.003	0	0	1331.65	27.65
Junc H209	1303.343	0	0	1331.65	28.31
Junc H208	1300.596	0	0	1331.64	31.04
Junc H207	1298.424	0	0	1331.63	33.21
Junc H206	1298.728	0	0	1331.63	32.9
Junc H205	1300	0	0	1331.7	31.7
Junc H204	1304.06	0	0	1331.84	27.78
Junc H203	1304.17	0	0	1331.92	27.75
Junc H202	1310.494	0	0	1332.7	22.2
Junc H201	1311.344	0	0	1333.06	21.72
Junc H200	1311.646	0	0	1333.14	21.5
Junc H199	1311.221	0	0	1333.79	22.57
Junc H198	1310.767	0	0	1334.09	23.33
Junc H197	1309.244	0	0	1334.77	25.53
Junc H196	1308.968	0	0	1335.91	26.94
Junc H195	1309.165	0	0	1336.65	27.48
Junc H194	1308.547	0	0	1337.5	28.96
Junc H193	1307.77	0	0	1338.41	30.64
Junc H192	1308.711	0.190145	0.29	1335.08	26.36
Junc H191	1305.539	0.130278	0.2	1338.31	32.77
Junc H190	1312.138	0.120809	0.18	1337.82	25.69
Junc H189	1312.95	0.068076	0.1	1337.83	24.88
Junc H188	1313.245	0.167532	0.25	1337.82	24.58
Junc H187	1313.823	0.065802	0.1	1337.83	24.01
Junc H186	1314.998	0.281829	0.42	1342.13	27.13
Junc H185	1315.206	0.20675	0.31	1342.15	26.94
Junc H184	1318.782	0.300575	0.45	1343.71	24.93
Junc H183	1317.004	0.263938	0.4	1343.73	26.73
Junc H182	1314.884	0.045638	0.07	1339.01	24.12
Junc H181	1316.292	0.209394	0.31	1338.31	22.02
Junc H180	1315.43	0.233891	0.35	1338.32	22.89
Junc H179	1316.234	0.213673	0.32	1338.01	21.78
Junc H178	1316.067	0.091704	0.14	1338.02	21.95
Junc H177	1314.767	0.093654	0.14	1337.87	23.1
Junc H176	1313.924	0.04183	0.06	1337.84	23.92
Junc H175	1312.48	0.102793	0.15	1335.96	23.48
Junc H174	1310.743	0.139249	0.21	1335.96	25.22
Junc H173	1309.79	0.139901	0.21	1334.7	24.91
Junc H172	1308.939	0.221022	0.33	1334.71	25.77
Junc H171	1304.522	0.190705	0.29	1333.64	29.12
Junc H170	1305.863	0.096557	0.14	1333.65	27.79
Junc H169	1311.136	0.259355	0.39	1338.29	27.15

Junc H168	1309.177	0.105853	0.16	1338.31	29.13
Junc H167	1308.302	0.035668	0.05	1338.31	30.01
Junc H166	1307.191	0.081318	0.12	1338.31	31.12
Junc H165	1307.525	0.045364	0.07	1338.31	30.78
Junc H164	1306.482	0.230711	0.35	1338.32	31.84
Junc H163	1319.302	0.364488	0.55	1343.14	23.84
Junc H162	1321.119	0.264947	0.4	1343.13	22.02
Junc H161	1320.877	0.102105	0.15	1343.15	22.27
Junc H160	1320.877	0.063619	0.1	1343.15	22.27
Junc H159	1321.637	0.066072	0.1	1343.23	21.59
Junc H158	1322.92	0.434908	0.65	1343.27	20.35
Junc H157	1323.613	0.159776	0.24	1343.33	19.72
Junc H156	1313.8	0.142337	0.21	1338.93	25.13
Junc H155	1310.721	0.356046	0.53	1343.69	32.96
Junc H154	1305.3	0.121257	0.18	1338.64	33.34
Junc H153	1308.754	0	0	1338.65	29.89
Junc H152	1306.699	0	0	1337.42	30.73
Junc H151	1305.922	0.183637	0.28	1334.55	28.63
Junc H150	1309.311	0.166739	0.25	1335.61	26.3
Junc H149	1305.328	0.104139	0.16	1334.32	28.99
Junc H148	1304.764	0.095801	0.14	1334.16	29.39
Junc H147	1304.747	0.109269	0.16	1334.04	29.29
Junc H146	1305.043	0.0659	0.1	1334.55	29.51
Junc H145	1304.325	0	0	1333.9	29.57
Junc H144	1306.655	0.086981	0.13	1334.11	27.46
Junc H143	1304.413	0.068604	0.1	1332.92	28.51
Junc H142	1307.137	0.091363	0.14	1333.9	26.77
Junc H141	1306.94	0.059993	0.09	1332.97	26.03
Junc H140	1305.812	0.041943	0.06	1333.53	27.72
Junc H139	1305.482	0.034672	0.05	1333.15	27.67
Junc H138	1305.174	0	0	1333.43	28.25
Junc H137	1305.587	0	0	1333.38	27.8
Junc H136	1305.605	0.08465	0.13	1333.31	27.7
Junc H135	1302.766	0.068629	0.1	1333	30.23
Junc H134	1302.578	0.077987	0.12	1333	30.42
Junc H133	1303.51	0.097026	0.15	1332.97	29.46
Junc H132	1302.34	0.059197	0.09	1332.93	30.59
Junc H131	1302.617	0.131435	0.2	1332.84	30.22
Junc H130	1302.652	0.055119	0.08	1332.82	30.17
Junc H129	1302.613	0.132206	0.2	1332.8	30.18
Junc H128	1302.692	0.049068	0.07	1332.78	30.09
Junc H127	1302.701	0.055546	0.08	1332.75	30.05
Junc H126	1302.602	0.073408	0.11	1332.75	30.15
Junc H125	1302.466	0.07945	0.12	1332.73	30.27
Junc H124	1302.086	0	0	1332.67	30.59
Junc H123	1303.565	0.224677	0.34	1336.94	33.37
Junc H122	1305.041	0.276656	0.41	1336.96	31.92

Junc H121	1308.814	0.443888	0.67	1336.54	27.73
Junc H120	1306.177	0.300886	0.45	1336.88	30.7
Junc H119	1307.996	0	0	1338	30
Junc H118	1311.936	0.104066	0.16	1337.2	25.26
Junc H117	1314.337	0.082881	0.12	1337.2	22.86
Junc H116	1315.086	0.221953	0.33	1337.19	22.1
Junc H115	1314.449	0.031755	0.05	1337.23	22.78
Junc H114	1320.713	0	0	1344.54	23.83
Junc H113	1322.155	0	0	1344.67	22.52
Junc H112	1321.29	0.294661	0.44	1344.09	22.8
Junc H111	1316.996	0.310776	0.47	1344.03	27.04
Junc H110	1321.135	0.178154	0.27	1344.06	22.93
Junc H109	1321.498	0.107717	0.16	1344.06	22.56
Junc H108	1318.941	0.321799	0.48	1343.99	25.04
Junc H107	1315.951	0.263774	0.4	1343.98	28.03
Junc H106	1315.081	0.291788	0.44	1343.98	28.9
Junc H105	1312.757	0.143874	0.22	1343.99	31.23
Junc H104	1322.426	0.128115	0.19	1343.99	21.57
Junc H103	1322.173	0.07339	0.11	1344	21.82
Junc H102	1320.73	0.047912	0.07	1343.99	23.26
Junc H101	1321.292	0.090388	0.14	1343.99	22.7
Junc H100	1322.411	0.283606	0.43	1343.99	21.58
Junc H099	1315.723	0.122045	0.18	1343.99	28.26
Junc H098	1318.863	0.141287	0.21	1343.78	24.91
Junc H097	1320.164	0.103057	0.15	1343.78	23.61
Junc H096	1319.494	0.103422	0.16	1343.78	24.29
Junc H095	1316.614	0.101821	0.15	1343.85	27.24
Junc H094	1318.11	0.16419	0.25	1343.8	25.69
Junc H093	1317.064	0.069096	0.1	1343.81	26.74
Junc H092	1317.205	0.160874	0.24	1343.81	26.6
Junc H091	1318.544	0.149696	0.22	1343.76	25.21
Junc H090	1319.451	0.242661	0.36	1343.73	24.28
Junc H089	1319.807	0.180048	0.27	1343.75	23.94
Junc H088	1324.351	0.265714	0.4	1344.33	19.98
Junc H087	1325.729	0.099986	0.15	1344.36	18.63
Junc H086	1325.398	0.061706	0.09	1344.36	18.96
Junc H085	1325.632	0.114159	0.17	1344.41	18.77
Junc H084	1325.859	0.082471	0.12	1344.41	18.55
Junc H083	1325.624	0.12096	0.18	1344.59	18.97
Junc H082	1327.212	0.192429	0.29	1344.6	17.38
Junc H081	1321.981	0.130279	0.2	1344.03	22.05
Junc H080	1321.009	0.149505	0.22	1344.03	23.02
Junc H079	1325.809	0.379849	0.57	1344.77	18.96
Junc H078	1329.036	0.288819	0.43	1344.73	15.69
Junc H077	1327.726	0.108296	0.16	1344.56	16.84
Junc H076	1329.732	0.085422	0.13	1344.74	15.01
Junc H075	1330.165	0.120584	0.18	1344.74	14.57

Junc H074	1329.983	0.031809	0.05	1344.74	14.76
Junc H073	1330.213	0.156843	0.24	1344.75	14.54
Junc H072	1329.488	0.09164	0.14	1344.75	15.26
Junc H071	1330	0.108018	0.16	1344.75	14.75
Junc H070	1328.014	0.0997	0.15	1344.62	16.6
Junc H069	1329.998	0.08599	0.13	1344.84	14.84
Junc H068	1330.681	0.231299	0.35	1344.84	14.16
Junc H067	1326.346	0.311643	0.47	1344.76	18.42
Junc H066	1328.379	0.167709	0.25	1344.77	16.39
Junc H065	1329.923	0.120089	0.18	1344.74	14.82
Junc H064	1329.236	0.072638	0.11	1344.74	15.51
Junc H063	1328.641	0.058354	0.09	1344.74	16.1
Junc H062	1327.772	0.044325	0.07	1344.75	16.98
Junc H061	1327.084	0.059493	0.09	1344.71	17.63
Junc H060	1324.836	0.156798	0.24	1344.43	19.6
Junc H059	1324.687	0.072164	0.11	1344.44	19.75
Junc H058	1326.912	0.16743	0.25	1344.69	17.78
Junc H057	1324.645	0.099224	0.15	1344.22	19.58
Junc H056	1323.853	0.146743	0.22	1344.04	20.19
Junc H055	1326.811	0.243859	0.37	1344.65	17.84
Junc H054	1322.659	0.134344	0.2	1344.01	21.35
Junc H053	1320.947	0.092192	0.14	1344	23.06
Junc H052	1318.037	0.258804	0.39	1344.65	26.61
Junc H051	1316.595	0.116238	0.17	1344.01	27.41
Junc H050	1315.252	0.16918	0.25	1344.01	28.76
Junc H049	1323.444	0.187146	0.28	1344.16	20.72
Junc H048	1323.616	0.070964	0.11	1344.3	20.69
Junc H047	1324.108	0	0	1344.88	20.77
Junc H046	1325.149	0.161438	0.24	1344.79	19.64
Junc H045	1323.437	0.327254	0.49	1344.76	21.32
Junc H044	1323.556	0.146645	0.22	1344.75	21.2
Junc H043	1326.587	0.211944	0.32	1344.77	18.18
Junc H042	1326.186	0.104234	0.16	1344.77	18.59
Junc H041	1327.018	0	0	1345.8	18.78
Junc H040	1325.475	0.282753	0.42	1344.79	19.32
Junc H039	1327.712	0.238299	0.36	1344.82	17.11
Junc H038	1328.832	0.289185	0.43	1344.79	15.95
Junc H037	1328.406	0.187601	0.28	1344.8	16.4
Junc H036	1328.68	0.185239	0.28	1344.82	16.14
Junc H035	1327.455	0.064378	0.1	1347.23	19.78
Junc H034	1326.768	0.161013	0.24	1347.23	20.46
Junc H033	1329.719	0.135937	0.2	1347.23	17.51
Junc H032	1330.63	0	0	1347.81	17.18
Junc H031	1330.091	0	0	1347.13	17.04
Junc H030	1327.313	0.089031	0.13	1345.65	18.34
Junc H029	1329.215	0.227009	0.34	1345.65	16.44
Junc H028	1326.779	0.049888	0.07	1344.89	18.11

Junc H027	1326.235	0.050486	0.08	1344.85	18.62
Junc H026	1325.517	0.069664	0.1	1344.79	19.28
Junc H025	1324.508	0.21058	0.32	1344.79	20.29
Junc H024	1330.382	0.241717	0.36	1344.76	14.38
Junc H023	1329.239	0.169793	0.25	1344.62	15.38
Junc H022	1328.615	0.263399	0.4	1344.62	16
Junc H021	1328.182	0.143969	0.22	1344.63	16.44
Junc H020	1329.904	0.217197	0.33	1344.76	14.86
Junc H019	1330.481	0.246898	0.37	1345.06	14.58
Junc H018	1330.42	0.243036	0.36	1345.64	15.22
Junc H017	1330.768	0.354992	0.53	1346.8	16.03
Junc H016	1330.631	0.173267	0.26	1346.85	16.22
Junc H015	1331.122	0	0	1348.26	17.14
Junc H014	1308.971	0	0	1338.97	30
Junc H013	1310.935	0.081435	0.12	1343.7	32.77
Junc H012	1318.449	0.177618	0.27	1343.19	24.75
Junc H011	1319.473	0.041764	0.06	1343.19	23.72
Junc H010	1321.637	0.055184	0.08	1343.23	21.59
Junc H009	1324.767	0	0	1344.58	19.82
Junc H008	1325.619	0	0	1344.73	19.11
Junc H007	1326.569	0	0	1344.8	18.23
Junc H006	1326.81	0	0	1344.82	18.01
Junc H005	1330.264	0	0	1345.9	15.64
Junc H004	1330.959	0	0	1346.65	15.69
Junc H003	1330.983	0	0	1347.32	16.33
Junc H002	1331.108	0	0	1347.82	16.71
Junc H001	1332.17	0	0	1350.17	18
Junc H800	1305.157	0.01	0.01	1333.38	28.23
Junc Bansbari4	1344	162.3	243.45	1371.02	27.02
Junc Bansbari7	1332	40.37	60.56	1368.57	36.57
Junc Bansbari15	1326.372	0	0	1364.67	38.3
Junc Bansbari9	1313.41	26.37	39.56	1363.33	49.92
Junc Bansbari10	1309.028	0	0	1363.05	54.02
Junc Bansbari11	1308.994	32.65	48.97	1361.61	52.62
Junc Bansbari22	1327.087	0	0	1365.18	38.1
Junc Bansbari24	1320.713	0	0	1363.03	42.31
Junc Bansbari26	1308.24	0	0	1361.24	53
Junc Bansbari23	1324.211	0	0	1364.2	39.98
Junc Bansbari25	1312.137	0	0	1361.74	49.6

Junc Bansbari27	1308.284	38.75	58.12	1359.72	51.44
Junc Bansbari21	1331.625	0	0	1367.19	35.56
Junc H600	1313.8	0.4	0.6	1343.52	29.72
Junc H601	1314.241	0.2	0.3	1343.53	29.29
Junc H602	1313.073	0.1	0.15	1338.1	25.03
Junc H603	1303.334	0.06	0.09	1337.14	33.8
Junc Bansbari20	1342	0	0	1370.92	28.92
Junc I308	1341	36.12	54.18	1370.71	29.71
Junc 1	1332.17	0	0	1368.05	35.88
Junc 2	1332.17	0.461295	0.69	1350.17	18
Junc 3	1331.122	0.455162	0.68	1347.72	16.6
Junc 4	1330.63	0.138399	0.21	1347.32	16.69
Junc 5	1330.091	0.158088	0.24	1347.13	17.04
Junc 6	1327.018	0.161518	0.24	1345.03	18.01
Junc 7	1324.108	0.352437	0.53	1344.87	20.76
Junc 8	1322.155	0.443835	0.67	1344.14	21.98
Junc 9	1320.713	0.133064	0.2	1344.06	23.35
Junc 10	1315.951	0	0	1344.27	28.32
Junc 11	1312.757	0	0	1344.11	31.35
Junc 12	1315.723	0	0	1343.99	28.27
Junc 13	1317.205	0	0	1343.86	26.66
Junc 14	1318.544	0	0	1343.83	25.28
Junc 15	1317.004	0	0	1343.74	26.74
Junc 16	1314.241	0	0	1343.85	29.61
Junc 17	1313.8	0	0	1343.86	30.06
Junc 18	1305.3	0	0	1343.96	38.66
Junc 19	1308.971	0	0	1344	35.03
Junc 20	1324.767	0.200115	0.3	1343.35	18.58
Junc 21	1319.473	0	0	1344.42	24.95
Junc 22	1308.971	0.145069	0.22	1336.79	27.82
Junc 23	1308.754	0.118578	0.18	1335.97	27.22
Junc 24	1306.699	0.245992	0.37	1335.1	28.4
Junc 25	1305.922	0	0	1336.09	30.17
Junc 26	1305.328	0	0	1335.09	29.76
Junc 27	1304.764	0	0	1334.16	29.4
Junc 28	1304.747	0	0	1334.05	29.31
Junc 29	1304.325	0.080027	0.12	1332.83	28.51
Junc 30	1304.413	0	0	1333.73	29.32
Junc 31	1306.94	0	0	1333.65	26.71
Junc 32	1305.482	0	0	1333.46	27.98
Junc 33	1305.174	0.012163	0.02	1333.19	28.01
Junc 34	1305.587	0.00219	0	1333.24	27.66
Junc 35	1305.605	0	0	1333.31	27.7
Junc 36	1302.578	0	0	1333.13	30.55
Junc 37	1302.34	0	0	1333.08	30.74

Junc 38	1302.652	0	0	1332.98	30.33
Junc 39	1302.692	0	0	1332.93	30.24
Junc 40	1302.701	0	0	1332.9	30.2
Junc 41	1302.466	0	0	1332.85	30.39
Junc 42	1302.086	0.026345	0.04	1332.67	30.59
Junc 43	1303.145	0	0	1332.46	29.32
Junc 44	1301.857	0	0	1332.31	30.45
Junc 45	1305.658	0	0	1332	26.34
Junc 46	1299.661	0	0	1331.79	32.13
Junc 47	1304.281	0	0	1331.65	27.37
Junc 48	1304.003	0.10057	0.15	1330.97	26.97
Junc 49	1303.343	0.093967	0.14	1330.29	26.95
Junc 50	1300.596	0.495604	0.74	1330.17	29.58
Junc 51	1298.424	0.355017	0.53	1330.88	32.46
Junc 52	1298.728	0.184809	0.28	1331.63	32.9
Junc 53	1300	0.289111	0.43	1331.69	31.69
Junc 54	1304.06	0.148835	0.22	1331.6	27.54
Junc 55	1304.17	0.325941	0.49	1331.59	27.42
Junc 56	1308	0.242991	0.36	1332.42	24.42
Junc 57	1310.494	0.436372	0.65	1331.33	20.84
Junc 58	1311.344	0.216924	0.33	1331.24	19.89
Junc 59	1311.646	0.052075	0.08	1331.25	19.6
Junc 60	1311.221	0.365012	0.55	1331.98	20.76
Junc 61	1310.767	0.218352	0.33	1334.09	23.32
Junc 62	1309.244	0.119177	0.18	1333.97	24.73
Junc 63	1308.968	0.338019	0.51	1333.94	24.97
Junc 64	1309.165	0.295954	0.44	1334.17	25.01
Junc 65	1308.547	0.235524	0.35	1335.9	27.35
Junc 66	1307.77	0.161531	0.24	1338.41	30.64
Junc 67	1320.713	0	0	1337.97	17.26
Junc 70	1307.996	0.148905	0.22	1337.04	29.04
Junc 71	1308.284	0.306928	0.46	1337.59	29.31
Junc 72	1308.295	0.171968	0.26	1337.45	29.16
Junc 73	1308.708	0.130697	0.2	1336.92	28.21
Junc 74	1306.255	0.20437	0.31	1336.72	30.46
Junc 75	1309.133	0.187046	0.28	1336.89	27.76
Junc 76	1310.543	0.116182	0.17	1336.44	25.9
Junc 77	1309.902	0.138418	0.21	1336.4	26.5
Junc 78	1309.319	0.15152	0.23	1336.41	27.09
Junc 79	1308.639	0.143268	0.21	1336.78	28.15
Junc 80	1307.788	0.204116	0.31	1336.6	28.81
Junc 81	1306.751	0.097429	0.15	1336.62	29.87
Junc 82	1306.298	0.026181	0.04	1336.65	30.35
Junc 83	1304.213	0.059627	0.09	1336.78	32.57
Junc 84	1305.593	0	0	1336.81	31.22
Junc 85	1306.115	0	0	1336.83	30.72
Junc 86	1299.661	0	0	1336.86	37.2

Junc 87	1301.857	0	0	1336.9	35.05
Junc 88	1303.313	0	0	1336.94	33.62
Junc 89	1304.345	0	0	1337.14	32.79
Junc 90	1306.177	0	0	1337.39	31.21
Junc 91	1307.572	0	0	1337.72	30.15
Junc 92	1307.996	0.126866	0.19	1337.98	29.98
Junc 68	1324.108	0	0	1344.88	20.77
Junc 69	1324.108	0	0	1344.88	20.77
Junc 93	1323.556	0	0	1344.78	21.22
Junc 94	1323.437	0	0	1344.8	21.36
Junc 95	1323.556	0	0	1344.78	21.22
Junc 96	1316.595	0	0	1344.68	28.08
Junc 97	1322.659	0	0	1344.68	22.02
Junc 98	1322.659	0	0	1344.77	22.11
Junc 99	1326.81	0	0	1344.82	18.01
Junc 100	1326.81	0	0	1344.8	17.99
Junc 101	1326.81	0.222148	0.33	1344.82	18.01
Junc 102	1327.726	0	0	1344.75	17.03
Junc 103	1328.014	0	0	1344.75	16.74
Junc 104	1324.645	0	0	1344.7	20.05
Junc 105	1327.084	0	0	1344.75	17.67
Junc 106	1327.084	0	0	1344.76	17.68
Junc 107	1331.108	0.249359	0.37	1347.72	16.61
Junc 108	1330.983	0.105288	0.16	1347.32	16.33
Junc 109	1330.959	0.234445	0.35	1345.71	14.75
Junc 110	1330.264	0.35293	0.53	1344.89	14.62
Junc 111	1326.569	0.072506	0.11	1344.49	17.93
Junc 112	1325.619	0.322089	0.48	1343.84	18.22
Junc 113	1302.466	0	0	1332.75	30.29
Junc 114	1302.692	0	0	1332.8	30.11
Junc 115	1302.652	0	0	1332.84	30.19
Junc 116	1302.34	0	0	1332.97	30.63
Junc 117	1305.482	0	0	1333.53	28.05
Junc 118	1306.94	0	0	1333.91	26.97
Junc 119	1304.413	0	0	1334.12	29.71
Junc 120	1304.325	0	0	1334.55	30.23
Junc 121	1304.747	0	0	1332.77	28.03
Junc 122	1300.373	0	0	1331.93	31.56
Junc 123	1301.656	0	0	1332.51	30.86
Junc 124	1301.656	0	0	1332.51	30.86
Junc 125	1300.788	0	0	1332.04	31.25
Junc 126	1300.788	0	0	1331.96	31.17
Junc 127	1301.134	0	0	1332.06	30.93
Junc 128	1300	0	0	1331.7	31.7
Junc 129	1300	0	0	1331.7	31.7
Junc 130	1303.164	0	0	1331.7	28.54
Junc 131	1304.535	0	0	1331.64	27.11

Junc 132	1302.986	0	0	1331.64	28.66
Junc 133	1303.164	0	0	1331.7	28.54
Junc 134	1301.044	0	0	1331.83	30.79
Junc 135	1320.713	0	0	1337.97	17.26
Junc 136	1317.004	0.263938	0.4	1343.56	26.56
Junc 137	1305.328	0	0	1335.63	30.31
Junc 138	1308.754	0	0	1338.65	29.89
Junc 139	1302.086	0	0	1332.67	30.59
Junc 140	1300.373	0	0	1331.87	31.5
Junc 141	1308.971	0	0	1343.99	35.02
Junc 142	1308.971	0	0	1343.99	35.02
Junc 143	1308	0	0	1332.43	24.43
Resvr Bansbari	1374.4	#N/A	-899.93	1374.4	0

6.3.3 Design of DNI Zone - I (A 2.4)

The DNI-I model has been designed and the model features are prepared accordingly. DNI-I has been designed using inside diameters (66.8mm, 80.4mm and 98.6mm) for HDPE PE100-PN6 pipes and the diameters (150mm, 200mm, 250mm & 300mm) for DI pipes. After optimizing the pipe diameters for HDPE & DI pipes, all 760 demand nodes have pressure head between 20m & 40m and 45 demand nodes have pressure between 40m & 50m.

The demarcation of DNI-I Boundary is shown in **Figure 6.5** and DNI-I Design Model at Peak Demand (7.00) is shown in **Figure 6.6.**

The details of DNI-I/Pipe material & length/Bulk Meter, Isolation Valves, PRVs/PRVs with Set pressure/Location of Air Valve, Washout Valve & Fire hydrants are shown in the **Tables 6.15/6.16/6.17/6.18/6.19** respectively.

Figure 6.5: Demarcation of DNI Zone - I Boundary

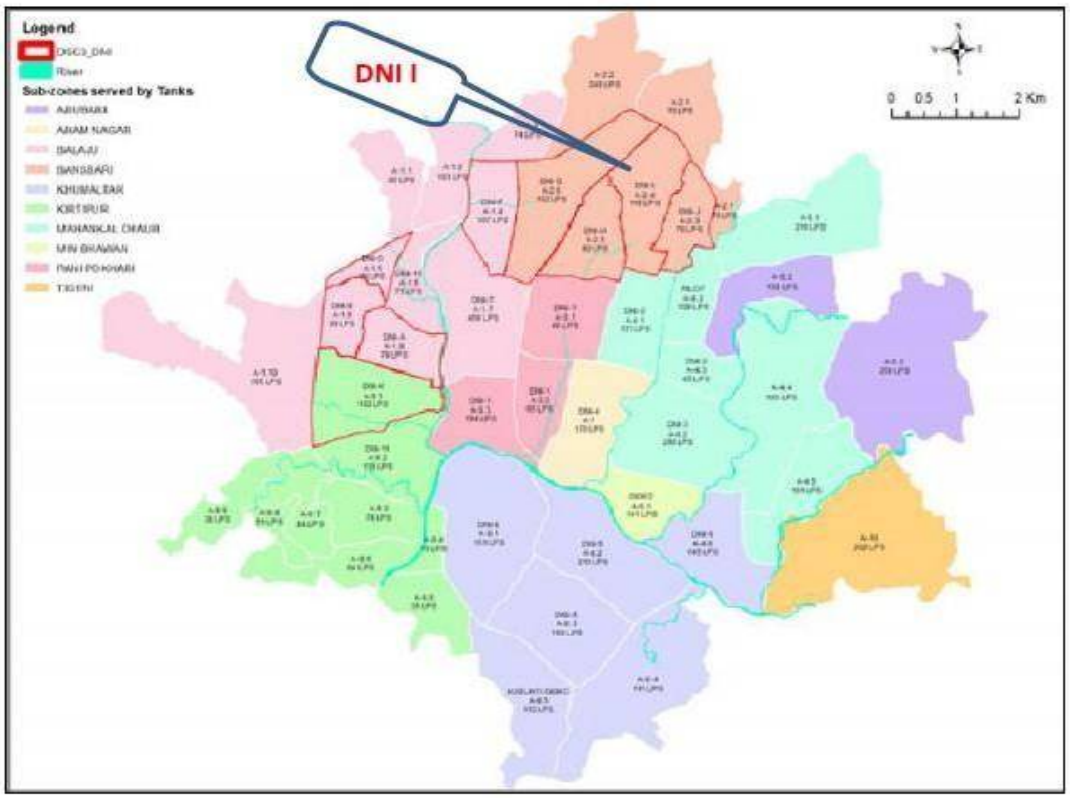


Table 6.15: Design of DNI Zone - I

Description	
Reservoir	Bansbari
Outlet Elevation of the Reservoir (m)	1374.40
Total Demand (LPS)	116.19
Total number of nodes	805
Total Number of Pipes	974
Total Length of Pipes	54,092
Number of PRVs	06
Number of Pumps	0
At Peak Time (7:00) - Only for HDPE pipes within DNI	
Number of Nodes have Pressure < 5m	0
Number of Nodes have Pressure [5m,10m]	0
Number of Nodes have Pressure [20m,40m]	760
Number of Nodes have Pressure [40m,50m]	45
Number of Nodes have Pressure [50m,60m]	0
Number of Nodes have Pressure > 60m	0
At Lowest Demand Time (1:00) - Only for HDPE pipes within DNI	
Number of Nodes have Pressure < 5m	0
Number of Nodes have Pressure [5m,10m]	0
Number of Nodes have Pressure [20m,40m]	751
Number of Nodes have Pressure [40m,50m]	54
Number of Nodes have Pressure [50m,60m]	0
Number of Nodes have Pressure > 60m	0

Table 6.16: Details of Pipe material and length

Pipe Length of DNI-I (m)	
Reservoir	Bansbari
Pipe Diameter (mm)	Length (m)
HDPE PIPE-PE100, PN6	
66.80 (75)	24,029.50
80.40 (90)	15,972
98.60 (110)	7,914.50
DI PIPE	
150	3,333
200	913
250	951.50
300	22
Grand Total	53,135.50

Table 6.17: Details of Bulk Meter/Isolation Valve/PRV's

LOCATION OF BM/IV/PRV FOR DNI_I									
DNI	DMA	# Bulk Meter	Size of BM	# Isolation Valve	Size of IV	# PRV	Size of PRV	From_Junc	To_Junc
I	1	1	300	3	300	1	300	BANSBARI2	IOO1
I	2	1	200	3	200	1	200	BANSBARI20	I308
I	3	1	150	3	150	1	150	BANSBARI29	163
I	4	1	150	3	150	1	150	BANSBARI25	I037
I	5	1	150	3	150	1	150	BANSBARI22	I027

Table 6.18: Details of PRV's with Set Pressure

DNI	DMA	# PRV	Size of PRV	Set pressure (m)	From_Junc	To_Junc
I	1	1	300	17	BANSBARI2	IOO1
I	2	1	200	16	BANSBARI20	I308
I	3	1	150	23	BANSBARI29	163
I	4	1	150	30	BANSBARI25	I037
I	5	1	150	16	BANSBARI22	I027

Table 6.19: Details of location of Air Valve/ Washout Valve/Fire Hydrant

LOCATION OF AV/IV/WV/FH FOR DNI_I				
DNI	# Air Valve	# Wash out Valve	# Fire Hydrant	
	Provide at Junction	Provide at Junction	Provide at Junction	On pipe dia (mm)
I	I001	I127	I001	150 DI PIPE
	I012	I433	I009	150 DI PIPE
	I025	I460	I017	150 DI PIPE
	I031	I475	I027	150 DI PIPE
	I036	I296	I030	150 DI PIPE
	I040	I550	I036	150 DI PIPE
	I753	I270	I042	150 DI PIPE
	I064	I248	I044	150 DI PIPE
	I069	I579	I753	150 DI PIPE
	I076	I232	I055	90 HDPE PIPE
	I096	I229	I064	90 HDPE PIPE
	I103	I181	I068	90 HDPE PIPE
	I108	I671	I075	90 HDPE PIPE
	I308	I713	I078	110 HDPE PIPE
	I125	I731	I080	110 HDPE PIPE
	I151	I784	I084	150 DI PIPE
	I169	I765	I087	150 DI PIPE
	I221	I716	I096	150 DI PIPE
	I624	I695	I103	150 DI PIPE
	I679	I657	I108	150 DI PIPE
	I717	I634	I121	110 HDPE PIPE
	I736	I640	I129	110 HDPE PIPE
	I020	I520	I137	110 HDPE PIPE
	I275	I515	I157	110 HDPE PIPE
	I303	I498	I275	110 HDPE PIPE

DNI	# Air Valve	# Wash out Valve	# Fire Hydrant	
I	Provide at Junction	Provide at Junction	Provide at Junction	On pipe dia (mm)
	I540	I373	I281	110 HDPE PIPE
		I417	I167	110 HDPE PIPE
		I430	I169	110 HDPE PIPE
			I216	110 HDPE PIPE
			I652	110 HDPE PIPE
			I717	110 HDPE PIPE
			I748	90 HDPE PIPE
			I180	90 HDPE PIPE
			I193	90 HDPE PIPE
			I662	90 HDPE PIPE
			I534	90 HDPE PIPE
			I367	90 HDPE PIPE
			I379	90 HDPE PIPE
			I486	90 HDPE PIPE
			I442	90 HDPE PIPE
			I324	90 HDPE PIPE

Figure 6.6: DNI Zone - I Design Model at Peak Demand at 7.00 AM

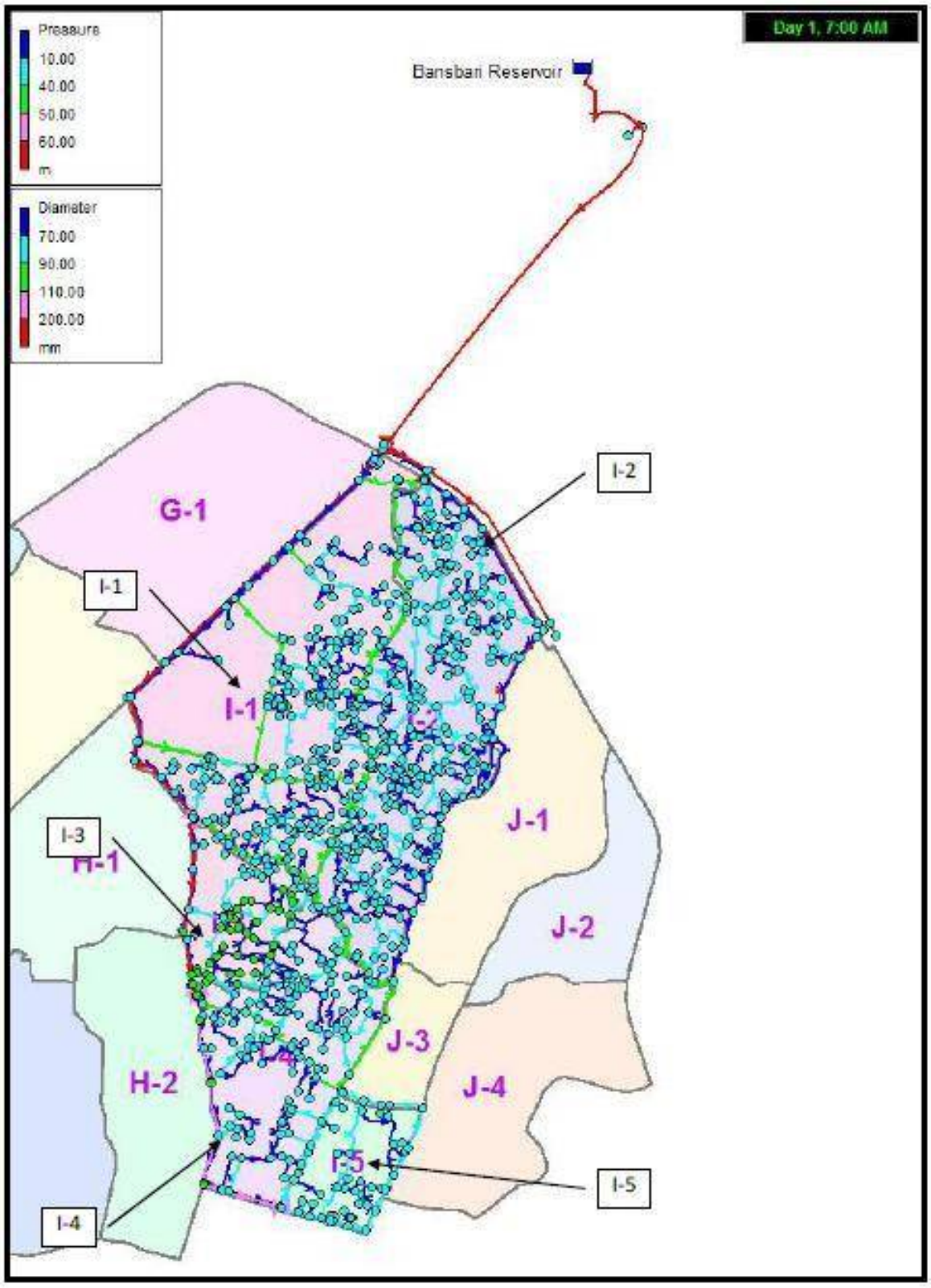


Table 6.20 Details of Pipe Design for DNI I (at peak time 7.00)

Link ID	Length	Diameter	Roughness	Material	Flow	Velocity	Unit Headloss	Friction Factor
	m	mm			LPS	m/s	m/km	
Pipe I452_I453	18.79271	62.2	130		0.95	0.31	2.48	0.031
Pipe I451_I459	23.30536	62.2	130	HDPE-PE 100 PN10	1.58	0.52	6.33	0.029
Pipe I451_I452	7.446541	62.2	130	HDPE-PE 100 PN10	0.57	0.19	0.98	0.033
Pipe I449_I451	70.78441	62.2	130	HDPE-PE 100 PN10	2.23	0.73	11.9	0.027
Pipe I449_I450	18.65965	62.2	130	HDPE-PE 100 PN10	0.26	0.09	0.22	0.036
Pipe I447_I449	47.32466	62.2	130	HDPE-PE 100 PN10	2.67	0.88	16.7	0.026
Pipe I447_I448	20.61221	62.2	130	HDPE-PE 100 PN10	0.25	0.08	0.21	0.038
Pipe I445_I446	42.14	62.2	130	HDPE-PE 100 PN10	0.35	0.12	0.4	0.036
Pipe I445_I128	53.69207	62.2	130	HDPE-PE 100 PN10	-0.43	0.14	0.56	0.035
Pipe I443_I445	42.7037	62.2	130	HDPE-PE 100 PN10	-0.24	0.08	0.2	0.038
Pipe I443_I444	56.79013	62.2	130	HDPE-PE 100 PN10	0.53	0.17	0.83	0.034
Pipe I442_I447	62.07	62.2	130	HDPE-PE 100 PN10	3.15	1.04	22.6	0.026
Pipe I442_I443	66.80977	62.2	130	HDPE-PE 100 PN10	0.59	0.19	1	0.033
Pipe I440_I442	90.84288	62.2	130	HDPE-PE 100 PN10	-1.16	0.38	3.54	0.03
Pipe I440_I441	34.76	62.2	130	HDPE-PE 100 PN10	0.3	0.1	0.28	0.037
Pipe I438_I440	9.340194	62.2	130	HDPE-PE 100 PN10	-1.04	0.34	2.9	0.03
Pipe I438_I439	60.92	62.2	130	HDPE-PE 100 PN10	0.9	0.3	2.22	0.031
Pipe I436_I437	54.52792	62.2	130	HDPE-PE 100 PN10	0.87	0.29	2.1	0.031
Pipe I434_I436	98.78545	62.2	130	HDPE-PE 100 PN10	1.56	0.51	6.13	0.029
Pipe I434_I435	29.86613	62.2	130	HDPE-PE 100 PN10	1.21	0.4	3.85	0.03
Pipe I432_I434	59.40411	62.2	130	HDPE-PE 100 PN10	3.16	1.04	22.8	0.026
Pipe I432_I433	60.94008	62.2	130	HDPE-PE 100 PN10	0.44	0.15	0.6	0.034
Pipe I431_I438	76.12476	62.2	130	HDPE-PE 100 PN10	-0.8	0.26	1.8	0.032

Pipe I431_I432	39.18867	62.2	130	HDPE-PE 100 PN10	3.92	1.29	34	0.025
Pipe I429_I430	20.73791	62.2	130	HDPE-PE 100 PN10	0.12	0.04	0.06	0.043
Pipe I429_I427	9.542074	62.2	130	HDPE-PE 100 PN10	-1.31	0.43	4.45	0.029
Pipe I427_I428	18.58829	62.2	130	HDPE-PE 100 PN10	0.18	0.06	0.12	0.04
Pipe I426_I427	119.8968	62.2	130	HDPE-PE 100 PN10	1.56	0.51	6.13	0.029
Pipe I426_I424	36.96973	62.2	130	HDPE-PE 100 PN10	-2.87	0.94	19	0.026
Pipe I424_I425	49.77577	62.2	130	HDPE-PE 100 PN10	0.15	0.05	0.07	0.04
Pipe I424_I111	27.18	62.2	130	HDPE-PE 100 PN10	-3.21	1.06	23.5	0.026
Pipe I423_I106	14.76	62.2	130	HDPE-PE 100 PN10	-0.75	0.25	1.57	0.032
Pipe I422_I423	34.17097	62.2	130	HDPE-PE 100 PN10	-0.52	0.17	0.8	0.034
Pipe I422_I420	47.29049	62.2	130	HDPE-PE 100 PN10	0.23	0.08	0.19	0.038
Pipe I420_I421	14.42132	62.2	130	HDPE-PE 100 PN10	0.49	0.16	0.71	0.033
Pipe I419_I422	49.66356	62.2	130	HDPE-PE 100 PN10	0.12	0.04	0.05	0.04
Pipe I419_I420	23.06631	62.2	130	HDPE-PE 100 PN10	0.4	0.13	0.49	0.035
Pipe I418_I419	52.74426	62.2	130	HDPE-PE 100 PN10	0.77	0.25	1.66	0.032
Pipe I416_I418	28.1232	62.2	130	HDPE-PE 100 PN10	0.31	0.1	0.3	0.036
Pipe I416_I417	44.48015	62.2	130	HDPE-PE 100 PN10	0.18	0.06	0.11	0.039
Pipe I415_I418	50.13977	62.2	130	HDPE-PE 100 PN10	0.71	0.23	1.44	0.032
Pipe I415_I416	48.36089	62.2	130	HDPE-PE 100 PN10	0.68	0.22	1.31	0.032
Pipe I413_I414	43.49	62.2	130	HDPE-PE 100 PN10	0.3	0.1	0.29	0.036
Pipe I413_I109	92.02	62.2	130	HDPE-PE 100 PN10	-0.49	0.16	0.71	0.034
Pipe I412_I415	73.42	62.2	130	HDPE-PE 100 PN10	1.58	0.52	6.33	0.029
Pipe I412_I413	58.45753	62.2	130	HDPE-PE 100 PN10	0.03	0.01	0	0.036
Pipe I410_I411	43.48624	62.2	130	HDPE-PE 100 PN10	0.22	0.07	0.16	0.039
Pipe I410_I110	36.05	62.2	130	HDPE-PE 100 PN10	-2.01	0.66	9.83	0.028
Pipe	8.609085	62.2	130	HDPE-PE 100	-1.68	0.55	7.05	0.028

I408_I410				PN10				
Pipe I408_I409	26.15137	62.2	130	HDPE-PE 100 PN10	0.09	0.03	0.03	0.044
Pipe I406_I408	30.63067	62.2	130	HDPE-PE 100 PN10	-1.46	0.48	5.43	0.029
Pipe I406_I407	37.08858	62.2	130	HDPE-PE 100 PN10	0.25	0.08	0.21	0.037
Pipe I404_I406	91.2924	62.2	130	HDPE-PE 100 PN10	-0.71	0.23	1.44	0.032
Pipe I404_I405	56.48554	62.2	130	HDPE-PE 100 PN10	0.75	0.25	1.6	0.032
Pipe I403_I412	60.9042	62.2	130	HDPE-PE 100 PN10	-0.8	0.26	1.81	0.031
Pipe I403_I404	24.66256	62.2	130	HDPE-PE 100 PN10	0.32	0.1	0.32	0.036
Pipe I401_I403	17.29967	62.2	130	HDPE-PE 100 PN10	-0.36	0.12	0.41	0.036
Pipe I401_I402	59.89	62.2	130	HDPE-PE 100 PN10	0.24	0.08	0.2	0.038
Pipe I399_I401	24.50071	62.2	130	HDPE-PE 100 PN10	-0.26	0.09	0.22	0.038
Pipe I399_I400	21.09	62.2	130	HDPE-PE 100 PN10	0.12	0.04	0.06	0.042
Pipe I397_I399	11.1251	62.2	130	HDPE-PE 100 PN10	-0.2	0.06	0.13	0.04
Pipe I397_I398	63.1082	62.2	130	HDPE-PE 100 PN10	0.27	0.09	0.24	0.037
Pipe I395_I397	9.40795	62.2	130	HDPE-PE 100 PN10	0.13	0.04	0.06	0.044
Pipe I395_I396	45.81	62.2	130	HDPE-PE 100 PN10	0.19	0.06	0.13	0.039
Pipe I393_I395	34.54265	62.2	130	HDPE-PE 100 PN10	0.22	0.07	0.16	0.039
Pipe I393_I394	43.59992	62.2	130	HDPE-PE 100 PN10	0.23	0.08	0.18	0.038
Pipe I391_I392	21.89678	62.2	130	HDPE-PE 100 PN10	0.26	0.08	0.22	0.038
Pipe I391_I371	48.01035	62.2	130	HDPE-PE 100 PN10	0.41	0.14	0.53	0.035
Pipe I389_I391	43.29559	62.2	130	HDPE-PE 100 PN10	0.8	0.26	1.8	0.032
Pipe I389_I390	36.85999	62.2	130	HDPE-PE 100 PN10	0.23	0.08	0.18	0.038
Pipe I388_I393	39.84826	62.2	130	HDPE-PE 100 PN10	0.64	0.21	1.18	0.033
Pipe I388_I382	62.26	62.2	130	HDPE-PE 100 PN10	2.23	0.73	11.9	0.027
Pipe I385_I387	6.263199	62.2	130	HDPE-PE 100 PN10	0.05	0.02	0.02	0.101
Pipe I385_I386	7.614068	62.2	130	HDPE-PE 100 PN10	0.09	0.03	0.04	0.05

Pipe I383_I385	20.35244	62.2	130	HDPE-PE 100 PN10	0.17	0.06	0.1	0.04
Pipe I383_I384	19.46224	62.2	130	HDPE-PE 100 PN10	0.11	0.03	0.05	0.046
Pipe I382_I383	68.41627	62.2	130	HDPE-PE 100 PN10	0.41	0.14	0.52	0.035
Pipe I382_I380	50.41953	62.2	130	HDPE-PE 100 PN10	1.53	0.5	5.95	0.029
Pipe I380_I381	34.94937	62.2	130	HDPE-PE 100 PN10	0.16	0.05	0.09	0.039
Pipe I380_I379	15.79586	62.2	130	HDPE-PE 100 PN10	1.2	0.39	3.77	0.03
Pipe I379_I389	35.23694	62.2	130	HDPE-PE 100 PN10	1.15	0.38	3.49	0.03
Pipe I379_I376	42.90183	62.2	130	HDPE-PE 100 PN10	1.32	0.43	4.52	0.029
Pipe I376_I378	31.09714	62.2	130	HDPE-PE 100 PN10	0.45	0.15	0.62	0.034
Pipe I376_I377	11.50099	62.2	130	HDPE-PE 100 PN10	0.11	0.03	0.05	0.052
Pipe I375_I374	39.65448	62.2	130	HDPE-PE 100 PN10	-0.38	0.13	0.45	0.035
Pipe I374_I376	19.27366	62.2	130	HDPE-PE 100 PN10	-0.7	0.23	1.38	0.032
Pipe I374_I372	67.43741	62.2	130	HDPE-PE 100 PN10	0.18	0.06	0.11	0.04
Pipe I372_I373	32.05605	62.2	130	HDPE-PE 100 PN10	0.36	0.12	0.41	0.035
Pipe I372_I371	7.873238	62.2	130	HDPE-PE 100 PN10	-0.28	0.09	0.26	0.038
Pipe I371_I369	78.66034	62.2	130	HDPE-PE 100 PN10	-0.11	0.04	0.05	0.041
Pipe I370_I369	20.36492	62.2	130	HDPE-PE 100 PN10	-0.31	0.1	0.31	0.037
Pipe I369_I368	19.01793	62.2	130	HDPE-PE 100 PN10	-0.76	0.25	1.64	0.032
Pipe I368_I489	41.47658	62.2	130	HDPE-PE 100 PN10	-1.24	0.41	4.02	0.03
Pipe I367_I368	104.015	62.2	130	HDPE-PE 100 PN10	-0.18	0.06	0.11	0.039
Pipe I365_I367	73.38	62.2	130	HDPE-PE 100 PN10	-2.45	0.81	14.2	0.027
Pipe I365_I366	20.10774	62.2	130	HDPE-PE 100 PN10	0.23	0.08	0.19	0.039
Pipe I364_I510	97.76676	62.2	130	HDPE-PE 100 PN10	1.02	0.33	2.79	0.03
Pipe I364_I506	46.86412	62.2	130	HDPE-PE 100 PN10	1.24	0.41	4.04	0.03
Pipe I364_I365	43.93669	62.2	130	HDPE-PE 100 PN10	-1.88	0.62	8.73	0.028
Pipe	29.91962	62.2	130	HDPE-PE 100	-0.26	0.08	0.22	0.037

I363_I362				PN10				
Pipe I362_I364	58.8243	62.2	130	HDPE-PE 100 PN10	0.56	0.18	0.92	0.033
Pipe I362_I360	23.1497	62.2	130	HDPE-PE 100 PN10	-0.94	0.31	2.42	0.031
Pipe I360_I361	23.5616	62.2	130	HDPE-PE 100 PN10	0.27	0.09	0.23	0.036
Pipe I359_I360	46.18907	62.2	130	HDPE-PE 100 PN10	1.33	0.44	4.6	0.029
Pipe I359_I358	36.32186	62.2	130	HDPE-PE 100 PN10	0.27	0.09	0.23	0.037
Pipe I358_I516	47.15478	62.2	130	HDPE-PE 100 PN10	1.8	0.59	8.02	0.028
Pipe I357_I358	59.93	62.2	130	HDPE-PE 100 PN10	1.73	0.57	7.45	0.028
Pipe I357_I355	6.266329	62.2	130	HDPE-PE 100 PN10	0.67	0.22	1.28	0.033
Pipe I356_I355	16.79806	62.2	130	HDPE-PE 100 PN10	-0.1	0.03	0.04	0.042
Pipe I355_I354	31.55236	62.2	130	HDPE-PE 100 PN10	0.5	0.17	0.76	0.034
Pipe I354_I359	47.22	62.2	130	HDPE-PE 100 PN10	1.82	0.6	8.17	0.028
Pipe I354_I352	19.26187	62.2	130	HDPE-PE 100 PN10	0.42	0.14	0.53	0.035
Pipe I352_I353	30.73447	62.2	130	HDPE-PE 100 PN10	0.09	0.03	0.03	0.041
Pipe I350_I352	102.436	62.2	130	HDPE-PE 100 PN10	-0.14	0.05	0.07	0.041
Pipe I350_I351	15.44218	62.2	130	HDPE-PE 100 PN10	0.2	0.06	0.13	0.037
Pipe I349_I367	52.13141	62.2	130	HDPE-PE 100 PN10	-1.34	0.44	4.65	0.029
Pipe I349_I350	39.3245	62.2	130	HDPE-PE 100 PN10	0.29	0.09	0.26	0.037
Pipe I345_I347	63.97667	62.2	130	HDPE-PE 100 PN10	0.3	0.1	0.29	0.036
Pipe I345_I346	12.41987	62.2	130	HDPE-PE 100 PN10	0.09	0.03	0.02	0.033
Pipe I344_I343	55.34706	62.2	130	HDPE-PE 100 PN10	0.1	0.03	0.04	0.045
Pipe I344_I342	55.08199	62.2	130	HDPE-PE 100 PN10	0.09	0.03	0.04	0.045
Pipe I343_I342	14.64406	62.2	130	HDPE-PE 100 PN10	-0.05	0.02	0.01	0.05
Pipe I342_I338	109.8577	62.2	130	HDPE-PE 100 PN10	-0.35	0.12	0.39	0.036
Pipe I341_I339	24.86949	62.2	130	HDPE-PE 100 PN10	-0.43	0.14	0.56	0.035
Pipe I339_I340	19.02551	62.2	130	HDPE-PE 100 PN10	0.2	0.07	0.14	0.04

Pipe I339_I338	75.03686	62.2	130	HDPE-PE 100 PN10	-0.78	0.26	1.72	0.032
Pipe I338_I337	15.7572	62.2	130	HDPE-PE 100 PN10	-1.26	0.41	4.16	0.03
Pipe I337_I349	14.27084	62.2	130	HDPE-PE 100 PN10	-0.92	0.3	2.33	0.031
Pipe I335_I337	34.36285	62.2	130	HDPE-PE 100 PN10	0.38	0.13	0.45	0.035
Pipe I335_I336	21.31118	62.2	130	HDPE-PE 100 PN10	0.21	0.07	0.16	0.039
Pipe I333_I335	201.3588	62.2	130	HDPE-PE 100 PN10	0.84	0.28	1.97	0.031
Pipe I333_I334	25.78084	62.2	130	HDPE-PE 100 PN10	0.28	0.09	0.27	0.037
Pipe I332_I333	58.57999	62.2	130	HDPE-PE 100 PN10	1.55	0.51	6.07	0.029
Pipe I332_I331	40.66064	62.2	130	HDPE-PE 100 PN10	-1.85	0.61	8.48	0.028
Pipe I331_I379	150.55	62.2	130	HDPE-PE 100 PN10	1.42	0.47	5.16	0.029
Pipe I331_I330	31.16125	62.2	130	HDPE-PE 100 PN10	-2.07	0.68	10.5	0.027
Pipe I330_I388	26.97647	62.2	130	HDPE-PE 100 PN10	-1.53	0.5	5.97	0.029
Pipe I328_I329	19.90797	62.2	130	HDPE-PE 100 PN10	0.19	0.06	0.13	0.039
Pipe I328_I327	34.89059	62.2	130	HDPE-PE 100 PN10	-1.16	0.38	3.58	0.03
Pipe I327_I330	104.4655	62.2	130	HDPE-PE 100 PN10	0.74	0.24	1.55	0.032
Pipe I327_I326	32.04086	62.2	130	HDPE-PE 100 PN10	-2.12	0.7	10.9	0.027
Pipe I326_I429	23.83136	62.2	130	HDPE-PE 100 PN10	-1.12	0.37	3.34	0.03
Pipe I326_I324	61.18012	62.2	130	HDPE-PE 100 PN10	-1.17	0.39	3.65	0.03
Pipe I324_I325	30.79728	62.2	130	HDPE-PE 100 PN10	0.2	0.07	0.14	0.039
Pipe I324_I322	7.102565	62.2	130	HDPE-PE 100 PN10	-1.51	0.5	5.78	0.029
Pipe I322_I323	42.1819	62.2	130	HDPE-PE 100 PN10	0.2	0.07	0.13	0.039
Pipe I322_I320	18.22086	62.2	130	HDPE-PE 100 PN10	-1.75	0.58	7.66	0.028
Pipe I320_I321	30.0007	62.2	130	HDPE-PE 100 PN10	0.14	0.05	0.07	0.041
Pipe I319_I426	54.44159	62.2	130	HDPE-PE 100 PN10	-1.1	0.36	3.25	0.03
Pipe I319_I320	28.9106	62.2	130	HDPE-PE 100 PN10	1.98	0.65	9.56	0.028
Pipe	18.20301	62.2	130	HDPE-PE 100	0.99	0.33	2.65	0.031

I317_I319				PN10				
Pipe I317_I318	24.9319	62.2	130	HDPE-PE 100 PN10	0.1	0.03	0.04	0.043
Pipe I315_I317	35.27908	62.2	130	HDPE-PE 100 PN10	1.17	0.38	3.6	0.03
Pipe I315_I316	11.4079	62.2	130	HDPE-PE 100 PN10	0.13	0.04	0.07	0.045
Pipe I312_I314	16.46698	62.2	130	HDPE-PE 100 PN10	0.13	0.04	0.06	0.043
Pipe I312_I313	10.43051	62.2	130	HDPE-PE 100 PN10	0.19	0.06	0.13	0.04
Pipe I311_I312	4.704297	62.2	130	HDPE-PE 100 PN10	0.34	0.11	0.35	0.034
Pipe I311_I310	84.73065	62.2	130	HDPE-PE 100 PN10	-1.39	0.46	5	0.029
Pipe I310_I315	39.70238	62.2	130	HDPE-PE 100 PN10	1.39	0.46	4.98	0.029
Pipe I310_I308	75.45	62.2	130	HDPE-PE 100 PN10	-3.05	1	21.3	0.026
Pipe I309_I308	85.03	62.2	130	HDPE-PE 100 PN10	-1.61	0.53	6.57	0.028
Pipe I309_I118	47.0507	62.2	130	HDPE-PE 100 PN10	2.83	0.93	18.6	0.026
Pipe I306_I307	10	62.2	130	HDPE-PE 100 PN10	0.2	0.07	0.13	0.037
Pipe I306_I250	98.22483	62.2	130	HDPE-PE 100 PN10	0.95	0.31	2.46	0.031
Pipe I304_I306	12.58	62.2	130	HDPE-PE 100 PN10	1.35	0.45	4.74	0.029
Pipe I304_I305	23.79032	62.2	130	HDPE-PE 100 PN10	0.44	0.15	0.59	0.034
Pipe I304_I303	61.22788	62.2	130	HDPE-PE 100 PN10	1.78	0.59	7.87	0.028
Pipe I303_I561	89.85	62.2	130	HDPE-PE 100 PN10	0.95	0.31	2.46	0.031
Pipe I303_I556	61.03923	62.2	130	HDPE-PE 100 PN10	0.05	0.02	0.01	0.05
Pipe I303_I301	50.2307	62.2	130	HDPE-PE 100 PN10	1.36	0.45	4.78	0.029
Pipe I301_I302	30.59286	62.2	130	HDPE-PE 100 PN10	0.34	0.11	0.36	0.036
Pipe I301_I300	148.7271	62.2	130	HDPE-PE 100 PN10	0.65	0.21	1.21	0.033
Pipe I300_I484	70.93306	62.2	130	HDPE-PE 100 PN10	-0.6	0.2	1.06	0.033
Pipe I298_I300	41.15328	62.2	130	HDPE-PE 100 PN10	-0.66	0.22	1.25	0.032
Pipe I298_I299	9.977918	62.2	130	HDPE-PE 100 PN10	0.11	0.03	0.04	0.045
Pipe I297_I298	16.47482	62.2	130	HDPE-PE 100 PN10	-0.1	0.03	0.04	0.043

Pipe I295_I297	33.97106	62.2	130	HDPE-PE 100 PN10	0.11	0.04	0.05	0.045
Pipe I295_I296	21.77505	62.2	130	HDPE-PE 100 PN10	0.19	0.06	0.13	0.041
Pipe I294_I295	19.47241	62.2	130	HDPE-PE 100 PN10	0.39	0.13	0.47	0.035
Pipe I293_I483	99.18909	62.2	130	HDPE-PE 100 PN10	-0.45	0.15	0.61	0.034
Pipe I293_I294	36.32912	62.2	130	HDPE-PE 100 PN10	0.75	0.25	1.58	0.032
Pipe I292_I293	13.66253	62.2	130	HDPE-PE 100 PN10	0.43	0.14	0.58	0.034
Pipe I290_I291	29.13944	62.2	130	HDPE-PE 100 PN10	0.41	0.13	0.51	0.035
Pipe I289_I290	58.87029	62.2	130	HDPE-PE 100 PN10	-1.17	0.38	3.62	0.03
Pipe I289_I288	34.90919	62.2	130	HDPE-PE 100 PN10	0.18	0.06	0.12	0.04
Pipe I288_I292	13.62313	62.2	130	HDPE-PE 100 PN10	-0.36	0.12	0.42	0.036
Pipe I287_I289	23.43368	62.2	130	HDPE-PE 100 PN10	-0.52	0.17	0.81	0.034
Pipe I287_I288	23.37053	62.2	130	HDPE-PE 100 PN10	-0.46	0.15	0.64	0.034
Pipe I287_I286	55.04837	62.2	130	HDPE-PE 100 PN10	0.57	0.19	0.95	0.033
Pipe I286_I294	50.1088	62.2	130	HDPE-PE 100 PN10	-0.2	0.07	0.15	0.039
Pipe I286_I281	48.87663	62.2	130	HDPE-PE 100 PN10	0.18	0.06	0.11	0.038
Pipe I284_I297	8.453215	62.2	130	HDPE-PE 100 PN10	-0.16	0.05	0.09	0.038
Pipe I284_I285	7.336458	62.2	130	HDPE-PE 100 PN10	0.01	0	0	0
Pipe I283_I282	11.23352	62.2	130	HDPE-PE 100 PN10	-0.02	0.01	0	0
Pipe I282_I284	4.433053	62.2	130	HDPE-PE 100 PN10	-0.14	0.05	0.07	0.039
Pipe I281_I282	31.4248	62.2	130	HDPE-PE 100 PN10	-0.07	0.02	0.02	0.041
Pipe I281_I279	15.83133	62.2	130	HDPE-PE 100 PN10	-0.13	0.04	0.06	0.037
Pipe I279_I280	17.14229	62.2	130	HDPE-PE 100 PN10	0.04	0.01	0.01	0.051
Pipe I279_I276	16.03009	62.2	130	HDPE-PE 100 PN10	-0.36	0.12	0.41	0.035
Pipe I278_I277	30.20347	62.2	130	HDPE-PE 100 PN10	-0.65	0.22	1.24	0.033
Pipe I277_I298	7.378752	62.2	130	HDPE-PE 100 PN10	-0.43	0.14	0.56	0.034
Pipe	43.42462	62.2	130	HDPE-PE 100	0.26	0.08	0.22	0.037

I276_I277				PN10				
Pipe I276_I275	194.98	62.2	130	HDPE-PE 100 PN10	-1.9	0.63	8.89	0.028
Pipe I275_I304	60.61	62.2	130	HDPE-PE 100 PN10	2.33	0.77	13	0.027
Pipe I274_I275	141.13	62.2	130	HDPE-PE 100 PN10	-0.81	0.27	1.83	0.031
Pipe I273_I271	27.13012	62.2	130	HDPE-PE 100 PN10	1.2	0.4	3.8	0.03
Pipe I271_I272	46.3903	62.2	130	HDPE-PE 100 PN10	0.31	0.1	0.32	0.036
Pipe I271_I269	69.29753	62.2	130	HDPE-PE 100 PN10	0.77	0.25	1.67	0.032
Pipe I269_I270	23.55881	62.2	130	HDPE-PE 100 PN10	0.19	0.06	0.12	0.038
Pipe I269_I025	89.57	62.2	130	HDPE-PE 100 PN10	0.26	0.09	0.23	0.037
Pipe I266_I268	10.33836	62.2	130	HDPE-PE 100 PN10	0.13	0.04	0.06	0.038
Pipe I266_I267	13.79377	62.2	130	HDPE-PE 100 PN10	0.19	0.06	0.13	0.039
Pipe I265_I266	36.24948	62.2	130	HDPE-PE 100 PN10	0.4	0.13	0.5	0.035
Pipe I265_I026	126.08	62.2	130	HDPE-PE 100 PN10	0.43	0.14	0.56	0.035
Pipe I264_I265	66.80127	62.2	130	HDPE-PE 100 PN10	0.96	0.32	2.53	0.031
Pipe I264_I262	12.22503	62.2	130	HDPE-PE 100 PN10	-1	0.33	2.73	0.031
Pipe I262_I263	20.47444	62.2	130	HDPE-PE 100 PN10	0.09	0.03	0.04	0.046
Pipe I262_I261	123.26	62.2	130	HDPE-PE 100 PN10	-1.77	0.58	7.77	0.028
Pipe I261_I259	25.29	62.2	130	HDPE-PE 100 PN10	2.17	0.71	11.4	0.027
Pipe I260_I259	55.17256	62.2	130	HDPE-PE 100 PN10	-0.24	0.08	0.19	0.038
Pipe I259_I257	47.11594	62.2	130	HDPE-PE 100 PN10	1.71	0.56	7.3	0.028
Pipe I257_I258	19.73144	62.2	130	HDPE-PE 100 PN10	0.09	0.03	0.03	0.042
Pipe I257_I255	37.5384	62.2	130	HDPE-PE 100 PN10	1.36	0.45	4.78	0.029
Pipe I255_I256	30.42709	62.2	130	HDPE-PE 100 PN10	0.28	0.09	0.25	0.036
Pipe I255_I251	29.01556	62.2	130	HDPE-PE 100 PN10	0.9	0.3	2.24	0.031
Pipe I252_I254	11.39022	62.2	130	HDPE-PE 100 PN10	0.06	0.02	0.01	0.04
Pipe I252_I253	15.07319	62.2	130	HDPE-PE 100 PN10	0.11	0.03	0.04	0.04

Pipe I251_I252	49.02784	62.2	130	HDPE-PE 100 PN10	0.28	0.09	0.26	0.037
Pipe I250_I251	105.4596	62.2	130	HDPE-PE 100 PN10	-0.35	0.11	0.38	0.036
Pipe I249_I570	27.77492	62.2	130	HDPE-PE 100 PN10	-0.3	0.1	0.28	0.037
Pipe I249_I250	37.35227	62.2	130	HDPE-PE 100 PN10	-0.84	0.28	1.97	0.031
Pipe I249_I245	30.6751	62.2	130	HDPE-PE 100 PN10	1.01	0.33	2.77	0.03
Pipe I246_I248	18.27878	62.2	130	HDPE-PE 100 PN10	0.24	0.08	0.2	0.037
Pipe I246_I247	16.84205	62.2	130	HDPE-PE 100 PN10	0.09	0.03	0.03	0.034
Pipe I245_I246	23.08615	62.2	130	HDPE-PE 100 PN10	0.39	0.13	0.48	0.035
Pipe I244_I577	65.32293	62.2	130	HDPE-PE 100 PN10	0.36	0.12	0.4	0.036
Pipe I244_I245	21.2246	62.2	130	HDPE-PE 100 PN10	-0.51	0.17	0.79	0.034
Pipe I243_I580	66.57445	62.2	130	HDPE-PE 100 PN10	-1.19	0.39	3.73	0.03
Pipe I243_I244	63.36841	62.2	130	HDPE-PE 100 PN10	0.35	0.11	0.39	0.036
Pipe I242_I582	91.8818	62.2	130	HDPE-PE 100 PN10	0.62	0.21	1.13	0.033
Pipe I242_I240	25.67268	62.2	130	HDPE-PE 100 PN10	1.08	0.36	3.15	0.03
Pipe I240_I241	23.97824	62.2	130	HDPE-PE 100 PN10	0.18	0.06	0.11	0.039
Pipe I240_I238	15.31148	62.2	130	HDPE-PE 100 PN10	0.84	0.28	1.95	0.031
Pipe I239_I238	34.05402	62.2	130	HDPE-PE 100 PN10	-0.08	0.03	0.02	0.042
Pipe I238_I236	113.1667	62.2	130	HDPE-PE 100 PN10	0.67	0.22	1.28	0.032
Pipe I236_I647	30.10544	62.2	130	HDPE-PE 100 PN10	-0.56	0.18	0.93	0.033
Pipe I236_I237	65.59678	62.2	130	HDPE-PE 100 PN10	0.3	0.1	0.3	0.036
Pipe I236_I233	58.00193	62.2	130	HDPE-PE 100 PN10	0.61	0.2	1.09	0.033
Pipe I234_I235	32.14221	62.2	130	HDPE-PE 100 PN10	0.25	0.08	0.2	0.037
Pipe I233_I234	73.54884	62.2	130	HDPE-PE 100 PN10	0.3	0.1	0.29	0.037
Pipe I231_I233	47.13577	62.2	130	HDPE-PE 100 PN10	0.05	0.02	0.01	0.05
Pipe I231_I232	32.59039	62.2	130	HDPE-PE 100 PN10	0.14	0.05	0.07	0.041
Pipe	78.06824	62.2	130	HDPE-PE 100	0.37	0.12	0.42	0.035

I230_I231				PN10				
Pipe I228_I230	68.25864	62.2	130	HDPE-PE 100 PN10	-0.07	0.02	0.02	0.047
Pipe I228_I229	38.54307	62.2	130	HDPE-PE 100 PN10	0.31	0.1	0.31	0.036
Pipe I227_I244	69.84214	62.2	130	HDPE-PE 100 PN10	-0.3	0.1	0.28	0.037
Pipe I227_I243	30.04228	62.2	130	HDPE-PE 100 PN10	-0.72	0.24	1.47	0.032
Pipe I225_I227	43.69624	62.2	130	HDPE-PE 100 PN10	-0.88	0.29	2.15	0.031
Pipe I225_I226	55.46241	62.2	130	HDPE-PE 100 PN10	0.2	0.07	0.14	0.039
Pipe I223_I225	47.02	62.2	130	HDPE-PE 100 PN10	-0.45	0.15	0.61	0.034
Pipe I223_I224	39.72	62.2	130	HDPE-PE 100 PN10	0.19	0.06	0.13	0.039
Pipe I221_I223	107.78	62.2	130	HDPE-PE 100 PN10	-0.15	0.05	0.08	0.041
Pipe I221_I222	23.49627	62.2	130	HDPE-PE 100 PN10	0.24	0.08	0.19	0.038
Pipe I219_I220	16.92452	62.2	130	HDPE-PE 100 PN10	0.15	0.05	0.09	0.043
Pipe I219_I217	39.6409	62.2	130	HDPE-PE 100 PN10	0.9	0.3	2.25	0.031
Pipe I217_I218	31.85148	62.2	130	HDPE-PE 100 PN10	0.67	0.22	1.28	0.032
Pipe I217_I216	100.1552	62.2	130	HDPE-PE 100 PN10	0.16	0.05	0.09	0.04
Pipe I216_I242	36.62035	62.2	130	HDPE-PE 100 PN10	-1.14	0.38	3.45	0.03
Pipe I216_I214	38.1695	62.2	130	HDPE-PE 100 PN10	1.21	0.4	3.84	0.03
Pipe I214_I215	39.09945	62.2	130	HDPE-PE 100 PN10	0.24	0.08	0.19	0.038
Pipe I214_I212	16.65556	62.2	130	HDPE-PE 100 PN10	0.89	0.29	2.17	0.031
Pipe I212_I213	23.45756	62.2	130	HDPE-PE 100 PN10	0.27	0.09	0.24	0.038
Pipe I212_I211	113.5355	62.2	130	HDPE-PE 100 PN10	0.28	0.09	0.26	0.037
Pipe I211_I234	37.66983	62.2	130	HDPE-PE 100 PN10	0.11	0.04	0.05	0.043
Pipe I211_I207	30.64423	62.2	130	HDPE-PE 100 PN10	-0.51	0.17	0.77	0.034
Pipe I208_I210	10.78847	62.2	130	HDPE-PE 100 PN10	0.05	0.02	0.01	0.072
Pipe I208_I209	17.03485	62.2	130	HDPE-PE 100 PN10	0.1	0.03	0.03	0.041
Pipe I207_I208	17.09683	62.2	130	HDPE-PE 100 PN10	0.18	0.06	0.11	0.039

Pipe I207_I206	7.392862	62.2	130	HDPE-PE 100 PN10	-0.81	0.27	1.83	0.032
Pipe I206_I204	28.13537	62.2	130	HDPE-PE 100 PN10	0.12	0.04	0.05	0.044
Pipe I204_I205	30.64715	62.2	130	HDPE-PE 100 PN10	0.16	0.05	0.09	0.04
Pipe I204_I203	121.8687	62.2	130	HDPE-PE 100 PN10	-0.32	0.1	0.32	0.036
Pipe I203_I228	30.20377	62.2	130	HDPE-PE 100 PN10	0.51	0.17	0.79	0.034
Pipe I203_I200	32.65789	62.2	130	HDPE-PE 100 PN10	-1.04	0.34	2.93	0.03
Pipe I201_I202	14.51842	62.2	130	HDPE-PE 100 PN10	0.19	0.06	0.13	0.041
Pipe I201_I200	33.43436	62.2	130	HDPE-PE 100 PN10	0.13	0.04	0.06	0.04
Pipe I200_I198	23.86511	62.2	130	HDPE-PE 100 PN10	-0.99	0.33	2.65	0.031
Pipe I198_I036	47.93	62.2	130	HDPE-PE 100 PN10	0.44	0.15	0.6	0.035
Pipe I197_I037	68.8	62.2	130	HDPE-PE 100 PN10	-1.45	0.48	5.4	0.029
Pipe I196_I199	93.17364	62.2	130	HDPE-PE 100 PN10	0.18	0.06	0.12	0.039
Pipe I196_I198	19.41405	62.2	130	HDPE-PE 100 PN10	-0.64	0.21	1.19	0.033
Pipe I194_I196	89.53372	62.2	130	HDPE-PE 100 PN10	-0.39	0.13	0.47	0.035
Pipe I194_I195	39.14389	62.2	130	HDPE-PE 100 PN10	0.27	0.09	0.23	0.037
Pipe I193_I700	22.87446	62.2	130	HDPE-PE 100 PN10	-0.33	0.11	0.35	0.037
Pipe I193_I197	174.1692	62.2	130	HDPE-PE 100 PN10	-1.33	0.44	4.62	0.029
Pipe I192_I670	37.40312	62.2	130	HDPE-PE 100 PN10	0.6	0.2	1.05	0.033
Pipe I192_I193	16.68366	62.2	130	HDPE-PE 100 PN10	-1.53	0.5	5.97	0.029
Pipe I191_I671	36.03741	62.2	130	HDPE-PE 100 PN10	0.22	0.07	0.17	0.038
Pipe I191_I194	95.64399	62.2	130	HDPE-PE 100 PN10	0.09	0.03	0.03	0.043
Pipe I190_I666	59.0482	62.2	130	HDPE-PE 100 PN10	-0.21	0.07	0.16	0.039
Pipe I190_I192	38.67282	62.2	130	HDPE-PE 100 PN10	-0.84	0.28	1.97	0.031
Pipe I188_I191	46.45057	62.2	130	HDPE-PE 100 PN10	0.39	0.13	0.48	0.035
Pipe I188_I189	43.36	62.2	130	HDPE-PE 100 PN10	0.25	0.08	0.21	0.038
Pipe	93.72044	62.2	130	HDPE-PE 100	0.09	0.03	0.03	0.044

I187_I665				PN10				
Pipe I187_I190	35.11926	62.2	130	HDPE-PE 100 PN10	-0.93	0.31	2.36	0.031
Pipe I186_I230	102.1853	62.2	130	HDPE-PE 100 PN10	0.76	0.25	1.64	0.032
Pipe I186_I188	17.44941	62.2	130	HDPE-PE 100 PN10	0.73	0.24	1.49	0.032
Pipe I183_I185	36.08462	62.2	130	HDPE-PE 100 PN10	0.27	0.09	0.24	0.037
Pipe I183_I184	24.66399	62.2	130	HDPE-PE 100 PN10	0.41	0.14	0.52	0.035
Pipe I182_I187	41.63752	62.2	130	HDPE-PE 100 PN10	-0.74	0.24	1.54	0.032
Pipe I182_I183	52.01359	62.2	130	HDPE-PE 100 PN10	0.87	0.29	2.1	0.031
Pipe I180_I186	32.99015	62.2	130	HDPE-PE 100 PN10	-0.33	0.11	0.35	0.036
Pipe I180_I181	65.50923	62.2	130	HDPE-PE 100 PN10	0.28	0.09	0.25	0.037
Pipe I179_I182	92.00428	62.2	130	HDPE-PE 100 PN10	0.22	0.07	0.17	0.038
Pipe I178_I651	108.7855	62.2	130	HDPE-PE 100 PN10	-0.38	0.12	0.45	0.035
Pipe I178_I179	25.54823	62.2	130	HDPE-PE 100 PN10	0.42	0.14	0.53	0.035
Pipe I177_I180	109.6071	62.2	130	HDPE-PE 100 PN10	0.23	0.08	0.18	0.038
Pipe I175_I177	38.90352	62.2	130	HDPE-PE 100 PN10	-0.34	0.11	0.36	0.036
Pipe I175_I176	24.46757	62.2	130	HDPE-PE 100 PN10	0.1	0.03	0.04	0.043
Pipe I173_I175	64.4955	62.2	130	HDPE-PE 100 PN10	-0.05	0.02	0.01	0.05
Pipe I173_I174	34.42103	62.2	130	HDPE-PE 100 PN10	0.11	0.04	0.04	0.041
Pipe I172_I649	57.7703	62.2	130	HDPE-PE 100 PN10	-0.21	0.07	0.14	0.038
Pipe I172_I178	107.699	62.2	130	HDPE-PE 100 PN10	0.15	0.05	0.08	0.041
Pipe I171_I623	92.25525	62.2	130	HDPE-PE 100 PN10	-1.5	0.5	5.77	0.029
Pipe I170_I173	30.71915	62.2	130	HDPE-PE 100 PN10	0.19	0.06	0.13	0.04
Pipe I168_I169	128.1903	62.2	130	HDPE-PE 100 PN10	-1.15	0.38	3.53	0.03
Pipe I167_I592	16.44372	62.2	130	HDPE-PE 100 PN10	0.71	0.23	1.44	0.032
Pipe I167_I171	154.2237	62.2	130	HDPE-PE 100 PN10	-1.41	0.46	5.1	0.029
Pipe I165_I168	43.26133	62.2	130	HDPE-PE 100 PN10	0.54	0.18	0.87	0.033

Pipe I165_I166	17.20211	62.2	130	HDPE-PE 100 PN10	0.12	0.04	0.05	0.041
Pipe I164_I590	30.4416	62.2	130	HDPE-PE 100 PN10	0.75	0.25	1.58	0.032
Pipe I164_I167	74.95061	62.2	130	HDPE-PE 100 PN10	-0.65	0.22	1.24	0.032
Pipe I162_I165	77.05	62.2	130	HDPE-PE 100 PN10	0.78	0.26	1.72	0.032
Pipe I162_I163	37.57	62.2	130	HDPE-PE 100 PN10	0.16	0.05	0.09	0.041
Pipe I160_I162	55.51	62.2	130	HDPE-PE 100 PN10	1.08	0.36	3.12	0.03
Pipe I160_I161	20.57715	62.2	130	HDPE-PE 100 PN10	0.12	0.04	0.05	0.042
Pipe I159_I588	52.48751	62.2	130	HDPE-PE 100 PN10	0.78	0.26	1.72	0.032
Pipe I159_I164	95.07136	62.2	130	HDPE-PE 100 PN10	0.24	0.08	0.19	0.038
Pipe I158_I540	45.7505	62.2	130	HDPE-PE 100 PN10	2.38	0.78	13.5	0.027
Pipe I158_I160	32.12	62.2	130	HDPE-PE 100 PN10	1.26	0.42	4.17	0.029
Pipe I157_I530	83.14028	62.2	130	HDPE-PE 100 PN10	1.03	0.34	2.87	0.03
Pipe I157_I159	37.8212	62.2	130	HDPE-PE 100 PN10	1.15	0.38	3.5	0.03
Pipe I157_I153	64.18431	62.2	130	HDPE-PE 100 PN10	-2.38	0.78	13.5	0.027
Pipe I155_I158	70.92805	62.2	130	HDPE-PE 100 PN10	-1.86	0.61	8.53	0.028
Pipe I155_I156	10.74484	62.2	130	HDPE-PE 100 PN10	0.14	0.05	0.07	0.038
Pipe I153_I154	9.810735	62.2	130	HDPE-PE 100 PN10	0.06	0.02	0.02	0.047
Pipe I153_I152	12.88491	62.2	130	HDPE-PE 100 PN10	-2.46	0.81	14.4	0.027
Pipe I152_I151	29.42	62.2	130	HDPE-PE 100 PN10	-3.37	1.11	25.7	0.025
Pipe I151_I357	32.03973	62.2	130	HDPE-PE 100 PN10	0.76	0.25	1.64	0.032
Pipe I150_I155	52.90012	62.2	130	HDPE-PE 100 PN10	-1.7	0.56	7.2	0.028
Pipe I148_I150	49.95346	62.2	130	HDPE-PE 100 PN10	-0.52	0.17	0.8	0.034
Pipe I148_I149	65.41481	62.2	130	HDPE-PE 100 PN10	0.2	0.07	0.14	0.038
Pipe I146_I151	99.12808	62.2	130	HDPE-PE 100 PN10	-1.07	0.35	3.07	0.03
Pipe I146_I147	64.23211	62.2	130	HDPE-PE 100 PN10	0.16	0.05	0.09	0.04
Pipe	60.36907	62.2	130	HDPE-PE 100	-0.04	0.01	0.01	0.054

I144_I148				PN10				
Pipe I144_I145	61.2551	62.2	130	HDPE-PE 100 PN10	0.31	0.1	0.31	0.036
Pipe I143_I144	22.37	62.2	130	HDPE-PE 100 PN10	0.4	0.13	0.51	0.035
Pipe I141_I146	71.80609	62.2	130	HDPE-PE 100 PN10	-0.71	0.23	1.43	0.032
Pipe I141_I142	21.46958	62.2	130	HDPE-PE 100 PN10	0.21	0.07	0.15	0.039
Pipe I139_I143	47.88	62.2	130	HDPE-PE 100 PN10	2.08	0.68	10.5	0.027
Pipe I139_I140	40.18	62.2	130	HDPE-PE 100 PN10	0.19	0.06	0.12	0.039
Pipe I138_I348	82.29394	62.2	130	HDPE-PE 100 PN10	0.19	0.06	0.13	0.039
Pipe I138_I141	19.41261	62.2	130	HDPE-PE 100 PN10	-0.42	0.14	0.54	0.035
Pipe I137_I345	89.47031	62.2	130	HDPE-PE 100 PN10	0.63	0.21	1.17	0.033
Pipe I137_I138	38.38828	62.2	130	HDPE-PE 100 PN10	-0.12	0.04	0.05	0.041
Pipe I135_I139	44.78	62.2	130	HDPE-PE 100 PN10	2.31	0.76	12.7	0.027
Pipe I135_I136	28.22846	62.2	130	HDPE-PE 100 PN10	0.22	0.07	0.16	0.039
Pipe I134_I135	45.16623	62.2	130	HDPE-PE 100 PN10	2.61	0.86	16	0.026
Pipe I133_I341	71.59011	62.2	130	HDPE-PE 100 PN10	-0.19	0.06	0.12	0.039
Pipe I133_I137	55.21255	62.2	130	HDPE-PE 100 PN10	0.7	0.23	1.4	0.032
Pipe I132_I344	35.0536	62.2	130	HDPE-PE 100 PN10	0.57	0.19	0.95	0.033
Pipe I132_I133	81.99934	62.2	130	HDPE-PE 100 PN10	0.79	0.26	1.76	0.032
Pipe I130_I134	105.6246	62.2	130	HDPE-PE 100 PN10	1.04	0.34	2.89	0.03
Pipe I130_I131	39.31476	62.2	130	HDPE-PE 100 PN10	0.3	0.1	0.29	0.036
Pipe I129_I332	39.94787	62.2	130	HDPE-PE 100 PN10	-0.1	0.03	0.04	0.044
Pipe I129_I132	132.3947	62.2	130	HDPE-PE 100 PN10	1.58	0.52	6.34	0.029
Pipe I128_I130	132.98	62.2	130	HDPE-PE 100 PN10	1.59	0.52	6.42	0.028
Pipe I126_I128	36.56	62.2	130	HDPE-PE 100 PN10	0.31	0.1	0.3	0.036
Pipe I126_I127	31.82	62.2	130	HDPE-PE 100 PN10	0.18	0.06	0.11	0.039
Pipe I125_I328	60.21587	62.2	130	HDPE-PE 100 PN10	-0.73	0.24	1.5	0.032

Pipe I125_I129	87.43011	62.2	130	HDPE-PE 100 PN10	1.68	0.55	7.07	0.028
Pipe I123_I126	142.69	62.2	130	HDPE-PE 100 PN10	0.61	0.2	1.09	0.033
Pipe I123_I124	49.82218	62.2	130	HDPE-PE 100 PN10	0.42	0.14	0.54	0.035
Pipe I121_I125	114.5468	62.2	130	HDPE-PE 100 PN10	1.32	0.44	4.55	0.029
Pipe I121_I122	63.55152	62.2	130	HDPE-PE 100 PN10	0.31	0.1	0.31	0.036
Pipe I120_I311	59.28645	62.2	130	HDPE-PE 100 PN10	-0.97	0.32	2.57	0.031
Pipe I120_I121	59.87175	62.2	130	HDPE-PE 100 PN10	1.88	0.62	8.69	0.028
Pipe I118_I120	111.6988	62.2	130	HDPE-PE 100 PN10	1.63	0.54	6.69	0.028
Pipe I118_I119	59.56102	62.2	130	HDPE-PE 100 PN10	0.39	0.13	0.47	0.035
Pipe I116_I800	81.28263	62.2	130	HDPE-PE 100 PN10	-1.43	0.47	5.26	0.029
Pipe I116_I123	238.1001	62.2	130	HDPE-PE 100 PN10	1.41	0.46	5.1	0.029
Pipe I115_I001	152.51	150	110	DI	-11.29	0.64	4.51	0.033
Pipe I113_I112	59.94	62.2	130	DI	-0.15	0.05	0.08	0.041
Pipe I112_I111	73.81725	250	110	DI	34.1	0.69	2.9	0.03
Pipe I111_I110	85.31809	250	110	DI	28.2	0.57	2.04	0.03
Pipe I109_I110	344.12	200	110	DI	-28.2	0.9	6.05	0.029
Pipe I109_I108	31.53	200	110	DI	22.27	0.71	3.91	0.031
Pipe I107_I108	30.52	200	110	DI	-19.8	0.63	3.14	0.031
Pipe I107_I106	81.1719	200	110	DI	19.8	0.63	3.14	0.031
Pipe I106_I105	173.06	200	110	DI	19.8	0.63	3.14	0.031
Pipe I104_I491	70.04	62.2	130	DI	1.47	0.48	5.54	0.029
Pipe I104_I105	63.62	150	110	DI	-5.77	0.33	1.3	0.036
Pipe I104_I103	44.59	150	110	DI	5.77	0.33	1.31	0.036
Pipe I103_I501	96.43	62.2	130	DI	0.93	0.31	2.35	0.031
Pipe I103_I102	223.27	150	110	DI	5.77	0.33	1.3	0.036
Pipe	52.88879	150	110	DI	5.77	0.33	1.3	0.036

I102_I101								
Pipe I101_I097	66.88665	150	110	DI	5.77	0.33	1.3	0.036
Pipe I098_I100	33.74649	62.2	130	DI	0.27	0.09	0.24	0.037
Pipe I098_I099	19.95737	62.2	130	DI	0.1	0.03	0.04	0.045
Pipe I097_I098	13.77	62.2	130	DI	0.49	0.16	0.71	0.034
Pipe I097_I096	31.52894	150	110	DI	5.77	0.33	1.3	0.036
Pipe I096_I538	67.22	62.2	130	DI	-0.04	0.01	0.01	0.054
Pipe I096_I095	38.30911	150	110	DI	5.77	0.33	1.3	0.036
Pipe I095_I093	28.19376	150	110	DI	5.77	0.33	1.3	0.036
Pipe I093_I094	17.83	62.2	130	DI	0.19	0.06	0.13	0.039
Pipe I093_I092	41.68	150	110	DI	5.77	0.33	1.3	0.036
Pipe I092_I090	15.44	200	110	DI	5.77	0.18	0.32	0.037
Pipe I090_I091	58.49	62.2	130	DI	0.24	0.08	0.18	0.037
Pipe I090_I088	18.50436	200	110	DI	5.77	0.18	0.32	0.037
Pipe I088_I089	30.95	62.2	130	DI	0.14	0.05	0.07	0.04
Pipe I088_I087	48.66636	150	110	DI	5.77	0.33	1.3	0.036
Pipe I087_I609	48.8	62.2	130	DI	0.18	0.06	0.12	0.039
Pipe I087_I086	64.62721	150	110	DI	5.77	0.33	1.3	0.036
Pipe I086_I085	56.00028	150	110	DI	5.77	0.33	1.3	0.036
Pipe I085_I637	105.67	62.2	130	DI	0.29	0.1	0.28	0.036
Pipe I085_I084	97.56511	150	110	DI	5.77	0.33	1.3	0.036
Pipe I084_I082	22.00287	150	110	DI	5.77	0.33	1.31	0.036
Pipe I082_I083	31.35	62.2	130	DI	0.18	0.06	0.11	0.038
Pipe I081_I082	104.12	150	110	DI	-5.77	0.33	1.3	0.036
Pipe I080_I079	128.01	62.2	130	DI	1.45	0.48	5.36	0.029
Pipe I079_I685	56.45591	62.2	130	DI	1.12	0.37	3.35	0.03

Pipe I079_I078	206.135	62.2	130	DI	0	0	0	0
Pipe I078_I077	56.13941	62.2	130	DI	-2.22	0.73	11.9	0.027
Pipe I077_I740	119.07	62.2	130	DI	2.15	0.71	11.1	0.027
Pipe I076_I754	41.18	62.2	130	DI	1.48	0.49	5.6	0.029
Pipe I076_I075	70.4	62.2	130	DI	-1.58	0.52	6.3	0.029
Pipe I075_I766	30.83928	62.2	130	DI	1.39	0.46	4.97	0.029
Pipe I075_I073	59.67787	62.2	130	DI	1	0.33	2.71	0.031
Pipe I073_I074	27.89254	62.2	130	DI	0.32	0.1	0.32	0.036
Pipe I073_I071	25.06649	62.2	130	DI	0.61	0.2	1.09	0.033
Pipe I071_I072	35.32267	62.2	130	DI	0.43	0.14	0.56	0.034
Pipe I071_I070	105.4591	62.2	130	DI	0.03	0.01	0	0.049
Pipe I070_I069	134.1256	62.2	130	DI	-0.3	0.1	0.3	0.036
Pipe I069_I068	96.44063	62.2	130	DI	-0.73	0.24	1.52	0.032
Pipe I068_I066	53.91736	62.2	130	DI	0.98	0.32	2.6	0.031
Pipe I066_I067	16.33784	62.2	130	DI	0.16	0.05	0.08	0.036
Pipe I066_I065	72.02324	62.2	130	DI	0.74	0.24	1.55	0.032
Pipe I065_I064	69.36175	62.2	130	DI	-0.42	0.14	0.55	0.035
Pipe I064_I060	58.77168	62.2	130	DI	-0.54	0.18	0.87	0.033
Pipe I061_I063	26.31937	62.2	130	DI	0.21	0.07	0.15	0.038
Pipe I061_I062	5.436544	62.2	130	DI	0.13	0.04	0.05	0.035
Pipe I060_I061	25.94704	62.2	130	DI	0.4	0.13	0.49	0.035
Pipe I060_I058	49.07556	62.2	130	DI	-1.02	0.34	2.82	0.03
Pipe I058_I059	15.05412	62.2	130	DI	0.1	0.03	0.04	0.043
Pipe I058_I056	12.13035	62.2	130	DI	-1.16	0.38	3.57	0.03
Pipe I056_I057	10.73597	62.2	130	DI	0.09	0.03	0.04	0.059
Pipe	25.68605	62.2	130	DI	-1.26	0.42	4.18	0.029

I056_I055								
Pipe I055_I053	39.16504	62.2	130	DI	1.78	0.59	7.91	0.028
Pipe I053_I054	41.34367	62.2	130	DI	0.18	0.06	0.11	0.039
Pipe I053_I051	35.5179	62.2	130	DI	1.52	0.5	5.9	0.029
Pipe I051_I052	40.41943	62.2	130	DI	0.29	0.09	0.27	0.036
Pipe I051_I050	54.96421	62.2	130	DI	1.13	0.37	3.39	0.03
Pipe I048_I049	93.46434	62.2	130	DI	0.58	0.19	1	0.033
Pipe I047_I048	112.64	62.2	130	DI	1.14	0.38	3.46	0.03
Pipe I047_I045	21.945	150	110	DI	-3.08	0.17	0.4	0.039
Pipe I045_I046	106.72	62.2	130	DI	0.56	0.18	0.92	0.033
Pipe I045_I044	61.33	150	110	DI	-3.08	0.17	0.41	0.04
Pipe I043_I778	58.54	62.2	130	DI	2.6	0.85	15.8	0.026
Pipe I043_I044	159.93	150	110	DI	6.18	0.35	1.48	0.036
Pipe I042_I719	40.63	62.2	130	DI	1.32	0.43	4.5	0.029
Pipe I042_I043	169.4635	150	110	DI	6.18	0.35	1.48	0.036
Pipe I040_I042	105.5642	150	110	DI	8.91	0.5	2.91	0.034
Pipe I040_I041	22.38	62.2	130	DI	0.38	0.12	0.45	0.036
Pipe I039_I712	34.02	62.2	130	DI	0.77	0.25	1.65	0.032
Pipe I039_I040	101.0161	150	110	DI	8.91	0.5	2.91	0.034
Pipe I038_I710	78.17	62.2	130	DI	1.92	0.63	9.07	0.028
Pipe I038_I039	39.54	150	110	DI	8.91	0.5	2.91	0.034
Pipe I037_I038	24.94	150	110	DI	25.97	1.47	21.1	0.029
Pipe I034_I036	35.28035	150	110	DI	3.14	0.18	0.42	0.039
Pipe I034_I035	19.38	62.2	130	DI	0.07	0.02	0.02	0.049
Pipe I033_I201	15.58	62.2	130	DI	0.38	0.12	0.45	0.036
Pipe I033_I034	31.24732	150	110	DI	3.14	0.18	0.42	0.039

Pipe I031_I033	109.4212	150	110	DI	3.14	0.18	0.42	0.039
Pipe I031_I032	36.28	62.2	130	DI	0.47	0.15	0.66	0.034
Pipe I030_I206	113.58	62.2	130	DI	1.04	0.34	2.91	0.03
Pipe I030_I031	92.83797	150	110	DI	3.14	0.18	0.42	0.039
Pipe I028_I030	199.592	150	110	DI	5.38	0.3	1.14	0.036
Pipe I028_I029	35.55	62.2	130	DI	0.3	0.1	0.29	0.037
Pipe I027_I219	105.56	62.2	130	DI	1.17	0.39	3.64	0.03
Pipe I027_I028	86.46797	150	110	DI	5.38	0.3	1.14	0.036
Pipe I026_I221	43.97	62.2	130	DI	0.29	0.09	0.27	0.037
Pipe I025_I026	10.04	150	110	DI	2.15	0.12	0.21	0.041
Pipe I023_I025	90.99708	150	110	DI	2.15	0.12	0.21	0.042
Pipe I023_I024	19.4	62.2	130	DI	0.25	0.08	0.2	0.037
Pipe I022_I785	44.37	62.2	130	DI	1.24	0.41	4.04	0.03
Pipe I022_I023	64.83919	150	110	DI	2.15	0.12	0.21	0.042
Pipe I021_I022	98.17203	150	110	DI	2.15	0.12	0.21	0.042
Pipe I020_I273	225.5	62.2	130	DI	1.34	0.44	4.67	0.029
Pipe I019_I274	227.44	62.2	130	DI	0.76	0.25	1.63	0.032
Pipe I018_I019	146.02	150	110	DI	9.05	0.51	2.99	0.034
Pipe I017_I018	3.612167	150	110	DI	13.75	0.78	6.51	0.032
Pipe I015_I017	202.4128	150	110	DI	13.75	0.78	6.5	0.032
Pipe I015_I016	129.33	62.2	130	DI	2.92	0.96	19.7	0.026
Pipe I013_I015	209.193	200	110	DI	13.75	0.44	1.6	0.033
Pipe I013_I014	61.87	62.2	130	DI	1.42	0.47	5.18	0.029
Pipe I012_I290	202.33	62.2	130	DI	2.81	0.92	18.4	0.026
Pipe I012_I013	36.63	200	110	DI	13.75	0.44	1.6	0.033
Pipe	60.12	250	110	DI	31.26	0.64	2.47	0.03

I011_I012								
Pipe I010_I011	109.1388	250	110	DI	31.26	0.64	2.47	0.03
Pipe I009_I431	97.15	74.8	130	DI	3.93	0.9	13.9	0.026
Pipe I009_I010	62.25	250	110	DI	31.26	0.64	2.47	0.03
Pipe I007_I009	52.11	250	110	DI	46.06	0.94	5.06	0.028
Pipe I007_I008	30.73	62.2	130	DI	0.44	0.15	0.6	0.034
Pipe I006_I116	126.4	62.2	130	DI	0.33	0.11	0.35	0.036
Pipe I006_I007	257.1294	250	110	DI	46.06	0.94	5.06	0.028
Pipe I004_I006	71.17107	250	110	DI	46.06	0.94	5.06	0.028
Pipe I004_I005	14.85	62.2	130	DI	0.2	0.07	0.13	0.037
Pipe I004_I002	10.44182	250	110	DI	-46.06	0.94	5.06	0.028
Pipe I002_I003	17.6	62.2	130	DI	0.18	0.06	0.11	0.038
Pipe I001_I002	39.15233	250	110	DI	46.06	0.94	5.06	0.028
Pipe 1	470	1000	110	DI	840.24	1.07	1.28	0.022
Pipe 2	50	500	110	DI	104.7	0.53	0.79	0.027
Pipe 3	1300	900	110	DI	735.54	1.16	1.67	0.022
Pipe 6	626.15	400	110	DI	105.3	0.84	2.37	0.027
Pipe 7	50	300	110	DI	105.3	1.49	9.64	0.026
Pipe 9	974.69	600	110	DI	270.62	0.96	1.89	0.024
Pipe I800_I115	29.95	62.2	130	DI	-1.55	0.51	6.12	0.029
Pipe I800_I112	84.59996	250	110	DI	34.1	0.69	2.9	0.03
Pipe I785_I787	16.84329	62.2	130	DI	0.22	0.07	0.16	0.038
Pipe I785_I786	16.35085	62.2	130	DI	0.88	0.29	2.11	0.031
Pipe I783_I784	44.61162	62.2	130	DI	0.71	0.23	1.44	0.032
Pipe I783_I781	65.14695	62.2	130	DI	-0.2	0.07	0.13	0.039
Pipe I781_I782	24.10405	62.2	130	DI	0.29	0.1	0.28	0.036
Pipe I779_I781	44.01548	62.2	130	DI	0.86	0.28	2.04	0.031
Pipe I779_I780	28.77382	62.2	130	DI	0.21	0.07	0.16	0.038
Pipe	47.69875	62.2	130	DI	1.2	0.39	3.78	0.03

I778_I783								
Pipe I778_I779	21.94476	62.2	130	DI	1.19	0.39	3.74	0.03
Pipe I776_I777	26.81354	62.2	130	DI	0.15	0.05	0.08	0.042
Pipe I776_I065	33.67504	62.2	130	DI	-1.02	0.33	2.79	0.03
Pipe I774_I776	36.55974	62.2	130	DI	-0.7	0.23	1.4	0.032
Pipe I774_I775	40.47277	62.2	130	DI	0.21	0.07	0.15	0.039
Pipe I772_I774	21.63891	62.2	130	DI	-0.39	0.13	0.47	0.035
Pipe I772_I773	37.02509	62.2	130	DI	0.35	0.12	0.39	0.035
Pipe I770_I772	36.16808	62.2	130	DI	0.09	0.03	0.03	0.046
Pipe I770_I771	30.59622	62.2	130	DI	0.29	0.1	0.27	0.037
Pipe I769_I770	23.51168	62.2	130	DI	0.52	0.17	0.82	0.033
Pipe I769_I055	108.4482	62.2	130	DI	-1.35	0.44	4.73	0.029
Pipe I767_I769	110.4314	62.2	130	DI	-0.47	0.15	0.67	0.034
Pipe I767_I768	39.30666	62.2	130	DI	0.56	0.18	0.91	0.033
Pipe I766_I767	140.8315	62.2	130	DI	0.9	0.29	2.2	0.031
Pipe I766_I763	144.7196	62.2	130	DI	0.02	0.01	0	0.04
Pipe I764_I765	25.81172	62.2	130	DI	0.31	0.1	0.3	0.036
Pipe I764_I069	13.1307	62.2	130	DI	-0.37	0.12	0.42	0.035
Pipe I763_I764	41.99799	62.2	130	DI	0.09	0.03	0.03	0.045
Pipe I763_I068	95.61182	62.2	130	DI	-0.75	0.25	1.57	0.032
Pipe I760_I761	95.55698	62.2	130	DI	0.43	0.14	0.56	0.035
Pipe I760_I050	92.76269	62.2	130	DI	-1.01	0.33	2.76	0.03
Pipe I759_I760	26.33427	62.2	130	DI	-0.32	0.11	0.33	0.036
Pipe I758_I759	72.17043	62.2	130	DI	-0.11	0.04	0.05	0.043
Pipe I756_I758	104.7467	62.2	130	DI	0.22	0.07	0.16	0.038
Pipe I756_I757	39.05381	62.2	130	DI	0.52	0.17	0.81	0.034

Pipe I754_I756	72.16669	62.2	130	DI	0.9	0.29	2.2	0.031
Pipe I754_I755	28.77497	62.2	130	DI	0.29	0.09	0.27	0.037
Pipe I753_I047	170.15	150	110	DI	-3.08	0.17	0.41	0.04
Pipe I751_I752	54.2466	62.2	130	DI	0.54	0.18	0.87	0.033
Pipe I750_I753	147.82	62.2	130	DI	-1.88	0.62	8.74	0.028
Pipe I750_I751	36.55407	62.2	130	DI	0.74	0.24	1.54	0.032
Pipe I748_I750	68.99621	62.2	130	DI	-0.88	0.29	2.15	0.031
Pipe I748_I747	78.5448	62.2	130	DI	1.14	0.37	3.43	0.03
Pipe I747_I746	27.03265	62.2	130	DI	0.45	0.15	0.62	0.034
Pipe I747_I745	39.80113	62.2	130	DI	0.35	0.11	0.38	0.036
Pipe I746_I749	71.47777	62.2	130	DI	0.22	0.07	0.16	0.038
Pipe I745_I746	39.55921	62.2	130	DI	0.1	0.03	0.04	0.043
Pipe I743_I745	47.85472	62.2	130	DI	0.13	0.04	0.06	0.042
Pipe I743_I744	19.45998	62.2	130	DI	0.38	0.12	0.44	0.035
Pipe I741_I743	17.0359	62.2	130	DI	0.81	0.27	1.82	0.031
Pipe I741_I742	12.50033	62.2	130	DI	0.18	0.06	0.12	0.04
Pipe I740_I748	80.30826	62.2	130	DI	0.66	0.22	1.26	0.032
Pipe I740_I741	103.3691	62.2	130	DI	1.13	0.37	3.41	0.03
Pipe I738_I739	72.31	62.2	130	DI	0.43	0.14	0.56	0.035
Pipe I738_I077	87.80086	62.2	130	DI	-0.64	0.21	1.17	0.033
Pipe I736_I738	26.54551	62.2	130	DI	-0.32	0.1	0.32	0.036
Pipe I736_I737	23.47397	62.2	130	DI	0.33	0.11	0.34	0.036
Pipe I734_I736	33.85499	62.2	130	DI	0.12	0.04	0.05	0.042
Pipe I734_I735	98.77	62.2	130	DI	0.31	0.1	0.3	0.036
Pipe I732_I734	36.46039	62.2	130	DI	0.5	0.16	0.74	0.034
Pipe	53	62.2	130	DI	0.53	0.17	0.83	0.034

I732_I733								
Pipe I729_I732	13.08051	62.2	130	DI	0.63	0.21	1.14	0.032
Pipe I729_I731	139.44	62.2	130	DI	0.88	0.29	2.16	0.031
Pipe I729_I730	40.50634	62.2	130	DI	0.23	0.08	0.18	0.037
Pipe I727_I729	26.08019	62.2	130	DI	0.96	0.32	2.53	0.031
Pipe I727_I728	15.92809	62.2	130	DI	0.2	0.06	0.13	0.039
Pipe I725_I726	18.15221	62.2	130	DI	0.15	0.05	0.07	0.039
Pipe I725_I717	40.76	62.2	130	DI	-0.18	0.06	0.12	0.039
Pipe I724_I725	37.29417	62.2	130	DI	0.18	0.06	0.11	0.04
Pipe I722_I724	17.48082	62.2	130	DI	-0.27	0.09	0.23	0.037
Pipe I722_I723	16.82796	62.2	130	DI	0.08	0.03	0.03	0.044
Pipe I720_I722	36.27592	62.2	130	DI	-0.1	0.03	0.04	0.047
Pipe I720_I721	16.94788	62.2	130	DI	0.24	0.08	0.18	0.036
Pipe I719_I720	95.29055	62.2	130	DI	0.46	0.15	0.64	0.034
Pipe I719_I718	140.5766	62.2	130	DI	0.23	0.08	0.18	0.038
Pipe I718_I724	32.7618	62.2	130	DI	0.56	0.19	0.93	0.033
Pipe I718_I706	73.24	62.2	130	DI	-0.54	0.18	0.87	0.033
Pipe I717_I727	68.43068	62.2	130	DI	1.39	0.46	4.96	0.029
Pipe I715_I717	70.78184	62.2	130	DI	-1.33	0.44	4.57	0.029
Pipe I715_I716	37.64519	62.2	130	DI	0.34	0.11	0.37	0.036
Pipe I712_I714	100.2719	62.2	130	DI	0.35	0.12	0.39	0.036
Pipe I712_I713	25.67129	62.2	130	DI	0.23	0.08	0.18	0.038
Pipe I710_I711	58.92642	62.2	130	DI	0.31	0.1	0.3	0.036
Pipe I710_I708	25.5012	62.2	130	DI	1.39	0.46	4.99	0.029
Pipe I708_I709	48.04	62.2	130	DI	0.24	0.08	0.2	0.038
Pipe I708_I707	34.44757	62.2	130	DI	1.26	0.41	4.15	0.03

Pipe I707_I805	30.52153	62.2	130	DI	0.2	0.07	0.14	0.038
Pipe I707_I706	44.4634	62.2	130	DI	0.88	0.29	2.15	0.031
Pipe I706_I717	69.41332	62.2	130	DI	-0.7	0.23	1.39	0.032
Pipe I704_I705	14.57948	62.2	130	DI	0.05	0.02	0.01	0.042
Pipe I702_I704	15.63051	62.2	130	DI	0.13	0.04	0.06	0.041
Pipe I702_I703	11.26202	62.2	130	DI	0.1	0.03	0.04	0.047
Pipe I701_I706	41.40454	62.2	130	DI	-1.3	0.43	4.41	0.029
Pipe I701_I702	46.67799	62.2	130	DI	0.36	0.12	0.4	0.035
Pipe I700_I701	33.26138	62.2	130	DI	-0.79	0.26	1.75	0.032
Pipe I700_I699	87.91506	62.2	130	DI	0.3	0.1	0.29	0.036
Pipe I699_I715	18.8903	62.2	130	DI	-0.87	0.29	2.07	0.031
Pipe I696_I698	62.26316	62.2	130	DI	0.17	0.06	0.1	0.04
Pipe I696_I697	41.04304	62.2	130	DI	0.2	0.07	0.13	0.038
Pipe I694_I696	107.7676	62.2	130	DI	0.74	0.25	1.57	0.032
Pipe I694_I695	21.50496	62.2	130	DI	0.26	0.09	0.23	0.038
Pipe I692_I694	41.49881	62.2	130	DI	1.25	0.41	4.11	0.03
Pipe I692_I693	52.54022	62.2	130	DI	0.38	0.13	0.46	0.035
Pipe I691_I689	105.2529	62.2	130	DI	-0.22	0.07	0.17	0.038
Pipe I689_I690	59.05552	62.2	130	DI	0.28	0.09	0.26	0.037
Pipe I689_I687	22.86625	62.2	130	DI	-0.69	0.23	1.35	0.032
Pipe I687_I688	30.50656	62.2	130	DI	0.19	0.06	0.12	0.039
Pipe I687_I686	21.92749	62.2	130	DI	-0.96	0.32	2.51	0.031
Pipe I686_I692	54.63703	62.2	130	DI	1.84	0.61	8.41	0.028
Pipe I686_I078	118.132	62.2	130	DI	-1.8	0.59	8.01	0.028
Pipe I685_I686	103.3788	62.2	130	DI	1.71	0.56	7.33	0.028
Pipe	60.12165	62.2	130	DI	1.05	0.34	2.94	0.03

I682_I685								
Pipe I682_I684	61.40024	62.2	130	DI	0.22	0.07	0.17	0.038
Pipe I682_I683	28.61086	62.2	130	DI	0.23	0.08	0.18	0.038
Pipe I681_I682	48.53265	62.2	130	DI	1.75	0.58	7.63	0.028
Pipe I681_I080	84.35	62.2	130	DI	-1.22	0.4	3.89	0.03
Pipe I679_I680	50.17081	62.2	130	DI	0.21	0.07	0.15	0.038
Pipe I679_I081	54.39412	62.2	130	DI	-1.92	0.63	9.03	0.028
Pipe I678_I679	20.40054	62.2	130	DI	-1.44	0.47	5.32	0.029
Pipe I676_I681	22.42523	62.2	130	DI	0.62	0.2	1.12	0.033
Pipe I676_I677	62.65465	62.2	130	DI	0.28	0.09	0.26	0.037
Pipe I674_I675	11.2353	62.2	130	DI	0.29	0.09	0.28	0.038
Pipe I674_I646	64.34249	62.2	130	DI	0.29	0.1	0.28	0.037
Pipe I672_I673	12.65749	62.2	130	DI	0.05	0.02	0.01	0.049
Pipe I672_I664	29.09523	62.2	130	DI	-0.21	0.07	0.14	0.038
Pipe I670_I672	36.15863	62.2	130	DI	-0.05	0.02	0.01	0.054
Pipe I668_I670	36.12166	62.2	130	DI	-0.48	0.16	0.7	0.034
Pipe I668_I669	14.46138	62.2	130	DI	0.05	0.02	0.01	0.049
Pipe I666_I668	5.653203	62.2	130	DI	-0.39	0.13	0.45	0.034
Pipe I666_I667	12.21171	62.2	130	DI	0.06	0.02	0.02	0.067
Pipe I664_I699	38.79771	62.2	130	DI	-1.06	0.35	3.02	0.03
Pipe I662_I664	34.29965	62.2	130	DI	-0.68	0.22	1.32	0.032
Pipe I662_I663	16.66896	62.2	130	DI	0.06	0.02	0.02	0.06
Pipe I660_I662	15.43394	62.2	130	DI	-0.58	0.19	1	0.033
Pipe I660_I661	13.39894	62.2	130	DI	0.16	0.05	0.09	0.04
Pipe I659_I658	23.00181	62.2	130	DI	-0.12	0.04	0.05	0.041
Pipe I658_I660	79.95328	62.2	130	DI	-0.35	0.11	0.38	0.036

Pipe I656_I657	11.21775	62.2	130	DI	0.17	0.05	0.09	0.038
Pipe I656_I179	143.6393	62.2	130	DI	0.26	0.08	0.22	0.037
Pipe I655_I658	23.00435	62.2	130	DI	-0.1	0.03	0.04	0.042
Pipe I655_I656	36.15282	62.2	130	DI	0.7	0.23	1.39	0.032
Pipe I653_I655	41.55931	62.2	130	DI	0.74	0.24	1.56	0.032
Pipe I653_I654	17.2272	62.2	130	DI	0.39	0.13	0.48	0.035
Pipe I652_I676	148.5914	62.2	130	DI	1.03	0.34	2.86	0.03
Pipe I652_I653	67.8903	62.2	130	DI	1.32	0.44	4.55	0.029
Pipe I651_I652	90.76804	62.2	130	DI	-1.29	0.42	4.33	0.029
Pipe I650_I649	16.81039	62.2	130	DI	-0.32	0.1	0.32	0.036
Pipe I649_I651	25.97898	62.2	130	DI	-0.65	0.21	1.22	0.033
Pipe I647_I648	68.70894	62.2	130	DI	0.29	0.1	0.28	0.037
Pipe I647_I177	36.56942	62.2	130	DI	-1.1	0.36	3.22	0.03
Pipe I646_I678	20.78417	62.2	130	DI	-1.41	0.46	5.11	0.029
Pipe I644_I646	52.81267	62.2	130	DI	-1.61	0.53	6.54	0.028
Pipe I644_I645	30.42073	62.2	130	DI	0.2	0.07	0.14	0.037
Pipe I643_I644	65.72476	62.2	130	DI	-1.17	0.39	3.64	0.03
Pipe I643_I084	104.94	62.2	130	DI	-0.46	0.15	0.65	0.034
Pipe I641_I643	78.44822	62.2	130	DI	-1.2	0.39	3.78	0.03
Pipe I641_I642	44.50776	62.2	130	DI	0.27	0.09	0.23	0.037
Pipe I639_I641	6.272646	62.2	130	DI	-0.74	0.24	1.57	0.032
Pipe I639_I640	67.71201	62.2	130	DI	0.4	0.13	0.51	0.035
Pipe I637_I638	11.02788	62.2	130	DI	0.25	0.08	0.22	0.038
Pipe I636_I637	12.92617	62.2	130	DI	0.01	0	0	0
Pipe I636_I635	22.18607	62.2	130	DI	-0.23	0.08	0.17	0.038
Pipe	6.836451	62.2	130	DI	-0.3	0.1	0.28	0.036

I635_I639								
Pipe I633_I635	29.13875	62.2	130	DI	0	0	0	0
Pipe I633_I634	33.47825	62.2	130	DI	0.21	0.07	0.16	0.039
Pipe I632_I636	28.41969	62.2	130	DI	0.31	0.1	0.31	0.036
Pipe I632_I633	18.92236	62.2	130	DI	0.28	0.09	0.26	0.037
Pipe I631_I632	19.87813	62.2	130	DI	0.68	0.22	1.33	0.032
Pipe I631_I620	37.1064	62.2	130	DI	0.37	0.12	0.42	0.035
Pipe I628_I630	11.69912	62.2	130	DI	0.26	0.08	0.22	0.037
Pipe I628_I629	14.88322	62.2	130	DI	0.26	0.09	0.22	0.037
Pipe I627_I631	47.82579	62.2	130	DI	1.17	0.38	3.62	0.03
Pipe I627_I628	55.41682	62.2	130	DI	0.62	0.2	1.11	0.033
Pipe I625_I627	73.21385	62.2	130	DI	2.05	0.67	10.2	0.027
Pipe I625_I626	57.18207	62.2	130	DI	0.22	0.07	0.16	0.039
Pipe I625_I624	36.73268	62.2	130	DI	-1.44	0.47	5.33	0.029
Pipe I624_I674	136.515	62.2	130	DI	0.78	0.26	1.72	0.032
Pipe I623_I624	27.9312	62.2	130	DI	2.47	0.81	14.5	0.027
Pipe I622_I625	33.22041	62.2	130	DI	1.04	0.34	2.9	0.03
Pipe I622_I623	30.06776	62.2	130	DI	-2.68	0.88	16.8	0.026
Pipe I620_I621	47.0018	62.2	130	DI	0.28	0.09	0.26	0.037
Pipe I620_I618	24.36346	62.2	130	DI	-0.06	0.02	0.01	0.039
Pipe I618_I619	11.54733	62.2	130	DI	0.07	0.02	0.01	0.031
Pipe I618_I616	62.2747	62.2	130	DI	-0.28	0.09	0.27	0.037
Pipe I616_I617	15.16139	62.2	130	DI	0.1	0.03	0.04	0.042
Pipe I615_I616	31.55139	62.2	130	DI	0.55	0.18	0.9	0.033
Pipe I613_I615	38.59485	62.2	130	DI	0.8	0.26	1.8	0.032
Pipe I613_I614	12.95828	62.2	130	DI	0.1	0.03	0.05	0.053

Pipe I612_I622	165.5519	62.2	130	DI	-1.4	0.46	5.04	0.029
Pipe I612_I613	31.26398	62.2	130	DI	0.98	0.32	2.61	0.031
Pipe I611_I636	60.8162	62.2	130	DI	-0.48	0.16	0.69	0.034
Pipe I611_I086	119.74	62.2	130	DI	-0.06	0.02	0.01	0.045
Pipe I609_I610	19.94723	62.2	130	DI	0.29	0.1	0.28	0.036
Pipe I608_I611	45.71378	62.2	130	DI	-0.25	0.08	0.21	0.038
Pipe I608_I609	70.97846	62.2	130	DI	0.3	0.1	0.3	0.036
Pipe I607_I608	29.84093	62.2	130	DI	0.25	0.08	0.2	0.037
Pipe I605_I607	69.8801	62.2	130	DI	0.47	0.15	0.66	0.034
Pipe I605_I606	12.62027	62.2	130	DI	0.15	0.05	0.08	0.039
Pipe I604_I605	11.08403	62.2	130	DI	0.71	0.23	1.42	0.032
Pipe I603_I602	11.36234	62.2	130	DI	-0.11	0.04	0.05	0.051
Pipe I602_I604	14.84627	62.2	130	DI	0.46	0.15	0.65	0.034
Pipe I600_I602	23.46753	62.2	130	DI	0.61	0.2	1.08	0.033
Pipe I600_I601	14.43867	62.2	130	DI	0.07	0.02	0.01	0.025
Pipe I599_I615	30.2668	62.2	130	DI	-0.13	0.04	0.06	0.041
Pipe I599_I600	7.928373	62.2	130	DI	0.72	0.24	1.48	0.032
Pipe I598_I597	20.04592	62.2	130	DI	0.01	0	0	0
Pipe I598_I092	98.49	62.2	130	DI	0.19	0.06	0.12	0.039
Pipe I597_I607	64.92165	62.2	130	DI	0.06	0.02	0.02	0.051
Pipe I597_I595	83.32788	62.2	130	DI	-0.28	0.09	0.26	0.037
Pipe I595_I596	15.37823	62.2	130	DI	0.16	0.05	0.09	0.039
Pipe I595_I593	40.56123	62.2	130	DI	-0.67	0.22	1.28	0.032
Pipe I594_I604	51.066	62.2	130	DI	0.29	0.1	0.27	0.037
Pipe I593_I594	7.633844	62.2	130	DI	-0.27	0.09	0.23	0.035
Pipe	52.40269	62.2	130	DI	-0.53	0.17	0.83	0.033

I593_I588								
Pipe I592_I612	17.15964	62.2	130	DI	-0.23	0.07	0.16	0.037
Pipe I592_I591	56.8884	62.2	130	DI	0.86	0.28	2.03	0.031
Pipe I591_I599	28.59734	62.2	130	DI	0.65	0.21	1.21	0.032
Pipe I590_I591	44.54702	62.2	130	DI	-0.1	0.03	0.04	0.043
Pipe I589_I594	35.83074	62.2	130	DI	0.64	0.21	1.17	0.033
Pipe I589_I590	15.42985	62.2	130	DI	-0.74	0.24	1.55	0.032
Pipe I588_I589	44.06675	62.2	130	DI	0	0	0	0
Pipe I586_I587	18.45054	62.2	130	DI	0.11	0.04	0.05	0.043
Pipe I586_I170	58.95355	62.2	130	DI	0.24	0.08	0.2	0.038
Pipe I584_I585	62.81033	62.2	130	DI	0.39	0.13	0.47	0.035
Pipe I584_I169	59.7039	62.2	130	DI	-1.91	0.63	8.94	0.028
Pipe I582_I586	11.57863	62.2	130	DI	0.41	0.13	0.5	0.034
Pipe I582_I583	57.64131	62.2	130	DI	0.09	0.03	0.03	0.042
Pipe I580_I584	47.93386	62.2	130	DI	-1.41	0.46	5.1	0.029
Pipe I580_I581	12.70827	62.2	130	DI	0.08	0.03	0.02	0.041
Pipe I577_I579	14.00925	62.2	130	DI	0.07	0.02	0.02	0.052
Pipe I577_I578	25.43089	62.2	130	DI	0.12	0.04	0.06	0.043
Pipe I576_I168	67.67635	62.2	130	DI	-1.46	0.48	5.42	0.029
Pipe I574_I576	35.90043	62.2	130	DI	-0.68	0.22	1.32	0.032
Pipe I574_I575	29.05894	62.2	130	DI	0.09	0.03	0.03	0.041
Pipe I572_I574	11.2267	62.2	130	DI	-0.52	0.17	0.81	0.034
Pipe I572_I573	30.28475	62.2	130	DI	0.04	0.01	0.01	0.057
Pipe I570_I571	38.40638	62.2	130	DI	0.12	0.04	0.05	0.04
Pipe I568_I570	9.264903	62.2	130	DI	0.5	0.16	0.75	0.034
Pipe I568_I569	15.14174	62.2	130	DI	0.1	0.03	0.04	0.046

Pipe I567_I572	45.65556	62.2	130	DI	-0.36	0.12	0.4	0.035
Pipe I567_I568	32.90798	62.2	130	DI	0.65	0.21	1.21	0.033
Pipe I567_I561	35.36137	62.2	130	DI	-0.45	0.15	0.62	0.034
Pipe I565_I576	30.87896	62.2	130	DI	-0.58	0.19	0.99	0.033
Pipe I565_I566	10.79264	62.2	130	DI	0.11	0.04	0.04	0.04
Pipe I564_I565	17.88173	62.2	130	DI	-0.43	0.14	0.57	0.034
Pipe I562_I564	40.71501	62.2	130	DI	-0.33	0.11	0.35	0.036
Pipe I562_I563	42.63338	62.2	130	DI	0.11	0.04	0.05	0.044
Pipe I561_I562	64.41622	62.2	130	DI	0.1	0.03	0.03	0.041
Pipe I558_I560	123.5674	62.2	130	DI	0.22	0.07	0.16	0.038
Pipe I558_I559	29.32719	62.2	130	DI	0.18	0.06	0.12	0.04
Pipe I556_I558	20.22	62.2	130	DI	0.58	0.19	0.99	0.033
Pipe I556_I557	29.46713	62.2	130	DI	0.15	0.05	0.08	0.041
Pipe I556_I546	45.12266	62.2	130	DI	-0.21	0.07	0.15	0.038
Pipe I553_I555	22.1767	62.2	130	DI	0.21	0.07	0.15	0.038
Pipe I553_I554	16.94188	62.2	130	DI	0.43	0.14	0.56	0.034
Pipe I551_I553	35.73919	62.2	130	DI	0.72	0.24	1.47	0.032
Pipe I551_I552	28.19134	62.2	130	DI	0.12	0.04	0.06	0.043
Pipe I549_I551	10.85917	62.2	130	DI	0.92	0.3	2.3	0.031
Pipe I549_I550	35.68162	62.2	130	DI	0.2	0.07	0.13	0.038
Pipe I547_I549	29.51928	62.2	130	DI	1.2	0.39	3.78	0.03
Pipe I547_I548	17.98426	62.2	130	DI	0.11	0.03	0.04	0.042
Pipe I546_I547	11.25652	62.2	130	DI	1.36	0.45	4.81	0.029
Pipe I546_I544	7.526991	62.2	130	DI	-1.62	0.53	6.58	0.028
Pipe I544_I545	29.4	62.2	130	DI	0.19	0.06	0.12	0.04
Pipe	26.76696	62.2	130	DI	-1.65	0.54	6.87	0.028

I544_I542								
Pipe I543_I542	64.99	62.2	130	DI	-0.22	0.07	0.16	0.038
Pipe I542_I540	48.13622	62.2	130	DI	-1.81	0.6	8.15	0.028
Pipe I540_I541	51.51474	62.2	130	DI	0.33	0.11	0.36	0.036
Pipe I539_I598	46.91783	62.2	130	DI	0.45	0.15	0.61	0.034
Pipe I539_I095	69.65	62.2	130	DI	0.04	0.01	0.01	0.057
Pipe I538_I537	30.00213	62.2	130	DI	0.57	0.19	0.97	0.033
Pipe I537_I539	12.08422	62.2	130	DI	0.66	0.22	1.27	0.032
Pipe I537_I536	58.93437	62.2	130	DI	-0.24	0.08	0.19	0.037
Pipe I536_I538	59.14924	62.2	130	DI	-0.3	0.1	0.3	0.036
Pipe I534_I536	28.61292	62.2	130	DI	0.23	0.08	0.18	0.038
Pipe I534_I535	51.9895	62.2	130	DI	0.12	0.04	0.06	0.042
Pipe I533_I532	23.34409	62.2	130	DI	-0.25	0.08	0.2	0.038
Pipe I532_I534	18.36148	62.2	130	DI	0.47	0.15	0.66	0.034
Pipe I530_I532	16.53351	62.2	130	DI	0.77	0.25	1.67	0.032
Pipe I530_I531	35.14589	62.2	130	DI	0.06	0.02	0.01	0.045
Pipe I528_I527	63.37062	62.2	130	DI	-0.13	0.04	0.06	0.042
Pipe I527_I529	33.45143	62.2	130	DI	0.08	0.03	0.03	0.044
Pipe I524_I526	11.93185	62.2	130	DI	0.06	0.02	0.01	0.041
Pipe I524_I525	9.213843	62.2	130	DI	0.03	0.01	0	0
Pipe I523_I527	5.554205	62.2	130	DI	0.27	0.09	0.24	0.037
Pipe I523_I524	17.28128	62.2	130	DI	0.16	0.05	0.09	0.043
Pipe I523_I521	44.34155	62.2	130	DI	-0.48	0.16	0.69	0.034
Pipe I521_I522	33.12082	62.2	130	DI	0.2	0.07	0.14	0.039
Pipe I521_I152	35.80667	62.2	130	DI	-0.83	0.27	1.92	0.031
Pipe I519_I518	37.59711	62.2	130	DI	-0.1	0.03	0.04	0.043

Pipe I518_I520	28.75909	62.2	130	DI	0.24	0.08	0.2	0.037
Pipe I518_I513	28.4628	62.2	130	DI	-0.44	0.14	0.59	0.035
Pipe I516_I517	14.65711	62.2	130	DI	0.06	0.02	0.02	0.056
Pipe I516_I514	8.550985	62.2	130	DI	1.63	0.54	6.74	0.028
Pipe I514_I515	75.35434	62.2	130	DI	0.3	0.1	0.29	0.036
Pipe I514_I513	26.48094	62.2	130	DI	1.21	0.4	3.86	0.03
Pipe I511_I513	23.8163	62.2	130	DI	-0.69	0.23	1.37	0.032
Pipe I511_I512	11.37329	62.2	130	DI	0.16	0.05	0.09	0.041
Pipe I510_I538	139.9655	62.2	130	DI	1.22	0.4	3.89	0.03
Pipe I510_I511	24.06966	62.2	130	DI	-0.48	0.16	0.69	0.034
Pipe I510_I508	17.61382	62.2	130	DI	0.16	0.05	0.09	0.039
Pipe I508_I509	13.6652	62.2	130	DI	0.12	0.04	0.05	0.044
Pipe I508_I507	27.59982	62.2	130	DI	-0.05	0.02	0.01	0.058
Pipe I507_I503	83.97266	62.2	130	DI	0.57	0.19	0.97	0.033
Pipe I506_I507	47.06585	62.2	130	DI	0.8	0.26	1.8	0.032
Pipe I505_I504	58.56699	62.2	130	DI	-0.24	0.08	0.2	0.038
Pipe I504_I101	54.7	62.2	130	DI	0.52	0.17	0.82	0.034
Pipe I503_I504	31.16762	62.2	130	DI	1	0.33	2.71	0.03
Pipe I503_I498	26.9739	62.2	130	DI	-0.59	0.2	1.04	0.033
Pipe I501_I502	52.34847	62.2	130	DI	0.19	0.06	0.13	0.04
Pipe I500_I501	16.9061	62.2	130	DI	-0.42	0.14	0.55	0.035
Pipe I500_I102	83.97	62.2	130	DI	0.36	0.12	0.41	0.035
Pipe I498_I500	33.87274	62.2	130	DI	0.08	0.03	0.03	0.051
Pipe I498_I499	12.18929	62.2	130	DI	0.12	0.04	0.06	0.052
Pipe I495_I497	14.30409	62.2	130	DI	0.13	0.04	0.05	0.036
Pipe	8.024828	62.2	130	DI	0.11	0.04	0.04	0.037

I495_I496								
Pipe I494_I498	44.27252	62.2	130	DI	0.88	0.29	2.16	0.031
Pipe I494_I495	3.668624	62.2	130	DI	0.25	0.08	0.24	0.044
Pipe I494_I492	51.94026	62.2	130	DI	-0.69	0.23	1.35	0.032
Pipe I493_I506	74.13278	62.2	130	DI	-0.22	0.07	0.16	0.038
Pipe I493_I494	37.76758	62.2	130	DI	0.52	0.17	0.81	0.034
Pipe I492_I493	40.37661	62.2	130	DI	0.58	0.19	0.98	0.033
Pipe I491_I492	12.94514	62.2	130	DI	1.44	0.47	5.33	0.029
Pipe I491_I103	26.37	62.2	130	DI	-0.08	0.03	0.02	0.04
Pipe I489_I490	41.81	62.2	130	DI	0.34	0.11	0.37	0.036
Pipe I489_I105	68.16	62.2	130	DI	-1.54	0.51	6.05	0.029
Pipe I487_I488	6.964086	62.2	130	DI	0.15	0.05	0.06	0.034
Pipe I487_I150	111.0496	62.2	130	DI	-0.99	0.33	2.65	0.031
Pipe I486_I487	130.5726	62.2	130	DI	-0.73	0.24	1.53	0.032
Pipe I485_I486	35.25397	62.2	130	DI	-0.79	0.26	1.74	0.032
Pipe I484_I485	36.22446	62.2	130	DI	-0.72	0.24	1.47	0.032
Pipe I483_I484	21.69824	62.2	130	DI	0.13	0.04	0.06	0.043
Pipe I483_I481	12.90856	62.2	130	DI	-0.68	0.22	1.3	0.032
Pipe I481_I482	10.25267	62.2	130	DI	0.1	0.03	0.03	0.032
Pipe I481_I480	21.54711	62.2	130	DI	-0.81	0.27	1.84	0.032
Pipe I480_I485	23.19074	62.2	130	DI	0.24	0.08	0.19	0.039
Pipe I478_I479	21.10124	62.2	130	DI	0.2	0.07	0.14	0.039
Pipe I478_I143	17.88	62.2	130	DI	-1.6	0.53	6.47	0.028
Pipe I477_I486	29.88317	62.2	130	DI	0.25	0.08	0.21	0.038
Pipe I477_I476	15.60429	62.2	130	DI	-0.78	0.26	1.7	0.032
Pipe I476_I478	72.50017	62.2	130	DI	-1.29	0.43	4.36	0.029

Pipe I475_I476	30.53436	62.2	130	DI	-0.42	0.14	0.55	0.035
Pipe I474_I475	23.7565	62.2	130	DI	-0.31	0.1	0.31	0.036
Pipe I474_I473	35.95948	62.2	130	DI	0.21	0.07	0.16	0.039
Pipe I473_I477	4.547544	62.2	130	DI	-0.49	0.16	0.72	0.034
Pipe I472_I480	7.587686	62.2	130	DI	1.09	0.36	3.18	0.03
Pipe I472_I473	28.79941	62.2	130	DI	-0.66	0.22	1.25	0.032
Pipe I471_I474	37.99471	62.2	130	DI	0.02	0.01	0	0
Pipe I471_I472	58.95115	62.2	130	DI	0.48	0.16	0.7	0.034
Pipe I470_I467	21.17298	62.2	130	DI	-0.1	0.03	0.04	0.044
Pipe I469_I134	91.47887	62.2	130	DI	-2.81	0.93	18.4	0.026
Pipe I468_I469	72.12291	62.2	130	DI	-1.06	0.35	2.99	0.03
Pipe I468_I452	19.20079	62.2	130	DI	0.42	0.14	0.54	0.035
Pipe I467_I469	11.96419	62.2	130	DI	-1.58	0.52	6.28	0.029
Pipe I466_I468	61.43596	62.2	130	DI	-0.46	0.15	0.65	0.034
Pipe I466_I467	38.16453	62.2	130	DI	-1.35	0.45	4.73	0.029
Pipe I465_I471	21.91181	62.2	130	DI	0.68	0.22	1.3	0.032
Pipe I465_I466	41.04156	62.2	130	DI	-1.66	0.55	6.94	0.028
Pipe I464_I465	9.776159	62.2	130	DI	-0.92	0.3	2.3	0.031
Pipe I464_I292	70.74252	62.2	130	DI	0.97	0.32	2.55	0.031
Pipe I461_I464	98.64903	62.2	130	DI	0.35	0.12	0.39	0.036
Pipe I461_I463	23.48905	62.2	130	DI	0.36	0.12	0.41	0.036
Pipe I461_I462	30.1418	62.2	130	DI	0.34	0.11	0.36	0.036
Pipe I459_I461	42.22253	62.2	130	DI	1.19	0.39	3.74	0.03
Pipe I459_I460	46.892	62.2	130	DI	0.23	0.08	0.17	0.037
Pipe I456_I458	17.07012	62.2	130	DI	0.13	0.04	0.06	0.041
Pipe	19.55728	62.2	130	DI	0.22	0.07	0.17	0.038

I456_I457								
Pipe I455_I456	29.44532	62.2	130	DI	0.41	0.14	0.52	0.035
Pipe I453_I455	28.58587	62.2	130	DI	0.57	0.19	0.97	0.033
Pipe I453_I454	39.75818	62.2	130	DI	0.28	0.09	0.27	0.037
Pipe 10	150.51	62.2	130	DI	1.73	0.57	7.44	0.028
Pipe 12	81.59	62.2	130	DI	1.28	0.42	4.28	0.029
Pipe 13	73.95	62.2	130	DI	0.72	0.24	1.48	0.032
Pipe 14	86.11	62.2	130	DI	3.09	1.02	21.9	0.026
Pipe 15	342.01	62.2	130	DI	0.74	0.24	1.55	0.032
Pipe 16	26.46	62.2	130	DI	-0.66	0.22	1.27	0.033
Pipe 17	27.33	62.2	130	DI	1.75	0.58	7.61	0.028
Pipe 18	82.2	62.2	130	DI	1.51	0.5	5.82	0.029
Pipe 19	172.34	62.2	130	DI	0.66	0.22	1.27	0.032
Pipe 20	61.67	62.2	130	DI	3.5	1.15	27.6	0.025
Pipe 21	44.58	62.2	130	DI	1.88	0.62	8.69	0.028
Pipe 22	220.1	62.2	130	DI	0.65	0.21	1.23	0.032
Pipe 23	53.56	62.2	130	DI	0.91	0.3	2.28	0.031
Pipe 24	66.98	62.2	130	DI	1.28	0.42	4.27	0.029
Pipe 25	32.07	62.2	130	DI	0.72	0.24	1.49	0.032
Pipe 26	38.72	62.2	130	DI	0.63	0.21	1.15	0.033
Pipe 27	28.28	62.2	130	DI	0.56	0.18	0.92	0.033
Pipe 28	41.5	62.2	130	DI	0.33	0.11	0.34	0.036
Pipe 29	15.46	62.2	130	DI	0.44	0.15	0.6	0.034
Pipe 30	18.49	62.2	130	DI	0.17	0.06	0.1	0.039
Pipe 31	48.78	62.2	130	DI	-0.04	0.01	0.01	0.043
Pipe 32	65.36	62.2	130	DI	-0.36	0.12	0.41	0.036
Pipe 33	56.16	62.2	130	DI	-0.66	0.22	1.25	0.032
Pipe 34	98.53	62.2	130	DI	-1.16	0.38	3.55	0.03
Pipe 35	22.21	62.2	130	DI	-1.77	0.58	7.81	0.028
Pipe 36	103.85	62.2	130	DI	-2.04	0.67	10.1	0.027
Pipe 59	170.25	62.2	130	DI	0.82	0.27	1.89	0.031
Pipe 60	21.93	62.2	130	DI	-0.84	0.27	1.94	0.031
Pipe 61	58.09	62.2	130	DI	-1.62	0.53	6.59	0.028
Pipe 62	157.97	62.2	130	DI	1.25	0.41	4.1	0.03
Pipe 63	172.56	62.2	130	DI	-1.61	0.53	6.57	0.028
Pipe 64	105.74	62.2	130	DI	-0.49	0.16	0.72	0.034
Pipe 65	102.89	62.2	130	DI	-1.01	0.33	2.73	0.03
Pipe 66	38.79	62.2	130	DI	-1.93	0.64	9.15	0.028
Pipe 67	24.81	62.2	130	DI	1.53	0.5	5.92	0.029
Pipe 69	36.56	62.2	130	DI	0.4	0.13	0.49	0.035
Pipe 70	31.49	62.2	130	DI	0.28	0.09	0.25	0.037
Pipe 71	110.13	62.2	130	DI	-0.14	0.04	0.07	0.041

Pipe 72	95.07	62.2	130	DI	-0.83	0.27	1.9	0.031
Pipe 73	202.61	62.2	130	DI	-0.32	0.11	0.33	0.036
Pipe 74	86.64	62.2	130	DI	-1.06	0.35	3	0.03
Pipe 77	90.95	62.2	130	DI	0.13	0.04	0.07	0.042
Pipe 78	64.85	62.2	130	DI	-0.21	0.07	0.16	0.039
Pipe 79	102.42	62.2	130	DI	-1.69	0.56	7.13	0.028
Pipe 80	60.92	62.2	130	DI	-1.93	0.64	9.16	0.028
Pipe 82	143.71	62.2	130	DI	-1.07	0.35	3.06	0.03
Pipe 84	202.25	62.2	130	DI	2.24	0.74	12	0.027
Pipe 85	208.89	62.2	130	DI	-2.43	0.8	14	0.027
Pipe 86	36.62	62.2	130	DI	-4.06	1.33	36.2	0.025
Pipe 87	59.53	62.2	130	DI	0.07	0.02	0.02	0.043
Pipe 88	109.17	62.2	130	DI	-0.84	0.28	1.98	0.031
Pipe 89	62.98	62.2	130	DI	-1.54	0.51	6	0.029
Pipe 90	50.94	62.2	130	DI	-0.19	0.06	0.13	0.039
Pipe 91	257.86	62.2	130	DI	-0.86	0.28	2.03	0.031
Pipe 92	71.21	62.2	130	DI	-2.24	0.74	12.1	0.027
Pipe 93	10.48	62.2	130	DI	-2.49	0.82	14.7	0.027
Pipe 94	39.32	62.2	130	DI	-2.71	0.89	17.1	0.026
Pipe 11	158.97	550	110	DI	205.07	0.86	1.73	0.025
Pipe 37	152.99	500	110	DI	159.48	0.81	1.73	0.026
Pipe 41	9.74	400	110	DI	243.45	1.94	11.2	0.023
Pipe 58	151.44	250	110	DI	82.07	1.67	14.8	0.026
Pipe 68	332.32	250	110	DI	82.07	1.67	14.8	0.026
Pipe 75	255.59	150	110	DI	11.85	0.67	4.94	0.032
Pipe 76	331.03	150	110	DI	11.85	0.67	4.94	0.032
Pipe 81	196.97	150	110	DI	11.85	0.67	4.94	0.032
Pipe 83	78.94	200	110	DI	11.85	0.38	1.21	0.033
Pipe 96	197.35	250	110	DI	68.64	1.4	10.6	0.027
Pipe 97	162.14	250	110	DI	68.64	1.4	10.6	0.027
Pipe 38	207.1	200	110	DI	45.09	1.44	14.4	0.028
Pipe 40	7.75	200	110	DI	45.09	1.44	14.4	0.028
Pipe 5	0.58	150	110	DI	4.64	0.26	0.77	0.033
Pipe 8	28.99	150	110	DI	11.29	0.64	4.51	0.033
Pipe 43	85.48	150	110	DI	11.29	0.64	4.51	0.033
Pipe 45	47.91	150	110	DI	11.29	0.64	4.51	0.033
Pipe 46	113.6	150	110	DI	11.29	0.64	4.51	0.033
Pipe 47	60.06	150	110	DI	11.29	0.64	4.51	0.033
Pipe 48	21.69	150	110	DI	11.29	0.64	4.51	0.033
Pipe 49	106.31	150	110	DI	11.29	0.64	4.51	0.033
Pipe 50	36.37	150	110	DI	11.29	0.64	4.51	0.033
Pipe 52	37.29	150	110	DI	11.29	0.64	4.51	0.033
Pipe 53	131.07	150	110	DI	11.76	0.67	4.86	0.032
Pipe 54	108.16	150	110	DI	11.76	0.67	4.86	0.032

Pipe 55	44.99	150	110	DI	7.17	0.41	1.95	0.035
Pipe 56	45.04	150	110	DI	7.17	0.41	1.95	0.035
Pipe 57	47.83	150	110	DI	7.17	0.41	1.95	0.035
Pipe 95	21.77	150	110	DI	7.17	0.41	1.94	0.035
Pipe 99	61.68	150	110	DI	7.17	0.41	1.95	0.035
Pipe 100	49.96	150	110	DI	7.17	0.41	1.95	0.035
Pipe 101	57	150	110	DI	7.17	0.41	1.95	0.035
Pipe 102	71.9	150	110	DI	7.17	0.41	1.95	0.035
Pipe 103	32.77	150	110	DI	1.24	0.07	0.08	0.046
Pipe 104	55.21	150	110	DI	1.24	0.07	0.08	0.045
Pipe 105	77.59	150	110	DI	1.24	0.07	0.07	0.045
Pipe 106	43.62	150	110	DI	1.24	0.07	0.08	0.045
Pipe 107	132.98	150	110	DI	1.24	0.07	0.08	0.045
Pipe 108	61.98	150	110	DI	-2.15	0.12	0.21	0.042
Pipe 109	49.89	150	110	DI	-2.15	0.12	0.21	0.042
Pipe 110	66.98	150	110	DI	-2.15	0.12	0.21	0.042
Pipe 111	29.81	150	110	DI	-2.15	0.12	0.21	0.042
Pipe 112	47.48	150	110	DI	-2.15	0.12	0.21	0.042
Pipe 113	46.75	150	110	DI	-2.15	0.12	0.21	0.042
Pipe 114	107.18	150	110	DI	-2.15	0.12	0.21	0.041
Pipe 115	44.1	150	110	DI	-2.15	0.12	0.21	0.042
Pipe 116	2.16	62.2	130	DI	-3.49	1.15	27.4	0.025
Pipe 117	9.95	62.2	130	DI	0.1	0.03	0.03	0.034
Pipe 118	3.72	62.2	130	DI	3.43	1.13	26.5	0.025
Pipe 119	1.04	150	110	DI	3.39	0.19	0.43	0.034
Pipe 120	1.91	150	110	DI	4.7	0.27	0.86	0.036
Pipe 122	0.74	150	110	DI	4.59	0.26	0.8	0.035
Pipe 123	1.17	150	110	DI	14.79	0.84	7.38	0.031
Pipe 124	5.12	62.2	130	DI	-0.03	0.01	0	0
Pipe 125	0.65	150	110	DI	-0.47	0.03	0	0
Pipe 126	84.31	150	110	DI	13.91	0.79	6.64	0.032
Pipe 127	48.07	150	110	DI	12.45	0.7	5.41	0.032
Pipe 128	113.25	150	110	DI	12.45	0.7	5.4	0.032
Pipe 129	60.57	150	110	DI	12.45	0.7	5.41	0.032
Pipe 130	126.94	150	110	DI	12.45	0.7	5.4	0.032
Pipe 131	73.65	150	110	DI	12.45	0.7	5.4	0.032
Pipe 132	14.65	150	110	DI	12.45	0.7	5.4	0.032
Pipe 133	133.8	150	110	DI	9.13	0.52	3.05	0.034
Pipe 134	83.98	150	110	DI	9.13	0.52	3.05	0.034
Pipe 135	55.24	150	110	DI	9.13	0.52	3.04	0.034
Pipe 136	38.46	150	110	DI	9.13	0.52	3.05	0.034
Pipe 137	19.45	150	110	DI	9.13	0.52	3.05	0.034
Pipe 138	79.21	150	110	DI	9.13	0.52	3.05	0.034
Pipe 139	100.2	150	110	DI	9.13	0.52	3.04	0.034

Pipe 140	30.09	150	110	DI	5.05	0.29	1.01	0.037
Pipe 141	12.82	150	110	DI	5.05	0.29	1.02	0.037
Pipe 142	64.43	150	110	DI	5.05	0.29	1.01	0.037
Pipe 143	37.71	150	110	DI	5.05	0.29	1.02	0.037
Pipe 144	57.62	150	110	DI	5.05	0.29	1.02	0.037
Pipe 145	38.47	150	110	DI	5.05	0.29	1.01	0.037
Pipe 146	78.76	150	110	DI	5.05	0.29	1.02	0.037
Pipe 147	161.64	150	110	DI	5.05	0.29	1.02	0.037
Pipe 148	106.42	150	110	DI	5.05	0.29	1.02	0.037
Pipe 149	28.44	150	110	DI	-1.69	0.1	0.14	0.044
Pipe 150	147.09	150	110	DI	-1.69	0.1	0.13	0.043
Pipe 151	71.14	150	110	DI	-1.69	0.1	0.13	0.043
Pipe 152	100.15	150	110	DI	-1.69	0.1	0.13	0.043
Pipe 153	0.93	150	110	DI	6.17	0.35	1.44	0.035
Pipe 155	0.98	150	110	DI	2.47	0.14	0.15	0.023
Pipe 156	0.69	150	110	DI	4.08	0.23	0.65	0.036
Pipe 157	0.99	150	110	DI	6.74	0.38	1.65	0.033
Pipe 158	0.91	150	110	DI	4.09	0.23	0.65	0.036
Pipe 159	0.89	150	110	DI	14.02	0.79	6.86	0.032
Pipe 160	0.66	150	110	DI	5.9	0.33	1.35	0.036
Pipe 161	0.69	150	110	DI	1.47	0.08	0	0
Pipe 162	48.14	150	110	DI	3.14	0.18	0.42	0.039
Pipe 163	18.91	150	110	DI	0.91	0.05	0.04	0.043
Pipe 164	113.23	150	110	DI	0.91	0.05	0.04	0.048
Pipe 165	130.91	150	110	DI	0.91	0.05	0.04	0.046
Pipe 166	46.13	150	110	DI	0.91	0.05	0.05	0.05
Pipe 167	18.59	150	110	DI	0.91	0.05	0.04	0.044
Pipe 168	33.07	150	110	DI	-1.03	0.06	0.05	0.047
Pipe 169	124.01	150	110	DI	-1.03	0.06	0.05	0.046
Pipe 170	39.1	150	110	DI	-2.78	0.16	0.33	0.04
Pipe 171	82.35	150	110	DI	-2.78	0.16	0.34	0.04
Pipe 172	104.33	150	110	DI	-2.78	0.16	0.34	0.04
Pipe 173	103.79	150	110	DI	-2.78	0.16	0.34	0.04
Pipe 174	172.81	150	110	DI	-5.71	0.32	1.28	0.036
Pipe 175	105.28	150	110	DI	-5.71	0.32	1.28	0.036
Pipe 176	1.07	150	110	DI	2.34	0.13	0.28	0.047
Pipe 177	0.5	150	110	DI	1.94	0.11	0.3	0.073
Pipe 179	216.39	150	110	DI	-0.01	0	0	0
Pipe 180	197.09	150	110	DI	-0.01	0	0	0
Pipe 181	263.9	150	110	DI	-0.41	0.02	0.01	0.056
Pipe 182	129.73	150	110	DI	-0.41	0.02	0.01	0.051
Pipe 183	84.8	150	110	DI	-3.24	0.18	0.45	0.039
Pipe 184	189.57	150	110	DI	-3.24	0.18	0.45	0.039
Pipe 185	100.2	150	110	DI	-7.27	0.41	1.99	0.035

Pipe 186	85.02	150	110	DI	-7.27	0.41	2	0.035
Pipe 187	134.4	150	110	DI	-7.27	0.41	2	0.035
Pipe 188	128.13	150	110	DI	-7.27	0.41	2	0.035
Pipe 189	116.45	150	110	DI	-7.27	0.41	2	0.035
Pipe 190	15.91	150	110	DI	-7.27	0.41	2	0.035
Pipe 191	203.19	150	110	DI	-7.27	0.41	2	0.035
Pipe 192	70.73	150	110	DI	-7.27	0.41	2	0.035
Pipe 194	1.03	150	110	DI	3.08	0.17	0.29	0.028
Pipe 195	1.73	150	110	DI	2.83	0.16	0.34	0.04
Pipe 196	0.41	150	110	DI	3.1	0.18	0.36	0.035
Pipe 197	1.29	150	110	DI	4.03	0.23	0.69	0.039
Pipe 198	4.26	150	110	DI	0.4	0.02	0	0
Pipe 199	139.91	150	110	DI	10.06	0.57	3.64	0.033
Pipe 201	105.46	62.2	130	DI	1.44	0.47	5.31	0.029
Pipe 202	119.94	150	110	DI	10.06	0.57	3.64	0.033
Pipe 203	99.88	150	110	DI	5.45	0.31	1.17	0.036
Pipe 204	85.16	150	110	DI	5.45	0.31	1.17	0.036
Pipe 205	0.75	62.2	130	DI	-2.77	0.91	17.9	0.026
Pipe 206	117.78	150	110	DI	5.45	0.31	1.17	0.036
Pipe 207	0.69	62.2	130	DI	3.08	1.01	21.8	0.026
Pipe 208	90.99	62.2	130	DI	0.62	0.21	1.13	0.033
Pipe 209	60.52	62.2	130	DI	0.2	0.07	0.14	0.039
Pipe 210	1.34	62.2	130	DI	-0.17	0.06	0.11	0.042
Pipe 211	36.69	62.2	130	DI	0.06	0.02	0.02	0.045
Pipe 212	14.52	62.2	130	DI	-0.46	0.15	0.65	0.034
Pipe 214	99.41	62.2	130	DI	-1.35	0.44	4.7	0.029
Pipe 215	1.5	62.2	130	DI	-0.88	0.29	2.08	0.031
Pipe 216	1.02	62.2	130	DI	3.73	1.23	30.9	0.025
Pipe 217	75.9	62.2	130	DI	-0.65	0.22	1.23	0.033
Pipe 218	78.55	62.2	130	DI	-1.2	0.39	3.77	0.03
Pipe 220	147.32	150	110	DI	2.91	0.16	0.37	0.04
Pipe 223	234.44	150	110	DI	-0.35	0.02	0.01	0.051
Pipe 225	205.66	150	110	DI	-0.35	0.02	0.01	0.058
Pipe 227	413.39	150	110	DI	-4.46	0.25	0.81	0.037
Pipe 228	63.4	150	110	DI	2.15	0.12	0.21	0.042
Pipe 229	0.95	150	110	DI	6.9	0.39	1.72	0.033
Pipe 230	2.11	62.2	130	DI	0.69	0.23	1.41	0.034
Pipe 231	365.43	150	110	DI	2.72	0.15	0.32	0.04
Pipe 233	1.83	150	110	DI	6.37	0.36	1.55	0.035
Pipe 234	374.11	150	110	DI	0.98	0.06	0.05	0.046
Pipe 235	64.09	62.2	130	DI	1.98	0.65	9.6	0.028
Pipe 236	67.55	62.2	130	DI	0.63	0.21	1.14	0.033
Pipe 237	59.42	62.2	130	DI	-0.32	0.11	0.33	0.036
Pipe 238	55.78	62.2	130	DI	-0.9	0.3	2.24	0.031

Pipe 239	28.81	62.2	130	DI	-1.09	0.36	3.17	0.03
Pipe 240	99.02	62.2	130	DI	-1.31	0.43	4.45	0.029
Pipe 241	0.57	150	110	DI	-2.57	0.15	0.52	0.073
Pipe 242	0.68	150	110	DI	-4.34	0.25	0.88	0.043
Pipe 243	0.6	150	110	DI	-5.93	0.34	1.24	0.032
Pipe 39	2.24	150	110	DI	-4.63	0.26	0.86	0.037
Pipe 232	3.36	150	110	DI	-4.73	0.27	0.89	0.036
Pipe 245	194.68	150	110	DI	-10.17	0.58	3.72	0.033
Pipe 246	216.74	150	110	DI	10.17	0.58	3.71	0.033
Pipe 247	0.92	150	110	DI	17.52	0.99	10.2	0.031
Pipe 248	0.81	62.2	130	DI	-3.29	1.08	24.6	0.026
Pipe 249	201.63	150	110	DI	10.17	0.58	3.71	0.033
Pipe 250	0.32	150	110	DI	3.63	0.21	0.47	0.032
Pipe 251	0.34	150	110	DI	3.37	0.19	0.44	0.035
Pipe 252	0.35	150	110	DI	17.06	0.97	9.78	0.031
Pipe 253	72.11	150	110	DI	4.46	0.25	0.8	0.037
Pipe 254	1.65	150	110	DI	4.1	0.23	0.72	0.039
Pipe 255	2.88	150	110	DI	2.86	0.16	0.36	0.041
Pipe 256	198.09	150	110	DI	-2.91	0.16	0.37	0.04
Pipe 257	130.38	150	110	DI	7.4	0.42	2.06	0.035
Pipe 258	1.34	150	110	DI	4.49	0.25	0.89	0.041
Pipe 259	0.85	150	110	DI	2.73	0.15	0.35	0.043
Pipe 260	0.87	150	110	DI	2.23	0.13	0.17	0.032
Pipe 261	0.32	150	110	DI	2.23	0.13	0	0
Pipe 262	1.03	150	110	DI	2.94	0.17	0.43	0.046
Pipe 263	1.43	150	110	DI	1.75	0.1	0.1	0.031
Pipe 121	0.86	62.2	130	DI	4.02	1.32	35.7	0.025
Pipe 154	10.58	62.2	130	DI	-0.9	0.3	2.21	0.031
Pipe 178	174.91	150	110	DI	9.24	0.52	3.11	0.034
Pipe 213	106.72	150	110	DI	9.24	0.52	3.11	0.034
Pipe 219	94.92	62.2	130	DI	-1.19	0.39	3.75	0.03
Pipe 221	1.83	62.2	130	DI	-2.26	0.74	12.3	0.027
Pipe 222	1.94	62.2	130	DI	4.33	1.43	40.8	0.025
Pipe 224	0.7	62.2	130	DI	-0.22	0.07	0	0
Pipe 226	0.6	62.2	130	DI	1.96	0.64	9.18	0.027
Pipe 266	165.88	150	110	DI	2.65	0.15	0.31	0.04
Pipe 267	112.33	62.2	130	DI	-0.01	0	0	0
Pipe 268	54.59	62.2	130	DI	-0.36	0.12	0.41	0.035
Pipe 269	149.86	150	110	DI	3.32	0.19	0.47	0.039
Pipe 270	1.3	62.2	130	DI	-3.64	1.2	29.5	0.025
Pipe 271	1.32	62.2	130	DI	2.41	0.79	13.8	0.027
Pipe 272	73.11	62.2	130	DI	-0.01	0	0	0
Pipe 273	20.53	62.2	130	DI	-0.2	0.06	0.14	0.04
Pipe 274	25.44	62.2	130	DI	-0.32	0.11	0.33	0.036

Pipe 275	75.72	62.2	130	DI	-0.56	0.18	0.93	0.033
Pipe 276	59.93	62.2	130	DI	-0.19	0.06	0.12	0.039
Pipe 277	93.79	62.2	130	DI	0.49	0.16	0.73	0.034
Pipe 278	3.9	62.2	130	DI	-0.17	0.06	0.08	0.029
Pipe 279	154.68	150	110	DI	5.93	0.34	1.37	0.036
Pipe 280	196.34	150	110	DI	2.73	0.15	0.33	0.04
Pipe 281	2.63	62.2	130	DI	1.25	0.41	4.13	0.03
Pipe 282	2.22	62.2	130	DI	1.95	0.64	9.39	0.028
Pipe 283	62.99	62.2	130	DI	-1.42	0.47	5.16	0.029
Pipe 284	286.3	150	110	DI	-3.62	0.21	0.55	0.038
Pipe 285	0.97	62.2	130	DI	-1.26	0.42	4.14	0.029
Pipe 286	0.95	62.2	130	DI	4.68	1.54	47	0.024
Pipe 287	238.37	150	110	DI	8.08	0.46	2.43	0.034
Pipe 288	68.52	62.2	130	DI	1.17	0.39	3.62	0.03
Pipe 289	169.06	62.2	130	DI	0.83	0.27	1.92	0.031
Pipe 292	2.12	62.2	130	DI	-1.72	0.57	7.37	0.028
Pipe 293	2.21	62.2	130	DI	2.74	0.9	17.4	0.026
Pipe 294	213.62	62.2	130	DI	1.12	0.37	3.35	0.03
Pipe 295	0.98	62.2	130	DI	-1.92	0.63	9.11	0.028
Pipe 296	0.77	62.2	130	DI	-5.79	1.91	70	0.024
Pipe 297	35.28	62.2	130	DI	2.42	0.8	13.9	0.027
Pipe 298	37.93	62.2	130	DI	-0.69	0.23	1.38	0.032
Valve 51	#N/A	150	#N/A	DI	33.23	1.88	14.5	0
Valve 98	#N/A	150	#N/A	DI	11.85	0.67	15.1	0
Valve 42	#N/A	200	#N/A	DI	54.18	1.72	12.1	0
Valve 44	#N/A	300	#N/A	DI	61.99	0.88	9.67	0
Valve 4	#N/A	150	#N/A	DI	13.43	0.76	19.3	0

Table 6.21.Details of Pressure for DNI I (at peak time 7.00)

Node ID	Elevation	Base Demand	Peak Demand	Head	Pressure
	m	LPS	LPS	m	m
Junc Bansbari1	1356	0	0	1373.8	17.8
Junc TO_A-2.1	1356	69.8	104.7	1373.76	17.76
Junc Bansbari2	1344.993	0	0	1371.62	26.63
Junc Bansbari3	1336.028	0	0	1369.87	33.85
Junc To_A-2.3	1336.008	70.2	105.3	1369.39	33.39
Junc To_A-2.5	1332.208	82	123	1369.51	37.3
Junc I805	1308.615	0.1357	0.2	1339.49	30.88
Junc I800	1343.34	0.0813	0.12	1360.65	17.31

Junc I787	1330.013	0.1449	0.22	1355.51	25.5
Junc I786	1330.062	0.5837	0.88	1355.48	25.41
Junc I785	1330.013	0.0983	0.15	1355.51	25.5
Junc I784	1307.434	0.4746	0.71	1337.46	30.02
Junc I783	1309.849	0.4559	0.68	1337.52	27.67
Junc I782	1310.904	0.1962	0.29	1337.52	26.62
Junc I781	1310.813	0.2435	0.37	1337.53	26.72
Junc I780	1310.353	0.1432	0.21	1337.61	27.26
Junc I779	1310.506	0.0792	0.12	1337.62	27.11
Junc I778	1310.353	0.1376	0.21	1337.7	27.35
Junc I777	1315.319	0.1001	0.15	1335.64	20.32
Junc I776	1312.959	0.1113	0.17	1335.64	22.68
Junc I775	1312.819	0.139	0.21	1335.58	22.76
Junc I774	1315.284	0.0673	0.1	1335.59	20.3
Junc I773	1315.445	0.2348	0.35	1335.56	20.12
Junc I772	1315.179	0.0854	0.13	1335.58	20.4
Junc I771	1314.947	0.1929	0.29	1335.57	20.62
Junc I770	1315.015	0.0965	0.14	1335.58	20.56
Junc I769	1314.918	0.2387	0.36	1335.6	20.68
Junc I768	1314.604	0.3701	0.56	1335.49	20.88
Junc I767	1314.507	0.5395	0.81	1335.52	21.02
Junc I766	1314.897	0.3176	0.48	1335.83	20.94
Junc I765	1306.926	0.2039	0.31	1335.83	28.9
Junc I764	1306.39	0.0994	0.15	1335.83	29.44
Junc I763	1308.344	0.449	0.67	1335.83	27.49
Junc I761	1314.679	0.2842	0.43	1335.1	20.42
Junc I760	1313.552	0.1743	0.26	1335.15	21.6
Junc I759	1313.601	0.1424	0.21	1335.14	21.54
Junc I758	1314.187	0.2178	0.33	1335.14	20.95
Junc I757	1315.307	0.3474	0.52	1335.12	19.82
Junc I756	1315.296	0.104	0.16	1335.15	19.86
Junc I755	1317.968	0.1918	0.29	1335.31	17.34
Junc I754	1316.348	0.1988	0.3	1335.31	18.97
Junc I753	1313.381	0	0	1339.17	25.79
Junc I752	1313.47	0.3606	0.54	1337.78	24.31
Junc I751	1313.545	0.1308	0.2	1337.82	24.28
Junc I750	1313.786	0.1753	0.26	1337.88	24.09
Junc I749	1313.249	0.1446	0.22	1337.43	24.18
Junc I748	1314.516	0.2728	0.41	1337.73	23.22
Junc I747	1313.877	0.2276	0.34	1337.46	23.58
Junc I746	1312.758	0.225	0.34	1337.45	24.69
Junc I745	1312.527	0.245	0.37	1337.45	24.92
Junc I744	1312.245	0.2503	0.38	1337.44	25.2
Junc I743	1312.159	0.2034	0.31	1337.45	25.29

Junc I742	1312.522	0.1226	0.18	1337.48	24.96
Junc I741	1312.564	0.0942	0.14	1337.48	24.92
Junc I740	1315.296	0.2344	0.35	1337.83	22.54
Junc I739	1313.84	0.2842	0.43	1339.02	25.18
Junc I738	1313.741	0.2132	0.32	1339.05	25.31
Junc I737	1312.86	0.2177	0.33	1339.04	26.18
Junc I736	1312.599	0.0721	0.11	1339.05	26.45
Junc I735	1312.46	0.2037	0.31	1339.02	26.56
Junc I734	1310.985	0.1369	0.21	1339.05	28.06
Junc I733	1310.455	0.3508	0.53	1339	28.55
Junc I732	1309.406	0.0881	0.13	1339.08	29.67
Junc I731	1307.99	0.5898	0.88	1338.76	30.77
Junc I730	1309.815	0.1536	0.23	1339.08	29.27
Junc I729	1309.072	0.0698	0.1	1339.09	30.02
Junc I728	1307.618	0.1301	0.2	1339.15	31.54
Junc I727	1307.347	0.1521	0.23	1339.16	31.81
Junc I726	1307.533	0.0969	0.15	1339.52	31.99
Junc I725	1307.18	0.1439	0.22	1339.52	32.34
Junc I724	1307.803	0.0792	0.12	1339.52	31.72
Junc I723	1308.404	0.0552	0.08	1339.52	31.11
Junc I722	1308.054	0.056	0.08	1339.52	31.47
Junc I721	1308.749	0.1596	0.24	1339.51	30.77
Junc I720	1308.44	0.2113	0.32	1339.52	31.08
Junc I719	1308.768	0.4205	0.63	1339.58	30.81
Junc I718	1308.465	0.1378	0.21	1339.55	31.09
Junc I717	1306.759	0.2152	0.32	1339.5	32.74
Junc I716	1307.332	0.2287	0.34	1339.16	31.83
Junc I715	1307.588	0.078	0.12	1339.17	31.58
Junc I714	1308.788	0.233	0.35	1340.02	31.24
Junc I713	1308.533	0.1537	0.23	1340.06	31.52
Junc I712	1308.135	0.1239	0.19	1340.06	31.93
Junc I711	1310.06	0.2035	0.31	1339.75	29.69
Junc I710	1308.879	0.1491	0.22	1339.76	30.89
Junc I709	1308.807	0.1624	0.24	1339.9	31.1
Junc I708	1309.278	0.0881	0.13	1339.64	30.36
Junc I707	1308.655	0.1147	0.17	1339.49	30.84
Junc I706	1308.223	0.187	0.28	1339.4	31.18
Junc I705	1307.77	0.0347	0.05	1339.2	31.43
Junc I704	1307.637	0.0491	0.07	1339.2	31.56
Junc I703	1307.8	0.0649	0.1	1339.2	31.4
Junc I702	1307.755	0.089	0.13	1339.2	31.44
Junc I701	1308.845	0.1032	0.15	1339.22	30.37
Junc I700	1309.05	0.1083	0.16	1339.16	30.11
Junc I699	1307.802	0.0701	0.11	1339.13	31.33

Junc I698	1312.592	0.114	0.17	1336.74	24.15
Junc I697	1315.664	0.1326	0.2	1336.74	21.07
Junc I696	1315.503	0.2499	0.37	1336.74	21.24
Junc I695	1311.865	0.1745	0.26	1336.91	25.04
Junc I694	1312.483	0.1642	0.25	1336.91	24.43
Junc I693	1312.728	0.2563	0.38	1337.06	24.33
Junc I692	1314.807	0.1383	0.21	1337.08	22.28
Junc I691	1317.73	0.1481	0.22	1337.44	19.71
Junc I690	1317.689	0.189	0.28	1337.44	19.75
Junc I689	1317.374	0.1198	0.18	1337.46	20.08
Junc I688	1318.315	0.125	0.19	1337.48	19.17
Junc I687	1318.098	0.0587	0.09	1337.49	19.39
Junc I686	1317.367	0.469	0.7	1337.54	20.18
Junc I685	1321.124	0.3028	0.45	1338.3	17.18
Junc I684	1317.678	0.1482	0.22	1338.47	20.79
Junc I683	1318.794	0.1553	0.23	1338.47	19.68
Junc I682	1318.335	0.1661	0.25	1338.48	20.14
Junc I681	1319.91	0.0582	0.09	1338.85	18.94
Junc I680	1319.653	0.1379	0.21	1353.72	34.07
Junc I679	1320.337	0.1793	0.27	1353.73	33.39
Junc I678	1319.91	0.02	0.03	1353.62	33.71
Junc I677	1318.805	0.1897	0.28	1338.86	20.05
Junc I676	1319.048	0.0821	0.12	1338.87	19.83
Junc I675	1316.634	0.1916	0.29	1353.53	36.89
Junc I674	1316.798	0.1356	0.2	1353.53	36.73
Junc I673	1308.489	0.0345	0.05	1339.01	30.52
Junc I672	1308.382	0.0687	0.1	1339.01	30.63
Junc I671	1309.743	0.1482	0.22	1342.56	32.82
Junc I670	1308.935	0.1135	0.17	1339.01	30.08
Junc I669	1308.605	0.0324	0.05	1338.99	30.38
Junc I668	1308.942	0.0301	0.05	1338.99	30.04
Junc I667	1309.028	0.0427	0.06	1338.98	29.96
Junc I666	1309.071	0.0725	0.11	1338.98	29.91
Junc I665	1308.495	0.0629	0.09	1338.89	30.39
Junc I664	1308.397	0.1168	0.18	1339.02	30.62
Junc I663	1308.429	0.0387	0.06	1338.97	30.54
Junc I662	1310.518	0.0241	0.04	1338.97	28.45
Junc I661	1308.185	0.1054	0.16	1338.95	30.77
Junc I660	1311.191	0.0534	0.08	1338.96	27.76
Junc I659	1314.414	0.0798	0.12	1338.92	24.51
Junc I658	1309.355	0.0833	0.12	1338.92	29.57
Junc I657	1308.401	0.1109	0.17	1338.87	30.47
Junc I656	1308.907	0.1826	0.27	1338.87	29.97
Junc I655	1309.252	0.0988	0.15	1338.92	29.67

Junc I654	1308.708	0.2601	0.39	1338.98	30.27
Junc I653	1309.415	0.1267	0.19	1338.99	29.57
Junc I652	1316.459	0.261	0.39	1339.3	22.84
Junc I651	1312.621	0.1733	0.26	1338.91	26.28
Junc I650	1315.812	0.2105	0.32	1338.87	23.06
Junc I649	1313.326	0.0848	0.13	1338.87	25.55
Junc I648	1315.019	0.1961	0.29	1342.49	27.47
Junc I647	1312.521	0.1613	0.24	1342.51	29.98
Junc I646	1319.048	0.0628	0.09	1353.51	34.46
Junc I645	1320.018	0.1353	0.2	1353.16	33.14
Junc I644	1321.285	0.1549	0.23	1353.17	31.88
Junc I643	1321.257	0.2924	0.44	1352.93	31.67
Junc I642	1314.988	0.1775	0.27	1352.62	37.63
Junc I641	1319.386	0.1247	0.19	1352.63	33.24
Junc I640	1321.091	0.2698	0.4	1352.59	31.5
Junc I639	1319.453	0.0265	0.04	1352.62	33.17
Junc I638	1320.048	0.1689	0.25	1352.61	32.56
Junc I637	1320.234	0.0363	0.05	1352.61	32.38
Junc I636	1319.307	0.0303	0.05	1352.61	33.31
Junc I635	1319.602	0.0462	0.07	1352.62	33.02
Junc I634	1311.526	0.1414	0.21	1352.61	41.09
Junc I633	1313.327	0.0482	0.07	1352.62	39.29
Junc I632	1313.896	0.0597	0.09	1352.62	38.73
Junc I631	1313.012	0.0806	0.12	1352.65	39.64
Junc I630	1314.61	0.1714	0.26	1352.76	38.15
Junc I629	1315.431	0.1723	0.26	1352.76	37.33
Junc I628	1314.979	0.0683	0.1	1352.76	37.78
Junc I627	1314.704	0.1718	0.26	1352.82	38.12
Junc I626	1314.799	0.1435	0.22	1353.56	38.76
Junc I625	1311.926	0.1472	0.22	1353.57	41.64
Junc I624	1312.107	0.1649	0.25	1353.76	41.66
Junc I623	1312.211	0.0554	0.08	1354.17	41.96
Junc I622	1312.227	0.1588	0.24	1353.67	41.44
Junc I621	1319.349	0.1892	0.28	1352.62	33.27
Junc I620	1315.561	0.0944	0.14	1352.63	37.07
Junc I619	1315.822	0.0456	0.07	1352.63	36.81
Junc I618	1316.863	0.1044	0.16	1352.63	35.77
Junc I617	1318.758	0.0682	0.1	1352.65	33.89
Junc I616	1319.824	0.1095	0.16	1352.65	32.83
Junc I615	1318.35	0.0831	0.12	1352.68	34.33
Junc I614	1318.597	0.0659	0.1	1352.75	34.15
Junc I613	1318.174	0.0532	0.08	1352.75	34.58
Junc I612	1318.267	0.1284	0.19	1352.83	34.56
Junc I611	1319.791	0.1872	0.28	1352.57	32.78

Junc I610	1322.427	0.1951	0.29	1352.54	30.11
Junc I609	1322.014	0.1294	0.19	1352.54	30.53
Junc I608	1319.56	0.1304	0.2	1352.56	33
Junc I607	1322.345	0.1903	0.29	1352.57	30.22
Junc I606	1317.712	0.1025	0.15	1352.61	34.9
Junc I605	1318.214	0.0574	0.09	1352.62	34.4
Junc I604	1318.277	0.0303	0.05	1352.63	34.35
Junc I603	1318.869	0.0719	0.11	1352.64	33.77
Junc I602	1318.652	0.028	0.04	1352.64	33.99
Junc I601	1315.789	0.0458	0.07	1352.67	36.88
Junc I600	1316.209	0.0258	0.04	1352.67	36.46
Junc I599	1316.573	0.0375	0.06	1352.68	36.1
Junc I598	1321.846	0.1659	0.25	1352.57	30.72
Junc I597	1323.094	0.1531	0.23	1352.57	29.48
Junc I596	1316.063	0.1063	0.16	1352.59	36.53
Junc I595	1315.443	0.1512	0.23	1352.59	37.15
Junc I594	1315.649	0.0481	0.07	1352.64	37
Junc I593	1315.72	0.0916	0.14	1352.64	36.92
Junc I592	1318.013	0.0547	0.08	1352.83	34.81
Junc I591	1317.255	0.0722	0.11	1352.71	35.46
Junc I590	1317.317	0.0694	0.1	1352.71	35.39
Junc I589	1317.129	0.0672	0.1	1352.69	35.56
Junc I588	1317.044	0.1706	0.26	1352.69	35.64
Junc I587	1317.525	0.0749	0.11	1342.62	25.1
Junc I586	1317.708	0.0342	0.05	1342.62	24.92
Junc I585	1318.183	0.2588	0.39	1356.31	38.13
Junc I584	1317.243	0.074	0.11	1356.34	39.1
Junc I583	1317.368	0.0606	0.09	1342.63	25.26
Junc I582	1317.225	0.0845	0.13	1342.63	25.4
Junc I581	1316.351	0.0537	0.08	1356.1	39.75
Junc I580	1316.08	0.0918	0.14	1356.1	40.02
Junc I579	1316.891	0.0453	0.07	1355.8	38.91
Junc I578	1317.459	0.0826	0.12	1355.8	38.34
Junc I577	1317.197	0.1091	0.16	1355.8	38.6
Junc I576	1319.937	0.1294	0.19	1356.06	36.12
Junc I575	1318.116	0.0612	0.09	1356.01	37.89
Junc I574	1319.379	0.0448	0.07	1356.01	36.63
Junc I573	1318.259	0.0293	0.04	1356	37.74
Junc I572	1319.074	0.0807	0.12	1356	36.92
Junc I571	1318.674	0.0794	0.12	1355.93	37.26
Junc I570	1320.115	0.0556	0.08	1355.93	35.82
Junc I569	1321.657	0.0655	0.1	1355.94	34.28
Junc I568	1320.325	0.0344	0.05	1355.94	35.62
Junc I567	1320.625	0.1071	0.16	1355.98	35.36

Junc I566	1320.837	0.0721	0.11	1356.02	35.19
Junc I565	1320.794	0.0289	0.04	1356.03	35.23
Junc I564	1320.739	0.0667	0.1	1356.02	35.28
Junc I563	1322.397	0.072	0.11	1356	33.6
Junc I562	1322.467	0.2134	0.32	1356	33.53
Junc I561	1321.476	0.2655	0.4	1356	34.53
Junc I560	1323.856	0.1443	0.22	1356.2	32.35
Junc I559	1323.156	0.1214	0.18	1356.22	33.06
Junc I558	1323.329	0.1207	0.18	1356.22	32.89
Junc I557	1322.34	0.0988	0.15	1355.65	33.31
Junc I556	1323.329	0.0716	0.11	1355.65	32.32
Junc I555	1320.119	0.14	0.21	1355.41	35.29
Junc I554	1321.342	0.2859	0.43	1355.4	34.06
Junc I553	1321.049	0.0533	0.08	1355.41	34.36
Junc I552	1322.015	0.0823	0.12	1355.46	33.45
Junc I551	1321.851	0.0501	0.08	1355.47	33.62
Junc I550	1319.411	0.133	0.2	1355.49	36.08
Junc I549	1322.028	0.0532	0.08	1355.49	33.46
Junc I548	1321.769	0.0702	0.11	1355.6	33.83
Junc I547	1322.254	0.0414	0.06	1355.6	33.35
Junc I546	1322.254	0.0294	0.04	1355.66	33.4
Junc I545	1323.055	0.124	0.19	1356.37	33.31
Junc I544	1322.271	0.0239	0.04	1355.71	33.44
Junc I543	1321.1	0.1459	0.22	1356.45	35.35
Junc I542	1320.512	0.107	0.16	1355.89	35.38
Junc I541	1324.522	0.2229	0.33	1356.26	31.74
Junc I540	1318.555	0.1556	0.23	1356.28	37.73
Junc I539	1317.972	0.1203	0.18	1352.6	34.63
Junc I538	1310.515	0.2007	0.3	1352.64	42.13
Junc I537	1313.589	0.1011	0.15	1352.61	39.02
Junc I536	1312.895	0.1969	0.3	1352.63	39.73
Junc I535	1316.159	0.083	0.12	1352.63	36.47
Junc I534	1314.001	0.0734	0.11	1352.63	38.63
Junc I533	1314.249	0.1645	0.25	1352.64	38.39
Junc I532	1314.795	0.0384	0.06	1352.64	37.85
Junc I531	1316.856	0.0377	0.06	1352.67	35.81
Junc I530	1315.745	0.1369	0.21	1352.67	36.93
Junc I529	1317.175	0.0549	0.08	1353.86	36.68
Junc I528	1314.291	0.0851	0.13	1353.85	39.56
Junc I527	1317.581	0.0397	0.06	1353.86	36.28
Junc I526	1318.678	0.039	0.06	1353.86	35.18
Junc I525	1317.937	0.0169	0.03	1353.86	35.92
Junc I524	1318.879	0.0492	0.07	1353.86	34.98
Junc I523	1317.787	0.0343	0.05	1353.86	36.07

Junc I522	1319.34	0.1346	0.2	1353.89	34.55
Junc I521	1320.492	0.1003	0.15	1353.89	33.4
Junc I520	1311.714	0.1632	0.24	1353.22	41.5
Junc I519	1315.405	0.0647	0.1	1353.22	37.82
Junc I518	1312.972	0.0636	0.1	1353.22	40.25
Junc I517	1317.242	0.0428	0.06	1353.4	36.16
Junc I516	1319.11	0.066	0.1	1353.4	34.29
Junc I515	1319.2	0.2007	0.3	1353.32	34.12
Junc I514	1318.601	0.0817	0.12	1353.34	34.74
Junc I513	1314.961	0.0547	0.08	1353.24	38.28
Junc I512	1311.275	0.106	0.16	1353.2	41.93
Junc I511	1312.703	0.0363	0.05	1353.2	40.5
Junc I510	1317.681	0.0755	0.11	1353.19	35.51
Junc I509	1319.634	0.0788	0.12	1353.19	33.55
Junc I508	1319.784	0.0616	0.09	1353.19	33.4
Junc I507	1319.675	0.1228	0.18	1353.19	33.51
Junc I506	1319.914	0.1473	0.22	1353.27	33.36
Junc I505	1319.683	0.1632	0.24	1353.01	33.33
Junc I504	1321.924	0.1548	0.23	1353.02	31.1
Junc I503	1315.948	0.1104	0.17	1353.11	37.16
Junc I502	1330.063	0.1259	0.19	1353.14	23.07
Junc I501	1323.465	0.2122	0.32	1353.14	29.68
Junc I500	1324.879	0.0897	0.13	1353.13	28.25
Junc I499	1322.292	0.0768	0.12	1353.13	30.84
Junc I498	1319.528	0.066	0.1	1353.13	33.61
Junc I497	1321.283	0.0852	0.13	1353.23	31.94
Junc I496	1318.613	0.071	0.11	1353.23	34.61
Junc I495	1321.283	0.0105	0.02	1353.23	31.95
Junc I494	1320.927	0.048	0.07	1353.23	32.3
Junc I493	1326.312	0.1822	0.27	1353.26	26.95
Junc I492	1326.63	0.1202	0.18	1353.3	26.67
Junc I491	1326.516	0.0726	0.11	1353.37	26.85
Junc I490	1328.525	0.2261	0.34	1355.2	26.67
Junc I489	1330.597	0.204	0.31	1355.09	24.49
Junc I488	1319.699	0.0977	0.15	1355.62	35.92
Junc I487	1319.548	0.0715	0.11	1355.62	36.07
Junc I486	1323.774	0.1302	0.2	1355.42	31.65
Junc I485	1322.48	0.2038	0.31	1355.36	32.88
Junc I484	1327.151	0.1634	0.25	1355.31	28.15
Junc I483	1327.416	0.0692	0.1	1355.31	27.89
Junc I482	1325.781	0.0672	0.1	1355.32	29.54
Junc I481	1326.027	0.0215	0.03	1355.32	29.3
Junc I480	1323.271	0.029	0.04	1355.36	32.09
Junc I479	1330.164	0.1345	0.2	1355.77	25.6

Junc I478	1331.942	0.0702	0.11	1355.77	23.83
Junc I477	1323.545	0.0268	0.04	1355.43	31.88
Junc I476	1324.701	0.0635	0.1	1355.45	30.75
Junc I475	1325.676	0.0731	0.11	1355.44	29.76
Junc I474	1323.47	0.0777	0.12	1355.43	31.96
Junc I473	1323.529	0.03	0.05	1355.42	31.89
Junc I472	1323.278	0.0338	0.05	1355.39	32.11
Junc I471	1323.222	0.1148	0.17	1355.43	32.21
Junc I470	1327.074	0.0635	0.1	1355.92	28.85
Junc I469	1328.975	0.1214	0.18	1356	27.02
Junc I468	1327.671	0.115	0.17	1355.78	28.11
Junc I467	1326.453	0.0855	0.13	1355.92	29.47
Junc I466	1325.157	0.1027	0.15	1355.74	30.58
Junc I465	1323.898	0.0457	0.07	1355.46	31.56
Junc I464	1325.014	0.2009	0.3	1355.44	30.42
Junc I463	1327.308	0.2406	0.36	1355.46	28.16
Junc I462	1327.843	0.2249	0.34	1355.46	27.62
Junc I461	1327.354	0.0948	0.14	1355.47	28.12
Junc I460	1325.896	0.153	0.23	1355.62	29.73
Junc I459	1330.636	0.1074	0.16	1355.63	25
Junc I458	1334.673	0.0859	0.13	1355.68	21.01
Junc I457	1335.17	0.1479	0.22	1355.68	20.51
Junc I456	1334.589	0.0411	0.06	1355.68	21.09
Junc I455	1330.596	0.1071	0.16	1355.7	25.1
Junc I454	1333.87	0.1899	0.28	1355.71	21.84
Junc I453	1328.697	0.0645	0.1	1355.73	27.03
Junc I452	1327.963	0.0262	0.04	1355.77	27.81
Junc I451	1327.902	0.0469	0.07	1355.78	27.88
Junc I450	1333.166	0.1726	0.26	1356.62	23.45
Junc I449	1332.959	0.1205	0.18	1356.62	23.66
Junc I448	1334.12	0.1657	0.25	1357.41	23.29
Junc I447	1334.142	0.1542	0.23	1357.41	23.27
Junc I446	1335.751	0.236	0.35	1358.8	23.05
Junc I445	1334.561	0.1218	0.18	1358.81	24.25
Junc I444	1334.946	0.3507	0.53	1358.76	23.81
Junc I443	1334.069	0.2028	0.3	1358.8	24.74
Junc I442	1334.039	0.3463	0.52	1358.87	24.83
Junc I441	1333.999	0.1968	0.3	1358.45	24.45
Junc I440	1334.157	0.0793	0.12	1358.55	24.39
Junc I439	1331.698	0.5983	0.9	1358.3	26.6
Junc I438	1334.048	0.1566	0.23	1358.52	24.48
Junc I437	1337.387	0.5804	0.87	1354.98	17.59
Junc I436	1336.01	0.4565	0.68	1355.09	19.08
Junc I435	1338.215	0.8065	1.21	1355.58	17.37

Junc I434	1337.097	0.264	0.4	1355.7	18.6
Junc I433	1334.474	0.2957	0.44	1357.02	22.54
Junc I432	1336.275	0.2119	0.32	1357.05	20.78
Junc I431	1335.787	0.5426	0.81	1358.39	22.6
Junc I430	1335.575	0.0816	0.12	1356.66	21.09
Junc I429	1335.93	0.0434	0.07	1356.66	20.73
Junc I428	1336.3	0.123	0.18	1356.7	20.4
Junc I427	1336.053	0.0424	0.06	1356.71	20.65
Junc I426	1339.148	0.1388	0.21	1357.44	18.29
Junc I425	1340.351	0.0973	0.15	1358.14	17.79
Junc I424	1340.508	0.1342	0.2	1358.14	17.64
Junc I423	1335.034	0.1521	0.23	1355.7	20.66
Junc I422	1334.998	0.2686	0.4	1355.67	20.67
Junc I421	1331.926	0.3265	0.49	1355.65	23.72
Junc I420	1332.292	0.0943	0.14	1355.66	23.37
Junc I419	1332.282	0.1681	0.25	1355.67	23.39
Junc I418	1331.527	0.1646	0.25	1355.76	24.23
Junc I417	1322.97	0.1206	0.18	1355.76	32.79
Junc I416	1331.078	0.1274	0.19	1355.77	24.69
Junc I415	1335.45	0.1299	0.19	1355.83	20.38
Junc I414	1334.542	0.2017	0.3	1356.29	21.75
Junc I413	1335.694	0.3431	0.51	1356.31	20.61
Junc I412	1335.601	0.2792	0.42	1356.31	20.7
Junc I411	1338.301	0.1441	0.22	1356.54	18.24
Junc I410	1338.721	0.0757	0.11	1356.55	17.83
Junc I409	1338.111	0.0571	0.09	1356.48	18.37
Junc I408	1338.586	0.0897	0.13	1356.49	17.9
Junc I407	1337.563	0.1692	0.25	1356.31	18.75
Junc I406	1337.953	0.3267	0.49	1356.32	18.37
Junc I405	1337.158	0.5019	0.75	1356.1	18.94
Junc I404	1336.216	0.1838	0.28	1356.19	19.97
Junc I403	1335.694	0.0847	0.13	1356.2	20.5
Junc I402	1333.473	0.1612	0.24	1356.21	22.74
Junc I401	1335.306	0.0679	0.1	1356.19	20.88
Junc I400	1335.552	0.0816	0.12	1356.22	20.66
Junc I399	1335.635	0.043	0.06	1356.18	20.55
Junc I398	1336.495	0.1794	0.27	1356.17	19.67
Junc I397	1335.607	0.0356	0.05	1356.18	20.57
Junc I396	1335.63	0.127	0.19	1356.21	20.58
Junc I395	1335.646	0.059	0.09	1356.18	20.54
Junc I394	1335.624	0.1559	0.23	1356.18	20.56
Junc I393	1334.329	0.1263	0.19	1356.19	21.86
Junc I392	1320.637	0.1704	0.26	1354.91	34.27
Junc I391	1323.997	0.0886	0.13	1354.91	30.91

Junc I390	1321.226	0.154	0.23	1354.98	33.76
Junc I389	1327.975	0.0764	0.11	1354.99	27.01
Junc I388	1331.747	0.156	0.23	1356.23	24.49
Junc I387	1326.777	0.0344	0.05	1355.43	28.66
Junc I386	1328.964	0.0626	0.09	1355.43	26.47
Junc I385	1328.054	0.0168	0.03	1355.43	27.38
Junc I384	1331.527	0.0704	0.11	1355.44	23.91
Junc I383	1329.613	0.091	0.14	1355.44	25.82
Junc I382	1331.715	0.1888	0.28	1355.47	23.76
Junc I381	1329.473	0.1049	0.16	1355.17	25.7
Junc I380	1328.598	0.1182	0.18	1355.17	26.57
Junc I379	1327.452	0.0972	0.15	1355.11	27.66
Junc I378	1325.628	0.3011	0.45	1354.9	29.27
Junc I377	1325.917	0.0707	0.11	1354.92	29
Junc I376	1325.495	0.0443	0.07	1354.92	29.42
Junc I375	1323.672	0.2543	0.38	1354.87	31.2
Junc I374	1325.089	0.0885	0.13	1354.89	29.8
Junc I373	1320.522	0.2418	0.36	1354.87	34.35
Junc I372	1321.6	0.0654	0.1	1354.88	33.28
Junc I371	1322.139	0.1648	0.25	1354.89	32.75
Junc I370	1329.271	0.2074	0.31	1354.88	25.61
Junc I369	1332.014	0.2242	0.34	1354.89	22.88
Junc I368	1330.296	0.1991	0.3	1354.92	24.63
Junc I367	1323.138	0.3751	0.56	1354.91	31.77
Junc I366	1321.075	0.1549	0.23	1353.84	32.77
Junc I365	1320.119	0.222	0.33	1353.84	33.73
Junc I364	1318.603	0.122	0.18	1353.46	34.86
Junc I363	1320.937	0.1712	0.26	1353.51	32.57
Junc I362	1322.55	0.0839	0.13	1353.52	30.97
Junc I361	1325.522	0.1799	0.27	1353.57	28.04
Junc I360	1323.643	0.0794	0.12	1353.57	29.93
Junc I359	1324.452	0.1452	0.22	1353.78	29.33
Junc I358	1322.972	0.1311	0.2	1353.78	30.8
Junc I357	1326.185	0.0649	0.1	1354.71	28.52
Junc I356	1330.121	0.065	0.1	1354.7	24.58
Junc I355	1326.185	0.0431	0.06	1354.7	28.51
Junc I354	1327.474	0.0596	0.09	1354.67	27.2
Junc I353	1332.135	0.0595	0.09	1354.66	22.53
Junc I352	1327.375	0.1253	0.19	1354.66	27.29
Junc I351	1326.488	0.1301	0.2	1354.65	28.17
Junc I350	1325.987	0.1521	0.23	1354.66	28.67
Junc I349	1326.436	0.0867	0.13	1354.67	28.23
Junc I348	1334.384	0.1281	0.19	1354.33	19.95
Junc I347	1333.198	0.1987	0.3	1354.22	21.02

Junc I346	1334.527	0.0604	0.09	1354.23	19.71
Junc I345	1334.678	0.1638	0.25	1354.23	19.56
Junc I344	1335.744	0.2522	0.38	1354.53	18.78
Junc I343	1334.193	0.0967	0.15	1354.53	20.33
Junc I342	1330.158	0.2638	0.4	1354.53	24.37
Junc I341	1335.267	0.1589	0.24	1354.43	19.16
Junc I340	1335.443	0.1329	0.2	1354.44	18.99
Junc I339	1335.328	0.1044	0.16	1354.44	19.11
Junc I338	1327.105	0.0843	0.13	1354.57	27.46
Junc I337	1326.792	0.0304	0.05	1354.63	27.84
Junc I336	1325.291	0.143	0.21	1354.65	29.35
Junc I335	1325.164	0.165	0.25	1354.65	29.48
Junc I334	1335.573	0.1892	0.28	1355.04	19.47
Junc I333	1336.104	0.2798	0.42	1355.05	18.94
Junc I332	1334.707	0.1354	0.2	1355.4	20.7
Junc I331	1335.512	0.1476	0.22	1355.75	20.24
Junc I330	1329.134	0.1322	0.2	1356.07	26.94
Junc I329	1335.815	0.1283	0.19	1356.11	20.29
Junc I328	1334.016	0.1613	0.24	1356.11	22.09
Junc I327	1334.917	0.1459	0.22	1356.23	21.32
Junc I326	1335.554	0.1155	0.17	1356.58	21.03
Junc I325	1337.625	0.1348	0.2	1356.8	19.18
Junc I324	1337.567	0.087	0.13	1356.81	19.24
Junc I323	1337.636	0.1318	0.2	1356.84	19.21
Junc I322	1337.696	0.0327	0.05	1356.85	19.15
Junc I321	1338.052	0.0951	0.14	1356.99	18.93
Junc I320	1337.941	0.0539	0.08	1356.99	19.05
Junc I319	1338.786	0.0767	0.12	1357.26	18.48
Junc I318	1338.555	0.0647	0.1	1357.31	18.76
Junc I317	1338.907	0.054	0.08	1357.31	18.41
Junc I316	1340.041	0.085	0.13	1357.44	17.4
Junc I315	1340.012	0.0643	0.1	1357.44	17.43
Junc I314	1338.652	0.0861	0.13	1357.21	18.56
Junc I313	1339.385	0.1269	0.19	1357.21	17.83
Junc I312	1338.999	0.0148	0.02	1357.21	18.21
Junc I311	1338.999	0.0533	0.08	1357.21	18.21
Junc I310	1341.241	0.1745	0.26	1357.64	16.4
Junc I309	1343.371	0.1643	0.25	1358.68	15.31
Junc I308	1343.245	0	0	1359.24	16
Junc I307	1323.578	0.1349	0.2	1356.24	32.66
Junc I306	1323.848	0.1351	0.2	1356.24	32.39
Junc I305	1325.726	0.2948	0.44	1356.12	30.39
Junc I304	1325.872	0.0713	0.11	1356.13	30.26
Junc I303	1328.118	0.2487	0.37	1355.65	27.53

Junc I302	1322.728	0.2252	0.34	1355.4	32.67
Junc I301	1325.043	0.249	0.37	1355.41	30.37
Junc I300	1329.977	0.3948	0.59	1355.23	25.25
Junc I299	1330.482	0.0703	0.11	1355.18	24.7
Junc I298	1330.496	0.0144	0.02	1355.18	24.68
Junc I297	1330.567	0.0303	0.05	1355.18	24.61
Junc I296	1330.63	0.1264	0.19	1355.18	24.55
Junc I295	1330.682	0.0614	0.09	1355.18	24.5
Junc I294	1330.754	0.1013	0.15	1355.19	24.44
Junc I293	1330.823	0.0882	0.13	1355.25	24.42
Junc I292	1329.786	0.1138	0.17	1355.25	25.47
Junc I291	1332.77	0.2705	0.41	1355.45	22.68
Junc I290	1332.857	0.8238	1.24	1355.47	22.61
Junc I289	1331.454	0.3118	0.47	1355.25	23.8
Junc I288	1331.01	0.0562	0.08	1355.25	24.24
Junc I287	1331.076	0.2755	0.41	1355.23	24.16
Junc I286	1330.869	0.3964	0.59	1355.18	24.31
Junc I285	1330.56	0.0057	0.01	1355.18	24.62
Junc I284	1330.588	0.0092	0.01	1355.18	24.59
Junc I283	1330.558	0.0128	0.02	1355.18	24.62
Junc I282	1330.599	0.0315	0.05	1355.18	24.58
Junc I281	1330.684	0.2536	0.38	1355.18	24.49
Junc I280	1330.585	0.0291	0.04	1355.18	24.59
Junc I279	1330.624	0.1236	0.19	1355.18	24.55
Junc I278	1330.388	0.4365	0.65	1355.14	24.75
Junc I277	1330.502	0.0239	0.04	1355.17	24.67
Junc I276	1330.563	0.8558	1.28	1355.18	24.62
Junc I275	1325.175	0.3325	0.5	1356.92	31.74
Junc I274	1329.884	1.0471	1.57	1356.66	26.78
Junc I273	1329.884	0.1123	0.17	1355.92	26.04
Junc I272	1329.907	0.2091	0.31	1355.81	25.9
Junc I271	1329.791	0.0776	0.12	1355.82	26.03
Junc I270	1329.613	0.1264	0.19	1355.7	26.09
Junc I269	1329.723	0.2111	0.32	1355.71	25.98
Junc I268	1329.249	0.0868	0.13	1355.74	26.49
Junc I267	1328.75	0.1295	0.19	1355.74	26.99
Junc I266	1329.249	0.0511	0.08	1355.74	26.49
Junc I265	1330.05	0.0919	0.14	1355.76	25.71
Junc I264	1329.884	0.0088	0.01	1355.92	26.04
Junc I263	1329.269	0.0626	0.09	1355.96	26.69
Junc I262	1329.48	0.4469	0.67	1355.96	26.48
Junc I261	1325.175	0.3029	0.45	1356.92	31.74
Junc I260	1325.361	0.1569	0.24	1356.62	31.26
Junc I259	1324.553	0.1513	0.23	1356.63	32.08

Junc I258	1324.562	0.06	0.09	1356.28	31.72
Junc I257	1324.096	0.1735	0.26	1356.28	32.19
Junc I256	1325.414	0.1872	0.28	1356.1	30.68
Junc I255	1323.969	0.1165	0.17	1356.1	32.14
Junc I254	1326.104	0.0405	0.06	1356.03	29.92
Junc I253	1325.672	0.0705	0.11	1356.03	30.35
Junc I252	1325.342	0.0767	0.12	1356.03	30.69
Junc I251	1323.743	0.1834	0.28	1356.04	32.3
Junc I250	1319.567	0.3028	0.45	1356	36.43
Junc I249	1319.13	0.0828	0.12	1355.93	36.8
Junc I248	1320.238	0.1626	0.24	1355.83	35.59
Junc I247	1320.467	0.0626	0.09	1355.83	35.36
Junc I246	1319.218	0.0348	0.05	1355.83	36.61
Junc I245	1318.081	0.0732	0.11	1355.84	37.76
Junc I244	1317.647	0.1411	0.21	1355.82	38.18
Junc I243	1317.146	0.0801	0.12	1355.85	38.7
Junc I242	1317.146	0.0591	0.09	1342.73	25.59
Junc I241	1316.46	0.1194	0.18	1342.65	26.19
Junc I240	1316.829	0.0446	0.07	1342.65	25.82
Junc I239	1318.537	0.0508	0.08	1342.62	24.09
Junc I238	1316.661	0.0626	0.09	1342.62	25.96
Junc I237	1314.623	0.2028	0.3	1342.46	27.83
Junc I236	1312.992	0.2084	0.31	1342.48	29.49
Junc I235	1315.195	0.1659	0.25	1342.39	27.19
Junc I234	1314.783	0.1064	0.16	1342.39	27.61
Junc I233	1312.335	0.2466	0.37	1342.41	30.08
Junc I232	1313.201	0.0917	0.14	1342.41	29.21
Junc I231	1312.321	0.1164	0.17	1342.41	30.09
Junc I230	1310.909	0.2162	0.32	1342.45	31.54
Junc I229	1311.987	0.2076	0.31	1342.43	30.45
Junc I228	1310.99	0.183	0.27	1342.45	31.46
Junc I227	1320.255	0.0885	0.13	1355.8	35.55
Junc I226	1322.313	0.1339	0.2	1355.7	33.39
Junc I225	1322.053	0.1563	0.23	1355.71	33.66
Junc I224	1323.262	0.1287	0.19	1355.68	32.42
Junc I223	1323.413	0.0687	0.1	1355.68	32.27
Junc I222	1326.047	0.1584	0.24	1355.67	29.62
Junc I221	1327.074	0.1332	0.2	1355.67	28.6
Junc I220	1327.114	0.1015	0.15	1342.7	15.59
Junc I219	1323.951	0.0771	0.12	1342.7	18.75
Junc I218	1325.58	0.4454	0.67	1342.57	17
Junc I217	1323.27	0.0518	0.08	1342.62	19.35
Junc I216	1321.218	0.0617	0.09	1342.61	21.39
Junc I215	1317.317	0.161	0.24	1342.45	25.14

Junc I214	1320.017	0.0516	0.08	1342.46	22.44
Junc I213	1324.216	0.1794	0.27	1342.42	18.2
Junc I212	1320.472	0.2252	0.34	1342.42	21.95
Junc I211	1318.512	0.4515	0.68	1342.39	23.88
Junc I210	1314.621	0.031	0.05	1342.42	27.8
Junc I209	1313.999	0.065	0.1	1342.42	28.42
Junc I208	1314.38	0.0241	0.04	1342.42	28.04
Junc I207	1317.279	0.0807	0.12	1342.42	25.14
Junc I206	1316.822	0.0768	0.12	1342.43	25.61
Junc I205	1313.41	0.1069	0.16	1342.43	29.02
Junc I204	1314.782	0.1813	0.27	1342.43	27.65
Junc I203	1312.942	0.143	0.21	1342.47	29.53
Junc I202	1315.235	0.1283	0.19	1342.57	27.33
Junc I201	1314.194	0.0385	0.06	1342.57	28.37
Junc I200	1311.672	0.0478	0.07	1342.57	30.89
Junc I199	1310.206	0.1225	0.18	1342.59	32.39
Junc I198	1310.553	0.1068	0.16	1342.63	32.08
Junc I197	1311.17	0.0786	0.12	1339.95	28.78
Junc I196	1311.672	0.0456	0.07	1342.61	30.93
Junc I195	1310.247	0.1772	0.27	1342.55	32.31
Junc I194	1310.2	0.1408	0.21	1342.56	32.36
Junc I193	1309.181	0.0874	0.13	1339.15	29.97
Junc I192	1309.287	0.0607	0.09	1339.05	29.76
Junc I191	1309.023	0.0536	0.08	1342.57	33.54
Junc I190	1308.729	0.0838	0.13	1338.97	30.25
Junc I189	1310.029	0.1681	0.25	1342.58	32.55
Junc I188	1310.027	0.0556	0.08	1342.59	32.56
Junc I187	1310.248	0.0649	0.1	1338.89	28.64
Junc I186	1310.258	0.0794	0.12	1342.61	32.36
Junc I185	1309.929	0.1823	0.27	1338.71	28.78
Junc I184	1310.467	0.2759	0.41	1338.7	28.24
Junc I183	1310.027	0.1232	0.18	1338.72	28.69
Junc I182	1309.736	0.0601	0.09	1338.83	29.09
Junc I181	1310.438	0.1846	0.28	1342.59	32.15
Junc I180	1309.939	0.1894	0.28	1342.6	32.66
Junc I179	1311.701	0.2987	0.45	1338.84	27.14
Junc I178	1312.351	0.0769	0.12	1338.86	26.51
Junc I177	1312.462	0.057	0.09	1342.62	30.16
Junc I176	1315.86	0.0651	0.1	1342.61	26.75
Junc I175	1315.202	0.126	0.19	1342.61	27.41
Junc I174	1317.927	0.0728	0.11	1342.61	24.68
Junc I173	1316.389	0.0867	0.13	1342.61	26.22
Junc I172	1315.112	0.0366	0.05	1338.86	23.75
Junc I171	1315.112	0.0647	0.1	1353.64	38.53

Junc I170	1317.963	0.0365	0.05	1342.61	24.65
Junc I169	1317.963	0.2221	0.33	1356.88	38.91
Junc I168	1319.728	0.1606	0.24	1356.42	36.7
Junc I167	1318.416	0.0272	0.04	1352.85	34.44
Junc I166	1322.148	0.0794	0.12	1356.46	34.31
Junc I165	1321.507	0.081	0.12	1356.46	34.95
Junc I164	1319.18	0.0979	0.15	1352.76	33.58
Junc I163	1321.896	0.1061	0.16	1356.59	34.69
Junc I162	1318.857	0.0915	0.14	1356.59	37.74
Junc I161	1318.549	0.0776	0.12	1356.77	38.22
Junc I160	1317.563	0.0452	0.07	1356.77	39.2
Junc I159	1317.591	0.0858	0.13	1352.78	35.19
Junc I158	1318.851	0.065	0.1	1356.9	38.05
Junc I157	1318.827	0.1298	0.19	1352.91	34.08
Junc I156	1321.89	0.0957	0.14	1356.29	34.4
Junc I155	1321.533	0.0131	0.02	1356.29	34.76
Junc I154	1321.129	0.0404	0.06	1353.77	32.64
Junc I153	1321.46	0.0178	0.03	1353.77	32.31
Junc I152	1322.256	0.048	0.07	1353.96	31.7
Junc I151	1325.301	0.0564	0.08	1354.76	29.46
Junc I150	1328.695	0.125	0.19	1355.91	27.22
Junc I149	1327.344	0.1344	0.2	1355.86	28.52
Junc I148	1330.781	0.1857	0.28	1355.87	25.09
Junc I147	1332.806	0.1092	0.16	1354.45	21.64
Junc I146	1332.283	0.133	0.2	1354.45	22.17
Junc I145	1328.377	0.2085	0.31	1355.85	27.48
Junc I144	1332.942	0.0866	0.13	1355.87	22.93
Junc I143	1333.702	0.0489	0.07	1355.88	22.18
Junc I142	1334.158	0.1407	0.21	1354.35	20.19
Junc I141	1334.193	0.0537	0.08	1354.35	20.16
Junc I140	1332.815	0.1236	0.19	1356.38	23.57
Junc I139	1334.295	0.0301	0.05	1356.39	22.09
Junc I138	1334.331	0.0712	0.11	1354.34	20.01
Junc I137	1334.466	0.1232	0.18	1354.34	19.87
Junc I136	1334.238	0.1457	0.22	1356.95	22.71
Junc I135	1334.46	0.0546	0.08	1356.96	22.5
Junc I134	1334.628	0.1332	0.2	1357.68	23.05
Junc I133	1334.682	0.1872	0.28	1354.42	19.73
Junc I132	1336.841	0.1473	0.22	1354.56	17.72
Junc I131	1337.167	0.1994	0.3	1357.97	20.81
Junc I130	1337.566	0.1727	0.26	1357.98	20.42
Junc I129	1334.377	0.1323	0.2	1355.4	21.02
Junc I128	1334.41	0.0688	0.1	1358.84	24.43
Junc I127	1334.148	0.117	0.18	1358.85	24.7

Junc I126	1333.955	0.088	0.13	1358.85	24.9
Junc I125	1331.53	0.248	0.37	1356.02	24.49
Junc I124	1337.155	0.2784	0.42	1358.98	21.83
Junc I123	1335.724	0.2515	0.38	1359.01	23.29
Junc I122	1336.481	0.2074	0.31	1356.52	20.04
Junc I121	1335.851	0.1617	0.24	1356.54	20.69
Junc I120	1338.294	0.4825	0.72	1357.06	18.77
Junc I119	1341.996	0.2584	0.39	1357.78	15.78
Junc I118	1341.994	0.5443	0.82	1357.81	15.81
Junc I116	1343.382	0.2357	0.35	1360.23	16.84
Junc I115	1343.92	0	0	1361.27	17.35
Junc I113	1340.499	0.0988	0.15	1358.89	18.39
Junc I112	1342.864	0	0	1359	16.14
Junc I111	1341.471	0	0	1358.79	17.31
Junc I110	1340.088	0	0	1358.61	18.52
Junc I109	1335.517	0	0	1356.53	21.01
Junc I108	1335.696	0	0	1356.41	20.71
Junc I107	1336.046	0	0	1356.31	20.26
Junc I106	1334.414	0	0	1356.05	21.64
Junc I105	1324.825	0	0	1355.51	30.68
Junc I104	1327.357	0	0	1355.43	28.07
Junc I103	1330.456	0	0	1355.37	24.91
Junc I102	1328.879	0	0	1355.08	26.2
Junc I101	1325.622	0	0	1355.01	29.39
Junc I100	1319.099	0.1819	0.27	1352.67	33.57
Junc I099	1319.125	0.0647	0.1	1352.68	33.55
Junc I098	1319.54	0.0782	0.12	1352.68	33.14
Junc I097	1319.061	0	0	1354.92	35.86
Junc I096	1319.325	0	0	1354.88	35.56
Junc I095	1320.642	0	0	1354.83	34.19
Junc I094	1321.434	0.1275	0.19	1352.57	31.14
Junc I093	1321.118	0	0	1354.79	33.68
Junc I092	1321.749	0	0	1354.74	32.99
Junc I091	1322.788	0.1567	0.24	1352.54	29.75
Junc I090	1321.719	0	0	1354.74	33.02
Junc I089	1321.946	0.0954	0.14	1352.54	30.6
Junc I088	1321.791	0	0	1354.73	32.94
Junc I087	1321.997	0	0	1354.67	32.67
Junc I086	1320.829	0	0	1354.58	33.75
Junc I085	1320.913	0	0	1354.51	33.6
Junc I084	1320.71	0	0	1354.38	33.67
Junc I083	1321.465	0.1194	0.18	1353.16	31.7
Junc I082	1321.057	0	0	1354.35	33.3
Junc I081	1321.286	0.0875	0.13	1354.22	32.93

Junc I080	1321.212	0.1104	0.17	1339.18	17.96
Junc I079	1319.888	0.2199	0.33	1338.49	18.6
Junc I078	1316.461	0.2819	0.42	1338.49	22.03
Junc I077	1316.928	0.1491	0.22	1339.16	22.23
Junc I076	1316.799	0.0648	0.1	1335.54	18.75
Junc I075	1312.341	0.0903	0.14	1335.99	23.65
Junc I074	1310.659	0.2112	0.32	1335.82	25.16
Junc I073	1309.048	0.0492	0.07	1335.83	26.78
Junc I072	1311.967	0.287	0.43	1335.78	23.81
Junc I071	1308.782	0.103	0.15	1335.8	27.02
Junc I070	1306.988	0.22	0.33	1335.8	28.81
Junc I069	1306.396	0.0406	0.06	1335.84	29.44
Junc I068	1306.328	0.2681	0.4	1335.99	29.66
Junc I067	1307.409	0.1061	0.16	1335.84	28.43
Junc I066	1306.645	0.0526	0.08	1335.84	29.2
Junc I065	1309.402	0.0973	0.15	1335.73	26.33
Junc I064	1316.042	0.0803	0.12	1335.77	19.73
Junc I063	1315.272	0.1415	0.21	1335.81	20.53
Junc I062	1315.288	0.0889	0.13	1335.81	20.52
Junc I061	1315.279	0.0357	0.05	1335.81	20.53
Junc I060	1315.407	0.054	0.08	1335.82	20.42
Junc I059	1315.244	0.0682	0.1	1335.96	20.72
Junc I058	1314.688	0.0233	0.03	1335.96	21.27
Junc I057	1315.179	0.0592	0.09	1336	20.82
Junc I056	1314.301	0.0108	0.02	1336	21.7
Junc I055	1313.569	0.0595	0.09	1336.11	22.54
Junc I054	1313.582	0.12	0.18	1335.8	22.21
Junc I053	1311.97	0.0543	0.08	1335.8	23.83
Junc I052	1313.782	0.1924	0.29	1335.58	21.8
Junc I051	1312.526	0.0703	0.11	1335.59	23.07
Junc I050	1313.381	0.0793	0.12	1335.41	22.02
Junc I049	1312.462	0.3887	0.58	1338.37	25.9
Junc I048	1311.306	0.3725	0.56	1338.46	27.15
Junc I047	1310.916	0	0	1339.24	28.33
Junc I046	1310.851	0.3717	0.56	1338.79	27.94
Junc I045	1310.691	0	0	1339.25	28.56
Junc I044	1310.269	0	0	1339.28	29.01
Junc I043	1307.745	0	0	1339.51	31.77
Junc I042	1308.811	0	0	1339.76	30.95
Junc I041	1308.729	0.2526	0.38	1339.83	31.1
Junc I040	1305.868	0	0	1340.07	34.2
Junc I039	1308.241	0	0	1340.36	32.12
Junc I038	1308.427	0	0	1340.48	32.05
Junc I037	1311.003	0	0	1341	30

Junc I036	1310.159	0	0	1342.65	32.49
Junc I035	1311.001	0.0486	0.07	1342.58	31.58
Junc I034	1313.157	0	0	1342.66	29.51
Junc I033	1315.392	0	0	1342.68	27.29
Junc I032	1320.029	0.3126	0.47	1342.56	22.53
Junc I031	1319.624	0	0	1342.72	23.1
Junc I030	1321.549	0	0	1342.76	21.21
Junc I029	1325.763	0.1987	0.3	1342.82	17.06
Junc I028	1325.294	0	0	1342.99	17.7
Junc I027	1327.089	0	0	1343.09	16
Junc I026	1327.089	0	0	1356.97	29.88
Junc I025	1327.089	0	0	1356.97	29.88
Junc I024	1328.249	0.1643	0.25	1355.68	27.43
Junc I023	1328.236	0	0	1356.99	28.76
Junc I022	1329.923	0	0	1357.01	27.08
Junc I021	1330.565	0	0	1357.03	26.46
Junc I019	1331.041	0	0	1357.04	26
Junc I018	1332.208	0	0	1357.48	25.27
Junc I017	1332.208	0	0	1357.5	25.29
Junc I016	1332.621	1.9482	2.92	1352.39	19.77
Junc I015	1332.964	0	0	1358.81	25.85
Junc I014	1333.73	0.9467	1.42	1357.55	23.82
Junc I013	1334.081	0	0	1359.15	25.07
Junc I012	1334.796	0	0	1359.21	24.41
Junc I011	1335.122	0	0	1359.36	24.23
Junc I010	1336.415	0	0	1359.63	23.21
Junc I009	1337.923	0	0	1359.78	21.86
Junc I008	1339.394	0.2962	0.44	1359.73	20.33
Junc I007	1338.633	0	0	1360.04	21.41
Junc I006	1343.661	0	0	1361.35	17.68
Junc I005	1344.167	0.1325	0.2	1361.13	16.96
Junc I004	1344.69	0	0	1361.71	17.02
Junc I003	1344.509	0.121	0.18	1361.28	16.77
Junc I002	1344.666	0	0	1361.76	17.09
Junc I001	1344.957	0	0	1361.96	17
Junc Bansbari7	1332.028	43.7	65.55	1369.78	37.75
Junc Bansbari20	1343.92	0	0	1371.36	27.44
Junc Bansbari21	1331.041	0	0	1367.27	36.23
Junc Bansbari22	1327.089	0	0	1362.37	35.28
Junc Bansbari23	1322.738	0	0	1360.65	37.91

Junc Bansbari24	1318.401	15.7	23.55	1358.56	40.15
Junc Bansbari25	1312.131	0	0	1355.45	43.32
Junc Bansbari26	1307.285	0	0	1355.36	48.07
Junc Bansbari27	1308.811	0	0	1354.39	45.58
Junc Bansbari28	1310.269	0	0	1352.75	42.48
Junc Bansbari29	1313.381	0	0	1351.49	38.11
Junc Bansbari4	1344.993	162.3	243.45	1371.52	26.52
Junc 1	1310.159	0	0	1355.57	45.41
Junc 2	1344.957	0.1356	0.2	1361.96	17
Junc 3	1343.92	0.1153	0.17	1360.84	16.92
Junc 4	1343.34	0	0	1361.14	17.8
Junc 5	1343.382	0	0	1360.75	17.37
Junc 6	1341.994	0	0	1360.54	18.54
Junc 7	1338.294	0	0	1360.02	21.73
Junc 8	1335.851	0	0	1359.75	23.9
Junc 9	1335.724	0	0	1359.66	23.93
Junc 10	1331.53	0	0	1359.18	27.65
Junc 11	1333.955	0	0	1359.01	25.06
Junc 12	1334.41	0	0	1358.84	24.43
Junc 13	1337.566	0	0	1358.21	20.64
Junc 14	1334.628	0	0	1357.68	23.05
Junc 15	1334.46	0	0	1357.59	23.13
Junc 16	1334.295	0	0	1357.51	23.21
Junc 17	1333.702	0	0	1357.41	23.71
Junc 18	1332.942	0	0	1357.37	24.43
Junc 19	1330.781	0	0	1357.25	26.47
Junc 20	1328.695	0	0	1357.15	28.46
Junc 21	1321.533	0	0	1357.04	35.51
Junc 22	1318.851	0	0	1356.9	38.05
Junc 23	1317.563	0	0	1356.9	39.34
Junc 24	1318.857	0	0	1356.89	38.04
Junc 25	1321.507	0	0	1356.89	35.38
Junc 26	1319.728	0	0	1356.89	37.16
Junc 27	1317.963	0	0	1356.88	38.91
Junc 28	1317.243	0	0	1356.89	39.65
Junc 29	1316.08	0	0	1356.9	40.82
Junc 30	1317.146	0	0	1356.91	39.77
Junc 31	1320.255	0	0	1356.92	36.66
Junc 32	1322.053	0	0	1356.93	34.88

Junc 33	1323.413	0	0	1356.94	33.53
Junc 34	1327.074	0	0	1356.96	29.89
Junc 35	1327.089	0.0253	0.04	1355.69	28.6
Junc 36	1327.089	0.1544	0.23	1355.69	28.6
Junc 37	1328.236	0.0676	0.1	1355.68	27.44
Junc 38	1329.923	0.1547	0.23	1355.69	25.77
Junc 39	1330.565	0.1628	0.24	1356.42	25.85
Junc 40	1331.041	0.1424	0.21	1356.98	25.94
Junc 41	1331.041	0.6632	0.99	1357.03	25.99
Junc 42	1332.208	0.1347	0.2	1357.47	25.27
Junc 43	1332.208	0.7932	1.19	1357.38	25.17
Junc 44	1332.964	1.1638	1.75	1354.94	21.98
Junc 45	1334.081	0.1367	0.21	1357.87	23.79
Junc 46	1334.796	0.2743	0.41	1359.18	24.38
Junc 47	1335.122	0.611	0.92	1359.18	24.06
Junc 48	1336.415	0.4617	0.69	1359.39	22.98
Junc 49	1337.923	0.1833	0.27	1359.74	21.82
Junc 50	1338.633	0.1459	0.22	1359.75	21.11
Junc 51	1343.661	0.7048	1.06	1360.27	16.61
Junc 52	1344.69	0.033	0.05	1361.13	16.44
Junc 53	1344.666	0.0234	0.04	1361.28	16.62
Junc 54	1343.245	0.1516	0.23	1359.24	16
Junc 55	1343.371	0	0	1358.68	15.31
Junc 56	1341.994	0	0	1358.43	16.43
Junc 57	1338.294	0	0	1357.81	19.52
Junc 58	1335.851	0	0	1357.49	21.63
Junc 59	1331.53	0	0	1356.8	25.27
Junc 60	1334.41	0	0	1356.4	21.99
Junc 61	1334.377	0	0	1356.32	21.95
Junc 62	1336.841	0	0	1355.92	19.07
Junc 63	1334.682	0	0	1355.66	20.98
Junc 64	1334.466	0	0	1355.49	21.02
Junc 65	1334.331	0	0	1355.37	21.04
Junc 66	1334.193	0	0	1355.31	21.12
Junc 67	1332.283	0	0	1355.07	22.79
Junc 68	1325.301	0	0	1354.77	29.47
Junc 69	1322.256	0	0	1354.74	32.48
Junc 70	1321.46	0	0	1354.72	33.26
Junc 71	1318.827	0	0	1354.66	35.83
Junc 72	1317.591	0	0	1354.62	37.03
Junc 73	1318.857	0	0	1354.56	35.71
Junc 74	1319.18	0	0	1354.52	35.34
Junc 75	1318.416	0	0	1354.44	36.03
Junc 76	1315.112	0	0	1354.28	39.17

Junc 77	1312.211	0	0	1354.17	41.96
Junc 78	1312.107	0	0	1354.17	42.07
Junc 79	1316.798	0	0	1354.19	37.4
Junc 80	1319.048	0	0	1354.2	35.16
Junc 81	1321.286	0	0	1354.22	32.93
Junc 82	1321.057	0.0569	0.09	1353.17	32.11
Junc 83	1320.71	0.1011	0.15	1352.99	32.28
Junc 84	1320.913	0.1376	0.21	1352.64	31.73
Junc 85	1320.829	0.1613	0.24	1352.57	31.75
Junc 86	1321.997	0.0917	0.14	1352.55	30.55
Junc 87	1321.791	0.0432	0.06	1352.55	30.76
Junc 88	1321.719	0.0261	0.04	1352.55	30.83
Junc 89	1321.749	0.0477	0.07	1352.56	30.81
Junc 90	1321.118	0.0254	0.04	1352.57	31.45
Junc 91	1320.642	0.0717	0.11	1352.6	31.96
Junc 92	1319.325	0.0884	0.13	1352.64	33.32
Junc 93	1319.061	0.0451	0.07	1352.69	33.63
Junc 94	1325.622	0.104	0.16	1352.98	27.35
Junc 95	1328.879	0.0696	0.1	1353.1	24.22
Junc 96	1330.456	0.1448	0.22	1353.37	22.91
Junc 97	1327.357	0.1038	0.16	1353.76	26.4
Junc 98	1324.825	0.2559	0.38	1355.5	30.67
Junc 99	1334.414	0.0683	0.1	1355.72	21.3
Junc 100	1336.046	0.157	0.24	1356.2	20.15
Junc 101	1335.696	0.0392	0.06	1356.4	20.71
Junc 102	1335.517	0.2833	0.42	1356.37	20.85
Junc 103	1340.088	0.2299	0.34	1356.9	16.81
Junc 104	1341.471	0.2087	0.31	1358.78	17.31
Junc 105	1342.864	0.2739	0.41	1358.89	16.03
Junc 106	1327.089	0.0754	0.11	1343.09	16
Junc 107	1325.294	0.2932	0.44	1342.83	17.53
Junc 108	1321.549	0.4564	0.68	1342.76	21.21
Junc 109	1319.624	0.1482	0.22	1342.58	22.96
Junc 110	1315.392	0.0223	0.03	1342.57	27.18
Junc 111	1313.157	0.0337	0.05	1342.58	29.42
Junc 112	1310.159	0.0284	0.04	1342.6	32.44
Junc 113	1310.553	0	0	1342.63	32.08
Junc 114	1311.672	0	0	1342.63	30.96
Junc 115	1310.2	0	0	1342.62	32.42
Junc 116	1309.023	0	0	1342.62	33.59
Junc 117	1310.027	0	0	1342.62	32.59
Junc 118	1310.258	0	0	1342.61	32.36
Junc 119	1309.939	0	0	1342.62	32.68
Junc 120	1312.462	0	0	1342.62	30.16

Junc 121	1315.202	0	0	1342.64	27.43
Junc 122	1316.389	0	0	1342.66	26.27
Junc 123	1317.225	0	0	1342.7	25.47
Junc 124	1317.146	0	0	1342.73	25.59
Junc 125	1323.951	0	0	1342.95	19
Junc 126	1311.003	0.0489	0.07	1340.33	29.32
Junc 127	1308.427	0.1226	0.18	1340.47	32.05
Junc 128	1308.241	0.1064	0.16	1340.12	31.88
Junc 129	1305.868	0.0924	0.14	1339.84	33.97
Junc 130	1308.811	0.191	0.29	1339.76	30.95
Junc 131	1307.745	0.1796	0.27	1338.63	30.88
Junc 132	1310.269	0.155	0.23	1339.28	29.01
Junc 133	1310.691	0.1494	0.22	1338.89	28.2
Junc 134	1310.916	0.3456	0.52	1338.85	27.93
Junc 135	1313.381	0.2488	0.37	1339.17	25.79
Junc 136	1314.516	0	0	1339.17	24.66
Junc 137	1316.928	0	0	1339.17	22.24
Junc 138	1319.888	0	0	1339.18	19.29
Junc 139	1321.212	0	0	1339.18	17.96
Junc 140	1319.91	0	0	1339.21	19.3
Junc 141	1316.459	0	0	1339.3	22.84
Junc 142	1312.621	0	0	1339.5	26.88
Junc 143	1315.112	0	0	1339.67	24.56
Junc 144	1312.351	0	0	1339.94	27.59
Junc 145	1309.736	0	0	1340.19	30.46
Junc 146	1309.287	0	0	1340.42	31.14
Junc 147	1309.181	0	0	1340.46	31.28
Junc 148	1311.17	0	0	1340.86	29.69
Junc 149	1308.655	0	0	1339.96	31.31
Junc 150	1308.427	0	0	1340.47	32.05
Junc 151	1309.278	0	0	1339.91	30.64
Junc 152	1306.759	0	0	1339.53	32.77
Junc 153	1309.072	0	0	1339.41	30.34
Junc 154	1312.599	0	0	1339.31	26.71
Junc 155	1316.928	0	0	1339.16	22.23
Junc 156	1316.928	0	0	1339.17	22.24
Junc 157	1313.741	0	0	1339.06	25.32
Junc 158	1310.985	0	0	1339.05	28.06
Junc 159	1309.406	0	0	1339.05	29.64
Junc 160	1309.072	0	0	1339.06	29.98
Junc 161	1306.759	0	0	1339.52	32.76
Junc 162	1308.223	0	0	1339.62	31.39
Junc 163	1313.381	0	0	1336.38	23
Junc 164	1316.042	0	0	1336.06	20.02

Junc 165	1306.988	0	0	1335.99	29
Junc 166	1312.341	0	0	1335.99	23.65
Junc 167	1331.041	0	0	1357.04	26
Junc 168	1325.175	0	0	1356.92	31.74
Junc 169	1325.872	0	0	1356.3	30.43
Junc 170	1328.118	0	0	1356.22	28.11
Junc 171	1323.329	0	0	1356.24	32.91
Junc 172	1322.271	0	0	1356.37	34.1
Junc 173	1320.512	0	0	1356.46	35.95
Junc 174	1318.851	0	0	1356.9	38.05
Junc 175	1318.851	0	0	1356.9	38.05
Junc 176	1332.857	0	0	1358.45	25.59
Junc 177	1330.563	0	0	1357.64	27.08
Junc 178	1325.175	0	0	1356.92	31.75
Junc 179	1334.796	0	0	1359.2	24.4
Junc 180	1308.427	0	0	1340.47	32.05
Junc 181	1316.799	0	0	1336.05	19.25
Junc 182	1306.328	0.2681	0.4	1335.99	29.66
Junc 183	1313.569	0	0	1336.11	22.54
Junc 184	1337.923	0	0	1359.77	21.85
Junc 185	1334.048	0	0	1359.23	25.18
Junc 186	1334.048	0	0	1358.44	24.39
Junc 187	1334.157	0	0	1358.46	24.3
Junc 188	1334.039	0	0	1358.82	24.78
Junc 189	1334.039	0	0	1358.89	24.86
Junc 190	1334.561	0	0	1358.82	24.25
Junc 191	1334.41	0	0	1358.84	24.43
Junc 192	1334.41	0	0	1358.84	24.43
Junc 193	1331.747	0	0	1356.21	24.47
Junc 194	1331.747	0	0	1356.25	24.51
Junc 195	1335.646	0	0	1356.21	20.57
Junc 196	1335.635	0	0	1356.22	20.58
Junc 197	1335.306	0	0	1356.23	20.92
Junc 198	1335.601	0	0	1356.3	20.69
Junc 199	1335.694	0	0	1356.3	20.61
Junc 200	1335.517	0	0	1356.37	20.85
Junc 201	1335.601	0	0	1356.32	20.72
Junc 202	1335.512	0	0	1355.89	20.38
Junc 203	1323.138	0	0	1354.92	31.79
Junc 204	1325.301	0	0	1354.77	29.47
Junc 205	1324.825	0	0	1355.5	30.68
Junc 206	1324.825	0	0	1355.46	30.63
Junc 207	1330.597	0	0	1355.21	24.61
Junc 208	1323.138	0	0	1354.89	31.75

Junc 209	1327.474	0	0	1354.17	26.7
Junc 210	1325.301	0	0	1354.71	29.41
Junc 211	1326.185	0	0	1354.22	28.04
Resvr Bansbari	1374.4	#N/A	-840.24	1374.4	0

6.3.4 Design of DNI zone - J (A 2.3)

The DNI-J model has been designed and the model features are prepared accordingly. DNI-J has been designed using inside diameters (66.8mm, 80.4mm and 98.6mm) for HDPE PE100-PN6 pipes and the diameters (150mm, 200mm & 250mm) for DI pipes. After optimizing the pipe diameters for HDPE & DI pipes, all 560 demand nodes have pressure head between 14m & 40m and 45 demand nodes have pressure between 40m & 50m.

The demarcation of DNI-J Boundary is shown in **Figure 6.7** and DNI-J Design Model at Peak Demand (7.00) is shown in **Figure 6.8.**

The details of DNI-J/Pipe material & length/Bulk Meter, Isolation Valves, PRVs/PRVs with Set pressure/Location of Air Valve, Washout Valve & Fire hydrants are shown in the **Tables 6.22/6.23/6.24/6.25/6.26** respectively.

Figure 6.7: Demarcation of DNI Zone - J Boundary

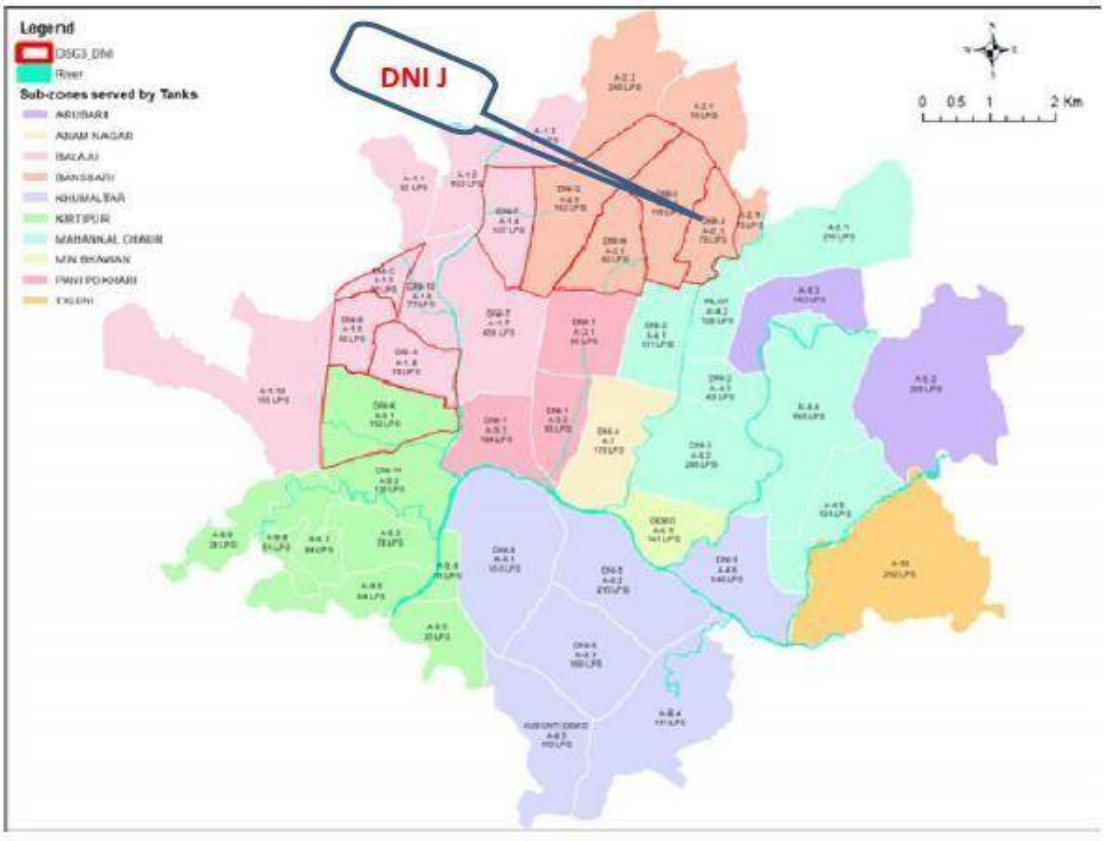


Table 6.22: Design of DNI Zone - J

Description	
Reservoir	Bansbari
Outlet Elevation of the Reservoir (m)	1374.40
Total Demand (LPS)	70.21
Total number of nodes	574
Total Number of Pipes	721
Total Length of Pipes	39,977
Number of PRVs	03
Number of Pumps	0
At Peak Time (7:00) - Only for HDPE pipes within DNI	
Number of Nodes have Pressure < 5m	0
Number of Nodes have Pressure [5m,10m]	0
Number of Nodes have Pressure [20m,40m]	560
Number of Nodes have Pressure [40m,50m]	14
Number of Nodes have Pressure [50m,60m]	0
Number of Nodes have Pressure > 60m	0
At Lowest Demand Time (1:00) - Only for HDPE pipes within DNI	
Number of Nodes have Pressure < 5m	0
Number of Nodes have Pressure [5m,10m]	0
Number of Nodes have Pressure [20m,40m]	547
Number of Nodes have Pressure [40m,50m]	27
Number of Nodes have Pressure [50m,60m]	0
Number of Nodes have Pressure > 60m	0

Table 6.23: Pipe details

Pipe Length of DNI-J (m)	
Reservoir	Bansbari
Pipe Diameter (mm)	Length (m)
HDPE PIPE-PE100, PN6	
66.80 (75)	17,061
80.40 (90)	10,928.50
98.60 (110)	4,202
DI PIPE	
150	4,251.50
200	951.50
250	11
Grand Total	37,405.50

Table 6.24: Details of Bulk Meter/Isolation Valve/PRV's

LOCATION OF BM/IV/PRV FOR DNI_J									
DNI	DMA	# Bulk Meter	Size of BM	# Isolation Valve	Size of IV	# PRV	Size of PRV	From_Junc	To_Junc
J	1	MainLine	400	3	400	0	0	BANSBARI20	BANSBARI3
J	2	1	200	3	200	1	200	BANSBARI30	J001
J	3	1	150	3	150	1	150	BANSBARI31	J570
J	4	1	200	3	200	1	200	BANSBARI32	J395
J	5	1	150	3		1	150	BANSBARI40	J300

Table 6.25: Details of PRV's with Set Pressure

DNI	DMA	# PRV	Size of PRV	Set pressure (m)	From_Junc	To_Junc
J	1	1	200	22	BANSBARI30	J001
J	2	1	150	23	BANSBARI31	J570
J	3	1	200	30	BANSBARI32	J395
J	4	1	150	18	BANSBARI40	J300

Table 6.26: Details of location of Air Valve/Washout Valve/Fire Hydrant

LOCATION OF AV/IV/WV/FH FOR DNI_J				
DNI	# Air Valve	# Wash out Valve	# Fire Hydrant	
	Provide at Junction	Provide at Junction	Provide at Junction	On pipe dia (mm)
J	J001	J028	J001	150 DI PIPE
	J188	J040	J012	150 DI PIPE
	J281	J123	J052	150 DI PIPE
	J545	J118	J155	150 DI PIPE
	J537	J108	J179	150 DI PIPE
	J518	J200	J270	150 DI PIPE
	J505	J288	J300	150 DI PIPE
	J398	J285	J321	150 DI PIPE
	I363	J172	J545	150 DI PIPE
	J023	J096	J485	150 DI PIPE
	J002	J222	J517	150 DI PIPE
	J064	J240	J505	150 DI PIPE
	J260	J369	J575	150 DI PIPE
	J485	J319	J445	150 DI PIPE
	J154	J482	J398	150 DI PIPE
	J264	J392	J395	150 DI PIPE
	J386	J590	J363	150 DI PIPE
	J230	J412	J060	150 DI PIPE
	J332	J428	J570	150 DI PIPE
		J437	J014	150 DI PIPE
		J472	J073	110 HDPE PIPE
		J455	J212	110 HDPE PIPE
		J490	J247	110 HDPE PIPE
		J510	J238	110 HDPE PIPE
		J501	J332	110 HDPE PIPE
			J565a	110 HDPE PIPE
			J347	110 HDPE PIPE
			J286	110 HDPE PIPE
			J263	110 HDPE PIPE
			J169	110 HDPE PIPE
			J048	90 HDPE PIPE
			J116	90 HDPE PIPE
			J139	90 HDPE PIPE
			J224	90 HDPE PIPE
			J218	90 HDPE PIPE

DNI	# Air Valve	# Wash out Valve	# Fire Hydrant	
J	Provide at Junction	Provide at Junction	Provide at Junction	On pipe dia (mm)
			J418	90 HDPE PIPE
			J431	90 HDPE PIPE
			J463	90 HDPE PIPE
			J494	90 HDPE PIPE
			J326	90 HDPE PIPE
			J186	90 HDPE PIPE

Figure 6.8: DNI Zone - J Design Model at Peak Demand at 7.00 AM

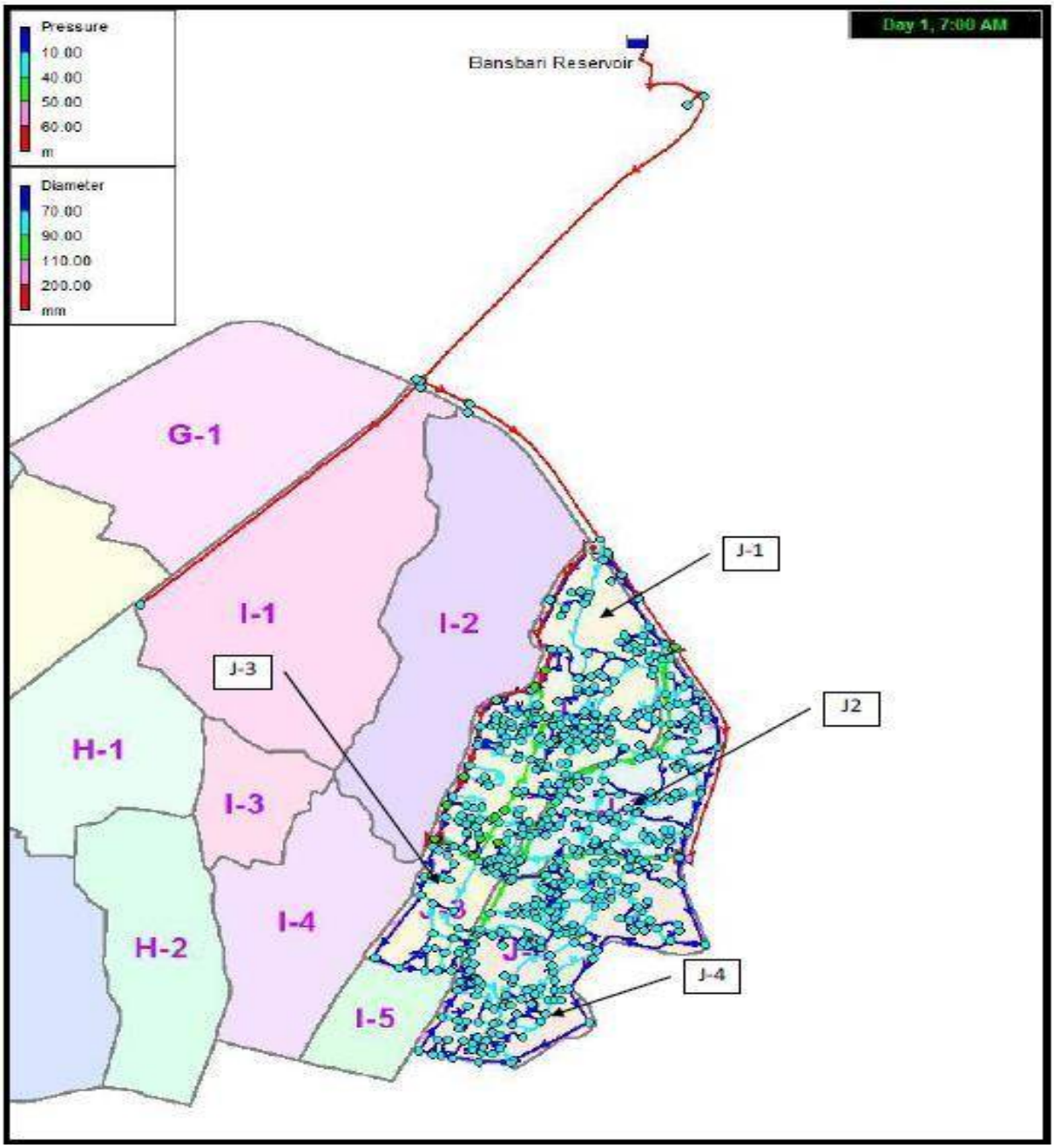


Table 6.27.Details of Pipe Design for DNI J (at peak time 7.00)

Link ID	Length	Diameter	Roughness	Material	Flow	Velocity	Unit Headloss	Friction Factor
	m	mm			LPS	m/s	m/km	
Pipe J001_J003	47.59852	150	110	DI	24.49	1.39	18.93	0.029
Pipe J002_J004	79.23446	150	110	DI	9.34	0.53	3.17	0.033
Pipe J003_J006	132.01	62.2	130	HDPE-PE 100 PN10	2.29	0.75	12.55	0.027
Pipe J004_J005	42.15	62.2	130	HDPE-PE 100 PN10	0.15	0.05	0.08	0.041
Pipe J004_J014	91.48203	150	110	DI	9.34	0.53	3.18	0.033
Pipe J006_J007	30.96021	62.2	130	HDPE-PE 100 PN10	0.37	0.12	0.43	0.035
Pipe J006_J008	11.51714	62.2	130	HDPE-PE 100 PN10	1.83	0.6	8.3	0.028
Pipe J008_J009	50.69401	62.2	130	HDPE-PE 100 PN10	0.4	0.13	0.5	0.035
Pipe J008_J010	23.02775	62.2	130	HDPE-PE 100 PN10	1.38	0.46	4.94	0.029
Pipe J010_J048	178.0226	62.2	130	HDPE-PE 100 PN10	0.88	0.29	2.14	0.031
Pipe J011_J010	58.32397	62.2	130	HDPE-PE 100 PN10	-0.32	0.1	0.32	0.036
Pipe J011_J013	30.49037	62.2	130	HDPE-PE 100 PN10	0.81	0.27	1.85	0.031
Pipe J012_J001	223.27	150	110	DI	-10.95	0.62	4.26	0.033
Pipe J012_J011	50.46	62.2	130	HDPE-PE 100 PN10	0.76	0.25	1.64	0.032
Pipe J015_J014	107.1203	150	110	DI	-9.34	0.53	3.17	0.033
Pipe J015_J017	36.92	62.2	130	HDPE-PE 100 PN10	1	0.33	2.73	0.03
Pipe J017_J018	50.18932	62.2	130	HDPE-PE 100 PN10	0.57	0.19	0.95	0.033
Pipe J017_J021	27.7415	62.2	130	HDPE-PE 100 PN10	0.28	0.09	0.25	0.037
Pipe J018_J019	13.40023	62.2	130	HDPE-PE 100 PN10	0.19	0.06	0.12	0.04
Pipe J018_J020	20.60757	62.2	130	HDPE-PE 100 PN10	0.31	0.1	0.31	0.036
Pipe J021_J023	50.24	62.2	130	HDPE-PE 100 PN10	-0.88	0.29	2.14	0.031
Pipe J021_J029	47.0265	62.2	130	HDPE-PE 100 PN10	1	0.33	2.73	0.031
Pipe J024_J023	4.552495	150	110	DI	-9.34	0.53	3.17	0.033

Pipe J024_J026	56	62.2	130	HDPE-PE 100 PN10	1.45	0.48	5.39	0.029
Pipe J025_J024	21.7	150	110	DI	-9.34	0.53	3.18	0.033
Pipe J026_J027	22.84482	62.2	130	HDPE-PE 100 PN10	-0.31	0.1	0.31	0.037
Pipe J027_J028	24.29686	62.2	130	HDPE-PE 100 PN10	0.14	0.05	0.07	0.042
Pipe J027_J029	47.01474	62.2	130	HDPE-PE 100 PN10	-0.58	0.19	0.97	0.033
Pipe J029_J030	7.953259	62.2	130	HDPE-PE 100 PN10	0.34	0.11	0.37	0.036
Pipe J030_J031	16.35682	62.2	130	HDPE-PE 100 PN10	0.08	0.02	0.02	0.036
Pipe J030_J032	23.87863	62.2	130	HDPE-PE 100 PN10	0.22	0.07	0.16	0.038
Pipe J032_J034	6.989521	62.2	130	HDPE-PE 100 PN10	0.1	0.03	0.04	0.051
Pipe J033_J032	17.19774	62.2	130	HDPE-PE 100 PN10	-0.07	0.02	0.02	0.036
Pipe J035_J026	42.39307	62.2	130	HDPE-PE 100 PN10	-1.64	0.54	6.75	0.028
Pipe J035_J036	22.9921	62.2	130	HDPE-PE 100 PN10	0.48	0.16	0.69	0.034
Pipe J037_J035	67.01961	62.2	130	HDPE-PE 100 PN10	-1.01	0.33	2.74	0.03
Pipe J037_J039	83.53261	62.2	130	HDPE-PE 100 PN10	0.42	0.14	0.54	0.035
Pipe J038_J037	101.5319	62.2	130	HDPE-PE 100 PN10	-0.19	0.06	0.13	0.039
Pipe J039_J041	40.42396	62.2	130	HDPE-PE 100 PN10	-0.26	0.08	0.22	0.037
Pipe J040_J039	35.84138	62.2	130	HDPE-PE 100 PN10	-0.17	0.06	0.11	0.04
Pipe J041_J121	85.52	62.2	130	HDPE-PE 100 PN10	-0.65	0.21	1.22	0.033
Pipe J042_J041	51.16	62.2	130	HDPE-PE 100 PN10	-0.03	0.01	0	0.036
Pipe J042_J053	34.20503	62.2	130	HDPE-PE 100 PN10	0.84	0.28	1.95	0.031
Pipe J042_J121	74.63424	62.2	130	HDPE-PE 100 PN10	-0.83	0.27	1.9	0.031
Pipe J043_J042	3.879301	62.2	130	HDPE-PE 100 PN10	0.17	0.06	0.12	0.043
Pipe J043_J044	25.16	62.2	130	HDPE-PE 100 PN10	0.13	0.04	0.07	0.041
Pipe J045_J043	55.87	62.2	130	HDPE-PE 100 PN10	0.23	0.07	0.17	0.038
Pipe J045_J047	29.65	62.2	130	HDPE-PE 100 PN10	0.15	0.05	0.09	0.04
Pipe	3.784307	62.2	130	HDPE-PE 100	0.35	0.12	0.39	0.036

J046_J045				PN10				
Pipe J046_J050	109.0594	62.2	130	HDPE-PE 100 PN10	-0.59	0.2	1.03	0.033
Pipe J048_J046	86.08783	62.2	130	HDPE-PE 100 PN10	0.06	0.02	0.01	0.049
Pipe J048_J049	80.38	62.2	130	HDPE-PE 100 PN10	0.43	0.14	0.57	0.035
Pipe J050_J052	33.95	62.2	130	HDPE-PE 100 PN10	-0.69	0.23	1.35	0.032
Pipe J051_J050	99.84	62.2	130	HDPE-PE 100 PN10	0.54	0.18	0.86	0.033
Pipe J051_J052	76.87	150	110	DI	-10.95	0.62	4.26	0.033
Pipe J052_J012	174.2544	150	110	DI	-10.95	0.62	4.26	0.033
Pipe J053_J054	15.68656	62.2	130	HDPE-PE 100 PN10	0.21	0.07	0.15	0.038
Pipe J053_J055	62.80594	62.2	130	HDPE-PE 100 PN10	0.42	0.14	0.55	0.035
Pipe J056_J057	22.32	62.2	130	HDPE-PE 100 PN10	1.11	0.37	3.29	0.03
Pipe J056_J059	50.73941	150	110	DI	8.69	0.49	2.77	0.034
Pipe J057_J058	52.02464	62.2	130	HDPE-PE 100 PN10	0.35	0.11	0.38	0.036
Pipe J057_J062	62.64671	62.2	130	HDPE-PE 100 PN10	0.57	0.19	0.95	0.033
Pipe J059_J060	35.04526	150	110	DI	8.69	0.49	2.77	0.034
Pipe J060_J077	17.74694	150	110	DI	8.69	0.49	2.78	0.034
Pipe J061_J059	43.9	62.2	130	HDPE-PE 100 PN10	-0.19	0.06	0.13	0.039
Pipe J061_J060	48.4	62.2	130	HDPE-PE 100 PN10	0.46	0.15	0.65	0.034
Pipe J062_J061	25.44024	62.2	130	HDPE-PE 100 PN10	0.45	0.15	0.6	0.034
Pipe J062_J075	59.69642	62.2	130	HDPE-PE 100 PN10	0.7	0.23	1.41	0.032
Pipe J063_J062	30.10864	62.2	130	HDPE-PE 100 PN10	0.75	0.25	1.58	0.032
Pipe J063_J570	174.67	62.2	130	HDPE-PE 100 PN10	-1.84	0.6	8.34	0.028
Pipe J064_J025	162.62	62.2	130	HDPE-PE 100 PN10	-1.66	0.54	6.89	0.028
Pipe J064_J065	73.79957	62.2	130	HDPE-PE 100 PN10	0.81	0.27	1.81	0.031
Pipe J064_J072	106.0792	62.2	130	HDPE-PE 100 PN10	0.51	0.17	0.78	0.034
Pipe J065_J066	28.43803	62.2	130	HDPE-PE 100 PN10	0.24	0.08	0.19	0.037

Pipe J065_J069	25.53384	62.2	130	HDPE-PE 100 PN10	0.13	0.04	0.06	0.041
Pipe J067_J065	35.56685	62.2	130	HDPE-PE 100 PN10	-0.17	0.06	0.1	0.04
Pipe J068_J067	25.06508	62.2	130	HDPE-PE 100 PN10	-0.1	0.03	0.04	0.047
Pipe J069_J067	23.84584	62.2	130	HDPE-PE 100 PN10	0.16	0.05	0.09	0.04
Pipe J070_J069	26.1784	62.2	130	HDPE-PE 100 PN10	0.14	0.04	0.06	0.038
Pipe J071_J070	67.68128	62.2	130	HDPE-PE 100 PN10	-0.24	0.08	0.19	0.037
Pipe J072_J070	43.87849	62.2	130	HDPE-PE 100 PN10	0.63	0.21	1.16	0.033
Pipe J073_J063	61.8102	62.2	130	HDPE-PE 100 PN10	-0.91	0.3	2.26	0.031
Pipe J073_J074	42.23245	62.2	130	HDPE-PE 100 PN10	0.26	0.08	0.22	0.037
Pipe J074_J075	22.55323	62.2	130	HDPE-PE 100 PN10	-0.51	0.17	0.77	0.034
Pipe J075_J076	15.49207	62.2	130	HDPE-PE 100 PN10	0.08	0.03	0.03	0.054
Pipe J077_J078	54.14	62.2	130	HDPE-PE 100 PN10	0.41	0.14	0.53	0.035
Pipe J077_J082	142.4862	150	110	DI	8.69	0.49	2.78	0.034
Pipe J079_J074	27.76058	62.2	130	HDPE-PE 100 PN10	-0.6	0.2	1.06	0.033
Pipe J080_J079A	23.56143	62.2	130	HDPE-PE 100 PN10	-0.25	0.08	0.2	0.037
Pipe J080_J079B	23.56143	62.2	130	HDPE-PE 100 PN10	-0.25	0.08	0.2	0.037
Pipe J080_J081	33.85352	62.2	130	HDPE-PE 100 PN10	0.27	0.09	0.25	0.038
Pipe J081_J555	70.00407	62.2	130	HDPE-PE 100 PN10	-0.3	0.1	0.3	0.037
Pipe J082_J088	162.8	150	110	DI	8.69	0.49	2.78	0.034
Pipe J083_J081	39.74334	62.2	130	HDPE-PE 100 PN10	-0.29	0.09	0.27	0.037
Pipe J083_J082	109.02	62.2	130	HDPE-PE 100 PN10	-0.23	0.07	0.17	0.038
Pipe J083_J084	39.09254	62.2	130	HDPE-PE 100 PN10	0.2	0.07	0.14	0.039
Pipe J084_J097	54.14194	62.2	130	HDPE-PE 100 PN10	-0.27	0.09	0.25	0.037
Pipe J085_J084	6.165023	62.2	130	HDPE-PE 100 PN10	-0.36	0.12	0.39	0.034
Pipe J086_J085	45.20147	62.2	130	HDPE-PE 100 PN10	0.16	0.05	0.09	0.04
Pipe	21.79392	62.2	130	HDPE-PE 100	0.48	0.16	0.69	0.034

J086_J087				PN10				
Pipe J088_J086	68.06442	62.2	130	HDPE-PE 100 PN10	0.9	0.3	2.21	0.031
Pipe J089_J088	57.87232	62.2	130	HDPE-PE 100 PN10	-0.81	0.27	1.84	0.031
Pipe J089_J090	13.5436	62.2	130	HDPE-PE 100 PN10	0.19	0.06	0.12	0.037
Pipe J091_J089	17.51793	62.2	130	HDPE-PE 100 PN10	-0.39	0.13	0.48	0.035
Pipe J091_J092	12.95862	62.2	130	HDPE-PE 100 PN10	0.18	0.06	0.11	0.039
Pipe J093_J091	60.2636	62.2	130	HDPE-PE 100 PN10	-0.16	0.05	0.09	0.039
Pipe J093_J094	16.04306	62.2	130	HDPE-PE 100 PN10	0.63	0.21	1.16	0.033
Pipe J094_J095	2.441487	62.2	130	HDPE-PE 100 PN10	0.61	0.2	1.1	0.034
Pipe J095_J096	17.19016	62.2	130	HDPE-PE 100 PN10	0.56	0.18	0.92	0.033
Pipe J095_J213	146.1551	62.2	130	HDPE-PE 100 PN10	-0.07	0.02	0.02	0.045
Pipe J097_J094	146.2119	62.2	130	HDPE-PE 100 PN10	0.01	0	0	0
Pipe J097_J101	30.6731	62.2	130	HDPE-PE 100 PN10	-0.6	0.2	1.04	0.033
Pipe J099_J085	16.09323	62.2	130	HDPE-PE 100 PN10	-0.46	0.15	0.66	0.034
Pipe J099_J098	9.38219	62.2	130	HDPE-PE 100 PN10	0.12	0.04	0.05	0.034
Pipe J099_J100	7.754971	62.2	130	HDPE-PE 100 PN10	0.3	0.1	0.29	0.035
Pipe J101_J212	151.0969	62.2	130	HDPE-PE 100 PN10	-0.97	0.32	2.57	0.031
Pipe J102_J072	134.0324	62.2	130	HDPE-PE 100 PN10	0.24	0.08	0.2	0.038
Pipe J102_J104	18.67611	62.2	130	HDPE-PE 100 PN10	-0.77	0.25	1.66	0.032
Pipe J103_J102	42.2351	62.2	130	HDPE-PE 100 PN10	-0.35	0.11	0.38	0.036
Pipe J104_J106	79.87	62.2	130	HDPE-PE 100 PN10	-0.56	0.18	0.93	0.033
Pipe J105_J104	57.93385	62.2	130	HDPE-PE 100 PN10	0.67	0.22	1.28	0.032
Pipe J106_J105	64.30026	62.2	130	HDPE-PE 100 PN10	0.02	0.01	0	0.072
Pipe J106_J209	142.68	62.2	130	HDPE-PE 100 PN10	-1.01	0.33	2.78	0.03
Pipe J107_J105	53.30042	62.2	130	HDPE-PE 100 PN10	0.98	0.32	2.59	0.031
Pipe J107_J108	25.85854	62.2	130	HDPE-PE 100 PN10	0.09	0.03	0.03	0.04

Pipe J109_J107	28.13328	62.2	130	HDPE-PE 100 PN10	1.25	0.41	4.11	0.03
Pipe J109_J110	44.87817	62.2	130	HDPE-PE 100 PN10	-1.11	0.36	3.27	0.03
Pipe J109_J142	16.77833	62.2	130	HDPE-PE 100 PN10	-0.23	0.08	0.18	0.038
Pipe J110_J111	22.24742	62.2	130	HDPE-PE 100 PN10	0.29	0.1	0.27	0.037
Pipe J110_J130	4.55	62.2	130	HDPE-PE 100 PN10	-1.46	0.48	5.43	0.029
Pipe J111_J112	17.19122	62.2	130	HDPE-PE 100 PN10	0.08	0.03	0.03	0.044
Pipe J111_J113	17.95147	62.2	130	HDPE-PE 100 PN10	0.15	0.05	0.07	0.038
Pipe J113_J114	6.307511	62.2	130	HDPE-PE 100 PN10	0.11	0.04	0.05	0.041
Pipe J113_J115	7.461626	62.2	130	HDPE-PE 100 PN10	0.02	0.01	0	0
Pipe J116_J130	27.20673	62.2	130	HDPE-PE 100 PN10	-1.64	0.54	6.78	0.028
Pipe J117_J116	52.62	62.2	130	HDPE-PE 100 PN10	-0.64	0.21	1.19	0.033
Pipe J117_J119	48.02511	62.2	130	HDPE-PE 100 PN10	0.14	0.05	0.07	0.04
Pipe J118_J117	22.36373	62.2	130	HDPE-PE 100 PN10	-0.37	0.12	0.42	0.035
Pipe J120_J116	14.92	62.2	130	HDPE-PE 100 PN10	-1.56	0.51	6.17	0.029
Pipe J121_J120	6.812697	62.2	130	HDPE-PE 100 PN10	-0.98	0.32	2.62	0.031
Pipe J122_J120	28.1066	62.2	130	HDPE-PE 100 PN10	-0.53	0.17	0.84	0.033
Pipe J122_J123	13.95248	62.2	130	HDPE-PE 100 PN10	0.21	0.07	0.14	0.037
Pipe J124_J122	38.2892	62.2	130	HDPE-PE 100 PN10	-0.24	0.08	0.19	0.037
Pipe J124_J150	44.02442	62.2	130	HDPE-PE 100 PN10	0.67	0.22	1.29	0.032
Pipe J125_J124	12.63515	62.2	130	HDPE-PE 100 PN10	0.58	0.19	0.98	0.033
Pipe J125_J126	36.54529	62.2	130	HDPE-PE 100 PN10	0.07	0.02	0.02	0.043
Pipe J126_J127	7.774192	62.2	130	HDPE-PE 100 PN10	0.03	0.01	0	0
Pipe J128_J125	26.28862	62.2	130	HDPE-PE 100 PN10	0.72	0.24	1.48	0.032
Pipe J128_J129	30.73612	62.2	130	HDPE-PE 100 PN10	0.06	0.02	0.01	0.046
Pipe J130_J131	24.38602	62.2	130	HDPE-PE 100 PN10	1.87	0.61	8.61	0.028
Pipe	22.12202	62.2	130	HDPE-PE 100	0.87	0.29	2.09	0.031

J131_J128				PN10				
Pipe J132_J131	39.95696	62.2	130	HDPE-PE 100 PN10	-0.92	0.3	2.32	0.031
Pipe J132_J138	37.86145	62.2	130	HDPE-PE 100 PN10	0.56	0.19	0.93	0.033
Pipe J133_J132	25.12221	62.2	130	HDPE-PE 100 PN10	-0.26	0.09	0.22	0.037
Pipe J133_J134	9.665775	62.2	130	HDPE-PE 100 PN10	0.07	0.02	0.03	0.073
Pipe J135_J133	21.18198	62.2	130	HDPE-PE 100 PN10	-0.16	0.05	0.09	0.041
Pipe J135_J136	20.66259	62.2	130	HDPE-PE 100 PN10	0.04	0.01	0.01	0.05
Pipe J137_J135	30.17481	62.2	130	HDPE-PE 100 PN10	-0.05	0.02	0.01	0.045
Pipe J138_J139	3.138117	62.2	130	HDPE-PE 100 PN10	0.46	0.15	0.66	0.036
Pipe J138_J140	68.77	62.2	130	HDPE-PE 100 PN10	0.69	0.23	1.35	0.032
Pipe J139_J144	52.08244	62.2	130	HDPE-PE 100 PN10	0.64	0.21	1.18	0.033
Pipe J139_J207	47.931	62.2	130	HDPE-PE 100 PN10	-0.35	0.11	0.38	0.036
Pipe J140_J141	11.98552	62.2	130	HDPE-PE 100 PN10	0.06	0.02	0.01	0.037
Pipe J140_J142	22.64745	62.2	130	HDPE-PE 100 PN10	0.55	0.18	0.89	0.033
Pipe J142_J143	15.10492	62.2	130	HDPE-PE 100 PN10	0.26	0.09	0.24	0.038
Pipe J144_J145	11.45613	62.2	130	HDPE-PE 100 PN10	0.06	0.02	0.01	0.035
Pipe J144_J146	5.808834	62.2	130	HDPE-PE 100 PN10	0.5	0.16	0.74	0.033
Pipe J146_J170	8.183704	62.2	130	HDPE-PE 100 PN10	0.79	0.26	1.75	0.032
Pipe J147_J146	61.71311	62.2	130	HDPE-PE 100 PN10	0.31	0.1	0.3	0.036
Pipe J147_J148	21.15769	62.2	130	HDPE-PE 100 PN10	0.06	0.02	0.02	0.057
Pipe J149_J147	21.00603	62.2	130	HDPE-PE 100 PN10	0.49	0.16	0.73	0.034
Pipe J150_J149	11.67518	62.2	130	HDPE-PE 100 PN10	0.46	0.15	0.65	0.034
Pipe J150_J151	15.40101	62.2	130	HDPE-PE 100 PN10	0.15	0.05	0.08	0.037
Pipe J152_J149	24.05178	62.2	130	HDPE-PE 100 PN10	0.08	0.03	0.02	0.048
Pipe J152_J153	6.08764	62.2	130	HDPE-PE 100 PN10	-0.94	0.31	2.4	0.031
Pipe J153_J154	44.06715	62.2	130	HDPE-PE 100 PN10	-0.72	0.24	1.48	0.032

Pipe J155_J051	65.51665	150	110	DI	-10.95	0.62	4.26	0.033
Pipe J155_J154	71.69	62.2	130	HDPE-PE 100 PN10	1.46	0.48	5.43	0.029
Pipe J156_J155	14.95	150	110	DI	-10.95	0.62	4.26	0.033
Pipe J156_J188	105.17	150	110	DI	4.31	0.24	0.76	0.037
Pipe J157_J156	81.99	62.2	130	HDPE-PE 100 PN10	-1.82	0.6	8.2	0.028
Pipe J157_J189	48.67988	62.2	130	HDPE-PE 100 PN10	0.09	0.03	0.03	0.046
Pipe J158_J157	7.57536	62.2	130	HDPE-PE 100 PN10	-1.62	0.53	6.64	0.028
Pipe J158_J159	19.45395	62.2	130	HDPE-PE 100 PN10	0.57	0.19	0.96	0.033
Pipe J159_J154	29.01185	62.2	130	HDPE-PE 100 PN10	-0.48	0.16	0.7	0.034
Pipe J160_J153	25.74636	62.2	130	HDPE-PE 100 PN10	0.29	0.1	0.28	0.037
Pipe J160_J159	13.876	62.2	130	HDPE-PE 100 PN10	-1	0.33	2.7	0.031
Pipe J161_J160	10.65548	62.2	130	HDPE-PE 100 PN10	-0.68	0.22	1.33	0.032
Pipe J161_J162	9.960133	62.2	130	HDPE-PE 100 PN10	0.07	0.02	0.01	0.037
Pipe J163_J158	36.50127	62.2	130	HDPE-PE 100 PN10	-1	0.33	2.7	0.031
Pipe J163_J161	30.0336	62.2	130	HDPE-PE 100 PN10	-0.57	0.19	0.94	0.033
Pipe J164_J163	16.2384	62.2	130	HDPE-PE 100 PN10	-1.48	0.49	5.56	0.029
Pipe J164_J165	15.17549	62.2	130	HDPE-PE 100 PN10	0.1	0.03	0.04	0.043
Pipe J166_J164	8.448836	62.2	130	HDPE-PE 100 PN10	-1.34	0.44	4.67	0.029
Pipe J167_J166	7.984089	62.2	130	HDPE-PE 100 PN10	-0.68	0.22	1.3	0.032
Pipe J167_J168	53.97273	62.2	130	HDPE-PE 100 PN10	-0.51	0.17	0.77	0.034
Pipe J168_J152	65.01188	62.2	130	HDPE-PE 100 PN10	-0.81	0.27	1.83	0.031
Pipe J169_J168	11.48718	62.2	130	HDPE-PE 100 PN10	-0.17	0.06	0.1	0.039
Pipe J170_J169	31.74315	62.2	130	HDPE-PE 100 PN10	0.9	0.3	2.25	0.031
Pipe J170_J204	78.10449	62.2	130	HDPE-PE 100 PN10	-0.27	0.09	0.23	0.037
Pipe J171_J167	19.47538	62.2	130	HDPE-PE 100 PN10	-1.13	0.37	3.37	0.03
Pipe	36.83058	62.2	130	HDPE-PE 100	0.9	0.29	2.21	0.031

J171_J173				PN10				
Pipe J172_J171	9.589584	62.2	130	HDPE-PE 100 PN10	-0.17	0.06	0.09	0.037
Pipe J173_J175	18.87904	62.2	130	HDPE-PE 100 PN10	0.68	0.22	1.32	0.032
Pipe J174_J173	27.33052	62.2	130	HDPE-PE 100 PN10	-0.11	0.04	0.04	0.04
Pipe J175_J176	29.61324	62.2	130	HDPE-PE 100 PN10	0.46	0.15	0.64	0.034
Pipe J176_J177	68.3	62.2	130	HDPE-PE 100 PN10	0.2	0.07	0.14	0.038
Pipe J176_J191	54.15359	62.2	130	HDPE-PE 100 PN10	-0.14	0.05	0.07	0.042
Pipe J177_J178	13.42	150	110	DI	-4.31	0.24	0.75	0.037
Pipe J177_J194	77.30759	150	110	DI	4.31	0.24	0.76	0.038
Pipe J178_J175	78.92	62.2	130	HDPE-PE 100 PN10	-0.08	0.03	0.02	0.043
Pipe J178_J179	51.54374	150	110	DI	-4.31	0.24	0.76	0.038
Pipe J179_J180	34.74	62.2	130	HDPE-PE 100 PN10	0.08	0.03	0.03	0.041
Pipe J179_J188	111.52	150	110	DI	-4.31	0.24	0.76	0.038
Pipe J180_J182	17.64307	62.2	130	HDPE-PE 100 PN10	-0.28	0.09	0.26	0.037
Pipe J181_J180	39.93281	62.2	130	HDPE-PE 100 PN10	-0.23	0.07	0.17	0.038
Pipe J182_J183	13.70574	62.2	130	HDPE-PE 100 PN10	0.04	0.01	0.01	0.062
Pipe J182_J184	19.17595	62.2	130	HDPE-PE 100 PN10	-0.37	0.12	0.42	0.035
Pipe J184_J185	19.0526	62.2	130	HDPE-PE 100 PN10	0.07	0.02	0.02	0.037
Pipe J184_J186	23.69683	62.2	130	HDPE-PE 100 PN10	-0.48	0.16	0.69	0.034
Pipe J186_J166	35.02509	62.2	130	HDPE-PE 100 PN10	-0.64	0.21	1.18	0.032
Pipe J186_J187	18.53339	62.2	130	HDPE-PE 100 PN10	0.08	0.03	0.02	0.047
Pipe J188_J189	55.79	62.2	130	HDPE-PE 100 PN10	0.28	0.09	0.25	0.037
Pipe J189_J190	19.76155	62.2	130	HDPE-PE 100 PN10	0.11	0.04	0.05	0.042
Pipe J191_J192	12.02837	62.2	130	HDPE-PE 100 PN10	0.37	0.12	0.45	0.036
Pipe J191_J193	40.58	62.2	130	HDPE-PE 100 PN10	-0.68	0.22	1.31	0.032
Pipe J193_J169	74.81283	62.2	130	HDPE-PE 100 PN10	-0.92	0.3	2.32	0.031

Pipe J194_J195	42.35531	150	110	DI	4.31	0.24	0.76	0.038
Pipe J195_J196	51.55	62.2	130	HDPE-PE 100 PN10	0.64	0.21	1.19	0.033
Pipe J196_J198	18.408	62.2	130	HDPE-PE 100 PN10	0.11	0.04	0.05	0.047
Pipe J196_J595	16.47273	62.2	130	HDPE-PE 100 PN10	0.34	0.11	0.37	0.036
Pipe J198_J194	180.43	62.2	130	HDPE-PE 100 PN10	-0.35	0.12	0.39	0.036
Pipe J198_J199	10.99835	62.2	130	HDPE-PE 100 PN10	0.35	0.12	0.39	0.036
Pipe J200_J201	7.98752	62.2	130	HDPE-PE 100 PN10	-0.1	0.03	0.04	0.04
Pipe J201_J204	10.45388	62.2	130	HDPE-PE 100 PN10	-0.16	0.05	0.09	0.036
Pipe J202_J201	22.47692	62.2	130	HDPE-PE 100 PN10	0	0	0	0
Pipe J202_J203	6.984822	62.2	130	HDPE-PE 100 PN10	0.23	0.08	0.19	0.041
Pipe J205_J202	26.30302	62.2	130	HDPE-PE 100 PN10	0.3	0.1	0.28	0.037
Pipe J205_J204	9.971543	62.2	130	HDPE-PE 100 PN10	0.46	0.15	0.66	0.035
Pipe J206_J205	59.82103	62.2	130	HDPE-PE 100 PN10	0.89	0.29	2.19	0.031
Pipe J207_J206	38.60511	62.2	130	HDPE-PE 100 PN10	-0.72	0.24	1.49	0.032
Pipe J207_J208	15.85055	62.2	130	HDPE-PE 100 PN10	0.18	0.06	0.11	0.041
Pipe J209_J206	25.64507	62.2	130	HDPE-PE 100 PN10	1.76	0.58	7.71	0.028
Pipe J210_J211	32.68203	62.2	130	HDPE-PE 100 PN10	0.2	0.06	0.13	0.039
Pipe J212_J210	78.792	62.2	130	HDPE-PE 100 PN10	1.56	0.51	6.19	0.029
Pipe J212_J213	50.85747	62.2	130	HDPE-PE 100 PN10	1.83	0.6	8.26	0.028
Pipe J213_J214	41.95092	62.2	130	HDPE-PE 100 PN10	1.43	0.47	5.22	0.029
Pipe J214_J215	52.10933	62.2	130	HDPE-PE 100 PN10	0.52	0.17	0.8	0.034
Pipe J214_J216	82.40269	62.2	130	HDPE-PE 100 PN10	0.57	0.19	0.97	0.033
Pipe J216_J217	41.57671	62.2	130	HDPE-PE 100 PN10	0.19	0.06	0.13	0.039
Pipe J216_J218	8.025379	62.2	130	HDPE-PE 100 PN10	0.22	0.07	0.17	0.04
Pipe J218_J233	46.66102	62.2	130	HDPE-PE 100 PN10	0.26	0.09	0.23	0.037
Pipe	29.02905	62.2	130	HDPE-PE 100	0.15	0.05	0.08	0.043

J219_J218				PN10				
Pipe J219_J220	31.01823	62.2	130	HDPE-PE 100 PN10	0.21	0.07	0.15	0.039
Pipe J221_J219	33.93942	62.2	130	HDPE-PE 100 PN10	0.52	0.17	0.8	0.034
Pipe J221_J222	22.15173	62.2	130	HDPE-PE 100 PN10	0.11	0.04	0.05	0.04
Pipe J223_J221	28.81321	62.2	130	HDPE-PE 100 PN10	0.76	0.25	1.63	0.032
Pipe J223_J224	59.9054	62.2	130	HDPE-PE 100 PN10	-1.47	0.48	5.55	0.029
Pipe J223_J226	87.68358	62.2	130	HDPE-PE 100 PN10	0.47	0.16	0.67	0.034
Pipe J224_J093	62.06755	62.2	130	HDPE-PE 100 PN10	0.71	0.23	1.45	0.032
Pipe J224_J225	31.50018	62.2	130	HDPE-PE 100 PN10	0.24	0.08	0.19	0.038
Pipe J226_J229	49.36712	62.2	130	HDPE-PE 100 PN10	0.16	0.05	0.09	0.04
Pipe J227_J226	31.44097	62.2	130	HDPE-PE 100 PN10	-0.21	0.07	0.15	0.038
Pipe J227_J228	11.03694	62.2	130	HDPE-PE 100 PN10	0.14	0.04	0.08	0.049
Pipe J229_J227	31.21179	62.2	130	HDPE-PE 100 PN10	0.02	0.01	0	0
Pipe J229_J230	39.10537	62.2	130	HDPE-PE 100 PN10	0.02	0.01	0	0
Pipe J230_J235	52.92987	62.2	130	HDPE-PE 100 PN10	-0.63	0.21	1.14	0.033
Pipe J231_J230	15.67069	62.2	130	HDPE-PE 100 PN10	-0.48	0.16	0.7	0.034
Pipe J231_J232	19.1876	62.2	130	HDPE-PE 100 PN10	0.14	0.05	0.07	0.038
Pipe J233_J231	74.38652	62.2	130	HDPE-PE 100 PN10	-0.22	0.07	0.17	0.038
Pipe J233_J234	40.25237	62.2	130	HDPE-PE 100 PN10	0.23	0.07	0.17	0.038
Pipe J235_J236	58.34682	62.2	130	HDPE-PE 100 PN10	0.3	0.1	0.29	0.036
Pipe J237_J560	103.1332	62.2	130	HDPE-PE 100 PN10	-0.01	0	0	0
Pipe J238_J235	106.1249	62.2	130	HDPE-PE 100 PN10	0.27	0.09	0.24	0.037
Pipe J238_J237	2.1358	62.2	130	HDPE-PE 100 PN10	-1.31	0.43	4.46	0.029
Pipe J239_J238	94.67766	62.2	130	HDPE-PE 100 PN10	-0.74	0.24	1.55	0.032
Pipe J239_J241	27.61991	62.2	130	HDPE-PE 100 PN10	0.39	0.13	0.46	0.035
Pipe J240_J239	33.33472	62.2	130	HDPE-PE 100 PN10	-0.26	0.09	0.22	0.037

Pipe J241_J242	39.9637	62.2	130	HDPE-PE 100 PN10	0.1	0.03	0.03	0.04
Pipe J241_J243	12.98621	62.2	130	HDPE-PE 100 PN10	0.21	0.07	0.15	0.036
Pipe J243_J244	15.3115	62.2	130	HDPE-PE 100 PN10	0.06	0.02	0.02	0.066
Pipe J243_J245	16.20379	62.2	130	HDPE-PE 100 PN10	0.11	0.04	0.05	0.044
Pipe J245_J246	41.08393	62.2	130	HDPE-PE 100 PN10	0.16	0.05	0.09	0.04
Pipe J247_J245	29.96868	62.2	130	HDPE-PE 100 PN10	0.18	0.06	0.11	0.04
Pipe J247_J249	73.59974	62.2	130	HDPE-PE 100 PN10	-0.6	0.2	1.05	0.033
Pipe J248_J247	42.18314	62.2	130	HDPE-PE 100 PN10	-0.21	0.07	0.15	0.039
Pipe J249_J250	49.42515	62.2	130	HDPE-PE 100 PN10	0.29	0.09	0.27	0.037
Pipe J252_J210	34.53009	62.2	130	HDPE-PE 100 PN10	-1.15	0.38	3.5	0.03
Pipe J252_J249	37.52964	62.2	130	HDPE-PE 100 PN10	0.96	0.32	2.52	0.031
Pipe J253_J252	32.0393	62.2	130	HDPE-PE 100 PN10	-0.16	0.05	0.09	0.041
Pipe J254_J209	12.7508	62.2	130	HDPE-PE 100 PN10	-1.68	0.55	7.08	0.028
Pipe J254_J255	24.32883	62.2	130	HDPE-PE 100 PN10	0.12	0.04	0.06	0.045
Pipe J256_J254	25.69919	62.2	130	HDPE-PE 100 PN10	-1.51	0.5	5.79	0.029
Pipe J256_J257	52.83304	62.2	130	HDPE-PE 100 PN10	0.22	0.07	0.16	0.038
Pipe J258_J256	26.35687	62.2	130	HDPE-PE 100 PN10	-1.22	0.4	3.91	0.03
Pipe J258_J260	19.02786	62.2	130	HDPE-PE 100 PN10	0.83	0.27	1.94	0.031
Pipe J259_J258	47.42368	62.2	130	HDPE-PE 100 PN10	-0.27	0.09	0.25	0.037
Pipe J260_J295	141.81	62.2	130	HDPE-PE 100 PN10	-0.18	0.06	0.12	0.039
Pipe J261_J260	98.15178	62.2	130	HDPE-PE 100 PN10	-0.87	0.29	2.09	0.031
Pipe J261_J262	8.881318	62.2	130	HDPE-PE 100 PN10	0.23	0.08	0.18	0.039
Pipe J263_J193	121.464	62.2	130	HDPE-PE 100 PN10	-0.04	0.01	0.01	0.051
Pipe J263_J261	21.2118	62.2	130	HDPE-PE 100 PN10	-0.49	0.16	0.73	0.034
Pipe J264_J263	71.66008	62.2	130	HDPE-PE 100 PN10	-0.14	0.04	0.07	0.041
Pipe	41.5144	62.2	130	HDPE-PE 100	-0.41	0.13	0.52	0.035

J264_J298				PN10				
Pipe J265_J264	44.5036	62.2	130	HDPE-PE 100 PN10	-0.25	0.08	0.2	0.038
Pipe J265_J286	141.2526	62.2	130	HDPE-PE 100 PN10	-0.8	0.26	1.8	0.032
Pipe J266_J265	15.78905	62.2	130	HDPE-PE 100 PN10	-0.86	0.28	2.05	0.031
Pipe J266_J267	12.84309	62.2	130	HDPE-PE 100 PN10	0.11	0.04	0.05	0.044
Pipe J268_J266	53.89718	62.2	130	HDPE-PE 100 PN10	-0.66	0.22	1.26	0.032
Pipe J268_J269	21.1442	62.2	130	HDPE-PE 100 PN10	0.11	0.04	0.04	0.038
Pipe J270_J195	78.60306	150	110	DI	-4.31	0.24	0.76	0.037
Pipe J270_J268	126.45	62.2	130	HDPE-PE 100 PN10	-0.27	0.09	0.24	0.037
Pipe J271_J270	29.36781	150	110	DI	-4.31	0.24	0.76	0.038
Pipe J272_J271	54.72	62.2	130	HDPE-PE 100 PN10	-0.22	0.07	0.16	0.038
Pipe J273_J271	41.07248	150	110	DI	-4.31	0.24	0.76	0.038
Pipe J273_J274	42.44	62.2	130	HDPE-PE 100 PN10	0.81	0.27	1.82	0.032
Pipe J274_J275	23.59935	62.2	130	HDPE-PE 100 PN10	0.11	0.04	0.05	0.046
Pipe J274_J276	25.55683	62.2	130	HDPE-PE 100 PN10	0.52	0.17	0.8	0.034
Pipe J276_J277	23.79735	62.2	130	HDPE-PE 100 PN10	0.09	0.03	0.03	0.046
Pipe J276_J278	26.9126	62.2	130	HDPE-PE 100 PN10	0.35	0.11	0.38	0.035
Pipe J278_J279	24.83936	62.2	130	HDPE-PE 100 PN10	0.13	0.04	0.07	0.043
Pipe J278_J280	26.52553	62.2	130	HDPE-PE 100 PN10	0.13	0.04	0.06	0.041
Pipe J281_J273	83.95272	150	110	DI	-4.31	0.24	0.76	0.038
Pipe J282_J281	91	62.2	130	HDPE-PE 100 PN10	-1.16	0.38	3.55	0.03
Pipe J282_J283	58.49926	62.2	130	HDPE-PE 100 PN10	0.22	0.07	0.17	0.038
Pipe J284_J282	27.97323	62.2	130	HDPE-PE 100 PN10	-0.76	0.25	1.63	0.032
Pipe J284_J285	60.25916	62.2	130	HDPE-PE 100 PN10	0.21	0.07	0.15	0.038
Pipe J286_J284	10.85946	62.2	130	HDPE-PE 100 PN10	-0.43	0.14	0.56	0.035
Pipe J287_J286	62.69424	62.2	130	HDPE-PE 100 PN10	0.49	0.16	0.73	0.034

Pipe J287_J288	53.58345	62.2	130	HDPE-PE 100 PN10	0.2	0.07	0.14	0.039
Pipe J289_J287	35.04571	62.2	130	HDPE-PE 100 PN10	0.75	0.25	1.61	0.032
Pipe J290_J289	32.62806	62.2	130	HDPE-PE 100 PN10	-0.93	0.3	2.34	0.031
Pipe J290_J291	33.51798	62.2	130	HDPE-PE 100 PN10	0.13	0.04	0.06	0.043
Pipe J290_J292	61.96522	62.2	130	HDPE-PE 100 PN10	0.65	0.21	1.21	0.033
Pipe J292_J293	30.64996	62.2	130	HDPE-PE 100 PN10	0.18	0.06	0.11	0.038
Pipe J292_J294	13.65808	62.2	130	HDPE-PE 100 PN10	0.33	0.11	0.34	0.036
Pipe J294_J295	25.49783	62.2	130	HDPE-PE 100 PN10	-0.85	0.28	2	0.031
Pipe J296_J294	24.0338	62.2	130	HDPE-PE 100 PN10	-1.12	0.37	3.33	0.03
Pipe J296_J297	26.98918	62.2	130	HDPE-PE 100 PN10	0.17	0.06	0.1	0.038
Pipe J298_J296	48.31782	62.2	130	HDPE-PE 100 PN10	-0.82	0.27	1.86	0.031
Pipe J298_J299	16.79536	62.2	130	HDPE-PE 100 PN10	0.26	0.09	0.22	0.037
Pipe J300_J303	63.37	62.2	130	HDPE-PE 100 PN10	1.4	0.46	5.06	0.029
Pipe J301_J300	24.68285	150	110	DI	-3.18	0.18	0.43	0.039
Pipe J301_J302	29.43	62.2	130	HDPE-PE 100 PN10	0.2	0.07	0.14	0.038
Pipe J303_J304	35.09	62.2	130	HDPE-PE 100 PN10	0.2	0.06	0.14	0.04
Pipe J305_J303	90.53	62.2	130	HDPE-PE 100 PN10	-1	0.33	2.69	0.031
Pipe J306_J305	33.16457	62.2	130	HDPE-PE 100 PN10	0.56	0.19	0.94	0.033
Pipe J306_J307	42.56259	62.2	130	HDPE-PE 100 PN10	0.47	0.15	0.66	0.034
Pipe J308_J306	15.11164	62.2	130	HDPE-PE 100 PN10	1.15	0.38	3.51	0.03
Pipe J309_J308	35.05045	62.2	130	HDPE-PE 100 PN10	-0.06	0.02	0.01	0.044
Pipe J310_J308	11.58006	62.2	130	HDPE-PE 100 PN10	1.23	0.4	3.96	0.03
Pipe J310_J311	25.26291	62.2	130	HDPE-PE 100 PN10	0.06	0.02	0.01	0.043
Pipe J312_J310	55.51162	62.2	130	HDPE-PE 100 PN10	1.34	0.44	4.64	0.029
Pipe J313_J312	38.88684	62.2	130	HDPE-PE 100 PN10	-1.76	0.58	7.73	0.028
Pipe	25.91904	62.2	130	HDPE-PE 100	-0.09	0.03	0.03	0.041

J314_J313				PN10				
Pipe J315_J313	28.02054	62.2	130	HDPE-PE 100 PN10	-1.51	0.5	5.8	0.029
Pipe J316_J315	39.7642	62.2	130	HDPE-PE 100 PN10	-0.25	0.08	0.21	0.037
Pipe J317_J301	112.8337	150	110	DI	-3.18	0.18	0.43	0.039
Pipe J317_J318	64.53	62.2	130	HDPE-PE 100 PN10	1.18	0.39	3.67	0.03
Pipe J318_J319	16.39967	62.2	130	HDPE-PE 100 PN10	0.56	0.18	0.92	0.033
Pipe J320_J318	58.25162	62.2	130	HDPE-PE 100 PN10	-0.33	0.11	0.34	0.036
Pipe J321_J317	64.10006	150	110	DI	-3.18	0.18	0.43	0.039
Pipe J322_J321	146.95	62.2	130	HDPE-PE 100 PN10	-0.99	0.33	2.66	0.031
Pipe J322_J323	59.71755	62.2	130	HDPE-PE 100 PN10	0.65	0.22	1.23	0.032
Pipe J323_J324	6.022707	62.2	130	HDPE-PE 100 PN10	0.53	0.17	0.84	0.034
Pipe J324_J480	57.51877	62.2	130	HDPE-PE 100 PN10	0.04	0.01	0.01	0.042
Pipe J325_J323	40.75173	62.2	130	HDPE-PE 100 PN10	0.04	0.01	0.01	0.055
Pipe J325_J328	58.20317	62.2	130	HDPE-PE 100 PN10	-0.45	0.15	0.62	0.034
Pipe J326_J305	185.9273	62.2	130	HDPE-PE 100 PN10	-1.38	0.46	4.95	0.029
Pipe J326_J325	63.11158	62.2	130	HDPE-PE 100 PN10	-0.04	0.01	0.01	0.057
Pipe J327_J326	64.6913	62.2	130	HDPE-PE 100 PN10	-0.64	0.21	1.2	0.033
Pipe J328_J315	213.5511	62.2	130	HDPE-PE 100 PN10	-1.2	0.39	3.78	0.03
Pipe J328_J480	37.96001	62.2	130	HDPE-PE 100 PN10	0.61	0.2	1.09	0.033
Pipe J329_J330	36.52158	62.2	130	HDPE-PE 100 PN10	0.2	0.07	0.14	0.039
Pipe J329_J483	114.1083	62.2	130	HDPE-PE 100 PN10	2.36	0.78	13.23	0.027
Pipe J331_J329	8.281334	62.2	130	HDPE-PE 100 PN10	2.59	0.85	15.78	0.026
Pipe J331_J332	66.54307	62.2	130	HDPE-PE 100 PN10	-3.48	1.15	27.32	0.025
Pipe J332_J333	68.39	62.2	130	HDPE-PE 100 PN10	1.71	0.56	7.29	0.028
Pipe J333_J334	35.85	62.2	130	HDPE-PE 100 PN10	0.39	0.13	0.46	0.035
Pipe J335_J333	27.06767	62.2	130	HDPE-PE 100 PN10	-1.46	0.48	5.43	0.029

Pipe J336_J335	15.81	62.2	130	HDPE-PE 100 PN10	-0.23	0.08	0.18	0.038
Pipe J336_J337	22.69035	62.2	130	HDPE-PE 100 PN10	0.07	0.02	0.02	0.047
Pipe J338_J336	19.35374	62.2	130	HDPE-PE 100 PN10	-0.11	0.04	0.05	0.041
Pipe J339_J335	41.74043	62.2	130	HDPE-PE 100 PN10	-1.33	0.44	4.58	0.029
Pipe J339_J430	46.22815	62.2	130	HDPE-PE 100 PN10	1.16	0.38	3.54	0.03
Pipe J340_J339	57.16	62.2	130	HDPE-PE 100 PN10	0.01	0	0	0
Pipe J341_J340	15.36752	62.2	130	HDPE-PE 100 PN10	-0.05	0.02	0.02	0.074
Pipe J341_J352	46.67841	62.2	130	HDPE-PE 100 PN10	-0.06	0.02	0.02	0.054
Pipe J342_J341	24.47194	62.2	130	HDPE-PE 100 PN10	-0.04	0.01	0.01	0.054
Pipe J342_J343	56.2752	62.2	130	HDPE-PE 100 PN10	-0.23	0.08	0.18	0.038
Pipe J343_J348	37.58294	62.2	130	HDPE-PE 100 PN10	-0.33	0.11	0.35	0.036
Pipe J344_J343	28.42127	62.2	130	HDPE-PE 100 PN10	0.1	0.03	0.04	0.043
Pipe J344_J345	97.25215	62.2	130	HDPE-PE 100 PN10	0.33	0.11	0.34	0.036
Pipe J345_J332	130.37	62.2	130	HDPE-PE 100 PN10	-0.02	0.01	0	0.054
Pipe J346_J237	77.3065	62.2	130	HDPE-PE 100 PN10	1.37	0.45	4.87	0.029
Pipe J347_J344	10.08555	62.2	130	HDPE-PE 100 PN10	0.62	0.2	1.14	0.033
Pipe J347_J348	39.56755	62.2	130	HDPE-PE 100 PN10	-0.06	0.02	0.02	0.047
Pipe J348_J349	17.61778	62.2	130	HDPE-PE 100 PN10	-0.5	0.16	0.74	0.034
Pipe J349_J350	8.468322	62.2	130	HDPE-PE 100 PN10	0.13	0.04	0.05	0.037
Pipe J349_J355	27.30264	62.2	130	HDPE-PE 100 PN10	-0.68	0.22	1.31	0.032
Pipe J350_J351	35.79213	62.2	130	HDPE-PE 100 PN10	0.55	0.18	0.9	0.033
Pipe J350_J423	79.8078	62.2	130	HDPE-PE 100 PN10	-0.54	0.18	0.86	0.033
Pipe J351_J340	59.38526	62.2	130	HDPE-PE 100 PN10	0.12	0.04	0.06	0.041
Pipe J351_J354	32.01557	62.2	130	HDPE-PE 100 PN10	0.08	0.03	0.03	0.044
Pipe J352_J351	14.45847	62.2	130	HDPE-PE 100 PN10	-0.24	0.08	0.2	0.037
Pipe	23.97742	62.2	130	HDPE-PE 100	0.1	0.03	0.04	0.045

J352_J353				PN10				
Pipe J355_J356	22.17332	62.2	130	HDPE-PE 100 PN10	0.38	0.13	0.46	0.035
Pipe J355_J420	37.21382	62.2	130	HDPE-PE 100 PN10	-1.17	0.38	3.62	0.03
Pipe J356_J357	36.20283	62.2	130	HDPE-PE 100 PN10	0.16	0.05	0.09	0.039
Pipe J358_J347	29.70172	62.2	130	HDPE-PE 100 PN10	0.68	0.22	1.32	0.032
Pipe J358_J356	51.32596	62.2	130	HDPE-PE 100 PN10	-0.02	0.01	0	0.053
Pipe J359_J360	108.8262	62.2	130	HDPE-PE 100 PN10	-0.74	0.24	1.54	0.032
Pipe J359_J373	97.13876	62.2	130	HDPE-PE 100 PN10	0.37	0.12	0.42	0.035
Pipe J360_J364	162.02	62.2	130	HDPE-PE 100 PN10	0.31	0.1	0.31	0.036
Pipe J361_J360	100.7946	62.2	130	HDPE-PE 100 PN10	0.02	0.01	0	0.064
Pipe J361_J362	11.54677	62.2	130	HDPE-PE 100 PN10	0.3	0.1	0.28	0.037
Pipe J363_J361	96.60252	62.2	130	HDPE-PE 100 PN10	0.43	0.14	0.56	0.035
Pipe J363_J364	132.09	150	110	DI	2.2	0.12	0.22	0.041
Pipe J364_J365	10.48997	150	110	DI	2.2	0.12	0.23	0.043
Pipe J365_J394	89.89	150	110	DI	2.2	0.12	0.22	0.041
Pipe J366_J365	82.29	62.2	130	HDPE-PE 100 PN10	-0.69	0.23	1.38	0.032
Pipe J366_J393	59.73905	62.2	130	HDPE-PE 100 PN10	-0.47	0.16	0.68	0.034
Pipe J367_J366	6.667907	62.2	130	HDPE-PE 100 PN10	-0.98	0.32	2.63	0.031
Pipe J368_J367	21.819	62.2	130	HDPE-PE 100 PN10	-0.56	0.19	0.93	0.033
Pipe J368_J369	15.84337	62.2	130	HDPE-PE 100 PN10	0.23	0.08	0.19	0.038
Pipe J368_J370	18.47513	62.2	130	HDPE-PE 100 PN10	0.26	0.08	0.22	0.037
Pipe J371_J367	53.99636	62.2	130	HDPE-PE 100 PN10	-0.37	0.12	0.42	0.035
Pipe J371_J372	25.27028	62.2	130	HDPE-PE 100 PN10	0.3	0.1	0.28	0.036
Pipe J373_J371	14.41157	62.2	130	HDPE-PE 100 PN10	0.05	0.02	0.01	0.043
Pipe J373_J374	30.22329	62.2	130	HDPE-PE 100 PN10	0.18	0.06	0.12	0.039
Pipe J376_J375	31.2403	62.2	130	HDPE-PE 100 PN10	-0.99	0.33	2.66	0.031

Pipe J377_J376	27.51777	62.2	130	HDPE-PE 100 PN10	-0.17	0.06	0.1	0.039
Pipe J378_J376	11.93444	62.2	130	HDPE-PE 100 PN10	-0.75	0.25	1.57	0.032
Pipe J378_J379	26.0834	62.2	130	HDPE-PE 100 PN10	0.2	0.07	0.14	0.039
Pipe J380_J378	42.07621	62.2	130	HDPE-PE 100 PN10	-0.47	0.15	0.66	0.034
Pipe J380_J421	19.89636	62.2	130	HDPE-PE 100 PN10	1.12	0.37	3.31	0.03
Pipe J381_J380	9.669186	62.2	130	HDPE-PE 100 PN10	0.72	0.24	1.46	0.032
Pipe J381_J382	27.64427	62.2	130	HDPE-PE 100 PN10	0.14	0.05	0.07	0.04
Pipe J383_J381	44.29	62.2	130	HDPE-PE 100 PN10	0.96	0.32	2.51	0.031
Pipe J384_J383	57.11	62.2	130	HDPE-PE 100 PN10	1.73	0.57	7.44	0.028
Pipe J384_J385	33.53105	62.2	130	HDPE-PE 100 PN10	0.23	0.08	0.18	0.038
Pipe J386_J375	67.86	62.2	130	HDPE-PE 100 PN10	2.07	0.68	10.38	0.027
Pipe J386_J384	25.80614	62.2	130	HDPE-PE 100 PN10	2.12	0.7	10.86	0.027
Pipe J387_J388	25.97554	62.2	130	HDPE-PE 100 PN10	0.25	0.08	0.21	0.037
Pipe J387_J550	91.63298	62.2	130	HDPE-PE 100 PN10	0.02	0.01	0	0.058
Pipe J389_J386	24.90805	62.2	130	HDPE-PE 100 PN10	1.7	0.56	7.23	0.028
Pipe J390_J389	15.44003	62.2	130	HDPE-PE 100 PN10	-0.7	0.23	1.38	0.032
Pipe J390_J392	86.30934	62.2	130	HDPE-PE 100 PN10	0.29	0.09	0.27	0.037
Pipe J391_J390	40.14034	62.2	130	HDPE-PE 100 PN10	-0.26	0.09	0.22	0.037
Pipe J393_J387	95.14807	62.2	130	HDPE-PE 100 PN10	0.37	0.12	0.43	0.035
Pipe J394_J393	47.51	62.2	130	HDPE-PE 100 PN10	1.11	0.36	3.27	0.03
Pipe J395_J389	116.61	62.2	130	HDPE-PE 100 PN10	2.48	0.82	14.54	0.027
Pipe J396_J395	92.12666	150	110	DI	-13.04	0.74	5.89	0.032
Pipe J396_J397	37.77	62.2	130	HDPE-PE 100 PN10	0.31	0.1	0.3	0.036
Pipe J398_J396	225.99	150	110	DI	-13.04	0.74	5.89	0.032
Pipe J398_J399	102.17	150	110	DI	11.09	0.63	4.36	0.033
Pipe	2.05	62.2	130	HDPE-PE 100	2.08	0.69	10.53	0.027

J399_J400				PN10				
Pipe J400_J401	43.36151	62.2	130	HDPE-PE 100 PN10	0.36	0.12	0.42	0.035
Pipe J400_J402	55.10039	62.2	130	HDPE-PE 100 PN10	1.62	0.53	6.63	0.028
Pipe J402_J403	60.49691	62.2	130	HDPE-PE 100 PN10	0.81	0.27	1.83	0.031
Pipe J402_J404	31.21194	62.2	130	HDPE-PE 100 PN10	0.57	0.19	0.95	0.033
Pipe J404_J405	37.021	62.2	130	HDPE-PE 100 PN10	0.27	0.09	0.24	0.037
Pipe J404_J406	45.83093	62.2	130	HDPE-PE 100 PN10	0.02	0.01	0	0
Pipe J406_J408	48.84121	62.2	130	HDPE-PE 100 PN10	0.68	0.22	1.32	0.032
Pipe J406_J590	40.56921	62.2	130	HDPE-PE 100 PN10	0.48	0.16	0.69	0.034
Pipe J408_J409	33.74019	62.2	130	HDPE-PE 100 PN10	0.1	0.03	0.04	0.045
Pipe J410_J408	35.38769	62.2	130	HDPE-PE 100 PN10	-0.43	0.14	0.56	0.035
Pipe J411_J406	14.57771	62.2	130	HDPE-PE 100 PN10	1.29	0.42	4.33	0.029
Pipe J411_J412	63.59648	62.2	130	HDPE-PE 100 PN10	0.49	0.16	0.71	0.034
Pipe J413_J411	61.45095	62.2	130	HDPE-PE 100 PN10	1.97	0.65	9.46	0.028
Pipe J413_J414	24.73	62.2	130	HDPE-PE 100 PN10	-0.61	0.2	1.08	0.033
Pipe J414_J383	37.92435	62.2	130	HDPE-PE 100 PN10	-0.71	0.23	1.44	0.032
Pipe J414_J415	29.95	62.2	130	HDPE-PE 100 PN10	0.26	0.09	0.23	0.037
Pipe J416_J413	40.36936	62.2	130	HDPE-PE 100 PN10	0.69	0.23	1.36	0.032
Pipe J416_J417	23.90621	62.2	130	HDPE-PE 100 PN10	0.17	0.06	0.11	0.041
Pipe J418_J416	32.76128	62.2	130	HDPE-PE 100 PN10	0.98	0.32	2.63	0.031
Pipe J419_J418	30.39	62.2	130	HDPE-PE 100 PN10	-0.57	0.19	0.95	0.033
Pipe J420_J419	40.01631	62.2	130	HDPE-PE 100 PN10	-0.69	0.23	1.37	0.032
Pipe J421_J419	61.71319	62.2	130	HDPE-PE 100 PN10	0.24	0.08	0.19	0.038
Pipe J421_J420	47.8859	62.2	130	HDPE-PE 100 PN10	0.7	0.23	1.39	0.032
Pipe J422_J418	25.62942	62.2	130	HDPE-PE 100 PN10	1.08	0.35	3.1	0.03
Pipe J423_J422	39.97	62.2	130	HDPE-PE 100 PN10	-1.34	0.44	4.65	0.029

Pipe J423_J424	64.92795	62.2	130	HDPE-PE 100 PN10	0.57	0.19	0.95	0.033
Pipe J424_J425	27.6368	62.2	130	HDPE-PE 100 PN10	0.07	0.02	0.02	0.039
Pipe J424_J426	59.37185	62.2	130	HDPE-PE 100 PN10	0.24	0.08	0.19	0.038
Pipe J426_J427	4.1709	62.2	130	HDPE-PE 100 PN10	0.2	0.06	0.14	0.041
Pipe J426_J430	26.86	62.2	130	HDPE-PE 100 PN10	-0.03	0.01	0.01	0.063
Pipe J427_J428	20.25439	62.2	130	HDPE-PE 100 PN10	0.09	0.03	0.03	0.042
Pipe J427_J429	27.82478	62.2	130	HDPE-PE 100 PN10	0.05	0.02	0.01	0.04
Pipe J430_J431	18.45963	62.2	130	HDPE-PE 100 PN10	1.02	0.33	2.79	0.031
Pipe J431_J466	79.9485	62.2	130	HDPE-PE 100 PN10	1.95	0.64	9.3	0.028
Pipe J432_J431	32.94327	62.2	130	HDPE-PE 100 PN10	1.02	0.34	2.8	0.03
Pipe J432_J433	8.542363	62.2	130	HDPE-PE 100 PN10	0.31	0.1	0.31	0.036
Pipe J432_J436	17.70671	62.2	130	HDPE-PE 100 PN10	-1.38	0.46	4.94	0.029
Pipe J433_J434	26.17796	62.2	130	HDPE-PE 100 PN10	0.06	0.02	0.01	0.041
Pipe J433_J435	24.99741	62.2	130	HDPE-PE 100 PN10	0.19	0.06	0.13	0.038
Pipe J436_J437	25.04	62.2	130	HDPE-PE 100 PN10	0.26	0.09	0.23	0.037
Pipe J436_J438	23.91253	62.2	130	HDPE-PE 100 PN10	-1.43	0.47	5.24	0.029
Pipe J438_J439	8.59787	62.2	130	HDPE-PE 100 PN10	-2.41	0.79	13.76	0.027
Pipe J438_J442	32.47532	62.2	130	HDPE-PE 100 PN10	0.88	0.29	2.13	0.031
Pipe J439_J440	92.43879	62.2	130	HDPE-PE 100 PN10	-1.9	0.63	8.88	0.028
Pipe J439_J443	58.52427	62.2	130	HDPE-PE 100 PN10	-0.8	0.26	1.8	0.032
Pipe J440_J422	18.85212	62.2	130	HDPE-PE 100 PN10	-2.39	0.79	13.59	0.027
Pipe J441_J440	23.54514	62.2	130	HDPE-PE 100 PN10	-0.19	0.06	0.12	0.039
Pipe J442_J468	84.70767	62.2	130	HDPE-PE 100 PN10	2.25	0.74	12.15	0.027
Pipe J443_J442	42.94067	62.2	130	HDPE-PE 100 PN10	1.65	0.54	6.81	0.028
Pipe J443_J444	30.57	62.2	130	HDPE-PE 100 PN10	-2.72	0.89	17.25	0.026
Pipe	210.7875	150	110	DI	-11.09	0.63	4.36	0.033

J444_J399								
Pipe J445_J444	36.42629	150	110	DI	-4.28	0.24	0.75	0.038
Pipe J445_J580	123.7546	150	110	DI	4.28	0.24	0.75	0.038
Pipe J446_J445	141.17	62.2	130	HDPE-PE 100 PN10	-2.6	0.85	15.85	0.026
Pipe J447_J446	21.90609	62.2	130	HDPE-PE 100 PN10	-0.37	0.12	0.43	0.036
Pipe J448_J446	71.71681	62.2	130	HDPE-PE 100 PN10	-1.92	0.63	9.07	0.028
Pipe J448_J449	19.25778	62.2	130	HDPE-PE 100 PN10	0.18	0.06	0.12	0.041
Pipe J450_J461	2.067922	62.2	130	HDPE-PE 100 PN10	-2.03	0.67	10	0.027
Pipe J451_J450	43.54503	62.2	130	HDPE-PE 100 PN10	-1.52	0.5	5.89	0.029
Pipe J451_J452	15.13951	62.2	130	HDPE-PE 100 PN10	1.58	0.52	6.31	0.029
Pipe J452_J453	19.2509	62.2	130	HDPE-PE 100 PN10	1.06	0.35	3.04	0.03
Pipe J452_J454	36.77771	62.2	130	HDPE-PE 100 PN10	0.43	0.14	0.55	0.035
Pipe J454_J455	23.6661	62.2	130	HDPE-PE 100 PN10	0.09	0.03	0.03	0.041
Pipe J454_J456	31.81957	62.2	130	HDPE-PE 100 PN10	0.21	0.07	0.16	0.039
Pipe J457_J451	50.10101	62.2	130	HDPE-PE 100 PN10	0.19	0.06	0.13	0.039
Pipe J457_J458	49.85258	62.2	130	HDPE-PE 100 PN10	0.1	0.03	0.04	0.041
Pipe J459_J457	28.87546	62.2	130	HDPE-PE 100 PN10	0.88	0.29	2.13	0.031
Pipe J459_J460	65.47318	62.2	130	HDPE-PE 100 PN10	-0.97	0.32	2.55	0.031
Pipe J460_J450	34.75777	62.2	130	HDPE-PE 100 PN10	-0.45	0.15	0.62	0.035
Pipe J461_J448	23.0985	62.2	130	HDPE-PE 100 PN10	-1.59	0.52	6.39	0.029
Pipe J461_J462	25.48476	62.2	130	HDPE-PE 100 PN10	-0.49	0.16	0.71	0.034
Pipe J462_J460	49.55599	62.2	130	HDPE-PE 100 PN10	0.65	0.21	1.22	0.033
Pipe J462_J463	51.45411	62.2	130	HDPE-PE 100 PN10	-1.25	0.41	4.12	0.03
Pipe J463_J464	14.26836	62.2	130	HDPE-PE 100 PN10	-1.64	0.54	6.74	0.028
Pipe J464_J465	26.33975	62.2	130	HDPE-PE 100 PN10	0.49	0.16	0.72	0.034
Pipe J464_J468	137.0293	62.2	130	HDPE-PE 100 PN10	-2.43	0.8	13.99	0.027

Pipe J466_J470	22.99399	62.2	130	HDPE-PE 100 PN10	0.8	0.26	1.81	0.032
Pipe J467_J466	7.178972	62.2	130	HDPE-PE 100 PN10	-1.08	0.35	3.11	0.03
Pipe J468_J467	35.09163	62.2	130	HDPE-PE 100 PN10	-0.51	0.17	0.78	0.034
Pipe J469_J478	55.53836	62.2	130	HDPE-PE 100 PN10	0.06	0.02	0.02	0.052
Pipe J469_J479	43.10668	62.2	130	HDPE-PE 100 PN10	0.46	0.15	0.64	0.034
Pipe J470_J471	11.53108	62.2	130	HDPE-PE 100 PN10	0.7	0.23	1.41	0.032
Pipe J471_J472	10.65053	62.2	130	HDPE-PE 100 PN10	0.09	0.03	0.03	0.037
Pipe J471_J475	31.42065	62.2	130	HDPE-PE 100 PN10	0.53	0.18	0.85	0.033
Pipe J473_J467	41.29527	62.2	130	HDPE-PE 100 PN10	-0.39	0.13	0.48	0.035
Pipe J473_J470	27.25442	62.2	130	HDPE-PE 100 PN10	-0.05	0.02	0.01	0.05
Pipe J473_J474	20.20056	62.2	130	HDPE-PE 100 PN10	0.28	0.09	0.26	0.036
Pipe J475_J476	25.80904	62.2	130	HDPE-PE 100 PN10	0.08	0.03	0.02	0.041
Pipe J475_J477	79.67583	62.2	130	HDPE-PE 100 PN10	0.23	0.08	0.18	0.038
Pipe J477_J331	60.26034	62.2	130	HDPE-PE 100 PN10	-0.66	0.22	1.26	0.032
Pipe J477_J469	14.88271	62.2	130	HDPE-PE 100 PN10	0.71	0.23	1.44	0.032
Pipe J480_J481	26.71	62.2	130	HDPE-PE 100 PN10	0.43	0.14	0.57	0.035
Pipe J481_J537	86.88047	150	110	DI	0.76	0.04	0.03	0.047
Pipe J482_J481	26.64	62.2	130	HDPE-PE 100 PN10	-0.1	0.03	0.04	0.043
Pipe J483_J484	18.18884	62.2	130	HDPE-PE 100 PN10	0.3	0.1	0.29	0.036
Pipe J483_J485	26.02408	62.2	130	HDPE-PE 100 PN10	1.92	0.63	9.08	0.028
Pipe J485_J486	155.1522	62.2	130	HDPE-PE 100 PN10	0.61	0.2	1.08	0.033
Pipe J486_J488	16.58044	62.2	130	HDPE-PE 100 PN10	0.1	0.03	0.04	0.039
Pipe J486_J489	33.51513	62.2	130	HDPE-PE 100 PN10	0.17	0.06	0.1	0.039
Pipe J487_J486	5.673618	62.2	130	HDPE-PE 100 PN10	-0.27	0.09	0.24	0.037
Pipe J489_J463	43.0392	62.2	130	HDPE-PE 100 PN10	-0.23	0.08	0.18	0.038
Pipe	42.71159	62.2	130	HDPE-PE 100	0.16	0.05	0.09	0.041

J489_J490				PN10				
Pipe J491_J487	63.34357	62.2	130	HDPE-PE 100 PN10	-0.2	0.06	0.13	0.039
Pipe J491_J492	45.99269	62.2	130	HDPE-PE 100 PN10	1.42	0.47	5.18	0.029
Pipe J492_J459	80.50583	62.2	130	HDPE-PE 100 PN10	0.92	0.3	2.33	0.031
Pipe J492_J493	42.67677	62.2	130	HDPE-PE 100 PN10	0.25	0.08	0.2	0.037
Pipe J494_J491	10.18429	62.2	130	HDPE-PE 100 PN10	1.37	0.45	4.85	0.029
Pipe J494_J495	28.61283	62.2	130	HDPE-PE 100 PN10	-2.35	0.77	13.15	0.027
Pipe J495_J496	25.89297	62.2	130	HDPE-PE 100 PN10	0.17	0.06	0.1	0.039
Pipe J495_J497	30.60996	62.2	130	HDPE-PE 100 PN10	-2.63	0.87	16.21	0.026
Pipe J497_J498	30.69408	62.2	130	HDPE-PE 100 PN10	0.16	0.05	0.09	0.041
Pipe J499_J497	3.66864	62.2	130	HDPE-PE 100 PN10	2.86	0.94	18.9	0.026
Pipe J499_J500	47.12779	62.2	130	HDPE-PE 100 PN10	-2.23	0.73	11.98	0.027
Pipe J500_J501	64.01422	62.2	130	HDPE-PE 100 PN10	0.8	0.26	1.79	0.032
Pipe J500_J502	10.80282	62.2	130	HDPE-PE 100 PN10	-3.2	1.05	23.39	0.026
Pipe J502_J503	27.55796	62.2	130	HDPE-PE 100 PN10	0.19	0.06	0.12	0.04
Pipe J502_J504	59.96	62.2	130	HDPE-PE 100 PN10	-3.51	1.15	27.62	0.025
Pipe J505_J504	14.54574	150	110	DI	4.04	0.23	0.67	0.037
Pipe J505_J506	89.99289	150	110	DI	-4.04	0.23	0.67	0.038
Pipe J506_J507	39.47	62.2	130	HDPE-PE 100 PN10	1.08	0.36	3.11	0.03
Pipe J506_J511	74.57906	150	110	DI	-4.04	0.23	0.67	0.038
Pipe J507_J508	28.80824	62.2	130	HDPE-PE 100 PN10	0.16	0.05	0.09	0.041
Pipe J507_J509	17.78978	62.2	130	HDPE-PE 100 PN10	0.83	0.27	1.92	0.031
Pipe J509_J499	22.75965	62.2	130	HDPE-PE 100 PN10	0.68	0.22	1.31	0.032
Pipe J509_J510	32.14559	62.2	130	HDPE-PE 100 PN10	0.08	0.03	0.02	0.044
Pipe J511_J512	69.28	62.2	130	HDPE-PE 100 PN10	0.18	0.06	0.12	0.039
Pipe J511_J513	37.45961	150	110	DI	-4.04	0.23	0.67	0.038

Pipe J513_J515	21.05822	150	110	DI	-4.04	0.23	0.67	0.038
Pipe J514_J513	61.44	62.2	130	HDPE-PE 100 PN10	-0.22	0.07	0.16	0.038
Pipe J515_J516	53.43	62.2	130	HDPE-PE 100 PN10	0.31	0.1	0.31	0.037
Pipe J515_J517	41.2	150	110	DI	-4.04	0.23	0.67	0.038
Pipe J517_J518	136.28	150	110	DI	-4.04	0.23	0.67	0.038
Pipe J518_J519	45.13	62.2	130	HDPE-PE 100 PN10	0.47	0.15	0.66	0.034
Pipe J518_J527	105.2093	150	110	DI	-4.04	0.23	0.67	0.038
Pipe J519_J520	57.41065	62.2	130	HDPE-PE 100 PN10	0.33	0.11	0.34	0.036
Pipe J519_J521	25.73395	62.2	130	HDPE-PE 100 PN10	-0.05	0.02	0.01	0.056
Pipe J521_J522	36.09181	62.2	130	HDPE-PE 100 PN10	0.21	0.07	0.15	0.038
Pipe J521_J523	37.08217	62.2	130	HDPE-PE 100 PN10	-0.41	0.14	0.53	0.035
Pipe J523_J494	43.23037	62.2	130	HDPE-PE 100 PN10	-0.88	0.29	2.12	0.031
Pipe J524_J523	67.59762	62.2	130	HDPE-PE 100 PN10	-0.22	0.07	0.17	0.038
Pipe J525_J524	21.91971	62.2	130	HDPE-PE 100 PN10	-0.15	0.05	0.08	0.04
Pipe J526_J524	49.21665	62.2	130	HDPE-PE 100 PN10	0.16	0.05	0.09	0.041
Pipe J527_J526	54.73	62.2	130	HDPE-PE 100 PN10	0.31	0.1	0.31	0.036
Pipe J527_J536	30.99676	150	110	DI	-4.04	0.23	0.67	0.038
Pipe J528_J526	21.10194	62.2	130	HDPE-PE 100 PN10	0.02	0.01	0	0
Pipe J528_J529	19.86954	62.2	130	HDPE-PE 100 PN10	0.18	0.06	0.11	0.04
Pipe J530_J528	32.93128	62.2	130	HDPE-PE 100 PN10	0.32	0.1	0.33	0.036
Pipe J531_J530	15.89127	62.2	130	HDPE-PE 100 PN10	-0.2	0.06	0.13	0.038
Pipe J531_J533	5.440716	62.2	130	HDPE-PE 100 PN10	0.13	0.04	0.05	0.036
Pipe J532_J531	4.658509	62.2	130	HDPE-PE 100 PN10	-0.05	0.02	0	0
Pipe J533_J534	4.791035	62.2	130	HDPE-PE 100 PN10	0.09	0.03	0.03	0.04
Pipe J533_J535	5.247092	62.2	130	HDPE-PE 100 PN10	0.03	0.01	0	0
Pipe	51.88	150	110	DI	-4.04	0.23	0.67	0.038

J536_J485								
Pipe J536_J530	28.01	62.2	130	HDPE-PE 100 PN10	0.61	0.2	1.07	0.033
Pipe J537_J538	65.73	62.2	130	HDPE-PE 100 PN10	0.15	0.05	0.08	0.041
Pipe J537_J539	39.86	150	110	DI	0.76	0.04	0.03	0.054
Pipe J539_J540	70.15	62.2	130	HDPE-PE 100 PN10	0.04	0.01	0.01	0.046
Pipe J539_J542	33.92	150	110	DI	0.76	0.04	0.03	0.042
Pipe J540_J324	54.80172	62.2	130	HDPE-PE 100 PN10	-0.37	0.12	0.43	0.035
Pipe J540_J541	34.16087	62.2	130	HDPE-PE 100 PN10	0.18	0.06	0.11	0.039
Pipe J542_J544	72.44801	150	110	DI	0.76	0.04	0.03	0.05
Pipe J543_J542	85.9	62.2	130	HDPE-PE 100 PN10	-0.65	0.21	1.23	0.033
Pipe J544_J322	157.22	62.2	130	HDPE-PE 100 PN10	0.65	0.21	1.21	0.033
Pipe J544_J545	79.87734	150	110	DI	0.76	0.04	0.03	0.048
Pipe J545_J321	255.6525	150	110	DI	-3.18	0.18	0.43	0.039
Pipe J550_J359	58.35609	62.2	130	HDPE-PE 100 PN10	-0.07	0.02	0.02	0.047
Pipe J555_J073	35.92508	62.2	130	HDPE-PE 100 PN10	-0.54	0.18	0.87	0.033
Pipe J555_J101	81.99371	62.2	130	HDPE-PE 100 PN10	-0.18	0.06	0.11	0.039
Pipe J560_J346	149.0532	62.2	130	HDPE-PE 100 PN10	-0.96	0.32	2.53	0.031
Pipe J565_J358	34.38189	62.2	130	HDPE-PE 100 PN10	0.86	0.28	2.07	0.031
Pipe J570_J056	99.74984	150	110	DI	8.69	0.49	2.78	0.034
Pipe J575_J504	254.42	150	110	DI	4.28	0.24	0.75	0.038
Pipe J580_J575	131.2987	150	110	DI	4.28	0.24	0.75	0.038
Pipe J585_J342	19.27796	62.2	130	HDPE-PE 100 PN10	-0.06	0.02	0.01	0.024
Pipe 9	1140	600	110	DI	283.18	1	2.06	0.024
Pipe 8	50	300	110	DI	61.98	0.88	3.61	0.028
Pipe 7	46.02	300	110	DI	59.37	0.84	3.33	0.028
Pipe 6	618.39	400	110	DI	105.3	0.84	2.37	0.027
Pipe 4	13.87	400	110	DI	243.3	1.94	11.19	0.023
Pipe 3	1300	900	110	DI	747.95	1.18	1.72	0.022
Pipe 2	50	500	110	DI	104.7	0.53	0.79	0.027

Pipe 1	470	1000	110	DI	852.65	1.09	1.32	0.022
Pipe To_A-2.3_J002	20.01	150	110	DI	9.34	0.53	3.18	0.033
Pipe J235_J560	20	62.2	130	HDPE-PE 100 PN10	-0.79	0.26	1.76	0.032
Pipe 10	76.53	62.2	130	HDPE-PE 100 PN10	1.64	0.54	6.79	0.028
Pipe 11	90.85	62.2	130	HDPE-PE 100 PN10	1.44	0.47	5.3	0.029
Pipe 12	111.8	62.2	130	HDPE-PE 100 PN10	1.25	0.41	4.11	0.03
Pipe 17	22.14	62.2	130	HDPE-PE 100 PN10	-2.49	0.82	14.71	0.027
Pipe 19	99.5	62.2	130	HDPE-PE 100 PN10	2.41	0.79	13.78	0.027
Pipe 20	50.66	62.2	130	HDPE-PE 100 PN10	1.02	0.34	2.82	0.03
Pipe 21	34.19	62.2	130	HDPE-PE 100 PN10	0.61	0.2	1.08	0.033
Pipe 22	18.52	62.2	130	HDPE-PE 100 PN10	0.92	0.3	2.34	0.031
Pipe 23	145.24	62.2	130	HDPE-PE 100 PN10	0.31	0.1	0.31	0.036
Pipe 24	161.43	62.2	130	HDPE-PE 100 PN10	-0.52	0.17	0.79	0.034
Pipe 26	130.39	62.2	130	HDPE-PE 100 PN10	0.52	0.17	0.8	0.034
Pipe 27	12.1	62.2	130	HDPE-PE 100 PN10	0.38	0.13	0.46	0.035
Pipe 28	89.19	62.2	130	HDPE-PE 100 PN10	-0.56	0.18	0.92	0.033
Pipe 30	92.8	62.2	130	HDPE-PE 100 PN10	2.16	0.71	11.26	0.027
Pipe 31	223.32	62.2	130	HDPE-PE 100 PN10	1.19	0.39	3.71	0.03
Pipe 32	97.8	62.2	130	HDPE-PE 100 PN10	2.43	0.8	14.02	0.027
Pipe 33	250.53	62.2	130	HDPE-PE 100 PN10	-0.17	0.06	0.1	0.04
Pipe 34	36.72	62.2	130	HDPE-PE 100 PN10	3.58	1.18	28.79	0.025
Pipe 35	124.32	62.2	130	HDPE-PE 100 PN10	0.54	0.18	0.87	0.033
Pipe 36	130.83	62.2	130	HDPE-PE 100 PN10	0.01	0	0	0
Pipe 37	253.25	62.2	130	HDPE-PE 100 PN10	-1.05	0.35	2.98	0.03
Pipe 38	14	62.2	130	HDPE-PE 100 PN10	3.22	1.06	23.55	0.026
Pipe 39	88.58	62.2	130	HDPE-PE 100 PN10	3.11	1.02	22.1	0.026
Pipe 40	74.99	62.2	130	HDPE-PE 100 PN10	1.89	0.62	8.79	0.028
Pipe 41	37.27	62.2	130	HDPE-PE 100 PN10	1.52	0.5	5.87	0.029

Pipe 42	21.42	62.2	130	HDPE-PE 100 PN10	1.2	0.39	3.79	0.03
Pipe 43	38.4	62.2	130	HDPE-PE 100 PN10	0.79	0.26	1.75	0.032
Pipe 44	133.4	62.2	130	HDPE-PE 100 PN10	0.7	0.23	1.38	0.032
Pipe 45	105.85	62.2	130	HDPE-PE 100 PN10	-0.01	0	0	0
Pipe 46	31.52	62.2	130	HDPE-PE 100 PN10	-0.5	0.17	0.76	0.034
Pipe 47	50.52	62.2	130	HDPE-PE 100 PN10	-1.18	0.39	3.69	0.03
Pipe 48	116.08	62.2	130	HDPE-PE 100 PN10	0.16	0.05	0.09	0.04
Pipe 49	40.09	62.2	130	HDPE-PE 100 PN10	-0.15	0.05	0.08	0.04
Pipe 50	33.87	62.2	130	HDPE-PE 100 PN10	-0.34	0.11	0.38	0.036
Pipe 51	72.01	62.2	130	HDPE-PE 100 PN10	-1.21	0.4	3.87	0.03
Pipe 52	80.39	62.2	130	HDPE-PE 100 PN10	-2.31	0.76	12.72	0.027
Pipe 53	256.4	62.2	130	HDPE-PE 100 PN10	1.1	0.36	3.21	0.03
Pipe 54	64.59	62.2	130	HDPE-PE 100 PN10	-0.23	0.08	0.18	0.038
Pipe 55	121.18	62.2	130	HDPE-PE 100 PN10	-1.62	0.53	6.58	0.028
Pipe 56	24.5	62.2	130	HDPE-PE 100 PN10	-1.87	0.62	8.63	0.028
Pipe 58	84.36	62.2	130	HDPE-PE 100 PN10	1.77	0.58	7.82	0.028
Pipe 59	41.67	62.2	130	HDPE-PE 100 PN10	0.82	0.27	1.86	0.031
Pipe 60	29.32	62.2	130	HDPE-PE 100 PN10	0.5	0.16	0.75	0.034
Pipe 61	80.44	62.2	130	HDPE-PE 100 PN10	0.59	0.19	1.02	0.033
Pipe 62	42.31	62.2	130	HDPE-PE 100 PN10	-0.24	0.08	0.19	0.038
Pipe 63	77.79	62.2	130	HDPE-PE 100 PN10	-0.84	0.28	1.97	0.031
Pipe 64	13.5	62.2	130	HDPE-PE 100 PN10	-0.84	0.28	1.95	0.031
Pipe 65	51.66	62.2	130	HDPE-PE 100 PN10	-0.9	0.3	2.22	0.031
Pipe 66	110.81	62.2	130	HDPE-PE 100 PN10	-1.1	0.36	3.25	0.03
Pipe 67	104.77	62.2	130	HDPE-PE 100 PN10	-1.58	0.52	6.3	0.029
Pipe 68	15.51	62.2	130	HDPE-PE 100 PN10	3.05	1	21.34	0.026
Pipe 69	67.16	62.2	130	HDPE-PE 100 PN10	1.37	0.45	4.83	0.029
Pipe 70	77.31	62.2	130	HDPE-PE 100 PN10	0.41	0.13	0.52	0.035

Pipe 71	204.64	62.2	130	HDPE-PE 100 PN10	-0.7	0.23	1.4	0.032
Pipe 72	218.92	62.2	130	HDPE-PE 100 PN10	-1.61	0.53	6.56	0.028
Pipe 13	70.3495	150	110	DI	-9.34	0.53	3.18	0.033
Pipe 14	70.56	62.2	130	HDPE-PE 100 PN10	0.02	0.01	0	0.039
Pipe 15	31.8058	62.2	130	HDPE-PE 100 PN10	-1.79	0.59	7.97	0.028
Pipe 16	89.05	62.2	130	HDPE-PE 100 PN10	1.24	0.41	4.02	0.03
Pipe 25	118.2097	62.2	130	HDPE-PE 100 PN10	-0.91	0.3	2.25	0.031
Pipe 57	30.77967	62.2	130	HDPE-PE 100 PN10	-0.91	0.3	2.26	0.031
Pipe 80	67.98	200	110	DI	10.5	0.33	0.97	0.034
Pipe 81	119.98	200	110	DI	10.5	0.33	0.97	0.034
Pipe 84	119.02	200	110	DI	10.5	0.33	0.97	0.034
Pipe 85	115.21	200	110	DI	10.5	0.33	0.97	0.034
Pipe 86	122.59	200	110	DI	10.5	0.33	0.97	0.034
Pipe 88	33.5	300	110	DI	45.93	0.65	2.07	0.029
Pipe 89	221.17	200	110	DI	10.5	0.33	0.97	0.034
Pipe 90	282.38	200	110	DI	10.5	0.33	0.97	0.034
Pipe 91	177.76	200	110	DI	10.5	0.33	0.97	0.034
Pipe 95	783.96	200	110	DI	38.14	1.21	10.59	0.028
Pipe 73	382.05	300	110	DI	-59.37	0.84	3.33	0.028
Pipe 77	11.34	300	110	DI	59.37	0.84	3.33	0.028
Pipe 29	161.82	500	110	DI	159.48	0.81	1.73	0.026
Pipe 79	32.13	250	110	DI	54.18	1.1	8.16	0.033
Pipe 5	46.43	62.2	130	HDPE-PE 100 PN10	-1.78	0.59	7.9	0.028
Pipe 82	5.06	62.2	130	HDPE-PE 100 PN10	-0.99	0.33	2.65	0.031
Pipe 83	268.71	150	110	DI	5.09	0.29	1.03	0.037
Pipe 87	379.5	150	110	DI	5.09	0.29	1.03	0.037
Pipe 92	317.52	150	110	DI	1.81	0.1	0.15	0.043
Pipe 93	136.81	150	110	DI	-1.22	0.07	0.07	0.046
Pipe 94	129.7	150	110	DI	-1.22	0.07	0.07	0.045
Pipe 96	1.62	150	110	DI	-10.95	0.62	4.23	0.032
Pipe 98	1.09	150	110	DI	3.03	0.17	0.27	0.027
Pipe 99	0.96	150	110	DI	4.25	0.24	0.62	0.032
Pipe 100	0.85	150	110	DI	-3.28	0.19	0.35	0.03
Pipe 101	1.19	150	110	DI	3.09	0.18	0.38	0.036
Pipe 102	0.85	150	110	DI	6.63	0.38	1.75	0.037
Pipe 104	242.05	150	110	DI	0.3	0.02	0.01	0.055
Pipe 105	286.94	150	110	DI	-0.9	0.05	0.04	0.047
Pipe 106	491.37	150	110	DI	-3.37	0.19	0.48	0.039
Pipe 107	273.34	150	110	DI	-8.04	0.46	2.41	0.034

Pipe 108	237.98	150	110	DI	-8.04	0.46	2.41	0.034
Pipe 109	1.46	150	110	DI	4.5	0.25	0.82	0.037
Pipe 110	2.25	150	110	DI	2.47	0.14	0.26	0.04
Pipe 111	1.07	150	110	DI	1.89	0.11	0.14	0.036
Pipe 112	0.93	150	110	DI	4.68	0.26	0.8	0.034
Pipe 113	5.1	150	110	DI	8.69	0.49	2.77	0.034
Pipe 114	5	150	110	DI	2.2	0.12	0.24	0.045
Pipe 115	2.36	150	110	DI	6.49	0.37	1.64	0.036
Pipe 116	5.57	62.2	130	HDPE-PE 100 PN10	-2.53	0.83	15.07	0.027
Pipe 117	4.63	62.2	130	HDPE-PE 100 PN10	1.3	0.43	4.44	0.029
Pipe 118	199.33	150	110	DI	2.66	0.15	0.31	0.04
Pipe 119	174.06	150	110	DI	-1.2	0.07	0.07	0.046
Pipe 120	3.33	62.2	130	HDPE-PE 100 PN10	2.59	0.85	15.69	0.026
Pipe 121	3.12	62.2	130	HDPE-PE 100 PN10	1.28	0.42	4.25	0.029
Pipe 122	64.22	150	110	DI	-0.76	0.04	0.03	0.049
Pipe 123	282.55	150	110	DI	-0.76	0.04	0.03	0.048
Pipe 124	0.58	150	110	DI	3.26	0.18	0.26	0.022
Pipe 125	116.66	150	110	DI	-4.01	0.23	0.66	0.038
Pipe 126	150.42	150	110	DI	-4.01	0.23	0.66	0.038
Pipe 127	1.04	150	110	DI	3.31	0.19	0.43	0.036
Pipe 128	1.77	150	110	DI	3.93	0.22	0.67	0.04
Pipe 129	141.18	150	110	DI	20.2	1.14	13.24	0.03
Pipe 130	390.87	150	110	DI	5.81	0.33	1.32	0.036
Pipe 131	541.28	150	110	DI	5.81	0.33	1.32	0.036
Pipe 132	0.75	62.2	130	HDPE-PE 100 PN10	-3.94	1.3	34.33	0.025
Pipe 133	0.96	62.2	130	HDPE-PE 100 PN10	0.47	0.15	0.62	0.032
Pipe 134	1.2	150	110	DI	4.9	0.28	0.99	0.038
Pipe 135	0.91	150	110	DI	14.39	0.81	7.2	0.032
Pipe 136	249.99	150	110	DI	9.98	0.56	3.59	0.033
Pipe 137	119.98	150	110	DI	4.43	0.25	0.8	0.037
Pipe 138	81.51	62.2	130	HDPE-PE 100 PN10	1.88	0.62	8.69	0.028
Pipe 139	2.32	62.2	130	HDPE-PE 100 PN10	0.92	0.3	2.31	0.031
Pipe 140	39.44	62.2	130	HDPE-PE 100 PN10	1.73	0.57	7.44	0.028
Pipe 141	25.92	62.2	130	HDPE-PE 100 PN10	1.46	0.48	5.47	0.029
Pipe 142	80.75	62.2	130	HDPE-PE 100 PN10	0.61	0.2	1.09	0.033
Pipe 143	0.83	62.2	110	DI	-2.02	0.67	13.63	0.038
Pipe 144	0.83	62.2	130	HDPE-PE 100 PN10	3.53	1.16	28.15	0.025

Pipe 145	285.93	150	110	DI	4.43	0.25	0.8	0.037
Pipe 146	217.09	150	110	DI	4.04	0.23	0.67	0.038
Pipe 147	1.79	150	110	DI	1.77	0.1	0.17	0.049
Pipe 148	1.97	62.2	130	HDPE-PE 100 PN10	0.19	0.06	0.08	0.023
Pipe 149	1.99	62.2	130	HDPE-PE 100 PN10	6	1.97	74.71	0.023
Pipe 150	25.96	62.2	130	HDPE-PE 100 PN10	0.04	0.01	0.01	0.033
Pipe 151	119.27	62.2	130	HDPE-PE 100 PN10	0.73	0.24	1.51	0.032
Pipe 152	20.79	62.2	130	HDPE-PE 100 PN10	0.73	0.24	1.51	0.032
Pipe 153	72.54	62.2	130	HDPE-PE 100 PN10	0.47	0.15	0.66	0.034
Pipe 154	53.29	62.2	130	HDPE-PE 100 PN10	0.43	0.14	0.58	0.034
Pipe 155	41.59	62.2	130	HDPE-PE 100 PN10	0.44	0.15	0.6	0.034
Pipe 156	28.93	62.2	130	HDPE-PE 100 PN10	0.21	0.07	0.16	0.039
Pipe 157	67.84	62.2	130	HDPE-PE 100 PN10	-0.17	0.06	0.11	0.04
Pipe 158	3.05	150	110	DI	1.95	0.11	0.2	0.047
Pipe 159	1.31	150	110	DI	6.81	0.39	1.7	0.034
Pipe 160	1.97	150	110	DI	8.32	0.47	2.57	0.034
Pipe 75	1.24	150	110	DI	15.15	0.86	7.8	0.031
Pipe 97	16.95	62.2	130	HDPE-PE 100 PN10	1.69	0.56	7.17	0.028
Pipe 103	1.49	62.2	130	HDPE-PE 100 PN10	4.55	1.5	44.75	0.024
Pipe 161	145.98	150	110	DI	8.91	0.5	2.91	0.034
Pipe 162	313.91	150	110	DI	8.91	0.5	2.91	0.034
Pipe 163	189.28	150	110	DI	8.91	0.5	2.91	0.034
Pipe 164	218.55	150	110	DI	-1.5	0.08	0.11	0.044
Pipe 165	114.1	62.2	130	HDPE-PE 100 PN10	0.27	0.09	0.24	0.037
Pipe 166	103.09	62.2	130	HDPE-PE 100 PN10	-0.42	0.14	0.54	0.035
Pipe 167	28.82	62.2	130	HDPE-PE 100 PN10	1.98	0.65	9.58	0.028
Pipe 168	22.97	62.2	130	HDPE-PE 100 PN10	1.34	0.44	4.65	0.029
Pipe 169	4.29	62.2	130	HDPE-PE 100 PN10	0.72	0.24	1.49	0.032
Pipe 170	76.58	62.2	130	HDPE-PE 100 PN10	0.69	0.23	1.36	0.032
Pipe 171	55.62	62.2	130	HDPE-PE 100 PN10	0.59	0.19	1.01	0.033
Pipe 172	93.86	62.2	130	HDPE-PE 100 PN10	-0.43	0.14	0.57	0.035
Pipe 173	1.26	62.2	130	HDPE-PE 100 PN10	1.28	0.42	4.37	0.03

Pipe 174	1.6	62.2	130	HDPE-PE 100 PN10	3.49	1.15	27.44	0.025
Pipe 175	1.33	150	110	DI	3.56	0.2	0.56	0.041
Pipe 176	1.29	150	110	DI	3.85	0.22	0.69	0.043
Valve 18	#N/A	200	#N/A	HDPE-PE 100 PN10	38.14	1.21	22.61	0
Valve 74	#N/A	150	#N/A	HDPE-PE 100 PN10	10.5	0.59	26.63	0
Valve 76	#N/A	150	#N/A	HDPE-PE 100 PN10	21.23	1.2	17.28	0
Valve 78	#N/A	200	#N/A	HDPE-PE 100 PN10	35.44	1.13	11.42	0

Table 6.28.Details of Pressure for DNI J (at peak time 7.00)

Node ID	Elevation	Base Demand	**Peak Demand (LPS)**	Head	Pressure
	m	LPS	LPS	m	m
Junc J001	1336.308	0	0	1358.31	22
Junc J002	1334.022	0	0	1357.34	23.32
Junc J003	1334.234	0	0	1357.41	23.17
Junc J004	1333.164	0	0	1357.09	23.93
Junc J005	1334.956	0.101589	0.15	1356.75	21.8
Junc J006	1341.977	0.057648	0.09	1355.67	13.7
Junc J007	1333.302	0.248069	0.37	1355.66	22.36
Junc J008	1341.402	0.028536	0.04	1355.58	14.18
Junc J009	1335.577	0.269072	0.4	1355.55	19.98
Junc J010	1339.555	0.125138	0.19	1355.46	15.91
Junc J011	1335.026	0.177535	0.27	1355.45	20.42
Junc J012	1334.888	0	0	1357.35	22.46
Junc J013	1335.801	0.542866	0.81	1355.39	19.59
Junc J014	1331.988	0	0	1356.8	24.81
Junc J015	1329.072	0	0	1356.46	27.39
Junc J017	1327.241	0.108227	0.16	1355.71	28.47
Junc J018	1330.364	0.044792	0.07	1355.67	25.3
Junc J019	1331.632	0.124478	0.19	1355.67	24.03
Junc J020	1331.254	0.208439	0.31	1355.66	24.41
Junc J021	1324.402	0.101046	0.15	1355.71	31.31
Junc J023	1324.401	0	0	1356.24	31.84
Junc J024	1324.401	0	0	1356.22	31.82
Junc J025	1324.835	0	0	1356.15	31.32
Junc J026	1321.975	0.079188	0.12	1355.53	33.55
Junc J027	1316.81	0.08601	0.13	1355.53	38.72
Junc J028	1318.961	0.09385	0.14	1355.53	36.57
Junc J029	1325.006	0.055011	0.08	1355.58	30.57
Junc J030	1325.748	0.035678	0.05	1355.58	29.83
Junc J031	1325.58	0.050223	0.08	1355.58	30
Junc J032	1327.637	0.030093	0.05	1355.57	27.94

Junc J033	1327.319	0.049212	0.07	1355.57	28.25
Junc J034	1328.17	0.064492	0.1	1355.57	27.4
Junc J035	1322.431	0.10509	0.16	1355.24	32.81
Junc J036	1322.581	0.316684	0.48	1355.22	32.64
Junc J037	1326.095	0.263785	0.4	1355.06	28.96
Junc J038	1332.807	0.12681	0.19	1355.04	22.24
Junc J039	1325.325	0.335327	0.5	1355.01	29.69
Junc J040	1329.834	0.116659	0.17	1355.01	25.17
Junc J041	1325.228	0.240857	0.36	1355.02	29.79
Junc J042	1328.36	0.107153	0.16	1355.07	26.71
Junc J043	1328.838	0.034269	0.05	1355.07	26.23
Junc J044	1330.026	0.089443	0.13	1355.01	24.99
Junc J045	1335.634	0.084849	0.13	1355.08	19.45
Junc J046	1336.079	0.198953	0.3	1355.08	19
Junc J047	1336.281	0.103118	0.15	1354.96	18.67
Junc J048	1342.291	0.548999	0.82	1355.08	12.79
Junc J049	1332.613	0.287454	0.43	1354.86	22.25
Junc J050	1334.1	0.421059	0.63	1355.2	21.1
Junc J051	1334.014	0	0	1356.28	22.27
Junc J052	1333.878	0	0	1356.61	22.73
Junc J053	1330.253	0.136821	0.21	1355	24.75
Junc J054	1331.417	0.140909	0.21	1355	23.59
Junc J055	1331.829	0.281592	0.42	1354.97	23.14
Junc J056	1326.352	0	0	1350.78	24.42
Junc J057	1332.325	0.131808	0.2	1349.61	17.28
Junc J058	1333.159	0.231583	0.35	1349.59	16.43
Junc J059	1325.528	0	0	1350.64	25.11
Junc J060	1325.784	0	0	1350.54	24.75
Junc J061	1332.726	0.118381	0.18	1349.53	16.81
Junc J062	1335.336	0.111391	0.17	1349.55	14.21
Junc J063	1335.558	0.120713	0.18	1349.59	14.04
Junc J064	1335.436	0.225198	0.34	1355.03	19.6
Junc J065	1334.198	0.178684	0.27	1354.9	20.7
Junc J066	1334.68	0.161033	0.24	1354.89	20.21
Junc J067	1333.534	0.150369	0.23	1354.9	21.36
Junc J068	1333.045	0.066492	0.1	1354.9	21.85
Junc J069	1334.015	0.071449	0.11	1354.9	20.88
Junc J070	1334.462	0.171311	0.26	1354.9	20.44
Junc J071	1332.88	0.159138	0.24	1354.89	22.01
Junc J072	1335.3	0.082708	0.12	1354.95	19.65
Junc J073	1335.3	0.073205	0.11	1349.46	14.16
Junc J074	1332.704	0.106985	0.16	1349.45	16.74
Junc J075	1330.996	0.079288	0.12	1349.46	18.47
Junc J076	1331.116	0.051899	0.08	1349.46	18.35

Junc J077	1326.245	0	0	1350.49	24.24
Junc J078	1328.066	0.275346	0.41	1349.43	21.36
Junc J079	1332.852	0.072433	0.11	1349.42	16.56
Junc J080	1333.82	0.148343	0.22	1349.41	15.59
Junc J081	1334.615	0.192199	0.29	1349.4	14.79
Junc J082	1323.272	0	0	1350.09	26.82
Junc J083	1334.316	0.208034	0.31	1349.39	15.08
Junc J084	1334.229	0.079146	0.12	1349.39	15.16
Junc J085	1334.222	0.033707	0.05	1349.39	15.16
Junc J086	1331.156	0.173911	0.26	1349.39	18.23
Junc J087	1330.626	0.318025	0.48	1349.37	18.75
Junc J088	1320.887	0.202518	0.3	1349.54	28.65
Junc J089	1322.836	0.151897	0.23	1349.43	26.6
Junc J090	1322.243	0.12766	0.19	1349.43	27.19
Junc J091	1322.4	0.031505	0.05	1349.43	27.03
Junc J092	1322.4	0.121647	0.18	1349.42	27.02
Junc J093	1323.281	0.161616	0.24	1349.42	26.14
Junc J094	1324.168	0.025841	0.04	1349.4	25.23
Junc J095	1324.168	0.076653	0.11	1349.4	25.23
Junc J096	1325.482	0.371065	0.56	1349.38	23.9
Junc J097	1334.11	0.208108	0.31	1349.4	15.29
Junc J098	1334.17	0.083253	0.12	1349.37	15.2
Junc J099	1334.187	0.023745	0.04	1349.37	15.19
Junc J100	1334.076	0.202148	0.3	1349.37	15.3
Junc J101	1333.326	0.13258	0.2	1349.43	16.11
Junc J102	1332.816	0.119798	0.18	1354.98	22.16
Junc J103	1332.785	0.230224	0.35	1354.96	22.18
Junc J104	1332.875	0.307179	0.46	1355.01	22.13
Junc J105	1326.326	0.218549	0.33	1355.08	28.76
Junc J106	1331.7	0.289287	0.43	1355.08	23.38
Junc J107	1318.878	0.123638	0.19	1355.22	36.34
Junc J108	1319.626	0.060262	0.09	1355.22	35.59
Junc J109	1317.897	0.056909	0.09	1355.34	37.44
Junc J110	1318.723	0.039738	0.06	1355.48	36.76
Junc J111	1319.78	0.038894	0.06	1355.48	35.7
Junc J112	1319.777	0.054466	0.08	1355.48	35.7
Junc J113	1319.552	0.011833	0.02	1355.48	35.92
Junc J114	1319.559	0.07622	0.11	1355.48	35.92
Junc J115	1319.661	0.011704	0.02	1355.48	35.81
Junc J116	1319.545	0.054729	0.08	1355.32	35.78
Junc J117	1320.124	0.088976	0.13	1355.17	35.05
Junc J118	1320.532	0.243617	0.37	1355.16	34.63
Junc J119	1331.131	0.094095	0.14	1355.17	24.03
Junc J120	1320.107	0.03034	0.05	1355.23	35.12

Junc J121	1320.107	0.105304	0.16	1355.21	35.11
Junc J122	1320.516	0.055507	0.08	1355.21	34.69
Junc J123	1320.861	0.137131	0.21	1355.21	34.34
Junc J124	1320.819	0.098933	0.15	1355.2	34.38
Junc J125	1320.533	0.048313	0.07	1355.21	34.68
Junc J126	1319.733	0.026867	0.04	1355.21	35.48
Junc J127	1319.805	0.021784	0.03	1355.21	35.41
Junc J128	1319.648	0.059297	0.09	1355.25	35.6
Junc J129	1319.547	0.039736	0.06	1355.25	35.7
Junc J130	1318.723	0.034355	0.05	1355.51	36.78
Junc J131	1318.942	0.05072	0.08	1355.3	36.36
Junc J132	1317.681	0.065066	0.1	1355.2	37.52
Junc J133	1319.365	0.02105	0.03	1355.2	35.83
Junc J134	1318.613	0.046088	0.07	1355.2	36.59
Junc J135	1318.787	0.046254	0.07	1355.2	36.41
Junc J136	1319.241	0.02679	0.04	1355.2	35.96
Junc J137	1316.707	0.03318	0.05	1355.2	38.49
Junc J138	1316.602	0.070535	0.11	1355.17	38.57
Junc J139	1316.602	0.10992	0.16	1355.17	38.57
Junc J140	1317.876	0.05025	0.08	1355.36	37.48
Junc J141	1318.358	0.041068	0.06	1355.36	37
Junc J142	1325.362	0.03734	0.06	1355.34	29.98
Junc J143	1323.782	0.175719	0.26	1355.34	31.55
Junc J144	1316.61	0.049717	0.07	1355.11	38.5
Junc J145	1316.741	0.043186	0.06	1355.11	38.36
Junc J146	1316.622	0.012073	0.02	1355.1	38.48
Junc J147	1318.53	0.082236	0.12	1355.12	36.59
Junc J148	1319.274	0.042964	0.06	1355.12	35.85
Junc J149	1319.837	0.030067	0.05	1355.14	35.3
Junc J150	1320.671	0.035958	0.05	1355.14	34.47
Junc J151	1321.147	0.101868	0.15	1355.14	33.99
Junc J152	1318.191	0.034895	0.05	1355.14	36.95
Junc J153	1318.289	0.05145	0.08	1355.15	36.86
Junc J154	1319.302	0.167686	0.25	1355.22	35.91
Junc J155	1333.188	0	0	1356	22.81
Junc J156	1333.321	0	0	1355.94	22.62
Junc J157	1332.153	0.070698	0.11	1355.26	23.11
Junc J158	1331.928	0.034814	0.05	1355.21	23.29
Junc J159	1322.583	0.037459	0.06	1355.2	32.61
Junc J160	1321.498	0.015959	0.02	1355.16	33.66
Junc J161	1327.13	0.031785	0.05	1355.14	28.01
Junc J162	1319.741	0.044862	0.07	1355.14	35.4
Junc J163	1331.093	0.059379	0.09	1355.12	24.02
Junc J164	1325.458	0.021468	0.03	1355.03	29.57

Junc J165	1324.857	0.067755	0.1	1355.02	30.17
Junc J166	1324.433	0.016435	0.02	1354.99	30.55
Junc J167	1323.894	0.038794	0.06	1354.98	31.08
Junc J168	1314.835	0.086248	0.13	1355.02	40.18
Junc J169	1315.343	0.104854	0.16	1355.02	39.67
Junc J170	1319.581	0.100526	0.15	1355.09	35.51
Junc J171	1322.711	0.041608	0.06	1354.91	32.2
Junc J172	1317.259	0.111895	0.17	1354.91	37.65
Junc J173	1332.305	0.072184	0.11	1354.83	22.52
Junc J174	1332.052	0.07358	0.11	1354.83	22.78
Junc J175	1331.127	0.094124	0.14	1354.8	23.68
Junc J176	1327.696	0.267682	0.4	1354.78	27.09
Junc J177	1330.944	0	0	1355.72	24.78
Junc J178	1331.296	0	0	1355.73	24.44
Junc J179	1331.581	0	0	1355.77	24.19
Junc J180	1331.381	0.09461	0.14	1354.92	23.53
Junc J181	1330.917	0.150268	0.23	1354.91	23.99
Junc J182	1331.637	0.0251	0.04	1354.92	23.28
Junc J183	1331.405	0.029622	0.04	1354.92	23.51
Junc J184	1332.081	0.028115	0.04	1354.93	22.85
Junc J185	1331.779	0.045841	0.07	1354.93	23.15
Junc J186	1332.439	0.058193	0.09	1354.94	22.51
Junc J187	1331.794	0.050793	0.08	1354.94	23.15
Junc J188	1332.378	0	0	1355.86	23.48
Junc J189	1333.539	0.170172	0.26	1355.26	21.72
Junc J190	1332.162	0.073786	0.11	1355.26	23.1
Junc J191	1314.212	0.10751	0.16	1354.79	40.58
Junc J192	1314.763	0.248522	0.37	1354.78	40.02
Junc J193	1314.862	0.136737	0.21	1354.84	39.98
Junc J194	1329.697	0	0	1355.67	25.97
Junc J195	1328.838	0	0	1355.63	26.8
Junc J196	1325.24	0.128158	0.19	1354.55	29.31
Junc J198	1324.868	0.07104	0.11	1354.55	29.68
Junc J199	1325.048	0.235151	0.35	1354.55	29.5
Junc J200	1319.523	0.068421	0.1	1355.1	35.58
Junc J201	1320.741	0.036904	0.06	1355.1	34.36
Junc J202	1321.051	0.045876	0.07	1355.1	34.05
Junc J203	1319.901	0.153906	0.23	1355.1	35.2
Junc J204	1321.028	0.021105	0.03	1355.11	34.08
Junc J205	1321.292	0.091031	0.14	1355.11	33.82
Junc J206	1325.345	0.094861	0.14	1355.24	29.9
Junc J207	1322.465	0.134029	0.2	1355.19	32.72
Junc J208	1320.932	0.117872	0.18	1355.18	34.25
Junc J209	1329.073	0.033635	0.05	1355.44	26.37

Junc J210	1328.978	0.144981	0.22	1349.33	20.36
Junc J211	1329.224	0.130714	0.2	1349.33	20.11
Junc J212	1330.922	0.212751	0.32	1349.82	18.9
Junc J213	1330.364	0.222779	0.33	1349.4	19.04
Junc J214	1330.532	0.222942	0.33	1349.18	18.65
Junc J215	1329.671	0.345171	0.52	1349.14	19.47
Junc J216	1326.356	0.108978	0.16	1349.1	22.75
Junc J217	1325.673	0.129448	0.19	1349.1	23.42
Junc J218	1326.034	0.067026	0.1	1349.1	23.07
Junc J219	1322.743	0.106068	0.16	1349.1	26.36
Junc J220	1325.418	0.141302	0.21	1349.1	23.68
Junc J221	1321.368	0.086	0.13	1349.13	27.76
Junc J222	1323.225	0.076473	0.11	1349.13	25.9
Junc J223	1321.174	0.160591	0.24	1349.18	28
Junc J224	1322.341	0.107103	0.16	1349.51	27.17
Junc J225	1324.655	0.158165	0.24	1349.5	24.85
Junc J226	1319.724	0.065631	0.1	1349.12	29.39
Junc J227	1319.989	0.064121	0.1	1349.11	29.12
Junc J228	1319.901	0.091141	0.14	1349.11	29.21
Junc J229	1319.369	0.080248	0.12	1349.11	29.74
Junc J230	1318.046	0.112	0.17	1349.11	31.07
Junc J231	1320.341	0.074591	0.11	1349.1	28.76
Junc J232	1320.433	0.096369	0.14	1349.1	28.67
Junc J233	1325.576	0.172145	0.26	1349.09	23.51
Junc J234	1325.382	0.151596	0.23	1349.08	23.7
Junc J235	1317.118	0.089759	0.13	1349.17	32.06
Junc J236	1322.667	0.199302	0.3	1349.16	26.49
Junc J237	1315.792	0.04818	0.07	1349.21	33.42
Junc J238	1315.792	0.197909	0.3	1349.2	33.41
Junc J239	1319.059	0.061921	0.09	1349.05	29.99
Junc J240	1319.06	0.173661	0.26	1349.05	29.99
Junc J241	1319.921	0.049512	0.07	1349.04	29.12
Junc J242	1320.367	0.064428	0.1	1349.04	28.67
Junc J243	1320.663	0.032815	0.05	1349.04	28.38
Junc J244	1320.36	0.038302	0.06	1349.04	28.68
Junc J245	1321.184	0.082562	0.12	1349.04	27.85
Junc J246	1321.461	0.109163	0.16	1349.03	27.57
Junc J247	1322.138	0.142009	0.21	1349.04	26.9
Junc J248	1323.323	0.137796	0.21	1349.03	25.71
Junc J249	1326.913	0.049692	0.07	1349.12	22.21
Junc J250	1327.632	0.19193	0.29	1349.1	21.47
Junc J252	1328.164	0.018551	0.03	1349.21	21.05
Junc J253	1328.376	0.106378	0.16	1349.21	20.83
Junc J254	1327.966	0.033891	0.05	1355.35	27.38

Junc J255	1323.364	0.082253	0.12	1355.35	31.99
Junc J256	1326.913	0.045833	0.07	1355.2	28.29
Junc J257	1321.106	0.145279	0.22	1355.19	34.09
Junc J258	1325.569	0.074214	0.11	1355.1	29.53
Junc J259	1319.517	0.183259	0.27	1355.09	35.57
Junc J260	1324.271	0.097403	0.15	1355.06	30.79
Junc J261	1318.629	0.097671	0.15	1354.86	36.23
Junc J262	1318.452	0.154128	0.23	1354.85	36.4
Junc J263	1314.178	0.264281	0.4	1354.84	40.66
Junc J264	1312.516	0.198326	0.3	1354.84	42.32
Junc J265	1313.272	0.125226	0.19	1354.83	41.55
Junc J266	1312.982	0.060548	0.09	1354.79	41.81
Junc J267	1312.456	0.072407	0.11	1354.79	42.34
Junc J268	1322.061	0.18718	0.28	1354.73	32.67
Junc J269	1322.07	0.074958	0.11	1354.73	32.66
Junc J270	1325.917	0	0	1355.57	29.66
Junc J271	1325.255	0	0	1355.55	30.3
Junc J272	1326.659	0.146747	0.22	1354.71	28.05
Junc J273	1324.795	0	0	1355.52	30.73
Junc J274	1324.931	0.118632	0.18	1354.72	29.79
Junc J275	1324.937	0.074391	0.11	1354.72	29.78
Junc J276	1321.176	0.053844	0.08	1354.7	33.52
Junc J277	1322.605	0.058395	0.09	1354.7	32.09
Junc J278	1323.808	0.057504	0.09	1354.69	30.88
Junc J279	1318.369	0.087557	0.13	1354.69	36.32
Junc J280	1316.566	0.087048	0.13	1354.69	38.12
Junc J281	1323.906	0	0	1355.46	31.55
Junc J282	1313.231	0.116546	0.17	1355.13	41.9
Junc J283	1320.357	0.148079	0.22	1355.12	34.77
Junc J284	1311.32	0.082185	0.12	1355.09	43.77
Junc J285	1312.281	0.140835	0.21	1355.08	42.8
Junc J286	1311.682	0.077379	0.12	1355.08	43.4
Junc J287	1313.415	0.037799	0.06	1355.13	41.71
Junc J288	1312.694	0.136494	0.2	1355.12	42.42
Junc J289	1314.407	0.074963	0.11	1355.18	40.78
Junc J290	1314.557	0.100724	0.15	1355.11	40.55
Junc J291	1315.039	0.08536	0.13	1355.1	40.07
Junc J292	1317.457	0.09498	0.14	1355.03	37.58
Junc J293	1315.504	0.118069	0.18	1355.03	39.52
Junc J294	1317.43	0.03957	0.06	1355.03	37.6
Junc J295	1317.283	0.137996	0.21	1355.08	37.8
Junc J296	1317.805	0.086708	0.13	1354.95	37.14
Junc J297	1317.635	0.113719	0.17	1354.94	37.31
Junc J298	1314.311	0.098645	0.15	1354.86	40.55

Junc J299	1315.023	0.173473	0.26	1354.85	39.83
Junc J300	1323.906	0	0	1341.91	18
Junc J301	1324.057	0	0	1341.9	17.84
Junc J302	1323.064	0.133975	0.2	1341.69	18.63
Junc J303	1315.52	0.139112	0.21	1341.58	26.06
Junc J304	1315.323	0.131173	0.2	1341.58	26.26
Junc J305	1311.168	0.117581	0.18	1341.34	30.17
Junc J306	1313.341	0.079331	0.12	1341.37	28.03
Junc J307	1315.595	0.310896	0.47	1341.34	25.75
Junc J308	1313.251	0.014105	0.02	1341.42	28.17
Junc J309	1321.038	0.038168	0.06	1341.42	20.39
Junc J310	1313.533	0.036579	0.05	1341.47	27.94
Junc J311	1321.836	0.036901	0.06	1341.47	19.63
Junc J312	1315.195	0.103627	0.16	1341.73	26.53
Junc J313	1313.657	0.109974	0.16	1341.43	27.77
Junc J314	1315.608	0.058915	0.09	1341.43	25.82
Junc J315	1312.319	0.039287	0.06	1341.27	28.95
Junc J316	1320.965	0.168147	0.25	1341.26	20.29
Junc J317	1320.736	0	0	1341.85	21.11
Junc J318	1311.953	0.196105	0.29	1340.66	28.71
Junc J319	1311.265	0.371408	0.56	1340.64	29.38
Junc J320	1312.285	0.218603	0.33	1340.64	28.36
Junc J321	1319.888	0	0	1341.82	21.93
Junc J322	1312.799	0.655933	0.98	1340.49	27.7
Junc J323	1310.467	0.109169	0.16	1340.42	29.95
Junc J324	1309.911	0.081191	0.12	1340.42	30.51
Junc J325	1310.806	0.249118	0.37	1340.42	29.62
Junc J326	1319.253	0.519081	0.78	1340.42	21.17
Junc J327	1314.068	0.428965	0.64	1340.34	26.28
Junc J328	1308.958	0.090631	0.14	1340.46	31.5
Junc J329	1308.769	0.022242	0.03	1332.22	23.45
Junc J330	1308.261	0.135203	0.2	1332.22	23.96
Junc J331	1308.89	0.154241	0.23	1332.35	23.46
Junc J332	1309.593	0.538154	0.81	1334.17	24.58
Junc J333	1308.007	0.167206	0.25	1333.67	25.66
Junc J334	1309.642	0.257737	0.39	1334.29	24.65
Junc J335	1307.7	0.085899	0.13	1333.52	25.82
Junc J336	1307.941	0.032431	0.05	1334.31	26.37
Junc J337	1307.731	0.045685	0.07	1334.31	26.58
Junc J338	1308.764	0.074657	0.11	1334.31	25.55
Junc J339	1306.899	0.114687	0.17	1333.33	26.43
Junc J340	1308.078	0.039734	0.06	1334.34	26.26
Junc J341	1308.742	0.050865	0.08	1334.34	25.6
Junc J342	1309.601	0.137477	0.21	1334.34	24.74

Junc J343	1312.723	0.130467	0.2	1334.35	21.63
Junc J344	1313.435	0.130491	0.2	1334.35	20.92
Junc J345	1312.319	0.234016	0.35	1334.32	22
Junc J346	1312.674	0.087	0.13	1349.59	36.91
Junc J347	1313.452	0.07789	0.12	1334.36	20.91
Junc J348	1310.436	0.073048	0.11	1334.36	23.93
Junc J349	1309.143	0.034915	0.05	1334.38	25.23
Junc J350	1308.997	0.076245	0.11	1334.38	25.38
Junc J351	1309.608	0.066475	0.1	1334.34	24.74
Junc J352	1310.137	0.059309	0.09	1334.34	24.2
Junc J353	1311.339	0.064603	0.1	1334.34	23
Junc J354	1308.32	0.056627	0.08	1334.34	26.02
Junc J355	1307.814	0.071476	0.11	1334.41	26.6
Junc J356	1308.836	0.131163	0.2	1334.4	25.57
Junc J357	1317.095	0.107942	0.16	1334.4	17.3
Junc J358	1316.026	0.13961	0.21	1334.4	18.38
Junc J359	1319.891	0.205064	0.31	1349.38	29.49
Junc J360	1322.341	0.166903	0.25	1349.55	27.21
Junc J361	1322.993	0.073168	0.11	1349.55	26.56
Junc J362	1322.644	0.196785	0.3	1349.55	26.9
Junc J363	1320.824	0.238484	0.36	1349.6	28.78
Junc J364	1310.441	0	0	1349.6	39.16
Junc J365	1308.618	0	0	1349.6	40.98
Junc J366	1309.619	0.12369	0.19	1349.38	39.76
Junc J367	1310.116	0.036596	0.05	1349.36	39.25
Junc J368	1311.098	0.048548	0.07	1349.34	38.24
Junc J369	1311.369	0.156419	0.23	1349.34	37.97
Junc J370	1314.358	0.170497	0.26	1349.34	34.98
Junc J371	1316.067	0.079836	0.12	1349.34	33.27
Junc J372	1316.658	0.198388	0.3	1349.33	32.67
Junc J373	1315.365	0.085782	0.13	1349.34	33.97
Junc J374	1313.278	0.122919	0.18	1349.34	36.06
Junc J375	1318.444	0.113709	0.17	1334.81	16.37
Junc J376	1316.505	0.047097	0.07	1334.73	18.22
Junc J377	1314.735	0.114809	0.17	1334.72	19.99
Junc J378	1314.38	0.053633	0.08	1334.71	20.33
Junc J379	1312.137	0.13264	0.2	1334.7	22.57
Junc J380	1308.026	0.045725	0.07	1334.68	26.65
Junc J381	1307.946	0.06844	0.1	1334.69	26.75
Junc J382	1306.569	0.093102	0.14	1334.69	28.12
Junc J383	1307.647	0.137446	0.21	1334.8	27.15
Junc J384	1310.204	0.106106	0.16	1335.26	25.05
Junc J385	1309.329	0.154854	0.23	1335.25	25.92
Junc J386	1311.689	0.03273	0.05	1335.54	23.85

Junc J387	1311.793	0.066635	0.1	1349.38	37.59
Junc J388	1310.953	0.167456	0.25	1349.37	38.42
Junc J389	1310.324	0.055597	0.08	1335.72	25.4
Junc J390	1310.316	0.101124	0.15	1335.7	25.38
Junc J391	1308.883	0.172424	0.26	1335.69	26.81
Junc J392	1307.068	0.190426	0.29	1335.67	28.61
Junc J393	1309.086	0.176102	0.26	1349.42	40.33
Junc J394	1307.416	0	0	1349.58	42.16
Junc J395	1307.416	0	0	1337.42	30
Junc J396	1305.423	0	0	1336.87	31.45
Junc J397	1305.305	0.20486	0.31	1336.36	31.05
Junc J398	1304.453	0	0	1335.54	31.09
Junc J399	1302.807	0	0	1335.1	32.29
Junc J400	1302.926	0.179102	0.27	1334.15	31.22
Junc J401	1303.664	0.242766	0.36	1334.13	30.47
Junc J402	1303.047	0.164094	0.25	1333.78	30.74
Junc J403	1303.618	0.538914	0.81	1333.67	30.05
Junc J404	1302.808	0.181544	0.27	1333.75	30.95
Junc J405	1302.706	0.180239	0.27	1333.75	31.04
Junc J406	1302.106	0.105637	0.16	1333.75	31.65
Junc J408	1301.672	0.101059	0.15	1333.69	32.02
Junc J409	1302.408	0.06679	0.1	1333.69	31.28
Junc J410	1302.374	0.284255	0.43	1333.67	31.3
Junc J411	1302.713	0.125886	0.19	1333.82	31.1
Junc J412	1302.273	0.324806	0.49	1333.77	31.5
Junc J413	1303.947	0.123536	0.19	1334.4	30.45
Junc J414	1306.513	0.067126	0.1	1334.75	28.23
Junc J415	1306.482	0.175735	0.26	1334.53	28.05
Junc J416	1305.753	0.08091	0.12	1334.45	28.7
Junc J417	1305.439	0.116554	0.17	1334.45	29.01
Junc J418	1305.219	0.061207	0.09	1334.54	29.32
Junc J419	1306.093	0.07481	0.11	1334.6	28.51
Junc J420	1306.613	0.148504	0.22	1334.55	27.93
Junc J421	1307.458	0.11949	0.18	1334.61	27.16
Junc J422	1305.105	0.043851	0.07	1334.62	29.51
Junc J423	1307.006	0.154159	0.23	1334.45	27.44
Junc J424	1307.429	0.174939	0.26	1334.38	26.95
Junc J425	1308.081	0.045409	0.07	1334.38	26.3
Junc J426	1306.124	0.048604	0.07	1334.37	28.25
Junc J427	1306.315	0.035946	0.05	1334.37	28.06
Junc J428	1307.132	0.059065	0.09	1334.37	27.24
Junc J429	1307.553	0.036581	0.05	1334.37	26.82
Junc J430	1305.453	0.093716	0.14	1333.17	27.72
Junc J431	1305.055	0.057756	0.09	1333.12	28.06

Junc J432	1304.345	0.034495	0.05	1333.21	28.87
Junc J433	1304.189	0.043675	0.07	1333.21	29.02
Junc J434	1303.598	0.037375	0.06	1333.21	29.61
Junc J435	1304.671	0.127925	0.19	1333.2	28.53
Junc J436	1304.074	0.029552	0.04	1333.3	29.22
Junc J437	1304.467	0.174953	0.26	1334.41	29.95
Junc J438	1304.15	0.067341	0.1	1333.42	29.27
Junc J439	1303.392	0.19567	0.29	1333.54	30.15
Junc J440	1304.398	0.203604	0.31	1334.36	29.96
Junc J441	1304.876	0.123852	0.19	1334.36	29.48
Junc J442	1303.388	0.182448	0.27	1333.35	29.97
Junc J443	1301.302	0.181206	0.27	1333.65	32.34
Junc J444	1300.622	0	0	1334.18	33.55
Junc J445	1300.324	0	0	1334.15	33.83
Junc J446	1302.535	0.203158	0.3	1330.88	28.34
Junc J447	1302.883	0.247359	0.37	1330.87	27.99
Junc J448	1301.553	0.098465	0.15	1330.23	28.68
Junc J449	1301.745	0.122993	0.18	1330.23	28.48
Junc J450	1301.593	0.040227	0.06	1330.06	28.47
Junc J451	1301.271	0.089285	0.13	1329.8	28.53
Junc J452	1301.239	0.060605	0.09	1329.71	28.47
Junc J453	1301.308	0.709193	1.06	1329.65	28.34
Junc J454	1301.146	0.078766	0.12	1329.69	28.54
Junc J455	1301.156	0.06165	0.09	1329.69	28.53
Junc J456	1302.009	0.14307	0.21	1329.68	27.67
Junc J457	1301.441	0.391186	0.59	1329.81	28.37
Junc J458	1301.438	0.065942	0.1	1329.81	28.37
Junc J459	1301.698	0.675561	1.01	1329.87	28.17
Junc J460	1301.475	0.087374	0.13	1330.04	28.56
Junc J461	1301.616	0.028419	0.04	1330.08	28.47
Junc J462	1301.856	0.078887	0.12	1330.1	28.24
Junc J463	1302.87	0.101897	0.15	1330.31	27.44
Junc J464	1303.176	0.203027	0.3	1330.41	27.23
Junc J465	1303.785	0.324927	0.49	1330.39	26.6
Junc J466	1305.95	0.044833	0.07	1332.38	26.42
Junc J467	1305.978	0.116103	0.17	1332.35	26.37
Junc J468	1304.692	0.220908	0.33	1332.33	27.63
Junc J469	1307.726	0.1303	0.2	1332.25	24.53
Junc J470	1306.234	0.034911	0.05	1332.33	26.1
Junc J471	1306.034	0.050719	0.08	1332.32	26.28
Junc J472	1305.861	0.061558	0.09	1332.32	26.46
Junc J473	1306.573	0.105271	0.16	1332.33	25.76
Junc J474	1306.605	0.188671	0.28	1332.33	25.72
Junc J475	1306.498	0.149053	0.22	1332.29	25.79

Junc J476	1306.831	0.05289	0.08	1332.29	25.46
Junc J477	1307.947	0.120816	0.18	1332.28	24.33
Junc J478	1306.886	0.039417	0.06	1332.25	25.37
Junc J479	1307.321	0.30486	0.46	1332.23	24.91
Junc J480	1307.644	0.146208	0.22	1340.42	32.77
Junc J481	1306.691	0	0	1341.72	35.03
Junc J482	1307.557	0.067248	0.1	1340.4	32.84
Junc J483	1306.313	0.086037	0.13	1330.71	24.4
Junc J484	1306.399	0.202664	0.3	1330.71	24.31
Junc J485	1306.369	0.086172	0.13	1330.48	24.11
Junc J486	1302.382	0.044988	0.07	1330.31	27.93
Junc J487	1302.198	0.049377	0.07	1330.31	28.11
Junc J488	1302.192	0.067673	0.1	1330.31	28.12
Junc J489	1303.606	0.163745	0.25	1330.3	26.7
Junc J490	1301.844	0.10338	0.16	1330.3	28.46
Junc J491	1303.246	0.097214	0.15	1330.3	27.05
Junc J492	1302.499	0.166277	0.25	1330.06	27.56
Junc J493	1302.059	0.165048	0.25	1330.05	27.99
Junc J494	1303.05	0.067597	0.1	1330.35	27.3
Junc J495	1303.065	0.075678	0.11	1330.72	27.66
Junc J496	1302.286	0.111469	0.17	1330.72	28.44
Junc J497	1302.7	0.045867	0.07	1331.22	28.52
Junc J498	1303.035	0.106169	0.16	1331.22	28.18
Junc J499	1302.789	0.036102	0.05	1331.29	28.5
Junc J500	1301.879	0.114308	0.17	1331.85	29.97
Junc J501	1301.576	0.533403	0.8	1331.74	30.16
Junc J502	1301.879	0.074949	0.11	1332.11	30.23
Junc J503	1302.194	0.125425	0.19	1332.1	29.91
Junc J504	1300.379	0	0	1333.77	33.39
Junc J505	1300.379	0	0	1333.78	33.4
Junc J506	1302.84	0	0	1333.84	31
Junc J507	1302.06	0.059605	0.09	1331.35	29.29
Junc J508	1302.937	0.106476	0.16	1331.35	28.41
Junc J509	1302.585	0.049919	0.07	1331.32	28.73
Junc J510	1302.802	0.051479	0.08	1331.32	28.52
Junc J511	1304.136	0	0	1333.89	29.75
Junc J512	1304.308	0.121777	0.18	1330.81	26.5
Junc J513	1304.697	0	0	1333.91	29.22
Junc J514	1304.392	0.143561	0.22	1330.59	26.2
Junc J515	1305.014	0	0	1333.93	28.91
Junc J516	1304.751	0.205856	0.31	1330.5	25.75
Junc J517	1307.203	0	0	1333.96	26.75
Junc J518	1306.217	0	0	1334.05	27.83
Junc J519	1305.137	0.124044	0.19	1330.24	25.1

Junc J520	1305.812	0.2193	0.33	1330.22	24.4
Junc J521	1304.513	0.10475	0.16	1330.24	25.72
Junc J522	1304.585	0.13933	0.21	1330.23	25.65
Junc J523	1304.095	0.159337	0.24	1330.26	26.16
Junc J524	1304.591	0.153786	0.23	1330.24	25.65
Junc J525	1303.468	0.101054	0.15	1330.24	26.77
Junc J526	1306.279	0.115198	0.17	1330.25	23.97
Junc J527	1307.818	0	0	1334.12	26.3
Junc J528	1306.432	0.079352	0.12	1330.25	23.82
Junc J529	1306.064	0.119287	0.18	1330.25	24.18
Junc J530	1307.479	0.061159	0.09	1330.26	22.78
Junc J531	1306.74	0.012584	0.02	1330.26	23.52
Junc J532	1306.576	0.030447	0.05	1330.26	23.68
Junc J533	1306.529	0.004736	0.01	1330.26	23.73
Junc J534	1306.349	0.062436	0.09	1330.26	23.91
Junc J535	1306.331	0.020457	0.03	1330.26	23.93
Junc J536	1307.409	0	0	1334.14	26.73
Junc J537	1307.676	0	0	1341.72	34.04
Junc J538	1307.761	0.097161	0.15	1340.39	32.62
Junc J539	1308.293	0	0	1341.71	33.42
Junc J540	1309.764	0.152126	0.23	1340.39	30.63
Junc J541	1311.123	0.120216	0.18	1340.39	29.27
Junc J542	1308.758	0	0	1341.71	32.96
Junc J543	1311.634	0.435366	0.65	1340.3	28.67
Junc J544	1311.312	0	0	1341.71	30.4
Junc J545	1316.724	0	0	1341.71	24.98
Junc J550	1320.04	0.055551	0.08	1349.38	29.34
Junc J555	1334.706	0.275739	0.41	1349.42	14.72
Junc J560	1317.114	0.11097	0.17	1349.21	32.1
Junc J565	1317.114	0.027768	0.04	1334.47	17.36
Junc J570	1328.053	0	0	1351.05	23
Junc J580	1301.147	0	0	1334.06	32.91
Junc J585	1308.897	0.040357	0.06	1334.34	25.44
Junc J590	1303.446	0.318163	0.48	1333.73	30.28
Junc J595	1325.418	0.227642	0.34	1354.55	29.13
Junc J575	1300.835	0	0	1333.96	33.12
Junc To_A-2.5	1331	188.79	283.18	1369.19	38.19
Junc To_A-2.4	1344	41.32	61.98	1371.36	27.36
Junc To_A-2.3	1334.645	0	0	1369.64	34.99
Junc Bansbari3	1335.417	0	0	1369.79	34.38
Junc Bansbari2	1344	0	0	1371.54	27.54
Junc TO_A-2.1	1356	69.8	104.7	1373.74	17.74
Junc Bansbari1	1356	0	0	1373.78	17.78
Junc Bansbari4	1343.41	162.2	243.3	1371.38	27.97

Junc 295a	1315.195	0	0	1355.44	40.24
Junc J565a	1319.812	0	0	1334.74	14.93
Junc Bansbari31	1328	0	0	1368.33	40.33
Junc Bansbari32	1308	0	0	1360.03	52.03
Junc Bansbari30	1334	0	0	1369.72	35.72
Junc Bansbari33	1332	0	0	1369.51	37.51
Junc Bansbari34	1329	0	0	1369.23	40.23
Junc Bansbari35	1329	0	0	1369.17	40.17
Junc Bansbari36	1332	0	0	1369.05	37.05
Junc Bansbari37	1329	0	0	1368.88	39.88
Junc Bansbari38	1326	0	0	1368.76	42.76
Junc Bansbari39	1323	0	0	1368.65	45.65
Junc Bansbari40	1320	0	0	1368.53	48.53
Junc 1	1326.945	0	0	1368.37	41.42
Junc Bansbari20	1342	0	0	1371.26	29.26
Junc I308	1341	36.12	54.18	1371	30
Junc 2	1336.308	0.113689	0.17	1356.96	20.66
Junc 3	1334.234	0.318352	0.48	1357.33	23.1
Junc 4	1334.022	0.03249	0.05	1357.28	23.25
Junc 5	1333.164	0.036306	0.05	1356.76	23.59
Junc 6	1331.988	0.122672	0.18	1356.27	24.29
Junc 7	1329.072	0.149495	0.22	1355.81	26.74
Junc 8	1324.401	0.08814	0.13	1355.81	31.41
Junc 9	1324.401	0.037648	0.06	1355.83	31.43
Junc 10	1324.835	0.064643	0.1	1356.15	31.32
Junc 11	1335.3	0	0	1355.88	20.58
Junc 12	1329.073	0	0	1355.49	26.41
Junc 13	1315.195	0	0	1355.44	40.24
Junc 14	1311.682	0	0	1355.45	43.77
Junc 15	1323.906	0.108777	0.16	1355.46	31.55
Junc 16	1324.795	0.101179	0.15	1354.8	30
Junc 17	1325.255	0.064241	0.1	1354.72	29.46
Junc 18	1325.917	0.117899	0.18	1354.7	28.78
Junc 19	1328.838	0.126742	0.19	1354.61	25.78
Junc 20	1329.697	0.167472	0.25	1354.62	24.93

Junc 21	1330.944	0.13019	0.2	1354.78	23.83
Junc 22	1331.296	0.090454	0.14	1354.8	23.51
Junc 23	1331.581	0.081781	0.12	1354.92	23.34
Junc 24	1332.378	0.132321	0.2	1355.28	22.9
Junc 25	1333.321	0.124347	0.19	1355.94	22.62
Junc 26	1333.188	0.15084	0.23	1355.61	22.42
Junc 27	1334.014	0.279385	0.42	1355.28	21.27
Junc 28	1333.878	0.282284	0.42	1355.24	21.36
Junc 29	1334.888	0.097875	0.15	1355.53	20.64
Junc 30	1336.308	0	0	1358.3	21.99
Junc 31	1328.053	0.168275	0.25	1351.05	23
Junc 32	1326.352	0.182415	0.27	1349.68	23.33
Junc 33	1325.528	0.14536	0.22	1349.54	24.01
Junc 34	1325.784	0.097919	0.15	1349.5	23.72
Junc 35	1326.245	0.132353	0.2	1349.46	23.21
Junc 36	1323.272	0.401182	0.6	1349.41	26.14
Junc 37	1320.887	0	0	1349.64	28.75
Junc 38	1320.824	0	0	1349.63	28.8
Junc 39	1310.441	0.297764	0.45	1349.5	39.06
Junc 40	1308.618	0.162956	0.24	1349.49	40.88
Junc 41	1307.416	0.152061	0.23	1349.58	42.16
Junc 42	1320.04	0	0	1349.57	29.53
Junc 43	1312.674	0	0	1349.59	36.91
Junc 44	1330.922	0	0	1349.82	18.9
Junc 45	1335.3	0	0	1350.48	15.18
Junc 46	1320.824	0	0	1349.62	28.8
Junc 47	1320.824	0	0	1349.63	28.8
Junc 48	1322.341	0	0	1349.56	27.22
Junc 49	1323.906	0.02252	0.03	1341.91	18
Junc 50	1324.057	0.035439	0.05	1341.69	17.64
Junc 51	1320.736	0.137848	0.21	1340.9	20.16
Junc 52	1319.888	0.223659	0.34	1340.89	21
Junc 53	1316.724	0.354074	0.53	1341.71	24.98
Junc 54	1311.312	0.296822	0.45	1340.69	29.37
Junc 55	1308.758	0.14397	0.22	1340.41	31.65
Junc 56	1308.293	0.102521	0.15	1340.39	32.1
Junc 57	1307.676	0.111144	0.17	1340.39	32.71
Junc 58	1306.691	0.112423	0.17	1340.4	33.71
Junc 59	1308.958	0	0	1341.72	32.76
Junc 60	1315.195	0	0	1341.73	26.53
Junc 61	1311.168	0	0	1341.81	30.64
Junc 62	1307.416	0.174268	0.26	1337.41	30
Junc 63	1311.689	0	0	1335.55	23.86
Junc 64	1312.319	0	0	1335.03	22.71

Junc 65	1306.369	0	0	1334.17	27.8
Junc 66	1307.409	0.049543	0.07	1330.29	22.88
Junc 67	1307.818	0.118418	0.18	1330.27	22.45
Junc 68	1306.217	0.161236	0.24	1330.27	24.05
Junc 69	1307.203	0.063565	0.1	1330.45	23.25
Junc 70	1305.014	0.066611	0.1	1330.52	25.5
Junc 71	1304.697	0.069801	0.1	1330.6	25.9
Junc 72	1304.136	0.124758	0.19	1330.82	26.68
Junc 73	1302.84	0.092767	0.14	1331.48	28.64
Junc 74	1300.379	0.072407	0.11	1333.43	33.05
Junc 75	1300.379	0.363089	0.54	1333.76	33.38
Junc 76	1300.835	0.709193	1.06	1333.01	32.17
Junc 77	1301.147	0.353878	0.53	1333.01	31.86
Junc 78	1300.324	0.297509	0.45	1333.12	32.79
Junc 79	1300.622	0.223247	0.33	1334.17	33.55
Junc 80	1302.807	0.230906	0.35	1334.17	31.36
Junc 81	1304.453	0.472721	0.71	1335.54	31.09
Junc 82	1305.423	0.443534	0.67	1336.37	30.95
Junc 83	1311.689	0	0	1335.51	23.82
Junc 84	1311.689	0	0	1335.54	23.85
Junc 85	1305.105	0	0	1334.64	29.54
Junc 86	1304.15	0	0	1334.55	30.4
Junc 87	1307.647	0	0	1334.81	27.16
Junc 88	1307.647	0	0	1334.83	27.19
Junc 89	1306.513	0	0	1334.54	28.03
Junc 90	1303.947	0	0	1334.72	30.77
Junc 91	1305.219	0	0	1334.63	29.41
Junc 92	1305.105	0	0	1334.63	29.53
Junc 93	1309.593	0	0	1334.32	24.73
Junc 94	1309.593	0	0	1334.32	24.73
Junc 95	1309.593	0	0	1334.32	24.73
Junc 96	1304.15	0	0	1334.45	30.3
Junc 97	1304.074	0	0	1334.42	30.35
Junc 98	1305.453	0	0	1334.37	28.92
Junc 99	1306.899	0	0	1334.34	27.44
Junc 100	1307.7	0	0	1334.32	26.62
Junc 101	1308.007	0	0	1334.31	26.3
Junc 102	1334.234	0	0	1357.4	23.16
Junc 103	1341.402	0	0	1356.97	15.57
Junc 104	1336.079	0	0	1356.06	19.98
Junc 105	1318.723	0	0	1355.51	36.79
Junc 106	1318.723	0	0	1355.51	36.78
Junc 107	1329.073	0	0	1355.48	26.41
Junc 108	1329.073	0	0	1355.48	26.41

Junc 109	1316.602	0	0	1355.45	38.85
Junc 110	1319.545	0	0	1355.23	35.69
Junc 111	1320.107	0	0	1355.12	35.02
Junc 112	1328.838	0	0	1355.01	26.18
Junc 113	1328.36	0	0	1355.02	26.66
Junc 114	1335.634	0	0	1354.96	19.32
Junc 115	1342.291	0	0	1354.9	12.61
Resvr Bansbari	1374.4	#N/A	-852.65	1374.4	0

6.3.5 Pipe Abstract

Table 6.29: Abstract of Pipe Length of DNI 7C area

DNI 7C Pipe Detail

Sn	Pipe Dia	Unit	DMA G			DMA H			DMA I			DMA J			Grand Total		
			Total	HDD	Open Cut	Total	HDD	Open Cut	Total	HDD	Open Cut	Total	HDD	Open Cut	Total Pipe Length	Opencut	HDD
A	Primary Main																
2	900mm	m	1,361.85		1,361.85										1,361.85	1,361.85	-
			-												-	-	-
B	Secondary and Tertiar		-												-	-	-
1	600mm	m	1,181.25		1,181.25	-			-			-			1,181.25	1,181.25	-
3	500mm	m	61.95		61.95	-			169.05		169.05	-			231.00	231.00	-
4	400mm	m	1,145.55		1,145.55	-			648.90		648.90	-			1,794.45	1,794.45	-
5	315mm	m	398.20	398.20		1,251.80	1,251.80		-			482.90	482.90		2,132.90	-	2,132.90
6	280mm	m	1,356.00	1,356.00		527.44	527.44		1,587.06	1,587.06		-			3,470.50	-	3,470.50
7	225mm	m	807.00	807.00		85.00	85.00		-			2,030.00	2,030.00		2,922.00	-	2,922.00
8	160mm	m	19,802.03	12,143.00	7,659.03	13,227.18	7,239.00	5,988.18	18,121.30	17,447.00	674.30	13,679.20	9,090.00	4,589.20	64,829.71	18,910.71	45,919.00
9	75mm	m	63,192.24		63,192.24	36,750.63		36,750.63	50,646.96		50,646.96	33,651.07		33,651.07	184,240.89	184,240.89	-
			89,306.06	**14,704.20**	**74,601.86**	**51,842.05**	**9,103.24**	**42,738.81**	**71,173.27**	**19,034.06**	**52,139.21**	**49,843.17**	**11,602.90**	**38,240.27**	**262,164.54**	**207,720.15**	**54,444.40**

Table 6.30: Abstract

Description	DNI-G	DNI-H	DNI-I	DNI-J
Pipe Length (m)				
Isolation Valve	7	3	6	4
Bulk Meter	7	3	6	4
Fire Hydrant	53	29	41	41
Air Valve	12	20	26	19
Washout Valve	27	24	28	25
PRV	7	3	6	4
DMA	7	3	5	4

7

Project Cost

7.1 Basis of Costing

The unit price or lump sum prices were analysed considering the following:

- Standard GON norms of unit price analysis and other accepted norms in recent ICB and LCB contracts in the country and elsewhere
- Market Prices/FOB prices for imported materials as pipes, accessories etc.
- Wages of skilled and unskilled labor
- Construction technology
- Mobilization and demobilization cost
- Overheads and profit
- Contract tax or VAT

Break-down into plant, materials and labor component for all unit prices was derived. Unit rates for individual items were determined on basic inputs, overheads and profit including the determination of the foreign exchange component of each element.

Table 7.1: Cost Estimate for DNI- 7C area

Project Name:	**DNI - 7C - V 01**	
Total Cost	**2,459,551,675.13**	
Contengencies @ 20%	491,910,335.03	
Sub Total	***2,951,462,010.16***	
13% VAT	383,690,061.32	
Grand Total	**3,335,152,071.48**	
Projected project cost including VAT Only	2,779,293,392.90	
Duration of projct	30.00	months
Equivalent to year	2.50	years

8

Operation and Maintenance Plan

8.1 General

A well-designed Operation and Maintenance (O&M) Plan for a water supply system is critical to ensure that the design intent is conveyed in daily operation resulting in maximum benefit to the residents at the minimum possible level of investment. Proper implementation of the O&M plan results in low maintenance cost and ensures longer service life of all system components.

The critical issues to be taken care of in the development of an O&M Plan will be the maintenance of equipment, pipelines, valves & other appurtenances and the system of providing house service connections.

8.2 Proposed Maintenance System

8.2.1 Preventive Maintenance

The preventive maintenance of a water distribution system is a set of activities that shall be performed on a regular basis.
Preventive maintenance may increase the initial project cost marginally, but will result in an economical maintenance of the system over the project life. Specifically, in the internal water distribution system, preventive maintenance will increase the life of water mains and appurtenances, which in turn will assure regular and uninterrupted water supply to consumers.

The water distribution system is usually one of the most expensive components of a water supply system and its proper maintenance will reflect on the functioning of the system and its associated service life. The KMC has an advantage on this water supply project with respect to O&M, since no major electrical and mechanical equipment's are installed in the system and electric power is apparently not relied on.

Maintenance issues in pipelines will differ from place to place depending on the conditions encountered. Selection of suitable pipe material and periodical maintenance is essential to ensure protected water supply at the most economical rate with minimum breakdowns, which will ultimately manifest itself as consumer satisfaction. The points to be considered while planning are enumerated below:

- Periodic inspection of mechanical / electrical equipment such as pumps and motors installed at the WTP, valves, capacitors, voltage stabilizer etc. shall be done for trouble-free operation and optimum performance
- Materials of superior quality shall be procured for replacements
- Newly laid mains shall be regularly tested
- Precautionary measures against corrosion shall be performed
- Leak detection surveys shall be performed from time to time.
- Ducts shall be provided across streets to permit easy laying of additional mains, if required

- Provisions of stubs (short length mains) shall be made to accommodate a group of ferrule connections
- Equipment like submersible dewatering pumps, pipe cutting machines, cutting machines, pipe detectors, leak detectors, lighting sets, spare valves etc. shall be arranged for O&M.
- Preparation of 'ward manuals' with details of mains, valves, hydrants, etc. within a ward or zone shall be done.
- Emergency labor teams to work on Sunday and holidays to attend emergency works shall be available.
- Liaison with custodians of other utilities for proper work co-ordination and reduced interference shall be taken care.
- Adequate staff training shall be arranged from time to time.
- A system of information dissemination to consumers on possible disruption in supply shall be established.

8.2.2 Breakdown / Emergency Maintenance

In case of damage (burst) resulting on a main, the following operational sequence shall be adopted:

- Labor workforce (skilled & unskilled) shall be mobilized and required materials shall be assimilated and the team shall be directed to the breakdown site.
- Main control stations / senior off
-
- icers concerned with maintenance of

water distribution shall be informed of the situation and the progress monitored.

- The concerned control office shall be intimated to isolate the damaged main and alternative supply arrangements (if possible tankers) for water supply to the localities affected shall be pressed into action.
- Utilities such as Roads, Electricity & Telephones shall be informed of the breakdown and requested to be present at site to ensure coordination.
- The local traffic police shall be informed to ensure proper traffic regulation.
- Isolation of the water main by closing sluice valves on all sides shall be done if the pipe is damaged severely.

8.2.3 Maintenance of Appurtenances

The objective of installing appurtenances on water pipelines is to permit control of water supply, protect the pipelines and assist with periodical cleaning. Normally installed appurtenances are described below.

Sluice valves

Sluice valves are required to control and regulate water supply and shall be provided at suitable locations considering the length of pipeline and take off branches. Defects normally reported on the sluice valves are the following:

- **Gland leaks:** Gland leaks can be rectified by replacing the hemp packing when noticeable leaks are observed.
- **Spindle damage:** Unequal application of pressure results in damage to the spindle, which can be avoided by training valve operators to operate the valve in accordance with manufacturer's recommendations on tightening pressure. It is necessary to have spare spindles for the full range of valves to ensure replacement in the shortest possible time frame
- **Partial valve closure:** Debris accumulated in the valve seat and around spindle heads causes this problem and can be removed by opening the top cover of the sluice valves. Round out of spindle heads are a direct consequence of wear and tear and this can be reduced by using specially prepared caps

It is a recommended practice to provide a name plate on the valve chamber or near the curb edge detailing sluice valves with location, size and direction of opening. This will reduce the complaints regarding sluice valves getting buried during road construction and/or trench backfill. When possible, sluice valves shall be installed along pavements. Sluice valves in roads where there is intense traffic shall be provided with heavy-duty covers with markings of pipeline alignment to avoid intentional or accidental damage.

8.2.4 Scour Valves

Scour valves are normally provided at the bottom of pipelines (normally horizontal) and operated to flush and dewater the mains.

8.2.5 Air Valves

Air valves are provided on the top of pipelines where there is an acute horizontal / vertical direction changes.

8.2.6 Quality of Materials

The water supply system will work without (or with very minimal) interruption if the procured materials such as pipes and appurtenances are of standard quality. It is therefore necessary to use standard materials of approved make and establish procedures right from procurement of materials to installation, testing and commissioning.

The pipes procured shall be subjected to hydraulic pressure tests as specified in IS: 1536-1967. If the testing facility does not exist, a manufacturer's test certificate shall be obtained and filed for reference. Manufacturers shall test pipes in the presence of the representative of KUKL and submit a test certificate while delivering the pipes.

Valves, hydrants and other appurtenances shall be tested prior to installation. It is recommended to invest more in procuring good quality materials rather than purchasing inferior materials and then incur high maintenance expenditure.

8.2.7 Maintenance of Service Reservoirs

The important aspects to be considered in the maintenance of service reservoir are:

- **Measurement of inflows / outflows:** Supply and Discharge flows or at least discharge flows shall be measured to ensure the losses. Water level indicators and flow indicators / recorders shall be in working condition.
- **Structural leakage:** All structural damages and leak shall be promptly repaired.
- **External Pollution:** Manhole openings, ventilation shafts and overflow pipes shall be adequately protected and checked periodically to prevent any contaminant infiltration.
- General cleanliness in and around the service reservoirs shall be maintained and observed.
- A garden around the service reservoir can be provided, wherever possible, for aesthetic reasons.
- A program to clean the service reservoir at least twice in a year shall be undertaken. Such cleaning process shall be performed during non-supply times or a facility to by-pass the water supply shall be in place.
- Appropriate safety measures to prevent entry of unauthorized persons shall be provided.
- All guide and hand railings shall be maintained in a safe and firm condition.

8.2.8 Maintenance of Bulk Distribution System

Conveyance and water distribution are items that involve substantial expenditure in a large water supply scheme. For effective maintenance, the entire water distribution system shall be divided into zones served preferably from a minimum number of service reservoirs. Operation and

Maintenance of the water distribution system shall be entrusted to at least a Junior Engineer who shall be the authorised official of the controlling authority to receive and deal with complaints. Appropriate registers shall be maintained to record complaints and track follow up action to ensure that the complaint is addressed. He shall be provided with sufficient funds to face an emergency. If the complaint is such that it cannot be dealt with at his level, the Junior Engineer shall promptly refer the matter to a higher authority and also intimate the action taken to the complaint. Frequent vigilance checks in areas receiving maximum complaints shall be made as an essential part of the supervisory staff's daily schedule of duties.

8.2.9 Annual O&M Cost

It is envisioned and recommended that KUKL will be responsible for Maintenance and Operation of the entire water supply system. However, it may also be possible for KUKL to privatize the O&M through a fixed cost contract and supervise the maintenance.

9

Institutional Strengthening & Training

9.1 General

Good Organisation set-up is a prerequisite for efficient maintenance of a water supply system. A local body with a good organisational set-up and definite tasks assigned to its employees will have minimum maintenance problems. The existing Organisation set-up in KUKL is very small, considering the future improvements to the water supply system of Kathmandu City.

9.2 Present Institutional Set-up & Restructuring

The institutional framework for urban development was created in early 1990's with the establishment of the Ministry of Housing and Physical Planning (now under newly formed Ministry of Urban Development - MoUD), Nepal Water Supply Corporation (NWSC), Urban Development Training Centre, and town development committees in each municipality. The Town Development Fund was established in the mid-1990s as a source of urban finance. Several Government Ministries, departments and other agencies are involved in the management of the water supply sector and related activities. Major institutions involved and responsible for development and management of water supply services in the Kathmandu Valley are:

- **Ministry of Urban Development** (**MoUD)** is responsible for formulating national level policies and programs and guiding sector activities to meet objectives and targets.

- **Department of Water Supply and Sewerage (DWSS)** is the lead agency in the sector and is responsible for water supply services in rural areas and small urban centers.

- **Nepal Water Supply Corporation (NWSC)** is a semi-autonomous corporation responsible for water supply and sewerage in major urban centres outside of Kathmandu Valley.

- **Kathmandu Valley Water Supply Management Board (KVWSMB)** is an autonomous body established under WSMB Act (2006) and responsible for water supply and sewerage services in Kathmandu Valley.

- **Water Supply Tariff Fixation Commission (WSTFC)** is an autonomous body responsible for economic regulation of water supply and wastewater services and to fix the tariff.

- **Kathmandu Upatyaka Khanepani Limited (KUKL)** was set up in 2008 under a Public Private Partnership (PPP) model under the Companies Act for operation and maintenance of water supply system in Kathmandu Valley under lease and license (30 year) from KVWSMB.

9.3 Training for Water Supply Personnel

9.3.1 Introduction

Recruitment of trained engineering personnel for management of water works is an important issue confronting organisation like Public Health Engineering Department, Municipalities and Industries possessing their own waterworks. Of equal importance is the problem of keeping such personnel technically updated. Special efforts to impart in-service training or continuing professional education should go along with employment of such personnel.

In view of the rapidly changing pace of science and technology, individuals initially educated in traditional disciplines in engineering and employed in the waterworks industry should obtain additional training, if they are to continue performing their technical duties effectively. Formal academic education may not equip an employee to cope indefinitely with challenges posed.

Necessity of Training

A valuable resource in a waterworks utility is the personnel. Their proficiency directly influences quality of service and overall economy. Creative, hard- working and well-trained employees capable of achieving high standards of performance enhance the status of a utility company with resultant additional benefits such as the following:

- Increased efficiency of operation with advanced knowledge of operational practice;
- Overall economy by virtue of expanded skilled operation and maintenance;
- Improvement in quality of treated water;
- Improved public relations; and
- Improved public health conditions due to supply of water of superior quality closely controlled by trained laboratory staff.

In recent years, there has been an increased realisation of importance of maintaining specialised operating personnel and attention has also been focussed on the need for training employees at different levels. Training cannot end with just one course. To be effective, it has to be a continuous process. Each employee should be trained year after year through employment. In this town, due to lack of training both for the field staff as well as the Engineers; the maintenance system is found to be not satisfactory. It is therefore necessary that periodical intensive training be given to the operating staff with the following areas of focus:

- Interaction with consumers
- Need for providing potable water supply
- Description and application details of instruments and other accessories required for maintenance work
- Need for proper maintenance of the same and monitoring how each activity shall be operated upon / performed.

- During emergency break down, how system has to be restore within a minimum breakdown period.
- Training and field visits to other project sites to get firsthand information about proper maintenance procedures.
- Maintaining of records and necessary field documents regarding Operation and Maintenance (O&M) of various units in the water supply scheme and periodical interaction with higher authorities for effective follow up action.

9.3.2 Training Requirements

The existing water supply scheme was constructed by KUKL. The headworks, Sundarijal Water Treatment Plant, existing service reservoirs and internal water distribution system are being maintained by the KUKL. Though most of them are qualified for the O&M of water supply schemes, they are not trained to handle and properly operate and maintain the electrical and mechanical equipment in water treatment plant. This results in frequent failure of starters and other electrical equipment like switches and control panel. At the time when KUKL employs its own staff for O&M, the staff needs training for proper O&M of the equipment and the proposed water supply scheme.

9.3.3 Training Plan

The operating staff of KUKL shall to be trained in the following:

- Basic principle of various machineries working
- Basic Knowledge in the working of motor, starters, circuit breakers & switches.
- Purpose of various types of valves – Sluice valve and Scour valve etc.
- Valve operations at headworks and in the gravity main.
- Preventive maintenance of electrical and mechanical equipment
- Attending to minor repairs, major repairs – procedure to be followed
- Various types of pipes and pipe materials – pressure ratings
- Log books – maintenance & upkeep of records
- Importance of keeping good health and hygiene
- Management of crises in the Operation & Maintenance

10

Procurement Strategy

10.1 Implementation Options

The Proposed improvement works under 7C DNI areas have been divided into Contract Package 6.

Contract Package 6: DNI Zone - G, H, I & J.

The various options considered for the implementation of the Distribution Network Improvement System are as follows:

- International Supply and Construction Contract
- International Supply Contract and separate International Construction Contract
- International Supply Contract and separate Local Construction Contract

10.2 Proposed Implementation Method

Considering the size, the relative lack of complexity, and the capabilities of available international contractors, it is recommended that the construction of the project be accomplished by one competitively bid, qualified contractor or joint venture. The recommended approach was discussed and agreed with PID.

To follow the ADB's Procurement Guidelines it is proposed to use International Competitive Bidding for the supply and construct pipeline contract. The adoption of ICB will not exclude local contractors. They can form joint ventures either with international or local contractors.

10.3 Construction Period

A 30-month construction period is proposed.

10.4 Post Qualification of Contractors/Tenderers

It has been discussed and agreed with PID to perform post qualification rather than prequalification of bidders. This will further accelerate project implementation by ensuring that tender documents for the supply and construction contract will be issued in the shortest possible time.

10.5 Form of Tender

The model form of contract will be ADB's Standard Bidding Documents for Procurement of Works (without Prequalification), dated September 2010. International Competitive Bidding will be conducted in accordance with ADB's Single-Stage, Two-envelope Bidding procedure. It is based on the Master Procurement Document entitled "Bidding Document for the Procurement of

Works", prepared by multilateral development banks and other public international financial institutions which reflects the majority view of these institutions. This document has the structure and the provisions of the Master Procurement Document, except where ADB-specific considerations have required a change.

The documents have been prepared in the following volumes:

Volume: I – Bidding Procedures
Section 1: Instructions to Bidders
Section 2: Bid Data Sheet
Section 3: Evaluation and Qualification Criteria
Section 4: Bidding Forms (including BOQ)
Section 5: Eligible Countries

Volume: II – Requirements – Specifications
Section 6A: Technical Specifications

Volume: III – Requirements - Drawings
Section 6B: Drawings

Volume: IV – Conditions of Contract and Contract Forms
Section 7: General Conditions of Contract
Section 8: Particular Conditions of Contract
Section 9: Contract Forms

By referring the above bid documents, other documents have been prepared and submitted separately.

10.6 Quantity and Cost Estimates

Based on the detail design and drawings prepared, the bills of quantities have been prepared for all components of the project. Cost estimates were prepared considering the established quantity of works and unit prices.

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SECTION 1

1. Introduction

1.1 GENERAL BACKGROUND

Nestled in the lap of Himalayas, Nepal is a small and beautiful country spreading over a geographical area of 147,181 sq. km. The population of Nepal is recorded 26.4 million (Census 2011). The urbanization rate is lower at 16% in comparison with its South Asian counter parts. The capital city Kathmandu is the largest urban centre and has been experiencing rapid urban growth in recent years. The last decade experienced a growth of 7% which is one of the highest in the urbanizing world.

The Kathmandu valley is spread over an area of 900 sq. km, and comprises five municipalities and is home to about 30% of the country's urban population.

The rapid increase in population affected both by natural growth and immigration, has increased the demand for infrastructure services, housing, and for other amenities in Kathmandu Valley. The infrastructure development, on the other hand, has not been up to the requirement. These are resulted in large gap in service delivery, especially in basic services like water supply, sewerage and power supply. Lack of operational wastewater system facilities converted the holy Bagmati River into a highly polluted river.

The project was developed using lessons from previous ADB interventions. An important lesson from earlier projects was to give importance to rehabilitation of networks along with creation of assets. Accordingly, the project will focus on reducing non-revenue water (NRW) and improving the existing network. To drive efficiencies and introduce best practices, the project will utilize the District Metering Areas (DMA) approach for distribution network improvement (DNI) and non-revenue water (NRW) reduction. With the completion of Melamchi tunnel, Kathmandu Valley will receive an additional 170 million litres per day (MLD) upon completion of stage one while the current average availability is only 100 MLD against a demand of 367 MLD for 2014-15. The project will adopt contracts with adequate provisions to monitor NRW reduction, introduce asset management plan, and develop geographical information system (GIS) to maximize benefits.

The expected impact of the project is sustainable water supply services for residents of Kathmandu Valley covered under the scope. The expected outcome is improved access, efficiency, and reliability of water supply services to the residents of Kathmandu Valley including poor women and men. The project will prioritize underserved areas and poor sections of the population in Kathmandu Valley. The project will further enhance capacities of the urban areas to attract investments, increase productivity and create enabling environment for higher economic growth. Piped water through individual household connection will relieve women of

the drudgery of managing water, thereby giving them more time for social and economically productive activities.

1.2 PROJECT BACKGROUND

Kathmandu Valley is currently suffering from chronic water shortages and inefficient service delivery. To improve the present conditions of water supply and wastewater services in Kathmandu Valley, the Government of Nepal(GoN), with the assistance of several development partners, has embarked on a two-pronged improvement strategy that includes capital investments for infrastructure development, i.e., supply augmentation and system improvement and institutional reforms. In order to assist GoN in this endeavor, the Asian Development Bank(ADB) has provided loans covering both infrastructure investment and institutional reforms, namely Loan1820-NEP : Melamchi Water Supply Project and Loans2058/2059-NEP : Kathmandu Valley Water Services Sector Development Program.

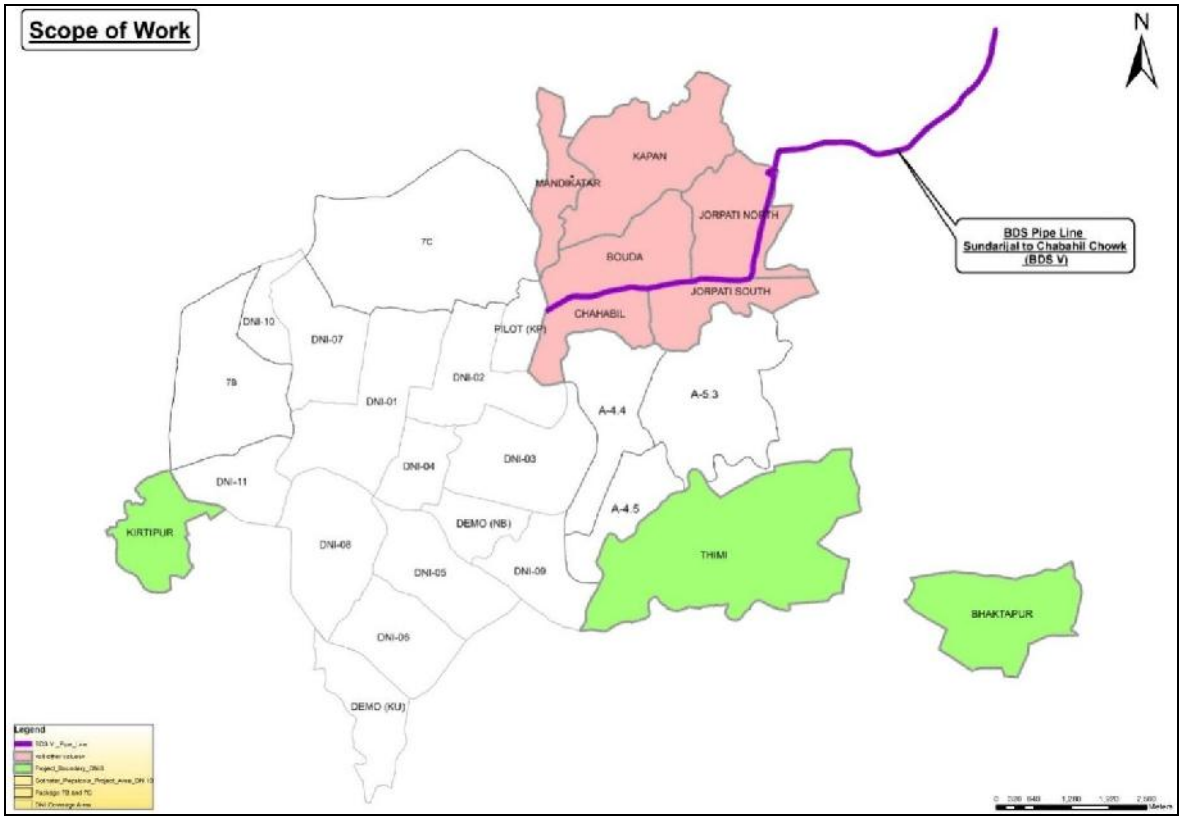
To address the water supply challenges in the Kathmandu Valley, the government updated its ambitious capital investment and asset management program (CIAMP) in 2010, which envisages providing 135 liters per capita per day (lpcd) to the residents of Kathmandu Valley by 2025 from the current level of 45 lpcd. The plan defines two major phases for rehabilitation and expansion of the water supply and wastewater system. Phase 1 (2012-2016) focuses on rehabilitation of existing assets, development of a new water source, and initial expansion of the water distribution and wastewater system. Phase 2 (2016-2025) focuses on additional source augmentation and further expansion of the water distribution and wastewater system.

In line with Phase 1 requirements, ADB approved the original project on 16 September 2011 and it became effective on 7 February 2012. The $80 million loan complements ongoing investments to improve access, efficiency, and reliability of water supply services for the residents of Kathmandu Valley through improving the distribution system and enhancing operational and financial performance of the water utility, the Kathmandu Upatyaka Khanepani Limited (KUKL). Phase 1 is also supported by the Melamchi Water Supply Project (MWSP) and the Kathmandu Valley Wastewater Management Project. The Kathmandu Valley Wastewater Management Project will manage the wastewater generated from households receiving water from these projects. Phase 1 investment is the first step towards improving services but is still inadequate for serving the entire population of the Client's service area.

Additional financing (this project) will support the completion of Phase 1 and will start Phase 2 investments with a focus on distribution network expansion and improvement. The additional financing is in line with ADB's Nepal country partnership strategy, which supports the government's development objective of accelerated, sustainable, and inclusive economic growth.

1.3 SCOPE OF THESE DESIGN WORKS FOR DNI 9

Survey, investigation, detail design, bidding documents preparation and procurement support for the DNI 9 (Chabahil, Bouda, Jorpati, Kapan, Mandikatar)
Figure 1.1 indicates the location of the DNI boundaries and the Red area is DNI9.



< Figure 1.1: Location of DNI >

The Consultant understands and acknowledges the work to be completed under the Contract with detailed scheduling and resources planned for the most efficient implementation.

For DNI9 works, the Consultant reviewed the master plan, related documents, current status and identified Mandikatar, Kapan and Jorpati area was not included in the master plan. These boundaries are outside of Kathmandu Metro boundary where 510MLD is planned to be distributed from Sundarijal WTP. The Consultant reviewed and had population projection of these areas. After conferencing with PID and KUKL, we have decided to target certain existing/new SRTs to carry on with the design. The next Master plan [post Melamchi Phase (CIAMP)] shall consider the existing sources and distribute according to our DNI designs and modify if necessary.

Additional boundaries are targeted as following; Mandikatar targeted from OLD Bansbari, Kapan from Arubari, Jorpati (North) from NEW Mahankal and Jorpati (South) from OLD

Mahankal SRT. For boundaries within the Kathmandu Metro boundary will follow target SRTs as per CIAMP and other previous reports.

Details of the targeted SRTs will be shown in section 2.

1.4 INSTITUTIONAL ARRANGEMENT

Following are the key agencies involved in the project implementation.

(i) **Executing Agency:** The Ministry of Water Supply (MoWS) is the executing agency responsible for overall strategic planning, guidance and management of the project and for ensuring compliance with loan covenants.

(ii) **Implementing Agency:** KUKL, the asset operator and service provider, through its existing Project Implementation Directorate (PID), is the implementing agency responsible for (i) project planning, implementation, monitoring and supervision, (ii) reporting to KUKL Board of Directors, MoWS and ADB, and (iii) coordination of all activities in the project. PID is staffed with sufficient number of experienced professionals headed by Project Director, who is a Joint Secretary level GON officer. PID is supported by the following consultants:

(iii) **Project Steering Committee (PSC):** Chaired by the Secretary, MoWS, has been established to provide policy guidance, accomplish reform measures, oversee project implementation and ensure cooperation of all agencies involved in the project.

(iv) **Design, Supervision and Management Consultant (DSC 05):** To support PID in project management, engineering design, construction supervision, procurement of goods and services, institutional development and capacity building.

(v) **Community Awareness and Participation Consultant (CAPC):** Towards assisting in community awareness and participation within project area.

Continuation to signing of loan by Government of Nepal with Asian Development Bank, through a competitive bidding process DOHWA Inc. in association with BDA P. Ltd., ERMC and TAEC Consult P. Ltd. is appointed as Design, Supervision and Management Consultant (DSC 05) for this loan no. 2776/3255 (NEP) SF project.

SECTION 2

2. EXISTING WATER SUPPLY SCENARIO –KATHMANDU

Water is Nepal's largest available natural resources with over 6,000 rivers having a combined length of 45,000 km. Still the access to water supply is limited. The water supply system in Kathmandu Valley is dependent partly on ground water and partly on surface water sources. In all, at present water is drawn from 31 surface sources and 75 deep tube wells (54 operational) located in different parts of the valley. The total water production from these sources put together is about 100 MLD (dry season) to 150 MLD (monsoon). These sources supply water to 21 Water Treatment Plants (WTPs) with a total treatment capacity of 85 MLD. The treated water is fed into 44 service reservoirs, from where water is supplied through 1,240km of distribution lines, over 165,000 consumer connections and 1,200 public stand posts to about 2 million consumers.

The water supply system suffers both from partial coverage (only 70% of the total 2.8 million population covered) and inadequate supply (100 to 150 MLD production as against an estimated demand of 190 MLD at consumer end). Added to this is the old water supply system with aging old and profusely leaking pipes resulting in high water losses (estimated at 45%). Besides, there are numerous illegal and unauthorized multiple connection, resulting in a large portion of unaccounted for water (UFW).

Under the water shortage conditions, KUKL (the agency responsible for water supply in Kathmandu Valley) has applied a rationing system whereby water is allowed to flow to different sections of the metropolitan/urban area in rotation. The control system developed by KUKL is complex to implement as it requires KUKL staff to operate with over 1000 valves for distribution. The result is an inequitable distribution of water, particularly as the areas close to the water sources are very difficult to isolate. While some parts of the city have an abundance of water and enjoy 24-hour supply, a large share of the population only receives water for a few hours every 2-5days and even then, the pressure is low and the quality is poor. As most areas receive intermittent supply with low pressure, use of pumps to suck water and bypassing of water meters are believed to be quite common techniques used by the consumers. People in many areas often receive one-hour supply in every fourth day only.

The outdated system with old design, ad-hoc development on need basis and old and damaged pipes has given rise to contamination of treated water. Water quality at the consumers end is far less than desired and it is a common practice to treat or boil water for potable use. While the basic cost of piped water in Kathmandu may be cheap, the other direct and indirect costs associated with its use seem very high. The mushrooming of firms supplying the household level water purification systems in Kathmandu is an indication of growing water quality concerns among the general public – a recent survey report states that there are about 64 water vendors in Kathmandu.

Besides, there is sprawling private water supply market supplying treated water at a rate of Rs. 5-10 per 20 liters to the consumers. Around 60% of the households in Kathmandu either boil water or use some form of water purification devices to attain quality water for drinking use. Also, an estimated 20% of the households depend on packaged water supply. On an average, the current "water cost" is around Rs. 350-500 per month per household. Besides the exorbitant costs associated with these alternative strategies, there is no assurance of quality.

The typical/specific problems exhibited in entire Kathmandu distribution network and as well in the DNI9 areas are as follows:

- Little equity in water supply; some properties get very good supply with good pressure for 6-7 hours, while others get only 1 to 2 hours supply every fourth or fifth day with very poor pressure;
- Very high-water leakage and losses in the area.
- No control mechanism for isolating the service area for maintenance;
- Multiple house connections to a trunk water supply main;
- Old and undersized water distribution mains;
- No operational fire hydrants;
- Long, multiple house connection pipe work;
- Areas of poor water supply service;
- Many non-operational consumer meters.

Many of such households also have secondary water sources like hand pumps, dug well or other such facilities to supplement their daily requirements. In addition, same households also supplement their drinking water requirements through the use of private tankers and bottled water.

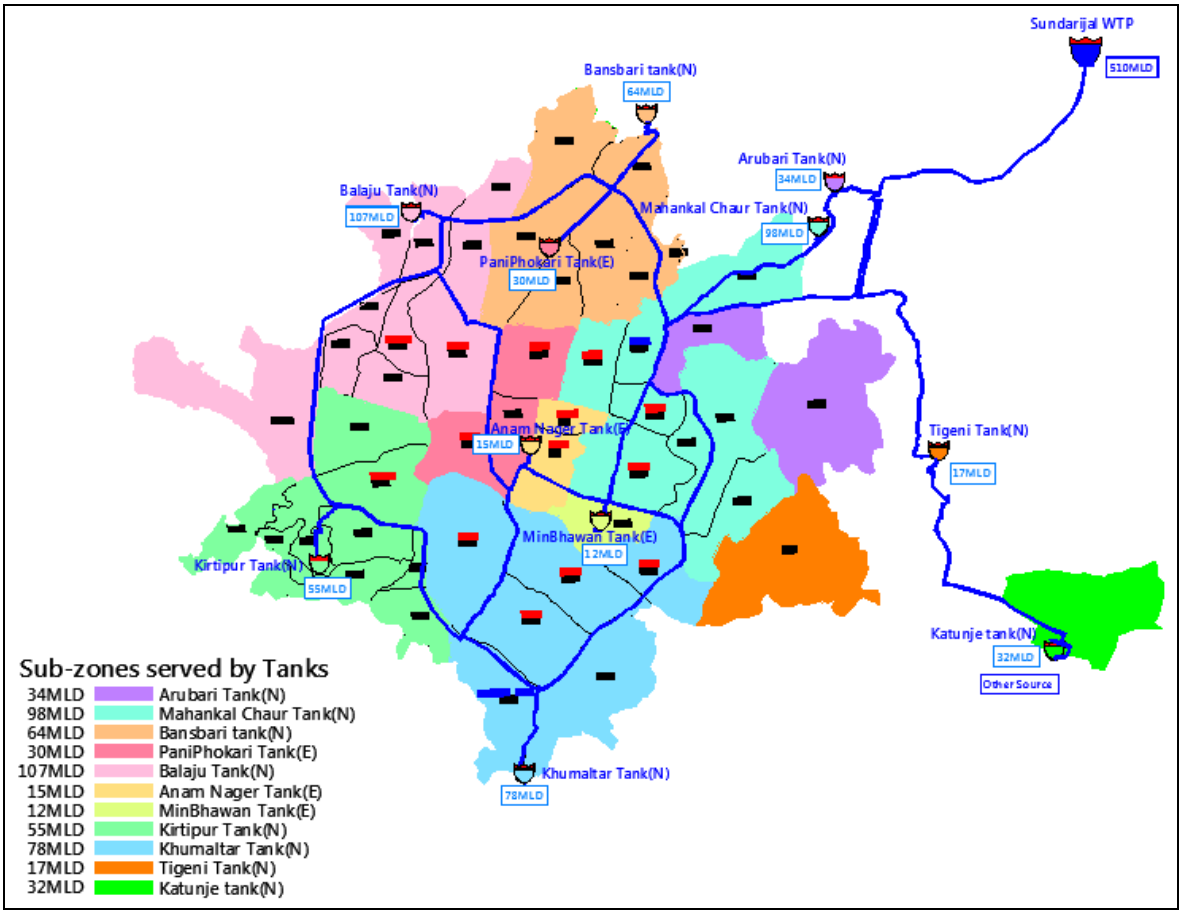
SECTION 3

3. DESIGN BOUNDARY

3.1 REVIEW OF MASTERPLAN [CIAMP REPORT]

According to the Master plan, the CIAMP Report (2010), 510MLD from Sundarijal WTP will be distributed to each reservoir to be supplied for distribution for the target year 2030. The 510MLD will be fully supplied to the Kathmandu Metro supply boundary and all facilities being used at present will be utilized in the post Melamchi stage. In AF Report (2014), Bhaktapur was included in the distribution plan which increased the total demand to 542MLD. This is going beyond the CIAMP and shall be updated during the second Master plan.

We have considered 510MLD within the original boundary but included Bhaktapur separately since it's included in the AF report. The distribution boundary, population projection and demand for each SRTs are as shown below;



<Figure 3.1: Demand for Each SRTs>

Table 3.1: The population distribution, demand and supply plan for each reservoir

Reservoir	Population			Demand(MLD)						Each reservoir supply
	2015	2025	2030	2015	2025	2030	Each reservoir distribution			
BALAJU	360,281	519,247	617,585	60.9	87.8	104.4	36.5	72.1	107.1	107
BANSBARI	192,990	297,670	368,976	32.6	50.3	62.4	19.6	41.3	64.0	64
PANIPOKHARI	102,486	146,124	172,043	17.3	24.7	29.1	10.4	20.3	29.8	30
MAHANKAL CHAUR	335,262	478,016	562,798	56.7	80.8	95.1	34.0	66.4	97.6	98
AARUBARI	83,959	146,477	195,469	14.2	24.8	33.0	8.5	20.3	33.9	34
MINBHAWAN	41,855	59,677	70,261	7.1	10.1	11.9	4.2	8.3	12.2	12
ANAMNAGAR	50,519	72,030	84,806	8.5	12.2	14.3	5.1	10.0	14.7	15
KHUMALTAR	292,730	391,550	449,027	49.5	66.2	75.9	29.7	54.4	77.9	78
KIRTIPUR	165,309	256,477	319,447	27.9	43.4	54.0	16.8	35.6	55.4	55
TIGENI	51,867	81,334	100,424	8.8	13.8	17.0	5.3	11.3	17.4	17
Total	**1,677,258**	**2,448,602**	**2,940,836**	**283.5**	**413.9**	**497.1**	**170**	**340**	**510**	**510**
KATUNJE	137,722	172,993	188,473	23.3	29.3	31.9	-	29	32	32
GRAND TOTAL	**3,354,516**	**4,897,204**	**5,881,672**	**283.5**	**413.9**	**497.1**	**170**	**369**	**542**	**542**

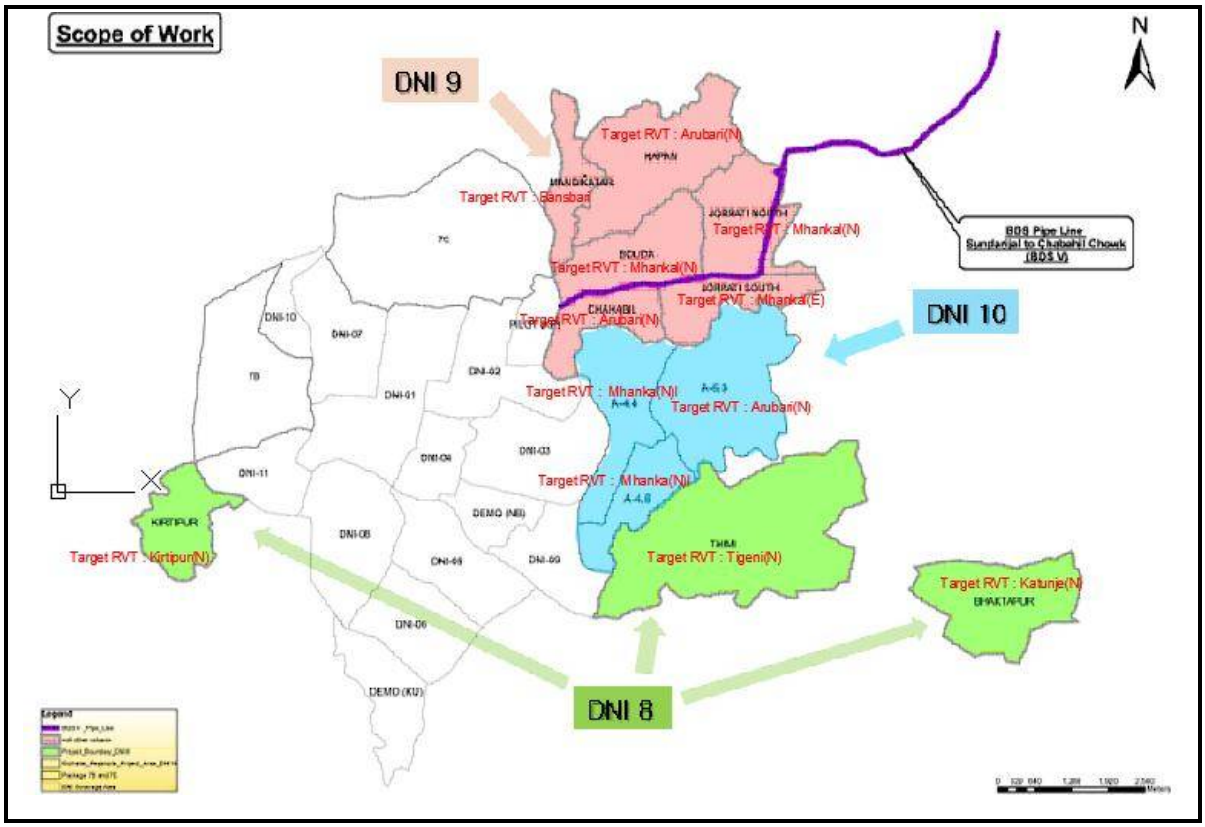
3.2 DISTRIBUTION BOUNDARY

The project boundary as per the ToR was Thimi, Bhaktapur, Kirtipur, Jorpati, Bouda, Chabahil, Mandikatar and Kapan. Consultant had numerous meetings with PID and KUKL to discuss the boundary and distribution plan. After final approval from PID/KUKL, we have finalized the boundary and distribution plan of DNIs April, 2017.

Consultant has made additional population projection and demand calculation since several distribution boundaries were not included in the Master plan i.e. CIAMP report and finalized the DNI boundaries.

3.2.1 Determination of the Distribution Boundary

The design was carried out with continuous consultation with PID/KUKL since the boundary is now going beyond the master plan. After reviewing the CIAMP and AF reports, the final distribution boundary has been determined. The target SRTs and boundaries are shown below;



< Figure 3.2: Target SRTs and Boundaries>

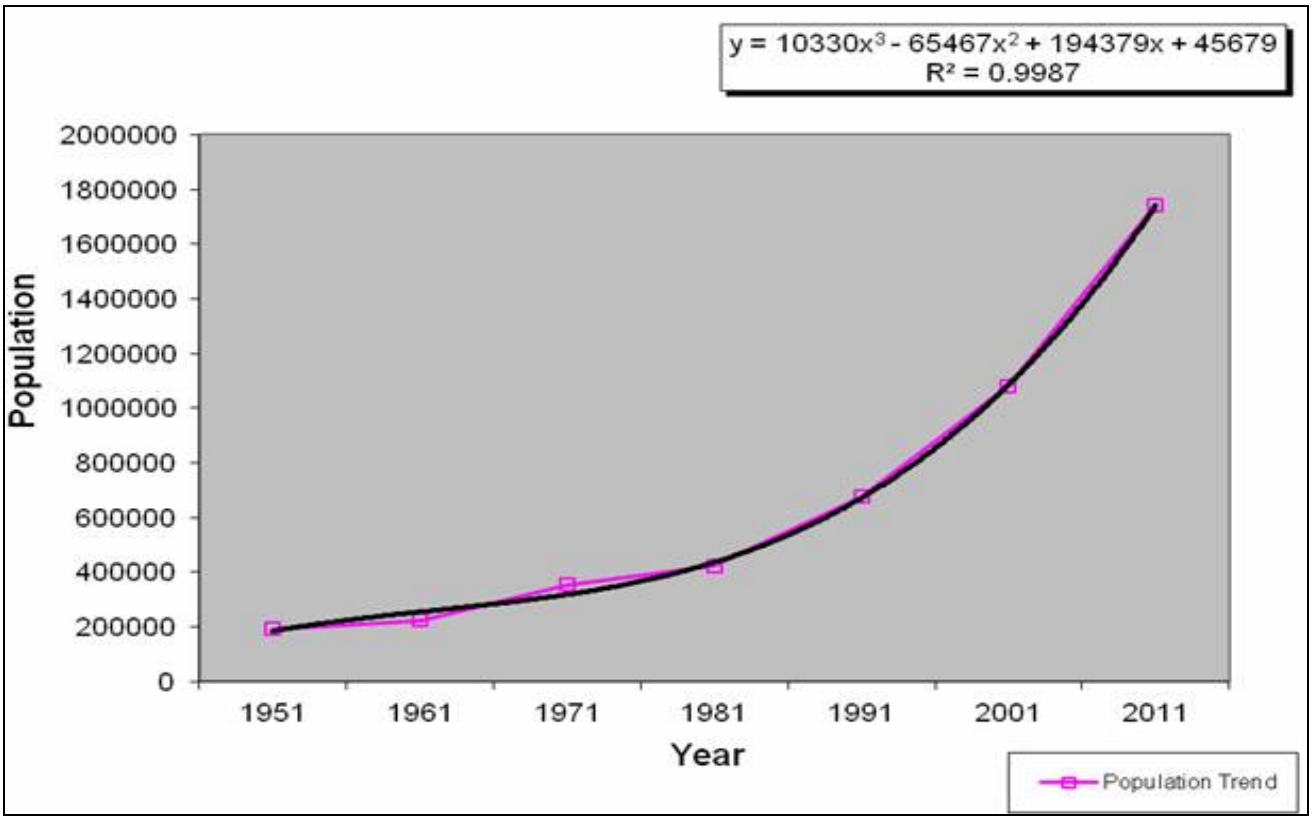
DNI boundaries are divided into DNI8, DNI9 and DNI10 considering the bidding date of project and possibility.

3.3 POPULATION PROJECTION & WATER DEMAND

3.3.1 General

Estimation of the demand is one of the critical factors in the design of the water supply system. The design population projection finds its base upon the historic census population, the present population and its expected rate of growth.
Demographic methods for projecting population include numerical methods such as Arithmetic increase, Incremental increase, Geometric increase, Exponential, Polynomial logarithmic and Power series. The best fitting among these is generally used in projecting population for water supply schemes.

Population projection for Kathmandu Metro zone in the CIAMP report was based on historic population figures from year 1951 to 2011 collected from the country's census website for various urban and village bodies. Third order polynomial of the above methods was decided for the projection based on the historic population.



< Figure 3.3: Polynomial Third Order Curve of Historic Population Growth >

For the unity with the other/previous designs we have adopted the same population projection with the CIAMP report for boundaries inside the Kathmandu Metro zone.

For the boundaries beyond the Kathmandu Metro zone i.e boundaries not included in the master plan (Bhaktapur, Mandikatar, Kapan, Jorpati), consultant had population projection using same projection method which is third order polynomial.

Accordingly, based on the population projection DNI8, 9 and 10 population of year 2025 and 2030 is shown below in table 3.2;

Table 3.2: Design Population for 2025 and 2030 Years(DNI8, DNI9 & DNI10 areas)

Target supply area		DNI (Master plan)	DNI (Out of KUKL service area)	Water source	Population	
					2025	2030
DNI8	Thimi	A-10		Sundarijal WTP	81,335	100,426
		-	A-11	Other source	57,459	70,947
	Bhaktapur	-	A-12	Other source	100,484	106,026
	Kirtipur	A-9.3 A-9.6 A-9.7 A-9.8		Sundarijal WTP	60,208	83,004

DNI9-a	Kapan	-	A-13	Other Source	126,887	163,957
	Mandikatar	-	A-14	Bansbari WTP	37,205	47,511
DNI9-b	Jorpati (N)	-	A-15	Other Source	69,878	81,288
	Bouda	A-5.1		Sundarijal WTP	91,410	107,622
	Chabahil	A-5.2		Sundarijal WTP	56,442	66,453
	Jorpati (S)	-	A-16	Mahankal WTP	79,627	92,628
DNI10	Pepsicola	A-4.4 A-4.5		Sundarijal WTP	90,036	129,017
	Gothatar	A-5.3		Sundarijal WTP	125,261	147,476
				Total	976,232	1,196,355

The total population within the boundary of our scope of work is 1,196,355 for target year 2030.

3.3.2 Estimation of Water Demand

Per-Capita demand has been decided as 135 lpcd for permanent population, 40 lpcd for temporary (floating) population including UFW at 15% in the previous DNI designs. Temporary population has been estimated 30% of the permanent population. Thus total lpcd is [135+(0.3*40)]*1.15 = 169.05lpcd.

After discussing with PID/KUKL, we have adopted same per-capita demand for unity of the DNI designs. Although Kapan, Mandikatar and Jorpati are outside of the Kathmandu Metro zone, the time pattern and demand is expected to be similar. We have applied the same per-capita to all of our designs accordingly.

Table 3.3: Design Demand for 2025 and 2030 Years(DNI8, DNI9 & DNI10 areas)

Target supply area		DNI	Target Reservoir	Water source	Population		Demand(MLD)	
					2025	2030	2025	2030
DNI8	Thimi	A-10	Tigeni	Sundarijal WTP	81,335	100,426	13.75	16.98
		-	Tigeni	Other Source	57,459	70,947	9.71	11.99
	Bhaktapur	A-12	Katunje	Other Source	100,484	106,026	16.99	17.92
	Kirtipur	A-9.3 A-9.6 A-9.7 A-9.8	Kirtipur	Sundarijal WTP	60,208	83,004	10.18	14.04
DNI9-a	Kapan	A-13	Arubari	Other Source	126,887	163,957	21.44	27.72
	Mandikatar	A-14	Bansbari (Old)	Bansbari WTP	37,205	47,511	6.29	8.04
DNI9-b	Jorpati(N)	A-15	Mahankal	Other Source	69,878	81,288	11.82	13..74
	Bouda	A-5.1	Mahankal	Sundarijal WTP	91,410	107,622	15.45	18.20
	Chabahil	A-5.2	Arubari	Sundarijal WTP	56,442	66,453	9.54	11.23
	Jorpati(S)	A-16	Mahankal(Old)	Mahankal WTP	79,627	92,628	13.45	15.67
DNI10	Pepsicola	A-4.4	Mahankal	Sundarijal WTP	90,036	129,017	15.24	21.81

		A-4.5						
	Gothatar	**A-5.3**	**Arubari**	**Sundarijal WTP**	**125,261**	**147,476**	**21.17**	**24.94**
Total					**976,232**	**1,196,355**	**165.03**	**188.54**

3.3.3 Fire Fighting Demand (*)

It is usual to provide for firefighting demand as a coincident draft on the distribution system along with the normal supply to the consumers as assumed. A provision in Kiloliters per day based on the formula 100√P where p = population in thousands may be adopted for communities larger than 50,000. It is desirable that one third of the firefighting requirements form part of the service storage. Table 3.4 indicates Fire demand calculations in each of the supply area.

Table 3.4: Fire Fighting Demand

Target supply area		Projected Population Design Year-2030	Fire Demand = 100*√(p)	
		2030	KLD	MLD
DNI8	Thimi	171,373	41,397.22	0.04
	Bhaktapur	106,026	32,561.63	0.03
	Kirtipur	83,004	28,810.41	0.03
DNI9-a	Kapan	163,957	40,491.60	0.04
	Mandikatar	47,511	21,797.02	0.02
DNI9-b	Jorpati(N)	81,288	28,511.05	0.03
	Bouda	107,622	32,805.79	0.03
	Chabahil	66,453	25,778.48	0.03
	Jorpati(S)	92,628	30,434.85	0.03
DNI10	Pepsicola	129,017	35,918.94	0.04
	Gothatar	147,476	38,402.60	0.04

SECTION 4

4. TOPOGRAPHICAL SURVEY

4.1 TOPOGRAPHIC SURVEY FOR DISTRIBUTION LINES:

Detailed topographical survey work was conducted for new 7B & 7C DNI Zones. The survey using Electronic Total Station covered extraction of features which included boundaries, topographical and contours. Later the agency re- produced the survey drawings in required format for further design by DSC 3.

As part of above survey along the major roads, control points were established. Survey work commenced by establishing bench mark as available by geodetic survey branch under Government of Nepal. The survey data stored in total station was later transferred for further processing using AutoCAD.

The survey was to be undertaken with within a tolerance of ±5cm or size of the Boundary Marker whichever is coarser.

Note: Currently the topographical survey has been carried out only on main roads (only 30%). The levels of intermediate roads have been obtained by interpolating with the levels surveyed on main roads.

After awarding the contract, the Contractor should carry out 100% topographical survey to verify the correctness of the levels adopted in the design and the refinement of the hydraulic model is necessary. The Contractor should also carry out the soil investigation wherever necessary and should submit a report.

SECTION 5

5. DESIGN STANDARDS AND APPROACH

5.1 GENERAL

Primary design parameters are established for commencing the engineer designs. These parameters are largely based on the guidelines specified in Central Public Health and Environmental Engineering Organization (CPHEEO)

Manual on Water Supply and Treatment, Government of India, choice of technology and service level and as well have been discussed with PID, KUKL and finalized. For the present and future purposes, the following basic design parameters are discussed in the following sections.

5.2 DESIGN PERIOD

Distribution network has been designed to meet demand for the year 2030.

5.3 POPULATION

Projection of population for 2025 and 2030 years has been considered as explained in the previous chapter.

5.4 PER-CAPITA DEMAND

Per-capita demand for permanent population is 135 lpcd. 40 lpcd for temporary (floating) population calculated 30% of permanent population. Included UFW 15% and fire demand. Thus, total lpcd of 169.05.

5.5 PEAK FACTOR

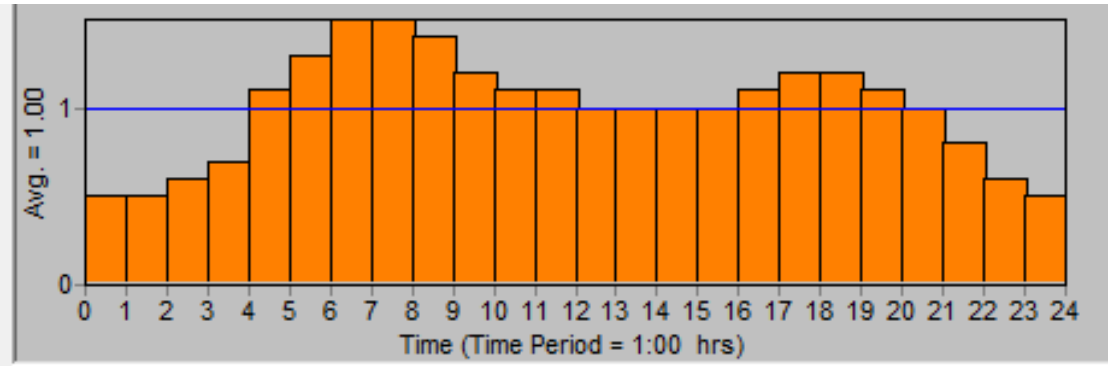
A peak demand factor of 1.5 has been adopted in the design.

5.6 TIME PATTERN

The boundary of this design is outside Kathmandu Metro zone but intimated. We have considered as same sphere of life and followed the same time pattern of the previous DNI designs within the Kathmandu Metro. The time pattern is shown below;

Table 5.1: Time Pattern

Time (hr)	0~1	1~2	2~3	3~4	4~5	5~6	6~7	7~8	8~9	9~10	10~11	11~12
Factor	0.5	0.5	0.6	0.7	1.1	1.3	1.5	1.5	1.4	1.2	1.1	1.1
Time (hr)	12~13	13~14	14~15	15~16	16~17	17~18	18~19	19~20	20~21	21~22	22~23	23~24
Factor	1.0	1.0	1.0	1.0	1.1	1.2	1.2	1.1	1.0	0.8	0.6	0.5



5.7 RESIDUAL HEAD

Hydraulic analysis and sizing of pipes has been performed to ensure a residual pressure of minimum 1 bar (10m) and 5 bar (50m).

5.8 VELOCITY

As far as possible it was attempted to restrict the flow velocities in distribution pipelines between 0.5m/s and 2.0m/s.

5.9 ALLOWABLE HEAD LOSS

Head loss of 10m/km has been limited in the distribution network.

5.10 LOSS COEFFICIENT: HAZEN WILLIAM "C" VALUES

The 'C' value of 110 for DI and 130 for HDPE pipes have been adopted in the design.

5.11 NODAL DEMAND

Proportional nodal demand distribution (by area) using "Thiessen" Polygon has been adopted in the design.

5.12 DISTRICT METERED AREA (DMA)

In practice, there will always be a significant variation in size of DMA due to the layout of the existing infrastructure and the need to optimize pressure management. DMAs are often sized by the number of properties, where typically a property is supplied by a single customer connection.

Henceforth, DNI's is divided into District Metered Area (DMA) with an average households ranging from 500 to 3,000 for each DMA. In our Design average of 1,500 Households have been considered (Or) shall be based on topography of the service area. Ref: International Water Association (IWA) Guidelines, February2007, Version 1.

5.13 DESIGN AND SIZE OF MAINS

Pipe DN400 mm and larger have been designated as Primary Mains but if the mains are too large considering the flow and velocity, we have decided less than DN400mm. Secondary and Tertiary Mains are considered to be less than DN400mm but it's finalized based on flow.

5.14 PIPE MATERIAL

Selection of pipe material has been performed considering the following parameters:

- Hazen-Williams Coefficient
- Ability to withstand Internal / External pressure
- Ease in handling and lowering of pipes
- Corrosion Resistance
- Pipe jointing materials
- Trouble-free maintenance & operation should be ensured
- Availability of specials and fittings

However, the final selections of the pipe materials were discussed with PID/KUKL and have been agreed as following;

- HDPE pipe with electro-fusion fittings will be used for distribution lines smaller than DN 150mm, and for service connections.
- DI pipe will be used for mains DN 150mm and larger than DN 150mm.
- HDPE Pipe size increments, as per availability of materials in the market.

Eg: HDPE pipe of DN75, DN90, DN 110, per IS 4984 as secondary and tertiary mains, and DI pipe as per ISO 2531 as primary mains.

5.15 PIPING LAYOUT

- Minimize dead ends by looping of all mains.
- Dual mains are being provided in all roads greater than 7-meter width, and as needed to hydraulically isolate each sub-DMA.
- DSC-03 staff visited several locations in the field to assess the practicality of placing dual mains between every sub-DMA, which will allow complete hydraulic separation of each sub-DMA and also allow for permanent meter installations at the inlet(s) to each sub-DMA.
- Many of the streets between sub-DMAs are quite narrow and also contain sewers which zigzag from one side of the street to another. For these reasons, it will usually not be possible to place dual water mains in such streets while maintaining an adequate separation distance from these sewers. Therefore, when unavoidable (the majority of such cases are unavoidable), we will design such dual mains to be placed in a common trench with an appropriate nominal amount of separation (e.g., 300 mm clear separation). Such dual mains will provide the desired hydraulic isolation of sub-DMAs, but will still necessitate extending service laterals across the street (which would have been avoided had it been possible to place one main on either side of the street).
- Where dead - end main occurs, it shall be provided washout for flushing purposes.
- Flushing device shall not be directly connected to the sewer – Where dead-end mains occur, they shall be provided with a fire hydrant if flow and pressure are sufficient or with an approved flushing hydrant or blow-off for flushing purposes. It is recommended that all water quality problem areas in the distribution systems be flushed at least twice each year. No flushing device shall be directly connected to any sewer.

5.16 TESTING & COMMISSIONING

The pipelines shall be tested and commissioned using the procedure and methodology as per relevant IS/ISO standards & latest amendments.

5.17 VALVES & APPURTENANCES

Isolation valve locations shall be based on the following considerations:

- Limiting the number of customers (100 to 150) that will be out of service.
- Limiting the number (3 to 5) of fire hydrants out of service
- Limiting the time, (2 hours) takes to drain a pipe segment
- Limiting the number of customers (100 to 150) impacted by future system modifications
- Limiting future construction within major streets or intersections
- Avoiding excessive number of valves thus reducing initial cost
- Shall be located at major or critical street intersections

· Line valves at primary mains shall be spaced not more than 1km (or) shall be based on site condition

5.17.1 Air valve locations

At the highest point in respective distribution network

· In special locations (such as near district meters)
· Shall be installed only at Primary and Secondary mains

5.17.2 Fire Hydrant Locations

Shall be installed at Secondary mains

· Shall be located at major or critical intersections
· Maximum coverage approximately 5 Hectares per hydrant
· Maximum spacing approximately 250 meters
· Minimum tapping size shall be at DN200mm for commercial FH and DN150mm for residential FH.

5.17.3 Electromagnetic Flow Meters

It is proposed to install electromagnetic bulk flow meters, each at every inlet pipe of respective service reservoirs.

5.17.4 Bulk Meters

It is proposed to install at every inlet to each DMA's.

5.17.5 Scour Valves/Wash out Valves

Scour valves are located at selected low-points and at appropriate locations to facilitate water and silt removal from the system in cleaning and maintenance operations.

5.17.6 Thrust/Anchor Block

Thrust Blocks prevents pipe movement when a pressure system is activated and pressurized. Thrust blocking is required at all points of change of direction in the pipe line. Most blocking is done where a fitting, valve, or hydrant is installed. There may be times when side blocking is necessary because of curvature occurring without the use of fittings. Usually good compacted backfill will provide the necessary anchor for side thrust. Concrete blocking is the most commonly recommended method of blocking. Concrete is placed directly on the fitting against the line of thrust. The concrete must also pour against undisturbed earth. The size of the blocking will vary with the size of pipe, working pressure exerted, type of fitting, degree of flow direction change, and the soil conditions.

Anchor Blocks are provided wherever the pipe is being laid where the nature of ground is steep in nature and wherever the pipeline crosses the rivers/valley in order to hold the pipe and to avoid the dislocation of pipe from the alignment.

5.18 JOINT RESTRAINT

A properly designed, restrained pipeline uses the bearing strength and frictional resistance of the soil to turn the pipeline into a thrust block. The same basic parameters required to determine the size of a thrust block are used to determine the amount of pipe that must be restrained to resist thrust forces underground. These parameters are pipe size, pipe type, test pressure, fitting type, trench type, depth of bury, soil type, and safety factor.

Using joint restraints opens possibilities that are not available with thrust blocks. When construction is required in congested underground areas it is next to impossible to pour thrust blocks without interfering with other utilities. Also, the use of thrust blocks in congested areas poses a problem when construction or maintenance of a different utility occurs in close proximity to the thrust block. Because the bearing area of a restrained pipeline is not concentrated in a small area, excavations in close proximity do not pose the danger that could be experienced with thrust blocks.

5.19 THRUST RESTRAINT FOR DNI WORKS

In flexible non-restrained jointed pipelines (e.g. Tyton type joints or similar), forces at bends, tees, tapers, closed valves, dead ends etc. will generally be absorbed by thrust blocks. Concrete thrust blocks take the forces from the pipeline and transmit them to the soil adjacent to the pipe trench. Thrust blocks shall be constructed of cast-in-place concrete. The bearing faces of the thrust blocks will be placed against undisturbed natural soil. Thrust forces and siting of anchor blocks will conform with the field test pressure of the pipeline. Dimensioning of the thrust blocks must be dependent on the bearing capacity of the prevailing soil.

5.20 PRESSURE REDUCING VALVE (PRV) CHAMBERS

They are necessary in order to maintain a constant delivery of acceptable service pressure which should not be more than the required max head of 5 bars - regardless of varying high inlet pressure.

5.21 BULK METERS AND OTHER VALVE CHAMBERS

Supply of water to the DNI areas will be from primary mains fed from the respective reservoirs. In order to enhance water auditing, bulk meter chambers will be provided. These chambers comprise of control valves (Sluice Valve) and other necessary appurtenances to control water from the transmission main and isolating distribution blocks from maintenance purposes. Each bulk meter will be well equipped with flow sensor & data loggers to record flow rate for analysis and record keeping. Similarly, other valve chambers have been provided to isolate parts of the distribution system for maintenance or in case of damage.

5.22 PRESSURE TEST POINT CHAMBERS

Pressure test point chambers have been provided for each DMA at maximum and minimum pressure level and locations were pressure tests are necessary.

5.23 AIR VALVE CHAMBERS

Air valve chambers with drain pipes and sluice valves have been provided along the primary and secondary main alignments. The air valves are double orifice (with ball/gate valve isolation).

5.24 WATER REVENUE METERS

Dry dial volumetric rotary piston type water revenue meter for all house connections are proposed. These household water meters have 15mm, 20mm and 25mm Nominal Diameter and have been recommended for use elsewhere in Kathmandu.

5.25 HOUSE SERVICE CONNECTIONS

All house service connections shall be of non-metallic pipe in order to reduce leakage at the service connection points.

5.26 CHAMBERS

All chambers are M 20 Grade RCC Chamber. All the chambers have been designed for heavy traffic load (heaviest axle load of 8 ton) and limiting cracking width philosophy assuming other design parameter such as depth of pipe, location of ground water table, soil characteristic, etc.

5.27 RIVER CROSSINGS

River crossings may be made by:

- Constructing a separate pipe bridge
- Attaching the pipe to an existing bridge
- Installing the pipe on the footpath of an existing bridge
- Laying the pipe in the bed of the river in a siphon.

A pipe bridge would be vulnerable to accidents or other attacks. The structure must be above maximum flood level. Additionally, a pipe bridge would require an earthquake resisting design, which would be very expensive taking into account the high ground accelerations to be expected

in the Kathmandu Valley. Pipelines, connected to existing road bridges, are only permitted if these are connected laterally to its structure. This is of course a difficult solution since appropriate supporting structures have to be designed and incorporated to the existing bridge construction. The pipeline must not overload the structure and expansion joints would be required to accommodate movement of the bridge and pipeline.

Permanent installation on footpaths of the bridge is not allowed by the DOR. The rivers to be crossed by the BDS have a low water level and flow at the end of the dry season. This will allow the pipes to be laid in the riverbed by diverting the river water. Hence normal pipe laying practice would suffice to achieve a technically and economical sound river crossing construction.

For river crossings therefore we recommend a siphon design rather than a pipe bridge design due to safety and cost reasons. The pipeline itself will be surrounded by reinforced concrete.

5.28 ROAD WORKS

All road works, road crossings and other works belonging to roads are subject to the approval of the Department of Roads and relevant municipal entities. For the approval of all road works, submittal of layouts and details and descriptions of the works to be executed are required by these entities in advance of the works.

Roads generally have to be crossed perpendicular to the road axis; however, in some cases the pipeline will run along the road. It is assumed the pipes will be installed in an open trench with the temporary diversion of vehicular traffic. The precise details of the temporary diversion and traffic control will be the responsibility of the contractor.

The pipe trench backfill will continue up to the underside of the sub-base of the road surface. The installation of the road sub-structure and final completion of the road surface then will be done by the contractor.

5.29 PUMP HOUSE & RESERVOIR TANK & OHT

DNI designs have been preferentially designed to supply by gravity flow. However, for the boundaries inevitable of gravity flow has been considered as pumping zones.

Considering the power supply and stability of the supply system, reservoir tanks or Over Head Tanks are planned. The water will be pumped to a upper level reservoir/OHT then supplied by gravity to the DNIs. The capacity of the reservoir/OHT has been purposed to be enough to distribute 24 hours although stopping the pump at the pick time between 5:00PM till 11:00PM.

5.30 OPERATING HOUSE

Operating House shall be constructed for the Pump house area along with the construction of inspection chamber of toilet, septic tank and soak pit.

5.31 SURFACE DRAIN

Tick type concrete surface drain will be constructed both sides for the roads having width more than 7 m while for the roads having width from 4 to 7 m drain will be constructed only single side. However, there is no provision of such type of drain for roads with width less than 4 m. Similarly, brick masonry wall shall be constructed at the back of tick drain.

Catch pit shall also be constructed for every 100 m of the drain in a staggered manner.

5.32 DESIGN APPROACH

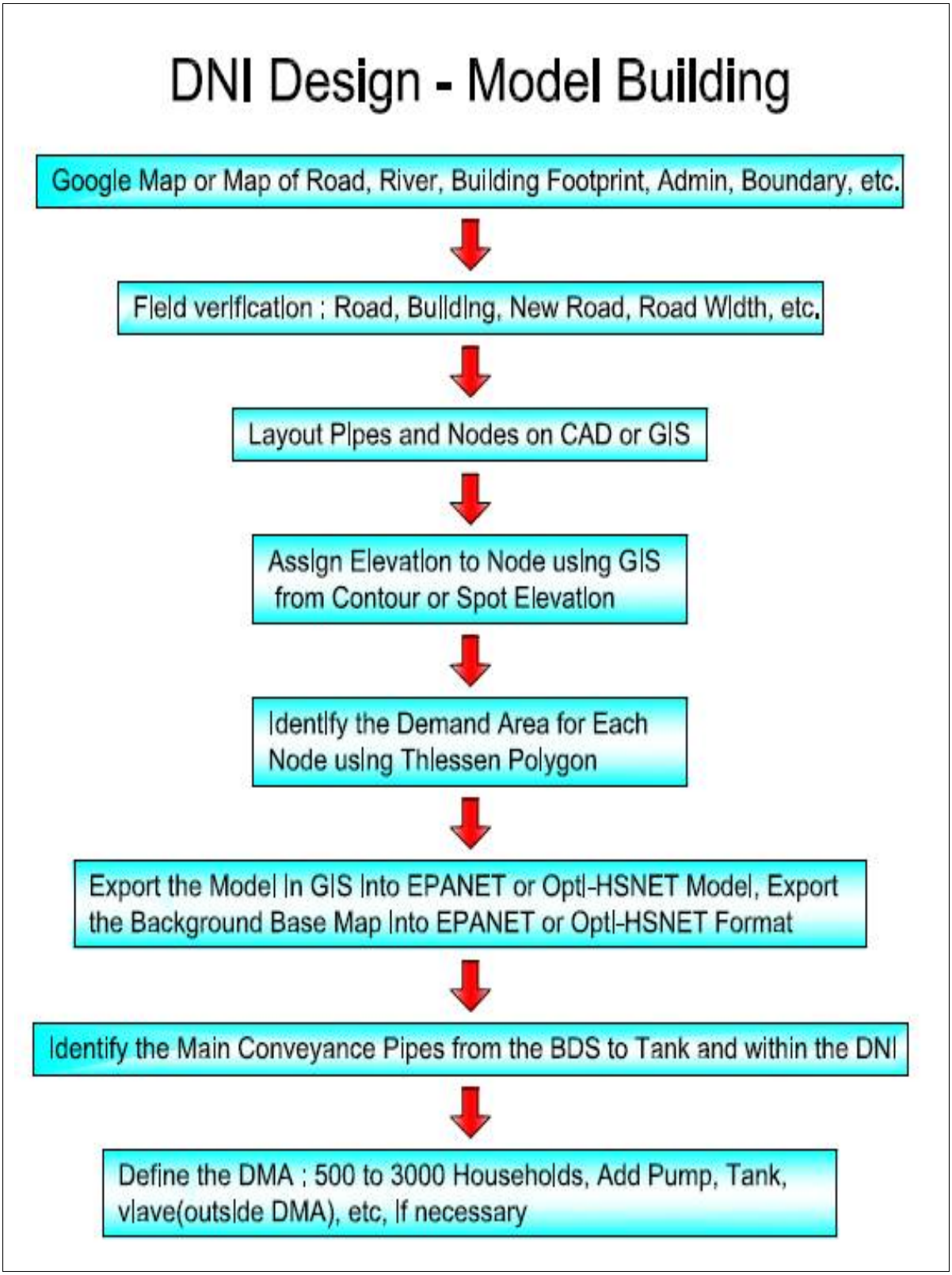
5.32.1 Design criteria summary

For the unity of the DNI designs, DSC05 have followed most of the DSC03 design criteria as per the discussions with PID/KUKL. However, during the detail design, DSC05 made some improvements in the design and again after further discussions with PID/KUKL, made some changes in the design criteria. The final design criteria of DSC05 DNI design is shown below;

Table 5.2: Design Criteria

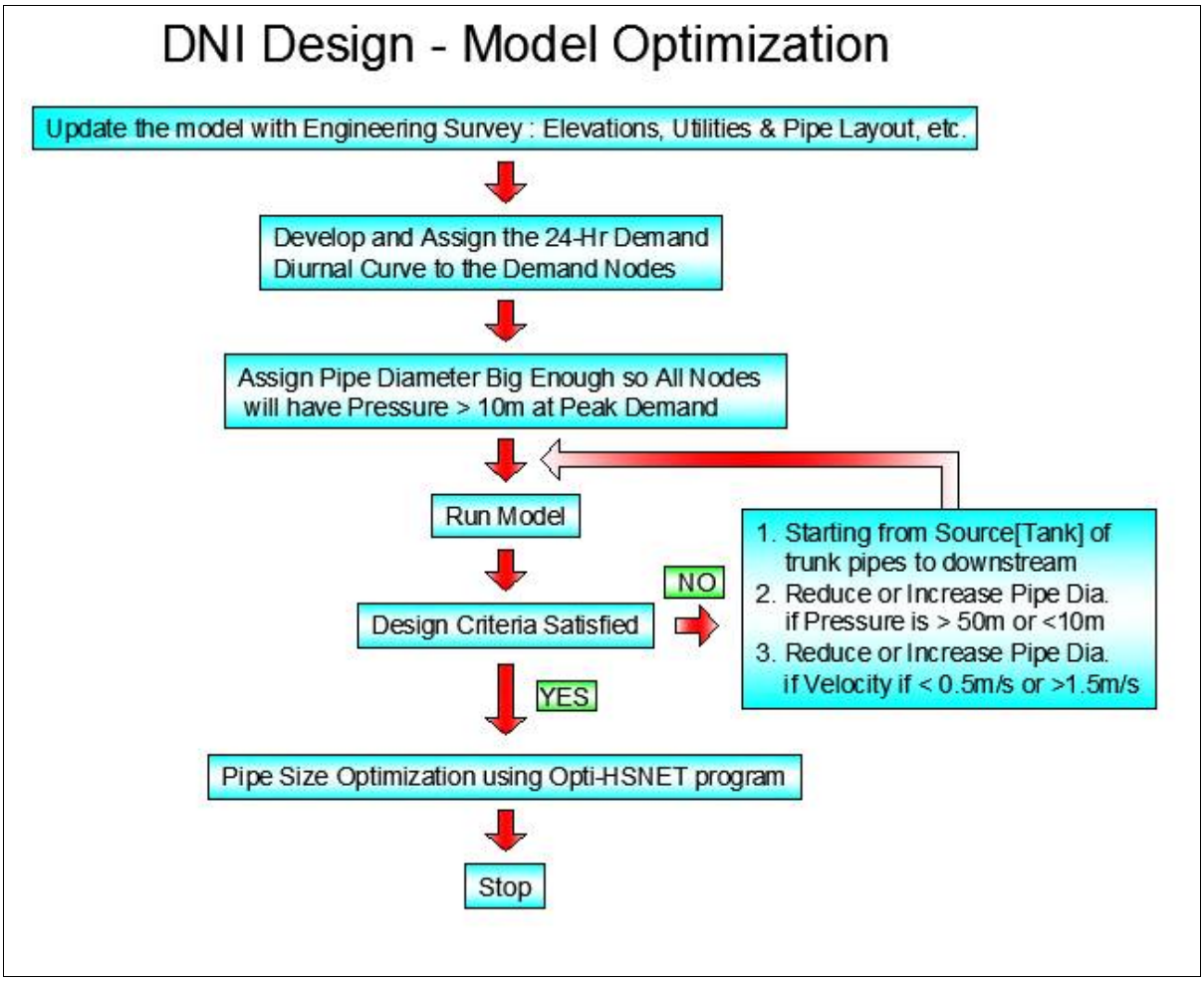
Criteria	Applied to Design	Remarks
Target Year	2030	
Population	Thirty year	
Per-Capita demand	(135+40) lpcd + 15% UFW and fire Demand	
Peak Factor	1.5	
Residual Head	1 bar(10m) ~ 5 bar(50m)	Due to change of PN6 to PN10, Maximum residual head changed to 5bars (50m)
Velocity	0.5m/s ~ 2.0m/s	
Allowable Head Loss	10m/km	
Criteria	**Applied to Design**	**Remarks**
Loss Coefficient : Hazen William	DI : C=110 , HDPE : C=130	
Nodal Demand Distribution	Using “Thiessen” Polygon	
District Metered Area (DMA)	DMA : 150 to 200 ha (in area) Sub-DMA : Average household 500 to 3,000 or Based on topography of service area	
Size of Mains	Primary Mains : D400mm and larger Secondary Mains : D150mm ~ D350mm Tertiary Mains : D145mm and below	Fire Hydrants installed at Secondary Mains(DI) House connection shall be connected to Tertiary Mains (HDPE)
Pipe Material	~ D140mm : HDPE, PN10 D150mm ~ : DI, K9	Changed Class of HDPE from PN6 to PN10
Fire Hydrant	Maximum coverage approximately 5 Ha Tapping size shall be at D150mm/D200mm	Changed D110mm to D150mm (Secondary Mains)

5.32.2 DNI Design – Model Building



< Figure 5.1 :DNI Design - Modeling Building >

5.32.3 DNI Design – Model Optimization

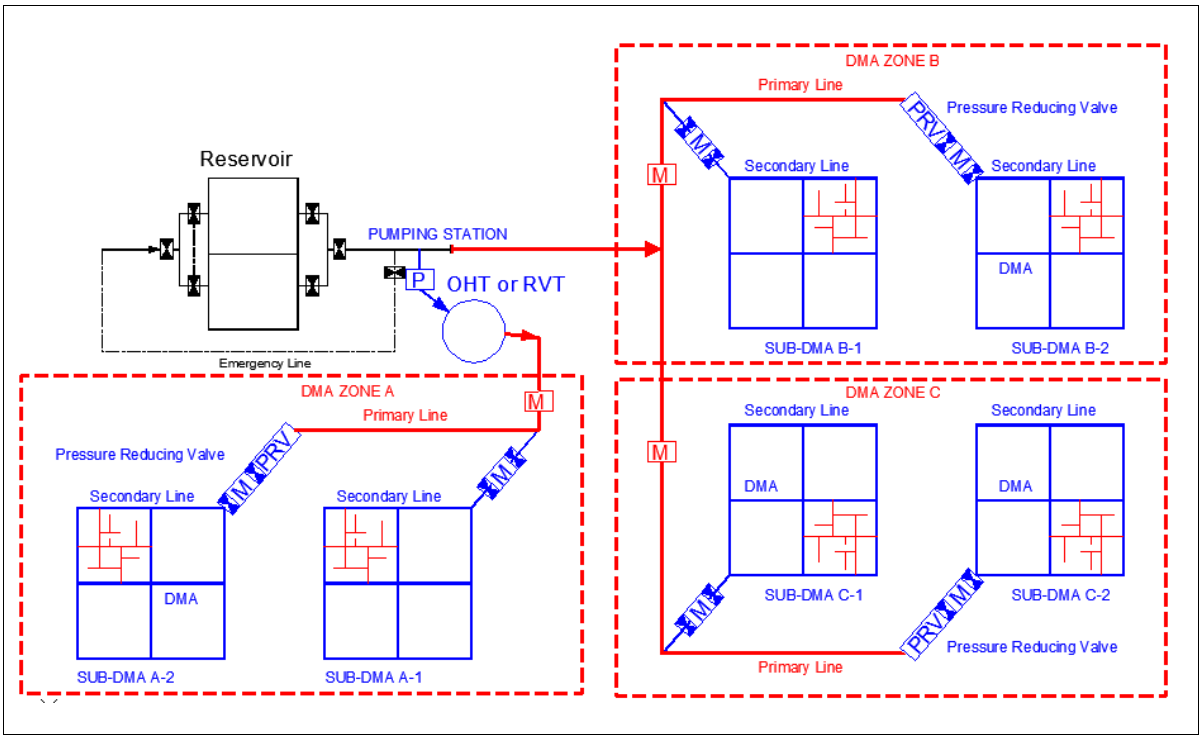


< Figure 5.2 :DNI Design – Model Optimization >

In order to adapt advanced and modernized design of water supply pipe design, the Consultant is planning to use EPA-NET and Opti-HSNET for design and confirmation. Opti-HSNET is recently built software for hydraulic calculation of water supply system and it run based on EPA-NET, world widely used program, with additional features. It provides complex calculation for maximizing use of the pipeline and lead the designer to select the most appropriate diameter of the pipe.

Opti-HSNET is developed software for analyzing the most optimum pipeline using input data of pipe network drawing, demand and unit cost for each pipe diameter. Based on node pressure and velocity of the water, it determines the configuration of the network and find the most ideal diameter based on Gradient Algorithm. The analyzed design can be confirmed and adjusted using the EPA-NET. First, the Consultant shall design the network using EPA-NET and the design shall be ran by Opti-HSNET program so that minor adjustment can be made for the most optimized water supply network.

5.33 DESIGN OF DISTRICT METER AREA (DMA)

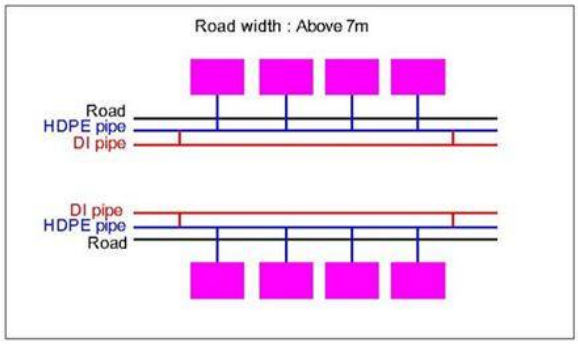
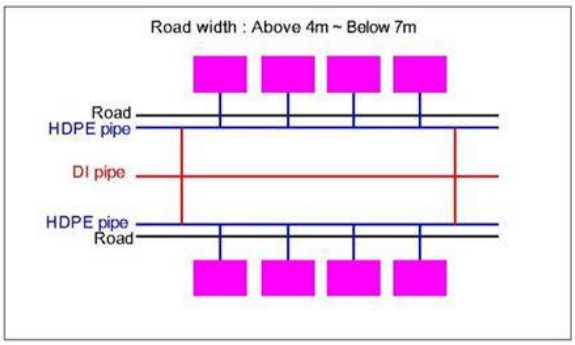
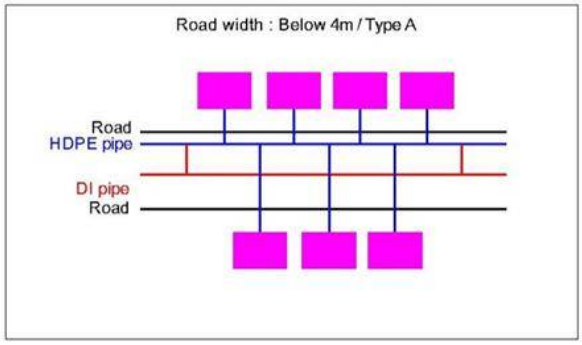
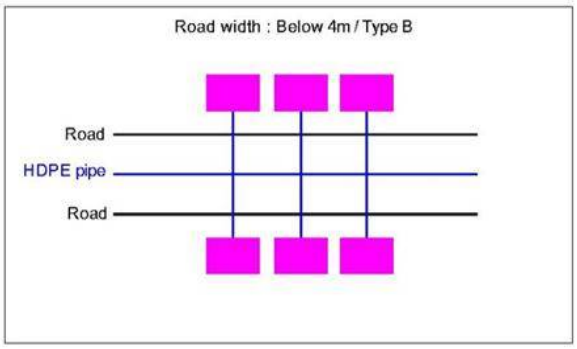


< Figure 5.3: Schematic Diagram of DMA>

- DMA Design
  - · Supply via single main (preferable) or multiple feeds
  - · Isolate area with adjacent DMA's (i.e., no flow into adjacent DMAs).
  - · Cascade into an adjacent DMA (to be avoided if at all possible)
  - · Minimum variation in ground level across the DMA
  - · SUB DMA ZONE: 500-1500 households.
- Monitor/locate/Control leakage
- Manage pressure
- Minimize utilities inside DMA
  - · Pump
  - · Water Tank
  - · Isolated valves, PRVs

5.34 RETICULATION PIPES

Table 5.3: Schematic Diagram of House Connection

	Two DI pipes are purposed in roads with 7m width or above since most DMA zones are divided by large roads. We have minimized two DI pipes lying where DMA zones are not overlapping, but it's based on consideration of fire hydrants and other facilities.
	One DI pipe is purposed in roads with 4~7m width, but for unavoidable DMA zone overlapping, two DI pipes are purposed.
	For narrow roads below 4m width will have DI pipe only when it's necessary for stable pressure control.
	Where DI pipe is not necessary for pressure control, HDPE pipe is purposed as tertiary main for house connections.

House connections shall only be connected to Tertiary mains which are all HDPE pipes for simplicity of connection. The model has been designed accordingly.

The sizing of isolation valve, air valve, washout valve and fire hydrant is specified in Table: 5.4 below;

Table 5.4: Sizing of Valves

Sizing of Valves				
Pipe Dia(mm)	**Isolation Valve**	**Air Valve**	**Washout Valve**	**Fire Hydrant**
75	50	-	80	-
90	80	-	80	-
110	100	-	80	-
150	150	50	80	100
200	200	50	80	100
250	250	50	80	100
300	300	50	80	100
350	300	80	100	100
400	400	80	100	100
450	-	80	100	-
500	-	100	100	-
600	-	100	100	-
700	-	150	150	-
800	-	150	150	-
900	-	150	150	-
above 1000	-	200	200	-

· Air Valve: Purposed only at Primary and Secondary mains.

· Fire Hydrant: Purposed only at Secondary (DI) mains for stable pressure

SECTION 6

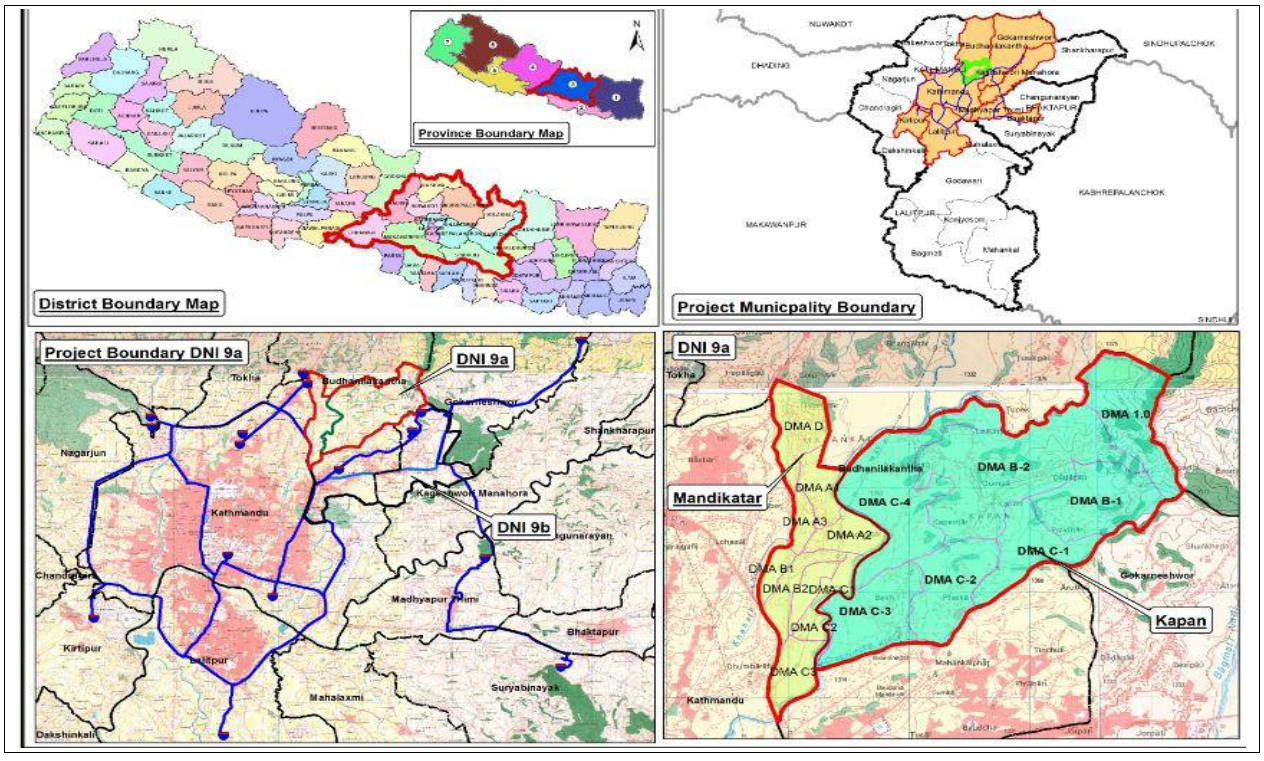
6. PROPOSED DISTRIBUTION NETWORK IMPROVEMENT (DNI9-A : MANDIKATAR AREA)

6.1 GENERAL

This design report covers Mandikatar of DNI 9 which we will now define as DNI 9-a. DNI9-a was not included in the master plan i.e Kathmandu Metro zone. Consultant have carried out population projection and finalized the demand and boundary. We've tried to maximize gravity flow to minimize pumping boundaries. After consultation with KUKL and review of OLD Bansbari WTP/SRT, Mandikatar has been designed to be supplied from OLD Bansbari SRT.

6.2 LOCATION

Mandikatar are located in the North of Kathmandu Metro zone. The topography shows severe difference in elevation, resulting difficulty to form DMA zones with stable pressure. The hydraulic modeling has been designed based on the topography, elevation, hydraulic pressure, DMA zoning etc.



< Figure 6.1: Location map >

6.3 POPULATION AND DEMAND PROJECTION

Mandikatar have shown steep growth of population for 20 years. Population projection has been done using polynomial third order curve. Details are shown below;

Table 6.3: Population of District: Kathmandu, Mahankal

Ward No.	Population 1991	Population 2001	Population 2011
1	67	218	287
2	86	278	382
3	74	240	1,376
4	141	459	1,472
5	296	965	2,261
6	277	903	2,102
7	292	951	1,291
8	212	691	2,317
9	644	2,103	6,509
sum	2,089	6,808	17,997

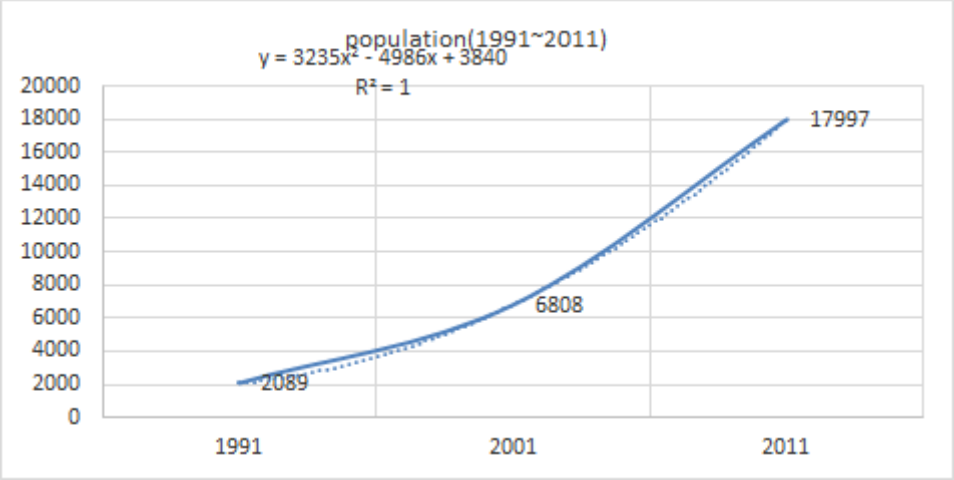


Table 6.4: Population and Demand Projection (Mandikatar area)

ward NO.	Population			spread of area	Population		Demand	
	(2011)	(2025)	(2030)		(2025)	(2030)	(2025)	(2030)
1	287	803	1,025	0%	-	-	-	-
2	382	1,068	1,364	0%	-	-	-	-
3	1,376	3,849	4,915	0%	-	-	-	-
4	1,472	4,117	5,258	0%	-	-	-	-
5	2,261	6,324	8,076	65%	4,111	5,249	0.69	0.89
6	2,102	5,879	7,508	100%	5,879	7,508	0.99	1.27
7	1,291	3,611	4,611	70%	2,528	3,228	0.43	0.55
8	2,317	6,481	8,276	100%	6,481	8,276	1.10	1.40
9	6,509	18,206	23,250	100%	18,206	23,250	3.08	3.93
Sum	14,480	50,339	64,284		37,205	47,511	6.29	8.04

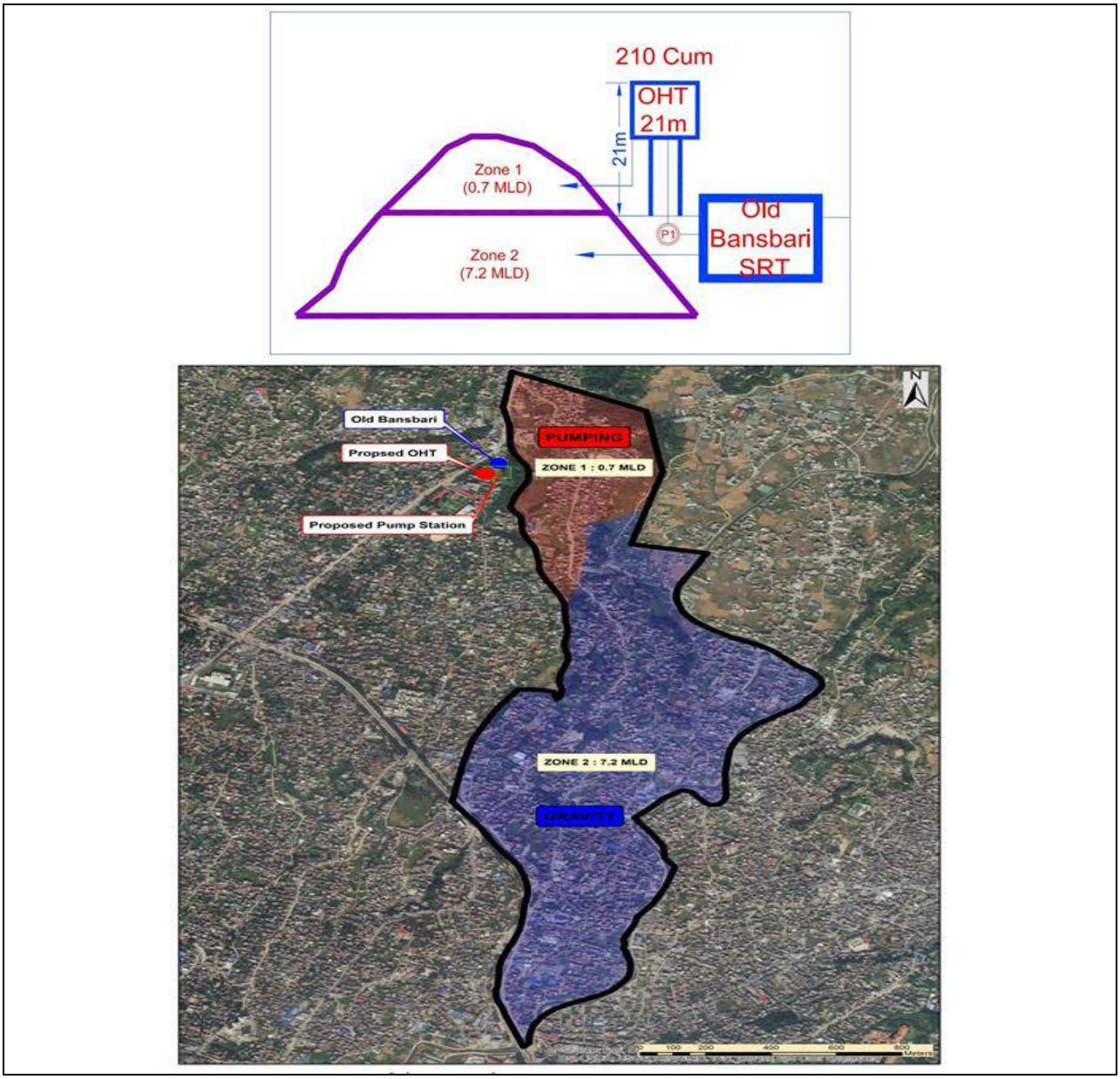
6.4 DISTRIBUTION METHOD

6.4.1 Mandikatar

With Mandikatar, topography survey, population and demand projection and service boundary, gravity and pumping zone was reviewed.

Unavoidable pumping zones were found and purposed to be supplied by pumping to new OHT.

< Figure 6.3: Schematic Diagram of Supply plan for Mandikatar area>



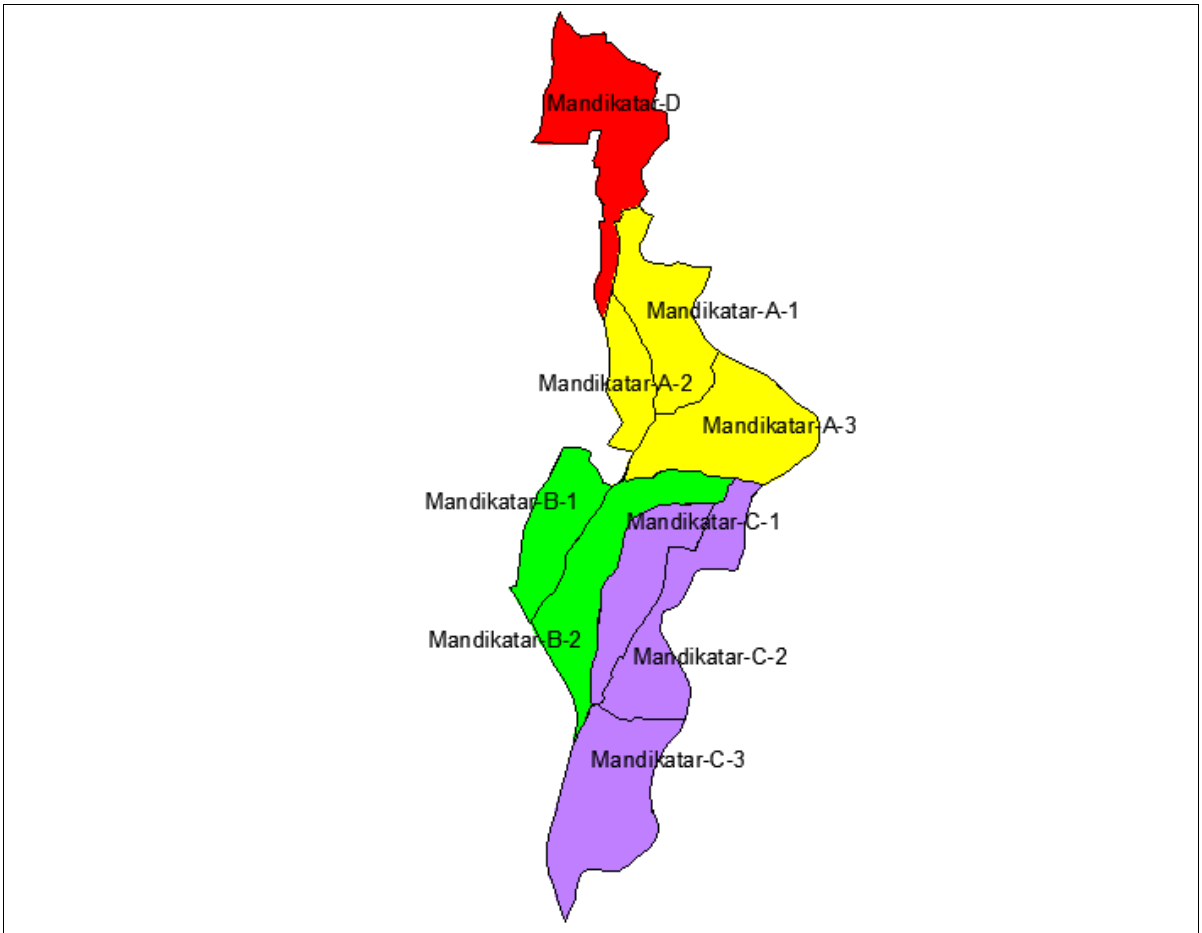
· Target Reservoir: Old Bansbari SRT (Currently in supply from Existing Source)
· New Structures: Mandikatar Pumping Station, Mandikatar OHT

6.5 DESIGN OF DNI-9A (MANDIKATAR)

6.5.1 DMA Zone

District Metered Area (DMA) zones are formed with an average households ranging from 500 to 3,000 but based on topography conditions.

DMA zone of Mandikatar area is mainly divided into 4 different DMA zones A, B, C and D and divided each into 1 to 3 sub-DMA zones.



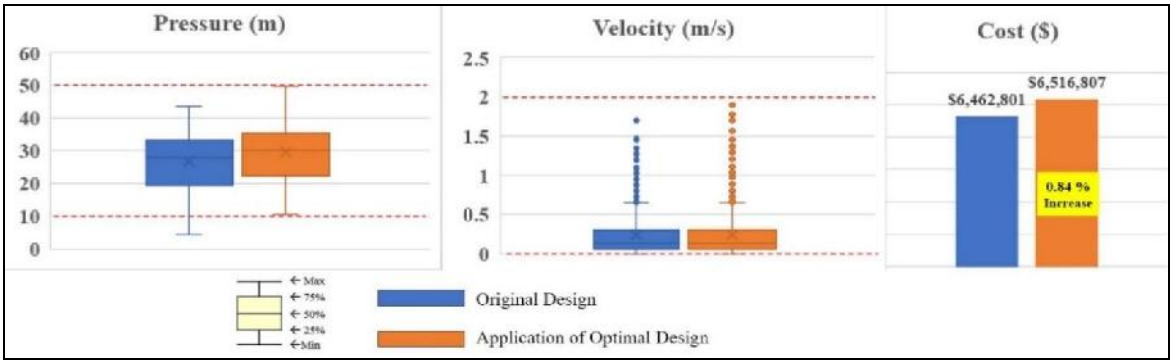
DMA	Sub-DMA	Supply Method	
D	-	Pumping	Mandikatar SRT(OLD) → Mandikatar pumping station → Mandikatar OHT → Supply
A	A-1, A-2, A-3	Gravity	Mandikatar SRT(OLD) → Supply
B	B-1, B-2	Gravity	Mandikatar SRT(OLD) → Supply
C	C-1, C-2, C-3, C-4	Gravity	Mandikatar SRT(OLD) → Supply

< Figure 6.9: Mandikatar area DMA zone >

6.5.2 Pipe Diameter Optimization

Hydraulic modeling of Mandikatar consists, 933 links for pipes, 787 nodes, 2 pressure reducing valves (1 No. of 200mm dia and 2 No. of 150mm dia (PRV)), 1 pumps, 2 OHT and 1 reservoir. The pressure distribution is ranged from 0.95 ~ 4.85kgf/cm2 at average time zone (15:00), 0.45 ~ 4.36 kgf/cm^2 at the maximum usage time zone (7:00), 1.17 ~ 5.12 kgf/cm^2 at the minimum usage time zone (0:00).

The hydraulic analysis has been optimized to improve hydraulic reliability. Through proper rearrangement of the pipe, we have increased the pressure distribution in the low pressure area and decreased the pressure in the high points. The water pressure has been optimized to 1.17 ~ 5.11 kgf/cm^2 at the average time zone, 1.06 ~ 4.97 kgf/cm^2 at the maximum usage time zone and 1.19 ~ 5.19 kgf/cm^2 at the minimum usage time zone.

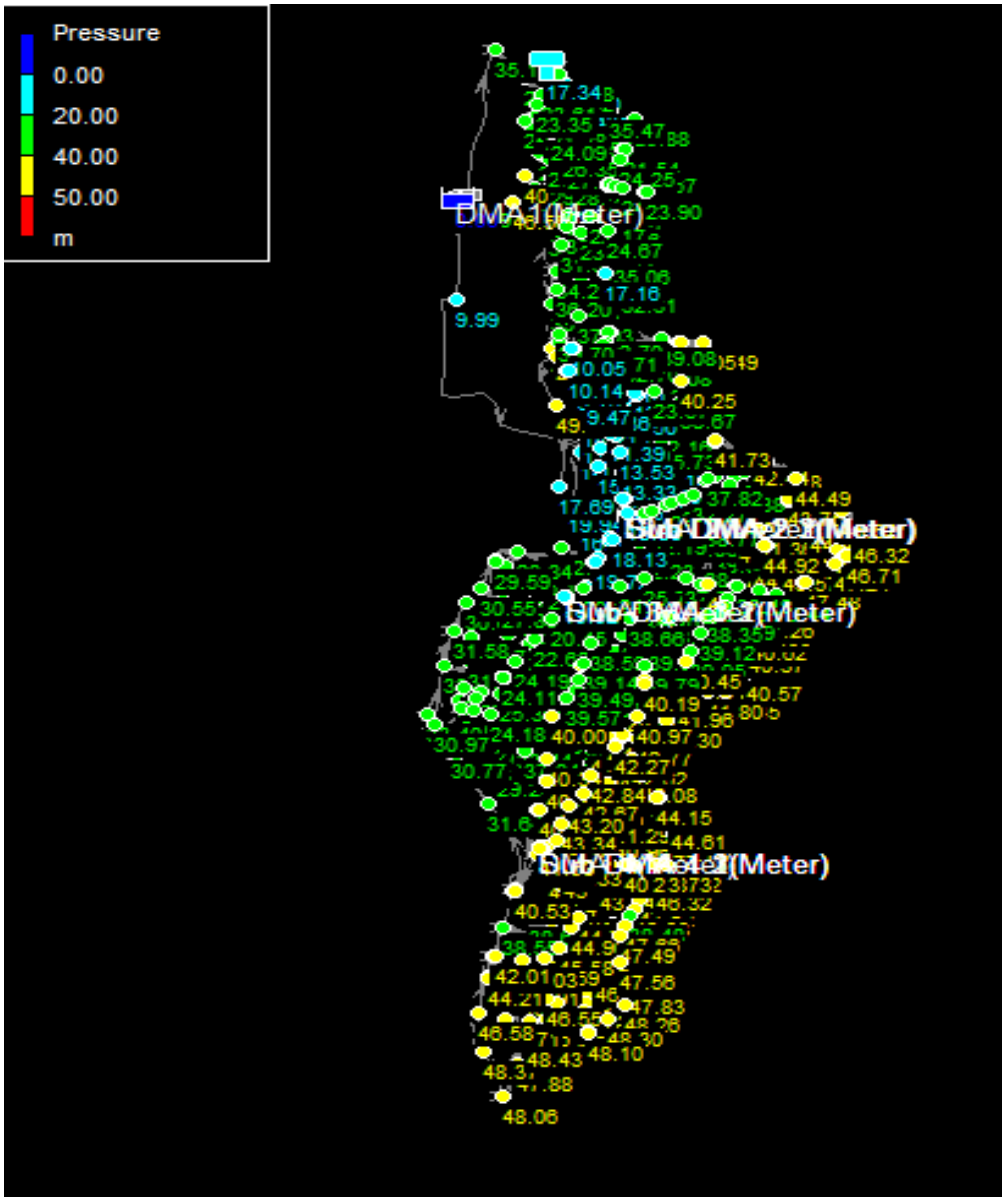


< Figure 6.10 : The Comparison results of WDS design (Mandikatar Network)>

The analysis result shown above has been completed by Opti-HSNET program after draft EPA-net modelling. According to the result of this analysis program and back data, pipe diameters and modeling was finalized.

6.5.3 Modeling

Mandikatar DNI modeling was finalized with 400mm, 350mm, 300mm, 200mm, 150mm DI pipes and HDPE PE100-PN10 pipes with inner diameters of 62.2mm and 74.8mm. Consultant have optimized the pipe diameter to limit the hydraulic pressure within 1 bar (10m) to 5bar (50m) and all of the nodes are between this range.



< Figure 6.11: EPANET Modeling of Mandikatar>

6.5.4 Pipe material and length

Primary and secondary mains are DI Pipes; Tertiary mains are HDPE-PE100, PN10 pipes. Pipe material and length of Mandikatar area is shown below;

Table 6.9: Details of Pipe material and length

Description		
Reservoir	Old Bansbari	W.L : 1,363

Total Demand (LPS)	DMA D (Pumping)		8.24
	DMA A (Gravity)		20.22
	DMA B (Gravity)		18.90
	DMA C (Gravity)		44.93
Total Number of Nodes	787		
Pipe Length (m)	HDPE (PN10)	DN 75 (62.2)	41792.92
		DN 90 (74.8)	58.18
	DI	DN 160	13117.81 HDD
		DN 200	731.09 HDD
		DN 300	1222
		DN 350	307.06
		DN 400	1362
	Sum		**58591.06**

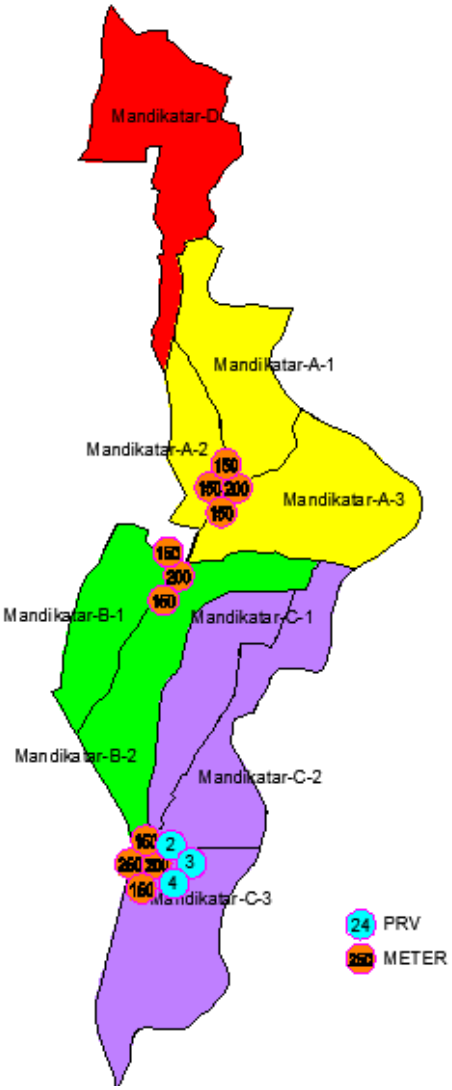
6.5.5 Bulk Meter and PRVs

As mentioned above, Bulk meters and PRV locations were decided as per the DMA design concept. Seven (7) Bulk meters and two (2) PRVs are purposed in Mandikatar.

Table 6.10: Details of Bulk meter and PRV's

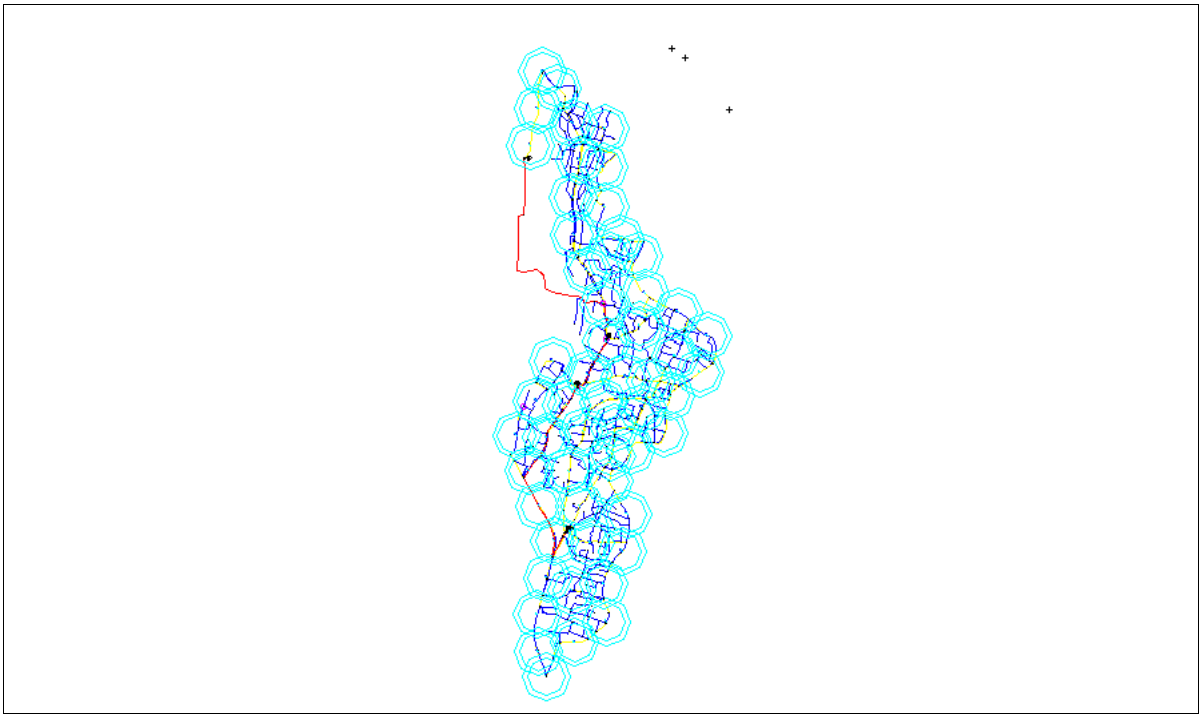
Location of Bulk Meter/PRV's			
Bulk meter	D 400mm	1No	DMA Zone

	D 200mm	1 No	DMA Zone
	D 300mm	1 No	DMA Zone
	D 150mm	5 Nos	DMA Zone
PRV's	Valve ID	Diameter	Setting Pressure (m)
	1	150	42
	1	200	44



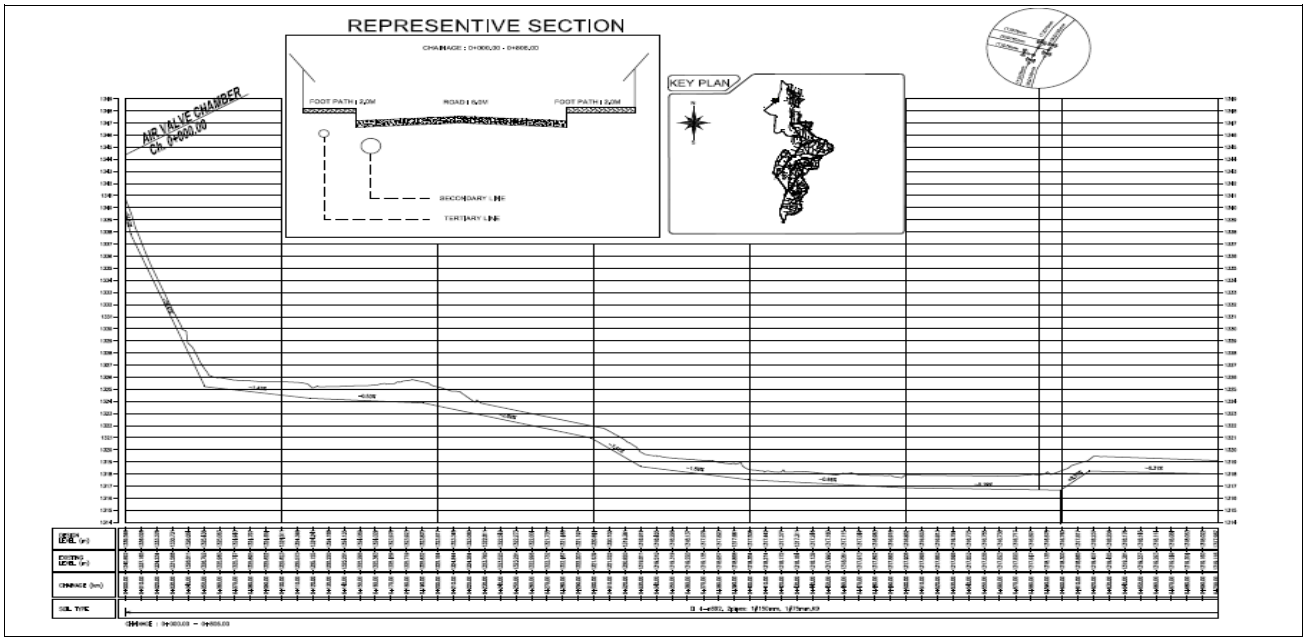
6.5.6 Fire hydrant, Air valve, Washout valve and Isolation valve

Fire hydrants are purposed only in secondary mains and each fire hydrant is located to cover 5ha.



< Figure 6.12 :Range of Fire Hydrant in Mandikatar>

Air valves and washout valves are purposed along primary and secondary mains along the road, depending on the profile of the roads.



< Figure 6.13: Profile of Mandikatar with Valves>

Isolation valves are purposed to divide Sub-DMA zones into 2 to 3 zones for maintenance propose based on site conditions but with minimum quantity of valves.

6.7 DESIGN OF RVT

Existing SRT

6.8 DESIGN OF OHT

6.8.1 General

Two (2) OHTs are purposed in Mandikatar in the existing Golfutar Tank boundary. The 210cum capacity OHT is enough to supply to the pumping boundary of Mandikatar. However, consultation with PID/KUKL, second 350cum capacity OHT has been additionally planed in the remaining area to be supplied for the nearby demands. The consultant, after discussion with PID/KUKL, has designed the pump to fill up both OHTs i.e total capacity of 560cum, within 8 hours.

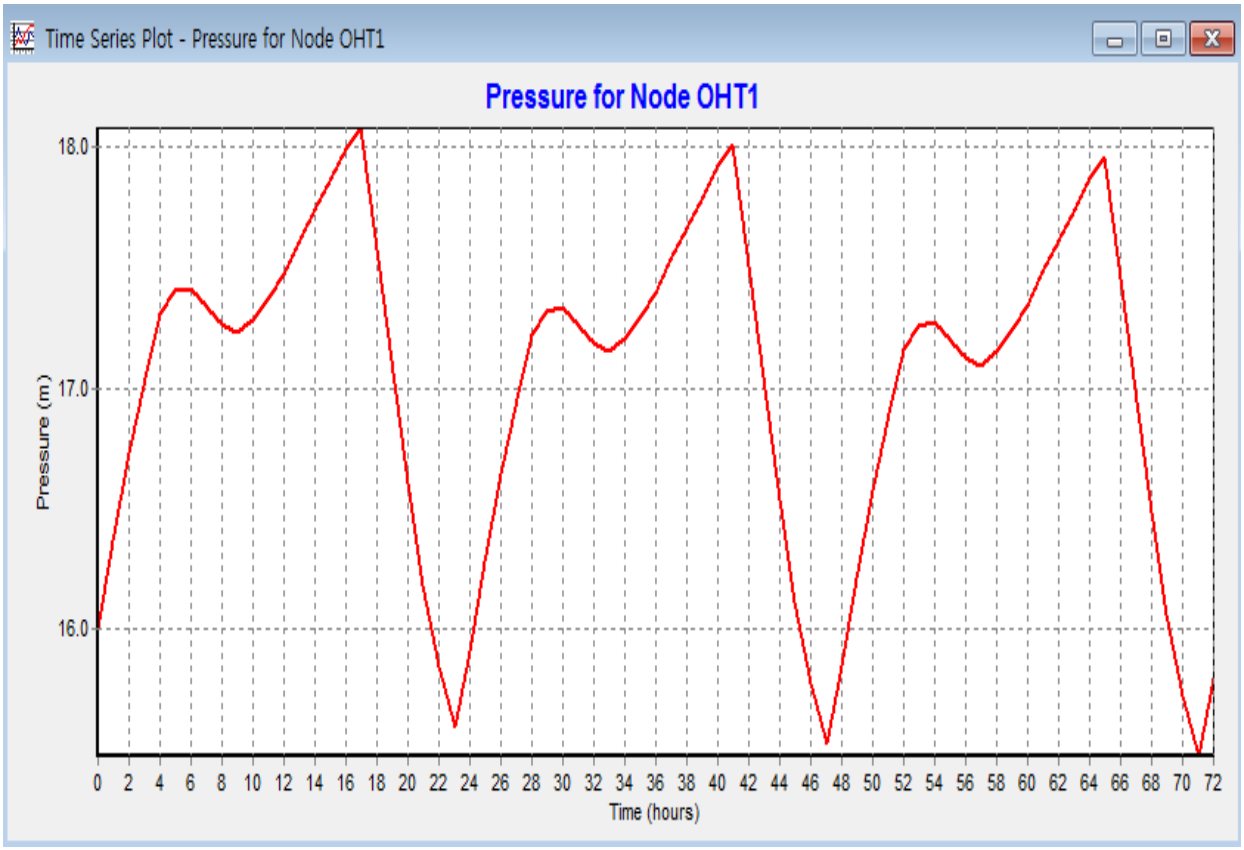
The DNI boundary for 210cum OHT has been designed but the 350cum OHT doesn't have a DNI plan yet. The design of DNI for the 350cum OHT shall be undertaken according to the pump capacity etc.

Contractors shall carry out soil investigation and revise as per results if necessary.

6.8.2 Capacity

The two (2) OHT capacity of Mandikatar is 210cum and 350cum, thus total of 560cum. The additional maximum flow to other boundaries is expected 5lps. The water level difference is calculated with demand of Mandikatar and additional 5lps flow.

The OHT capacity is bigger than the pump capacity at this moment. After finalization of additional distribution plan, pump enlargement consideration is required.

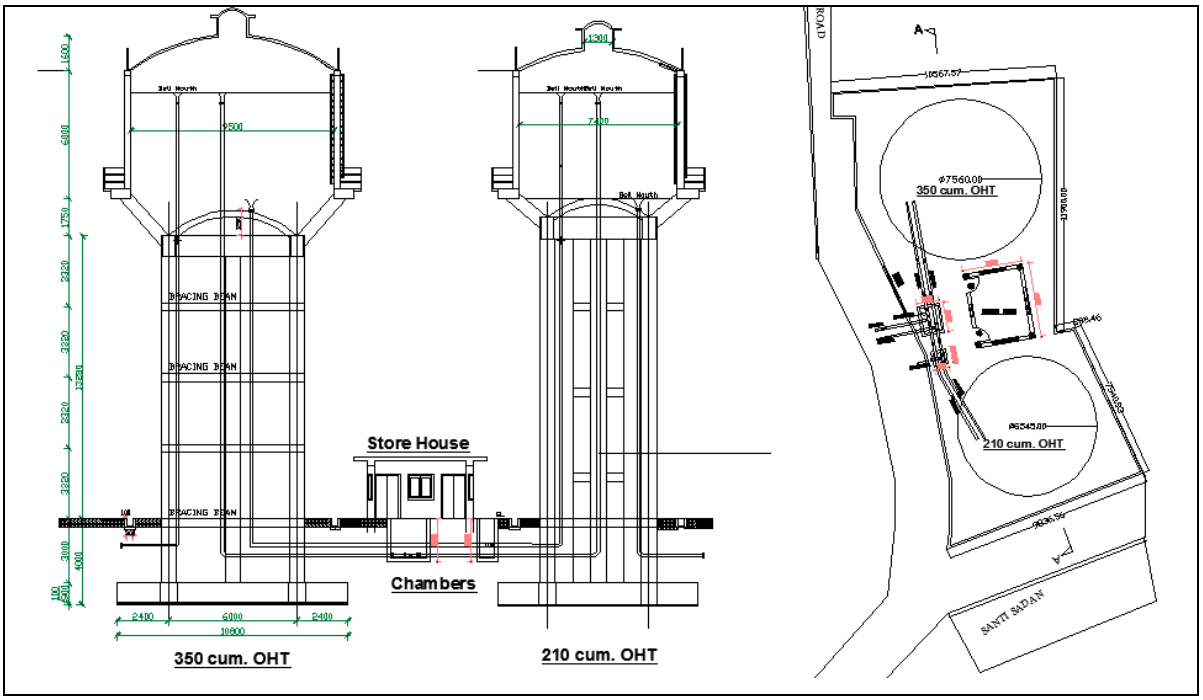


< Figure 6.17: The Water Level of OHT as per time>

6.8.3 Composition of OHT

OHT is a composition of the elevated Tank with inlet, outlet, overflow and drainage mains and stairways. For operation, storage warehouse will be placed inside the OHT boundary.

Pumping to two (2) different OHTs with a single pumping station is a big challenge in operation. The design has been undertaken to connect the outlets of two OHTs so it can be operated simultaneously, but can be separated after when it's necessary to operate two (2) OHTs separately.



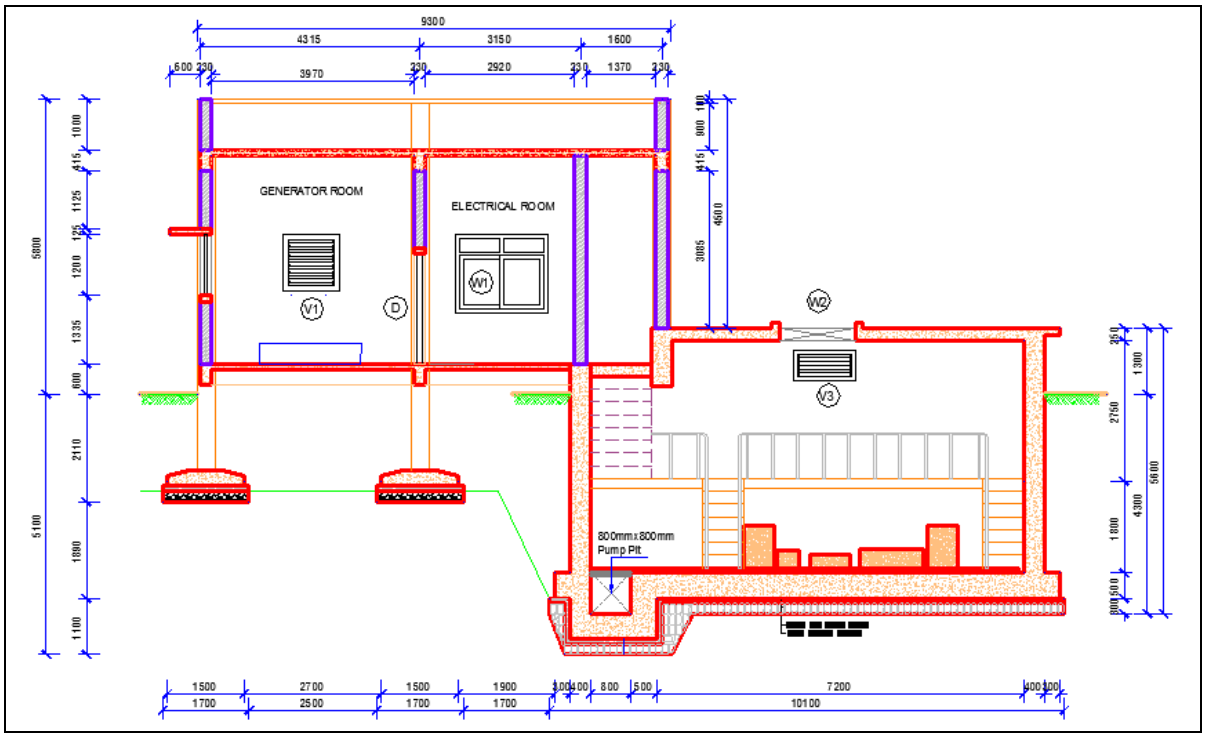
< Figure 6.18: Drawing of OHT>

6.9 DESIGN OF PUMPING STATION

6.9.1 General

3 pumping stations are purposed for DNI9a. Mandikatar pumping station will be supplying to Mandikatar pumping zone. For better access of operation and maintenance, electrical room has been integrated in the pumping station with accessible walkways.

Contractors shall carry out soil investigation and revise as per results if necessary.



< Figure 6.19: Drawing of Pumping Station>

6.9.2 Mechanical Design

General

The mechanical equipment is important in the O&M of pumping station. For the safe and stable O&M of pumping station, the mechanical equipment and relevant accessories shall be selected in terms of durability, accuracy, and simple structures and operation logics. And the devices shall be compatible with the manual and automatic operations. The economic feasibility shall be considered as an important factor for choosing the mechanical equipment.

In general, the mechanical works for pumping station includes the design of the following items.

- Pump
- Pipe and Valves plant
- Water Hammer Control System (Kirtipur, Arubari PS)

Design Criteria

The design criteria shall consider including the proper, compatibility, energy-saving, efficiency, economic feasibility, O&M, environmental protection and the required area of installation, etc.

Table 6.11 illustrates the summary of the mechanical design criteria as shown below.

Table 6.11: The Summary of the Mechanical Design Criteria

Category	Descriptions
Selection of equipment	• Selection of equipment with suitable for facility capacity and superior efficiency • Selection of equipment with spare parts and compatibility
Energy Saving and Economy Feasibility	• Selection of equipment with energy saving • Minimizing the initial construction cost and the maintenance cost
Convenience in O&M and Working Environment	• Planning of equipment maintenance by using the maintenance hoist • Securing the workspace for operator • Planning of traffic line considering the O&M for operator • Application of cover guard for the rotating equipment

Mechanical major facility planning

- **Clear water pump**

The clear water is pressurized through the pump in order to transmit the clear water to OHT or RVT. If necessary, the pump shall be operated accordingly with the change in water usage. The automatic operation, efficiency, cost and conveniences regarding O&M were considered for the pump selection.

The number of pumps for installation is determined by the capacity of pumping station, flow range, power consumption and flow rate of individual pump. The maximum discharge flow rate of pumping station with all the duty pumps and the rising mains in operation shall be equal or greater than the maximum discharge flow rate, which is required by the client.

The pumps are determined by considering the pump head and flow characteristics, which are close to the requirements of entire pumping stations. The stand-by capacity is designed to maintain the operation of pumping station in case of the daily-based maintenance and the interruption in entire pump operations due to pump failure. In other words, one stand-by pump, which has the similar specification with the duty pump, is provided in addition to the required number of duty pumps.

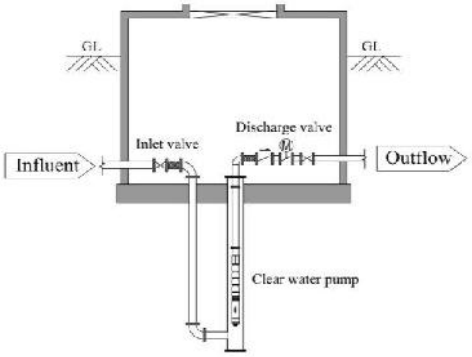
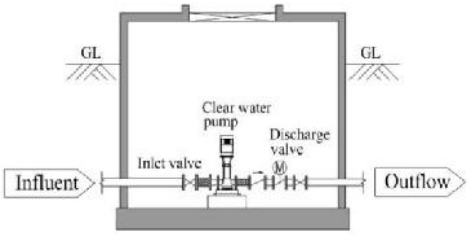
- **Valve**

The manual valve is installed on the suction and discharge side of pump to shut down the water during O&M period. And a motorized valve and a check valve are provided for the pump operation and the water hammer reduction. The working pressure of valve is determined in terms of the pump head and the pipeline pressure.

■ Water hammer control system

In the case of pumping stations with high pump head, the most appropriate water hammer control system is determined from the computation analysis is for pumps and pipeline facilities.

Table 6.12: Comparison of Pump Type

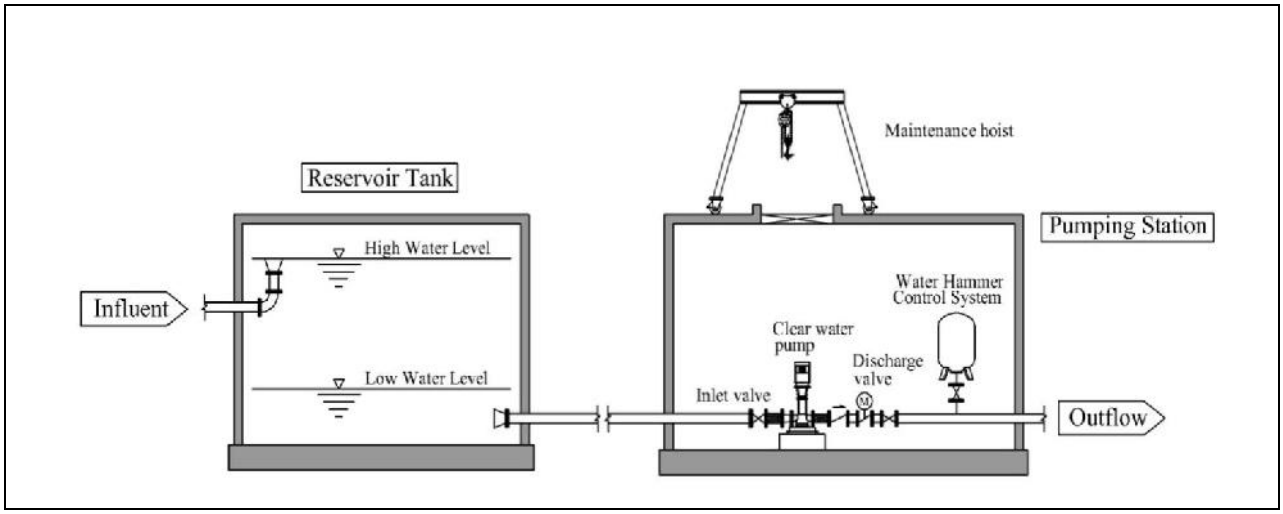
Items	Submersible (Deep Well) Pump	Land Pump (Centrifugal Pump)
Appearance		
Descriptions	• Direct connecting type model with smaller outer diameter and longer body length compared with other submersible pumps.	• Integral type model with connection between pump and motor or connection of Pump and motor via couplings. • Suction/discharge of flow in either horizontal or vertical direction
Capacity	0.6~270 ㎥/hr	0.6 ~ 1,800 ㎥/hr
Head Range	5~500 m	3 ~ 300 m
Advantage	• Capable of Low Capacity and High Head • Small area of installation and low noise level due to the underground installation	• Convenience in O&M by installing on the ground level. • High pump efficiency • Possible to check the pump operation status through the naked eye inspection. • High resistant to corrosion compared with the submersible pump
Dis-Advantage	• Low in efficiency compared with the centrifugal pump • Short operating year compared with the centrifugal pump • Difficult in O&M due to the underwater installation • Vulnerable to corrosion compared with the centrifugal Pump	• Requires the large area for pumping station • Moderate Noise (below 85dB)
Selection		◎
Conclusion	Centrifugal pump is selected due to the high efficiency compared with submersible pump and the convenience in O&M.	

The pumps from respective pumping stations are provided in terms of pump capacity, efficiency and O&M.

Table 6.13: Comparison of Centrifugal Pump Type

Items	Vertical Multi-Stage Pump	End Suction Pump
Appearance		
Description	• Integrated model with connection between pump and motor. • Collinearly aligned pipes with same size (in diameter) from the suction/discharge side. • Efficient in the flow discharge due to the centrifugal force through the rotation of impeller.	• Connection of Pump and motor via couplings. • Spiral-shaped casing • Efficient in the flow discharge due to the centrifugal force through the rotation of impeller..
Capacity	0.6 ~ 198 ㎥/hr	2 ~ 1,800 ㎥/hr
Head Range	5 ~ 300 m	3 ~ 90 m
Advantage	• Effective in the low flow rate and mid/high head range. • Convenience in maintenance enabling assembly/disassembly of pump without the dismantling of pipe. • Vertical type requiring small area of installation • Convenient in pipe work construction with collinearly aligned pipes from the suction/discharge side. • Higher in efficiency compared with end suction pump.	• Effective in the mid/low flow rate and mid/low head range. • Convenience in maintenance for simple configuration with casing, impeller and bearing
Dis-advantage	• Narrow range of flow rate selection • The inlet and outlet positions of the pump cannot be changed.	• Horizontal type requiring a large area of installation • The inlet and outlet positions of the pump cannot be changed.
Pumping Stations in Application	• Arubari • Pulahari • Mandikatar	

Overview of Pumping Station



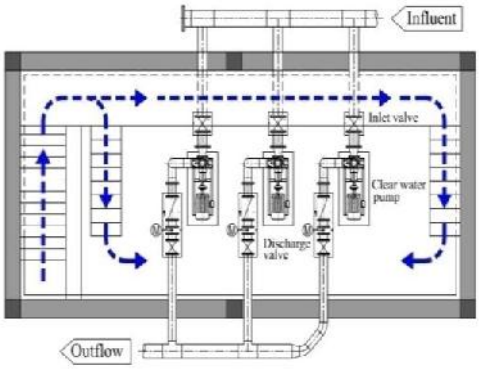
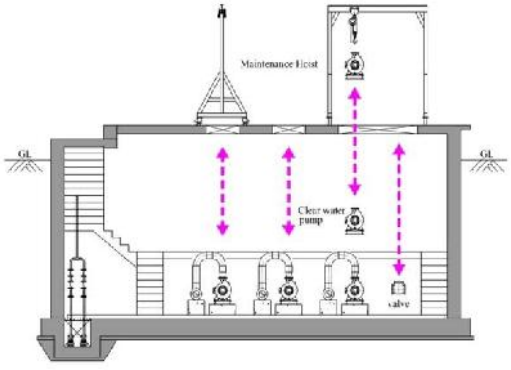
< Figure 6.20: Schematic Diagram of Pumping Station >

The most appropriate pumps for each pumping station are provided in terms of the capacity, head, efficiency and O&M.

In the case of pumping stations with the high pump head, the most appropriate water hammer control system is determined from the computation analysisis for pumps and pipeline facilities.

The manual gantry crane with the manual chain block and trolley, are applied for the maintenance of pumping stations.

For the stable operation in the start/stop sequence of pump, the motorized butterfly valve and the check valve are applied on the discharge side of pump.

Items	Maintenance Traffic Line	Equipment Access Line
Appearance		

< Figure 6.21 :Pumping Station Layout and Maintenance Plan>

The planning of traffic line on stairs and walkways are applied to the design for the convenience in equipment maintenance by the operator.

At the upper part of pumping station, the equipment roof hatch is applied for the maintenance of equipment by using the maintenance hoist.
The drain pit and drain pumps are designed for the drainage of sewage that may occur during the maintenance and cleaning inside the pump station.

Table 6.14: Conditions of Pump Operation

Name of pumping station	Capacity (m^3/day)	Reservoir L.W.L(m)	OHT or TANK H.W.L(m)	Water Hammer Control System	Remark
Mandikatar	1.26	1,364	1,387	-	

The pump shall be stopped at RVT and L.W.L, and automatically operated according to OHT or RVT H.W.L.

For the stable operation in the start/stop sequence of pump, the pump shall be automatically operated with the motorized valve.

The direct pumping shall be automatically operated through the inverter in order to adjust the flow rate with the changes in pressure.

The bladder tanks are key equipment for preventing the water hammer and shall be able to monitor from remote area or on-site.

All the equipment related to automatic operation are supplied by SCADA SYSTEM

The above items are provided as the design conditions, and could be changed with the site conditions and construction status.

6.9.3 Electric Design

General

- **Overview**

Electrical system is essential for safe and reliable operation of a pumping system. The arrangement for providing the electricity to a pumping station shall be determined in discussion with the local Distribution Centre of Nepal Electricity Authority.

Special attention is drawn to the following:

(a) Maximum demand and the estimated load profile;
(b) Maximum instantaneous load;
(c) Supply voltage;
(d) Power transformer;
(e) Stability and reliability of power supply;
(f) Starting equipment;
(g) Statutory regulations;
(h) Energy efficiency and power quality;

- **Scope of work**

The electrical facility will be organized to supply the stable electricity to the new pumping station.

Scope of Electrical Works shall be consisted of following items.

- 11kV Power Supply (Incoming &Metering)
- 11kV/415V Transformer
- (415V is selected instead of 400V for reliable operation of pump from NEA line)
- Emergency Power Supply (Diesel Generator)
- 400V Motor Control Centers (MCC)
- Power & Control Cables including Cable ladders and Conduits
- Grounding & Lightning Protection System
- Lighting & Socket Outlet System
- Exclude Automatic operation and measurement (Supplied from SCADA System)

- **General Design Concept**

General design concept of Electrical work will be based on followings.

- Stability and reliability of power supply
- Ease of operation and maintenance
- Enough space for the efficient movement of operators and equipment, and future plan

- **Use of high-efficiency equipment for saving**

Electrical works shall be conformed to latest Codes and Standards such as the followings

- IEC(International Electro-Technical Commission) Code
- NEC(National Electrical Code) Code
- ISO(International Standard Organization) Code
- IEEE(Institute of Electrical and Electronics Engineers) Code
- NEA(Nepal electricity Authority) Standards
- Nepal Standards or India Standards (IS)

Site Survey of the existing electrical facility

- **Location of pumping station**

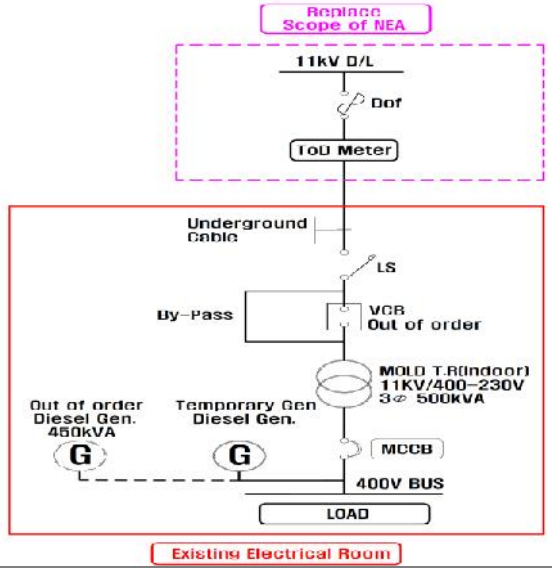
Installation location of the pumping station is as follows.

Table 6.15: Location of pumping station

Pumping Station	Location	Remark
Mandikatar	Site in the existing Bansbari WTP	

- **Current condition of the existing facilities**

Table 6.16: Current condition of the existing facilities

Pumping Station	Mandikatar
System Diagram	

11kV Power Incoming

- **Incoming Voltage**

An 11kV Incoming line will be planned to supply electricity from the nearest existing 11kV distribution line of NEA (Nepal Electric Supply Company).

Type of incoming Voltage was consulted with NEA and the capacity of the electrical facility is following.

Table 6.17: NEA's Regulation

Contract Demands	Supply Voltage	Remark
For contract demands below 25kVA	Low Voltage (400V)	
For contract demands above 25kVA	Medium Voltage (11kV)	

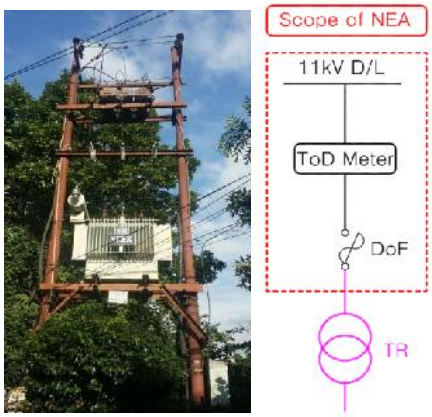
- **Scope of Work**

The Contractor shall pay all expenses for 11 KV incoming line and ToD Meter which will be supplied and installed by NEA.

The electrical facility will be supplied by NEA as follows.

- An 11kV Distribution Line from the nearest NEA's existing 11kV distribution line to project area.
- H-Pole, LA, PT & CT, ToD Meter, Drop Fuse, Earthing system.
- Installation of 11kV/415V Transformer only (Transformer will be supplied by contractor).

Table 6.18: Installation of ToD Meter

Classifications	Outdoor H-Pole Type (Below 200kVA)	Outdoor H-Pole Type (Above 200kVA)
System Diagram		
Tod Meter	Secondary side of the Transformer	Primary side of the Drop Fuse

- **Power Incoming Method**

Power supply of Project area in Kathmandu city will not completely reliable, and short time blackout shall be considered.

Due to unavailability of electrical parallel network system between sub-stations, Dual power incoming system is not economically feasible, since new construction of another distribution line is required.

Therefore, single line power incoming system is selected on design and emergency power generator with enough capacity for regular Pumping Station operation is to be installed and operated during temporary power blackout.

Table 6.19: Comparison of Power Incoming System

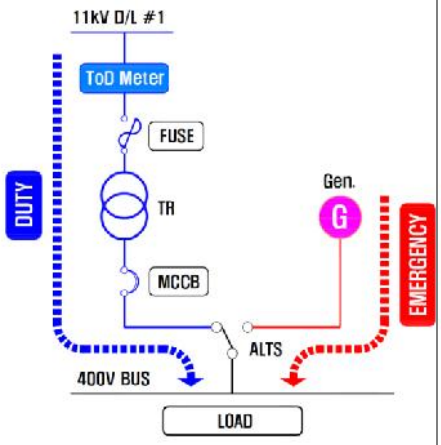
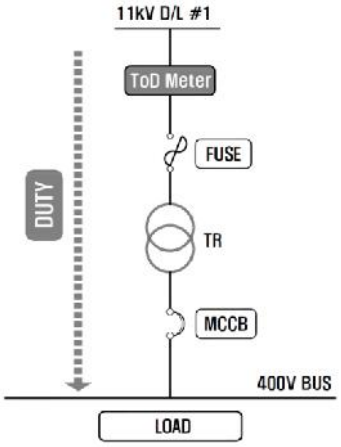
Classifications	1 Line Power Incoming + Generator System	1 Line Power Incoming System
System Diagram		
Advantage	• Emergency Operation will be available when Transformer or NEA distribution line fails. • The power supply will be stable and reliable.	• Easy maintenance with simple equipment. • Lower cost of equipment.
Disadvantage	• Inconvenient maintenance. • Higher cost of equipment.	• Limited load operation. • Emergency Operation will not be available when Transformer or NEA distribution line fails.
Selection	◎	

Table 6.20: Incoming Voltage& Demand Power

Pumping Station	Demand Power (kVA)	Incoming Voltage	Method
Mandikatar	23.56	400V, 3Phase 4W, 50Hz	Incoming from LV distribution panel in existing WTP (TR:500kVA)

11kV/415V Transformer

- **Demand Factor of Load**

Considering the characteristics of load, it shall be planned by demand factor of each facility.

Table 6.21: Demand Factor Categories

Item	Demand Factor(ß)	
Facilities	ß1 : 0.1	The Intermittent Working Load
	ß2 : 0.6	The Discontinuous Working Load
	ß3 : 1.0	The Continuous Working Load

- **Transformer Capacity**

The transformer capacity shall be determined by applying 20% extra on maximum demand load.

Voltage Sag of Transformer shall be below15% at starting of high capacity motor-pump.

Efficiency of motors: Efficiency of individual motors

Power Factor of motors: 0.95

Table 6.22: Demand Power

Item	Demand Power	Allowance rate (20%)	Total Demand Power	Remark
Mandikatar	23.56kVA	4.71kVA	28.27kVA	

Table 6.23: Transformer Capacity

Item	Max. Demand Power	Transformer			Remark
		Capacity	Primary Voltage	Secondary Voltage	
Mandikatar	28.27kVA	Using existing transformer			

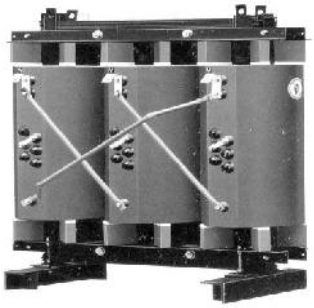
Note: The rated voltage of the system is 400V, but the rated voltage of the transformer is selected at 415V to consider the voltage drop of the system

- **Transformer Types**

Currently, oil immersed transformer is mostly used in Nepal and domestic manufactures are available for easy to maintain and convenient to replace the equipment due to blackout.

Therefore, oil immersed transformer is selected in design because (i) lower cost than mold transformer, (ii) no cooling system required, (iii) high durability again hot climate and high humidity in Kathmandu and lastly (iv)more common transformer type in Nepal.

Table 6.24: Comparison of Transformer Types

Classifications	Oil Type Transformer	MOLD Type Transformer
External form		
Inflammability /Explosiveness	• Inflammable and has the risk of explosion.	• Flame-retardant, self • extinguishing, non-explosive
Noise Degree	Low	Medium
Power Loss	Medium	Low
Repairing and Inspection	• Check insulation oil leakage and features • Check leakage of nitrogen gas	• Exterior Inspection • Cooling fan in case of air cooling type
Cost	100 %	150 %
Advantages	• Low noise • Inexpensive • Suitable for the tropical region	• Excellent moisture resistance and stain resistance • Installation area is small.
Disadvantages	• Risk of oil spillage. • Installation area is large and is heavy	• Expensive • Take large possession
Selection	◎	

Emergency Power supply

Installation of diesel generator as an emergency power for emergency operation of pump station when mains power fails shall be provided.

Generators are operated automatically at main power failure.

All regular loads are disconnected automatically at main power failure.

After power outage, all of the loads shall be transferred to the NEA's power line and the generator shall stop.

The emergency generator's capacity is designed to be able to operate at full load.

The capacity of each station's emergency generator is following as:

Table 6.25: Capacity of pumping station's emergency generator

Pumping Station	Generator Capacity	Voltage	Remark
Mandikatar	Using existing generator		

System Voltage

The following system voltage shall be applied to all equipment except Distribution Transformer (415V).

Table 6.26: System Voltage

Description	Used Voltage	Remarks
Incoming Voltage	AC 3phase 3Wire, 11kV, 50Hz	
Low voltage distribution	AC 3phase 4Wire, 400V, 50Hz	
Low voltage motor	AC 3phase 3Wire, 400V, 50Hz	
Lighting & Socket Outlet	AC 1phase 2Wire, 230V, 50Hz AC 3phase 4Wire, 400V, 50Hz	

Equipment Layout plan (Pumping Station)

- **Installation Plan**

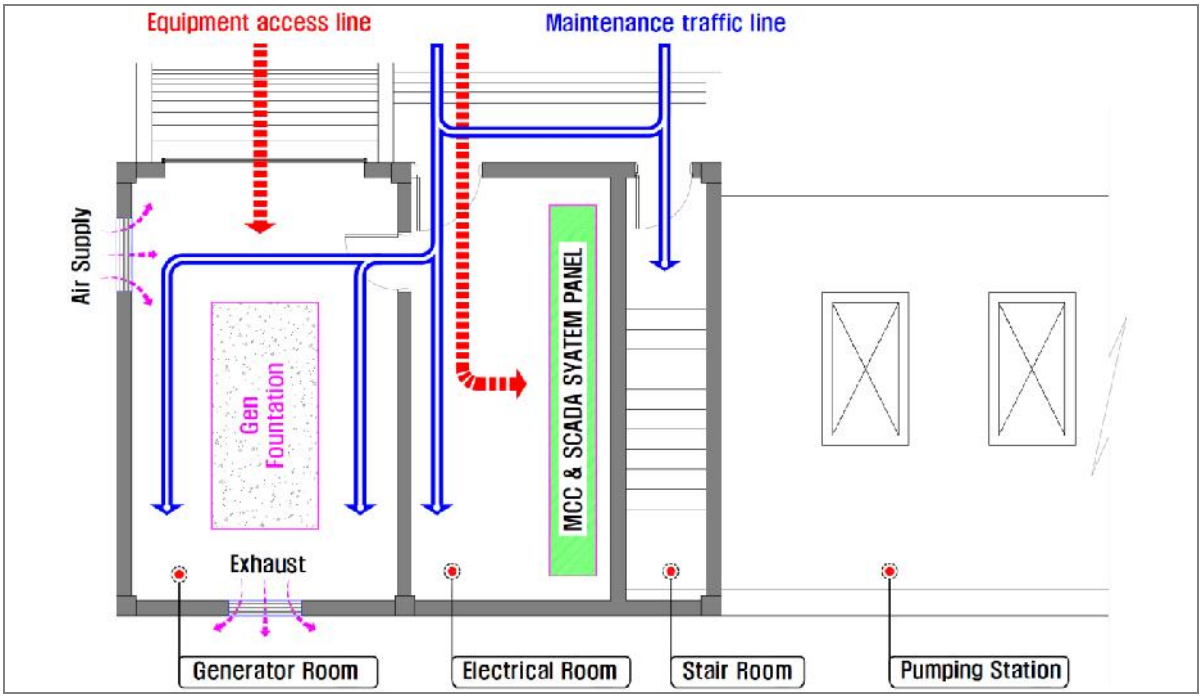
In order to improve the durability of electrical equipment, the Electrical equipment is planned to be an indoor type.

The layout of the electrical room is planned with considering the efficient movement of the operators and the equipment.

The generator and electrical room shall have enough space for increasing convenience of operation and maintenance.

The electrical room shall have a space for installation of SCADA SYSTEM in the future plan.

- **Layout Plan of Pumping Station**



< Figure 6.23: Arrangement Plan of Main Electricity Room>

Type of Circuit Breaker

- **Low Voltage Circuit Breaker**

Air Circuit Breaker (ACB): Above 600A (Rated Current)
Mold Case Circuit Breaker (MCCB): Upto 600A (Rated Current)

Power Factor Improvement

Object of Power Factor Improvement is to reduce power loss in line and supply good quality of electric power.

Power Factor Correction shall be 0.95 or above at the main transformer.

Static capacitors shall be connected in parallel with individual motors.

The condenser will be attached to the end of motor.

Motor Control Center

The Motor Control Center (MCC) shall be the Metal Enclosed type.

MCC shall consist of Auto transfer switch, Circuit breakers and starter units for each circuit to control and protect motor-pump.

The motor control center is designed to facilitate easy access and maintenance.

The motor control center shall be installed in the electrical room near the load.

Digital protection Relay with excellent protection characteristic for motors is selected for the Motor projection relay.

- **Rated Voltage of Motor and Electric Drives**

The rated voltage of the motor is selected by considering the usage and characteristics of load.

- Starting current, voltage sag at startup of motor and starting characteristic.

Table 6.27: Rated Voltage of Motor

Motor Capacity	Selected Voltage	Remarks
Below 0.5kW	AC single phase, 230V AC three phase, 400V	
Between 0.5kW~250kW	AC three phase, 400V	

- **Electric Drives**

The optimum starting method shall be selected by the loading characteristics (suppressing within 15 % of system voltage drop rate during startup) and the starting method that can extend equipment duration and energy cut down of equipment.

Table 6.28: Electric Drive of Motor

Motor Capacity	Selected Drives	Remarks
Below 15kW Above 15kW ~ Below 30kW	Direct on Line(DOL) Star Delta	
Above 30kW ~ Below 250kW	Soft-Starter	
When flow control is required	Inverter(V.V.V.F.)	

Motor power of each pumping stations is as follows:

Table 6.29: Unit Power of Motor

Pumping Station	Power (kW)	Q'ty (stand-by)	Starting Drives
Mandikatar	7.5	3(1)	Direct on Line(DOL)

Cabling Works

Feeding cables are installed from electrical switchboards to all electrical equipment in the plant, such as motors, valves, control units etc.

Cables outside buildings shall be laid underground in PE conduit.

Cables inside buildings shall be installed on cable-tray(ladder type) or in PE conduit.

All low voltage cable shall be copper conductor, XLPE or PVC insulated as per specification.
The voltage drop shall not be more than 2 % of continuous maximum current at the rated voltage.

During starting or re-acceleration the transient voltage depression at the terminals of any motor shall not be more than 15 % of the rated equipment voltage.

Table 6.30: Cable Specification

Description	Type	Min. Size	Max. Size	Remarks
Low Voltage Power	0.6/1kV XLPE Insulated PVC Sheathed Power Cable	2.5㎟	300㎟	
Low Voltage Power	400V BUS-DUCT (CU)	2nd of Large T.R 1st of Large Generator		
Low Voltage Motor	0.6/1kV XLPE Insulated PVC Sheathed Power Cable	2.5㎟	240㎟	
Lighting	0.6/1kV PVC Insulated Wire	2.5㎟	-	
Control	0.6/1kV PVC Insulated PVC Sheathed Control Cable	1.5㎟	-	

Lighting Facilities

- **Interior Lighting**

The illumination level for lighting facilities shall be in accordance with the following tables.

Table 6.31: Illumination level

Main Rooms	TYPE	Design Lux	Remark
Electrical Room	Tube Light Fluorescent lamp 2x36W	200	
Emergency Generator Room	Tube Light Fluorescent lamp 2x36W	200	
Pump Room	Tube Light` Fluorescent lamp 2x36W	200	

- **Lightning Protection System**

Lightning Protection is planned to protect equipment in pumping station, and to set a protecting zone by applying rolling sphere method which is conformed to IEC 62305.

- Protecting area : level 4
- Rolling sphere radius : 60m
- Lightning rod : single rod

- **Grounding System**

(a) Installation Plan

It shall be planned that the reliability of grounding system is improved (maintaining total grounding resistance of 10Ω) by applying common grounding and structure grounding systems.

(b) Selection of Grounding Method

The method that provides stability, an excellent construction and economic efficiency as well as being appropriate for IEC regulation based on equipotent structure is selected. The grounding method comparison is as follows.

Table 6.32: Comparison of Grounding Methods

Item	Common Grounding	Individual Grounding
Grounding Method	▪ All earth electrodes will be connected together ▪ The common earth bar in a site or more are grounded with earth object and ground object.	▪ Earth electrode will be provided separately.
Advantage	▪It can gain a low grounding resistance. ▪It will eliminate potential mutual interference on ground. ▪ In spite of malfunction of some electrode, the reliable earthing system will be provided.	▪It will be suitable on all type of soil condition of land. ▪ Ground potential rising rate will be low.
Disadvantage	▪If objects are spreaded widely, ground potential will rise. ▪ Expensive.	▪If the individual grounding is worked in limited area, construction has difficulty. ▪ There will be potential mutual interference between separate two earthing electrodes.
Selection	◎	

SECTION 7

7. PROJECT COST

7.1 BASIS OF COSTING

The unit prices or lump sum prices were analyzed considering the following:

- Standard GON norms of unit price analysis and other accepted norms in recent ICB and LCB contracts in the country and elsewhere
- Market Prices/FOB prices for imported materials as pipes, accessories etc.
- Wages of skilled and unskilled labor
- Construction technology
- Mobilization and demobilization cost
- Overheads and profit
- VAT and other applicable taxes

Break-down into plant, materials and labor component for all unit prices was derived. Unit rates for individual items were determined on basic inputs, overheads and profit including the determination of the foreign exchange component of each element.

Table 7.1: Cost Estimate for DNI 9a – Mandikatar.

Kathmandu Upatyaka Khanepani Limited
Project Implementation Directorate

Kathmandu Valley Water Supply Improvement Project
Distribution Network Improvement Works
Contract No. KUKL/DNI-9a\/MANDIKHATAR

Summary of Bill of Quantities

Part No.	Work No.	Description of Works	Amount (NRs.)
A		**Preliminary, Provisional and General Work**	
	A1	Preliminary and General Work	
	A2	Provisional Work	
B		**Civil Works**	
	B1	Site Clearance, Earthwork, Sand Filling, Shoring and Other Earth Material Related Works	102,814,779.99
	B2	Brickwork	2,999,151.77
	B3	Concrete Related Work	86,106,202.59
	B4	Surface Finishing Work	2,653,755.32
	B5	Reinstatement and Pavement Work	101,907,843.48
	B6	Metal Related Work	891,368.40
	B7	Other Building Works	1,169,934.95
	B8	Miscellaneous Works	540,450.00
	B9	HDD works	45,941,074.63
C		**Pipe line, Pipe Fitting and Other Pipe Line Related Works**	
	C1	Pipe Supply, laying and jointing works	71,359,819.74
	C2	Supply and Installation of Pipe Fittings, Valves and Appurtenances	125,486,301.02
	C3	Hydrostatic Testing and Disinfection Work	5,461,409.38
D		**Mechanical Works**	
		Preliminary, Provisional and General Work	
	D1	Mandikatar Pumping Station	6,375,897.71
E		**Electrical Works**	
		Mandikatar Pumping Station	7,550,604.00

F		**Others**	
	F1	Supply of Pipes, Fittings and Accessories for Operation & Maintenance	4,483,826.56
	F2	Day Works	3,230,852.40
		Total of KUKL/DNI-9a/ Mandikatar	**568,973,271.94**

SECTION 8

8. OPERATION AND MAINTENANCE PLAN

8.1 GENERAL

A well-designed Operation and Maintenance (O&M) Plan for a water supply system is critical to ensure that the design intent is conveyed in daily operation resulting in maximum benefit to the residents at the minimum possible level of investment. Proper implementation of the O&M plan results in low maintenance cost and ensures longer service life of all system components.

The critical issues to be taken care of in the development of an O&M Plan will be the maintenance of equipment, pipelines, valves & other appurtenances and the system of providing house service connections.

8.2 PROPOSED MAINTENANCE SYSTEM

8.2.1 General

The preventive maintenance of a water distribution system is a set of activities that shall be performed on a regular basis.

Preventive maintenance may increase the initial project cost marginally, but will result in an economical maintenance of the system over the project life. Specifically, in the internal water distribution system, preventive maintenance will increase the life of water mains and appurtenances, which in turn will assure regular and uninterrupted water supply to consumers.

The water distribution system is usually one of the most expensive components of a water supply system and its proper maintenance will reflect on the functioning of the system and its associated service life. The KMC has an advantage on this water supply project with respect to O&M, since no major electrical and mechanical equipment's are installed in the system and electric power is apparently not relied on.

Maintenance issues in pipelines will differ from place to place depending on the conditions encountered. Selection of suitable pipe material and periodical maintenance is essential to ensure protected water supply at the most economical rate with minimum breakdowns, which will ultimately manifest itself as consumer satisfaction. The points to be considered while planning are enumerated below:

- Periodic inspection of mechanical / electrical equipment such as pumps and motors installed at the WTP, valves, capacitors, voltage stabilizer etc. shall be done for trouble-free operation and optimum performance
- Materials of superior quality shall be procured for replacements
- Newly laid mains shall be regularly tested

- Precautionary measures against corrosion shall be performed
- Leak detection surveys shall be performed from time to time.
- Ducts shall be provided across streets to permit easy laying of additional mains, if required
- Provisions of stubs (short length mains) shall be made to accommodate a group of ferrule connections
- Equipment like pumps, pipe cutting machines, cutting machines, pipe detectors, leak detectors, lighting sets, spare valves etc. shall be arranged for O&M.
- Preparation of 'ward manuals' with details of mains, valves, hydrants, etc. within a ward or zone shall be done.
- Emergency labor teams to work on Sunday and holidays to attend emergency works shall be available.
- Liaison with custodians of other utilities for proper work co-ordination and reduced interference shall be taken care.
- Adequate staff training shall be arranged from time to time.
- A system of information dissemination to consumers on possible disruption in supply shall be established.

8.2.2 Breakdown / Emergency Maintenance

In case of damage (burst) resulting on a main, the following operational sequence shall be adopted:

- Labor workforce (skilled & unskilled) shall be mobilized and required materials shall be assimilated and the team shall be directed to the breakdown site.
- Main control stations / senior officers concerned with maintenance of water distribution shall be informed of the situation and the progress monitored.
- The concerned control office shall be intimated to isolate the damaged main and alternative supply arrangements (if possible tankers) for water supply to the localities affected shall be pressed into action.
- Utilities such as Roads, Electricity & Telephones shall be informed of the breakdown and requested to be present at site to ensure coordination.
- The local traffic police shall be informed to ensure proper traffic regulation.
- Isolation of the water main by closing sluice valves on all sides shall be done if the pipe is damaged severely.

8.2.3 Maintenance of Appurtenances

The objective of installing appurtenances on water pipelines is to permit control of water supply, protect the pipelines and assist with periodical cleaning. Normally installed appurtenances are described below.

Sluice valves

Sluice valves are required to control and regulate water supply and shall be provided at suitable locations considering the length of pipeline and take off branches. Defects normally reported on the sluice valves are the following:

- **Gland leaks:** Gland leaks can be rectified by replacing the hemp packing when noticeable leaks are observed.
- **Spindle damage:** Unequal application of pressure results in damage to the spindle, which can be avoided by training valve operators to operate the valve in accordance with manufacturer's recommendations on tightening pressure. It is necessary to have spare spindles for the full range of valves to ensure replacement in the shortest possible time frame
- **Partial valve closure:** Debris accumulated in the valve seat and around spindle heads causes this problem and can be removed by opening the top cover of the sluice valves. Round out of spindle heads are a direct consequence of wear and tear and this can be reduced by using specially prepared caps

It is a recommended practice to provide a name plate on the valve chamber or near the curb edge detailing sluice valves with location, size and direction of opening. This will reduce the complaints regarding sluice valves getting buried during road construction and/or trench backfill. When possible, sluice valves shall be installed along pavements. Sluice valves in roads where there is intense traffic shall be provided with heavy-duty covers with markings of pipeline alignment to avoid intentional or accidental damage.

8.2.4 Scour Valves

Scour valves are normally provided at the bottom of pipelines (normally horizontal) and operated to flush and dewater the mains.

8.2.5 Air Valves

Air valves are provided on the top of pipelines where there is an acute horizontal / vertical direction changes.

8.2.6 Quality of Materials

The water supply system will work without (or with very minimal) interruption if the procured materials such as pipes and appurtenances are of standard quality. It is therefore necessary to use

standard materials of approved make and establish procedures right from procurement of materials to installation, testing and commissioning.

The pipes procured shall be subjected to hydraulic pressure tests as specified in IS: 1536-1967. If the testing facility does not exist, a manufacturer's test certificate shall be obtained and filed for reference. Manufacturers shall test pipes in the presence of the representative of KUKL and submit a test certificate while delivering the pipes.

Valves, hydrants and other appurtenances shall be tested prior to installation. It is recommended to invest more in procuring good quality materials rather than purchasing inferior materials and then incur high maintenance expenditure.

8.2.7 Maintenance of Service Reservoirs

The important aspects to be considered in the maintenance of service reservoir are:

- **Measurement of inflows / outflows:** Supply and Discharge flows or at least discharge flows shall be measured to ensure the losses. Water level indicators and flow indicators / recorders shall be in working condition.
- **Structural leakage:** All structural damages and leak shall be promptly repaired.
- **External Pollution:** Manhole openings, ventilation shafts and overflow pipes shall be adequately protected and checked periodically to prevent any contaminant infiltration.
- General cleanliness in and around the service reservoirs shall be maintained and observed.
- A garden around the service reservoir can be provided, wherever possible, for aesthetic reasons.
- A program to clean the service reservoir at least twice in a year shall be undertaken. Such cleaning process shall be performed during non-supply times or a facility to by-pass the water supply shall be in place.
- Appropriate safety measures to prevent entry of unauthorized persons
- Shall be provided.
- All guide and hand railings shall be maintained in a safe and firm condition.

8.2.8 Maintenance of Bulk Distribution System

Conveyance and water distribution are items that involve substantial expenditure in a large water supply scheme. For effective maintenance, the entire water distribution system shall be divided into zones served preferably from a minimum number of service reservoirs. Operation and Maintenance of the water distribution system shall be entrusted to at least a Junior Engineer who shall be the authorized official of the controlling authority to receive and deal with complaints. Appropriate registers shall be maintained to record complaints and track follow up action to ensure that the complaint is addressed. He shall be provided with sufficient funds to face an

emergency. If the complaint is such that it cannot be dealt with at his level, the Junior Engineer shall promptly refer the matter to a higher authority and also intimate the action taken to the complaint. Frequent vigilance checks in areas receiving maximum complaints shall be made as an essential part of the supervisory staff's daily schedule of duties.

8.2.9 Annual O&M Cost

It is envisioned and recommended that KUKL will be responsible for Maintenance and Operation of the entire water supply system. However, it may also be possible for KUKL to privatize the O&M through a fixed cost contract and supervise the maintenance.

SECTION 9

9. INSTITUTIONAL STRENGTHENING & TRAINING

9.1 GENERAL

Good Organization set-up is a prerequisite for efficient maintenance of a water supply system. A local body with a good organizational set-up and definite tasks assigned to its employees will have minimum maintenance problems. The existing Organization set-up in KUKL is very small, considering the future improvements to the water supply system of Kathmandu City

9.2 PRESENT INSTITUTIONAL SET-UP & RESTRUCTURING

The institutional framework for Water Supply was created in early 1990's with the establishment of the Ministry of Housing and Physical Planning (now under newly formed Ministry of Water Supply - MoWS), Nepal Water Supply Corporation (NWSC), Water Supply Training Centre, and town development committees in each municipality. The Town Development Fund was established in the mid-1990s as a source of urban finance. Several Government Ministries, departments and other agencies are involved in the management of the water supply sector and related activities. Major institutions involved and responsible for development and management of water supply services in the Kathmandu Valley are:

- **Ministry of Water Supply (MoWS)** is responsible for formulating national level policies and programs and guiding sector activities to meet objectives and targets.

- **Department of Water Supply and Sewerage Management (DWSSM)** is the lead agency in the sector and is responsible for water supply services in rural areas and small urban centers.

- **Nepal Water Supply Corporation (NWSC)** is a semi-autonomous corporation responsible for water supply and sewerage in major urban centres outside of Kathmandu Valley.

- **Kathmandu Valley Water Supply Management Board (KVWSMB)** is an autonomous body established under WSMB Act (2006) and responsible for water supply and sewerage services in Kathmandu Valley.

- **Water Supply Tariff Fixation Commission (WSTFC)** is an autonomous body responsible for economic regulation of water supply and wastewater services and to fix the tariff.

- **Kathmandu Upatyaka Khanepani Limited (KUKL)** was set up in 2008 under a Public Private Partnership (PPP) model under the Companies Act for operation and

maintenance of water supply system in Kathmandu Valley under lease and license (30 year) from KVWSMB.

9.3 TRAINING FOR WATER SUPPLY PERSONNEL

9.3.1 Introduction

Recruitment of trained engineering personnel for management of water works is an important issue confronting organization like Public Health Engineering Department, Municipalities and Industries possessing their own waterworks. Of equal importance is the problem of keeping such personnel technically updated. Special efforts to impart in-service training or continuing professional education should go along with employment of such personnel.

In view of the rapidly changing pace of science and technology, individuals initially educated in traditional disciplines in engineering and employed in the waterworks industry should obtain additional training, if they are to continue performing their technical duties effectively. Formal academic education may not equip an employee to cope indefinitely with challenges posed.

Necessity of Training

A valuable resource in a waterworks utility is the personnel. Their proficiency directly influences quality of service and overall economy. Creative, hard- working and well-trained employees capable of achieving high standards of performance enhance the status of a utility company with resultant additional benefits such as the following:

- Increased efficiency of operation with advanced knowledge of operational practice;
- Overall economy by virtue of expanded skilled operation and maintenance;
- Improvement in quality of treated water;
- Improved public relations; and
- Improved public health conditions due to supply of water of superior quality closely controlled by trained laboratory staff.

In recent years, there has been an increased realization of importance of maintaining specialized operating personnel and attention has also been focused on the need for training employees at different levels. Training cannot end with just one course. To be effective, it has to be a continuous process. Each employee should be trained year after year through employment. In this town, due to lack of training both for the field staff as well as the Engineers; the maintenance system is found to be not satisfactory. It is therefore necessary that periodical intensive training be given to the operating staff with the following areas of focus:

- Interaction with consumers
- Need for providing potable water supply
- Description and application details of instruments and other accessories required for maintenance work

- Need for proper maintenance of the same and monitoring how each activity shall be operated upon / performed.
- During emergency break down, how system has to be restore within a minimum breakdown period.
- Training and field visits to other project sites to get firsthand information about proper maintenance procedures.
- Maintaining of records and necessary field documents regarding Operation and Maintenance (O&M) of various units in the water supply scheme and periodical interaction with higher authorities for effective follow up action.

9.3.2 Training Requirements

The existing water supply scheme was constructed by KUKL. The headworks, Sundarijal Water Treatment Plant, existing service reservoirs and internal water distribution system are being maintained by the KUKL. Though most of them are qualified for the O&M of water supply schemes, they are not trained to handle and properly operate and maintain the electrical and mechanical equipment in water treatment plant. This results in frequent failure of starters and other electrical equipment like switches and control panel. At the time when KUKL employs its own staff for O&M, the staff needs training for proper O&M of the equipment and the proposed water supply scheme.

9.3.3 Training Plan

The operating staff of KUKL shall to be trained in the following:

- Basic principle of various machineries working
- Basic Knowledge in the working of motor, starters, circuit breakers & switches.
- Purpose of various types of valves – Sluice valve and Scour valve etc.
- Valve operations at headworks and in the gravity main.
- Preventive maintenance of electrical and mechanical equipment
- Attending to minor repairs, major repairs – procedure to be followed
- Various types of pipes and pipe materials – pressure ratings
- Log books – maintenance & upkeep of records
- Importance of keeping good health and hygiene
- Management of crises in the Operation & Maintenance

SECTION 10

10. PROCUREMENT STRATEGY

10.1 IMPLEMENTATION OPTIONS

The Proposed improvement works under Mandikatar DNI

Contract Package 7: DNI 9a - Mandikatar

The various options considered for the implementation of the Distribution Network Improvement System are as follows:

- International Supply and Construction Contract
- International Supply Contract and separate International Construction Contract
- International Supply Contract and separate Local Construction Contract

10.2 PROPOSED IMPLEMENTATION METHOD

Considering the size, the relative lack of complexity, and the capabilities of available international contractors, it is recommended that the construction of the project be accomplished by one competitively bid, qualified contractor or joint venture. The recommended approach was discussed and agreed with PID.

To follow the ADB's Procurement Guidelines it is proposed to use International Competitive Bidding for the supply and construct pipeline contract. The adoption of ICB will not exclude local contractors. They can form joint ventures either with international or local contractors.

10.3 CONSTRUCTION PERIOD

A 30-month construction period is proposed for Package 7.

10.4 POST QUALIFICATION OF CONTRACTORS/TENDERERS

It has been discussed and agreed with PID to perform post qualification rather than prequalification of bidders. This will further accelerate project implementation by ensuring that tender documents for the supply and construction contract will be issued in the shortest possible time.

10.5 FORM OF TENDER

As discussed with PID, the procurement guideline shall be adopted Nepal Governments policy.

10.6 QUANTITY AND COST ESTIMATES

Based on the detail design and drawings prepared, the bills of quantities have been prepared for all components of the project. Cost estimates were prepared considering the established quantity of works and unit prices.

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SECTION 1

1. INTRODUCTION

1.1 GENERAL BACKGROUND

Nestled in the lap of Himalayas, Nepal is a small and beautiful country spreading over a geographical area of 147,181 sq. km. The population of Nepal is recorded 26.4 million (Census 2011). The urbanization rate is lower at 16% in comparison with its South Asian counter parts. The capital city Kathmandu is the largest urban centre and has been experiencing rapid urban growth in recent years. The last decade experienced a growth of 7% which is one of the highest in the urbanizing world.

The Kathmandu valley is spread over an area of 900 sq. km, and comprises five municipalities and is home to about 30% of the country's urban population.

The rapid increase in population affected both by natural growth and immigration, has increased the demand for infrastructure services, housing, and for other amenities in Kathmandu Valley. The infrastructure development, on the other hand, has not been up to the requirement. These are resulted in large gap in service delivery, especially in basic services like water supply, sewerage and power supply. Lack of operational wastewater system facilities converted the holy Bagmati River into a highly polluted river.

The project was developed using lessons from previous ADB interventions. An important lesson from earlier projects was to give importance to rehabilitation of networks along with creation of assets. Accordingly, the project will focus on reducing non-revenue water (NRW) and improving the existing network. To drive efficiencies and introduce best practices, the project will utilize the District Metering Areas (DMA) approach for distribution network improvement (DNI) and non-revenue water (NRW) reduction. With the completion of Melamchi tunnel, Kathmandu Valley will receive an additional 170 million litres per day (MLD) upon completion of stage one while the current average availability is only 100 MLD against a demand of 367 MLD for 2014-15. The project will adopt contracts with adequate provisions to monitor NRW reduction, introduce asset management plan, and develop geographical information system (GIS) to maximize benefits.

The expected impact of the project is sustainable water supply services for residents of Kathmandu Valley covered under the scope. The expected outcome is improved access, efficiency, and reliability of water supply services to the residents of Kathmandu Valley including poor women and men. The project will prioritize underserved areas and poor sections of the population in Kathmandu Valley. The project will further enhance capacities of the urban areas to attract investments, increase productivity and create enabling environment for higher economic growth. Piped water through individual household connection will relieve women of

the drudgery of managing water, thereby giving them more time for social and economically productive activities.

1.2 PROJECT BACKGROUND

Kathmandu Valley is currently suffering from chronic water shortages and inefficient service delivery. To improve the present conditions of water supply and wastewater services in Kathmandu Valley, the Government of Nepal(GoN), with the assistance of several development partners, has embarked on a two-pronged improvement strategy that includes capital investments for infrastructure development, i.e., supply augmentation and system improvement and institutional reforms. In order to assist GoN in this endeavor, the Asian Development Bank (ADB) has provided loans covering both infrastructure investment and institutional reforms, namely Loan 1820-NEP: Melamchi Water Supply Project and Loans 2058/2059-NEP: Kathmandu Valley Water Services Sector Development Program.

To address the water supply challenges in the Kathmandu Valley, the government updated its ambitious capital investment and asset management program (CIAMP) in 2010, which envisages providing 135 liters per capita per day (lpcd) to the residents of Kathmandu Valley by 2025 from the current level of 45 lpcd. The plan defines two major phases for rehabilitation and expansion of the water supply and wastewater system. Phase 1 (2012-2016) focuses on rehabilitation of existing assets, development of a new water source, and initial expansion of the water distribution and wastewater system. Phase 2 (2016-2025) focuses on additional source augmentation and further expansion of the water distribution and wastewater system.

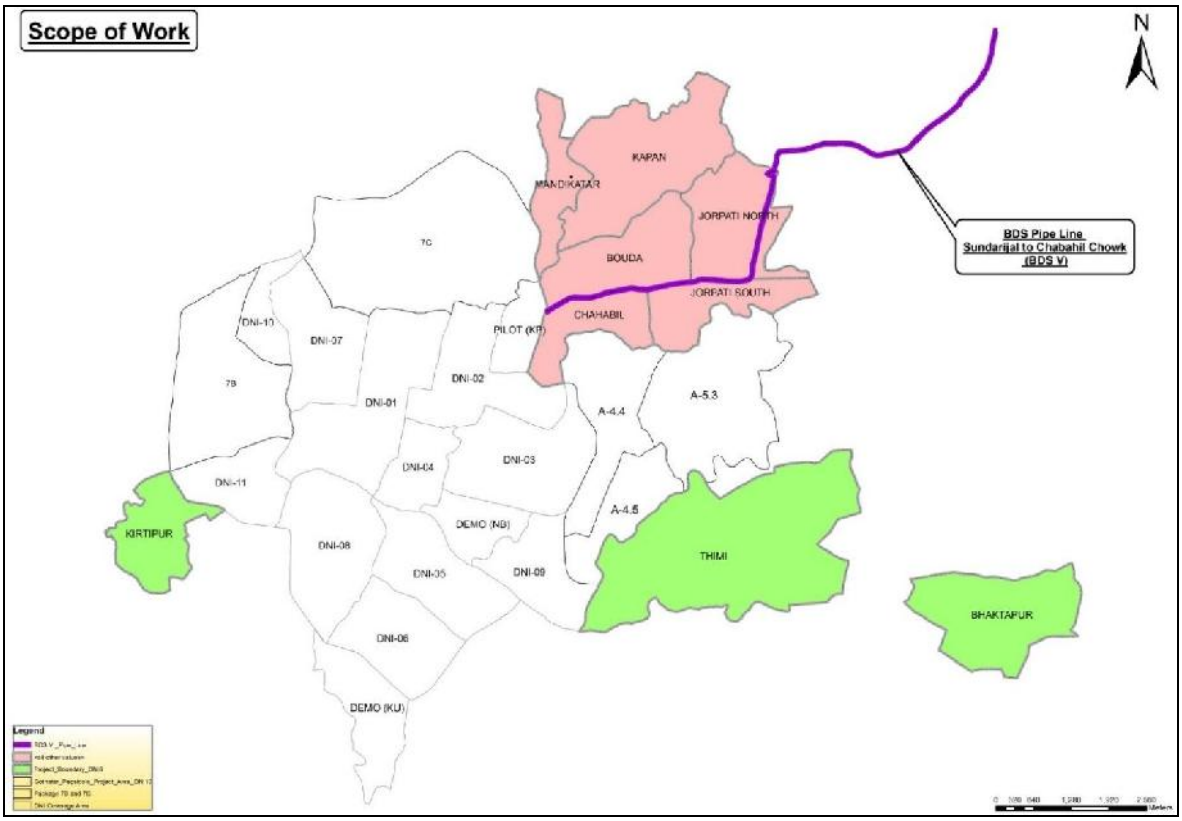
In line with Phase 1 requirements, ADB approved the original project on 16 September 2011 and it became effective on 7 February 2012. The $80 million loan complements ongoing investments to improve access, efficiency, and reliability of water supply services for the residents of Kathmandu Valley through improving the distribution system and enhancing operational and financial performance of the water utility, the Kathmandu Upatyaka Khanepani Limited (KUKL). Phase 1 is also supported by the Melamchi Water Supply Project (MWSP) and the Kathmandu Valley Wastewater Management Project. The Kathmandu Valley Wastewater Management Project will manage the wastewater generated from households receiving water from these projects. Phase 1 investment is the first step towards improving services but is still inadequate for serving the entire population of the Client's service area.

Additional financing (this project) will support the completion of Phase 1 and will start Phase 2 investments with a focus on distribution network expansion and improvement. The additional financing is in line with ADB's Nepal country partnership strategy, which supports the government's development objective of accelerated, sustainable, and inclusive economic growth.

1.3 SCOPE OF THESE DESIGN WORKS FOR DNI 9

Survey, investigation, detail design, bidding documents preparation and procurement support for the DNI9 (Chabahil, Bouda, Jorpati, Kapan, Mandikatar)

Figure 1.1 indicates the location of the DNI boundaries and the Red area is DNI 9.



< Figure 1.1: Location of DNI >

The Consultant understands and acknowledges the work to be completed under the Contract with detailed scheduling and resources planned for the most efficient implementation.

For DNI9 works, the Consultant reviewed the master plan, related documents, current status and identified Mandikatar, Kapan and Jorpati area was not included in the master plan. These boundaries are outside of Kathmandu Metro boundary where 510 MLD is planned to be distributed from Sundarijal WTP. The Consultant reviewed and had population projection of these areas. After conferencing with PID and KUKL, we have decided to target certain existing/new SRTs to carry on with the design. The next Master plan [post Melamchi Phase (CIAMP)] shall consider the existing sources and distribute according to our DNI designs and modify if necessary.

Additional boundaries are targeted as following; Mandikatar targeted from OLD Bansbari, Kapan from Arubari, Jorpati (North) from NEW Mahankal and Jorpati (South) from OLD Mahankal SRT. For boundaries within the Kathmandu Metro boundary will follow target SRTs as per CIAMP and other previous reports.

Details of the targeted SRTs will be shown in section 2.

1.4 INSTITUTIONAL ARRANGEMENT

Following are the key agencies involved in the project implementation.

(i) **Executing Agency:** The Ministry of Water Supply (MoWS) is the executing agency responsible for overall strategic planning, guidance and management of the project and for ensuring compliance with loan covenants.

(ii) **Implementing Agency:** KUKL, the asset operator and service provider, through its existing Project Implementation Directorate (PID), is the implementing agency responsible for (i) project planning, implementation, monitoring and supervision; (ii) reporting to KUKL Board of Directors, MoWS and ADB; and (iii) coordination of all activities in the project. PID is staffed with sufficient number of experienced professionals headed by Project Director, who is a Joint Secretary level GON officer. PID is supported by the following consultants:

(iii) **Project Steering Committee (PSC):** Chaired by the Secretary, MoWS, has been established to provide policy guidance, accomplish reform measures, oversee project implementation and ensure cooperation of all agencies involved in the project.

(iv) **Design, Supervision and Management Consultant (DSC 05):** To support PID in project management, engineering design, construction supervision, procurement of goods and services, institutional development and capacity building.

(v) **Community Awareness and Participation Consultant (CAPC):** Towards assisting in community awareness and participation within project area.

Continuation to signing of loan by Government of Nepal with Asian Development Bank, through a competitive bidding process DOHWA Inc. in association with BDA P. Ltd., ERMC and TAEC Consult P. Ltd. is appointed as Design, Supervision and Management Consultant (DSC 05) for this loan no. 2776/3255 (NEP) SF project.

SECTION 2

2. Existing Water Supply Scenario –Kathmandu

Water is Nepal's largest available natural resources with over 6,000 rivers having a combined length of 45,000 km. Still the access to water supply is limited. The water supply system in Kathmandu Valley is dependent partly on ground water and partly on surface water sources. In all, at present water is drawn from 31 surface sources and 75 deep tube wells (54 operational) located in different parts of the valley. The total water production from these sources put together is about 100 MLD (dry season) to 150 MLD (monsoon). These sources supply water to 21 Water Treatment Plants (WTPs) with a total treatment capacity of 85 MLD. The treated water is fed into 44 service reservoirs, from where water is supplied through 1,240km of distribution lines, over 165,000 consumer connections and 1,200 public stand posts to about 2 million consumers.

The water supply system suffers both from partial coverage (only 70% of the total 2.8 million population covered) and inadequate supply (100 to 150 MLD production as against an estimated demand of 190 MLD at consumer end). Added to this is the old water supply system with aging old and profusely leaking pipes resulting in high water losses (estimated at 45%). Besides, there are numerous illegal and unauthorized multiple connection, resulting in a large portion of unaccounted for water (UFW).

Under the water shortage conditions, KUKL (the agency responsible for water supply in Kathmandu Valley) has applied a rationing system whereby water is allowed to flow to different sections of the metropolitan/urban area in rotation. The control system developed by KUKL is complex to implement as it requires KUKL staff to operate with over 1000 valves for distribution. The result is an inequitable distribution of water, particularly as the areas close to the water sources are very difficult to isolate. While some parts of the city have an abundance of water and enjoy 24-hour supply, a large share of the population only receives water for a few hours every 2-5days and even then, the pressure is low and the quality is poor. As most areas receive intermittent supply with low pressure, use of pumps to suck water and bypassing of water meters are believed to be quite common techniques used by the consumers. People in many areas often receive one-hour supply in every fourth day only.

The outdated system with old design, ad-hoc development on need basis and old and damaged pipes has given rise to contamination of treated water. Water quality at the consumers end is far less than desired and it is a common practice to treat or boil water for potable use. While the basic cost of piped water in Kathmandu may be cheap, the other direct and indirect costs associated with its use seem very high. The mushrooming of firms supplying the household level water purification systems in Kathmandu is an indication of growing water quality concerns among the general public – a recent survey report states that there are about 64 water vendors in Kathmandu.

Besides, there is sprawling private water supply market supplying treated water at a rate of Rs. 5-10 per 20 liters to the consumers. Around 60% of the households in Kathmandu either boil water or use some form of water purification devices to attain quality water for drinking use. Also, an estimated 20% of the households depend on packaged water supply. On an average, the current "water cost" is around Rs. 350-500 per month per household. Besides the exorbitant costs associated with these alternative strategies, there is no assurance of quality.

The typical/specific problems exhibited in entire Kathmandu distribution network and as well in the DNI9 areas are as follows:

- Little equity in water supply; some properties get very good supply with good pressure for 6-7 hours, while others get only 1 to 2 hours supply every fourth or fifth day with very poor pressure;
- Very high-water leakage and losses in the area.
- No control mechanism for isolating the service area for maintenance;
- Multiple house connections to a trunk water supply main;
- Old and undersized water distribution mains;
- No operational fire hydrants;
- Long, multiple house connection pipe work;
- Areas of poor water supply service;
- Many non-operational consumer meters.

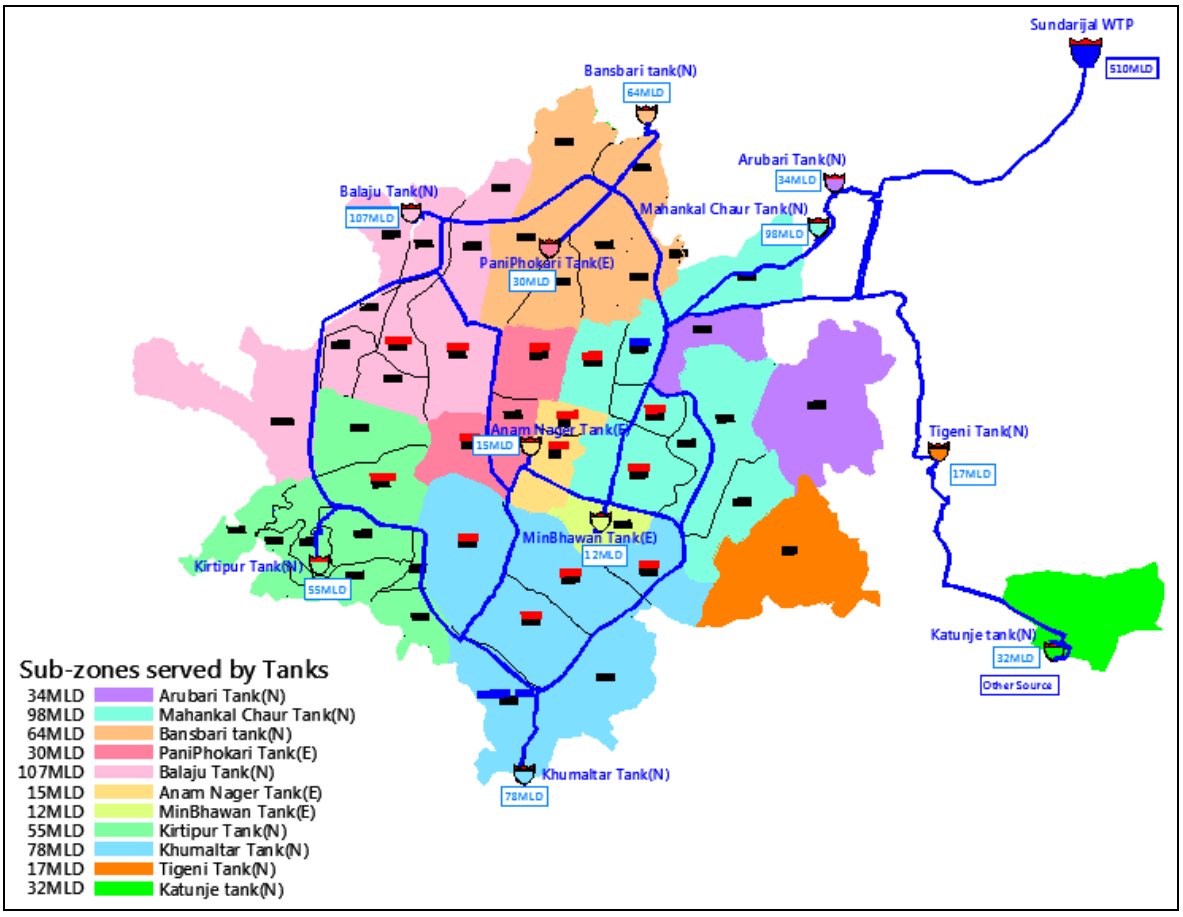
Many of such households also have secondary water sources like hand pumps, dug well or other such facilities to supplement their daily requirements. In addition, same households also supplement their drinking water requirements through the use of private tankers and bottled water.

SECTION 3

3. Design Boundary

3.1 REVIEW OF MASTERPLAN [CIAMP REPORT]

According to the Master plan, the CIAMP Report (2010), 510MLD from Sundarijal WTP will be distributed to each reservoir to be supplied for distribution for the target year 2030. The 510MLD will be fully supplied to the Kathmandu Metro supply boundary and all facilities being used at present will be utilized in the post Melamchi stage. In AF Report (2014), Bhaktapur was included in the distribution plan which increased the total demand to 542MLD. This is going beyond the CIAMP and shall be updated during the second Master plan.
We have considered 510MLD within the original boundary but included Bhaktapur separately since it's included in the AF report. The distribution boundary, population projection and demand for each SRT are as shown below;



< Figure 3.1: Demand for Each SRT>

Table 3.1 : The population distribution, demand and supply plan for each reservoir

Reservoir	Population			Demand (MLD)						Each reservoir supply
	2015	2025	2030	2015	2025	2030	Each reservoir distribution			
BALAJU	360,281	519,247	617,585	60.9	87.8	104.4	36.5	72.1	107.1	107
BANSBARI	192,990	297,670	368,976	32.6	50.3	62.4	19.6	41.3	64.0	64
PANIPOKHARI	102,486	146,124	172,043	17.3	24.7	29.1	10.4	20.3	29.8	30
MAHANKAL CHAUR	335,262	478,016	562,798	56.7	80.8	95.1	34.0	66.4	97.6	98
AARUBARI	83,959	146,477	195,469	14.2	24.8	33.0	8.5	20.3	33.9	34
MINBHAWAN	41,855	59,677	70,261	7.1	10.1	11.9	4.2	8.3	12.2	12
ANAMNAGAR	50,519	72,030	84,806	8.5	12.2	14.3	5.1	10.0	14.7	15
KHUMALTAR	292,730	391,550	449,027	49.5	66.2	75.9	29.7	54.4	77.9	78
KIRTIPUR	165,309	256,477	319,447	27.9	43.4	54.0	16.8	35.6	55.4	55
TIGANI	51,867	81,334	100,424	8.8	13.8	17.0	5.3	11.3	17.4	17
Total	**1,677,258**	**2,448,602**	**2,940,836**	**283.5**	**413.9**	**497.1**	**170**	**340**	**510**	**510**
KATUNJE	137,722	172,993	188,473	23.3	29.3	31.9	-	29	32	32
Grand Total	**3,354,516**	**4,897,204**	**5,881,672**	**283.5**	**413.9**	**497.1**	**170**	**369**	**542**	**542**

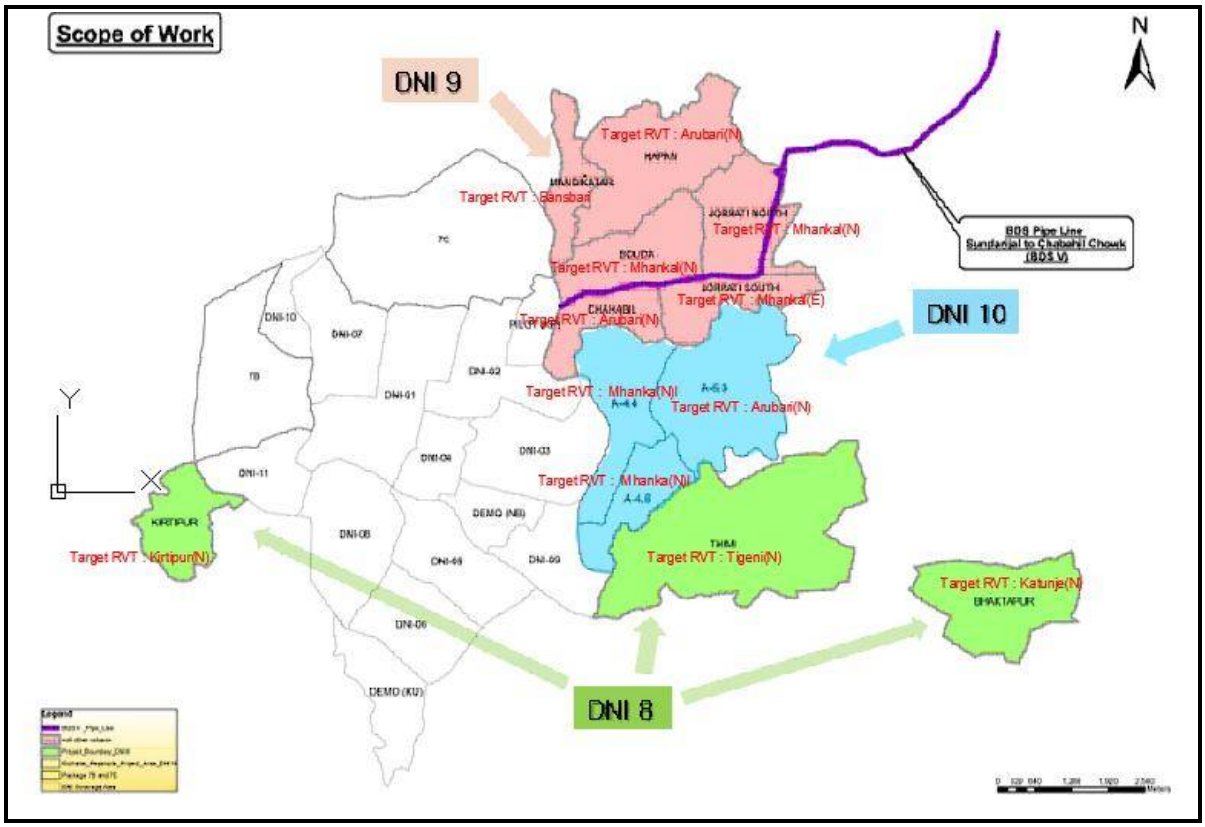
3.2 DISTRIBUTION BOUNDARY

The project boundary as per the ToR was Thimi, Bhaktapur, Kirtipur, Jorpati, Bouda, Chabahil, Mandikatar and Kapan. Consultant had numerous meetings with PID and KUKL to discuss the boundary and distribution plan. After final approval from PID/KUKL, we have finalized the boundary and distribution plan of DNIs April, 2017.

Consultant has made additional population projection and demand calculation since several distribution boundaries were not included in the Masterplan i.e CIAMP report and finalized the DNI boundaries.

3.2.1 Determination of the distribution boundary

The design was carried out with continuous consultation with PID/KUKL since the boundary is now going beyond the masterplan. After reviewing the CIAMP and AF reports, the final distribution boundary has been determined. The target SRTs and boundaries are shown below;



< Figure 3.2: Target SRTs and Boundaries>

DNI boundaries are divided into DNI8, DNI9 and DNI10 considering the bidding date of project and possibility.

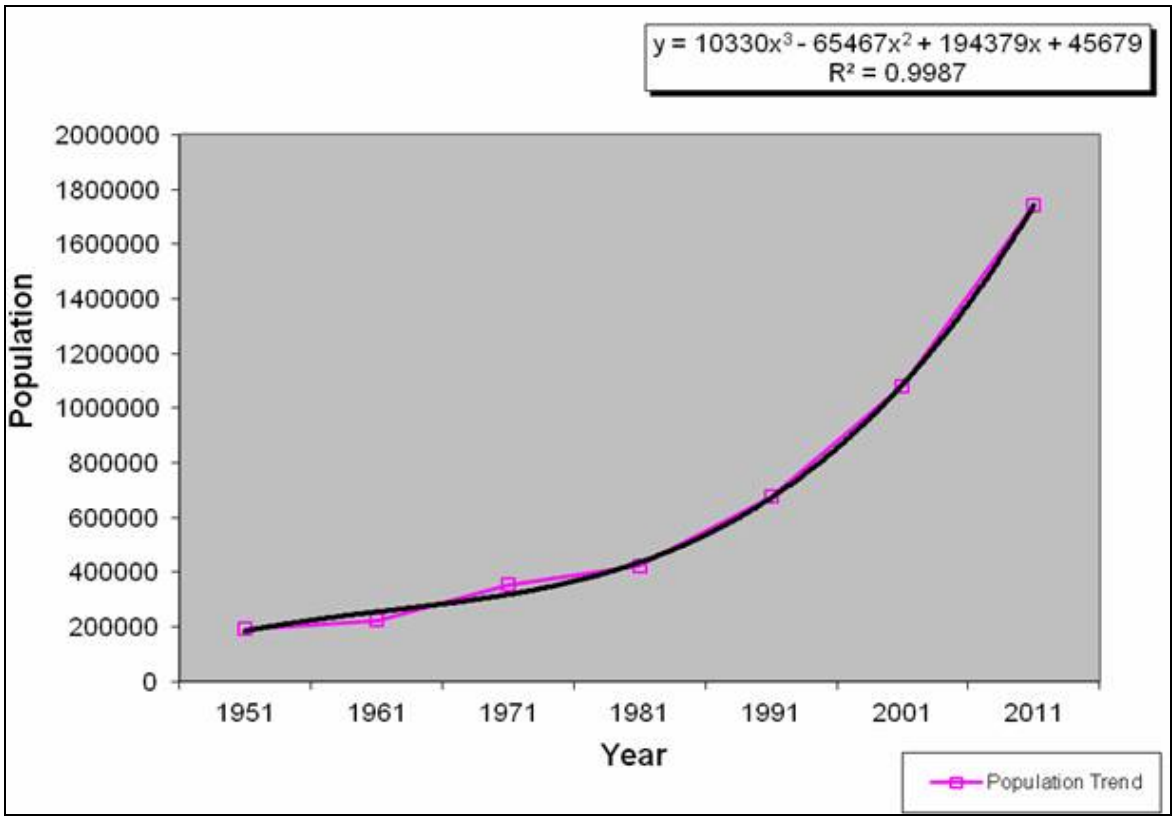
3.3 POPULATION PROJECTION & WATER DEMAND

3.3.1 General

Estimation of the demand is one of the critical factors in the design of the water supply system. The design population projection finds its base upon the historic census population, the present population and its expected rate of growth.

Demographic methods for projecting population include numerical methods such as Arithmetic increase, Incremental increase, Geometric increase, Exponential, Polynomial logarithmic and Power series. The best fitting among these is generally used in projecting population for water supply schemes.

Population projection for Kathmandu Metro zone in the CIAMP report was based on historic population figures from year 1951 to 2011 collected from the country's census website for various urban and village bodies. Third order polynomial of the above methods was decided for the projection based on the historic population.



< Figure 3.3: Polynomial Third Order Curve of Historic Population Growth >

For the unity with the other/previous designs we have adopted the same population projection with the CIAMP report for boundaries inside the Kathmandu Metro zone.
For the boundaries beyond the Kathmandu Metro zone i.e boundaries not included in the masterplan (Bhaktapur, Mandikatar, Kapan, Jorpati), consultant had population projection using same projection method which is third order polynomial.

Accordingly, based on the population projection DNI8, 9 and 10 population of year 2025 and 2030 is shown below in table 3.2;

Table 3.2: Design Population for 2025 and 2030 Years (DNI8, DNI9 & DNI10 areas)

Target supply area		DNI (Master plan)	DNI (Out of KUKL service area)	Water Source	Population	
					2025	2030
DNI8	Thimi	A-10		Sundarijal WTP	81,335	100,426
		-	A-11	Other Source	57,459	70,947
	Bhaktapur	-	A-12	Other Source	100,484	106,026
	Kirtipur	A-9.3 A-9.6 A-9.7 A-9.8		Sundarijal WTP	60,208	83,004

DNI9-a	Kapan	-	A-13	Other Source	126,887	163,957
	Mandikatar	-	A-14	Bansbari WTP	37,205	47,511
DNI9-b	Jorpati(N)	-	A-15	Other Source	69,878	81,288
	Bouda	A-5.1		Sundarijal WTP	91,410	107,622
	Chabahil	A-5.2		Sundarijal WTP	56,442	66,453
	Jorpati(S)	-	A-16	Mahankal WTP	79,627	92,628
DNI10	Pepsicola	A-4.4 A-4.5		Sundarijal WTP	90,036	129,017
	Gothatar	A-5.3		Sundarijal WTP	125,261	147,476
				Total	976,232	1,196,355

The total population within the boundary of our scope of work is 1,196,355 for target year 2030.

3.3.2 Estimation of Water Demand

Per-Capita demand has been decided as 135 lpcd for permanent population, 40 lpcd for temporary (floating) population including UFW at 15% in the previous DNI designs. Temporary population has been estimated 30% of the permanent population. Thus total lpcd is [135+(0.3*40)]*1.15 = 169.05lpcd.

After discussing with PID/KUKL, we have adopted same per-capita demand for unity of the DNI designs. Although Kapan, Mandikatar and Jorpati is outside of the Kathmandu Metro zone, the time pattern and demand is expected to be similar. We have applied the same per-capita to all of our designs accordingly.

Table 3.3: Design Demand for 2025 and 2030 Years (DNI 8, DNI 9 & DNI 10 areas)

Target supply area		DNI	Target Reservoir	Water source	Population		Demand(MLD)	
					2025	2030	2025	2030
DNI8	Thimi	A-10	Tigeni	Sundarijal WTP	81,335	100,426	13.75	16.98
		-	Tigeni	Other source	57,459	70,947	9.71	11.99
	Bhaktapur	A-12	Katunje	Other source	100,484	106,026	16.99	17.92
	Kirtipur	A-9.3 A-9.6 A-9.7 A-9.8	Kirtipur	Sundarijal WTP	60,208	83,004	10.18	14.04
DNI9-a	Kapan	A-13	Arubari	Other source	126,887	163,957	21.44	27.72
	Mandikatar	A-14	Bansbari (Old)	Bansbari WTP	37,205	47,511	6.29	8.04
DNI9-b	Jorpati(N)	A-15	Mahankal	Other Source	69,878	81,288	11.82	13..74
	Bouda	A-5.1	Mahankal	Sundarijal WTP	91,410	107,622	15.45	18.20
	Chabahil	A-5.2	Arubari	Sundarijal WTP	56,442	66,453	9.54	11.23
	Jorpati(S)	A-16	Mahankal(Old)	Mahankal WTP	79,627	92,628	13.45	15.67

DNI10	**Pepsicola**	**A-4.4 A-4.5**	**Mahankal**	**Sundarijal WTP**	**90,036**	**129,017**	**15.24**	**21.81**
	Gothatar	**A-5.3**	**Arubari**	**Sundarijal WTP**	**125,261**	**147,476**	**21.17**	**24.94**
				Total	**976,232**	**1,196,355**	**165.03**	**188.54**

3.3.3 Fire Fighting Demand (*)

It is usual to provide for firefighting demand as a coincident draft on the distribution system along with the normal supply to the consumers as assumed. A provision in Kiloliters per day based on the formula $100\sqrt{P}$ where p = population in thousands may be adopted for communities larger than 50,000. It is desirable that one third of the firefighting requirements form part of the service storage.

Table 3.4 indicates Fire demand calculations in each of the supply area.

Table 3.4: Fire Fighting Demand

Target supply area		Projected Population Design Year-2030	Fire Demand = 100*√(p)	
		2030	KLD	MLD
DNI8	Thimi	171,373	41,397.22	0.04
	Bhaktapur	106,026	32,561.63	0.03
	Kirtipur	83,004	28,810.41	0.03
DNI9-a	Kapan	163,957	40,491.60	0.04
	Mandikatar	47,511	21,797.02	0.02
DNI9-b	Jorpati (N)	81,288	28,511.05	0.03
	Bouda	107,622	32,805.79	0.03
	Chabahil	66,453	25,778.48	0.03
	Jorpati (S)	92,628	30,434.85	0.03
DNI10	Pepsicola	129,017	35,918.94	0.04
	Gothatar	147,476	38,402.60	0.04

SECTION 4

4. Topographical Survey

4.1 TOPOGRAPHIC SURVEY FOR DISTRIBUTION LINES:

Detailed topographical survey work was conducted for new DNI-9b Zones. The survey using Electronic Total Station covered extraction of features which included boundaries, topographical and contours. Later the agency re- produced the survey drawings in required format for further design by DNI-9b.

As part of above survey along the major roads, control points were established. Survey work commenced by establishing bench mark as available by geodetic survey branch under Government of Nepal. The survey data stored in total station was later transferred for further processing using AutoCAD.

The survey was to be undertaken with within a tolerance of ±5cm or size of the Boundary Marker whichever is coarser.

Note: Currently the topographical survey has been carried out only on main roads (only 30%). The levels of intermediate roads have been obtained by interpolating with the levels surveyed on main roads.

After awarding the contract, the Contractor should carry out 100% topographical survey to verify the correctness of the levels adopted in the design and the refinement of the hydraulic model is necessary. The Contractor should also carry out the soil investigation wherever necessary and should submit a report.

SECTION 5

5. Design Standards and Approach

5.1 GENERAL

Primary design parameters are established for commencing the engineer designs. These parameters are largely based on the guidelines specified in Central Public Health and Environmental Engineering Organization (CPHEEO)

– Manual on Water Supply and Treatment, Government of India, choice of technology and service level and as well have been discussed with PID, KUKL and finalized. For the present and future purposes, the following basic design parameters are discussed in the following sections.

5.2 DESIGN PERIOD

Distribution network has been designed to meet demand for the year 2030.

5.3 POPULATION

Projection of population for 2025 and 2030 years has been considered as explained in the previous chapter.

5.4 PER-CAPITA DEMAND

Per-capita demand for permanent population is 135 lpcd. 40 lpcd for temporary (floating) population calculated 30% of permanent population. Included UFW 15% and fire demand. Thus, total lpcd of 169.05.

5.5 PEAK FACTOR

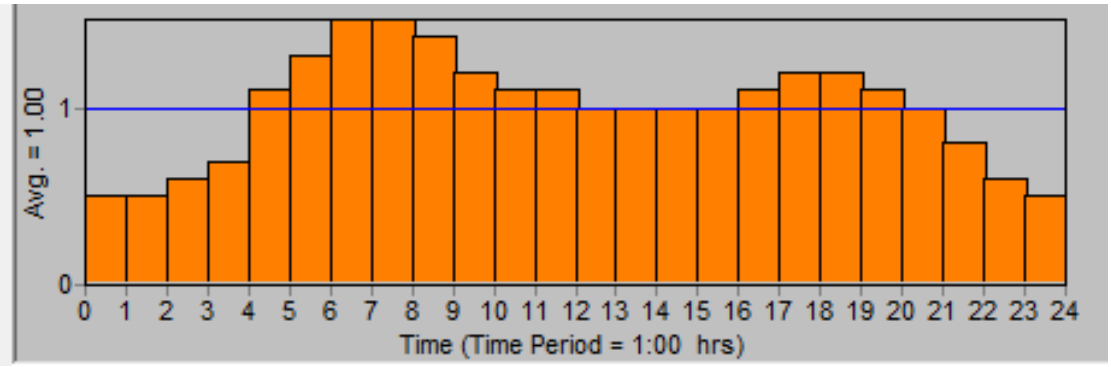
A peak demand factor of 1.5 has been adopted in the design.

5.6 TIME PATTERN

The boundary of this design is outside Kathmandu Metro zone but intimated. We have considered as same sphere of life and followed the same time pattern of the previous DNI designs within the Kathmandu Metro. The time pattern is shown below;

Table 5.1: Time pattern

Time(hr)	0~1	1~2	2~3	3~4	4~5	5~6	6~7	7~8	8~9	9~10	10~11	11~12
Factor	0.5	0.5	0.6	0.7	1.1	1.3	1.5	1.5	1.4	1.2	1.1	1.1
Time(hr)	12~13	13~14	14~15	15~16	16~17	17~18	18~19	19~20	20~21	21~22	22~23	23~24
Factor	1.0	1.0	1.0	1.0	1.1	1.2	1.2	1.1	1.0	0.8	0.6	0.5



5.7 RESIDUAL HEAD

Hydraulic analysis and sizing of pipes has been performed to ensure a residual pressure of minimum 1 bar (10m) and 5 bar (50m).

5.8 VELOCITY

As far as possible it was attempted to restrict the flow velocities in distribution pipelines between 0.5m/s and 2.0m/s.

5.9 ALLOWABLE HEAD LOSS

Head loss of 10m/km has been limited in the distribution network.

5.10 LOSS COEFFICIENT: HAZEN WILLIAM "C" VALUES

The 'C' value of 110 for DI and 130 for HDPE pipes have been adopted in the design.

5.11 NODAL DEMAND

Proportional nodal demand distribution (by area) using "Thiessen" Polygon has been adopted in the design.

5.12 DISTRICT METERED AREA (DMA)

In practice, there will always be a significant variation in size of DMA due to the layout of the existing infrastructure and the need to optimize pressure management. DMAs are often sized by the number of properties, where typically a property is supplied by a single customer connection.

Henceforth, DNI's is divided into District Metered Area (DMA) with an average households ranging from 500 to 3,000 for each DMA. In our Design average of 1,500 Households have been considered. (Or) shall be based on topography of the service area. Ref: International Water Association (IWA) Guidelines, February 2007, Version 1.

5.13 DESIGN AND SIZE OF MAINS

Pipe DN400 mm and larger have been designated as Primary Mains but if the mains are too large considering the flow and velocity, we have decided less than DN400mm. Secondary and Tertiary Mains are considered to be less than DN400mm but it's finalized based on flow.

5.14 PIPE MATERIAL

Selection of pipe material has been performed considering the following parameters:

- Hazen-Williams Coefficient
- Ability to withstand Internal / External pressure
- Ease in handling and lowering of pipes
- Corrosion Resistance
- Pipe jointing materials
- Trouble-free maintenance & operation should be ensured
- Availability of specials and fittings

However, the final selections of the pipe materials were discussed with PID/KUKL and have been agreed as following;

- HDPE pipe with electro-fusion fittings will be used for distribution lines smaller than DN 150mm, and for service connections.
- DI pipe will be used for mains DN 150mm and larger than DN 150mm.
- HDPE Pipe size increments, as per availability of materials in the market.

Eg: HDPE pipe of DN75, DN90, DN 110, per IS 4984 as secondary and tertiary mains, and DI pipe as per ISO 2531 as primary mains.

5.15 PIPING LAYOUT

- Minimize dead ends by looping of all mains.
- Dual mains are being provided in all roads greater than 7-meter width, and as needed to hydraulically isolate each sub-DMA.
- DSC-03 staff visited several locations in the field to assess the practicality of placing dual mains between every sub-DMA, which will allow complete hydraulic separation of each sub-DMA and also allow for permanent meter installations at the inlet(s) to each sub-DMA.
- Many of the streets between sub-DMAs are quite narrow and also contain sewers which zigzag from one side of the street to another. For these reasons, it will usually not be possible to place dual water mains in such streets while maintaining an adequate separation distance from these sewers. Therefore, when unavoidable (the majority of such cases are unavoidable), we will design such dual mains to be placed in a common trench with an appropriate nominal amount of separation (e.g., 300 mm clear separation). Such dual mains will provide the desired hydraulic isolation of sub-DMAs, but will still necessitate extending service laterals across the street (which would have been avoided had it been possible to place one main on either side of the street).
- Where dead - end main occurs, it shall be provided washout for flushing purposes.
- Flushing device shall not be directly connected to the sewer – Where dead-end mains occur, they shall be provided with a fire hydrant if flow and pressure are sufficient or with an approved flushing hydrant or blow-off for flushing purposes. It is recommended that all water quality problem areas in the distribution systems be flushed at least twice each year. No flushing device shall be directly connected to any sewer.

5.16 TESTING & COMMISSIONING

The pipelines shall be tested and commissioned using the procedure and methodology as per relevant IS/ISO standards & latest amendments.

5.17 VALVES & APPURTENANCES

Isolation valve locations shall be based on the following considerations:

- Limiting the number of customers (100 to 150) that will be out of service.
- Limiting the number (3 to 5) of fire hydrants out of service
- Limiting the time, (2 hours) takes to drain a pipe segment
- Limiting the number of customers (100 to 150) impacted by future system modifications
- Limiting future construction within major streets or intersections
- Avoiding excessive number of valves thus reducing initial cost
- Shall be located at major or critical street intersections

- Line valves at primary mains shall be spaced not more than 1km (or) shall be based on site condition

5.17.1 Air valve locations

At the highest point in respective distribution network

- In special locations (such as near district meters)
- Shall be installed only at Primary and Secondary mains

5.17.2 Fire Hydrant Locations

Shall be installed at Secondary mains

- Shall be located at major or critical intersections
- Maximum coverage approximately 5 Hectares per hydrant
- Maximum spacing approximately 250 meters
- Minimum tapping size shall be at DN200mm for commercial FH and DN150mm for residential FH.

5.17.3 Electromagnetic Flow Meters

It is proposed to install electromagnetic bulk flow meters, each at every inlet pipe of respective service reservoirs.

5.17.4 Bulk Meters

It is proposed to install at every inlet to each DMA's.

5.17.5 Scour Valves/Wash out Valves

Scour valves are located at selected low-points and at appropriate locations to facilitate water and silt removal from the system in cleaning and maintenance operations.

5.17.6 Thrust/Anchor Block

Thrust Blocks prevents pipe movement when a pressure system is activated and pressurized. Thrust blocking is required at all points of change of direction in the pipe line. Most blocking is done where a fitting, valve, or hydrant is installed. There may be times when side blocking is necessary because of curvature occurring without the use of fittings. Usually good compacted backfill will provide the necessary anchor for side thrust. Concrete blocking is the most commonly recommended method of blocking. Concrete is placed directly on the fitting against the line of thrust. The concrete must also pour against undisturbed earth. The size of the blocking will vary with the size of pipe, working pressure exerted, type of fitting, degree of flow direction change, and the soil conditions.

Anchor Blocks are provided wherever the pipe is being laid where the nature of ground is steep in nature and wherever the pipeline crosses the rivers/valley in order to hold the pipe and to avoid the dislocation of pipe from the alignment.

5.18 JOINT RESTRAINT

A properly designed, restrained pipeline uses the bearing strength and frictional resistance of the soil to turn the pipeline into a thrust block. The same basic parameters required to determine the size of a thrust block are used to determine the amount of pipe that must be restrained to resist thrust forces underground. These parameters are pipe size, pipe type, test pressure, fitting type, trench type, depth of bury, soil type, and safety factor.

Using joint restraints opens possibilities that are not available with thrust blocks. When construction is required in congested underground areas it is next to impossible to pour thrust blocks without interfering with other utilities. Also, the use of thrust blocks in congested areas poses a problem when construction or maintenance of a different utility occurs in close proximity to the thrust block. Because the bearing area of a restrained pipeline is not concentrated in a small area, excavations in close proximity do not pose the danger that could be experienced with thrust blocks.

5.19 THRUST RESTRAINT FOR DNI WORKS

In flexible non-restrained jointed pipelines (e.g. Tyton type joints or similar), forces at bends, tees, tapers, closed valves, dead ends etc. will generally be absorbed by thrust blocks. Concrete thrust blocks take the forces from the pipeline and transmit them to the soil adjacent to the pipe trench. Thrust blocks shall be constructed of cast-in-place concrete. The bearing faces of the thrust blocks will be placed against undisturbed natural soil. Thrust forces and siting of anchor blocks will conform with the field test pressure of the pipeline. Dimensioning of the thrust blocks must be dependent on the bearing capacity of the prevailing soil.

5.20 PRESSURE REDUCING VALVE (PRV) CHAMBERS

They are necessary in order to maintain a constant delivery of acceptable service pressure which should not be more than the required max head of 5 bars - regardless of varying high inlet pressure.

5.21 BULK METERS AND OTHER VALVE CHAMBERS

Supply of water to the DNI areas will be from primary mains fed from the respective reservoirs. In order to enhance water auditing, bulk meter chambers will be provided. These chambers comprise of control valves (Sluice Valve) and other necessary appurtenances to control water from the transmission main and isolating distribution blocks from maintenance purposes. Each bulk meter will be well equipped with flow sensor & data loggers to record flow rate for analysis and record keeping. Similarly, other valve chambers have been provided to isolate parts of the distribution system for maintenance or in case of damage.

5.22 PRESSURE TEST POINT CHAMBERS

Pressure test point chambers have been provided for each DMA at maximum and minimum pressure level and locations were pressure tests are necessary.

5.23 AIR VALVE CHAMBERS

Air valve chambers with drain pipes and sluice valves have been provided along the primary and secondary main alignments. The air valves are double orifice (with ball/gate valve isolation).

5.24 WATER REVENUE METERS

Dry dial volumetric rotary piston type water revenue meter for all house connections are proposed. These household water meters have 15mm, 20mm and 25mm Nominal Diameter and have been recommended for use elsewhere in Kathmandu.

5.25 HOUSE SERVICE CONNECTIONS

All house service connections shall be of non-metallic pipe in order to reduce leakage at the service connection points.

5.26 CHAMBERS

All chambers are M 20 Grade RCC Chamber. All the chambers have been designed for heavy traffic load (heaviest axle load of 8 ton) and limiting cracking width philosophy assuming other design parameter such as depth of pipe, location of ground water table, soil characteristic, etc.

5.27 RIVER CROSSINGS

River crossings may be made by:

- Constructing a separate pipe bridge
- Attaching the pipe to an existing bridge
- Installing the pipe on the footpath of an existing bridge
- Laying the pipe in the bed of the river in a siphon.

A pipe bridge would be vulnerable to accidents or other attacks. The structure must be above maximum flood level. Additionally, a pipe bridge would require an earthquake resisting design, which would be very expensive taking into account the high ground accelerations to be expected in the Kathmandu Valley. Pipelines, connected to existing road bridges, are only permitted if these are connected laterally to its structure. This is of course a difficult solution sinceappropriate supporting structures have to be designed and incorporated to the existing bridge construction. The pipeline must not overload the structure and expansion joints would be required to accommodate movement of the bridge and pipeline.

Permanent installation on footpaths of the bridge is not allowed by the DOR. The rivers to be crossed by the BDS have a low water level and flow at the end of the dry season. This will allow the pipes to be laid in the riverbed by diverting the river water. Hence normal pipe laying practice would suffice to achieve a technically and economical sound river crossing construction.

For river crossings therefore we recommend a siphon design rather than a pipe bridge design due to safety and cost reasons. The pipeline itself will be surrounded by reinforced concrete.

5.28 ROAD WORKS

All road works, road crossings and other works belonging to roads are subject to the approval of the Department of Roads and relevant municipal entities. For the approval of all road works, submittal of layouts and details and descriptions of the works to be executed are required by these entities in advance of the works.

Roads generally have to be crossed perpendicular to the road axis; however, in some cases the pipeline will run along the road. It is assumed the pipes will be installed in an open trench with the temporary diversion of vehicular traffic. The precise details of the temporary diversion and traffic control will be the responsibility of the contractor.

The pipe trench backfill will continue up to the underside of the sub-base of the road surface. The installation of the road sub-structure and final completion of the road surface then will be done by the contractor.

5.29 PUMP HOUSE & RESERVOIR TANK & OHT

DNI designs have been preferentially designed to supply by gravity flow. However, for the boundaries inevitable of gravity flow has been considered as pumping zones.

Considering the power supply and stability of the supply system, reservoir tanks or Over Head Tanks are planned. The water will be pumped to a upper level reservoir/OHT then supplied by gravity to the DNIs. The capacity of the reservoir/OHT has been purposed to be enough to distribute 24 hours although stopping the pump at the pick time between 5:00PM till 11:00PM.

5.30 OPERATING HOUSE

Operating House shall be constructed for the Pump house area along with the construction of inspection chamber of toilet, septic tank and soak pit.

5.31 SURFACE DRAIN

Tick type concrete surface drain will be constructed both sides for the roads having width more than 7 m while for the roads having width from 4 to 7 m drain will be constructed only single side. However, there is no provision of such type of drain for roads with width less than 4 m. Similarly, brick masonry wall shall be constructed at the back of tick drain.

Catch pit shall also be constructed for every 100 m of the drain in a staggered manner.

5.32 DESIGN APPROACH

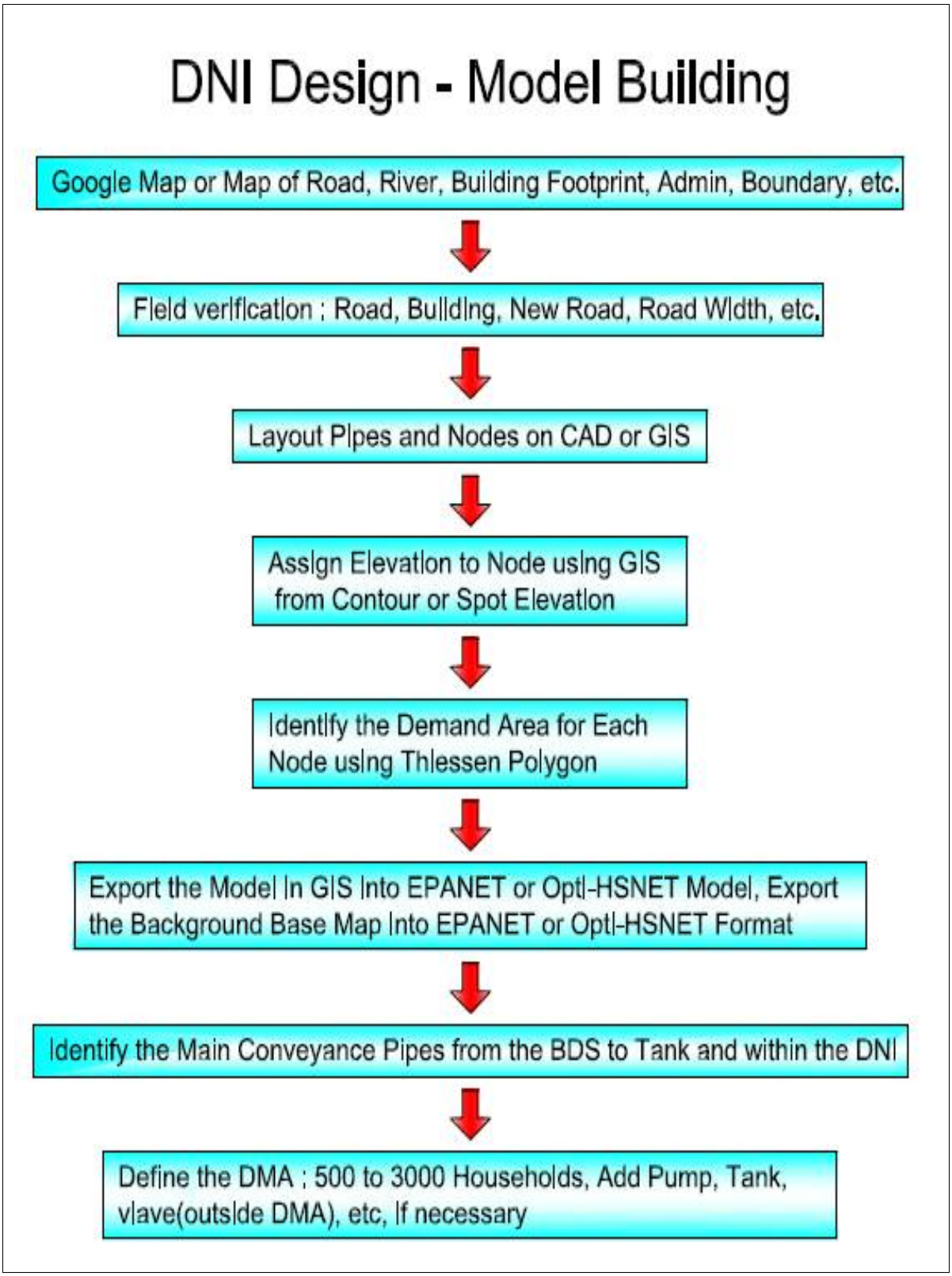
5.32.1 Design criteria summary

For the unity of the DNI designs, DSC05 have followed most of the DSC03 design criteria as per the discussions with PID/KUKL. However, during the detail design, DSC05 made some improvements in the design and again after further discussions with PID/KUKL, made some changes in the design criteria. The final design criteria of DSC05 DNI design is shown below;

Table 5.2: Design Criteria

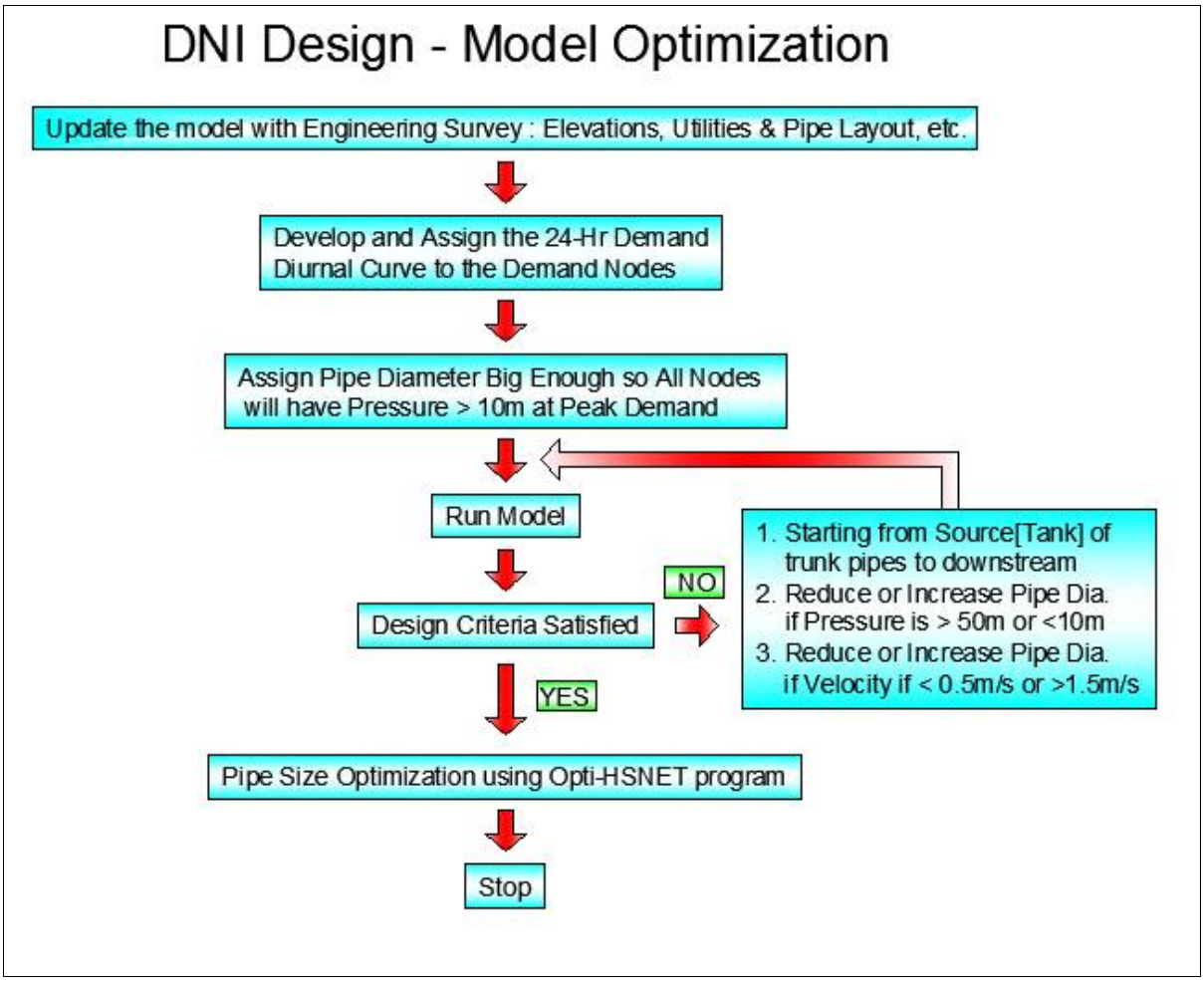
Criteria	Applied to Design	Remarks
Target Year	2030	
Population	Thirty year	
Per-Capita demand	(135+40)lpcd + 15% UFW and fire Demand	
Peak Factor	1.5	
Residual Head	1 bar(10m) ~ 5 bar(50m)	Due to change of PN6 to PN10, Maximum residual head changed to 5bars (50m)
Velocity	0.5m/s ~ 2.0m/s	
Allowable Head Loss	10m/km	
Criteria	**Applied to Design**	**Remarks**
Loss Coefficient : Hazen William	DI : C=110 , HDPE : C=130	
Nodal Demand Distribution	Using “Thiessen” Polygon	
District Metered Area (DMA)	DMA : 150 to 200 ha (in area) Sub-DMA : Average household 500 to 3,000 or Based on topography of service area	
Size of Mains	Primary Mains : D400mm and larger Secondary Mains : D150mm ~ D350mm Tertiary Mains : D145mm and below	Fire Hydrants installed at Secondary Mains(DI) House connection shall be connected to Tertiary Mains (HDPE)
Pipe Material	~ D140mm : HDPE, PN10 D150mm ~ : DI, K9	Changed Class of HDPE from PN6 to PN10
Fire Hydrant	Maximum coverage approximately 5 Ha Tapping size shall be at D150mm/D200mm	Changed D110mm to D150mm (Secondary Mains)

5.32.2 DNI Design – Model Building



< Figure 5.1 : DNI Design - Modeling Building >

5.32.3 DNI Design – Model Optimization

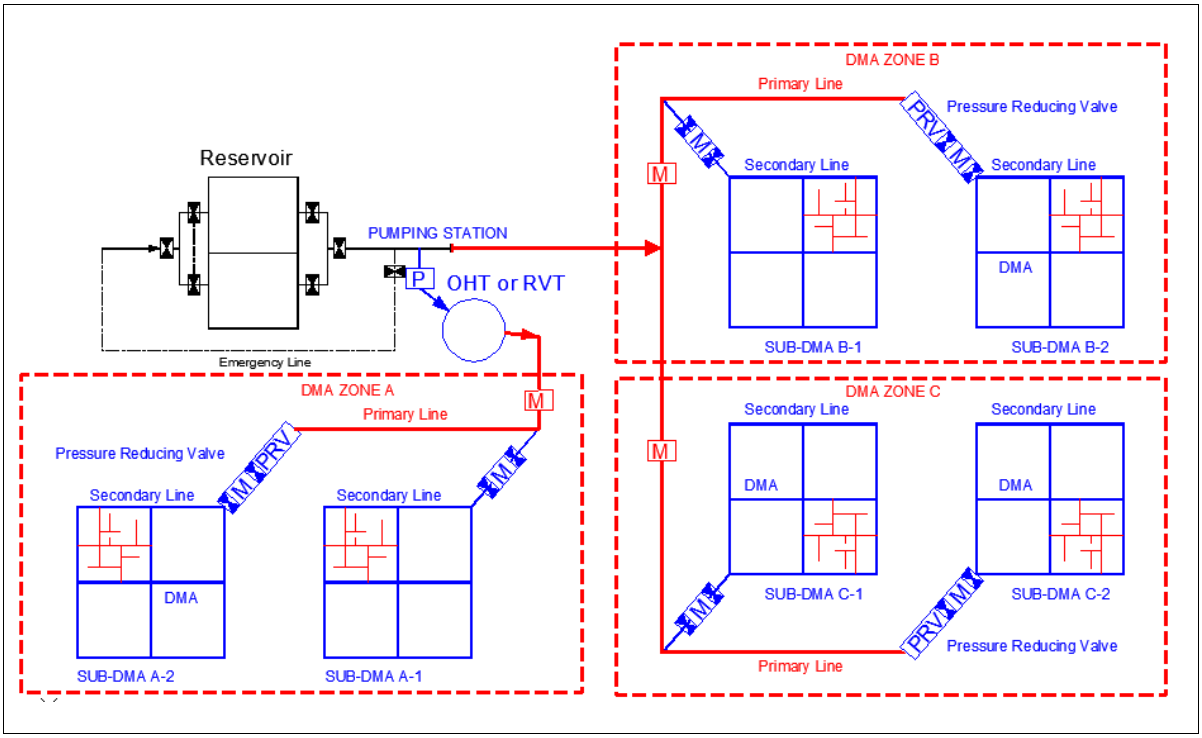


< Figure 5.2 : DNI Design – Model Optimization>

In order to adapt advanced and modernized design of water supply pipe design, the Consultant used EPA-NET and Opti-HSNET for design and confirmation. Opti-HSNET is recently built software for hydraulic calculation of water supply system and it run based on EPA-NET, world widely used program, with additional features. It provides complex calculation for maximizing use of the pipeline and lead the designer to select the most appropriate diameter of the pipe.

Opti-HSNET is developed software for analyzing the most optimum pipeline using input data of pipe network drawing, demand and unit cost for each pipe diameter. Based on node pressure and velocity of the water, it determines the configuration of the network and find the most ideal diameter based on Gradient Algorithm. The analyzed design can be confirmed and adjusted using the EPA-NET. First, the Consultant shall design the network using EPA-NET and the design shall be ran by Opti-HSNET program so that minor adjustment can be made for the most optimized water supply network.

5.33 Design of District Meter Area (DMA)

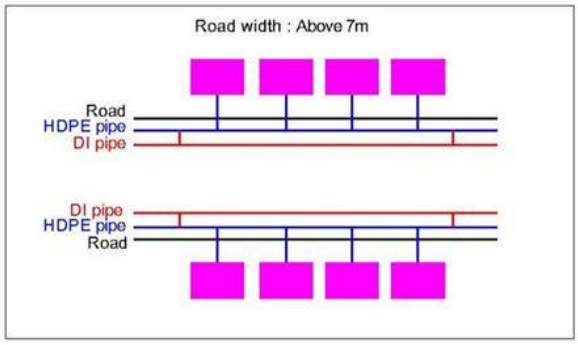
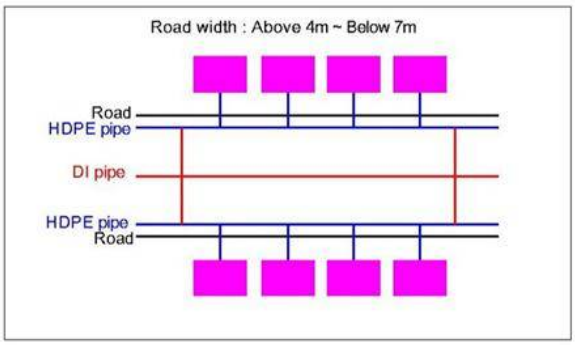
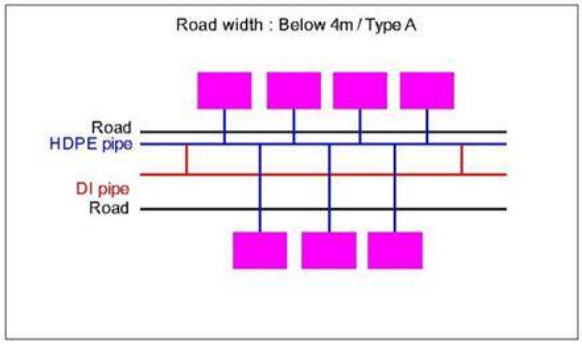
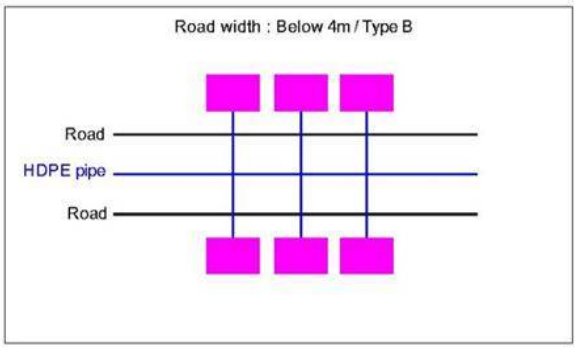


< Figure 5.3 : Schematic Diagram of DMA>

- DMA Design
  - · Supply via single main (preferable) or multiple feeds
  - · Isolate area with adjacent DMA's (i.e., no flow into adjacent DMAs).
  - · Cascade into an adjacent DMA (to be avoided if at all possible)
  - · Minimum variation in ground level across the DMA
  - · SUB DMA ZONE: 500-1500 households.
- Monitor/locate/Control leakage
- Manage pressure
- Minimize utilities inside DMA
  - · Pump
  - · Water Tank
  - · Isolated valves, PRVs

5.34 Reticulation Pipes

Table 5.3: Schematic Diagram of House Connection

	Two DI pipes are purposed in roads with 7m width or above since most DMA zones are divided by large roads. We have minimized two DI pipes lying where DMA zones are not overlapping, but it's based on consideration of fire hydrants and other facilities.
	One DI pipe is purposed in roads with 4~7m width, but for unavoidable DMA zone overlapping, two DI pipes are purposed.
	For narrow roads below 4m width will have DI pipe only when it's necessary for stable pressure control.
	Where DI pipe is not necessary for pressure control, HDPE pipe is purposed as tertiary main for house connections.

House connections shall only be connected to Tertiary mains which are all HDPE pipes for simplicity of connection. The model has been designed accordingly.

The sizing of isolation valve, air valve, washout valve and fire hydrant is specified in Table: 5.4 below;

Table 5.4: Sizing of Valves

Sizing of Valves				
Pipe Dia (mm)	**Isolation Valve**	**Air Valve**	**Washout Valve**	**Fire Hydrant**
75	50	-	80	-
90	80	-	80	-
110	100	-	80	-
150	150	50	80	100
200	200	50	80	100
250	250	50	80	100
300	300	50	80	100
350	300	80	100	100
400	400	80	100	100
450	-	80	100	-
500	-	100	100	-
600	-	100	100	-
700	-	150	150	-
800	-	150	150	-
900	-	150	150	-
above 1000	-	200	200	-

· Air Valve: Purposed only at Primary and Secondary mains.
· Fire Hydrant: Purposed only at Secondary (DI) mains for stable pressure

SECTION 6

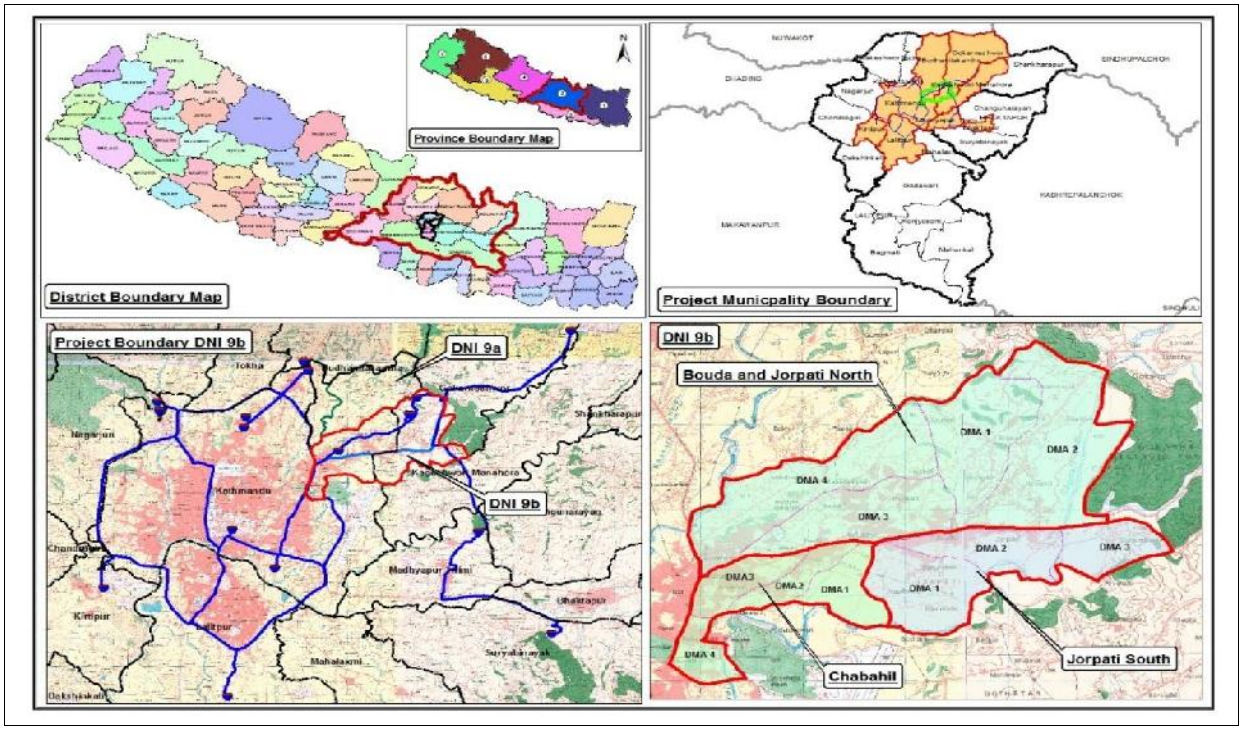
6. Proposed Distribution Network Improvement (DNI9-b：Jorpati(S) & Bouda, Jorpati (N), chabahil)

6.1 GENERAL

This design report covers Jorpati (N) & Bouda, Jorpati (S) and Chabahil of DNI9 which we will now define as DNI9-b. Jorpati area of DNI9-b was not included in the masterplan i.e Kathmandu Metro zone. Therefore consultant have carried out population projection and finalized the demand of Jorpati area. About Chabahil and Bouda area, consultant applied population and demand of SF report (Optimization of Bulk Distribution System, September 2013). We've tried to maximize gravity flow to minimize pumping boundaries. Bouda and Chabahil area has been designed to be supplied from the new Mahankal and Arubari SRT respectively. After consultation with KUKL and review of OLD Mahankal WTP/SRT, Jorpati (S) has been designed to be supplied from OLD Mahankal SRT. Jorpati (N) is targeted to be supplied from Arubari SRT but ultimately the water source shall be from other/existing sources.

6.2 LOCATION

DNI-9b area is located in the North of Kathmandu Metro zone. The topography shows severe difference in elevation, resulting difficulty to form DMA zones with stable pressure. The hydraulic modeling has been designed based on the topography, elevation, hydraulic pressure, DMA zoning etc.



< Figure 6.1: Location map >

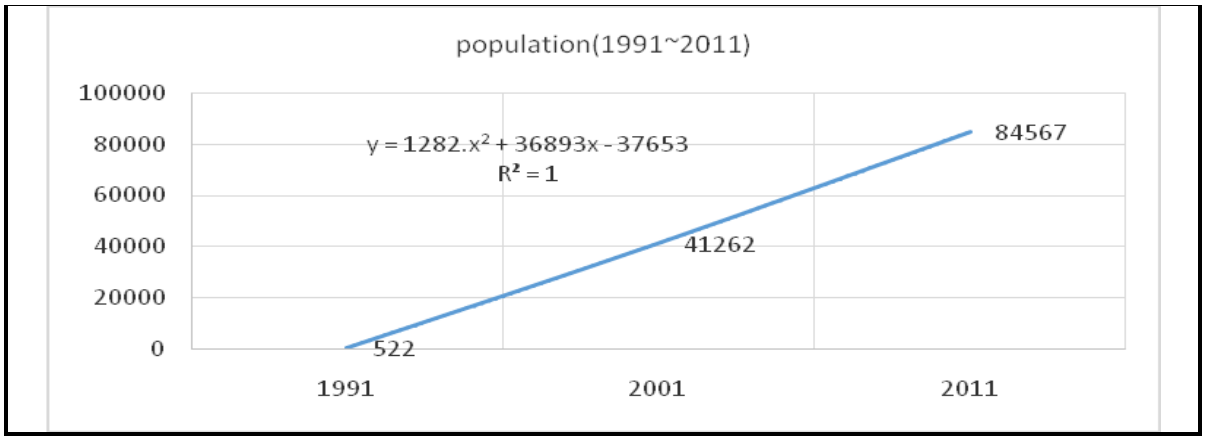


Table 6.1: Population and Demand Projection (Chabahil area) by SF report

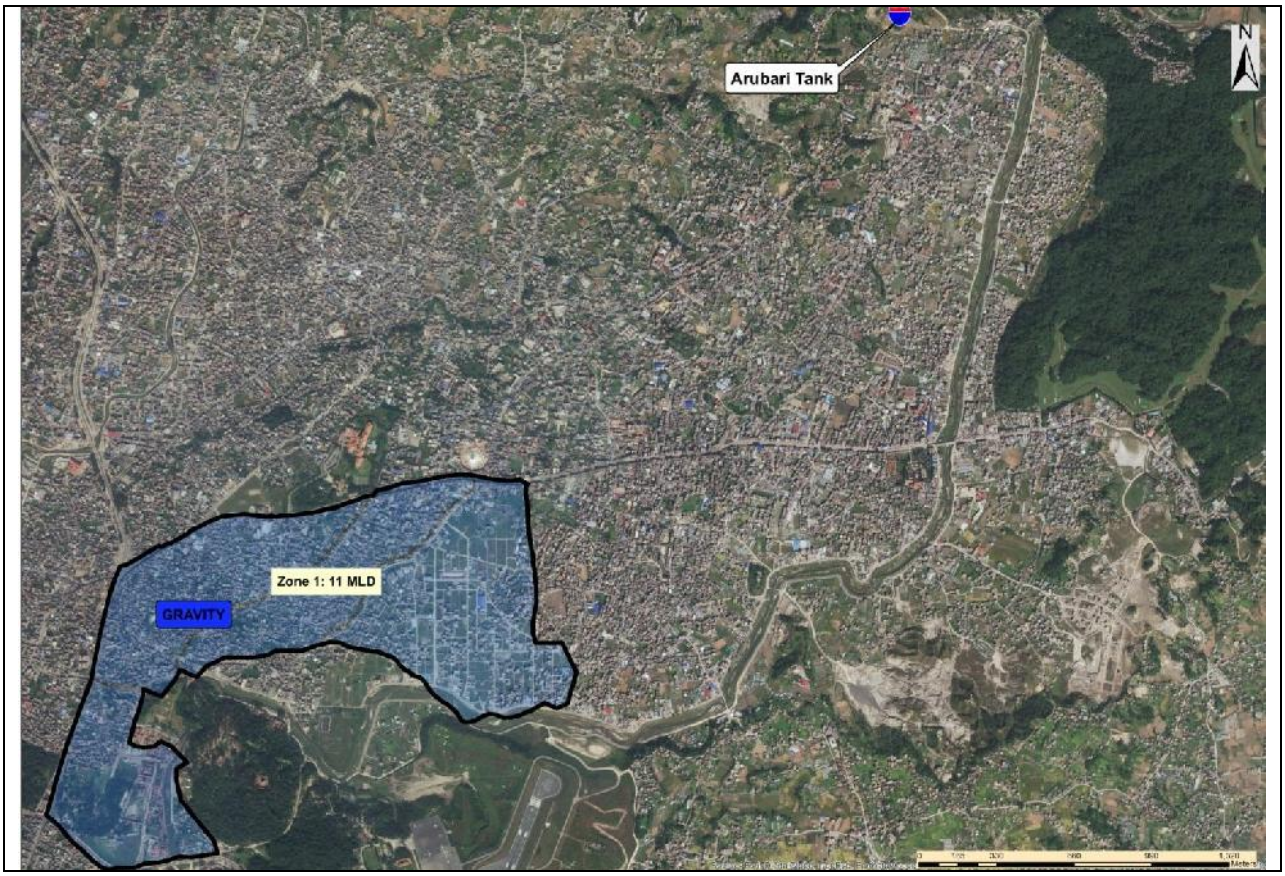
Kathmandu metropolitan city		Population			Spread of area	Population		Demand	
		(2011)	(2025)	(2030)		(2025)	(2030)	(2025)	(2030)
A-5.2	6	60,344	102,997	121,265	22.74%	23,420	27,574	3.96	4.66
A-5.2	7	51,581	91,771	108,048	29.35%	26,939	31,717	4.55	5.36
A-5.2	8	10,738	22,553	26,553	26.97%	6,082	7,161	1.03	1.21
Sum		**122,663**	**217,321**	**255,866**		**56,442**	**66,453**	**9.54**	**11.23**

6.4.3 Chabahil

Same with Jorpati (N) & Bouda, topography survey, population and demand projection and service boundary, gravity and pumping zone was reviewed.

It is possible to supply all regions of Chabahil by gravity from Arubari SRT

The schematic diagram of distribution plan for Chabahil is shown below.



< Figure 6.2: Schematic Diagram of Supply plan for Chabahil area >

· Target reservoir: New Arubari SRT

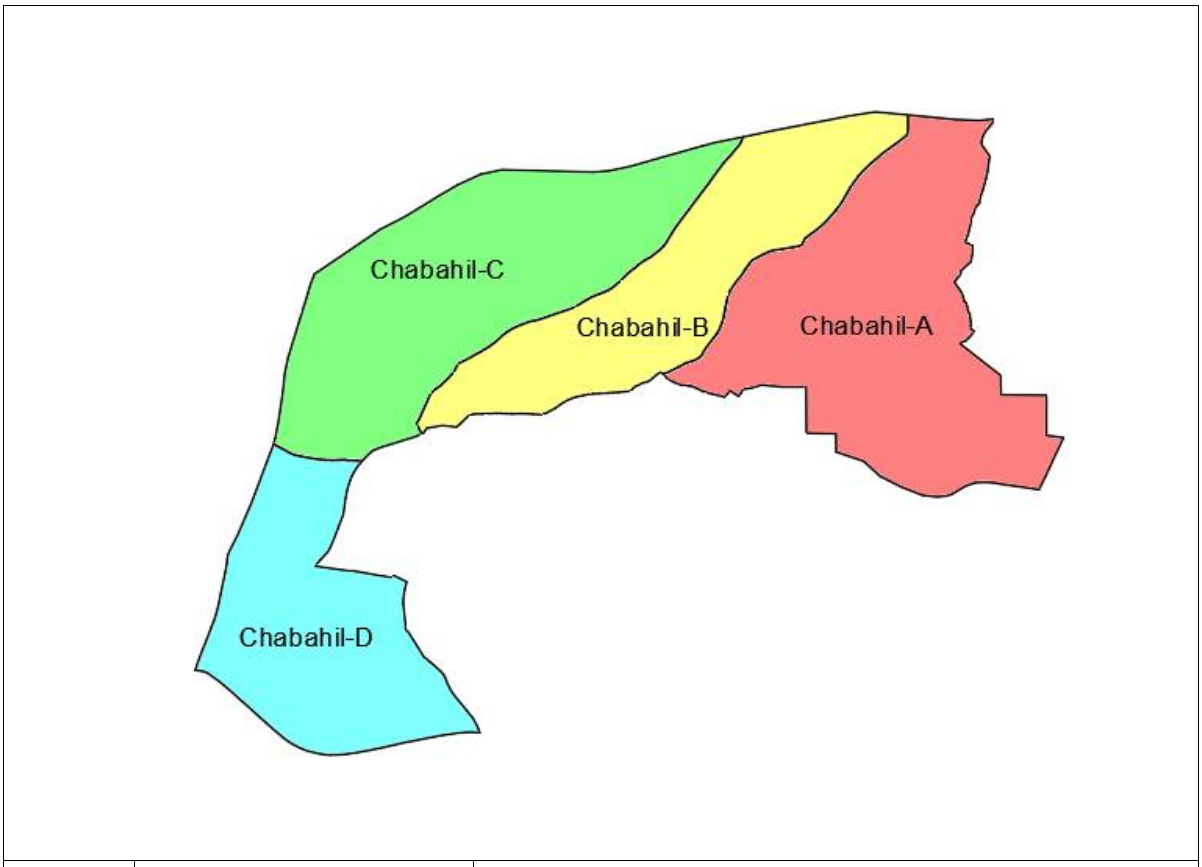
The analysis result shown above has been completed by Opti-HSNET program after draft EPA-net modelling. According to the result of this analysis program and back data, pipe diameters and modeling was finalized.

6.7 Design of DNI (Chabahil)

6.7.1 DMA Zone

District Metered Area (DMA) zones are formed with an average households ranging from 500 to 3,000 but based on topography conditions.

DMA zone of Chabahil area is mainly divided into 4 different DMA zones A, B, C and D.



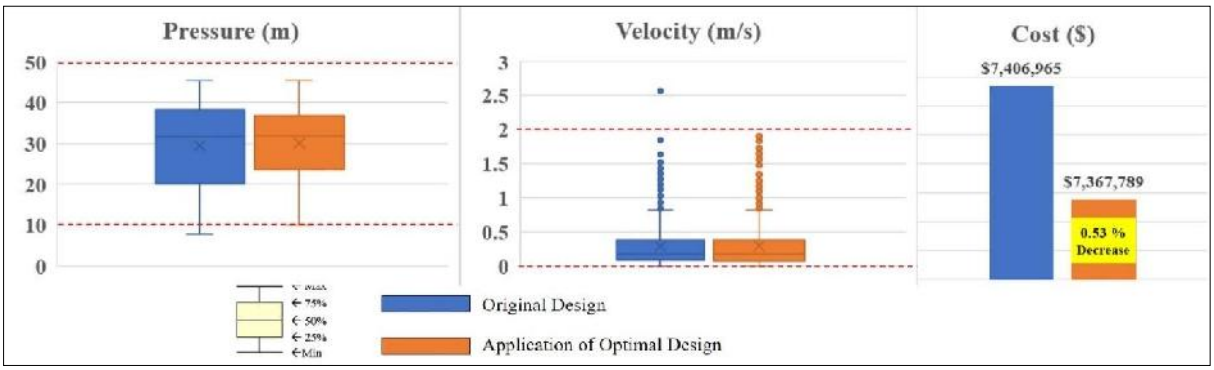
DMA	Sub-DMA	Supply Method	
A	-	Gravity	New Arubari SRT → Supply
B	-	Gravity	New Arubari SRT → Supply
C	-	Gravity	New Arubari SRT → Supply
D	-	Gravity	New Arubari SRT → Supply

< Figure 6.9: Chabahil area DMA zone >

6.7.2 Pipe Diameter Optimization

Chabahil Network consists of 1086 pipes, 832nodes, 4 pressure reducing valves, and 1 reservoir. The pressure distribution is 1.01 ~ 4.79 kgf/cm^2 at the average time zone (15:00), 0.78 ~ 4.55 kgf/cm^2 at the maximum usage time zone (7:00), 1.01 ~ 4.99 kgf/cm^2 at the minimum usage time zone (0:00) and hydraulic reliability evaluation grade of the original design is in 1st grade. However, after applying the optimum design and reinforcement technology, the design cost is reduced by 0.53% is also 1.01 ~ 4.79 kgf/cm^2 at the average time zone, 1.00 ~ 4.55 kgf/cm^2 at the maximum usage time zone and 1.01 ~ 4.99 kgf/cm^2 at the minimum usage time zone. As a

result, comparing in the average time zone, the pressure distribution of optimal design is improved 0.9%. It is satisfied with a hydraulic standard of 1.00 kgf/cm^2 and obtains economic benefits through the proper arrangement of the landscapes at the same time.

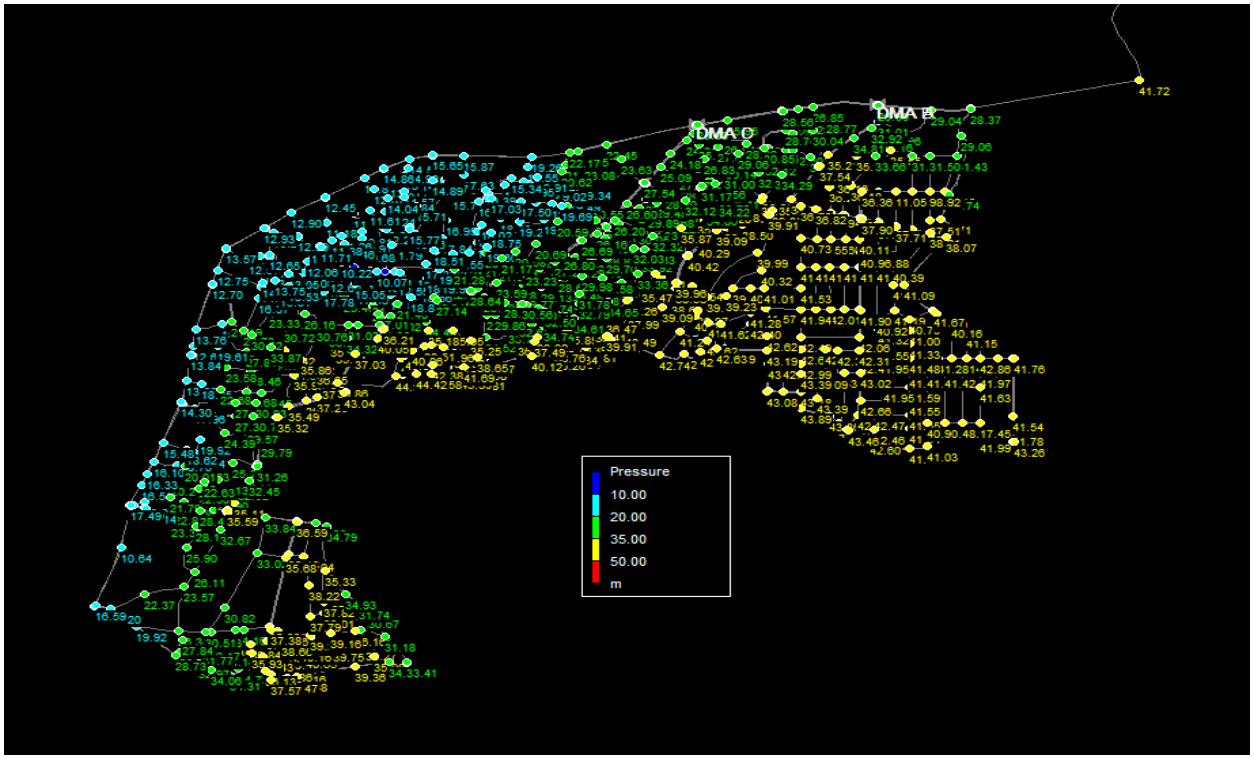


< <Fig 6.10> The Comparison results of WDS design (Chabahil Network)

The analysis result shown above has been completed by Opti-HSNET program after draft EPA-net modelling. According to the result of this analysis program and back data, pipe diameters and modeling was finalized.

6.7.3 Modeling

Chabahil DNI modeling was finalized with 600mm, 250mm, 200mm, 150mm DI pipes and HDPE PE100-PN10 pipes with inner diameters of 62.2mm and 74.8mm. Consultant have optimized the pipe diameter to limit the hydraulic pressure within 1 bar (10m) to 5 bar (50m) and all of the nodes are between this range.



< Figure 6.11: EPANET Modeling of Chabahil>

6.7.4 Pipe material and length

Primary and secondary mains are DI pipe, Tertiary mains are HDPE-PE100, PN10 pipes. Pipe material and length of Chabahil area is shown below;

Table 6.2: Details of Pipe material and length

Description		
Reservoir	New Arubari	W.L : 1,375.9
Total Demand (LPS)	DMA A(Gravity)	42.27
	DMA B(Gravity)	23.66
	DMA C(Gravity)	32.58
	DMA D(Gravity)	25.12
Total number of nodes	832	

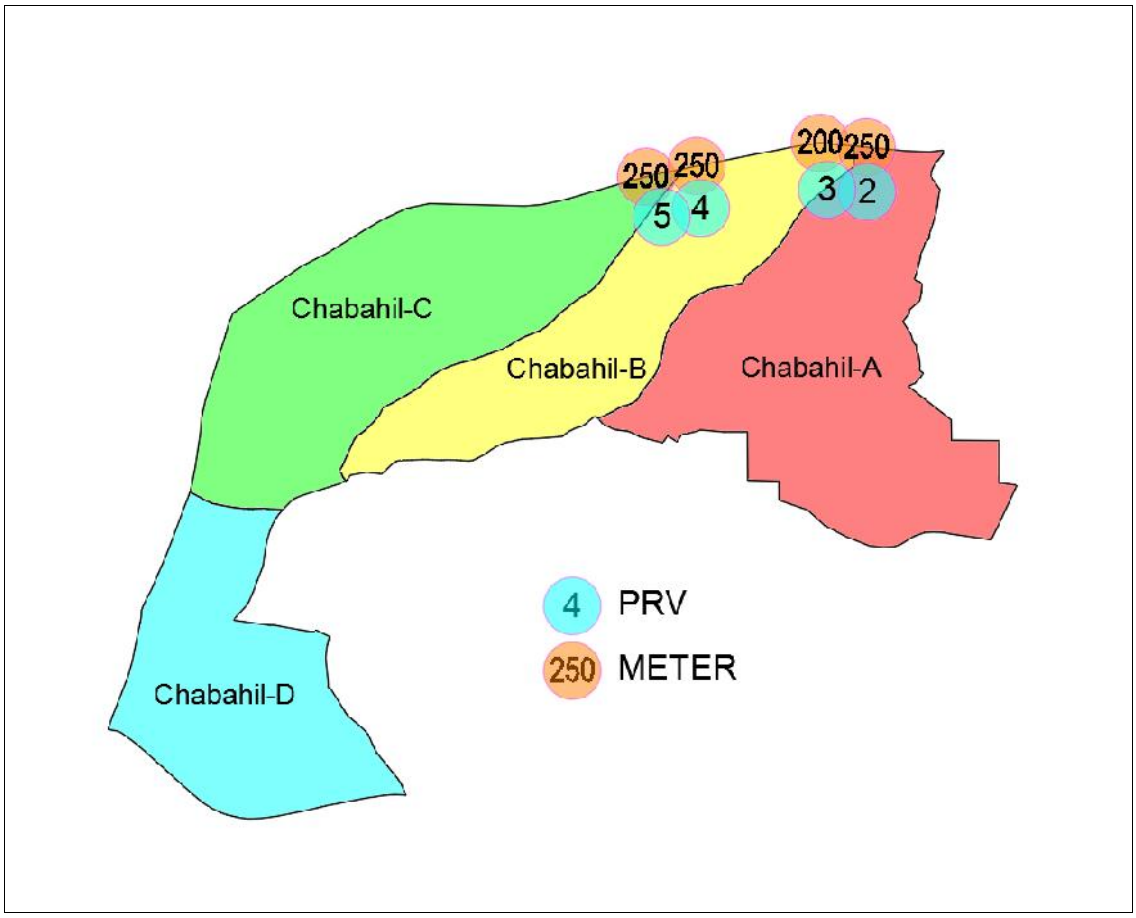
Pipe Length (m)	HDPE (PN10)	DN 75(62.2)	54093.8
	DI	DN 160	10720.97 HDD
		DN 200	343.71 HDD
		DN 250	1655.58 HDD
		DN 300	428.7
		DN 350	2.43
		DN 500	3,243.43
	Sum		70488m

6.7.5 Bulk Meter and PRVs

As mentioned above, Bulk meters and PRV locations were decided as per the DMA design concept. Five (5) Bulk meters and Four (4) PRVs are purposed in Chabahil.

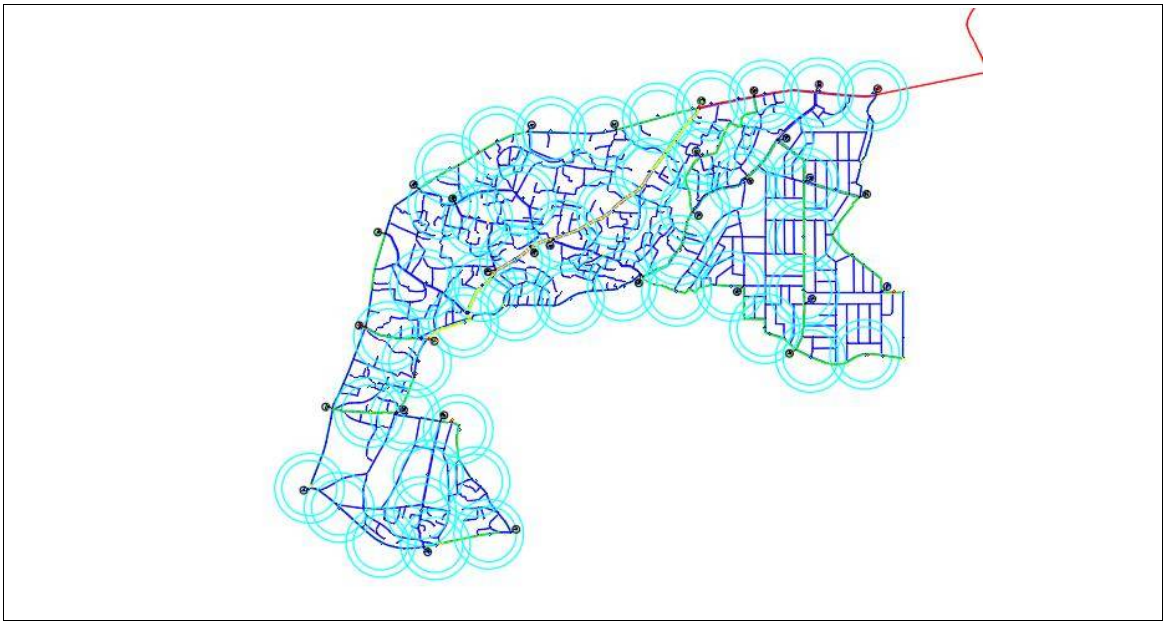
Table 6.3: Details of Bulk meter and PRV's

Location of Bulk Meter/PRV's			
Bulk meter	D150mm	1 No	DMA A
	D200mm	1 No	DMA B
	D250mm	2 No	DMA C AND D
	D500mm	1 No	DMA Zone
PRV's	Valve ID	Diameter	Setting Pressure(m)
	2	150	25
	3	200	25
	4	250	28
	5	250	40



6.7.6 Fire hydrant, Air valve, Washout valve and Isolation valve

Fire hydrants are purposed only in secondary mains and each fire hydrant is located to cover 5ha.



< Figure 6.12: Range of Fire Hydrant in Chabahil>

Air valves and washout valves are purposed along primary and secondary mains along the road, depending on the profile of the roads.

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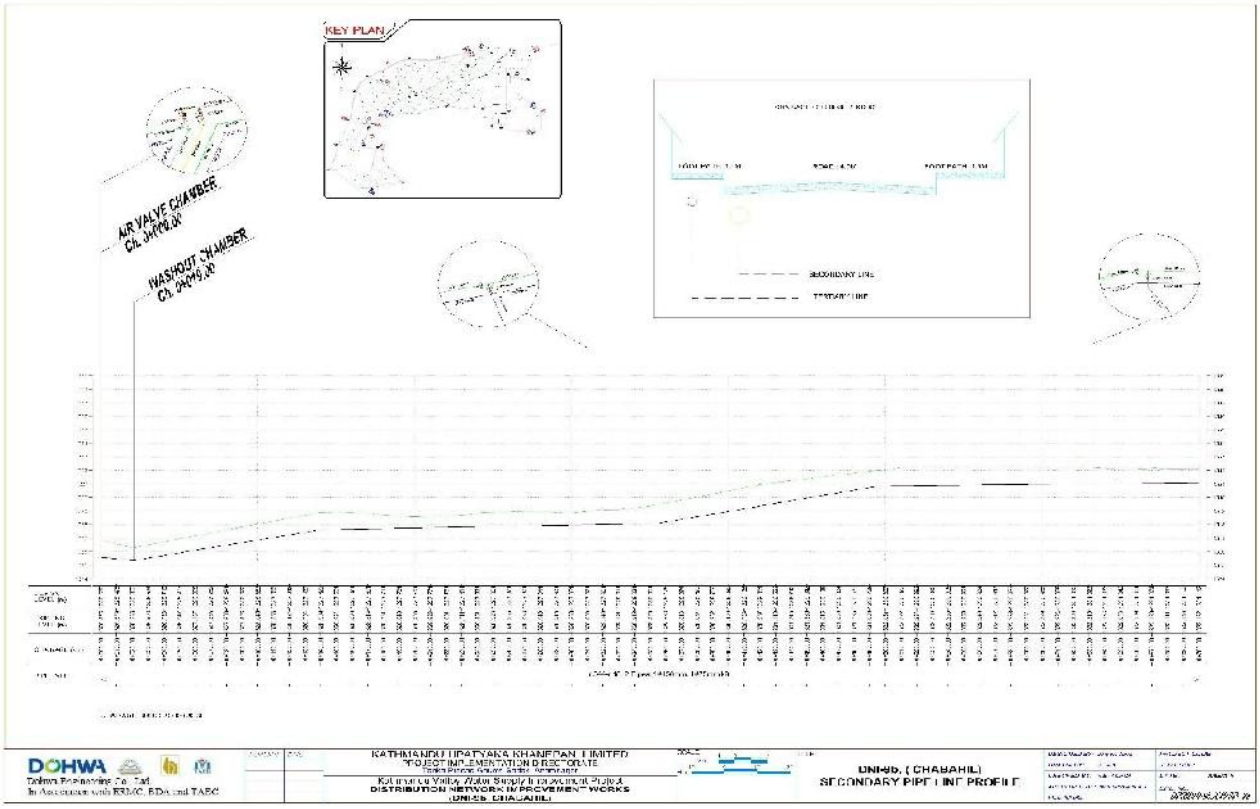
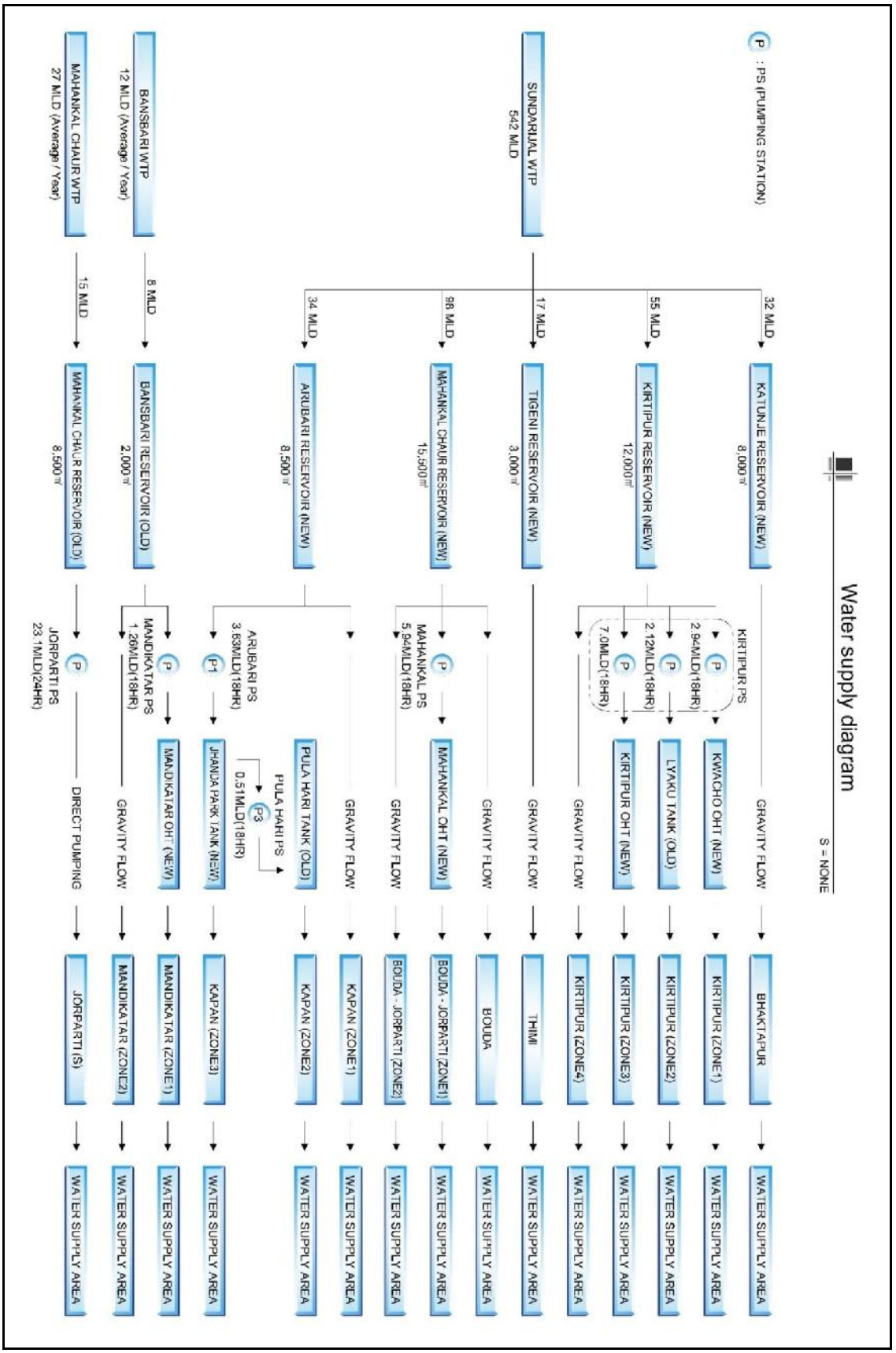


< Figure 6.13: Profile of Chabahil with Valves >

Isolation valves are purposed to divide Sub - DMA zones into 2 to 3 zones for maintenance propose based on site conditions but with minimum quantity of valves.


Water supply diagram
S = NONE
P : PS (PUMPING STATION)
SUNDARIJAL WTP
542 MLD
BANSBARI WTP
12 MLD (Average / Year)
MAHANKAL CHAUR WTP
27 MLD (Average / Year)
32 MLD
55 MLD
17 MLD
98 MLD
34 MLD
8 MLD
15 MLD
KATUNJE RESERVOIR (NEW)
8,000㎥
KIRTIPUR RESERVOIR (NEW)
12,000㎥
TIGENI RESERVOIR (NEW)
3,000㎥
MAHANKAL CHAUR RESERVOIR (NEW)
15,500㎥
ARUBARI RESERVOIR (NEW)
8,500㎥
BANSBARI RESERVOIR (OLD)
2,000㎥
MAHANKAL CHAUR RESERVOIR (OLD)
8,500㎥
KIRTIPUR PS
2.94MLD(18HR)
2.12MLD(18HR)
7.0MLD(18HR)
MAHANKAL PS
5.94MLD(18HR)
ARUBARI PS
3.63MLD(18HR)
0.51MLD(18HR)
MANDIKATAR PS
1.26MLD(18HR)
JORPARTI PS
23.1MLD(24HR)
GRAVITY FLOW
GRAVITY FLOW
GRAVITY FLOW
GRAVITY FLOW
GRAVITY FLOW
GRAVITY FLOW
GRAVITY FLOW
DIRECT PUMPING
KWACHO OHT (NEW)
LYAKU TANK (OLD)
KIRTIPUR OHT (NEW)
MAHANKAL OHT (NEW)
PULA HARI TANK (OLD)
PULA HARI PS
JHANJA PARK TANK (NEW)
MANDIKATAR OHT (NEW)
BHAKTAPUR
KIRTIPUR (ZONE1)
KIRTIPUR (ZONE2)
KIRTIPUR (ZONE3)
KIRTIPUR (ZONE4)
THIMI
BOUDA
BOUDA - JORPARTI (ZONE1)
BOUDA - JORPARTI (ZONE2)
KAPAN (ZONE1)
KAPAN (ZONE2)
KAPAN (ZONE3)
MANDIKATAR (ZONE1)
MANDIKATAR (ZONE2)
JORPARTI (S)
WATER SUPPLY AREA
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SECTION 7

7. Project cost

7.1 BASIS OF COSTING

The unit prices or lump sum prices were analyzed considering the following:

- Standard GON norms of unit price analysis and other accepted norms in recent ICB and LCB contracts in the country and elsewhere
- Market Prices/FOB prices for imported materials as pipes, accessories etc.
- Wages of skilled and unskilled labor
- Construction technology
- Mobilization and demobilization cost
- Overheads and profit
- VAT and other applicable taxes

Break-down into plant, materials and labor component for all unit prices was derived. Unit rates for individual items were determined on basic inputs, overheads and profit including the determination of the foreign exchange component of each element.

Table 7.1: Cost Estimate for DNI 9b, Chabahil

Summary of Bill of Quantities

Part No.	Work No.	Description of Works	Amount
A		**Preliminary, Provisional and General Work**	
	A1	Preliminary and General Work	
	A2	Provisional Work	
B		**Civil Works**	
	B1	Site Clearance, Earthwork, Sand Filling, Shoring and Other Earth Material Related Works	106,403,714.09
	B2	Brickwork	1,226,782.59
	B3	Concrete Related Work	45,319,036.36
	B4	Surface Finishing Work	347,208.09
	B5	Reinstatement and Pavement Work	124,703,916.83
	B6	Metal Related Work	1,279,851.08
	B7	Miscellaneous Works	1,092,534.00
	B8	Chabahil	55,712,826.59
C		**Pipe line, Pipe Fitting and Other Pipe Line Related Works**	
	C1	Pipe Supply, laying and jointing works for Open Cut and HDD	115,338,550.92
	C2	Supply and Installation of Pipe Fittings, Valves and Appurtenances	155,948,985.63
	C3	Hydrostatic Testing and Disinfection Work	5,001,480.62
D		**Others**	
	D1	Supply of Pipes, Fittings and Accessories for Operation & Maintenance	3,947,967.04
	D2	Day Works	3,230,852.40
		Sub Total	**619,553,706.24**

SECTION 8

8. operation and maintenance plan

8.1 GENERAL

A well-designed Operation and Maintenance (O&M) Plan for a water supply system is critical to ensure that the design intent is conveyed in daily operation resulting in maximum benefit to the residents at the minimum possible level of investment. Proper implementation of the O&M plan results in low maintenance cost and ensures longer service life of all system components.

The critical issues to be taken care of in the development of an O&M Plan will be the maintenance of equipment, pipelines, valves & other appurtenances and the system of providing house service connections.

8.2 PROPOSED MAINTENANCE SYSTEM

8.2.1 General

The preventive maintenance of a water distribution system is a set of activities that shall be performed on a regular basis.

Preventive maintenance may increase the initial project cost marginally, but will result in an economical maintenance of the system over the project life. Specifically, in the internal water distribution system, preventive maintenance will increase the life of water mains and appurtenances, which in turn will assure regular and uninterrupted water supply to consumers.

The water distribution system is usually one of the most expensive components of a water supply system and its proper maintenance will reflect on the functioning of the system and its associated service life. The KMC has an advantage on this water supply project with respect to O&M, since no major electrical and mechanical equipment’s are installed in the system and electric power is apparently not relied on.

Maintenance issues in pipelines will differ from place to place depending on the conditions encountered. Selection of suitable pipe material and periodical maintenance is essential to ensure protected water supply at the most economical rate with minimum breakdowns, which will ultimately manifest itself as consumer satisfaction. The points to be considered while planning are enumerated below:

- Periodic inspection of mechanical / electrical equipment such as pumps and motors installed at the WTP, valves, capacitors, voltage stabilizer etc. shall be done for trouble-free operation and optimum performance
- Materials of superior quality shall be procured for replacements
- Newly laid mains shall be regularly tested

- Precautionary measures against corrosion shall be performed
- Leak detection surveys shall be performed from time to time.
- Ducts shall be provided across streets to permit easy laying of additional mains, if required
- Provisions of stubs (short length mains) shall be made to accommodate a group of ferrule connections
- Equipment like pumps, pipe cutting machines, cutting machines, pipe detectors, leak detectors, lighting sets, spare valves etc. shall be arranged for O&M.
- Preparation of 'ward manuals' with details of mains, valves, hydrants, etc. within a ward or zone shall be done.
- Emergency labor teams to work on Sunday and holidays to attend emergency works shall be available.
- Liaison with custodians of other utilities for proper work co-ordination and reduced interference shall be taken care.
- Adequate staff training shall be arranged from time to time.
- A system of information dissemination to consumers on possible disruption in supply shall be established.

8.2.2 Breakdown / Emergency Maintenance

In case of damage (burst) resulting on a main, the following operational sequence shall be adopted:

- Labor workforce (skilled & unskilled) shall be mobilized and required materials shall be assimilated and the team shall be directed to the breakdown site.
- Main control stations / senior officers concerned with maintenance ofwater distribution shall be informed of the situation and the progress monitored.
- The concerned control office shall be intimated to isolate the damagedmain and alternative supply arrangements (if possible tankers) for water supply to the localities affected shall be pressed into action.
- Utilities such as Roads, Electricity & Telephones shall be informed of the breakdown and requested to be present at site to ensure coordination.
- The local traffic police shall be informed to ensure proper traffic regulation.
- Isolation of the water main by closing sluice valves on all sides shall be done if the pipe is damaged severely.

8.2.3 Maintenance of Appurtenances

The objective of installing appurtenances on water pipelines is to permit control of water supply, protect the pipelines and assist with periodical cleaning. Normally installed appurtenances are described below.

Sluice valves

Sluice valves are required to control and regulate water supply and shall be provided at suitable locations considering the length of pipeline and take off branches. Defects normally reported on the sluice valves are the following:

- **Gland leaks:** Gland leaks can be rectified by replacing the hemp packing when noticeable leaks are observed.
- **Spindle damage:** Unequal application of pressure results in damage to the spindle, which can be avoided by training valve operators to operate the valve in accordance with manufacturer's recommendations on tightening pressure. It is necessary to have spare spindles for the full range of valves to ensure replacement in the shortest possible time frame
- **Partial valve closure:** Debris accumulated in the valve seat and around spindle heads causes this problem and can be removed by opening the top cover of the sluice valves. Round out of spindle heads are a direct consequence of wear and tear and this can be reduced by using specially prepared caps

It is a recommended practice to provide a name plate on the valve chamber or near the curb edge detailing sluice valves with location, size and direction of opening. This will reduce the complaints regarding sluice valves getting buried during road construction and/or trench backfill. When possible, sluice valves shall be installed along pavements. Sluice valves in roads where there is intense traffic shall be provided with heavy-duty covers with markings of pipeline alignment to avoid intentional or accidental damage.

8.2.4 Scour Valves

Scour valves are normally provided at the bottom of pipelines (normally horizontal) and operated to flush and dewater the mains.

8.2.5 Air Valves

Air valves are provided on the top of pipelines where there is an acute horizontal / vertical direction changes.

8.2.6 Quality of Materials

The water supply system will work without (or with very minimal) interruption if the procured materials such as pipes and appurtenances are of standard quality. It is therefore necessary to use

standard materials of approved make and establish procedures right from procurement of materials to installation, testing and commissioning.

The pipes procured shall be subjected to hydraulic pressure tests as specified in IS: 1536-1967. If the testing facility does not exist, a manufacturer's test certificate shall be obtained and filed for reference. Manufacturers shall test pipes in the presence of the representative of KUKL and submit a test certificate while delivering the pipes.

Valves, hydrants and other appurtenances shall be tested prior to installation. It is recommended to invest more in procuring good quality materials rather than purchasing inferior materials and then incur high maintenance expenditure.

8.2.7 Maintenance of Service Reservoirs

The important aspects to be considered in the maintenance of service reservoir are:

- **Measurement of inflows / outflows:** Supply and Discharge flows or at least discharge flows shall be measured to ensure the losses. Water level indicators and flow indicators / recorders shall be in working condition.
- **Structural leakage:** All structural damages and leak shall be promptly repaired.
- **External Pollution:** Manhole openings, ventilation shafts and overflow pipes shall be adequately protected and checked periodically to prevent any contaminant infiltration.
- General cleanliness in and around the service reservoirs shall be maintained and observed.
- A garden around the service reservoir can be provided, wherever possible, for aesthetic reasons.
- A program to clean the service reservoir at least twice in a year shall be undertaken. Such cleaning process shall be performed during non-supply times or a facility to by-pass the water supply shall be in place.
- Appropriate safety measures to prevent entry of unauthorized persons
- shall be provided.
- All guide and hand railings shall be maintained in a safe and firm condition.

8.2.8 Maintenance of Bulk Distribution System

Conveyance and water distribution are items that involve substantial expenditure in a large water supply scheme. For effective maintenance, the entire water distribution system shall be divided into zones served preferably from a minimum number of service reservoirs. Operation and Maintenance of the water distribution system shall be entrusted to at least a Junior Engineer who shall be the authorized official of the controlling authority to receive and deal with complaints. Appropriate registers shall be maintained to record complaints and track follow up action to ensure that the complaint is addressed. He shall be provided with sufficient funds to face an

emergency. If the complaint is such that it cannot be dealt with at his level, the Junior Engineer shall promptly refer the matter to a higher authority and also intimate the action taken to the complaint. Frequent vigilance checks in areas receiving maximum complaints shall be made as an essential part of the supervisory staff's daily schedule of duties.

8.2.9 Annual O&M Cost

It is envisioned and recommended that KUKL will be responsible for Maintenance and Operation of the entire water supply system. However, it may also be possible for KUKL to privatize the O&M through a fixed cost contract and supervise the maintenance.

SECTION 9

9. institutional strengthening & training

9.1 GENERAL

Good Organization set-up is a prerequisite for efficient maintenance of a water supply system. A local body with a good organizational set-up and definite tasks assigned to its employees will have minimum maintenance problems. The existing Organization set-up in KUKL is very small, considering the future improvements to the water supply system of Kathmandu City

9.2 PRESENT INSTITUTIONAL SET-UP & RESTRUCTURING

The institutional framework for urban development was created in early 1990's with the establishment of the Ministry of Housing and Physical Planning (now under newly formed Ministry of Water Supply - MoWS), Nepal Water Supply Corporation (NWSC), Urban Development Training Centre, and town development committees in each municipality. The Town Development Fund was established in the mid-1990s as a source of urban finance. Several Government Ministries, departments and other agencies are involved in the management of the water supply sector and related activities. Major institutions involved and responsible for development and management of water supply services in the Kathmandu Valley are:

- **Ministry of Water Supply (MoWS)** is responsible for formulating national level policies and programs and guiding sector activities to meet objectives and targets.

- **Department of Water Supply and Sewerage (DWSS)** is the lead agency in the sector and is responsible for water supply services in rural areas and small urban centers.

- **Nepal Water Supply Corporation (NWSC)** is a semi-autonomous corporation responsible for water supply and sewerage in major urban centres outside of Kathmandu Valley.

- **Kathmandu Valley Water Supply Management Board (KVWSMB)** is an autonomous body established under WSMB Act (2006) and responsible for water supply and sewerage services in Kathmandu Valley.

- **Water Supply Tariff Fixation Commission (WSTFC)** is an autonomous body responsible for economic regulation of water supply and wastewater services and to fix the tariff.

- **Kathmandu Upatyaka Khanepani Limited (KUKL)** was set up in 2008 under a Public Private Partnership (PPP) model under the Companies Act for operation and maintenance of water supply system in Kathmandu Valley under lease and license (30 year) from KVWSMB.

9.3 TRAINING FOR WATER SUPPLY PERSONNEL

9.3.1 Introduction

Recruitment of trained engineering personnel for management of water works is an important issue confronting organization like Public Health Engineering Department, Municipalities and Industries possessing their own waterworks. Of equal importance is the problem of keeping such personnel technically updated. Special efforts to impart in-service training or continuing professional education should go along with employment of such personnel.

In view of the rapidly changing pace of science and technology, individuals initially educated in traditional disciplines in engineering and employed in the waterworks industry should obtain additional training, if they are to continue performing their technical duties effectively. Formal academic education may not equip an employee to cope indefinitely with challenges posed.

Necessity of Training

A valuable resource in a waterworks utility is the personnel. Their proficiency directly influences quality of service and overall economy. Creative, hard- working and well-trained employees capable of achieving high standards of performance enhance the status of a utility company with resultant additional benefits such as the following:

- Increased efficiency of operation with advanced knowledge of operational practice;
- Overall economy by virtue of expanded skilled operation and maintenance;
- Improvement in quality of treated water;
- Improved public relations; and
- Improved public health conditions due to supply of water of superior quality closely controlled by trained laboratory staff.

In recent years, there has been an increased realization of importance of maintaining specialized operating personnel and attention has also been focused on the need for training employees at different levels. Training cannot end with just one course. To be effective, it has to be a continuous process. Each employee should be trained year after year through employment. In this town, due to lack of training both for the field staff as well as the Engineers; the maintenance system is found to be not satisfactory. It is therefore necessary that periodical intensive training be given to the operating staff with the following areas of focus:

- Interaction with consumers
- Need for providing potable water supply
- Description and application details of instruments and other accessories required for maintenance work
- Need for proper maintenance of the same and monitoring how each activity shall be operated upon / performed.

- During emergency break down, how system has to be restore within a minimum breakdown period.
- Training and field visits to other project sites to get firsthand information about proper maintenance procedures.
- Maintaining of records and necessary field documents regarding Operation and Maintenance (O&M) of various units in the water supply scheme and periodical interaction with higher authorities for effective follow up action.

9.3.2 Training Requirements

The existing water supply scheme was constructed by KUKL. The headworks, Sundarijal Water Treatment Plant, existing service reservoirs and internal water distribution system are being maintained by the KUKL. Though most of them are qualified for the O&M of water supply schemes, they are not trained to handle and properly operate and maintain the electrical and mechanical equipment in water treatment plant. This results in frequent failure of starters and other electrical equipment like switches and control panel. At the time when KUKL employs its own staff for O&M, the staff needs training for proper O&M of the equipment and the proposed water supply scheme.

9.3.3 Training Plan

The operating staff of KUKL shall to be trained in the following:

- Basic principle of various machineries working
- Basic Knowledge in the working of motor, starters, circuit breakers & switches.
- Purpose of various types of valves – Sluice valve and Scour valve etc.
- Valve operations at headworks and in the gravity main.
- Preventive maintenance of electrical and mechanical equipment
- Attending to minor repairs, major repairs – procedure to be followed
- Various types of pipes and pipe materials – pressure ratings
- Log books – maintenance & upkeep of records
- Importance of keeping good health and hygiene
- Management of crises in the Operation & Maintenance

SECTION 10

10. Procurement Strategy

10.1 IMPLEMENTATION OPTIONS

The Proposed improvement works under Chabahil DNI areas:

Contract Package 7: DNI 9b

Since the above packages are being taken up by government of Nepal funding, Procurement as per public procurement office document (PPMO) shall be followed.

10.2 FORM OF TENDER

As discussed with PID, the procurement guideline shall be adopted Nepal Governments policy.

10.3 CONSTRUCTION PERIOD

A 30-month construction period is proposed for Package 7.

10.4 QUANTITY AND COST ESTIMATES

Based on the detail design and drawings prepared, the bills of quantities have been prepared for all components of the project. Cost estimates were prepared considering the established quantity of works and unit prices.