ADDIS ABABA UNIVERSITY ADDIS ABABA INSTITUTE OF TECHNOLOGY WATER SUPPLY COVERAGE, HYDRAULIC MODELING AND

PERFORMANCE EVALUATION OF DISTRIBUTION SYSTEM (Case Study of Adama Town)

A Thesis Submitted to the School of Graduate Studies of Addis Ababa University in Partial Fulfillment of the Degree of Master of Science in Civil Engineering. (Major in Hydraulic Engineering)

By Dereje Wakjira

Advisor Geremew Sahilu (PhD)

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Approved by Board of Examiners

Dr. Geremew Sahilu Advisor	____________________ Signature
Dr. ________________________________ Internal Examiner	____________________ Signature
Dr.________________________________ External Examiner	____________________ Signature
Ato ________________________________ Chairman	____________________ Signature

ABSTRACT

Water distribution systems are designed to fulfill all requirements of potable water needed for decades. Initial system designs frequently consider any anticipated changes likely to happen. However, as time elapsed they slowly begin to fail to satisfy customers' requirements. Adama town is the capital city of Oromia regional state. It is also one of the largest cities of the region as well as the country with a total population of around 373,600. At present the principal source of drinking water for the town is River Awash located west of the town, about 11 km from the central office. The paper considered this source for analysis. The main objective of this study is to investigate the state of the existing water distribution system, coverage and evaluate the hydraulic performance of the water distribution network with the aid of computer analysis. The peak hour demand is analyzed to verify that the existing sizes of network pipes are sufficiently provide the minimum required pressure at all demand points. The minimum hour demand is analyzed for evaluation of pipe material and strength of the network.

To evaluate the existing performance of water distribution system, a model was developed utilizing Water CAD software. The model can be used to solve ongoing problems, analyze proposed operational changes, and prepare for unusual events. Calibrations of data on pressure at different location were collected. The model run was performed for different scenarios to analyze the system model, what if conditions. These scenarios are at average day demand, peak hourly demand and Minimum day demand. Comparing representative samples of the distribution main's pressure field-test with the model-simulated values showed a reasonable and small difference to calibrate the model. The model analysis result showed the different problems of the system, these are oversized and undersized pipes, zero flow velocity and low pressures (-67m up to 9m H_2O) due to pipe size and topography of the area.

Key Words: *Water Distribution System, Modeling, Watercad, Hydraulic Performance, Water Demand, Maximum Pressure, Minimum Pressure, Velocity, Source, Adama.*

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LIST OF ABBREVIATIONS

ATWSSE	Adama Town Water Supply and Sewerage Enterprise
AAWSA	Addis Ababa Water and Sewerage Authority
CSA	Central Statistical Agency
C	Hazen-Williams coefficient
CWTM	Clear Water Transmission Main
CW	Clear Water
D	Diameter
DCI	Ductile cast iron
GI	Galvanized iron
i.e	that is
L/cap/day	Litter per capita per day
L/s	liter per second
L	Length
km	Kilometer
KW	Kilowatt
m	Meter
m/s	meter per second
m^3/d	meter cub per day

mm	Millimeter
masl	meter above sea level
MWR	Ministry of Water Resource
OWRB	Oromia Water Resource Bureau
OWMEB	Oromia Water, Mineral and Energy Bureau
OWWDSE	Oromia Water Work Design and Supervision Enterprise
Q	Discharge
UAP	Universal Access Program
WHO	World Health Organization
UN	United Nations
UFW	Unaccounted for water
V	Velocity
Z	Elevation

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1. INTRODUCTION

1.1 BACKGROUND

Water, a valuable resource, is used as the main raw material by our civilization. It is usually found in lakes, rivers, reservoirs and underground sources. From the sources it is abstracted and pumped or gravitated into supply network systems. Water supply systems are mandatory for supplying water to the users. The main components of water supply systems are: (1) treatment works; (2) supply network of trunk mains and main reservoirs; (3) distribution network. The untreated raw water is conveyed to the treatment plant. The treated water is then transmitted to water users through the water distribution systems.

The water distribution system is a hydraulic infrastructure consisting of various elements such as pipes, tanks, reservoirs, pumps, and valves. All of them are crucial in delivering water of acceptable quality with specified pressure. The distribution systems can be either looped or branched.

In earlier times appearances of water distribution systems were not a complex network system. They were a system of single line or very few lines. In ancient cities Aqueduct supplied water through tubular conduits from the source and branched out into the city and the palace (W. Mays, 2004). When cities were small, obtaining clean water was not a major problem; however, as cities grew to larger populations and much higher densities there was a much greater need for water infrastructure. With advances in science particularly in engineering more complicated systems were emerged with new arena of pipe analysis.

Analysis of a pipe network is essential to understand or evaluate a pipe network system. In a branched pipe network, the pipe discharges are unique and can be obtained simply by applying discharge continuity equations at all the nodes. However, in case of a looped pipe network, the number of pipes is too large to find the pipe discharges by merely applying discharge continuity equations at nodes. The analysis of looped network is carried out by using additional equations found from the fact that while traversing along a loop, as one reaches at the starting node, the net head loss is zero(Swamee et al., 2008).

A water distribution network simulation model represents a real system using mathematical formulations to predict the system responses under a wide range of conditions without interrupting the actual systems (Walski et al., 2001). There are two types of simulation which are: (1) steady-state; and (2) extended period simulation. Steady-state refers to the conditions that remain constant with time. And it is necessary when simulation is performed to predict the response to a unique set of hydraulic conditions (for example, peak hour demand). Steady-state simulation determines the flows, pressure, valve position, pump operating attributes etc at a certain time. Whereas, extended period simulation determines the state of the system over time. It simulates the variation of tank water levels, pressure, flows in response to varying demand conditions (Cesario, 1995).

The simulation of hydraulic behavior of pipe network in which pressurized water is fed is not an easy task. It involves solving a set of simultaneous non-linear equations, for example; continuity equation (conservation of flow to be satisfied at each node), energy equation and the equation that relates pipe flow and head-losses, such as the Hazen-Williams, Darcy-Weisbach and Mannings equations. With the advent of soft computing technology, researchers have been interested to use this technology in problems with iterative computations. There are many useful and efficient computer programs available for water distribution network simulation. Water Cad (Bentley) is one such popular simulation tool which plays an important role in the layout, design and operation of the network. The water engineers use this simulation model to determine the optimal (least-cost) pipe sizes for supplying water to the consumers or to determine the optimal network parameters (pipe roughness coefficients and nodal demands) to increase the reliability of the model. Traditional approach uses a trial and error method. They assume one trial pipe sizes or network parameters and check the adequacy of the model. If the assumed variables are not adequate to satisfy the hydraulic conditions, for example, the engineer makes further changes to the values of the variables to arrive at a workable alternative.

The current pipe network system of Adama town is inaugurated in November 2002. Population is growing rapidly with expansion of the city. Due to burden on the water distribution system now it is facing some problems. Analyses of pipe systems using models are a recent approach to evaluate the performance of water distribution network.

1.2 STATEMENT OF THE PROBLEM

Inadequacies of water supply along with the deterioration of water quality in a distribution system are the major problems facing city water works all over the world. The problem is especially severe in most developing-country cities and towns including Adama; where increased urbanization, population growth, poor city planning, and shortage of sufficient resources creating combined effect.

Adama, one of the rapidly urbanized towns of Ethiopia, is suffering from the shortage of water due to the following points.

- The quantity of raw water being used from Awash River is around **285 l/s (24,624m3/d)** where as the required would be **410 l/s (35,424m3/d)**.(OWWDSE, 2011)
- Frequent pipe bursts and excessive leakages in the network due to the existence of old pipe lines have also decreasing the coverage capacity of the service Unaccounted for water has been increasing from 15.44% to 45.46% of water production**. (**OWWDSE, 2011)
- Moreover, there is no alternative water source for emergency case; if supply fails from Awash River; water supply situation is becoming worst in the town due to lack of emergency water supply. (OWWDSE, 2011).

There are instants in which water shortage is accelerated by undesirable pressure within distribution system. High leakage and pipe failure (due to unmaintained maximum pressure) as well as provision of insufficient supply (due to unmaintained minimum pressure) are situations which propagate water shortage within distribution system.

Therefore to give appropriate solution, we must study the hydraulic parameters, the variations, and the relations between them and other factors, which control the performance of the water supply networks for increasing the efficiencies of the water supply distribution systems. In other way the computer model is used for the purpose of Planning, designing, rehabilitation, expansion and Leakage controlling.

1.3 RESEARCH OBJECTIVE

1.3.1 1.3.1 General objective:

The objective of this study is to know the water supply coverage and to evaluate the performance of the full existing water distribution system using hydraulic simulation software (WATER CAD) and recommend changes, if any, in the existing system and to use the model to control the distribution system.

1.3.2 1.3.2 Specific objectives:

To fulfill the above general objective the following specific objectives are used.

1. To evaluate the current water supply coverage.
2. To explore the hydraulic performance of the distribution system.
3. To model the existing water distribution network.
4. Identify the existing water supply problems and give appropriate recommendation.

1.4 SIGNIFICANCE OF THE STUDY

This research investigated the current situation of Adama town water coverage and distribution network system and identified some of the present problems. Based on findings, better system management was proposed. Actions that can be taken to improve hydraulic performance of distribution system and creation of new pressure zones. Hopefully, the insights that can be drawn from this study will initiate further research on similar other sites and will contribute to solving the existing problems of water distribution system.

2. LITRATURE REVIEW

2.1 URBAN WATER SUPPLY COVERAGE AND DEMAND

2.1.1 Urban Water Supply coverage

Water supply coverage provides a picture of the water supply situation of one specific country or town and helps to compare one country with others and the inter and intra town distribution with in specific country. The percentages of population with or without piped water connection are a relevant indicator to compare the coverage of water supply in urban areas. (UN-Habitat, 2003) According to the Global Water supply and Sanitation Assessment 2009 Report, the African largest towns are having 53% house connection or yard tap 31% served by public tap while 41% of the populations are un- served. The actual water supply coverage in towns of developing countries in general and African towns in particular is very low while compared to the demand. On the other hand, a minimum quantity of 25 liters of potable water per person per day provided at a minimum flow rate of not less than 10 liters per minute with the source being available within 200 meters from a household and the supply not interrupted for more than 7 days per year (i.e. water should be available 98% of the time) is considered as a basic service for African towns' domestic water supply (Wallingford, 2003).

2.1.2 Urban Water Supply Demand and Management

Water demand is defined as the volume of water quested by users to satisfy their needs. In a simplified way it is often considered equal to water consumption, although conceptually the two terms do not have the same meaning (Wallingford, 2003). In most developing countries, the theoretical water demand considerably exceeds the actual consumptive water use. Urban water demand is classified in to different categories: the domestic water demand that includes in house use and out of house use is among the others. Urban water demand is usually quoted in terms of liter per capital per day (l/cap/day) (Mwendera et al, 2003.). In many African towns, urban water demands are often non-homogeneous.

Water demand management refers to any socially beneficially action that reduces average or peak water withdrawals or consumption form either surface or ground water, consistent with the protection or enhancement of water quality (Tate,2000). According to Rothert and Macy (2000), water demand management is adaptation and implementation of strategy by water institute to influence the water demand and usage in order to meet any of the following objectives: economic efficiency, social development, social equity (Mwendera etal. 2003).

2.2 WATER DISTRIBUTION SYSTEM

2.2.1 Introduction

Water distribution systems consist of pipeline networks and associated components, most of which is underground and exposed to soil corrosion and mechanical stress from the surrounding soil, surface traffic, and internal water pressure (Ahammed and Melchers 1997). Pipe failure in water distribution systems disrupts the water supply to consumers and reduces the reliability of the system. It is found that about 35% to 60% of the supplied volume is wasted due to pipe leakages (Babovic et al, 2002). Therefore, inspection, control and planned maintenance and rehabilitation programs are necessary to properly operate existing water distribution systems (Saegrov et al 1999).

A well planned water distribution network is very essential in the development of urban areas. The network is built to satisfy various consumer demands while meeting minimum pressure requirements at certain nodes. In the design stage it is of interest to arrive at the least-cost solutions that satisfy a set of constraints including demand and pressure requirements. Often it is also of interest to arrive at less expensive solutions that, however, violate slightly the constraints. Accordingly, research interests have been concentrating on the development of efficient evolutionary algorithms (optimization techniques) to search for the optimal combination of decision variables (e.g. pipe diameters) from a large number of solutions.

2.2.2 Types of Water Distribution Systems

2.2.2.1 Branching Systems

This type of distribution networks is the most economical system, and common in the developing countries due to its low cost. In this system, when there is need for developing the network, new branches follow that development and new dead ends will be constructed.

The branching systems have some disadvantages such as the following:

- The dead ends cause accumulation of sediments, which result in increasing contamination and health risks.
- The maintenance operation upstream of the network will prevent water to reach the downstream due to the interruption of the whole area of maintenance.
- The fluctuating demand causes high-pressure oscillations.

2.2.2.2 Grid Systems

There are no dead ends in this type of distribution networks. The maintenance operation did not affect the interruption on the whole area as in the branching system, this type of layout is highly desirable because, for any given area on the grid, water can be supplied from more than one direction. This results in substantially lower head losses than would otherwise occur and, with valves located properly, allows for minimum inconvenience when repairs or maintenance activities are required. The whole area is covered with mains that form the grid system.

2.2.2.3 Ring Systems

The mains form a ring around the area under service, secondary pipes connecting the mains and delivering the water to the consumers.

2.2.2.4 Radial Systems

The area under service in the radial system is divided into subareas, and a storage tank is placed in the center of each subarea to supply water to the consumer.

2.2.3 Methods of Water Distribution

2.2.3.1 Gravity Distribution

This is possible, when the source of supply water is at some elevation above the city, so that sufficient pressure can be maintained in the mains for domestic and fire services. The advantage of this method of distribution is saving power that needed for pumping.

2.2.3.2 Distribution by Pumping Without Storage

In this method of distribution, water is pumped directly into the mains with no other outlet than the water actually consumed. The pumping rate should be sufficient to satisfy the demand. This method is the least desirable way of distribution; the power failure leads to complete interruption in water supply.

An advantage of direct pumping is that a large fire service pump may be used which can run up the pressure to any desired amount permitted by the construction of mains.

2.2.3.3 Distribution by means of pumps with storage

In this method an elevated tanks or reservoirs are used to maintain the excess water pumped during periods of low consumption, and these stored quantities of water may be used during the periods of high consumption. This method allows fairly uniform rates of pumping and hence is economical. (Steel, E.W. and T.J.McGhee, 1979).

2.2.4 Design of Distribution Networks

2.2.4.1 Hydraulics

The purpose of a system of pipes is to supply water at adequate pressure and flow. However, pressure is lost by the action of friction at the pipe wall. The pressure loss is also dependent on the water demand, pipe length, gradient and diameter. Several established empirical equations describe the pressure–flow relationship (Webber, 1971), and these have been incorporated into network modeling software packages to facilitate their solution and use. When designing a piped system, the aim is to ensure that there is sufficient pressure at the point of supply to provide an adequate flow to the consumer. For example, in England and Wales, water companies are required to supply water to a single property at a minimum of 10 m head of pressure at the boundary stop tap with a flow rate of 9 l/min (OFWAT, 1999). This minimum pressure increases as the number of properties supplied through a single service pipe (WHO, 2004).

2.2.4.1.1 Negative Pressures

Situations that may give rise to negative pressures should always be avoided. Faecal organisms and cultivable human viruses may be present in groundwater adjacent to a pipeline and drawn into a pipe during transient low or negative pressures (Le Chevallier et al., 2003).

Hydraulic models can be used to identify where, when and how negative pressures may occur. Preventative measures such as system reinforcement may then be identified and implemented.

Until such measures are effective, staff responsible for the daily operation of the network should be informed of these situations and hence where, when and how contamination of the network may occur. Such situations may occur where there are:-

- Properties on high ground.
- Remote properties at the end of long lengths of pipe.
- Demands that are greater than the design demand.
- Pipes of inadequate capacity (too small diameter).
- Rough pipes (e.g. corroding iron pipes or pipes with a build-up of sediment).
- Equipment failures (e.g. pumps and valves).

2.2.4.1.2 Appropriate pressures

Pressure at any point in the system should be maintained within a range whereby the maximum pressure avoids pipe bursts and the minimum ensures that water is supplied at adequate flow rates for all expected demands. This may require pressure boosting at strategic locations in the network (WHO, 2004).

In general Water distribution systems can be divided into four main components:

1. Water sources and intake works
2. Treatment works and storage
3. Transmission mains, and
4. Distribution network.

2.2.5 Sources and Treatment Works of Water Distribution System

Untreated water (also called raw water) may come from groundwater sources or surface waters such as lakes, reservoirs, and rivers. The raw water is usually transported to a water treatment plant, where it is processed to produce treated water (also known as potable or finished water).

The degree to which the raw water is processed to achieve portability depends on the characteristics of the raw water, relevant drinking water standards, treatment processes used, and the characteristics of the distribution system (Japan Water works Association, 1990).

Before leaving the plant and entering the water distribution system, treated surface water usually enters a unit called a clear well. The clear well serves three main purposes in water treatment. First, it provides contact time for disinfectants such as chlorine that are added near the end of the treatment process. Adequate contact time is required to achieve acceptable levels of disinfection**.** (Japan Water works Association, 1990). Second, the clear well provides storage that acts as a buffer between the treatment plant and the distribution system. Distribution systems naturally fluctuate between periods of high and low water usage, thus the clear well stores excess treated water during periods of low demand and delivers it during periods of peak demand. In the case of groundwater, many sources offer up consistently high quality water that could be consumed without disinfection.

2.2.6 Water Distribution Facilities

The distribution system can be classified into gravity type and pump boosting type, depending on the height relation between the service reservoir and the distribution area. If any proper high place is available in or near the distribution area, the service reservoir is located there to adopt gravity flow type, and if not available, pump-boosting type is adopted (Japan Water works Association, 1990).

The design distribution flow in the normal state is the maximum hourly distribution flow in the design daily supply of the design distribution area covered by each distribution pipeline, and is decided on the assumption that all the customers in the distribution are use water simultaneously at the time.

2.2.6.1 Service Reservoir

2.2.6.1.1 General

The two main functions of distribution reservoirs are to equalize supply and demand over periods of varying consumption and to supply water during equipment failure or for fire demand.

The location of service reservoir should be at the center of the distribution area or as close to it as possible, and if any proper high place is available, pipe distribution can be realized. If there is no high place, pump boosting type distribution is adopted.

It is usually economical to have equalizing reservoirs at various points in the distribution system so that main supply lines, pumping plants, and treatment plants can be sized for maximum daily instead of maximum hourly demand. During hours of maximum demand, water flows from these reservoirs to the consumers. When the demand drops off, the flow refills the reservoir. A mass diagram can be used to determine the required capacity of the reservoir. Equalizing reservoirs are usually built at the opposite end of the system from the source of supply, so that during peak flows the maximum distance from the supply to the consumer is cut in half. It is necessary for an equalizing reservoir to have an elevation high enough to provide adequate pressure throughout the system served. For the correct hydraulic grade, it is necessary to build the reservoir above the area it serves. If the topography will not allow a surface reservoir, a standpipe or an elevated tank must be constructed. **(**Jeffrey A. Gilbert, P.E.1992**)**

2.2.6.1.2 Type of Reservoirs

The two main types of reservoir are the ground level type (GLR) and elevated water tank type (EWT). Whenever the local topographical conditions permit, ground level reservoirs are preferable. Ground level reservoirs will be usually be of solid block masonry or reinforced concrete, cylindrical or rectangular but under special circumstances may be of glass reinforced plastic (GRP). Elevated tanks will be cylindrical or conical in reinforced concrete. (MWR, 2006).

2.2.6.1.3 Capacity

The capacity of a service reservoir must be decided base on the following conditions.

- ❖ The standard effective capacity shall be the 12-hour amount of the design maximum daily supply of the service area, and it shall be increased, considering the regional characteristics, the stability of water works facilities, etc.
- ❖ The amount of water to be added for firefighting shall conform to water for firefighting.

2.3 COMPUTERIZED HYDRAULIC MODELING

Most small communities do not have very complex networks as compared to cities; however, they have poor data and records regarding their systems. In such cases, when one has to evaluate the hydraulics and the water quality of the distribution systems, it is advantageous to use computer models. Computer models making use of hydraulic simulation software are capable of mimicking the behavior of a real time system and have the capability of predicting the performance of the same system for future 'what if' scenarios (Haestad Methods, 2003).

Some rural water districts that have the capability of maintaining and updating real time models, have used hydraulic simulation models in conjunction with geographic information systems, allowing them to perform criticality studies with greater precision (Zhang, ESRI Users Conference, 2009). This can be cost effective as it will provide decision support in operation and maintenance of their systems.

2.3.1 Advantages Of Computerized Network Analysis

2.3.1.1 Feasibility

The most important advantage of computer modeling is that it makes network analysis feasible. Without computerized techniques, analysis is slow and impractical, except for very simple systems. Before computerized network analysis, over design was the common reaction to uncertainty caused by the inability to accurately predict flows and pressures in a system. By providing reliable information, network analysis enables the user to more efficiently analyze, design, and plan water systems. (AWWA, 1989)

2.3.1.2 Cost

The cost of computer hardware and software is relatively small compared to the amount of money that can be saved by designing a water system efficiently and accurately. Water facilities are expensive, and the cost savings achieved through proper sizing and installation can range from thousands of dollars to millions of dollars. Efficient operating strategies developed through use of network analysis can also be used to minimize energy costs, thus increasing cost savings. (AWWA, 1989)

2.3.1.3 Socio-economic/Environmental Impacts

Several socio-economic and environmental considerations make network analysis a, standard utility tool. Increasing construction costs, combined with increasing population and consumption, make systematic analysis necessary to efficiently design, plan, and operate a system. Water-consumption-management plans can be used to save water and to redefine consumption patterns that lead to more efficient use of facilities. (AWWA, 1989)

2.3.1.4 To Enhance Computer Control System

Many utilities would like to move towards computer-controlled or, at least, computer-assisted real-time operation. Many utilities routinely use computer programs for off-line studies of operation and of capacity expansion. The trend towards real-time control is motivated by some or all of the following factors, in combinations that vary among systems.

- Operation of the existing system is becoming increasingly more complex. New facilities are added and the existing ones are further interconnected. Sources of different qualities, reliabilities, and costs are introduced. Demands increase, and it is more difficult to meet them reliably. All of these changes require system- wide, rather than local, considerations in the preparation of operating plans.
- Retirement of experienced operators, who often are not replaced by people of similar capability or experience.
- Aging systems fail more frequently, leading to difficult operational decisions that must be made quickly under stress.
- High operating costs justify investments in attempts to optimize.
- Control and computer hardware are rapidly becoming cheaper, more available, and reliable.
- Computer control systems in treatment plants, power systems, and water systems are becoming more common, providing experience from which to learn.
- Managers, engineers, and operators are more comfortable and less threatened by computers.
- Mathematical models, optimization algorithms, and control software have developed considerably in recent years. (AWWA, 1989)

2.3.2 Type of Hydraulic Modeling

Widespread introduction of personal computers has enhanced hydraulic design of distribution networks. Commercial programmes available on the market, sometimes even free of charge, enable a very precise and quick calculation, which makes them equally suitable for the design of simple rural systems or large urban networks of a few thousand pipes. Accessibility of such software and PCs to the engineers of developing countries has been significantly improved since the mid-nineties. There are different types of hydraulic models available for water supply distribution analysis and evaluation. They are as follows:-

2.3.2.1 EPANET

EPANET, the least expensive of the models presented in this research, is a free software package developed by the U.S. Environmental Protection Agency (EPA), originally and primarily for use as an evaluation tool by any party concerned with distribution system water quality.

EPANET operates in a Windows environment for model output viewing and manipulation. Although EPANET performs extended period simulations only, the program comes equipped to model such water quality phenomena as reactions within the bulk flow and reactions within the pipe wall. The program's solution algorithms are extremely fast, and the low-flow convergence problems inherent in node-oriented systems have been at least partially resolved with the hybrid method. The major drawback of EPANET as compared to commercial modeling programs is the use of the text editor for data input. Although EPANET lacks graphical input capabilities, the program provides attractive, color-coded output mapping. Despite its limitations, EPANET, as an overall modeling package for predicting head losses, pressures, and water quality in a distribution system, performs quite well.

2.3.2.2 WaterCAD

WaterCAD, produced and marketed by Haestad Methods of Waterbury, Connecticut, is a stand-alone hydraulic modeling program containing its own graphical editor and strong modeling capabilities that features a Windows-based interface to EPANET. WaterCAD can produce a distribution system network either scaled or schematically and with or without underlying DXF background maps. The resulting network can be color-coded to reflect modeling results, and WaterCAD also carries adequate annotation capabilities.

Some of WaterCAD's modeling features include a scenario management tool, fire flow and water quality analysis capabilities, and graphing and profiling of model results and system appurtenance characteristics. WaterCAD also can generate contour plots to demonstrate areas of high pressure, low fire flow availability, hydraulic grade line elevation, and many other pertinent system attributes. WaterCAD provides both steady state and extended period simulation analyses.

For data input and output, WaterCAD uses tables that are contained directly within the modeling environment, as opposed to a text-editing program. Data for populating the model with can be written to and output can be written from these tables using the database connectivity feature of WaterCAD. WaterCAD also has the ability to connect with Environmental Systems Research Institute, Inc.'s (ESRI's), GIS programs using the SHAPEFILE for model data import and export.

2.3.2.3 Cybernet

Cybernet, also produced and marketed by Haestad Methods, contains the same hydraulic modeling capabilities as WaterCAD, but can operate within AutoCAD for Windows; Cybernet is basically WaterCAD with the ability to operate in the AutoCAD environment. This operating mode provides the user with all of the capabilities of AutoCAD release 14, thereby allowing for graphical compatibility with other drawings produced within an organization. The AutoCAD environment gives the software much more graphical flexibility in producing high-quality graphical output, along with the modeling results.

2.3.2.4 H_2ONET

H_2ONET is a modeling program provided by MW Soft, Inc., a software subsidiary of Montgomery-Watson out of Pasadena, California, which features a Windows-based AutoCAD interface to EPANET. Like Cybernet, H_2O NET uses the AutoCAD release 14 environment to create network model drawings with all the capabilities of AutoCAD; however, H_2ONET requires AutoCAD and cannot operate as a stand-alone program.

H_2ONET provides a large range of modeling capabilities, including scenario management, fire flow modeling and fire hydrant analysis, and water quality analysis. Some of the features that set H_2ONET apart include a supervisory control and data acquisition (SCADA) interface, which allows for the extraction of real-time modeling data directly from a SCADA system in an ASCII format for use in model calibration and operator emergency response training; and an energy management module for use in identifying the most energy-efficient and cost-effective operational policies.

2.3.2.5 SynerGEE Water

SynerGEE Water, the new water modeling software from Stoner Associates, out of Carlisle, Pennsylvania, does not use the hybrid method of equations for solving the network analysis. SynerGEE uses the Newton-Raphson method and nodal (or H) equations. Because SynerGEE products have the ability to effectively model large, complex systems in excess of 100,000 pipes, the program historically has been used mostly by clients with large distribution systems. However, the advanced modules in SynerGEE 3.0 make the program attractive to a utility system of any size.

In general all of the programs discussed have comparable capabilities and features. For simple water distribution systems with only a few pressure zones, all of the programs produce similar results when presented with similar problems. Therefore, the model evaluation ultimately involves comparing the differences in the presentation of model results, both graphical and textual, and the additional capabilities or features that each package offers. Also, the hydraulic model selected should be easy to use. Tables 2.1 and 2.2 summarize the two mostly used model evaluation. Table 2.1 compares each model using the criteria, and Table 2.2 outlines the major advantages and disadvantages of each model.

Table 2-1 Model Comparison

	EPANET	**WaterCAD**
Range of Applications		
❖ Water Quality Analysis Capabilities	Yes	Yes
❖ Fire Flow Analysis Capabilities	No	Yes
❖ Ability to Establish Open Links with Database Software	No	Yes
❖ Links to SCADA system	No	No
❖ Links to Geographical Information Systems (GIS)	No	Yes
Documentation Capabilities		
❖ Diagnostic Messaging Capabilities	Yes	Yes
❖ On-Line Help Service	Yes /No	Yes
❖ Documentation Capabilities for Individual System Components.	No	Yes
Graphical Display Capabilities		
❖ Clear Annotation of Model Components	Yes /No	Yes
❖ Site Layout Capabilities	Yes /No	Yes /No
❖ Graphing/Profiling of System Components/Model Results	Yes	Yes
❖ Contour Plots of Model Result Areas	Yes /No	Yes
Ease of Use		
❖ Scenario Management Capabilities	No	Yes
❖ Software User Support	No	Yes
❖ Windows Environment	Yes	Yes
Notes :- Yes/ No - Yes, but with limited functionality		

Table 2-2 Model Advantages and Disadvantages

Modeling Software	Advantages	Disadvantages
EPANET	❖ Free Software	❖ Inadequate Software Support ❖ No Scenario Management ❖ Text Editor for Data Input ❖ Y2K Compliance unknown
WaterCAD	❖ Relatively low pricing for capabilities. ❖ Scenario Management ❖ "Flex Tables" for Data Input/Output/Manipulation ❖ Good reputation in the industry for user support ❖ Ease of Use ❖ Links to GIS ❖ Passed Y2K compliance	❖ Map printing capabilities directly from program are not as strong as AutoCAD-based programs.

2.3.2.5.1 Principles of Network Hydraulics

In networks of interconnected hydraulic elements, every element is influenced by each of its neighbors; the entire system is interrelated in such a way that the condition of one element must be consistent with the condition of all other elements (Walski et al., 2003) . According to (K. Swamee and Sharma, 2009; E. Larock and et al., 2000; EPA, 2005; Walski et al., 2003; W. Mays, 2000) interconnections of hydraulic elements are defined in concepts of conservation of mass and energy.

2.3.2.5.1.1 Conservation of Mass

‘The principle of conservation of mass dictates that the fluid mass entering any pipe will be equal to the mass leaving the pipe (since fluid is typically neither created nor destroyed in hydraulic systems). In network modeling, all outflows are lumped at the nodes or junctions’ (Walski etal.2003).

$$\sum_{pipes} Qi - U$$

Where, Qi = inflow to node in i-th pipe (L^3/T)

U = water used at node (L^3/T)

The term for accumulation of water at nodes is required to describe stored and withdrawn water from tanks, while extended period simulation is regarded (Walski et al., 2003).

$$\sum_{pipes} Qi - U - ds/dt = 0$$

Where, dS/dt = changes in storage (L^3/T)

2.3.2.5.1.2 Conservation of Energy

'The principle of conservation of energy dictates that the difference in energy between two points must be the same regardless of the path that is taken' (Bernoulli, 1738 cited in Walski et al., 2003).

$$P_1 / \gamma + z_1 + V^2{}_1 / 2g + = P_2 / \gamma + z_2 + V^2{}_2 / 2g + hl$$

Where:

- P = the pressure (Ib/ft^2 or N/m^2)
- γ = the specific weight of the fluid (Ib/ft^3 or N/m^3)
- z = the elevation at the centroid (ft or m)
- V = the fluid velocity (ft/s or m/ s)
- g = gravitational acceleration (ft/s^2 or m/ s^2)
- hl = the combined head loss (ft or m)

Therefore, in connected network the difference in energy at any two point is equal to the energy increases from pumps and energy losses in pipes (frictional head loss) as well as energy losses in bending and fittings (minor head loss) that occur in the path between them.

There are three forms of energy:

- Pressure head - p / γ
- Velocity head - $V^2 / 2g$
- Elevation head – z

2.3.2.5.2 Head Loss

The total water loss in a distribution pipe and pipe fittings between two points of consideration is called head loss. There two types of head losses.

2.3.2.5.2.1 Surface Resistance

Head loss on the account of surface resistance, friction loss depends on:

- Pipe length.
- Coefficient of surface resistance, friction factor.

2.3.2.5.2.2 Form Resistance

The form-resistance losses are due to bends, elbows, valves, enlargers, reducers, and so forth categorized as minor loss.

2.3.2.5.2.3 Head Loss Equations

Hazen-Williams equation and the Darcy-Weisbach equation are the most commonly methods used for determining head losses in pressure piping systems.

2.3.2.5.2.4 Hazen-Williams Equation

The most frequently equation used in the design and analysis of water distribution networks, it was developed by the experiment and used only for water within temperatures normally experienced in potable water systems.

$$h_L = \frac{6.79L}{D^{1.16}}\left(\frac{V}{C}\right)^{1.85}$$

Where:-

- h_L = Head loss in meter of water column
- V = Average Velocity (m/s)
- C = Hazen-Williams roughness coefficient (-)
- L = Length of considered pipe section (m)
- D = Diameter of pipe (m)
- Q = discharge (Flow) through pipe (m3/s)

2.3.2.5.2.5 Darcy – Weisbach (Colebrook-White) Equation

This equation is a theoretically based equation, and its common use in the analysis of pressure pipe systems. For any flow rate and any incompressible fluid. It can be applied to open channel flow (free-surface flow).

$$h_L = \lambda \frac{L}{D} \frac{V^2}{2g}$$

Where

- ❖ h_L = Head loss in meter of water column, mwc
- ❖ l = Darcy-Weisbach Friction factor (-)
- ❖ L = Length of considered pipe section (m)
- ❖ D = Diameter of pipe (m)
- ❖ V = Velocity of flow through pipe (m/s)
- ❖ g = Acceleration due to gravitational force (m/s2)
- ❖ Q = discharge (Flow rate) through pipe (m3/s)

Because of non-empirical origins, the Darcy-Weisbach equation is viewed by many engineers as the most accurate method for modeling friction losses. However, the Hazen Williams formula is widely used for manual design and analysis of a pipe line system for its less complexity than Darcy Weisbach.

In any case, the end result of any design is to select and quantify appropriate and economical pressure pipes and fittings that can deliver the required quantity of water and pressure to consumers provided that all other design criteria are met.

2.3.2.6 Water Distribution Simulation

Simulation refers to the process of imitating the behavior of one system through the functions another. In our case, the term simulation refers to the process of using a mathematical representation or real system, called a model.

Simulation can be used to predict system responses to under a wide range of conditions without disrupting the actual system, and solutions can be evaluated before time, money, and materials are invested in a real-world project.

There are two most basic types of simulations that a model may perform, depending on what the modeler is trying to observe or predict. These are:

- Steady state simulation.
- Extended period simulation (EPS).

2.3.2.6.1 Steady State Simulation

It computes the state of the system (flows, pressures, pump operating attributes, valve position, and so on) assuming that hydraulic demands and boundary conditions do not change with respect to time.

A steady-state simulation provides information regarding the equilibrium flows, pressures, and other variables defining the state of the network for a unique set of hydraulic demands and boundary conditions.

Steady-state models are generally used to analyze specific worst-case conditions such as peak demand times, fire protection usage, and system component failures in which the effects of time are not particularly significant.

2.3.2.6.2 Extended Period Simulation

Extended period simulation tracks a system over time, and it is a serious of linked steady state run.

The need to run extended period simulation is because the system operations change over time.

- Demands vary over the course of the day.
- Pumps and wells go on and off.
- Valves open and close.
- Tanks fill and draw.

Simulation Duration: An extended-period simulation can be run for any length of time, depending on the purpose of the analysis. The most common simulation duration is typically a multiple of 24 hours, because the most recognizable pattern for demands and operations is a daily one.

Hydraulic Time Step: An important decision when running an extended-period simulation is the selection of the hydraulic time step. The time step is the length of time for one steady-state portion of an EPS, and it should be selected such that changes in system hydraulics from one increment to the next are gradual. A time step, too large may cause abrupt hydraulic changes to occur, making it difficult for the model to give good results. Using an EPS model we can simulate based on the peak, minimum and average day demands.

2.3.2.7 Hydraulic design parameters

The main hydraulic parameters in water distribution networks are the pressure and the flow rate, other relevant design factors are the pipe diameters, velocities, and the hydraulic gradients.

2.3.2.7.1 Pressure

The pressure at nodes depends on the adopted minimum and maximum pressures within the network, topographic circumstances, and the size of the network.

The minimum pressure should be maintained to avoid water column separation and to ensure that consumers' demands are provided at all times. The maximum pressure constraints results from service performance requirements such fire needs or the pressure –bearing capacity of the pipes , also limit the leakage in the distribution system , especially that there is a direct relationship between the high pressure and the increasing of leakage value in the system.

2.3.2.7.2 Flow rate

It is the quantity of water passes within a certain time through a certain section.

Velocity is directly proportional to the flow rate. For a known pipe diameter and a known velocity, the flow rate through a section can be estimated.

Low velocities affect the proper supply and will be undesirable for hygienic reasons (sediment formation may cause due to the long time of retention).

2.3.3 Model Calibration

A hydraulic network model calibration is necessary to take into account the physical changes that may occur in the network. Calibration includes the determination of network parameters (pipe roughness coefficients and nodal demands). The parameters are often not exactly known and very much sensitive to the age of the pipe which necessitates periodical measurement for optimal management of water delivery systems. Therefore, the parameters are determined through model calibration. Since the manual calibration is very time consuming and tedious, an automatic calibration technique is used.

In the calibration process, the parameters are adjusted so that the simulated pressure, pipe flow and tank level mimic the measured field value. Several studies (Ormsbee, 1989; Lansey and Basnet, 1991; Ferreri et al., 1994; Lingireddy and Ormsbee, 1998; Vitkovsky et al., 2000; Lingireddy and Ormsbee, 2002) have been carried out to establish an automatic calibration scheme. The main aim is to develop a robust, efficient and reliable automatic procedure that maintains close resemblance between the model output and the field results.

3. DESCRIPTION OF THE STUDY AREA

3.1 BACKGROUND

Adama was founded in the year 1917 at its current place. Its name was derived from Afan Oromo "**Adami**" which means highly dominated by cactus trees.

The history of Adama as an urban centre begins with the emergence of the Addis Ababa-Djibouti railway which passes through the town. The first houses were the railway station and the dwellings of the railway workers. The indigenous people started to settle to exchange goods and services with railway workers and passengers.

Adama became the capital of Yerer and Kereyu Province in 1946 and its name was changed from Adama to Nazret. It regained its native name "Adama" following the establishment of Oromia Regional State and became the capital town of East Showa Zonal Administration.

At present the town is the capital city of Adama special zone Administration. It is also one of the largest cities of the region as well as the country with a total population of around **373,600.**

3.2 PHYSICAL FEATURES

3.2.1 Location And Accessibility

Adama town is located about 100 km South-East of Addis Ababa. It is situated in the Great Rift Valley on relatively flat lowland between two mountain ridges. The Geographical location of the town ranges from $8^0$27.5'N-$8^0$35.7'N and $39^0$13.5'E-$39^0$19'E (see the location of Adama on Ethiopia, Figures 3.1).

The town is accessible by a good asphalt road (Express way) from Addis Ababa. It is also accessible by asphalt and better gravel roads from West, East, and North and South directions of the country because of its strategic setting at a junction of roads leading to those areas.

3.2.2 Topography

Topography of Adama town varies from ground elevations of 1,595masl to 1,740masl. The southern central part of the town constitutes the lowest areas with ground elevation ranging from 1595masl to 1630masl.

Areas with higher altitudes are found from the central to the northern and on the southern verges of the town. The altitude of these areas varies from 1630masl to 1740masl.

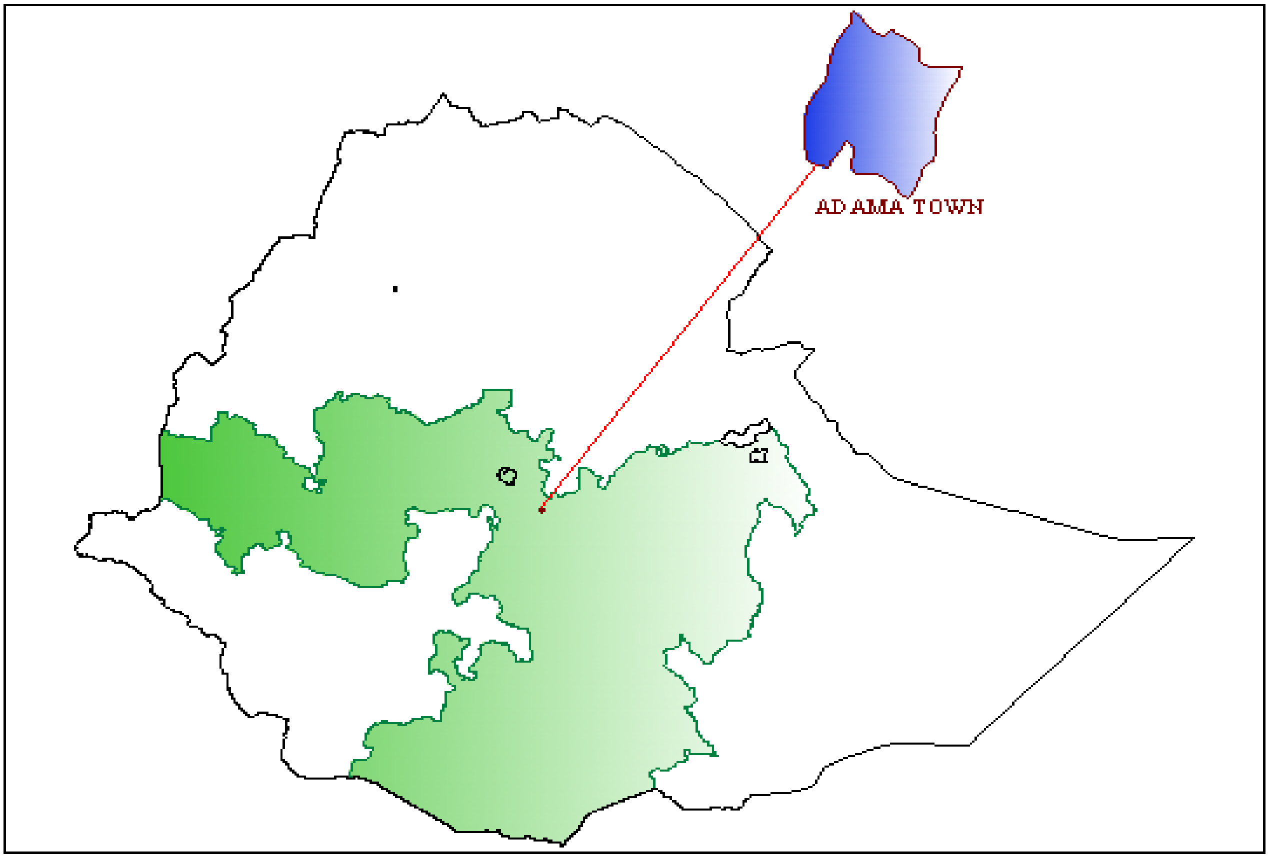

Figure 3-1 Location Map of Adama Town

3.2.3 Climate

Adama town is located in the Grit Rift Valley of tropical climatic zone. There are four climatic seasons, Gena/Kremt, (rainy period) Bona/Bega, (dry period) Belg (small rains) and Meher (a spell between the long and small rains).

The daily temperature varies between 5.5^{o}c during November/December and 35^{o}c during March to May. The mean annual ambient temperature is between 19 ^{o}c and 22 ^{0}c. Maximum temperatures usually occur in March to May. The mean monthly maximum exceed 30 ^{0}c. Minimum temperatures are at their lowest in November.

The mean annual rainfall for the years 1995-1998 is 822.5 mm. The wettest months are July and August. The average amount of rainfall in July is 230 mm and in August 200 mm.

3.3 EXISTING WATER SUPPLY SYSTEM

Adama town has a modern water supply system which is managed by Enterprise and Board of administration. The system was commissioned and inaugurated in November 2002.

The system was designed and implemented to cover the water demand of the town in two phases. As the 1st phase design of the system has almost being completed by the end of 2013; implementation of the second phase of the project should be required.

The Existing design capacity of the water supply system is 330l/s. At present the system is serving both Adama and Wonji towns with a population of more than 400,000 which is by far more than its capacity. The existing Water Supply System Components are summarized in the following sections. (OWWDSE, 2011)

3.3.1 Water Supply Source

At present the principal source of drinking water for the town of Adama is River Awash, located west of the town, about 11 km from the town (Figure 3.1). It is also noted that the old sources were groundwater obtained from the Melka Hidda source (Table 3.1) and also from other wells around the town (Table 3.2). According to the data the entire boreholes is now closed due to excess fluoride content.

Table 3-1 Ground Water from Melka Hidda Source

No	Casing (inch)	Drilling period	Depth (m)	Q, l/s	Riser (inch)	Fluoride [F-] (mg/lt)	Rehabilitation
1	10	---	36	7.7	2	2.4-2.9	
2	6	---	59	4.8	2	Na	
3	10	1954	68	6	2	Na	
4	8	1954	69	6	2	Na	1961
5	8	1968	80	8	2	Na	1964
6	8	1967	80	6	2	5.3	1966
7	8 ½	1972	80	7	3	5.5	1968
8	8	1979	82	6	3	Na	1978
9	8	1979	56	6	3	-	1978
10	10	1957	145	2	-	7.75	

Source:-Adama Town Water supply improvement Report 2013

N.B:- Na means not available (no data).

Table 3-2 Ground Water Source around the Town

Well No.	Depth (m)	Q(l/s)	$[F^-]$, mg/l	Remarks
Old RRC well	180	4	Na	Hot water, 35 ^{0}c
Old RRC well	180	5	na	Hot water, 35 ^{0}c
Old RRC well	-	-	-	Hot water
Yilma Dheressa well	134	4	na	Dedicated to urban farms
Kebele 02, Beggo Adragot well	180	4	na	
Dhakaa Adii	246	2	Na	
(Horsisa Lakku)				
Kebele 03 well		-	-	University community

Source Adama Improvement Report final.

N.B:- Na means not available (no data)

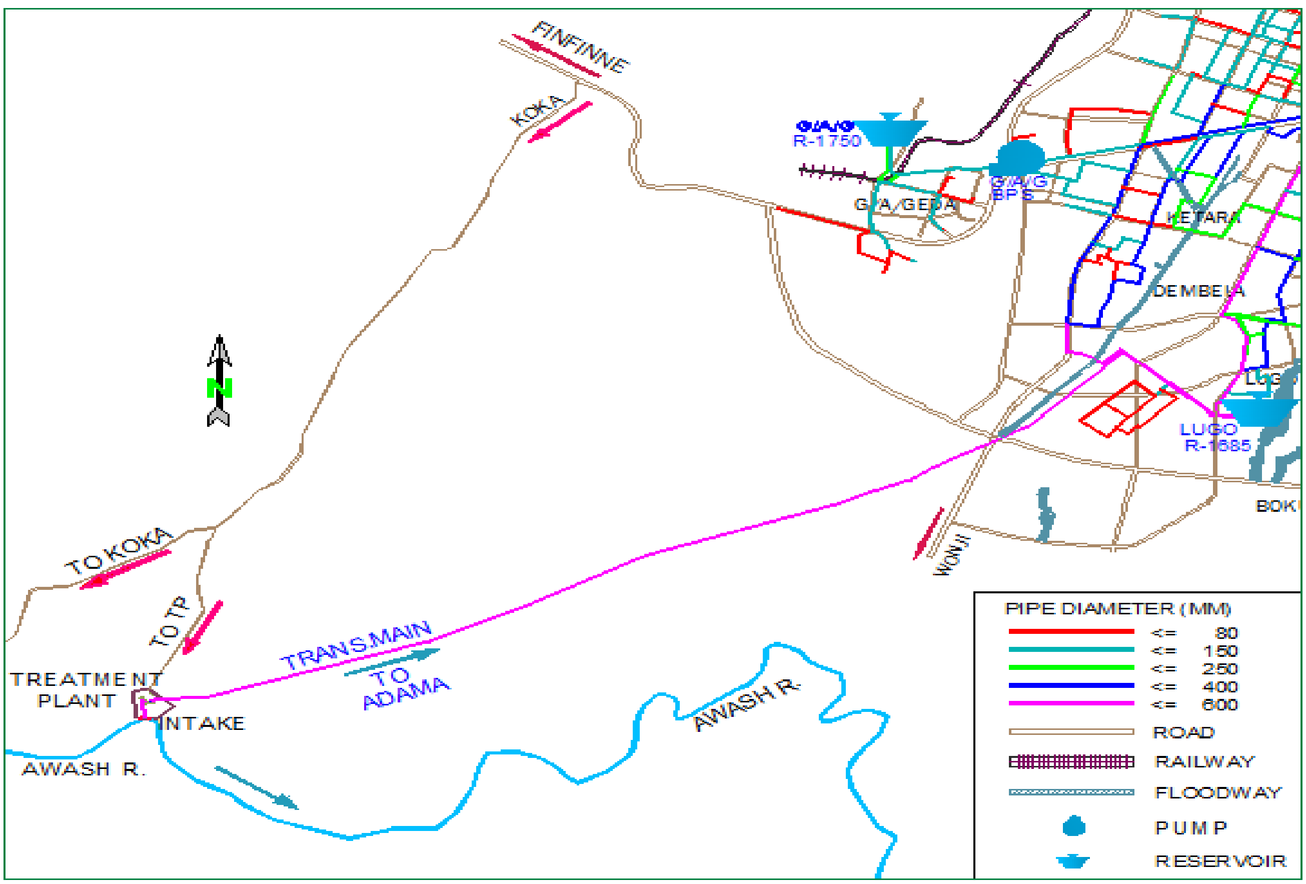

Figure 3-2 General Layout of Source and Transmission line

3.3.2 River Intake and Raw Water Pumping Station

The raw water intake is a type of Concrete River Side Box located at the left bank of Awash River. The design capacity of the river intake is 330/s for phase I and 550 l/s for phase II.

The intake consists of four openings through which water are conveyed to the raw water pumping sumps .The water is then lifted from these sumps to the treatment plant located at 200m with seven submersible pumps.

The maximum and minimum water levels are set at 1,538 masl and 1,536 masl respectively. The intake and raw water pumping station comprise of the following Major Electro Mechanical Equipment (EME) (See Table 3.3 and Plate 3.1).

Plate No. 3-1 River Intake and Raw Water Pumping Station

Table 3-3 Intake and Raw Water Pumping Station EM Data

No	RAW WATER INTAKE AND PUMPING STATION	
1	**Submersible Pumps**	
	Quantity	8 (7 duty, 1 standby)
	Flow	169.7 m^3 per hour (47.14l/s)
	Head	30 m
2	**Pipe work, Valves & Accessories**	
	Each delivery line	comprises of 150 DN Mild steel pipe work and pipe supports, with swing type check valves and RSV Isolating Valves
	Delivery manifold	Each 150 DN line is tied into a common 450 DN-delivery manifold (sized for future duty of 550 L/sec).

3.4 WATER TREATMENT PLANT

3.4.1 Treatment Process

The treatment process follows the following steps:

- Pre-Chlorination,
- Rapid Mixing
- Flocculation,
- Clarification,
- Filtration,
- Disinfection,
- Final pH Adjustment.

3.4.2 Inlet to Treatment Plant and Rapid Mixing

For the inlet to the Treatment Plant a 600 DN stainless steel puddle flange for connection to the raw water Rising Main are installed. Flow from the raw water pump station enters a division box through a 600 DN stainless steel puddle pipe flanged to BS 4505 T10 which allows a 330/220 l/sec split between the existing works and any future extension. The puddle pipe is sized for the future extension rising main to this inlet puddle flange. The division box is intentionally lifted to allow sufficient head for flow through the plant. The flow between stage one and future could be fine-tuned by an adjustable weir plate.

3.4.3 Clarifiers

Six up flow sludge blanket (USB) type clarifiers are installed for sedimentation of flocs. The clarifiers have 9m x 9m dimensions at the water surface giving an upward velocity of 2.44 m/h at a plant flow rate of 330 l/sec. These clarifiers are designed to hydraulically pass the maximum flow rate of 514 l/sec when one clarifier out for maintenance. The clarifier data have been summarized in Plate 3.2 and table 3.4 below.

Plate No. 3-2 USB Clarifier

Table 3-4 Data of Installed Clarifiers.

CLARIFIER	
Number of USB Clarifiers	6
Size of Each Clarifier	9m x 9m dimensions at the water surface
upward velocity	2.44 m/h at a plant flow rate of 330 l/sec
Maximum Design Capacity	maximum flow of 514 l/sec when one clarifier out for maintenance
Pipes and fittings	DN 400 inlet feed pipe

Plate No. 3-3 Partial View of Treatment Plant.

3.5 WATER TRANSMISSION FACILITIES

The water Transmission system includes the following important system components.

1. Clear Water Pumping Station.
2. The Clear water Transmission Main

3.5.1 Clear Water Pump Station

Eight Clear Water KSB High Pressure Centrifugal Pumps (7 duties, 1 standby). Model WKLn 125/5 (5 stage), fitted with 110 KW Motors, are supplied by KSB Pumps (S.A.) (Pty) Limited are installed.

Plate No. 3-4 **Partial View of Clear Water Pump Station**

These pumps have been provided for the first stage duty and not for the second stage duty, which contain 8 surface pumps (see the detail on table 3.5). All pumps, pipe work, valves and electrical switchgear will have to be removed and replaced with equipment to suit the future duty.

Table 3-5 Data of Installed Pumps

Clear Water Pump Station	
Quantity	8 (7 duty, 1 standby)
Make	KSB
Model	WKLn 125/5 (5 stage)
Flow	154.3 m3 per hour (42.86 l/s)
Head	145m
NPSH required	3.3 m
Operating speed	1480 rpm
Shaft seal	Packed Gland
Discharge Flange	125NB (Vert) DIN 2533/16
Suction Flange	150NB (End) Din 2533/16
Installed Power	110 KW
Absorbed Power	96.79 KW
Enclosure	IP 55
Voltage	380V/3 Phase / 50 Hz

3.5.2 The Clear water Transmission Main (CWTM)

The CWTM was designed to convey the phase II maximum day demand of 550 l/s from the CW Pump station of average elevation of 1560 masl to Lugo service reservoir 1685 masl as shown in Figure below. The transmission main has a nominal diameter of 600 mm of DI pipe and a total length of around 10.6 km. As it has been laid across gullies and flood routes, around 11 (eleven) large and medium span gulley crossing structures and anchor blocks are built for protection of pipes. See figure 3.2 for layout of transmission line.

3.6 WATER DISTRIBUTION FACILITIES

3.6.1 General Description

The water distribution system includes the following significant system components.

1. Service reservoirs which are used for balancing the variable demands of the town.
2. The distribution network which distributes water to customers through its primary, secondary and tertiary components with a flow of gravity.
3. Booster pumping Stations which are pumping water to the higher levels of the town where gravity flow could not achieved by lower reservoirs.

As mentioned earlier, the topography of Adama town varies from ground elevations of 1,595 to 1,740 masl. This topographic configuration of the town has necessitated dividing the distribution system into 5 (Five) separate pressure zones as listed on table 3.6.

Table 3-6 Existing and New Supply Zones

N.o	Operational Supply Zone	Status
1	LUGO	Existing
2	ADAMA UNIVERSITY	Existing
3	GELMA ABA GADA	Existing
4	BOKU	New
5	DHAKA ADI	New

The water pumped from Awash River of Clear pump station enters into Lugo Reservoir which is the main storage and supply zone of the town.

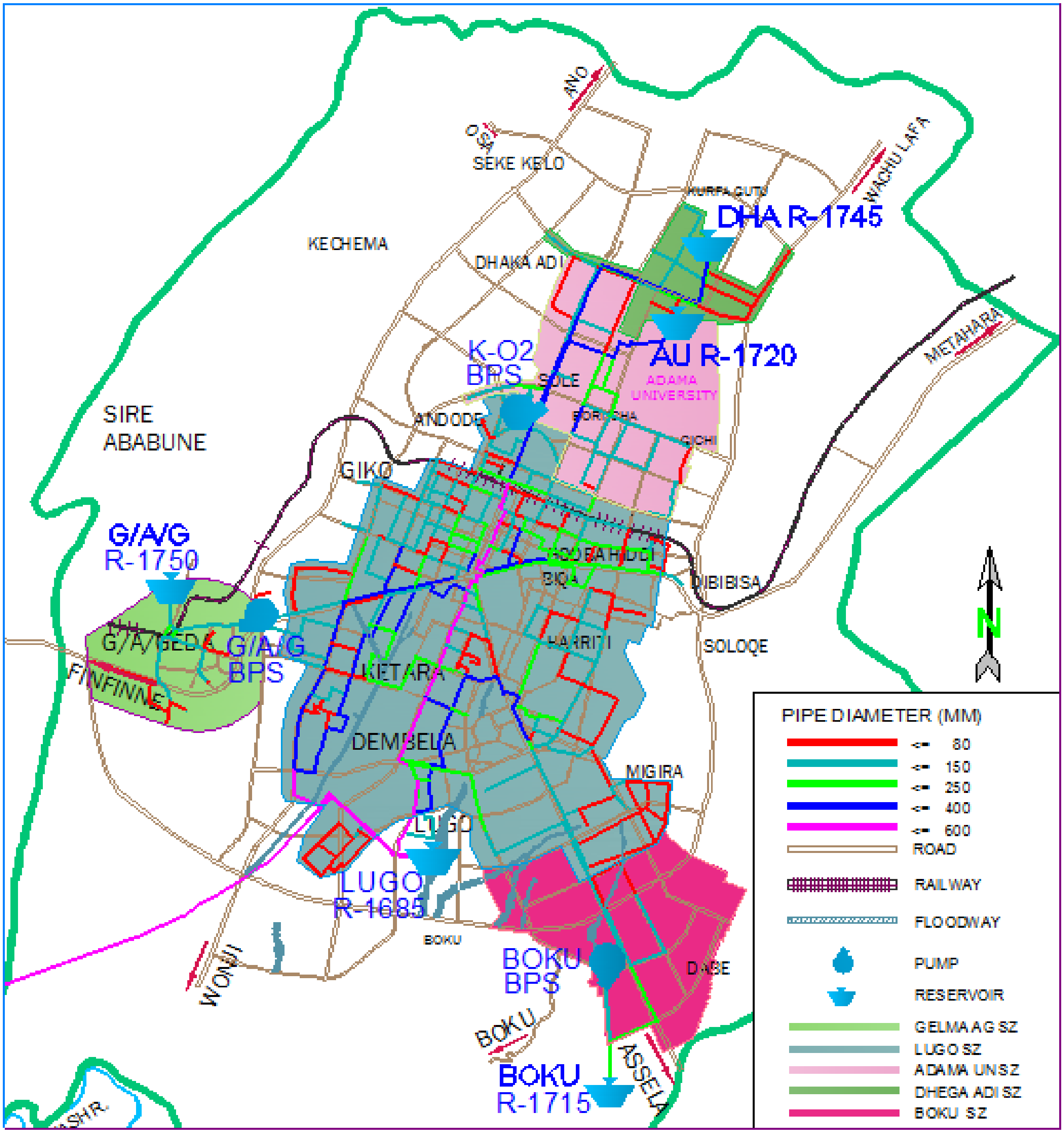

Figure 3-3 Layout and Supply Zones of Distribution System

Source:-Adama town water supply feasibility study report AutoCAD data.

3.6.2 Reservoirs

3.6.2.1 Locations of Reservoirs

It has been mentioned that the distribution system has been divided into 5 pressures zones. Each supply zone has been commanded and governed by the location and ground level of respective reservoir. In general 7 (seven) existing and recently constructed reservoirs are found. Their respective locations have been summarized and presented in table 3.7.

Table 3-7 Location of Reservoirs

No	Name	Ground Level (Masl)	Size(m^3)	Location	Remark
1	Lugo Reservoir-1	1685	2000	Northern	Existing
2	Lugo Reservoir-2	1685	4000	Southern	Existing
3	Adama University Reservoir	1720	1000	North Eastern	Existing
4	Dhaka Adi Reservoir	1745	1000	North Eastern	New
5	Boku Reservoir	1715	500	South Eastern	New
6	Gelma Aba Gada Reservoir	1750	200	Western	Existing
7	Kebele 02 Reservoir	1650		Central	Booster Ps

3.6.3 Distribution Network

3.6.3.1 Description of the Network

The existing and under construction distribution Systems covers around 50% or 2575 hectares of Adama Town. The network configuration is a combination of both branched and looped type. However a looped system is dominating due to the convenient plan of the town. The general layout of the distribution system has been presented in Figure 3.4.

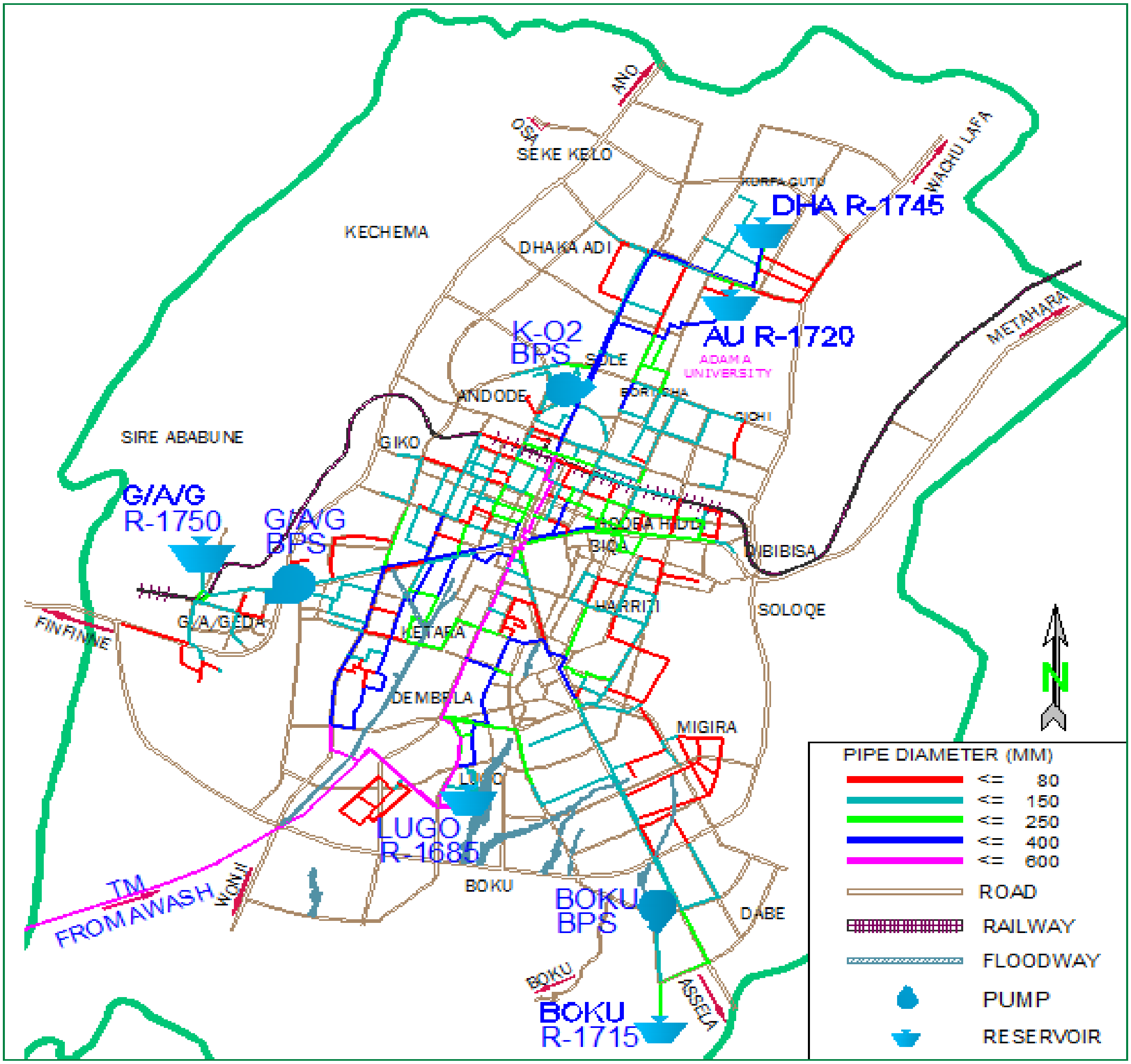

Figure 3-4 Layout of Distribution System

The total length of existing network is around 153.70 km. The total estimated quantities of existing and pipes new constructed are summarized in table 3.8.

Table 3-8 Quantities of Existing Pipe Network

ITEM NO	DIAMETER, DN (mm)	LENGTH (m)
1	40	870
2	50	11,020
3	65	1,440
4	80	23,770
5	100	22,530
6	150	30,670
7	200	23,480
8	250	390.
9	300	17,940
10	400	3,300
11	500	3,880
12	600	14,410
Total		**153,700**

As described in table 3.8, 30,670m of the system contains pipe of 150mm. This figure is relatively high when compared to 23,770, 23,480 of 80mm and 200mm pipe diameter respectively. A single pipe of 250mm diameter is the lowest. It is only 390m

4. RESEARCH METHODOLOGY

This chapter discusses in detail the steps taken to construct the model of the existing water distribution system of the town of Adama. The steps were:

- Modeling Tools
- Source of data and method of data collection
- Method of Data analysis
- Way of model calibration and validation.

4.1 MODELING TOOL

Water distribution network mathematical models have become increasingly accepted within the water industry as a mechanism for simulating the behavior of water distribution systems. They are intended to replicate the behavior of an actual or proposed system under various demand loading and operating conditions. Their purpose is to support the decision-making processes in various utility management applications including planning, evaluation design, operation, and water quality improvement of water distribution systems.

The hydraulic simulation software used for this study is WaterCAD distribution Systems. Water CAD was selected due to ease of model building and operation and its greater programming capabilities as compared to EPANET. The other reason why Water CAD is a powerful, easy-to-use is:-

- Ability to Establish Open Links with Database Software.
- Links to Geographical Information Systems (GIS).
- Scenario Management Capabilities.
- Used for firefighting flow and constituent concentration analyses, energy consumption and capital cost management.
- Software User Support.
- Popular for water supply design.

Water CAD provides sensitive access to the tools needed to model complex hydraulic situations. Some of the key features allow us to:

- ❖ Perform steady state and extended period simulations.
- ❖ Analyze multiple time-variable demands at any junction node.
- ❖ Quickly identify operating inefficiencies in the system.
- ❖ Perform hydraulically equivalent network skeletonization including data scrubbing, branch trimming, and series and parallel pipe removal.
- ❖ Efficiently manage large data sets and different "what if" situations with database query and edit tools.

4.2 SOURCE OF DATA

I. System Maps

System maps are typically the most useful documents for gaining an overall understanding of a water distribution system because they illustrate a wide variety of valuable system characteristics. System maps may include information such as:-

- ❖ Pipe alignment, connectivity, material, diameter, and so on.
- ❖ The locations of other system components, such as tanks and valves.
- ❖ Pressure zone boundaries.
- ❖ Elevations.
- ❖ Miscellaneous notes or references for tank characteristics.
- ❖ ·Background information, such as the locations of roadways, streams, planning zones, and so on.

For this study system maps were collected from Oromia Water, Mineral and Energy Bureau and Oromia Water Work Design and Supervision Enterprise.

II. Topographic Maps

A topographic map uses sets of lines called contours to indicate elevations of the ground surface. Contour lines represent a contiguous set of points that are at the same elevation and can be thought of as the outline of a horizontal "slice" of the ground surface. For this study topographic maps of Adama Town were used to extract the elevation of nodes.

III. Existing Population

Data on existing and future population of the project has been estimated on the information obtained from CSA. In general, the population of the water supply project encompasses:

- Population residing in Adama town.
- Population residing in Wonji town and Wonji Sugar Factory.
- Floating Population.
- Rural villages found in and around Adama town and
- Those rural Villages are living along the transmission mains of the project.

For this study population data for Wonji town, Floating population, and rural village found in and around Adama town and rural village living along transmission main were collected from Adama town water supply feasibility study by Oromia Water Work Design and Supervision Enterprise.

Additional data collected includes: reservoir data, source data, Pump data, and Valve data.

4.3 METHOD OF DATA ANALYSIS

The physical characteristics of the system were represented in the model by nodes and pipes (or 'elements'). The nodes, joined together by pipes, represent: pipe junctions, changes in pipe diameter and the locations of system attributes such as valves and of large demands. The node and pipe data sets contain geographic co-ordinates, ground levels, basic demand information, internal diameter and friction coefficients, pump curves, service reservoir type and valve.

Water demand was allocated to the node nearest to its draw off point. Nodal demands were distributed based on population estimates served by the nodes; with considerations of leakage and pattern of use.

4.3.1 4.3.1 Population Projection

It is essential that the water supply system is designed to meet the requirements of population expected to be living in the town at the end of the design period taking into account of design period and annual growth rate.

Estimates for the future population of the project are based on Growth Rate -Based on 2007 CSA Analytical Report. Population projections have been made using medium variant growth rates as shown below in table 4.1 and equations respectively.

Table 4-1 Population Growth Rate

Variant	Year						
	1995-2000	2000-2005	2005-2010	2010-2015	2015-2020	2020-2025	2025-2030
Low	5	4.3	4.3	4.1	4	3.8	3.5
Medium	**5.1**	**4.7**	**4.6**	**4.4**	**4.2**	**4**	**3.8**
High	5.3	5.2	5	4.8	4.7	4.5	4.4

Geometric Increase method of population forecasting has been adopted for this research. Because this, method is mostly applicable for growing towns and cities having vast scope of expansion, like Adama town.

$$P_n = P_o(1 + 0.01r)^n$$

Where

P_n = Design population (after n years)

P_p = Present population (at the start of design period)

r = Annual population growth rate in %

n = Design period in years.

4.4 WATER DEMANDS

4.4.1 General

A fundamental consideration for planning and designing of any water supply system or its component parts is an estimate of the amount of water expected to be used by the customers on the system.

The total water requirement of a project is normally estimated by its uses for domestic purposes such as drinking, cooking, ablution, washing clothes and utensils and cleaning houses, and for non-domestic purposes such as public, commercial, industrial and fire fighting institutions, and livestock watering. In addition unaccounted for water should be considered while calculating the total water requirement of the system. The following sub sections outline how to calculate the total water demand of the project.

4.4.2 Domestic Water Demand

As earlier, domestic water demand includes water used for basic needs such as drinking, cooking, ablution, washing clothes and utensils and cleaning houses. The average amount of water used per person per day varies from country to country as well as from place to place within a country.

The major important factors for these variations are:

- Level of water supply services
- Per-capita per day water consumption
- Climatic conditions
- Level of socio economic development
- Affordability and willingness of people to pay for water supply services
- Water Quality Standard and etc.

4.4.2.1 Level of Water Supply Services

As mentioned above the level of a water supply service greatly affects the water demand of the users. If the level of service is excellent like house connection, the demand for water is also very high due to its multipurpose such as toilet flushing, laundry machines and bathing rooms. The water demand of the users decreases as the level of the water supply service decreases and vice versa.

Consequently, the following common three types of service levels have been adopted for designing water supply projects.

1. House Connections (HC);
2. Yard Connections (YC); And
3. Public Fountains.

4.4.2.2 Per capita Water Demand

The amount of water used per person per day for daily life and activity is known as Per capita water demand which uses as a base for estimating the domestic water demand of customers. It is normally a function of the daily basic needs but should be adjusted by socioeconomic development and climatologic factors.

Taking into account the socioeconomic study of the town and experience of similar projects the Per capita water demand of the town is presented in tab Table below.

Table 4-2 Percapita Water Demand of the Town (Liter per Day)

Purpose of water	Year					
	2015			**2025**		
	HC	**YC**	**PF**	**HC**	**YC**	**PF**
Drinking	1.5	1.5	1.5	1.5	1.5	1.5
Cooking	5.5	4	3.5	5.5	4	4
Ablution	10	8.5	6	12	9	7.5
Washing Utensils	5	5	2	6	5	2.5
Laundry	15	8	7	13	10	7
House Cleaning	4	3	0	5	5	2.5
Bath or shower	15	10	0	20	12	
Toilet	4		0	12	3.5	0
Other						
Total	**60**	**40**	**20**	**75**	**50**	**25**

4.4.2.3 Climatic and Socio- Economic Adjustment Factors

As mentioned in the aforementioned section the water used by a person normally depends on the climatic and socioeconomic conditions of the area. This means water is more used at hot areas than cold ones. In addition reach people consume more water than the poor ones. These are adjusted by multiplying the adjustment factors with total domestic demand. Climatic and Socio-economic Condition Adjustment Factors are presented in the following two tables respectively.

Table 4-3 Climate Adjustment Factors

Group	Mean Annual Precipitation (mm)	Factor
A	600 or less	1.1
B	601-900	1.05
C	901 or more	1

Source: - OWWDSE, 2011

Table 4-4 Socio-Economic Adjustment Factors Climate Adjustment Factors

Group	Description	Factor
A	Towns enjoying high living standards and with high potential for development	1.1
B	Towns having a very high potential for development, but lower living standards at present	1.05
C	Towns under normal Ethiopian conditions	1
D	Advanced rural towns	0.9

Source: - OWWDSE, 2011

The mean annual precipitation of Adama Town is around **822.5mm**. This situation could categorize the project area under **Group B** with climatic adjustment factor of **1.05.** Socio-economically, the town can be grouped under "**Towns having a very high potential for development, but lower living standards at present"** with Socio-economic adjustment Factor of **1.05**.

Therefore, the combined Climatic and Socio-Economic adjustment factor of the town is **1.1**

4.4.3 Non Domestic Water Demands

The Non Domestic Water Demands normally include the following categories

1. Industrial Water Demand,
2. Commercial and Public Water Demands
3. Livestock Water Demand,
4. Unaccounted For Water (UFW)
5. Water Demand for Fire Fighting

4.4.3.1 Industrial Water Demand

The development plans of many towns indicate that there are plans to establish some small to medium scale industries. In most cases big industries are assumed to have their own water supply systems.

Where there is no distinct data for the project area, it is recommended to take 5 to 10% of the domestic water demand, depending on the size of the project. About 10% has been taken for this thesis. (OWWDSE, 2011)

4.4.3.2 Commercial and Public Water Demands

Commercial demand includes water requirement for restaurants, Cinema houses, railways, bus stations, shopping centers, Local drinks etc whereas public demand includes water required by schools, hospitals, public offices, military camps, public parks, dispensaries, day-care centers and so on.

In case where exhaustive estimation of the public and commercial institutions is not possible it is recommended to take 20 to 40% of the domestic water demand, depending on the size of population. In this paper an average 30% has been assumed reasonable due to Small-scale industrial enterprises will not be categorized separately but should be included in the allowance for institutional and commercial demand. However, water demand for larger industries will be treated separately. (MWR, 2006)

4.4.3.3 Unaccounted For Water (UFW)

Unaccounted-for water (UFW) is expressed as a percentage of the total water produced for the system.

UFW arises from system leakage, water taken by illegal connections, inaccuracies in metering, overflowing of reservoirs, and legitimate unmetered use such as fire fighting, flushing, etc.

For this research unaccounted for water is obtained from Adama Town water supply and sanitation the UFW based on the amount of production versus the amount of bill collected.

4.4.3.4 Water Demand for Fire Fighting

Water demand for firefighting purposes shall be assessed on a town-by-town basis, depending on the existence of equipment and the capacity of any fire fighting service. Fire hydrants shall be installed at public and municipality interest such as schools, shops, hospitals, fuel stations and at salient points of distribution network. This demand is taken of by increasing the volume of the storage tanks by 10 %. (MWR, 2006)

4.4.4 Design Demands

The consumption patterns of different users of water supply services vary on hourly, daily and annual basis. Keeping records of these variations can help in developing standard peak factors for a given locality, which is the basis for the design of different water supply components. Poor estimation of these factors can lead to under or over design of water supply systems. To evaluate the different elements of a water supply scheme, the following design demands will be considered.

4.4.4.1 Average day demand:

The average daily demand is the total annual (average) water demand distributed over 365 days. It obtained by simply summing up the domestic and non-domestic demands as well as unaccounted for water (UFW). These form the basis to estimate the maximum day and the peak hour demand. For an average day demand, 20 to 24 hrs of pumping are recommended.

4.4.4.2 Maximum day demand/seasonal peak factor

The maximum day water demand is considered to meet water consumption changes with seasons and days of the week. It also represents the changes in demand with season and some special events happening in any specified year. The maximum day demand is obtained by multiplying the average day demand with the maximum day factor.

4.4.4.3 Peak hour demand:

This occurs when particularly all the water taps are opened at a particular rush hour. Such event happens during morning hours when most people use water for bathing, cooking and could also occur towards the end of the day due to peoples' need for water for the same purpose after working hours.

The peak hour demand is the highest demand of any one-hour over the maximum day. It represents the diurnal variations in water demand resulting from the behavioral patterns of the local population. The peak hour demand is obtained by multiplying the maximum day demand with the peak hour factor.

As stated earlier, both the maximum day and peak hour factors greatly depend on the size of the population to be served. It is always advisable to adopt peak factors developed from locally recorded consumption data or from a water services having similar climatic, cultural and socio-economic characteristics.

In the absence of such data, the designer can flexibly adopt the peak factors given in the following table considering the local situation.

Table 4-5 Recommended Water Demand Peak Factors

Population size	Maximum day factor	Peak hour factor
<2,000		2.6
2,000-10,000		2.4-2.2
10,000-50,000	1.3-1.5	2.2-1.8
50,000-80,000		1.8-1.7
>80,000	1.2	<1.7

Source: - The World Bank Issue paper for project Design, Final Report, 2006.

4.4.5 Nodal Demand Calculation

Demand allocation to consumption points are estimated using the following procedures.

1. Population size for each kebeles of Adama is projected.
2. From the known areas of kebeles and projected population for the design year, population density of the kebele is calculated.
3. Water demand is projected based on the pressure zones.
4. Location of nodal demand or consumption points is selected for demand allocating in the project area.
5. Service areas for each consumption point are delineated.
6. The delineated areas are overlapped to the kebeles and pressure zones.
7. Nodal demand is calculated using the following formulae.

$$Nd = \sum pi.dj$$

Where

- N_d = Nodal demand
- pi = population in each kebeles of the service area.
- dj = per capital demand for each pressure zones of the service area.
- i = subscript referring to the i-th kebele in the service area.
- j = subscript referring to the j-th pressure zone in the service area.

4.4.6 Transmission and Distribution Mains

4.4.6.1 Transmission Main

The transmission main, although it may have a small number of service connections on it, it is used to convey the majority of flow from the source, treatment plant, and/or storage facilities to the distribution system where the majority of service connections are located. It is designed to transport the maximum day demand of water to service reservoirs and for peak hour demand from reservoir to distribution network. It should also be designed for peak hour demands where direct pumping is required from source and/or treatment plant to distribution system.

4.4.6.2 Distribution Main

4.4.6.2.1 Demand Patterns

Water demand in a distribution system fluctuates over time. For example, residential water use on a typical weekday is higher than average in the morning before people go to work, and is usually highest in the evening when residents are preparing dinner, washing clothes, etc. This variation in demand over time can be modeled using demand patterns.

Demand patterns are multipliers that vary with time and are applied to a given base demand, most typically the average daily demand. The highest multiplier of demand pattern is equivalent to the peak hour demand factor. Hence distribution networks are designed for a capacity of peak hour demands (PHD).

Hour	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	Total
Adama Town Demand Pattern	0.3	0.3	0.3	0.3	0.3	0.7	1.1	1.7	1.6	1.5	1.5	1.4	1.4	1.4	1.3	1.5	1.6	1.5	1.4	1	0.7	0.5	0.4	0.3	24

Table 4-6 Demand Patterns of Distribution Network

Source: OWWDSE, 2011.

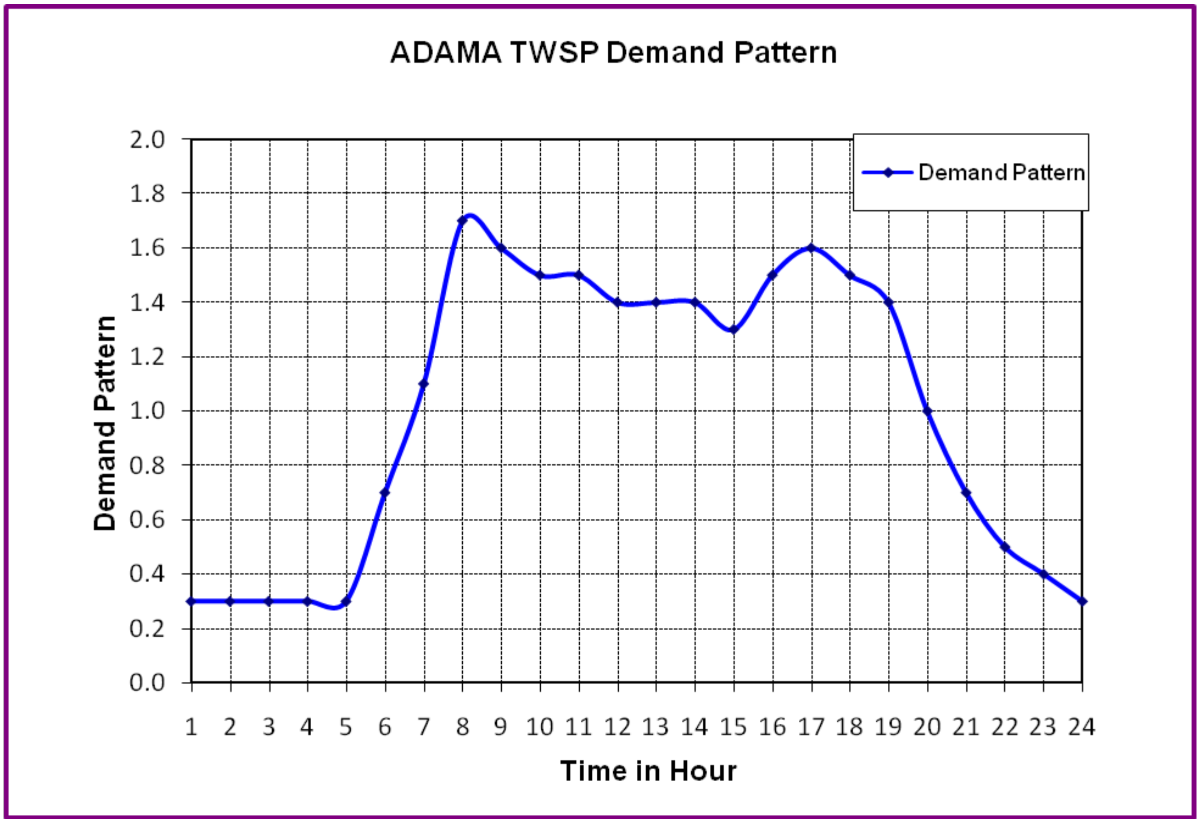

Figure 4-1 Graph of Demand Pattern

4.4.6.2.2 Pressure Requirements

- Gravity supply from the service reservoir at lowest water level condition
- As a rule, a minimum manometeric head of 15m is considered as adequate during Peak Hour Demands. However, in exceptional cases, depending on the topography of the area, lower pressure levels may be permitted, but not less than 10 m.

- A maximum of 80m manometeric head, to avoid risking leaks and bursts in the distribution system, particularly during minimum flow conditions and when the static pressure would be dominant.

- Pipe pressure classes are chosen for the maximum pressure head that may occur under no or minimum consumption condition which is set at nil or 10 percent of the average day demand and the service reservoir at maximum water level.

- The operating pressures in the distribution network shall be as follows:

	Normal Conditions	**Exceptional Conditions**
Minimum Maximum	15 m water head 60 m water head	10 m water head 80 m water head

4.4.6.2.3 VELOCITIES IN THE MAINS

- Water velocities shall be maintained at less than 2 m/sec, except in short sections. Velocities in small diameter pipes (<DN100) may need even lower limiting velocities.

    - ✓ Maximum velocities of major transfer mains < 2.5 m/s.
    - ✓ Maximum velocities of distribution mains < 2 m/s.
    - ✓ Minimum 0.6 m/s.

- A minimum velocity of 0.6 m/sec can be taken, but for looped systems there will be pipelines with sections of zero velocity.

4.4.6.3 Hydraulic Computation

The distribution system will be designed as a looped system unless it is of the simplest configuration. Looped systems will be designed using a computerized network analysis programme.

Typical pipe roughness values are shown below. These values may vary depending on the manufacturer, workmanship, age, and many other factors.

Table 4-7 Pipe Roughness for Different Pipe Material

C-Value for Hazen-Williams			
Types of Pipes	**UPVC**	**Steel**	**DCI /GI**
New	130	110	120
Existing	100-110	90-110	100-110

Source: MWR, 2006

In designing the distribution network, we use the Hazen William formula with C value of UPVC, Steel DCI/GI as follow by taking the average of each material. For UPVC take 105, Steel 100 and DCI/GI take 105. Because we have no the exact year in which each pipe is installed.

4.4.7 Modeling the Existing Distribution System

To analyze and improve the existing water distribution system, a model was developed utilizing Water CAD software (Water CAD for Auto CAD 2004 software).

4.4.7.1 Working Methodology

The approaches adopted for each of the system components to perform the model are described below.

- All the existing water distribution system and other related available data have been collected.
- Missed data for modeling of the system have been generated using different software like Global mapper for the data of location and elevation of junction.
- The existing water distribution layout has been built using Water CAD for Auto CAD 2004 software tools, model representation.
- All the existing and generated data have been entered into the built model.
- The model has been simulated for single period and extended period.
- Using different scenarios the model has been analyzed and then the water distribution system was evaluated.

4.4.8 Building Data Base for Modeling Water Supply Systems

The purpose of creating data base for a water supply system is to export and import data elements between the WaterCAD model and date base files so as efficiently perform the analysis of the system and produce the required out puts.

There are four ways to input the data required to build network which mainly depends on the format in which the data being stored, the complexity of the project and personal experience of designers. In case of this project Microsoft Excel Spread Sheets are used for establishing the data bases of the network as a starting point and other methods will be employed as required. The arrangement of basic project data and corresponding modeling elements have been outlined as follows.

4.4.8.1 Water Demand Data

The water demand data and respective supply points are represented as nodes junction nodes in WaterCAD as mentioned earlier. The water demands data and their respective points of locations have been spatially distributed in accordance with the master plan of the town and density of population or other water user customers. Either the average or maximum day demand of those areas could be used when modeling demand points.

4.4.8.2 Water Supply Sources data

All selected alternative water supply sources such as Boreholes, Dam and Storage, River Intakes and springs, and their respective locations, and sources quantities are modeled as reservoirs and arranged in Microsoft Excel Spread Sheets.

4.4.8.3 Transmission and distribution network

Knowing the locations of possible water supply sources and locations of Demand points, the next question is how to convey the required water from supply sources to demand points. Depending on the topographic conditions, the logical starts at this stage are the selection of best routes, laying out of transmission and distribution mains and definition of data elements required to build the network. The transmission mains are designed for a capacity of maximum daily water demands while distribution networks are for peak hourly demands of the project.

4.4.8.4 Pumping Stations

Pumping stations are designed for maximum daily water demands. Arrangement of appropriate locations for pumping stations, installation of wet wells and pumps are the modeling components of pumping stations.

4.4.8.5 Reservoirs

Service reservoirs (Tanks) are designed to balance the hourly fluctuations of water demands. Capacities are determined by either the storage requirements of one third maximum day demand or mass curve analysis of the inflow verses outflow systems. Service reservoirs are located at higher ground elevations where water will be distributed to target communities with flow of gravity.

4.4.8.6 Valves

Installation of Valves such as Pressure reducing valves (PRV) Air releasing Valves (ARV), Flow Control Valves (FCV), Flush out Valves (FOV), etc, at the required locations and data elements.

4.4.9 Synchronization of data base

Following the establishment of data base for the water supply distribution network, New Project File will be created for the design software. Then connection of data base with the project file will be performed to start the hydraulic analysis of the water supply system. The process of describing and interpreting data base of Microsoft Excel to WaterCAD data files is called data base connection. Finally, the synchronization process is conducted for matching the data bases of both Software's to commence the hydraulic analysis of the project.

4.5 CALIBRATING HYDRAULIC NETWORK MODELS

Calibration is the process of comparing the model results to field observations and, if necessary, adjusting the data describing the system until model-predicted performance reasonably agrees with measured system performance over a wide range of operating conditions.

Even though the required data have been collected and entered into a hydraulic simulation software package, the modeler cannot assume that the model is an accurate mathematical representation of the system. The hydraulic simulation software simply solves the equations of continuity and energy using the supplied data; thus, the quality of the data will dictate the quality of the results.

The accuracy of a hydraulic model depends on how well it has been calibrated, so a calibration analysis should always be performed before a model is used for decision-making purposes.

Pressure Measurement

Pressures are measured throughout the water distribution system to monitor the level of service and to collect data for use in model calibration. Pressure readings are commonly taken at fire hydrants also at hose bibs, and home faucets (Bentley, 2008)

If the measurements are taken at a location other than, a direct connection to a water main (for example, at a house hose bib), the head loss between the supply main and the site where pressure is measured must be considered. Models can be calibrated using one steady-state simulation, but the more steady-state simulations for which calibration is achieved, the more closely the model will represent the behavior of the real system.

Acceptable levels of calibration

- 85% of field test measurements should be within ± 0.5 m or ± 5% of the maximum head loss across the system, whichever is greater.
- 95% of field test measurements should be within ± 0.75 m or ± 7.5% of the maximum head loss across the system, whichever is greater.
- 100% of field test measurements should be within ± 2 m or ± 15% of the maximum head loss across the system, whichever is greater.

Sampling location

A typical network representation of a water network may include hundreds or thousands of links and nodes. Ideally, during the water distribution model calibration process is adjusted for each link and each node. However, only a small percentage of representative sample measurements can be made available for the use of model calibration due to the limited financial and labor requirements for data collection. Therefore, it is of utmost importance to have a comprehensive methodology and efficient tool that can assist the engineer in achieving a highly accurate model under practical conditions (Bentley, 2008).

Selection of sampling sites is typically a compromise between selecting sites that provide the greatest amount of information and sites that are most amenable to sampling. Sites should be spread throughout the study area and should reflect a variety of situations of interest, such as transmission mains and local lines, areas served directly from a source, and areas under the influence of tanks. In addition, sampling taps should be placed close to mains.

Data collection can be classified as either point reading (grab samples) or continuous monitoring. Point reading involves collecting data for a single location at a specific point in time, and continuous monitoring involves collecting data at a single location over time. For point readings, samples should be collected at locations where the parameter being measured is steady so that the sample measurement is representative of the location over a long period.

Twelve representative sample measurements to the water main spread throughout the study area have been selected for the calibration. It was difficult to take measurement at a direct connection to the water main nodes, due to size of pressure gauge available in for this research from my friend working at AWWSA, which is 25mm.

The measurements were taken at a location other than the direct connection to the water mains, nearer to the supply main nodes at homes faucet. The locations of the representative samples of a supply main nodes and the corresponding home faucet (field test).

5. RESULTS AND DISCUSSION

5.1 DEMAND ALALYSIS

5.1.1 Population

According to CSA data, the population of Adama town in 2007 was 222,035. If we project this figure to year 2015 and 2025, it is about 446,100 and 654,011 respectively. The following Table and Figure summarize population projection of the town starting from year 2011 2025 in 5 years intervals.

Table 5-1 Projected Population of the Project

No	Description	2011	2015	2020	2025
1	Population growth rate	4.36%	4.20%	4.00%	3.80%
	Total Population	**381,440**	**446,100**	**542,748**	**654,011**
1.1	Adama Town	271,562	320,140	389,499	469,346
1.2	Wonji Town	75,201	85,080	103,513	124,733
1.3	Rural Villages Residing Town Fringes, along TM & Floating (10%)	34,676	40,879	49,736	59,932

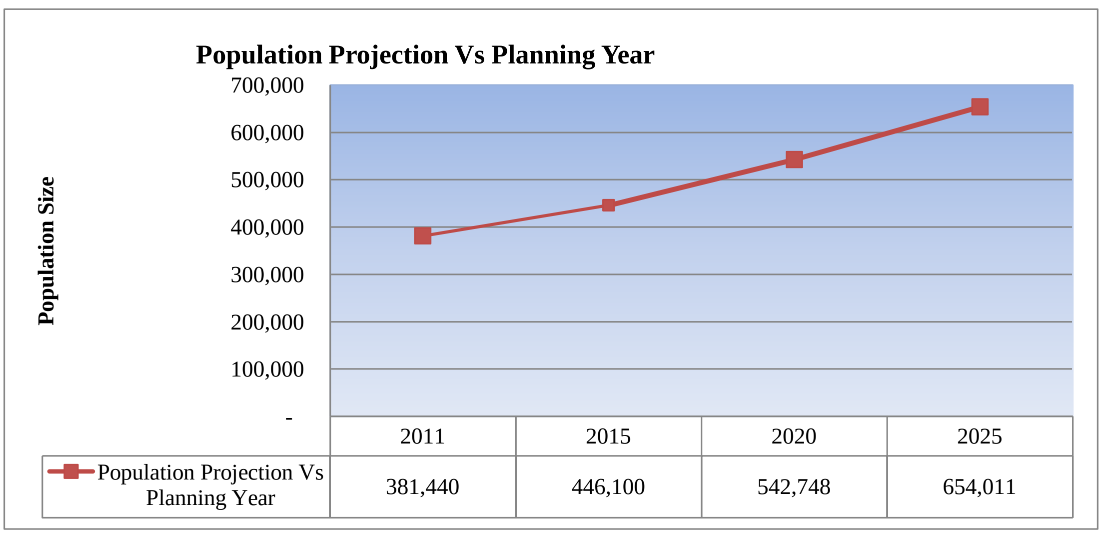

Figure 5-1 Graph of Population Projection Vs Planning Year.

5.1.2 Summary Of Domestic Water Demand

Based on the methodology of calculating the total daily domestic water demand of the town is then calculated by applying all the aforementioned factors and the results are summarized in table below.

No	**Town: Adama** **Description**	**Unit**	**2011**	**2015**	**2020**	**2025**
1	**Total population**	**No**	**381,440**	**446,100**	**542,748**	**654,011**
	Coverage by service Level					
	HC (house connection)		5.1%	5.1%	10.1%	15.1%
	YC(yard connection)		71.1%	71.1%	65.8%	60.6%
	PF(public fountain)		10.5%	10.5%	24.1%	24.4%
	NC(no connction)		13.3%	13.0%	0.0%	0.0%
	Population served by					
	HC	No	19,453	22,751	54,709	98,429
	YC	No	271,204	317,177	357,291	396,004
	PF	No	40,051	46,840	130,802	159,579
	NC	No	50,731	57,993	0	0
2	**Demand**					
2.1	Domestic					
	Per capita demand					
	HC	l/c/d	60.00	60.00	68.00	75.00
	YC	l/c/d	40.00	40.00	45.00	50.00
	PF	l/c/d	20.00	20.00	23.00	25.00
	Consumption (daily)					
	HC	m^3/d	1,167	1,365	3,720	7,382
	YC	m^3/d	10,848	12,687	16,078	19,800
	PF	m^3/d	801	937	3,008	3,989
	Sub Total		12,816	14,989	22,807	31,172
	Climatic and Socio-Economic factor	combined	1.1	1.1	1.1	1.1
	Total Domestic Demand	**m^3/d**	**14,098**	**16,488**	**25,087**	**34,289**

Table 5-2 Summary of Domestic Water Demand

According to the table 5.2 the total domestic water demand will increased from 14,098m^3/d in 2011 to 34,289 m^3/d in 2025 due the population number and method of connection.

5.1.3 Summary of the Total Water Demands

Finally the total water demand of the project will be established by summarizing all water demand requirements mentioned in the foregoing methodology section as follows. This includes Average day demand, Maximum day demand and Peak hourly demand of values by the year of 2015, 2020 and 2025

Table 5-3 Summary of Total Water Demand and Coverage

No	Towns: Adama				
	Description	**Unit**	**2015**	**2020**	**2025**
1	**Total Population**	**No**	**446,100**	**542,748**	**654,011**
2	**Total Water Demand**	**m³/d**	**28,672**	**43,627**	**59,629**
	Domestic Demand	m³/d	16,488	25,087	34,289
	Public and Commercial (20 to 40%)=30%	m³/d	4,946	7,526	10,287
	Industrial Demand (10%)	m³/d	1,649	2,509	3,429
	Un-Accounted For Water(33.9%) average		5,589	8,505	11,624
		%	33.9%	33.9%	33.9%
3.1	**Avg Day Demand (ADD)**	**m³/d**	**28,672**	**43,627**	**59,629**
		l/s	**331.9**	**504.9**	**690.1**
3.2	Maximum Day Factor		1.2	1.2	1.2
	Maximum Day Demand (MDD) -	**m³/d**	**34,407**	**52,352**	**71,554**
		l/s	**398.2**	**605.9**	**828.2**
	Peak hour Factor		1.7	1.7	1.7
3.3	**Peak hour Demand**	**l/s**	**564.2**	**858.4**	**1173.2**
3.4	**Daily Production**	**l/s**	**300**	**560**	**560**
		m3/d	**25,920**	**48,384**	**48,384**
3.5	**Real losses =80% total loss=0.8*33.9%= 27.12%**	**m3/d**	**7,030**	**13,122**	**13,122**
3.6	**Actual production**	**m3/d**	**18,890**	**35,262**	**35,262**
3.7	**Water Supply Coverage of Adama Town =actual/ADD*100**	**%**	**65.88**	**80.83**	**59.14**

N.B:- Unaccounted for water (m3) = [Real losses] + [Apparent losses]

Where Real losses= mainly leakage and poor O&M practice

And Apparent losses= illegal connections, accounting errors and meter inaccuracy

By rule of thumb, apparent losses is 20% of total water losses (Seago and et al, (2005)) From the table 5.3 the water supply coverage of the Adama town will decrease as the demand of water increases. So it is necessary to search for other means of getting additional source.

5.1.4 Nodal Demand Calculation

The Average demand for five zones is tabulated in table 5.4. From the table the maximum and minimum user of demand is located in Lugo and Gelma Aba Gada zone respectively. Both of the zones contain a population of 308,912 and 5,876 respectively.

Table 5-4 Average Day Demand for Each Zone

No	Zone	Name of Zone	Population		Base Demand(l/s)	
			2015	2025	2015	2025
1	R09EBO-1715	BOKU	24,703	36,217	18.38	27.96
2	RCOL-1725	ADAMA UNIVERSITY	78,907	115,683	58.70	89.32
3	RDHA-1750	DHAKA ADI	27,701	40,612	20.61	31.36
4	RGA-1750	GELMA ABA GADA	5,876	8,615	4.37	6.65
5	RLUGO-1685	LUGO	308,912	452,885	229.80	349.66
TOTAL			**446,100**	**654,011**	**331.9**	**504.9**

5.2 MODEL ANALYSIS

Analysis of the model of existing system has been made by running the model at current year daily average, daily minimum, at peaking and temporal variations of demand with different scenarios.

5.2.1 Steady-state Analysis

The model has been performed in steady state run for the average daily demand, which is the demand at every node not changing throughout 24 hours of a day. The software simulates Steady-State hydraulic calculation based on mass and energy conservation equations principle. Use appendix for the results.

5.2.2 Extended-Period Simulation

The system conditions have been computed over twenty-four hours with a specified time increment of one hour and starting model run time at 12:00 AM. The software simulates non-steady-State hydraulic calculation based on mass and energy conservation principle.

The model can be simulated for every hour time setup in the twenty-four hour duration. However, for the analysis the peak and minimum hours, demand has been simulated to identify the current problems of the system and then identify the problem of the model based on the design criteria of the water distribution system, parameters like pressure and velocity.

Use appendix, the attached results of the system performed run from:

- For the minimum hour consumption.
- For the peak hour consumption.

5.2.3 Pipes

Pipes are links that convey water from one point in the network to another. Since, pipes service as link to connect nodes. They are also the major physical component part of a water distribution system. Due to their importance, pipes are frequently referred as the central part of a water distribution network system.

The water distribution main model has a total length of **143,623.00m**, which integrates.

Table 5-5 WaterCAD Data Pipe Data Network result

No.	Diameter (mm)	Length (m)	Material Type	Percentage of coverage
1.00	50.00	10,757.00	uPVC	7.49
2.00	50.00	1,127.00	GI	0.78
3.00	65.00	1,440.00	GI	1.00
4.00	80.00	23,768.00	uPVC	16.55
5.00	100.00	12,812.00	uPVC	8.92
6.00	100.00	1,037.00	DI	0.72
7.00	150.00	27,108.00	uPVC	18.87
8.00	150.00	2,184.00	DI	1.52
9.00	200.00	22,802.00	uPVC	15.88
10.00	200.00	619.00	DI	0.43
11.00	250.00	386.00	uPVC	0.27
12.00	300.00	10,470.00	uPVC	7.29
13.00	300.00	7,501.00	DI	5.22
14.00	400.00	3,304.00	DI	2.30
15.00	500.00	3,875.00	DI	2.70
16.00	600.00	14,433.00	DI	10.05
Total Length		**143,623.00**		

As depicted in table 5.5, 18.87% of the system contains pipe of 150mm uPVC. This figure is relatively high when compared to 16.55%, 15.88% of 80mm and 200mm uPVC pipe diameter respectively. A single pipe of 250mm uPVC diameter is the lowest. It is only 0.27%. In terms of material type, Polyvinyl chloride (uPVC) pipe is the major pipe.

Additionally the water distribution main model inventory also consists of 800-pressure pipe, 9 reservoir including clear water tank and booster station, 648-junctions and 16-pumps.

5.3 CALIBRATING HYDRAULIC NETWORK MODELS

The credibility of a model is merely evident if a model result precisely reflects observed field values. Thus, to have a confidence on model result it needs to calibrate and validate a model.

The measurements were taken at a location other than the direct connection to the water mains, nearer to the supply main nodes at homes faucet. The locations of the representative samples of a supply main nodes and the corresponding home faucet (field test) are shown in table 5.8.

For the calibration, the head loss between the supply main nodes and the site where pressure is measured had been considered. The head loss included the elevation head and pipe friction loss between a two corresponding locations. These head losses and the total head loss are shown in table. At base scenarios of the model, the average head loss gradient is calculated to be 2.4 m/km. These values of head loss gradients have been applied in the calculations pipe length friction loss in the calibration.

As a result, almost 100% of the field test measurements were within ± 2 m, showing an acceptable level of pressure calibration criteria. The comparison of model simulated and field test are shown table and figure. The calibrations have been carried for the base scenarios, for the model validation. Calibrations base scenarios were within the acceptable level. Hence, the model is valid for the scenarios.

	Sample Node				corresponding Field Test Measurement Location			Head Loss between sample node and field test location		
S.No	Junction	X	Y	Z	X	Y	Z	Elevation Head(m)	Friction loss(m)	Total Head Loss(m)
1	N64A	529273	945095	1633	529356	945095	1630	3	0.35	3.35
2	N29A2	529504	944224	1622	529504	944224	1621	1	0.14	1.14
3	N81B	528061	940774	1633	528003	940708	1624	9	1.21	10.21
4	N51B	528692	944962	1631	528638	944982	1630	1	0.26	1.26
5	N44A	527383	943496	1634	527530	943533	1632	2	1.16	3.16
6	N20A	531123	943573	1605	531103	943492	1606	1	0.23	1.23
7	N28A	530064	944168	1627	530064	944167	1625	2	2.1	4.1
8	N69	530510	945300	1640.5	530510	945300	1640	0.5	0.19	0.69
9	N10A	529581	942668	1617	529656	942685	1622	5	0.73	5.73
10	N36A	528208	942698	1613	528207	942697	1614	1	0.11	1.11
11	N48	528266	944578	1626	528295	944572	1624	2	0.46	2.46
12	N15E	529008	940771	1677	528736	941735	1674	3	1.59	4.59

Table 5-6 Locations of the Representative Samples of Supply Main Nodes and the Corresponding Home Faucet.

S.No	Sample Nodes	Simulated model pressure	Field measured pressure at Customer tap (mH2O)	Total Head Loss between the two locations (m)	The likely Simulated pressure at supply main node(m)	Error (m)	Time from start (hr)	Scenario
1	N64A	46.56	45	3.35	43.21	1.79	10:00	Base Scenario
2	N29A2	56.21	53	1.14	55.07	-2.07	10:00	
3	N81B	48.17	40	10.21	37.96	2.04	10:00	
4	N51B	38.38	36	1.26	37.12	-1.12	10:00	
5	N44A	45.69	43	3.16	42.53	0.47	10:00	
6	N20A	65.21	63	1.23	63.98	-0.98	10:00	
7	N28A	53.34	51	4.1	49.24	1.76	11:00	
8	N69	36.91	35	0.69	36.22	-1.22	11:00	
9	N10A	61.2	57	5.73	55.47	1.53	11:00	
10	N36A	67.48	65	1.11	66.37	-1.37	11:00	
11	N48	18.18	16	2.46	15.72	0.28	11:00	
12	N15E	5.96	3	4.59	1.37	1.63	11:00	

Table 5-7 Comparison of simulated pressure results with field-measured data

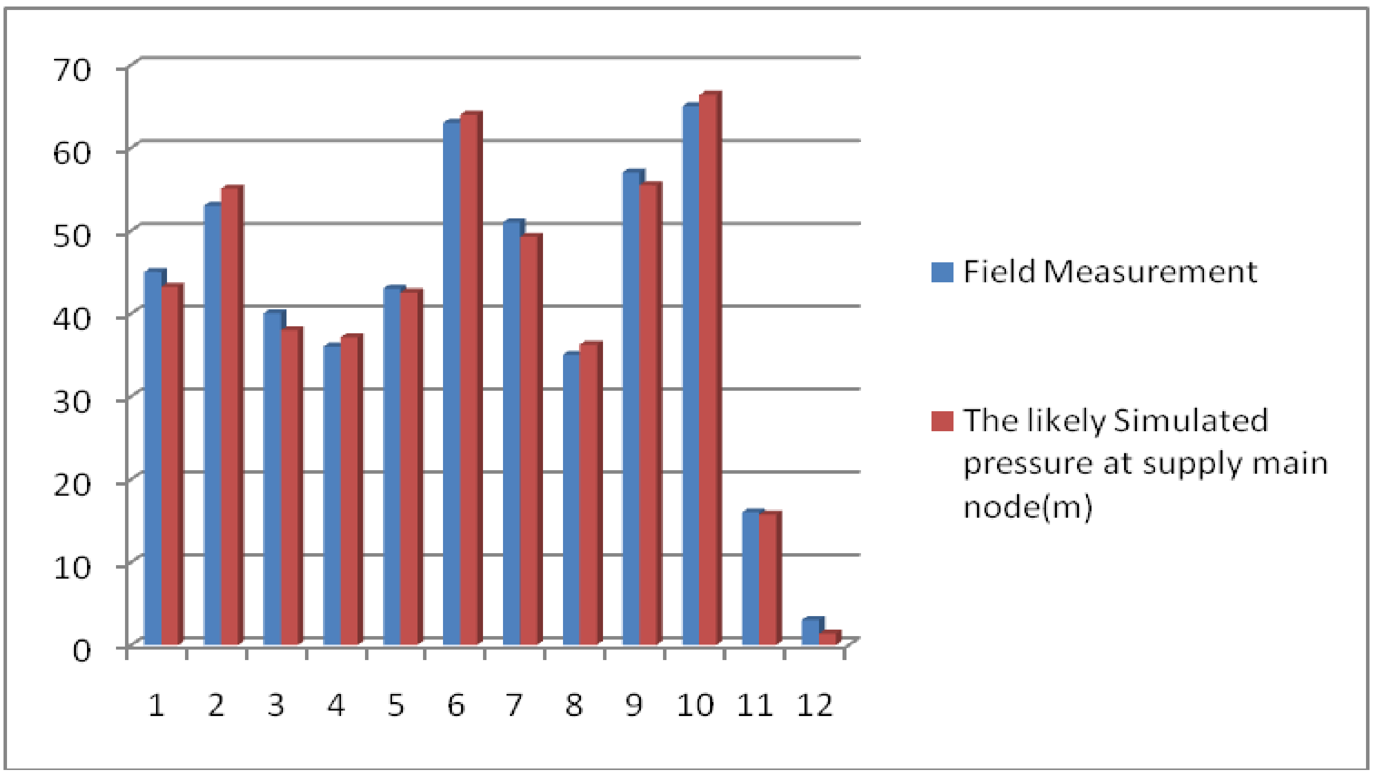

Figure 5-2 Locations of Supply Mains Node and Pressure Field-Test Measurement

N.B :- The limitation of calibration is , we have take all the data at the location where water is available b/c it is difficult to take the data in the absence water and the other ways there is no variation in water level through time.

5.4 PERFORMANCE EVALUATION

5.4.1 Evaluation of Transmission Main

At present the transmission main has been safely transporting 300 l/s design demand with a velocity of 1.06 m/s and head loss gradient of 1.7m/km.

Table 5-8 Hydraulic Analysis Results of Tm for Existing Condition and Future Maximum Day Demand

L (m)	DN (mm)	Q (l/s)	V (m/s)	HL Grdnt (m/km)	Material
10,597	600	300	1.06	1.7	DI
10,597	600	560	1.96	5.2	DI

N.B the current pumps lefts only 330 l/s so it is necessary to change either the type of pump or increasing number of pumps to get the required discharge near the future.

Additionally, if the required discharge after 2020 increased we must add diameter of pipe to acquire the limit of pressure and velocity within the standard range.

5.4.2 Evaluation of Distribution System

Analysis of the existing distribution network has been conducted for two condition of the peak and minimum demands of the system, as described in the evaluation criteria.

The peak hour demand is thus 518 l/s. It occurs from 6-7 AM in the morning when most people get up for daily business. The existing minimum consumption is 97 l/s. It occurs from 11PM to 3AM hours in the night.

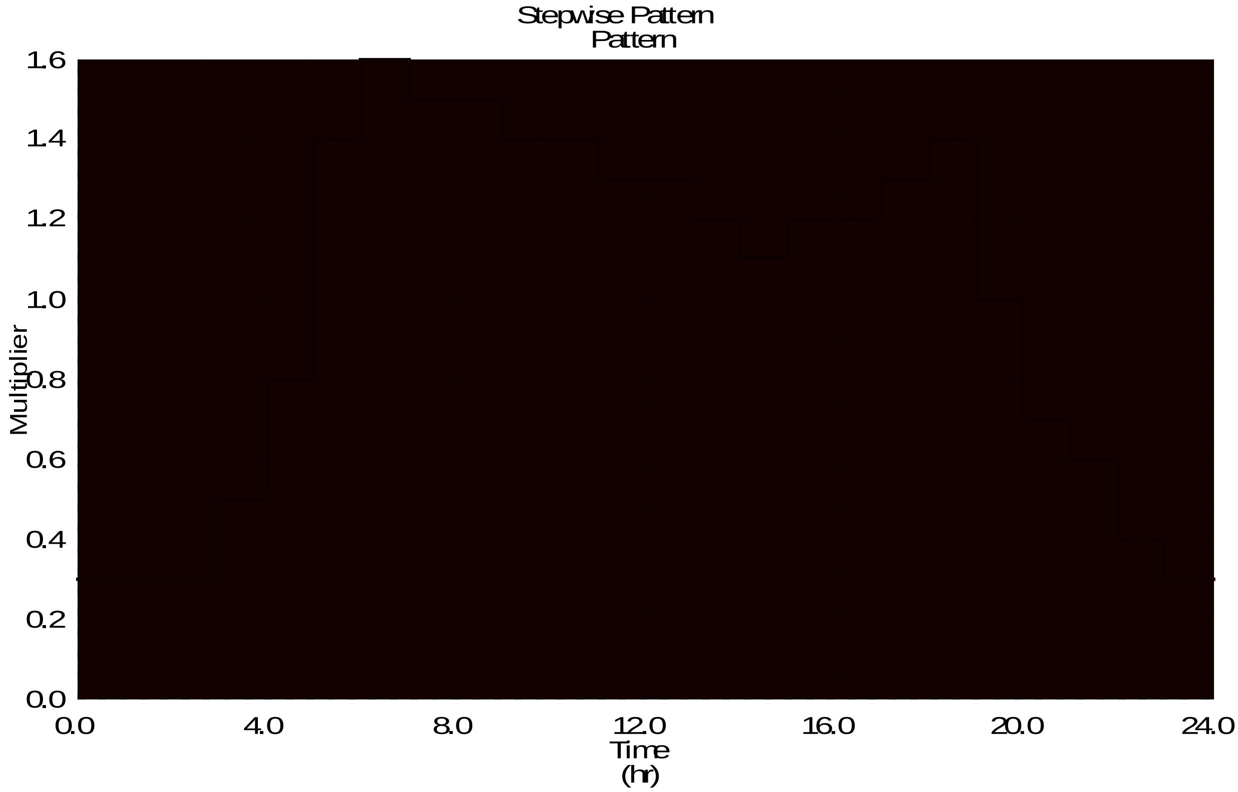

Figure 5-3 Peak and Minimum Hours Consumption Pattern

Consequently, hydraulic analysis results of the network during **Peak and Minimum Hour Demands** of the system are summarized as follows.

1. The existing distribution system covers around 50% or 2575 ha of the Master Plan area of the town. It has also limited to the central low elevation areas of Adama town; it should be expanded to the elevated areas to solve the current water shortage of the residents.

2. Some parts of the network couldn't meet the minimum required pressure of 10 m H2O during the peak hour demand. These are found around Migira and Giko areas, and some parts of Lugo Supply Zone. The pressures are varying from negative 67 to 9 m H2O. The main reasons for such lower pressures are.

    - ❖ The installed pipes were small in sizes
    - ❖ Relatively found on higher ground levels.
    - ❖ Increased population and water demand.

Undersized pipes can usually be found by looking for pipes with high velocities. Increasing the diameter of the pipe in the model should result in a corresponding decrease in velocity and increase in pressure.

The optimal velocity in pumped lines can range from 1 to 3 m/s, depending on the relative size of the peak and average flow rates (Walski, T.M.,1983).When checking designs for permissible velocities some engineers use 1.5 m/s as a maximum, other use 2.4m/s, and yet still others use 3.1m/s.

Consistent low pressure problem is due to trying to serve customers at too high an elevation for that pressure zone. High pressures are usually caused by serving customers at low elevation for the pressure zone. Usually, high pressures are easiest to evaluate with model runs at low demands. This range corresponds to minimum night time demands for a typical system. If the engineer feels that pressures are too high, the usual solution is to establish a new pressure zone for the lower elevation using PRVs.

3. Evaluation of the capacities of both existing and new reservoirs proved that the total storage capacities of existing and new reservoirs cover only 77% of the requirement which is 12,300m3.(refer table 5.7)

Table 5-9 Reservoir Capacity Evaluation

4.

Town: Adama	**2015**	**2020**	**2025**
Population (No)	435,470	529,815	638,427
Water Demand (l/s)	389	591	808
Existing (l/s)	330	330	330
Additional (l/s)	59	261	478
Maximum DD (M^3)	33,587	51,105	69,849
Existing (m^3)	28,512	28,512	28,512
Additional (m^3)	5,075	22,593	41,337
Cumulative Reservoir Capacity (m^3)	12,300	18,700	25,600
Existing (m^3)	9,500	13,500	13,500
Cumulative Additional (m^3)	**2,800**	**5,200**	**12,100**
Coverage (%)	**77**	**72**	**53**

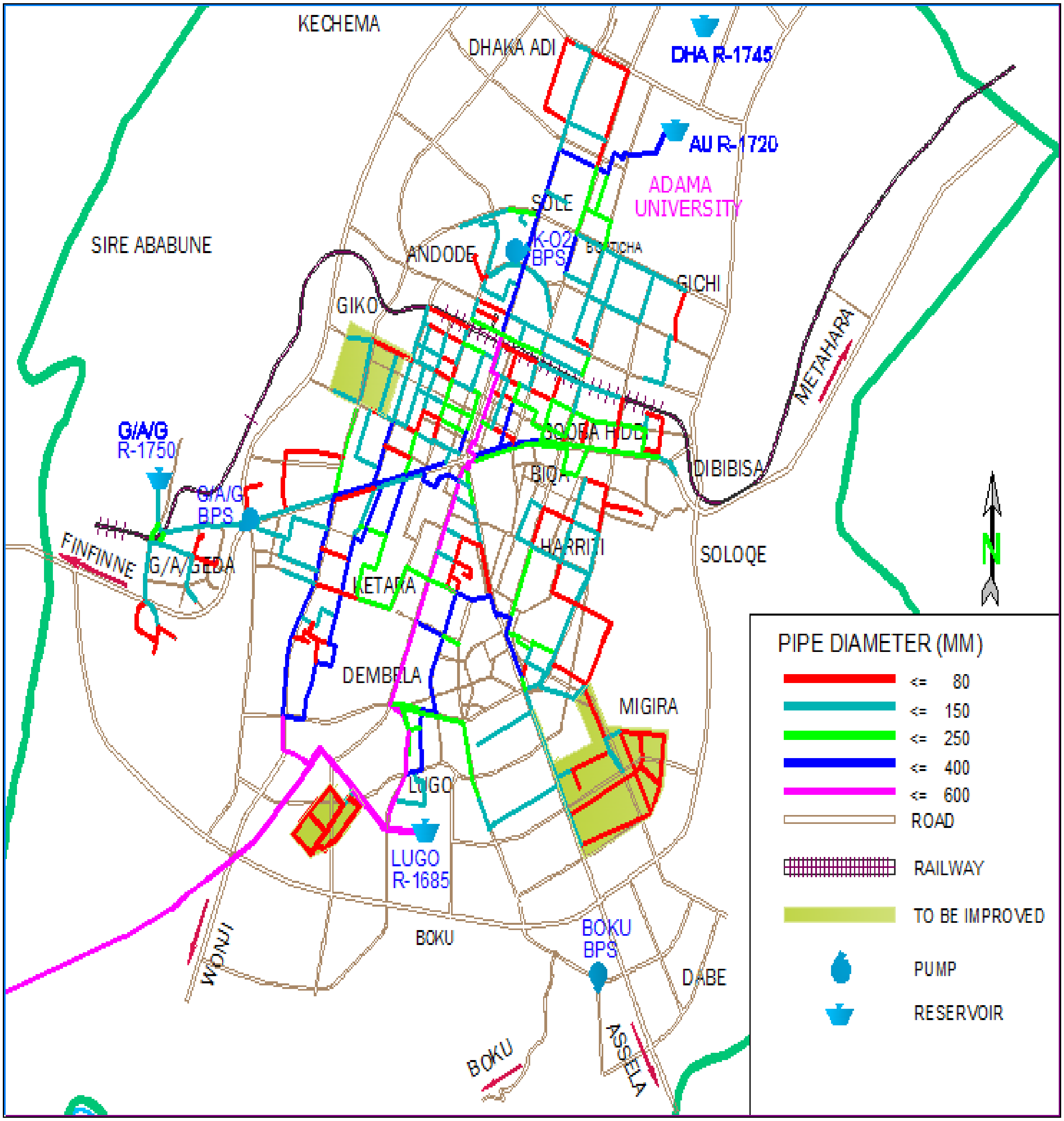

Figure 5-4 Parts of the network requiring Improvement

6. CONCLUSION AND RECOMMENDATION

6.1 CONCLUSION

The research project focused to know water supply coverage, model hydraulic, and to evaluate the distribution system, and resulted in the following key achievements:

- The water supply coverage is only 65.88% of the town master plan based on the current demand and production.
- Shortage of service pressure at different junction due to topographic and size of pipes.
- Unaccounted for water has been increasing from 15.44% to 45.46% of water production.
- Pressure based hydraulic performance evaluation indicated that acceptable minimum pressure value has not been met. During peak hour flow, parts of the distribution system receive water with low pressure and under some circumstances risk of obtaining no water is observed because of the pressure in the distribution system is beyond permissible minimum requirement. These are found around **Migira** and **Giko** areas, and some parts of **Lugo Supply Zone**. The pressures are varying from negative 67 to 9 m H2O.
- Most parts of the central network being suffered by lower flow velocities of less than 0.5m/s due to unnecessarily congestion of pipe network. This is to the extent of occurring zero (no) flow conditions in some of the pipes.
- Evaluation of the capacities of both existing and new reservoirs proved that the total storage capacities of existing and new reservoirs cover only 77%.
- Besides, there is no alternative water source for emergency case; if supply fails from Awash River, water supply situation is becoming worst in the town due to lack of emergency water supply source.
- In general, the simulated hydraulic result indicated that the current hydraulic performance of Adama town distribution system is not satisfactory. But it doesn't mean that the system is not functional. Rather the frequency of service interruption is relatively high. This interruption is partly contributing for the current water shortage in the town.

6.2 RECOMMENDATION

1. The existing distribution system is limited to the central lowlands of Adama town; it should be expanded to the highland areas to solve the current water shortage of the town.

2. It is most recommended that the areas located at the low pressure (higher ground level), needs additional pressure tanks or new pressure zone by pumping the water from the nearest booster pumps to solve the problems of poor pressures at the area.

3. WaterCAD is a commonly used network simulation tool. Other hydraulic network solvers such as EPANET, H_2ONET etc. should be considered in the water distribution network performance and compared with that of WaterCAD.

4. Pressure readings need to be taken at more than twelve locations to verify the result of the simulation to increase the accuracy of the model.

5. The entire pump installed at clear water tank and booster stations must be changed or increased to pump the future demand.

6. ATWSSE should gather the X, Y, coordinates of its customer water meters to make a model using Water CAD with GIS integrated software, for more precise and faster way of modeling in demand allocation. Each customer account assigned an x-y coordinate in a GIS. Then, each account can be assigned to a node in the model based on polygons around each node in the GIS. By querying the customer information database, the average demand at each node for any billing period can be determined. The billing data must now be corrected for unaccounted-for water. When working with high-quality GIS data, the modeler can much more precisely assign demands to nodes.

7. The deficit of water supply in the system should be reduced by minimizing the large amount of unaccounted for water (existing UFW 38.17%).

8. Finding other source for emergency time is necessary to compensate the problem, like rain water harvesting and finding ground water around the town.

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APPENDIX

Some of the Higher Water Consumers

NO.	NAME OF ENTITY	WATER CONSUMPTION (M^3)		AMOUNT PAID (BIRR)		Remark
		MONTHLY	ANNUAL	MONTHLY	ANNUAL	
1	Galmaa Abba-Gadaa	899	10,788	7,102	85,224	Works below Capacity
2	Oromia JSPTLRI	1,300	15,600	10,270	123,240	
3	Adama-Ras Hotel	2,151	25,812	17,700	204,000	Being expanded
4	Wonji-Shawa Suger Factory	14,500	174,000	40,890	490,680	Being expanded
5	Adama University	3,797	45,564	30,000	360,000	
6	ACOS Ethiopia PLC	316	3,792	2,500	30,000	Works below Capacity
7	Adama Steel Factory	59	708	468	5,616	
8	Small households	5	60	20	244	
9	Large households	10	120	51	606	
10	Defense Camp	2,154	25,848	17,022	204,264	
11	Small hotels	100	1,200	790	9,480	
12	Private colleges	991	11,892	6,000	72,000	
13	Adama Hospital	2,215	26,580	17,500	210,000	
14	Associations	1,560	18,720	12,324	147,888	
15	Fuel Stations	72	864	570	6,840	

Source: Adama water supply design socio economy report by Oromia water work and design supervision Enterprise

The Difference between Production and Consumption

Year	Production in m^3/year	Consumption in m^3/year	Water loss in m^3/year	Water loss in %
1994/2002	2,461,799	2,081,697	380,102	15.44%
1995/2003	3,882,655	2,467,033	1,415,622	36.46%
1996/2004	3,762,134	2,656,750	1,105,384	29.38%
19972005	1,894,313	1,184,612	709,701	37.46%
1998/2006	3,472,112	2,119,406	1,352,706	38.96%
1999/2007	4,516,573	2,463,524	2,053,049	45.46%
2000/2008	4,014,970	2,893,567	1,121,403	27.93%
Average	3,429,222	2,266,656	1,162,567	33.90%

APPENDIX C. Nodal Steady State Analysis Results at Average Day Demand

S.No	Label	Elevation (m)	Zone	Demand (Calculated) (l/s)	Base Flow (l/s)	Pressure (m H2O)	Pattern	Calculated Hydraulic Grade (m)	X (m)	Y (m)
1.00	N28AA	1,626.00	RLUGO-1685	0.10	0.10	53.91	Fixed	1,679.97	530,037.00	944,106.00
2.00	N29A''	1,623.00	RLUGO-1685	0.10	0.10	57.02	Fixed	1,679.93	529,608.00	944,117.00
3.00	N29A'	1,623.00	RLUGO-1685	0.10	0.10	56.94	Fixed	1,679.96	529,569.00	944,133.00
4.00	N27A	1,623.00	RLUGO-1685	0.10	0.10	56.51	Fixed	1,679.94	530,386.00	944,148.00
5.00	N69A	1,651.00	RLUGO-1685	0.10	0.10	27.18	Fixed	1,677.93	530,300.00	945,704.00
6.00	N69A1	1,645.00	RLUGO-1685	0.10	0.10	32.80	Fixed	1,677.67	530,428.00	945,580.00
7.00	N29A	1,621.00	RLUGO-1685	0.10	0.10	59.17	Fixed	1,680.03	529,537.00	944,045.00
8.00	N27A2	1,625.00	RLUGO-1685	0.10	0.10	54.85	Fixed	1,679.96	530,201.00	944,136.00
9.00	NG-46	1,691.00	RGA-1750	0.10	0.10	65.87	Fixed	1,757.00	526,570.00	943,034.00
10.00	NG-16	1,694.00	RGA-1750	0.10	0.10	62.96	Fixed	1,757.09	526,286.00	943,073.00
11.00	NG-01	1,720.00	RGA-1750	0.10	0.10	37.05	Fixed	1,757.13	525,784.00	943,199.00
12.00	NG-68	1,697.00	RGA-1750	0.10	0.10	63.91	Fixed	1,761.04	526,184.00	943,330.00
13.00	NG-57	1,672.00	RGA-1750	0.10	0.10	97.60	Fixed	1,769.80	526,694.00	943,365.00
14.00	NG-31	1,706.00	RGA-1750	0.10	0.10	50.78	Fixed	1,756.88	525,623.00	942,413.00
15.00	NG-02	1,716.00	RGA-1750	0.10	0.10	40.86	Fixed	1,756.94	525,801.00	942,624.00
16.00	NG-90	1,698.00	RGA-1750	0.10	0.10	58.69	Fixed	1,756.81	525,835.00	942,184.00
17.00	N22	1,618.00	RLUGO-1685	0.20	0.20	61.72	Fixed	1,679.91	530,636.00	944,110.00

18.00	N56B	1,628.00	RLUGO-1685	0.20	0.20	51.39	Fixed	1,679.91	530,133.00	944,673.00
19.00	N56	1,628.00	RLUGO-1685	0.20	0.20	51.82	Fixed	1,679.91	530,128.00	944,659.00
20.00	N39B3	1,623.00	RLUGO-1685	0.20	0.20	58.57	Fixed	1,681.51	527,644.00	942,288.00
21.00	N39B5	1,619.00	RLUGO-1685	0.20	0.20	62.18	Fixed	1,681.48	527,671.00	942,345.00
22.00	N28B1'	1,622.00	RLUGO-1685	0.20	0.20	58.31	Fixed	1,680.09	529,615.00	944,008.00
23.00	N81A1	1,641.00	RLUGO-1685	0.20	0.20	41.13	Fixed	1,681.99	528,252.00	940,754.00
24.00	N22A	1,616.00	RLUGO-1685	0.20	0.20	64.18	Fixed	1,679.90	530,687.00	944,071.00
25.00	N81A	1,631.00	RLUGO-1685	0.20	0.20	51.40	Fixed	1,682.40	528,124.00	940,852.00
26.00	N22A1	1,616.00	RLUGO-1685	0.20	0.20	63.84	Fixed	1,679.91	530,635.00	944,076.00
27.00	N47A3	1,628.00	RLUGO-1685	0.20	0.20	51.77	Fixed	1,679.58	528,941.00	944,867.00
28.00	N47A4	1,626.00	RLUGO-1685	0.20	0.20	53.76	Fixed	1,679.59	529,018.00	944,837.00
29.00	N103D	1,662.00	RCOL-1725	0.20	0.20	60.44	Fixed	1,722.97	530,194.00	946,145.00
30.00	N29A3	1,624.00	RLUGO-1685	0.20	0.20	55.86	Fixed	1,679.50	529,514.00	944,220.00
31.00	N29A2	1,623.00	RLUGO-1685	0.20	0.20	56.21	Fixed	1,679.50	529,504.00	944,224.00
32.00	N81C1	1,630.00	RLUGO-1685	0.20	0.20	51.24	Fixed	1,681.00	527,838.00	940,360.00
33.00	N28A''	1,622.00	RLUGO-1685	0.20	0.20	57.90	Fixed	1,679.99	529,886.00	944,073.00
34.00	N53A1	1,620.00	RLUGO-1685	0.20	0.20	60.07	Fixed	1,680.19	528,918.00	944,221.00
35.00	N63B	1,636.00	RLUGO-1685	0.20	0.20	43.12	Fixed	1,679.08	529,616.00	945,358.00
36.00	N63B1	1,634.00	RLUGO-1685	0.20	0.20	44.87	Fixed	1,678.88	529,853.00	945,267.00
37.00	N53A	1,620.00	RLUGO-1685	0.20	0.20	60.19	Fixed	1,680.31	528,912.00	944,206.00
	N68A3	1,646.00	RLUGO-	0.20	0.20	32.01	Fixed	1,678.29		

38.00			1685						530,006.00	945,622.00
39.00	N28A	1,627.00	RLUGO-1685	0.30	0.30	53.34	Fixed	1,679.95	530,064.00	944,168.00
40.00	N54B1'	1,634.00	RLUGO-1685	0.30	0.30	45.13	Fixed	1,679.19	529,930.00	945,127.00
41.00	N29A1	1,623.00	RLUGO-1685	0.30	0.30	56.59	Fixed	1,679.50	529,426.00	944,021.00
42.00	N65	1,636.00	RLUGO-1685	0.30	0.30	43.75	Fixed	1,679.48	528,993.00	945,237.00
43.00	N29	1,623.00	RLUGO-1685	0.30	0.30	57.17	Fixed	1,679.93	529,321.00	944,063.00
44.00	N45A'	1,642.00	RLUGO-1685	0.30	0.30	38.16	Fixed	1,679.79	527,062.00	943,421.00
45.00	N47A2	1,632.00	RLUGO-1685	0.30	0.30	47.06	Fixed	1,679.52	528,915.00	945,039.00
46.00	N69A2	1,642.00	RLUGO-1685	0.30	0.30	35.09	Fixed	1,677.42	530,495.00	945,397.00
47.00	N62	1,637.00	RLUGO-1685	0.30	0.30	41.79	Fixed	1,678.87	530,003.00	945,312.00
48.00	N81C	1,622.00	RLUGO-1685	0.30	0.30	58.73	Fixed	1,680.99	527,759.00	940,421.00
49.00	N55A	1,625.00	RLUGO-1685	0.30	0.30	54.45	Fixed	1,679.95	530,059.00	944,518.00
50.00	NG-55	1,647.00	RGA-1750	0.30	0.30	124.04	Fixed	1,771.29	526,776.00	943,375.00
51.00	NG-50	1,716.00	RGA-1750	0.30	0.30	40.78	Fixed	1,756.86	525,884.00	942,421.00
52.00	NG-52	1,709.00	RGA-1750	0.30	0.30	47.71	Fixed	1,756.81	525,829.00	942,178.00
53.00	NG-09	1,711.00	RGA-1750	0.30	0.30	46.06	Fixed	1,757.15	525,865.00	943,197.00
54.00	NG-75	1,706.00	RGA-1750	0.30	0.30	51.07	Fixed	1,757.18	525,942.00	943,284.00
55.00	NG-61	1,692.00	RGA-1750	0.30	0.30	73.24	Fixed	1,765.39	526,446.00	943,367.00
56.00	N55	1,625.00	RLUGO-1685	0.30	0.30	54.58	Fixed	1,679.94	530,069.00	944,514.00
57.00	NG-27	1,702.00	RGA-1750	0.30	0.30	54.87	Fixed	1,756.98	525,728.00	942,654.00
58.00	N39A7	1,616.00	RLUGO-1685	0.30	0.30	64.97	Fixed	1,681.55	527,756.00	942,300.00

59.00	N100R6	1,681.00	RCOL-1725	0.30	0.30	40.43	Fixed	1,721.13	531,238.00	946,799.00
60.00	N46A2	1,620.00	RLUGO-1685	0.30	0.30	61.27	Fixed	1,681.16	528,515.00	943,723.00
61.00	NG-40	1,706.00	RGA-1750	0.30	0.30	50.45	Fixed	1,756.82	526,396.00	943,262.00
62.00	N65B	1,635.00	RLUGO-1685	0.30	0.30	44.63	Fixed	1,679.49	529,076.00	945,205.00
63.00	N22A4	1,625.00	RLUGO-1685	0.30	0.30	54.62	Fixed	1,680.00	530,147.00	944,091.00
64.00	N65C	1,630.00	RLUGO-1685	0.30	0.30	49.16	Fixed	1,679.52	528,996.00	945,005.00
65.00	N14B3	1,620.00	RLUGO-1685	0.30	0.30	60.29	Fixed	1,680.49	529,468.00	942,911.00
66.00	N14B1	1,620.00	RLUGO-1685	0.30	0.30	60.51	Fixed	1,680.51	529,556.00	942,955.00
67.00	NG-39	1,703.00	RGA-1750	0.30	0.30	53.30	Fixed	1,756.60	526,080.00	942,315.00
68.00	N64A1	1,623.00	RLUGO-1685	0.30	0.30	56.42	Fixed	1,679.43	529,552.00	944,625.00
69.00	N54F	1,628.00	RLUGO-1685	0.30	0.30	50.89	Fixed	1,679.48	529,877.00	944,759.00
70.00	N24A1	1,606.00	RLUGO-1685	0.30	0.30	73.55	Fixed	1,679.79	531,761.00	943,988.00
71.00	N103C1	1,662.00	RCOL-1725	0.30	0.30	60.86	Fixed	1,722.98	530,150.00	946,173.00
72.00	N103C2	1,663.00	RCOL-1725	0.30	0.30	59.83	Fixed	1,722.97	530,202.00	946,166.00
73.00	N54A	1,630.00	RLUGO-1685	0.30	0.30	49.28	Fixed	1,679.35	529,841.00	944,899.00
74.00	N24D	1,607.00	RLUGO-1685	0.30	0.30	72.39	Fixed	1,679.62	531,771.00	944,049.00
75.00	N38A3	1,619.00	RLUGO-1685	0.30	0.30	62.76	Fixed	1,681.41	527,797.00	942,584.00
76.00	N30	1,621.00	RLUGO-1685	0.30	0.30	59.25	Fixed	1,680.33	529,500.00	943,889.00
77.00	N28B1	1,623.00	RLUGO-1685	0.30	0.30	57.51	Fixed	1,680.13	529,620.00	943,968.00
78.00	N54D	1,629.00	RLUGO-1685	0.30	0.30	50.67	Fixed	1,679.57	529,995.00	944,712.00
	N38A1	1,620.00	RLUGO-	0.30	0.30	60.85	Fixed	1,681.40		

79.00			1685						527,696.00	942,460.00
80.00	N47B	1,627.00	RLUGO-1685	0.30	0.30	53.40	Fixed	1,680.22	528,375.00	944,440.00
81.00	N47C	1,623.00	RLUGO-1685	0.30	0.30	56.45	Fixed	1,679.91	528,471.00	944,401.00
82.00	N107	1,656.00	RCOL-1725	0.40	0.40	66.80	Fixed	1,723.00	530,013.00	946,276.00
83.00	N39A6	1,613.00	RLUGO-1685	0.40	0.40	68.12	Fixed	1,681.60	527,978.00	942,247.00
84.00	N28A'	1,626.00	RLUGO-1685	0.40	0.40	53.86	Fixed	1,679.97	529,938.00	944,218.00
85.00	N30A5	1,622.00	RLUGO-1685	0.40	0.40	58.24	Fixed	1,680.48	529,427.00	943,779.00
86.00	N37	1,616.00	RLUGO-1685	0.40	0.40	65.82	Fixed	1,681.55	527,887.00	942,274.00
87.00	N51A	1,625.00	RLUGO-1685	0.40	0.40	54.23	Fixed	1,679.53	529,144.00	944,788.00
88.00	N103C	1,667.00	RCOL-1725	0.40	0.40	55.94	Fixed	1,723.00	530,162.00	946,263.00
89.00	N35A	1,615.00	RLUGO-1685	0.40	0.40	65.87	Fixed	1,681.17	528,332.00	943,331.00
90.00	N43B3	1,617.00	RLUGO-1685	0.40	0.40	64.19	Fixed	1,681.19	528,280.00	943,219.00
91.00	N52B'	1,622.00	RLUGO-1685	0.40	0.40	57.38	Fixed	1,679.56	529,054.00	944,563.00
92.00	N54E	1,625.00	RLUGO-1685	0.40	0.40	54.52	Fixed	1,679.63	529,934.00	944,558.00
93.00	N39B4	1,621.00	RLUGO-1685	0.40	0.40	60.22	Fixed	1,681.48	527,607.00	942,378.00
94.00	N32B	1,621.00	RLUGO-1685	0.40	0.40	59.68	Fixed	1,680.43	529,278.00	943,940.00
95.00	N54D'	1,631.00	RLUGO-1685	0.40	0.40	47.66	Fixed	1,679.07	530,131.00	945,049.00
96.00	N21B	1,606.00	RLUGO-1685	0.40	0.40	63.89	Fixed	1,670.23	531,221.00	943,535.00
97.00	N63B'	1,644.00	RLUGO-1685	0.40	0.40	31.97	Fixed	1,676.26	529,627.00	945,853.00
98.00	N29B	1,623.00	RLUGO-1685	0.40	0.40	56.52	Fixed	1,679.78	529,690.00	944,315.00
99.00	N63B'1	1,644.00	RLUGO-1685	0.40	0.40	32.53	Fixed	1,676.33	529,595.00	945,837.00

100.00	N15F	1,666.00	RLUGO-1685	0.40	0.40	17.57	Fixed	1,683.18	528,662.00	940,832.00
101.00	N57A	1,619.00	RLUGO-1685	0.40	0.40	60.76	Fixed	1,679.84	530,934.00	944,355.00
102.00	N57A'	1,616.00	RLUGO-1685	0.40	0.40	63.38	Fixed	1,679.83	531,038.00	944,317.00
103.00	N22A2	1,623.00	RLUGO-1685	0.40	0.40	56.67	Fixed	1,679.96	530,325.00	944,113.00
104.00	N61A	1,637.00	RLUGO-1685	0.40	0.40	41.77	Fixed	1,678.85	530,202.00	945,232.00
105.00	N15F2	1,683.00	RLUGO-1685	0.40	0.40	(0.02)	Fixed	1,682.98	528,855.00	940,791.00
106.00	N54B1	1,635.00	RLUGO-1685	0.40	0.40	44.57	Fixed	1,679.24	529,898.00	945,046.00
107.00	NG-35	1,701.00	RGA-1750	0.40	0.40	55.72	Fixed	1,756.83	525,861.00	942,290.00
108.00	N64A2	1,626.00	RLUGO-1685	0.40	0.40	53.75	Fixed	1,679.39	529,602.00	944,702.00
109.00	N81B	1,634.00	RLUGO-1685	0.40	0.40	48.12	Fixed	1,682.01	528,061.00	940,774.00
110.00	N27C	1,618.00	RLUGO-1685	0.40	0.40	61.40	Fixed	1,679.88	530,668.00	944,185.00
111.00	N30A8	1,624.00	RLUGO-1685	0.40	0.40	56.14	Fixed	1,680.50	529,130.00	943,717.00
112.00	N64A	1,633.00	RLUGO-1685	0.40	0.40	46.65	Fixed	1,679.48	529,273.00	945,128.00
113.00	N43A2	1,633.00	RLUGO-1685	0.40	0.40	47.69	Fixed	1,680.55	527,472.00	943,437.00
114.00	N24C	1,607.00	RLUGO-1685	0.40	0.40	72.90	Fixed	1,679.79	531,580.00	944,069.00
115.00	N48	1,626.00	RLUGO-1685	0.40	0.40	18.18	Fixed	1,643.86	528,266.00	944,578.00
116.00	N24A	1,607.00	RLUGO-1685	0.40	0.40	72.62	Fixed	1,679.79	531,572.00	944,013.00
117.00	N22A5	1,624.00	RLUGO-1685	0.40	0.40	55.92	Fixed	1,680.06	529,853.00	944,026.00
118.00	N48B	1,624.00	RLUGO-1685	0.40	0.40	20.07	Fixed	1,643.81	528,237.00	944,498.00
119.00	N43A3	1,634.00	RLUGO-1685	0.40	0.40	46.77	Fixed	1,680.46	527,418.00	943,233.00
	N32	1,619.00	RLUGO-	0.40	0.40	61.33	Fixed	1,680.44		

120.00			1685						528,780.00	943,828.00
121.00	N43A4	1,635.00	RLUGO-1685	0.40	0.40	45.26	Fixed	1,680.44	527,360.00	943,249.00
122.00	N43A6	1,636.00	RLUGO-1685	0.40	0.40	44.97	Fixed	1,680.56	527,314.00	943,076.00
123.00	N63A1	1,634.00	RLUGO-1685	0.40	0.40	45.50	Fixed	1,679.17	529,580.00	945,264.00
124.00	N28C	1,624.00	RLUGO-1685	0.40	0.40	55.66	Fixed	1,679.77	529,812.00	944,268.00
125.00	N4	1,602.00	RLUGO-1685	0.40	0.40	71.79	Fixed	1,673.50	530,200.00	941,852.00
126.00	N35	1,617.00	RLUGO-1685	0.40	0.40	63.72	Fixed	1,681.17	528,256.00	943,354.00
127.00	N43B4	1,617.00	RLUGO-1685	0.40	0.40	64.26	Fixed	1,681.21	528,181.00	943,252.00
128.00	N6	1,602.00	RLUGO-1685	0.40	0.40	70.11	Fixed	1,672.40	530,367.00	941,892.00
129.00	N11	1,618.00	RLUGO-1685	0.40	0.40	61.44	Fixed	1,679.79	529,391.00	942,742.00
130.00	N31	1,616.00	RLUGO-1685	0.40	0.40	63.91	Fixed	1,680.51	529,021.00	943,837.00
131.00	N11A	1,622.00	RLUGO-1685	0.40	0.40	58.09	Fixed	1,680.21	529,277.00	942,786.00
132.00	N7A	1,601.00	RLUGO-1685	0.40	0.40	71.63	Fixed	1,672.46	530,502.00	942,077.00
133.00	N11A2	1,618.00	RLUGO-1685	0.40	0.40	61.98	Fixed	1,679.92	529,430.00	942,842.00
134.00	N64D	1,627.00	RLUGO-1685	0.40	0.40	51.78	Fixed	1,679.37	529,391.00	944,850.00
135.00	N46	1,619.00	RLUGO-1685	0.40	0.40	60.92	Fixed	1,680.49	528,412.00	943,743.00
136.00	N7D	1,602.00	RLUGO-1685	0.40	0.40	69.85	Fixed	1,672.46	530,460.00	941,998.00
137.00	N7B1	1,606.00	RLUGO-1685	0.50	0.50	68.25	Fixed	1,674.60	530,117.00	942,280.00
138.00	N7AB	1,604.00	RLUGO-1685	0.50	0.50	69.74	Fixed	1,674.01	530,285.00	942,278.00
139.00	N7B	1,603.00	RLUGO-1685	0.50	0.50	71.32	Fixed	1,674.12	530,266.00	942,223.00
140.00	N64B	1,630.00	RLUGO-1685	0.50	0.50	48.81	Fixed	1,679.35	529,707.00	944,952.00

141.00	N8A	1,612.00	RLUGO-1685	0.50	0.50	63.33	Fixed	1,675.21	529,977.00	942,355.00
142.00	N81E	1,630.00	RLUGO-1685	0.50	0.50	50.76	Fixed	1,681.20	527,849.00	940,531.00
143.00	N52'	1,626.00	RLUGO-1685	0.50	0.50	53.70	Fixed	1,679.49	529,335.00	944,711.00
144.00	N43A7	1,630.00	RLUGO-1685	0.50	0.50	50.55	Fixed	1,680.71	527,479.00	943,022.00
145.00	N67C	1,650.00	RLUGO-1685	0.50	0.50	27.73	Fixed	1,677.98	529,684.00	946,136.00
146.00	N14B	1,621.00	RLUGO-1685	0.50	0.50	59.47	Fixed	1,680.59	529,373.00	943,028.00
147.00	N52D	1,622.00	RLUGO-1685	0.50	0.50	57.50	Fixed	1,679.62	528,931.00	944,612.00
148.00	N64B1	1,631.00	RLUGO-1685	0.50	0.50	48.53	Fixed	1,679.35	529,472.00	945,049.00
149.00	N56B1	1,628.00	RLUGO-1685	0.50	0.50	52.26	Fixed	1,679.87	530,246.00	944,627.00
150.00	N22B	1,615.00	RLUGO-1685	0.50	0.50	64.83	Fixed	1,679.88	530,849.00	944,095.00
151.00	N53B	1,620.00	RLUGO-1685	0.50	0.50	59.94	Fixed	1,680.06	528,795.00	944,273.00
152.00	N39A3	1,616.00	RLUGO-1685	0.50	0.50	66.11	Fixed	1,681.92	527,691.00	941,894.00
153.00	N39A4	1,614.00	RLUGO-1685	0.50	0.50	67.25	Fixed	1,681.79	527,731.00	942,106.00
154.00	N22C	1,613.00	RLUGO-1685	0.50	0.50	66.45	Fixed	1,679.87	530,938.00	944,082.00
155.00	N39A5	1,614.00	RLUGO-1685	0.50	0.50	67.07	Fixed	1,681.69	527,926.00	942,059.00
156.00	N29B'	1,622.00	RLUGO-1685	0.50	0.50	57.75	Fixed	1,679.48	529,568.00	944,363.00
157.00	N68C1	1,639.00	RLUGO-1685	0.50	0.50	40.40	Fixed	1,679.04	529,649.00	945,451.00
158.00	N24E2	1,617.00	RLUGO-1685	0.50	0.50	62.60	Fixed	1,679.59	531,820.00	944,352.00
159.00	N46A1	1,620.00	RLUGO-1685	0.50	0.50	60.94	Fixed	1,681.16	528,422.00	943,703.00
160.00	N45'	1,642.00	RLUGO-1685	0.50	0.50	33.12	Fixed	1,675.03	527,089.00	943,742.00
	N45'A	1,642.00	RLUGO-	0.50	0.50	33.54	Fixed	1,675.67		

161.00			1685						526,900.00	943,704.00
162.00	N55B	1,631.00	RLUGO-1685	0.50	0.50	48.99	Fixed	1,679.80	530,616.00	944,762.00
163.00	N43A5	1,644.00	RLUGO-1685	0.50	0.50	35.35	Fixed	1,679.91	527,039.00	943,337.00
164.00	N56A	1,631.00	RLUGO-1685	0.50	0.50	48.52	Fixed	1,679.81	530,342.00	944,867.00
165.00	NG-41	1,728.00	RGA-1750	0.50	0.50	28.64	Fixed	1,756.70	524,969.00	942,909.00
166.00	N38B	1,616.00	RLUGO-1685	0.50	0.50	65.57	Fixed	1,681.43	527,965.00	942,522.00
167.00	N45	1,649.00	RLUGO-1685	0.50	0.50	30.35	Fixed	1,679.46	526,944.00	943,394.00
168.00	N24B	1,617.00	RLUGO-1685	0.60	0.60	62.57	Fixed	1,679.70	531,627.00	944,402.00
169.00	N43A	1,622.00	RLUGO-1685	0.60	0.60	59.15	Fixed	1,680.88	527,806.00	943,142.00
170.00	N32C	1,620.00	RLUGO-1685	0.60	0.60	59.68	Fixed	1,679.94	529,114.00	944,147.00
171.00	N81B1	1,621.00	RLUGO-1685	0.60	0.60	59.86	Fixed	1,681.41	527,897.00	940,944.00
172.00	N67A	1,638.00	RLUGO-1685	0.60	0.60	39.97	Fixed	1,678.01	529,721.00	945,624.00
173.00	N43	1,622.00	RLUGO-1685	0.60	0.60	58.89	Fixed	1,681.00	527,747.00	942,943.00
174.00	N67	1,639.00	RLUGO-1685	0.60	0.60	39.15	Fixed	1,678.02	529,739.00	945,670.00
175.00	N65A	1,638.00	RLUGO-1685	0.60	0.60	41.86	Fixed	1,679.45	529,049.00	945,380.00
176.00	N31B	1,618.00	RLUGO-1685	0.60	0.60	62.21	Fixed	1,680.71	529,463.00	943,253.00
177.00	N106A"	1,656.00	RCOL-1725	0.60	0.60	63.26	Fixed	1,719.59	531,138.00	945,956.00
178.00	N24E1	1,614.00	RLUGO-1685	0.60	0.60	65.54	Fixed	1,679.58	531,794.00	944,238.00
179.00	IAU-01	1,646.00	RCOL-1725	0.60	0.60	72.01	Fixed	1,718.26	531,049.00	945,223.00
180.00	N101	1,674.00	RCOL-1725	0.60	0.60	47.13	Fixed	1,721.13	531,173.00	946,619.00
181.00	N52B	1,622.00	RLUGO-1685	0.60	0.60	57.17	Fixed	1,679.50	529,247.00	944,488.00

182.00	N81D	1,623.00	RLUGO-1685	0.60	0.60	57.10	Fixed	1,680.69	527,676.00	940,314.00
183.00	N52A	1,621.00	RLUGO-1685	0.60	0.60	58.37	Fixed	1,679.50	529,193.00	944,346.00
184.00	N46B	1,618.00	RLUGO-1685	0.60	0.60	62.13	Fixed	1,680.40	528,472.00	943,899.00
185.00	N32A	1,619.00	RLUGO-1685	0.60	0.60	61.51	Fixed	1,680.37	528,828.00	943,989.00
186.00	N39B	1,624.00	RLUGO-1685	0.60	0.60	57.56	Fixed	1,681.58	527,452.00	942,327.00
187.00	N47A	1,617.00	RLUGO-1685	0.60	0.60	63.18	Fixed	1,680.32	528,550.00	944,102.00
188.00	N22D	1,610.00	RLUGO-1685	0.60	0.60	69.76	Fixed	1,679.88	530,812.00	943,817.00
189.00	N22E	1,608.00	RLUGO-1685	0.60	0.60	63.64	Fixed	1,671.33	530,905.00	943,787.00
190.00	N56A1	1,633.00	RLUGO-1685	0.60	0.60	45.51	Fixed	1,678.99	530,379.00	944,953.00
191.00	N25A	1,606.00	RLUGO-1685	0.60	0.60	73.55	Fixed	1,679.78	531,979.00	943,848.00
192.00	N43B2	1,615.00	RLUGO-1685	0.60	0.60	65.62	Fixed	1,681.01	528,442.00	942,958.00
193.00	N43B1	1,614.00	RLUGO-1685	0.60	0.60	67.24	Fixed	1,681.01	528,289.00	943,001.00
194.00	N30A7	1,620.00	RLUGO-1685	0.60	0.60	60.22	Fixed	1,680.34	529,541.00	943,724.00
195.00	N47A1	1,630.00	RLUGO-1685	0.60	0.60	49.89	Fixed	1,679.60	528,860.00	944,899.00
196.00	N55A'	1,627.00	RLUGO-1685	0.70	0.70	52.50	Fixed	1,679.87	530,525.00	944,518.00
197.00	N57	1,621.00	RLUGO-1685	0.70	0.70	58.72	Fixed	1,679.86	530,765.00	944,422.00
198.00	N106A'	1,665.00	RCOL-1725	0.70	0.70	55.33	Fixed	1,720.42	531,028.00	946,247.00
199.00	N64E	1,628.00	RLUGO-1685	0.70	0.70	51.21	Fixed	1,679.51	529,197.00	944,927.00
200.00	N27B3	1,626.00	RLUGO-1685	0.70	0.70	53.95	Fixed	1,679.90	530,434.00	944,275.00
201.00	N44A1	1,620.00	RLUGO-1685	0.70	0.70	60.53	Fixed	1,680.64	527,941.00	943,591.00
	N27B2	1,630.00	RLUGO-	0.70	0.70	49.81	Fixed	1,679.92		

202.00			1685						530,333.00	944,416.00
203.00	N21C	1,604.00	RLUGO-1685	0.70	0.70	65.84	Fixed	1,669.92	531,384.00	943,523.00
204.00	N63A	1,630.00	RLUGO-1685	0.70	0.70	48.73	Fixed	1,679.33	529,531.00	945,198.00
205.00	N21D	1,603.00	RLUGO-1685	0.70	0.70	66.68	Fixed	1,669.82	531,566.00	943,468.00
206.00	N46B1	1,622.00	RLUGO-1685	0.70	0.70	57.93	Fixed	1,680.31	528,207.00	944,001.00
207.00	N15A	1,628.00	RLUGO-1685	0.70	0.70	54.04	Fixed	1,682.02	528,740.00	941,703.00
208.00	N15B2	1,638.00	RLUGO-1685	0.70	0.70	44.19	Fixed	1,682.06	528,839.00	941,464.00
209.00	N15B1	1,639.00	RLUGO-1685	0.70	0.70	43.48	Fixed	1,682.35	528,824.00	941,461.00
210.00	N10A2	1,626.00	RLUGO-1685	0.70	0.70	50.67	Fixed	1,676.57	529,860.00	942,519.00
211.00	N10	1,627.00	RLUGO-1685	0.70	0.70	50.81	Fixed	1,677.67	529,789.00	942,715.00
212.00	N15	1,625.00	RLUGO-1685	0.70	0.70	57.14	Fixed	1,682.03	528,611.00	941,712.00
213.00	N20B	1,607.00	RLUGO-1685	0.70	0.70	63.52	Fixed	1,670.95	531,159.00	943,717.00
214.00	N20A	1,605.00	RLUGO-1685	0.70	0.70	65.21	Fixed	1,670.55	531,123.00	943,573.00
215.00	N81D1	1,614.00	RLUGO-1685	0.70	0.70	66.49	Fixed	1,680.80	527,460.00	940,507.00
216.00	N14A	1,623.00	RLUGO-1685	0.70	0.70	57.31	Fixed	1,680.89	529,162.00	943,111.00
217.00	ILu-01	1,619.00	RLUGO-1685	0.70	0.70	62.27	Fixed	1,680.99	529,419.00	942,275.00
218.00	N31C	1,624.00	RLUGO-1685	0.70	0.70	56.76	Fixed	1,680.64	529,364.00	943,622.00
219.00	N106A	1,663.00	RCOL-1725	0.70	0.70	57.36	Fixed	1,720.43	530,904.00	946,292.00
220.00	ILEBO-01	1,617.00	RLUGO-1685	0.70	0.70	57.60	Fixed	1,674.61	529,653.00	940,823.00
221.00	N30A	1,622.00	RLUGO-1685	0.70	0.70	58.22	Fixed	1,680.23	529,526.00	943,947.00
222.00	N49	1,622.00	RLUGO-1685	0.70	0.70	58.75	Fixed	1,680.55	528,211.00	944,430.00

223.00	N30A2	1,622.00	RLUGO-1685	0.70	0.70	58.30	Fixed	1,680.36	529,470.00	943,888.00
224.00	N22D1	1,614.00	RLUGO-1685	0.70	0.70	65.94	Fixed	1,679.88	530,632.00	943,866.00
225.00	N43B	1,619.00	RLUGO-1685	0.80	0.80	62.47	Fixed	1,681.25	528,125.00	943,052.00
226.00	N15D2	1,659.00	RLUGO-1685	0.80	0.80	23.55	Fixed	1,682.71	528,999.00	941,003.00
227.00	N15D	1,651.00	RLUGO-1685	0.80	0.80	31.63	Fixed	1,682.64	528,904.00	941,089.00
228.00	N15A1	1,657.00	RLUGO-1685	0.80	0.80	25.88	Fixed	1,682.76	528,791.00	941,071.00
229.00	N31A	1,626.00	RLUGO-1685	0.80	0.80	54.61	Fixed	1,680.78	529,248.00	943,334.00
230.00	N59	1,622.00	RLUGO-1685	0.80	0.80	57.83	Fixed	1,679.78	531,354.00	944,531.00
231.00	N58	1,629.00	RLUGO-1685	0.80	0.80	50.64	Fixed	1,679.80	530,863.00	944,665.00
232.00	N81C3	1,633.00	RLUGO-1685	0.80	0.80	48.20	Fixed	1,681.06	527,933.00	940,424.00
233.00	N15E	1,677.00	RLUGO-1685	0.80	0.80	5.96	Fixed	1,682.85	529,008.00	940,771.00
234.00	N36	1,615.00	RLUGO-1685	0.80	0.80	66.66	Fixed	1,681.34	528,035.00	942,744.00
235.00	N44B2	1,635.00	RLUGO-1685	0.80	0.80	44.08	Fixed	1,679.27	527,339.00	943,716.00
236.00	N111C	1,642.00	RCOL-1725	0.80	0.80	76.82	Fixed	1,718.68	530,775.00	945,088.00
237.00	N44A	1,634.00	RLUGO-1685	0.80	0.80	45.69	Fixed	1,679.91	527,383.00	943,496.00
238.00	N47	1,623.00	RLUGO-1685	0.80	0.80	57.12	Fixed	1,680.23	528,641.00	944,336.00
239.00	N111A'	1,649.00	RCOL-1725	0.80	0.80	69.72	Fixed	1,718.92	530,942.00	945,486.00
240.00	N111A	1,651.00	RCOL-1725	0.80	0.80	68.07	Fixed	1,719.01	530,975.00	945,569.00
241.00	N15F7	1,682.00	RLUGO-1685	0.80	0.80	2.82	Fixed	1,684.60	528,897.00	940,535.00
242.00	N68A2	1,641.00	RLUGO-1685	0.80	0.80	36.82	Fixed	1,678.10	529,939.00	945,444.00
	N68C	1,646.00	RLUGO-	0.80	0.80	32.28	Fixed	1,678.42		

243.00			1685						530,108.00	945,583.00
244.00	N105D	1,685.00	RCOL-1725	0.90	0.90	32.50	Fixed	1,717.56	530,778.00	947,815.00
245.00	N33	1,619.00	RLUGO-1685	0.90	0.90	62.33	Fixed	1,681.01	528,778.00	943,784.00
246.00	N12A	1,627.00	RLUGO-1685	0.90	0.90	54.73	Fixed	1,681.94	528,985.00	941,654.00
247.00	N2	1,633.00	RLUGO-1685	0.90	0.90	48.70	Fixed	1,682.09	528,962.00	941,481.00
248.00	N12A1	1,626.00	RLUGO-1685	0.90	0.90	55.77	Fixed	1,681.75	529,144.00	941,623.00
249.00	N70'	1,651.00	RCOL-1725	0.90	0.90	66.91	Fixed	1,718.38	531,124.00	945,415.00
250.00	N70	1,652.00	RCOL-1725	0.90	0.90	66.03	Fixed	1,718.37	531,150.00	945,405.00
251.00	N59A	1,616.00	RLUGO-1685	0.90	0.90	64.01	Fixed	1,679.80	531,293.00	944,290.00
252.00	N81F	1,618.00	RLUGO-1685	0.90	0.90	62.74	Fixed	1,681.03	527,654.00	940,701.00
253.00	N7A1	1,602.00	RLUGO-1685	0.90	0.90	68.20	Fixed	1,669.99	530,606.00	942,043.00
254.00	N15F5	1,672.00	RLUGO-1685	1.00	1.00	11.16	Fixed	1,683.64	528,585.00	940,558.00
255.00	N15F4	1,670.00	RLUGO-1685	1.00	1.00	13.68	Fixed	1,683.44	528,590.00	940,681.00
256.00	N103B	1,667.00	RCOL-1725	1.00	1.00	55.11	Fixed	1,722.41	530,683.00	946,354.00
257.00	N7C	1,604.00	RLUGO-1685	1.00	1.00	69.87	Fixed	1,673.51	530,219.00	942,097.00
258.00	N3F	1,597.00	RLUGO-1685	1.00	1.00	26.36	Fixed	1,623.54	531,318.00	941,449.00
259.00	N3I	1,603.00	RLUGO-1685	1.00	1.00	10.37	Fixed	1,613.45	531,561.00	941,133.00
260.00	N3H	1,594.00	RLUGO-1685	1.00	1.00	24.54	Fixed	1,618.20	531,538.00	941,439.00
261.00	N10A	1,617.00	RLUGO-1685	1.00	1.00	61.20	Fixed	1,678.74	529,581.00	942,668.00
262.00	N71B	1,639.00	RCOL-1725	1.00	1.00	69.56	Fixed	1,708.56	531,966.00	945,083.00
263.00	N71BC	1,641.00	RCOL-1725	1.00	1.00	67.67	Fixed	1,708.53	531,906.00	945,107.00

264.00	N108A	1,656.00	RCOL-1725	1.00	1.00	66.85	Fixed	1,722.97	529,446.00	946,118.00
265.00	N24E	1,614.00	RLUGO-1685	1.00	1.00	65.94	Fixed	1,679.79	531,608.00	944,242.00
266.00	N6A1	1,598.00	RLUGO-1685	1.00	1.00	68.08	Fixed	1,666.03	530,777.00	941,760.00
267.00	N6A	1,598.00	RLUGO-1685	1.00	1.00	66.65	Fixed	1,664.36	530,891.00	941,862.00
268.00	N67E1	1,647.00	RLUGO-1685	1.00	1.00	30.46	Fixed	1,677.98	529,878.00	946,027.00
269.00	N38A	1,621.00	RLUGO-1685	1.00	1.00	60.18	Fixed	1,681.39	527,546.00	942,515.00
270.00	N36A	1,613.00	RLUGO-1685	1.10	1.10	67.48	Fixed	1,681.01	528,208.00	942,698.00
271.00	N43A1	1,624.00	RLUGO-1685	1.10	1.10	56.62	Fixed	1,680.76	527,864.00	943,337.00
272.00	N24	1,611.00	RLUGO-1685	1.10	1.10	68.87	Fixed	1,679.82	531,237.00	944,049.00
273.00	N14	1,628.00	RLUGO-1685	1.10	1.10	52.50	Fixed	1,681.01	529,069.00	942,868.00
274.00	N6B4	1,598.00	RLUGO-1685	1.10	1.10	68.58	Fixed	1,666.71	531,084.00	942,513.00
275.00	N78	1,640.00	RCOL-1725	1.10	1.10	78.06	Fixed	1,718.22	530,967.00	945,012.00
276.00	NG-53	1,640.00	RGA-1750	1.10	1.10	133.35	Fixed	1,773.62	526,897.00	943,385.00
277.00	N6B1	1,599.00	RLUGO-1685	1.10	1.10	65.42	Fixed	1,664.44	531,047.00	942,121.00
278.00	N102A	1,657.00	RCOL-1725	1.10	1.10	62.88	Fixed	1,719.55	531,127.00	945,926.00
279.00	N44	1,621.00	RLUGO-1685	1.20	1.20	59.24	Fixed	1,680.62	527,955.00	943,638.00
280.00	NG-37	1,707.00	RGA-1750	1.20	1.20	49.94	Fixed	1,756.87	526,313.00	942,671.00
281.00	N38A2	1,618.00	RLUGO-1685	1.20	1.20	63.37	Fixed	1,681.40	527,752.00	942,439.00
282.00	N82C	1,613.00	RLUGO-1685	1.20	1.20	69.95	Fixed	1,682.71	527,645.00	941,144.00
283.00	N82A	1,613.00	RLUGO-1685	1.20	1.20	69.32	Fixed	1,682.86	527,790.00	941,308.00
	N103A	1,667.00	RCOL-1725	1.20	1.20	55.27	Fixed	1,722.49		

284.00									530,448.00	946,449.00
285.00	N68D	1,650.00	RLUGO-1685	1.20	1.20	27.77	Fixed	1,678.15	530,175.00	945,752.00
286.00	N3B	1,595.00	RLUGO-1685	1.20	1.20	29.48	Fixed	1,624.73	531,199.00	941,269.00
287.00	N6C	1,598.00	RLUGO-1685	1.20	1.20	26.83	Fixed	1,624.41	531,141.00	941,382.00
288.00	N7	1,600.00	RLUGO-1685	1.20	1.20	73.35	Fixed	1,673.50	530,560.00	942,187.00
289.00	N17B	1,621.00	RLUGO-1685	1.20	1.20	52.19	Fixed	1,673.75	530,272.00	943,583.00
290.00	N21	1,612.00	RLUGO-1685	1.20	1.20	61.89	Fixed	1,673.72	530,423.00	943,523.00
291.00	N39A1	1,615.00	RLUGO-1685	1.20	1.20	67.15	Fixed	1,682.13	527,608.00	941,571.00
292.00	N36A2	1,620.00	RLUGO-1685	1.20	1.20	61.38	Fixed	1,681.00	528,800.00	942,973.00
293.00	N51B	1,631.00	RLUGO-1685	1.30	1.30	38.38	Fixed	1,668.97	528,692.00	944,962.00
294.00	N106	1,672.00	RCOL-1725	1.30	1.30	49.30	Fixed	1,721.16	531,051.00	946,666.00
295.00	N34	1,615.00	RLUGO-1685	1.30	1.30	65.41	Fixed	1,681.03	528,567.00	943,260.00
296.00	N31D	1,622.00	RLUGO-1685	1.30	1.30	58.51	Fixed	1,680.35	529,590.00	943,531.00
297.00	N18A	1,603.00	RLUGO-1685	1.30	1.30	70.13	Fixed	1,673.29	530,626.00	943,037.00
298.00	N103	1,665.00	RCOL-1725	1.30	1.30	57.78	Fixed	1,723.02	530,357.00	946,222.00
299.00	N20	1,606.00	RLUGO-1685	1.40	1.40	65.31	Fixed	1,671.66	531,051.00	943,286.00
300.00	N39	1,617.00	RLUGO-1685	1.40	1.40	65.69	Fixed	1,682.50	527,341.00	941,279.00
301.00	N19	1,599.00	RLUGO-1685	1.40	1.40	72.70	Fixed	1,672.32	530,958.00	942,913.00
302.00	NN-01	1,615.00	RLUGO-1685	1.40	1.40	60.21	Fixed	1,675.38	529,583.00	941,019.00
303.00	N42	1,624.00	RLUGO-1685	1.40	1.40	56.57	Fixed	1,681.08	527,713.00	942,828.00
304.00	N18C	1,599.00	RLUGO-1685	1.50	1.50	71.36	Fixed	1,670.96	530,515.00	942,747.00

305.00	N105A	1,685.00	RCOL-1725	1.50	1.50	35.72	Fixed	1,720.48	530,702.00	947,099.00
306.00	N44B	1,620.00	RLUGO-1685	1.50	1.50	59.97	Fixed	1,680.55	528,050.00	943,989.00
307.00	N44B4	1,625.00	RLUGO-1685	1.50	1.50	53.53	Fixed	1,679.13	527,710.00	944,044.00
308.00	N44B3	1,631.00	RLUGO-1685	1.50	1.50	47.75	Fixed	1,679.00	527,384.00	944,038.00
309.00	N18B	1,606.00	RLUGO-1685	1.50	1.50	65.29	Fixed	1,671.78	530,760.00	943,395.00
310.00	N71	1,657.00	RCOL-1725	1.50	1.50	60.99	Fixed	1,718.50	531,322.00	945,834.00
311.00	N39B1	1,624.00	RLUGO-1685	1.50	1.50	58.13	Fixed	1,681.75	527,401.00	942,156.00
312.00	N36A1	1,616.00	RLUGO-1685	1.50	1.50	65.19	Fixed	1,681.00	528,619.00	942,587.00
313.00	N17	1,621.00	RLUGO-1685	1.60	1.60	53.04	Fixed	1,674.20	530,098.00	943,251.00
314.00	N18	1,613.00	RLUGO-1685	1.60	1.60	61.10	Fixed	1,674.31	530,285.00	943,165.00
315.00	N105A4	1,685.00	RCOL-1725	1.60	1.60	32.06	Fixed	1,717.46	530,683.00	947,854.00
316.00	N102	1,659.00	RCOL-1725	1.60	1.60	60.61	Fixed	1,720.19	530,810.00	946,057.00
317.00	N105C1	1,689.00	RCOL-1725	1.60	1.60	29.84	Fixed	1,718.63	530,827.00	947,413.00
318.00	N9	1,614.00	RLUGO-1685	1.70	1.70	61.76	Fixed	1,675.66	530,031.00	942,497.00
319.00	N50	1,636.00	RLUGO-1685	1.70	1.70	11.06	Fixed	1,646.73	528,398.00	945,080.00
320.00	N16A	1,622.00	RLUGO-1685	1.70	1.70	58.42	Fixed	1,680.24	529,675.00	943,188.00
321.00	NN-02	1,620.00	RLUGO-1685	1.70	1.70	50.54	Fixed	1,670.64	529,771.00	940,565.00
322.00	N69	1,640.00	RLUGO-1685	1.70	1.70	36.91	Fixed	1,677.32	530,510.00	945,300.00
323.00	N105	1,676.00	RCOL-1725	1.70	1.70	45.61	Fixed	1,721.67	530,599.00	946,836.00
324.00	N39A	1,621.00	RLUGO-1685	1.70	1.70	60.83	Fixed	1,682.30	527,350.00	941,590.00
	N109	1,657.00	RCOL-1725	1.80	1.80	60.05	Fixed	1,716.93		

325.00									532,088.00	945,538.00
326.00	N111	1,648.00	RCOL-1725	1.80	1.80	70.50	Fixed	1,719.01	530,663.00	945,687.00
327.00	N4B	1,615.00	RLUGO-1685	1.80	1.80	51.57	Fixed	1,666.31	529,642.00	941,343.00
328.00	N100R5	1,684.00	RCOL-1725	1.80	1.80	36.63	Fixed	1,721.13	531,352.00	946,752.00
329.00	N81	1,632.00	RLUGO-1685	1.90	1.90	50.68	Fixed	1,683.22	528,189.00	940,928.00
330.00	N3J	1,612.00	RLUGO-1685	1.90	1.90	(4.20)	Fixed	1,607.86	531,781.00	940,966.00
331.00	N3J1	1,632.00	RLUGO-1685	1.90	1.90	(16.44)	Fixed	1,615.53	531,828.00	941,426.00
332.00	N9B	1,599.00	RLUGO-1685	2.00	2.00	73.41	Fixed	1,672.33	530,795.00	942,634.00
333.00	N71'	1,657.00	RCOL-1725	2.00	2.00	60.71	Fixed	1,717.54	531,709.00	945,680.00
334.00	N109B	1,644.00	RCOL-1725	2.00	2.00	73.44	Fixed	1,717.58	531,552.00	945,244.00
335.00	N6B3	1,597.00	RLUGO-1685	2.00	2.00	68.07	Fixed	1,665.23	531,211.00	942,456.00
336.00	N106B	1,678.00	RCOL-1725	2.20	2.20	42.24	Fixed	1,719.89	531,151.00	946,920.00
337.00	N12	1,621.00	RLUGO-1685	2.30	2.30	59.65	Fixed	1,680.99	529,233.00	942,335.00
338.00	N12A4	1,623.00	RLUGO-1685	2.30	2.30	58.21	Fixed	1,681.33	529,105.00	942,008.00
339.00	N13	1,633.00	RLUGO-1685	2.40	2.40	48.10	Fixed	1,681.30	528,911.00	942,465.00
340.00	N77	1,625.00	RCOL-1725	2.50	2.50	83.29	Fixed	1,708.34	531,598.00	944,725.00
341.00	N105A2	1,674.00	RCOL-1725	2.60	2.60	43.65	Fixed	1,717.74	530,435.00	947,228.00
342.00	N105C'	1,702.00	RCOL-1725	2.70	2.70	15.78	Fixed	1,717.49	531,414.00	947,558.00
343.00	N3G	1,616.00	RLUGO-1685	3.10	3.10	(9.73)	Fixed	1,605.95	531,677.00	940,693.00
344.00	N3	1,601.00	RLUGO-1685	3.20	3.20	49.59	Fixed	1,650.69	530,571.00	941,027.00
345.00	N3B2	1,601.00	RLUGO-1685	3.20	3.20	42.56	Fixed	1,643.36	530,847.00	940,934.00

346.00	ILEBO-23	1,596.00	RLUGO-1685	3.20	3.20	28.43	Fixed	1,623.99	531,350.00	941,093.00
347.00	N4A	1,602.00	RLUGO-1685	3.30	3.30	64.40	Fixed	1,666.42	530,289.00	941,647.00
348.00	N54	1,626.00	RLUGO-1685	3.30	3.30	53.86	Fixed	1,679.58	529,811.00	944,609.00
349.00	ILWA-01	1,635.00	RLUGO-1685	3.50	3.50	11.47	Fixed	1,646.59	528,129.00	945,101.00
350.00	ILWA-02	1,627.00	RLUGO-1685	3.50	3.50	16.22	Fixed	1,643.65	527,950.00	944,605.00
351.00	N61	1,636.00	RLUGO-1685	3.70	3.70	42.68	Fixed	1,678.77	530,450.00	945,135.00
352.00	N58A2	1,638.00	RLUGO-1685	4.00	4.00	40.65	Fixed	1,678.75	530,952.00	944,935.00
353.00	N3E	1,600.00	RLUGO-1685	4.00	4.00	15.13	Fixed	1,614.69	531,489.00	941,084.00
354.00	N54A1	1,625.00	RLUGO-1685	4.00	4.00	53.95	Fixed	1,679.43	529,656.00	944,585.00
355.00	J-1618	1,602.00	RLUGO-1685	4.30	4.30	57.88	Fixed	1,660.00	530,578.00	940,943.00
356.00	N100U2	1,687.00	RCOL-1725	5.10	5.10	33.97	Fixed	1,721.13	531,436.00	946,785.00
357.00	N100U3	1,664.00	RCOL-1725	5.10	5.10	55.68	Fixed	1,719.90	531,218.00	946,177.00
358.00	N100U1	1,702.00	RCOL-1725	5.10	5.10	19.44	Fixed	1,721.16	531,736.00	946,806.00
359.00	N3D	1,606.00	RLUGO-1685	5.50	5.50	27.31	Fixed	1,633.48	530,727.00	940,683.00
360.00	N3C	1,612.00	RLUGO-1685	5.70	5.70	18.11	Fixed	1,629.73	530,855.00	940,398.00
361.00	ILWBO-01	1,632.00	RLUGO-1685	6.80	6.80	44.04	Fixed	1,676.13	527,339.00	942,948.00

APPENDIX D. Nodal Steady State Analysis Results at Minimum Day Demand

S.No	Label	Elevation (m)	Zone	Demand (Calculated) (l/s)	Base Flow (l/s)	Pressure (m H2O)	Pattern	Calculated Hydraulic Grade (m)	X (m)	Y (m)
1.00	N28A	1,627.00	RLUGO-1685	0.10	0.10	57.11	Fixed	1,683.73	530,064.00	944,168.00
2.00	N54B1'	1,634.00	RLUGO-1685	0.10	0.10	49.11	Fixed	1,683.18	529,930.00	945,127.00
3.00	N65	1,636.00	RLUGO-1685	0.10	0.10	48.29	Fixed	1,684.02	528,993.00	945,237.00
4.00	N29	1,623.00	RLUGO-1685	0.10	0.10	61.35	Fixed	1,684.12	529,321.00	944,063.00
5.00	N45A'	1,642.00	RLUGO-1685	0.10	0.10	42.19	Fixed	1,683.82	527,062.00	943,421.00
6.00	N47A2	1,632.00	RLUGO-1685	0.10	0.10	51.57	Fixed	1,684.04	528,915.00	945,039.00
7.00	N69A2	1,642.00	RLUGO-1685	0.10	0.10	39.94	Fixed	1,682.28	530,495.00	945,397.00
8.00	N29A1	1,623.00	RLUGO-1685	0.10	0.10	61.10	Fixed	1,684.02	529,426.00	944,021.00
9.00	NG-09	1,711.00	RGA-1750	0.10	0.10	47.00	Fixed	1,758.09	525,865.00	943,197.00
10.00	N62	1,637.00	RLUGO-1685	0.10	0.10	45.85	Fixed	1,682.94	530,003.00	945,312.00
11.00	NG-61	1,692.00	RGA-1750	0.10	0.10	75.57	Fixed	1,767.73	526,446.00	943,367.00
12.00	N81C	1,622.00	RLUGO-1685	0.10	0.10	62.29	Fixed	1,684.55	527,759.00	940,421.00
13.00	NG-27	1,702.00	RGA-1750	0.10	0.10	55.97	Fixed	1,758.09	525,728.00	942,654.00
14.00	N39A7	1,616.00	RLUGO-1685	0.10	0.10	67.80	Fixed	1,684.39	527,756.00	942,300.00
15.00	NG-50	1,716.00	RGA-1750	0.10	0.10	41.99	Fixed	1,758.08	525,884.00	942,421.00
16.00	N55A	1,625.00	RLUGO-1685	0.10	0.10	58.22	Fixed	1,683.72	530,059.00	944,518.00
17.00	NG-75	1,706.00	RGA-1750	0.10	0.10	51.99	Fixed	1,758.10	525,942.00	943,284.00
	NG-52	1,709.00	RGA-1750	0.10	0.10		Fixed			

18.00						48.98		1,758.08	525,829.00	942,178.00
19.00	N55	1,625.00	RLUGO-1685	0.10	0.10	58.36	Fixed	1,683.72	530,069.00	944,514.00
20.00	NG-55	1,647.00	RGA-1750	0.10	0.10	126.92	Fixed	1,774.17	526,776.00	943,375.00
21.00	N100R6	1,681.00	RCOL-1725	0.10	0.10	41.60	Fixed	1,722.31	531,238.00	946,799.00
22.00	N46A2	1,620.00	RLUGO-1685	0.10	0.10	64.37	Fixed	1,684.27	528,515.00	943,723.00
23.00	N22A4	1,625.00	RLUGO-1685	0.10	0.10	58.35	Fixed	1,683.74	530,147.00	944,091.00
24.00	N65B	1,635.00	RLUGO-1685	0.10	0.10	49.15	Fixed	1,684.02	529,076.00	945,205.00
25.00	NG-40	1,706.00	RGA-1750	0.10	0.10	51.70	Fixed	1,758.08	526,396.00	943,262.00
26.00	N65C	1,630.00	RLUGO-1685	0.10	0.10	53.67	Fixed	1,684.04	528,996.00	945,005.00
27.00	N14B3	1,620.00	RLUGO-1685	0.10	0.10	63.87	Fixed	1,684.07	529,468.00	942,911.00
28.00	N14B1	1,620.00	RLUGO-1685	0.10	0.10	64.07	Fixed	1,684.07	529,556.00	942,955.00
29.00	NG-39	1,703.00	RGA-1750	0.10	0.10	54.76	Fixed	1,758.07	526,080.00	942,315.00
30.00	N64A1	1,623.00	RLUGO-1685	0.10	0.10	60.97	Fixed	1,683.99	529,552.00	944,625.00
31.00	N24A1	1,606.00	RLUGO-1685	0.10	0.10	77.47	Fixed	1,683.72	531,761.00	943,988.00
32.00	N24D	1,607.00	RLUGO-1685	0.10	0.10	76.47	Fixed	1,683.71	531,771.00	944,049.00
33.00	N54A	1,630.00	RLUGO-1685	0.10	0.10	53.22	Fixed	1,683.30	529,841.00	944,899.00
34.00	N54F	1,628.00	RLUGO-1685	0.10	0.10	54.78	Fixed	1,683.38	529,877.00	944,759.00
35.00	N103C2	1,663.00	RCOL-1725	0.10	0.10	61.97	Fixed	1,725.12	530,202.00	946,166.00
36.00	N103C1	1,662.00	RCOL-1725	0.10	0.10	62.99	Fixed	1,725.12	530,150.00	946,173.00
37.00	N28B1	1,623.00	RLUGO-1685	0.10	0.10	61.13	Fixed	1,683.76	529,620.00	943,968.00
38.00	N30	1,621.00	RLUGO-1685	0.10	0.10	62.76	Fixed	1,683.85	529,500.00	943,889.00

39.00	N38A1	1,620.00	RLUGO-1685	0.10	0.10	63.82	Fixed	1,684.37	527,696.00	942,460.00
40.00	N38A3	1,619.00	RLUGO-1685	0.10	0.10	65.71	Fixed	1,684.36	527,797.00	942,584.00
41.00	N54D	1,629.00	RLUGO-1685	0.10	0.10	54.55	Fixed	1,683.45	529,995.00	944,712.00
42.00	N47B	1,627.00	RLUGO-1685	0.10	0.10	57.39	Fixed	1,684.21	528,375.00	944,440.00
43.00	N47C	1,623.00	RLUGO-1685	0.10	0.10	60.73	Fixed	1,684.19	528,471.00	944,401.00
44.00	N28A'	1,626.00	RLUGO-1685	0.10	0.10	57.61	Fixed	1,683.73	529,938.00	944,218.00
45.00	N30A5	1,622.00	RLUGO-1685	0.10	0.10	61.67	Fixed	1,683.91	529,427.00	943,779.00
46.00	N107	1,656.00	RCOL-1725	0.10	0.10	68.91	Fixed	1,725.12	530,013.00	946,276.00
47.00	N39A6	1,613.00	RLUGO-1685	0.10	0.10	70.91	Fixed	1,684.39	527,978.00	942,247.00
48.00	N103C	1,667.00	RCOL-1725	0.10	0.10	58.05	Fixed	1,725.12	530,162.00	946,263.00
49.00	N37	1,616.00	RLUGO-1685	0.10	0.10	68.64	Fixed	1,684.38	527,887.00	942,274.00
50.00	N51A	1,625.00	RLUGO-1685	0.10	0.10	58.72	Fixed	1,684.03	529,144.00	944,788.00
51.00	N43B3	1,617.00	RLUGO-1685	0.10	0.10	67.27	Fixed	1,684.28	528,280.00	943,219.00
52.00	N35A	1,615.00	RLUGO-1685	0.10	0.10	68.96	Fixed	1,684.27	528,332.00	943,331.00
53.00	N54E	1,625.00	RLUGO-1685	0.10	0.10	58.37	Fixed	1,683.49	529,934.00	944,558.00
54.00	N52B'	1,622.00	RLUGO-1685	0.10	0.10	61.85	Fixed	1,684.04	529,054.00	944,563.00
55.00	N54D'	1,631.00	RLUGO-1685	0.10	0.10	51.73	Fixed	1,683.14	530,131.00	945,049.00
56.00	N39B4	1,621.00	RLUGO-1685	0.10	0.10	63.12	Fixed	1,684.39	527,607.00	942,378.00
57.00	N32B	1,621.00	RLUGO-1685	0.10	0.10	63.47	Fixed	1,684.23	529,278.00	943,940.00
58.00	N21B	1,606.00	RLUGO-1685	0.10	0.10	77.24	Fixed	1,683.61	531,221.00	943,535.00
	N63B'	1,644.00	RLUGO-	0.10	0.10		Fixed			

59.00			1685			37.95		1,682.25	529,627.00	945,853.00
60.00	N61A	1,637.00	RLUGO-1685	0.10	0.10	45.91	Fixed	1,683.00	530,202.00	945,232.00
61.00	N29B	1,623.00	RLUGO-1685	0.10	0.10	60.29	Fixed	1,683.56	529,690.00	944,315.00
62.00	N15F2	1,683.00	RLUGO-1685	0.10	0.10	1.58	Fixed	1,684.58	528,855.00	940,791.00
63.00	N63B'1	1,644.00	RLUGO-1685	0.10	0.10	38.45	Fixed	1,682.26	529,595.00	945,837.00
64.00	N57A'	1,616.00	RLUGO-1685	0.10	0.10	67.26	Fixed	1,683.72	531,038.00	944,317.00
65.00	N57A	1,619.00	RLUGO-1685	0.10	0.10	64.63	Fixed	1,683.72	530,934.00	944,355.00
66.00	N15F	1,666.00	RLUGO-1685	0.10	0.10	19.01	Fixed	1,684.62	528,662.00	940,832.00
67.00	N22A2	1,623.00	RLUGO-1685	0.10	0.10	60.43	Fixed	1,683.73	530,325.00	944,113.00
68.00	N54B1	1,635.00	RLUGO-1685	0.10	0.10	48.54	Fixed	1,683.22	529,898.00	945,046.00
69.00	N64A2	1,626.00	RLUGO-1685	0.10	0.10	58.18	Fixed	1,683.84	529,602.00	944,702.00
70.00	NG-35	1,701.00	RGA-1750	0.10	0.10	56.96	Fixed	1,758.08	525,861.00	942,290.00
71.00	N30A8	1,624.00	RLUGO-1685	0.10	0.10	59.56	Fixed	1,683.93	529,130.00	943,717.00
72.00	N81B	1,634.00	RLUGO-1685	0.10	0.10	50.70	Fixed	1,684.60	528,061.00	940,774.00
73.00	N27C	1,618.00	RLUGO-1685	0.10	0.10	65.23	Fixed	1,683.72	530,668.00	944,185.00
74.00	N43A2	1,633.00	RLUGO-1685	0.10	0.10	51.33	Fixed	1,684.19	527,472.00	943,437.00
75.00	N64A	1,633.00	RLUGO-1685	0.10	0.10	51.16	Fixed	1,684.01	529,273.00	945,128.00
76.00	N43A3	1,634.00	RLUGO-1685	0.10	0.10	50.46	Fixed	1,684.15	527,418.00	943,233.00
77.00	N24C	1,607.00	RLUGO-1685	0.10	0.10	76.82	Fixed	1,683.72	531,580.00	944,069.00
78.00	N22A5	1,624.00	RLUGO-1685	0.10	0.10	59.60	Fixed	1,683.75	529,853.00	944,026.00
79.00	N24A	1,607.00	RLUGO-1685	0.10	0.10	76.54	Fixed	1,683.72	531,572.00	944,013.00

80.00	N32	1,619.00	RLUGO-1685	0.10	0.10	65.12	Fixed	1,684.23	528,780.00	943,828.00
81.00	N48B	1,624.00	RLUGO-1685	0.10	0.10	58.51	Fixed	1,682.33	528,237.00	944,498.00
82.00	N48	1,626.00	RLUGO-1685	0.10	0.10	56.58	Fixed	1,682.34	528,266.00	944,578.00
83.00	N4	1,602.00	RLUGO-1685	0.10	0.10	82.05	Fixed	1,683.77	530,200.00	941,852.00
84.00	N43A4	1,635.00	RLUGO-1685	0.10	0.10	48.95	Fixed	1,684.14	527,360.00	943,249.00
85.00	N6	1,602.00	RLUGO-1685	0.10	0.10	81.40	Fixed	1,683.72	530,367.00	941,892.00
86.00	N43A6	1,636.00	RLUGO-1685	0.10	0.10	48.59	Fixed	1,684.18	527,314.00	943,076.00
87.00	N35	1,617.00	RLUGO-1685	0.10	0.10	66.82	Fixed	1,684.27	528,256.00	943,354.00
88.00	N63A1	1,634.00	RLUGO-1685	0.10	0.10	49.50	Fixed	1,683.18	529,580.00	945,264.00
89.00	N28C	1,624.00	RLUGO-1685	0.10	0.10	59.44	Fixed	1,683.56	529,812.00	944,268.00
90.00	N43B4	1,617.00	RLUGO-1685	0.10	0.10	67.33	Fixed	1,684.29	528,181.00	943,252.00
91.00	N7A	1,601.00	RLUGO-1685	0.10	0.10	82.87	Fixed	1,683.72	530,502.00	942,077.00
92.00	N11A	1,622.00	RLUGO-1685	0.10	0.10	61.98	Fixed	1,684.11	529,277.00	942,786.00
93.00	N46	1,619.00	RLUGO-1685	0.10	0.10	64.66	Fixed	1,684.24	528,412.00	943,743.00
94.00	N11	1,618.00	RLUGO-1685	0.10	0.10	65.74	Fixed	1,684.10	529,391.00	942,742.00
95.00	N7D	1,602.00	RLUGO-1685	0.10	0.10	81.09	Fixed	1,683.72	530,460.00	941,998.00
96.00	N64D	1,627.00	RLUGO-1685	0.10	0.10	56.03	Fixed	1,683.63	529,391.00	944,850.00
97.00	N31	1,616.00	RLUGO-1685	0.10	0.10	67.33	Fixed	1,683.93	529,021.00	943,837.00
98.00	N11A2	1,618.00	RLUGO-1685	0.10	0.10	66.15	Fixed	1,684.10	529,430.00	942,842.00
99.00	N7B1	1,606.00	RLUGO-1685	0.10	0.10	77.46	Fixed	1,683.83	530,117.00	942,280.00
	N81E	1,630.00	RLUGO-	0.10	0.10		Fixed			

100.00			1685			54.11		1,684.56	527,849.00	940,531.00
101.00	N7AB	1,604.00	RLUGO-1685	0.10	0.10	79.51	Fixed	1,683.80	530,285.00	942,278.00
102.00	N7B	1,603.00	RLUGO-1685	0.10	0.10	80.99	Fixed	1,683.80	530,266.00	942,223.00
103.00	N64B	1,630.00	RLUGO-1685	0.10	0.10	52.86	Fixed	1,683.41	529,707.00	944,952.00
104.00	N8A	1,612.00	RLUGO-1685	0.10	0.10	71.96	Fixed	1,683.86	529,977.00	942,355.00
105.00	N52'	1,626.00	RLUGO-1685	0.10	0.10	58.22	Fixed	1,684.02	529,335.00	944,711.00
106.00	N14B	1,621.00	RLUGO-1685	0.10	0.10	62.95	Fixed	1,684.07	529,373.00	943,028.00
107.00	N43A7	1,630.00	RLUGO-1685	0.10	0.10	54.06	Fixed	1,684.23	527,479.00	943,022.00
108.00	N67C	1,650.00	RLUGO-1685	0.10	0.10	32.07	Fixed	1,682.32	529,684.00	946,136.00
109.00	N52D	1,622.00	RLUGO-1685	0.10	0.10	61.93	Fixed	1,684.06	528,931.00	944,612.00
110.00	N64B1	1,631.00	RLUGO-1685	0.10	0.10	52.59	Fixed	1,683.42	529,472.00	945,049.00
111.00	N56B1	1,628.00	RLUGO-1685	0.10	0.10	56.09	Fixed	1,683.71	530,246.00	944,627.00
112.00	N22B	1,615.00	RLUGO-1685	0.10	0.10	68.67	Fixed	1,683.72	530,849.00	944,095.00
113.00	N39A3	1,616.00	RLUGO-1685	0.10	0.10	68.63	Fixed	1,684.45	527,691.00	941,894.00
114.00	N53B	1,620.00	RLUGO-1685	0.10	0.10	64.03	Fixed	1,684.16	528,795.00	944,273.00
115.00	N39A4	1,614.00	RLUGO-1685	0.10	0.10	69.88	Fixed	1,684.43	527,731.00	942,106.00
116.00	N22C	1,613.00	RLUGO-1685	0.10	0.10	70.30	Fixed	1,683.72	530,938.00	944,082.00
117.00	N68C1	1,639.00	RLUGO-1685	0.10	0.10	44.48	Fixed	1,683.13	529,649.00	945,451.00
118.00	N39A5	1,614.00	RLUGO-1685	0.10	0.10	69.78	Fixed	1,684.41	527,926.00	942,059.00
119.00	N29B'	1,622.00	RLUGO-1685	0.10	0.10	62.27	Fixed	1,684.01	529,568.00	944,363.00
120.00	N46A1	1,620.00	RLUGO-1685	0.10	0.10	64.04	Fixed	1,684.27	528,422.00	943,703.00

121.00	N24E2	1,617.00	RLUGO-1685	0.10	0.10	66.71	Fixed	1,683.71	531,820.00	944,352.00
122.00	N45'	1,642.00	RLUGO-1685	0.10	0.10	41.43	Fixed	1,683.36	527,089.00	943,742.00
123.00	N45'A	1,642.00	RLUGO-1685	0.10	0.10	41.24	Fixed	1,683.39	526,900.00	943,704.00
124.00	NG-41	1,728.00	RGA-1750	0.10	0.10	30.01	Fixed	1,758.07	524,969.00	942,909.00
125.00	N55B	1,631.00	RLUGO-1685	0.10	0.10	52.89	Fixed	1,683.70	530,616.00	944,762.00
126.00	N45	1,649.00	RLUGO-1685	0.10	0.10	34.46	Fixed	1,683.58	526,944.00	943,394.00
127.00	N56A	1,631.00	RLUGO-1685	0.10	0.10	52.41	Fixed	1,683.70	530,342.00	944,867.00
128.00	N43A5	1,644.00	RLUGO-1685	0.10	0.10	39.33	Fixed	1,683.89	527,039.00	943,337.00
129.00	N38B	1,616.00	RLUGO-1685	0.10	0.10	68.49	Fixed	1,684.36	527,965.00	942,522.00
130.00	N24B	1,617.00	RLUGO-1685	0.10	0.10	66.58	Fixed	1,683.71	531,627.00	944,402.00
131.00	N81B1	1,621.00	RLUGO-1685	0.10	0.10	63.02	Fixed	1,684.57	527,897.00	940,944.00
132.00	N43	1,622.00	RLUGO-1685	0.10	0.10	62.20	Fixed	1,684.31	527,747.00	942,943.00
133.00	N43A	1,622.00	RLUGO-1685	0.10	0.10	62.56	Fixed	1,684.29	527,806.00	943,142.00
134.00	N67	1,639.00	RLUGO-1685	0.10	0.10	43.44	Fixed	1,682.32	529,739.00	945,670.00
135.00	N32C	1,620.00	RLUGO-1685	0.10	0.10	63.86	Fixed	1,684.13	529,114.00	944,147.00
136.00	N67A	1,638.00	RLUGO-1685	0.10	0.10	44.29	Fixed	1,682.34	529,721.00	945,624.00
137.00	N65A	1,638.00	RLUGO-1685	0.10	0.10	46.41	Fixed	1,684.01	529,049.00	945,380.00
138.00	N31B	1,618.00	RLUGO-1685	0.10	0.10	65.53	Fixed	1,684.03	529,463.00	943,253.00
139.00	N101	1,674.00	RCOL-1725	0.10	0.10	48.59	Fixed	1,722.59	531,173.00	946,619.00
140.00	N52A	1,621.00	RLUGO-1685	0.10	0.10	62.88	Fixed	1,684.02	529,193.00	944,346.00
	N24E1	1,614.00	RLUGO-	0.10	0.10		Fixed			

141.00			1685			69.66		1,683.71	531,794.00	944,238.00
142.00	N106A''	1,656.00	RCOL-1725	0.10	0.10	66.22	Fixed	1,722.55	531,138.00	945,956.00
143.00	N52B	1,622.00	RLUGO-1685	0.10	0.10	61.68	Fixed	1,684.02	529,247.00	944,488.00
144.00	N81D	1,623.00	RLUGO-1685	0.10	0.10	60.94	Fixed	1,684.54	527,676.00	940,314.00
145.00	IAU-01	1,646.00	RCOL-1725	0.10	0.10	76.23	Fixed	1,722.49	531,049.00	945,223.00
146.00	N32A	1,619.00	RLUGO-1685	0.10	0.10	65.35	Fixed	1,684.22	528,828.00	943,989.00
147.00	N46B	1,618.00	RLUGO-1685	0.10	0.10	65.94	Fixed	1,684.23	528,472.00	943,899.00
148.00	N39B	1,624.00	RLUGO-1685	0.10	0.10	60.37	Fixed	1,684.41	527,452.00	942,327.00
149.00	N47A	1,617.00	RLUGO-1685	0.10	0.10	67.06	Fixed	1,684.22	528,550.00	944,102.00
150.00	N22D	1,610.00	RLUGO-1685	0.10	0.10	73.60	Fixed	1,683.72	530,812.00	943,817.00
151.00	N22E	1,608.00	RLUGO-1685	0.10	0.10	75.95	Fixed	1,683.66	530,905.00	943,787.00
152.00	N56A1	1,633.00	RLUGO-1685	0.10	0.10	49.63	Fixed	1,683.12	530,379.00	944,953.00
153.00	N25A	1,606.00	RLUGO-1685	0.10	0.10	77.48	Fixed	1,683.72	531,979.00	943,848.00
154.00	N30A7	1,620.00	RLUGO-1685	0.10	0.10	63.75	Fixed	1,683.88	529,541.00	943,724.00
155.00	N47A1	1,630.00	RLUGO-1685	0.10	0.10	54.36	Fixed	1,684.08	528,860.00	944,899.00
156.00	N43B2	1,615.00	RLUGO-1685	0.10	0.10	68.80	Fixed	1,684.20	528,442.00	942,958.00
157.00	N43B1	1,614.00	RLUGO-1685	0.10	0.10	70.42	Fixed	1,684.19	528,289.00	943,001.00
158.00	N57	1,621.00	RLUGO-1685	0.10	0.10	62.57	Fixed	1,683.72	530,765.00	944,422.00
159.00	N55A'	1,627.00	RLUGO-1685	0.10	0.10	56.34	Fixed	1,683.72	530,525.00	944,518.00
160.00	N106A'	1,665.00	RCOL-1725	0.10	0.10	57.50	Fixed	1,722.59	531,028.00	946,247.00
161.00	N27B2	1,630.00	RLUGO-1685	0.10	0.10	53.60	Fixed	1,683.72	530,333.00	944,416.00

162.00	N27B3	1,626.00	RLUGO-1685	0.10	0.10	57.77	Fixed	1,683.72	530,434.00	944,275.00
163.00	N44A1	1,620.00	RLUGO-1685	0.10	0.10	64.14	Fixed	1,684.26	527,941.00	943,591.00
164.00	N64E	1,628.00	RLUGO-1685	0.10	0.10	55.70	Fixed	1,684.02	529,197.00	944,927.00
165.00	N21C	1,604.00	RLUGO-1685	0.10	0.10	79.49	Fixed	1,683.59	531,384.00	943,523.00
166.00	N46B1	1,622.00	RLUGO-1685	0.10	0.10	61.84	Fixed	1,684.22	528,207.00	944,001.00
167.00	N21D	1,603.00	RLUGO-1685	0.10	0.10	80.42	Fixed	1,683.59	531,566.00	943,468.00
168.00	N63A	1,630.00	RLUGO-1685	0.10	0.10	52.82	Fixed	1,683.42	529,531.00	945,198.00
169.00	N15B2	1,638.00	RLUGO-1685	0.10	0.10	46.51	Fixed	1,684.39	528,839.00	941,464.00
170.00	N15	1,625.00	RLUGO-1685	0.10	0.10	59.48	Fixed	1,684.37	528,611.00	941,712.00
171.00	N15A	1,628.00	RLUGO-1685	0.10	0.10	56.39	Fixed	1,684.37	528,740.00	941,703.00
172.00	N10A2	1,626.00	RLUGO-1685	0.10	0.10	58.01	Fixed	1,683.93	529,860.00	942,519.00
173.00	N10	1,627.00	RLUGO-1685	0.10	0.10	57.12	Fixed	1,683.98	529,789.00	942,715.00
174.00	N15B1	1,639.00	RLUGO-1685	0.10	0.10	45.56	Fixed	1,684.43	528,824.00	941,461.00
175.00	N20A	1,605.00	RLUGO-1685	0.10	0.10	78.26	Fixed	1,683.62	531,123.00	943,573.00
176.00	N20B	1,607.00	RLUGO-1685	0.10	0.10	76.19	Fixed	1,683.64	531,159.00	943,717.00
177.00	N81D1	1,614.00	RLUGO-1685	0.10	0.10	70.23	Fixed	1,684.54	527,460.00	940,507.00
178.00	ILu-01	1,619.00	RLUGO-1685	0.10	0.10	65.47	Fixed	1,684.20	529,419.00	942,275.00
179.00	N14A	1,623.00	RLUGO-1685	0.10	0.10	60.50	Fixed	1,684.08	529,162.00	943,111.00
180.00	N31C	1,624.00	RLUGO-1685	0.10	0.10	60.09	Fixed	1,683.98	529,364.00	943,622.00
181.00	N106A	1,663.00	RCOL-1725	0.10	0.10	59.53	Fixed	1,722.61	530,904.00	946,292.00
	ILEBO-	1,617.00	RLUGO-	0.10	0.10		Fixed			

182.00	01		1685			63.14		1,680.17	529,653.00	940,823.00
183.00	N49	1,622.00	RLUGO-1685	0.10	0.10	62.44	Fixed	1,684.25	528,211.00	944,430.00
184.00	N30A	1,622.00	RLUGO-1685	0.10	0.10	61.79	Fixed	1,683.80	529,526.00	943,947.00
185.00	N30A2	1,622.00	RLUGO-1685	0.10	0.10	61.80	Fixed	1,683.86	529,470.00	943,888.00
186.00	N22D1	1,614.00	RLUGO-1685	0.10	0.10	69.77	Fixed	1,683.72	530,632.00	943,866.00
187.00	N15D	1,651.00	RLUGO-1685	0.20	0.20	33.49	Fixed	1,684.50	528,904.00	941,089.00
188.00	N15D2	1,659.00	RLUGO-1685	0.20	0.20	25.36	Fixed	1,684.53	528,999.00	941,003.00
189.00	N43B	1,619.00	RLUGO-1685	0.20	0.20	65.51	Fixed	1,684.30	528,125.00	943,052.00
190.00	N15A1	1,657.00	RLUGO-1685	0.20	0.20	27.64	Fixed	1,684.53	528,791.00	941,071.00
191.00	N31A	1,626.00	RLUGO-1685	0.20	0.20	57.86	Fixed	1,684.04	529,248.00	943,334.00
192.00	N58	1,629.00	RLUGO-1685	0.20	0.20	54.54	Fixed	1,683.70	530,863.00	944,665.00
193.00	N59	1,622.00	RLUGO-1685	0.20	0.20	61.74	Fixed	1,683.70	531,354.00	944,531.00
194.00	N81C3	1,633.00	RLUGO-1685	0.20	0.20	51.69	Fixed	1,684.56	527,933.00	940,424.00
195.00	N36	1,615.00	RLUGO-1685	0.20	0.20	69.64	Fixed	1,684.33	528,035.00	942,744.00
196.00	N15E	1,677.00	RLUGO-1685	0.20	0.20	7.66	Fixed	1,684.56	529,008.00	940,771.00
197.00	N44B2	1,635.00	RLUGO-1685	0.20	0.20	48.77	Fixed	1,683.97	527,339.00	943,716.00
198.00	N111C	1,642.00	RCOL-1725	0.20	0.20	80.64	Fixed	1,722.51	530,775.00	945,088.00
199.00	N44A	1,634.00	RLUGO-1685	0.20	0.20	49.74	Fixed	1,683.97	527,383.00	943,496.00
200.00	N47	1,623.00	RLUGO-1685	0.20	0.20	61.08	Fixed	1,684.20	528,641.00	944,336.00
201.00	N111A	1,651.00	RCOL-1725	0.20	0.20	71.57	Fixed	1,722.53	530,975.00	945,569.00
202.00	N111A'	1,649.00	RCOL-1725	0.20	0.20	73.31	Fixed	1,722.52	530,942.00	945,486.00

203.00	N68C	1,646.00	RLUGO-1685	0.20	0.20	36.40	Fixed	1,682.56	530,108.00	945,583.00
204.00	N15F7	1,682.00	RLUGO-1685	0.20	0.20	3.14	Fixed	1,684.92	528,897.00	940,535.00
205.00	N68A2	1,641.00	RLUGO-1685	0.20	0.20	41.14	Fixed	1,682.44	529,939.00	945,444.00
206.00	N105D	1,685.00	RCOL-1725	0.20	0.20	38.19	Fixed	1,723.26	530,778.00	947,815.00
207.00	N33	1,619.00	RLUGO-1685	0.20	0.20	65.51	Fixed	1,684.20	528,778.00	943,784.00
208.00	N2	1,633.00	RLUGO-1685	0.20	0.20	51.00	Fixed	1,684.39	528,962.00	941,481.00
209.00	N12A1	1,626.00	RLUGO-1685	0.20	0.20	58.35	Fixed	1,684.33	529,144.00	941,623.00
210.00	N12A	1,627.00	RLUGO-1685	0.20	0.20	57.15	Fixed	1,684.37	528,985.00	941,654.00
211.00	N70	1,652.00	RCOL-1725	0.20	0.20	70.14	Fixed	1,722.49	531,150.00	945,405.00
212.00	N70'	1,651.00	RCOL-1725	0.20	0.20	71.02	Fixed	1,722.49	531,124.00	945,415.00
213.00	N59A	1,616.00	RLUGO-1685	0.20	0.20	67.91	Fixed	1,683.72	531,293.00	944,290.00
214.00	N81F	1,618.00	RLUGO-1685	0.20	0.20	66.26	Fixed	1,684.55	527,654.00	940,701.00
215.00	N7A1	1,602.00	RLUGO-1685	0.20	0.20	81.78	Fixed	1,683.59	530,606.00	942,043.00
216.00	N103B	1,667.00	RCOL-1725	0.20	0.20	57.27	Fixed	1,724.57	530,683.00	946,354.00
217.00	N15F5	1,672.00	RLUGO-1685	0.20	0.20	12.24	Fixed	1,684.73	528,585.00	940,558.00
218.00	N15F4	1,670.00	RLUGO-1685	0.20	0.20	14.91	Fixed	1,684.68	528,590.00	940,681.00
219.00	N7C	1,604.00	RLUGO-1685	0.20	0.20	80.11	Fixed	1,683.77	530,219.00	942,097.00
220.00	N3F	1,597.00	RLUGO-1685	0.20	0.20	83.95	Fixed	1,681.24	531,318.00	941,449.00
221.00	N3I	1,603.00	RLUGO-1685	0.20	0.20	77.51	Fixed	1,680.72	531,561.00	941,133.00
222.00	N3H	1,594.00	RLUGO-1685	0.20	0.20	87.18	Fixed	1,680.97	531,538.00	941,439.00
	N10A	1,617.00	RLUGO-	0.20	0.20		Fixed			

223.00			1685			66.50		1,684.04	529,581.00	942,668.00
224.00	N71BC	1,641.00	RCOL-1725	0.20	0.20	81.11	Fixed	1,721.99	531,906.00	945,107.00
225.00	N71B	1,639.00	RCOL-1725	0.20	0.20	82.97	Fixed	1,722.00	531,966.00	945,083.00
226.00	N108A	1,656.00	RCOL-1725	0.20	0.20	68.99	Fixed	1,725.12	529,446.00	946,118.00
227.00	N24E	1,614.00	RLUGO-1685	0.20	0.20	69.86	Fixed	1,683.72	531,608.00	944,242.00
228.00	N6A1	1,598.00	RLUGO-1685	0.20	0.20	85.41	Fixed	1,683.39	530,777.00	941,760.00
229.00	N6A	1,598.00	RLUGO-1685	0.20	0.20	85.56	Fixed	1,683.31	530,891.00	941,862.00
230.00	N67E1	1,647.00	RLUGO-1685	0.20	0.20	34.79	Fixed	1,682.32	529,878.00	946,027.00
231.00	N38A	1,621.00	RLUGO-1685	0.20	0.20	63.16	Fixed	1,684.38	527,546.00	942,515.00
232.00	N36A	1,613.00	RLUGO-1685	0.20	0.20	70.65	Fixed	1,684.18	528,208.00	942,698.00
233.00	N24	1,611.00	RLUGO-1685	0.20	0.20	72.76	Fixed	1,683.72	531,237.00	944,049.00
234.00	N43A1	1,624.00	RLUGO-1685	0.20	0.20	60.12	Fixed	1,684.28	527,864.00	943,337.00
235.00	N14	1,628.00	RLUGO-1685	0.20	0.20	55.60	Fixed	1,684.13	529,069.00	942,868.00
236.00	N6B4	1,598.00	RLUGO-1685	0.20	0.20	85.27	Fixed	1,683.43	531,084.00	942,513.00
237.00	N78	1,640.00	RCOL-1725	0.20	0.20	82.32	Fixed	1,722.49	530,967.00	945,012.00
238.00	N6B1	1,599.00	RLUGO-1685	0.20	0.20	84.25	Fixed	1,683.31	531,047.00	942,121.00
239.00	NG-53	1,640.00	RGA-1750	0.20	0.20	136.28	Fixed	1,776.55	526,897.00	943,385.00
240.00	N102A	1,657.00	RCOL-1725	0.20	0.20	65.88	Fixed	1,722.55	531,127.00	945,926.00
241.00	N44	1,621.00	RLUGO-1685	0.20	0.20	62.87	Fixed	1,684.25	527,955.00	943,638.00
242.00	NG-37	1,707.00	RGA-1750	0.20	0.20	51.15	Fixed	1,758.08	526,313.00	942,671.00
243.00	N38A2	1,618.00	RLUGO-1685	0.20	0.20	66.33	Fixed	1,684.37	527,752.00	942,439.00

244.00	N82C	1,613.00	RLUGO-1685	0.20	0.20	71.82	Fixed	1,684.59	527,645.00	941,144.00
245.00	N82A	1,613.00	RLUGO-1685	0.20	0.20	71.07	Fixed	1,684.61	527,790.00	941,308.00
246.00	N68D	1,650.00	RLUGO-1685	0.20	0.20	31.93	Fixed	1,682.32	530,175.00	945,752.00
247.00	N103A	1,667.00	RCOL-1725	0.20	0.20	57.35	Fixed	1,724.58	530,448.00	946,449.00
248.00	N6C	1,598.00	RLUGO-1685	0.20	0.20	83.58	Fixed	1,681.28	531,141.00	941,382.00
249.00	N3B	1,595.00	RLUGO-1685	0.20	0.20	85.93	Fixed	1,681.30	531,199.00	941,269.00
250.00	N17B	1,621.00	RLUGO-1685	0.20	0.20	62.21	Fixed	1,683.79	530,272.00	943,583.00
251.00	N21	1,612.00	RLUGO-1685	0.20	0.20	71.94	Fixed	1,683.78	530,423.00	943,523.00
252.00	N7	1,600.00	RLUGO-1685	0.20	0.20	83.60	Fixed	1,683.77	530,560.00	942,187.00
253.00	N36A2	1,620.00	RLUGO-1685	0.20	0.20	64.51	Fixed	1,684.14	528,800.00	942,973.00
254.00	N39A1	1,615.00	RLUGO-1685	0.20	0.20	69.51	Fixed	1,684.49	527,608.00	941,571.00
255.00	N51B	1,631.00	RLUGO-1685	0.30	0.30	52.99	Fixed	1,683.61	528,692.00	944,962.00
256.00	N106	1,672.00	RCOL-1725	0.30	0.30	50.91	Fixed	1,722.77	531,051.00	946,666.00
257.00	N34	1,615.00	RLUGO-1685	0.30	0.30	68.58	Fixed	1,684.21	528,567.00	943,260.00
258.00	N31D	1,622.00	RLUGO-1685	0.30	0.30	62.05	Fixed	1,683.90	529,590.00	943,531.00
259.00	N18A	1,603.00	RLUGO-1685	0.30	0.30	80.58	Fixed	1,683.76	530,626.00	943,037.00
260.00	N103	1,665.00	RCOL-1725	0.30	0.30	59.88	Fixed	1,725.12	530,357.00	946,222.00
261.00	N20	1,606.00	RLUGO-1685	0.30	0.30	77.30	Fixed	1,683.68	531,051.00	943,286.00
262.00	N39	1,617.00	RLUGO-1685	0.30	0.30	67.75	Fixed	1,684.55	527,341.00	941,279.00
263.00	N19	1,599.00	RLUGO-1685	0.30	0.30	84.07	Fixed	1,683.71	530,958.00	942,913.00
	NN-01	1,615.00	RLUGO-	0.30	0.30		Fixed			

264.00			1685			65.45		1,680.62	529,583.00	941,019.00
265.00	N42	1,624.00	RLUGO-1685	0.30	0.30	59.81	Fixed	1,684.33	527,713.00	942,828.00
266.00	N18C	1,599.00	RLUGO-1685	0.30	0.30	84.01	Fixed	1,683.64	530,515.00	942,747.00
267.00	N44B	1,620.00	RLUGO-1685	0.30	0.30	63.66	Fixed	1,684.25	528,050.00	943,989.00
268.00	N44B4	1,625.00	RLUGO-1685	0.30	0.30	58.44	Fixed	1,684.05	527,710.00	944,044.00
269.00	N105A	1,685.00	RCOL-1725	0.30	0.30	38.74	Fixed	1,723.51	530,702.00	947,099.00
270.00	N44B3	1,631.00	RLUGO-1685	0.30	0.30	52.72	Fixed	1,683.97	527,384.00	944,038.00
271.00	N18B	1,606.00	RLUGO-1685	0.30	0.30	77.17	Fixed	1,683.69	530,760.00	943,395.00
272.00	N71	1,657.00	RCOL-1725	0.30	0.30	64.99	Fixed	1,722.50	531,322.00	945,834.00
273.00	N36A1	1,616.00	RLUGO-1685	0.30	0.30	68.34	Fixed	1,684.16	528,619.00	942,587.00
274.00	N39B1	1,624.00	RLUGO-1685	0.30	0.30	60.81	Fixed	1,684.43	527,401.00	942,156.00
275.00	N18	1,613.00	RLUGO-1685	0.30	0.30	70.58	Fixed	1,683.81	530,285.00	943,165.00
276.00	N17	1,621.00	RLUGO-1685	0.30	0.30	62.63	Fixed	1,683.81	530,098.00	943,251.00
277.00	N105A4	1,685.00	RCOL-1725	0.30	0.30	37.86	Fixed	1,723.26	530,683.00	947,854.00
278.00	N102	1,659.00	RCOL-1725	0.30	0.30	63.01	Fixed	1,722.60	530,810.00	946,057.00
279.00	N105C1	1,689.00	RCOL-1725	0.30	0.30	34.56	Fixed	1,723.35	530,827.00	947,413.00
280.00	N9	1,614.00	RLUGO-1685	0.30	0.30	69.96	Fixed	1,683.88	530,031.00	942,497.00
281.00	N50	1,636.00	RLUGO-1685	0.30	0.30	46.74	Fixed	1,682.48	528,398.00	945,080.00
282.00	N16A	1,622.00	RLUGO-1685	0.30	0.30	62.08	Fixed	1,683.91	529,675.00	943,188.00
283.00	NN-02	1,620.00	RLUGO-1685	0.30	0.30	57.61	Fixed	1,677.73	529,771.00	940,565.00
284.00	N105	1,676.00	RCOL-1725	0.30	0.30	47.60	Fixed	1,723.67	530,599.00	946,836.00

285.00	N69	1,640.00	RLUGO-1685	0.30	0.30	41.85	Fixed	1,682.28	530,510.00	945,300.00
286.00	N39A	1,621.00	RLUGO-1685	0.30	0.30	63.04	Fixed	1,684.52	527,350.00	941,590.00
287.00	N109	1,657.00	RCOL-1725	0.40	0.40	65.53	Fixed	1,722.42	532,088.00	945,538.00
288.00	N111	1,648.00	RCOL-1725	0.40	0.40	74.01	Fixed	1,722.53	530,663.00	945,687.00
289.00	N4B	1,615.00	RLUGO-1685	0.40	0.40	68.63	Fixed	1,683.41	529,642.00	941,343.00
290.00	N100R5	1,684.00	RCOL-1725	0.40	0.40	37.63	Fixed	1,722.13	531,352.00	946,752.00
291.00	N81	1,632.00	RLUGO-1685	0.40	0.40	52.12	Fixed	1,684.67	528,189.00	940,928.00
292.00	N3J	1,612.00	RLUGO-1685	0.40	0.40	68.23	Fixed	1,680.44	531,781.00	940,966.00
293.00	N3J1	1,632.00	RLUGO-1685	0.40	0.40	48.73	Fixed	1,680.83	531,828.00	941,426.00
294.00	N9B	1,599.00	RLUGO-1685	0.40	0.40	84.77	Fixed	1,683.71	530,795.00	942,634.00
295.00	N71'	1,657.00	RCOL-1725	0.40	0.40	65.61	Fixed	1,722.45	531,709.00	945,680.00
296.00	N109B	1,644.00	RCOL-1725	0.40	0.40	78.30	Fixed	1,722.45	531,552.00	945,244.00
297.00	N6B3	1,597.00	RLUGO-1685	0.40	0.40	86.15	Fixed	1,683.35	531,211.00	942,456.00
298.00	N106B	1,678.00	RCOL-1725	0.40	0.40	45.45	Fixed	1,723.12	531,151.00	946,920.00
299.00	N12	1,621.00	RLUGO-1685	0.50	0.50	62.86	Fixed	1,684.20	529,233.00	942,335.00
300.00	N12A4	1,623.00	RLUGO-1685	0.50	0.50	61.14	Fixed	1,684.26	529,105.00	942,008.00
301.00	N13	1,633.00	RLUGO-1685	0.50	0.50	51.00	Fixed	1,684.21	528,911.00	942,465.00
302.00	N77	1,625.00	RCOL-1725	0.50	0.50	96.91	Fixed	1,721.98	531,598.00	944,725.00
303.00	N105A2	1,674.00	RCOL-1725	0.50	0.50	49.22	Fixed	1,723.31	530,435.00	947,228.00
304.00	N105C'	1,702.00	RCOL-1725	0.50	0.50	21.39	Fixed	1,723.12	531,414.00	947,558.00
	N3G	1,616.00	RLUGO-	0.60	0.60		Fixed			

305.00			1685			64.51		1,680.34	531,677.00	940,693.00
306.00	N3	1,601.00	RLUGO-1685	0.60	0.60	81.45	Fixed	1,682.62	530,571.00	941,027.00
307.00	N3B2	1,601.00	RLUGO-1685	0.60	0.60	81.37	Fixed	1,682.24	530,847.00	940,934.00
308.00	ILEBO-23	1,596.00	RLUGO-1685	0.60	0.60	85.59	Fixed	1,681.26	531,350.00	941,093.00
309.00	N4A	1,602.00	RLUGO-1685	0.70	0.70	81.36	Fixed	1,683.41	530,289.00	941,647.00
310.00	N54	1,626.00	RLUGO-1685	0.70	0.70	57.71	Fixed	1,683.44	529,811.00	944,609.00
311.00	ILWA-02	1,627.00	RLUGO-1685	0.70	0.70	54.81	Fixed	1,682.32	527,950.00	944,605.00
312.00	ILWA-01	1,635.00	RLUGO-1685	0.70	0.70	47.28	Fixed	1,682.47	528,129.00	945,101.00
313.00	N61	1,636.00	RLUGO-1685	0.70	0.70	46.93	Fixed	1,683.02	530,450.00	945,135.00
314.00	N58A2	1,638.00	RLUGO-1685	0.80	0.80	44.93	Fixed	1,683.04	530,952.00	944,935.00
315.00	N3E	1,600.00	RLUGO-1685	0.80	0.80	81.09	Fixed	1,680.79	531,489.00	941,084.00
316.00	N54A1	1,625.00	RLUGO-1685	0.80	0.80	58.51	Fixed	1,684.00	529,656.00	944,585.00
317.00	J-1618	1,602.00	RLUGO-1685	0.90	0.90	68.22	Fixed	1,670.36	530,578.00	940,943.00
318.00	N100U3	1,664.00	RCOL-1725	1.00	1.00	58.34	Fixed	1,722.57	531,218.00	946,177.00
319.00	N100U1	1,702.00	RCOL-1725	1.00	1.00	19.81	Fixed	1,721.53	531,736.00	946,806.00
320.00	N100U2	1,687.00	RCOL-1725	1.00	1.00	34.78	Fixed	1,721.94	531,436.00	946,785.00
321.00	N3D	1,606.00	RLUGO-1685	1.10	1.10	75.48	Fixed	1,681.74	530,727.00	940,683.00
322.00	N3C	1,612.00	RLUGO-1685	1.10	1.10	69.82	Fixed	1,681.55	530,855.00	940,398.00
323.00	ILWBO-01	1,632.00	RLUGO-1685	1.40	1.40	51.97	Fixed	1,684.08	527,339.00	942,948.00

APPENDIX E. Nodal Extended Period Simulation Results at Peak Hour

S.No	Label	Elevation (m)	Zone	Demand (Calculated) (l/s)	Base Flow (l/s)	Pressure (m H2O)	Pattern	Calculated Hydraulic Grade (m)	X (m)	Y (m)
1	N54C	1,628	RLUGO-1685	0.1	0.1	46.92	Fixed	1,675.01	530,099	944,965
2	N28AA	1,626	RLUGO-1685	0.1	0.1	49.53	Fixed	1,675.58	530,037	944,106
3	N29A'	1,623	RLUGO-1685	0.2	0.2	52.64	Fixed	1,675.65	529,569	944,133
4	N29A''	1,623	RLUGO-1685	0.2	0.2	52.7	Fixed	1,675.61	529,608	944,117
5	NG-01	1,720	RGA-1750	0.2	0.2	36.79	Fixed	1,756.86	525,784	943,199
6	NG-68	1,697	RGA-1750	0.2	0.2	63.12	Fixed	1,760.25	526,184	943,330
7	NG-31	1,706	RGA-1750	0.2	0.2	50.18	Fixed	1,756.28	525,623	942,413
8	NG-46	1,691	RGA-1750	0.2	0.2	65.43	Fixed	1,756.57	526,570	943,034
9	NG-02	1,716	RGA-1750	0.2	0.2	40.34	Fixed	1,756.42	525,801	942,624
10	NG-16	1,694	RGA-1750	0.2	0.2	62.65	Fixed	1,756.77	526,286	943,073
11	N69A	1,651	RLUGO-1685	0.2	0.2	22.15	Fixed	1,672.89	530,300	945,704
12	N29A	1,621	RLUGO-1685	0.2	0.2	54.9	Fixed	1,675.75	529,537	944,045
13	N27A2	1,625	RLUGO-1685	0.2	0.2	50.44	Fixed	1,675.54	530,201	944,136
14	NG-57	1,672	RGA-1750	0.2	0.2	95.83	Fixed	1,768.02	526,694	943,365
15	N69A1	1,645	RLUGO-1685	0.2	0.2	27.4	Fixed	1,672.27	530,428	945,580
16	NG-90	1,698	RGA-1750	0.2	0.2	57.99	Fixed	1,756.10	525,835	942,184
17	N27A	1,623	RLUGO-1685	0.2	0.2	52.08	Fixed	1,675.50	530,386	944,148
18	N56	1,628	RLUGO-1685	0.2	0.2	47.38	Fixed	1,675.46	530,128	944,659
19	N22	1,618	RLUGO-1685	0.2	0.2	57.25	Fixed	1,675.42	530,636	944,110
20	N56B	1,628	RLUGO-1685	0.2	0.2	46.95	Fixed	1,675.46	530,133	944,673
21	N39B5	1,619	RLUGO-	0.3	0.3	58.73	Fixed	1,678.02	527,671	942,345

			1685							
22	N39B3	1,623	RLUGO-1685	0.3	0.3	55.14	Fixed	1,678.07	527,644	942,288
23	N81A1	1,641	RLUGO-1685	0.3	0.3	37.7	Fixed	1,678.54	528,252	940,754
24	N28B1'	1,622	RLUGO-1685	0.3	0.3	54.06	Fixed	1,675.83	529,615	944,008
25	N22A1	1,616	RLUGO-1685	0.3	0.3	59.36	Fixed	1,675.42	530,635	944,076
26	N81A	1,631	RLUGO-1685	0.3	0.3	48.54	Fixed	1,679.54	528,124	940,852
27	N22A	1,616	RLUGO-1685	0.3	0.3	59.7	Fixed	1,675.41	530,687	944,071
28	N103D	1,662	RCOL-1725	0.3	0.3	58.54	Fixed	1,721.07	530,194	946,145
29	N47A4	1,626	RLUGO-1685	0.3	0.3	48.74	Fixed	1,674.56	529,018	944,837
30	N47A3	1,628	RLUGO-1685	0.3	0.3	46.74	Fixed	1,674.53	528,941	944,867
31	N29A2	1,623	RLUGO-1685	0.4	0.4	51.18	Fixed	1,674.46	529,504	944,224
32	N29A3	1,624	RLUGO-1685	0.4	0.4	50.82	Fixed	1,674.46	529,514	944,220
33	N28A''	1,622	RLUGO-1685	0.4	0.4	53.53	Fixed	1,675.61	529,886	944,073
34	N81C1	1,630	RLUGO-1685	0.4	0.4	46.44	Fixed	1,676.20	527,838	940,360
35	N63B1	1,634	RLUGO-1685	0.4	0.4	39.94	Fixed	1,673.94	529,853	945,267
36	N63B	1,636	RLUGO-1685	0.4	0.4	38.45	Fixed	1,674.41	529,616	945,358
37	N68A3	1,646	RLUGO-1685	0.4	0.4	27.19	Fixed	1,673.45	530,006	945,622
38	N53A	1,620	RLUGO-1685	0.4	0.4	55.65	Fixed	1,675.76	528,912	944,206
39	N53A1	1,620	RLUGO-1685	0.4	0.4	55.43	Fixed	1,675.55	528,918	944,221
40	N28A	1,627	RLUGO-1685	0.4	0.4	48.93	Fixed	1,675.53	530,064	944,168
41	N54B1'	1,634	RLUGO-1685	0.4	0.4	40.54	Fixed	1,674.59	529,930	945,127

42	N65	1,636	RLUGO-1685	0.4	0.4	38.71	Fixed	1,674.42	528,993	945,237
43	N29	1,623	RLUGO-1685	0.4	0.4	52.38	Fixed	1,675.14	529,321	944,063
44	N45A'	1,642	RLUGO-1685	0.4	0.4	33.51	Fixed	1,675.13	527,062	943,421
45	N47A2	1,632	RLUGO-1685	0.4	0.4	42.02	Fixed	1,674.47	528,915	945,039
46	N69A2	1,642	RLUGO-1685	0.4	0.4	29.35	Fixed	1,671.67	530,495	945,397
47	N29A1	1,623	RLUGO-1685	0.4	0.4	51.56	Fixed	1,674.46	529,426	944,021
48	NG-09	1,711	RGA-1750	0.4	0.4	45.83	Fixed	1,756.92	525,865	943,197
49	N62	1,637	RLUGO-1685	0.4	0.4	37.14	Fixed	1,674.21	530,003	945,312
50	NG-61	1,692	RGA-1750	0.4	0.4	71.88	Fixed	1,764.03	526,446	943,367
51	N81C	1,622	RLUGO-1685	0.4	0.4	53.91	Fixed	1,676.16	527,759	940,421
52	NG-27	1,702	RGA-1750	0.4	0.4	54.4	Fixed	1,756.51	525,728	942,654
53	N39A7	1,616	RLUGO-1685	0.4	0.4	61.61	Fixed	1,678.18	527,756	942,300
54	NG-50	1,716	RGA-1750	0.4	0.4	40.15	Fixed	1,756.23	525,884	942,421
55	N55A	1,625	RLUGO-1685	0.4	0.4	50.04	Fixed	1,675.53	530,059	944,518
56	NG-75	1,706	RGA-1750	0.4	0.4	50.88	Fixed	1,756.98	525,942	943,284
57	NG-52	1,709	RGA-1750	0.4	0.4	47.01	Fixed	1,756.10	525,829	942,178
58	N55	1,625	RLUGO-1685	0.4	0.4	50.17	Fixed	1,675.53	530,069	944,514
59	NG-55	1,647	RGA-1750	0.4	0.4	122.16	Fixed	1,769.40	526,776	943,375
60	N100R6	1,681	RCOL-1725	0.5	0.5	39.11	Fixed	1,719.81	531,238	946,799
61	N46A2	1,620	RLUGO-1685	0.5	0.5	57.6	Fixed	1,677.48	528,515	943,723
62	N22A4	1,625	RLUGO-1685	0.5	0.5	50.24	Fixed	1,675.61	530,147	944,091
63	N65B	1,635	RLUGO-1685	0.5	0.5	39.58	Fixed	1,674.43	529,076	945,205
64	NG-40	1,706	RGA-1750	0.5	0.5	49.77	Fixed	1,756.14	526,396	943,262
65	N65C	1,630	RLUGO-1685	0.5	0.5	44.13	Fixed	1,674.48	528,996	945,005
66	N14B3	1,620	RLUGO-	0.5	0.5	55.96	Fixed	1,676.14	529,468	942,911

			1685							
67	N14B1	1,620	RLUGO-1685	0.5	0.5	56.21	Fixed	1,676.19	529,556	942,955
68	NG-39	1,703	RGA-1750	0.5	0.5	52.31	Fixed	1,755.61	526,080	942,315
69	N64A1	1,623	RLUGO-1685	0.5	0.5	51.37	Fixed	1,674.38	529,552	944,625
70	N24A1	1,606	RLUGO-1685	0.5	0.5	68.91	Fixed	1,675.14	531,761	943,988
71	N24D	1,607	RLUGO-1685	0.5	0.5	67.52	Fixed	1,674.74	531,771	944,049
72	N54A	1,630	RLUGO-1685	0.5	0.5	44.73	Fixed	1,674.79	529,841	944,899
73	N54F	1,628	RLUGO-1685	0.5	0.5	46.38	Fixed	1,674.97	529,877	944,759
74	N103C2	1,663	RCOL-1725	0.5	0.5	57.93	Fixed	1,721.07	530,202	946,166
75	N103C1	1,662	RCOL-1725	0.5	0.5	58.96	Fixed	1,721.08	530,150	946,173
76	N28B1	1,623	RLUGO-1685	0.5	0.5	53.29	Fixed	1,675.89	529,620	943,968
77	N30	1,621	RLUGO-1685	0.5	0.5	55.14	Fixed	1,676.21	529,500	943,889
78	N38A1	1,620	RLUGO-1685	0.5	0.5	57.32	Fixed	1,677.86	527,696	942,460
79	N38A3	1,619	RLUGO-1685	0.5	0.5	59.26	Fixed	1,677.90	527,797	942,584
80	N54D	1,629	RLUGO-1685	0.5	0.5	46.19	Fixed	1,675.07	529,995	944,712
81	N47B	1,627	RLUGO-1685	0.6	0.6	48.68	Fixed	1,675.49	528,375	944,440
82	N47C	1,623	RLUGO-1685	0.6	0.6	51.35	Fixed	1,674.80	528,471	944,401
83	N28A'	1,626	RLUGO-1685	0.6	0.6	49.48	Fixed	1,675.58	529,938	944,218
84	N30A5	1,622	RLUGO-1685	0.6	0.6	54.22	Fixed	1,676.45	529,427	943,779
85	N107	1,656	RCOL-1725	0.6	0.6	64.94	Fixed	1,721.14	530,013	946,276
86	N39A6	1,613	RLUGO-1685	0.6	0.6	64.8	Fixed	1,678.27	527,978	942,247
87	N103C	1,667	RCOL-1725	0.6	0.6	54.08	Fixed	1,721.14	530,162	946,263
88	N37	1,616	RLUGO-1685	0.6	0.6	62.46	Fixed	1,678.19	527,887	942,274

89	N51A	1,625	RLUGO-1685	0.6	0.6	49.21	Fixed	1,674.50	529,144	944,788
90	N43B3	1,617	RLUGO-1685	0.6	0.6	60.54	Fixed	1,677.53	528,280	943,219
91	N35A	1,615	RLUGO-1685	0.6	0.6	62.21	Fixed	1,677.50	528,332	943,331
92	N54E	1,625	RLUGO-1685	0.6	0.6	50.06	Fixed	1,675.16	529,934	944,558
93	N52B'	1,622	RLUGO-1685	0.6	0.6	52.37	Fixed	1,674.53	529,054	944,563
94	N54D'	1,631	RLUGO-1685	0.6	0.6	42.97	Fixed	1,674.37	530,131	945,049
95	N39B4	1,621	RLUGO-1685	0.6	0.6	56.77	Fixed	1,678.03	527,607	942,378
96	N32B	1,621	RLUGO-1685	0.6	0.6	55.23	Fixed	1,675.97	529,278	943,940
97	N21B	1,606	RLUGO-1685	0.6	0.6	45.12	Fixed	1,651.43	531,221	943,535
98	N63B'	1,644	RLUGO-1685	0.6	0.6	24.53	Fixed	1,668.81	529,627	945,853
99	N61A	1,637	RLUGO-1685	0.6	0.6	37.02	Fixed	1,674.09	530,202	945,232
100	N29B	1,623	RLUGO-1685	0.6	0.6	52.14	Fixed	1,675.40	529,690	944,315
101	N15F2	1,683	RLUGO-1685	0.6	0.6	-1.94	Fixed	1,681.06	528,855	940,791
102	N63B'1	1,644	RLUGO-1685	0.6	0.6	25.19	Fixed	1,668.97	529,595	945,837
103	N57A'	1,616	RLUGO-1685	0.6	0.6	58.8	Fixed	1,675.24	531,038	944,317
104	N57A	1,619	RLUGO-1685	0.6	0.6	56.2	Fixed	1,675.27	530,934	944,355
105	N15F	1,666	RLUGO-1685	0.6	0.6	15.86	Fixed	1,681.46	528,662	940,832
106	N22A2	1,623	RLUGO-1685	0.6	0.6	52.25	Fixed	1,675.53	530,325	944,113
107	N54B1	1,635	RLUGO-1685	0.6	0.6	40	Fixed	1,674.66	529,898	945,046
108	N64A2	1,626	RLUGO-1685	0.7	0.7	48.76	Fixed	1,674.40	529,602	944,702
109	NG-35	1,701	RGA-1750	0.7	0.7	55.05	Fixed	1,756.16	525,861	942,290

110	N30A8	1,624	RLUGO-1685	0.7	0.7	52.12	Fixed	1,676.48	529,130	943,717
111	N81B	1,634	RLUGO-1685	0.7	0.7	44.72	Fixed	1,678.61	528,061	940,774
112	N27C	1,618	RLUGO-1685	0.7	0.7	56.9	Fixed	1,675.38	530,668	944,185
113	N43A2	1,633	RLUGO-1685	0.7	0.7	43.42	Fixed	1,676.27	527,472	943,437
114	N64A	1,633	RLUGO-1685	0.7	0.7	41.62	Fixed	1,674.44	529,273	945,128
115	N43A3	1,634	RLUGO-1685	0.7	0.7	42.45	Fixed	1,676.13	527,418	943,233
116	N24C	1,607	RLUGO-1685	0.7	0.7	68.27	Fixed	1,675.15	531,580	944,069
117	N22A5	1,624	RLUGO-1685	0.7	0.7	51.62	Fixed	1,675.76	529,853	944,026
118	N24A	1,607	RLUGO-1685	0.7	0.7	67.99	Fixed	1,675.15	531,572	944,013
119	N32	1,619	RLUGO-1685	0.7	0.7	56.9	Fixed	1,675.99	528,780	943,828
120	N48B	1,624	RLUGO-1685	0.7	0.7	-34.92	Fixed	1,588.71	528,237	944,498
121	N48	1,626	RLUGO-1685	0.7	0.7	-36.73	Fixed	1,588.84	528,266	944,578
122	N4	1,602	RLUGO-1685	0.7	0.7	57.56	Fixed	1,659.24	530,200	941,852
123	N43A4	1,635	RLUGO-1685	0.7	0.7	40.93	Fixed	1,676.10	527,360	943,249
124	N6	1,602	RLUGO-1685	0.7	0.7	54.36	Fixed	1,656.62	530,367	941,892
125	N43A6	1,636	RLUGO-1685	0.7	0.7	40.73	Fixed	1,676.31	527,314	943,076
126	N35	1,617	RLUGO-1685	0.7	0.7	60.06	Fixed	1,677.50	528,256	943,354
127	N63A1	1,634	RLUGO-1685	0.7	0.7	40.89	Fixed	1,674.56	529,580	945,264
128	N28C	1,624	RLUGO-1685	0.7	0.7	51.27	Fixed	1,675.37	529,812	944,268
129	N43B4	1,617	RLUGO-1685	0.7	0.7	60.62	Fixed	1,677.56	528,181	943,252
130	N7A	1,601	RLUGO-	0.7	0.7	55.96	Fixed	1,656.75	530,502	942,077

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131	N11A	1,622	RLUGO-1685	0.7	0.7	53.2	Fixed	1,675.31	529,277	942,786
132	N46	1,619	RLUGO-1685	0.7	0.7	56.52	Fixed	1,676.09	528,412	943,743
133	N11	1,618	RLUGO-1685	0.7	0.7	55.9	Fixed	1,674.25	529,391	942,742
134	N7D	1,602	RLUGO-1685	0.7	0.7	54.17	Fixed	1,656.75	530,460	941,998
135	N64D	1,627	RLUGO-1685	0.7	0.7	46.91	Fixed	1,674.49	529,391	944,850
136	N31	1,616	RLUGO-1685	0.7	0.7	59.91	Fixed	1,676.50	529,021	943,837
137	N11A2	1,618	RLUGO-1685	0.7	0.7	56.66	Fixed	1,674.59	529,430	942,842
138	N7B1	1,606	RLUGO-1685	0.7	0.7	55.53	Fixed	1,661.85	530,117	942,280
139	N81E	1,630	RLUGO-1685	0.7	0.7	46.24	Fixed	1,676.67	527,849	940,531
140	N7AB	1,604	RLUGO-1685	0.7	0.7	56.21	Fixed	1,660.46	530,285	942,278
141	N7B	1,603	RLUGO-1685	0.7	0.7	57.95	Fixed	1,660.71	530,266	942,223
142	N64B	1,630	RLUGO-1685	0.7	0.7	44.08	Fixed	1,674.61	529,707	944,952
143	N8A	1,612	RLUGO-1685	0.7	0.7	51.47	Fixed	1,663.33	529,977	942,355
144	N52'	1,626	RLUGO-1685	0.7	0.7	48.67	Fixed	1,674.45	529,335	944,711
145	N14B	1,621	RLUGO-1685	0.8	0.8	55.28	Fixed	1,676.39	529,373	943,028
146	N43A7	1,630	RLUGO-1685	0.8	0.8	46.41	Fixed	1,676.56	527,479	943,022
147	N67C	1,650	RLUGO-1685	0.8	0.8	22.7	Fixed	1,672.94	529,684	946,136
148	N52D	1,622	RLUGO-1685	0.8	0.8	52.51	Fixed	1,674.62	528,931	944,612
149	N64B1	1,631	RLUGO-1685	0.8	0.8	43.78	Fixed	1,674.58	529,472	945,049
150	N56B1	1,628	RLUGO-1685	0.8	0.8	47.77	Fixed	1,675.37	530,246	944,627

151	N22B	1,615	RLUGO-1685	0.8	0.8	60.31	Fixed	1,675.35	530,849	944,095
152	N39A3	1,616	RLUGO-1685	0.8	0.8	63.1	Fixed	1,678.91	527,691	941,894
153	N53B	1,620	RLUGO-1685	0.8	0.8	55.2	Fixed	1,675.31	528,795	944,273
154	N39A4	1,614	RLUGO-1685	0.8	0.8	64.12	Fixed	1,678.66	527,731	942,106
155	N22C	1,613	RLUGO-1685	0.8	0.8	61.93	Fixed	1,675.33	530,938	944,082
156	N68C1	1,639	RLUGO-1685	0.8	0.8	35.71	Fixed	1,674.34	529,649	945,451
157	N39A5	1,614	RLUGO-1685	0.8	0.8	63.84	Fixed	1,678.46	527,926	942,059
158	N29B'	1,622	RLUGO-1685	0.8	0.8	52.71	Fixed	1,674.44	529,568	944,363
159	N46A1	1,620	RLUGO-1685	0.8	0.8	57.27	Fixed	1,677.48	528,422	943,703
160	N24E2	1,617	RLUGO-1685	0.8	0.8	57.68	Fixed	1,674.66	531,820	944,352
161	N45'	1,642	RLUGO-1685	0.9	0.9	22.26	Fixed	1,664.15	527,089	943,742
162	N45'A	1,642	RLUGO-1685	0.9	0.9	23.58	Fixed	1,665.68	526,900	943,704
163	NG-41	1,728	RGA-1750	0.9	0.9	27.78	Fixed	1,755.84	524,969	942,909
164	N55B	1,631	RLUGO-1685	0.9	0.9	44.42	Fixed	1,675.22	530,616	944,762
165	N45	1,649	RLUGO-1685	0.9	0.9	25.62	Fixed	1,674.72	526,944	943,394
166	N56A	1,631	RLUGO-1685	0.9	0.9	43.98	Fixed	1,675.25	530,342	944,867
167	N43A5	1,644	RLUGO-1685	0.9	0.9	30.75	Fixed	1,675.30	527,039	943,337
168	N38B	1,616	RLUGO-1685	0.9	0.9	62.1	Fixed	1,677.96	527,965	942,522
169	N24B	1,617	RLUGO-1685	0.9	0.9	57.82	Fixed	1,674.93	531,627	944,402
170	N81B1	1,621	RLUGO-1685	0.9	0.9	55.63	Fixed	1,677.18	527,897	940,944
171	N43	1,622	RLUGO-1685	0.9	0.9	54.97	Fixed	1,677.07	527,747	942,943

172	N43A	1,622	RLUGO-1685	0.9	0.9	55.12	Fixed	1,676.84	527,806	943,142
173	N67	1,639	RLUGO-1685	0.9	0.9	34.19	Fixed	1,673.05	529,739	945,670
174	N32C	1,620	RLUGO-1685	0.9	0.9	54.89	Fixed	1,675.14	529,114	944,147
175	N67A	1,638	RLUGO-1685	0.9	0.9	34.95	Fixed	1,672.98	529,721	945,624
176	N65A	1,638	RLUGO-1685	0.9	0.9	36.8	Fixed	1,674.39	529,049	945,380
177	N31B	1,618	RLUGO-1685	0.9	0.9	58.29	Fixed	1,676.77	529,463	943,253
178	N101	1,674	RCOL-1725	0.9	0.9	45.63	Fixed	1,719.62	531,173	946,619
179	N52A	1,621	RLUGO-1685	0.9	0.9	53.34	Fixed	1,674.46	529,193	944,346
180	N24E1	1,614	RLUGO-1685	0.9	0.9	60.61	Fixed	1,674.65	531,794	944,238
181	N106A"	1,656	RCOL-1725	0.9	0.9	59.59	Fixed	1,715.91	531,138	945,956
182	N52B	1,622	RLUGO-1685	0.9	0.9	52.14	Fixed	1,674.45	529,247	944,488
183	N81D	1,623	RLUGO-1685	0.9	0.9	51.87	Fixed	1,675.44	527,676	940,314
184	IAU-01	1,646	RCOL-1725	0.9	0.9	66.5	Fixed	1,712.73	531,049	945,223
185	N32A	1,619	RLUGO-1685	1	1	57.01	Fixed	1,675.87	528,828	943,989
186	N46B	1,618	RLUGO-1685	1	1	57.65	Fixed	1,675.92	528,472	943,899
187	N39B	1,624	RLUGO-1685	1	1	54.21	Fixed	1,678.23	527,452	942,327
188	N47A	1,617	RLUGO-1685	1	1	58.62	Fixed	1,675.76	528,550	944,102
189	N22D	1,610	RLUGO-1685	1	1	65.24	Fixed	1,675.35	530,812	943,817
190	N22E	1,608	RLUGO-1685	1	1	46.4	Fixed	1,654.06	530,905	943,787
191	N56A1	1,633	RLUGO-1685	1	1	40.74	Fixed	1,674.21	530,379	944,953
192	N25A	1,606	RLUGO-1685	1	1	68.91	Fixed	1,675.13	531,979	943,848
193	N30A7	1,620	RLUGO-	1	1	56.1	Fixed	1,676.21	529,541	943,724

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194	N47A1	1,630	RLUGO-1685	1	1	44.84	Fixed	1,674.54	528,860	944,899
195	N43B2	1,615	RLUGO-1685	1	1	61.87	Fixed	1,677.26	528,442	942,958
196	N43B1	1,614	RLUGO-1685	1	1	63.5	Fixed	1,677.25	528,289	943,001
197	N57	1,621	RLUGO-1685	1	1	54.2	Fixed	1,675.33	530,765	944,422
198	N55A'	1,627	RLUGO-1685	1	1	47.99	Fixed	1,675.36	530,525	944,518
199	N106A'	1,665	RCOL-1725	1.1	1.1	52.81	Fixed	1,717.88	531,028	946,247
200	N27B2	1,630	RLUGO-1685	1.1	1.1	45.37	Fixed	1,675.48	530,333	944,416
201	N27B3	1,626	RLUGO-1685	1.1	1.1	49.48	Fixed	1,675.42	530,434	944,275
202	N44A1	1,620	RLUGO-1685	1.1	1.1	56.27	Fixed	1,676.38	527,941	943,591
203	N64E	1,628	RLUGO-1685	1.1	1.1	46.19	Fixed	1,674.48	529,197	944,927
204	N21C	1,604	RLUGO-1685	1.1	1.1	46.65	Fixed	1,650.68	531,384	943,523
205	N46B1	1,622	RLUGO-1685	1.1	1.1	53.33	Fixed	1,675.70	528,207	944,001
206	N21D	1,603	RLUGO-1685	1.1	1.1	47.35	Fixed	1,650.44	531,566	943,468
207	N63A	1,630	RLUGO-1685	1.1	1.1	43.91	Fixed	1,674.50	529,531	945,198
208	N15B2	1,638	RLUGO-1685	1.1	1.1	41.41	Fixed	1,679.28	528,839	941,464
209	N15	1,625	RLUGO-1685	1.1	1.1	54.37	Fixed	1,679.25	528,611	941,712
210	N15A	1,628	RLUGO-1685	1.1	1.1	51.24	Fixed	1,679.21	528,740	941,703
211	N10A2	1,626	RLUGO-1685	1.1	1.1	40.69	Fixed	1,666.57	529,860	942,519
212	N10	1,627	RLUGO-1685	1.1	1.1	42.35	Fixed	1,669.19	529,789	942,715
213	N15B1	1,639	RLUGO-1685	1.1	1.1	41.01	Fixed	1,679.88	528,824	941,461

214	N20A	1,605	RLUGO-1685	1.1	1.1	46.89	Fixed	1,652.18	531,123	943,573
215	N20B	1,607	RLUGO-1685	1.1	1.1	45.75	Fixed	1,653.14	531,159	943,717
216	N81D1	1,614	RLUGO-1685	1.1	1.1	61.41	Fixed	1,675.70	527,460	940,507
217	ILu-01	1,619	RLUGO-1685	1.1	1.1	58.32	Fixed	1,677.04	529,419	942,275
218	N14A	1,623	RLUGO-1685	1.1	1.1	53.55	Fixed	1,677.12	529,162	943,111
219	N31C	1,624	RLUGO-1685	1.1	1.1	52.84	Fixed	1,676.71	529,364	943,622
220	N106A	1,663	RCOL-1725	1.2	1.2	54.85	Fixed	1,717.92	530,904	946,292
221	ILEBO-01	1,617	RLUGO-1685	1.2	1.2	51.94	Fixed	1,668.95	529,653	940,823
222	N49	1,622	RLUGO-1685	1.2	1.2	54.38	Fixed	1,676.17	528,211	944,430
223	N30A	1,622	RLUGO-1685	1.2	1.2	54.05	Fixed	1,676.05	529,526	943,947
224	N30A2	1,622	RLUGO-1685	1.2	1.2	54.21	Fixed	1,676.26	529,470	943,888
225	N22D1	1,614	RLUGO-1685	1.2	1.2	61.43	Fixed	1,675.37	530,632	943,866
226	N15D	1,651	RLUGO-1685	1.2	1.2	29.41	Fixed	1,680.42	528,904	941,089
227	N15D2	1,659	RLUGO-1685	1.2	1.2	21.39	Fixed	1,680.54	528,999	941,003
228	N43B	1,619	RLUGO-1685	1.2	1.2	58.87	Fixed	1,677.65	528,125	943,052
229	N15A1	1,657	RLUGO-1685	1.2	1.2	23.79	Fixed	1,680.67	528,791	941,071
230	N31A	1,626	RLUGO-1685	1.3	1.3	50.77	Fixed	1,676.94	529,248	943,334
231	N58	1,629	RLUGO-1685	1.3	1.3	46.06	Fixed	1,675.20	530,863	944,665
232	N59	1,622	RLUGO-1685	1.3	1.3	53.22	Fixed	1,675.17	531,354	944,531
233	N81C3	1,633	RLUGO-1685	1.3	1.3	43.48	Fixed	1,676.33	527,933	940,424
234	N36	1,615	RLUGO-1685	1.3	1.3	63.12	Fixed	1,677.80	528,035	942,744

235	N15E	1,677	RLUGO-1685	1.3	1.3	3.91	Fixed	1,680.80	529,008	940,771
236	N44B2	1,635	RLUGO-1685	1.3	1.3	38.38	Fixed	1,673.56	527,339	943,716
237	N111C	1,642	RCOL-1725	1.3	1.3	71.89	Fixed	1,713.74	530,775	945,088
238	N44A	1,634	RLUGO-1685	1.3	1.3	41.03	Fixed	1,675.24	527,383	943,496
239	N47	1,623	RLUGO-1685	1.3	1.3	52.48	Fixed	1,675.58	528,641	944,336
240	N111A	1,651	RCOL-1725	1.3	1.3	63.6	Fixed	1,714.54	530,975	945,569
241	N111A'	1,649	RCOL-1725	1.3	1.3	65.13	Fixed	1,714.32	530,942	945,486
242	N68C	1,646	RLUGO-1685	1.4	1.4	27.57	Fixed	1,673.71	530,108	945,583
243	N15F7	1,682	RLUGO-1685	1.4	1.4	2.44	Fixed	1,684.22	528,897	940,535
244	N68A2	1,641	RLUGO-1685	1.4	1.4	31.83	Fixed	1,673.11	529,939	945,444
245	N105D	1,685	RCOL-1725	1.4	1.4	25.19	Fixed	1,710.24	530,778	947,815
246	N33	1,619	RLUGO-1685	1.4	1.4	58.57	Fixed	1,677.25	528,778	943,784
247	N2	1,633	RLUGO-1685	1.4	1.4	45.94	Fixed	1,679.32	528,962	941,481
248	N12A1	1,626	RLUGO-1685	1.4	1.4	52.65	Fixed	1,678.63	529,144	941,623
249	N12A	1,627	RLUGO-1685	1.4	1.4	51.81	Fixed	1,679.02	528,985	941,654
250	N70	1,652	RCOL-1725	1.5	1.5	60.67	Fixed	1,713.00	531,150	945,405
251	N70'	1,651	RCOL-1725	1.5	1.5	61.56	Fixed	1,713.02	531,124	945,415
252	N59A	1,616	RLUGO-1685	1.5	1.5	59.4	Fixed	1,675.19	531,293	944,290
253	N81F	1,618	RLUGO-1685	1.5	1.5	57.98	Fixed	1,676.25	527,654	940,701
254	N7A1	1,602	RLUGO-1685	1.5	1.5	49.1	Fixed	1,650.85	530,606	942,043
255	N103B	1,667	RCOL-1725	1.5	1.5	53.16	Fixed	1,720.46	530,683	946,354
256	N15F5	1,672	RLUGO-1685	1.5	1.5	9.87	Fixed	1,682.35	528,585	940,558
257	N15F4	1,670	RLUGO-1685	1.5	1.5	12.2	Fixed	1,681.97	528,590	940,681
258	N7C	1,604	RLUGO-	1.5	1.5	55.66	Fixed	1,659.27	530,219	942,097

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259	N3F	1,597	RLUGO-1685	1.6	1.6	-57.08	Fixed	1,539.92	531,318	941,449
260	N3I	1,603	RLUGO-1685	1.6	1.6	-87.05	Fixed	1,515.83	531,561	941,133
261	N3H	1,594	RLUGO-1685	1.6	1.6	-66.29	Fixed	1,527.18	531,538	941,439
262	N10A	1,617	RLUGO-1685	1.6	1.6	54.22	Fixed	1,671.74	529,581	942,668
263	N71BC	1,641	RCOL-1725	1.6	1.6	48.68	Fixed	1,689.50	531,906	945,107
264	N71B	1,639	RCOL-1725	1.6	1.6	50.62	Fixed	1,689.58	531,966	945,083
265	N108A	1,656	RCOL-1725	1.6	1.6	64.94	Fixed	1,721.06	529,446	946,118
266	N24E	1,614	RLUGO-1685	1.6	1.6	61.31	Fixed	1,675.15	531,608	944,242
267	N6A1	1,598	RLUGO-1685	1.6	1.6	43.49	Fixed	1,641.39	530,777	941,760
268	N6A	1,598	RLUGO-1685	1.6	1.6	39.76	Fixed	1,637.42	530,891	941,862
269	N67E1	1,647	RLUGO-1685	1.7	1.7	25.44	Fixed	1,672.95	529,878	946,027
270	N38A	1,621	RLUGO-1685	1.7	1.7	56.65	Fixed	1,677.85	527,546	942,515
271	N36A	1,613	RLUGO-1685	1.7	1.7	63.73	Fixed	1,677.25	528,208	942,698
272	N24	1,611	RLUGO-1685	1.7	1.7	64.28	Fixed	1,675.22	531,237	944,049
273	N43A1	1,624	RLUGO-1685	1.7	1.7	52.48	Fixed	1,676.62	527,864	943,337
274	N14	1,628	RLUGO-1685	1.8	1.8	48.82	Fixed	1,677.32	529,069	942,868
275	N6B4	1,598	RLUGO-1685	1.8	1.8	44.95	Fixed	1,643.03	531,084	942,513
276	N78	1,640	RCOL-1725	1.8	1.8	72.49	Fixed	1,712.64	530,967	945,012
277	N6B1	1,599	RLUGO-1685	1.8	1.8	38.64	Fixed	1,637.61	531,047	942,121
278	NG-53	1,640	RGA-1750	1.8	1.8	131.38	Fixed	1,771.65	526,897	943,385
279	N102A	1,657	RCOL-1725	1.8	1.8	59.16	Fixed	1,715.82	531,127	945,926
280	N44	1,621	RLUGO-1685	1.9	1.9	54.96	Fixed	1,676.33	527,955	943,638
281	NG-37	1,707	RGA-1750	1.9	1.9	49.32	Fixed	1,756.25	526,313	942,671

282	N38A2	1,618	RLUGO-1685	1.9	1.9	59.84	Fixed	1,677.86	527,752	942,439
283	N82C	1,613	RLUGO-1685	1.9	1.9	67.72	Fixed	1,680.47	527,645	941,144
284	N82A	1,613	RLUGO-1685	1.9	1.9	67.22	Fixed	1,680.76	527,790	941,308
285	N68D	1,650	RLUGO-1685	1.9	1.9	23.04	Fixed	1,673.42	530,175	945,752
286	N103A	1,667	RCOL-1725	1.9	1.9	53.44	Fixed	1,720.66	530,448	946,449
287	N6C	1,598	RLUGO-1685	1.9	1.9	-55.41	Fixed	1,542.01	531,141	941,382
288	N3B	1,595	RLUGO-1685	1.9	1.9	-52.31	Fixed	1,542.78	531,199	941,269
289	N17B	1,621	RLUGO-1685	2	2	38.3	Fixed	1,659.82	530,272	943,583
290	N21	1,612	RLUGO-1685	2	2	47.96	Fixed	1,659.75	530,423	943,523
291	N7	1,600	RLUGO-1685	2	2	59.11	Fixed	1,659.23	530,560	942,187
292	N36A2	1,620	RLUGO-1685	2	2	57.66	Fixed	1,677.27	528,800	942,973
293	N39A1	1,615	RLUGO-1685	2	2	64.34	Fixed	1,679.31	527,608	941,571
294	N51B	1,631	RLUGO-1685	2	2	18.25	Fixed	1,648.80	528,692	944,962
295	N106	1,672	RCOL-1725	2	2	47.76	Fixed	1,719.62	531,051	946,666
296	N34	1,615	RLUGO-1685	2	2	61.66	Fixed	1,677.28	528,567	943,260
297	N31D	1,622	RLUGO-1685	2.1	2.1	54.39	Fixed	1,676.22	529,590	943,531
298	N18A	1,603	RLUGO-1685	2.2	2.2	55.6	Fixed	1,658.73	530,626	943,037
299	N103	1,665	RCOL-1725	2.2	2.2	55.95	Fixed	1,721.18	530,357	946,222
300	N20	1,606	RLUGO-1685	2.2	2.2	48.53	Fixed	1,654.85	531,051	943,286
301	N39	1,617	RLUGO-1685	2.2	2.2	63.24	Fixed	1,680.04	527,341	941,279
302	N19	1,599	RLUGO-1685	2.3	2.3	56.83	Fixed	1,656.42	530,958	942,913
303	NN-01	1,615	RLUGO-	2.3	2.3	54.85	Fixed	1,670.00	529,583	941,019

			1685							
304	N42	1,624	RLUGO-1685	2.3	2.3	52.72	Fixed	1,677.23	527,713	942,828
305	N18C	1,599	RLUGO-1685	2.3	2.3	53.61	Fixed	1,653.18	530,515	942,747
306	N44B	1,620	RLUGO-1685	2.3	2.3	55.61	Fixed	1,676.18	528,050	943,989
307	N44B4	1,625	RLUGO-1685	2.3	2.3	47.45	Fixed	1,673.04	527,710	944,044
308	N105A	1,685	RCOL-1725	2.3	2.3	32.41	Fixed	1,717.17	530,702	947,099
309	N44B3	1,631	RLUGO-1685	2.3	2.3	41.56	Fixed	1,672.79	527,384	944,038
310	N18B	1,606	RLUGO-1685	2.4	2.4	48.67	Fixed	1,655.13	530,760	943,395
311	N71	1,657	RCOL-1725	2.4	2.4	55.81	Fixed	1,713.30	531,322	945,834
312	N36A1	1,616	RLUGO-1685	2.4	2.4	61.45	Fixed	1,677.25	528,619	942,587
313	N39B1	1,624	RLUGO-1685	2.4	2.4	54.94	Fixed	1,678.55	527,401	942,156
314	N18	1,613	RLUGO-1685	2.5	2.5	47.99	Fixed	1,661.17	530,285	943,165
315	N17	1,621	RLUGO-1685	2.5	2.5	39.78	Fixed	1,660.91	530,098	943,251
316	N105A4	1,685	RCOL-1725	2.5	2.5	24.6	Fixed	1,709.98	530,683	947,854
317	N102	1,659	RCOL-1725	2.5	2.5	57.77	Fixed	1,717.35	530,810	946,057
318	N105C1	1,689	RCOL-1725	2.6	2.6	24	Fixed	1,712.78	530,827	947,413
319	N9	1,614	RLUGO-1685	2.7	2.7	50.52	Fixed	1,664.40	530,031	942,497
320	N50	1,636	RLUGO-1685	2.7	2.7	-39.88	Fixed	1,595.69	528,398	945,080
321	N16A	1,622	RLUGO-1685	2.7	2.7	54.09	Fixed	1,675.90	529,675	943,188
322	NN-02	1,620	RLUGO-1685	2.7	2.7	43.52	Fixed	1,663.61	529,771	940,565
323	N105	1,676	RCOL-1725	2.7	2.7	43.84	Fixed	1,719.90	530,599	946,836
324	N69	1,640	RLUGO-1685	2.7	2.7	31.03	Fixed	1,671.44	530,510	945,300
325	N39A	1,621	RLUGO-1685	2.7	2.7	58.19	Fixed	1,679.66	527,350	941,590
326	N109	1,657	RCOL-1725	2.8	2.8	52.7	Fixed	1,709.57	532,088	945,538

327	N111	1,648	RCOL-1725	2.8	2.8	66.03	Fixed	1,714.54	530,663	945,687
328	N4B	1,615	RLUGO-1685	2.9	2.9	27.38	Fixed	1,642.07	529,642	941,343
329	N100R5	1,684	RCOL-1725	2.9	2.9	35.44	Fixed	1,719.93	531,352	946,752
330	N81	1,632	RLUGO-1685	3	3	48.96	Fixed	1,681.50	528,189	940,928
331	N3J	1,612	RLUGO-1685	3.1	3.1	-109.35	Fixed	1,502.50	531,781	940,966
332	N3J1	1,632	RLUGO-1685	3.1	3.1	-110.98	Fixed	1,520.80	531,828	941,426
333	N9B	1,599	RLUGO-1685	3.1	3.1	57.56	Fixed	1,656.44	530,795	942,634
334	N71'	1,657	RCOL-1725	3.2	3.2	54.21	Fixed	1,711.03	531,709	945,680
335	N109B	1,644	RCOL-1725	3.2	3.2	66.98	Fixed	1,711.10	531,552	945,244
336	N6B3	1,597	RLUGO-1685	3.2	3.2	42.39	Fixed	1,639.50	531,211	942,456
337	N106B	1,678	RCOL-1725	3.6	3.6	38.36	Fixed	1,716.01	531,151	946,920
338	N12	1,621	RLUGO-1685	3.7	3.7	55.71	Fixed	1,677.04	529,233	942,335
339	N12A4	1,623	RLUGO-1685	3.7	3.7	54.62	Fixed	1,677.73	529,105	942,008
340	N13	1,633	RLUGO-1685	3.8	3.8	44.65	Fixed	1,677.84	528,911	942,465
341	N77	1,625	RCOL-1725	4	4	64.03	Fixed	1,689.04	531,598	944,725
342	N105A2	1,674	RCOL-1725	4.1	4.1	36.56	Fixed	1,710.63	530,435	947,228
343	N105C'	1,702	RCOL-1725	4.3	4.3	8.42	Fixed	1,710.12	531,414	947,558
344	N3G	1,616	RLUGO-1685	5	5	-117.52	Fixed	1,497.94	531,677	940,693
345	N3	1,601	RLUGO-1685	5.1	5.1	3.77	Fixed	1,604.78	530,571	941,027
346	N3B2	1,601	RLUGO-1685	5.1	5.1	-13.42	Fixed	1,587.26	530,847	940,934
347	ILEBO-23	1,596	RLUGO-1685	5.2	5.2	-54.38	Fixed	1,541.01	531,350	941,093
348	N4A	1,602	RLUGO-1685	5.3	5.3	40.36	Fixed	1,642.33	530,289	941,647
349	N54	1,626	RLUGO-1685	5.3	5.3	49.4	Fixed	1,675.11	529,811	944,609
350	ILWA-02	1,627	RLUGO-1685	5.6	5.6	-38.99	Fixed	1,588.34	527,950	944,605

351	ILWA-01	1,635	RLUGO-1685	5.6	5.6	-39.66	Fixed	1,595.36	528,129	945,101
352	N61	1,636	RLUGO-1685	5.9	5.9	37.73	Fixed	1,673.81	530,450	945,135
353	N58A2	1,638	RLUGO-1685	6.3	6.3	35.64	Fixed	1,673.73	530,952	944,935
354	N3E	1,600	RLUGO-1685	6.4	6.4	-80.57	Fixed	1,518.80	531,489	941,084
355	N54A1	1,625	RLUGO-1685	6.5	6.5	48.9	Fixed	1,674.37	529,656	944,585
356	J-1618	1,602	RLUGO-1685	6.9	6.9	48.06	Fixed	1,650.16	530,578	940,943
357	N100U3	1,664	RCOL-1725	8.1	8.1	52.45	Fixed	1,716.67	531,218	946,177
358	N100U1	1,702	RCOL-1725	8.1	8.1	18.89	Fixed	1,720.61	531,736	946,806
359	N100U2	1,687	RCOL-1725	8.1	8.1	32.93	Fixed	1,720.08	531,436	946,785
360	N3D	1,606	RLUGO-1685	8.8	8.8	-42.36	Fixed	1,563.67	530,727	940,683
361	N3C	1,612	RLUGO-1685	9.1	9.1	-56.75	Fixed	1,554.72	530,855	940,398
362	ILWBO-01	1,632	RLUGO-1685	10.8	10.8	33.34	Fixed	1,665.41	527,339	942,948

APPENDIX F. Link Steady State Analysis Results at Average Day Demand

S.No	Label	Length (m)	Velocity (m/s)	Diameter (mm)	Material	Hazen-Williams C	Discharge (l/s)	Pressure Pipe Headloss (m)	Headloss Gradient (m/km)
1.00	P-1792	403.00	1.10	600.00	DI	110.00	310.60	0.98	2.40
2.00	P-1799	69.00	1.10	600.00	DI	110.00	310.60	0.17	2.40
3.00	P-1777	275.00	1.10	600.00	DI	110.00	310.60	0.67	2.40
4.00	P-1782	819.00	1.10	600.00	DI	110.00	310.60	2.00	2.40
5.00	P-1788	318.00	1.10	600.00	DI	110.00	310.60	0.78	2.40
6.00	P-1780	1,656.00	1.10	600.00	DI	110.00	310.60	4.04	2.40
7.00	P-1784	730.00	1.10	600.00	DI	110.00	310.60	1.78	2.40
8.00	P-1794	133.00	1.10	600.00	DI	110.00	310.60	0.33	2.40
9.00	P-1793	70.00	1.10	600.00	DI	110.00	310.60	0.17	2.40
10.00	P-1772	16.00	1.10	600.00	DI	110.00	310.60	0.04	2.40
11.00	P-1783	20.00	1.10	600.00	DI	110.00	310.60	0.05	2.40
12.00	P-1796	62.00	1.10	600.00	DI	110.00	310.60	0.15	2.40
13.00	P-1773	6.00	1.10	600.00	DI	110.00	310.60	0.02	2.40
14.00	P-1800	77.00	1.10	600.00	DI	110.00	310.60	0.19	2.40
15.00	P-1798	32.00	1.10	600.00	DI	110.00	310.60	0.08	2.40
16.00	P-1770	1,920.00	1.10	600.00	DI	110.00	310.60	4.69	2.40

17.00	PE-466	67.00	0.05	300.00	DI	110.00	3.30	-	-
18.00	PE-486	244.00	0.66	300.00	DI	110.00	(46.90)	0.53	2.20
19.00	PE-464	123.00	0.02	300.00	DI	110.00	(1.50)	-	-
20.00	PE-508	138.00	1.06	300.00	DI	110.00	75.00	0.71	5.10
21.00	PE-484	415.00	0.63	300.00	DI	110.00	(44.70)	0.82	2.00
22.00	PE-465	62.00	0.05	300.00	DI	110.00	3.30	-	-
23.00	PE-509	319.00	0.72	300.00	DI	110.00	(50.80)	0.80	2.50
24.00	PE-463	191.00	0.02	300.00	DI	110.00	(1.20)	-	-
25.00	P-1779	69.00	1.10	600.00	DI	110.00	310.60	0.17	2.40
26.00	P-1786	309.00	1.10	600.00	DI	110.00	310.60	0.75	2.40
27.00	P-1791	61.00	1.10	600.00	DI	110.00	310.60	0.15	2.40
28.00	P-1790	34.00	1.10	600.00	DI	110.00	310.60	0.08	2.40
29.00	PE-469	45.00	0.19	300.00	DI	110.00	(13.40)	0.01	0.20
30.00	PE-468	203.00	0.19	300.00	DI	110.00	13.40	0.04	0.20
31.00	PE-507	183.00	0.64	400.00	DI	110.00	81.00	0.27	1.50
32.00	P-1785	351.00	1.10	600.00	DI	110.00	310.60	0.86	2.40
33.00	ED-14	122.00	0.36	300.00	DI	110.00	25.20	0.08	0.70
34.00	ED-09	263.00	0.36	300.00	DI	110.00	25.20	0.18	0.70
35.00	ED-10	303.00	0.36	300.00	DI	110.00	25.20	0.21	0.70
36.00	ED-16	81.00	0.36	300.00	DI	110.00	25.20	0.06	0.70
	ED-25				DI	110.00	25.20	0.08	0.70

37.00		120.00	0.36	300.00					
38.00	ED-19	73.00	0.36	300.00	DI	110.00	25.20	0.05	0.70
39.00	ED-12	222.00	0.36	300.00	DI	110.00	25.20	0.15	0.70
40.00	ED-11	267.00	0.36	300.00	DI	110.00	25.20	0.18	0.70
41.00	ED-24	186.00	0.36	300.00	DI	110.00	25.20	0.13	0.70
42.00	ED-08	182.00	0.36	300.00	DI	110.00	25.20	0.12	0.70
43.00	ED-30	3.00	0.36	300.00	DI	110.00	25.20	-	0.70
44.00	ED-26	125.00	0.36	300.00	DI	110.00	25.20	0.09	0.70
45.00	ED-31	368.00	0.36	300.00	DI	110.00	25.20	0.25	0.70
46.00	ED-05	57.00	0.36	300.00	DI	110.00	25.20	0.04	0.70
47.00	ED-32	190.00	0.36	300.00	DI	110.00	25.20	0.13	0.70
48.00	ED-33	95.00	0.36	300.00	DI	110.00	25.20	0.06	0.70
49.00	P-1771	430.00	1.10	600.00	DI	110.00	310.60	1.05	2.40
50.00	P-1778	323.00	1.10	600.00	DI	110.00	310.60	0.79	2.40
51.00	P-1775	214.00	1.10	600.00	DI	110.00	310.60	0.52	2.40
52.00	P-1776	20.00	1.10	600.00	DI	110.00	310.60	0.05	2.40
53.00	P-1774	272.00	1.10	600.00	DI	110.00	310.60	0.66	2.40
54.00	P-1789	122.00	1.10	600.00	DI	110.00	310.60	0.30	2.40
55.00	P-1795	91.00	1.10	600.00	DI	110.00	310.60	0.22	2.40
56.00	P-1797	42.00	1.10	600.00	DI	110.00	310.60	0.10	2.40
57.00	PB-24	131.00	0.94	150.00	DI	110.00	16.60	1.21	9.20

58.00	PB-23	873.00	0.94	150.00	DI	110.00	16.60	8.07	9.20
59.00	PB-20	119.00	0.94	150.00	DI	110.00	16.60	1.10	9.20
60.00	PB-21	261.00	0.94	150.00	DI	110.00	16.60	2.42	9.20
61.00	P-1781	1,210.00	1.10	600.00	DI	110.00	310.60	2.95	2.40
62.00	P-1787	430.00	1.10	600.00	DI	110.00	310.60	1.05	2.40
63.00	PB-22	182.00	0.94	150.00	DI	110.00	16.60	1.68	9.20
64.00	PE-154	96.00	0.87	600.00	DI	110.00	(246.50)	0.15	1.60
65.00	PE-343	215.00	0.50	500.00	DI	110.00	97.50	0.15	0.70
66.00	PE-91	54.00	0.62	500.00	DI	110.00	122.30	0.06	1.10
67.00	PE-349	87.00	0.48	500.00	DI	110.00	94.80	0.06	0.70
68.00	PE-252	61.00	0.10	300.00	DI	110.00	(6.90)	-	0.10
69.00	PE-158	279.00	1.24	600.00	DI	110.00	(351.20)	0.86	3.10
70.00	PE-157	34.00	1.24	600.00	DI	110.00	(351.20)	0.10	3.10
71.00	PE-138	166.00	0.65	600.00	DI	110.00	(184.90)	0.16	0.90
72.00	PE-348	158.00	0.48	500.00	DI	110.00	94.00	0.10	0.60
73.00	PE-192	204.00	0.39	400.00	DI	110.00	48.50	0.12	0.60
74.00	PE-193	266.00	0.35	400.00	DI	110.00	43.90	0.12	0.50
75.00	PE-161	19.00	0.52	500.00	DI	110.00	102.80	0.01	0.80
76.00	PE-169	120.00	0.47	500.00	DI	110.00	93.20	0.08	0.60
77.00	PE-341	94.00	0.50	500.00	DI	110.00	97.80	0.07	0.70
	PE-				DI	110.00	61.80	0.31	0.90

78.00	189	354.00	0.49	400.00					
79.00	PE-127	433.00	0.54	600.00	DI	110.00	(152.90)	0.28	0.70
80.00	PE-249	107.00	0.09	300.00	DI	110.00	(6.40)	0.01	0.10
81.00	PE-98	157.00	0.59	500.00	DI	110.00	(116.40)	0.15	1.00
82.00	PE-93	30.00	0.61	500.00	DI	110.00	119.90	0.03	1.00
83.00	PE-163	550.00	0.49	500.00	DI	110.00	95.60	0.37	0.70
84.00	PE-94	118.00	0.61	500.00	DI	110.00	(120.60)	0.12	1.00
85.00	PE-186	569.00	0.52	400.00	DI	110.00	65.10	0.55	1.00
86.00	PE-167	25.00	0.47	500.00	DI	110.00	93.20	0.02	0.60
87.00	PE-346	84.00	0.48	500.00	DI	110.00	94.40	0.06	0.70
88.00	PE-342	42.00	0.50	500.00	DI	110.00	97.60	0.03	0.70
89.00	PE-339	41.00	0.59	500.00	DI	110.00	116.10	0.04	1.00
90.00	PE-155	73.00	0.87	600.00	DI	110.00	(246.50)	0.12	1.60
91.00	PE-251	148.00	0.10	300.00	DI	110.00	(6.90)	0.01	0.10
92.00	PE-90	96.00	0.62	500.00	DI	110.00	121.60	0.10	1.00
93.00	PE-139	178.00	0.65	600.00	DI	110.00	(184.90)	0.17	0.90
94.00	PE-187	178.00	0.51	400.00	DI	110.00	63.60	0.17	0.90
95.00	PE-113	260.00	0.46	600.00	DI	110.00	(128.80)	0.12	0.50
96.00	PE-266	49.00	0.35	400.00	DI	110.00	43.50	0.02	0.50
97.00	PE-92	40.00	0.62	500.00	DI	110.00	122.30	0.04	1.10
98.00	PE-159	77.00	1.25	600.00	DI	110.00	(352.10)	0.24	3.10

99.00	PE-95	12.00	0.58	500.00	DI	110.00	(114.50)	0.01	0.90
100.00	PE-165	157.00	0.48	500.00	DI	110.00	94.40	0.10	0.70
101.00	PE-248	128.00	0.09	300.00	DI	110.00	(6.40)	0.01	0.10
102.00	PE-107	239.00	0.45	600.00	DI	110.00	(126.10)	0.11	0.50
103.00	PE-345	163.00	0.46	500.00	DI	110.00	90.70	0.10	0.60
104.00	PE-467	301.00	0.12	300.00	DI	110.00	8.40	0.03	0.10
105.00	PE-461	130.00	0.20	300.00	DI	110.00	14.00	0.03	0.20
106.00	PE-519	290.00	0.67	400.00	DI	110.00	83.80	0.45	1.60
107.00	PE-470	483.00	0.45	300.00	DI	110.00	32.10	0.52	1.10
108.00	PE-188	211.00	0.50	400.00	DI	110.00	62.30	0.19	0.90
109.00	PE-147	271.00	0.85	600.00	DI	110.00	(241.10)	0.41	1.50
110.00	PE-160	52.00	1.25	600.00	DI	110.00	(352.10)	0.16	3.10
111.00	PE-340	86.00	0.50	500.00	DI	110.00	97.90	0.06	0.70
112.00	PE-168	119.00	0.47	500.00	DI	110.00	93.20	0.08	0.60
113.00	PE-162	526.00	0.52	500.00	DI	110.00	102.80	0.40	0.80
114.00	PE-164	62.00	0.48	500.00	DI	110.00	94.40	0.04	0.70
115.00	PE-250	118.00	0.09	300.00	DI	110.00	(6.40)	0.01	0.10
116.00	PE-427	199.00	0.67	400.00	DI	110.00	84.70	0.32	1.60
117.00	PE-191	208.00	0.39	400.00	DI	110.00	48.80	0.12	0.60
118.00	PE-267	469.00	0.26	400.00	DI	110.00	32.60	0.13	0.30
	PE-				DI	110.00	94.40	0.08	0.70

119.00	347	118.00	0.48	500.00					
120.00	PE-156	124.00	0.88	600.00	DI	110.00	(247.40)	0.20	1.60
121.00	PE-130	810.00	0.64	600.00	DI	110.00	(181.70)	0.73	0.90
122.00	PE-185	311.00	0.47	500.00	DI	110.00	91.80	0.19	0.60
123.00	PE-190	119.00	0.43	400.00	DI	110.00	54.40	0.08	0.70
124.00	PE-102	311.00	0.43	600.00	DI	110.00	(122.70)	0.14	0.40
125.00	PE-344	318.00	0.48	500.00	DI	110.00	93.90	0.21	0.60
126.00	PE-166	73.00	0.47	500.00	DI	110.00	93.20	0.05	0.60
127.00	EG-92	32.00	0.16	150.00	DI	110.00	(2.80)	0.01	0.30
128.00	EG-38	34.00	0.16	150.00	DI	110.00	2.80	0.01	0.30
129.00	EG-39	24.00	0.16	150.00	DI	110.00	2.80	0.01	0.30
130.00	EG-93	3.00	-	200.00	DI	110.00	-	-	-
131.00	P-1324	45.00	0.89	100.00	DI	110.00	7.00	0.61	13.40
132.00	EG-87	2.00	0.22	200.00	DI	110.00	7.00	-	0.50
133.00	EG-97	52.00	-	200.00	DI	110.00	-	-	-
134.00	EG-96	369.00	-	200.00	DI	110.00	-	-	-
135.00	EG-37	41.00	0.16	150.00	DI	110.00	2.80	0.01	0.30
136.00	EG-82	37.00	0.16	150.00	DI	110.00	2.80	0.01	0.30
137.00	EG-32	64.00	0.16	150.00	DI	110.00	2.80	0.02	0.30
138.00	EG-36	34.00	0.16	150.00	DI	110.00	2.80	0.01	0.30
139.00	EG-33	50.00	0.16	150.00	DI	110.00	2.80	0.02	0.30

140.00	EG-34	30.00	0.16	150.00	DI	110.00	2.80	0.01	0.30
141.00	EG-35	38.00	0.16	150.00	DI	110.00	2.80	0.01	0.30
142.00	EG-86	4.00	0.61	100.00	DI	110.00	4.80	0.03	6.70
143.00	P-1205	1.00	0.81	200.00	DI	110.00	25.40	-	4.90
144.00	P-1206	1.00	0.26	350.00	DI	110.00	25.40	-	0.30
145.00	P-1207	205.00	0.66	600.00	DI	110.00	(185.60)	0.19	0.90
146.00	P-1204	1.00	-	200.00	DI	110.00	-	-	-
147.00	ED-01	2.00	-	200.00	DI	110.00	-	-	-
148.00	ED-02	1.00	-	200.00	DI	110.00	-	-	-
149.00	P-1203	1.00	-	200.00	DI	110.00	-	-	-
150.00	P-1208	187.00	0.74	600.00	DI	110.00	(208.50)	0.22	1.20
151.00	EG-83	3.00	0.61	100.00	DI	110.00	4.80	0.02	6.70
152.00	EG-84	4.00	0.61	100.00	DI	110.00	4.80	0.02	6.70
153.00	EG-85	4.00	0.61	100.00	DI	110.00	4.80	0.03	6.70
154.00	EG-02	16.00	1.22	100.00	DI	110.00	9.60	0.38	24.20
155.00	P-1209	30.00	1.06	300.00	DI	110.00	75.00	0.16	5.10
156.00	P-1210	2.00	1.06	300.00	DI	110.00	75.00	0.01	5.10
157.00	PB-08	3.00	0.84	150.00	DI	110.00	14.80	0.02	7.40
158.00	EG-27	21.00	0.16	150.00	DI	110.00	2.80	0.01	0.30
159.00	EG-08	86.00	1.03	100.00	DI	110.00	8.10	1.51	17.50
	EG-09	37.00			DI	110.00	7.80	0.60	16.40

160.00			1.00	100.00					
161.00	EG-07	57.00	1.03	100.00	DI	110.00	8.10	0.99	17.50
162.00	EG-13	18.00	1.00	100.00	DI	110.00	7.80	0.30	16.40
163.00	EG-10	8.00	1.00	100.00	DI	110.00	7.80	0.13	16.50
164.00	EG-11	5.00	1.00	100.00	DI	110.00	7.80	0.08	16.40
165.00	EG-12	23.00	1.00	100.00	DI	110.00	7.80	0.38	16.50
166.00	EG-06	46.00	1.03	100.00	DI	110.00	8.10	0.81	17.50
167.00	EG-54	48.00	0.07	50.00	DI	110.00	0.10	0.01	0.30
168.00	EG-01	121.00	1.08	100.00	DI	110.00	(8.50)	2.33	19.20
169.00	EG-94	34.00	-	200.00	DI	110.00	-	-	-
170.00	EG-04	56.00	1.05	100.00	DI	110.00	8.20	1.01	18.10
171.00	EG-05	63.00	1.03	100.00	DI	110.00	8.10	1.10	17.50
172.00	EG-03	27.00	1.05	100.00	DI	110.00	8.20	0.48	18.10
173.00	EG-14	43.00	1.00	100.00	DI	110.00	7.80	0.71	16.50
174.00	EG-95	144.00	-	200.00	DI	110.00	-	-	-
175.00	EG-23	38.00	0.98	100.00	DI	110.00	7.70	0.61	15.90
176.00	EG-26	26.00	0.16	150.00	DI	110.00	2.80	0.01	0.30
177.00	EG-31	41.00	0.16	150.00	DI	110.00	2.80	0.01	0.30
178.00	EG-28	8.00	0.16	150.00	DI	110.00	2.80	-	0.30
179.00	EG-29	5.00	0.16	150.00	DI	110.00	2.80	-	0.40
180.00	EG-30	18.00	0.16	150.00	DI	110.00	2.80	0.01	0.30

181.00	EG-18	29.00	0.98	100.00	DI	110.00	7.70	0.46	15.90
182.00	EG-15	37.00	1.00	100.00	DI	110.00	7.80	0.60	16.50
183.00	EG-16	23.00	1.00	100.00	DI	110.00	7.80	0.39	16.40
184.00	EG-17	70.00	1.00	100.00	DI	110.00	7.80	1.16	16.40
185.00	EG-22	47.00	0.98	100.00	DI	110.00	7.70	0.75	15.90
186.00	EG-19	34.00	0.98	100.00	DI	110.00	7.70	0.55	15.90
187.00	EG-20	32.00	0.98	100.00	DI	110.00	7.70	0.51	15.90
188.00	EG-21	61.00	0.98	100.00	DI	110.00	7.70	0.98	15.90
189.00	P-1958	1.00	0.81	200.00	DI	110.00	25.40	-	4.90
190.00	PB-25	2.00	0.94	150.00	DI	110.00	16.60	0.02	9.30
191.00	PB-26	110.00	0.94	150.00	DI	110.00	16.60	1.01	9.20
192.00	ED-03	2.00	0.80	200.00	DI	110.00	25.20	0.01	5.00
193.00	P-1954	5.00	0.61	400.00	DI	110.00	76.00	0.01	1.30
194.00	ED-34	6.00	0.36	300.00	DI	110.00	25.20	-	0.70
195.00	ED-35	1.00	0.80	200.00	DI	110.00	25.20	-	4.90
196.00	PAS-02	2.00	0.14	600.00	DI	110.00	(38.80)	-	-
197.00	PAS-12	2.00	0.27	600.00	DI	110.00	77.60	-	0.20
198.00	PAS-14	2.00	0.14	600.00	DI	110.00	38.80	-	0.10
199.00	PAS-15	1.00	0.14	600.00	DI	110.00	38.80	-	-
200.00	PAS-10	2.00	0.41	600.00	DI	110.00	116.50	-	0.40
	PAS-	2.00			DI	110.00	(77.60)	-	0.20

201.00	04		0.27	600.00					
202.00	PAS-06	2.00	0.41	600.00	DI	110.00	(116.50)	-	0.40
203.00	PAS-08	2.00	0.55	600.00	DI	110.00	155.30	-	0.70
204.00	P-1953	50.00	0.72	300.00	DI	110.00	50.80	0.13	2.50
205.00	ED-15	119.00	0.36	300.00	DI	110.00	25.20	0.08	0.70
206.00	ED-28	42.00	0.36	300.00	DI	110.00	25.20	0.03	0.70
207.00	ED-22	179.00	0.36	300.00	DI	110.00	25.20	0.12	0.70
208.00	ED-17	41.00	0.36	300.00	DI	110.00	25.20	0.03	0.70
209.00	ED-29	23.00	0.36	300.00	DI	110.00	25.20	0.02	0.70
210.00	ED-27	40.00	0.36	300.00	DI	110.00	25.20	0.03	0.70
211.00	ED-21	139.00	0.36	300.00	DI	110.00	25.20	0.10	0.70
212.00	ED-23	110.00	0.36	300.00	DI	110.00	25.20	0.08	0.70
213.00	ED-06	105.00	0.36	300.00	DI	110.00	25.20	0.07	0.70
214.00	ED-07	157.00	0.36	300.00	DI	110.00	25.20	0.11	0.70
215.00	P-1952	23.00	0.72	300.00	DI	110.00	50.80	0.06	2.50
216.00	ED-04	33.00	0.36	300.00	DI	110.00	25.20	0.02	0.70
217.00	ED-18	43.00	0.36	300.00	DI	110.00	25.20	0.03	0.70
218.00	ED-20	228.00	0.36	300.00	DI	110.00	25.20	0.16	0.70
219.00	ED-13	136.00	0.36	300.00	DI	110.00	25.20	0.09	0.70
220.00	PQS-01	1.00	0.14	600.00	DI	110.00	38.80	-	0.10
221.00	PAS-13	1.00	0.14	600.00	DI	110.00	38.80	-	-

222.00	PQS-03	1.00	0.14	600.00	DI	110.00	38.80	-	0.10
223.00	P-1191	23.00	1.06	300.00	DI	110.00	(75.00)	0.12	5.10
224.00	PQS-05	1.00	0.14	600.00	DI	110.00	38.80	-	-
225.00	PAS-09	1.00	0.14	600.00	DI	110.00	38.80	-	0.10
226.00	PQS-07	1.00	0.14	600.00	DI	110.00	38.80	-	-
227.00	PAS-11	1.00	0.14	600.00	DI	110.00	38.80	-	0.10
228.00	P-1192	1.00	0.72	300.00	DI	110.00	50.80	-	2.40
229.00	P-1198	1.00	0.53	350.00	DI	110.00	50.80	-	1.10
230.00	P-1199	31.00	0.72	300.00	DI	110.00	50.80	0.08	2.50
231.00	P-1200	1.00	-	200.00	DI	110.00	-	-	-
232.00	P-1197	1.00	0.81	200.00	DI	110.00	25.40	-	4.90
233.00	P-1193	1.00	0.40	200.00	DI	110.00	12.70	-	1.30
234.00	P-1194	1.00	0.40	200.00	DI	110.00	12.70	-	1.30
235.00	P-1196	1.00	0.81	200.00	DI	110.00	25.40	-	5.10
236.00	PQS-09	1.00	0.14	600.00	DI	110.00	38.80	-	-
237.00	PQS-10	2.00	0.69	600.00	DI	110.00	194.10	-	1.10
238.00	PQS-12	2.00	0.82	600.00	DI	110.00	232.90	-	1.40
239.00	PQS-14	2.00	0.96	600.00	DI	110.00	271.70	-	2.00
240.00	PQS-08	2.00	0.55	600.00	DI	110.00	155.30	-	0.70
241.00	PQS-02	2.00	0.14	600.00	DI	110.00	38.80	-	0.10
	PQS-	2.00			DI	110.00	77.60	-	0.10

242.00	04		0.27	600.00					
243.00	PQS-06	2.00	0.41	600.00	DI	110.00	116.50	-	0.40
244.00	P-1173	10.00	1.10	600.00	DI	110.00	310.60	0.02	2.40
245.00	PAS-05	1.00	0.14	600.00	DI	110.00	38.80	-	-
246.00	PQS-11	1.00	0.14	600.00	DI	110.00	38.80	-	-
247.00	PAS-07	1.00	0.14	600.00	DI	110.00	38.80	-	-
248.00	PQS-13	1.00	0.14	600.00	DI	110.00	38.80	-	-
249.00	PAS-01	1.00	0.14	600.00	DI	110.00	38.80	-	0.10
250.00	PQS-15	1.00	0.14	600.00	DI	110.00	38.80	-	0.10
251.00	PAS-03	1.00	0.14	600.00	DI	110.00	38.80	-	-
252.00	ED-55	706.00	-	50.00	GI	110.00	-	-	-
253.00	ED-46	271.00	-	50.00	GI	110.00	-	-	-
254.00	ED-51	746.00	-	65.00	GI	110.00	-	-	-
255.00	ED-53	694.00	-	65.00	GI	110.00	-	-	-
256.00	ED-54	150.00	-	50.00	GI	110.00	-	-	-
257.00	PE-216	333.00	0.17	80.00	uPVC	110.00	(0.80)	0.26	0.80
258.00	PE-358	315.00	0.18	150.00	uPVC	110.00	3.20	0.14	0.40
259.00	PE-272	104.00	0.34	80.00	uPVC	110.00	(1.70)	0.31	3.00
260.00	PE-291	113.00	0.45	100.00	uPVC	110.00	3.50	0.43	3.80
261.00	PE-247	279.00	0.29	150.00	uPVC	110.00	(5.10)	0.29	1.00
262.00	PE-356	131.00	0.10	200.00	uPVC	110.00	3.30	0.01	0.10

263.00	PE-03	434.00	0.72	50.00	uPVC	110.00	(1.40)	8.73	20.10
264.00	PE-219	427.00	0.01	200.00	uPVC	110.00	(0.50)	-	-
265.00	PE-14	220.00	1.07	80.00	uPVC	110.00	(5.40)	5.34	24.20
266.00	PE-174	26.00	0.12	80.00	uPVC	110.00	0.60	0.01	0.40
267.00	PE-220	289.00	0.05	200.00	uPVC	110.00	(1.70)	0.01	-
268.00	PE-240	404.00	0.20	150.00	uPVC	110.00	3.60	0.22	0.50
269.00	PE-315	239.00	0.15	200.00	uPVC	110.00	4.60	0.05	0.20
270.00	PE-45	159.00	0.61	200.00	uPVC	110.00	(19.30)	0.48	3.00
271.00	PE-331	213.00	0.09	100.00	uPVC	110.00	0.70	0.04	0.20
272.00	PE-25	230.00	0.93	100.00	uPVC	110.00	(7.30)	3.30	14.40
273.00	PE-365	166.00	0.17	150.00	uPVC	110.00	3.10	0.07	0.40
274.00	PE-388	259.00	0.07	200.00	uPVC	110.00	(2.10)	0.01	-
275.00	PE-74	148.00	0.24	50.00	uPVC	110.00	(0.50)	0.40	2.70
276.00	PE-310	207.00	0.14	150.00	uPVC	110.00	(2.50)	0.06	0.30
277.00	PE-406	256.00	0.09	200.00	uPVC	110.00	2.80	0.02	0.10
278.00	PE-227	104.00	0.16	300.00	uPVC	110.00	11.50	0.02	0.20
279.00	PE-214	260.00	0.29	300.00	uPVC	110.00	(20.40)	0.12	0.50
280.00	PE-353	136.00	0.05	50.00	uPVC	110.00	0.10	0.02	0.20
281.00	PE-47	158.00	0.63	200.00	uPVC	110.00	(19.70)	0.49	3.10
282.00	PE-420	540.00	0.05	150.00	uPVC	110.00	(0.90)	0.02	-
	PE-			80.00	uPVC	110.00	(0.70)	0.11	0.60

283.00	414	199.00	0.14						
284.00	PE-352	68.00	0.08	50.00	uPVC	110.00	(0.10)	0.02	0.30
285.00	PE-386	265.00	0.04	150.00	uPVC	110.00	0.70	0.01	-
286.00	PE-75	105.00	0.35	80.00	uPVC	110.00	1.70	0.32	3.00
287.00	PE-292	224.00	0.03	100.00	uPVC	110.00	(0.30)	0.01	-
288.00	PE-182	274.00	0.17	80.00	uPVC	110.00	(0.90)	0.23	0.80
289.00	PE-50	248.00	0.06	80.00	uPVC	110.00	(0.30)	0.03	0.10
290.00	PE-323	208.00	0.15	80.00	uPVC	110.00	(0.80)	0.14	0.70
291.00	PE-303	365.00	0.31	150.00	uPVC	110.00	(5.50)	0.44	1.20
292.00	PE-281	378.00	0.15	300.00	uPVC	110.00	10.60	0.05	0.10
293.00	PE-58	310.00	0.42	50.00	uPVC	110.00	(0.80)	2.33	7.50
294.00	PE-306	88.00	0.10	100.00	uPVC	110.00	(0.80)	0.02	0.20
295.00	PE-223	331.00	0.15	50.00	uPVC	110.00	0.30	0.38	1.10
296.00	PE-327	151.00	0.15	100.00	uPVC	110.00	1.20	0.08	0.50
297.00	PE-15	403.00	1.01	80.00	uPVC	110.00	5.10	8.85	22.00
298.00	PE-24	103.00	0.93	100.00	uPVC	110.00	(7.30)	1.48	14.40
299.00	PE-85	312.00	0.13	200.00	uPVC	110.00	(4.10)	0.05	0.20
300.00	PE-246	173.00	0.26	150.00	uPVC	110.00	(4.60)	0.15	0.90
301.00	PE-245	180.00	0.23	150.00	uPVC	110.00	(4.20)	0.13	0.70
302.00	PE-384	259.00	0.11	200.00	uPVC	110.00	3.30	0.03	0.10
303.00	PE-362	12.00	0.22	50.00	uPVC	110.00	0.40	0.03	2.20

304.00	PE-150	154.00	0.26	150.00	uPVC	110.00	4.60	0.13	0.80
305.00	PE-72	384.00	0.29	100.00	uPVC	110.00	(2.30)	0.66	1.70
306.00	PE-432	255.00	0.12	50.00	uPVC	110.00	0.20	0.20	0.80
307.00	PE-41	118.00	0.46	200.00	uPVC	110.00	(14.50)	0.21	1.80
308.00	PE-425	215.00	0.25	200.00	uPVC	110.00	(7.70)	0.12	0.60
309.00	PE-397	337.00	0.09	200.00	uPVC	110.00	2.80	0.03	0.10
310.00	PE-258	138.00	0.34	80.00	uPVC	110.00	1.70	0.40	2.90
311.00	PE-269	217.00	0.26	300.00	uPVC	110.00	18.20	0.08	0.40
312.00	PE-33	172.00	0.60	100.00	uPVC	110.00	(4.70)	1.10	6.40
313.00	PE-106	354.00	0.15	150.00	uPVC	110.00	(2.70)	0.11	0.30
314.00	PE-424	197.00	0.23	100.00	uPVC	110.00	(1.80)	0.21	1.10
315.00	PE-372	262.00	0.19	80.00	uPVC	110.00	1.00	0.27	1.00
316.00	PE-298	213.00	0.28	80.00	uPVC	110.00	(1.40)	0.44	2.10
317.00	PE-368	127.00	0.23	150.00	uPVC	110.00	4.10	0.09	0.70
318.00	PE-284	232.00	0.17	200.00	uPVC	110.00	5.30	0.06	0.30
319.00	PE-44	135.00	0.49	100.00	uPVC	110.00	3.90	0.60	4.50
320.00	PE-387	263.00	0.10	100.00	uPVC	110.00	(0.80)	0.06	0.20
321.00	PE-203	135.00	0.14	80.00	uPVC	110.00	0.70	0.07	0.50
322.00	PE-304	240.00	0.10	150.00	uPVC	110.00	1.70	0.03	0.10
323.00	PE-330	88.00	0.03	100.00	uPVC	110.00	(0.20)	-	-
	PE-				uPVC	110.00	(2.10)	0.02	-

324.00	225	327.00	0.07	200.00					
325.00	PE-120	204.00	1.06	300.00	uPVC	110.00	75.10	1.05	5.20
326.00	PE-232	53.00	0.13	150.00	uPVC	110.00	2.30	0.01	0.20
327.00	PE-326	149.00	0.13	100.00	uPVC	110.00	(1.00)	0.06	0.40
328.00	PE-239	387.00	0.04	150.00	uPVC	110.00	0.70	0.01	-
329.00	PE-71	311.00	0.13	100.00	uPVC	110.00	1.00	0.12	0.40
330.00	PE-383	24.00	0.21	200.00	uPVC	110.00	6.70	0.01	0.40
331.00	PE-237	494.00	0.15	50.00	uPVC	110.00	0.30	0.52	1.10
332.00	PE-412	192.00	0.13	50.00	uPVC	110.00	0.30	0.17	0.90
333.00	PE-80	293.00	0.05	200.00	uPVC	110.00	(1.40)	0.01	-
334.00	PE-181	259.00	0.15	80.00	uPVC	110.00	(0.80)	0.17	0.70
335.00	PE-241	211.00	0.18	150.00	uPVC	110.00	3.10	0.09	0.40
336.00	PE-229	79.00	0.04	200.00	uPVC	110.00	1.20	-	-
337.00	PE-328	215.00	0.07	100.00	uPVC	110.00	0.60	0.03	0.10
338.00	PE-105	40.00	0.28	80.00	uPVC	110.00	1.40	0.08	2.10
339.00	PE-136	79.00	0.46	300.00	uPVC	110.00	32.40	0.09	1.10
340.00	PE-423	266.00	0.15	150.00	uPVC	110.00	(2.70)	0.08	0.30
341.00	PE-309	153.00	0.04	200.00	uPVC	110.00	(1.10)	-	-
342.00	PE-317	233.00	0.11	100.00	uPVC	110.00	(0.80)	0.06	0.30
343.00	PE-96	126.00	0.24	100.00	uPVC	110.00	1.90	0.15	1.20
344.00	PE-263	589.00	0.31	150.00	uPVC	110.00	(5.50)	0.70	1.20

345.00	PE-366	15.00	0.09	200.00	uPVC	110.00	2.90	-	0.10
346.00	PE-319	92.00	0.14	100.00	uPVC	110.00	1.10	0.04	0.40
347.00	PE-77	190.00	0.14	80.00	uPVC	110.00	0.70	0.10	0.50
348.00	PE-26	65.00	0.93	100.00	uPVC	110.00	(7.30)	0.93	14.40
349.00	PE-350	279.00	0.25	300.00	uPVC	110.00	18.00	0.10	0.40
350.00	PE-173	459.00	0.28	80.00	uPVC	110.00	1.40	0.93	2.00
351.00	PE-389	256.00	0.09	200.00	uPVC	110.00	(2.80)	0.02	0.10
352.00	PE-30	109.00	1.03	80.00	uPVC	110.00	5.20	2.47	22.60
353.00	PE-336	153.00	0.09	100.00	uPVC	110.00	0.70	0.03	0.20
354.00	PE-301	153.00	0.12	100.00	uPVC	110.00	1.00	0.05	0.30
355.00	PE-371	273.00	0.05	80.00	uPVC	110.00	(0.20)	0.02	0.10
356.00	PE-151	232.00	0.21	150.00	uPVC	110.00	3.80	0.14	0.60
357.00	PE-376	281.00	0.08	200.00	uPVC	110.00	2.60	0.02	0.10
358.00	PE-233	245.00	0.25	200.00	uPVC	110.00	7.90	0.14	0.60
359.00	PE-302	132.00	0.19	150.00	uPVC	110.00	(3.30)	0.06	0.50
360.00	PE-129	437.00	0.76	300.00	uPVC	110.00	53.60	1.21	2.80
361.00	PE-408	318.00	0.06	200.00	uPVC	110.00	2.00	0.01	-
362.00	PE-183	290.00	0.08	50.00	uPVC	110.00	(0.20)	0.11	0.40
363.00	PE-277	603.00	1.05	100.00	uPVC	110.00	(8.20)	10.94	18.10
364.00	PE-121	213.00	1.05	300.00	uPVC	110.00	74.10	1.07	5.00
	PE-				uPVC	110.00	(2.00)	0.02	-

365.00	431	376.00	0.06	200.00					
366.00	PE-244	87.00	0.33	150.00	uPVC	110.00	5.90	0.12	1.40
367.00	PE-117	122.00	0.30	80.00	uPVC	110.00	1.50	0.29	2.40
368.00	PE-205	80.00	0.11	80.00	uPVC	110.00	0.50	0.03	0.30
369.00	PE-369	123.00	0.15	150.00	uPVC	110.00	2.70	0.04	0.30
370.00	PE-76	163.00	0.27	80.00	uPVC	110.00	1.40	0.31	1.90
371.00	PE-416	111.00	0.10	200.00	uPVC	110.00	3.20	0.01	0.10
372.00	PE-334	212.00	0.01	80.00	uPVC	110.00	(0.10)	-	-
373.00	PE-81	187.00	0.07	200.00	uPVC	110.00	(2.10)	0.01	-
374.00	PE-351	155.00	0.13	300.00	uPVC	110.00	8.80	0.02	0.10
375.00	PE-278	317.00	1.89	80.00	uPVC	110.00	9.50	22.24	70.20
376.00	PE-283	14.00	0.20	200.00	uPVC	110.00	6.20	0.01	0.40
377.00	PE-401	122.00	0.04	150.00	uPVC	110.00	0.60	-	-
378.00	PE-09	290.00	0.63	80.00	uPVC	110.00	(3.20)	2.67	9.20
379.00	PE-42	173.00	0.46	200.00	uPVC	110.00	(14.50)	0.31	1.80
380.00	PE-119	121.00	0.66	200.00	uPVC	110.00	(20.90)	0.42	3.50
381.00	PE-43	57.00	0.48	200.00	uPVC	110.00	(15.00)	0.11	1.90
382.00	PE-78	263.00	0.23	80.00	uPVC	110.00	(1.20)	0.38	1.50
383.00	PE-06	276.00	0.72	50.00	uPVC	110.00	(1.40)	5.58	20.20
384.00	PE-144	259.00	0.13	200.00	uPVC	110.00	(4.00)	0.04	0.20
385.00	PE-270	252.00	0.25	300.00	uPVC	110.00	17.90	0.09	0.40

386.00	PE-66	374.00	0.24	100.00	uPVC	110.00	1.90	0.46	1.20
387.00	PE-101	199.00	0.05	200.00	uPVC	110.00	1.50	0.01	-
388.00	PE-39	261.00	0.47	100.00	uPVC	110.00	3.70	1.05	4.00
389.00	PE-325	216.00	0.04	100.00	uPVC	110.00	(0.30)	0.01	-
390.00	PE-08	462.00	0.65	50.00	uPVC	110.00	(1.30)	7.66	16.60
391.00	PE-128	404.00	0.37	300.00	uPVC	110.00	26.50	0.30	0.70
392.00	PE-285	16.00	0.56	80.00	uPVC	110.00	2.80	0.12	7.30
393.00	PE-38	164.00	0.38	50.00	uPVC	110.00	0.80	1.04	6.30
394.00	PE-177	141.00	0.18	50.00	uPVC	110.00	0.30	0.21	1.50
395.00	PE-367	143.00	0.31	80.00	uPVC	110.00	1.50	0.35	2.40
396.00	PE-54	285.00	0.90	80.00	uPVC	110.00	(4.50)	5.07	17.80
397.00	PE-305	82.00	0.06	100.00	uPVC	110.00	0.50	0.01	0.10
398.00	PE-379	167.00	0.12	300.00	uPVC	110.00	8.60	0.02	0.10
399.00	PE-31	356.00	0.84	80.00	uPVC	110.00	4.20	5.58	15.70
400.00	PE-230	41.00	0.13	150.00	uPVC	110.00	2.30	0.01	0.20
401.00	PE-04	861.00	0.75	50.00	uPVC	110.00	(1.50)	18.79	21.80
402.00	PE-131	130.00	0.08	200.00	uPVC	110.00	2.50	0.01	0.10
403.00	PE-135	52.00	0.46	300.00	uPVC	110.00	32.40	0.06	1.10
404.00	PE-200	95.00	0.29	300.00	uPVC	110.00	20.80	0.05	0.50
405.00	PE-430	101.00	0.20	100.00	uPVC	110.00	(1.60)	0.09	0.90
	PE-99				uPVC	110.00	5.50	0.26	1.20

406.00		219.00	0.31	150.00					
407.00	PE-242	61.00	0.15	150.00	uPVC	110.00	2.70	0.02	0.30
408.00	PE-83	60.00	0.09	200.00	uPVC	110.00	(2.80)	0.01	0.10
409.00	PE-60	323.00	0.04	150.00	uPVC	110.00	(0.80)	0.01	-
410.00	PE-178	323.00	0.31	80.00	uPVC	110.00	(1.60)	0.81	2.50
411.00	PE-124	97.00	1.07	300.00	uPVC	110.00	75.80	0.51	5.20
412.00	PE-179	237.00	0.32	80.00	uPVC	110.00	1.60	0.60	2.50
413.00	PE-286	134.00	0.19	80.00	uPVC	110.00	0.90	0.13	1.00
414.00	PE-114	223.00	0.68	200.00	uPVC	110.00	21.30	0.80	3.60
415.00	PE-378	146.00	0.06	200.00	uPVC	110.00	1.90	0.01	-
416.00	PE-377	120.00	0.06	200.00	uPVC	110.00	1.90	-	-
417.00	PE-134	261.00	0.46	300.00	uPVC	110.00	32.40	0.28	1.10
418.00	PE-104	185.00	0.28	80.00	uPVC	110.00	1.40	0.38	2.10
419.00	PE-289	511.00	0.06	300.00	uPVC	110.00	3.90	0.01	-
420.00	PE-402	273.00	0.05	50.00	uPVC	110.00	0.10	0.04	0.10
421.00	PE-393	34.00	0.03	200.00	uPVC	110.00	(0.90)	-	-
422.00	PE-152	80.00	0.17	150.00	uPVC	110.00	3.00	0.03	0.40
423.00	PE-403	182.00	0.11	200.00	uPVC	110.00	3.50	0.02	0.10
424.00	PE-294	209.00	0.28	100.00	uPVC	110.00	(2.20)	0.34	1.60
425.00	PE-337	515.00	0.07	50.00	uPVC	110.00	0.10	0.12	0.20
426.00	PE-314	136.00	0.13	100.00	uPVC	110.00	(1.00)	0.05	0.40

427.00	PE-357	324.00	0.11	300.00	uPVC	110.00	8.10	0.03	0.10
428.00	PE-333	213.00	0.11	50.00	uPVC	110.00	(0.20)	0.14	0.60
429.00	PE-201	133.00	-	80.00	uPVC	110.00	-	-	-
430.00	PE-68	369.00	0.25	80.00	uPVC	110.00	(1.20)	0.59	1.60
431.00	PE-382	111.00	0.15	200.00	uPVC	110.00	4.80	0.03	0.20
432.00	PE-212	151.00	0.07	150.00	uPVC	110.00	(1.30)	0.01	0.10
433.00	PE-125	40.00	1.06	300.00	uPVC	110.00	75.10	0.20	5.20
434.00	PE-375	299.00	0.01	80.00	uPVC	110.00	(0.10)	-	-
435.00	PE-355	135.00	0.18	50.00	uPVC	110.00	(0.30)	0.20	1.50
436.00	PE-421	195.00	0.23	100.00	uPVC	110.00	(1.80)	0.22	1.10
437.00	PE-236	96.00	-	150.00	uPVC	110.00	0.10	-	-
438.00	PE-391	82.00	0.10	80.00	uPVC	110.00	(0.50)	0.02	0.30
439.00	PE-32	56.00	0.26	150.00	uPVC	110.00	4.50	0.05	0.80
440.00	PE-133	162.00	0.47	300.00	uPVC	110.00	33.30	0.19	1.10
441.00	PE-11	85.00	0.62	50.00	uPVC	110.00	1.20	1.29	15.20
442.00	PE-34	223.00	1.83	150.00	uPVC	110.00	32.40	7.08	31.70
443.00	PE-199	195.00	0.30	300.00	uPVC	110.00	21.20	0.10	0.50
444.00	PE-197	215.00	0.33	300.00	uPVC	110.00	23.20	0.13	0.60
445.00	PE-324	148.00	0.10	150.00	uPVC	110.00	(1.70)	0.02	0.10
446.00	PE-221	315.00	0.03	200.00	uPVC	110.00	(0.80)	-	-
	PE-18			80.00	uPVC	110.00	(7.30)	20.40	42.80

447.00		477.00	1.45						
448.00	PE-29	90.00	0.02	100.00	uPVC	110.00	0.20	-	-
449.00	PE-195	192.00	0.34	300.00	uPVC	110.00	23.70	0.12	0.60
450.00	PE-28	141.00	0.17	150.00	uPVC	110.00	(3.00)	0.06	0.40
451.00	PE-217	179.00	0.27	80.00	uPVC	110.00	1.30	0.33	1.90
452.00	PE-215	233.00	0.26	300.00	uPVC	110.00	18.30	0.09	0.40
453.00	PE-300	215.00	0.33	80.00	uPVC	110.00	(1.60)	0.58	2.70
454.00	PE-20	196.00	1.34	100.00	uPVC	110.00	(10.50)	5.57	28.40
455.00	PE-360	119.00	0.22	50.00	uPVC	110.00	0.40	0.26	2.20
456.00	PE-282	167.00	0.20	200.00	uPVC	110.00	6.20	0.06	0.40
457.00	PE-392	254.00	0.11	200.00	uPVC	110.00	3.50	0.03	0.10
458.00	PE-415	161.00	0.16	100.00	uPVC	110.00	(1.30)	0.09	0.60
459.00	PE-05	293.00	0.39	50.00	uPVC	110.00	(0.80)	1.91	6.50
460.00	PE-141	114.00	0.45	300.00	uPVC	110.00	31.80	0.12	1.10
461.00	PE-35	682.00	1.54	150.00	uPVC	110.00	27.30	15.73	23.10
462.00	PE-295	218.00	0.05	300.00	uPVC	110.00	3.30	-	-
463.00	PE-359	11.00	0.10	300.00	uPVC	110.00	7.40	-	0.10
464.00	PE-320	271.00	0.08	100.00	uPVC	110.00	0.70	0.05	0.20
465.00	PE-256	121.00	0.49	150.00	uPVC	110.00	(8.60)	0.33	2.70
466.00	PE-260	325.00	0.17	80.00	uPVC	110.00	0.90	0.27	0.80
467.00	PE-207	97.00	0.16	80.00	uPVC	110.00	(0.80)	0.07	0.70

468.00	PE-89	240.00	0.17	200.00	uPVC	110.00	(5.20)	0.06	0.30
469.00	PE-268	167.00	0.30	300.00	uPVC	110.00	21.60	0.09	0.50
470.00	PE-418	532.00	0.18	150.00	uPVC	110.00	(3.10)	0.22	0.40
471.00	PE-329	215.00	0.08	100.00	uPVC	110.00	0.60	0.04	0.20
472.00	PE-82	153.00	0.09	200.00	uPVC	110.00	(2.80)	0.01	0.10
473.00	PE-364	157.00	0.14	200.00	uPVC	110.00	4.60	0.03	0.20
474.00	PE-419	191.00	0.10	200.00	uPVC	110.00	3.10	0.02	0.10
475.00	PE-222	321.00	0.22	300.00	uPVC	110.00	15.30	0.09	0.30
476.00	PE-396	301.00	0.13	200.00	uPVC	110.00	4.10	0.05	0.20
477.00	PE-211	60.00	-	150.00	uPVC	110.00	(0.10)	-	-
478.00	PE-21	378.00	1.73	100.00	uPVC	110.00	13.60	17.22	45.60
479.00	PE-280	85.00	0.22	150.00	uPVC	110.00	3.90	0.05	0.60
480.00	PE-308	345.00	0.06	200.00	uPVC	110.00	(1.90)	0.01	-
481.00	PE-64	14.00	0.15	200.00	uPVC	110.00	4.70	-	0.20
482.00	PE-55	30.00	0.90	80.00	uPVC	110.00	(4.50)	0.54	17.80
483.00	PE-196	150.00	0.34	300.00	uPVC	110.00	23.70	0.09	0.60
484.00	PE-194	259.00	0.35	300.00	uPVC	110.00	25.00	0.17	0.70
485.00	PE-184	135.00	0.22	50.00	uPVC	110.00	0.40	0.30	2.20
486.00	PE-118	108.00	0.21	80.00	uPVC	110.00	1.10	0.13	1.20
487.00	PE-394	213.00	0.12	200.00	uPVC	110.00	3.70	0.03	0.10
	PE-17				uPVC	110.00	(2.80)	0.32	2.50

488.00		126.00	0.36	100.00					
489.00	PE-153	98.00	0.17	150.00	uPVC	110.00	3.00	0.04	0.40
490.00	PE-426	215.00	0.07	150.00	uPVC	110.00	1.30	0.02	0.10
491.00	PE-363	133.00	0.09	50.00	uPVC	110.00	0.20	0.05	0.40
492.00	PE-410	57.00	0.03	200.00	uPVC	110.00	(0.90)	-	-
493.00	PE-255	314.00	0.54	50.00	uPVC	110.00	(1.10)	3.79	12.10
494.00	PE-198	200.00	0.31	300.00	uPVC	110.00	21.70	0.10	0.50
495.00	PE-97	170.00	0.09	200.00	uPVC	110.00	(2.80)	0.01	0.10
496.00	PE-79	417.00	0.23	100.00	uPVC	110.00	(1.80)	0.45	1.10
497.00	PE-172	162.00	0.32	80.00	uPVC	110.00	1.60	0.42	2.60
498.00	PE-115	108.00	0.01	80.00	uPVC	110.00	-	-	-
499.00	PE-210	159.00	0.03	150.00	uPVC	110.00	(0.50)	-	-
500.00	PE-86	70.00	0.14	200.00	uPVC	110.00	(4.50)	0.01	0.20
501.00	PE-312	206.00	0.08	80.00	uPVC	110.00	(0.40)	0.04	0.20
502.00	PE-116	152.00	0.31	80.00	uPVC	110.00	(1.60)	0.38	2.50
503.00	PE-65	205.00	0.20	150.00	uPVC	110.00	3.50	0.11	0.50
504.00	PE-36	715.00	0.10	150.00	uPVC	110.00	1.80	0.11	0.20
505.00	PE-297	345.00	0.01	200.00	uPVC	110.00	(0.40)	-	-
506.00	PE-126	136.00	1.06	300.00	uPVC	110.00	75.10	0.70	5.20
507.00	PE-399	100.00	0.04	150.00	uPVC	110.00	0.60	-	-
508.00	PE-176	100.00	0.07	80.00	uPVC	110.00	0.40	0.02	0.20

509.00	PE-224	159.00	0.05	200.00	uPVC	110.00	(1.40)	-	-
510.00	EG-55	32.00	0.15	50.00	uPVC	110.00	0.30	0.04	1.20
511.00	EG-56	142.00	0.15	50.00	uPVC	110.00	0.30	0.16	1.20
512.00	EG-90	55.00	0.15	50.00	uPVC	110.00	0.30	0.06	1.20
513.00	EG-48	79.00	0.10	150.00	uPVC	110.00	1.70	0.01	0.10
514.00	EG-51	30.00	0.15	100.00	uPVC	110.00	1.20	0.01	0.50
515.00	EG-50	263.00	0.15	100.00	uPVC	110.00	1.20	0.13	0.50
516.00	EG-49	281.00	0.07	50.00	uPVC	110.00	0.10	0.07	0.30
517.00	EG-91	33.00	0.15	200.00	uPVC	110.00	4.60	0.01	0.20
518.00	PB-07	208.00	0.84	150.00	uPVC	110.00	14.80	1.55	7.40
519.00	P-1846	284.00	1.18	150.00	uPVC	110.00	20.80	3.97	14.00
520.00	P-1844	89.00	1.08	150.00	uPVC	110.00	19.10	1.07	11.90
521.00	EG-24	4.00	0.43	150.00	uPVC	110.00	7.70	0.01	2.20
522.00	EG-41	80.00	0.15	200.00	uPVC	110.00	4.60	0.02	0.20
523.00	EG-40	3.00	0.15	200.00	uPVC	110.00	4.60	-	0.20
524.00	EG-25	20.00	0.16	150.00	uPVC	110.00	2.80	0.01	0.30
525.00	EG-52	34.00	0.15	100.00	uPVC	110.00	1.20	0.02	0.50
526.00	EG-59	57.00	0.14	150.00	uPVC	110.00	2.50	0.02	0.30
527.00	EG-58	27.00	0.15	150.00	uPVC	110.00	2.60	0.01	0.30
528.00	EG-57	54.00	0.15	150.00	uPVC	110.00	2.60	0.02	0.30
	EG-60	81.00			uPVC	110.00	2.50	0.02	0.30

529.00			0.14	150.00					
530.00	EG-72	91.00	0.08	80.00	uPVC	110.00	0.40	0.02	0.20
531.00	EG-62	152.00	0.14	150.00	uPVC	110.00	2.50	0.04	0.30
532.00	EG-61	65.00	0.14	150.00	uPVC	110.00	2.50	0.02	0.30
533.00	EG-42	25.00	0.10	150.00	uPVC	110.00	1.70	-	0.10
534.00	EG-47	82.00	0.10	150.00	uPVC	110.00	1.70	0.01	0.10
535.00	EG-89	95.00	0.15	100.00	uPVC	110.00	1.20	0.05	0.50
536.00	EG-53	27.00	0.15	100.00	uPVC	110.00	1.20	0.01	0.50
537.00	EG-46	70.00	0.10	150.00	uPVC	110.00	1.70	0.01	0.10
538.00	EG-43	63.00	0.10	150.00	uPVC	110.00	1.70	0.01	0.10
539.00	EG-44	45.00	0.10	150.00	uPVC	110.00	1.70	0.01	0.10
540.00	EG-45	73.00	0.10	150.00	uPVC	110.00	1.70	0.01	0.10
541.00	P-1839	351.00	0.73	200.00	uPVC	110.00	23.00	1.45	4.10
542.00	ED-44	183.00	-	80.00	uPVC	110.00	-	-	-
543.00	PE-488	141.00	0.08	200.00	uPVC	110.00	2.60	0.01	0.10
544.00	PE-502	70.00	0.11	100.00	uPVC	110.00	(0.90)	0.02	0.30
545.00	PE-485	254.00	0.12	100.00	uPVC	110.00	1.00	0.08	0.30
546.00	PE-228	123.00	0.16	300.00	uPVC	110.00	(11.10)	0.02	0.10
547.00	PE-462	401.00	0.47	200.00	uPVC	110.00	14.70	0.72	1.80
548.00	PE-440	404.00	0.35	150.00	uPVC	110.00	6.30	0.61	1.50
549.00	ED-42	733.00	-	150.00	uPVC	110.00	-	-	-

550.00	PE-500	209.00	0.40	50.00	uPVC	110.00	0.80	1.40	6.70
551.00	PE-498	48.00	0.10	80.00	uPVC	110.00	0.50	0.01	0.30
552.00	PE-501	36.00	0.20	50.00	uPVC	110.00	0.40	0.07	1.90
553.00	PE-483	282.00	0.62	150.00	uPVC	110.00	(10.90)	1.19	4.20
554.00	PE-472	483.00	0.24	100.00	uPVC	110.00	(1.90)	0.59	1.20
555.00	PE-471	273.00	0.44	80.00	uPVC	110.00	2.20	1.26	4.60
556.00	ED-39	284.00	-	200.00	uPVC	110.00	-	-	-
557.00	PE-226	208.00	0.20	300.00	uPVC	110.00	14.20	0.05	0.20
558.00	P-1840	18.00	0.73	200.00	uPVC	110.00	23.00	0.08	4.10
559.00	PB-18	403.00	0.84	150.00	uPVC	110.00	14.80	3.00	7.40
560.00	PB-19	327.00	0.84	150.00	uPVC	110.00	14.80	2.44	7.40
561.00	P-1842	184.00	0.73	200.00	uPVC	110.00	23.00	0.76	4.10
562.00	P-1833	58.00	0.73	200.00	uPVC	110.00	23.00	0.24	4.10
563.00	P-1847	126.00	1.08	150.00	uPVC	110.00	19.10	1.51	11.90
564.00	P-1838	181.00	0.73	200.00	uPVC	110.00	23.00	0.75	4.10
565.00	P-1836	324.00	0.73	200.00	uPVC	110.00	23.00	1.34	4.10
566.00	P-1835	240.00	0.73	200.00	uPVC	110.00	23.00	0.99	4.10
567.00	P-1837	215.00	0.73	200.00	uPVC	110.00	23.00	0.89	4.10
568.00	P-1834	141.00	0.73	200.00	uPVC	110.00	23.00	0.58	4.10
569.00	P-1841	208.00	0.69	200.00	uPVC	110.00	21.50	0.76	3.70
	P-1843				uPVC	110.00	19.10	8.07	11.90

570.00		675.00	1.08	150.00					
571.00	PB-14	434.00	0.84	150.00	uPVC	110.00	14.80	3.23	7.40
572.00	P-1832	21.00	0.73	200.00	uPVC	110.00	23.00	0.09	4.10
573.00	PB-16	616.00	-	200.00	uPVC	110.00	-	-	-
574.00	P-812	392.00	0.86	100.00	uPVC	110.00	6.80	4.95	12.60
575.00	P-811	232.00	0.41	100.00	uPVC	110.00	3.20	0.74	3.20
576.00	PB-11	753.00	-	200.00	uPVC	110.00	-	-	-
577.00	PE1-450	226.00	0.09	100.00	uPVC	110.00	0.70	0.04	0.20
578.00	P-1758	196.00	0.02	200.00	uPVC	110.00	0.70	-	-
579.00	PB-15	458.00	0.84	150.00	uPVC	110.00	14.80	3.41	7.40
580.00	P-1819	270.00	0.20	150.00	uPVC	110.00	3.50	0.14	0.50
581.00	P-1822	306.00	0.20	150.00	uPVC	110.00	(3.50)	0.16	0.50
582.00	PB-03	371.00	-	80.00	uPVC	110.00	-	-	-
583.00	PB-02	443.00	-	200.00	uPVC	110.00	-	-	-
584.00	PB-01	121.00	-	200.00	uPVC	110.00	-	-	-
585.00	PB-06	458.00	-	100.00	uPVC	110.00	-	-	-
586.00	PB-05	275.00	-	100.00	uPVC	110.00	-	-	-
587.00	PB-04	407.00	-	80.00	uPVC	110.00	-	-	-
588.00	PB-10	808.00	-	100.00	uPVC	110.00	-	-	-
589.00	PB-13	447.00	-	100.00	uPVC	110.00	-	-	-
590.00	EG-80	57.00	0.13	100.00	uPVC	110.00	1.00	0.02	0.40

591.00	EG-79	79.00	0.14	100.00	uPVC	110.00	1.10	0.04	0.50
592.00	EG-67	68.00	0.10	80.00	uPVC	110.00	0.50	0.02	0.30
593.00	EG-68	59.00	0.10	80.00	uPVC	110.00	0.50	0.02	0.30
594.00	EG-70	24.00	0.08	80.00	uPVC	110.00	0.40	-	0.20
595.00	EG-69	57.00	0.10	80.00	uPVC	110.00	0.50	0.02	0.30
596.00	EG-78	801.00	0.11	80.00	uPVC	110.00	0.50	0.28	0.30
597.00	EG-66	110.00	0.10	80.00	uPVC	110.00	0.50	0.04	0.30
598.00	EG-81	166.00	0.13	100.00	uPVC	110.00	1.00	0.06	0.40
599.00	EG-77	133.00	0.08	80.00	uPVC	110.00	(0.40)	0.03	0.20
600.00	EG-73	97.00	0.08	80.00	uPVC	110.00	0.40	0.02	0.20
601.00	EG-88	223.00	0.15	50.00	uPVC	110.00	0.30	0.26	1.20
602.00	EG-65	30.00	0.14	150.00	uPVC	110.00	2.50	0.01	0.30
603.00	EG-64	116.00	0.14	150.00	uPVC	110.00	2.50	0.03	0.30
604.00	EG-74	53.00	0.08	80.00	uPVC	110.00	0.40	0.01	0.20
605.00	EG-71	57.00	0.08	80.00	uPVC	110.00	0.40	0.01	0.20
606.00	PB-09	436.00	-	80.00	uPVC	110.00	-	-	-
607.00	EG-76	9.00	0.05	80.00	uPVC	110.00	0.30	-	0.10
608.00	EG-75	56.00	0.08	80.00	uPVC	110.00	0.40	0.01	0.20
609.00	EG-63	48.00	0.14	150.00	uPVC	110.00	2.50	0.01	0.30
610.00	P-806	235.00	0.40	200.00	uPVC	110.00	12.50	0.31	1.30
	P-808	32.00			uPVC	110.00	11.90	0.04	1.20

611.00			0.38	200.00					
612.00	PE-433	229.00	0.14	150.00	uPVC	110.00	2.50	0.06	0.30
613.00	PE-204	61.00	0.03	80.00	uPVC	110.00	0.20	-	-
614.00	PE-37	103.00	1.19	200.00	uPVC	110.00	(37.50)	1.05	10.20
615.00	PE-69	361.00	0.35	50.00	uPVC	110.00	0.70	1.94	5.40
616.00	PE-261	326.00	0.12	80.00	uPVC	110.00	(0.60)	0.13	0.40
617.00	PE-145	124.00	0.15	200.00	uPVC	110.00	(4.70)	0.03	0.20
618.00	PE-288	300.00	0.07	80.00	uPVC	110.00	(0.40)	0.05	0.20
619.00	PE-275	603.00	0.29	150.00	uPVC	110.00	5.10	0.63	1.00
620.00	PE-293	20.00	0.28	100.00	uPVC	110.00	(2.20)	0.03	1.60
621.00	PE-57	301.00	0.32	50.00	uPVC	110.00	0.60	1.37	4.50
622.00	PE-63	129.00	0.83	300.00	uPVC	110.00	58.40	0.42	3.20
623.00	PE-409	176.00	0.01	200.00	uPVC	110.00	(0.20)	-	-
624.00	PE-290	130.00	0.45	100.00	uPVC	110.00	3.50	0.49	3.80
625.00	PE-10	52.00	0.62	50.00	uPVC	110.00	1.20	0.79	15.20
626.00	PE-354	154.00	0.13	300.00	uPVC	110.00	(8.90)	0.02	0.10
627.00	PE-299	208.00	0.13	80.00	uPVC	110.00	(0.70)	0.11	0.50
628.00	PE-429	98.00	0.14	100.00	uPVC	110.00	(1.10)	0.04	0.40
629.00	ED-37	120.00	-	250.00	uPVC	110.00	-	-	-
630.00	PE-449	28.00	0.10	100.00	uPVC	110.00	0.80	0.01	0.20
631.00	ED-52	647.00	-	80.00	uPVC	110.00	-	-	-

632.00	PE-475	357.00	0.34	100.00	uPVC	110.00	(2.70)	0.80	2.20
633.00	PE-445	215.00	0.67	150.00	uPVC	110.00	11.80	1.05	4.90
634.00	PE-495	172.00	0.03	150.00	uPVC	110.00	(0.50)	-	-
635.00	ED-43	739.00	-	100.00	uPVC	110.00	-	-	-
636.00	PE-439	298.00	0.89	80.00	uPVC	110.00	4.50	5.22	17.50
637.00	PE-110	197.00	0.12	80.00	uPVC	110.00	0.60	0.08	0.40
638.00	PE-175	116.00	0.12	80.00	uPVC	110.00	0.60	0.05	0.40
639.00	PE-12	87.00	0.62	50.00	uPVC	110.00	1.20	1.32	15.20
640.00	PE-19	188.00	0.64	80.00	uPVC	110.00	3.20	1.76	9.40
641.00	PE-254	193.00	0.27	50.00	uPVC	110.00	(0.50)	0.64	3.30
642.00	PE-87	110.00	0.14	200.00	uPVC	110.00	(4.50)	0.02	0.20
643.00	PE-276	179.00	1.29	50.00	uPVC	110.00	2.50	10.63	59.40
644.00	PE-321	255.00	0.01	200.00	uPVC	110.00	0.30	-	-
645.00	PE-235	270.00	0.20	150.00	uPVC	110.00	(3.60)	0.15	0.50
646.00	PE-61	364.00	0.50	150.00	uPVC	110.00	(8.70)	1.02	2.80
647.00	PE-84	53.00	0.10	200.00	uPVC	110.00	(3.00)	0.01	0.10
648.00	PE-46	50.00	0.63	200.00	uPVC	110.00	(19.70)	0.16	3.10
649.00	PE-271	182.00	0.39	150.00	uPVC	110.00	6.90	0.33	1.80
650.00	PE-395	89.00	0.10	200.00	uPVC	110.00	3.10	0.01	0.10
651.00	PE-70	383.00	0.46	100.00	uPVC	110.00	(3.60)	1.51	3.90
	PE-				uPVC	110.00	1.40	-	-

652.00	398	191.00	0.05	200.00					
653.00	PE-262	344.00	0.41	80.00	uPVC	110.00	(2.10)	1.42	4.10
654.00	PE-16	190.00	0.65	150.00	uPVC	110.00	(11.40)	0.87	4.60
655.00	PE-231	44.00	0.13	150.00	uPVC	110.00	2.30	0.01	0.20
656.00	PE-202	196.00	0.21	80.00	uPVC	110.00	(1.10)	0.24	1.20
657.00	PE-279	519.00	0.55	100.00	uPVC	110.00	4.30	2.87	5.50
658.00	PE-259	85.00	0.34	80.00	uPVC	110.00	1.70	0.25	2.90
659.00	PE-108	226.00	0.25	100.00	uPVC	110.00	2.00	0.30	1.30
660.00	PE-400	45.00	0.04	150.00	uPVC	110.00	0.60	-	-
661.00	PE-405	248.00	0.04	50.00	uPVC	110.00	0.10	0.02	0.10
662.00	PE-51	182.00	0.29	80.00	uPVC	110.00	(1.40)	0.39	2.10
663.00	PE-311	239.00	0.04	200.00	uPVC	110.00	1.20	-	-
664.00	PE-48	23.00	0.55	300.00	uPVC	110.00	38.70	0.03	1.50
665.00	PE-07	87.00	0.60	50.00	uPVC	110.00	(1.20)	1.24	14.30
666.00	PE-40	125.00	0.69	100.00	uPVC	110.00	(5.40)	1.04	8.30
667.00	PE-322	214.00	0.07	100.00	uPVC	110.00	(0.60)	0.03	0.10
668.00	PE-23	153.00	0.80	100.00	uPVC	110.00	(6.20)	1.66	10.90
669.00	PE-49	447.00	0.54	300.00	uPVC	110.00	38.20	0.66	1.50
670.00	PE-273	470.00	0.12	150.00	uPVC	110.00	(2.10)	0.09	0.20
671.00	PE-209	66.00	0.16	80.00	uPVC	110.00	0.80	0.05	0.70
672.00	PE-149	142.00	0.28	150.00	uPVC	110.00	5.00	0.14	1.00

673.00	PE-53	139.00	0.68	80.00	uPVC	110.00	(3.40)	1.48	10.60
674.00	PE-422	266.00	0.18	200.00	uPVC	110.00	(5.60)	0.08	0.30
675.00	PE-27	46.00	0.93	100.00	uPVC	110.00	(7.30)	0.67	14.40
676.00	PE-514	46.00	0.14	150.00	uPVC	110.00	2.60	0.01	0.30
677.00	PE-493	351.00	0.06	150.00	uPVC	110.00	1.00	0.02	0.10
678.00	PE-496	135.00	0.03	150.00	uPVC	110.00	(0.50)	-	-
679.00	PE-447	89.00	0.29	150.00	uPVC	110.00	5.10	0.09	1.00
680.00	PE-460	400.00	0.46	200.00	uPVC	110.00	(14.60)	0.71	1.80
681.00	PE-480	625.00	0.12	80.00	uPVC	110.00	0.60	0.26	0.40
682.00	PE-516	178.00	0.27	100.00	uPVC	110.00	2.10	0.26	1.50
683.00	PE-456	203.00	0.56	200.00	uPVC	110.00	17.50	0.51	2.50
684.00	PE-478	69.00	0.63	80.00	uPVC	110.00	3.20	0.63	9.20
685.00	ED-49	867.00	-	100.00	uPVC	110.00	-	-	-
686.00	PE-438	180.00	0.89	80.00	uPVC	110.00	4.50	3.15	17.50
687.00	PE-453	333.00	0.01	100.00	uPVC	110.00	(0.10)	-	-
688.00	PE-436	214.00	0.14	150.00	uPVC	110.00	2.50	0.06	0.30
689.00	PE-452	432.00	0.16	100.00	uPVC	110.00	1.30	0.24	0.60
690.00	PE-511	112.00	0.14	150.00	uPVC	110.00	2.60	0.03	0.30
691.00	PE-442	464.00	0.05	100.00	uPVC	110.00	(0.40)	0.03	0.10
692.00	PE-435	38.00	0.14	150.00	uPVC	110.00	2.50	0.01	0.30
	ED-40		-		uPVC	110.00	-	-	-

693.00		257.00		200.00					
694.00	PE-503	134.00	0.11	100.00	uPVC	110.00	(0.90)	0.04	0.30
695.00	PE-512	125.00	0.14	150.00	uPVC	110.00	2.60	0.04	0.30
696.00	PE-517	194.00	0.25	100.00	uPVC	110.00	2.00	0.25	1.30
697.00	PE-492	149.00	0.04	200.00	uPVC	110.00	1.40	-	-
698.00	PE-491	22.00	0.03	100.00	uPVC	110.00	0.20	-	-
699.00	ED-38	42.00	-	200.00	uPVC	110.00	-	-	-
700.00	PE-497	384.00	0.09	150.00	uPVC	110.00	(1.50)	0.04	0.10
701.00	PE-490	52.00	0.07	100.00	uPVC	110.00	0.50	0.01	0.10
702.00	PE-457	131.00	0.12	200.00	uPVC	110.00	3.60	0.02	0.10
703.00	PE-446	388.00	0.34	150.00	uPVC	110.00	(6.00)	0.54	1.40
704.00	PE-448	196.00	0.38	100.00	uPVC	110.00	(3.00)	0.55	2.80
705.00	PE-444	462.00	0.14	150.00	uPVC	110.00	2.50	0.13	0.30
706.00	PE-487	59.00	0.08	200.00	uPVC	110.00	2.60	-	0.10
707.00	PE-481	103.00	0.20	80.00	uPVC	110.00	(1.00)	0.11	1.10
708.00	PE-506	109.00	0.25	100.00	uPVC	110.00	(1.90)	0.14	1.20
709.00	PE-437	65.00	0.20	150.00	uPVC	110.00	3.50	0.03	0.50
710.00	PE-473	691.00	0.37	80.00	uPVC	110.00	(1.90)	2.41	3.50
711.00	ED-48	276.00	-	100.00	uPVC	110.00	-	-	-
712.00	PE-459	343.00	0.40	150.00	uPVC	110.00	7.00	0.64	1.90
713.00	PE-434	214.00	0.14	150.00	uPVC	110.00	2.50	0.06	0.30

714.00	PE-474	449.00	0.16	80.00	uPVC	110.00	0.80	0.34	0.80
715.00	PE-441	417.00	0.44	150.00	uPVC	110.00	7.80	0.95	2.30
716.00	PE-489	91.00	0.11	100.00	uPVC	110.00	0.90	0.03	0.30
717.00	PE-454	398.00	0.34	80.00	uPVC	110.00	1.70	1.18	3.00
718.00	PE-510	71.00	0.14	150.00	uPVC	110.00	2.60	0.02	0.30
719.00	PE-477	230.00	0.63	80.00	uPVC	110.00	3.20	2.12	9.20
720.00	PE-451	206.00	0.22	50.00	uPVC	110.00	0.40	0.46	2.20
721.00	PE-482	237.00	0.23	100.00	uPVC	110.00	(1.80)	0.27	1.10
722.00	PE-443	433.00	0.30	100.00	uPVC	110.00	2.40	0.79	1.80
723.00	PE-458	254.00	0.33	200.00	uPVC	110.00	10.30	0.24	0.90
724.00	PE-499	42.00	0.40	50.00	uPVC	110.00	0.80	0.28	6.70
725.00	PE-505	190.00	0.22	100.00	uPVC	110.00	(1.70)	0.19	1.00
726.00	ED-45	108.00	-	80.00	uPVC	110.00	-	-	-
727.00	ED-47	378.00	-	100.00	uPVC	110.00	-	-	-
728.00	PE-476	338.00	0.55	100.00	uPVC	110.00	(4.30)	1.85	5.50
729.00	PE-504	134.00	0.11	100.00	uPVC	110.00	(0.90)	0.04	0.30
730.00	PE-479	49.00	0.12	80.00	uPVC	110.00	0.60	0.02	0.40
731.00	PE-494	240.00	0.06	150.00	uPVC	110.00	1.00	0.01	0.10
732.00	ED-36	266.00	-	250.00	uPVC	110.00	-	-	-
733.00	ED-41	286.00	-	200.00	uPVC	110.00	-	-	-
	PE-				uPVC	110.00	(1.30)	0.12	0.60

734.00	450	206.00	0.16	100.00					
735.00	PE-513	108.00	0.14	150.00	uPVC	110.00	2.60	0.03	0.30
736.00	PE-518	98.00	0.22	100.00	uPVC	110.00	1.70	0.10	1.00
737.00	ED-50	429.00	-	100.00	uPVC	110.00	-	-	-
738.00	PE-515	135.00	0.29	100.00	uPVC	110.00	2.30	0.22	1.60
739.00	PE-370	258.00	0.13	150.00	uPVC	110.00	2.30	0.06	0.20
740.00	PE-238	433.00	0.06	300.00	uPVC	110.00	4.00	0.01	-
741.00	PE-62	715.00	0.48	200.00	uPVC	110.00	(15.00)	1.35	1.90
742.00	PE-67	163.00	0.09	100.00	uPVC	110.00	0.70	0.03	0.20
743.00	PE-100	26.00	0.31	150.00	uPVC	110.00	5.50	0.03	1.20
744.00	PE-171	100.00	0.46	100.00	uPVC	110.00	3.60	0.39	3.90
745.00	PE-22	541.00	1.95	80.00	uPVC	110.00	(9.80)	39.95	73.80
746.00	PE-407	247.00	0.04	80.00	uPVC	110.00	(0.20)	0.01	0.10
747.00	PE-88	301.00	0.15	200.00	uPVC	110.00	(4.80)	0.07	0.20
748.00	PE-411	62.00	0.24	50.00	uPVC	110.00	(0.50)	0.17	2.70
749.00	PE-180	343.00	0.20	80.00	uPVC	110.00	1.00	0.39	1.10
750.00	PE-137	351.00	0.43	300.00	uPVC	110.00	30.10	0.33	0.90
751.00	PE-380	118.00	0.12	300.00	uPVC	110.00	8.50	0.01	0.10
752.00	PE-385	261.00	0.09	80.00	uPVC	110.00	0.50	0.07	0.30
753.00	PE-243	333.00	0.36	150.00	uPVC	110.00	6.40	0.53	1.60
754.00	PE-73	296.00	0.39	80.00	uPVC	110.00	2.00	1.11	3.80

755.00	PE-332	161.00	0.07	100.00	uPVC	110.00	0.50	0.02	0.10
756.00	PE-146	174.00	0.40	300.00	uPVC	110.00	28.50	0.15	0.90
757.00	PE-265	470.00	0.02	200.00	uPVC	110.00	0.70	-	-
758.00	PE-122	486.00	0.47	80.00	uPVC	110.00	(2.40)	2.57	5.30
759.00	PE-417	117.00	0.04	80.00	uPVC	110.00	(0.20)	0.01	-
760.00	PE-274	284.00	0.16	150.00	uPVC	110.00	(2.80)	0.09	0.30
761.00	PE-13	89.00	0.62	50.00	uPVC	110.00	1.20	1.35	15.20
762.00	PE-59	355.00	0.38	100.00	uPVC	110.00	3.00	0.97	2.70
763.00	PE-208	53.00	0.16	80.00	uPVC	110.00	0.80	0.04	0.70
764.00	PE-132	249.00	0.18	200.00	uPVC	110.00	5.80	0.08	0.30
765.00	PE-213	180.00	0.09	150.00	uPVC	110.00	(1.60)	0.02	0.10
766.00	PE-142	86.00	0.48	300.00	uPVC	110.00	34.10	0.10	1.20
767.00	PE-257	329.00	0.17	150.00	uPVC	110.00	(3.00)	0.13	0.40
768.00	PE-287	166.00	0.29	150.00	uPVC	110.00	(5.10)	0.17	1.00
769.00	PE-143	377.00	0.48	300.00	uPVC	110.00	34.10	0.45	1.20
770.00	PE-374	294.00	0.04	150.00	uPVC	110.00	0.80	0.01	-
771.00	PE-234	565.00	0.06	300.00	uPVC	110.00	4.60	0.02	-
772.00	PE-109	242.00	0.13	80.00	uPVC	110.00	(0.60)	0.12	0.50
773.00	PE-02	874.00	0.73	40.00	uPVC	110.00	0.90	23.78	27.20
774.00	PE-307	153.00	0.10	200.00	uPVC	110.00	3.20	0.02	0.10
	PE-			80.00	uPVC	110.00	0.40	0.04	0.20

775.00	413	191.00	0.08						
776.00	PE-103	230.00	0.15	150.00	uPVC	110.00	2.70	0.07	0.30
777.00	PE-253	249.00	0.41	150.00	uPVC	110.00	(7.30)	0.50	2.00
778.00	PE-111	80.00	0.06	80.00	uPVC	110.00	0.30	0.01	0.10
779.00	PE-404	509.00	0.04	150.00	uPVC	110.00	0.70	0.01	-
780.00	PE-01	312.00	0.84	100.00	uPVC	110.00	6.60	3.75	12.00
781.00	PE-390	250.00	0.09	200.00	uPVC	110.00	(2.80)	0.02	0.10
782.00	PE-170	100.00	0.68	100.00	uPVC	110.00	5.40	0.82	8.20
783.00	PE-296	11.00	0.10	200.00	uPVC	110.00	3.10	-	0.10
784.00	PE-52	191.00	0.29	80.00	uPVC	110.00	(1.40)	0.41	2.10
785.00	PE-148	59.00	0.28	150.00	uPVC	110.00	5.00	0.06	1.00
786.00	PE-335	89.00	0.03	100.00	uPVC	110.00	0.30	-	-
787.00	PE-264	363.00	0.14	200.00	uPVC	110.00	4.30	0.07	0.20
788.00	PE-318	150.00	0.12	50.00	uPVC	110.00	0.20	0.12	0.80
789.00	PE-206	72.00	0.03	80.00	uPVC	110.00	0.10	-	-
790.00	PE-316	112.00	0.02	200.00	uPVC	110.00	0.60	-	-
791.00	PE-313	242.00	0.08	150.00	uPVC	110.00	(1.40)	0.02	0.10
792.00	PE-123	112.00	1.07	300.00	uPVC	110.00	75.80	0.59	5.20
793.00	PE-112	97.00	0.06	80.00	uPVC	110.00	0.30	0.01	0.10
794.00	PE-218	426.00	0.03	200.00	uPVC	110.00	1.10	0.01	-
795.00	PE-373	217.00	0.23	80.00	uPVC	110.00	1.10	0.30	1.40

796.00	PE-361	11.00	0.22	50.00	uPVC	110.00	0.40	0.02	2.20
797.00	PE-56	505.00	0.45	150.00	uPVC	110.00	(7.90)	1.17	2.30
798.00	PE-338	144.00	-	150.00	uPVC	110.00	-	-	-
799.00	PE-428	380.00	0.12	80.00	uPVC	110.00	0.60	0.17	0.40
800.00	PE-381	68.00	0.12	300.00	uPVC	110.00	8.50	0.01	0.10

APPENDIX G Link Extended Period Simulation Results at Peak Hour

S.No	Label	Length (m)	Velocity (m/s)	Diameter (mm)	Material	Hazen-Williams C	Discharge (l/s)	Pressure Pipe Headloss (m)	Headloss Gradient (m/km)
1	P-1792	403	1.1	600	DI	110	310.6	0.98	2.4
2	P-1799	69	1.1	600	DI	110	310.6	0.17	2.4
3	P-1777	275	1.1	600	DI	110	310.6	0.67	2.4
4	P-1782	819	1.1	600	DI	110	310.6	2	2.4
5	P-1788	318	1.1	600	DI	110	310.6	0.78	2.4
6	P-1780	1,656	1.1	600	DI	110	310.6	4.04	2.4
7	P-1784	730	1.1	600	DI	110	310.6	1.78	2.4
8	P-1794	133	1.1	600	DI	110	310.6	0.33	2.4
9	P-1793	70	1.1	600	DI	110	310.6	0.17	2.4
10	P-1772	16	1.1	600	DI	110	310.6	0.04	2.4
11	P-1783	20	1.1	600	DI	110	310.6	0.05	2.4
12	P-1796	62	1.1	600	DI	110	310.6	0.15	2.4
13	P-1773	6	1.1	600	DI	110	310.6	0.02	2.4
14	P-1800	77	1.1	600	DI	110	310.6	0.19	2.4
15	P-1798	32	1.1	600	DI	110	310.6	0.08	2.4
16	P-1770	1,920	1.1	600	DI	110	310.6	4.69	2.4

17	PE-466	67	0.48	300	DI	110	33.8	0.08	1.2
18	PE-486	244	0.66	300	DI	110	-46.4	0.52	2.1
19	PE-464	123	0.44	300	DI	110	-30.9	0.12	1
20	PE-508	138	1.06	300	DI	110	75	0.71	5.1
21	PE-484	415	0.61	300	DI	110	-43	0.76	1.8
22	PE-465	62	0.48	300	DI	110	33.8	0.07	1.2
23	PE-509	319	0.75	300	DI	110	-52.7	0.85	2.7
24	PE-463	191	0.43	300	DI	110	-30.4	0.19	1
25	P-1779	69	1.1	600	DI	110	310.6	0.17	2.4
26	P-1786	309	1.1	600	DI	110	310.6	0.75	2.4
27	P-1791	61	1.1	600	DI	110	310.6	0.15	2.4
28	P-1790	34	1.1	600	DI	110	310.6	0.08	2.4
29	PE-469	45	0.71	300	DI	110	-50	0.11	2.4
30	PE-468	203	0.71	300	DI	110	50	0.49	2.4
31	PE-507	183	0.68	400	DI	110	85	0.29	1.6
32	P-1785	351	1.1	600	DI	110	310.6	0.86	2.4
33	ED-14	122	0.36	300	DI	110	25.2	0.08	0.7
34	ED-09	263	0.36	300	DI	110	25.2	0.18	0.7
35	ED-10	303	0.36	300	DI	110	25.2	0.21	0.7
36	ED-16	81	0.36	300	DI	110	25.2	0.06	0.7
37	ED-25	120	0.36	300	DI	110	25.2	0.08	0.7
38	ED-19	73	0.36	300	DI	110	25.2	0.05	0.7
39	ED-12	222	0.36	300	DI	110	25.2	0.15	0.7
40	ED-11	267	0.36	300	DI	110	25.2	0.18	0.7

41	ED-24	186	0.36	300	DI	110	25.2	0.13	0.7
42	ED-08	182	0.36	300	DI	110	25.2	0.12	0.7
43	ED-30	3	0.36	300	DI	110	25.2	0	0.7
44	ED-26	125	0.36	300	DI	110	25.2	0.09	0.7
45	ED-31	368	0.36	300	DI	110	25.2	0.25	0.7
46	ED-05	57	0.36	300	DI	110	25.2	0.04	0.7
47	ED-32	190	0.36	300	DI	110	25.2	0.13	0.7
48	ED-33	95	0.36	300	DI	110	25.2	0.06	0.7
49	P-1771	430	1.1	600	DI	110	310.6	1.05	2.4
50	P-1778	323	1.1	600	DI	110	310.6	0.79	2.4
51	P-1775	214	1.1	600	DI	110	310.6	0.52	2.4
52	P-1776	20	1.1	600	DI	110	310.6	0.05	2.4
53	P-1774	272	1.1	600	DI	110	310.6	0.66	2.4
54	P-1789	122	1.1	600	DI	110	310.6	0.3	2.4
55	P-1795	91	1.1	600	DI	110	310.6	0.22	2.4
56	P-1797	42	1.1	600	DI	110	310.6	0.1	2.4
57	PB-24	131	0.94	150	DI	110	16.6	1.21	9.2
58	PB-23	873	0.94	150	DI	110	16.6	8.07	9.2
59	PB-20	119	0.94	150	DI	110	16.6	1.1	9.2
60	PB-21	261	0.94	150	DI	110	16.6	2.42	9.2
61	P-1781	1,210	1.1	600	DI	110	310.6	2.95	2.4
62	P-1787	430	1.1	600	DI	110	310.6	1.05	2.4
63	PB-22	182	0.94	150	DI	110	16.6	1.68	9.2
64	PE-154	96	1.24	600	DI	110	-350	0.29	3
65	PE-343	215	0.6	500	DI	110	118.4	0.21	1
66	PE-91	54	0.8	500	DI	110	156.2	0.09	1.7
67	PE-	87	0.54	500	DI	110	106.6	0.07	0.8

	349								
68	PE-252	61	0.12	300	DI	110	-8.4	0.01	0.1
69	PE-158	279	1.78	600	DI	110	-503.9	1.67	6
70	PE-157	34	1.78	600	DI	110	-503.9	0.2	6
71	PE-138	166	0.94	600	DI	110	-265.3	0.3	1.8
72	PE-348	158	0.54	500	DI	110	106	0.13	0.8
73	PE-192	204	0.55	400	DI	110	69.2	0.22	1.1
74	PE-193	266	0.5	400	DI	110	62.9	0.24	0.9
75	PE-161	19	0.77	500	DI	110	150.9	0.03	1.6
76	PE-169	120	0.69	500	DI	110	135.5	0.15	1.3
77	PE-341	94	0.6	500	DI	110	118.8	0.09	1
78	PE-189	354	0.71	400	DI	110	89.3	0.62	1.7
79	PE-127	433	0.74	600	DI	110	-210.4	0.51	1.2
80	PE-249	107	0.11	300	DI	110	-7.7	0.01	0.1
81	PE-98	157	0.77	500	DI	110	-151.3	0.25	1.6
82	PE-93	30	0.79	500	DI	110	154.7	0.05	1.6
83	PE-163	550	0.71	500	DI	110	139.3	0.74	1.3
84	PE-94	118	0.79	500	DI	110	-155.9	0.19	1.7
85	PE-186	569	0.75	400	DI	110	94.4	1.1	1.9
86	PE-167	25	0.69	500	DI	110	135.5	0.03	1.3
87	PE-346	84	0.57	500	DI	110	112.1	0.08	0.9
88	PE-342	42	0.6	500	DI	110	118.6	0.04	1

89	PE-339	41	0.75	500	DI	110	146.6	0.06	1.5
90	PE-155	73	1.24	600	DI	110	-350	0.22	3
91	PE-251	148	0.12	300	DI	110	-8.4	0.01	0.1
92	PE-90	96	0.79	500	DI	110	155	0.16	1.6
93	PE-139	178	0.94	600	DI	110	-265.3	0.33	1.8
94	PE-187	178	0.73	400	DI	110	92	0.33	1.8
95	PE-113	260	0.6	600	DI	110	-169.6	0.21	0.8
96	PE-266	49	0.5	400	DI	110	62.2	0.04	0.9
97	PE-92	40	0.8	500	DI	110	156.2	0.07	1.7
98	PE-159	77	1.79	600	DI	110	-505.3	0.47	6
99	PE-95	12	0.76	500	DI	110	-148.8	0.02	1.5
100	PE-165	157	0.7	500	DI	110	137.4	0.21	1.3
101	PE-248	128	0.11	300	DI	110	-7.7	0.01	0.1
102	PE-107	239	0.58	600	DI	110	-165.2	0.18	0.8
103	PE-345	163	0.55	500	DI	110	108.2	0.14	0.8
104	PE-467	301	0.59	300	DI	110	41.9	0.53	1.7
105	PE-461	130	0.08	300	DI	110	-5.9	0.01	0
106	PE-519	290	0.71	400	DI	110	89.1	0.5	1.7
107	PE-470	483	0.33	300	DI	110	23.2	0.28	0.6
108	PE-188	211	0.72	400	DI	110	90	0.37	1.8
109	PE-147	271	1.21	600	DI	110	-342.1	0.79	2.9
110	PE-	52	1.79	600	DI	110	-505.3	0.32	6

	160								
111	PE-340	86	0.61	500	DI	110	119	0.09	1
112	PE-168	119	0.69	500	DI	110	135.5	0.15	1.3
113	PE-162	526	0.77	500	DI	110	150.9	0.82	1.6
114	PE-164	62	0.7	500	DI	110	137.4	0.08	1.3
115	PE-250	118	0.11	300	DI	110	-7.7	0.01	0.1
116	PE-427	199	0.74	400	DI	110	92.7	0.37	1.9
117	PE-191	208	0.55	400	DI	110	69.7	0.23	1.1
118	PE-267	469	0.37	400	DI	110	46.7	0.25	0.5
119	PE-347	118	0.57	500	DI	110	112.1	0.11	0.9
120	PE-156	124	1.24	600	DI	110	-351.5	0.38	3.1
121	PE-130	810	0.92	600	DI	110	-258.8	1.41	1.7
122	PE-185	311	0.68	500	DI	110	133.3	0.39	1.2
123	PE-190	119	0.62	400	DI	110	77.5	0.16	1.3
124	PE-102	311	0.57	600	DI	110	-159.8	0.22	0.7
125	PE-344	318	0.58	500	DI	110	113.4	0.29	0.9
126	PE-166	73	0.69	500	DI	110	135.5	0.09	1.3
127	EG-92	32	0.05	150	DI	110	0.8	0	0
128	EG-38	34	0.05	150	DI	110	-0.8	0	0
129	EG-39	24	0.05	150	DI	110	-0.8	0	0
130	EG-93	3	0	200	DI	110	0	0	0
131	P-1324	45	0.89	100	DI	110	7	0.61	13.4
132	EG-87	2	0.22	200	DI	110	7	0	0.5

133	EG-97	52	0	200	DI	110	0	0	0
134	EG-96	369	0	200	DI	110	0	0	0
135	EG-37	41	0.05	150	DI	110	-0.8	0	0
136	EG-82	37	0.05	150	DI	110	-0.8	0	0
137	EG-32	64	0.05	150	DI	110	-0.8	0	0
138	EG-36	34	0.05	150	DI	110	-0.8	0	0
139	EG-33	50	0.05	150	DI	110	-0.8	0	0
140	EG-34	30	0.05	150	DI	110	-0.8	0	0
141	EG-35	38	0.05	150	DI	110	-0.8	0	0
142	EG-86	4	0.64	100	DI	110	5.1	0.03	7.4
143	P-1205	1	0.84	200	DI	110	26.4	0	5.4
144	P-1206	1	0.27	350	DI	110	26.4	0	0.3
145	P-1207	205	0.94	600	DI	110	-266.4	0.38	1.8
146	P-1204	1	0	200	DI	110	0	0	0
147	ED-01	2	0	200	DI	110	0	0	0
148	ED-02	1	0	200	DI	110	0	0	0
149	P-1203	1	0	200	DI	110	0	0	0
150	P-1208	187	1.04	600	DI	110	-294.3	0.41	2.2
151	EG-83	3	0.64	100	DI	110	5.1	0.02	7.4
152	EG-84	4	0.64	100	DI	110	5.1	0.03	7.4
153	EG-85	4	0.64	100	DI	110	5.1	0.03	7.4
154	EG-02	16	1.29	100	DI	110	10.1	0.42	26.6
155	P-1209	30	1.06	300	DI	110	75	0.16	5.1
156	P-1210	2	1.06	300	DI	110	75	0.01	5.1
157	PB-08	3	0.84	150	DI	110	14.8	0.02	7.4
158	EG-27	21	0.05	150	DI	110	-0.8	0	0
159	EG-08	86	0.98	100	DI	110	7.7	1.37	15.9
160	EG-09	37	0.92	100	DI	110	7.2	0.52	14.3
161	EG-07	57	0.98	100	DI	110	7.7	0.9	15.9
162	EG-13	18	0.92	100	DI	110	7.2	0.26	14.3

163	EG-10	8	0.92	100	DI	110	7.2	0.11	14.3
164	EG-11	5	0.92	100	DI	110	7.2	0.07	14.3
165	EG-12	23	0.92	100	DI	110	7.2	0.33	14.3
166	EG-06	46	0.98	100	DI	110	7.7	0.73	15.9
167	EG-54	48	0.11	50	DI	110	0.2	0.03	0.6
168	EG-01	121	1.06	100	DI	110	-8.3	2.24	18.5
169	EG-94	34	0	200	DI	110	0	0	0
170	EG-04	56	1	100	DI	110	7.9	0.93	16.7
171	EG-05	63	0.98	100	DI	110	7.7	1	15.9
172	EG-03	27	1	100	DI	110	7.9	0.45	16.7
173	EG-14	43	0.92	100	DI	110	7.2	0.62	14.3
174	EG-95	144	0	200	DI	110	0	0	0
175	EG-23	38	0.89	100	DI	110	7	0.51	13.5
176	EG-26	26	0.05	150	DI	110	-0.8	0	0
177	EG-31	41	0.05	150	DI	110	-0.8	0	0
178	EG-28	8	0.05	150	DI	110	-0.8	0	0
179	EG-29	5	0.05	150	DI	110	-0.8	0	0
180	EG-30	18	0.05	150	DI	110	-0.8	0	0
181	EG-18	29	0.89	100	DI	110	7	0.39	13.5
182	EG-15	37	0.92	100	DI	110	7.2	0.52	14.3
183	EG-16	23	0.92	100	DI	110	7.2	0.33	14.3
184	EG-17	70	0.92	100	DI	110	7.2	1	14.3
185	EG-22	47	0.89	100	DI	110	7	0.64	13.5
186	EG-19	34	0.89	100	DI	110	7	0.46	13.5
187	EG-20	32	0.89	100	DI	110	7	0.43	13.5
188	EG-21	61	0.89	100	DI	110	7	0.83	13.5
189	P-1958	1	0.84	200	DI	110	26.4	0	5.4
190	PB-25	2	0.94	150	DI	110	16.6	0.02	9.3
191	PB-26	110	0.94	150	DI	110	16.6	1.01	9.2
192	ED-03	2	0.8	200	DI	110	25.2	0.01	5
193	P-1954	5	0.62	400	DI	110	78	0.01	1.4
194	ED-34	6	0.36	300	DI	110	25.2	0	0.7
195	ED-35	1	0.8	200	DI	110	25.2	0	4.9
196	PAS-02	2	0.14	600	DI	110	-38.8	0	0

197	PAS-12	2	0.27	600	DI	110	77.6	0	0.2
198	PAS-14	2	0.14	600	DI	110	38.8	0	0.1
199	PAS-15	1	0.14	600	DI	110	38.8	0	0
200	PAS-10	2	0.41	600	DI	110	116.5	0	0.4
201	PAS-04	2	0.27	600	DI	110	-77.6	0	0.2
202	PAS-06	2	0.41	600	DI	110	-116.5	0	0.4
203	PAS-08	2	0.55	600	DI	110	155.3	0	0.7
204	P-1953	50	0.75	300	DI	110	52.7	0.13	2.7
205	ED-15	119	0.36	300	DI	110	25.2	0.08	0.7
206	ED-28	42	0.36	300	DI	110	25.2	0.03	0.7
207	ED-22	179	0.36	300	DI	110	25.2	0.12	0.7
208	ED-17	41	0.36	300	DI	110	25.2	0.03	0.7
209	ED-29	23	0.36	300	DI	110	25.2	0.02	0.7
210	ED-27	40	0.36	300	DI	110	25.2	0.03	0.7
211	ED-21	139	0.36	300	DI	110	25.2	0.1	0.7
212	ED-23	110	0.36	300	DI	110	25.2	0.08	0.7
213	ED-06	105	0.36	300	DI	110	25.2	0.07	0.7
214	ED-07	157	0.36	300	DI	110	25.2	0.11	0.7
215	P-1952	23	0.75	300	DI	110	52.7	0.06	2.7
216	ED-04	33	0.36	300	DI	110	25.2	0.02	0.7
217	ED-18	43	0.36	300	DI	110	25.2	0.03	0.7
218	ED-20	228	0.36	300	DI	110	25.2	0.16	0.7
219	ED-13	136	0.36	300	DI	110	25.2	0.09	0.7
220	PQS-01	1	0.14	600	DI	110	38.8	0	0.1
221	PAS-13	1	0.14	600	DI	110	38.8	0	0
222	PQS-03	1	0.14	600	DI	110	38.8	0	0.1
223	P-	23	1.06	300	DI	110	-75	0.12	5.1

	1191								
224	PQS-05	1	0.14	600	DI	110	38.8	0	0
225	PAS-09	1	0.14	600	DI	110	38.8	0	0.1
226	PQS-07	1	0.14	600	DI	110	38.8	0	0
227	PAS-11	1	0.14	600	DI	110	38.8	0	0.1
228	P-1192	1	0.75	300	DI	110	52.7	0	2.6
229	P-1198	1	0.55	350	DI	110	52.7	0	1.3
230	P-1199	31	0.75	300	DI	110	52.7	0.08	2.7
231	P-1200	1	0	200	DI	110	0	0	0
232	P-1197	1	0.84	200	DI	110	26.4	0	5.1
233	P-1193	1	0.42	200	DI	110	13.2	0	1.5
234	P-1194	1	0.42	200	DI	110	13.2	0	1.5
235	P-1196	1	0.84	200	DI	110	26.4	0	5.4
236	PQS-09	1	0.14	600	DI	110	38.8	0	0
237	PQS-10	2	0.69	600	DI	110	194.1	0	1.1
238	PQS-12	2	0.82	600	DI	110	232.9	0	1.4
239	PQS-14	2	0.96	600	DI	110	271.7	0	2
240	PQS-08	2	0.55	600	DI	110	155.3	0	0.7
241	PQS-02	2	0.14	600	DI	110	38.8	0	0.1
242	PQS-04	2	0.27	600	DI	110	77.6	0	0.1
243	PQS-06	2	0.41	600	DI	110	116.5	0	0.4

244	P-1173	10	1.1	600	DI	110	310.6	0.02	2.4
245	PAS-05	1	0.14	600	DI	110	38.8	0	0
246	PQS-11	1	0.14	600	DI	110	38.8	0	0
247	PAS-07	1	0.14	600	DI	110	38.8	0	0
248	PQS-13	1	0.14	600	DI	110	38.8	0	0
249	PAS-01	1	0.14	600	DI	110	38.8	0	0.1
250	PQS-15	1	0.14	600	DI	110	38.8	0	0.1
251	PAS-03	1	0.14	600	DI	110	38.8	0	0
252	ED-55	706	0	50	GI	110	0	0	0
253	ED-46	271	0	50	GI	110	0	0	0
254	ED-51	746	0	65	GI	110	0	0	0
255	ED-53	694	0	65	GI	110	0	0	0
256	ED-54	150	0	50	GI	110	0	0	0
257	PE-216	333	0.25	80	uPVC	110	-1.3	0.57	1.7
258	PE-358	315	0.23	150	uPVC	110	4	0.21	0.7
259	PE-272	104	0.53	80	uPVC	110	-2.7	0.69	6.7
260	PE-291	113	0.58	100	uPVC	110	4.5	0.67	6
261	PE-247	279	0.39	150	uPVC	110	-6.9	0.51	1.8
262	PE-356	131	0.14	200	uPVC	110	4.4	0.03	0.2
263	PE-03	434	1.15	50	uPVC	110	-2.3	20.86	48.1
264	PE-219	427	0.07	200	uPVC	110	-2.1	0.02	0.1
265	PE-14	220	1.71	80	uPVC	110	-8.6	12.74	57.9
266	PE-174	26	0.19	80	uPVC	110	0.9	0.02	1
267	PE-	289	0.13	200	uPVC	110	-4.1	0.05	0.2

	220								
268	PE-240	404	0.26	150	uPVC	110	4.7	0.35	0.9
269	PE-315	239	0.17	200	uPVC	110	5.2	0.06	0.3
270	PE-45	159	0.98	200	uPVC	110	-30.9	1.14	7.2
271	PE-331	213	0.1	100	uPVC	110	0.8	0.05	0.2
272	PE-25	230	1.48	100	uPVC	110	-11.6	7.89	34.3
273	PE-365	166	0.21	150	uPVC	110	3.7	0.09	0.6
274	PE-388	259	0.11	200	uPVC	110	-3.5	0.03	0.1
275	PE-74	148	0.39	50	uPVC	110	-0.8	0.96	6.4
276	PE-310	207	0.17	150	uPVC	110	-3	0.08	0.4
277	PE-406	256	0.15	200	uPVC	110	4.6	0.05	0.2
278	PE-227	104	0.22	300	uPVC	110	15.3	0.03	0.3
279	PE-214	260	0.41	300	uPVC	110	-28.9	0.23	0.9
280	PE-353	136	0.09	50	uPVC	110	0.2	0.05	0.4
281	PE-47	158	1.01	200	uPVC	110	-31.6	1.18	7.5
282	PE-420	540	0.1	150	uPVC	110	-1.8	0.08	0.2
283	PE-414	199	0.23	80	uPVC	110	-1.1	0.27	1.4
284	PE-352	68	0.12	50	uPVC	110	-0.2	0.05	0.7
285	PE-386	265	0.07	150	uPVC	110	1.3	0.02	0.1
286	PE-75	105	0.55	80	uPVC	110	2.8	0.76	7.2
287	PE-292	224	0.03	100	uPVC	110	-0.2	0.01	0
288	PE-182	274	0.28	80	uPVC	110	-1.4	0.55	2
289	PE-50	248	0.1	80	uPVC	110	-0.5	0.08	0.3
290	PE-	208	0.04	80	uPVC	110	0.2	0.01	0.1

	323								
291	PE-303	365	0.4	150	uPVC	110	-7.1	0.69	1.9
292	PE-281	378	0.21	300	uPVC	110	14.7	0.09	0.3
293	PE-58	310	0.67	50	uPVC	110	-1.3	5.55	17.9
294	PE-306	88	0.06	100	uPVC	110	-0.5	0.01	0.1
295	PE-223	331	0.23	50	uPVC	110	0.4	0.8	2.4
296	PE-327	151	0.14	100	uPVC	110	1.1	0.07	0.5
297	PE-15	403	1.62	80	uPVC	110	8.1	21.13	52.4
298	PE-24	103	1.48	100	uPVC	110	-11.6	3.53	34.3
299	PE-85	312	0.19	200	uPVC	110	-6.1	0.11	0.4
300	PE-246	173	0.35	150	uPVC	110	-6.1	0.25	1.5
301	PE-245	180	0.31	150	uPVC	110	-5.5	0.21	1.2
302	PE-384	259	0.16	200	uPVC	110	5	0.06	0.2
303	PE-362	12	0.23	50	uPVC	110	0.5	0.03	2.5
304	PE-150	154	0.37	150	uPVC	110	6.6	0.26	1.7
305	PE-72	384	0.47	100	uPVC	110	-3.7	1.57	4.1
306	PE-432	255	0.2	50	uPVC	110	0.4	0.47	1.9
307	PE-41	118	0.74	200	uPVC	110	-23.2	0.5	4.2
308	PE-425	215	0.34	200	uPVC	110	-10.8	0.22	1
309	PE-397	337	0.14	200	uPVC	110	4.4	0.06	0.2
310	PE-258	138	0.57	80	uPVC	110	2.8	1.04	7.5
311	PE-269	217	0.37	300	uPVC	110	26	0.16	0.7
312	PE-33	172	0.95	100	uPVC	110	-7.5	2.62	15.2
313	PE-106	354	0.27	150	uPVC	110	-4.7	0.31	0.9

314	PE-424	197	0.26	100	uPVC	110	-2.1	0.28	1.4
315	PE-372	262	0.18	80	uPVC	110	0.9	0.24	0.9
316	PE-298	213	0.36	80	uPVC	110	-1.8	0.69	3.2
317	PE-368	127	0.25	150	uPVC	110	4.4	0.1	0.8
318	PE-284	232	0.23	200	uPVC	110	7.1	0.11	0.5
319	PE-44	135	0.79	100	uPVC	110	6.2	1.44	10.7
320	PE-387	263	0.15	100	uPVC	110	-1.2	0.13	0.5
321	PE-203	135	0.2	80	uPVC	110	1	0.15	1.1
322	PE-304	240	0.13	150	uPVC	110	2.3	0.06	0.2
323	PE-330	88	0.01	100	uPVC	110	0.1	0	0
324	PE-225	327	0.07	200	uPVC	110	-2.3	0.02	0.1
325	PE-120	204	1.7	300	uPVC	110	120	2.5	12.3
326	PE-232	53	0.18	150	uPVC	110	3.1	0.02	0.4
327	PE-326	149	0.13	100	uPVC	110	-1.1	0.06	0.4
328	PE-239	387	0.06	150	uPVC	110	1	0.02	0.1
329	PE-71	311	0.21	100	uPVC	110	1.6	0.29	0.9
330	PE-383	24	0.33	200	uPVC	110	10.5	0.02	1
331	PE-237	494	0.22	50	uPVC	110	0.4	1.11	2.2
332	PE-412	192	0.21	50	uPVC	110	0.4	0.41	2.1
333	PE-80	293	0.07	200	uPVC	110	-2.3	0.02	0.1
334	PE-181	259	0.25	80	uPVC	110	-1.2	0.42	1.6
335	PE-	211	0.23	150	uPVC	110	4	0.14	0.7

	241								
336	PE-229	79	0.05	200	uPVC	110	1.4	0	0
337	PE-328	215	0.08	100	uPVC	110	0.7	0.04	0.2
338	PE-105	40	0.4	80	uPVC	110	2	0.16	3.9
339	PE-136	79	0.68	300	uPVC	110	48.3	0.18	2.3
340	PE-423	266	0.29	150	uPVC	110	-5.2	0.28	1.1
341	PE-309	153	0.04	200	uPVC	110	-1.3	0	0
342	PE-317	233	0.12	100	uPVC	110	-0.9	0.08	0.3
343	PE-96	126	0.32	100	uPVC	110	2.5	0.25	2
344	PE-263	589	0.4	150	uPVC	110	-7	1.09	1.9
345	PE-366	15	0.14	200	uPVC	110	4.5	0	0.2
346	PE-319	92	0.11	100	uPVC	110	-0.9	0.03	0.3
347	PE-77	190	0.22	80	uPVC	110	1.1	0.24	1.3
348	PE-26	65	1.48	100	uPVC	110	-11.6	2.23	34.3
349	PE-350	279	0.39	300	uPVC	110	27.3	0.22	0.8
350	PE-173	459	0.45	80	uPVC	110	2.2	2.21	4.8
351	PE-389	256	0.14	200	uPVC	110	-4.4	0.05	0.2
352	PE-30	109	1.64	80	uPVC	110	8.3	5.9	53.9
353	PE-336	153	0.1	100	uPVC	110	0.8	0.04	0.2
354	PE-301	153	0.16	100	uPVC	110	1.3	0.09	0.6
355	PE-371	273	0.08	80	uPVC	110	-0.4	0.06	0.2
356	PE-151	232	0.3	150	uPVC	110	5.3	0.26	1.1
357	PE-	281	0.13	200	uPVC	110	4.2	0.05	0.2

	376								
358	PE-233	245	0.32	200	uPVC	110	10.2	0.23	0.9
359	PE-302	132	0.22	150	uPVC	110	-3.9	0.09	0.6
360	PE-129	437	1.2	300	uPVC	110	84.5	2.8	6.4
361	PE-408	318	0.11	200	uPVC	110	3.4	0.04	0.1
362	PE-183	290	0.13	50	uPVC	110	-0.3	0.26	0.9
363	PE-277	603	1.67	100	uPVC	110	-13.1	26	43.1
364	PE-121	213	1.68	300	uPVC	110	118.5	2.56	12
365	PE-431	376	0.09	200	uPVC	110	-2.8	0.03	0.1
366	PE-244	87	0.41	150	uPVC	110	7.2	0.17	1.9
367	PE-117	122	0.5	80	uPVC	110	2.5	0.73	6
368	PE-205	80	0.15	80	uPVC	110	0.7	0.05	0.6
369	PE-369	123	0.24	150	uPVC	110	4.2	0.09	0.7
370	PE-76	163	0.43	80	uPVC	110	2.2	0.75	4.6
371	PE-416	111	0.17	200	uPVC	110	5.2	0.03	0.3
372	PE-334	212	0.04	80	uPVC	110	0.2	0.01	0.1
373	PE-81	187	0.1	200	uPVC	110	-3.2	0.02	0.1
374	PE-351	155	0.2	300	uPVC	110	13.9	0.03	0.2
375	PE-278	317	3.03	80	uPVC	110	15.2	53.11	167.5
376	PE-283	14	0.28	200	uPVC	110	8.7	0.01	0.7
377	PE-401	122	0.06	150	uPVC	110	1	0.01	0.1
378	PE-09	290	1.01	80	uPVC	110	-5.1	6.38	22

379	PE-42	173	0.74	200	uPVC	110	-23.2	0.73	4.2
380	PE-119	121	1.1	200	uPVC	110	-34.5	1.07	8.8
381	PE-43	57	0.76	200	uPVC	110	-23.9	0.26	4.5
382	PE-78	263	0.37	80	uPVC	110	-1.9	0.92	3.5
383	PE-06	276	1.15	50	uPVC	110	-2.3	13.33	48.2
384	PE-144	259	0.16	200	uPVC	110	-5.1	0.06	0.3
385	PE-270	252	0.36	300	uPVC	110	25.6	0.18	0.7
386	PE-66	374	0.39	100	uPVC	110	3.1	1.09	2.9
387	PE-101	199	0.02	200	uPVC	110	0.5	0	0
388	PE-39	261	0.75	100	uPVC	110	5.9	2.52	9.7
389	PE-325	216	0.03	100	uPVC	110	0.2	0.01	0
390	PE-08	462	1.03	50	uPVC	110	-2	18.3	39.6
391	PE-128	404	0.63	300	uPVC	110	44.6	0.79	2
392	PE-285	16	0.76	80	uPVC	110	3.8	0.21	12.8
393	PE-38	164	0.61	50	uPVC	110	1.2	2.48	15.1
394	PE-177	141	0.28	50	uPVC	110	0.6	0.51	3.6
395	PE-367	143	0.33	80	uPVC	110	1.7	0.4	2.8
396	PE-54	285	1.44	80	uPVC	110	-7.3	12.12	42.5
397	PE-305	82	0.11	100	uPVC	110	0.9	0.02	0.3
398	PE-379	167	0.19	300	uPVC	110	13.5	0.04	0.2
399	PE-31	356	1.35	80	uPVC	110	6.8	13.32	37.4
400	PE-230	41	0.18	150	uPVC	110	3.1	0.02	0.4
401	PE-04	861	1.2	50	uPVC	110	-2.4	44.87	52.1
402	PE-131	130	0.17	200	uPVC	110	5.4	0.04	0.3
403	PE-135	52	0.68	300	uPVC	110	48.3	0.12	2.3

404	PE-200	95	0.42	300	uPVC	110	29.6	0.09	0.9
405	PE-430	101	0.27	100	uPVC	110	-2.1	0.15	1.5
406	PE-99	219	0.42	150	uPVC	110	7.4	0.45	2
407	PE-242	61	0.19	150	uPVC	110	3.3	0.03	0.5
408	PE-83	60	0.14	200	uPVC	110	-4.4	0.01	0.2
409	PE-60	323	0.07	150	uPVC	110	-1.2	0.02	0.1
410	PE-178	323	0.5	80	uPVC	110	-2.5	1.94	6
411	PE-124	97	1.72	300	uPVC	110	121.3	1.21	12.5
412	PE-179	237	0.5	80	uPVC	110	2.5	1.43	6.1
413	PE-286	134	0.26	80	uPVC	110	1.3	0.24	1.8
414	PE-114	223	1.11	200	uPVC	110	35	2.01	9
415	PE-378	146	0.1	200	uPVC	110	3.1	0.02	0.1
416	PE-377	120	0.1	200	uPVC	110	3.1	0.01	0.1
417	PE-134	261	0.68	300	uPVC	110	48.3	0.59	2.3
418	PE-104	185	0.4	80	uPVC	110	2	0.72	3.9
419	PE-289	511	0.08	300	uPVC	110	5.3	0.02	0
420	PE-402	273	0.07	50	uPVC	110	0.1	0.08	0.3
421	PE-393	34	0.03	200	uPVC	110	-1	0	0
422	PE-152	80	0.23	150	uPVC	110	4.1	0.05	0.7
423	PE-403	182	0.18	200	uPVC	110	5.7	0.06	0.3
424	PE-294	209	0.37	100	uPVC	110	-2.9	0.56	2.7
425	PE-	515	0.06	50	uPVC	110	-0.1	0.11	0.2

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426	PE-314	136	0.14	100	uPVC	110	-1.1	0.06	0.4
427	PE-357	324	0.17	300	uPVC	110	11.9	0.06	0.2
428	PE-333	213	0.11	50	uPVC	110	0.2	0.14	0.7
429	PE-201	133	0.03	80	uPVC	110	0.1	0	0
430	PE-68	369	0.39	80	uPVC	110	-2	1.41	3.8
431	PE-382	111	0.23	200	uPVC	110	7.3	0.06	0.5
432	PE-212	151	0.13	150	uPVC	110	-2.3	0.04	0.2
433	PE-125	40	1.7	300	uPVC	110	120.2	0.49	12.3
434	PE-375	299	0.03	80	uPVC	110	0.2	0.01	0
435	PE-355	135	0.18	50	uPVC	110	-0.4	0.21	1.6
436	PE-421	195	0.32	100	uPVC	110	-2.5	0.4	2
437	PE-236	96	0.02	150	uPVC	110	0.3	0	0
438	PE-391	82	0.14	80	uPVC	110	-0.7	0.05	0.6
439	PE-32	56	0.41	150	uPVC	110	7.3	0.11	2
440	PE-133	162	0.7	300	uPVC	110	49.7	0.39	2.4
441	PE-11	85	0.98	50	uPVC	110	1.9	3.07	36.2
442	PE-34	223	2.93	150	uPVC	110	51.8	16.91	75.7
443	PE-199	195	0.43	300	uPVC	110	30.2	0.19	1
444	PE-197	215	0.47	300	uPVC	110	33.3	0.25	1.1
445	PE-324	148	0.1	150	uPVC	110	-1.7	0.02	0.1
446	PE-221	315	0.01	200	uPVC	110	-0.2	0	0
447	PE-18	477	2.32	80	uPVC	110	-11.6	48.7	102.1

448	PE-29	90	0.04	100	uPVC	110	0.3	0	0
449	PE-195	192	0.48	300	uPVC	110	34.1	0.23	1.2
450	PE-28	141	0.27	150	uPVC	110	-4.8	0.13	0.9
451	PE-217	179	0.35	80	uPVC	110	1.8	0.55	3.1
452	PE-215	233	0.36	300	uPVC	110	25.2	0.16	0.7
453	PE-300	215	0.42	80	uPVC	110	-2.1	0.93	4.3
454	PE-20	196	2.14	100	uPVC	110	-16.8	13.3	67.8
455	PE-360	119	0.23	50	uPVC	110	0.5	0.3	2.5
456	PE-282	167	0.28	200	uPVC	110	8.7	0.11	0.7
457	PE-392	254	0.18	200	uPVC	110	5.8	0.08	0.3
458	PE-415	161	0.26	100	uPVC	110	-2	0.22	1.3
459	PE-05	293	0.62	50	uPVC	110	-1.2	4.56	15.6
460	PE-141	114	0.66	300	uPVC	110	46.6	0.24	2.1
461	PE-35	682	2.47	150	uPVC	110	43.6	37.55	55.1
462	PE-295	218	0.06	300	uPVC	110	4.1	0.01	0
463	PE-359	11	0.16	300	uPVC	110	11	0	0.1
464	PE-320	271	0.19	100	uPVC	110	-1.5	0.21	0.8
465	PE-256	121	0.54	150	uPVC	110	-9.6	0.4	3.3
466	PE-260	325	0.3	80	uPVC	110	1.5	0.77	2.4
467	PE-207	97	0.25	80	uPVC	110	-1.3	0.16	1.7
468	PE-89	240	0.25	200	uPVC	110	-7.9	0.14	0.6
469	PE-268	167	0.44	300	uPVC	110	31.3	0.17	1
470	PE-418	532	0.26	150	uPVC	110	-4.5	0.44	0.8

471	PE-329	215	0.09	100	uPVC	110	0.7	0.04	0.2
472	PE-82	153	0.14	200	uPVC	110	-4.4	0.03	0.2
473	PE-364	157	0.2	200	uPVC	110	6.4	0.06	0.4
474	PE-419	191	0.14	200	uPVC	110	4.5	0.04	0.2
475	PE-222	321	0.29	300	uPVC	110	20.8	0.15	0.5
476	PE-396	301	0.2	200	uPVC	110	6.4	0.12	0.4
477	PE-211	60	0.02	150	uPVC	110	-0.4	0	0
478	PE-21	378	2.76	100	uPVC	110	21.7	41.11	108.9
479	PE-280	85	0.35	150	uPVC	110	6.3	0.13	1.5
480	PE-308	345	0.07	200	uPVC	110	-2.2	0.02	0.1
481	PE-64	14	0.24	200	uPVC	110	7.6	0.01	0.5
482	PE-55	30	1.44	80	uPVC	110	-7.3	1.3	42.5
483	PE-196	150	0.48	300	uPVC	110	34.1	0.18	1.2
484	PE-194	259	0.51	300	uPVC	110	36.1	0.34	1.3
485	PE-184	135	0.35	50	uPVC	110	0.7	0.72	5.3
486	PE-118	108	0.36	80	uPVC	110	1.8	0.35	3.2
487	PE-394	213	0.19	200	uPVC	110	5.8	0.07	0.3
488	PE-17	126	0.58	100	uPVC	110	-4.6	0.76	6
489	PE-153	98	0.23	150	uPVC	110	4.1	0.07	0.7
490	PE-426	215	0.21	150	uPVC	110	3.7	0.12	0.6
491	PE-363	133	0.09	50	uPVC	110	0.2	0.06	0.4
492	PE-410	57	0.04	200	uPVC	110	-1.4	0	0
493	PE-	314	0.87	50	uPVC	110	-1.7	9.04	28.8

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494	PE-198	200	0.44	300	uPVC	110	31	0.2	1
495	PE-97	170	0.06	200	uPVC	110	-2	0.01	0
496	PE-79	417	0.37	100	uPVC	110	-2.9	1.08	2.6
497	PE-172	162	0.51	80	uPVC	110	2.5	0.99	6.1
498	PE-115	108	0.05	80	uPVC	110	-0.2	0.01	0.1
499	PE-210	159	0.06	150	uPVC	110	-1	0.01	0.1
500	PE-86	70	0.21	200	uPVC	110	-6.7	0.03	0.4
501	PE-312	206	0.09	80	uPVC	110	-0.4	0.05	0.2
502	PE-116	152	0.55	80	uPVC	110	-2.7	1.07	7
503	PE-65	205	0.32	150	uPVC	110	5.6	0.25	1.2
504	PE-36	715	0.16	150	uPVC	110	2.9	0.26	0.4
505	PE-297	345	0.01	200	uPVC	110	-0.4	0	0
506	PE-126	136	1.7	300	uPVC	110	120.2	1.68	12.3
507	PE-399	100	0.06	150	uPVC	110	1	0.01	0.1
508	PE-176	100	0.11	80	uPVC	110	0.6	0.04	0.4
509	PE-224	159	0.04	200	uPVC	110	-1.3	0	0
510	EG-55	32	0.25	50	uPVC	110	0.5	0.09	2.8
511	EG-56	142	0.25	50	uPVC	110	0.5	0.39	2.8
512	EG-90	55	0.25	50	uPVC	110	0.5	0.15	2.8
513	EG-48	79	0.16	150	uPVC	110	2.8	0.03	0.3
514	EG-51	30	0.24	100	uPVC	110	1.9	0.03	1.2
515	EG-50	263	0.24	100	uPVC	110	1.9	0.31	1.2
516	EG-49	281	0.11	50	uPVC	110	0.2	0.18	0.6
517	EG-91	33	0.24	200	uPVC	110	7.4	0.02	0.5
518	PB-07	208	0.84	150	uPVC	110	14.8	1.55	7.4
519	P-1846	284	1.38	150	uPVC	110	24.4	5.34	18.8

520	P-1844	89	1.23	150	uPVC	110	21.7	1.35	15.1
521	EG-24	4	0.4	150	uPVC	110	7	0.01	1.8
522	EG-41	80	0.24	200	uPVC	110	7.4	0.04	0.5
523	EG-40	3	0.24	200	uPVC	110	7.4	0	0.5
524	EG-25	20	0.05	150	uPVC	110	-0.8	0	0
525	EG-52	34	0.24	100	uPVC	110	1.9	0.04	1.2
526	EG-59	57	0.22	150	uPVC	110	4	0.04	0.6
527	EG-58	27	0.24	150	uPVC	110	4.2	0.02	0.7
528	EG-57	54	0.24	150	uPVC	110	4.2	0.04	0.7
529	EG-60	81	0.22	150	uPVC	110	4	0.05	0.6
530	EG-72	91	0.12	80	uPVC	110	0.6	0.04	0.5
531	EG-62	152	0.22	150	uPVC	110	4	0.1	0.6
532	EG-61	65	0.22	150	uPVC	110	4	0.04	0.6
533	EG-42	25	0.16	150	uPVC	110	2.8	0.01	0.3
534	EG-47	82	0.16	150	uPVC	110	2.8	0.03	0.3
535	EG-89	95	0.24	100	uPVC	110	1.9	0.11	1.2
536	EG-53	27	0.24	100	uPVC	110	1.9	0.03	1.2
537	EG-46	70	0.16	150	uPVC	110	2.8	0.02	0.3
538	EG-43	63	0.16	150	uPVC	110	2.8	0.02	0.3
539	EG-44	45	0.16	150	uPVC	110	2.8	0.02	0.3
540	EG-45	73	0.16	150	uPVC	110	2.8	0.03	0.3
541	P-1839	351	0.89	200	uPVC	110	27.9	2.07	5.9
542	ED-44	183	0	80	uPVC	110	0	0	0
543	PE-488	141	0.13	200	uPVC	110	4.1	0.02	0.2
544	PE-502	70	0.13	100	uPVC	110	-1	0.03	0.4
545	PE-485	254	0.19	100	uPVC	110	1.5	0.2	0.8
546	PE-228	123	0.21	300	uPVC	110	-14.7	0.03	0.3
547	PE-462	401	0.74	200	uPVC	110	23.2	1.69	4.2
548	PE-440	404	0.57	150	uPVC	110	10	1.46	3.6
549	ED-42	733	0	150	uPVC	110	0	0	0

550	PE-500	209	0.63	50	uPVC	110	1.2	3.33	16
551	PE-498	48	0.22	80	uPVC	110	1.1	0.07	1.4
552	PE-501	36	0.32	50	uPVC	110	0.6	0.16	4.4
553	PE-483	282	0.97	150	uPVC	110	-17.1	2.73	9.7
554	PE-472	483	0.35	100	uPVC	110	-2.8	1.16	2.4
555	PE-471	273	0.77	80	uPVC	110	3.9	3.61	13.2
556	ED-39	284	0	200	uPVC	110	0.1	0	0
557	PE-226	208	0.27	300	uPVC	110	19.2	0.09	0.4
558	P-1840	18	0.89	200	uPVC	110	27.9	0.11	5.9
559	PB-18	403	0.84	150	uPVC	110	14.8	3	7.4
560	PB-19	327	0.84	150	uPVC	110	14.8	2.44	7.4
561	P-1842	184	0.89	200	uPVC	110	27.9	1.09	5.9
562	P-1833	58	0.89	200	uPVC	110	27.9	0.34	5.9
563	P-1847	126	1.23	150	uPVC	110	21.7	1.91	15.1
564	P-1838	181	0.89	200	uPVC	110	27.9	1.07	5.9
565	P-1836	324	0.89	200	uPVC	110	27.9	1.92	5.9
566	P-1835	240	0.89	200	uPVC	110	27.9	1.42	5.9
567	P-1837	215	0.89	200	uPVC	110	27.9	1.28	5.9
568	P-1834	141	0.89	200	uPVC	110	27.9	0.83	5.9
569	P-1841	208	0.81	200	uPVC	110	25.6	1.05	5.1
570	P-1843	675	1.23	150	uPVC	110	21.7	10.2	15.1
571	PB-14	434	0.84	150	uPVC	110	14.8	3.23	7.4

572	P-1832	21	0.89	200	uPVC	110	27.9	0.12	5.9
573	PB-16	616	0	200	uPVC	110	0	0	0
574	P-812	392	1.38	100	uPVC	110	10.8	11.82	30.1
575	P-811	232	0.66	100	uPVC	110	5.2	1.77	7.6
576	PB-11	753	0	200	uPVC	110	0	0	0
577	PE1-450	226	0.14	100	uPVC	110	1.1	0.1	0.4
578	P-1758	196	0.04	200	uPVC	110	1.1	0	0
579	PB-15	458	0.84	150	uPVC	110	14.8	3.41	7.4
580	P-1819	270	0.32	150	uPVC	110	5.6	0.33	1.2
581	P-1822	306	0.32	150	uPVC	110	-5.6	0.37	1.2
582	PB-03	371	0	80	uPVC	110	0	0	0
583	PB-02	443	0	200	uPVC	110	0	0	0
584	PB-01	121	0	200	uPVC	110	0	0	0
585	PB-06	458	0	100	uPVC	110	0	0	0
586	PB-05	275	0	100	uPVC	110	0	0	0
587	PB-04	407	0	80	uPVC	110	0	0	0
588	PB-10	808	0	100	uPVC	110	0	0	0
589	PB-13	447	0	100	uPVC	110	0	0	0
590	EG-80	57	0.2	100	uPVC	110	1.6	0.05	0.9
591	EG-79	79	0.23	100	uPVC	110	1.8	0.09	1.1
592	EG-67	68	0.17	80	uPVC	110	0.8	0.05	0.8
593	EG-68	59	0.17	80	uPVC	110	0.8	0.05	0.8
594	EG-70	24	0.12	80	uPVC	110	0.6	0.01	0.5
595	EG-69	57	0.17	80	uPVC	110	0.8	0.04	0.8
596	EG-78	801	0.17	80	uPVC	110	0.9	0.67	0.8
597	EG-66	110	0.17	80	uPVC	110	0.8	0.09	0.8
598	EG-81	166	0.2	100	uPVC	110	1.6	0.14	0.9
599	EG-77	133	0.14	80	uPVC	110	-0.7	0.07	0.5
600	EG-73	97	0.12	80	uPVC	110	0.6	0.04	0.5
601	EG-88	223	0.25	50	uPVC	110	0.5	0.61	2.8
602	EG-65	30	0.22	150	uPVC	110	4	0.02	0.6
603	EG-64	116	0.22	150	uPVC	110	4	0.08	0.6

604	EG-74	53	0.13	80	uPVC	110	0.7	0.03	0.5
605	EG-71	57	0.12	80	uPVC	110	0.6	0.03	0.4
606	PB-09	436	0	80	uPVC	110	0	0	0
607	EG-76	9	0.09	80	uPVC	110	0.4	0	0.2
608	EG-75	56	0.13	80	uPVC	110	0.7	0.03	0.5
609	EG-63	48	0.22	150	uPVC	110	4	0.03	0.6
610	P-806	235	0.64	200	uPVC	110	20	0.75	3.2
611	P-808	32	0.61	200	uPVC	110	19	0.09	2.9
612	PE-433	229	0.23	150	uPVC	110	4	0.15	0.7
613	PE-204	61	0.05	80	uPVC	110	0.3	0.01	0.1
614	PE-37	103	1.91	200	uPVC	110	-59.9	2.51	24.5
615	PE-69	361	0.56	50	uPVC	110	1.1	4.62	12.8
616	PE-261	326	0.16	80	uPVC	110	-0.8	0.24	0.7
617	PE-145	124	0.2	200	uPVC	110	-6.2	0.04	0.4
618	PE-288	300	0.12	80	uPVC	110	-0.6	0.11	0.4
619	PE-275	603	0.38	150	uPVC	110	6.7	1.04	1.7
620	PE-293	20	0.37	100	uPVC	110	-2.9	0.05	2.7
621	PE-57	301	0.51	50	uPVC	110	1	3.26	10.8
622	PE-63	129	1.32	300	uPVC	110	93.5	1	7.7
623	PE-409	176	0.01	200	uPVC	110	-0.3	0	0
624	PE-290	130	0.6	100	uPVC	110	4.7	0.83	6.4
625	PE-10	52	0.98	50	uPVC	110	1.9	1.89	36.2
626	PE-354	154	0.18	300	uPVC	110	-13	0.03	0.2
627	PE-299	208	0.17	80	uPVC	110	-0.8	0.16	0.8
628	PE-429	98	0.17	100	uPVC	110	-1.3	0.06	0.6
629	ED-37	120	0	250	uPVC	110	0	0	0
630	PE-	28	0.16	100	uPVC	110	1.3	0.02	0.6

	449								
631	ED-52	647	0	80	uPVC	110	0	0	0
632	PE-475	357	0.54	100	uPVC	110	-4.2	1.89	5.3
633	PE-445	215	1.07	150	uPVC	110	18.9	2.52	11.7
634	PE-495	172	0.04	150	uPVC	110	-0.8	0.01	0
635	ED-43	739	0	100	uPVC	110	0	0	0
636	PE-439	298	1.43	80	uPVC	110	7.2	12.47	41.8
637	PE-110	197	0.19	80	uPVC	110	1	0.2	1
638	PE-175	116	0.19	80	uPVC	110	0.9	0.11	1
639	PE-12	87	0.98	50	uPVC	110	1.9	3.16	36.2
640	PE-19	188	1.02	80	uPVC	110	5.1	4.21	22.4
641	PE-254	193	0.43	50	uPVC	110	-0.9	1.54	8
642	PE-87	110	0.21	200	uPVC	110	-6.7	0.05	0.4
643	PE-276	179	2.07	50	uPVC	110	4.1	25.75	143.9
644	PE-321	255	0.1	200	uPVC	110	3.3	0.03	0.1
645	PE-235	270	0.26	150	uPVC	110	-4.6	0.23	0.9
646	PE-61	364	0.79	150	uPVC	110	-14	2.44	6.7
647	PE-84	53	0.15	200	uPVC	110	-4.8	0.01	0.2
648	PE-46	50	1.01	200	uPVC	110	-31.6	0.37	7.5
649	PE-271	182	0.62	150	uPVC	110	11	0.79	4.3
650	PE-395	89	0.16	200	uPVC	110	4.9	0.02	0.2
651	PE-70	383	0.74	100	uPVC	110	-5.8	3.6	9.4
652	PE-398	191	0.07	200	uPVC	110	2.3	0.01	0.1
653	PE-262	344	0.63	80	uPVC	110	-3.2	3.14	9.1
654	PE-16	190	1.03	150	uPVC	110	-18.3	2.09	11

655	PE-231	44	0.18	150	uPVC	110	3.1	0.02	0.4
656	PE-202	196	0.31	80	uPVC	110	-1.5	0.47	2.4
657	PE-279	519	0.88	100	uPVC	110	6.9	6.85	13.2
658	PE-259	85	0.57	80	uPVC	110	2.8	0.64	7.5
659	PE-108	226	0.41	100	uPVC	110	3.2	0.73	3.2
660	PE-400	45	0.06	150	uPVC	110	1	0	0
661	PE-405	248	0.04	50	uPVC	110	0.1	0.02	0.1
662	PE-51	182	0.46	80	uPVC	110	-2.3	0.93	5.1
663	PE-311	239	0.03	200	uPVC	110	1.1	0	0
664	PE-48	23	0.88	300	uPVC	110	61.9	0.08	3.6
665	PE-07	87	0.96	50	uPVC	110	-1.9	2.96	34.2
666	PE-40	125	1.1	100	uPVC	110	-8.7	2.48	19.9
667	PE-322	214	0.14	100	uPVC	110	1.1	0.09	0.4
668	PE-23	153	1.27	100	uPVC	110	-10	3.97	25.9
669	PE-49	447	0.87	300	uPVC	110	61.2	1.57	3.5
670	PE-273	470	0.18	150	uPVC	110	-3.2	0.21	0.4
671	PE-209	66	0.23	80	uPVC	110	1.1	0.09	1.4
672	PE-149	142	0.41	150	uPVC	110	7.2	0.28	2
673	PE-53	139	1.09	80	uPVC	110	-5.5	3.53	25.3
674	PE-422	266	0.26	200	uPVC	110	-8.1	0.16	0.6
675	PE-27	46	1.48	100	uPVC	110	-11.6	1.59	34.3
676	PE-514	46	0.25	150	uPVC	110	4.5	0.04	0.8
677	PE-493	351	0.09	150	uPVC	110	1.6	0.04	0.1
678	PE-496	135	0.04	150	uPVC	110	-0.8	0	0

679	PE-447	89	0.46	150	uPVC	110	8.1	0.22	2.5
680	PE-460	400	0.75	200	uPVC	110	-23.6	1.74	4.3
681	PE-480	625	0.19	80	uPVC	110	0.9	0.61	1
682	PE-516	178	0.43	100	uPVC	110	3.4	0.62	3.5
683	PE-456	203	0.89	200	uPVC	110	28.1	1.22	6
684	PE-478	69	1.01	80	uPVC	110	5.1	1.5	21.9
685	ED-49	867	0	100	uPVC	110	0	0	0
686	PE-438	180	1.43	80	uPVC	110	7.2	7.51	41.8
687	PE-453	333	0.01	100	uPVC	110	-0.1	0	0
688	PE-436	214	0.23	150	uPVC	110	4	0.14	0.7
689	PE-452	432	0.26	100	uPVC	110	2	0.57	1.3
690	PE-511	112	0.25	150	uPVC	110	4.5	0.09	0.8
691	PE-442	464	0.08	100	uPVC	110	-0.7	0.08	0.2
692	PE-435	38	0.23	150	uPVC	110	4	0.03	0.7
693	ED-40	257	0	200	uPVC	110	0.1	0	0
694	PE-503	134	0.13	100	uPVC	110	-1	0.05	0.4
695	PE-512	125	0.25	150	uPVC	110	4.5	0.1	0.8
696	PE-517	194	0.4	100	uPVC	110	3.2	0.6	3.1
697	PE-492	149	0.07	200	uPVC	110	2.2	0.01	0.1
698	PE-491	22	0.04	100	uPVC	110	0.3	0	0.1
699	ED-38	42	0	200	uPVC	110	0.1	0	0
700	PE-	384	0.14	150	uPVC	110	-2.4	0.1	0.3

	497								
701	PE-490	52	0.11	100	uPVC	110	0.9	0.01	0.3
702	PE-457	131	0.18	200	uPVC	110	5.5	0.04	0.3
703	PE-446	388	0.54	150	uPVC	110	-9.6	1.28	3.3
704	PE-448	196	0.61	100	uPVC	110	-4.8	1.3	6.6
705	PE-444	462	0.23	150	uPVC	110	4	0.3	0.7
706	PE-487	59	0.13	200	uPVC	110	4.1	0.01	0.2
707	PE-481	103	0.32	80	uPVC	110	-1.6	0.26	2.6
708	PE-506	109	0.35	100	uPVC	110	-2.8	0.26	2.4
709	PE-437	65	0.32	150	uPVC	110	5.6	0.08	1.2
710	PE-473	691	0.61	80	uPVC	110	-3	5.89	8.5
711	ED-48	276	0	100	uPVC	110	0	0	0
712	PE-459	343	0.63	150	uPVC	110	11.2	1.53	4.5
713	PE-434	214	0.23	150	uPVC	110	4	0.14	0.7
714	PE-474	449	0.26	80	uPVC	110	1.3	0.77	1.7
715	PE-441	417	0.71	150	uPVC	110	12.5	2.28	5.5
716	PE-489	91	0.18	100	uPVC	110	1.4	0.06	0.7
717	PE-454	398	0.55	80	uPVC	110	2.8	2.82	7.1
718	PE-510	71	0.25	150	uPVC	110	4.5	0.06	0.8
719	PE-477	230	1.01	80	uPVC	110	5.1	5.03	21.9
720	PE-451	206	0.35	50	uPVC	110	0.7	1.11	5.4

721	PE-482	237	0.38	100	uPVC	110	-3	0.64	2.7
722	PE-443	433	0.49	100	uPVC	110	3.8	1.9	4.4
723	PE-458	254	0.53	200	uPVC	110	16.5	0.57	2.2
724	PE-499	42	0.63	50	uPVC	110	1.2	0.68	16
725	PE-505	190	0.3	100	uPVC	110	-2.4	0.34	1.8
726	ED-45	108	0	80	uPVC	110	0	0	0
727	ED-47	378	0.01	100	uPVC	110	0.1	0	0
728	PE-476	338	0.88	100	uPVC	110	-6.9	4.39	13
729	PE-504	134	0.13	100	uPVC	110	-1	0.05	0.4
730	PE-479	49	0.19	80	uPVC	110	0.9	0.05	1
731	PE-494	240	0.09	150	uPVC	110	1.6	0.03	0.1
732	ED-36	266	0	250	uPVC	110	0	0	0
733	ED-41	286	0	200	uPVC	110	0.1	0	0
734	PE-450	206	0.26	100	uPVC	110	-2	0.28	1.4
735	PE-513	108	0.25	150	uPVC	110	4.5	0.09	0.8
736	PE-518	98	0.35	100	uPVC	110	2.7	0.23	2.4
737	ED-50	429	0.01	100	uPVC	110	0.1	0	0
738	PE-515	135	0.46	100	uPVC	110	3.6	0.53	3.9
739	PE-370	258	0.19	150	uPVC	110	3.3	0.12	0.5
740	PE-238	433	0.08	300	uPVC	110	5.4	0.02	0
741	PE-62	715	0.77	200	uPVC	110	-24.1	3.23	4.5
742	PE-67	163	0.14	100	uPVC	110	1.1	0.07	0.4
743	PE-100	26	0.42	150	uPVC	110	7.4	0.05	2
744	PE-	100	0.73	100	uPVC	110	5.7	0.92	9.2

	171								
745	PE-22	541	3.11	80	uPVC	110	-15.6	95.41	176.3
746	PE-407	247	0.06	80	uPVC	110	-0.3	0.03	0.1
747	PE-88	301	0.23	200	uPVC	110	-7.2	0.15	0.5
748	PE-411	62	0.39	50	uPVC	110	-0.8	0.4	6.4
749	PE-180	343	0.33	80	uPVC	110	1.6	0.92	2.7
750	PE-137	351	0.63	300	uPVC	110	44.6	0.69	2
751	PE-380	118	0.19	300	uPVC	110	13.3	0.02	0.2
752	PE-385	261	0.13	80	uPVC	110	0.7	0.14	0.5
753	PE-243	333	0.46	150	uPVC	110	8	0.8	2.4
754	PE-73	296	0.62	80	uPVC	110	3.1	2.66	9
755	PE-332	161	0.15	100	uPVC	110	1.2	0.08	0.5
756	PE-146	174	0.59	300	uPVC	110	41.9	0.3	1.7
757	PE-265	470	0.04	200	uPVC	110	1.2	0.01	0
758	PE-122	486	0.79	80	uPVC	110	-4	6.72	13.8
759	PE-417	117	0.06	80	uPVC	110	-0.3	0.01	0.1
760	PE-274	284	0.24	150	uPVC	110	-4.3	0.22	0.8
761	PE-13	89	0.98	50	uPVC	110	1.9	3.24	36.2
762	PE-59	355	0.6	100	uPVC	110	4.7	2.31	6.5
763	PE-208	53	0.23	80	uPVC	110	1.1	0.07	1.4
764	PE-132	249	0.3	200	uPVC	110	9.3	0.19	0.8
765	PE-213	180	0.16	150	uPVC	110	-2.8	0.06	0.3
766	PE-142	86	0.7	300	uPVC	110	49.5	0.21	2.4

767	PE-257	329	0.16	150	uPVC	110	-2.8	0.11	0.3
768	PE-287	166	0.37	150	uPVC	110	-6.5	0.27	1.6
769	PE-143	377	0.7	300	uPVC	110	49.5	0.9	2.4
770	PE-374	294	0.08	150	uPVC	110	1.5	0.03	0.1
771	PE-234	565	0.08	300	uPVC	110	5.9	0.03	0
772	PE-109	242	0.25	80	uPVC	110	-1.2	0.38	1.6
773	PE-02	874	1.17	40	uPVC	110	1.5	56.78	65
774	PE-307	153	0.12	200	uPVC	110	3.7	0.02	0.1
775	PE-413	191	0.13	80	uPVC	110	0.6	0.09	0.5
776	PE-103	230	0.24	150	uPVC	110	4.2	0.16	0.7
777	PE-253	249	0.51	150	uPVC	110	-9.1	0.75	3
778	PE-111	80	0.1	80	uPVC	110	0.5	0.02	0.3
779	PE-404	509	0.07	150	uPVC	110	1.2	0.04	0.1
780	PE-01	312	1.34	100	uPVC	110	10.5	8.94	28.6
781	PE-390	250	0.14	200	uPVC	110	-4.4	0.05	0.2
782	PE-170	100	1.1	100	uPVC	110	8.6	1.96	19.6
783	PE-296	11	0.12	200	uPVC	110	3.7	0	0.1
784	PE-52	191	0.46	80	uPVC	110	-2.3	0.97	5.1
785	PE-148	59	0.41	150	uPVC	110	7.2	0.12	2
786	PE-335	89	0.06	100	uPVC	110	0.4	0.01	0.1
787	PE-264	363	0.21	200	uPVC	110	6.7	0.15	0.4
788	PE-	150	0.07	50	uPVC	110	-0.1	0.04	0.3

	318								
789	PE-206	72	0.03	80	uPVC	110	0.1	0	0
790	PE-316	112	0.04	200	uPVC	110	-1.3	0	0
791	PE-313	242	0.09	150	uPVC	110	-1.7	0.03	0.1
792	PE-123	112	1.72	300	uPVC	110	121.3	1.4	12.5
793	PE-112	97	0.1	80	uPVC	110	0.5	0.03	0.3
794	PE-218	426	0.01	200	uPVC	110	0.3	0	0
795	PE-373	217	0.25	80	uPVC	110	1.2	0.35	1.6
796	PE-361	11	0.23	50	uPVC	110	0.5	0.03	2.5
797	PE-56	505	0.71	150	uPVC	110	-12.6	2.79	5.5
798	PE-338	144	0.31	150	uPVC	110	-5.5	0.17	1.2
799	PE-428	380	0.11	80	uPVC	110	0.5	0.13	0.3
800	PE-381	68	0.19	300	uPVC	110	13.3	0.01	0.2