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UNIVERSITÉ D'OTTAWA
UNIVERSITY OF OTTAWA

STORM SEWER JUNCTION GEOMETRY
AND RELATED ENERGY LOSSES

BY

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Submitted in partial fulfillment
of the requirements for the degree
of Master of Applied Science

Department of Civil Engineering
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Ottawa, Ontario
December 1975.

1

RESUME

Very little has been written about energy losses at junctions in sewer systems with circular pipes flowing partly full. Designers of sewer systems have made use of Hind's results (14)* and rules of thumb which take into account the number of pipes and the angles at which these pipes join at a junction to ensure the satisfactory performance of such sewer systems. The reason for making this study of storm sewer junction geometry and related energy losses was to provide designers with some information on this subject.

It is known that some junctions in existing systems fail to perform satisfactorily. Model tests conducted for the Borough of Scarborough suggested that alterations of the junction geometry, which could be accomplished simply in the field, could improve the junction hydraulics and hence the performance of the entire sewer system. The author was encouraged to study this subject due to the strong interest shown in this topic by Dr. D.R. Townsend, P.Eng., Department of Civil Engineering, University of Ottawa and W.J. Warwick, P.Eng., Director of Engineering for the Borough of Scarborough.

* see list of references listed at the end of thesis

The study was divided into three parts, namely:

- (1) to prepare a complete list of references on the subject of sewer junction energy losses, (2) to determine what effect junction geometry has on energy losses and, (3) to test junctions with different geometries, in order to obtain the most suitable configuration with respect to achieving minimum energy loss.

The second and third parts of the study were investigated with the aid of a physical model having a scale of 1:9.16. The model was assembled in the hydraulic laboratory of the University of Ottawa. The junction type chosen for the study was the common "main with single lateral" junction, where the main flow in passing directly through the junction box is augmented by the additional flow in the lateral. The program of tests consisted of a total of 268 separate experiments of which 210 were conducted on a 45° lateral and 58 on a 90° lateral. Energy loss coefficients were calculated for each junction geometry considered. In addition, backwater effects and power losses at the junction were evaluated.

The principal findings can be summarized as follows:

- (1) the recommended junction design practice of using channels of U-shaped cross-section resulted in minimum energy loss
- (2) the open junction box (with no finishing) resulted in the highest energy loss

(3) the presence of an invert joining the main inlet and outlet through the junction and a sidewall was effective in reducing energy loss

(4) hinged flow deflectors were not helpful in reducing losses in the 45° junction but were effective in the case of the 90° junction

(5) flow rate and the lateral to main flow ratio affect the energy loss coefficients

(6) increasing the junction length was not effective in reducing energy losses

(7) an abrupt or smooth drop provided through the junction between the inlet and outlet pipes was effective in reducing the energy loss and the backwater effect

(8) power losses were greater when an abrupt or smooth drop was provided through the junction

(9) the lost power ratio increased with increasing pipe slope

The importance of these findings can be summarized as follows:

(1) Designers are further encouraged to adopt the recommended design practice of specifying U-shaped channel cross-sections in junctions.

(2) Junction boxes should be kept as short as possible. In the model tests, the shorter overall length of junction gave reduced energy losses. The idea of lengthening the junction box is not recommended as there will be an increase in energy loss.

(3) The importance of providing a smooth or abrupt drop through the manhole was clearly demonstrated by the reduced energy losses and backwater effects in the presence of same. Proper provision of such a drop in the structure ensures efficient conveyance of flows.

(4) Curves are presented indicating how the energy loss coefficient varies with a varying lateral inflow.

DEDICATION

*To the people who lived near
Musa Dagh: their courage is
never forgotten.*

PREFACE

Very little has been written about energy losses at junctions in sewer systems with circular pipes flowing partly full. Designers of sewer systems have made use of Hind's results (14)* and rules of thumb which take into account the number of pipes and the angles at which these pipes join at a junction to ensure the satisfactory performance of such sewer systems. The reason for making this study of storm sewer junction geometry and related energy losses was to provide designers with some information on this subject.

It is known that some junctions in existing systems fail to perform satisfactorily. Model tests conducted for the Borough of Scarborough suggested that alterations of the junction geometry, which could be accomplished simply in the field, could improve the junction hydraulics and hence the performance of the entire sewer system. The author was encouraged to study this subject due to the strong interest shown in this topic by Dr. D.R. Townsend, P.Eng., Department of Civil Engineering, University of Ottawa and W.J. Warwick, P.Eng., Director of Engineering for the Borough of Scarborough.

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NOTATION

THE FOLLOWING SYMBOLS ARE USED IN THIS THESIS

SYMBOLSDIMENSIONS

A1	area of flow in the outlet	L^2
A2	area of flow in the lateral	L^2
A3	area of flow in the main	L^2
C	head loss coefficient, equation (2.1) (used by Ackers)	
CP	pitot tube calibration coefficient, equation (4.13)	
C·E·L·J	combined energy loss coefficient, equation (3.10)	
DP1	outlet pipe diameter	L
DP2	lateral pipe diameter	L
DP3	main pipe diameter	L
DR	ratio of depth immediately upstream from the junction box to the diameter of the upstream pipe	
D1	outlet flow depth	L
D2	lateral flow depth	L
D3	main flow depth	L
D1C	critical outlet flow depth	L
D3N	normal main flow depth	L
E	value of the energy grade line at a point, equation (2.6)	
E·G·L	energy grade line	L
ΔE·G·L	difference in energies or E·G·L	L
E·L	energy loss, equation (2.1)	L
E·L·J	energy loss at the junction, (3.1)	L
E3P	main specific energy at the junction, equation (3.4)	L
E1P	outlet specific energy at the junction, equation (3.4)	L
E3B	main energy line at the branch point	L
E1B	outlet energy line at the branch point	L
E2B	lateral energy line at the branch point	L
Ff	form loss due to wall friction, equation (3.6)	L
Fr	Froude number	
g	gravitational constant 980.6 cm/sec ²	L/T^2
H·G·L	hydraulic grade line	L
HR	hydraulic radius	L

SYMBOLSDIMENSIONS

HT	head loss or energy loss	L
Δh	change in the water surface	L
JUNCB	branch point see figure 3-1	L
JUNC1	horizontal location see figure 3-1	L
JUNC2	horizontal location see figure 3-1	L
JUNC3	horizontal location see figure 3-1	L
K	energy loss coefficient used by Hinds, Camp, Gharghourl	
K3	main loss coefficient relative to outlet velocity head, equation (3.13)	
K3M	main loss coefficient relative to main velocity head, equation (3.14)	
K2	lateral loss coefficient relative to outlet velocity head, equation (3.11)	
K2L	lateral loss coefficient relative to outlet velocity head, equation (3.12)	
KC	combined energy loss coefficient, equation (2.11)	
L·E·L·J·	lateral energy loss at the junction, equation (3.9)	L
L·P·R·	loss power ratio, equation (3.22)	L
L	length of the junction box	L
LMANDR	drop of invert elevation of the lateral pipe through the junction	L
MMANDR	drop of invert elevation of the main pipe through the junction	L
M·E·L·J·	main energy loss at the junction, equation (3.8)	L
M	momentum, equation (3.28)	ML/T
M1C	momentum at critical depth	ML/T ²
M3N	momentum at normal depth	ML/T ²
N1	horizontal location of downstream reference point	L
N2	horizontal location of lateral reference point	L
N3	horizontal location of main reference point	L
n	Manning's friction coefficient, equation (4.3)	$L^{\frac{1}{6}}$
P	power, equation (2.6)	ML ² /T ²
PR	ratio of power lost to power entering the junction (L·P·R·)	
Q	total discharge (QL + QM), equivalent to Q1	L ³ /T
QL	lateral discharge, equivalent to Q2	L ³ /T
QM	main discharge, equivalent to Q3	L ³ /T
QL/QM	relative discharge (QR)	

SYMBOLSDIMENSIONS

QM/Q	relative main discharge	
QL/Q	relative lateral discharge	
QR	relative discharge or flow rate (QL/QM)	
Qj	direct inlet flow, equation (2.14)	L^3
Qp	prototype discharge	L^3/T
Qm	model discharge	L^3/T
Re	Reynolds number	
R	pipe radius	L
ds/dt	change of water storage in the junction	L/T
S1	outlet pipe slope	
S2	lateral pipe slope	
S3	main pipe slope	
V	average velocity	L/T
V1	i) average uniform flow outlet velocity, equation (2.7)	L/T
	ii) average outlet velocity	
V2	average lateral velocity	L/T
V3	average main velocity	L/T
Vp	prototype velocity	L/T
Vm	model velocity	L/T
W	width of the junction	L
X1	length number (see chapter 4.1)	
X2	flow area number (see chapter 4.1)	
X3	main drop number (see chapter 4.1)	
X4	lateral drop number (see chapter 4.1)	
X5	pipe ratio number (see chapter 4.1)	
X6	angle number (see chapter 4.1)	
X7	slope number (see chapter 4.1)	
X8	slope number (see chapter 4.1)	
X9	slope number (see chapter 4.1)	
X10	lateral flow rate number (see chapter 4.1)	
X11	main flow rate number (see chapter 4.1)	
ΔY	change in the water surface elevation through the junction	L
y	invert drop, equation (2.2) (=Z)	L
Z	invert drop through the junction	L
ΔZ3	invert drop, see figure 3-1	L
ΔZ1	invert drop, see figure 3-1	L
Z1	outlet pipe invert	L
Z2	lateral pipe invert	L
Z3	main pipe invert	L
Δ	difference between or change	
α	velocity distribution or energy coefficient, equation (3.1)	
γ	specific weight of water	M/L ² T ²

SYMBOLSDIMENSIONS

θ	the angle of convergence between center- line of the main and the lateral pipe	degrees
μ	dynamic viscosity	M/LT
ρ	density of water	M/L ³
λ	scale ratio	

CHAPTER 1

INTRODUCTION

The hydraulic design of storm sewer junction structures requires the calculation of energy losses, (and associated backwater effects in the vicinity of the junction), to provide adequate flow capacity and hence prevent possible surcharging in the sewer system.

Some junctions are known to be hydraulically inadequate under certain flow conditions often due to backwater effects. Model tests done for the Borough of Scarborough (12)¹ suggested that simple structural alterations to ineffective junctions would improve the efficiency of same and hence the performance of the entire sewer system.

This conclusion, and the fact that very little research on junction design and performance has been done to date, encouraged the author to undertake this particular study.

The subject matter of this thesis is presented in the following order: chapter two presents the available literature on research related to energy losses at junctions including both "open channel" and "pipe full" flow conditions, but with emphasis on the former. The literature indicated that altering the junction geometry had been tried before with some success for the "pipe full" flow condition and for one existing storm sewer junction under open channel flow conditions.

¹ Numerals in parentheses refer to corresponding items in the List of References, page 129

The Thompson equation (31) equation (2.8) in the text, was developed using conservation of momentum principles to take into account the effect of invert drop on the water surface profile with a main and lateral flow. Other researchers developed depth prediction equations for junction flows, or energy loss coefficient equations for varying flows, velocities and junction angle. Because sewer designers need to know the elevation of the energy grade line (E.G.L.) and the hydraulic grade line (H.G.L.) throughout the system, knowledge of the losses at junctions is important. The second part of chapter two describes how these grade lines are calculated.

In chapter three is presented the theory used to calculate energy and power losses and the methods used by municipalities to design their storm sewer junctions. The calculated loss is based on the analysis suggested by T.R. Camp (8) using the specific energy concept and by Lorah (23) using an extended energy grade line. Five energy loss coefficients were calculated: the lateral energy loss coefficient (K_2) and the main energy loss coefficient (K_3) with respect to the outlet velocity head, the lateral energy loss coefficient (K_{2L}) and the main energy loss coefficient (K_{3M}) with respect to their respective inlet velocity heads, and the combined energy loss coefficient K_C , a loss coefficient which sums the lateral and main energy loss coefficient according to the fraction of

total flow that is in each of the two inlet pipes. Power loss is analyzed by means of the lost power ratio which is a dimensionless formulation of the power loss divided by the power input to the junction.

With regards to the procedures adopted by municipalities, the Denver Colorado Manual (41) is the most up to date, complete guide in storm drainage design.

In chapter four can be found the details of the hydraulic model approach used in this study. Using dimensional analysis on those parameters that define the hydraulics of the junction, a relationship is defined between the energy loss coefficient (K) and eleven dimensionless numbers. Because "scale effects" cannot be evaluated without some prototype tests, using the model results must necessarily include some engineering judgement.

From a supply tank, water was continually circulated through the model pipe system. Two water supply header boxes measured, by means of a weir, the respective discharges in the main and lateral pipes. The distance from the main header box to the junction was 6.5 meters and from the lateral header box to the junction was 5.5 meters. The header boxes were made of plywood, whereas the rest of the system was made of clear acrylic plastic to facilitate measurement of the water surface profiles in same. The water surface profile was recorded using a bank of 30 piezometers fixed to a single board and four

pointer gauges. Using a pitot tube, calibrated at the Canada Center of Inland Waters, measurements were made of the velocity profile at four stations upstream of the junction to check the uniformity of the flow and compute the energy correction coefficient (α). Nine different junction geometries were studied. The dimensions of the various geometric configurations are presented in the figures in chapter four.

Chapter five concerns itself with the experimental methodology, the type of data collected and the results of the velocity traverses. The experiments were conducted in the classical way by changing one variable at a time, keeping the others constant. The main flow rate was chosen to create a water surface backwater profile in the lateral upstream of the junction. The flow in the lateral was such that both pipes were in a design flow condition. The energy correction coefficient " α " was found to be sufficiently close to 1.0 to make the assumption $\alpha = 1.0$ valid for energy line calculation purposes.

Chapter six presents the results of the experimental program. The results are discussed under the headings of junction type, flow rate, manhole drop and manhole length, backwater effects and power loss.

Three criteria are used to judge the performance of the junction box: (i) the minimum energy loss, (ii) the least backwater effect and (iii) the lowest power losses. The test

results indicate that the optimal junction box was consistently the U-shaped channel configuration. The open junction box, (i.e. a box with no refinements and a storage volume used to trap sediment) resulted in the highest energy loss. In practice, junction boxes are frequently open for one reason or another.

A varying lateral flow rate has the effect of giving a non-linear relationship between "KC" the combined energy loss coefficient and (Q_L/Q_M) the relative flow rate.

The provision of an invert drop across the junction box decreased the depth of flow in the pipes upstream from the junction, hence providing additional flow capacity in the system, and preventing the junction from "choking" the design flow. Test results indicated that as the junction box decreased in length, the energy loss coefficient decreased also.

A greater percentage of the power entering the junction was lost when the invert drop across the junction was greater than zero. The lost power ratio (L.P.R.) increased with increasing pipe slope.

Chapter seven summarizes the conclusions. Designers are encouraged to adopt the recommended practice of specifying U-shaped channel cross-sections in storm sewer junctions since this type was shown in these tests to reduce energy losses. The practice of making junction boxes as short as possible appears to be good economic and hydraulic practice. Results showed that of the three lengths tested, the shortest box

length had associated with it the lowest energy losses. Lengthening the junction box to improve the hydraulics is not recommended as it will lead to higher energy losses and increased costs. The importance of providing an invert drop through the manhole is evident from the reduced backwater effects and the increased flow capacity available.

Further references on related topics can be found in appendix B. A review of recent literature on storm water management is given in appendix D.

CHAPTER 2

LITERATURE REVIEW

2.1 Energy Losses At Junctions

To the author's knowledge very little has been written about energy losses at junctions in a sewer system with circular pipes flowing partly full. No study has been made with the specific aim of providing the designer of sewer system junctions with empirical data on energy losses. Despite the fact that almost all investigators recommend that model studies be done for large junctions, again the author could not locate any reports on this subject.

In the literature search, use was made of the CAN-S-DI computerized information retrieval system at the National Science Library in Ottawa, Ontario, Canada. In addition, the usual periodicals and indexes were consulted (see Appendix B).

The most complete study on pressure changes in pipes flowing full (35) concluded that ".... the most pressing need for further study involves the investigation of pipes flowing partly full" (page 81 of (35)) and "..... at angles other than 90° with the junction wall" (page 81 of (35)). The following recommendations appear in

more recent publications: under "suggestion for further research":.... " an investigation of the significance of energy losses at side entry pits, junctions, and bends on the design diameters of individual pipes" (page 88 of (13)); in "Design of storm water sewers by nonlinear programming", the analysis ".... neglected the hydraulic losses at the junction"...." (page 6 of (20)) due to lack of data; McCormick stated: "further research into the subject of manhole energy losses would be of considerable assistance to designers" (page 14 of (26)).

The following discussion of various reports deals only with energy losses in storm sewers or models of storm sewers.

The only field study was done in England in 1959 (2) with 15.2 cm (6 in.) diameter smooth pipes at invert slopes of approximately 1.5%. Lateral flows were not considered. Manometers were installed 915 cm (3.0 ft) upstream and downstream from each of the four manholes tested. To the measured hydraulic grade line (H.G.L.) was added the kinetic energy term, (using average velocity), to give the energy grade line (E.G.L.) before and after the manhole structure. The friction loss, for an "equivalent"² length of pipe was subtracted from the difference in energies (i.e. $\Delta E.G.L.$) to establish the energy loss across the manhole structure.

²"equivalent" refers to a pipe in which the loss of head for a specified flow is the same as the loss of head of the pipe or pipes it replaces.

The head loss coefficient was then defined as

$$C = \frac{E \cdot L \cdot}{\frac{\bar{V}^2}{2g}} \dots\dots\dots(2.1)$$

where $E \cdot L \cdot$ = the energy loss, and $\frac{\bar{V}^2}{2g}$ = the average inlet velocity head.

In addition to the usual open invert design a "hatch-box"³ design was also tested. These experiments lead to the following conclusions:

- (1) Head losses in open invert manholes are small (maximum $C = 0.26$). Under surcharge⁴ conditions, and with bends included in the manhole, the head loss coefficients were much higher ($C_{max.} = 1.44$).
- (2) Hatch-boxes did not reduce the energy losses except under surcharge conditions.

Thomas Camp has written often about the hydraulics of sewers (8,9,10). He warned that:

".... if sufficient allowance is not made for invert drops at transitions, the transition may reduce the expected capacity of the sewer and cause surcharging at the peak design flows" (page 63 of (10)).

³A hatch-box refers to a closed pipe with a detachable profiled lid.

⁴Surcharging refers to the condition of pipe full flow with possible backing up of the flow in the manhole.

For a manhole without a lateral he recommended the following invert drop design equations

$$Y = \Delta E \cdot G \cdot L + HT \dots\dots\dots(2.2)$$

$$HT = KA \left(\frac{V^2}{2g} \right) \dots\dots\dots(2.3)$$

where Y = invert drop, $\Delta E \cdot G \cdot L$ = the change in projected energy grade line, HT = the head loss at the transition or junction, K = the energy loss coefficient.

Equation 2.3 resulted from measurements done by J. Hinds (14) in flume transitions, where K = 0.1 for increasing velocities and K = 0.2 for decreasing velocities. The values can be applied only to cases where subcritical flow conditions occur ("K" will be large for supercritical flows). Camp recommended a minimum drop of 6.0 mm (.02 ft) across the manhole and that the downstream pipe invert never be higher than the upstream ones, to prevent the collection of sediments.

With lateral flows, allowance for additional head loss should be made for the effects of stream curvature and jet impact. However, Camp did not provide recommended values.

Thienpont (40) did research on head losses in lateral drop chambers. He performed eighty tests to determine the head losses for four different junctions, of different cross sectional shapes. He defined the head loss coefficients

in a similar manner to that appearing in Ackers' equation

2.1 . The coefficient was in the range of 0.8 to 1.45 for a ratio of $\frac{Q_L}{Q}$ from 0.0 to 0.3 where Q is the total flow and Q_L = the lateral inflow ($Q = 10.3 \times 10^3 \text{ cm}^3 \text{ sec}^{-1}$). The lateral invert was at the same or higher elevation than the crown⁵ of the main inlet pipe. The pipes flowed full during all tests.

A great deal of air entrainment was observed in the main flow downstream of the junction. It was concluded that the direction of the side flow entering the manhole has little influence on the head loss, as long as it is less than 90° . Also, further complication of manhole construction, corresponding to the modified designs tested in this laboratory study (which seemed favorable but whose results were very uncertain) was not recommended.

In 1958, the University of Missouri (35) published results of experiments done to measure the magnitude of pressure changes at 90° open junctions with laterals (opposed and offset) and grate⁶ flow, in a storm drain system flowing full. In cases where the losses were large, modified structures were devised and tested.

⁵ Crown refers to the top of the pipe

⁶ Grate flow refers to flow entering the junction through a street gutter inlet

The results are presented in chart form with "K" coefficients versus relative flow rate. This report is a very thorough and detailed account with a concluding section on recommended methods for the design of junctions.

The Baltimore County design manual (3) takes the "Missouri" results (35) into account in their design standards. The Denver Colorado Manual (41) uses the "Missouri" results (35) directly without adjustment. The City of London, Ontario, also makes extensive use of the test results (17).

In the 1960's the University of Colorado conducted a very extensive program of studies on the movement of flood waves through storm drains (23, 48, 49, 50). A model study of the 91.5 cm (3.0 ft) diameter, 253 m (830 ft) long prototype outdoor experimental facility was performed:

- (1) to define the hydraulic performance of the junction,
- (2) to evaluate the energy losses due to turbulent mixing at the confluence of the main and lateral flows and those resulting from changes in channel geometry.

Jorah (23) presents the results for two different junctions under subcritical flow conditions. One junction had the lateral and main pipe crowns at the same elevation, whereas the second had the lateral and main pipe inverts at the same elevation. No main invert drop was provided

through the junction in both cases. The main pipe diameter was 7.95 cm (3.125 in.) and the lateral was 4.76 cm (1.874 in.). The junction box cross-section geometry below the spring line⁷ matched the main conduit cross-section.

Two hundred and six tests were performed resulting in two equations for power loss for combining flows in a 90° junction. These equations are:

$$PR = \frac{-0.482}{QR + 0.55} + 0.77 \dots\dots\dots(2.4)$$

where PR = the ratio of power lost to the power entering the junction, and QR = the ratio of lateral inflow to main conduit flow and,

$$PR = \frac{-2.78 + 1.71 DR}{QR + 3.122 - 1.67 DR} + 0.77 \dots\dots\dots(2.5)$$

where DR = the ratio of the depth immediately upstream from the junction box to the diameter of the main conduit.

Equation (2.4) applies to the "equal crowns" case and equation (2.5) corresponds to "equal inverts" case.

Power is defined as:

$$P = \gamma QE \dots\dots\dots(2.6)$$

where γ = the specific weight of water, Q = the flow rate, E = the energy grade line value.

⁷Spring line refers to the water level in a pipe flowing half-full.

Lorah concludes that, for a given ratio of lateral to main flow, the power loss is greater with the "crowns-even" inlet; the ratio of power lost to power entering for the same inlet is dependent only on QR; the ratio of power lost to power entering for the "inverts-even" inlet depends on QR and DR; the slope of the main conduit does not affect the power loss to power entering ratio for subcritical flow conditions; and the friction factor downstream from the junction has a larger value than the friction factor upstream. The report (23) also provided a comprehensive review of the literature on energy losses at junctions.

P. Gharghourl (12) studied the model performance of a prototype storm sewer junction as well as two modifications of that junction, with the aim of reducing the energy losses. The prototype junction was known to have failed to perform its function properly.

Head loss was evaluated by means of a coefficient defined by the relationship:

$$K = \frac{\Delta h}{\frac{(V_1)^2}{2g}} \dots\dots\dots (2.7)$$

where $\Delta h = h_3 - h_1$, where h_3 and h_1 are the elevations of the water surface just upstream and downstream of the junction respectively and V_1 is the uniform flow velocity calculated from the hydraulic elements chart for circular pipes. Flow in the inlet pipes was always under pressure (i.e. sucharged conditions prevailed) while flow in the outlet was always open channel flow.

"K" varied from 0.9 to 1.5 for lateral flows ranging from $17 \times 10^{-3} \text{ m}^3 \text{ sec}^{-1}$ (0.60 cfs) to $34 \times 10^{-3} \text{ m}^3 \text{ sec}^{-1}$ (1.2 cfs) and a main flow rate of $14.1 \times 10^{-3} \text{ m}^3 \text{ sec}^{-1}$ (0.50 cfs) to $31.2 \times 10^{-3} \text{ m}^3 \text{ sec}^{-1}$ (1.1 cfs).

The modified junction performed better, i.e., lower K values. This was due to improved flow streamlining accomplished by benching the channel to the pipe crowns. Head loss increased when the lateral flow became a significant part of the total flow.

A description of junction design and manhole design accepted by the City of Los Angeles is given in (31). The Thompson equation (for invert drop calculations), which appears in the Los Angeles Office Standard No. 115 "Hydraulic Analysis of Junctions" is expressed thus:

$$\frac{1}{2} (A_1 + A_3) \Delta y = \frac{Q^2}{A_1 g} - \frac{(QM)^2}{A_3 g} - \frac{(QL)^2 \cos \theta}{A_2 g} \dots\dots\dots (2.8)$$

in which A is the area of flow, Δy the change in the water surface elevation through the junction, θ = the angle of convergence between the centerline of the main and lateral pipes, $Q = QM + QL$ where QM = the flow in the main and QL = the flow in the lateral, subscripts (1) and (3) refer to sections downstream and upstream of the junctions respectively, and

$$\Delta y = Z + D_3 - D_1 \dots\dots\dots (2.9)$$

in which Z = the main invert drop, D_1 = the downstream flow depth, D_3 = the upstream flow depth. Equation (2.8) can be solved directly for Z if the flow rates are known.

Model tests at the laboratory of the Bureau of Engineering for Los Angeles City have verified the validity of the Thompson equation. The preceding section summarizes the major contributions concerning energy losses at sewer junctions.

The following reports also present research on junction flows.

Taylor (39) in 1944 investigated the problem of predicting the depths upstream from a junction when the flow rates in the branches, and the downstream depth, were known. He carried out experimental work in the laboratory using rectangular channels of equal width (10 cm) and zero slope. Using the momentum equation he was able to predict the depths satisfactorily for the 45° combining flow junction for subcritical flow conditions.

The fact that these results were of little use to sewer designers is obvious: sewer junctions have no simple geometry, sewer pipes do have a slope and, sewer pipes are normally circular in cross-section.

In 1950 the University of Minnesota modeled open channel junctions for a drainage system for Whiting Field Naval Air Station (6). The channels were trapezoid in cross section with up to $27.2 \times 10^6 \text{ cm}^3 \text{ sec}^{-1}$ (960 cfs) in the main

channel and up to $19.8 \times 10^5 \text{ cm}^3 \text{ sec}^{-1}$ (70 cfs) in the side channel. The investigators were primarily interested in the necessary wall heights near the confluence to prevent spill-over and erosion of the sides of the plateau along which the channels passed. In all cases flows were supercritical. Final designs included a fixed pier along the channel center-line to (i) direct the lateral flow (ii) direct the total combined flow.

Behlke (5) discussed the problems of diagonal waves and "pile up" problems at the intersection of two open channels containing supercritical flow.

He recommended (i) the use of a tapered baffle which extended from the main channel wall downstream in front of the side channel, and (ii) an enlargement of the downstream channel area to accommodate the added flow volume. These two suggestions minimized the degree of pile up and presence of diagonal waves.

Hu (15) investigated the methods used for calculating the water surface profiles in a soil drainage system. As in sewer system design, the design criteria assumes open channel flow conditions at the design discharge. Theoretical derivations resulted in a depth prediction equation:

$$\frac{(QM)^2}{gA_3^3} + (D_3 - R) A_3 + \frac{2}{3} \left[2RD_3 - (D_3)^2 \right]^{\frac{3}{2}}$$

$$= \frac{Q}{gA_1} + (D_1 - R) A_1 + \frac{2}{3} \left[2RD_1 - (D_1)^2 \right]^{\frac{3}{2}} \dots\dots(2.10)$$

where R = the pipe radius and the other variables are as defined previously. With one of the depths known, the other can be calculated. Comparison between predicted and actual water surface profiles, in a scale model using 6.75 cm, 7.6 cm, and 10.2 cm (2.6, 3, 4 in.) diameter pipes, was adequate.

Ruus (33) reported head loss due to combining flows in scale models of wyes and manifolds. Detailed description was presented of the construction, set up and preliminary tests on the model. Charts of head loss versus discharge or relative discharge $\left[\frac{QL}{QM}\right]$ were presented for fifteen different junctions tested. The following conclusions were made:

- (1) For symmetrical flow conditions the head loss in the wye or manifold diminishes with decreasing angle of bifurcation.
- (2) For symmetrical flow conditions the head loss in the wye or manifold with an angle of bifurcation not over 60° is less than 10% of the velocity head in the main pipe.
- (3) The head loss in a spherical wye increases rapidly with the increasing diameter of the wye.
- (4) Head loss coefficients at prototypes are likely to be different from those obtained in model tests. (page 606 in (33))

Many reports (27, 29, 30, 34, 43) have been written on the topic of flow in manifolds, which are important features in pumping and hydropower piping systems.

Much has also been written about energy losses in pipes, bends and junctions. Ito (19) presents equations to predict the energy loss and the power loss for combining and dividing flow at smooth tees with diameter ratios of unity, which are in good agreement with previous experimental work. He derived the following equation:

$$K_C = \frac{Q_M}{Q} (K_3) + \frac{Q_L}{Q} (K_2) \dots\dots\dots(2.11)$$

to evaluate the combining flow loss coefficient in which K_C = the combined loss coefficient, K_3 = the main loss coefficient, K_2 = the lateral loss coefficient. Graphs showing the variation of the loss coefficient with relative flow rate are presented. One conclusion of the experiments is that a large radius of curvature of the joining edges at the junction such as $R = 0.5D$ is very effective in reducing power and energy loss.

An equation similar to equation (2.11) was suggested by Villemonte (42).

Idel'chik in his "Handbook of Hydraulic Resistance" (page 247-274 of (18)) presents a complete set of values of energy loss coefficients for branch angles of 30° , 45° , 60° , and 90° . The loss coefficients are a function of the ratio pipe sectional areas and the ratio of flow rates. For the 45° branch angle he presents the following equations:

$$K_2 = 1 + \left(\frac{Q_L}{Q} \frac{A_1}{A_2} \right)^2 - 2 \left(1 - \frac{Q_L}{Q} \right)^2 - 1.41 \frac{A_1}{A_2} \left(\frac{Q_L}{Q} \right)^2 \dots\dots\dots (2.12)$$

and

$$K_3 = 1 \left(1 - \frac{Q_L}{Q} \right)^2 - 1.41 \frac{A_1}{A_2} \left(\frac{Q_L}{Q} \right)^2 \dots\dots\dots (2.13)$$

No special restrictions, for application of the equations, are given except that the pipes flow full. He states:

"The resistance coefficients of converging wyes are functions of the branch angle, the ratios of the cross sections of the three outlets $\left(\frac{A_3}{A_1}, \frac{A_2}{A_1}, \frac{A_2}{A_3} \right)$, the ratios of discharges $\left(\frac{Q_M}{Q}, \frac{Q_L}{Q} \right)$ and the ratios of velocities $\left(\frac{V_3}{V_1}, \frac{V_2}{V_1} \right)$." (page 248 of (18))

2.2 Storm Sewer Systems and Energy Losses

The Denver Manual (41) describes procedures for the hydraulic design of a storm sewer system taking into account energy losses at junctions. For open channel flow conditions, the energy grade line is recommended as a base for calculation whereas for conduits flowing full, the hydraulic grade line should be the reference line.

For open channel flow through a manhole, the Thompson formula (equation 2.8), or the results presented by Camp, can be used to determine the energy loss and the change of the E.G.L..

For conduits flowing full, energy losses are "compensated for" by a rise of pressure upstream of the junction, (calculated by means of the charts and coefficients first presented in the University of Missouri (35) study, and duplicated in the Denver Colorado Manual (41)).

The designer would, in the final design start with a point of known H.G.L. and E.G.L., a drainage outlet, or a point where the designed drainage system joins an existing system. Moving upstream and using the values for pipe friction, pipe slope and discharge, the E.G.L. and the H.G.L. could be calculated. At a junction, depending on whether open channel flow or pressure conduit flow exists, the E.G.L. and H.G.L. are adjusted accordingly. This procedure is carried out until the upstream inlets are reached.

A second, more recent method proposed by Yen and Sevuk (47) designs a storm sewer network with the aid of a computer. A multiple staged, branched sewer system, with the layout already determined, is designed by five methods: (i) the steady flow routing method (Rational Method), (ii) the Chicago Hydrograph Method, (iii) the SWMM Method, (iv) the ISS model (37), and (v) the kinematic wave model. Comparisons are presented. The ISS model appears to be the most accurate method. Its use is recommended for design of large sewer systems where accuracy will lead to significant savings and the high cost of the design process (computer use) is a small part of the total cost.

Junction or manhole hydraulics is considered in the following way. Junctions are classified into two categories: (i) those which are large, and have a storage capacity, with a practically horizontal water surface, called a reservoir type junction, and (ii) those which are small and have no storage capacity, called a point type junction. The equations which account for the hydraulic compatibility at the junction are (i) continuity equation:

$$Q_M + Q_L + Q_J - Q = \frac{ds}{dt} \dots\dots\dots(2.14)$$

in which Q_J = the direct inlet inflow and $\frac{ds}{dt}$ = the change in storage (zero for a point type junction), and (ii) an equation for the water surface:

$$Z_3 + D_3 = Z_2 + D_2 = Z_1 + H_1 + \frac{(V_1)^2}{2g} \dots\dots\dots(2.15)$$

in which Z = the pipe invert (for the point type junction $\frac{(V_1)^2}{2g} = 0$). In this way backwater effects at the junction are taken into account. For the solution method the reader shall refer to (37).

CHAPTER 3

THEORY, MEASUREMENT AND COMPUTATION OF ENERGY LOSS

3.1 Specific Energy at the Junction

With reference to figure 3-1, the following equation relating total energy upstream and downstream of a junction can be written for the main (figure 5 of (9)).

$$Z_3 + \frac{\alpha_3(V_3)^2}{2g} + D_3 - Ff_3 - M \cdot E \cdot L \cdot J - Ff_1 - \frac{\alpha_1(V_1)^2}{2g} - D_1 - Z_1 = 0 \quad \dots\dots\dots(3.1)$$

in which Z = the pipe invert elevation, α = the energy coefficient, g = gravitational acceleration, D = the flow depth, Ff = the energy loss due to wall friction (friction loss), $E \cdot L \cdot J$ = the energy loss at the junction (form loss) and V = the average velocity.

By inspection of figure 3-1, it can be seen that

$$Z_3 - Z_1 = \Delta Z_3 + \Delta Z_1 + MMANDR \quad \dots\dots\dots(3.2)$$

Rewriting equation 3.1 and grouping terms

$$\left\{ \frac{\alpha_3(V_3)^2}{2g} + D_3 - Ff_3 + \Delta Z_3 \right\} - \left\{ \frac{\alpha_1(V_1)^2}{2g} + D_1 + Ff_1 - \Delta Z_1 \right\} + MMANDR = M \cdot E \cdot L \cdot J \quad \dots\dots\dots(3.3)$$

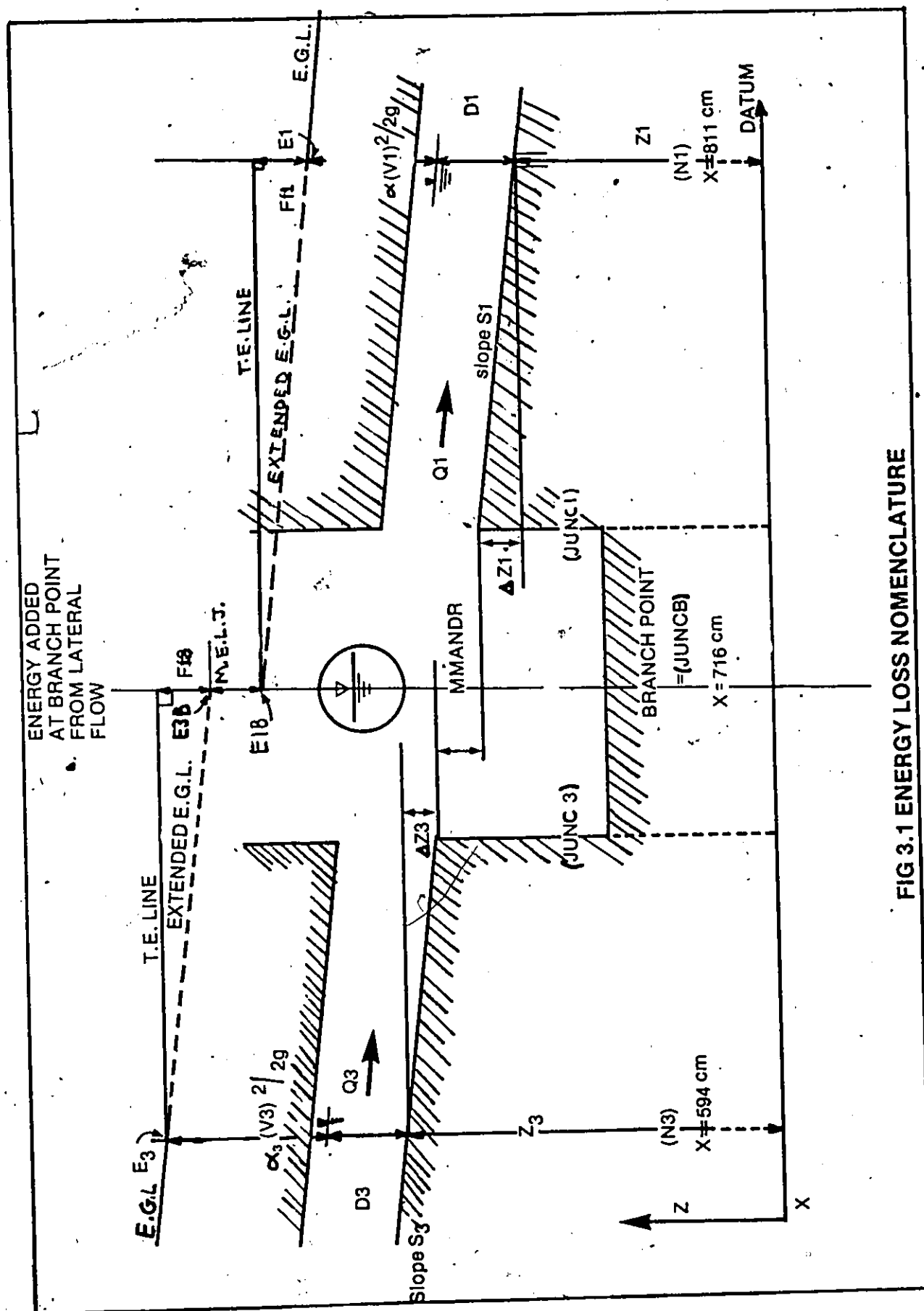


FIG 3.1 ENERGY LOSS NOMENCLATURE

in which MMANDR = the drop of the pipe invert through the manhole, ΔZ = the change in pipe invert elevation between the measuring point and the junction box wall.

Equation (3.3) may be simplified by rewriting it as

$$(E_{3P} - E_{1P}) + MMANDR = M \cdot E \cdot L \cdot J \dots\dots\dots (3.4)$$

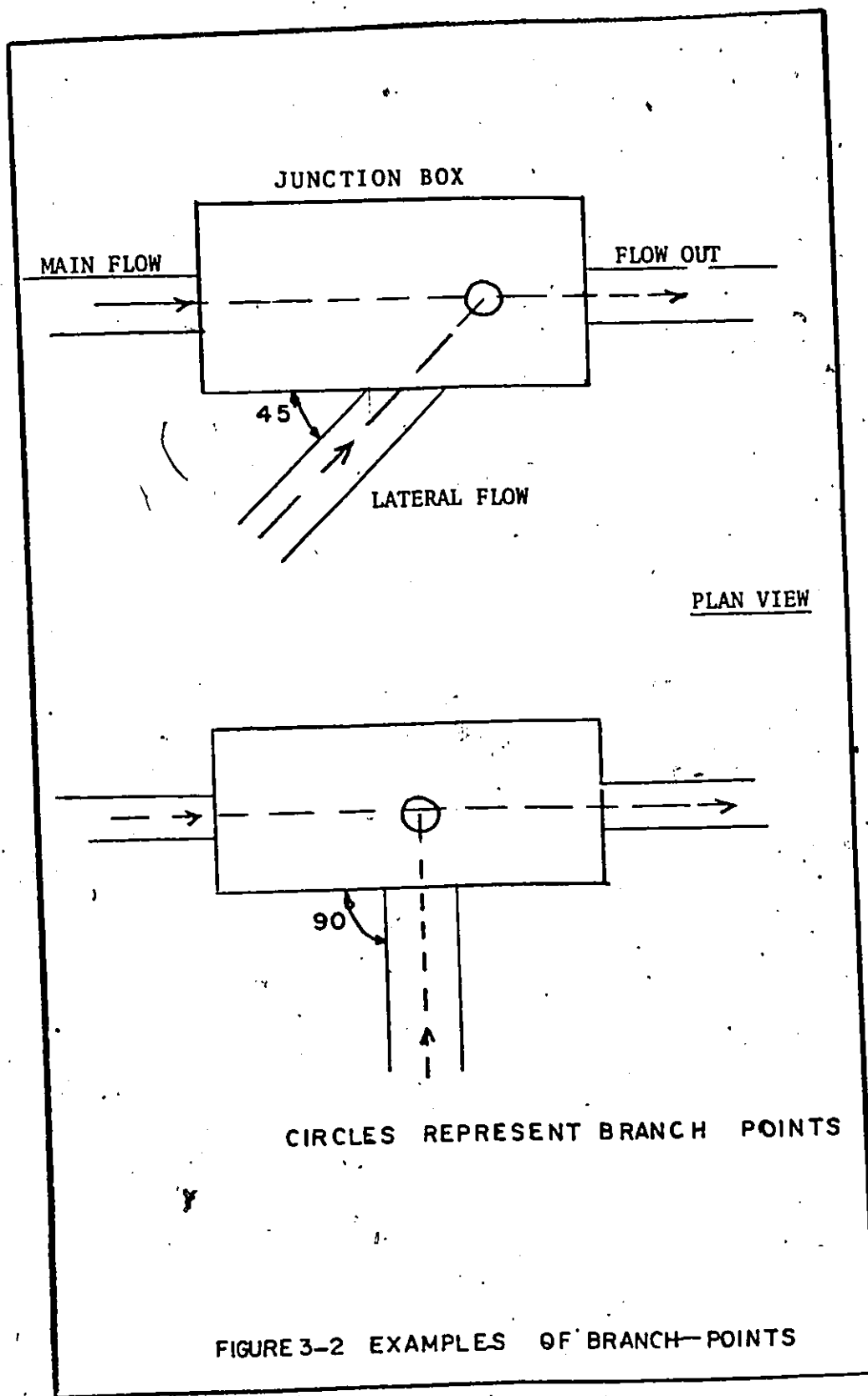
in which E_{3P} = the main specific energy at the "branch point" (see figure 3.2 for the explanation of branch point), E_{1P} = the outlet specific energy at the branch point. To solve for energy loss at the junction, the change in pipe invert elevation, the friction loss, the invert drop of the main and lateral pipe through the junction, the depth and the average velocities must be known quantities. These values are determined experimentally. An equation similar to equation 3.4 can be written for the lateral pipe

$$(E_{2P} - E_{1P}) + LMANDR = L \cdot E \cdot L \cdot J \dots\dots\dots (3.5)$$

in which LMANDR = the invert drop of the lateral pipe through the junction.

The values of the energy coefficients are $\alpha_3 \approx \alpha_2 \approx 1.0$ (from experimental data). The results are discussed in chapter five under the heading "velocity traverses".

The energy coefficient for the outlet pipe " α_1 " is also assigned the value of 1.0 for lack of experimental data.



The friction loss is determined by assuming uniform flow conditions between the points N1 and N3 (see figure 3.1). The uniform flow friction loss equals the pipe length between the tapping points multiplied by the pipe invert slope,

$$Ff_3 = (S_3) (JUNCB - N_3) \dots\dots\dots(3.6)$$

$$Ff_1 = (S_1) (N_1 - JUNCB) \dots\dots\dots(3.7)$$

in which S_3 = slope of main pipe, S_1 = slope of outlet pipe, N_1 = the location of the upstream reference point, N_3 = the location of the downstream reference point. The reference points N_1 , and N_3 are chosen in the section of pipe where the flow would normally be uniform.

The calculated energy loss at the junction can be subdivided into four components.

- (1) loss due to turbulent mixing of two streams with different velocity vectors,
- (2) loss due to turning of the stream as it passes from lateral to the outlet pipe,
- (3) expansion and contraction losses,
- (4) loss due to change in pipe invert elevation.

Losses 1, 2, and 3, are grouped together and are called the energy losses at the junction. Loss 4 is written as MMANDR or LMANDR.

Equations (3.4) and (3.5) can now be restated

$$(E_{3P} - E_{1P}) + M_{MANDR} = M \cdot E \cdot L \cdot J \cdot \dots\dots\dots(3.8)$$

$$(E_{2P} - E_{1P}) + L_{MANDR} = L \cdot E \cdot L \cdot J \cdot \dots\dots\dots(3.9)$$

in which $M \cdot E \cdot L \cdot J \cdot$ = the losses 1, 2, and 3 for the main pipe
and $L \cdot E \cdot L \cdot J \cdot$ = the losses 1, 2, and 3 (the lateral energy
losses) at the junction.

The combined energy loss at the junction can be
defined similar to equation 5 (in (42)) by

$$C \cdot E \cdot L \cdot J \cdot = (L \cdot E \cdot L \cdot J \cdot) \left[\frac{Q_2}{Q_1} \right]^2 + (M \cdot E \cdot L \cdot J \cdot) \left[\frac{Q_3}{Q_1} \right]^2 \dots\dots\dots(3.10)$$

where $C \cdot E \cdot L \cdot J \cdot$ = the combined energy loss for the junction.

At this point five energy loss coefficients can be
defined. The lateral energy loss with respect to the outlet
velocity is:

$$K_2 = \frac{L \cdot E \cdot L \cdot J \cdot}{\frac{(V_1)^2}{2g}} \dots\dots\dots(3.11)$$

The lateral energy loss with respect to the inlet velocity
head is:

$$K_{2L} = \frac{L \cdot E \cdot L \cdot J \cdot}{\frac{(V_2)^2}{2g}} \dots\dots\dots(3.12)$$

Similarly for the main pipe:

$$K_3 = \frac{M \cdot E \cdot L \cdot J \cdot}{\frac{(V_1)^2}{2g}} \dots\dots\dots(3.13)$$

$$K_{3M} = \frac{M \cdot E \cdot L \cdot J \cdot}{\frac{(V_3)^2}{2g}} \dots\dots\dots(3.14)$$

Also for the combined energy loss:

$$K_C = \frac{C \cdot E \cdot L \cdot J \cdot}{\frac{(V_1)^2}{2g}} \dots\dots\dots(3.15A)$$

The calculations are done on the computer. See Appendix G for the program. In terms of power at the junction:

$$K_C = \left[\left(\frac{PL}{(Q_2)(\gamma)} - \frac{(A - (L.P.R.)A)}{(Q_1)(\gamma)} + L_{MANDR} + C_2 - C_1 \right) \left(\frac{Q_2}{Q_1} \right) + \left(\frac{PM}{(Q_3)(\gamma)} - \frac{(A - (L.P.R.)A)}{(Q_1)(\gamma)} + M_{MANDR} + C_3 - C_1 \right) \left(\frac{Q_3}{Q_1} \right) \right] \frac{(V_1)^2}{2g} \dots\dots\dots(3.15B)$$

where $C_1 = \Delta Z_1 - Z_1$, $C_2 = \Delta Z_2 - Z_2$, $C_3 = \Delta Z_3 - Z_3$, $A = PM + PL$.

3.2 Power Losses at the Junction

As indicated in chapter 2, section 2.1, the power equation is defined by equation 2.6. For the lateral pipe:

$$PL = (Q_L)(\gamma)(E_{2B}) \dots\dots\dots(3.16)$$

is the power at the branch point where

$$E_{2B} = E_2 - F_{f2} \dots\dots\dots(3.17)$$

For the main pipe:

$$PM = (Q_M)(\gamma)(E_{3B}) \dots\dots\dots(3.18)$$

is the power at the branch point in which

$$E_{3B} = E_3 - Ff_3 \quad \dots\dots\dots(3.19)$$

For the outlet

$$P_O = (Q) (\gamma) (E_{1B}) \quad \dots\dots\dots(3.20)$$

is the power at the branch point in which

$$E_{1B} = E_1 + Ff_1 \quad \dots\dots\dots(3.21)$$

The flow at the junction can now be analyzed by means of the lost power ratio (L.P.R.) where

$$L.P.R. = \frac{P_M + P_L - P_O}{P_M + P_L} \quad \dots\dots\dots(3.22)$$

which is a dimensionless formulation of the power loss divided by the power input at the junction.

In chapter 6 the calculated values of L.P.R., K_C, K₃, and K₂, for the junction configurations tested are presented.

The following sections in this chapter outline briefly the various methods used by different municipalities to calculate energy loss at junctions.

3.3 Scarboro Method

The Borough uses a combination of quick and easy calculations done manually in tabular form, adjusted according to rules of thumb gained from practical experience. To determine the invert drop use is made of an equation similar to equation 3.8. In that equation there are two unknowns:

MMANDR and E.L.J.. E.L.J. is solved to give the desired result, i.e., the invert drop required to supply the sewer system with energy that was lost at the junction.

$$E.L.J. = \frac{K(V_1 - V_3)^2}{2g} \dots\dots\dots(3.23)$$

in which $K = 0.1$ for $V_1 > V_3$ and $K = 0.2$ for $V_1 < V_3$.

Equation (3.23) is used to calculate the energy loss at the junction. The calculation for the required invert drop is repeated for each inlet pipe and the outlet pipe, and the maximum value is adopted in the design.

In the present laboratory study, these calculations would be performed for the lateral and the outlet and the main and the outlet. As stated above, maximum calculated invert drop sets the required drop through the manhole. Furthermore it is recommended that the designer restrict the velocity change to not more than 0.61 meters per second (2.0 f.p.s.). In special cases bell-mouth entrances are considered. The following rules of thumb also apply in the design procedure

(36):

- (1) Endeavour to keep entrance and exit velocities equal.
- (2) No sewer pipes greater than 38.0 cm (15 in.) diameter should be turned through 90° .
- (3) No acute interior angles should be allowed in any case.

- (4) All sewer pipes turning through 45° or less in a manhole require a 7.62 cm (3 in.) drop.
- (5) All incoming sewer pipes turning through angles greater than 45° in a manhole require a 15.24 cm (6 in.) drop.
- (6) A minimum drop of 0.91 meters (3.0 ft) is required before a drop structure is used.
- (7) All manholes should be benched throughout to crown level on a vertical projection from spring line for all pipes.
- (8) All manhole chamber openings should be located on the upstream side of the manhole.
- (9) Minimum storm sewer size - 0.30 meters (12.0 in.) diameter at 0.50% slope.
- (10) Minimum sanitary sewer size - 25.4 cm (10.0 in.) diameter at 0.67% slope. (Exception 25.4 cm (10.0 in.) diameter asbestos cement at 0.50% slope)
- (11) The first or highest leg of all sewers should have a minimum grade of 1.00% and a maximum grade of 2.00%.
- (12) Minimum velocity of flow in both storm and sanitary sewers recommended 0.76 m/s (2.5 fps).
- (13) Maximum velocity of flow recommended:
Storm sewers: (no maximum)
Sanitary sewers - 4.57 m/s (15 fps)
- (14) Radial pipes less than 76.2 cm (30 in.) diameter are not recommended. Wedge-shaped pipes should not be used.

(15) No decrease in pipe diameter from a larger size upstream to a smaller size downstream should be allowed regardless of increase in grade.

(16) Where an increase in pipe size occurs at the downstream side of the manhole, maintain crowns of incoming and outgoing pipes level.

3.4 Baltimore Method

Cut-ins, wye branches, preformed concrete pipe fittings, manholes, brick bends, and type 1 junction chambers as discussed in reference (3), are standard details. Special junction chambers are used where velocities exceed 4.57 m/s (15 fps) or the largest pipe exceeds 1.22 m (48 in.) in diameter with streamlining to limit head losses. Type 1 junction chamber head losses are calculated using figures 3-3 and 3-4.

These curves are based upon surcharged pipes entering rectangular structures. For manholes, the calculated loss is the summation of "A", "B", "C", and "D" losses. For pipe sizes 83.8 cm (33 in.) and larger the "A" loss is substituted by the "C" loss. For a junction chamber type 1, the calculated loss is the summation of "B", "C", and "D" losses. For chambers with manholes the loss is calculated by summing "B", 1.5 "C" and 0.5 "D" losses. Final design limits the elevation of the hydraulic grade line to be (i) no more than 1.83 m (6 ft) above the crown of the pipe and (ii) not above an elevation of 0.457 m (1.5 ft) below the established street

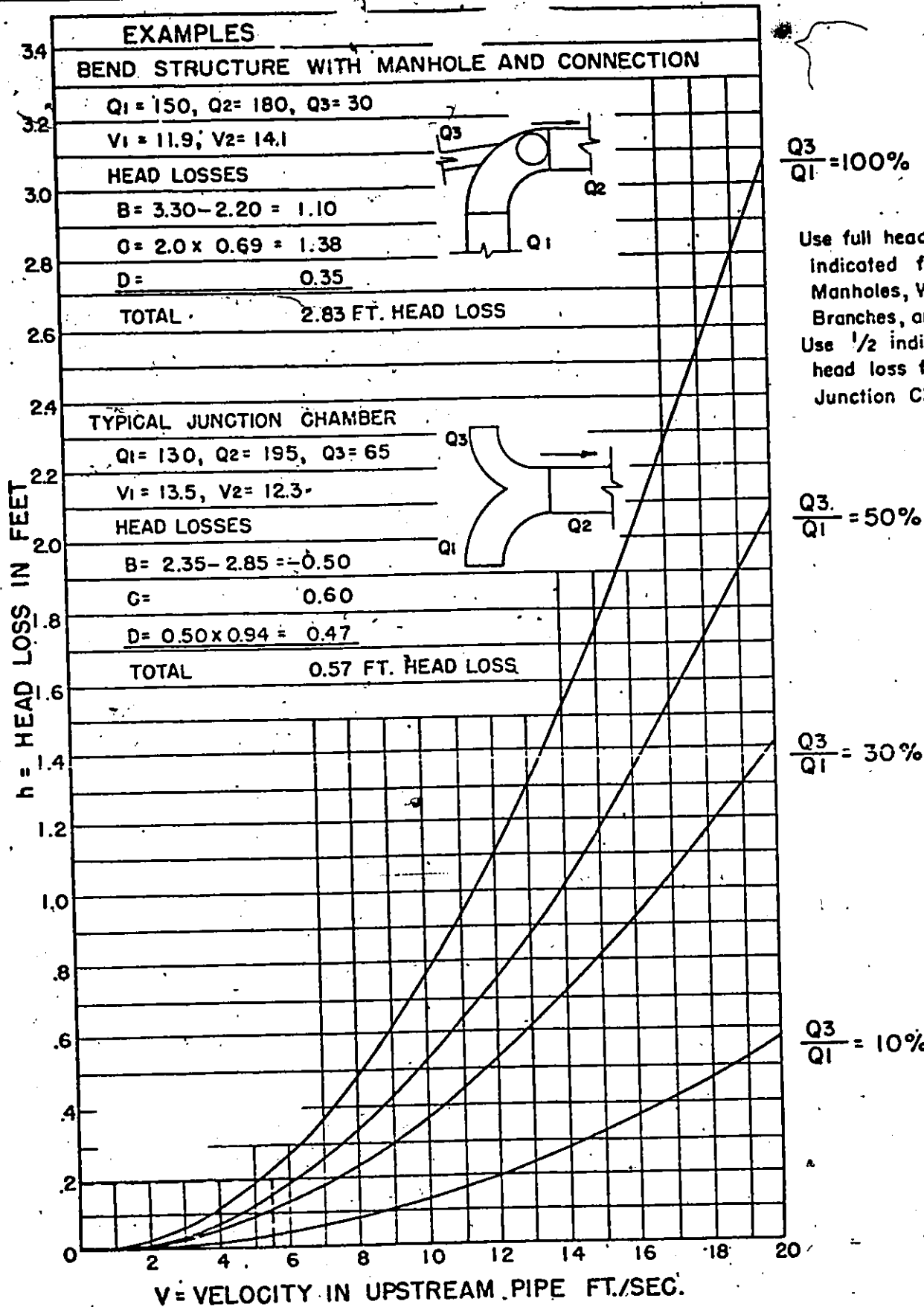


FIGURE 3-3

HEAD LOSS IN STRUCTURES

(From (3))

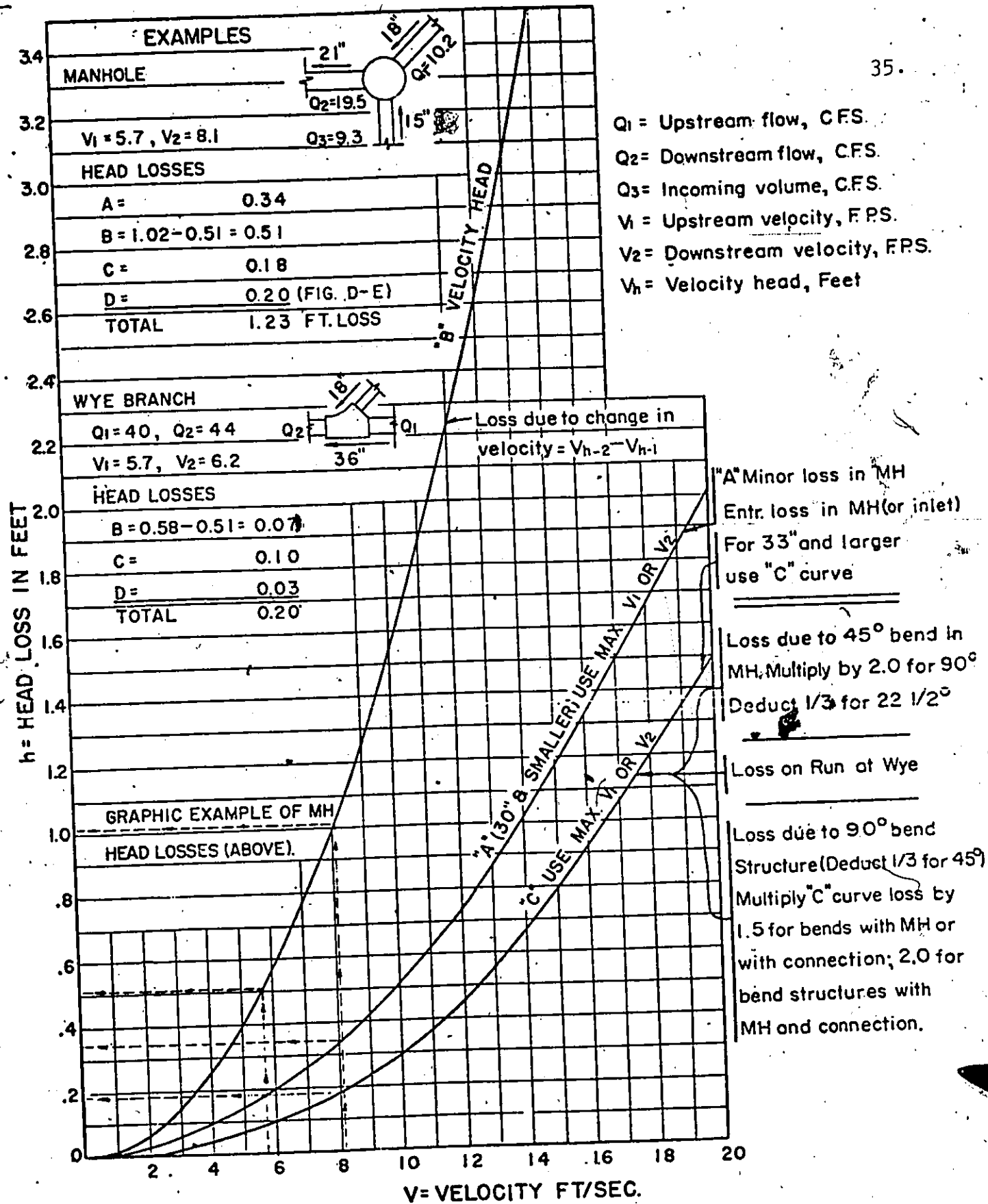


FIGURE 3-4 HEAD LOSS IN STRUCTURES

(From (3))

grade. The hydraulic grade line computations start at a point of known hydraulic grade line elevation (often the downstream end of the drainage system). The friction loss in the drain to the next structure is added to the known H.G.L. elevation. To this is added the head loss in the structure. This procedure is continued until the H.G.L. is determined everywhere along the pipe system.

3.5 Denver Method

The Denver Manual (41) is the most up to date (1969) complete guide in storm drainage design. Full use is made of the results of the University of Missouri studies (35) for calculating junction losses. For open channel flow the following practice is recommended.

For the change in pipe size

$$E.L.J. = K \Delta \left(\frac{V^2}{2g} \right) \dots\dots\dots (3.24)$$

in which $K = 0.1$ for increasing velocity and $K = 0.2$ for decreasing velocity if the flow is subcritical. For supercritical flow "K" values are not available. Values for head-loss coefficients in bends and junctions with free surface flows are also not available. For major junctions it is recommended that a model be constructed and tested.

Often gravity flow sewers operate as pressure conduits when actual runoff is greater than the design runoff value. Storm sewers are sometimes designed as pressure

conduits. The University of Missouri study results are used to analyze the position of the H.G.L. This is important to ensure proper functioning of the storm water inlets, and to prevent storm water discharging from the storm sewer onto the street (with the "popping" manhole cover phenomenon). Manhole construction and inside shaping details are summarized in figures 3-5 and 3-6. Furthermore, lateral pipes should not be located directly opposite each other.

Giving the manhole bottom a circular or U-shaped flow cross section is detrimental from an energy loss point of view when lateral flows are involved. Limited shaping of the invert to handle low flows is practical (41)

3.6 Los Angeles Method

The hydraulic analysis of sewer junctions for both open channel and pressure conduit flow is presented in office standard no. 115, storm drain design division, Bureau of Engineering, City of Los Angeles (31). The Thompson formula,

$$\frac{1}{2} (A_1 + A_3) (\Delta y) = \frac{Q^2}{A_1 g} - \frac{(QM)^2}{A_3 g} - \frac{(QL)^2 \cos \theta}{A_2 g} \dots \dots \dots (3.25)$$

where

$$\Delta y = Z + D_3 - D_1 \dots \dots \dots (3.26)$$

in which Z = MMANDR, D = the depth of flow (see figure 3-7)

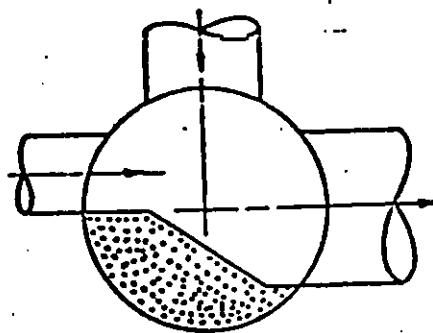
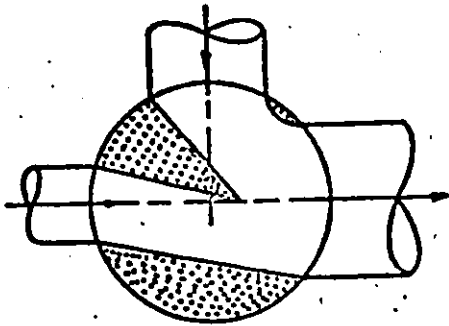
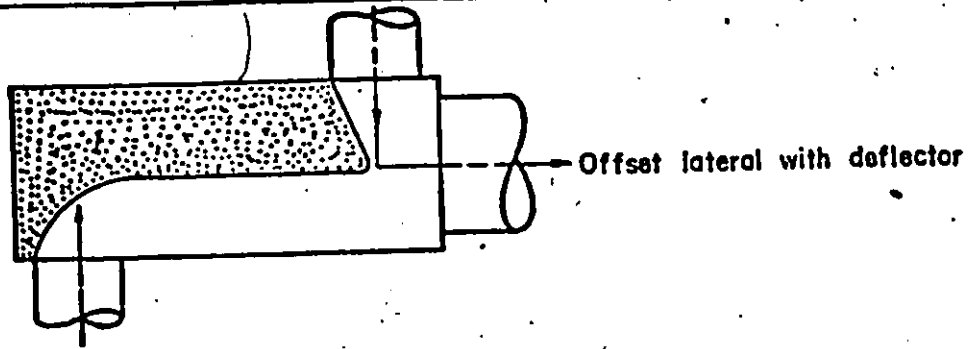
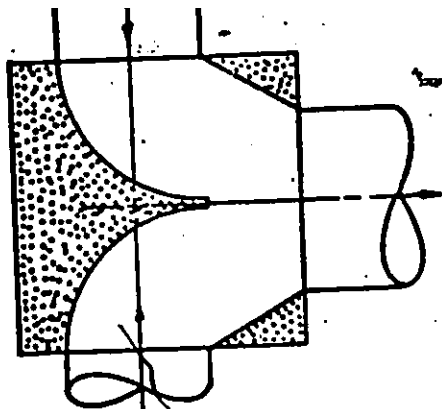
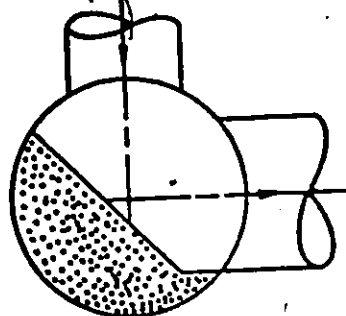


FIGURE 3-5

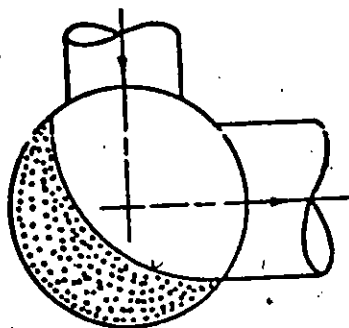
EXAMPLES OF INEFFICIENT MANHOLE SHAPING (from (41))



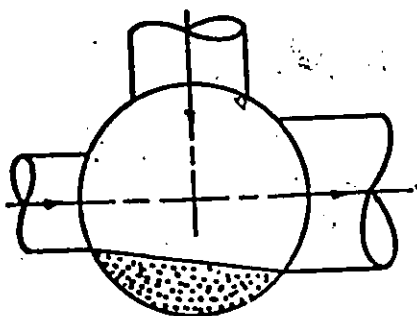
Directly opposed lateral with deflector
(head losses are still excessive with this method, but are significantly less than when no deflector exists.)



Bend with straight deflector



Bend with curved deflector

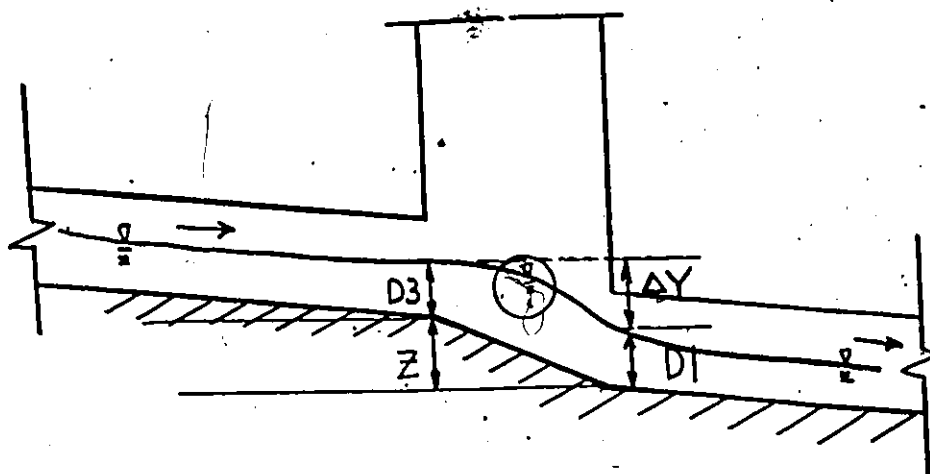


Inline upstream main & 90° lateral with deflector

FIGURE 3-6

EXAMPLES OF EFFICIENT MANHOLE SHAPING (from (41))

FIGURE 3-7 FLOW IN JUNCTION



is based on the "pressure plus momentum" theory, which equates all the pressures acting at the junction with the momentums

$$\sum_{i=1}^n P_i = \sum_{i=1}^n M_i \dots \dots \dots (3.27)$$

in which P_i = the hydrostatic pressure and M_i = the momentum.

Equation (3.27) is solved to give the Thompson formula based on the following assumptions:

- (1) the calculated pressure is the hydrostatic pressure,
- (2) friction losses are ignored,
- (3) the lateral inlet water surface elevation equals the average water surface elevation through the junction,
- (4) transition losses are ignored.

The Thompson equation is useful in three ways:

- (1) If the depths upstream and downstream of the junction are specified or given, the required invert drop can be calculated. This is useful in preliminary design.
- (2) If one depth and the invert drop are known the other depth can be calculated. This is useful when checking the hydraulic grade line in final design.
- (3) If equation (3.28), namely

$$M1C > M3N + M2 \cos \theta + \frac{1}{2} (A1 + A3) \Delta y \quad \dots (3.28)$$

in which $M1C$ = the momentum calculated (with $D1$ = critical depth), $M3N$ = the momentum calculated (with the depth equal to normal depth), applies then a hydraulic jump will occur upstream of the junction. If the hydraulic jump is unwanted the designer can calculate the value of Z so that an hydraulic jump cannot occur ($D3 = D3N$ and maximum $D1 = D1C$).

The minimum length of the transition structure (see page 1661 (38)) is the larger of the following: (i) a length computed with a maximum $12\frac{1}{2}$ degree interior angle between the opposite sides of the transition, or (ii) a length equal to the diameter of the larger pipe but not to exceed 1.8 m (6 ft).

In practice, drops across manholes for small sewers are never less than 0.03 m (0.1 ft). For side inlet junctions 0.03 m (0.1 ft) is added to the average slope of

the inlet and outlet sewers. The maximum drop of straight through flows is 0.18 m (0.6 ft). Special care is exercised in design to avoid hydraulic jumps or to confine their location to confluence structures.

CHAPTER 4

THE HYDRAULIC MODEL

4.1 Model Prototype Similitude.

A review of typical storm sewer junctions in Scarboro and Ottawa, Ontario revealed the variety of typical geometric conditions encountered in prototype junctions with variations in length, number of pipes, angles between the pipes, invert drop, flow area and finishing in the manhole. Rather than studying a particular junction, as was done by Gharghourl (12), it was decided to study the general case, with the objective of determining (i) what effect junction geometry has on energy loss (ii) testing alternative designs to minimize energy losses.

The parameters that can be varied by the designer are the following:

- (1) L, the length of the manhole
- (2) W the width of the flow channel
- (3) MMANDR the change in elevation of the main pipe through the manhole (invert drop)
- (4) LMANDR the change in elevation of the lateral pipe through the manhole
- (5) DP1 the downstream main pipe diameter

- (6) DP2 the lateral pipe diameter
- (7) DP3 the upstream main pipe diameter
- (8) θ the angle between the lateral and upstream main pipe center lines
- (9) S1 }
 (10) S2 } the respective slopes of the pipes
 (11) S3 }

The author is aware that the above parameters are often fixed due to constraints in the drainage system, e.g. energy needs to be dissipated where steep gradients occur. In those cases the designer will have little use for the results in this thesis.

The following fixed parameters, also necessary in defining the hydraulic performance of the junction are given:

- (12) μ the dynamic viscosity of water
- (13) ρ the density of water
- (14) n the friction coefficient
- (15) g the gravitational constant
- (16) Q2 the flow rate in the lateral
- (17) Q3 the flow rate in the upstream main pipe

The friction coefficient and the flow rates are fixed in a special sense. It has been established that the friction coefficient varies with depth of flow as well as for different pipe materials. The flow rate is fixed by virtue of a chosen design discharge for the drainage area, and

finally the design discharge is fixed by design criteria adopted by the various municipalities. These governing parameters are identified in figure 4-1.

From the continuity equation for the junction

$$Q_2 + Q_3 - Q_1 = \frac{ds}{dt} \dots\dots\dots(4.1)$$

or

$$Q_L + Q_M - Q = \frac{ds}{dt} \dots\dots\dots(4.2)$$

in which $Q_1 = Q$ = the junction outflow, $\frac{ds}{dt}$ = the time rate of change of storage in the junction ($\frac{ds}{dt} = 0$ in the present study). Manning's equation is expressed as

$$Q = \frac{A(HR)^{\frac{2}{3}} S^{\frac{1}{2}}}{n} \dots\dots\dots(4.3)$$

in which HR = the hydraulic radius, S = the pipe slope, A = flow area. Depth can be calculated if Q, n, and S are known. This is the case in all three pipes considered herein.

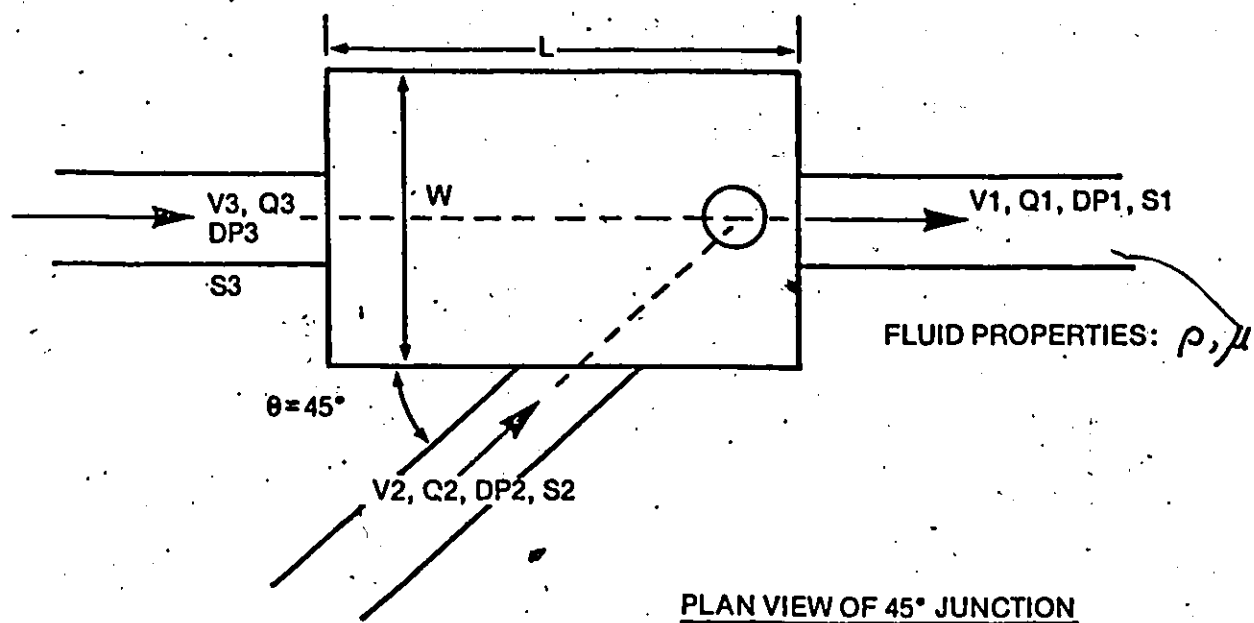
It is well known that, for incompressible fluid flow, the head loss coefficient K is a function of the geometry of the boundaries, the Reynolds number and the Froude number

$$K = f_k (\text{geometric conditions, Re, Fr}) \dots\dots\dots(4.4)$$

$$\text{in which } Re = \frac{\rho V D}{\mu}, \quad Fr = \frac{V}{\sqrt{g d}}$$

Hence,

$$K = f_k (L, W, MANDR, DP1, DP2, DP3, \rho, n, g, Q_2, Q_3) \dots\dots\dots(4.5)$$



*open channel flow

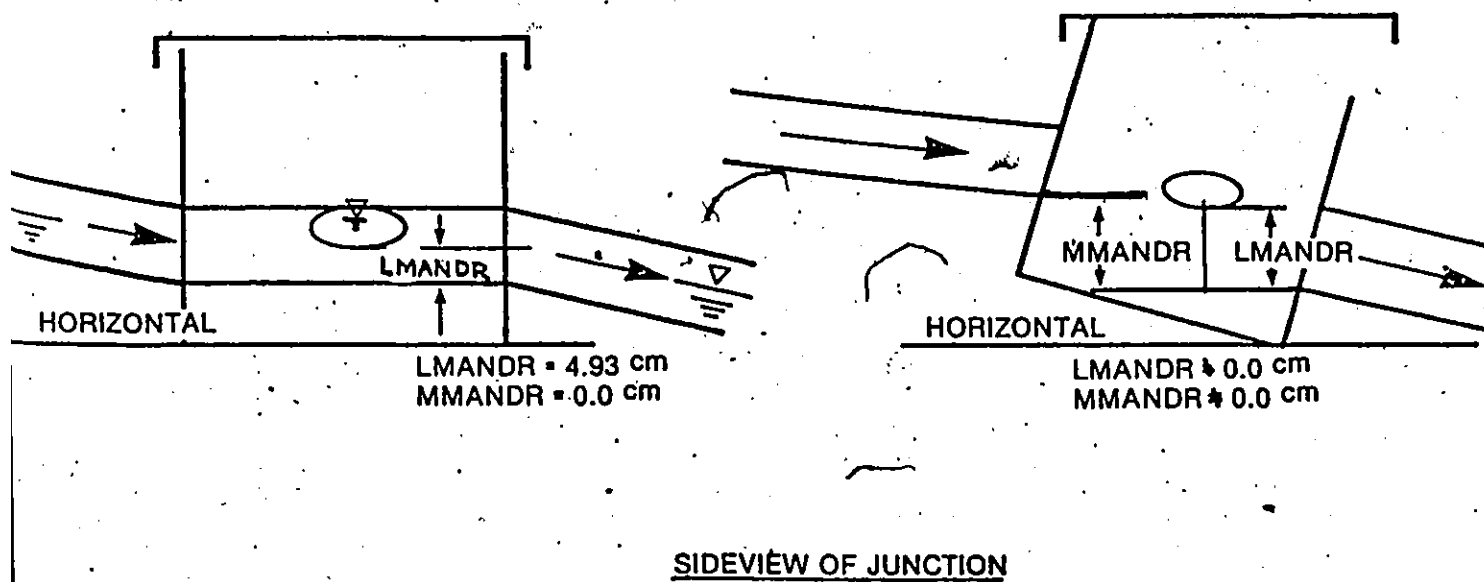


FIG. 4.1 HYDRAULIC AND GEOMETRIC PARAMETERS

Since the following parameters, i.e, MMANDR, LMANDR, L, W, Q3, Q2, S1, S2, S3, θ , are to be varied during the experiments, they cannot be selected as basic quantities (see page 9 of (46)). The basic quantities } therefore may be chosen from μ , ρ , n , g , DP1, DP2, DP3.

If flow in both the model and the prototype is considered rough turbulent, then viscosity (and hence the Reynolds number) can be ignored. Under these conditions (see page 111 of (46)), a small scale model is possible. When ρ , g , DP1 are chosen as the basic quantities, it can be shown that they are dimensionally independent i.e.

$$\begin{vmatrix} \rho & g & DP1 \\ -2 & -1 & 1 \\ -2 & -2 & 0 \\ 1 & 0 & 0 \end{vmatrix} \neq 0 \dots\dots\dots(4.6)$$

Two scale relationships are fixed (i.e. $\lambda_g = 1$ and $\lambda_\rho = 1$). The latter is due to the fact that the model fluid is the same as the prototype fluid. It is assumed that model and prototype fluid temperatures are effectively the same. The length scale is normally chosen to suit the available space in the laboratory, the available pipe sizes and the funds available for the study.

In this study the length scale is $\lambda_1 = 9.16$. Model pipe diameters of 15.1 cm (5.9 in.) and 9.98 cm (3.9 in.) represent, therefore, prototype pipe diameters of 0.914 m (36 in.) and 1.37 m (54 in.) - two commercially available and much used pipe sizes.

It can be shown that viscosity does influence the model flow behaviour. The term "scale effect" is the name given to such non-negligible effects introduced by forces other than the dominant one (gravity in this case). To evaluate the scale effect, the model results must be compared with prototype results.

The local energy losses due to changes in the flow area geometry are much greater than friction energy losses, and therefore the friction scale may be ignored. In view of these statements equation (4.5) may be written as:

$$K = f_k (X_1, \dots, X_{11}) \dots\dots\dots(4.7)$$

where

$X_1 = L/DP_1$	-----	length number
$X_2 = W/DP_1$	-----	flow area number
$X_3 = MMANDR/DP_1$	-----	main drop number
$X_4 = LMANDR/DP_1$	-----	lateral drop number
$X_5 = DP_2/DP_1$	-----	pipe ratio number
$X_6 = \theta$	-----	angle number
$X_7 = S_1$	-----	slope number
$X_8 = S_2$	-----	slope number
$X_9 = S_3$	-----	slope number
$X_{10} = Q_2/g^{1/2} (DP_1)^{2 1/2}$	-----	lateral flow rate no.
$X_{11} = Q_3/g^{1/2} (DP_1)^{2 1/2}$	-----	main flow rate number

Dynamic similarity is given by:

$$\lambda_{x_1} = \lambda_{x_2} = \dots \lambda_{x_{11}} = 1 \dots\dots\dots(4.8)$$

The following list of scale ratios can be derived

$$\lambda_Q = \lambda_1^{2\frac{1}{2}} \dots\dots\dots(4.9)$$

$$Q_p = Q_m (9.16)^{2\frac{1}{2}} \dots\dots\dots(4.10)$$

$$V_p = V_m (9.16)^{\frac{1}{2}} \dots\dots\dots(4.11)$$

where p and m stand for prototype and model values.

Using these scale ratios, and taking into account the scale effect, all model results may be translated into prototype performance.

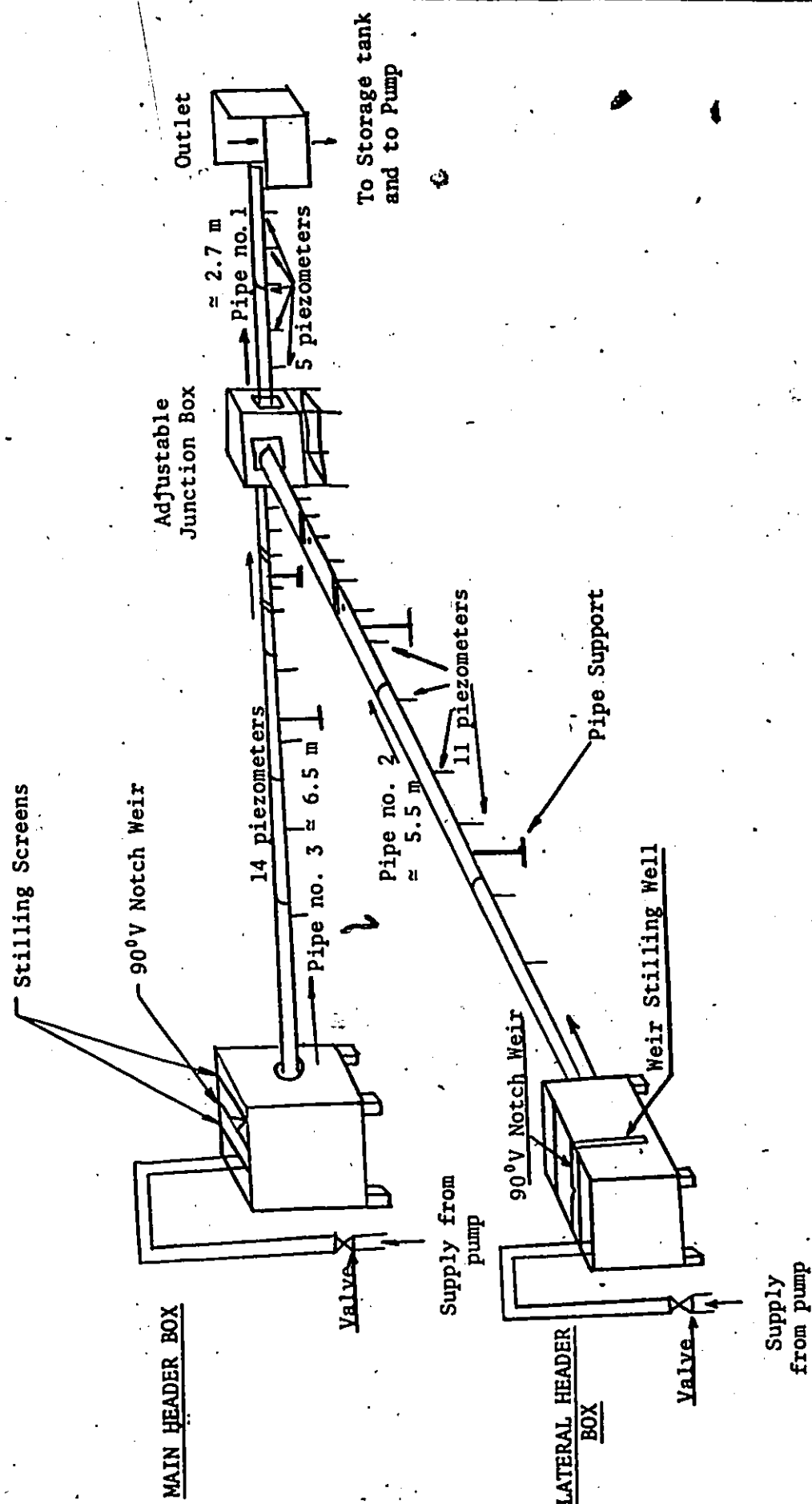
4.2 Physical Description of Model

A general layout of the apparatus is shown in figure 4-2A and 4-2B.

4.2.1 Head Boxes

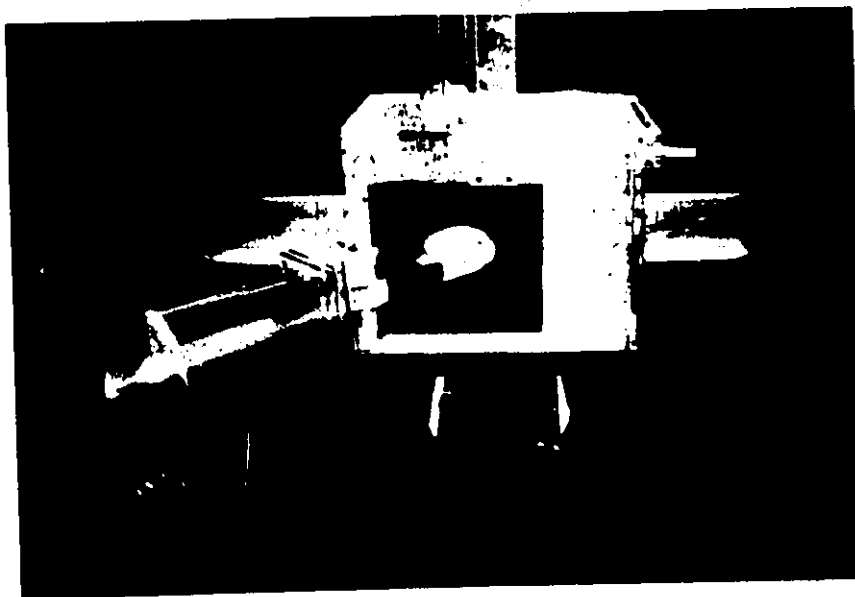
These units were used to supply and measure flows to the two pipes upstream from the junction. The boxes were built of 1.90 cm ($\frac{3}{4}$ in.) plywood, coated with poly-urethane to waterproof the wood. The nominal dimensions were as follows: length = 1.52 m (5ft), width 0.76 m (2.5 ft), depth = 1.06 m (3.5 ft) (see figure 4-3). Stilling screens were installed before the weirs and at the outlets of the header boxes to calm the water surface.

FIGURE 4-2A

GENERAL LAYOUT OF THE MODEL

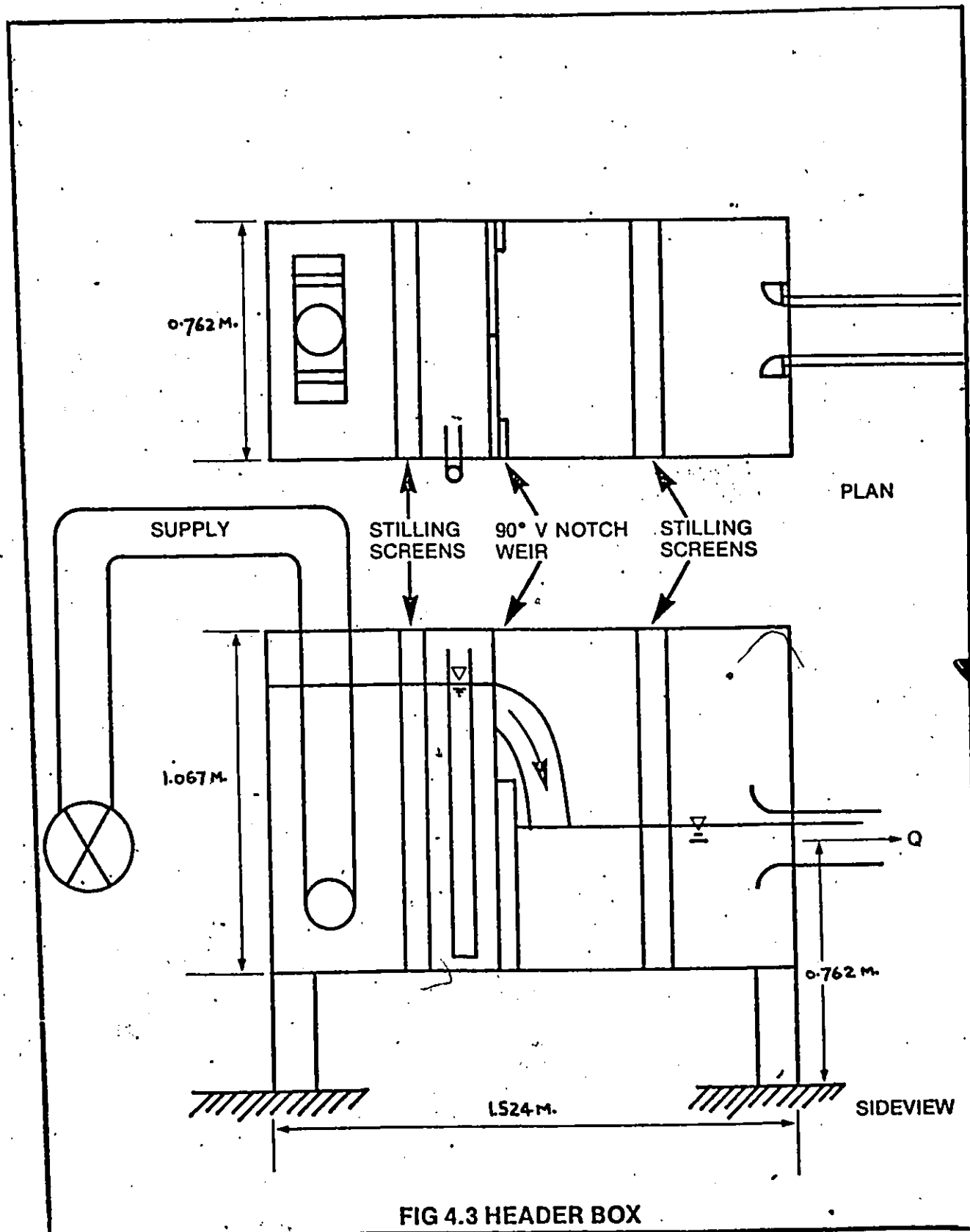


PIPE NETWORK AND CENTRAL PIEZOMETER



JUNCTION BOX

FIGURE 4-2B EXPERIMENTAL SET-UP



4.2.2. Weir Flow Measurements

A 90° sharp edged "v"-notch weir was placed in each header box to measure flows. Two identical weirs were machined from 0.127 cm ($\frac{1}{2}$ in.) thick plexiglass. The maximum design head for the weirs was one foot giving a capacity of 70,792 cm³ sec⁻¹ (2.5 cfs). The head above the "v"-notch was measured by recording the water surface elevation in a stilling well attached to the box (see figure 4-4).

Before experiments were started each weir was calibrated to produce rating curves for same.

For a particular setting of the valve on the supply pipe, the time taken to fill a known volume was recorded. Twenty readings were taken for the weir in the main header box and thirteen readings were taken for the weir in the lateral header box. The head above the "v"-notch and flow rate were plotted on logarithmic scale paper. The readings presented in figure 4-5. All stilling well readings were read with a cathetometer (figure 4-6).

4.2.3. Model Pipelines

The upstream main pipe was made up of four clear cast acrylic plastic tubes with a nominal inside diameter of 15.24 cm (6.0 in.) $\pm$ 0.50 cm and an outside diameter of 16.50 cm (6.5 in.) $\pm$ 0.50 cm totalling about 6.55 m (21.5 ft)

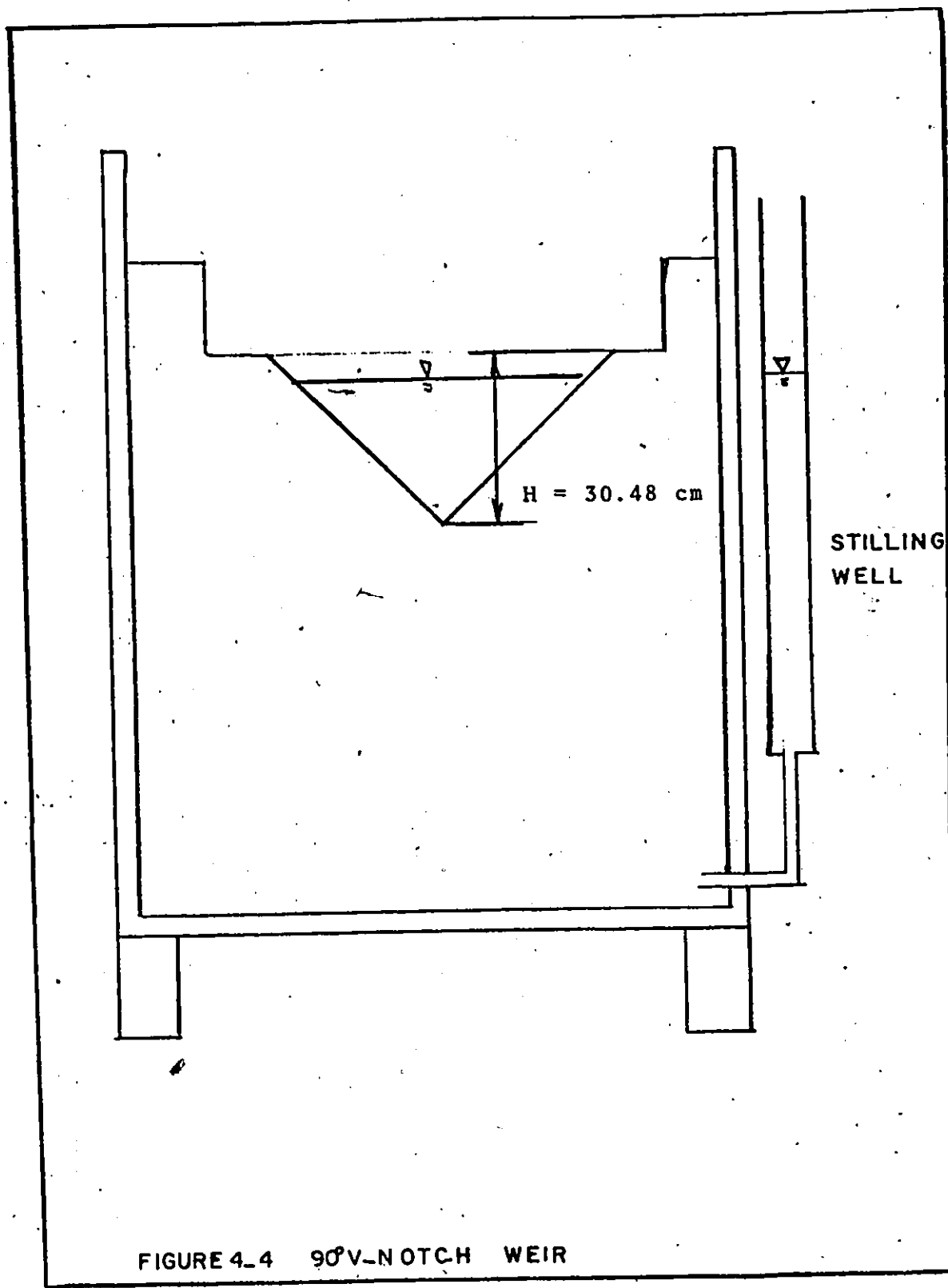
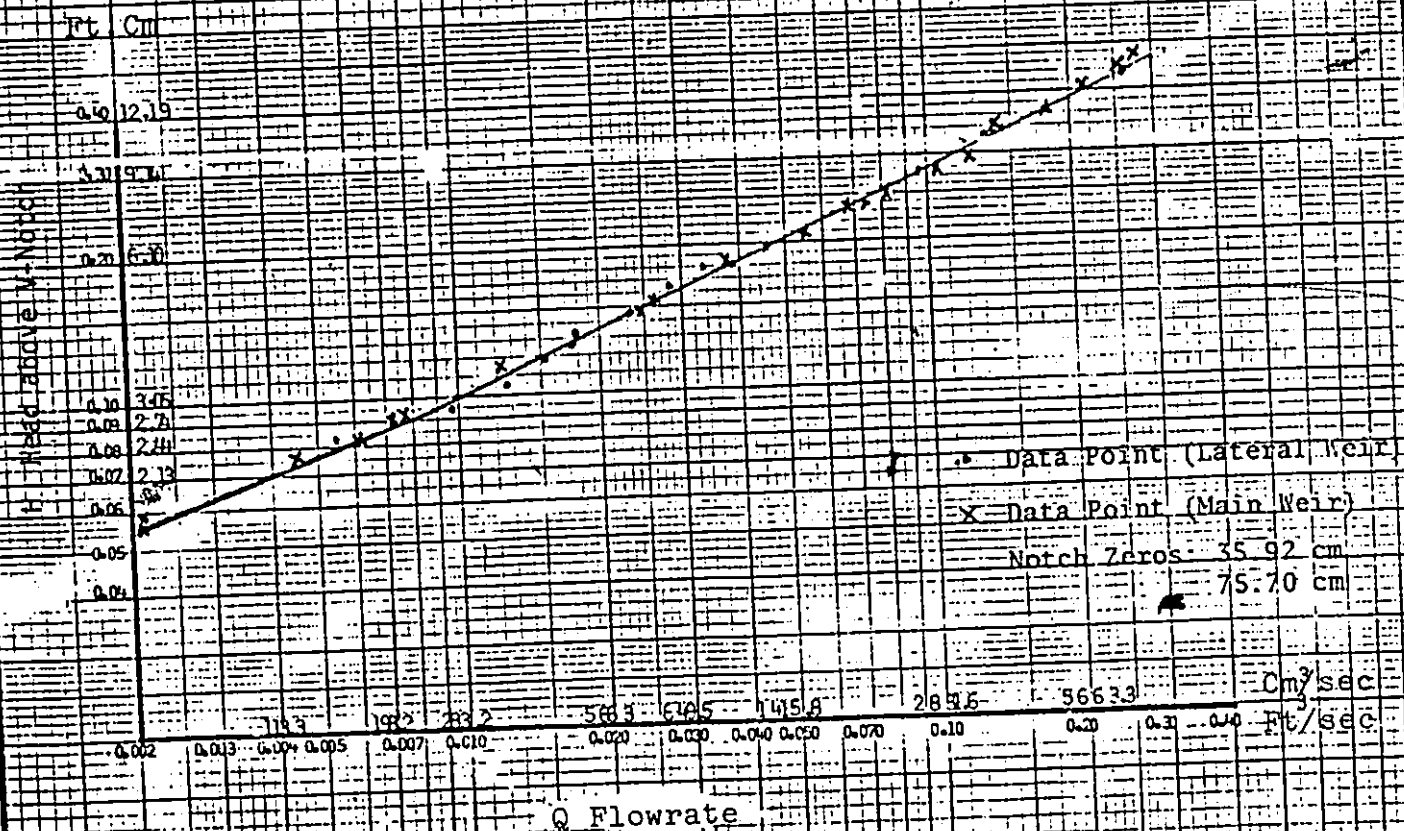
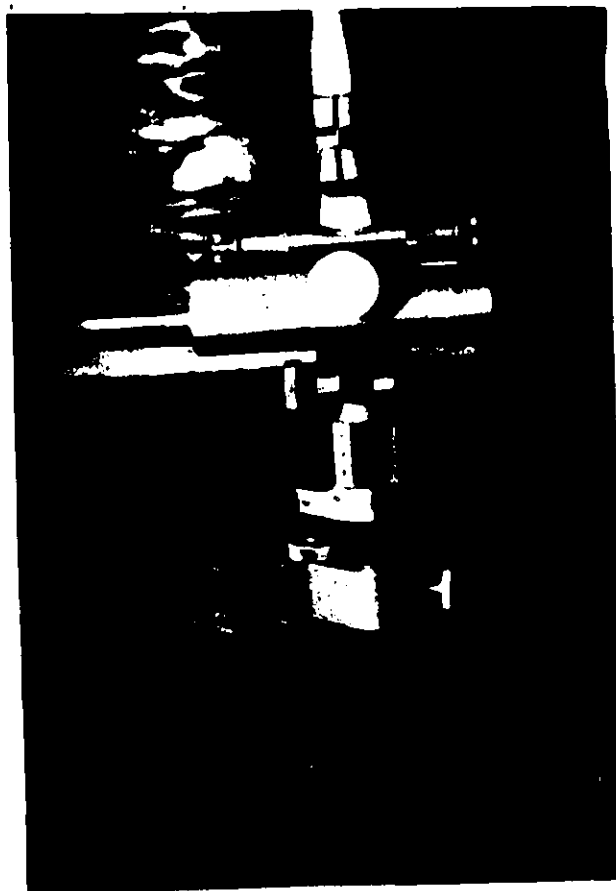


FIGURE 4-5

RATING CURVE: 90° V-NOTCH WEIR CALIBRATION

Data From Volume Measurements
PERPEX WEIR
Spring 1975 U. of C. Lab





CATHETOMETER

FIGURE 4-6 CATHETOMETER

in length. The ends of the tubes were machined square and plexiglass flanges were machined to fit the ends of the units. The pipe units were then bolted together using eight equally spaced bolts.

The pipe was supported by means of three equally spaced adjustable jacks, and attached with flexible couplings to the junction box, at the outflow end and the main header box, at the inflow end (see figure 4-7). A bell-mouth entry was provided at the inlet (with a radius of curvature of 3.05 cm (1.2 in.)) (see figure 4-7) to ensure a smooth entry of the flow to the pipe.

The lateral pipe was made up of three clear cast acrylic plastic tubes with a nominal inside diameter of 10.16 cm (4 in.) $\pm$ 0.50 cm and an outside diameter of 11.4 cm (4.5 in.) $\pm$ 0.50 cm totalling about 5.5 m (19 ft) in length. The pipe had two intermediate supports (two adjustable jacks). The pipe ends were attached as before with flexible couplings. The inlet was provided with a bell-mouth entry of radius 2.03 cm (0.8 in.).

With the main pipe 6.55 m (21.5 ft) long (or 43 pipe diameters) and the lateral 5.5 m (18 ft) long (or 54 pipe diameters) there was sufficient length (25 to 40 pipe diameters is usually sufficient) to develop uniform flow upstream of the junction box. Initial tests confirmed that uniform flow conditions were achieved in the pipes upstream of the junction box.

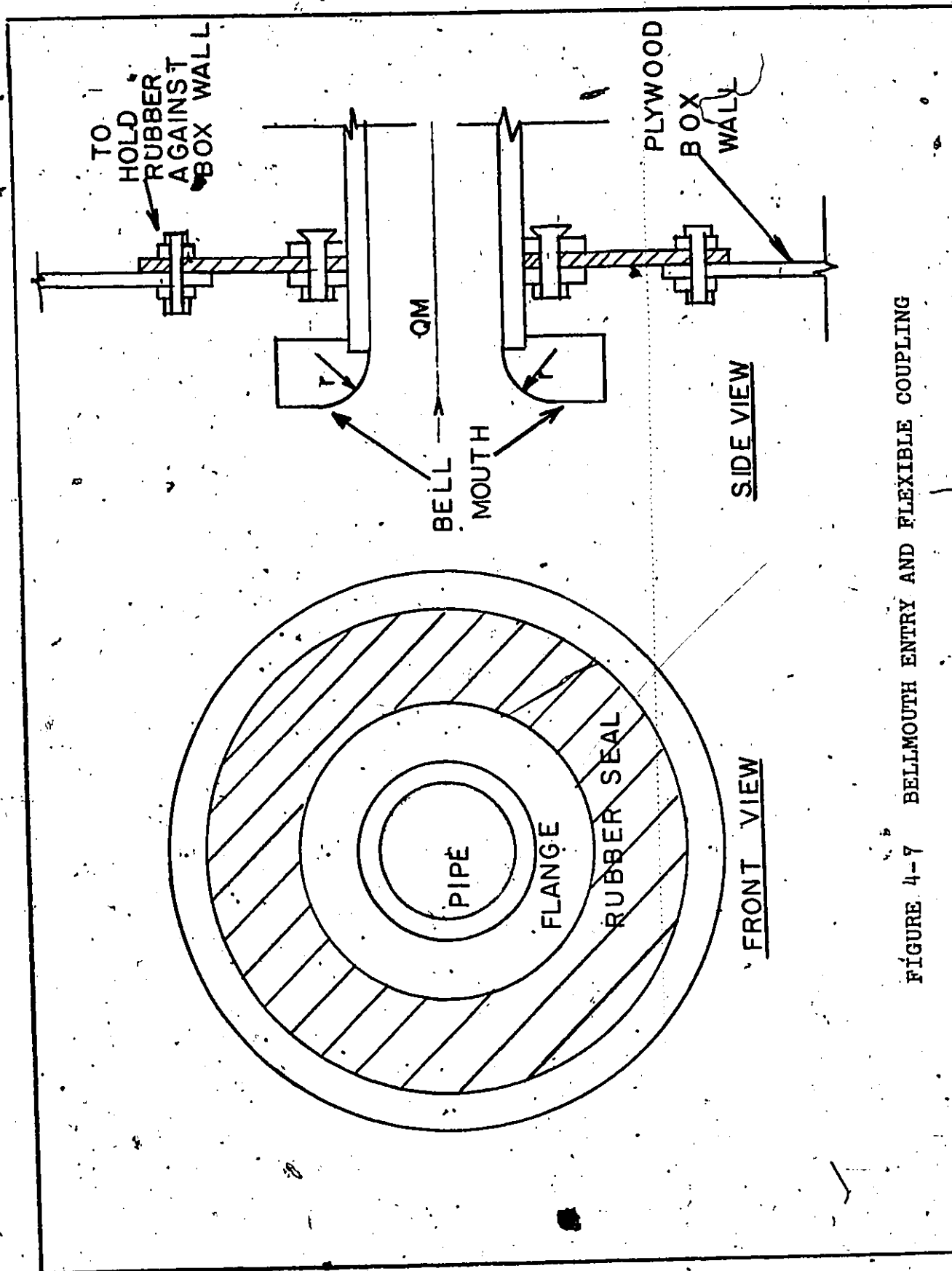


FIGURE 4-7 BELLMOUTH ENTRY AND FLEXIBLE COUPLING

The 2.7 m (9 ft) long outlet pipe was similar to the main pipe. One end was attached to the junction and the other end cantilevered from a single jack support. The flow conditions, at outlet, were therefore the "free-outfall" type.

Slope measurements were made for each individual pipe section with the pipe flowing near full by means of recording the change in elevation of measured length along the top of the pipe (see figure 4-8)

4.2.4 Piezometers

Thirty open piezometers were connected to the pipeline invert to record the hydraulic grade line in the pipes. Holes 1.6 mm ($\frac{1}{16}$ in.) in diameter, were drilled at various locations along the three pipelines at the piezometer tapping points (see figures 4-9, 4-10, 4-11). The tapping points were not evenly spaced insofar as closer spacings were made just upstream of the junction box where gradually varied water surface profiles were expected to occur. The construction details are presented in figure 4-12. All tapping points were connected to a manometer board, consisting of a corresponding number of clear plastic rigid tubes (1.27 cm ($\frac{1}{2}$ in.) I.D.), by lengths of flexible tubing. All piezometer levels were read with the aid of a cathethometer (see figure 4-6) (precision of the cathethometer is ± 0.0005 cm).

FIGURE 4-8

SLOPE INDICATOR SPACING (cm)

<u>SECTION 1</u>	<u>SECTION 2</u>	<u>SECTION 3</u>	<u>SECTION 4</u>
<u>Main Pipe</u>			
L = 165.10	L = 162.56	L = 121.92	L = 91.44
<u>Lateral Pipe</u>			
L = 165.10	L = 91.44	L = 152.40	
<u>Outlet Pipe</u>			
L = 167.64	L = 91.44		

PIPE LENGTH	167.64	165.10	162.56	152.40	121.92	91.44
Δ For Slope=.0005	.083	.082	.081	.076	.061	.046
Δ For Slope=.001	.167	.165	.162	.152	.122	.091
Δ For Slope=.002	.334	.330	.324	.304	.244	.183
Δ For Slope=.005	.838	.825	.813	.762	.610	.457
Δ For Slope=.010	1.676	1.650	1.626	1.524	1.219	.914

Δ is the change of pipe elevation over the slope indicator spacing (L)

JUNCTION 4-9

SPACING OF PIEZOMETER TAPPING POINTS
ALONG THE MAIN PIPE INVERT

POINT	LOCATION (cm)	COMMENT
0	0.0	Main Header Box
1	120.6	Tapping Point
2	176.5	Tapping Point
3	242.6	Tapping Point
4	303.5	Tapping Point
5	364.5	Tapping Point
6	425.5	Tapping Point
7	486.4	Tapping Point
8	510.0	Tapping Point
9	547.4	Tapping Point
10	563.2	Tapping Point
11	578.5	Tapping Point
12	593.7	Tapping Point
13	606.4	Tapping Point
14	608.9	Tapping Point
15	624.2	Tapping Point
16	639.5	Tapping Point
JUNCTION BOX	670.0	Junction 3 : End of Main Pipe
	715.7 or	Junction B : Branch
	694.3	Point
	732.2	Junction 1 : Beginning of outlet pipe
17	750.3	Tapping Point
18	780.8	Tapping Point
19	811.3	Tapping Point
20	872.3	Tapping Point
21	972.3	Tapping Point
	1035.4	End of Pipe

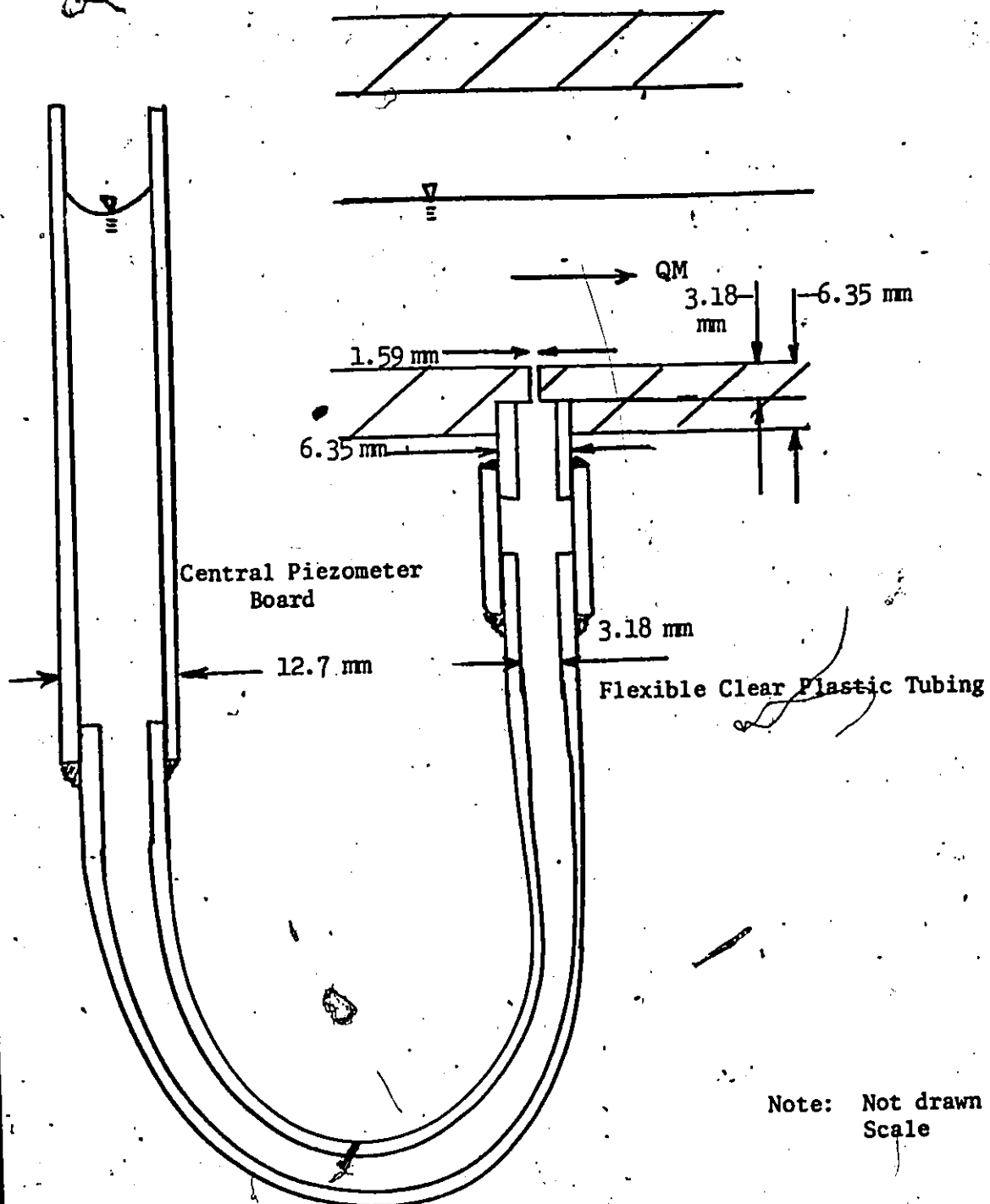
FIGURE 4-10
SPACING OF PIEZOMETER TAPPING POINTS
ALONG THE LATERAL PIPE INVERT
FOR A 45° JUNCTION

POINT	LOCATION (cm)	COMMENT
	275.6	Lateral Header Box
22	304.5	Tapping Point
23	365.5	Tapping Point
24	435.7	Tapping Point
25	396.6	Tapping Point
26	557.6	Tapping Point
27	586.7	Pointer Gauge
28	588.1	Tapping Point
29	618.5	Tapping Point
30	633.8	Tapping Point
31	644.4	Pointer Gauge
32	649.0	Tapping Point
33	664.3	Tapping Point
34	679.5	Tapping Point
JUNCTION BOX	687.8	Junction 2: End of Lateral Pipe
	715.7	Junction B: Branch Point
	732.2	Junction 1: Beginning of outlet pipe
35	750.3	Tapping Point
36	780.8	Tapping Point
37	811.3	Tapping Point
38	872.3	Tapping Point
39	972.6	Tapping Point
	1035.4	End of Pipe

FIGURE 4-11
SPACING OF PIEZOMETER TAPPING POINTS
ALONG THE LATERAL PIPE INVERT
FOR A 90° JUNCTION

POINT	LOCATION (cm)	COMMENT
	203.1	Lateral Header Box
22	292.0	Tapping Point
23	353.0	Tapping Point
24	423.2	Tapping Point
25	484.1	Tapping Point
26	545.1	Tapping Point
27	573.2	Pointer Gauge
28	575.6	Tapping Point
29	606.0	Tapping Point
30	621.3	Tapping Point
31	631.9	Pointer Gauge
32	636.5	Tapping Point
33	651.8	Tapping Point
34	667.0	Tapping Point
JUNCTION BOX	675.3	Junction 2: End of Lateral Pipe
	694.3	Junction B: Branch Point
	732.2	Junction 1: Beginning of Outlet Pipe
35	750.3	Tapping Point
36	780.8	Tapping Point
37	811.3	Tapping Point
38	872.3	Tapping Point
39	972.6	Tapping Point
	1035.4	End of Pipe

FIGURE 4-12 PIEZOMETER TAPPING



Before the commencement of tests, the lines were cleared with compressed air to dislodge air bubbles in the lines. Clear plastic tubing allowed observation of the lines for any trapped air bubbles.

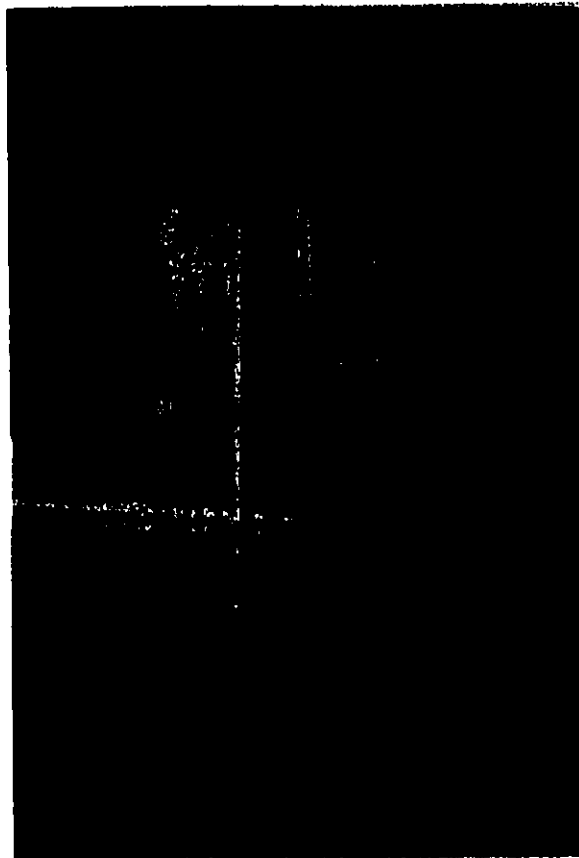
4.2.5 Velocity Traverses and Point-Gauge Stations

At approximately 5.2 m (17 ft) and 6.1 m (20 ft) from the main header box, and at 4.26 m (14 ft) and 4.87 m (16 ft) from the lateral header box, slots were cut in the crown of the pipes to enable measurements of water depth and velocity to be made. The slot was 0.64 cm ($\frac{1}{4}$ in.) wide and extended for a depth of $\frac{1}{4}$ of the pipe diameter. This was done so that a pitot tube could reach near the pipe wall at the "half-depth" elevation. (see figure 4-13).

The pitot tube used was calibrated by the National Calibration Service at the Canada Centre of Inland Waters in Burlington, Ontario. The pitot tube was of the cylindrical head type with a diameter of 0.32 cm ($\frac{1}{8}$ in.). The velocity measured by the instrument is given by

$$V = CP \sqrt{1961.2 \Delta h} \dots\dots\dots(4.12)$$

where Δh = the pitot tube reading differential in centimeters, and values for CP are given in Appendix E. Velocity traverses were made with as many as forty-one point velocity readings at both stations in each pipe with the flow held constant.



PITOT TUBE

FIGURE 4-13 PITOT TUBE ARRANGEMENT

4.3 Junction Details

The major experimental effort was directed at studying the energy losses for the case where the lateral pipe enters the junction at a 45° angle to the main pipe. For this case the geometry inside the junction box was altered in 9 ways using movable sections (see figure 4-14). Aside from the hydraulic properties of each junction type, there is a cost associated with each junction. No study was made of the costs associated with improved junctions versus the benefits to be derived from the improved hydraulics of the system as a whole. The 90° junction case was studied to compare with losses in a 45° junction.

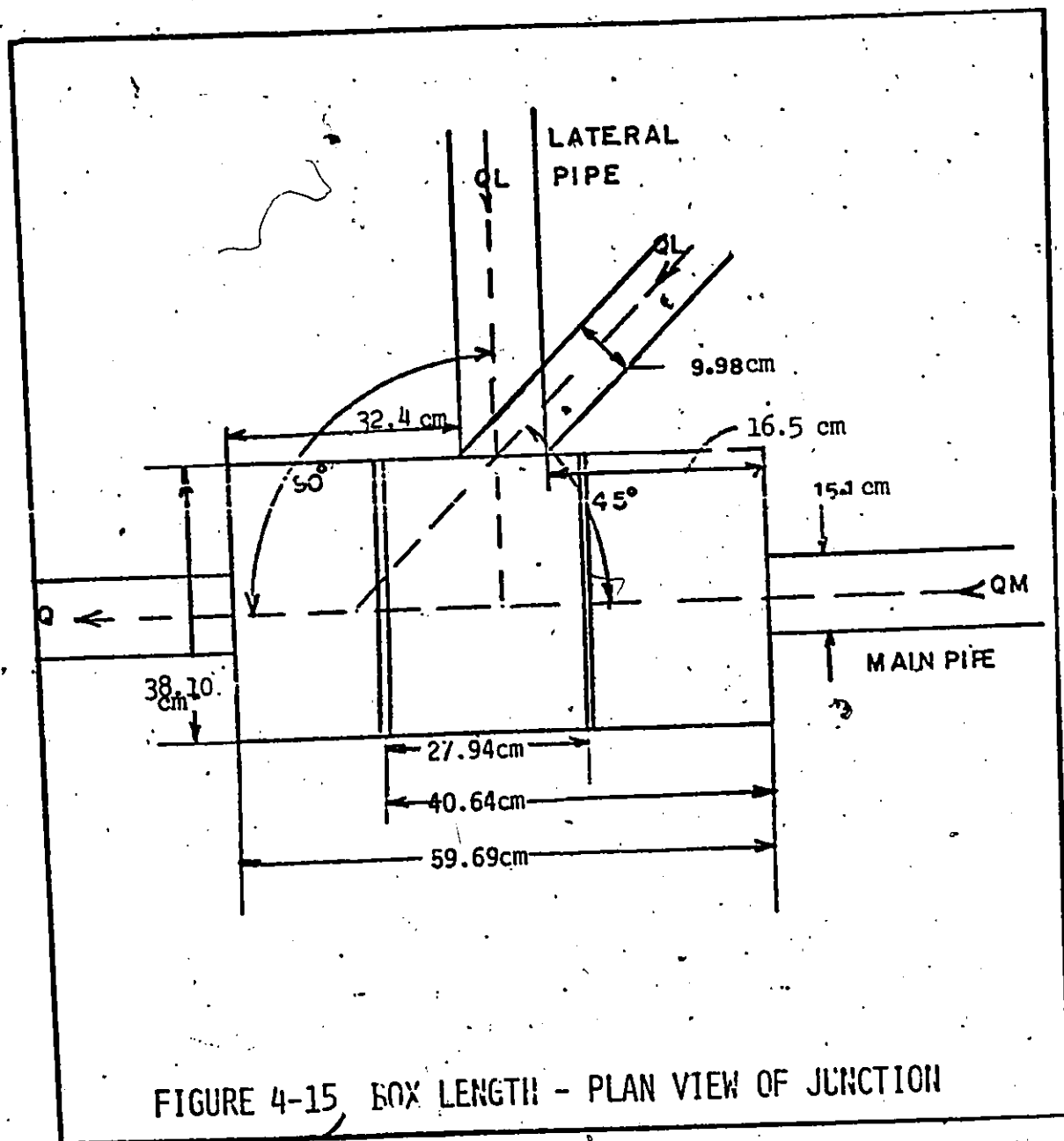
Junction Length: To test the effect of junction box length, tests were done for different box lengths. The junction box length took on three values in this study: 59.7 cm (23.5 in.), 40.6 cm (16 in.) for the 45° junction and 59.7 cm, 40.6 cm and 27.9 cm (11 in.) for the 90° junction (see figure 4-15). A 35.0 cm (14 in.) model length corresponds to a typical prototype length for these pipe diameters. It was hypothesized that a longer junction box would reduce energy losses. Some experiments for different junction configurations and pipe slopes were carried out to test this hypothesis.

"Open" Junction: The open junction is often encountered in prototype systems. In sanitary sewer junctions, the pipe inverts are joined smoothly with a shaped channel. In storm sewer junctions, the pipe inverts are not joined smoothly. The junction partially serves to catch sediment which bypassed the gutter inlet sediment trap.

FIGURE 4-14

JUNCTION TYPE AND NUMBER

<u>JUNCTION TYPE</u>	<u>JUNCTION NUMBER WITHOUT SIDEWALL</u>	<u>JUNCTION NUMBER WITH SIDEWALL</u>	<u>FIGURE NUMBER</u>
<u>Open Box</u>			
Open Box L = 59.69 cm	1	1A	4-13
Open Box L = 40.64 cm	2	2A	4-13
Open Box L = 27.94 cm	3	3A	4-13
<u>Deflectors</u>			
Fixed Downstream Deflector	4	4A	4-14
45.7 cm hinged deflector	5		4-15
15.2 cm hinged deflector	6	6A	4-15
<u>U Shaped Channel</u>			
U Shape	7		4-16
<u>Inverts Joined</u>			
Invert only	8	8A	4-17
<u>Expansion</u>			
Expansion	9		4-18
<u>No Manhole</u>			
Pipe joined directly	10		



Because it is the simplest junction to construct, and because it acts as a sediment trap, if the energy losses are low, this would be the preferred junction.

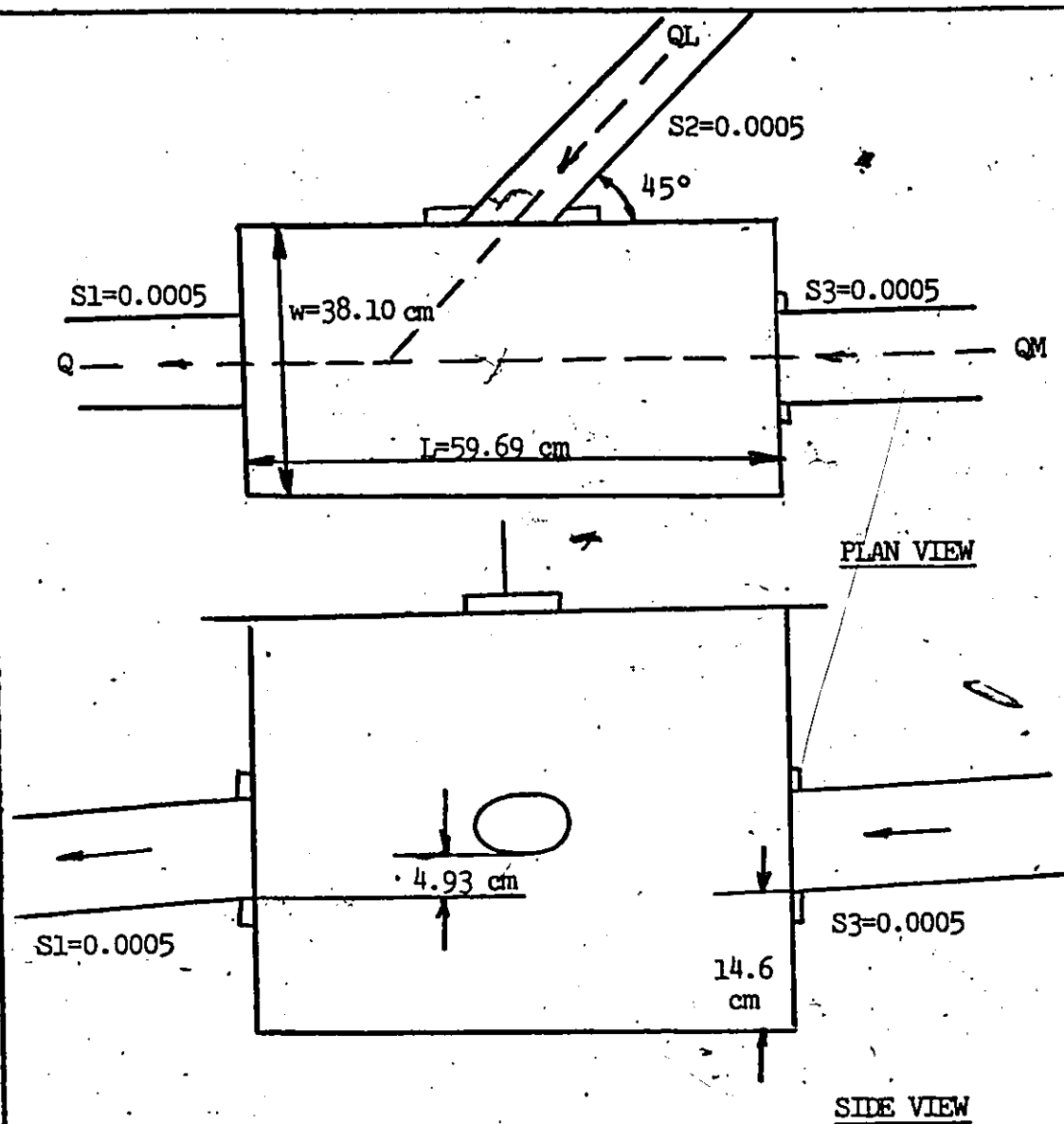
Pipe Elevations: The crowns of the incoming pipes were positioned at the same elevations and the outlet pipe crown was dropped according to the value of MMANDR.

Deflectors: A series of tests were conducted where a rigid deflector was attached to the downstream end of the junction box. The deflector projected far enough into the box (15.24 cm or 6 in.) to: (i) force an immediate change in direction of the incoming lateral flow and, (ii) ensure that both streams flowed in a common direction before free stream mixing occurred (see figure 4-18).

It was assumed that the latter effect would help reduce energy losses (and the generation of severe secondary currents) that would otherwise occur following the initial impact of the main and lateral flows.

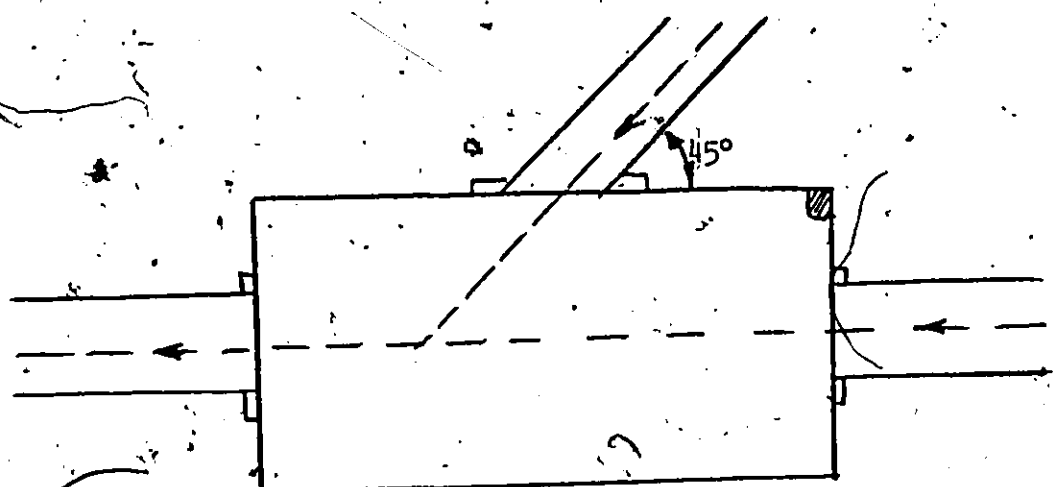
Two hinged deflectors were tested for the "inverts-joined" case and the "open box" type junction (see figure 4-19A, 4-19B). The main difference between these units and the fixed type is the fact that the hinged deflectors are capable of adjusting to the relative impact forces of the two incoming streams.

While it was felt that this feature merited investigation, it was nevertheless appreciated that hinged deflectors might malfunction under certain conditions, i.e., accumulation of sediments in the junction box and possibly cause severe flow obstruction in a prototype system.

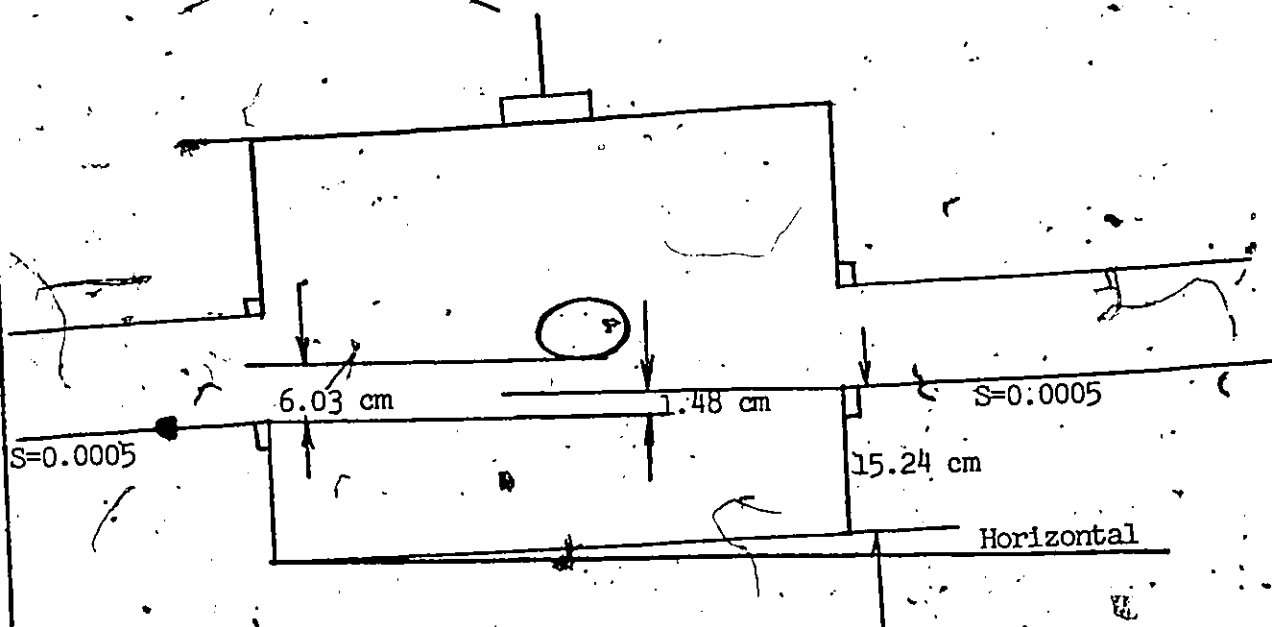


NOTE: Not drawn to scale

FIGURE 4-16
OPEN JUNCTION BOX FOR TEST SERIES 3



PLAN VIEW

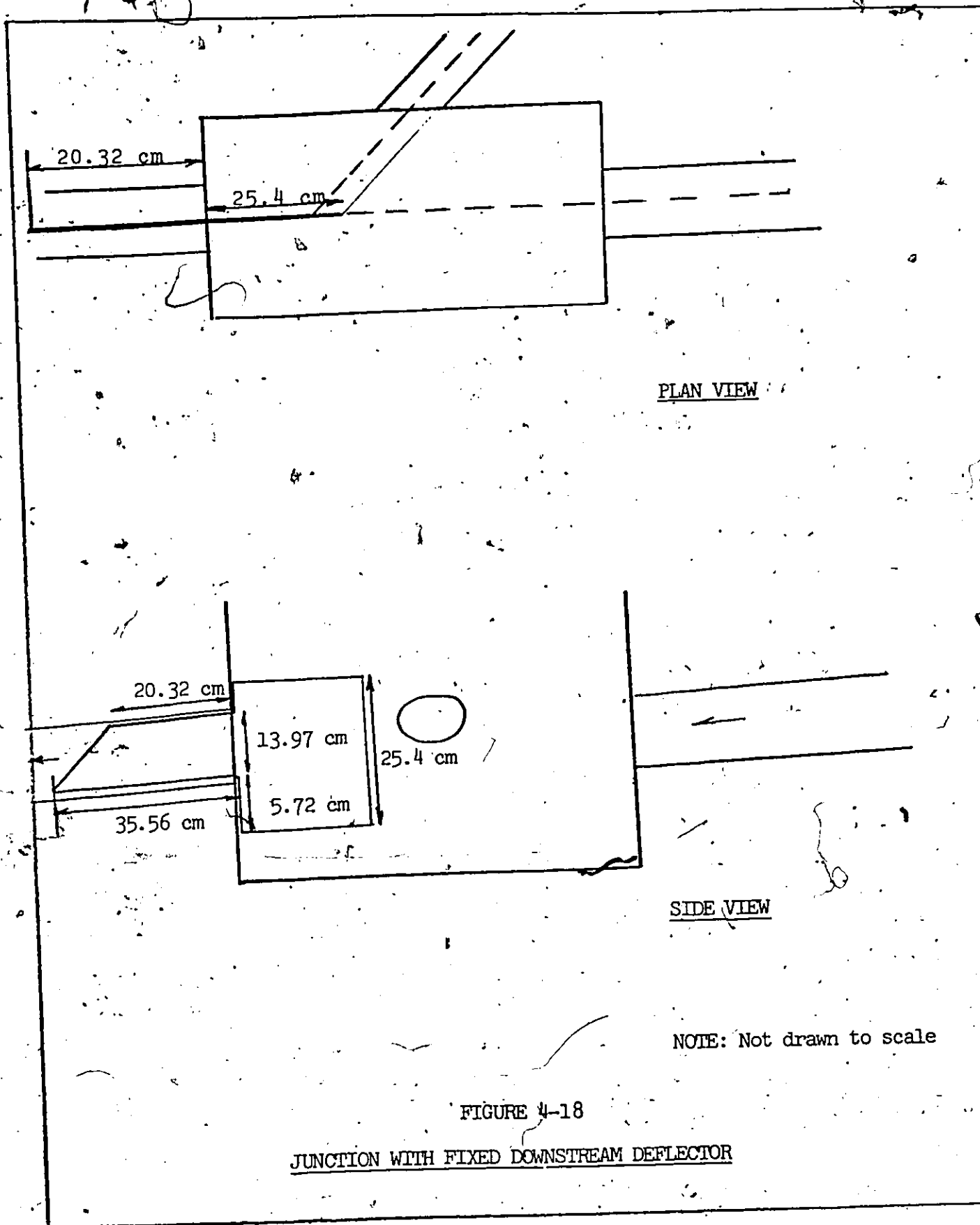


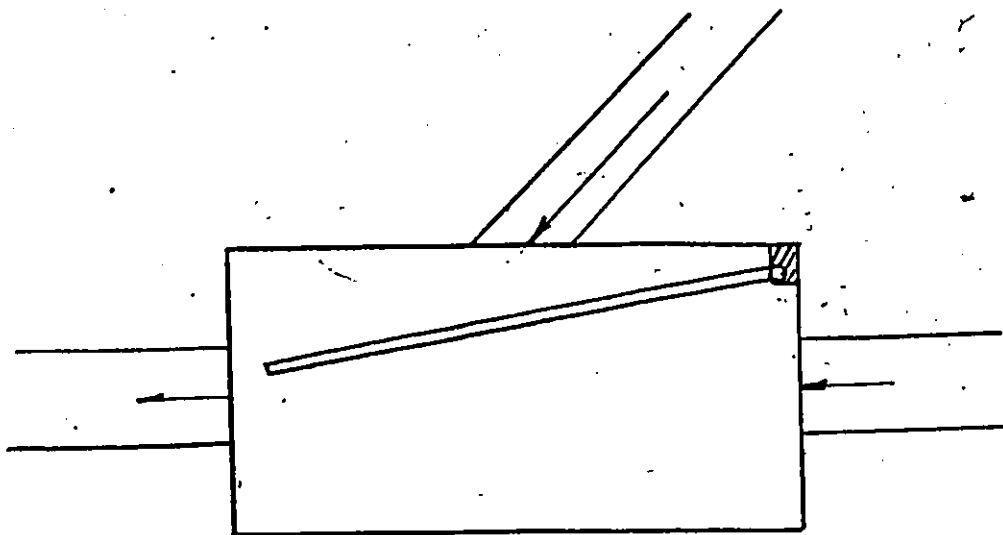
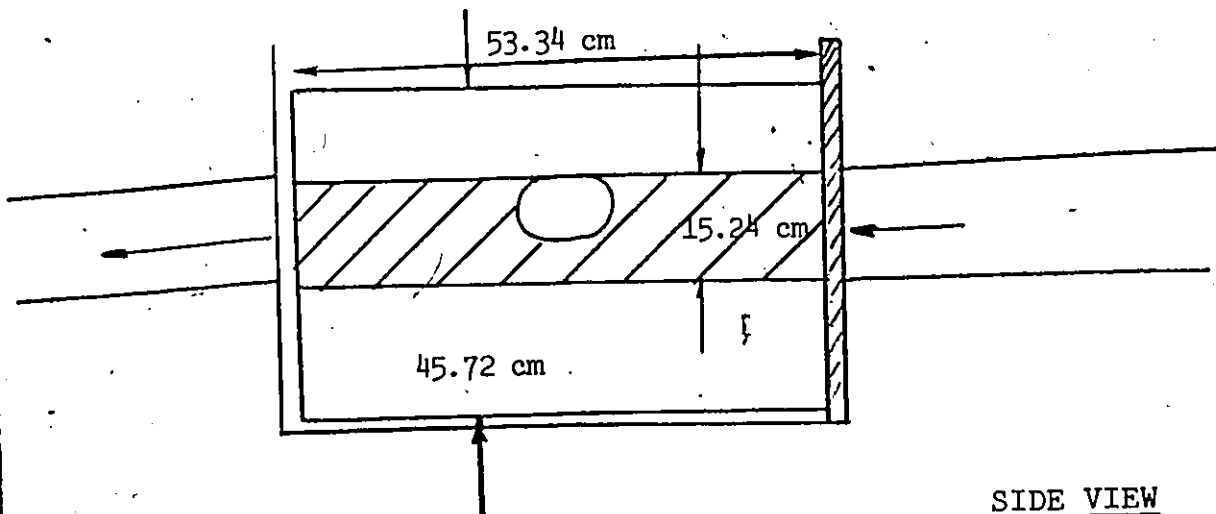
SIDE VIEW

NOTE: Not drawn to scale

FIGURE 4-17

OPEN JUNCTION BOX FOR TEST SERIES A AND B



PLAN VIEWSIDE VIEW

NOTE: Not drawn to scale

FIGURE 4-19AJUNCTION WITH HINGED DEFLECTORS 15.24 or 53.34cm



DEFLECTOR AND SIDEWALL



DYE COMING FROM SIDE CHANNEL

FIGURE 4-19B DEFLECTORS IN OPERATION

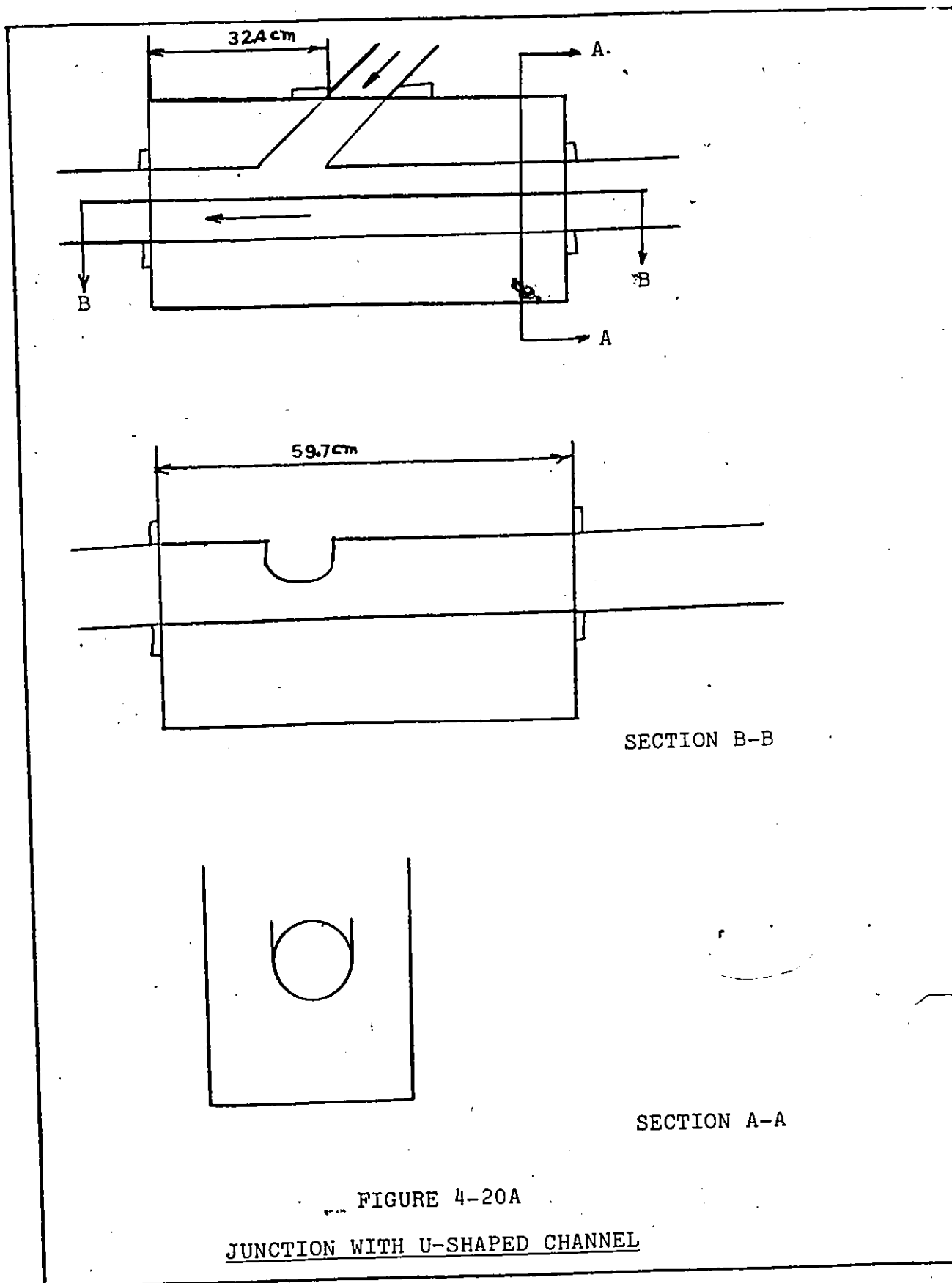
"U" Shaped Channel: The tests done by Gharghourl (12) led to the conclusion that manhole shaping and streamlining reduced the energy losses. Current recommended practice suggests the use of "U" shaped channels in junctions (page 145 of (45)) to minimize the change of cross sectional areas and the loss of energy.

In chapter three, mention was made of the possible detrimental effects of bottom shaping (Denver Colorado Manual (41)).

In this study, the "U" shaped channel was studied to compare the recommended practice with alternative designs (see figure 4-20A, 4-20B).

Inverts Joined: The case where inverts of pipes entering and leaving the junction box were joined, was tested to investigate the possible advantage of supporting the streams as they passed through the structure (figure 4-21). Furthermore, the University of Missouri tests showed a side-wall deflector to be an improvement. Hence the same junction configuration was adopted in these tests.

Expansion: If the velocities in the junction are small, then the kinetic energy loss due to jet impact should also be small. By expanding the flow area at the junction (thereby decreasing the velocity, for a constant discharge) and including the positive features such as no bottom finishing, a vertical sidewall, and minimal change in cross sectional flow area, a junction with many theoretically



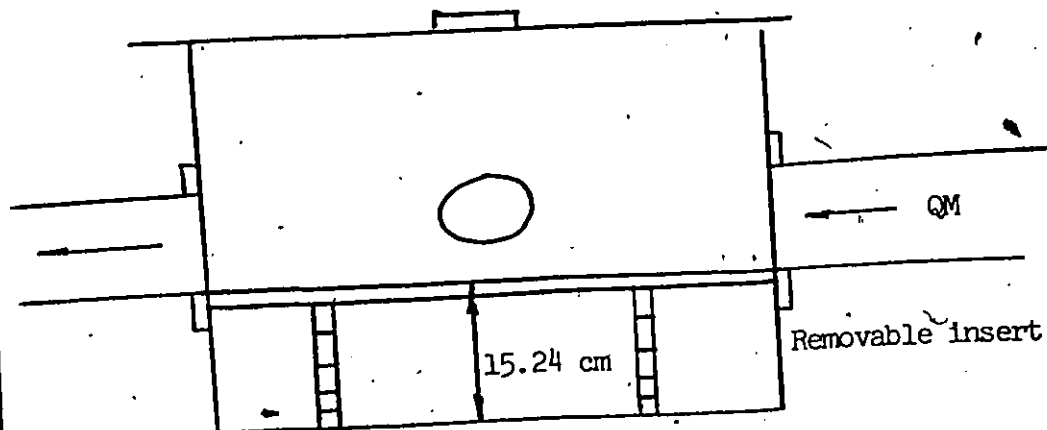


PLAN VIEW OF U-CHANNEL IN JUNCTION

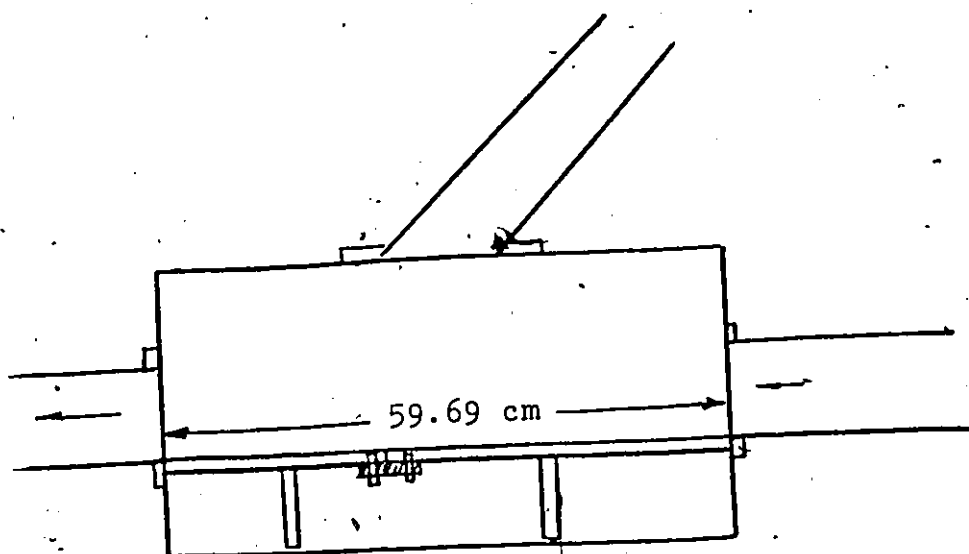


WAVE PILE-UP

FIGURE 4-20B U-SHAPED CHANNEL

SIDE VIEW

JUNCTION BOX WITH MAIN INVERTS JOINED

PLAN VIEW

NOTE: Not drawn to scale

FIGURE 4-21

JUNCTION BOX WITH SIDEWALL

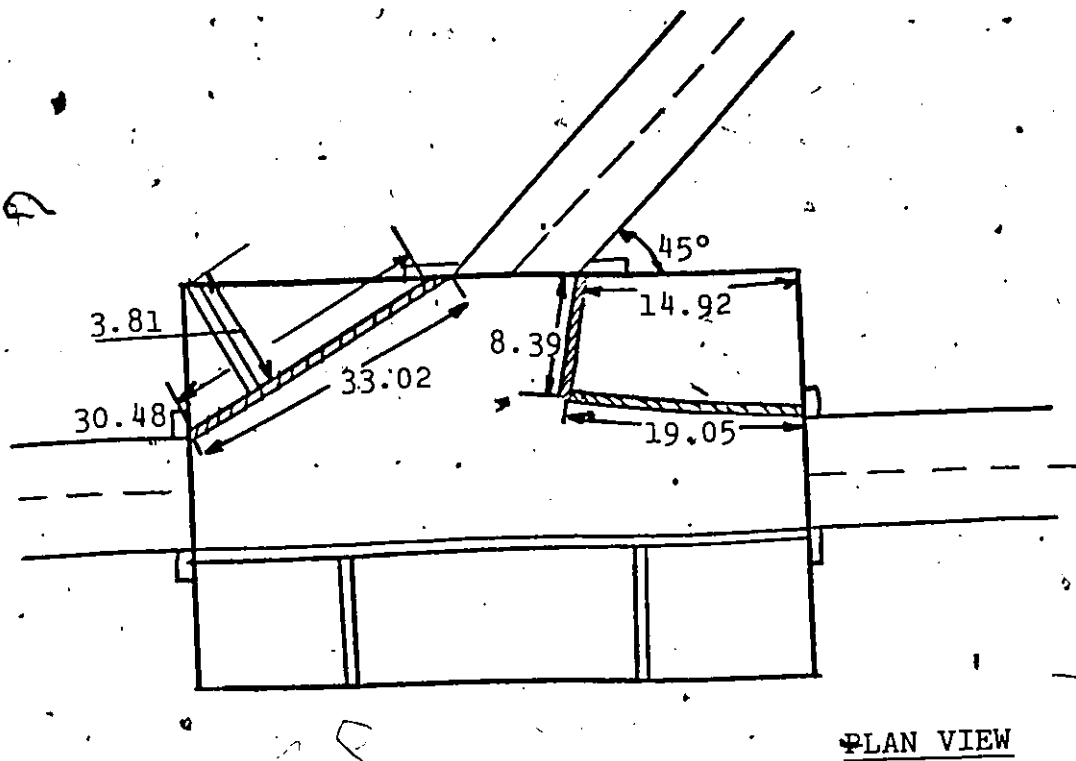
desirable features was developed. The streams were guided in the downstream direction by the junction boundaries (see figure 4-22).

Invert Drop across the Junction: A drop was given to the main pipe invert (MMANDR) by tilting the junction box (see figures 4-16, 4-17). At the same time the lateral pipe drop (LMANDR) was increased.

In practice the outlet pipe invert is usually lower, never higher, than the inlet pipe inverts. This is done to compensate for the energy lost at the junction due to impact and mixing of the streams. Some designers provide this drop to the outlet pipe invert elevation whereas others increase the slopes of the upstream pipes by an appropriate amount.

Tests were done with invert drops for the outlet pipe ranging from 0.0 to 3.96 cm (0 to 1½ in.).

Case with no Manhole: In this case the lateral pipe was joined directly to the main pipe (comparable to a precast "y-connection" in practice). No such case was investigated for the 90° junction, because it is generally not the practice to join these pipe sizes in this manner in prototype sewer systems (see figure 4-23).



NOTE: Not drawn to scale
All figures in cm

FIGURE 4-22

JUNCTION WITH EXPANSION



EXPANSION



PIPE JOINED DIRECTLY

FIGURE 4-23 EXPANSION AND PIPE JOINED DIRECTLY

CHAPTER 5EXPERIMENTAL PROCEDURE5.1 Data Collection

Appendix A presents the different conditions under which the tests were done. Appendix C presents the computer program used to reduce the collected data to the parameters of interest.

The end result of the testing was the determination of the energy loss coefficients for each junction flow considered. This required determination of the energy grade line and to this end, for each test run, the following data was recorded:

- (1) 14 piezometer readings along the upstream main pipe
- (2) 11 piezometer readings along the lateral pipe
- (3) 5 piezometer readings along the outlet pipe
- (4) water surface elevations in the stilling wells at the weirs in the lateral and main header boxes
- (5) two pointer gauge depth readings in the main pipe and two similar readings in the lateral pipe.

Up to nine runs were performed using the same junction type varying only the lateral flow rate or the main flow rate. The flow rate was controlled by adjusting the butterfly valves on the pipes delivering water to the main header box and the lateral header box. Completion of these groups of tests was followed by consideration of a different junction

geometry. This procedure was repeated for up to 9 junction geometries.

Following these initial tests the drop through the manhole (MMANDR) or the pipe slopes (S_1 , S_2 , S_3) and the length of the manhole (L) were changed. This sequence of experiments is summarized in the form of a flow chart (figure 5-1).

5.2 Flow Rates

Initial tests were done with the flow rate in the main held constant while the lateral flow rate was varied up to twice the rate in the main. The high lateral flow situation is of special interest, as it is responsible for higher energy losses. With the main flow at this low initial rate (test series 3, and A) the lateral flow water surface exhibited a drawdown profile (M2 curve) near the junction box.

A second higher value of the main flow rate was chosen to create a water surface backwater profile (M1 curve) in the lateral upstream of the junction. Test series B and all the following series of tests represent this condition, i.e., a high flow rate with backwater effects in both pipes without surcharge.

Tests on the 90° junction were also done with these maximum flow rates, i.e., repeating the rates used for similar slopes and junction types for the 45° junction.

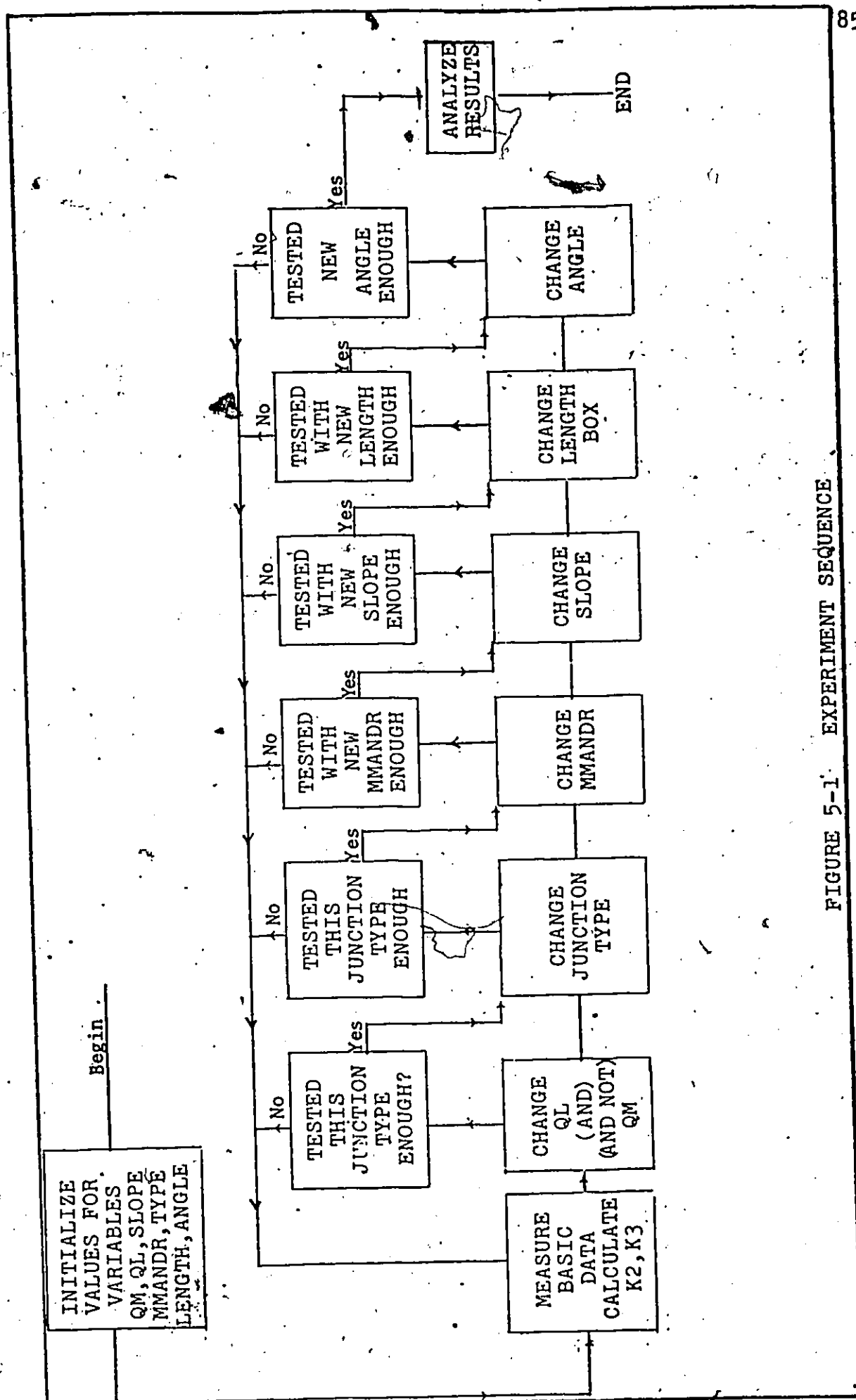


FIGURE 5-1: EXPERIMENT SEQUENCE

5.3 Piezometers

In nearly all cases the piezometer readings were steady. In some cases the levels moved up and down slowly. The recorded value was the average of the highest and lowest observed values. For each test, the cathetometer used to read the levels was kept in the same place. Every time the slope of the pipe was adjusted, the cathetometer was moved. Therefore level readings are consistent only for each test. For comparisons of water level elevation between tests, the computed H.G.L. was used.

5.4 Point Gauge Readings and Velocity Traverses

Point gauge readings were made for three purposes: (i) they provided a reference depth to which all piezometer readings could be related, and from which the H.G.L. could be calculated (ii) they provided checks on the calculated depths at the other three stations and (iii) they served as the depth used for the velocity traverses.

The velocity traverses were done for two purposes: (1) to check for a uniform velocity distribution at two stations upstream from the junction (ii) to obtain the value of " α " the energy coefficient, which is included in the kinetic energy term $\left(\frac{\alpha(V)^2}{2g} \right)$. No detailed experimental work was done to evaluate how " α " changed, at different sections of the pipe and in the junction for different junction types. Some experimental results were presented by Formica (see

page 466 in Chow (11)). For an expansion, Formica reported a sudden increase in " α " with gradual decay to its original value. A rapid contraction caused a decrease in the value of " α " in the downstream channel.

Yevjevich and Barnes (50) report energy coefficients measured in a circular cross section with open channel flow. They concluded that " α " varies between 1.05 and 1.01 for Reynolds numbers from 0.25×10^5 to 3.0×10^5 with " α " decreasing for increasing Reynolds numbers. The value of " α " also increased with a decrease in depth. They tested to a minimum depth of $\frac{1}{4}$ of the pipe diameter and flow rates between $0.5380 \text{ m}^3/\text{sec}$ (19 cfs) and $0.0566 \text{ m}^3/\text{sec}$ (2 cfs). The report by Yevjevich and Barnes (50) presents the most complete experimental investigation of " α " for open channel flow in circular cross sections.

The results of measurements done by the author agree well with the conclusions presented by Yevjevich and Barnes. The highest calculated value of " α " was 1.02. These results give support to the assumption of " α " = 1.0 used in the calculation of the E.G.L. as discussed in chapter two.

The use of " α " = 1 in the outlet pipe will lead to a value of E.L.J. ~~greater~~ greater than that if $\alpha > 1.0$ is used. Hence, the energy loss calculations are overestimated.

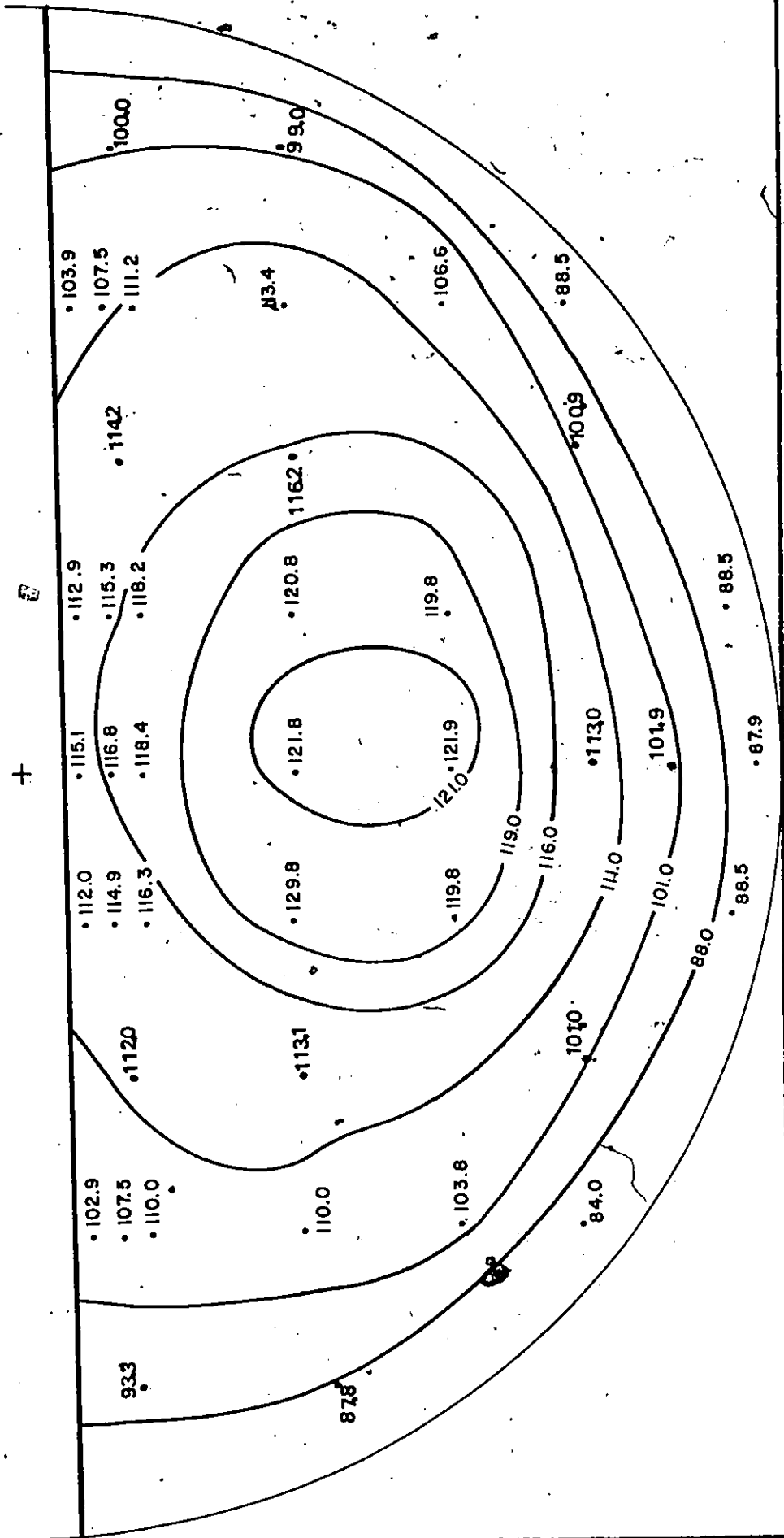
Two sample isovel⁸ patterns for flow in partially full conduits are presented in figures 5-2 and 5-3. The velocity distributions at consecutive stations are similar, indicating the presence of parallel streamlines upstream of the junction.

⁸ isovel - line of equal velocity

FIGURE 5-2A

ISOVELS FOR FIRST LATERAL STATION
(cm/sec.)

DEPTH = 4.67 cm
DIAMETER = 9.98 cm
AREA = 35.92 cm²
AVE. VELOCITY = 106.8 cm/sec
 $\alpha = 1.02$



ISOVELS FOR SECOND LATERAL STATION

 (cm/sec) 

FIGURE 5-3A
ISOVELS FOR FIRST MAIN STATION IN
(cm/sec)

DEPTH = 67.3 cm
AVE. VELOCITY = 90.5 cm/sec
AREA = 77.02 cm²
DIAMETER = 15.10 cm
 $\alpha = 1.02$

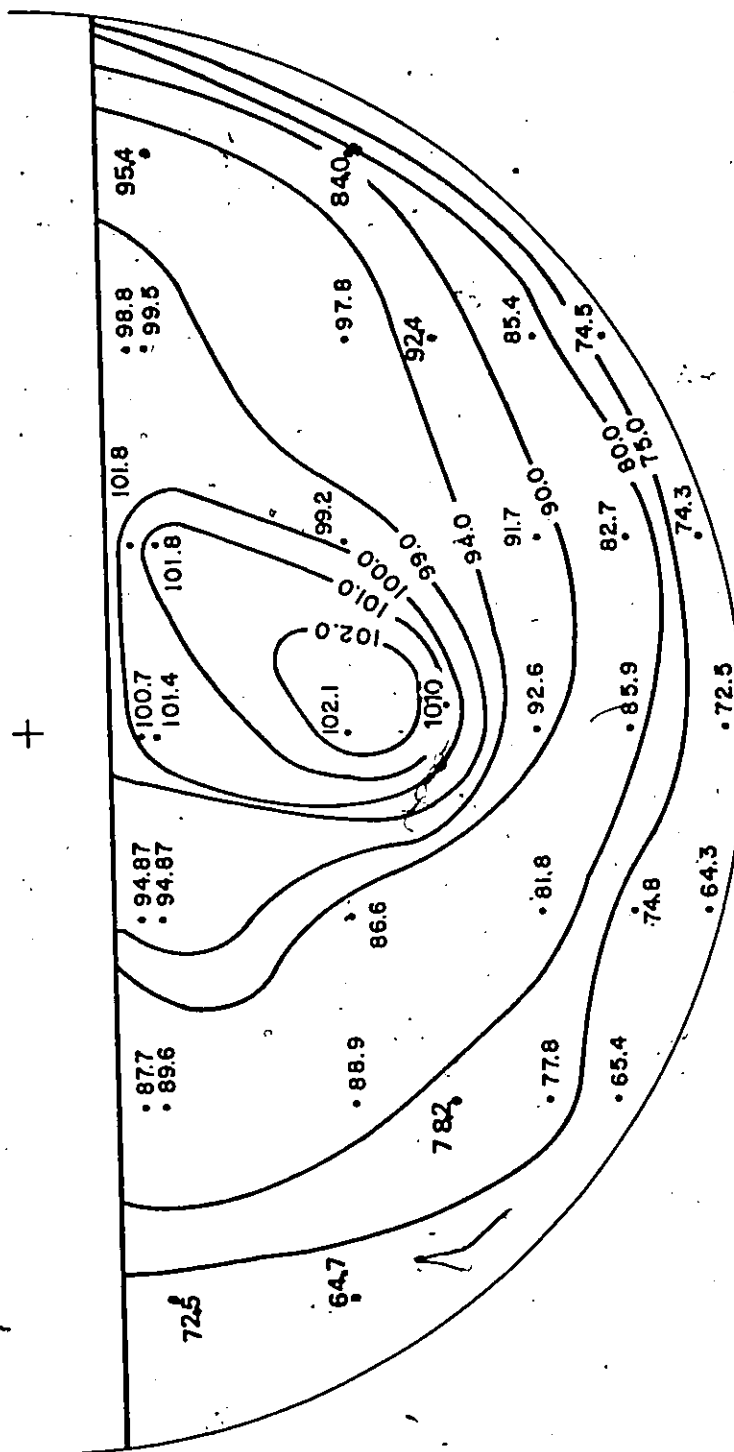
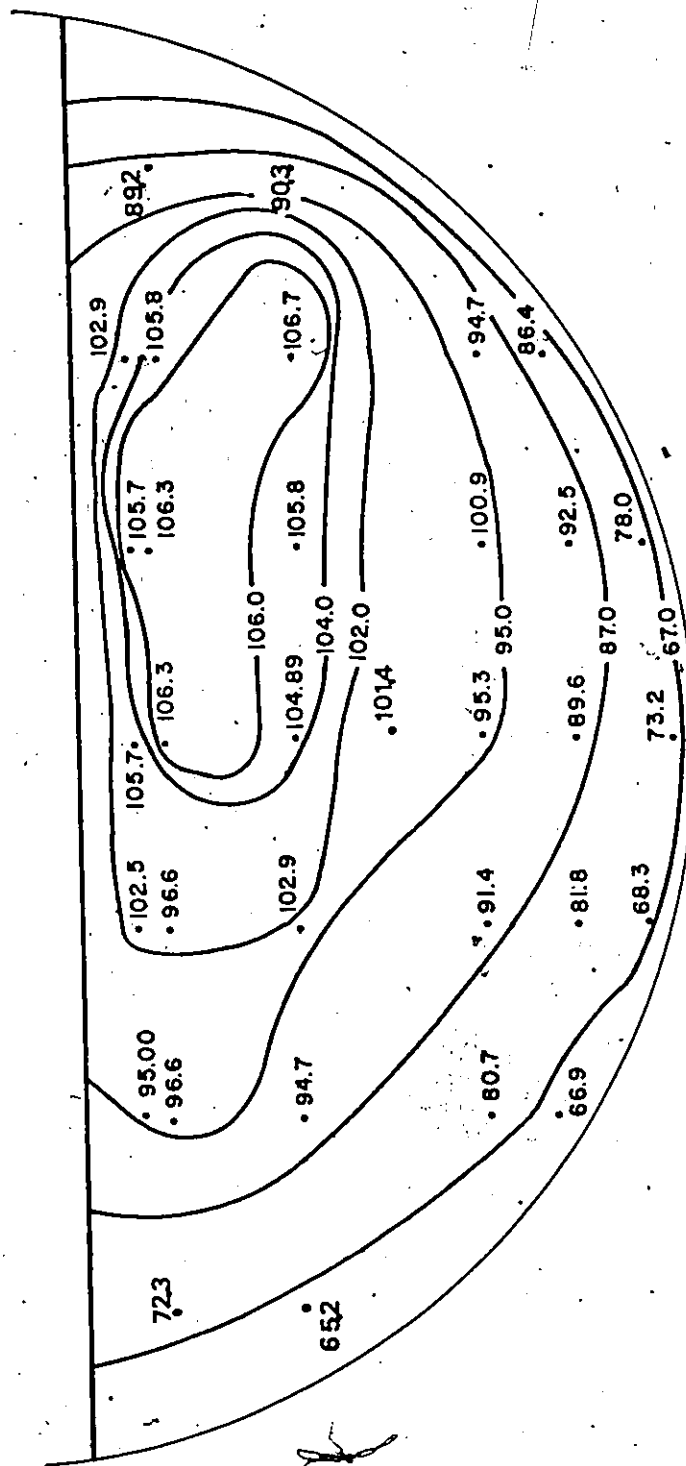


FIGURE 5-3B

ISOVELS FOR SECOND MAIN STATION IN cm/sec

DEPTH = 6.48 cm
 DIAMETER = 15.100 cm²
 AREA = 73.41 cm²
 AVE. VELOCITY = 96.8 cm/sec
 $\alpha = 102$

+



CHAPTER 6

ANALYSIS AND RESULTS

6.1 Energy Loss and Junction Type

Before reviewing the results, the reader's attention is drawn to the method by which the loss coefficients are derived. The equations in chapter three, equations (3.9), (3.11) for the lateral energy loss calculation and equations (3.8), (3.13) for the main energy loss calculation, are found in Fortran language in the computer program, lines 193-229, in Appendix C. The energies calculated are "projected" energies from upstream (N3), downstream (N1) and lateral (N2) reference points to the branch point. Ideally these reference points are located in zones of uniform flow, remote from hydraulic effects, e.g., hydraulic jump, backwater, drawdown) of the junction. Point N1 is ≈ 80 cm (31.5 in.) from the junction. Point N2 is ≈ 65 cm (25.6 in.) from the junction, and point N3 is ≈ 77 cm (30.3 in.) from the junction (see figures 4-9, 4-10, 4-11).

During some tests, these points were in the non-ideal zone where the junction has hydraulic effect, with the resultant change in the calculated losses. For slope of $\frac{1}{10}\%$, and $\frac{1}{4}\%$, the effect of changing the position of the reference points was studied. The loss coefficients changed little.

The velocity head used in the energy loss coefficient calculation was the velocity head at the first tapping point in the outlet pipe (≈ 22 cm (8.7 in.) from the junction box wall). This was the zone of rapidly varying flow. These considerations have been emphasized here to prevent hasty conclusions and comparisons with other experimental results.

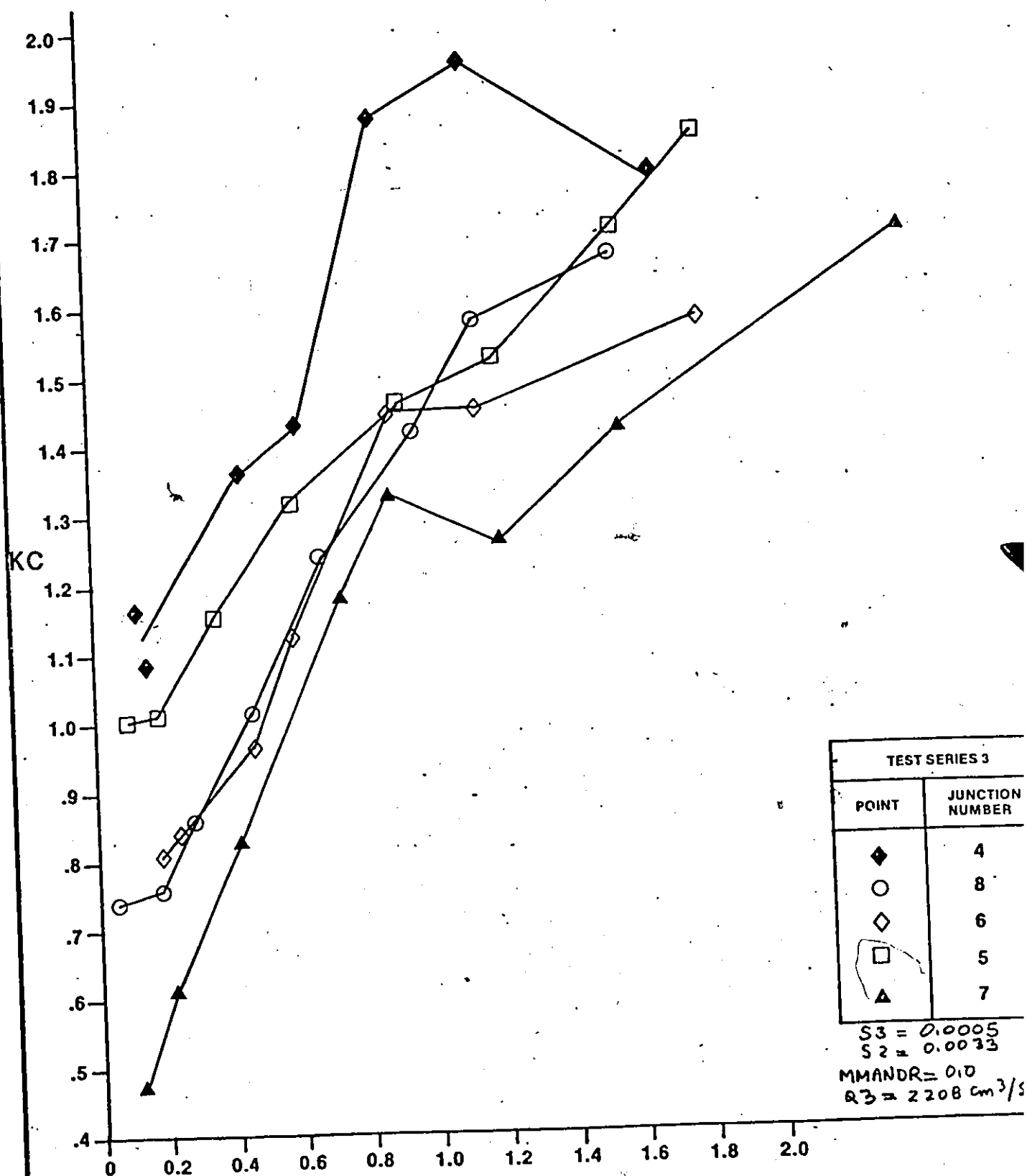
45° Junction

Each of the junction types can be considered as a change in the flow area number $\left[X_2 = \frac{W}{D_1}\right]$. Not only is the flow area available for the lateral and main stream flows (and therefore the velocities) altered, but also the general flow paths that the streams assume in the junction and the degree to which the two streams are allowed to mix with each other in the junction box.

Test results indicate (figures 6-1, 6-2, 6-3, 6-4) that the optimal junction box configuration is consistently the "U" shaped channel, (junction type 7)⁹, with the pipes joined directly (junction type 10) having the same favourable property of low energy loss.

With regard to other configurations of junction geometry investigated, the expansion (type 9), performed well in all test series. One can think of this type as a linear version of the "U" shaped channel with the additional feature of flow expansion upon entering the junction box. This particular configuration is easy to construct and has good hydraulic properties.

⁹see figure 4-14 for an explanation of the "type"



QR = RATIO 2 = QL/QM
 FIG. 6-1 ENERGY LOSS VS. RELATIVE DISCHARGE

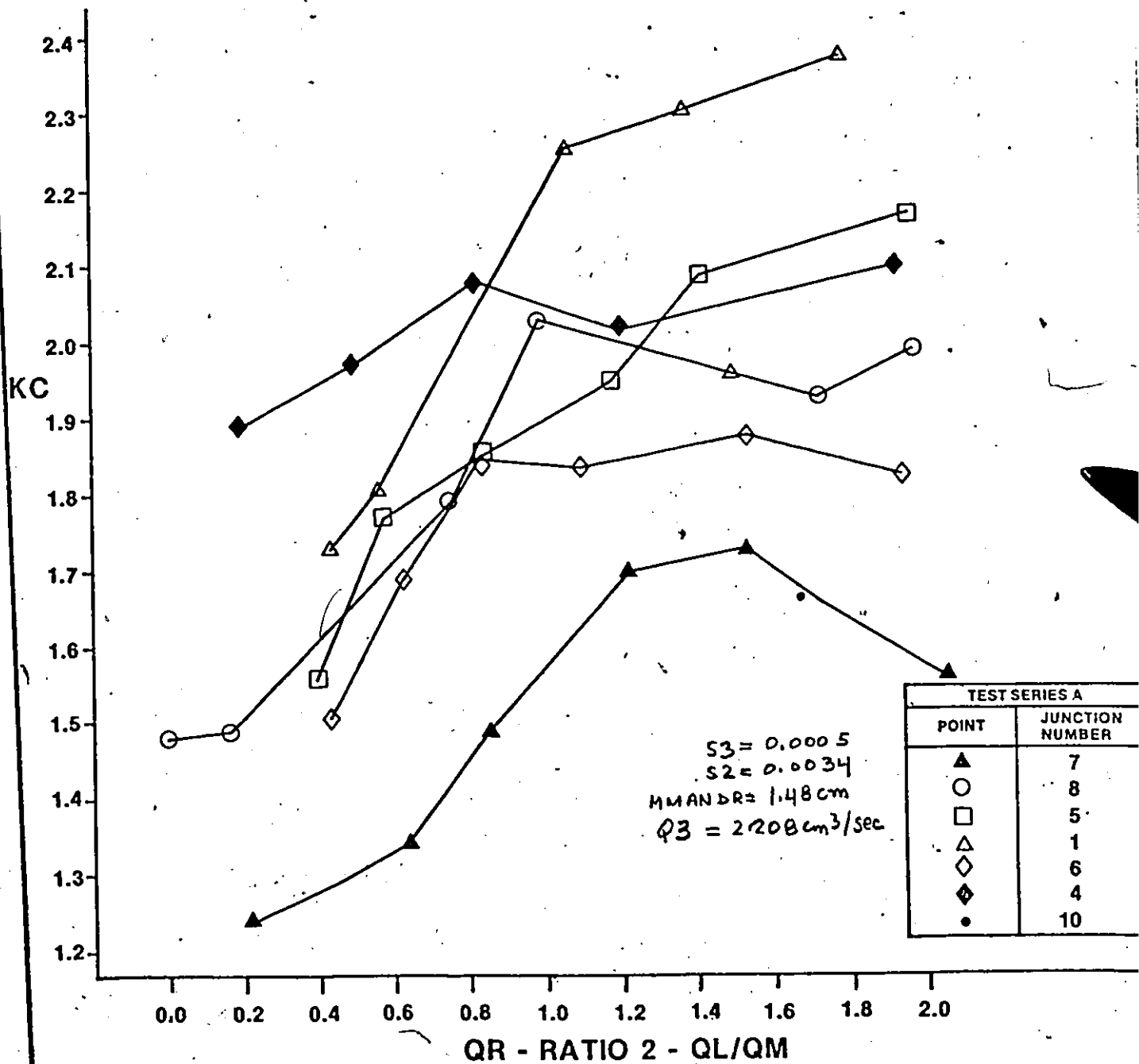


FIG. 6-2 ENERGY LOSS VS. RELATIVE DISCHARGE

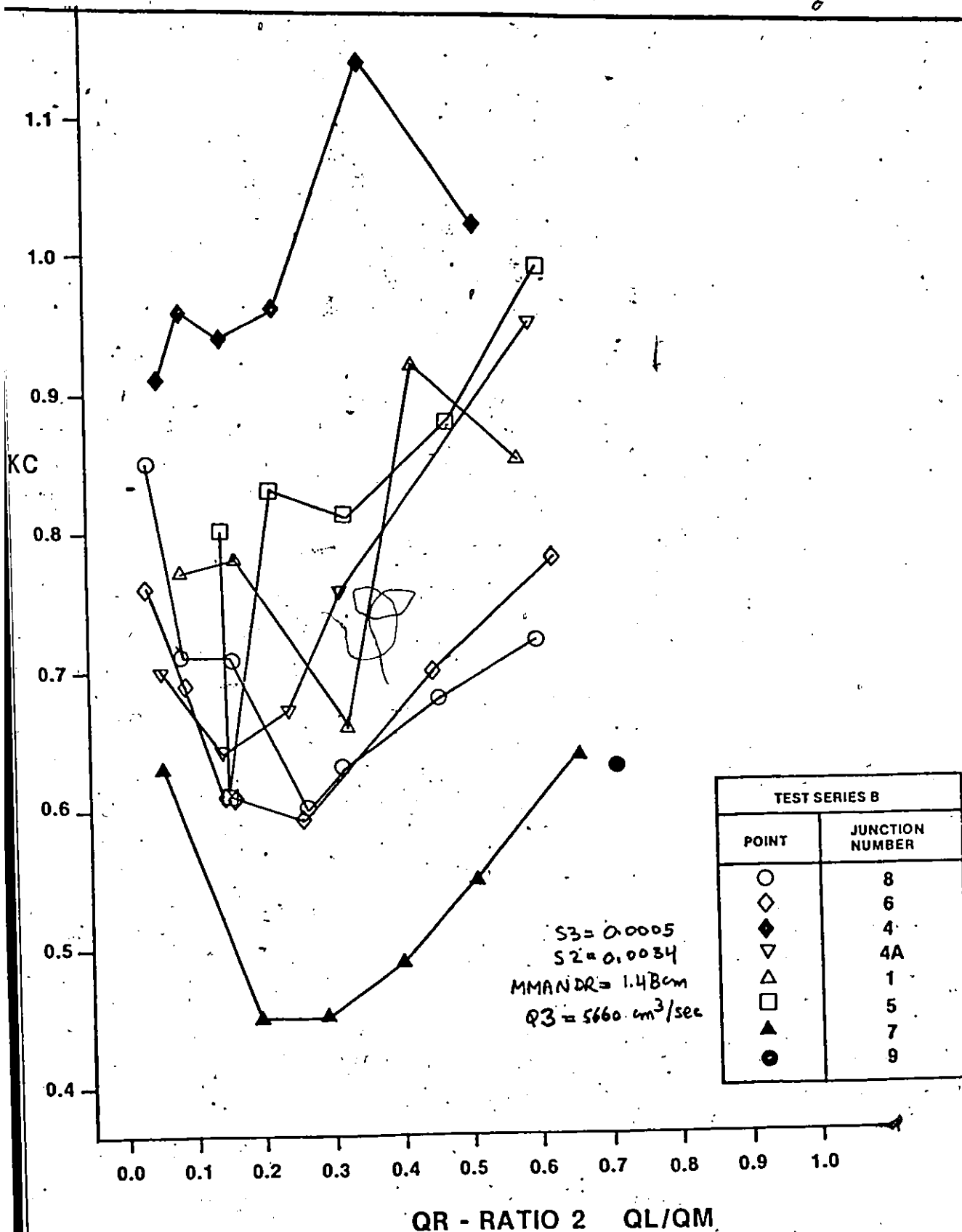


FIG. 6-3 ENERGY LOSS VS. RELATIVE DISCHARGE

ENERGY LOSS COEFFICIENTS - TEST SERIES C-N

TEST SERIES	QL/QM	KC	K3	JUNCTION TYPE
C1	0.63	0.32	0.29	8
C2	0.63	0.29	0.21	9
C3	0.63	0.29	0.29	6A
C4	0.45	0.50	0.53	4A
C5	0.45	0.30	0.32	1
C6	0.66	0.23	0.11	10
C7.1	0.65	0.27	0.23	7
C7.2	0.46	0.15	0.17	7
C7.3	0.26	0.12	0.16	7
D1.1	0.65	0.37	0.23	7
D1.2	0.35	0.28	0.17	7
D1.3	0.26	0.38	0.42	7
D1.4	1.84	0.86	-0.18	7
D2	0.72	0.61	0.30	1
D3	0.72	0.47	0.03	8A
D4	0.72	0.43	0.03	6A
D5	0.72	0.41	-0.10	9
D6.1	0.72	0.69	0.40	4A
D6.2	0.72	0.56	0.29	4A
E1	0.48	0.74	0.66	1
E2	0.48	0.57	0.52	8A
E3	0.48	0.45	0.25	9
E4	0.48	0.50	0.33	6A
E5	0.62	0.50	0.10	10
E6	0.70	0.48	0.10	7
F1.1	0.72	0.31	-0.22	7
F1.2	0.42	1.19	-0.28	7
F2	0.80	0.84	-0.10	4
F3	0.80	0.56	-0.23	8A
F4	0.80	0.17	-0.92	9
F5	0.80	0.52	0.37	6A
F6	0.80	0.86	0.05	1
G1	0.73	0.48	-0.26	9
G2	0.73	0.85	0.13	1A
G3	0.77	0.12	-0.45	10
G4	0.69	0.25	-0.19	7

FIGURE 6-4 (continued)

TEST SERIES	QL/QM	KC	K3	JUNCTION TYPE
H1.1	0.63	0.32	0.26	7
H1.2	0.27	0.17	0.23	7
H1.3	0.23	0.39	0.44	7
H2	0.72	0.31	0.18	9
H3	0.72	0.34	0.22	8A
H4	0.56	0.38	0.48	1A
I1.1	0.54	0.36	0.35	6A
I1.2	0.20	0.16	0.22	6A
I2	0.53	0.27	0.25	9
I3	0.53	0.31	0.31	8A
I4	0.53	0.36	0.35	2A
J1	0.54	0.41	0.30	6A
J2.1	0.54	0.41	0.33	9
J2.2	0.97	0.55	0.36	9
J3	0.72	0.47	0.35	8A
J4	0.70	0.42	0.34	2A
K1	0.64	0.24	0.23	6A
K2	0.64	0.23	0.20	9
K3	0.64	0.22	0.20	8A
K4	0.45	0.26	0.29	4A
N1	0.72	0.06	-0.30	4A
N2	0.72	0.02	-0.37	8A
N3	0.72	0.01	-0.27	6A
N4	0.72	0.02	-0.30	9
N5	0.72	0.03	-0.39	2

The open junction box (type 1) results in the highest energy losses, as was expected. The performance of the open box (type 1) can be compared with that of the inverts joined (type 8) to illustrate how a modification can reduce energy losses. Figure 6-5 illustrates that the energy loss coefficient is lower for type 8, and that in some cases (test series C5, H4) the lateral flow is decreased significantly in type 1 due to energy loss and backwater effects.

FIGURE 6-5

COMPARISON OF "OPEN" VS "INVERT" TYPE JUNCTION¹⁰

TEST SERIES	KC	JUNCTION TYPE	$\frac{QL}{QM}$
A2-3	2.03	8	0.99
A4-3	2.26	1	1.06
C1	0.32	8	0.63
C5	0.30	1	0.45
D2	0.47	8A	0.72
D3	0.61	1	0.72
E2	0.57	8A	0.72
E1	0.74	1	0.72
F3	0.56	8A	0.80
F6	0.86	1	0.80
H3	0.34	8A	0.72
H4	0.38	1	0.56

In all experiments open channel flow conditions were maintained in the pipes.

¹⁰ Type 1 is the open junction. Type 8 is the junction where the invert of the inlet and outlet are joined smoothly. Type 8A is type 8 with the sidewall.

Sangster, et al. (37) in their experiments with pipes flowing full found a sidewall effective in reducing energy losses. That this feature also appears to be desirable in open channel flow, without extensive testing, can be shown by comparing junction type 4 with junction type 4A in figure 6-3, and junction type 5 with type 5A for test series B6, where KC is reduced by 0.12 due to the sidewall. Without the sidewall, the lateral flow was observed to "pile-up" in the junction box corner. After test series B, all tests were done with a sidewall present.

The use of deflectors, type 4, 5, 6, either fixed or hinged, did not reduce the energy losses under experimental conditions described in this thesis. The drawings, figures 6-6, 6-7, illustrate some of the complex flow patterns observed by the use of potassium permanganate dye.

90° Junction

In the case of the 90° model junction, the lateral flow was turned through 90° in the junction box even though this is not the practice in prototype sewer systems for large pipes. Due to this large change of direction, the lateral flow rate was decreased, while the main flow rate was kept constant throughout all tests, to maintain open channel flow at about 1/2 of full depth.

Test results indicate that junction type 9, 6A, 8A were the optimal junctions (see figure 6-8).

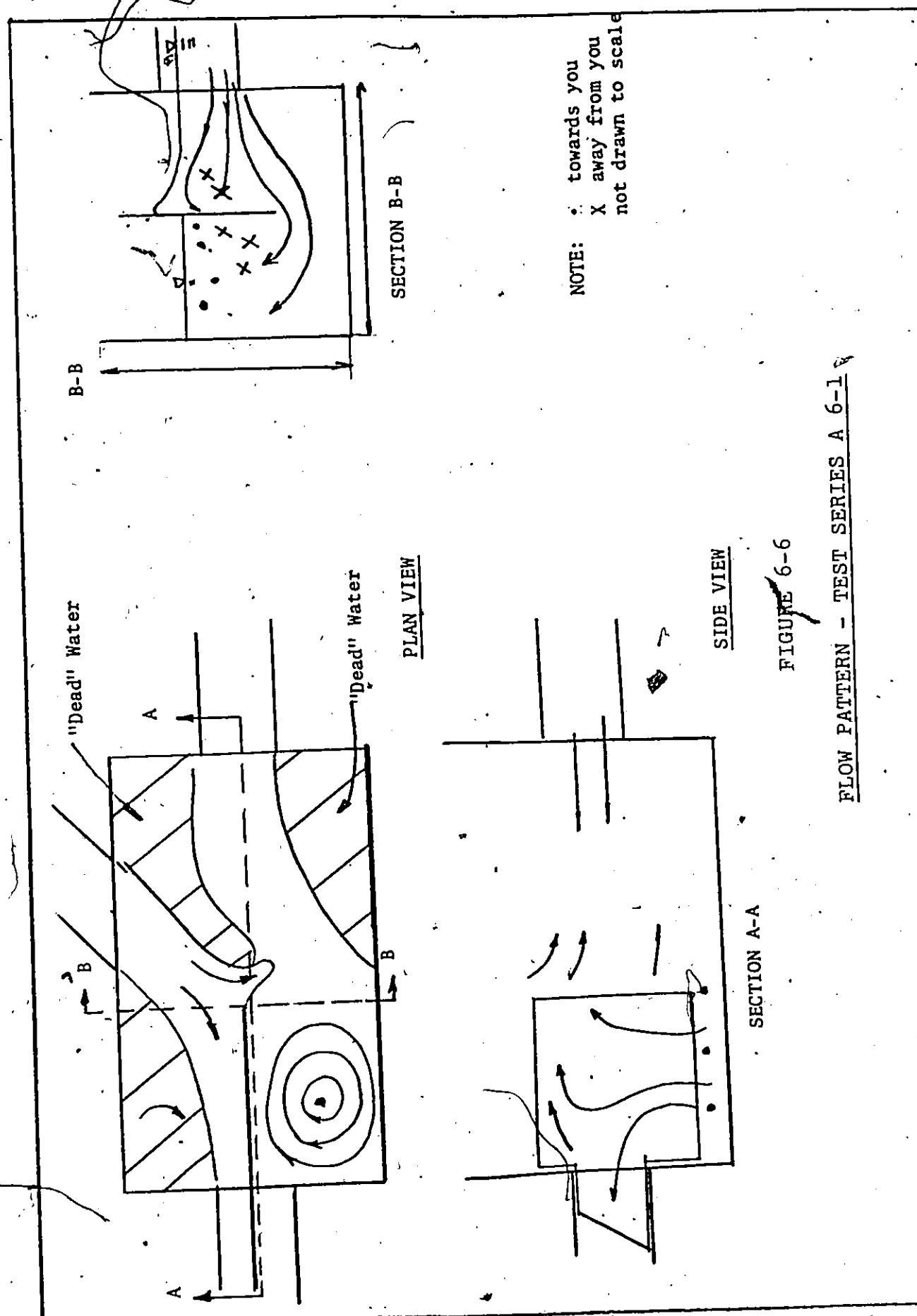


FIGURE 6-7: PLAN VIEW OF OBSERVED FLOW PATTERNS

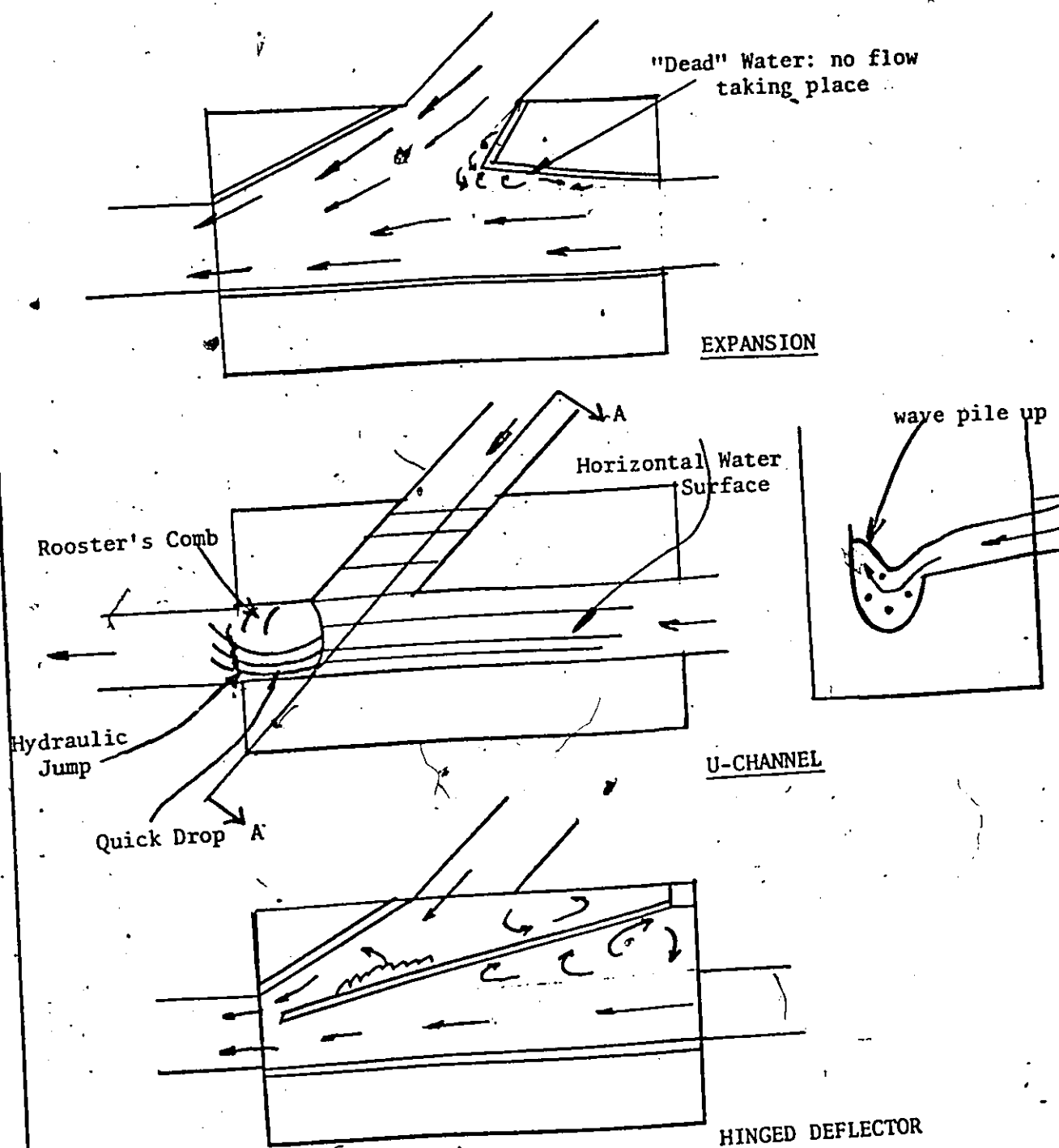


FIGURE 6-8

LOSS COEFFICIENTS FOR 90° TESTS

TEST SERIES	QL/QM	KC	JUNCTION TYPE	K3	BOX LENGTH
P1	0.35	0.65	2	0.76	40.6
P2	0.35	0.81	4	0.92	40.6
P4	0.35	-0.36	9	-0.26	40.6
P5	0.35	-0.02	6	-0.22	40.6
Q1	0.35	0.64	1A	0.77	59.7
Q2	0.35	0.44	8A	0.55	59.7
Q3	0.35	0.39	9	0.51	59.7
Q4	0.35	0.36	6A	0.49	59.7
R1	0.35	1.20	1	1.40	59.7
R2	0.35	0.40	8	0.38	59.7
R3	0.35	0.87	8A	1.17	59.7
R4	0.35	0.60	6A	0.85	59.7
R5	0.35	0.44	9	0.65	59.7
S1	0.35	1.33	2	1.55	40.6
S2	0.35	1.34	4A	1.54	40.6
S3.1	0.25	0.91	9	1.14	40.6
S3.2	0.41	0.93	9	1.13	40.6
S4	0.35	0.88	6A	1.10	40.6
T1.1	0.34	0.28	6A	0.33	40.6
T1.2	0.53	0.25	6A	0.29	40.6
T2.1	0.25	0.22	9	0.32	40.6
T2.2	0.34	0.22	9	0.27	40.6
T3	0.34	0.22	8A	0.28	40.6
T4	0.34	0.28	2A	0.33	40.6
T5	0.34	0.37	4A	0.43	40.6
T6	0.38	0.08	9	0.16	40.6
T7	0.34	0.16	8A	0.25	59.7
T8	0.34	0.37	1A	0.47	59.7
U1.1	0.34	0.63	9	0.53	59.7
U1.2	0.55	0.67	9	0.60	59.7
U2.1	0.34	0.60	8A	0.58	59.7
U2.2	0.70	0.80	8A	0.63	59.7
U3.1	0.34	0.83	1A	1.10	59.7
U3.2	0.70	0.96	1A	1.05	59.7

FIGURE 6-8 (continued)

TEST SERIES	QL/QM	KC	JUNCTION TYPE	K3	BOX LENGHT
U4.1	0.34	0.51	6	0.57	40.6
U4.2	0.55	0.41	6	0.42	40.6
U5.1	0.35	0.40	9	0.43	40.6
U5.2	0.55	1.02	9	1.02	40.6
U6.1	0.35	0.55	8A	0.57	40.6
U6.2	0.72	0.55	8A	0.51	40.6
U7.1	0.34	0.42	2A	0.50	40.6
U7.2	0.72	1.35	2A	1.30	40.6
U8.1	0.34	0.60	3A	0.68	27.9
U9.1	0.34	0.58	8A	0.65	27.9
U9.2	0.72	1.19	8A	1.09	27.9
V1	0.35	0.15	8A	0.22	27.9
V2	0.35	0.07	3A	0.15	27.9
V3.1	0.26	0.08	9	0.16	40.6
V3.2	0.39	0.34	9	0.30	40.6
V4.1	0.64	0.33	6A	0.42	40.6
V4.2	0.34	0.10	6A	0.17	40.6
V5.1	0.26	0.30	4A	0.37	40.6
V5.2	0.31	0.43	4A	0.47	40.6
W1	0.26	.32	9	0.12	40.6
W2	0.35	1.57	6A	-0.18	40.6
W3	0.25	.38	4A	0.36	40.6

The following features accounted for this performance: (i) the flow in the junction was always confined in a channel of similar dimensions as the pipes, and (ii) the lateral flow was directed towards the outlet.

As was the case in the 45° configuration the open junction box resulted in the highest energy losses, and greatest backwater effects. Modifications to the open box such as the placement of an invert and a sidewall, usually reduced the energy losses but not in all cases (see KC for U6.1 and U7.1, V1 and V2). Unlike the 45° test, the 15.2 cm deflector with invert (type 6A) also performed well. In test series V, junction type 6A had the second lowest energy loss coefficient next to the open box, type 2A. In test W2, type 6A had the highest losses. The flow in test series V, and W, with pipe slopes of 0.5% in the main and 1.4% in the lateral, was supercritical. The results of these tests suggest the need for more experimentation to study the behaviour of model junctions under supercritical flow conditions. Preliminary results for supercritical flow conditions indicate certain differences to corresponding data obtained for subcritical flows.

6.2 Energy Loss and Flow Rate

Energy loss is a function of the total flow rate (Q_1), and the proportioning of the flow in the lateral and the main pipe (Q_R). That this is so can be seen from figures 6-1,

6-2, 6-3, 6-9, 6-10, 6-11, 6-12, 6-13, 6-14, 6-15. The first three tests series (3,A,B) were carried out to examine this relationship in more detail, whereas test series after that only measured energy loss for the design flow condition¹¹ with different junction geometries. A summary of the curves as well as results from other experiments are presented in figure 6-15.

Using equations 2-12, 2-13 from (18), where energy is a function of flow rates and velocities, energy loss was calculated and compared to the measured values. No agreement was found; it can be said that energy loss in open channel junctions is also dependent on the geometric configuration and not only on flow rates.

6.2.1. Variation of the Lateral Flow Rate¹¹

The KC coefficient increased at a decreasing rate with increasing lateral flow (see figure 6-1, 6-2, 6-3, 6-4). For the very low lateral flow, $Q_L/Q_M = 0.05$ (figure 6-3). KC increased.

* The lateral energy loss coefficient (K_2) increased with increasing lateral flow rate. The main energy loss coefficient (K_3) decreased with increasing lateral flow for all types except the open junction box. In this case, the coefficients increased or fluctuated considerably.

¹¹ Design flows use a depth of 50%-100% of the pipe diameter depending on "the degree of conservatism with which the peak flows are calculated" (p. 130 of (45))

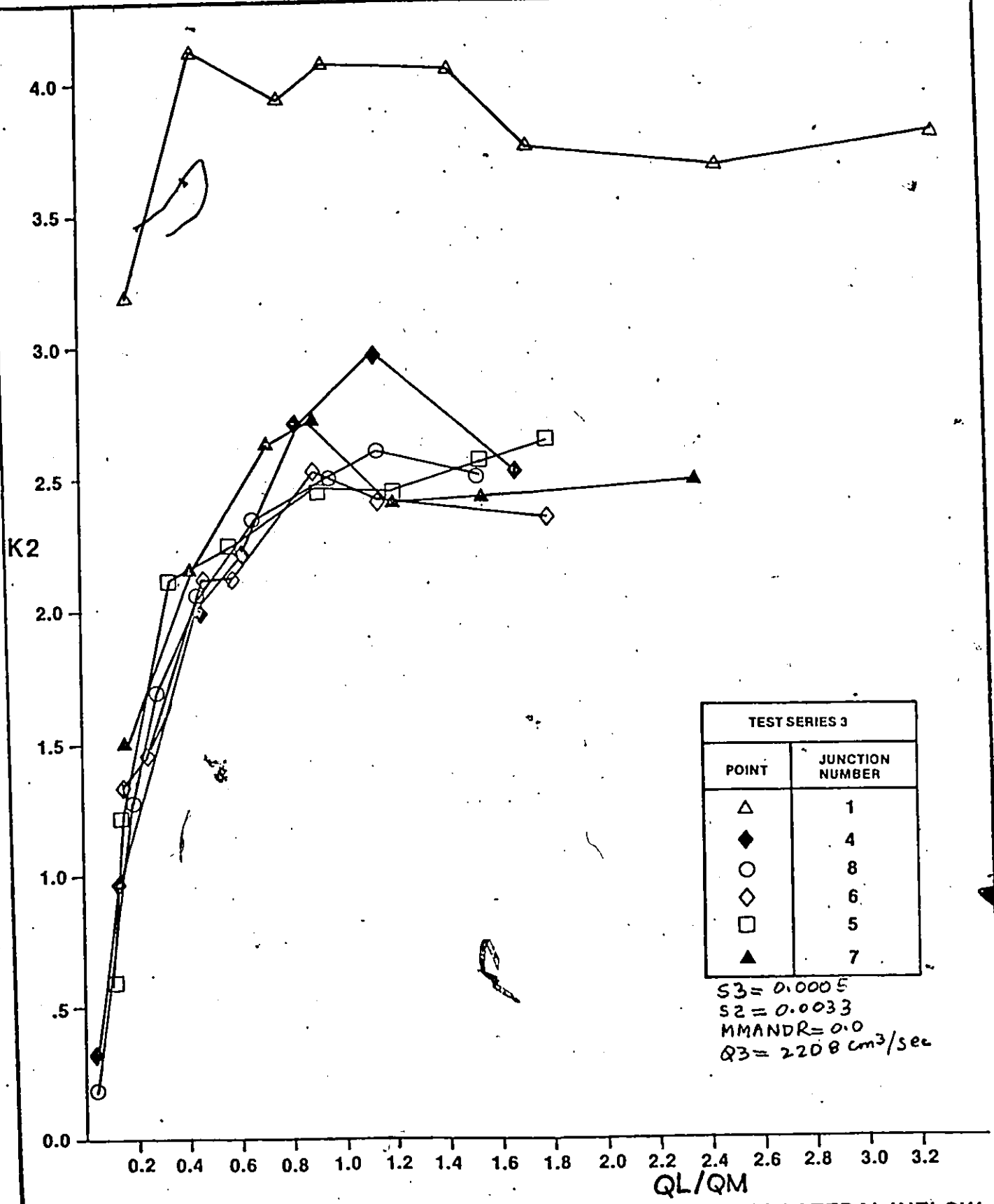


FIG. 6-9 LATERAL ENERGY LOSS COEFFICIENT FOR VARYING LATERAL INFLOW

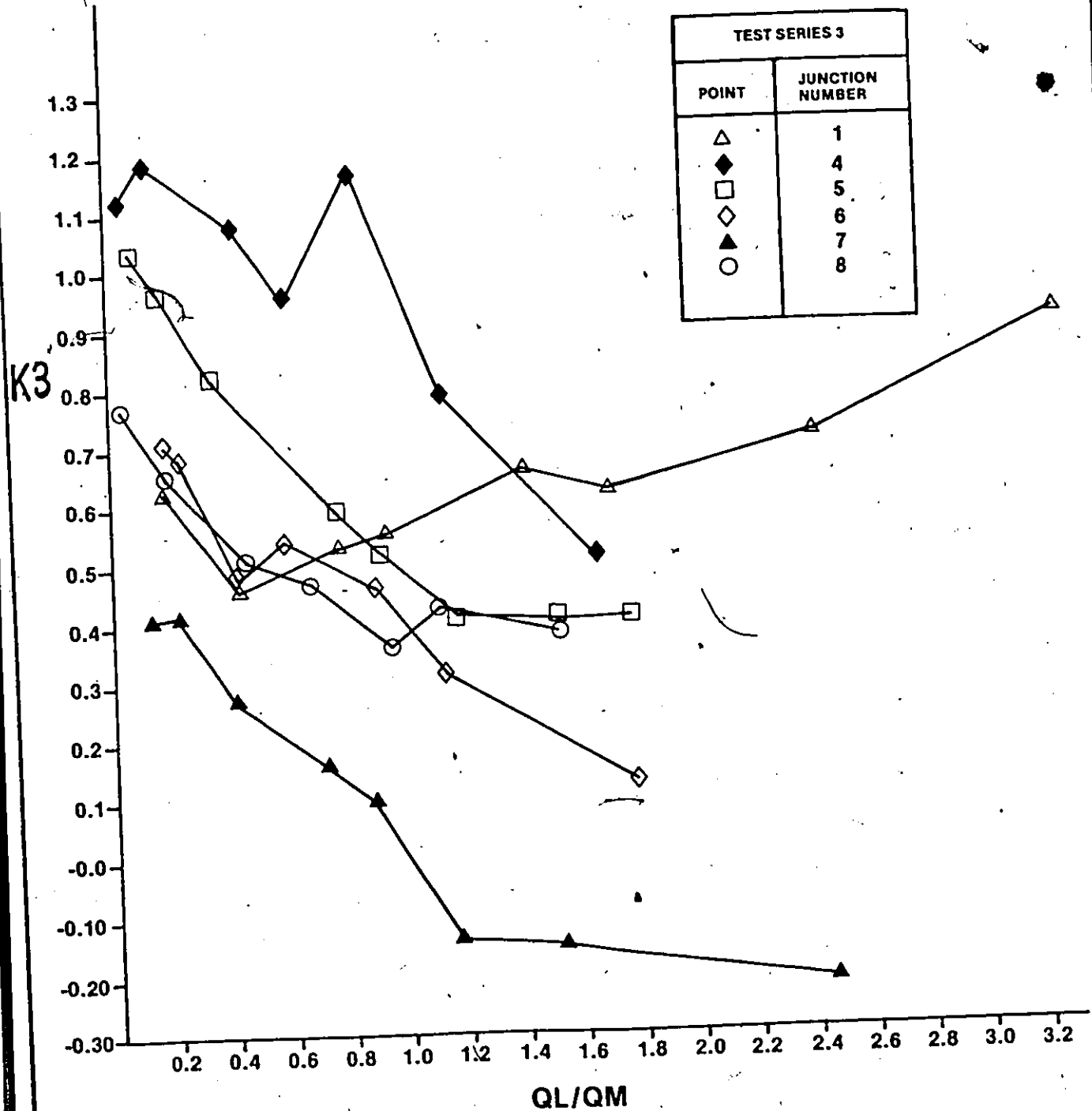


FIG. 6-10 MAIN ENERGY LOSS COEFFICIENT FOR VARYING LATERAL INFLOW

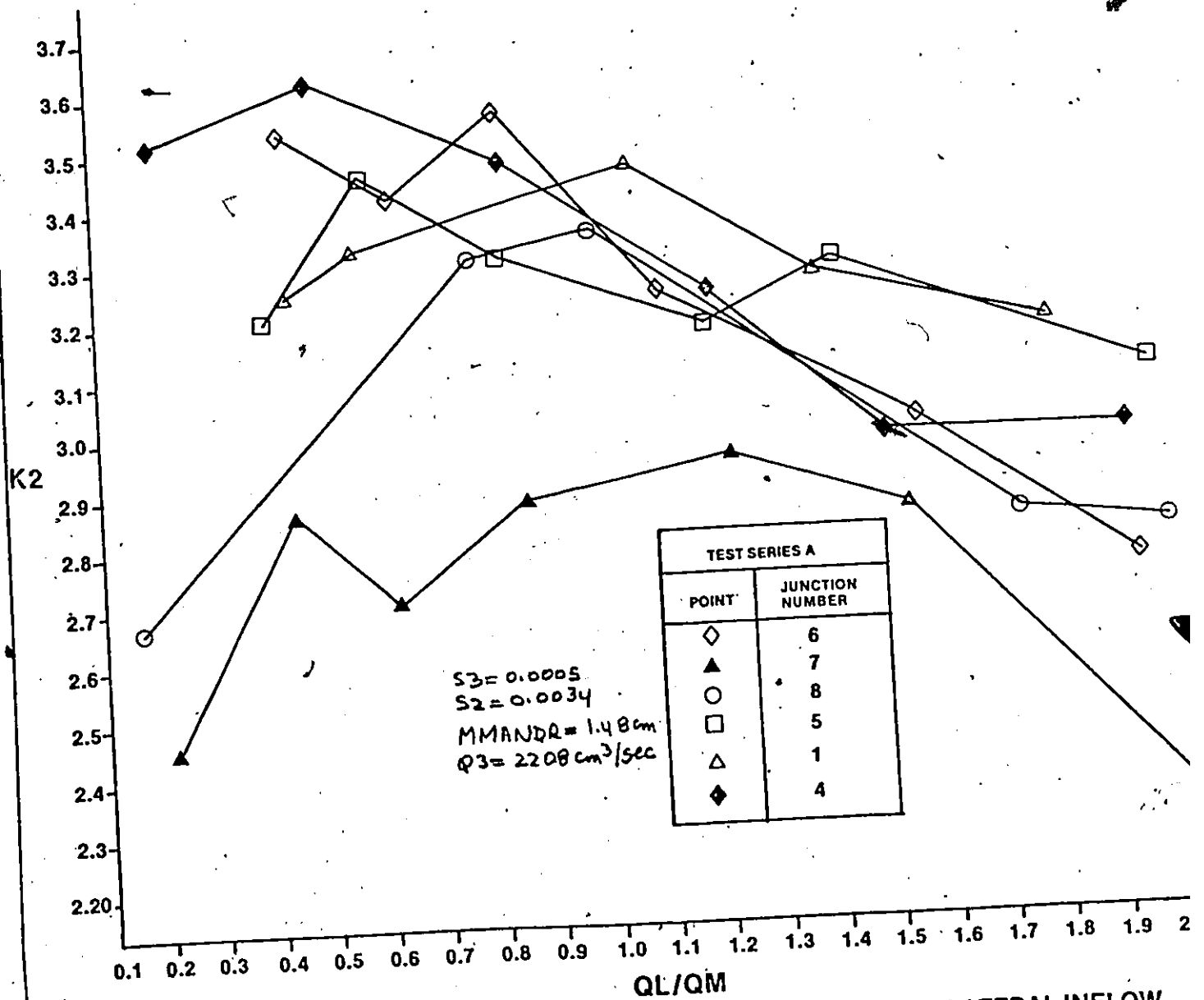


FIG. 6-11 LATERAL ENERGY LOSS COEFFICIENT FOR VARYING LATERAL INFLOW

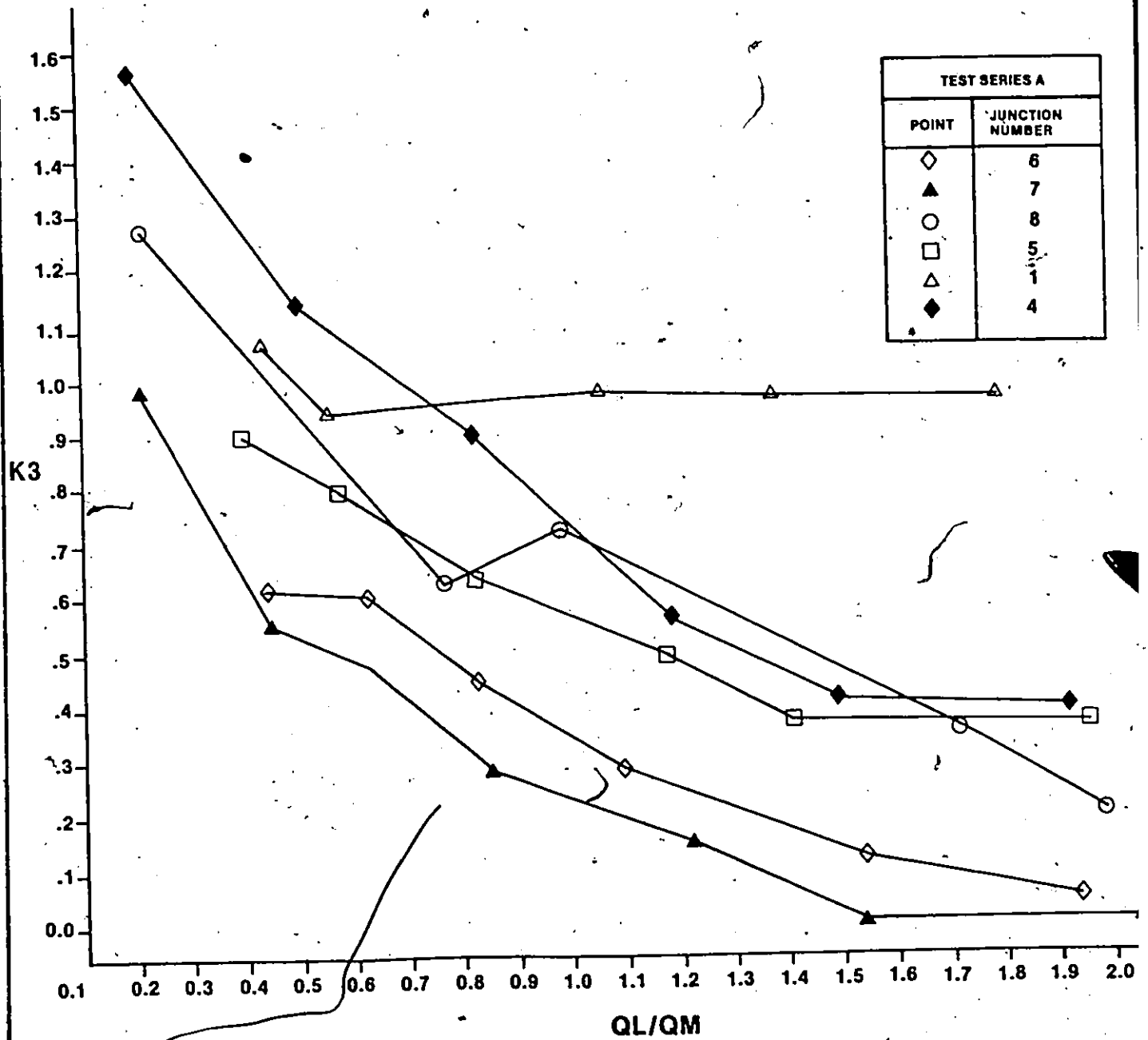


FIG. 6-12 MAIN ENERGY LOSS COEFFICIENT FOR VARYING LATERAL FLOW

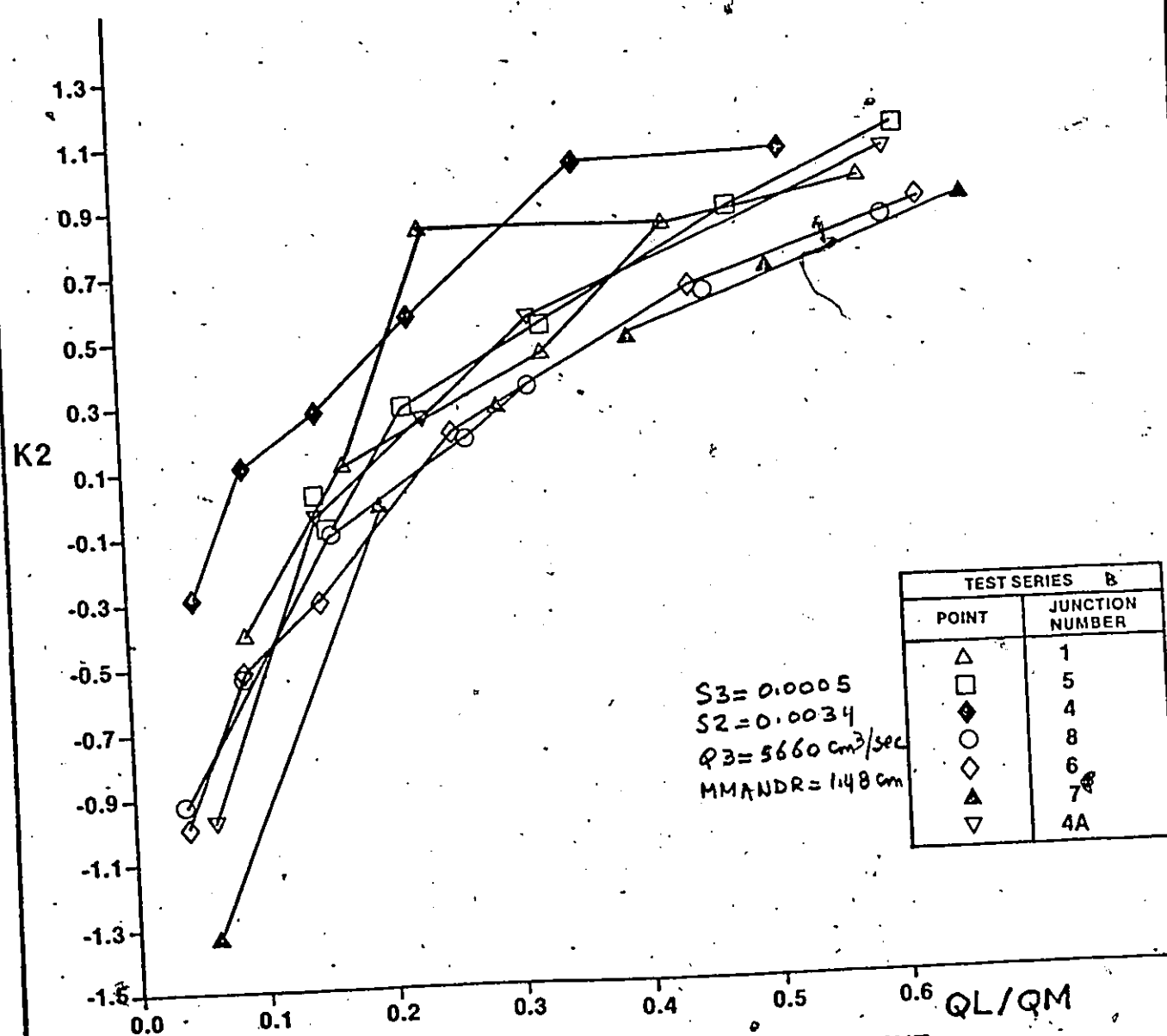


FIG. 6-13 LATERAL ENERGY LOSS COEFFICIENT FOR VARYING LATERAL IN FLOW

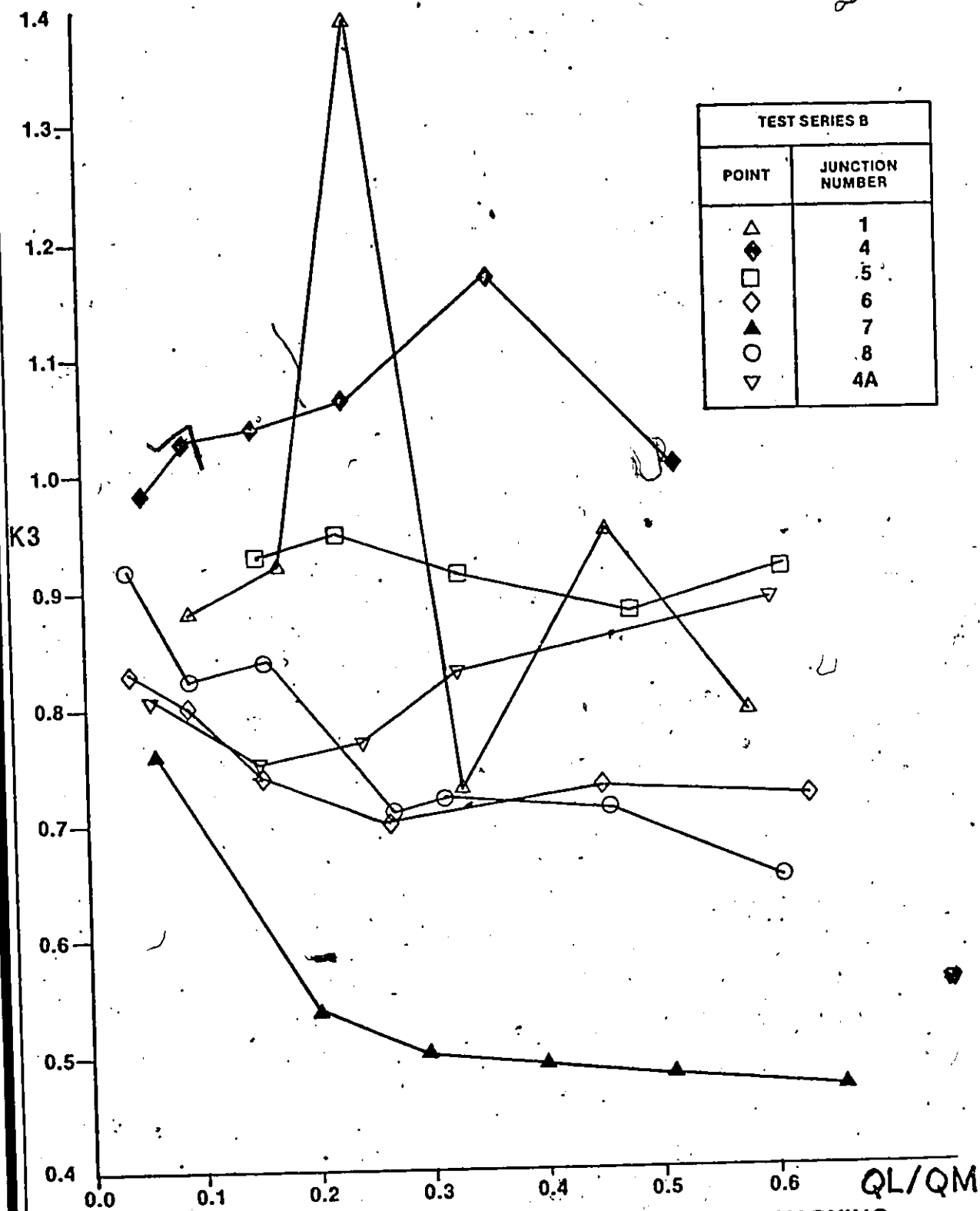


FIG. 6-14 MAIN ENERGY LOSS COEFFICIENT FOR VARYING LATERAL INFLOW

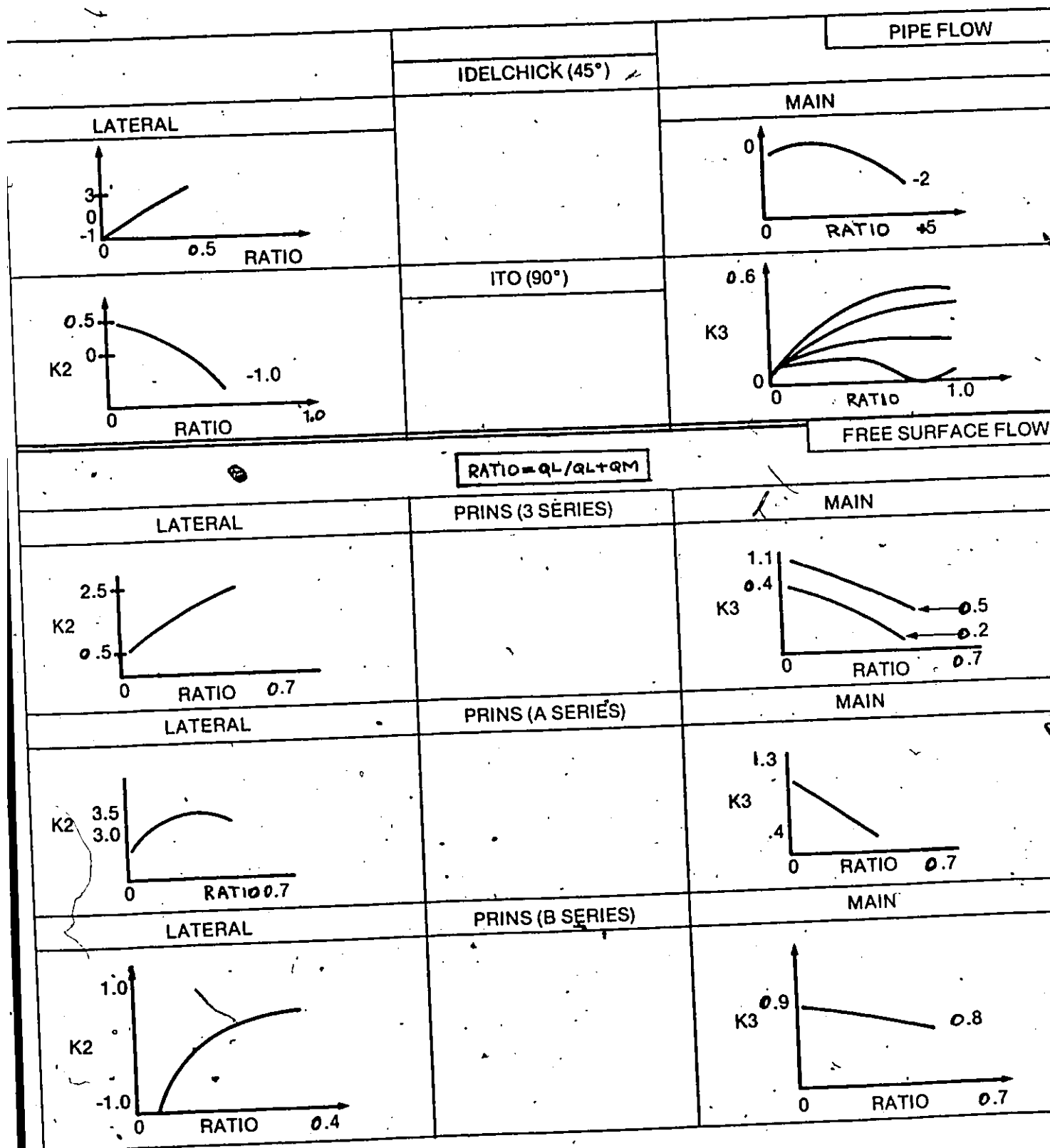


FIG. 6-15 GENERAL SHAPES OF ENERGY LOSS COEFFICIENTS' CURVES PLOTTED AGAINST RELATIVE FLOW RATE

6.2.2. Variation of the Main Flow Rate

For the same ratio of lateral to main flow, an increase in the main flow rate firstly decreased the range and value of K_C , (for example type 7 with $Q_L/Q_M = 0.5$ - test series B, $K_C = 0.55$ and test series A, $K_C = 1.3$), secondly decreased the value of K_2 from 3.2 to 0.7, and thirdly did not change the value of K_3 significantly.

6.3 Energy Loss with Respect to Manhole Drop and Length

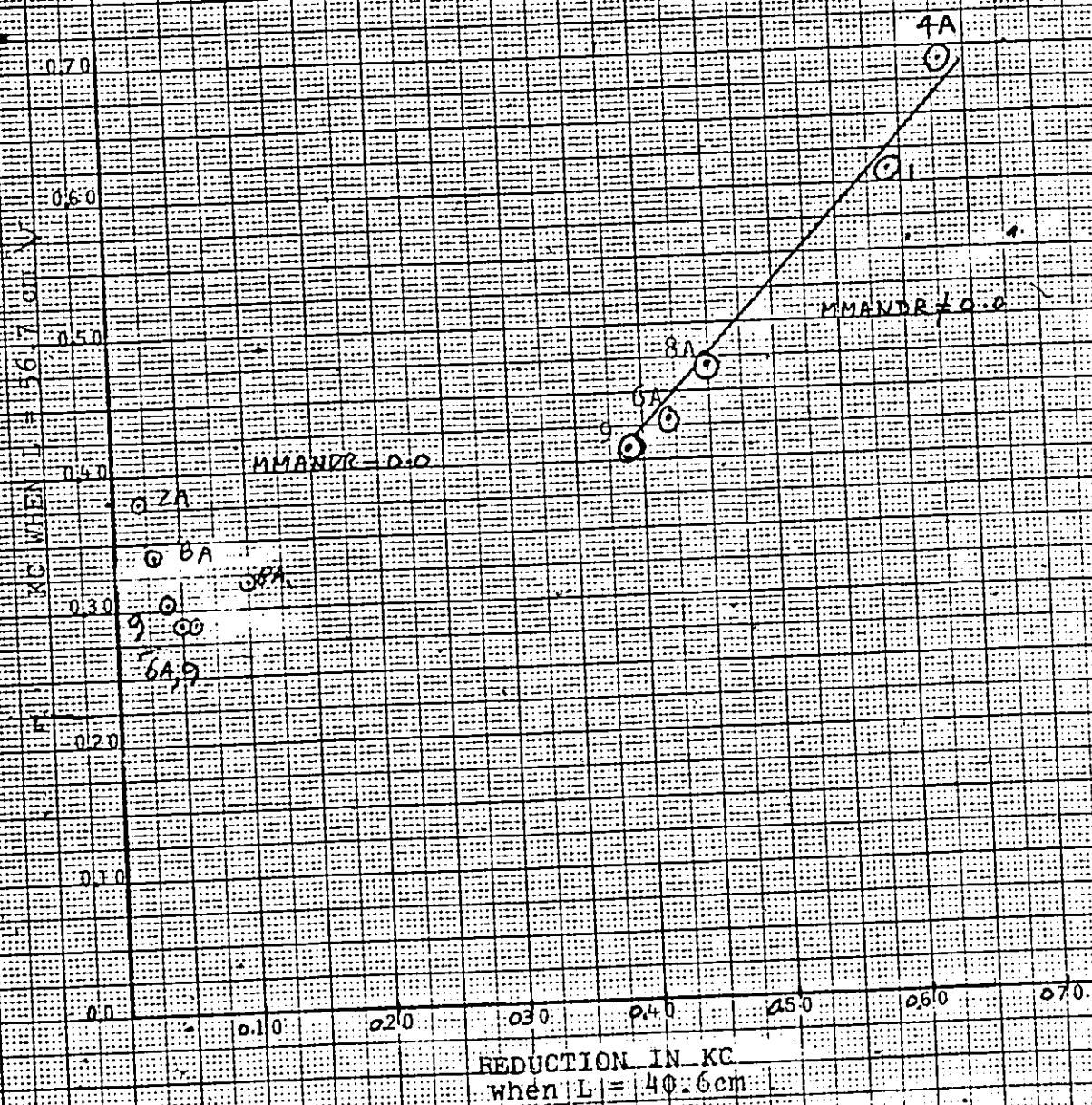
Limited tests were done to determine whether and how manhole drop and length affect energy loss. For the 45° junction (figure 6-16) the shorter manhole length for junction types 1A, 4A, 6A, 8A, 9 resulted in reduced energy loss coefficients. With a drop provided through the shorter manhole, the energy loss reductions were even more pronounced. The results for 12 tests for different junction configurations with the shorter junction suggest that the longer junction is not effective in reducing energy losses but instead increases the losses. This is a satisfying conclusion from the cost point of view for prototype systems.

For the 90° junction box inspection of the loss coefficients and box length in figure 6-8 suggested the following conclusions. For a slope of main pipe slope of 0.0005 (when $MANDR = 0.0$), the shorter 40.6 cm box had lower energy losses, whereas with an invert drop the longer

FIGURE 6-16

REDUCTION IN ENERGY LOSS FOR JUNCTION

LENGTH REDUCTION: (56.7 cm to 40.6 cm) 45° JUNCTION



box performed more favourably. With the slope of the main increased to 0.002 the reverse conclusions are true. The 27.94 cm long box in test series U8, U9 did not change the junction performance compared to the other results in test series U for longer boxes.

For the 45° junction provision of a drop through the manhole had the beneficial effect of reducing the energy loss and allowing the passage of a greater lateral discharge (the main discharge was kept constant except for test series D1, D3, and D5 (see figure 6-4)). The value of providing a drop through the junction has been demonstrated by the results of these experiments. Precisely how large a drop to provide for various types of junctions, to ensure efficient conveyance of the design flow and minimize the need for excavation cannot be ascertained with this limited data. The influence of manhole drop on the efficiency of the system with respect to backwater effects and power loss is discussed further in the following two sections.

6.4 Backwater Effects

The depth increase in the main flow immediately upstream of the junction with the addition of lateral flow provides a second criteria for judging the performance of the junction (the first being minimum energy loss). Energy losses caused by the mixing and expansion of the main and lateral flows at the confluence, produce changes in depth in the flow immediately upstream of the junction in both the main and the lateral pipes.

In figures 6-17, 6-18, and 6-19, are shown the increases in depth upstream of the junction in the main flow for different junction types due to the introduction of lateral flow. The different junction types exhibit different hydraulic effects (recall section (6.1) re. the reference points N1, N2, N3) such as this backwater effect. The water surface profile has a $M1^{12}$ or $S1^{12}$ shape. The introduction of a drop through the manhole has the effect of reducing or removing the backwater effect. The presence of a backwater is often the cause of sewer surcharging in prototype systems. Figure 6-18, illustrates the effect for different invert drops for different junction types. The expansion (type 9) reduces the backwater effect by 2.5 cm when $Q_L = 3.5 \times 10^3 \text{ cm}^3 \text{ sec}^{-1}$ and $Q_M = 5.66 \times 10^3 \text{ cm}^3 \text{ sec}^{-1}$ and is the most effective arrangement in doing so. Under supercritical flow conditions in the main, the lateral inflow forced the formation of a hydraulic jump in the main flow upstream from the junction.

Increased inlet and outlet junction velocities resulted from the provision of an invert drop. The depths of flow in the incoming pipes were reduced, hence providing additional flow capacity in the system or rather preventing the junction from "choking" the design flow.

¹² see p. 226, classification of flow profiles in (11)

FIGURE 6-17

BACKWATER
IN MAINPIPE - B SERIES

BACKWATER RATIO =
DEPTH INCREASE DUE TO BACKWATER
DEPTH IN MAIN WITHOUT BACKWATER X 100%

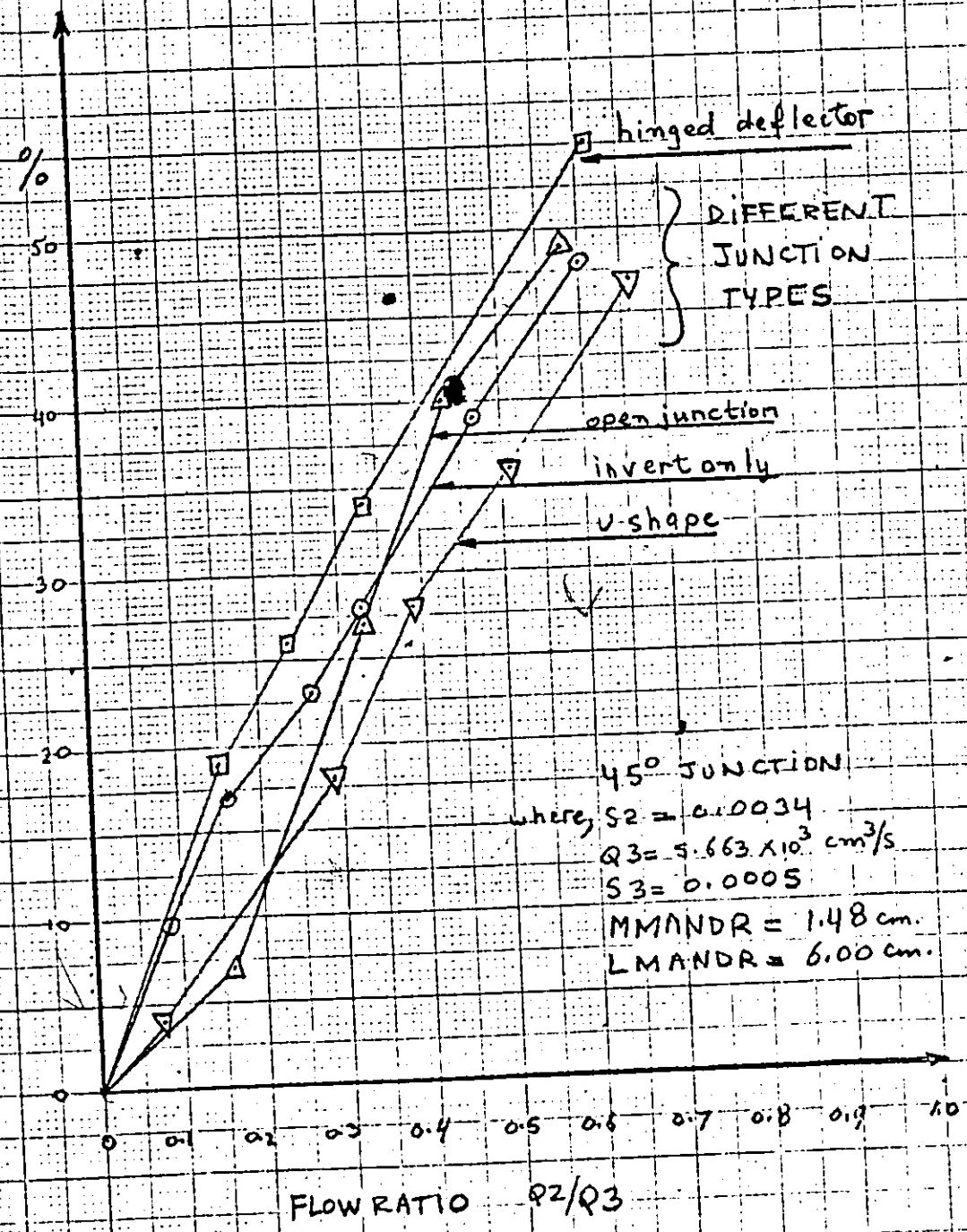


FIGURE 6-18
BACKWATER - C, D SERIES
IN MAIN PIPE

BACKWATER RATIO =
DEPTH IN MAIN WITH BACKWATER
DEPTH IN MAIN WITHOUT BACKWATER

%

120

110

100

90

80

70

60

50

40

30

20

10

0

0

0.1

0.2

0.3

0.4

0.5

0.6

0.7

0

0.1

0.2

0.3

0.4

0.5

0.6

0.7

0

0.1

0.2

0.3

0.4

0.5

0.6

0.7

0

0.1

0.2

0.3

0.4

0.5

0.6

0.7

0

0.1

0.2

0.3

0.4

0.5

0.6

0.7

FLOW RATIO - Q_2/Q_3

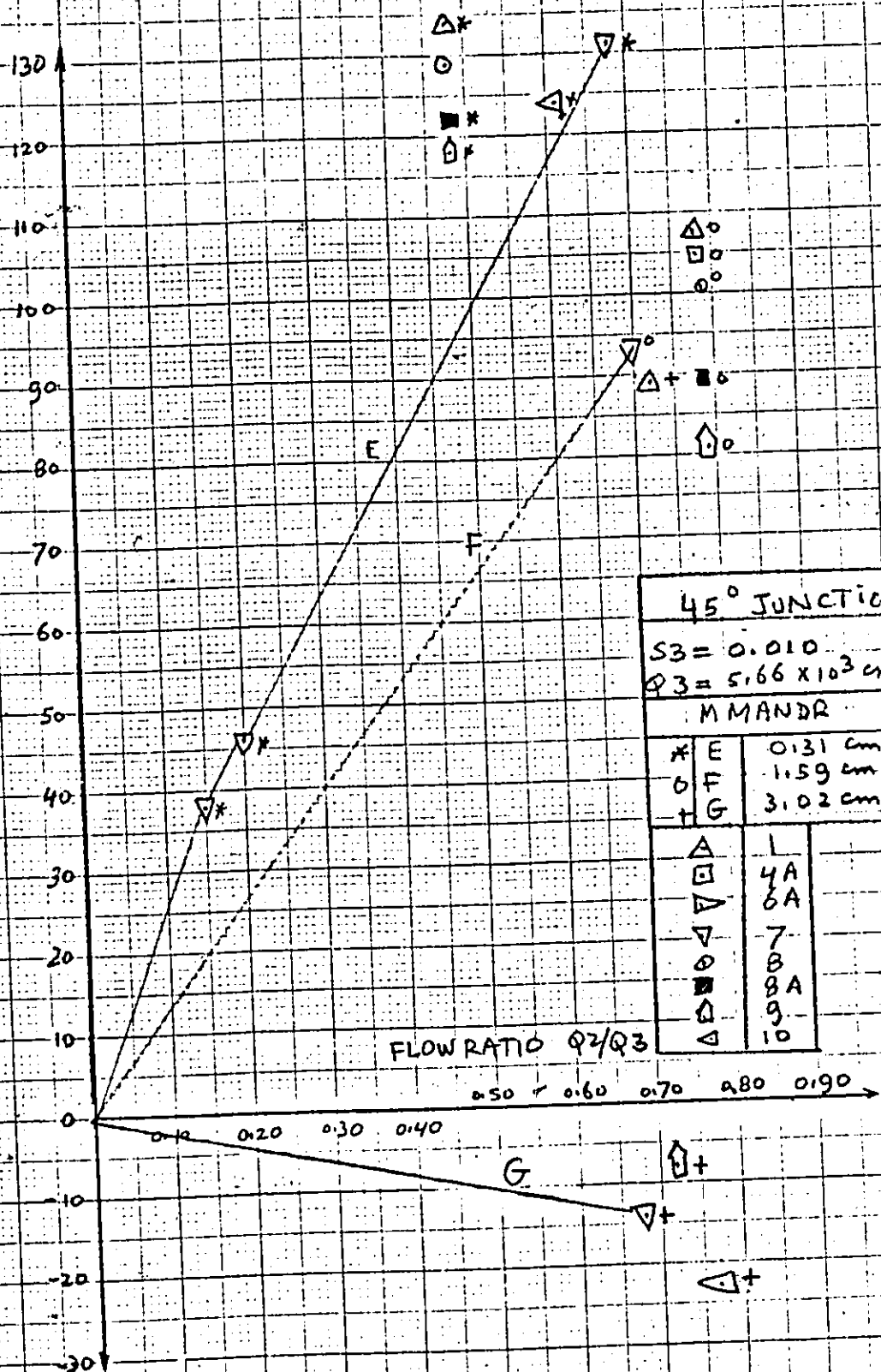
45° JUNCTION

$S_3 = 0.005$
 $Q_M = 5.66 \times 10^3 \text{ cm}^3/\text{sec}$

POINT	JUNCTION NO
△	1
□	4A
▽	6A
○	7
○	8
○	9
○	10
M MANDR	
•	C - 0.16
x	D - 1.43

FIGURE 6.19 BACKWATER IN MAIN PIPE
E, F, G SERIES

BACKWATER RATIO = $\frac{\text{DEPTH INCREASE DUE TO BACKWATER}}{\text{DEPTH IN MAIN WITHOUT BACKWATER}} \times 100\%$



45° JUNCTION

$S_3 = 0.010$
 $Q_3 = 5.66 \times 10^3 \text{ cm}^3/\text{sec}$

M MANDR

#	E	0.31 cm
0	F	1.59 cm
+	G	3.02 cm

△	1
□	4A
▽	6A
▽	7
○	8
■	8A
△	9
△	10

6.5 Power Losses

Power losses and the Lost Power Ratio (L.P.R.) provide a third criteria for judging the performance of the junction types as well as giving trends into general junction performance.

The power losses in the model's junction box for various combinations of discharge conduit slope, manhole drop and junction geometry are shown in figures 6-20, and 6-21, for the 45° junction, (no distinction being made of different junction geometries). The losses were analyzed by means of the lost power ratio (L.P.R. equation (3.22)) and the relative flow rate ($QR = QL/QM$) plotted on logarithmic paper.

A greater percentage of the power entering was lost when $MMANDR \neq 0.0$ than when $MMANDR = 0.0$ for $0.05 > QR > 3.0$. For $QR < 0.7$, $L.P.R. = 0.013$ when $MMANDR = 0.0$.

For the 90° junction no similar analysis could be carried out since $QR = 0.35$ for all tests, however, some power loss trends can be obtained from figure 6-22. These trends also apply for the 45° junction. The lost power ratio increased with increasing pipe slope, furthermore the lost power ratio increased when there was a drop through the manhole. For the 90° junction, the junction type 9 configuration consistently had the lowest L.P.R. of the junctions tested. The lines drawn on figure 6-20, 6-21 were drawn in by eye, using the criteria of minimum deviation from the chosen line.



LPR = LOST POWER RATIO = POWER LOST IN JUNCTION/POWER ENTERING

FIGURE E-20

LPR-QR RELATIONSHIP FOR 45° JUNCTION

100

Tests	
○	A
△	B
•	D, F, G, J, N
MANDRAZ 0.0	

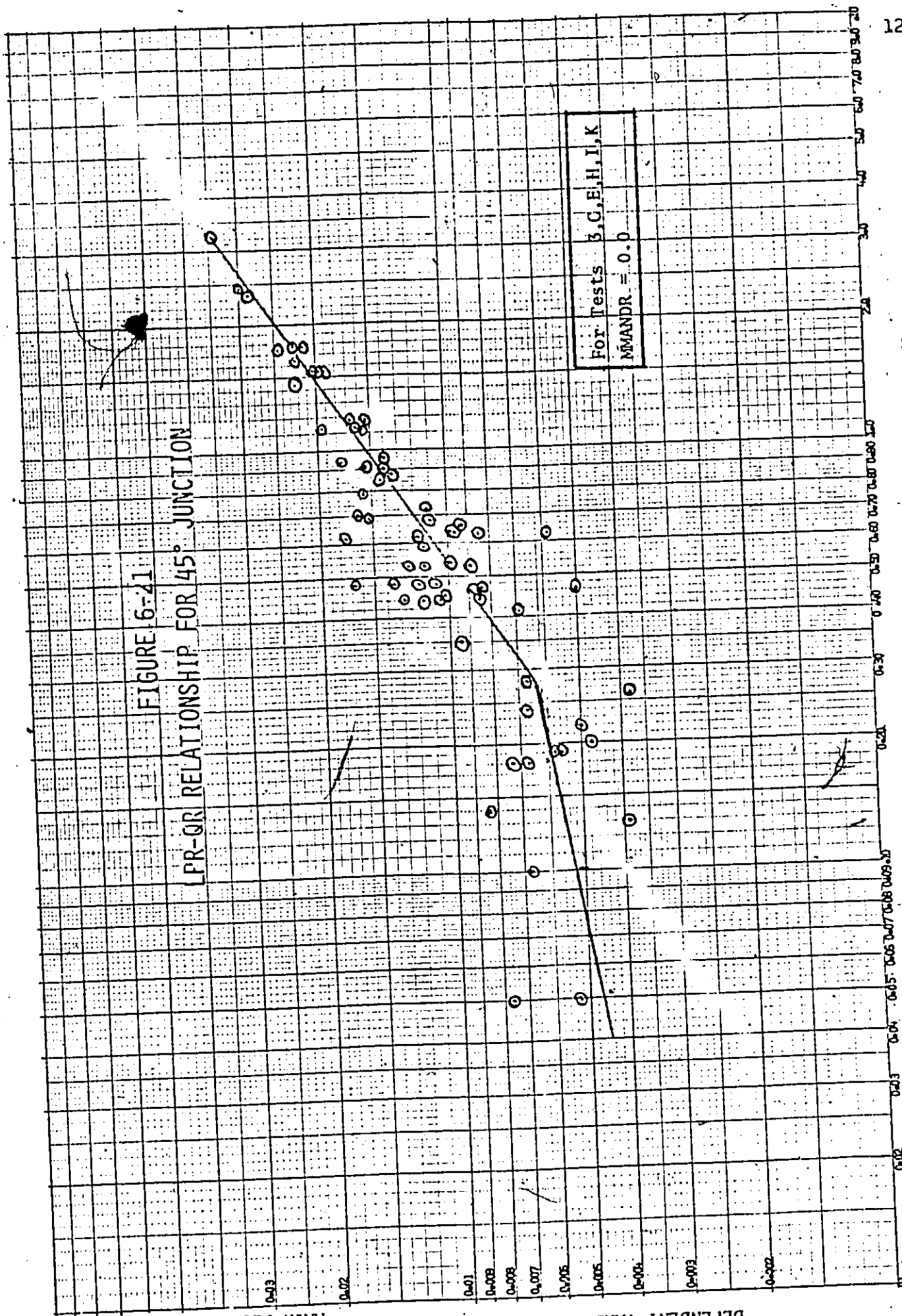
$$QR = RATIO^2 = \frac{LATERAL INFLOW}{MAIN INFLOW}$$

FIGURE 6-21
LPR-QR RELATIONSHIP FOR 45° JUNCTION

DEPENDENT VARIABLE $LPR = \text{RATIO } 2 = \frac{\text{LATERAL FLOW}}{\text{MAIN FLOW}}$

INDEPENDENT VARIABLE $QR = \text{RATIO } 2 = \frac{\text{LATERAL FLOW}}{\text{MAIN FLOW}}$

For Tests 3, G, E, H, I, K
MMANDR = 0.0



MAIN SLOPE	JUNCTION TYPE				
	1,1A,2,3A	4,4A	6,6A	8,8A	9
0.0005 (P,Q,R,S)	0.0106 2* 0.0097 1A 0.0142 1 0.0166 2*	0.0127 4* 0.0176 4A*	0.0058 6A 0.0075 6A 0.0113 6A*	0.0071 8A 0.0110 8 0.0135 8A *L = 40.6 cm	0.0063 0.0069 0.0113*
0.002 (T,U)	0.0113 2* 0.0077 1A 0.0121 1A 0.0155 2A*	0.0143 4A*	0.0107 6A* 0.0181 6*	0.0092 8A* 0.0039 8A 0.0102 8A 0.0175 8A* 0.0205 8A* *L = 40.6 cm *L = 27.9 cm	0.0084* 0.0020 * 0.0113 0.0143*
0.005 (V,M)	0.0026 2A*	0.0101 4A* 0.0161 4A*	0.0116 6A* 0.1214 6A*	0.0053 8A*	0.0029* 0.0139*

FIGURE 6-22

L.P.R. FOR THE 90° JUNCTION WHEN QR = 0.35

CHAPTER 7

CONCLUSIONS

7.1 Junction Type

The experimental results presented in the preceeding chapter confirm the recommended junction design practice of using U-shaped channels in junction structures. In the experiments this shape was consistently the optimal junction box configuration using the criteria of the lowest energy loss coefficient. The open junction box resulted in the highest energy losses. The presence of an invert connecting the upstream and downstream pipe inverts and a side wall was effective in reducing the energy losses. The deflectors tested were not helpful for the 45° junction but in the 90° junction, junction type 6 did exhibit reduced energy losses.

7.2 Variables Affecting Energy Loss

It can be said that energy loss in open channel junctions is not only dependent on flow rates or stream velocity but also on junction configuration, i.e, manhole drop, manhole length, angle of intersection of the incoming streams and channel cross-section, Equation (2-12) and (2-13) cannot be used to predict the energy loss coefficients in open channel junctions.

In the tests, the shorter overall length gave reduced energy losses. Lengthening the junction box to improve the hydraulics is not recommended. For the 45° junction the loss coefficient (KC) average was 0.49 with a variance of 0.26 when QL/QM averaged 0.56, while for the 90° junction the loss coefficient average was 0.54 with a variance of 0.38, when QL/QM averaged 0.39.

The single most important variable in junction design is the proper provision of an invert drop between the inlet and outlet pipe. Results have shown that an adequate invert drop can completely eliminate the backwater effects in the main upstream of the junction, due to the lateral flow. Especially in flat terrain, where provision of additional invert drop means more excavation, adequate invert drop will prevent surcharging in the system during high flows.

Further research should consider studying the following areas:

- (1) Prototype junction hydraulics must be studied to determine scale effects before analysis on small scale models can be applied in the design of prototype systems. Studies could consist of a comprehensive program field tests or alternatively an analysis of flow data as it becomes available from gauged sewer systems.

- (2) Field work could also determine which existing junctions fail to perform successfully during peak flow and which design features are responsible for this poor hydraulic performance.

(3) For the U-shaped junction extensive laboratory tests should be performed to determine the invert drop required to minimize the backwater effects in the incoming pipes.

(4) Future laboratory tests should be performed to determine suitable modifications in junction exit geometry to reduce energy losses and backwater effects.

(5) Future laboratory tests should be performed with the shorter length junction boxes for further comparison of the effect of junction length on energy losses.

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A P P E N D I X "A"

FIGURE A-1

45° ANGLE TESTS

TEST SERIES	NO. OF RUNS	LMANDR (cm)	MMANDR (cm)	M SLOPE	L SLOPE	C SLOPE	L (cm)
M1	9	5.08	0.00	.0005	.0033	.0005	59.7
L1	9	5.08	0.00	.0005	.0033	.0005	59.7
3	47	5.08	0.00	.0005	.0033	.0005	59.7
A	41	6.00	1.48	.0005	.0034	.0005	59.7
B,M2,L2	51	6.00	1.48	.0005	.0034	.0050	59.7
C1,2,3,4,5	5	5.24	-0.16	.0050	.0116	.005	59.7
C6,7,M3,L3	8	5.00	0.08	.0050	.0116	.005	59.7
D		6.00	1.43	.0050	.0130	.005	59.7
E,M4,L4	11	5.39	0.31	.0100	.0182	.0100	59.7
F	7	6.05	1.58	.0100	.0190	.0100	59.7
G	3	6.65	3.02	.0100	.0209	.0100	59.7
H,M5,L5	10	5.08	0.00	.002	.0078	.002	59.7
I	5	5.08	0.00	.002	.0078	.002	40.6
J	5	7.15	3.96	.002	.0098	.002	40.6
K	4	5.08	0.00	.005	.0116	.005	40.6
N	5	6.15	1.70	.005	.0137	.005	40.6
	210						

FIGURE A-2

90° ANGLE TESTS

TEST SERIES	NO. OF RUNS	LMANDR (cm)	MMANDR (cm)	M SLOPE	L SLOPE	C SLOPE	L (cm)
P	4	4.44	0.00	.0005	.0066	.0005	40.6
L ₅	2	4.44	0.00	.0005	.0066	.0005	40.6
Q	4	4.44	0.00	.0005	.0066	.0005	59.7
R	5	5.72	2.86	.0005	.0086	.0005	59.7
S	5	5.72	2.86	.0005	.0086	.0005	40.6
T _{1,2,3,4,5}	7	4.44	0.00	.002	.0099	.002	40.6
T _{6,7,8}	3	4.44	0.00	.002	.0099	.002	59.7
U	17	5.70	2.85	.002	.0101	.002	40.6, 27.9
V	8	4.44	0.00	.005	.0140	.005	59.7
W	3	6.19	3.17	.005	.0169	.005	40.6, 27.9
	<u>58</u>						40.6

FIGURE A-3

TEST SERIES, FLOW RATE, JUNCTION TYPE¹³

TEST SERIES	QM (cm ³ /sec x 10 ⁻³)	QL/QM	JUNCTION TYPE
L1.1	1.387(QL)		1
L1.2	2.152(QL)		1
L1.3	3.964(QL)		1
L1.4	3.114(QL)		1
L1.5	2.548(QL)		1
L1.6	.934(QL)		1
L1.7	.552(QL)		1
L1.8	.311(QL)		1
L1.9	.155(QL)		1
M1.1	7.079		1
M1.2	6.173		1
M1.3	4.530		1
M1.4	4.105		1
M1.5	2.180		1
M1.6	1.812		1
M1.7	1.160		1
M1.8	.481		1
3.1	1.217	3.26	1
	1.217	2.44	1
	1.217	1.72	1
	1.217	1.42	1
	1.217	0.94	1
	1.217	0.79	1
	1.217	0.44	1
	1.217	0.18	1
3.2	2.208	1.67	4
	2.208	1.13	4
	2.208	0.85	4
	2.208	0.62	4
	2.208	0.44	4
	2.208	0.14	4
	2.208	0.05	4

¹³ see figure 4-14

TEST SERIES	QM (cm ³ /sec x 10 ³)	QL/QM	JUNCTION TYPE
3.3	2.208	1.54	8
	2.208	0.96	8
	2.208	0.68	8
	2.208	0.46	8
	2.208	0.28	8
	2.208	0.19	8
	2.208	0.05	8
	2.208	1.13	8
3.4	2.208	1.14	6
	2.208	1.79	6
	2.208	0.90	6
	2.208	0.59	6
	2.208	0.47	6
	2.208	0.24	6
	2.208	0.19	6
3.5	2.208	1.79	5
	2.208	1.54	5
	2.208	1.19	5
	2.208	0.91	5
	2.208	0.59	5
	2.208	0.35	5
	2.208	0.18	5
	2.208	0.10	5
3.6	2.208	2.37	7
	2.208	1.54	7
	2.208	1.18	7
	2.208	0.88	7
	2.208	0.72	7
	2.208	0.41	7
	2.208	0.22	7
	2.208	0.13	7
A1	2.208	2.05	7
	5.578	0.81	7
	2.208	1.54	7
	2.208	1.22	7
	2.208	0.86	7
	2.208	0.63	7
	2.208	0.45	7
	2.208	0.22	7

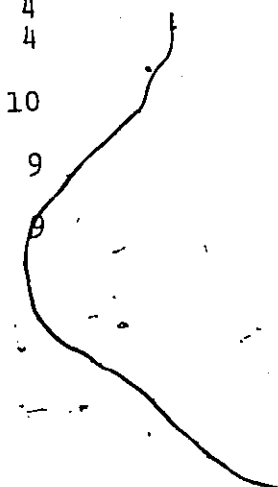
TEST SERIES

QM
(cm³/sec x 10³)

QL/QM

JUNCTION TYPE

A2	2.208	1.99	8
	2.208	1.73	8
	2.208	0.99	8
	2.208	0.77	8
	2.208	0.17	8
	2.208	0.13	8
	2.208	0.00	8
A3	2.208	1.96	5
	2.208	1.51	5
	2.208	1.18	5
	2.208	0.83	5
	2.208	0.58	5
	2.208	0.40	5
A4	2.208	1.79	1
	2.208	1.38	1
	2.208	1.06	1
	2.208	0.56	1
	2.208	0.44	1
A5	2.208	1.94	6
	2.208	1.54	6
	2.208	1.10	6
	2.208	0.83	6
	2.208	0.63	6
	2.208	0.44	6
A6	2.208	1.92	4
	2.208	1.50	4
	2.208	1.19	4
	2.208	0.83	4
	2.208	0.50	4
	2.208	0.20	4
A7	2.208	1.79	10
A8	2.208	1.85	9
A9	2.208	1.85	9



TEST SERIES	QM (cm ³ /sec x 10 ³)	QL/QM	JUNCTION TYPE
B1	5.663	0.60	8
	5.663	0.46	8
	5.663	0.27	8
	5.663	0.32	8
	5.663	0.16	8
	5.663	0.09	8
	5.663	0.04	8
B2	5.663	0.63	6
	5.663	0.45	6
	5.663	0.26	6
	5.663	0.15	6
	5.663	0.09	6
	5.663	0.04	6
B3	5.663	0.52	4
	5.663	0.36	4
	5.663	0.23	4
	5.663	0.15	4
	5.663	0.09	4
	5.663	0.06	4
B4	5.663	0.60	4A
	5.663	0.05	4A
	5.663	0.32	4A
	5.663	0.24	4A
	5.663	0.15	4A
	5.663	0.06	4A
B5	5.663	0.58	1
	5.663	0.43	1
	5.663	0.24	1
	5.663	0.33	1
	5.663	0.17	1
	5.663	0.09	1
B6	5.663	0.61	5
	5.663	0.61	5A
	5.663	0.48	5
	5.663	0.33	5
	5.663	0.22	5
	5.663	0.16	5
	5.663	0.15	5

TEST SERIES	QM (cm ³ /sec x 10 ³)	QL/QM	JUNCTION TYPE
B7	5.663	0.66	7
	5.663	0.51	7
	5.663	0.40	7
	5.663	0.29	7
	5.663	0.06	7
	5.663	0.20	7
B8	5.663	0.75	10
B9	5.663	0.72	9
B10	5.663	0.72	9
M2	5.663(QM)		1
	2.208(QM)		1
L2	3.964(QL)		1
	1.005(QL)		1
C1	5.663	0.63	8
C2	5.663	0.63	9
C3	5.663	0.63	6A
C4	5.663	0.45	4A
C5	5.663	0.45	1
C6	5.663	0.66	10
C7.1	5.663	0.65	7
C7.2	5.663	0.46	7
C7.3	5.663	0.26	7
M3	5.663(QM)		7
L3	2.548(QL)		7
	3.624(QL)		7
D1.1	5.663	0.65	7
D1.2	5.663	0.35	7
D1.3	7.787	0.26	7
D1.4	2.463	1.86	7
D2	5.663	0.72	1
D3	5.663	0.72	8A
D4	5.663	0.72	6A
D5	5.663	0.72	9
D6.1	5.663	0.72	4A
D6.2	5.663	0.72	4A

TEST SERIES

QM
(cm³/sec x 10⁻³)

QL/QM

JUNCTION TYPE

E1	5.663	0.48	1A
E2	5.663	0.48	8A
E3	5.663	0.48	9
E4	5.663	0.48	6A
E5	5.663	0.62	10
E6.1	5.663	0.70	7
E6.2	5.663	0.20	7
E6.3	5.663	0.15	7
M4	5.663(QM)		7
L4.1	1.146(QL)		7
L4.2	2.690(QL)		7
F1.1	5.663	0.72	7
F1.2	7.130	0.53	7
F2	5.663	0.80	4
F3	5.663	0.80	8A
F4	5.663	0.80	9
F5	5.663	0.80	6A
F6	5.663	0.80	1
G1	5.663	0.73	9
G2	5.663	0.73	1A
G3	5.663	0.77	10
G4	5.663	0.69	7
H1.1	5.663	0.63	7
H1.2	5.663	0.27	7
H1.3	7.079	0.23	7
M5.1	5.946(QM)		7
M5.2	5.663(QM)		7
L5	1.614(QL)		7
H2	5.663	0.72	9
H3	5.663	0.72	8A
H4	5.663	0.56	1A
I1.1	5.663	0.54	6A
I1.2	5.663	0.20	6A
I2	5.663	0.53	9
I3	5.663	0.53	8A
I4	5.663	0.53	2A

TEST SERIES	QM (cm ³ /sec x 10 ³)	QL/QM	JUNCTION TYPE
J1	5.663	0.54	6A
J2.1	5.663	0.54	9
J2.2	5.663	0.97	9
J3	5.663	0.72	8A
J4	5.663	0.70	2A
K1	5.663	0.64	6A
K2	5.663	0.64	9
K3	5.663	0.64	8A
K4	5.663	0.45	4A
N1	5.663	0.72	4A
N2	5.663	0.72	8A
N3	5.663	0.72	6A
N4	5.663	0.72	9
N5	5.663	0.72	2
P1	5.663	0.35	2
P2	5.663	0.35	4
P4	5.663	0.35	9
P5	5.663	0.35	6
L6.1	1.953(QL)		
L6.2	3.766(QL)		
Q1	5.663	0.35	1A
Q2	5.663	0.35	8A
Q3	5.663	0.35	9
Q4	5.663	0.35	6A
R1	5.663	0.35	1
R2	5.663	0.35	8
R3	5.663	0.35	8A
R4	5.663	0.35	6A
R5	5.663	0.35	9
S1	5.663	0.35	2
S2	5.663	0.35	4A
S3.1	5.663	0.25	9
S3.2	5.663	0.41	9
S4	5.663	0.35	6A

TEST SERIES

QM
(cm³/sec x 10³)

QL/QM

JUNCTION TYPE

T1.1	5.663	0.34	6A
T1.2	5.663	0.53	6A
T2.1	5.663	0.25	9
T2.2	5.663	0.34	9
T3	5.663	0.34	8A
T4	5.663	0.34	2A
T5	5.663	0.34	4A
T6	5.663	0.38	9
T7	5.663	0.34	8A
T8	5.663	0.34	1A
U1.1	5.663	0.34	9
U1.2	5.663	0.55	9
U2.1	5.663	0.34	8A
U2.2	5.663	0.70	8A
U3.1	5.663	0.34	1A
U3.2	5.663	0.70	1A
U4.1	5.663	0.34	6
U4.2	5.663	0.55	6
U5.1	5.663	0.35	9
U5.2	5.663	0.55	9
U6.1	5.663	0.35	8A
U6.2	5.663	0.72	8A
U7.1	5.663	0.34	2A
U7.2	5.663	0.72	2A
U8	5.663	0.34	3A
U9.1	5.663	0.34	8A
U9.2	5.663	0.72	8A
V1	5.663	0.35	8A
V2	5.663	0.35	2A
V3.1	5.663	0.26	9
V3.2	5.663	0.34	9
V4.1	5.663	0.64	6A
V4.2	5.663	0.34	6A
V5.1	5.663	0.26	4A
V5.2	5.663	0.31	4A
W1	5.663	0.26	9
W2	5.663	0.35	6A
W3	5.663	0.25	4A

APPENDIX "B"

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URBAN HYDROLOGY

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APPENDIX "C"


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77 DEPTH(13)=(PIEZ0(13)*2,54)/SQRT(1, -(MSLOPE**2))
78 HGL(13)=ELEV(13)+DEPTH(13)
79 HGL(8)=ELEV(8)+DEPTH(8)
80 DIFF=(PIEZ0(14)-PIEZ0(12))/15.2
81 HGRREC=(HGL(13)-(2,5*DIFF)
82 CORREC=HGL(14)-PIEZ0(14)
83 DO 53 I=1,GO TO 53
84 IF (I.EQ.8)GO TO 53
85 IF (I.EQ.13)GO TO 53
86 IF (I.EQ.14)GO TO 53
87 HGL(I)=PIEZ0(I)+CORREC
88 CONTINUE
89 DO 54 I=1,21 GO TO 54
90 IF (I.EQ.13)GO TO 54
91 IF (I.EQ.14)HGL(I)=ELEV(I)
92 DEPTH(I)=HGL(I)-ELEV(I)
93 GO TO 51
94 CONTINUE
95 DO 52 I=1,21
96 DEPTH(I)=0.0
97 HGL(I)=0.0
98 CONTINUE
99 IF (GO TO 47,54)/SQRT(1, -(LSLOPE**2))
100 DEPTH(27)=(PIEZ0(27)*2,54)/SQRT(1, -(LSLOPE**2))
101 ODEPTH(27)=ELEV(27)+DEPTH(27)
102 HGL(27)=ELEV(27)+DEPTH(27)
103 IF (GO NE,PIEZ0(32)-PIEZ0(30))/15.2
104 DIFF=(PIEZ0(31)-(4,6*DIFF)
105 HGRREC=HGL(32)-PIEZ0(32)
106 CONTINUE
107 DO 40 I=2,26 I=220(I)+CORREC
108 HGL(I)=PIEZ0(I)+CORREC
109 DO 41 I=2,30 I=218(I)+CORREC
110 HGL(I)=PIEZ0(I)+CORREC
111 DO 42 I=3,39 I=321(I)+CORREC
112 HGL(4 I)=22(I)GO TO 45
113 DO 43 I=2,34 I=22(I)GO TO 45
114 IF (I.EQ.31)GO TO 46
115 IF (I.EQ.31)HGL(I)=ELEV(I)
116 CONTINUE
117 IF (DEPTH(I).GT.9.98)GO TO 7
118 GO TO 8
119 DEPTH(I)=9.98
120 CONTINUE
121 DO 44 I=35,39
122 DEPTH(I)=HGL(I)-ELEV(I)
123 GO TO 49
124 CONTINUE
125 DO 47 I=22,39
126 DEPTH(I)=0.0
127 HGL(I)=0.0
128 CONTINUE
129 DO 48 I=1,20
130 WATSL0(I)=HGL(I)-HGL(I+1)/(POS(I+1)-POS(I))

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720 CONTINUE
WATSLD(21)=0.0
DO 721 I=22,38
WATSLD(I)=(HGL(I)-HGL(I+1))/(POS(I+1)-POS(I))
CONTINUE
721 WATSLD(39)=0.0

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CALCULATING THE EGL

```

CALL CALARE(DEPTH,CA,DIAH,EM,QL,AREA)
IF (QM.EQ.0.0) GO TO 62
DO 60 I=1,16
VLSQ(I)=SQRT((AREA(I)**2)/(1961.242))
VELO(I)=HGL(I)+ALPHA*VLSQ(I)
VELIN(I)=VELO(I)
DO 61 I=17,21
VLSQ(I)=SQRT((AREA(I)**2)/(1961.242))
VELO(I)=HGL(I)+ALPHA*VLSQ(I)
EGL(I)=HGL(I)+ALPHA*VLSQ(I)
VELOUT(I)=VELO(I)
GO TO 67
CONTINUE
VLSQ(I)=0.0
VELO(I)=0.0
VLSQ(I)=0.0
VLSQ(I)=0.0
CONTINUE
IF (QL.EQ.0.0) GO TO 63
DO 64 I=22,34
VLSQ(I)=SQRT((AREA(I)**2)/(1961.242))
VELO(I)=HGL(I)+ALPHA*VLSQ(I)
EGL(I)=HGL(I)+ALPHA*VLSQ(I)
VELIN(I)=VELO(I)
DO 65 I=35,39
VLSQ(I)=SQRT((AREA(I)**2)/(1961.242))
VELO(I)=HGL(I)+ALPHA*VLSQ(I)
EGL(I)=HGL(I)+ALPHA*VLSQ(I)
VELOUT(I)=VELO(I)
GO TO 68
CONTINUE
VLSQ(I)=0.0
VELO(I)=0.0
VLSQ(I)=0.0
VLSQ(I)=0.0

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CALCULATE FROUDE NUMBFR

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CALL CALHD(DEPTH,HD,DIAH,QM,QL,HYDEP)

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DO 412 I=1,21
FROUDE(I)=VELO(I)/SQRT(980.621*HYDEP(I))
GO TO 412
FROUDE(I)=0.0

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Y=QL/Q
IF(QM:EQ:0.0)GO TO 705
RATIO2(I)=QL/QM
GO TO 706
CONTINUE
RATIO2(I)=0.0
CONTINUE
CCLJ(I)=(LELJ(I)*Y)+(MCLJ(I))*(QM/Q)
IF(QL:EQ:0.0)GO TO 740
IF(ELJ(I)=CCLJ(I))/VELSQ(N3)
KC(I)=0.741
GO TO 741
KC(I)=CCLJ(I)/VELSQ(N6)
CONTINUE
X=(DIAM(2)**2.)/(DIAM(I)*2.)

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CALCULATE POWER LOSS

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I=1
GAMMA=62.0*0.160184
IF(QM:EQ:0.0)GO TO 703
IF(ELJ(I)=GAMMA**QM**F3(I))
PL(I)=GAMMA**QL**F2(I)
PO(I)=GAMMA**Q*EL(I)
PLR(I)=(PL(I)+PL(I))-PO(I)/(PM(I)+PL(I))
GO TO 704
CONTINUE
PM(I)=0.0
PO(I)=0.0
PL(I)=0.0
PLR(I)=0.0
CONTINUE

```

CALCULATE MOMENTUM IN AND OUT

```

RHO=GAMMA/980.621
I=1
MOMEN=RHO*QM*VELINM(I)
MOMENL=0.0
MOMENC=RHO*Q*VELOUT(I)

```

PRINT OUT OF OUTPUT

```

WRITE(3,70)
FORMAT(1,5X,'ELEVATION',7X,'DEPTH',7X,'HGL',10X,'VELOCITY HEAD',
*5X,'EGL',5X,'FROUDE NO',5X,'WATER SLOPE (H/V SLO)',VELOCITY,

```

```

DO 72 I=1,39
WRITE(3,71) ELEV(I),HGL(I),VELSQ(I),EGL(I),FROUDE(I),WAT
* SLO(I),VCL(I)
* SLO(I),VCL(I),I3,5X,F8,4,5X,F8,4,3X,F8,4,7X,F8,4,5X,F8,4,5X,F
FORMATT(10X,I3,5X,F8,4,5X,F8,4,3X,F8,4,7X,F8,4,5X,F8,4,5X,F
* 8,4,8X,F8,4)
CONTINUE(730)
WRITE(3,10X) MOMENTUM,MOMENTUML,MOMENTUMC
FORMATT(10X,I3,10X) MOMENTUM,MOMENTUML,MOMENTUMC
WRITE(3,10X) MOMENTUM,MOMENTUML,MOMENTUMC
FORMATT(10X,I3,10X,3F12.3)
FOR CONTINUE

```

ACCOUNTS OF ENERGY-LOSS VALUES

[illegible][illegible]

CALCULATE POWER LOSS

[illegible]

101 CONTINUE
311 WRITE(3,87)
312 FORMAT(11,1)
313 END
314 STOP
315 END

316 SUBROUTINE CALARC(DEPTH,CA,DIA,GM,QL,A)
317 DIMENSION A(39),DEPTH(39),DIA(2),CA(100),D(100),RELD(100)
318 INTEGER RELDEP

C AREA FOR LATERAL PIPE

319 IF(QL.EQ.0.0)GO TO 1
320 DO 2 I=2,34
321 D(I)=DEPTH(I)/DIA(1)
322 RELDEP(I)=D(I)*100
323 A(I)=CA(RELD(I))*DIA(1)**2
324 DO 3 I=35,39
325 D(I)=DEPTH(I)/DIA(2)
326 RELDEP(I)=D(I)*100
327 A(I)=CA(RELD(I))*DIA(2)**2
328 CONTINUE

AREA OF MAIN PIPE

329 IF(GM.EQ.0.0)GO TO 4
330 DO 5 I=1,2
331 D(I)=DEPTH(I)/DIA(2)
332 RELDEP(I)=D(I)*100
333 A(I)=CA(RELD(I))*DIA(2)**2
334 CONTINUE
335 RETURN
336 END

SUBROUTINE CALHD(DEPTH,HD,DIA,GM,QL,HYDEP)

337 DIMENSION D(100),RELD(100),DEPTH(39),HD(100),DIA(2),HYDEP(39)
338 INTEGER RELDEP
339 IF(QL.EQ.0.0)GO TO 1
340 DO 2 I=2,34
341 D(I)=DEPTH(I)/DIA(1)
342 RELDEP(I)=D(I)*100
343 HYDEP(I)=HD(RELD(I))*DIA(1)
344 DO 3 I=35,39
345 D(I)=DEPTH(I)/DIA(2)
346 RELDEP(I)=D(I)*100
347 HYDEP(I)=HD(RELD(I))*DIA(2)
348 CONTINUE
349 IF(GM.EQ.0.0)GO TO 4
350 DO 5 I=1,2
351 D(I)=DEPTH(I)/DIA(2)
352 RELDEP(I)=D(I)*100
353 HYDEP(I)=HD(RELD(I))*DIA(2)
354 CONTINUE
355 RETURN
356 END

SENTRY

APPENDIX "D" 4.

STORM WATER MANAGEMENT

With increased costs, with continued growth of urban areas and hence the need for additional storm sewer capacity, the problem of combined sewer overflows, and the awareness that storm water is also polluting our watercourses, much has been written recently about managing urban runoff drainage systems (1, 4, 7, 16, 21, 24, 28, 32), Appendix B.

A number of techniques have been suggested and some are in use to "get more for the public's money" i.e. make optimal use of existing and new systems.

The following techniques are, in the author's opinion, in the order "most effective" to "least effective" as regards improving the capacity and minimizing the cost.

The first management objective is to control the inflow rate to the sewer system. Urban Storm Drainage Criteria Manual (41) presents an entire chapter on the possibilities of using retention, detention, offstream channel, or onstream storage to reduce inflow rates to collection systems. Storage of rainfall near the point of rainfall occurrence can take the form of ponding on roof tops in parking lots, recreation areas, parks, road embankments, on site ponds. For example (41) (section 2.3, storage chapter) if $\frac{1}{2}$ inch of precipitation is detained, with a controlled release of the detained water, the peak runoff

from a 8.1 ha (20 acre) shopping centre site can be reduced from 50 cfs to 10 cfs. The inconvenience to parking lot users is small, whereas the cost benefits are great.

In (25) a further example is worked out for the impact that the construction of a shopping centre 7.4 ha (18.2 acres) of impervious area added to a 23 ha (57 acres) watershed has on the runoff. The plaza development increases the peak discharge by 25% and surcharges the existing system. With 1.3 cm ($\frac{1}{2}$ in.) of surface detention allowed, the peak runoff was less than the predevelopment runoff rate. This obviated the need for a relief sewer, and an enlargement of the existing system.

A second technique controls the flow in the system itself. Yen and Sevuk (47) have worked out an example of the effectiveness of a retention basin, for temporary storage of storm water, in reducing the required size of downstream sewers. They recommended the following:

(1) For new storm water disposal systems the wisdom of building expensive intermediate retention storage facilities to reduce sewer sizes is questionable. Retention basins with storage volume approaching that of the runoff volume can be effective in reducing pipe sizes.

(2) For modification of existing system, intermediate retention storage may be desirable to avoid reconstruction and to avoid overloading of treatment facilities.

The philosophy of the storage concept is to equalize the time distribution of flow, i.e. to aim for pipes flowing ~~full~~ a large percentage of the time, and not to have surcharging at one time and sewers empty some time later. A variation of the second technique is presently employed by Minneapolis - St. Paul (7), Detroit, Seattle, and Toronto. Because of areal and time variations in rainfall, the proportion of sewer capacity in use at a given time varies between various main sewers throughout a rain storm. Automatically controlled gates can constrict and redirect the flow in a main sewer until such time that the full capacity is needed. In this way, main sewers that might not be of use in a particular storm, can act as a storage area. Operation models exist to produce actual control decisions i.e. regulator settings, diversions, etc., during a storm event based on telemetered rainfall data.

A third technique considers the idea of increasing infiltration i.e. by means of porous pavements, or various landscaping practices to decrease flow in the sewer system.

A fourth technique, which has implications for existing and new systems, suggests the possibility of reducing excavation costs and surcharging frequency. Locally the problem of surcharging and public relations was commented on by W.J. Warwick (44). If the hydraulics of manholes and junctions can be improved and energy losses can be reduced the aforementioned benefits will be realized. No studies of this concept have been presented up to now (1975).

1

Using the Rational Method, Long (22) compared the cost sensitivity of various design criteria based on a 48.6 ha (120 acre) subdivision. To provide storm sewers to drain basements was found to be the most cost sensitive factor. The results are presented in figure D-1.

FIGURE D-1

MODIFIED DESIGN CRITERIA AND ASSOCIATED
STORM SYSTEM COSTS

	<u>Basic</u> <u>Criteria</u>	<u>Modified</u> <u>Criteria</u>	<u>Costs</u>
1. C (Single Family Residential) Q = CIA	.4	.5	+ 4.2%
	.4	.3	- 5.5%
2. C (Commercial)	.75	.9	+ .9%
3. Storm Frequency (yrs)	5	10	+ 7.8%
	5	2	- 5.8%
4. Inlet Time (min)	15	30	-11.0%
	15	10	+ 6.5%
5. Minimum Cover (ft)	10	5	-39.5%

APPENDIX "E"

PITOT TUBE CALIBRATION

Carriage Velocity (cm/sec)	Differential Head Δh (cm) at 30° Angle	$\sqrt{2g} \Delta h$	CP (Calibration Factor)
15.016	0.21	14.3503	1.0464
20.002	0.38	19.3038	1.0362
21.996	0.45	21.0066	1.0471
26.008	0.60	24.2564	1.0722
28.004	0.78	27.6565	1.0126
30.007	0.93	30.1990	0.9936
32.011	0.98	31.0001	1.0326
34.014	1.02	31.6265	1.0755
36.012	1.22	34.5884	1.0412
38.015	1.37	36.6531	1.0372
40.108	1.60	39.5104	1.0103
42.005	1.70	40.8296	1.0288
45.034	1.92	43.3911	1.0379
50.021	2.26	47.0765	1.0625
60.032	3.45	58.1648	1.0321
70.024	4.72	68.0333	1.0293
79.992	6.15	77.6583	1.0301
90.002	6.65	80.7535	1.0145
100.071	9.77	97.8808	1.0224
110.008	11.85	107.7977	1.0205
120.078	14.75	120.2670	0.9984
130.037	17.70	131.7459	0.9870
140.072	20.75	142.6459	0.9820
150.070	23.90	153.0909	0.9803
160.007	26.90	162.4151	0.9852
170.042	30.40	172.6582	0.9848
180.024	33.60	181.5181	0.9918
190.029	36.80	189.9653	1.0003
200.011	40.10	198.2999	1.0086
225.003	49.50	220.3195	1.0213
250.053	60.20	242.9677	1.0292
275.057	71.80	265.3460	1.0366
300.010	84.50	287.8583	1.0422

$$CP = \frac{V}{\sqrt{2g} \Delta h}$$

where V = velocity in cm/sec
 $g = 980.62 \text{ cm/sec}^2$
 Δh = differential head in cm

VOLUME II

LISTING OF OBSERVATIONS AND
CALCULATIONS DONE ON COMPUTER

POSITION	ALONG	PIPE (CM)	PER METER	READING
1	120.6	1	0.000	0.000
2	170.6	2	0.000	0.000
3	242.6	3	0.000	0.000
4	303.5	4	0.000	0.000
5	364.5	5	0.000	0.000
6	425.5	6	0.000	0.000
7	486.4	7	0.000	0.000
8	547.4	8	0.000	0.000
9	608.4	9	0.000	0.000
10	669.4	10	0.000	0.000
11	730.4	11	0.000	0.000
12	791.4	12	0.000	0.000
13	852.4	13	0.000	0.000
14	913.4	14	0.000	0.000
15	974.4	15	0.000	0.000
16	1035.4	16	0.000	0.000
17	1096.4	17	0.000	0.000
18	1157.4	18	0.000	0.000
19	1218.4	19	0.000	0.000
20	1279.4	20	0.000	0.000
21	1340.4	21	0.000	0.000
22	1401.4	22	0.000	0.000
23	1462.4	23	0.000	0.000
24	1523.4	24	0.000	0.000
25	1584.4	25	0.000	0.000
26	1645.4	26	0.000	0.000
27	1706.4	27	0.000	0.000
28	1767.4	28	0.000	0.000
29	1828.4	29	0.000	0.000
30	1889.4	30	0.000	0.000
31	1950.4	31	0.000	0.000
32	2011.4	32	0.000	0.000
33	2072.4	33	0.000	0.000
34	2133.4	34	0.000	0.000
35	2194.4	35	0.000	0.000
36	2255.4	36	0.000	0.000
37	2316.4	37	0.000	0.000
38	2377.4	38	0.000	0.000
39	2438.4	39	0.000	0.000
40	2499.4	40	0.000	0.000
41	2560.4	41	0.000	0.000
42	2621.4	42	0.000	0.000
43	2682.4	43	0.000	0.000
44	2743.4	44	0.000	0.000
45	2804.4	45	0.000	0.000
46	2865.4	46	0.000	0.000
47	2926.4	47	0.000	0.000
48	2987.4	48	0.000	0.000
49	3048.4	49	0.000	0.000
50	3109.4	50	0.000	0.000
51	3170.4	51	0.000	0.000
52	3231.4	52	0.000	0.000
53	3292.4	53	0.000	0.000
54	3353.4	54	0.000	0.000
55	3414.4	55	0.000	0.000
56	3475.4	56	0.000	0.000
57	3536.4	57	0.000	0.000
58	3597.4	58	0.000	0.000
59	3658.4	59	0.000	0.000
60	3719.4	60	0.000	0.000
61	3780.4	61	0.000	0.000
62	3841.4	62	0.000	0.000
63	3902.4	63	0.000	0.000
64	3963.4	64	0.000	0.000
65	4024.4	65	0.000	0.000
66	4085.4	66	0.000	0.000
67	4146.4	67	0.000	0.000
68	4207.4	68	0.000	0.000
69	4268.4	69	0.000	0.000
70	4329.4	70	0.000	0.000
71	4390.4	71	0.000	0.000
72	4451.4			

POSITION ALONG PIPE (CM)	PIEZOMETER	READING CM
1240.6	1	0.0000
1760.5	2	0.0000
2420.6	3	0.0000
3030.5	4	0.0000
3640.5	5	0.0000
4250.5	6	0.0000
4860.4	7	0.0000
5100.4	8	0.0000
5470.4	9	0.0000
5630.2	10	0.0000
5780.2	11	0.0000
5930.7	12	0.0000
6080.4	13	0.0000
6240.2	14	0.0000
6390.3	15	0.0000
7500.3	16	0.0000
7800.3	17	0.0000
8110.3	18	0.0000
8720.6	19	0.0000
9720.6	20	0.0000
3040.5	21	49.660
3650.7	22	49.470
4350.7	23	48.860
4900.6	24	48.640
5570.6	25	48.160
5830.7	26	29.040
5880.1	27	47.970
6180.5	28	48.120
6730.8	29	48.200
6770.4	30	20.040
6790.4	31	48.060
6790.4	32	47.920
6790.4	33	47.190
6790.4	34	43.530
7500.3	35	43.430
7800.3	36	43.290
8110.3	37	43.050
8720.6	38	42.610
9720.6	39	

FLOW RATE (CUBIC CENTIMETERS PER SECOND) 0.0000
LAT LATERAL 0.0000
SLC 0.0000
LATERAL DROP : MAIN 0.0000
MANHOLE 52 20.556

L1-2

POSITION ALONG PIPE (CM.)	PIEZOMETER	READING	CM
120.0	1	0.000	
176.0	2	0.000	
242.0	3	0.000	
303.0	4	0.000	
364.0	5	0.000	
425.0	6	0.000	
486.0	7	0.000	
510.0	8	0.000	
547.0	9	0.000	
563.0	10	0.000	
578.0	11	0.000	
593.0	12	0.000	
608.0	13	0.000	
624.0	14	0.000	
639.0	15	0.000	
654.0	16	0.000	
670.0	17	0.000	
685.0	18	0.000	
700.0	19	0.000	
715.0	20	0.000	
730.0	21	0.000	
745.0	22	0.000	
760.0	23	0.000	
775.0	24	0.000	
790.0	25	0.000	
805.0	26	0.000	
820.0	27	0.000	
835.0	28	0.000	
850.0	29	0.000	
865.0	30	0.000	
880.0	31	0.000	
895.0	32	0.000	
910.0	33	0.000	
925.0	34	0.000	
940.0	35	0.000	
955.0	36	0.000	
970.0	37	0.000	
985.0	38	0.000	
1000.0	39	0.000	
1015.0	40	0.000	
1030.0	41	0.000	
1045.0	42	0.000	
1060.0	43	0.000	
1075.0	44	0.000	
1090.0	45	0.000	
1105.0	46	0.000	
1120.0	47	0.000	
1135.0	48	0.000	
1150.0	49	0.000	
1165.0	50	0.000	
1180.0	51	0.000	
1195.0	52	0.000	
1210.0	53	0.000	
1225.0	54	0.000	
1240.0	55	0.000	
1255.0	56	0.000	
1270.0	57	0.000	
1285.0	58	0.000	
1300.0	59	0.000	
1315.0	60	0.000	
1330.0	61	0.000	
1345.0	62	0.000	
1360.0	63	0.000	
1375.0	64	0.000	
1390.0	65	0.000	
1405.0	66	0.000	
1420.0	67	0.000	
1435.0	68	0.000	
1450.0	69	0.000	
1465.0	70	0.000	
1480.0	71	0.000	
1495.0	72	0.000	
1510.0	73	0.000	
1525.0	74	0.000	
1540.0	75	0.000	
1555.0	76	0.000	
1570.0	77	0.000	
1585.0	78	0.000	
1600.0	79	0.000	
1615.0	80	0.000	
1630.0	81	0.000	
1645.0	82	0.000	
1660.0	83	0.000	
1675.0	84	0.000	
1690.0	85	0.000	
1705.0	86	0.000	
1720.0	87	0.000	
1735.0	88	0.000	
1750.0	89	0.000	
1765.0	90	0.000	
1780.0	91	0.000	
1795.0	92	0.000	
1810.0	93	0.000	
1825.0	94	0.000	
1840.0	95	0.000	
1855.0	96	0.000	
1870.0	97	0.000	
1885.0	98	0.000	
1900.0	99	0.000	
1915.0	100	0.000	

L1-3

POSITION ALONG PIPE (CM)	PIEZMETER READING	CM
120.5	0.000	
176.5	0.000	
242.5	0.000	
303.5	0.000	
364.5	0.000	
425.5	0.000	
486.5	0.000	
547.5	0.000	
608.5	0.000	
669.5	0.000	
730.5	0.000	
791.5	0.000	
852.5	0.000	
913.5	0.000	
974.5	0.000	
1035.5	0.000	
1096.5	0.000	
1157.5	0.000	
1218.5	0.000	
1279.5	0.000	
1340.5	0.000	
1401.5	0.000	
1462.5	0.000	
1523.5	0.000	
1584.5	0.000	
1645.5	0.000	
1706.5	0.000	
1767.5	0.000	
1828.5	0.000	
1889.5	0.000	
1950.5	0.000	
2011.5	0.000	
2072.5	0.000	
2133.5	0.000	
2194.5	0.000	
2255.5	0.000	
2316.5	0.000	
2377.5	0.000	
2438.5	0.000	
2499.5	0.000	
2560.5	0.000	
2621.5	0.000	
2682.5	0.000	
2743.5	0.000	
2804.5	0.000	
2865.5	0.000	
2926.5	0.000	
2987.5	0.000	
3048.5	0.000	
3109.5	0.000	
3170.5	0.000	
3231.5	0.000	
3292.5	0.000	
3353.5	0.000	
3414.5	0.000	
3475.5	0.000	
3536.5	0.000	
3597.5	0.000	
3658.5	0.000	
3719.5	0.000	
3780.5	0.000	
3841.5	0.000	
3902.5	0.000	
3963.5	0.000	
4024.5	0.000	
4085.5	0.000	
4146.5	0.000	
4207.5	0.000	
4268.5	0.000	
4329.5	0.000	
4390.5	0.000	
4451.5	0.000	
4512.5	0.000	
4573.5	0.000	
4634.5	0.000	
4695.5	0.000	
4756.5	0.000	
4817.5	0.000	
4878.5	0.000	
4939.5	0.000	
5000.5	0.000	
5061.5	0.000	
5122.5	0.000	
5183.5	0.000	
5244.5	0.000	
5305.5	0.000	
5366.5	0.000	
5427.5	0.000	
5488.5	0.000	
5549.5	0.000	
5610.5	0.000	
5671.5	0.000	
5732.5	0.000	
5793.5	0.000	
5854.5	0.000	
5915.5	0.000	
5976.5	0.000	
6037.5	0.000	
6098.5	0.000	
6159.5	0.000	
6220.5	0.000	
6281.5	0.000	
6342.5	0.000	
6403.5	0.000	
6464.5	0.000	
6525.5	0.000	
6586.5	0.000	
6647.5	0.000	
6708.5	0.000	
6769.5	0.000	
6830.5	0.000	
6891.5	0.000	
6952.5	0.000	
7013.5	0.000	
7074.5	0.000	
7135.5	0.000	
7196.5	0.000	
7257.5	0.000	
7318.5	0.000	
7379.5	0.000	
7440.5	0.000	
7501.5	0.000	
7562.5	0.000	
7623.5	0.000	
7684.5	0.000	
7745.5	0.000	
7806.5	0.000	
7867.5	0.000	
7928.5	0.000	
7989.5	0.000	
8050.5	0.000	
8111.5	0.000	
8172.5	0.000	
8233.5	0.000	
8294.5	0.000	
8355.5	0.000	
8416.5	0.000	
8477.5	0.000	
8538.5	0.000	
8599.5	0.000	
8660.5	0.000	
8721.5	0.000	
8782.5	0.000	
8843.5	0.000	
8904.5	0.000	
8965.5	0.000	
9026.5	0.000	
9087.5	0.000	
9148.5	0.000	
9209.5	0.000	
9270.5	0.000	
9331.5	0.000	
9392.5	0.000	
9453.5	0.000	
9514.5	0.000	
9575.5	0.000	
9636.5	0.000	
9697.5	0.000	
9758.5	0.000	
9819.5	0.000	
9880.5	0.000	
9941.5	0.000	
10002.5	0.000	
10063.5	0.000	
10124.5	0.000	
10185.5	0.000	
10246.5	0.000	
10307.5	0.000	
10368.5	0.000	
10429.5	0.000	
10490.5	0.000	
10551.5	0.000	
10612.5	0.000	
10673.5	0.000	
10734.5	0.000	
10795.5	0.000	
10856.5	0.000	
10917.5	0.000	
10978.5	0.000	
11039.5	0.000	
11100.5	0.000	
11161.5	0.000	
11222.5	0.000	
11283.5	0.000	
11344.5	0.000	
11405.5	0.000	
11466.5	0.000	
11527.5	0.000	
11588.5	0.000	
11649.5	0.000	
11710.5	0.000	
11771.5	0.000	
11832.5	0.000	
11893.5	0.000	
11954.5	0.000	
12015.5	0.000	
12076.5	0.000	
12137.5	0.000	
12198.5	0.000	
12259.5	0.000	
12320.5	0.000	
12381.5	0.000	
12442.5	0.000	
12503.5	0.000	
12564.5	0.000	
12625.5	0.000	
12686.5	0.000	
12747.5	0.000	
12808.5	0.000	
12869.5	0.000	
12930.5	0.000	
12991.5	0.000	
13052.5	0.000	
13113.5	0.000	
13174.5	0.000	
13235.5	0.000	
13296.5	0.000	
13357.5	0.000	
13418.5	0.000	
13479.5	0.000	
13540.5	0.000	
13601.5	0.000	
13662.5	0.000	
13723.5	0.000	
13784.5	0.000	
13845.5	0.000	
13906.5	0.000	
13967.5	0.000	
14028.5	0.000	
14089.5	0.000	
14150.5	0.000	
14211.5	0.000	
14272.5	0.000	
14333.5	0.000	
14394.5	0.000	
14455.5	0.000	
14516.5	0.000	
14577.5	0.000	
14638.5	0.000	
14699.5	0.000	
14760.5	0.000	
14821.5	0.000	
14882.5	0.000	
14943.5	0.000	
15004.5	0.000	
15065.5	0.000	
15126.5	0.000	
15187.5	0.000	
15248.5	0.000	
15309.5	0.000	
15370.5	0.000	
15431.5	0.000	
15492.5	0.000	
15553.5	0.000	
15614.5	0.000	
15675.5	0.000	
15736.5	0.000	
15797.5	0.000	
15858.5	0.000	
15919.5	0.000	
15980.5	0.000	
16041.5	0.000	
16102.5	0.000	
16163.5	0.000	
16224.5	0.000	
16285.5	0.000	
16346.5	0.000	
16407.5	0.000	
16468.5	0.000	
16529.5	0.000	
16590.5	0.000	
16651.5	0.000	
16712.5	0.000	
16773.5	0.000	
16834.5	0.000	
16895.5	0.000	
16956.5	0.000	
17017.5	0.000	
17078.5	0.000	
17139.5	0.000	
17200.5	0.000	
17261.5	0.000	
17322.5	0.000	
17383.5	0.000	
17444.5	0.000	
17505.5	0.000	
17566.5	0.000	
17627.5	0.000	
17688.5	0.000	
17749.5	0.000	
17810.5	0.000	
17871.5	0.000	
17932.5	0.000	
17993.5	0.000	
18054.5	0.000	
18115.5	0.000	
18176.5	0.000	
18237.5	0.000	
18298.5	0.000	
18359.5	0.000	
18420.5	0.000	
18481.5	0.000	
18542.5	0.000	
18603.5	0.000	
18664.5	0.000	
18725.5	0.000	
18786.5	0.000	
18847.5	0.000	
18908.5	0.000	
18969.5	0.000	
19030.5	0.000	
19091.5	0.000	
19152.5	0.000	
19213.5	0.000	
19274.5	0.000	
19335.5	0.000	
19396.5	0.000	
19457.5	0.000	
19518.5	0.000	
19579.5	0.000	
19640.5	0.000	
19701.5	0.000	
19762.5	0.000	
19823.5	0.000	
19884.5	0.000	
19945.5	0.000	
20006.5	0.000	
20067.5	0.000	
20128.5	0.000	
20189.5	0.000	
20250.5	0.000	
20311.5	0.000	
20372.5	0.000	
20433.5	0.000	
20494.5	0.000	
20555.5	0.000	
20616.5	0.000	
20677.5	0.000	
20738.5	0.000	
20799.5	0.000	
20860.5	0.000	
20921.5	0.000	
20982.5	0.000	
21043.5	0.000	
21104.5	0.000	
21165.5	0.000	
21226.5	0.000	
21287.5	0.000	
21348.5	0.000	
21409.5	0.000	
21470.5	0.000	
21531.5	0.000	
21592.5	0.000	
21653.5	0.000	
21714.5	0.000	
21775.5	0.000	
21836.5	0.000	
21897.5	0.000	
21958.5	0.000	
22019.5	0.000	
22080.5	0.000	
22141.5	0.000	
22202.5	0.000	
22263.5	0.000	
22324.5	0.000	
22385.5	0.000	
22446.5	0.000	
22507.5	0.000	
22568.5	0.000	
22629.5	0.000	
22690.5	0.000	
22751.5	0.000	
22812.5	0.000	
22873.5	0.000	
22934.5	0.000	
22995.5	0.000	
23056.5	0.000	
23117.5	0.000	
23178.5	0.000	
23239.5	0.000	
23300.5	0.000	
23361.5	0.000	
23422.5	0.000	
23483.5	0.000	
23544.5	0.000	
23605.5	0.000	
23666.5	0.000	
23727.5	0.000	
23788.5	0.000	
23849.5	0.000	
23910.5	0.000	
23971.5	0.000	
24032.5	0.000	
24093.5	0.000	
24154.5	0.000	
24215.5	0.000	
24276.5	0.000	
24337.5	0.000	
24398.5	0.000	
24459.5	0.000	
24520.5	0.000	
24581.5	0.000	
24642.5	0.0	

POSITION ALONG PIPE (CM)	PIEZOMETER	READING	CM
170.6	1	0.000	
160.6	2	0.000	
142.6	3	0.000	
130.6	4	0.000	
120.6	5	0.000	
102.6	6	0.000	
90.6	7	0.000	
80.6	8	0.000	
70.6	9	0.000	
60.6	10	0.000	
50.6	11	0.000	
40.6	12	0.000	
30.6	13	0.000	
20.6	14	0.000	
10.6	15	0.000	
0.6	16	0.000	
	17	0.000	
	18	0.000	
	19	0.000	
	20	0.000	
	21	0.000	
	22	0.000	
	23	0.000	
	24	0.000	
	25	0.000	
	26	0.000	
	27	0.000	
	28	0.000	
	29	0.000	
	30	0.000	
	31	0.000	
	32	0.000	
	33	0.000	
	34	0.000	
	35	0.000	
	36	0.000	
	37	0.000	
	38	0.000	
	39	0.000	
	40	0.000	
	41	0.000	
	42	0.000	
	43	0.000	
	44	0.000	
	45	0.000	
	46	0.000	
	47	0.000	
	48	0.000	
	49	0.000	
	50	0.000	
	51	0.000	
	52	0.000	
	53	0.000	
	54	0.000	
	55	0.000	
	56	0.000	
	57	0.000	
	58	0.000	
	59	0.000	
	60	0.000	
	61	0.000	
	62	0.000	
	63	0.000	
	64	0.000	
	65	0.000	
	66	0.000	
	67	0.000	
	68	0.000	
	69	0.000	
	70	0.000	
	71	0.000	
	72	0.000	
	73	0.000	
	74	0.000	
	75	0.000	
	76	0.000	
	77	0.000	
	78	0.000	
	79	0.000	
	80	0.000	
	81	0.000	
	82	0.000	
	83	0.000	
	84	0.000	
	85	0.000	
	86	0.000	
	87	0.000	
	88	0.000	
	89	0.000	
	90	0.000	
	91	0.000	
	92	0.000	
	93	0.000	
	94	0.000	
	95	0.000	
	96	0.000	
	97	0.000	
	98	0.000	
	99	0.000	
	100	0.000	

L1-5

POSITION	ALONG PIPE (CM)	PIEZOMETER	READING CM
	120.6	1	0.000
	176.5	2	0.000
	242.6	3	0.000
	303.5	4	0.000
	364.5	5	0.000
	425.5	6	0.000
	486.4	7	0.000
	510.0	8	0.000
	547.4	9	0.000
	563.2	10	0.000
	578.7	11	0.000
	593.7	12	0.000
	608.9	13	0.000
	624.2	14	0.000
	639.5	15	0.000
	750.3	16	0.000
	780.8	17	0.000
	811.3	18	0.000
	872.6	19	0.000
	904.5	20	0.000
	935.7	21	0.000
	966.6	22	0.000
	997.6	23	0.000
	1028.7	24	0.000
	1059.7	25	0.000
	1090.7	26	0.000
	1121.7	27	0.000
	1152.7	28	0.000
	1183.7	29	0.000
	1214.7	30	0.000
	1245.7	31	0.000
	1276.7	32	0.000
	1307.7	33	0.000
	1338.7	34	0.000
	1369.7	35	0.000
	1400.7	36	0.000
	1431.7	37	0.000
	1462.7	38	0.000
	1493.7	39	0.000
	1524.7	40	0.000
	1555.7	41	0.000
	1586.7	42	0.000
	1617.7	43	0.000
	1648.7	44	0.000
	1679.7	45	0.000
	1710.7	46	0.000
	1741.7	47	0.000
	1772.7	48	0.000
	1803.7	49	0.000
	1834.7	50	0.000
	1865.7	51	0.000
	1896.7	52	0.000
	1927.7	53	0.000
	1958.7	54	0.000
	1989.7	55	0.000
	2020.7	56	0.000
	2051.7	57	0.000
	2082.7	58	0.000
	2113.7	59	0.000
	2144.7	60	0.000
	2175.7	61	0.000
	2206.7	62	0.000
	2237.7	63	0.000
	2268.7	64	0.000
	2299.7	65	0.000
	2330.7	66	0.000
	2361.7	67	0.000
	2392.7	68	0.000
	2423.7	69	0.000
	2454.7	70	0.000
	2485.7	71	0.000
	2516.7	72	0.000
	2547.7	73	0.000
	2578.7	74	0.000
	2609.7	75	0.000
	2640.7	76	0.000
	2671.7	77	0.000
	2702.7	78	0.000
	2733.7	79	0.000
	2764.7	80	0.000
	2795.7	81	0.000
	2826.7	82	0.000
	2857.7	83	0.000
	2888.7	84	0.000
	2919.7	85	0.000
	2950.7	86	0.000
	2981.7	87	0.000
	3012.7	88	0.000
	3043.7	89	0.000
	3074.7	90	0.000
	3105.7	91	0.000
	3136.7	92	0.000
	3167.7	93	0.000
	3198.7	94	0.000
	3229.7	95	0.000
	3260.7	96	0.000
	3291.7	97	0.000
	3322.7	98	0.000
	3353.7	99	0.000
	3384.7	100	0.000

L1-6

POSITION ALONG PIPE (CM)	PIEZOMETER READING CM
120.6	0.000
176.5	0.000
242.6	0.000
303.5	0.000
364.5	0.000
425.5	0.000
486.4	0.000
510.0	0.000
547.4	0.000
563.2	0.000
578.5	0.000
593.7	0.000
606.4	0.000
608.0	0.000
624.2	0.000
639.5	0.000
750.3	0.000
780.8	0.000
811.3	0.000
872.3	0.000
972.6	0.000
364.5	46.750
365.5	46.410
435.7	46.250
496.6	45.930
557.6	45.885
583.7	45.570
598.1	45.710
618.5	45.710
633.6	45.710
644.4	45.675
649.0	45.675
664.3	45.490
679.5	41.160
750.3	41.180
780.8	41.080
811.3	40.800
872.3	40.560

FLOW RATE (CUBIC CENTIMETERS PER SECOND), 0.0000
 LATERAL 552.1782 MAIN
 SLOPE 0.00330 MAIN, 0.00000 OUTLET, 0.000500
 LATERAL DROP : MAIN 1.0000 LATERAL 4.930
 MANHOLE 25 1.463

LI-7

POSITION	ALONG PIPE(CM)	PIEZOMETER	READING	CM
1	120.6	1	0.000	
2	176.5	2	0.000	
3	242.6	3	0.000	
4	303.5	4	0.000	
5	364.5	5	0.000	
6	425.5	6	0.000	
7	486.4	7	0.000	
8	510.0	8	0.000	
9	547.4	9	0.000	
10	563.2	10	0.000	
11	578.5	11	0.000	
12	593.7	12	0.000	
13	606.4	13	0.000	
14	624.2	14	0.000	
15	639.5	15	0.000	
16	750.3	16	0.000	
17	780.8	17	0.000	
18	811.3	18	0.000	
19	872.3	19	0.000	
20	972.6	20	0.000	
21	972.6	21	0.000	
22	972.6	22	0.000	
23	972.6	23	0.000	
24	972.6	24	0.000	
25	972.6	25	0.000	
26	972.6	26	0.000	
27	972.6	27	0.000	
28	972.6	28	0.000	
29	972.6	29	0.000	
30	972.6	30	0.000	
31	972.6	31	0.000	
32	972.6	32	0.000	
33	972.6	33	0.000	
34	972.6	34	0.000	
35	972.6	35	0.000	
36	972.6	36	0.000	
37	972.6	37	0.000	
38	972.6	38	0.000	
39	972.6	39	0.000	
40	972.6	40	0.000	
41	972.6	41	0.000	
42	972.6	42	0.000	
43	972.6	43	0.000	
44	972.6	44	0.000	
45	972.6	45	0.000	
46	972.6	46	0.000	
47	972.6	47	0.000	
48	972.6	48	0.000	
49	972.6	49	0.000	
50	972.6	50	0.000	
51	972.6	51	0.000	
52	972.6	52	0.000	
53	972.6	53	0.000	
54	972.6	54	0.000	
55	972.6	55	0.000	
56	972.6	56	0.000	
57	972.6	57	0.000	
58	972.6	58	0.000	
59	972.6	59	0.000	
60	972.6	60	0.000	
61	972.6	61	0.000	
62	972.6	62	0.000	
63	972.6	63	0.000	
64	972.6	64	0.000	
65	972.6	65	0.000	
66	972.6	66	0.000	
67	972.6	67	0.000	
68	972.6	68	0.000	
69	972.6	69	0.000	
70	972.6	70	0.000	
71	972.6	71	0.000	
72	972.6	72	0.000	
73	972.6	73	0.000	
74	972.6	74	0.000	
75	972.6	75	0.000	
76	972.6	76	0.000	
77	972.6	77	0.000	
78	972.6	78	0.000	
79	972.6	79	0.000	
80	972.6	80	0.000	
81	972.6	81	0.000	
82	972.6	82	0.000	
83	972.6	83	0.000	
84	972.6	84	0.000	
85	972.6	85	0.000	
86	972.6	86	0.000	
87	972.6	87	0.000	
88	972.6	88	0.000	
89	972.6	89	0.000	
90	972.6	90	0.000	
91	972.6	91	0.000	
92	972.6	92	0.000	
93	972.6	93	0.000	
94	972.6	94	0.000	
95	972.6	95	0.000	
96	972.6	96	0.000	
97	972.6	97	0.000	
98	972.6	98	0.000	
99	972.6	99	0.000	
100	972.6	100	0.000	

FLOW RATE(CUBIC CENTIMETERS PER SECOND)
 LATERAL 311.4851MAIN
 ELCP 0.000500
 LATERAL 0.000500
 MANHOLE 0.000500
 1.95C 1.915C

21-8

POSITION	ALONG PIPE (CM)	PIEZOMETER	READING	CM
1	120.6	1	0.000	
2	176.3	2	0.000	
3	242.0	3	0.000	
4	303.0	4	0.000	
5	364.0	5	0.000	
6	425.0	6	0.000	
7	486.0	7	0.000	
8	510.0	8	0.000	
9	547.0	9	0.000	
10	567.0	10	0.000	
11	578.0	11	0.000	
12	597.0	12	0.000	
13	606.0	13	0.000	
14	608.0	14	0.000	
15	624.0	15	0.000	
16	639.0	16	0.000	
17	750.0	17	0.000	
18	780.0	18	0.000	
19	811.0	19	0.000	
20	872.0	20	0.000	
21	922.0	21	0.000	
22	934.0	22	45.430	
23	965.0	23	45.430	
24	975.0	24	45.180	
25	990.0	25	45.050	
26	990.0	26	44.740	
27	990.0	27	44.475	
28	990.0	28	44.570	
29	990.0	29	44.570	
30	990.0	30	44.570	
31	990.0	31	44.570	
32	990.0	32	44.570	
33	990.0	33	44.570	
34	990.0	34	44.570	
35	990.0	35	44.570	
36	990.0	36	44.570	
37	990.0	37	44.570	
38	990.0	38	44.570	
39	990.0	39	44.570	
40	990.0	40	44.570	
41	990.0	41	44.570	
42	990.0	42	44.570	
43	990.0	43	44.570	
44	990.0	44	44.570	
45	990.0	45	44.570	
46	990.0	46	44.570	
47	990.0	47	44.570	
48	990.0	48	44.570	
49	990.0	49	44.570	
50	990.0	50	44.570	
51	990.0	51	44.570	
52	990.0	52	44.570	
53	990.0	53	44.570	
54	990.0	54	44.570	
55	990.0	55	44.570	
56	990.0	56	44.570	
57	990.0	57	44.570	
58	990.0	58	44.570	
59	990.0	59	44.570	
60	990.0	60	44.570	
61	990.0	61	44.570	
62	990.0	62	44.570	
63	990.0	63	44.570	
64	990.0	64	44.570	
65	990.0	65	44.570	
66	990.0	66	44.570	
67	990.0	67	44.570	
68	990.0	68	44.570	
69	990.0	69	44.570	
70	990.0	70	44.570	
71	990.0	71	44.570	
72	990.0	72	44.570	
73	990.0	73	44.570	
74	990.0	74	44.570	
75	990.0	75	44.570	
76	990.0	76	44.570	
77	990.0	77	44.570	
78	990.0	78	44.570	
79	990.0	79	44.570	
80	990.0	80	44.570	
81	990.0	81	44.570	
82	990.0	82	44.570	
83	990.0	83	44.570	
84	990.0	84	44.570	
85	990.0	85	44.570	
86	990.0	86	44.570	
87	990.0	87	44.570	
88	990.0	88	44.570	
89	990.0	89	44.570	
90	990.0	90	44.570	
91	990.0	91	44.570	
92	990.0	92	44.570	
93	990.0	93	44.570	
94	990.0	94	44.570	
95	990.0	95	44.570	
96	990.0	96	44.570	
97	990.0	97	44.570	
98	990.0	98	44.570	
99	990.0	99	44.570	
100	990.0	100	44.570	

FLOW RATE (CURRIC CENTIMETERS PER SECOND) 0.0000
 LATERAL 0.0000 MAIN 0.0000 OUTLET 0.0000500
 MANHOLE DROP 0.0000 LATERAL 0.0000
 1.0000 13 0.811

LI-9

NO	K2	K3	K2L	K3M	LELJ	MELJ	TELL	TELM
1	9.76	0.00	4.19	0.00	5.016	0.00	10.46	0.00
2	8.52	0.00	5.69	0.00	5.16	0.00	10.46	0.00
3	5.73	0.00	2.91	0.00	5.73	0.00	11.03	0.00
4	6.44	0.00	3.22	0.00	5.50	0.00	10.80	0.00
5	7.64	0.00	3.25	0.00	5.29	0.00	10.59	0.00
6	14.85	0.00	5.97	0.00	4.83	0.00	9.99	0.00
7	19.59	0.00	7.05	0.00	4.69	0.00	10.13	0.00
8	27.49	0.00	10.37	0.00	4.79	0.00	9.99	0.00
9	27.49	0.00	10.37	0.00	3.75	0.00	9.05	0.00
10	27.49	0.00	10.37	0.00	59.15	0.00	32.20	0.00
11	27.49	0.00	10.37	0.00	64.93	0.00	34.46	0.00
12	27.49	0.00	10.37	0.00	76.37	0.00	44.27	0.00
13	27.49	0.00	10.37	0.00	72.49	0.00	41.05	0.00
14	27.49	0.00	10.37	0.00	54.18	0.00	36.86	0.00
15	27.49	0.00	10.37	0.00	43.13	0.00	25.25	0.00
16	27.49	0.00	10.37	0.00	39.26	0.00	21.66	0.00
17	27.49	0.00	10.37	0.00	30.10	0.00	18.49	0.00
18	27.49	0.00	10.37	0.00	26.06	0.00	17.11	0.00

KE: LATERAL LOSS COEFF. W.R.T. CUTLET VELOCITY
 K2L: MAIN LOSS COEFFICIENT W.R.T. CUTLET VELOCITY
 K3M: MAIN LOSS COEFFICIENT W.R.T. CUTLET VELOCITY
 K2L: W.R.T. LATERAL INLET VELOCITY
 K3M: W.R.T. MAIN INLET VELOCITY
 LELJ: LATERAL ENERGY LOSS DUE TO JUNCTION
 MELJ: MAIN ENERGY LOSS DUE TO JUNCTION
 TELJ: MAIN ENERGY LOSS THROUGH JUNCTION
 TELM: TOTAL ENERGY LOSS THROUGH JUNCTION
 FATIO: RATIO OF LATERAL FLOW TO TOTAL FLOW
 VELIN: INLET VELOCITY
 VELINM: INLET AND OUTLET VELOCITIES

LI

POSITION, ALONG	PIPE (CM)	PIEZOMETER	READING	CM
120.6	120.6	51.180	51.180	
176.6	176.6	50.950	50.950	
242.6	242.6	50.830	50.830	
303.5	303.5	50.710	50.710	
304.5	304.5	50.530	50.530	
425.5	425.5	50.420	50.420	
486.4	486.4	40.670	40.670	
510.0	510.0	50.330	50.330	
547.4	547.4	50.290	50.290	
563.2	563.2	50.250	50.250	
578.5	578.5	50.240	50.240	
593.7	593.7	40.665	40.665	
606.4	606.4	50.240	50.240	
608.9	608.9	50.175	50.175	
624.2	624.2	50.175	50.175	
639.5	639.5	48.740	48.740	
750.3	750.3	48.660	48.660	
780.8	780.8	48.420	48.420	
811.3	811.3	47.670	47.670	
872.3	872.3	40.880	40.880	
904.5	904.5	00.000	00.000	
955.5	955.5	00.000	00.000	
965.7	965.7	00.000	00.000	
996.6	996.6	00.000	00.000	
557.6	557.6	00.000	00.000	
587.7	587.7	00.000	00.000	
588.1	588.1	00.000	00.000	
618.5	618.5	00.000	00.000	
637.8	637.8	00.000	00.000	
644.4	644.4	00.000	00.000	
649.0	649.0	00.000	00.000	
664.3	664.3	00.000	00.000	
679.5	679.5	00.000	00.000	
700.3	700.3	00.000	00.000	
790.8	790.8	00.000	00.000	
811.3	811.3	00.000	00.000	
872.3	872.3	00.000	00.000	
972.6	972.6	00.000	00.000	

FLOW RATE (CUBIC CENTIMETERS PER SECOND) 7079.2070

LATERAL
 SLIDE 0.000000 MAIN 0.000000 OUTLET 0.000000
 LATERAL DRIP MAIN 0.000000 LATERAL 0.000000
 MANHOLE 78 4.685
 11.447

M1.1

POSITION ALONG PIPE(CM)	PIEZOMETER	READING	CM
120.6	1	49.860	
176.5	2	49.740	
242.6	3	49.620	
303.5	4	49.510	
364.5	5	49.390	
425.5	6	49.620	
486.4	7	49.150	
517.0	8	49.190	
547.4	9	49.180	
563.2	10	49.040	
578.5	11	49.020	
593.7	12	49.010	
606.4	13	49.220	
608.9	14	48.980	
624.2	15	48.960	
639.3	16	48.920	
750.3	17	47.810	
760.8	18	47.660	
811.3	19	47.340	
872.3	20	46.840	
972.6	21	46.720	
374.5	22	0.000	
365.5	23	0.000	
435.7	24	0.000	
496.6	25	0.000	
557.6	26	0.000	
583.7	27	0.000	
583.1	28	0.000	
618.5	29	0.000	
633.8	30	0.000	
644.4	31	0.000	
649.4	32	0.000	
664.3	33	0.000	
679.5	34	0.000	
730.3	35	0.000	
780.8	36	0.000	
811.3	37	0.000	
872.3	38	0.000	
972.6	39	0.000	

FLOW RATE(CUHC CENTIMETERS PER SECOND) 6173.6700
 LATERAL 0.0000MAIN
 SLUDGE 0.003300MAIN 0.006500OUTLET 0.0000500
 LATERAL DROP :MAIN 0.0000LATERAL 4.920
 MANHOLE 71 4.489
 106747 71

M1-2

POSITION	ALONG PIPE (CM)	PIEZOMETER	READING	CM
	120.6	2	48.290	
	176.5	3	48.190	
	242.6	4	48.080	
	303.5	5	48.000	
	364.5	6	47.890	
	425.5	7	47.790	
	486.4	8	47.710	
	510.0	9	47.670	
	547.4	10	47.675	
	563.2	11	47.630	
	578.5	12	47.610	
	593.7	13	3.615	
	606.4	14	47.600	
	624.0	15	47.570	
	639.5	16	47.525	
	750.3	17	46.620	
	780.8	18	46.430	
	811.3	19	46.230	
	872.2	20	45.670	
	972.2	21	45.090	
	304.5	22	0.000	
	365.0	23	0.000	
	435.7	24	0.000	
	496.6	25	0.000	
	557.6	26	0.000	
	583.7	27	0.000	
	588.1	28	0.000	
	618.5	29	0.000	
	633.8	30	0.000	
	644.4	31	0.000	
	649.0	32	0.000	
	664.3	33	0.000	
	679.5	34	0.000	
	750.3	35	0.000	
	780.8	36	0.000	
	811.3	37	0.000	
	872.2	38	0.000	
	972.2	39	0.000	
FLOW RATE (CUBIC CENTIMETERS PER SECOND)			4530.6910	
LATERAL				
SLQPE				
LATERAL	0.00330 MAIN	0.00050 OUTLET	0.00050	
MANHOLE	DEPT. MAIN	0.000 LATERAL	4.930	
	5.187	67	4.192	

M1-3

POSITION ALONG PIPE (CM)	PIEZOMETER	READING	CM
120.6	1	47.415	
176.5	2	47.325	
242.6	3	47.250	
307.5	4	47.140	
364.5	5	47.065	
425.5	6	46.930	
486.4	7	46.840	
510.0	8	3.350	
547.4	9	46.820	
563.2	10	46.780	
578.5	11	46.740	
593.7	12	46.720	
606.4	13	3.390	
624.2	14	46.720	
639.5	15	46.720	
650.3	16	46.700	
750.0	17	46.650	
811.0	18	45.650	
872.0	19	45.690	
972.0	20	45.420	
104.5	21	44.990	
136.5	22	44.440	
143.7	23	0.000	
149.6	24	0.000	
157.6	25	0.000	
1587.7	26	0.000	
1598.1	27	0.000	
1616.5	28	0.000	
1633.4	29	0.000	
1644.4	30	0.000	
1649.0	31	0.000	
1664.1	32	0.000	
1679.5	33	0.000	
1750.0	34	0.000	
1780.0	35	0.000	
1811.3	36	0.000	
1872.0	37	0.000	
1972.0	38	0.000	
1972.0	39	0.000	
1972.0	40	0.000	

FLOW RATE (CUBIC CENTIMETERS PER SECOND) .4195.9379

LATERAL C.00000MAIN

SLOPE

LATERAL 3.000300MAIN 0.000500OUTLET 0.000500

MANHOLE DROP :MAIN 4.930

MANHOLE 56 4.041

M1-4

POSITION ALONG PIPE (CM)	PIEZOMETER	READING	CM.
120.6	1	45.270	1
176.5	2	45.210	
242.6	3	45.140	
303.5	4	45.090	
364.5	5	44.980	
425.5	6	44.900	
486.4	7	44.880	
510.0	8	44.800	
547.4	9	44.810	
563.2	10	44.790	
578.5	11	44.760	
593.7	12	44.730	
606.4	13	44.545	
608.9	14	44.710	
624.2	15	44.690	
639.5	16	44.680	
750.7	17	44.090	
780.8	18	43.960	
811.3	19	43.750	
872.6	20	43.360	
972.6	21	42.930	
304.5	22	0.000	
365.5	23	0.000	
435.7	24	0.000	
496.6	25	0.000	
557.6	26	0.000	
583.7	27	0.000	
619.5	28	0.000	
633.8	29	0.000	
644.4	30	0.000	
649.0	31	0.000	
666.3	32	0.000	
679.5	33	0.000	
750.3	34	0.000	
780.8	35	0.000	
811.3	36	0.000	
872.6	37	0.000	
972.6	38	0.000	
FLOW RATE (CUBIC CENTIMETERS PER SECOND)			
LATERAL	0.000		
SLOPE	0.000		
LATERAL	0.000		
MANHOLE	0.000		
DRIP	0.000		
MAIN	0.000		
42	0.000		
6.481	0.000		
2.352	0.000		
2180	3970		

M1-5

POSITION ALONG PIPE (CM)	PIEZOMETER READING CM
120.6	44.430
176.6	44.430
242.6	44.430
303.6	44.430
364.6	44.430
425.6	44.430
486.6	44.430
547.6	44.430
608.6	44.430
669.6	44.430
730.6	44.430
791.6	44.430
852.6	44.430
913.6	44.430
974.6	44.430
1035.6	44.430
1096.6	44.430
1157.6	44.430
1218.6	44.430
1279.6	44.430
1340.6	44.430
1401.6	44.430
1462.6	44.430
1523.6	44.430
1584.6	44.430
1645.6	44.430
1706.6	44.430
1767.6	44.430
1828.6	44.430
1889.6	44.430
1950.6	44.430
2011.6	44.430
2072.6	44.430
2133.6	44.430
2194.6	44.430
2255.6	44.430
2316.6	44.430
2377.6	44.430
2438.6	44.430
2499.6	44.430
2560.6	44.430
2621.6	44.430
2682.6	44.430
2743.6	44.430
2804.6	44.430
2865.6	44.430
2926.6	44.430
2987.6	44.430
3048.6	44.430
3109.6	44.430
3170.6	44.430
3231.6	44.430
3292.6	44.430
3353.6	44.430
3414.6	44.430
3475.6	44.430
3536.6	44.430
3597.6	44.430
3658.6	44.430
3719.6	44.430
3780.6	44.430
3841.6	44.430
3902.6	44.430
3963.6	44.430
4024.6	44.430
4085.6	44.430
4146.6	44.430
4207.6	44.430
4268.6	44.430
4329.6	44.430
4390.6	44.430
4451.6	44.430
4512.6	44.430
4573.6	44.430
4634.6	44.430
4695.6	44.430
4756.6	44.430
4817.6	44.430
4878.6	44.430
4939.6	44.430
5000.6	44.430
5061.6	44.430
5122.6	44.430
5183.6	44.430
5244.6	44.430
5305.6	44.430
5366.6	44.430
5427.6	44.430
5488.6	44.430
5549.6	44.430
5610.6	44.430
5671.6	44.430
5732.6	44.430
5793.6	44.430
5854.6	44.430
5915.6	44.430
5976.6	44.430
6037.6	44.430
6098.6	44.430
6159.6	44.430
6220.6	44.430
6281.6	44.430
6342.6	44.430
6403.6	44.430
6464.6	44.430
6525.6	44.430
6586.6	44.430
6647.6	44.430
6708.6	44.430
6769.6	44.430
6830.6	44.430
6891.6	44.430
6952.6	44.430
7013.6	44.430
7074.6	44.430
7135.6	44.430
7196.6	44.430
7257.6	44.430
7318.6	44.430
7379.6	44.430
7440.6	44.430
7501.6	44.430
7562.6	44.430
7623.6	44.430
7684.6	44.430
7745.6	44.430
7806.6	44.430
7867.6	44.430
7928.6	44.430
7989.6	44.430
8050.6	44.430
8111.6	44.430
8172.6	44.430
8233.6	44.430
8294.6	44.430
8355.6	44.430
8416.6	44.430
8477.6	44.430
8538.6	44.430
8599.6	44.430
8660.6	44.430
8721.6	44.430
8782.6	44.430
8843.6	44.430
8904.6	44.430
8965.6	44.430
9026.6	44.430
9087.6	44.430
9148.6	44.430
9209.6	44.430
9270.6	44.430
9331.6	44.430
9392.6	44.430
9453.6	44.430
9514.6	44.430
9575.6	44.430
9636.6	44.430
9697.6	44.430
9758.6	44.430
9819.6	44.430
9880.6	44.430
9941.6	44.430
10002.6	44.430
10063.6	44.430
10124.6	44.430
10185.6	44.430
10246.6	44.430
10307.6	44.430
10368.6	44.430
10429.6	44.430
10490.6	44.430
10551.6	44.430
10612.6	44.430
10673.6	44.430
10734.6	44.430
10795.6	44.430
10856.6	44.430
10917.6	44.430
10978.6	44.430
11039.6	44.430
11100.6	44.430
11161.6	44.430
11222.6	44.430
11283.6	44.430
11344.6	44.430
11405.6	44.430
11466.6	44.430
11527.6	44.430
11588.6	44.430
11649.6	44.430
11710.6	44.430
11771.6	44.430
11832.6	44.430
11893.6	44.430
11954.6	44.430
12015.6	44.430
12076.6	44.430
12137.6	44.430
12198.6	44.430
12259.6	44.430
12320.6	44.430
12381.6	44.430
12442.6	44.430
12503.6	44.430
12564.6	44.430
12625.6	44.430
12686.6	44.430
12747.6	44.430
12808.6	44.430
12869.6	44.430
12930.6	44.430
12991.6	44.430
13052.6	44.430
13113.6	44.430
13174.6	44.430
13235.6	44.430
13296.6	44.430
13357.6	44.430
13418.6	44.430
13479.6	44.430
13540.6	44.430
13601.6	44.430
13662.6	44.430
13723.6	44.430
13784.6	44.430
13845.6	44.430
13906.6	44.430
13967.6	44.430
14028.6	44.430
14089.6	44.430
14150.6	44.430
14211.6	44.430
14272.6	44.430
14333.6	44.430
14394.6	44.430
14455.6	44.430
14516.6	44.430
14577.6	44.430
14638.6	44.430
14699.6	44.430
14760.6	44.430
14821.6	44.430
14882.6	44.430
14943.6	44.430
15004.6	44.430
15065.6	44.430
15126.6	44.430
15187.6	44.430
15248.6	44.430
15309.6	44.430
15370.6	44.430
15431.6	44.430
15492.6	44.430
15553.6	44.430
15614.6	44.430
15675.6	44.430
15736.6	44.430
15797.6	44.430
15858.6	44.430
15919.6	44.430
15980.6	44.430
16041.6	44.430
16102.6	44.430
16163.6	44.430
16224.6	44.430
16285.6	44.430
16346.6	44.430
16407.6	44.430
16468.6	44.430
16529.6	44.430
16590.6	44.430
16651.6	44.430
16712.6	44.430
16773.6	44.430
16834.6	44.430
16895.6	44.430
16956.6	44.430
17017.6	44.430
17078.6	44.430
17139.6	44.430
17200.6	44.430
17261.6	44.430
17322.6	44.430
17383.6	44.430
17444.6	44.430
17505.6	44.430
17566.6	44.430
17627.6	44.430
17688.6	44.430
17749.6	44.430
17810.6	44.430
17871.6	44.430
17932.6	44.430
17993.6	44.430
18054.6	44.430
18115.6	44.430
18176.6	44.430
18237.6	44.430
18298.6	44.430
18359.6	44.430
18420.6	44.430
18481.6	44.430
18542.6	44.430
18603.6	44.430
18664.6	44.430
18725.6	44.430
18786.6	44.430
18847.6	44.430
18908.6	44.430
18969.6	44.430
19030.6	44.430
19091.6	44.430
19152.6	44.430
19213.6	44.430
19274.6	44.430
19335.6	44.430
19396.6	44.430
19457.6	44.430
19518.6	44.430
19579.6	44.430
19640.6	44.430
19701.6	44.430
19762.6	44.430
19823.6	44.430
19884.6	44.430
19945.6	44.430
20006.6	44.430
20067.6	44.430
20128.6	44.430
20189.6	44.430
20250.6	44.430
20311.6	44.430
20372.6	44.430
20433.6	44.430
20494.6	44.430
20555.6	44.430
20616.6	44.430
20677.6	44.430
20738.6	44.430
20799.6	44.430
20860.6	44.430
20921.6	44.430
20982.6	44.430
21043.6	44.430
21104.6	44.430
21165.6	44.430
21226.6	44.430
21287.6	44.430
21348.6	44.430
21409.6	44.430
21470.6	44.430
21531.6	44.430
21592.6	44.430
21653.6	44.430
21714.6	44.430
21775.6	44.430
21836.6	44.430
21897.6	44.430
21958.6	44.430
22019.6	44.430
22080.6	44.430
22141.6	44.430
22202.6	44.430
22263.6	44.430
22324.6	44.430
22385.6	44.430
22446.6	44.430
22507.6	44.430
22568.6	44.430
22629.6	44.430
22690.6	44.430
22751.6	44.430
22812.6	44.430
22873.6	44.430
22934.6	44.430
22995.6	44.430
23056.6	44.430
23117.6	44.430
23178.6	44.430
23239.6	44.430
23300.6	44.430
23361.6	44.430
23422.6	44.430
23483.6	44.430
23544.6	44.430
23605.6	44.430
23666.6	44.430
23727.6	44.430
23788.6	44.430
23849.6	44.430
23910.6	44.430
23971.6	44.430
24032.6	44.430
24093.6	44.430
24154.6	44.430
24215.6	44.430
24276.6	44.430
24337.6	44.430
24398.6	44.430
24459.6	44.430
24520.6	44.430
24581.6	44.430
24642.6	44.430
24703.6	44.430
24764.6	44.430
24825.6	44.430
24886.6	44.430
24947.6	44.430
25008.6	44.430
25069.6	44.430
25130.6	44.430
25191.6	44.430
25252.6	44.430
25313.6	44.430
25374.6	44.430
25435.6	44.430
25496.6	44.430
25557.6	44.430
25618.6	44.430
25679.6	44.430
25740.6	44.430
25801.6	44.430
25862.6	44.430
25923.6	44.430
25984.6	44.430
26045.6	44.430
26106.6	44.430
26167.6	44.430
26228.6	44.430
26289.6	44.430
26350.6	44.430
26411.6	44.430
26472.6	44.430
26533.6	44.430
26594.6	44.430
26655.6	44.430
26716.6	44.430
26777.6	44.430
26838.6	44.430
26899.6	44.430
26960.6	44.430
27021.6	44.430
27082.6	44.430
27143.6	44.430
27204.6	44.430
27265.6	44.430

POSITION	ALONG PIPE (CM)	PIEZOMETER	READING	CM
	120.6	1	43.250	
	176.5	2	43.200	
	242.6	3	43.150	
	303.5	4	43.080	
	364.5	5	43.000	
	425.5	6	42.950	
	486.4	7	42.885	
	510.0	8	42.820	
	547.4	9	42.900	
	563.2	10	42.880	
	578.5	11	42.870	
	593.7	12	42.735	
	608.0	13	42.850	
	624.2	14	42.810	
	639.5	15	42.790	
	750.3	16	42.350	
	780.8	17	42.250	
	811.3	18	42.080	
	872.3	19	41.900	
	972.6	20	41.570	
	304.5	21	0.000	
	326.5	22	0.000	
	435.7	23	0.000	
	496.6	24	0.000	
	557.6	25	0.000	
	583.7	26	0.000	
	583.1	27	0.000	
	618.5	28	0.000	
	653.8	29	0.000	
	644.4	30	0.000	
	649.0	31	0.000	
	664.3	32	0.000	
	679.5	33	0.000	
	750.3	34	0.000	
	780.8	35	0.000	
	811.3	36	0.000	
	872.3	37	0.000	
	972.6	38	0.000	
	972.6	39	0.000	

FLOW RATE (CUBIC CENTIMETERS PER SECOND) 1160.9900
 LATERAL (200) MAIN
 SLOPE 0.00337 MAIN 0.00050 OUTLET 0.000500
 LATERAL DROB : MAIN C.000 LATERAL 4.920
 MANHOLE 29 20.610
 40424 29

M1-7

POSITION	ALONG PIPE (CM)	PIEZOMETER	READING	CM
1	120.6	1	41.900	
2	176.5	2	41.670	
3	242.6	3	41.670	
4	303.5	4	41.600	
5	364.5	5	41.600	
6	425.5	6	41.540	
7	486.4	7	41.440	
8	510.0	8	41.125	
9	547.4	9	41.430	
10	563.2	10	41.430	
11	578.5	11	41.390	
12	593.7	12	41.370	
13	606.4	13	41.175	
14	608.9	14	41.370	
15	624.2	15	41.370	
16	639.3	16	41.100	
17	750.3	17	41.050	
18	780.8	18	40.900	
19	811.3	19	40.720	
20	872.3	20	40.450	
21	904.5	21	0.000	
22	936.5	22	0.000	
23	965.7	23	0.000	
24	996.6	24	0.000	
25	1027.6	25	0.000	
26	1058.1	26	0.000	
27	1088.5	27	0.000	
28	1118.5	28	0.000	
29	1148.4	29	0.000	
30	1178.4	30	0.000	
31	1208.4	31	0.000	
32	1238.4	32	0.000	
33	1268.4	33	0.000	
34	1298.4	34	0.000	
35	1328.4	35	0.000	
36	1358.4	36	0.000	
37	1388.4	37	0.000	
38	1418.4	38	0.000	
39	1448.4	39	0.000	
40	1478.4	40	0.000	
41	1508.4	41	0.000	
42	1538.4	42	0.000	
43	1568.4	43	0.000	
44	1598.4	44	0.000	
45	1628.4	45	0.000	
46	1658.4	46	0.000	
47	1688.4	47	0.000	
48	1718.4	48	0.000	
49	1748.4	49	0.000	
50	1778.4	50	0.000	
51	1808.4	51	0.000	
52	1838.4	52	0.000	
53	1868.4	53	0.000	
54	1898.4	54	0.000	
55	1928.4	55	0.000	
56	1958.4	56	0.000	
57	1988.4	57	0.000	
58	2018.4	58	0.000	
59	2048.4	59	0.000	
60	2078.4	60	0.000	
61	2108.4	61	0.000	
62	2138.4	62	0.000	
63	2168.4	63	0.000	
64	2198.4	64	0.000	
65	2228.4	65	0.000	
66	2258.4	66	0.000	
67	2288.4	67	0.000	
68	2318.4	68	0.000	
69	2348.4	69	0.000	
70	2378.4	70	0.000	
71	2408.4	71	0.000	
72	2438.4	72	0.000	
73	2468.4	73	0.000	
74	2498.4	74	0.000	
75	2528.4	75	0.000	
76	2558.4	76	0.000	
77	2588.4	77	0.000	
78	2618.4	78	0.000	
79	2648.4	79	0.000	
80	2678.4	80	0.000	
81	2708.4	81	0.000	
82	2738.4	82	0.000	
83	2768.4	83	0.000	
84	2798.4	84	0.000	
85	2828.4	85	0.000	
86	2858.4	86	0.000	
87	2888.4	87	0.000	
88	2918.4	88	0.000	
89	2948.4	89	0.000	
90	2978.4	90	0.000	
91	3008.4	91	0.000	
92	3038.4	92	0.000	
93	3068.4	93	0.000	
94	3098.4	94	0.000	
95	3128.4	95	0.000	
96	3158.4	96	0.000	
97	3188.4	97	0.000	
98	3218.4	98	0.000	
99	3248.4	99	0.000	
100	3278.4	100	0.000	

M-8

ENERGY LOSS COEFFICIENTS									
NO	K2	K3	K2L	K3M	LELJ	MELJ	TELL	TELM	
1	0.00	0.81	0.00	1.08	0.00	1.22	0.00	1.33	
2	0.00	0.78	0.00	1.02	0.00	1.07	0.00	1.18	
3	0.00	0.87	0.00	1.12	0.00	0.97	0.00	1.04	
4	0.00	0.79	0.00	1.00	0.00	0.81	0.00	0.92	
5	0.00	1.01	0.00	1.32	0.00	0.63	0.00	0.74	
6	0.00	0.73	0.00	1.07	0.00	0.49	0.00	0.53	
7	0.00	0.84	0.00	1.14	0.00	0.42	0.00	0.39	
8	0.00	1.14	0.00	1.34	0.00	0.28	0.00	0.39	
MAIN FLOW									
7079.207									54.59
6173.777									51.94
4530.691									45.92
4105.935									44.72
2180.397									34.91
1912.278									35.17
1160.990									31.37
481.384									21.97

K2: LATERAL LOSS COEF W.R.T. OUTLET VELOCITY
 K3: MAIN LOSS COEFFICIENT W.R.T. OUTLET VELOCITY
 K2L: W.R.T. LATERAL INLET VELOCITY
 K3M: W.R.T. MAIN INLET VELOCITY
 LELJ: LATERAL ENERGY LOSS DUE TO JUNCTION
 MELJ: MAIN ENERGY LOSS DUE TO JUNCTION
 TELL: TOTAL ENERGY LOSS THROUGH JUNCTION
 TELM: TOTAL ENERGY LOSS THROUGH JUNCTION
 RATIO OF LATERAL FLOW TO TOTAL FLOW
 VELIN, VELOCUT: INLET AND OUTLET VELOCITIES

M1

POSITION	ALONG PIPE (CM)	PIEZOMETER	READING	CM
1	120.6	1	48.800	
2	176.5	2	48.860	
3	242.6	3	48.800	
4	303.5	4	48.800	
5	364.5	5	48.800	
6	425.5	6	48.800	
7	486.4	7	48.800	
8	547.4	8	48.800	
9	608.4	9	48.800	
10	669.4	10	48.800	
11	730.4	11	48.800	
12	791.4	12	48.800	
13	852.4	13	48.800	
14	913.4	14	48.800	
15	974.4	15	48.800	
16	1035.4	16	48.800	
17	1096.4	17	48.800	
18	1157.4	18	48.800	
19	1218.4	19	48.800	
20	1279.4	20	48.800	
21	1340.4	21	48.800	
22	1401.4	22	48.800	
23	1462.4	23	48.800	
24	1523.4	24	48.800	
25	1584.4	25	48.800	
26	1645.4	26	48.800	
27	1706.4	27	48.800	
28	1767.4	28	48.800	
29	1828.4	29	48.800	
30	1889.4	30	48.800	
31	1950.4	31	48.800	
32	2011.4	32	48.800	
33	2072.4	33	48.800	
34	2133.4	34	48.800	
35	2194.4	35	48.800	
36	2255.4	36	48.800	
37	2316.4	37	48.800	
38	2377.4	38	48.800	
39	2438.4	39	48.800	
40	2499.4	40	48.800	
41	2560.4	41	48.800	
42	2621.4	42	48.800	
43	2682.4	43	48.800	
44	2743.4	44	48.800	
45	2804.4	45	48.800	
46	2865.4	46	48.800	
47	2926.4	47	48.800	
48	2987.4	48	48.800	
49	3048.4	49	48.800	
50	3109.4	50	48.800	
51	3170.4	51	48.800	
52	3231.4	52	48.800	
53	3292.4	53	48.800	
54	3353.4	54	48.800	
55	3414.4	55	48.800	
56	3475.4	56	48.800	
57	3536.4	57	48.800	
58	3597.4	58	48.800	
59	3658.4	59	48.800	
60	3719.4	60	48.800	
61	3780.4	61	48.800	
62	3841.4	62	48.800	
63	3902.4	63	48.800	
64	3963.4	64	48.800	
65	4024.4	65	48.800	
66	4085.4	66	48.800	
67	4146.4	67	48.800	
68	4207.4	68	48.800	
69	4268.4	69	48.800	
70	4329.4	70	48.800	
71	4390.4	71	48.800	
72	4451.4	72	48.800	
73	4512.4	73	48.800	
74	4573.4	74	48.800	
75	4634.4	75	48.800	
76	4695.4	76	48.800	
77	4756.4	77	48.800	
78	4817.4	78	48.800	
79	4878.4	79	48.800	
80	4939.4	80	48.800	
81	5000.4	81	48.800	
82	5061.4	82	48.800	
83	5122.4	83	48.800	
84	5183.4	84	48.800	
85	5244.4	85	48.800	
86	5305.4	86	48.800	
87	5366.4	87	48.800	
88	5427.4	88	48.800	
89	5488.4	89	48.800	
90	5549.4	90	48.800	
91	5610.4	91	48.800	
92	5671.4	92	48.800	
93	5732.4	93	48.800	
94	5793.4	94	48.800	
95	5854.4	95	48.800	
96	5915.4	96	48.800	
97	5976.4	97	48.800	
98	6037.4	98	48.800	
99	6098.4	99	48.800	
100	6159.4	100	48.800	
101	6220.4	101	48.800	
102	6281.4	102	48.800	
103	6342.4	103	48.800	
104	6403.4	104	48.800	
105	6464.4	105	48.800	
106	6525.4	106	48.800	
107	6586.4	107	48.800	
108	6647.4	108	48.800	
109	6708.4	109	48.800	
110	6769.4	110	48.800	
111	6830.4	111	48.800	
112	6891.4	112	48.800	
113	6952.4	113	48.800	
114	7013.4	114	48.800	
115	7074.4	115	48.800	
116	7135.4	116	48.800	
117	7196.4	117	48.800	
118	7257.4	118	48.800	
119	7318.4	119	48.800	
120	7379.4	120	48.800	
121	7440.4	121	48.800	
122	7501.4	122	48.800	
123	7562.4	123	48.800	
124	7623.4	124	48.800	
125	7684.4	125	48.800	
126	7745.4	126	48.800	
127	7806.4	127	48.800	
128	7867.4	128	48.800	
129	7928.4	129	48.800	
130	7989.4	130	48.800	
131	8050.4	131	48.800	
132	8111.4	132	48.800	
133	8172.4	133	48.800	
134	8233.4	134	48.800	
135	8294.4	135	48.800	
136	8355.4	136	48.800	
137	8416.4	137	48.800	
138	8477.4	138	48.800	
139	8538.4	139	48.800	
140	8599.4	140	48.800	
141	8660.4	141	48.800	
142	8721.4	142	48.800	
143	8782.4	143	48.800	
144	8843.4	144	48.800	
145	8904.4	145	48.800	
146	8965.4	146	48.800	
147	9026.4	147	48.800	
148	9087.4	148	48.800	
149	9148.4	149	48.800	
150	9209.4	150	48.800	
151	9270.4	151	48.800	
152	9331.4	152	48.800	
153	9392.4	153	48.800	
154	9453.4	154	48.800	
155	9514.4	155	48.800	
156	9575.4	156	48.800	
157	9636.4	157	48.800	
158	9697.4	158	48.800	
159	9758.4	159	48.800	
160	9819.4	160	48.800	
161	9880.4	161	48.800	
162	9941.4	162	48.800	
163	10002.4	163	48.800	
164	10063.4	164	48.800	
165	10124.4	165	48.800	
166	10185.4	166	48.800	
167	10246.4	167	48.800	
168	10307.4	168	48.800	
169	10368.4	169	48.800	
170	10429.4	170	48.800	
171	10490.4	171	48.800	
172	10551.4	172	48.800	
173	10612.4	173	48.800	
174	10673.4	174	48.800	
175	10734.4	175	48.800	
176	10795.4	176	48.800	
177	10856.4	177	48.800	
178	10917.4	178	48.800	
179	10978.4	179	48.800	
180	11039.4	180	48.800	
181	11100.4	181	48.800	
182	11161.4	182	48.800	
183	11222.4	183	48.800	
184	11283.4	184	48.800	
185	11344.4	185	48.800	
186	11405.4	186	48.800	
187	11466.4	187	48.800	
188	11527.4	188	48.800	
189	11588.4	189	48.800	
190	11649.4	190	48.800	
191	11710.4	191	48.800	
192	11771.4	192	48.800	
193	11832.4	193	48.800	
194	11893.4	194	48.800	
195	11954.4	195	48.800	
196	12015.4	196	48.800	
197	12076.4	197	48.800	
198	12137.4	198	48.800	
199	12198.4	199	48.800	
200	12259.4	200	48.800	

3.11

POSITION	ALONG PIPE (CM)	PIEZOMETER	READING	CM
120.0	120.0	1	47.490	
176.0	176.0	2	47.380	
242.0	242.0	3	47.380	
308.0	308.0	4	47.380	
364.0	364.0	5	47.380	
420.0	420.0	6	47.380	
476.0	476.0	7	47.380	
532.0	532.0	8	47.380	
588.0	588.0	9	47.380	
644.0	644.0	10	47.380	
700.0	700.0	11	47.380	
756.0	756.0	12	47.380	
812.0	812.0	13	47.380	
868.0	868.0	14	47.380	
924.0	924.0	15	47.380	
980.0	980.0	16	47.380	
1036.0	1036.0	17	47.380	
1092.0	1092.0	18	47.380	
1148.0	1148.0	19	47.380	
1204.0	1204.0	20	47.380	
1260.0	1260.0	21	47.380	
1316.0	1316.0	22	47.380	
1372.0	1372.0	23	47.380	
1428.0	1428.0	24	47.380	
1484.0	1484.0	25	47.380	
1540.0	1540.0	26	47.380	
1596.0	1596.0	27	47.380	
1652.0	1652.0	28	47.380	
1708.0	1708.0	29	47.380	
1764.0	1764.0	30	47.380	
1820.0	1820.0	31	47.380	
1876.0	1876.0	32	47.380	
1932.0	1932.0	33	47.380	
1988.0	1988.0	34	47.380	
2044.0	2044.0	35	47.380	
2100.0	2100.0	36	47.380	
2156.0	2156.0	37	47.380	
2212.0	2212.0	38	47.380	
2268.0	2268.0	39	47.380	
2324.0	2324.0	40	47.380	
2380.0	2380.0	41	47.380	
2436.0	2436.0	42	47.380	
2492.0	2492.0	43	47.380	
2548.0	2548.0	44	47.380	
2604.0	2604.0	45	47.380	
2660.0	2660.0	46	47.380	
2716.0	2716.0	47	47.380	
2772.0	2772.0	48	47.380	
2828.0	2828.0	49	47.380	
2884.0	2884.0	50	47.380	
2940.0	2940.0	51	47.380	
2996.0	2996.0	52	47.380	
3052.0	3052.0	53	47.380	
3108.0	3108.0	54	47.380	
3164.0	3164.0	55	47.380	
3220.0	3220.0	56	47.380	
3276.0	3276.0	57	47.380	
3332.0	3332.0	58	47.380	
3388.0	3388.0	59	47.380	
3444.0	3444.0	60	47.380	
3500.0	3500.0	61	47.380	
3556.0	3556.0	62	47.380	
3612.0	3612.0	63	47.380	
3668.0	3668.0	64	47.380	
3724.0	3724.0	65	47.380	
3780.0	3780.0	66	47.380	
3836.0	3836.0	67	47.380	
3892.0	3892.0	68	47.380	
3948.0	3948.0	69	47.380	
4004.0	4004.0	70	47.380	
4060.0	4060.0	71	47.380	
4116.0	4116.0	72	47.380	
4172.0	4172.0	73	47.380	
4228.0	4228.0	74	47.380	
4284.0	4284.0	75	47.380	
4340.0	4340.0	76	47.380	
4396.0	4396.0	77	47.380	
4452.0	4452.0	78	47.380	
4508.0	4508.0	79	47.380	
4564.0	4564.0	80	47.380	
4620.0	4620.0	81	47.380	
4676.0	4676.0	82	47.380	
4732.0	4732.0	83	47.380	
4788.0	4788.0	84	47.380	
4844.0	4844.0	85	47.380	
4900.0	4900.0	86	47.380	
4956.0	4956.0	87	47.380	
5012.0	5012.0	88	47.380	
5068.0	5068.0	89	47.380	
5124.0	5124.0	90	47.380	
5180.0	5180.0	91	47.380	
5236.0	5236.0	92	47.380	
5292.0	5292.0	93	47.380	
5348.0	5348.0	94	47.380	
5404.0	5404.0	95	47.380	
5460.0	5460.0	96	47.380	
5516.0	5516.0	97	47.380	
5572.0	5572.0	98	47.380	
5628.0	5628.0	99	47.380	
5684.0	5684.0	100	47.380	
5740.0	5740.0	101	47.380	
5796.0	5796.0	102	47.380	
5852.0	5852.0	103	47.380	
5908.0	5908.0	104	47.380	
5964.0	5964.0	105	47.380	
6020.0	6020.0	106	47.380	
6076.0	6076.0	107	47.380	
6132.0	6132.0	108	47.380	
6188.0	6188.0	109	47.380	
6244.0	6244.0	110	47.380	
6300.0	6300.0	111	47.380	
6356.0	6356.0	112	47.380	
6412.0	6412.0	113	47.380	
6468.0	6468.0	114	47.380	
6524.0	6524.0	115	47.380	
6580.0	6580.0	116	47.380	
6636.0	6636.0	117	47.380	
6692.0	6692.0	118	47.380	
6748.0	6748.0	119	47.380	
6804.0	6804.0	120	47.380	
6860.0	6860.0	121	47.380	
6916.0	6916.0	122	47.380	
6972.0	6972.0	123	47.380	
7028.0	7028.0	124	47.380	
7084.0	7084.0	125	47.380	
7140.0	7140.0	126	47.380	
7196.0	7196.0	127	47.380	
7252.0	7252.0	128	47.380	
7308.0	7308.0	129	47.380	
7364.0	7364.0	130	47.380	
7420.0	7420.0	131	47.380	
7476.0	7476.0	132	47.380	
7532.0	7532.0	133	47.380	
7588.0	7588.0	134	47.380	
7644.0	7644.0	135	47.380	
7700.0	7700.0	136	47.380	
7756.0	7756.0	137	47.380	
7812.0	7812.0	138	47.380	
7868.0	7868.0	139	47.380	
7924.0	7924.0	140	47.380	
7980.0	7980.0	141	47.380	
8036.0	8036.0	142	47.380	
8092.0	8092.0	143	47.380	
8148.0	8148.0	144	47.380	
8204.0	8204.0	145	47.380	
8260.0	8260.0	146	47.380	
8316.0	8316.0	147	47.380	
8372.0	8372.0	148	47.380	
8428.0	8428.0	149	47.380	
8484.0	8484.0	150	47.380	
8540.0	8540.0	151	47.380	
8596.0	8596.0	152	47.380	
8652.0	8652.0	153	47.380	
8708.0	8708.0	154	47.380	
8764.0	8764.0	155	47.380	
8820.0	8820.0	156	47.380	
8876.0	8876.0	157	47.380	
8932.0	8932.0	158	47.380	
8988.0	8988.0	159	47.380	
9044.0	9044.0	160	47.380	
9100.0	9100.0	161	47.380	
9156.0	9156.0	162	47.380	
9212.0	9212.0	163	47.380	
9268.0	9268.0	164	47.380	
9324.0	9324.0	165	47.380	
9380.0	9380.0	166	47.380	
9436.0	9436.0	167	47.380	
9492.0	9492.0	168	47.380	
9548.0	9548.0	169	47.380	
9604.0	9604.0	170	47.380	
9660.0	9660.0	171	47.380	
9716.0	9716.0	172	47.380	
9772.0	9772.0	173	47.380	
9828.0	9828.0	174	47.380	
9884.0	9884.0	175	47.380	
9940.0	9940.0	176	47.380	
9996.0	9996.0	177	47.380	
10052.0	10052.0	178	47.380	
10108.0	10108.0	179	47.380	
10164.0	10164.0	180	47.380	
10220.0	10220.0	181	47.380	
10276.0	10276.0	182	47.380	
10332.0	10332.0	183	47.380	
10388.0	10388.0	184	47.380	
10444.0	10444.0	185	47.380	
10500.0	10500.0	186	47.380	
10556.0	10556.0	187	47.380	
10612.0	10612.0	188	47.380	
10668.0	10668.0	189	47.380	
10724.0	10724.0	190	47.380	
10780.0	10780.0	191	47.380	
10836.0	10836.0	192	47.380	
10892.0	10892.0	193	47.380	
10948.0	10948.0	194	47.380	
11004.0	11004.0	195	47.380	
11060.0	11060.0	196	47.380	
11116.0	11116.0	197	47.380	
11172.0	11172.0	198	47.380	
11228.0	11228.0	199	47.380	
11284.0	11284.0	200	47.380	
11340.0	11340.0	201	47.380	
11396.0	11396.0	202	47.380	
11452.0	11452.0	203	47.380	
11508.0	11508.0	204	47.380	
11564.0	11564.0	205	47.380	
11620.0	11620.0	206	47.380	
11676.0	11676.0	207	47.380	
11732.0	11732.0	208	47.380	
11788.0	11788.0	209	47.380	
11844.0	11844.0	210	47.380	
11900.0	11900.0	211	47.380	
11956.0	11956.0	212	47.380	
12012.0	12012.0	213	47.380	
12068.0	12068.0	214	47.380	
12124.0	12124.0	215	47.380	
12180.0	12180.0	216	47.380	
12236.0	12236.0	217	47.380	
12292.0	12292.0	218	47.380	
12348.0	12348.0	219	47.380	
12404.0	12404.0	220	47.380	
12460.0	12460.0	221	47.380	
12516.0	12516.0	222	47.380	
12572.0	12572.0	223	47.380	
12628.0	12628.0	224	47.380	
12684.0	12684.0	225	47.380	
12740.0	12740.0	226	47.380	
12796.0	12796.0	227	47.380	
12852.0	12852.0	228	47.380	
12908.0	12908.0	229	47.380	
12964.0	12964.0	230	47.380	
13020.0	13020.0	231	47.380	
13076.0	13076.0	232	47.380	
13132.0	13132.0	233	47.380	
13188.0	13188.0	234	47.380	
13244.0	13244.0	235	47.380	
13300.0	13300.0	236	47.380	
13356.0	13356.0	237	47.380	
13412.0	13412.0	238	47.380	
13468.0	13468.0	239	47.380	
13524.0	13524.0	240	47.380	
13580.0	13580.0	241	47.380	
13636.0	13636.0	242	47.380	
13692.0	13692.0	243	47.380	
13748.0	13748.0	244	47.380	
13804.0	13804.0	245	47.380	
13860.0	13860.0	246	47.380	

POSITION	ALONG PIPE(CM)	PIEZOMETER	READING	CM
	120.6	1	45.840	
	176.5	2	45.850	
	242.6	3	45.820	
	303.5	4	45.820	
	364.5	5	45.750	
	425.5	6	45.720	
	486.4	7	45.710	
	547.4	8	45.690	
	608.0	9	45.660	
	669.4	10	45.630	
	730.4	11	45.630	
	791.3	12	45.630	
	852.3	13	45.630	
	913.3	14	45.630	
	974.3	15	45.630	
	1035.3	16	45.630	
	1096.3	17	45.630	
	1157.3	18	45.630	
	1218.3	19	45.630	
	1279.3	20	45.630	
	1340.3	21	45.630	
	1401.3	22	45.630	
	1462.3	23	45.630	
	1523.3	24	45.630	
	1584.3	25	45.630	
	1645.3	26	45.630	
	1706.3	27	45.630	
	1767.3	28	45.630	
	1828.3	29	45.630	
	1889.3	30	45.630	
	1950.3	31	45.630	
	2011.3	32	45.630	
	2072.3	33	45.630	
	2133.3	34	45.630	
	2194.3	35	45.630	
	2255.3	36	45.630	
	2316.3	37	45.630	
	2377.3	38	45.630	
	2438.3	39	45.630	
	2499.3	40	45.630	
	2560.3	41	45.630	
	2621.3	42	45.630	
	2682.3	43	45.630	
	2743.3	44	45.630	
	2804.3	45	45.630	
	2865.3	46	45.630	
	2926.3	47	45.630	
	2987.3	48	45.630	
	3048.3	49	45.630	
	3109.3	50	45.630	
	3170.3	51	45.630	
	3231.3	52	45.630	
	3292.3	53	45.630	
	3353.3	54	45.630	
	3414.3	55	45.630	
	3475.3	56	45.630	
	3536.3	57	45.630	
	3597.3	58	45.630	
	3658.3	59	45.630	
	3719.3	60	45.630	
	3780.3	61	45.630	
	3841.3	62	45.630	
	3902.3	63	45.630	
	3963.3	64	45.630	
	4024.3	65	45.630	
	4085.3	66	45.630	
	4146.3	67	45.630	
	4207.3	68	45.630	
	4268.3	69	45.630	
	4329.3	70	45.630	
	4390.3	71	45.630	
	4451.3	72	45.630	
	4512.3	73	45.630	
	4573.3	74	45.630	
	4634.3	75	45.630	
	4695.3	76	45.630	
	4756.3	77	45.630	
	4817.3	78	45.630	
	4878.3	79	45.630	
	4939.3	80	45.630	
	5000.3	81	45.630	
	5061.3	82	45.630	
	5122.3	83	45.630	
	5183.3	84	45.630	
	5244.3	85	45.630	
	5305.3	86	45.630	
	5366.3	87	45.630	
	5427.3	88	45.630	
	5488.3	89	45.630	
	5549.3	90	45.630	
	5610.3	91	45.630	
	5671.3	92	45.630	
	5732.3	93	45.630	
	5793.3	94	45.630	
	5854.3	95	45.630	
	5915.3	96	45.630	
	5976.3	97	45.630	
	6037.3	98	45.630	
	6098.3	99	45.630	
	6159.3	100	45.630	
	6220.3	101	45.630	
	6281.3	102	45.630	
	6342.3	103	45.630	
	6403.3	104	45.630	
	6464.3	105	45.630	
	6525.3	106	45.630	
	6586.3	107	45.630	
	6647.3	108	45.630	
	6708.3	109	45.630	
	6769.3	110	45.630	
	6830.3	111	45.630	
	6891.3	112	45.630	
	6952.3	113	45.630	
	7013.3	114	45.630	
	7074.3	115	45.630	
	7135.3	116	45.630	
	7196.3	117	45.630	
	7257.3	118	45.630	
	7318.3	119	45.630	
	7379.3	120	45.630	
	7440.3	121	45.630	
	7501.3	122	45.630	
	7562.3	123	45.630	
	7623.3	124	45.630	
	7684.3	125	45.630	
	7745.3	126	45.630	
	7806.3	127	45.630	
	7867.3	128	45.630	
	7928.3	129	45.630	
	7989.3	130	45.630	
	8050.3	131	45.630	
	8111.3	132	45.630	
	8172.3	133	45.630	
	8233.3	134	45.630	
	8294.3	135	45.630	
	8355.3	136	45.630	
	8416.3	137	45.630	
	8477.3	138	45.630	
	8538.3	139	45.630	
	8599.3	140	45.630	
	8660.3	141	45.630	
	8721.3	142	45.630	
	8782.3	143	45.630	
	8843.3	144	45.630	
	8904.3	145	45.630	
	8965.3	146	45.630	
	9026.3	147	45.630	
	9087.3	148	45.630	
	9148.3	149	45.630	
	9209.3	150	45.630	
	9270.3	151	45.630	
	9331.3	152	45.630	
	9392.3	153	45.630	
	9453.3	154	45.630	
	9514.3	155	45.630	
	9575.3	156	45.630	
	9636.3	157	45.630	
	9697.3	158	45.630	
	9758.3	159	45.630	
	9819.3	160	45.630	
	9880.3	161	45.630	
	9941.3	162	45.630	
	10002.3	163	45.630	
	10063.3	164	45.630	
	10124.3	165	45.630	
	10185.3	166	45.630	
	10246.3	167	45.630	
	10307.3	168	45.630	
	10368.3	169	45.630	
	10429.3	170	45.630	
	10490.3	171	45.630	
	10551.3	172	45.630	
	10612.3	173	45.630	
	10673.3	174	45.630	
	10734.3	175	45.630	
	10795.3	176	45.630	
	10856.3	177	45.630	
	10917.3	178	45.630	
	10978.3	179	45.630	
	11039.3	180	45.630	
	11100.3	181	45.630	
	11161.3	182	45.630	
	11222.3	183	45.630	
	11283.3	184	45.630	
	11344.3	185	45.630	
	11405.3	186	45.630	
	11466.3	187	45.630	
	11527.3	188	45.630	
	11588.3	189	45.630	
	11649.3	190	45.630	
	11710.3	191	45.630	
	11771.3	192	45.630	
	11832.3	193	45.630	
	11893.3	194	45.630	
	11954.3	195	45.630	
	12015.3	196	45.630	
	12076.3	197	45.630	
	12137.3	198	45.630	
	12198.3	199	45.630	
	12259.3	200	45.630	
	12320.3	201	45.630	
	12381.3	202	45.630	
	12442.3	203	45.630	
	12503.3	204	45.630	
	12564.3	205	45.630	
	12625.3	206	45.630	
	12686.3	207	45.630	
	12747.3	208	45.630	
	12808.3	209	45.630	
	12869.3	210	45.630	
	12930.3	211	45.630	
	12991.3	212	45.630	
	13052.3	213	45.630	
	13113.3	214	45.630	
	13174.3	215	45.630	
	13235.3	216	45.630	
	13296.3	217	45.630	
	13357.3	218	45.630	
	13418.3	219	45.630	
	13479.3	220	45.630	
	13540.3	221	45.630	
	13601.3	222	45.630	
	13662.3	223	45.630	
	13723.3	224	45.630	
	13784.3	225	45.630	
	13845.3	226	45.630	
	13906.3	227	45.630	
	13967.3	228	45.630	
	14028.3	229	45.630	
	14089.3	230	45.630	
	14150.3	231	45.630	
	14211.3	232	45.630	
	14272.3	233	45.630	
	14333.3	234	45.630	
	14394.3	235	45.630	
	14455.3	236	45.630	
	14516.3	237	45.630	
	14577.3	238	45.630	
	14638.3	239	45.630	
	14699.3	240	45.630	
	14760.3	241	45.630	
	14821.3	242	45.630	
	14882.3	243	45.630	
	14943.3	244	45.630	
	15004.3	245	45.630	
	15065.3	246	45.630	
	15126.3	247	45.630	
	15187.3	248	45.630	
	15248.3	249	45.630	
	15309.3	250	45.630	
	15370.3	251	45.630	
	15431.3	252	45.630	
	15492.3	253	45.630	
	15553.3	254	45.630	
	15614.3	255	45.630	
	15675.3	256	45.630	
	15736.3	257	45.630	
	15797.3	258	45.630	
	15858.3	259	45.630	
	15919.3	260	45.630	
	15980.3	261	45.630	
	16041.3	262	45.630	
	16102.3	263	45.630	
	16163.3	264	45.630	
	16224.3	265	45.630	
	16285.3	266	45.630	
	16346.3	267	45.630	
	16407.3	268	45.630	
	16468.3	269	45.630	
	16529.3	270	45.630	
	16590.3	271	45.630	
	16651.3	272	45.630	
	16712.3	273	45.630	
	16773.3	274	45.630	
	16834.3	275	45.630	
	16895.3	276	45.630	
	16956.3	277	45.630	
	17017.3	278	45.630	
	17078.3	279	45.630	
	17139.3	280	45.630	
	17200.3	281	45.630	
	17261.3	282	45.630	
	17322.3	283	45.630	
	17383.3	284	45.630	
	17444.3	285	45.630	
	17505.3	286	45.630	

POSITION ALONG PIPE (CM)	PIEZOMETER READING CM
120.0	44.970
176.0	44.890
243.0	44.890
303.0	44.890
364.0	44.810
425.0	44.810
486.0	44.810
547.0	44.810
608.0	44.760
669.0	44.760
730.0	44.760
791.0	44.760
852.0	44.760
913.0	44.760
974.0	44.760
1035.0	44.760
1096.0	44.760
1157.0	44.760
1218.0	44.760
1279.0	44.760
1340.0	44.760
1401.0	44.760
1462.0	44.760
1523.0	44.760
1584.0	44.760
1645.0	44.760
1706.0	44.760
1767.0	44.760
1828.0	44.760
1889.0	44.760
1950.0	44.760
2011.0	44.760
2072.0	44.760
2133.0	44.760
2194.0	44.760
2255.0	44.760
2316.0	44.760
2377.0	44.760
2438.0	44.760
2499.0	44.760
2560.0	44.760
2621.0	44.760
2682.0	44.760
2743.0	44.760
2804.0	44.760
2865.0	44.760
2926.0	44.760
2987.0	44.760
3048.0	44.760
3109.0	44.760
3170.0	44.760
3231.0	44.760
3292.0	44.760
3353.0	44.760
3414.0	44.760
3475.0	44.760
3536.0	44.760
3597.0	44.760
3658.0	44.760
3719.0	44.760
3780.0	44.760
3841.0	44.760
3902.0	44.760
3963.0	44.760
4024.0	44.760
4085.0	44.760
4146.0	44.760
4207.0	44.760
4268.0	44.760
4329.0	44.760
4390.0	44.760
4451.0	44.760
4512.0	44.760
4573.0	44.760
4634.0	44.760
4695.0	44.760
4756.0	44.760
4817.0	44.760
4878.0	44.760
4939.0	44.760
5000.0	44.760
5061.0	44.760
5122.0	44.760
5183.0	44.760
5244.0	44.760
5305.0	44.760
5366.0	44.760
5427.0	44.760
5488.0	44.760
5549.0	44.760
5610.0	44.760
5671.0	44.760
5732.0	44.760
5793.0	44.760
5854.0	44.760
5915.0	44.760
5976.0	44.760
6037.0	44.760
6098.0	44.760
6159.0	44.760
6220.0	44.760
6281.0	44.760
6342.0	44.760
6403.0	44.760
6464.0	44.760
6525.0	44.760
6586.0	44.760
6647.0	44.760
6708.0	44.760
6769.0	44.760
6830.0	44.760
6891.0	44.760
6952.0	44.760
7013.0	44.760
7074.0	44.760
7135.0	44.760
7196.0	44.760
7257.0	44.760
7318.0	44.760
7379.0	44.760
7440.0	44.760
7501.0	44.760
7562.0	44.760
7623.0	44.760
7684.0	44.760
7745.0	44.760
7806.0	44.760
7867.0	44.760
7928.0	44.760
7989.0	44.760
8050.0	44.760
8111.0	44.760
8172.0	44.760
8233.0	44.760
8294.0	44.760
8355.0	44.760
8416.0	44.760
8477.0	44.760
8538.0	44.760
8599.0	44.760
8660.0	44.760
8721.0	44.760
8782.0	44.760
8843.0	44.760
8904.0	44.760
8965.0	44.760
9026.0	44.760
9087.0	44.760
9148.0	44.760
9209.0	44.760
9270.0	44.760
9331.0	44.760
9392.0	44.760
9453.0	44.760
9514.0	44.760
9575.0	44.760
9636.0	44.760
9697.0	44.760
9758.0	44.760
9819.0	44.760
9880.0	44.760
9941.0	44.760
10002.0	44.760
10063.0	44.760
10124.0	44.760
10185.0	44.760
10246.0	44.760
10307.0	44.760
10368.0	44.760
10429.0	44.760
10490.0	44.760
10551.0	44.760
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10673.0	44.760
10734.0	44.760
10795.0	44.760
10856.0	44.760
10917.0	44.760
10978.0	44.760
11039.0	44.760
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11161.0	44.760
11222.0	44.760
11283.0	44.760
11344.0	44.760
11405.0	44.760
11466.0	44.760
11527.0	44.760
11588.0	44.760
11649.0	44.760
11710.0	44.760
11771.0	44.760
11832.0	44.760
11893.0	44.760
11954.0	44.760
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12076.0	44.760
12137.0	44.760
12198.0	44.760
12259.0	44.760
12320.0	44.760
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12442.0	44.760
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12991.0	44.760
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13235.0	44.760
13296.0	44.760
13357.0	44.760
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13479.0	44.760
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13601.0	44.760
13662.0	44.760
13723.0	44.760
13784.0	44.760
13845.0	44.760
13906.0	44.760
13967.0	44.760
14028.0	44.760
14089.0	44.760
14150.0	44.760
14211.0	44.760
14272.0	44.760
14333.0	44.760
14394.0	44.760
14455.0	44.760
14516.0	44.760
14577.0	44.760
14638.0	44.760
14699.0	44.760
14760.0	44.760
14821.0	44.760
14882.0	44.760
14943.0	44.760
15004.0	44.760
15065.0	44.760
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15187.0	44.760
15248.0	44.760
15309.0	44.760
15370.0	44.760
15431.0	44.760
15492.0	44.760
15553.0	44.760
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15675.0	44.760
15736.0	44.760
15797.0	44.760
15858.0	44.760
15919.0	44.760
15980.0	44.760
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16102.0	44.760
16163.0	44.760
16224.0	44.760
16285.0	44.760
16346.0	44.760
16407.0	44.760
16468.0	44.760
16529.0	44.760
16590.0	44.760
16651.0	44.760
16712.0	44.760
16773.0	44.760
16834.0	44.760
16895.0	44.760
16956.0	44.760
17017.0	44.760
17078.0	44.760
17139.0	44.760
17200.0	44.760
17261.0	44.760
17322.0	44.760
17383.0	44.760
17444.0	44.760
17505.0	44.760
17566.0	44.760
17627.0	44.760
17688.0	44.760
17749.0	44.760
17810.0	44.760
17871.0	44.760
17932.0	44.760
17993.0	44.760
18054.0	44.760
18115.0	44.760
18176.0	44.760
18237.0	44.760
18298.0	44.760
18359.0	44.760
18420.0	44.760
18481.0	44.760
18542.0	44.760
18603.0	44.760
18664.0	44.760
18725.0	44.760
18786.0	44.760
18847.0	44.760
18908.0	44.760
18969.0	44.760
19030.0	44.760
19091.0	44.760
19152.0	44.760
19213.0	44.760
19274.0	44.760
19335.0	44.760
19396.0	44.760
19457.0	44.760
19518.0	44.760
19579.0	44.760
19640.0	44.760
19701.0	44.760
19762.0	44.760
19823.0	44.760
19884.0	44.760
19945.0	44.760
20006.0	44.760
20067.0	44.760
20128.0	44.760
20189.0	44.760
20250.0	44.760
20311.0	44.760
20372.0	44.760
20433.0	44.760
20494.0	44.760
20555.0	44.760
20616.0	44.760
20677.0	44.760
20738.0	44.760
20799.0	44.760
20860.0	44.760
20921.0	44.760
20982.0	44.760
21043.0	44.760
21104.0	44.760
21165.0	44.760
21226.0	44.760
21287.0	44.760
21348.0	44.760
21409.0	44.760
21470.0	44.760
21531.0	44.760
21592.0	44.760
21653.0	44.760
21714.0	44.760
21775.0	44.760
21836.0	44.760
21897.0	44.760
21958.0	44.760
22019.0	44.760
22080.0	44.760
22141.0	44.760
22202.0	44.760
22263.0	44.760
22324.0	44.760
22385.0	44.760
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22873.0	44.760
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23117.0	44.760
23178.0	44.760
23239.0	44.760
23300.0	44.760
23361.0	44.760
23422.0	44.760
23483.0	44.760
23544.0	44.760
23605.0	44.760
23666.0	44.760
23727.0	44.760
23788.0	44.760
23849.0	44.760
23910.0	44.760
23971.0	44.760
24032.0	44.760
24093.0	44.760
24154.0	44.760
24215.0	44.760
24276.0	44.760
24337.0	44.760
24398.0	44.760
24459.0	44.760
24520.0	44.760
24581.0	44.760
24642.0	44.760
24703.0	44.760
24764.0	44.760
24825.0	44.760
24886.0	44.760
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25069.0	44.760
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25191.0	44.760
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25313.0	44.760
25374.0	44.760
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25496.0	44.760
25557.0	44.760
25618.0	44.760
25679.0	44.760
25740.0	44.760
25801.0	44.760
25862.0	44.760
25923.0	44.760
25984.0	44.760
26045.0	44.760
26106.0	44.760
26167.0	44.760
26228.0	44.760
26289.0	44.760
26350.0	44.760
26411.0	44.760
26472.0	44.760
26533.0	44.760
26594.0	44.760
26655.0	44.760
26716.0	44.760
26777.0	44.760
26838.0	44.760
26899.0	44.760
26960.0	44.760
27021.0	44.760
27082.0	44.760
27143.0	44.760
27204.0	44.760
27265.0	44.760

POSITION ALONG PIPE (CM)	PIEZOMETER READING CM
120.6	44.600
176.6	44.620
242.6	44.610
303.6	44.560
364.6	44.560
425.6	44.570
486.6	2.410
510.0	44.520
547.4	44.520
563.2	44.520
578.2	2.470
593.7	44.520
606.9	44.500
624.2	44.480
659.5	43.340
750.3	43.330
790.8	43.130
811.7	43.850
872.6	43.550
904.5	46.890
936.7	47.400
975.6	47.130
1014.6	46.090
1057.6	46.620
1097.7	1.225
1138.1	46.400
1178.5	46.340
1218.9	1.280
1259.3	46.280
1299.7	46.210
1340.1	46.050
1380.5	43.340
1420.9	43.330
1461.3	43.130
1501.7	42.850
1542.1	42.500
1582.5	
1622.9	
1663.3	
1703.7	
1744.1	
1784.5	
1824.9	
1865.3	
1905.7	
1946.1	
1986.5	
2026.9	
2067.3	
2107.7	
2148.1	
2188.5	
2228.9	
2269.3	
2309.7	
2350.1	
2390.5	
2430.9	
2471.3	
2511.7	
2552.1	
2592.5	
2632.9	
2673.3	
2713.7	
2754.1	
2794.5	
2834.9	
2875.3	
2915.7	
2956.1	
2996.5	
3036.9	
3077.3	
3117.7	
3158.1	
3198.5	
3238.9	
3279.3	
3319.7	
3360.1	
3400.5	
3440.9	
3481.3	
3521.7	
3562.1	
3602.5	
3642.9	
3683.3	
3723.7	
3764.1	
3804.5	
3844.9	
3885.3	
3925.7	
3966.1	
4006.5	
4046.9	
4087.3	
4127.7	
4168.1	
4208.5	
4248.9	
4289.3	
4329.7	
4370.1	
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4450.9	
4491.3	
4531.7	
4572.1	
4612.5	
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4693.3	
4733.7	
4774.1	
4814.5	
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4895.3	
4935.7	
4976.1	
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5056.9	
5097.3	
5137.7	
5178.1	
5218.5	
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5299.3	
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5501.3	
5541.7	
5582.1	
5622.5	
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6147.7	
6188.1	
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6309.3	
6349.7	
6390.1	
6430.5	
6470.9	
6511.3	
6551.7	
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6955.7	
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7480.9	
7521.3	
7561.7	
7602.1	
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21499.7	
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21661.3	
21701.7	
21742.1	
21782.5	
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21863.3	
21903.7	
21944.1	
21984.5	
22024.9	
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22105.7	
22146.1	
22186.5	
22226.9	
22267.3	
22307.7	
22348.1	
22388.5	
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22469.3	
22509.7	
22550.1	
22590.5	
22630.9	
22671.3	
22711.7	
22752.1	
22792.5	
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22994.5	
23034.9	
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23115.7	
23156.1	
23196.5	
23236.9	
23277.3	
23317.7	
23358.1	
23398.5	
23438.9	
23479.3	
23519.7	
23560.1	
23600.5	
23640.9	
23681.3	
23721.7	
23762.1	
23802.5	

POSITION ALONG PIPE(CM.)	PIEZOMETER	READING	CM
126.6	1	43.950	
176.5	2	43.800	
242.6	3	43.800	
303.5	4	43.740	
364.5	5	43.740	
425.5	6	43.740	
486.4	7	43.740	
510.0	8	43.670	
547.4	9	43.670	
563.2	10	43.670	
578.7	11	43.670	
592.7	12	43.670	
606.4	13	43.670	
608.9	14	43.670	
624.0	15	43.670	
639.5	16	43.670	
750.3	17	43.670	
780.3	18	43.670	
811.3	19	43.670	
872.3	20	43.670	
972.6	21	43.670	
304.5	22	43.670	
365.5	23	43.670	
435.7	24	43.670	
496.6	25	43.670	
557.6	26	43.670	
587.7	27	43.670	
618.5	28	43.670	
649.3	29	43.670	
679.5	30	43.670	
751.7	31	43.670	
781.8	32	43.670	
811.3	33	43.670	
872.3	34	43.670	
972.6	35	43.670	

FLOW RATE (CUBIC CENTIMETERS PER SECOND) 1217.624
 LATERAL 538.0198 MAIN
 LATERAL 0.00500 OUTLET 0.00500
 LATERAL 5.080
 MANHOLE DEEP : MAIN 0.0 LATERAL 5.080

3.17

POSITION ALONG PIPE (CM)	PIEZOMETER	READING	CM
1200.6	1	43.570	
1760.5	2	43.420	
2420.5	3	43.380	
3080.5	4	43.310	
3640.5	5	43.270	
4200.5	6	43.250	
4860.4	7	43.250	
5100.0	8	43.250	
5470.4	9	43.250	
5630.5	10	43.250	
5678.5	11	43.250	
5930.7	12	43.250	
6060.4	13	43.225	
6080.0	14	43.210	
6220.3	15	43.200	
6390.5	16	43.200	
7500.3	17	42.400	
7800.8	18	42.300	
8110.3	19	41.710	
8720.6	20	41.710	
9720.3	21	41.710	
9720.3	22	41.710	
9720.3	23	41.710	
9720.3	24	41.710	
9720.3	25	41.710	
9720.3	26	41.710	
9720.3	27	41.710	
9720.3	28	41.710	
9720.3	29	41.710	
9720.3	30	41.710	
9720.3	31	41.710	
9720.3	32	41.710	
9720.3	33	41.710	
9720.3	34	41.710	
9720.3	35	41.710	
9720.3	36	41.710	
9720.3	37	41.710	
9720.3	38	41.710	
9720.3	39	41.710	
9720.3	40	41.710	

FLOW RATE (CURRIC CENTIMETERS PER SECOND) 1217.6247
 LATERAL 215.267944
 SLICE 0.000000
 LATERAL 0.000000
 MANHOLE DRD : MAIN 5.080

3.18

POSITION	ALONG PIPE (CM)	PIEZOMETER	READING	CM
	120.0	1	49.090	
	176.0	2	49.090	
	242.0	3	49.090	
	308.0	4	49.060	
	374.0	5	49.060	
	440.0	6	49.060	
	506.0	7	49.010	
	572.0	8	49.010	
	638.0	9	49.010	
	704.0	10	49.010	
	770.0	11	49.010	
	836.0	12	49.010	
	902.0	13	49.000	
	968.0	14	49.000	
	1034.0	15	49.000	
	1100.0	16	49.000	
	1166.0	17	47.960	
	1232.0	18	47.960	
	1298.0	19	46.830	
	1364.0	20	46.830	
	1430.0	21	46.830	
	1496.0	22	45.860	
	1562.0	23	51.000	
	1628.0	24	51.000	
	1694.0	25	51.070	
	1760.0	26	50.770	
	1826.0	27	50.420	
	1892.0	28	50.840	
	1958.0	29	50.310	
	2024.0	30	50.150	
	2090.0	31	50.150	
	2156.0	32	50.150	
	2222.0	33	50.030	
	2288.0	34	49.830	
	2354.0	35	49.310	
	2420.0	36	46.960	
	2486.0	37	47.030	
	2552.0	38	46.830	
	2618.0	39	46.500	
	2684.0	40	45.860	

FLOW RATE (CUBIC CENTIMETERS PER SECOND) 2208.7419
 LATERAL 3681.1820 MAIN
 SLUDGE 0.007400 MAIN 0.007000 OUTLET 0.000500
 MANHOLE DEPTH: MAIN 5.080 LATERAL 5.080

3.21

POSITION ALONG PIPE(CM)	PIEZOMETER READING CM
120.6	48.130
176.6	48.080
242.6	48.060
308.6	48.040
374.6	48.000
440.6	48.000
506.6	48.000
572.6	48.000
638.6	48.000
704.6	48.000
770.6	48.000
836.6	48.000
902.6	48.000
968.6	48.000
1034.6	48.000
1100.6	48.000
1166.6	48.000
1232.6	48.000
1298.6	48.000
1364.6	48.000
1430.6	48.000
1496.6	48.000
1562.6	48.000
1628.6	48.000
1694.6	48.000
1760.6	48.000
1826.6	48.000
1892.6	48.000
1958.6	48.000
2024.6	48.000
2090.6	48.000
2156.6	48.000
2222.6	48.000
2288.6	48.000
2354.6	48.000
2420.6	48.000
2486.6	48.000
2552.6	48.000
2618.6	48.000
2684.6	48.000
2750.6	48.000
2816.6	48.000
2882.6	48.000
2948.6	48.000
3014.6	48.000
3080.6	48.000
3146.6	48.000
3212.6	48.000
3278.6	48.000
3344.6	48.000
3410.6	48.000
3476.6	48.000
3542.6	48.000
3608.6	48.000
3674.6	48.000
3740.6	48.000
3806.6	48.000
3872.6	48.000
3938.6	48.000
4004.6	48.000
4070.6	48.000
4136.6	48.000
4202.6	48.000
4268.6	48.000
4334.6	48.000
4400.6	48.000
4466.6	48.000
4532.6	48.000
4598.6	48.000
4664.6	48.000
4730.6	48.000
4796.6	48.000
4862.6	48.000
4928.6	48.000
4994.6	48.000
5060.6	48.000
5126.6	48.000
5192.6	48.000
5258.6	48.000
5324.6	48.000
5390.6	48.000
5456.6	48.000
5522.6	48.000
5588.6	48.000
5654.6	48.000
5720.6	48.000
5786.6	48.000
5852.6	48.000
5918.6	48.000
5984.6	48.000
6050.6	48.000
6116.6	48.000
6182.6	48.000
6248.6	48.000
6314.6	48.000
6380.6	48.000
6446.6	48.000
6512.6	48.000
6578.6	48.000
6644.6	48.000
6710.6	48.000
6776.6	48.000
6842.6	48.000
6908.6	48.000
6974.6	48.000
7040.6	48.000
7106.6	48.000
7172.6	48.000
7238.6	48.000
7304.6	48.000
7370.6	48.000
7436.6	48.000
7502.6	48.000
7568.6	48.000
7634.6	48.000
7700.6	48.000
7766.6	48.000
7832.6	48.000
7898.6	48.000
7964.6	48.000
8030.6	48.000
8096.6	48.000
8162.6	48.000
8228.6	48.000
8294.6	48.000
8360.6	48.000
8426.6	48.000
8492.6	48.000
8558.6	48.000
8624.6	48.000
8690.6	48.000
8756.6	48.000
8822.6	48.000
8888.6	48.000
8954.6	48.000
9020.6	48.000
9086.6	48.000
9152.6	48.000
9218.6	48.000
9284.6	48.000
9350.6	48.000
9416.6	48.000
9482.6	48.000
9548.6	48.000
9614.6	48.000
9680.6	48.000
9746.6	48.000
9812.6	48.000
9878.6	48.000
9944.6	48.000
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10076.6	48.000
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10406.6	48.000
10472.6	48.000
10538.6	48.000
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10736.6	48.000
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11066.6	48.000
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11198.6	48.000
11264.6	48.000
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14168.6	48.000
14234.6	48.000
14300.6	48.000
14366.6	48.000
14432.6	48.000
14498.6	48.000
14564.6	48.000
14630.6	48.000
14696.6	48.000
14762.6	48.000
14828.6	48.000
14894.6	48.000
14960.6	48.000
15026.6	48.000
15092.6	48.000
15158.6	48.000
15224.6	48.000
15290.6	48.000
15356.6	48.000
15422.6	48.000
15488.6	48.000
15554.6	48.000
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15686.6	48.000
15752.6	48.000
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15884.6	48.000
15950.6	48.000
16016.6	48.000
16082.6	48.000
16148.6	48.000
16214.6	48.000
16280.6	48.000
16346.6	48.000
16412.6	48.000
16478.6	48.000
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16610.6	48.000
16676.6	48.000
16742.6	48.000
16808.6	48.000
16874.6	48.000
16940.6	48.000
17006.6	48.000
17072.6	48.000
17138.6	48.000
17204.6	48.000
17270.6	48.000
17336.6	48.000
17402.6	48.000
17468.6	48.000
17534.6	48.000
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17666.6	48.000
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17798.6	48.000
17864.6	48.000
17930.6	48.000
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18128.6	48.000
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18854.6	48.000
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19316.6	48.000
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19712.6	48.000
19778.6	48.000
19844.6	48.000
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19976.6	48.000
20042.6	48.000
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20240.6	48.000
20306.6	48.000
20372.6	48.000
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20504.6	48.000
20570.6	48.000
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20900.6	48.000
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21098.6	48.000
21164.6	48.000
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21362.6	48.000
21428.6	48.000
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21626.6	48.000
21692.6	48.000
21758.6	48.000
21824.6	48.000
21890.6	48.000
21956.6	48.000
22022.6	48.000
22088.6	48.000
22154.6	48.000
22220.6	48.000
22286.6	48.000
22352.6	48.000
22418.6	48.000
22484.6	48.000
22550.6	48.000
22616.6	48.000
22682.6	48.000
22748.6	48.000
22814.6	48.000
22880.6	48.000
22946.6	48.000
23012.6	48.000
23078.6	48.000
23144.6	48.000
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23276.6	48.000
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23408.6	48.000
23474.6	48.000
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23606.6	48.000
23672.6	48.000
23738.6	48.000
23804.6	48.000
23870.6	48.000
23936.6	48.000
24002.6	48.000
24068.6	48.000
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24266.6	48.000
24332.6	48.000
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24464.6	48.000
24530.6	48.000
24596.6	48.000
24662.6	48.000
24728.6	48.000
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25124.6	48.000
25190.6	48.000
25256.6	48.000
25322.6	48.000
25388.6	48.000
25454.6	48.000
25520.6	48.000
25586.6	48.000
25652.6	48.000
25718.6	48.000
25784.6	48.000
25850.6	48.000
25916.6	48.000
25982.6	48.000
26048.6	48.000
26114.6	48.000
26180.6	48.000
26246.6	48.000
26312.6	48.000
26378.6	48.000
26444.6	48.000
26510.6	48.000
26576.6	48.000
26642.6	48.000
26708.6	48.000
26774.6	48.000
26840.6	48.000
26906.6	48.000
26972.6	48.000
27038.6	48.000
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27170.6	48.000
27236.6	48.000
27302.6	48.000
27368.6	48.000
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27500.6	48.000
27566.6	48.000
27632.6	48.000
27698.6	48.000
27764.6	48.000
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27896.6	48.000
27962.6	48.000
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28094.6	48.000
28160.6	48.000
28226.6	48.000
28292.6	48.000
28358.6	48.000
28424.6	48.000
28490.6	48.000
28556.6	48.000
28622.6	48.000
28688.6	48.000
28754.6	48.000
28820.6	48.000
28886.6	48.000
28952.6	48.000
29018.6	48.000
29084.6	48.000
29150.6	48.000
29216.6	48.000
29282.6	48.000
29348.6	48.000
29414.6	48.000
29480.6	

POSITION ALONG PIPE (CM)	PIEZOMETER	READING	CM
120.6	1	47.580	
176.5	2	47.580	
242.6	3	47.580	
303.5	4	47.580	
364.5	5	47.580	
425.5	6	47.420	
486.4	7	47.420	
510.0	8	3.630	
547.4	9	47.420	
566.2	10	47.420	
578.5	11	47.420	
593.7	12	47.360	
606.4	13	3.850	
608.9	14	47.360	
624.2	15	47.360	
639.5	16	47.360	
750.3	17	45.880	
780.8	18	45.590	
811.3	19	45.490	
872.3	20	45.490	
972.5	21	45.490	
304.5	22	49.050	
365.5	23	48.950	
435.7	24	48.360	
496.6	25	48.050	
557.6	26	47.850	
583.7	27	47.850	
588.1	28	47.850	
618.5	29	47.850	
637.8	30	1.905	
644.4	31	47.840	
649.7	32	47.840	
664.3	33	47.840	
679.5	34	45.880	
750.3	35	45.590	
780.8	36	45.490	
811.3	37	45.490	
872.3	38	44.580	
972.5	39	44.580	

FLOW RATE (CURRIC CENTIMETERS PER SECOND)
 LATERAL 1868.9109 MAIN
 SLOPE 0.000000 MAIN 0.000000 LATERAL 5.080
 MANHOLE DROP : MAIN C.O. LATERAL 5.080

3.23

POSITION	ALONG PIPE (CM)	PIEZOMETER	READING	CM
	120.6	1	47.080	
	176.5	2	47.040	
	242.5	3	46.980	
	303.5	4	46.930	
	364.5	5	46.890	
	425.5	6	46.840	
	486.5	7	46.800	
	512.5	8	46.750	
	547.5	9	46.700	
	563.5	10	46.650	
	578.5	11	46.600	
	593.5	12	46.550	
	606.5	13	46.500	
	624.5	14	46.450	
	639.5	15	46.400	
	650.5	16	46.350	
	659.5	17	46.300	
	672.5	18	46.250	
	681.5	19	46.200	
	692.5	20	46.150	
	704.5	21	46.100	
	712.5	22	46.050	
	720.5	23	46.000	
	725.5	24	45.950	
	735.5	25	45.900	
	746.5	26	45.850	
	757.5	27	45.800	
	768.5	28	45.750	
	779.5	29	45.700	
	789.5	30	45.650	
	799.5	31	45.600	
	811.5	32	45.550	
	822.5	33	45.500	
	832.5	34	45.450	
	842.5	35	45.400	
	852.5	36	45.350	
	862.5	37	45.300	
	872.5	38	45.250	
	882.5	39	45.200	
	892.5	40	45.150	
	902.5	41	45.100	
	912.5	42	45.050	
	922.5	43	45.000	
	932.5	44	44.950	
	942.5	45	44.900	
	952.5	46	44.850	
	962.5	47	44.800	
	972.5	48	44.750	
	982.5	49	44.700	
	992.5	50	44.650	
	1002.5	51	44.600	
	1012.5	52	44.550	
	1022.5	53	44.500	
	1032.5	54	44.450	
	1042.5	55	44.400	
	1052.5	56	44.350	
	1062.5	57	44.300	
	1072.5	58	44.250	
	1082.5	59	44.200	
	1092.5	60	44.150	
	1102.5	61	44.100	
	1112.5	62	44.050	
	1122.5	63	44.000	
	1132.5	64	43.950	
	1142.5	65	43.900	
	1152.5	66	43.850	
	1162.5	67	43.800	
	1172.5	68	43.750	
	1182.5	69	43.700	
	1192.5	70	43.650	
	1202.5	71	43.600	
	1212.5	72	43.550	
	1222.5	73	43.500	
	1232.5	74	43.450	
	1242.5	75	43.400	
	1252.5	76	43.350	
	1262.5	77	43.300	
	1272.5	78	43.250	
	1282.5	79	43.200	
	1292.5	80	43.150	
	1302.5	81	43.100	
	1312.5	82	43.050	
	1322.5	83	43.000	
	1332.5	84	42.950	
	1342.5	85	42.900	
	1352.5	86	42.850	
	1362.5	87	42.800	
	1372.5	88	42.750	
	1382.5	89	42.700	
	1392.5	90	42.650	
	1402.5	91	42.600	
	1412.5	92	42.550	
	1422.5	93	42.500	
	1432.5	94	42.450	
	1442.5	95	42.400	
	1452.5	96	42.350	
	1462.5	97	42.300	
	1472.5	98	42.250	
	1482.5	99	42.200	
	1492.5	100	42.150	
	1502.5	101	42.100	
	1512.5	102	42.050	
	1522.5	103	42.000	
	1532.5	104	41.950	
	1542.5	105	41.900	
	1552.5	106	41.850	
	1562.5	107	41.800	
	1572.5	108	41.750	
	1582.5	109	41.700	
	1592.5	110	41.650	
	1602.5	111	41.600	
	1612.5	112	41.550	
	1622.5	113	41.500	
	1632.5	114	41.450	
	1642.5	115	41.400	
	1652.5	116	41.350	
	1662.5	117	41.300	
	1672.5	118	41.250	
	1682.5	119	41.200	
	1692.5	120	41.150	
	1702.5	121	41.100	
	1712.5	122	41.050	
	1722.5	123	41.000	
	1732.5	124	40.950	
	1742.5	125	40.900	
	1752.5	126	40.850	
	1762.5	127	40.800	
	1772.5	128	40.750	
	1782.5	129	40.700	
	1792.5	130	40.650	
	1802.5	131	40.600	
	1812.5	132	40.550	
	1822.5	133	40.500	
	1832.5	134	40.450	
	1842.5	135	40.400	
	1852.5	136	40.350	
	1862.5	137	40.300	
	1872.5	138	40.250	
	1882.5	139	40.200	
	1892.5	140	40.150	
	1902.5	141	40.100	
	1912.5	142	40.050	
	1922.5	143	40.000	
	1932.5	144	39.950	
	1942.5	145	39.900	
	1952.5	146	39.850	
	1962.5	147	39.800	
	1972.5	148	39.750	
	1982.5	149	39.700	
	1992.5	150	39.650	
	2002.5	151	39.600	
	2012.5	152	39.550	
	2022.5	153	39.500	
	2032.5	154	39.450	
	2042.5	155	39.400	
	2052.5	156	39.350	
	2062.5	157	39.300	
	2072.5	158	39.250	
	2082.5	159	39.200	
	2092.5	160	39.150	
	2102.5	161	39.100	
	2112.5	162	39.050	
	2122.5	163	39.000	
	2132.5	164	38.950	
	2142.5	165	38.900	
	2152.5	166	38.850	
	2162.5	167	38.800	
	2172.5	168	38.750	
	2182.5	169	38.700	
	2192.5	170	38.650	
	2202.5	171	38.600	
	2212.5	172	38.550	
	2222.5	173	38.500	
	2232.5	174	38.450	
	2242.5	175	38.400	
	2252.5	176	38.350	
	2262.5	177	38.300	
	2272.5	178	38.250	
	2282.5	179	38.200	
	2292.5	180	38.150	
	2302.5	181	38.100	
	2312.5	182	38.050	
	2322.5	183	38.000	
	2332.5	184	37.950	
	2342.5	185	37.900	
	2352.5	186	37.850	
	2362.5	187	37.800	
	2372.5	188	37.750	
	2382.5	189	37.700	
	2392.5	190	37.650	
	2402.5	191	37.600	
	2412.5	192	37.550	
	2422.5	193	37.500	
	2432.5	194	37.450	
	2442.5	195	37.400	
	2452.5	196	37.350	
	2462.5	197	37.300	
	2472.5	198	37.250	
	2482.5	199	37.200	
	2492.5	200	37.150	
	2502.5	201	37.100	
	2512.5	202	37.050	
	2522.5	203	37.000	
	2532.5	204	36.950	
	2542.5	205	36.900	
	2552.5	206	36.850	
	2562.5	207	36.800	
	2572.5	208	36.750	
	2582.5	209	36.700	
	2592.5	210	36.650	
	2602.5	211	36.600	
	2612.5	212	36.550	
	2622.5	213	36.500	
	2632.5	214	36.450	
	2642.5	215	36.400	
	2652.5	216	36.350	
	2662.5	217	36.300	
	2672.5	218	36.250	
	2682.5	219	36.200	
	2692.5	220	36.150	
	2702.5	221	36.100	
	2712.5	222	36.050	
	2722.5	223	36.000	
	2732.5	224	35.950	
	2742.5	225	35.900	
	2752.5	226	35.850	
	2762.5	227	35.800	
	2772.5	228	35.750	
	2782.5	229	35.700	
	2792.5	230	35.650	
	2802.5	231	35.600	
	2812.5	232	35.550	
	2822.5	233	35.500	
	2832.5	234	35.450	
	2842.5	235	35.400	
	2852.5	236	35.350	
	2862.5	237	35.300	
	2872.5	238	35.250	
	2882.5	239	35.200	
	2892.5	240	35.150	
	2902.5	241	35.100	
	2912.5	242	35.050	
	2922.5	243	35.000	
	2932.5	244	34.950	
	2942.5	245	34.900	
	2952.5	246	34.850	
	2962.5	247	34.800	
	2972.5	248	34.750	
	2982.5	249	34.700	
	2992.5	250	34.650	
	3002.5	251	34.600	
	3012.5	252	34.550	
	3022.5	253	34.500	
	3032.5	254	34.450	
	3042.5	255	34.400	
	3052.5	256	34.350	
	3062.5	257	34.300	
	3072.5	258	34.250	
	3082.5	259	34.200	
	3092.5	260	34.150	
	3102.5	261	34.100	
	3112.5	262	34.050	
	3122.5	263	34.000	
	3132.5	264	33.950	
	3142.5	265	33.900	
	3152.5	266	33.850	
	3162.5	267	33.800	
	3172.5	268	33.750	
	3182.5	269	33.700	
	3192.5	270	33.650	
	3202.5	271	33.600	
	3212.5	272	33.550	
	3222.5	273	33.500	
	3232.5	274	33.450	
	3242.5	275	33.400	
	3252.5	276	33.350	
	3262.5	277	33.300	
	3272.5	278	33.250	
	3282.5	279	33.200	
	3292.5	280	33.150	
	3302.5	281	33.100	
	3312.5	282	33.050	
	3322.5	283	33.000	
	3332.5	284	32.950	
	3342.5	285	32.900	
	3352.5	286	32.850	
	3362.5	287	32.800	
	3372.5	288	32.750	
	3382.5	289	32.700	
	3392.5	290		

POSITION, ALONG PIPE (CM)	PIEZOMETER PER SECOND	READING CM
120.6	1	46.480
176.5	2	46.430
242.5	3	46.400
303.5	4	46.400
364.5	5	46.320
425.5	6	46.270
486.4	7	46.250
510.0	8	3.195
547.4	9	46.250
563.2	10	46.240
578.5	11	46.240
593.7	12	46.240
606.4	13	3.250
624.2	14	46.240
639.5	15	46.240
750.3	16	46.240
780.8	17	44.860
811.3	18	44.770
872.6	19	44.500
972.6	20	44.230
962.7725MAIN	21	44.230
962.7725MAIN	22	44.230
962.7725MAIN	23	44.230
962.7725MAIN	24	44.230
962.7725MAIN	25	44.230
962.7725MAIN	26	44.230
962.7725MAIN	27	44.230
962.7725MAIN	28	44.230
962.7725MAIN	29	44.230
962.7725MAIN	30	44.230
962.7725MAIN	31	44.230
962.7725MAIN	32	44.230
962.7725MAIN	33	44.230
962.7725MAIN	34	44.230
962.7725MAIN	35	44.230
962.7725MAIN	36	44.230
962.7725MAIN	37	44.230
962.7725MAIN	38	44.230
962.7725MAIN	39	44.230
962.7725MAIN	40	44.230

3.25

POSITION ALONG PIPE (CM)	PIEZOMETER READING CM
120.6	45.780
176.5	45.660
242.6	45.660
270.5	45.660
304.5	45.550
325.5	45.450
486.4	45.450
510.7	2.790
547.4	45.380
563.2	45.380
578.5	45.380
593.7	2.940
606.4	45.380
608.9	45.380
624.2	45.380
639.5	44.100
751.2	44.100
780.8	44.090
811.3	43.890
872.3	43.600
872.3	43.230
904.5	45.030
965.7	45.030
435.7	45.570
496.6	45.570
557.6	45.400
583.7	45.400
588.8	45.450
618.5	45.520
637.8	45.800
644.4	45.450
649.7	45.450
664.1	45.450
679.5	44.100
750.3	44.040
780.8	43.890
811.3	43.600
872.3	43.230

FLOW RATE (CUBIC CENTIMETERS PER SECOND) 228.719
 LATERAL 305.8215 MAIN
 SLUDGE 3.334 MAIN 0.0050 OUTLET 0.0050
 LATERAL 0.0 LATERAL 5.18
 MANHOLE DROP : MAIN

326

POSITION ALONG PIPE (CM)	PIEZOMETER READING CM
120.6	45.370
176.5	45.280
242.6	45.280
303.5	45.260
364.5	45.110
425.5	45.060
486.4	45.060
510.0	45.060
547.4	44.980
563.2	44.980
578.5	44.980
593.7	44.980
606.4	44.980
608.0	44.980
624.2	44.980
630.5	44.980
750.3	44.980
780.9	44.980
811.3	44.980
872.3	44.980
972.6	44.980
304.5	44.980
365.5	44.980
435.7	44.980
406.6	44.980
557.6	44.980
583.7	44.980
584.1	44.980
618.5	44.980
637.3	44.980
644.4	44.980
649.1	44.980
664.3	44.980
679.5	44.980
750.3	44.980
780.9	44.980
811.3	44.980
872.3	44.980
972.6	44.980

FLOW RATE (CUBIC CENTIMETERS PER SECOND) 2203.7112
 LATERAL 177.60 MAIN
 LATERAL 0.000000 OUTLET 0.000500
 MANHOLE DROP : MAIN 5.080 LATERAL 5.080

3.27

NO	K2	K3	K2L	K3M	LEJ	MEJ	TELL	TELM	K2RUS	K2LRUS	K3RUS	K3MRUS	KC	CEL
1	2.54	0.52	1.71	5.72	3.56	0.72	8.64	0.72	1.51	0.74	-0.44	-2.86	1.78	2.50
2	2.58	0.79	2.91	5.54	3.29	0.88	9.37	0.88	1.12	0.76	-0.03	-0.58	1.95	2.16
3	2.79	1.17	1.84	5.73	2.25	0.97	7.07	0.97	0.84	0.76	0.15	0.39	1.97	1.56
4	2.21	0.95	1.46	3.81	1.69	0.85	6.07	0.85	0.53	0.69	0.22	0.45	1.43	1.28
5	2.96	1.08	1.52	3.55	0.58	0.91	5.82	0.91	0.22	0.45	0.18	0.23	1.36	1.14
6	0.32	1.19	1.92	2.52	0.74	0.92	5.32	0.84	-0.51	-6.62	0.08	0.00	1.08	0.90
7	0.32	1.12	1.82	1.95	0.24	0.84	5.32	0.84	-0.81	-71.99	0.00	0.00	1.08	0.81
MAIN FLOW LATERAL FLOW RATIO RATIO2 VELINM VELINL VELOUT														
2208.712	3681.189	0.63	1.67	15.77	70.91	70.91	52.50	10.473	8.956	11.197	11.197	11.197	11.197	
2208.712	2491.882	0.53	1.13	17.62	62.13	62.13	46.58	9.235	7.446	10.111	10.111	10.111	10.111	
2208.712	1868.911	0.46	0.85	18.25	49.03	49.03	40.41	8.946	6.116	9.932	9.932	9.932	9.932	
2208.712	1359.208	0.38	0.62	20.94	42.77	42.77	41.99	8.081	4.989	8.481	8.481	8.481	8.481	
2208.712	962.772	0.30	0.44	22.39	23.97	23.97	38.89	6.630	4.217	7.548	7.548	7.548	7.548	
2208.712	305.822	0.12	0.14	26.71	13.32	13.32	38.45	6.343	1.506	7.185	7.185	7.185	7.185	
2208.712	107.604	0.05	0.05	28.26										

K2: LATERAL LOSS COEFF W.E.T. OUTLET VELOCITY
 K3: MAIN LOSS COEFFICIENT W.E.T. OUTLET VELOCITY
 K2L: W.E.T. LATERAL INLET VELOCITY
 K3M: W.E.T. MAIN INLET VELOCITY
 LEJ: LATERAL ENERGY LOSS DUE TO JUNCTION
 MEJ: MAIN ENERGY LOSS DUE TO JUNCTION
 TELM: TOTAL ENERGY LOSS THROUGH JUNCTION
 RATIO OF LATERAL FLOW TO TOTAL FLOW
 VELIN: LATERAL FLOW INLET AND OUTLET VELOCITIES
 VELINL: LATERAL FLOW INLET VELOCITY
 VELOUT: LATERAL FLOW OUTLET VELOCITY
 K2RUS: BASED ON RUSSIAN PREDICTION EQUATION -FOR COMPARISON

POWER LOSS

MAIN POWER	LATERAL POWER	OUT POWER	POWER LOSS RATIO
244752.2500	418365.2500	648465.9375	1.0222
242354.3125	279440.9375	511561.0000	0.0194
241931.3125	207095.7500	442674.4375	0.0141
239751.0625	149084.1875	384354.5625	0.0118
238756.0000	104316.6250	339957.0000	0.0105
236605.6875	72718.6329	267160.8750	0.0084
235903.1250	11427.9063	245437.2500	0.0076

3.2

POSITION ALONG PIPE (CM)	PIEZOMETER READING CM
120.6	48.670
176.5	48.670
242.6	48.670
303.5	48.650
364.5	48.570
425.5	48.550
486.4	48.550
510.0	48.060
547.4	48.550
567.2	48.550
578.5	48.550
583.7	48.160
616.4	48.550
618.0	48.550
624.2	48.550
639.5	48.860
750.3	46.860
780.8	46.770
811.3	45.770
872.3	
972.6	

FLOW RATE (CUBIC CENTIMETERS PER SECOND) 2208.71
 LATERAL 3308.01 MAIN
 CLUPE 3308.01 MAIN
 LATERAL 3308.01 MAIN
 WEHOLE DRCD : MAIN LATERAL 5.08

3.31

90

POSITION	ALONG PIPE (CM)	PIEZOMETER	READING	CM
1	20.6	1	46.780	
2	27.6	2	46.740	
3	34.6	3	46.650	
4	41.6	4	46.650	
5	48.6	5	46.590	
6	55.6	6	46.530	
7	62.6	7	46.490	
8	69.6	8	46.490	
9	76.6	9	46.440	
10	83.6	10	46.440	
11	90.6	11	46.440	
12	97.6	12	46.440	
13	104.6	13	46.440	
14	111.6	14	46.440	
15	118.6	15	46.440	
16	125.6	16	46.440	
17	132.6	17	46.440	
18	139.6	18	46.440	
19	146.6	19	46.440	
20	153.6	20	46.440	
21	160.6	21	46.440	
22	167.6	22	46.440	
23	174.6	23	46.440	
24	181.6	24	46.440	
25	188.6	25	46.440	
26	195.6	26	46.440	
27	202.6	27	46.440	
28	209.6	28	46.440	
29	216.6	29	46.440	
30	223.6	30	46.440	
31	230.6	31	46.440	
32	237.6	32	46.440	
33	244.6	33	46.440	
34	251.6	34	46.440	
35	258.6	35	46.440	
36	265.6	36	46.440	
37	272.6	37	46.440	
38	279.6	38	46.440	
39	286.6	39	46.440	
40	293.6	40	46.440	
41	300.6	41	46.440	
42	307.6	42	46.440	
43	314.6	43	46.440	
44	321.6	44	46.440	
45	328.6	45	46.440	
46	335.6	46	46.440	
47	342.6	47	46.440	
48	349.6	48	46.440	
49	356.6	49	46.440	
50	363.6	50	46.440	
51	370.6	51	46.440	
52	377.6	52	46.440	
53	384.6	53	46.440	
54	391.6	54	46.440	
55	398.6	55	46.440	
56	405.6	56	46.440	
57	412.6	57	46.440	
58	419.6	58	46.440	
59	426.6	59	46.440	
60	433.6	60	46.440	
61	440.6	61	46.440	
62	447.6	62	46.440	
63	454.6	63	46.440	
64	461.6	64	46.440	
65	468.6	65	46.440	
66	475.6	66	46.440	
67	482.6	67	46.440	
68	489.6	68	46.440	
69	496.6	69	46.440	
70	503.6	70	46.440	
71	510.6	71	46.440	
72	517.6	72	46.440	
73	524.6	73	46.440	
74	531.6	74	46.440	
75	538.6	75	46.440	
76	545.6	76	46.440	
77	552.6	77	46.440	
78	559.6	78	46.440	
79	566.6	79	46.440	
80	573.6	80	46.440	
81	580.6	81	46.440	
82	587.6	82	46.440	
83	594.6	83	46.440	
84	601.6	84	46.440	
85	608.6	85	46.440	
86	615.6	86	46.440	
87	622.6	87	46.440	
88	629.6	88	46.440	
89	636.6	89	46.440	
90	643.6	90	46.440	
91	650.6	91	46.440	
92	657.6	92	46.440	
93	664.6	93	46.440	
94	671.6	94	46.440	
95	678.6	95	46.440	
96	685.6	96	46.440	
97	692.6	97	46.440	
98	699.6	98	46.440	
99	706.6	99	46.440	
100	713.6	100	46.440	

3.33

POSITION	ALONG	PIPE(CM)	PIZOMETER	READING	CM
	120.5		2	46.24	
	176.5		2	46.100	
	242.6		2	46.050	
	307.5		4	46.000	
	364.5		5	45.930	
	425.5		6	45.840	
	486.4		7	45.930	
	510.0		8	2.990	
	547.4		8	45.860	
	563.2		10	45.800	
	578.5		11	45.790	
	593.7		12	45.790	
	606.4		13	3.030	
	608.0		14	45.790	
	624.2		15	45.790	
	639.5		16	45.740	
	75.7		17	44.650	
	780.8		18	44.470	
	811.3		19	44.150	
	870.3		20	47.780	
	970.6		21	46.990	
	304.5		22	47.300	
	365.5		23	47.090	
	435.7		24	46.850	
	496.6		25	46.630	
	557.6		26	1.210	
	583.7		27	45.440	
	588.1		28	46.300	
	618.5		29	46.300	
	632.8		30	1.300	
	644.4		31	45.300	
	649.0		32	46.210	
	664.3		33	46.240	
	679.5		34	44.740	
	750.3		35	44.650	
	780.8		36	44.470	
	811.3		37	44.150	
	872.3		38	47.780	
	972.6		39		

FLOW RATE(CURRIC CENTIMETERS PER SECOND) 2298.7119
 LATERAL 1019.4760MAIN
 SLOPE 0.003400MAIN 0.000500OUTLET 0.000000
 LATERAL 0.003400MAIN 0.000500OUTLET 0.000000
 MANHOLE DECS :MAIN 0.003400MAIN 0.000500OUTLET 0.000000

3.34

POSITION ALONG PIPE (CM)	PIEZOMETER READING CM
120.6	45.970
176.5	45.760
242.6	45.680
303.5	45.680
364.5	45.680
425.5	45.510
486.4	45.510
510.0	45.410
547.4	45.380
563.2	45.380
578.5	45.380
593.7	45.380
606.4	45.380
624.2	45.380
639.5	44.380
750.0	44.290
780.0	44.200
811.7	44.200
872.3	43.560
972.6	46.630
304.5	46.630
365.5	46.370
435.7	46.800
495.6	45.890
557.6	45.720
583.7	45.720
618.1	45.720
633.5	45.720
644.4	45.720
649.0	45.650
664.3	44.380
679.5	44.290
750.0	44.200
780.0	43.940
811.7	43.560
872.3	
972.6	

FLOW RATE (CURRIC CENTIMETERS PER SECOND) 2208.7119
 LATERAL 622.9705 MAIN
 LATERAL 0.00500 OUTLET 0.000500
 LATERAL 0.003400 MAIN 0.000500 LATERAL 5.080
 MANHOLE DROP : MAIN 0.00 LATERAL 5.080

3.35

POSITION	ALONG PIPE (CM)	PIEZOMETER	READING	CM
	120.6	1	45.560	
	176.5	2	45.480	
	242.6	3	45.370	
	307.5	4	45.370	
	364.5	5	45.370	
	425.5	6	45.260	
	486.4	7	45.220	
	510.0	8	2.720	
	547.4	9	45.150	
	563.2	10	45.090	
	578.5	11	45.090	
	593.7	12	2.740	
	606.4	13	45.090	
	608.9	14	45.090	
	624.2	15	45.090	
	639.5	16	44.220	
	750.3	17	44.100	
	790.6	18	43.940	
	811.3	19	43.650	
	872.6	20	43.400	
	972.6	21	45.080	
	364.5	22	45.080	
	365.5	23	45.080	
	435.7	24	45.860	
	496.6	25	45.560	
	557.6	26	0.785	
	583.7	27	45.230	
	618.5	28	45.230	
	633.4	29	45.440	
	644.4	30	0.865	
	649.4	31	45.160	
	664.7	32	45.340	
	679.5	33	44.220	
	750.3	34	44.100	
	780.8	35	43.940	
	811.3	36	43.650	
	872.6	37	43.400	
	972.6	38	43.400	
		39	43.400	

FLOW RATE (CUBIC CENTIMETERS PER SECOND) 228.7119
 LATERAL 424.7524 MAIN
 SLOPE 0.000000 LATERAL 0.000000
 MANHOLE DEED : MAIN 6.0 LATERAL 5.000

3.36

POSITION ALONG PIPE (CM)	PIEZOMETER	READING	CM
120.6	1	45.320	
176.5	2	45.150	
242.6	3	45.010	
303.5	4	44.910	
364.5	5	44.730	
425.5	6	44.730	
486.4	7	44.730	
510.0	8	44.670	
547.4	9	44.670	
567.2	10	44.670	
578.5	11	44.670	
593.7	12	44.670	
606.4	13	44.670	
608.9	14	44.670	
624.2	15	44.670	
639.5	16	44.670	
750.3	17	44.670	
787.8	18	44.670	
811.3	19	44.670	
872.6	20	44.670	
972.6	21	44.670	
704.6	22	44.670	
365.7	23	44.670	
435.7	24	44.670	
496.6	25	44.670	
557.6	26	44.670	
587.7	27	44.670	
598.1	28	44.670	
618.5	29	44.670	
637.8	30	44.670	
644.4	31	44.670	
649.7	32	44.670	
664.3	33	44.670	
679.5	34	44.670	
750.3	35	44.670	
780.8	36	44.670	
811.3	37	44.670	
872.6	38	44.670	
972.6	39	44.670	

FLOW RATE (CUBIC CENTIMETERS PER SECOND) 2208.7119
 LATERAL 113.2673 MAIN
 SLCP= 0.00050
 LATERAL 10.00340 MAIN 0.00050 OUTLET 0.00050
 MANHOLE 0000 MAIN 5.000 LATERAL

3.37

POSITION ALONG PIPE (CM)	PIEZOMETER READING CM
120.6	47.560
176.5	47.560
242.6	47.560
303.5	47.560
364.5	47.560
425.5	47.480
486.0	47.490
510.0	47.680
547.4	47.480
563.2	47.480
578.5	47.480
593.7	47.480
606.4	3.780
608.9	47.480
624.2	47.470
679.5	47.460
750.7	46.150
780.8	46.030
811.7	45.800
872.6	45.500
972.6	45.120
104.5	49.890
135.5	49.400
143.5	49.160
157.6	48.750
187.7	48.230
207.7	48.270
237.7	48.520
267.7	48.660
288.7	48.220
318.7	48.440
338.7	47.930
368.7	46.130
398.7	45.900
428.7	45.500
458.7	45.100

FLOW RATE (CUBIC CENTIMETERS PER SECOND) 2208.7119
 LATERAL 2491.881 MAIN
 LATERAL 2491.881 MAIN
 MANHOLE DROP : MAIN 5.0390

3.30

NO	K2	K7	K2L	K3M	LELJ	MELJ	TELL	TELM	K2RUS	K2LRUS	K3RUS	K3MRUS	KC	CELJ
1	2.52	0.78	1.15	3.51	3.34	0.50	8.42	0.50	1.43	0.77	0.34	-2.20	1.67	2.22
2	2.52	0.36	1.81	1.91	2.72	0.39	7.80	0.39	0.96	0.77	0.04	-0.14	1.42	1.53
3	2.52	0.47	1.81	1.89	2.30	0.46	7.38	0.46	0.62	0.72	0.12	0.33	1.24	1.20
4	2.52	0.52	1.27	1.55	1.91	0.48	6.99	0.48	0.26	0.51	0.21	0.45	1.01	0.93
5	1.60	0.61	1.19	1.43	1.44	0.52	6.52	0.52	-0.12	-0.47	0.21	0.39	0.85	0.72
6	1.24	0.61	1.11	1.35	1.01	0.52	5.23	0.52	-0.35	-0.60	0.21	0.10	0.76	0.56
7	0.60	0.77	0.38	1.20	0.15	0.58	7.95	0.58	1.12	0.76	0.13	0.58	1.58	1.75
8	2.60	0.43	1.69	2.70	2.87	0.48	16.50	0.48	1.12	0.76	0.13	0.58	1.58	1.75
MAIN FLOW							VELINL	VELOUT						
2208.712	3398.619	0.61	0.61	1.54	0.56	59.34	59.34	59.34	51.00	10.178	8.435	10.680	8.435	10.680
2208.712	2125.762	0.44	0.44	0.56	0.56	62.20	62.20	62.20	46.04	8.800	5.327	9.194	46.04	8.800
2209.712	1567.792	0.44	0.44	0.56	0.56	57.03	57.03	57.03	43.65	8.111	5.327	8.577	43.65	8.111
2209.712	1010.406	0.33	0.33	0.46	0.46	45.82	45.82	45.82	40.96	7.498	3.365	7.977	40.96	7.498
2209.712	622.970	0.16	0.16	0.28	0.28	35.57	35.57	35.57	39.37	6.2796	2.725	7.315	39.37	6.2796
2208.712	424.752	0.05	0.05	0.19	0.19	18.95	18.95	18.95	38.55	6.2796	1.346	6.859	38.55	6.2796
2208.712	117.267	0.05	0.05	0.19	0.19	6.37	6.37	6.37	46.58	9.273	7.067	9.748	46.58	9.273
2209.712	2491.882	0.52	0.52	1.13	1.13									

K2: LATERAL LOSS COEFF W.R.T. OUTLET VELOCITY
 K3: MAIN LOSS COEFFICIENT W.R.T. OUTLET VELOCITY
 K2L: W.R.T. MAIN INLET VELOCITY
 K3M: W.R.T. MAIN INLET VELOCITY
 LELJ: LATERAL ENERGY LOSS DUE TO JUNCTION
 MELJ: MAIN ENERGY LOSS THROUGH JUNCTION
 TELJ: TOTAL ENERGY LOSS TO TOTAL FLOW
 FATIO: OF LATERAL FLOW TO TOTAL FLOW
 VELLIN: LATERAL FLOW TO MAIN FLOW VELOCITIES
 VELLOUT: LATERAL FLOW TO MAIN FLOW VELOCITIES
 K2RUS: BASED ON RUSSIAN PREDICTION EQUATION -FOR COMPARISON
 K3RUS: BASED ON RUSSIAN PREDICTION EQUATION -FOR COMPARISON

POWER LOSS

MAIN POWER	LATERAL POWER	OUT POWER	POWER LOSS RATIO
243617.9375	384413.7125	615582.1250	0.0198
240328.4375	235027.0625	469710.3125	0.0140
238955.7375	165120.0375	399615.0000	0.0110
237643.1250	111134.0000	345777.1875	0.0086
236430.5625	67318.8750	301918.5625	0.0067
236181.1250	45627.4805	280233.9375	0.0056
235175.1250	12111.2305	245881.8125	0.0053
241552.6875	278496.5625	511841.6875	0.0158

3.3

POSITION ALONG PIPE (CM)	PIEZOMETER	READING	CM
126.6	1	47.650	
176.6	2	47.600	
242.6	3	47.550	
303.6	4	47.550	
364.6	5	47.550	
425.6	6	47.550	
486.6	7	47.550	
547.6	8	47.550	
608.6	9	47.550	
669.6	10	47.550	
730.6	11	47.550	
791.6	12	47.550	
852.6	13	47.550	
913.6	14	47.550	
974.6	15	47.550	
1035.6	16	47.550	
1096.6	17	47.550	
1157.6	18	47.550	
1218.6	19	47.550	
1279.6	20	47.550	
1340.6	21	47.550	
1401.6	22	47.550	
1462.6	23	47.550	
1523.6	24	47.550	
1584.6	25	47.550	
1645.6	26	47.550	
1706.6	27	47.550	
1767.6	28	47.550	
1828.6	29	47.550	
1889.6	30	47.550	
1950.6	31	47.550	
2011.6	32	47.550	
2072.6	33	47.550	
2133.6	34	47.550	
2194.6	35	47.550	
2255.6	36	47.550	
2316.6	37	47.550	
2377.6	38	47.550	
2438.6	39	47.550	
2499.6	40	47.550	
2560.6	41	47.550	
2621.6	42	47.550	
2682.6	43	47.550	
2743.6	44	47.550	
2804.6	45	47.550	
2865.6	46	47.550	
2926.6	47	47.550	
2987.6	48	47.550	
3048.6	49	47.550	
3109.6	50	47.550	
3170.6	51	47.550	
3231.6	52	47.550	
3292.6	53	47.550	
3353.6	54	47.550	
3414.6	55	47.550	
3475.6	56	47.550	
3536.6	57	47.550	
3597.6	58	47.550	
3658.6	59	47.550	
3719.6	60	47.550	
3780.6	61	47.550	
3841.6	62	47.550	
3902.6	63	47.550	
3963.6	64	47.550	
4024.6	65	47.550	
4085.6	66	47.550	
4146.6	67	47.550	
4207.6	68	47.550	
4268.6	69	47.550	
4329.6	70	47.550	
4390.6	71	47.550	
4451.6	72	47.550	
4512.6	73	47.550	
4573.6	74	47.550	
4634.6	75	47.550	
4695.6	76	47.550	
4756.6	77	47.550	
4817.6	78	47.550	
4878.6	79	47.550	
4939.6	80	47.550	
5000.6	81	47.550	
5061.6	82	47.550	
5122.6	83	47.550	
5183.6	84	47.550	
5244.6	85	47.550	
5305.6	86	47.550	
5366.6	87	47.550	
5427.6	88	47.550	
5488.6	89	47.550	
5549.6	90	47.550	
5610.6	91	47.550	
5671.6	92	47.550	
5732.6	93	47.550	
5793.6	94	47.550	
5854.6	95	47.550	
5915.6	96	47.550	
5976.6	97	47.550	
6037.6	98	47.550	
6098.6	99	47.550	
6159.6	100	47.550	

3.41

POSITION	ALONG	PIPE(CM)	PIEZOMETER	READING	CM
	120.0	6	1	49.000	
	176.0	5	2	49.000	
	242.0	6	3	49.000	
	308.0	5	4	48.960	
	364.0	5	5	48.940	
	425.0	5	6	48.940	
	486.0	4	7	48.940	
	510.0	0	8	48.210	
	547.0	4	9	48.900	
	563.0	2	10	48.860	
	578.0	5	11	48.860	
	593.0	7	12	48.260	
	606.0	4	13	48.860	
	608.0	9	14	48.860	
	624.0	2	15	48.860	
	639.0	5	16	47.140	
	750.0	3	17	47.250	
	780.0	8	18	47.140	
	811.0	3	19	46.800	
	872.0	3	20	46.250	
	904.0	5	21	52.000	
	935.0	7	22	52.000	
	965.0	5	23	51.550	
	996.0	6	24	51.240	
	1027.0	7	25	50.940	
	1058.0	1	26	50.440	
	1089.0	5	27	50.240	
	1120.0	4	28	49.270	
	1151.0	3	29	47.140	
	1182.0	2	30	47.250	
	1213.0	1	31	46.800	
	1244.0	0	32	46.250	
	1275.0	9	33		
	1306.0	8	34		
	1337.0	7	35		
	1368.0	6	36		
	1399.0	5	37		
	1430.0	4	38		
	1461.0	3	39		
	1492.0	2	40		
	1523.0	1	41		
	1554.0	0	42		
	1585.0	9	43		
	1616.0	8	44		
	1647.0	7	45		
	1678.0	6	46		
	1709.0	5	47		
	1740.0	4	48		
	1771.0	3	49		
	1802.0	2	50		
	1833.0	1	51		
	1864.0	0	52		
	1895.0	9	53		
	1926.0	8	54		
	1957.0	7	55		
	1988.0	6	56		
	2019.0	5	57		
	2050.0	4	58		
	2081.0	3	59		
	2112.0	2	60		
	2143.0	1	61		
	2174.0	0	62		
	2205.0	9	63		
	2236.0	8	64		
	2267.0	7	65		
	2298.0	6	66		
	2329.0	5	67		
	2360.0	4	68		
	2391.0	3	69		
	2422.0	2	70		
	2453.0	1	71		
	2484.0	0	72		
	2515.0	9	73		
	2546.0	8	74		
	2577.0	7	75		
	2608.0	6	76		
	2639.0	5	77		
	2670.0	4	78		
	2701.0	3	79		
	2732.0	2	80		
	2763.0	1	81		
	2794.0	0	82		
	2825.0	9	83		
	2856.0	8	84		
	2887.0	7	85		
	2918.0	6	86		
	2949.0	5	87		
	2980.0	4	88		
	3011.0	3	89		
	3042.0	2	90		
	3073.0	1	91		
	3104.0	0	92		
	3135.0	9	93		
	3166.0	8	94		
	3197.0	7	95		
	3228.0	6	96		
	3259.0	5	97		
	3290.0	4	98		
	3321.0	3	99		
	3352.0	2	100		

FLOW RATE(CURRIC CENTIMETERS PER SECOND)
 LATERAL 3964.3569MAIN
 SLEEPE 0.003400MAIN 0.000500OUTLET 0.000500
 LATERAL 0.00 LATERAL 5.000
 MANHOLE DROP :MAIN 0.00 LATERAL 5.000

342

POSITION	ALNG	PIPE(CM)	PIEZOMETER	READING	CM
	120.6		1	47.34	
	176.5		2	47.170	
	242.6		3	47.179	
	303.5		4	47.050	
	364.5		5	47.050	
	425.5		6	47.000	
	496.4		7	47.000	
	510.0		8	3.460	
	547.4		9	47.000	
	563.2		10	47.000	
	578.5		11	46.930	
	593.7		12	46.930	
	606.4		13	3.510	
	624.2		14	46.930	
	639.5		15	46.930	
	750.8		16	46.930	
	781.8		17	45.730	
	811.3		18	45.590	
	872.3		19	45.350	
	972.6		20	44.570	
	304.5		21	49.270	
	365.5		22	49.120	
	435.7		23	48.620	
	496.6		24	48.500	
	557.6		25	48.160	
	583.7		26	1.880	
	618.5		27	47.800	
	633.9		28	47.970	
	644.4		29	47.970	
	649.0		30	1.910	
	664.7		31	47.940	
	679.5		32	47.770	
	750.3		33	47.720	
	811.3		34	45.730	
	872.3		35	45.590	
	872.3		36	45.350	
	872.3		37	45.100	
	872.3		38	44.570	
	872.3		39		

FLOW RATE(CUBIC CENTIMETERS PER SECOND) 2208.7119
 LATERAL 1082.1785MAIN
 SLOPE 0.003430MAIN 0.000500OUTLET 0.000500
 LATERAL 5.080
 MANHOLE DROP :MAIN 5.080

3.43

POSITION	ALONG PIPE (CM)	PIEZOMETER	READING	CM
	120.6	1	46.770	
	176.5	2	46.700	
	242.6	3	46.700	
	303.5	4	46.610	
	364.5	5	46.560	
	425.5	6	46.500	
	486.4	7	46.500	
	510.0	8	46.500	
	547.4	9	46.500	
	567.8	10	46.500	
	578.5	11	46.500	
	593.7	12	46.500	
	606.4	13	46.500	
	608.2	14	46.500	
	624.2	15	46.500	
	639.5	16	46.500	
	750.3	17	46.500	
	780.3	18	46.500	
	811.3	19	46.500	
	872.3	20	46.500	
	972.5	21	46.500	
	972.5	22	46.500	
	972.5	23	46.500	
	972.5	24	46.500	
	972.5	25	46.500	
	972.5	26	46.500	
	972.5	27	46.500	
	972.5	28	46.500	
	972.5	29	46.500	
	972.5	30	46.500	
	972.5	31	46.500	
	972.5	32	46.500	
	972.5	33	46.500	
	972.5	34	46.500	
	972.5	35	46.500	
	972.5	36	46.500	
	972.5	37	46.500	
	972.5	38	46.500	
	972.5	39	46.500	
	972.5	40	46.500	

FLOW RATE (CUBIC CENTIMETERS PER SECOND) 228.7119
 LATERAL 1302.5745 MAIN
 SLOPE 0.003400 MAIN 0.003500 OUTLET 0.003500
 LATERAL 1.00 LATERAL 5.00
 WENHOLE DRIP : MAIN

3.44

POSITION ALONG PIPE (CM)	PIEZOMETER	READING	CM
120.6	1	45.930	
176.5	2	45.780	
242.6	3	45.710	
303.5	4	45.620	
364.5	5	45.570	
425.5	6	45.460	
486.4	7	45.460	
511.0	8	45.760	
547.0	9	45.370	
563.2	10	45.370	
578.5	11	45.370	
593.7	12	45.370	
606.4	13	45.370	
608.9	14	45.370	
624.2	15	45.370	
639.5	16	45.370	
757.7	17	44.320	
780.8	18	44.190	
811.3	19	44.060	
872.6	20	43.780	
972.6	21	43.500	
304.5	22	46.270	
365.5	23	46.450	
435.7	24	46.100	
496.6	25	46.100	
557.6	26	45.710	
583.7	27	45.800	
618.1	28	45.540	
637.5	29	45.540	
644.4	30	45.540	
649.0	31	45.540	
664.7	32	45.540	
670.5	33	45.320	
750.7	34	44.320	
780.8	35	44.100	
811.3	36	44.060	
872.6	37	43.780	
972.6	38	43.500	

FLOW RATE (CUBIC CENTIMETERS PER SECOND) 229.7119
 LATERAL 527.8612 MAIN
 SLOPE 0.00340 MAIN 0.00500 OUTLET 0.00500
 MANHOLE DROP : MAIN 0.0 LATERAL 5.080

3.46

NO	K2	K3	K2L	K3M	LELJ	MELJ	TELL	TELM	K2RUS	K2LRUS	K3RUS	K3MRUS	KC	KCELJ
1	2.47	0.33	1.71	2.22	2.98	0.41	8.06	0.41	1.14	0.76	-0.13	-0.62	1.45	1.78
2	0.38	0.13	1.67	1.50	3.68	0.21	8.77	0.20	0.99	0.76	0.00	0.59	1.58	2.44
3	2.57	0.47	1.66	2.43	2.68	0.50	7.77	0.50	0.49	0.67	0.16	0.40	1.45	1.54
4	2.14	0.54	1.26	2.19	3.34	0.50	7.42	0.59	0.29	0.53	0.21	0.45	1.13	1.24
5	2.11	0.43	1.25	1.29	1.98	0.40	6.77	0.40	-0.23	1.21	0.23	0.35	0.97	0.72
6	1.47	0.69	1.11	1.62	1.25	0.50	6.14	0.56	-0.36	-2.71	0.21	0.30	0.84	0.64
7	1.34	0.71	1.08	1.37	1.16	0.56	6.14	0.56	-0.36	-2.71	0.21	0.30	0.81	0.64
MAIN FLOW	2520.198	0.53	0.53	0.53	1.14	0.56	18.94	69.76	49.07	9.19	7.09	9.60	9.60	9.60
LATERAL FLOW	3964.357	0.47	0.47	0.47	1.79	0.90	16.24	79.32	55.03	10.72	9.32	10.92	10.92	10.92
W.R.T. MAIN INLET VELOCITY	1982.178	0.37	0.37	0.37	0.90	0.59	20.09	53.54	45.64	8.59	7.70	8.29	8.29	8.29
LATERAL ENERGY LOSS DUE TO JUNCTION	1702.574	0.32	0.32	0.32	0.59	0.47	23.47	55.06	46.27	7.55	6.50	7.95	7.95	7.95
MAIN ENERGY LOSS THROUGH JUNCTION	1047.723	0.19	0.19	0.19	0.24	0.47	24.67	47.05	42.91	6.85	6.74	7.44	7.44	7.44
TOTAL ENERGY LOSS THROUGH JUNCTION	523.861	0.16	0.16	0.16	0.19	0.24	26.71	40.50	39.28	6.74	6.74	7.20	7.20	7.20
VELOCITY: INLET AND OUTLET VELOCITIES	410.086	0.16	0.16	0.16	0.19	0.24	28.26	40.50	39.28	6.74	6.74	7.20	7.20	7.20
RATIO: LATERAL FLOW TO MAIN FLOW	0.16	0.16	0.16	0.16	0.19	0.24	28.26	40.50	39.28	6.74	6.74	7.20	7.20	7.20
VELOCITY: LATERAL FLOW TO MAIN FLOW	0.16	0.16	0.16	0.16	0.19	0.24	28.26	40.50	39.28	6.74	6.74	7.20	7.20	7.20
RATIO: LATERAL JUNCTION LOSS COEFFICIENT	0.16	0.16	0.16	0.16	0.19	0.24	28.26	40.50	39.28	6.74	6.74	7.20	7.20	7.20
KC: COMBINED BASED ON RUSSIAN PREDICTION EQUATION - FOR COMPARISON	0.16	0.16	0.16	0.16	0.19	0.24	28.26	40.50	39.28	6.74	6.74	7.20	7.20	7.20

POWER LOSS

MAIN POWER	LATERAL POWER	OUT POWER	POWER LOSS RATIO
241231.1250	281728.1250	514561.1250	0.0216
24152.5000	452012.7125	687129.8750	0.0140
241154.1250	219813.4375	453483.4375	0.0114
238774.4375	142834.5000	376832.9375	0.0084
237584.6250	114354.8125	348979.1875	0.0067
236471.3750	564340.5273	290949.5000	0.0059
236158.1750	45019.3477	279506.7500	0.0059

3.4

POSITION ALONG PIPE (CM)	PIEZOMETER READING CM	FLOW RATE (CUBIC CENTIMETERS PER SECOND)
120.6	49.270	3964.350 MAIN
176.6	49.240	
242.6	49.240	
303.5	49.200	
364.5	49.200	
425.5	49.160	
486.4	49.210	
510.0	49.240	
547.4	49.210	
563.2	49.140	
578.5	49.180	
593.7	49.180	
606.4	49.180	
608.0	49.180	
624.0	49.180	
639.5	49.180	
750.7	49.180	
780.9	49.180	
811.3	49.180	
872.6	49.180	
972.6	49.180	
120.6	49.270	
176.6	49.240	
242.6	49.240	
303.5	49.200	
364.5	49.200	
425.5	49.160	
486.4	49.210	
510.0	49.240	
547.4	49.210	
563.2	49.140	
578.5	49.180	
593.7	49.180	
606.4	49.180	
608.0	49.180	
624.0	49.180	
639.5	49.180	
750.7	49.180	
780.9	49.180	
811.3	49.180	
872.6	49.180	
972.6	49.180	

FLOW RATE (CUBIC CENTIMETERS PER SECOND) 2209.7119
 LATERAL 3964.350 MAIN
 LATERAL 0.00000 OUTLET 0.00000
 MANHOLE PROP : MAIN 0.00000 LATERAL 5.00000

3.51

POSITION ALONG PIPE (CM)	PIEZOMETER	READING	CM
120.6	1	48.936	
176.6	2	48.760	
242.6	3	48.760	
303.5	4	48.760	
364.5	5	48.760	
425.5	6	48.650	
486.4	7	48.650	
547.4	8	48.650	
608.4	9	48.650	
669.4	10	48.650	
730.4	11	48.650	
791.4	12	48.650	
852.4	13	48.650	
913.4	14	48.650	
974.4	15	48.650	
1035.4	16	48.650	
1096.4	17	48.650	
1157.4	18	48.650	
1218.4	19	48.650	
1279.4	20	48.650	
1340.4	21	48.650	
1401.4	22	48.650	
1462.4	23	48.650	
1523.4	24	48.650	
1584.4	25	48.650	
1645.4	26	48.650	
1706.4	27	48.650	
1767.4	28	48.650	
1828.4	29	48.650	
1889.4	30	48.650	
1950.4	31	48.650	
2011.4	32	48.650	
2072.4	33	48.650	
2133.4	34	48.650	
2194.4	35	48.650	
2255.4	36	48.650	
2316.4	37	48.650	
2377.4	38	48.650	
2438.4	39	48.650	
2499.4	40	48.650	
2560.4	41	48.650	
2621.4	42	48.650	
2682.4	43	48.650	
2743.4	44	48.650	
2804.4	45	48.650	
2865.4	46	48.650	
2926.4	47	48.650	
2987.4	48	48.650	
3048.4	49	48.650	
3109.4	50	48.650	
3170.4	51	48.650	
3231.4	52	48.650	
3292.4	53	48.650	
3353.4	54	48.650	
3414.4	55	48.650	
3475.4	56	48.650	
3536.4	57	48.650	
3597.4	58	48.650	
3658.4	59	48.650	
3719.4	60	48.650	
3780.4	61	48.650	
3841.4	62	48.650	
3902.4	63	48.650	
3963.4	64	48.650	
4024.4	65	48.650	
4085.4	66	48.650	
4146.4	67	48.650	
4207.4	68	48.650	
4268.4	69	48.650	
4329.4	70	48.650	
4390.4	71	48.650	
4451.4	72	48.650	
4512.4	73	48.650	
4573.4	74	48.650	
4634.4	75	48.650	
4695.4	76	48.650	
4756.4	77	48.650	
4817.4	78	48.650	
4878.4	79	48.650	
4939.4	80	48.650	
5000.4	81	48.650	
5061.4	82	48.650	
5122.4	83	48.650	
5183.4	84	48.650	
5244.4	85	48.650	
5305.4	86	48.650	
5366.4	87	48.650	
5427.4	88	48.650	
5488.4	89	48.650	
5549.4	90	48.650	
5610.4	91	48.650	
5671.4	92	48.650	
5732.4	93	48.650	
5793.4	94	48.650	
5854.4	95	48.650	
5915.4	96	48.650	
5976.4	97	48.650	
6037.4	98	48.650	
6098.4	99	48.650	
6159.4	100	48.650	
6220.4	101	48.650	
6281.4	102	48.650	
6342.4	103	48.650	
6403.4	104	48.650	
6464.4	105	48.650	
6525.4	106	48.650	
6586.4	107	48.650	
6647.4	108	48.650	
6708.4	109	48.650	
6769.4	110	48.650	
6830.4	111	48.650	
6891.4	112	48.650	
6952.4	113	48.650	
7013.4	114	48.650	
7074.4	115	48.650	
7135.4	116	48.650	
7196.4	117	48.650	
7257.4	118	48.650	
7318.4	119	48.650	
7379.4	120	48.650	
7440.4	121	48.650	
7501.4	122	48.650	
7562.4	123	48.650	
7623.4	124	48.650	
7684.4	125	48.650	
7745.4	126	48.650	
7806.4	127	48.650	
7867.4	128	48.650	
7928.4	129	48.650	
7989.4	130	48.650	
8050.4	131	48.650	
8111.4	132	48.650	
8172.4	133	48.650	
8233.4	134	48.650	
8294.4	135	48.650	
8355.4	136	48.650	
8416.4	137	48.650	
8477.4	138	48.650	
8538.4	139	48.650	
8599.4	140	48.650	
8660.4	141	48.650	
8721.4	142	48.650	
8782.4	143	48.650	
8843.4	144	48.650	
8904.4	145	48.650	
8965.4	146	48.650	
9026.4	147	48.650	
9087.4	148	48.650	
9148.4	149	48.650	
9209.4	150	48.650	
9270.4	151	48.650	
9331.4	152	48.650	
9392.4	153	48.650	
9453.4	154	48.650	
9514.4	155	48.650	
9575.4	156	48.650	
9636.4	157	48.650	
9697.4	158	48.650	
9758.4	159	48.650	
9819.4	160	48.650	
9880.4	161	48.650	
9941.4	162	48.650	
10002.4	163	48.650	
10063.4	164	48.650	
10124.4	165	48.650	
10185.4	166	48.650	
10246.4	167	48.650	
10307.4	168	48.650	
10368.4	169	48.650	
10429.4	170	48.650	
10490.4	171	48.650	
10551.4	172	48.650	
10612.4	173	48.650	
10673.4	174	48.650	
10734.4	175	48.650	
10795.4	176	48.650	
10856.4	177	48.650	
10917.4	178	48.650	
10978.4	179	48.650	
11039.4	180	48.650	
11100.4	181	48.650	
11161.4	182	48.650	
11222.4	183	48.650	
11283.4	184	48.650	
11344.4	185	48.650	
11405.4	186	48.650	
11466.4	187	48.650	
11527.4	188	48.650	
11588.4	189	48.650	
11649.4	190	48.650	
11710.4	191	48.650	
11771.4	192	48.650	
11832.4	193	48.650	
11893.4	194	48.650	
11954.4	195	48.650	
12015.4	196	48.650	
12076.4	197	48.650	
12137.4	198	48.650	
12198.4	199	48.650	
12259.4	200	48.650	

3.52

POSITION	ALONG PIPE (CM)	PIEZOMETER	READING	CM
	120.5	1	47.880	
	176.5	2	47.840	
	242.5	3	47.810	
	303.5	4	47.800	
	364.5	5	47.780	
	425.5	6	47.760	
	486.5	7	47.740	
	510.5	8	3.720	
	547.5	9	47.740	
	563.5	10	47.720	
	578.5	11	47.720	
	593.5	12	47.720	
	606.5	13	3.790	
	608.5	14	47.720	
	624.5	15	47.720	
	639.5	16	47.680	
	750.5	17	46.240	
	780.5	18	46.070	
	811.5	19	45.860	
	872.5	20	45.500	
	972.5	21	44.970	
	204.5	22	49.960	
	255.5	23	49.760	
	255.5	24	49.320	
	435.5	25	49.090	
	496.5	26	48.800	
	557.5	27	48.120	
	587.5	28	48.650	
	588.5	29	49.580	
	618.5	30	49.540	
	633.5	31	2.130	
	644.5	32	48.460	
	649.5	33	48.370	
	664.5	34	47.980	
	679.5	35	46.240	
	750.5	36	46.070	
	790.5	37	45.860	
	811.5	38	45.500	
	872.5	39	44.970	
	972.5			

FLOW RATE (CUBIC CENTIMETERS PER SECOND) 2208.7119
 LATERAL 2633.4658 MAIN
 SLOPE 0.00340 MAIN 0.00050 OUTLET 0.000500
 LATERAL 0.00340 MAIN 0.00050 LATERAL 5.080
 MANHOLE ORCD: MAIN

3.53

POSITION ALONG PIPE(CM)	PIEZOMETER READING CM
120.6	47.350
176.5	47.240
242.6	47.210
303.5	47.130
364.5	47.060
425.5	47.040
486.4	47.070
510.4	47.450
547.4	47.010
553.2	47.000
578.5	47.000
593.7	47.000
606.4	3.525
608.9	47.000
624.2	47.000
639.5	47.000
750.3	45.650
780.8	45.600
811.3	45.350
872.3	44.970
972.6	44.450
104.5	48.760
165.5	48.670
235.7	48.280
256.6	48.170
267.4	47.730
357.7	1.690
388.1	47.430
618.5	47.590
637.8	47.590
644.4	1.760
649.4	47.550
664.7	47.420
679.5	47.200
750.3	45.650
780.8	45.600
811.3	45.520
872.3	44.970
972.6	44.450

FLOW RATE(CUBIC CENTIMETERS PER SECOND) 2219.7119
 LATERAL 2210.4949MAIN
 SLOPE 0.003400MAIN 0.000500LIFT 0.000500
 LATERAL 5.080
 MANHOLE DROP : MAIN LATERAL

3.54

POSITION ALONG PIPE(CM)	PIEZOMETER	READING	CM
126.6	1	47.700	
176.5	2	47.580	
242.6	3	47.640	
307.5	4	46.600	
364.5	5	46.500	
425.5	6	46.500	
486.4	7	46.490	
510.0	8	46.490	
547.4	9	46.490	
563.2	10	46.490	
578.5	11	46.490	
593.7	12	46.490	
606.4	13	46.490	
608.9	14	46.490	
624.2	15	46.490	
639.5	16	46.490	
750.8	17	45.100	
780.8	18	44.980	
811.3	19	44.840	
872.3	20	44.480	
972.6	21	44.090	
1041.5	22	47.520	
1204.5	23	48.070	
1351.5	24	47.460	
1435.7	25	47.460	
1496.6	26	47.100	
1557.6	27	1.475	
1583.7	28	46.850	
1618.5	29	46.850	
1632.3	30	46.940	
1644.4	31	1.520	
1649.0	32	46.780	
1664.2	33	46.700	
1679.5	34	46.700	
1750.3	35	45.100	
1780.8	36	44.980	
1811.3	37	44.840	
1872.3	38	44.480	
1972.6	39	44.090	

FLOW RATE(CUBIC CENTIMETERS PER SECOND) 2208.7119
 LATERAL 1302.5745MAIN
 CLUSE 00003400MAIN 00005000OUTLET 00000500
 LATERAL 00000000MAIN 00000000LATERAL 5.080
 MANHOLE DRCD :MAIN

3.55

POSITION ALONG PIPE(CM)	PIEZOMETER READING CM
120.6	46.200
176.5	46.080
242.6	46.080
303.5	46.000
364.5	45.970
425.5	45.950
486.4	45.910
547.4	45.850
608.4	45.830
669.4	45.830
730.4	45.830
791.4	45.830
852.4	45.830
913.4	45.830
974.4	45.830
1035.4	45.830
1096.4	45.830
1157.4	45.830
1218.4	45.830
1279.4	45.830
1340.4	45.830
1401.4	45.830
1462.4	45.830
1523.4	45.830
1584.4	45.830
1645.4	45.830
1706.4	45.830
1767.4	45.830
1828.4	45.830
1889.4	45.830
1950.4	45.830
2011.4	45.830
2072.4	45.830
2133.4	45.830
2194.4	45.830
2255.4	45.830
2316.4	45.830
2377.4	45.830
2438.4	45.830
2499.4	45.830
2560.4	45.830
2621.4	45.830
2682.4	45.830
2743.4	45.830
2804.4	45.830
2865.4	45.830
2926.4	45.830
2987.4	45.830
3048.4	45.830
3109.4	45.830
3170.4	45.830
3231.4	45.830
3292.4	45.830
3353.4	45.830
3414.4	45.830
3475.4	45.830
3536.4	45.830
3597.4	45.830
3658.4	45.830
3719.4	45.830
3780.4	45.830
3841.4	45.830
3902.4	45.830
3963.4	45.830
4024.4	45.830
4085.4	45.830
4146.4	45.830
4207.4	45.830
4268.4	45.830
4329.4	45.830
4390.4	45.830
4451.4	45.830
4512.4	45.830
4573.4	45.830
4634.4	45.830
4695.4	45.830
4756.4	45.830
4817.4	45.830
4878.4	45.830
4939.4	45.830
5000.4	45.830
5061.4	45.830
5122.4	45.830
5183.4	45.830
5244.4	45.830
5305.4	45.830
5366.4	45.830
5427.4	45.830
5488.4	45.830
5549.4	45.830
5610.4	45.830
5671.4	45.830
5732.4	45.830
5793.4	45.830
5854.4	45.830
5915.4	45.830
5976.4	45.830
6037.4	45.830
6098.4	45.830
6159.4	45.830
6220.4	45.830
6281.4	45.830
6342.4	45.830
6403.4	45.830
6464.4	45.830
6525.4	45.830
6586.4	45.830
6647.4	45.830
6708.4	45.830
6769.4	45.830
6830.4	45.830
6891.4	45.830
6952.4	45.830
7013.4	45.830
7074.4	45.830
7135.4	45.830
7196.4	45.830
7257.4	45.830
7318.4	45.830
7379.4	45.830
7440.4	45.830
7501.4	45.830
7562.4	45.830
7623.4	45.830
7684.4	45.830
7745.4	45.830
7806.4	45.830
7867.4	45.830
7928.4	45.830
7989.4	45.830
8050.4	45.830
8111.4	45.830
8172.4	45.830
8233.4	45.830
8294.4	45.830
8355.4	45.830
8416.4	45.830
8477.4	45.830
8538.4	45.830
8599.4	45.830
8660.4	45.830
8721.4	45.830
8782.4	45.830
8843.4	45.830
8904.4	45.830
8965.4	45.830
9026.4	45.830
9087.4	45.830
9148.4	45.830
9209.4	45.830
9270.4	45.830
9331.4	45.830
9392.4	45.830
9453.4	45.830
9514.4	45.830
9575.4	45.830
9636.4	45.830
9697.4	45.830
9758.4	45.830
9819.4	45.830
9880.4	45.830
9941.4	45.830
10002.4	45.830
10063.4	45.830
10124.4	45.830
10185.4	45.830
10246.4	45.830
10307.4	45.830
10368.4	45.830
10429.4	45.830
10490.4	45.830
10551.4	45.830
10612.4	45.830
10673.4	45.830
10734.4	45.830
10795.4	45.830
10856.4	45.830
10917.4	45.830
10978.4	45.830
11039.4	45.830
11100.4	45.830
11161.4	45.830
11222.4	45.830
11283.4	45.830
11344.4	45.830
11405.4	45.830
11466.4	45.830
11527.4	45.830
11588.4	45.830
11649.4	45.830
11710.4	45.830
11771.4	45.830
11832.4	45.830
11893.4	45.830
11954.4	45.830
12015.4	45.830
12076.4	45.830
12137.4	45.830
12198.4	45.830
12259.4	45.830
12320.4	45.830
12381.4	45.830
12442.4	45.830
12503.4	45.830
12564.4	45.830
12625.4	45.830
12686.4	45.830
12747.4	45.830
12808.4	45.830
12869.4	45.830
12930.4	45.830
12991.4	45.830
13052.4	45.830
13113.4	45.830
13174.4	45.830
13235.4	45.830
13296.4	45.830
13357.4	45.830
13418.4	45.830
13479.4	45.830
13540.4	45.830
13601.4	45.830
13662.4	45.830
13723.4	45.830
13784.4	45.830
13845.4	45.830
13906.4	45.830
13967.4	45.830
14028.4	45.830
14089.4	45.830
14150.4	45.830
14211.4	45.830
14272.4	45.830
14333.4	45.830
14394.4	45.830
14455.4	45.830
14516.4	45.830
14577.4	45.830
14638.4	45.830
14699.4	45.830
14760.4	45.830
14821.4	45.830
14882.4	45.830
14943.4	45.830
15004.4	45.830
15065.4	45.830
15126.4	45.830
15187.4	45.830
15248.4	45.830
15309.4	45.830
15370.4	45.830
15431.4	45.830
15492.4	45.830
15553.4	45.830
15614.4	45.830
15675.4	45.830
15736.4	45.830
15797.4	45.830
15858.4	45.830
15919.4	45.830
15980.4	45.830
16041.4	45.830
16102.4	45.830
16163.4	45.830
16224.4	45.830
16285.4	45.830
16346.4	45.830
16407.4	45.830
16468.4	45.830
16529.4	45.830
16590.4	45.830
16651.4	45.830
16712.4	45.830
16773.4	45.830
16834.4	45.830
16895.4	45.830
16956.4	45.830
17017.4	45.830
17078.4	45.830
17139.4	45.830
17200.4	45.830
17261.4	45.830
17322.4	45.830
17383.4	45.830
17444.4	45.830
17505.4	45.830
17566.4	45.830
17627.4	45.830
17688.4	45.830
17749.4	45.830
17810.4	45.830
17871.4	45.830
17932.4	45.830
17993.4	45.830
18054.4	45.830
18115.4	45.830
18176.4	45.830
18237.4	45.830
18298.4	45.830
18359.4	45.830
18420.4	45.830
18481.4	45.830
18542.4	45.830
18603.4	45.830
18664.4	45.830
18725.4	45.830
18786.4	45.830
18847.4	45.830
18908.4	45.830
18969.4	45.830
19030.4	45.830
19091.4	45.830
19152.4	45.830
19213.4	45.830
19274.4	45.830
19335.4	45.830
19396.4	45.830
19457.4	45.830
19518.4	45.830
19579.4	45.830
19640.4	45.830
19701.4	45.830
19762.4	45.830
19823.4	45.830
19884.4	45.830
19945.4	45.830
20006.4	45.830
20067.4	45.830
20128.4	45.830
20189.4	45.830
20250.4	45.830
20311.4	45.830
20372.4	45.830
20433.4	45.830
20494.4	45.830
20555.4	45.830
20616.4	45.830
20677.4	45.830
20738.4	45.830
20799.4	45.830
20860.4	45.830
20921.4	45.830
20982.4	45.830
21043.4	45.830
21104.4	45.830
21165.4	45.830
21226.4	45.830
21287.4	45.830
21348.4	45.830
21409.4	45.830
21470.4	45.830
21531.4	45.830
21592.4	45.830
21653.4	45.830
21714.4	45.830
21775.4	45.830
21836.4	45.830
21897.4	45.830
21958.4	45.830
22019.4	45.830
22080.4	45.830
22141.4	45.830
22202.4	45.830
22263.4	45.830
22324.4	45.830
22385.4	45.830
22446.4	45.830
22507.4	45.830
22568.4	45.830
22629.4	45.830
22690.4	45.830
22751.4	45.830
22812.4	45.830
22873.4	45.830
22934.4	45.830
22995.4	45.830
23056.4	45.830
23117.4	45.830
23178.4	45.830
23239.4	45.830
23300.4	45.830
23361.4	45.830
23422.4	45.830
23483.4	45.830
23544.4	45.830
23605.4	45.830
23666.4	45.830
23727.4	45.830
23788.4	45.830
23849.4	45.830
23910.4	45.830
23971.4	45.830
24032.4	45.830
24093.4	45.830
24154.4	45.830
24215.4	45.830
24276.4	45.830
24337.4	45.830
24398.4	45.830
24459.4	45.830
24520.4	45.830
24581.4	45.830
24642.4	45.830
24703.4	45.830
24764.4	45.830
24825.4	45.830
24886.4	45.830
24947.4	45.830
25008.4	45.830
25069.4	45.830
25130.4	45.830
25191.4	45.830
25252.4	45.830
25313.4	45.830
25374.4	45.830
25435.4	45.830
25496.4	45.830
25557.4	45.830
25618.4	45.830
25679.4	45.830
25740.4	45.830
25801.4	45.830
25862.4	45.830
25923.4	45.830
25984.4	45.830
26045.4	45.830
26106.4	45.830
26167.4	45.830
26228.4	45.830
26289.4	45.830
26350.4	45.830
26411.4	45.830
26472.4	45.830
26533.4	45.830
26594.4	45.830
26655.4	45.830
26716.4	45.830
26777.4	45.830
26838.4	45.830
26899.4	45.830
26960.4	45.830
27021.4	45.830
27082.4	45.830
27143.4	45.830
27204.4	45.830
27265.4	45.830
27326.4	

POSITION ALONG PIPE(CM)	PIEZOMETER	READING	CM
120.6	1	45.900	
176.5	2	45.750	
242.6	3	45.720	
303.5	4	45.660	
364.5	5	45.580	
425.5	6	45.450	
486.4	7	45.450	
510.0	8	45.400	
547.4	9	45.400	
563.2	10	45.400	
578.5	11	45.400	
597.7	12	45.400	
606.4	13	45.400	
608.9	14	45.400	
624.2	15	45.400	
639.5	16	45.400	
750.7	17	44.290	
780.8	18	44.220	
811.3	19	44.010	
872.3	20	43.770	
904.5	21	43.490	
972.6	22	46.000	
304.5	23	45.250	
365.5	24	45.890	
435.7	25	45.750	
406.6	26	45.450	
557.4	27	45.810	
583.7	28	45.450	
598.1	29	45.450	
618.5	30	45.450	
637.8	31	45.980	
644.4	32	45.350	
649.0	33	45.400	
664.3	34	45.400	
679.5	35	44.290	
750.3	36	44.220	
780.8	37	44.010	
811.3	38	43.770	
872.3	39	43.490	
972.6	40		

FLOW RATE(CUBIC CENTIMETERS PER SECOND) 2208.7119
 LATERAL 422.0989MAIN
 SLUDGE 0.000500OUTLET 0.000500
 LATERAL 0.000500MAIN 0.000500
 MANHOLE DROP :MAIN 6.5 LATERAL 5.780

3.57

POSITION ALONG PIPE (CM)	PIEZOMETER READING CM
120.6	45.680
176.5	45.680
242.6	45.550
303.5	45.490
364.5	45.440
425.5	45.360
486.4	45.270
510.0	45.150
547.4	45.130
563.2	45.170
578.5	45.170
593.7	45.180
606.4	45.120
608.0	45.100
624.2	44.140
639.3	44.050
750.3	43.920
780.8	43.640
811.3	43.630
872.5	43.630
972.6	43.630
364.5	43.630
365.5	43.630
435.7	43.630
496.6	43.630
557.6	43.630
583.7	43.630
618.5	43.630
672.8	43.630
644.4	43.630
649.0	43.630
664.7	43.630
679.3	43.630
750.3	43.630
780.8	43.630
811.3	43.630
872.6	43.630
972.6	43.630

FLOW RATE (CURRIC CENTIMETERS PER SECOND) 2209.7119
 LATERAL 226.5346 MAIN
 SLUDGE 0.003400 MAIN 0.000500 OUTLET 0.000500
 LATERAL 0.000500 MAIN 0.000500 LATERAL 5.180
 MANHOLE DROP: MAIN 0.000500 LATERAL 5.180

3.58

NO	ENERGY LOSS	K2	K3	K2L	K3M	LELJ	MELJ	TELL	TELM	K2RUS	K2LRUS	K3RUS	K3MRUS	KC	CELJ
1	2.57	0.41	1.05	4.55	3.64	0.56	8.72	0.56	1.57	0.73	-0.46	-3.59	1.85	2.54	
2	2.57	0.41	1.05	3.72	3.41	0.53	8.49	0.53	1.43	0.74	-0.34	-2.20	1.71	2.27	
3	2.46	0.41	1.44	2.89	3.02	0.51	8.10	0.51	1.18	0.76	-0.16	-0.78	1.52	1.65	
4	2.44	0.52	1.03	2.87	2.82	0.59	7.90	0.59	0.91	0.67	-0.01	-0.03	1.46	1.28	
5	2.24	0.78	1.33	3.10	2.18	0.76	7.26	0.76	0.49	0.08	0.23	0.40	1.32	1.02	
6	2.11	0.82	1.16	2.21	1.87	0.75	6.95	0.75	0.38	0.09	0.15	0.29	1.01	0.78	
7	1.31	0.97	1.22	1.95	1.44	0.75	5.50	0.75	-0.63	-1.38	0.15	0.16	1.00	0.72	
8	0.59	1.04	1.26	1.07	0.42	0.75	5.50	0.75	-1.38	-3.84	0.15	0.16	1.00	0.72	
MAIN FLOW							VELINL								
2208.712		3964.357		0.64	1.79		15.55		74.99	51.94	10.81	9.37	11.37		
2208.712		3398.019		0.61	1.54		16.76		72.23	51.00	10.12	8.44	10.65		
2208.712		2633.466		0.54	1.19		20.09		70.94	49.08	9.26	7.20	9.77		
2208.712		2010.495		0.48	0.91		21.89		68.80	47.12	8.54	6.28	9.13		
2208.712		1302.574		0.37	0.59		24.67		53.38	43.65	7.86	4.99	8.62		
2208.712		764.554		0.26	0.35		26.71		50.01	41.63	7.12	3.90	7.84		
2208.712		402.199		0.15	0.18		27.47		36.11	39.03	6.62	2.57	7.47		
2208.712		226.535		0.09	0.11				21.89	37.66	6.62	1.97	7.38		

K2: LATERAL LOSS COEF W.R.T. OUTLET VELOCITY
 K3: MAIN LOSS COEFFICIENT W.R.T. OUTLET VELOCITY
 K2L: W.P.T. LATERAL INLET VELOCITY
 K3M: W.P.T. MAIN INLET VELOCITY
 LELJ: LATERAL ENERGY LOSS DUE TO JUNCTION
 MELJ: MAIN ENERGY LOSS DUE TO JUNCTION
 TELM: TOTAL ENERGY LOSS THROUGH JUNCTION
 TEL: TOTAL ENERGY LOSS TO TOTAL FLOW
 PATTIO: OF LATERAL FLOW INLET AND OUTLET VELOCITIES
 PATTIO2: LATERAL FLOW TO MAIN FLOW
 PATTIO3: LATERAL JUNCTION LOSS COEFFICIENT
 KCRUS: COMBINED JUNCTION LOSS PREDICTION EQUATION -FOR COMPARISON
 KERUS: BASED ON RUSSIAN PREDICTION EQUATION

POWER LOSS

MAIN POWER	LATERAL POWER	OUT POWER	POWER LOSS RATIO
245136.9775	422199.7125	681669.5625	0.0225
243554.8125	384454.5625	615267.0000	0.0203
241608.7500	294671.8750	527215.4375	0.0169
240188.1875	223119.6250	456332.0625	0.0151
239067.5000	142835.7500	377401.3125	0.0118
237342.9375	83033.2500	317358.3125	0.0094
236527.4375	43135.1367	277630.4375	0.0073
236323.6250	24164.3100	258735.6625	0.0067

POSITION	ALONG PIPE (CM)	PIEZOMETER	READING	CM
	120.6	1	49.230	
	176.5	2	49.230	
	242.6	3	49.230	
	303.5	4	49.230	
	364.5	5	49.230	
	425.4	6	49.170	
	486.4	7	49.170	
	510.0	8	49.170	
	547.4	9	49.170	
	563.2	10	49.170	
	578.5	11	49.170	
	593.7	12	49.170	
	606.4	13	49.170	
	608.9	14	49.170	
	624.2	15	49.130	
	639.5	16	47.850	
	750.3	17	47.850	
	780.8	18	47.850	
	811.3	19	47.850	
	872.3	20	46.900	
	972.6	21	46.900	
	811.3	22	53.800	
	972.6	23	53.800	
	304.5	24	53.070	
	365.5	25	53.070	
	435.7	26	52.770	
	496.6	27	52.770	
	557.6	28	52.450	
	583.7	29	52.310	
	618.7	30	52.210	
	637.4	31	51.915	
	644.4	32	51.970	
	649.7	33	51.620	
	679.5	34	47.550	
	750.3	35	47.800	
	780.8	36	47.800	
	811.3	37	47.500	
	872.3	38	46.900	
	972.6	39	46.900	

FLOW RATE (CURRIC CENTIMETERS PER SECOND) 2208.71197
 LATERAL 5278.6133 MAIN
 SLOPE 3.00340 MAIN 0.000500 OUTLET 0.000500
 MANHOLE DROP : MAIN 0.0 LATERAL 5.080

3.61

POSITION ALONG PIPE (CM)	PIEZOMETER	READING	CM
120.6	1	47.830	
176.5	2	47.800	
242.6	3	47.780	
303.5	4	47.750	
364.5	5	47.740	
425.5	6	47.700	
486.4	7	47.690	
510.4	8	3.730	
547.4	9	47.690	
563.2	10	47.690	
578.5	11	47.690	
593.7	12	47.690	
606.4	13	3.820	
608.9	14	47.670	
624.2	15	47.670	
639.5	16	47.670	
750.3	17	46.530	
780.8	18	46.510	
811.3	19	46.470	
872.3	20	46.120	
972.6	21	45.590	
304.5	22	51.360	
365.7	23	51.150	
435.7	24	50.830	
496.6	25	50.630	
557.6	26	50.590	
583.7	27	2.995	
618.5	28	50.410	
633.8	29	50.310	
644.4	30	50.350	
649.0	31	2.995	
664.7	32	50.230	
679.5	33	50.150	
750.3	34	50.050	
780.8	35	46.530	
811.3	36	46.510	
872.3	37	46.470	
972.6	38	46.120	
	39	45.590	

FLOW RATE (CUBIC CENTIMETERS PER SECOND) 2298.7119
 LATERAL 3392.0190 MAIN
 SLOPE 0.003400 MAIN 0.006500 OUTLET 0.000500
 LATERAL 0.003400 MAIN 0.006500 OUTLET 0.000500
 MANHOLE DROP : MAIN 0.0 LATERAL 5.080

3.62

POSITION ALONG PIPE(CM)	PIEZOMETER	READING	CM
120.6	1	47.260	
176.5	2	47.130	
242.6	3	47.130	
303.5	4	47.020	
364.5	5	47.000	
425.5	6	46.980	
486.4	7	47.000	
516.0	8	47.000	
547.4	9	46.930	
563.2	10	46.930	
578.5	11	46.930	
597.7	12	46.900	
606.4	13	46.900	
624.2	14	47.000	
639.5	15	47.000	
756.0	16	46.930	
780.8	17	45.830	
811.3	18	45.700	
872.0	19	45.430	
872.0	20	44.880	
304.5	21	49.060	
365.5	22	49.940	
435.7	23	49.670	
496.6	24	49.150	
557.6	25	49.500	
583.7	26	2.575	
588.1	27	49.370	
618.5	28	49.310	
633.8	29	49.310	
644.4	30	2.545	
649.0	31	49.310	
664.3	32	49.250	
679.5	33	49.300	
750.3	34	45.980	
780.8	35	45.830	
811.3	36	45.700	
872.0	37	45.430	
972.6	38	44.880	

FLOW RATE(CUBIC CENTIMETERS PER SECOND) 220.7119

LATERAL 2637.4658MAIN
LATERAL 0.0050OUTLET 0.006507
LATERAL 5.007
MANHOLE DROP :MAIN 1.60 LATERAL

3.63

POSITION ALONG PIPE (CM)	PIEZOMETER	READING	CM
120.6	1	46.830	
176.5	2	46.760	
242.6	3	46.730	
303.5	4	46.620	
364.5	5	46.550	
425.5	6	46.490	
486.4	7	46.440	
510.0	8	46.480	
547.4	9	46.400	
563.2	10	46.400	
578.5	11	46.400	
593.7	12	46.400	
606.4	13	46.500	
608.9	14	46.400	
624.3	15	46.400	
639.5	16	45.500	
750.3	17	45.370	
780.8	18	45.270	
811.3	19	44.980	
872.3	20	44.550	
972.6	21	44.550	
304.5	22	49.270	
365.7	23	49.210	
435.7	24	48.950	
496.6	25	48.830	
557.6	26	48.800	
583.7	27	48.700	
598.1	28	48.700	
618.5	29	48.700	
633.8	30	48.700	
644.4	31	48.700	
649.0	32	48.600	
664.3	33	48.680	
679.5	34	45.500	
750.3	35	45.370	
780.8	36	45.270	
811.3	37	44.980	
872.3	38	44.550	
972.6	39	44.550	

FLOW RATE (CUBIC CENTIMETERS PER SECOND) 2209.7119

LATERAL 0.303400 MAIN 0.000500 OUTLET 0.000500
 MANHOLE DROP : MAIN 0.50 LATERAL 5.080

3.64

POSITION ALONG PIPE(CM)	PIEZOMETER	READING	CM
120.5	2	46.330	
176.5	3	46.260	
242.6	4	46.240	
307.5	5	46.170	
364.5	6	46.140	
425.5	7	46.060	
486.4	8	46.070	
510.0	9	3.160	
547.4	10	46.070	
563.2	11	46.050	
578.5	12	46.030	
593.7	13	3.200	
606.4	14	46.030	
608.9	15	46.030	
624.2	16	46.000	
659.5	17	45.160	
750.3	18	45.020	
780.5	19	44.880	
811.3	20	44.590	
872.3	21	44.130	
972.6	22	48.630	
304.5	23	48.530	
365.5	24	48.340	
435.7	25	48.260	
496.6	26	48.220	
557.6	27	2.060	
583.7	28	48.250	
588.1	29	48.160	
619.5	30	48.140	
637.4	31	2.110	
644.4	32	48.140	
649.0	33	48.070	
664.7	34	45.160	
679.5	35	45.020	
750.3	36	44.880	
780.5	37	44.590	
811.3	38	44.130	
872.3	39		

FLOW RATE(CUBIC CENTIMETERS PER SECOND) 2208.7119
 LATERAL 1585.7429MAIN
 SUCRE 0.00500OUTLET 0.000500
 LATERAL 0.00340MAIN 0.000500 LATEPAL 5.087
 MANHOLE DROP :MAIN

3.65

POSITION	ALONG PIPE(CM)	PIEZOMETER	READING	CM
	120.5	1	45.890	
	176.5	2	45.690	
	242.5	3	45.690	
	303.5	4	45.570	
	364.5	5	45.450	
	425.5	6	45.380	
	486.5	7	45.360	
	510.0	8	45.340	
	547.4	9	45.290	
	563.2	10	45.290	
	578.5	11	45.290	
	593.7	12	45.290	
	608.9	13	45.290	
	624.2	14	45.330	
	639.5	15	45.330	
	654.8	16	45.330	
	670.1	17	45.330	
	685.4	18	45.330	
	700.7	19	45.330	
	716.0	20	45.330	
	731.3	21	45.330	
	746.6	22	45.330	
	761.9	23	45.330	
	777.2	24	45.330	
	792.5	25	45.330	
	807.8	26	45.330	
	823.1	27	45.330	
	838.4	28	45.330	
	853.7	29	45.330	
	869.0	30	45.330	
	884.3	31	45.330	
	899.6	32	45.330	
	914.9	33	45.330	
	930.2	34	45.330	
	945.5	35	45.330	
	960.8	36	45.330	
	976.1	37	45.330	
	991.4	38	45.330	
	1006.7	39	45.330	
	1022.0	40	45.330	
	1037.3	41	45.330	
	1052.6	42	45.330	
	1067.9	43	45.330	
	1083.2	44	45.330	
	1098.5	45	45.330	
	1113.8	46	45.330	
	1129.1	47	45.330	
	1144.4	48	45.330	
	1159.7	49	45.330	
	1175.0	50	45.330	
	1190.3	51	45.330	
	1205.6	52	45.330	
	1220.9	53	45.330	
	1236.2	54	45.330	
	1251.5	55	45.330	
	1266.8	56	45.330	
	1282.1	57	45.330	
	1297.4	58	45.330	
	1312.7	59	45.330	
	1328.0	60	45.330	
	1343.3	61	45.330	
	1358.6	62	45.330	
	1373.9	63	45.330	
	1389.2	64	45.330	
	1404.5	65	45.330	
	1419.8	66	45.330	
	1435.1	67	45.330	
	1450.4	68	45.330	
	1465.7	69	45.330	
	1481.0	70	45.330	
	1496.3	71	45.330	
	1511.6	72	45.330	
	1526.9	73	45.330	
	1542.2	74	45.330	
	1557.5	75	45.330	
	1572.8	76	45.330	
	1588.1	77	45.330	
	1603.4	78	45.330	
	1618.7	79	45.330	
	1634.0	80	45.330	
	1649.3	81	45.330	
	1664.6	82	45.330	
	1679.9	83	45.330	
	1695.2	84	45.330	
	1710.5	85	45.330	
	1725.8	86	45.330	
	1741.1	87	45.330	
	1756.4	88	45.330	
	1771.7	89	45.330	
	1787.0	90	45.330	
	1802.3	91	45.330	
	1817.6	92	45.330	
	1832.9	93	45.330	
	1848.2	94	45.330	
	1863.5	95	45.330	
	1878.8	96	45.330	
	1894.1	97	45.330	
	1909.4	98	45.330	
	1924.7	99	45.330	
	1940.0	100	45.330	

3.66

POSITION ALONG PIPE (CM)	PIEZOMETER	READING	CM
128.0	1	45.400	
176.5	2	45.920	
242.6	3	45.200	
303.5	4	45.140	
364.5	5	45.140	
425.5	6	45.010	
486.4	7	44.970	
510.0	8	2.630	
547.4	9	44.890	
563.2	10	44.890	
578.5	11	44.880	
593.7	12	2.660	
606.4	13	44.880	
608.0	14	44.850	
624.2	15	44.770	
639.5	16	44.100	
750.3	17	44.000	
780.8	18	43.890	
811.3	19	43.650	
872.6	20	43.750	
972.6	21	43.750	
304.5	22	46.300	
365.5	23	46.230	
435.7	24	46.190	
496.6	25	46.140	
557.6	26	1.110	
587.7	27	46.080	
618.8	28	46.080	
637.9	29	46.080	
644.4	30	1.160	
649.0	31	45.970	
664.3	32	46.000	
679.5	33	46.100	
750.3	34	44.100	
780.8	35	44.100	
811.3	36	43.890	
872.6	37	43.650	
972.6	38	43.750	

3.67

FLOW RATE (CUBIC CENTIMETERS PER SECOND) 2208.7119
LATERAL 481.536CM MAIN
SLURRY 310.340CM MAIN 1.000500 OUTLET 1.000500
WANDS 0800 : MAIN LATERAL 51080

POSITION ALONG PIPE (CM)	PIEZOMETER READING CM
120.0	45.135
176.5	45.020
242.6	44.870
303.5	44.870
364.5	44.800
425.5	44.640
486.4	44.640
510.0	44.550
547.4	44.550
563.2	44.600
578.5	44.600
593.7	44.560
606.4	44.530
608.9	44.450
624.2	44.450
639.5	43.900
750.3	43.920
780.8	43.750
811.3	43.470
872.3	43.120
972.6	45.440
304.5	45.690
365.5	45.500
435.7	45.500
496.6	45.450
557.6	45.820
583.7	45.390
588.1	45.390
618.8	45.300
677.8	45.300
644.4	45.300
649.0	45.300
664.2	45.390
679.5	45.900
750.3	43.820
780.8	43.750
811.3	43.470
872.3	43.120
972.6	2208.7112

FLW DATE (CURIC CENTIMETERS PER SECOND) 2208.7112

LATERAL

SLICE 0.00340 MAIN 0.00050 OUTLET 0.00050

LATERAL 0.00050 LATERAL 5.080

MANHOLE DROP : MAIN

3.68

[illegible]

SSN 7 2345678

3.6

POSITION	ALONG PIPE (CM)	PIEZOMETER	READING	CM
	120.6	1	47.530	
	176.5	2	47.500	
	242.6	3	47.470	
	303.5	4	47.430	
	364.5	5	47.400	
	425.5	6	47.370	
	486.4	7	47.370	
	510.0	8	3.680	
	547.4	9	47.370	
	563.2	10	47.330	
	578.5	11	47.330	
	593.7	12	3.750	
	606.4	13	47.330	
	608.9	14	47.330	
	624.2	15	47.370	
	639.5	16	47.350	
	750.3	17	44.880	
	780.8	18	45.790	
	811.3	19	45.610	
	872.3	20	45.350	
	972.6	21	44.750	
	304.5	22	51.470	
	365.5	23	51.470	
	435.7	24	51.470	
	496.6	25	50.980	
	557.6	26	50.480	
	583.7	27	3.060	
	588.1	28	50.210	
	618.5	29	50.210	
	633.8	30	50.290	
	644.4	31	3.190	
	649.0	32	50.290	
	664.3	33	50.160	
	675.5	34	50.140	
	750.3	35	44.880	
	780.8	36	45.790	
	811.3	37	45.610	
	872.3	38	45.350	
	972.6	39	44.750	

FLOW RATE (CUBIC CENTIMETERS PER SECOND) 2208.7119
 LATERAL 4530.6514 MAIN
 SLOPE 0.003400 MAIN 0.000500 OUTLET 0.000500
 LATERAL 1.480 LATERAL 6.000
 MANHOLE DROP : MAIN

A1.1

POSITION ALONG PIPE (CM)	PIEZOMETER	READING CM
120.6	1	51.220
176.5	2	51.130
242.6	3	51.070
303.5	4	50.960
364.5	5	50.880
425.5	6	50.830
486.4	7	50.760
510.0	8	50.730
547.4	9	50.700
563.2	10	50.700
578.5	11	50.700
593.7	12	50.700
606.4	13	50.660
608.9	14	50.660
624.2	15	50.660
639.5	16	48.370
750.3	17	48.310
780.8	18	47.970
811.3	19	47.700
872.3	20	46.860
972.6	21	51.810
304.5	22	51.810
365.5	23	51.810
435.7	24	51.420
496.6	25	51.190
557.6	26	51.150
583.7	27	51.150
588.1	28	51.050
618.5	29	51.100
633.8	30	51.100
644.4	31	51.100
649.0	32	50.930
664.3	33	50.970
679.5	34	48.370
750.3	35	48.310
780.8	36	47.970
811.3	37	47.700
872.3	38	46.860
972.6	39	46.860

FLOW RATE (CUBIC CENTIMETERS PER SECOND) 5578.4141
 LATERAL 4530.6914 MAIN
 SLOPE 0.003400 MAIN 0.000500 OUTLET 0.000500
 LATERAL 1.480 LATERAL 6.000
 MANHOLE DROP : MAIN

41.2

POSITION ALONG PIPE (CM)	PIEZOMETER READING CM
120.6	46.790
176.5	46.710
242.6	46.660
303.5	46.600
364.5	46.520
425.5	46.440
486.4	46.480
510.0	3.315
547.4	46.420
563.2	46.490
578.5	46.360
593.7	46.410
606.4	3.230
608.9	46.410
624.2	46.500
639.5	46.380
750.3	45.080
780.8	45.150
811.3	44.960
872.3	44.580
972.6	44.180
435.7	49.230
365.5	50.130
304.5	50.610
972.6	44.180
811.3	44.580
496.6	49.230
557.6	2.380
583.7	48.730
618.5	48.620
633.8	48.970
644.4	2.630
649.0	49.240
664.3	49.030
679.5	49.340
750.3	45.080
780.8	45.150
811.3	44.960
872.3	44.580
972.6	44.180

FLOW RATE (CUBIC CENTIMETERS PER SECOND) 2208.7119
 LATERAL 3398.0190 MAIN
 SLOPE 0.003400 MAIN 0.000500 OUTLET 0.000500
 LATERAL 1.480 LATERAL 6.000
 MANHOLE DROP : MAIN

A1.3

POSITION ALONG PIPE (CM)	PIEZOMETER	READING	CM
120.6	1	46.000	
176.5	2	45.910	
242.6	3	45.880	
303.5	4	45.800	
364.5	5	45.790	
425.5	6	45.770	
486.4	7	45.750	
510.0	8	2.920	
547.4	9	45.680	
563.2	10	45.700	
578.5	11	45.640	
593.7	12	2.995	
606.4	13	45.700	
608.9	14	45.700	
624.2	15	45.640	
639.5	16	45.680	
750.3	17	44.140	
780.8	18	44.300	
811.3	19	44.120	
872.3	20	43.750	
972.6	21	43.420	
304.5	22	48.590	
365.5	23	49.380	
435.7	24	48.980	
496.6	25	48.630	
557.6	26	48.060	
583.7	27	1.960	
582.1	28	47.650	
618.5	29	47.770	
633.8	30	48.200	
644.4	31	2.290	
649.0	32	48.200	
664.3	33	48.270	
675.5	34	48.350	
750.3	35	44.410	
780.8	36	44.300	
811.3	37	44.120	
872.3	38	43.750	
972.6	39	43.420	

FLOW RATE (CUBIC CENTIMETERS PER SECOND) 2208.7119

LATERAL 2690.0989 MAIN
 SLOPE 0.003400 MAIN \ 0.005000 OUTLET 0.000500
 MANHOLE DROP : MAIN 1.480 LATERAL 6.000

A1.4

POSITION ALONG PIPE (CM)	PIEZOMETER READING CM
120.6	45.260
176.5	45.210
242.6	45.150
303.5	45.080
364.5	45.040
425.5	44.970
486.4	44.930
510.0	2.600
5547.4	44.920
563.2	44.880
578.7	44.880
593.7	2.690
606.4	44.880
624.2	44.800
639.5	43.600
750.3	43.680
780.8	43.460
811.3	43.150
872.3	43.820
972.6	47.670
304.5	48.200
365.5	47.900
435.7	47.750
496.6	47.240
557.6	1.590
583.7	46.900
588.1	46.700
618.5	47.350
633.2	1.890
644.4	47.400
649.0	47.370
664.3	47.510
679.5	43.600
750.3	43.680
780.8	43.460
811.3	43.100
872.3	43.820
972.6	

FLOW RATE (CUBIC CENTIMETERS PER SECOND) 2208.7119
 LATERAL 1897.2273 MAIN
 SLOPE 0.003400 MAIN 0.000500 OUTLET 0.000500
 LATERAL 1.480 LATERAL 6.000
 MANHOLE DROP : MAIN

41.5

POSITION ALONG PIPE(CM)	PIEZOMETER	READING	CM
120.6	1	45.140	
176.5	2	44.990	
242.6	3	44.910	
303.5	4	44.780	
364.5	5	44.690	
425.5	6	44.600	
486.4	7	44.540	
510.0	8	2.510	
547.4	9	44.480	
563.2	10	44.480	
578.5	11	44.480	
593.7	12	2.590	
606.4	13	44.480	
608.5	14	44.480	
624.2	15	44.390	
639.5	16	43.060	
750.3	17	43.260	
780.8	18	43.130	
811.3	19	42.780	
872.3	20	42.540	
972.6	21	47.080	
304.5	22	47.200	
365.5	23	47.200	
435.7	24	46.950	
496.6	25	46.440	
557.6	26	1.390	
583.7	27	46.220	
588.1	28	46.430	
618.5	29	46.430	
633.8	30	1.770	
644.4	31	46.700	
649.0	32	46.700	
664.3	33	46.740	
679.5	34	43.060	
750.3	35	43.260	
780.8	36	43.130	
811.3	37	42.780	
872.3	38	42.540	
972.6	39		
FLOW RATE(CUBIC CENTIMETERS PER SECOND)		2208.7119	
LATERAL		1387.5249MAIN	
SLOPE			
LATERAL	0.003400MAIN	0.000500OUTLET	0.000500
MANHOLE DROP :MAIN	1.480	LATERAL	6.000

A1.6

POSITION ALONG PIPE (CM)	PIEZOMETER	READING	CM
120.6	1	44.840	
176.5	2	44.740	
242.6	3	44.530	
303.5	4	44.390	
364.5	5	44.230	
425.5	6	44.090	
486.4	7	44.010	
510.0	8	2.300	
547.4	9	43.910	
563.2	10	43.910	
578.5	11	43.910	
593.7	12	43.910	
606.4	13	2.360	
608.9	14	43.910	
624.2	15	43.910	
639.5	16	43.910	
750.3	17	42.950	
780.8	18	42.830	
811.3	19	42.390	
872.3	20	42.110	
972.6	21	46.540	
304.5	22	46.540	
365.5	23	46.620	
435.7	24	46.350	
496.6	25	45.890	
557.6	26	1.120	
593.7	27	45.580	
588.1	28	46.000	
618.5	29	46.100	
633.8	30	1.510	
644.4	31	46.180	
649.0	32	46.240	
664.3	33	46.270	
679.5	34	42.950	
750.3	35	42.980	
780.8	36	42.830	
811.3	37	42.390	
872.3	38	42.110	
972.6	39		
FLOW RATE (CUBIC CENTIMETERS PER SECOND)		2208.7119	
LATERAL		991.0891	MAIN
SLOPE	0.003400	MAIN	0.000500
LATERAL	0.000500	OUTLET	0.000500
MANHOLE DROP	1.480	LATERAL	6.000

A1.7

POSITION ALONG PIPE (CM)	PIEZOMETER	READING	CM
120.6	1	44.600	
176.5	2	44.440	
242.6	3	44.310	
303.5	4	44.200	
364.5	5	44.050	
425.5	6	43.820	
486.4	7	43.640	
510.0	8	43.460	
547.4	9	43.530	
563.2	10	43.530	
578.5	11	43.530	
593.7	12	43.460	
606.4	13	43.400	
608.9	14	43.350	
624.2	15	43.290	
639.5	16	42.570	
750.3	17	42.400	
780.8	18	42.000	
811.3	19	41.720	
872.3	20	41.720	
972.3	21	45.700	
304.5	22	45.700	
365.5	23	45.530	
435.7	24	45.480	
496.6	25	45.000	
557.6	26	45.000	
583.7	27	44.680	
588.1	28	44.870	
619.5	29	45.000	
633.8	30	45.000	
644.4	31	45.070	
649.0	32	45.070	
664.3	33	45.070	
679.5	34	42.480	
750.3	35	42.570	
780.8	36	42.400	
811.3	37	42.400	
872.3	38	41.720	
972.6	39	41.720	
FLOW RATE (CUBIC CENTIMETERS PER SECOND)		2208.7119	
LATERAL		481.3860	MAIN
SLOPE		0.0005	OUTLET
LATERAL		0.0034	MAIN
MANHOLE DROP		1.480	LATERAL
		6.000	

A1.8

NO	ENERGY LOSS	COEFFICIENTS	K2L	K3M	LELJ	MELJ	TELL	TELM	K2RUS	K2LRUS	K3RUS	K3MRUS	KC	CEL
1	2.31	K3 0.01	1.95	0.10	5.03	0.02	11.03	1.50	1.69	0.72	-0.57	-5.27	1.56	3.38
2	1.09	0.38	1.15	1.40	2.41	0.84	8.41	2.32	0.80	0.76	-0.05	0.15	1.70	2.73
3	2.85	0.01	1.62	0.09	4.48	0.02	10.48	1.50	1.43	0.76	-0.34	-2.20	1.70	2.47
4	2.95	0.17	1.69	0.82	4.29	0.26	10.29	1.74	1.20	0.76	0.02	0.87	1.49	1.58
5	2.88	0.29	1.67	0.96	3.83	0.39	9.83	1.87	0.85	0.70	0.14	0.36	1.28	1.23
6	2.70	0.48	2.35	1.21	3.10	0.55	8.10	2.03	0.55	0.48	0.21	0.45	1.10	1.10
7	2.86	0.56	2.79	0.91	2.76	0.54	8.76	2.02	0.24	-1.69	0.22	0.33	1.24	1.10
8	2.45	0.98	2.27	1.09	2.16	0.87	8.16	2.35	-0.28	-1.69	0.22	0.33	1.24	1.10
MAIN FLOW														
2208.712	4530.691	0.67	2.05		18.59	34.39	63.28	65.31	11.134	10.540	13.498	9.672		
5578.414	4530.691	0.45	0.81		34.39	22.39	62.04	65.82	14.134	10.540	13.498	9.672		
2208.712	3398.019	0.61	1.54		34.39	22.39	58.40	55.56	9.888	8.370	8.431			
2208.712	2690.059	0.55	1.22		29.11	29.11	49.77	51.06	9.113	7.398	7.888			
2208.712	1897.227	0.46	0.86		30.00	30.00	43.14	47.39	8.301	5.134	7.211			
2208.712	1387.525	0.39	0.63		34.16	34.16	36.33	43.46	7.933	4.254	6.560			
2208.712	991.089	0.31	0.45		41.13	41.13	31.49	41.60	7.498	2.948	6.172			
2208.712	481.386	0.18	0.22						6.786					

K2: LATERAL LOSS COEFFICIENT W.R.T. OUTLET VELOCITY
 K3: MAIN LOSS COEFFICIENT W.R.T. OUTLET VELOCITY
 K2L: W.R.T. LATERAL INLET VELOCITY
 K3M: W.R.T. MAIN INLET VELOCITY
 LELJ: LATERAL ENERGY LOSS DUE TO JUNCTION
 MELJ: MAIN ENERGY LOSS DUE TO JUNCTION
 TELM: TOTAL ENERGY LOSS THROUGH JUNCTION
 TEL: OF LATERAL FLOW TO TOTAL FLOW
 VELIN: VELOCITY INLET AND OUTLET VELOCITIES
 VELOUT: VELOCITY INLET AND OUTLET VELOCITIES
 RATIO2: LATERAL FLOW TO MAIN FLOW
 RATIO: LATERAL FLOW TO MAIN FLOW
 KC: COMBINED JUNCTION LOSS COEFFICIENT
 CELJ: BASED ON RUSSIAN PREDICTION EQUATION -FOR COMPARISON
 K3RUS: BASED ON RUSSIAN PREDICTION EQUATION -FOR COMPARISON

POWER LOSS

MAIN POWER	LATERAL POWER	OUT. POWER	POWER LOSS RATIO
241384.5000	517822.4375	736408.7500	0.0300
630984.6875	519547.3125	1134933.0000	0.0136
238643.8750	382290.8125	605659.9375	0.0246
237446.8125	300034.0000	525395.1250	0.0225
235950.5000	209205.8125	437028.1875	0.0185
235503.8750	151468.3750	381454.2500	0.0143
234514.3750	107424.2500	338010.4375	0.0115
233657.0625	51549.0117	282254.1875	0.0103

POSITION ALONG PIPE (CM)	PIEZOMETER READING CM	FLOW RATE (CUBIC CENTIMETERS PER SECOND)
120.6	48.110	2208.7119
176.5	48.000	
242.6	48.000	
303.5	47.950	
364.5	47.910	
425.5	47.910	
486.4	47.910	
510.0	3.870	
547.4	47.850	
563.2	47.920	
578.5	47.870	
593.7	47.870	
606.4	3.860	
608.5	47.870	
624.2	47.870	
639.5	47.870	
750.3	45.720	
780.8	45.800	
811.3	45.660	
872.3	45.300	
972.6	44.730	
304.5	52.110	
365.5	51.150	
435.7	51.130	
496.6	50.600	
557.6	49.900	
583.7	2.710	
588.1	49.400	
618.5	49.250	
633.8	49.250	
644.4	2.800	
649.0	49.150	
664.3	48.950	
679.5	48.620	
750.3	45.720	
780.8	45.800	
811.3	45.660	
872.3	45.300	
972.6	44.730	

FLOW RATE (CUBIC CENTIMETERS PER SECOND) 2208.7119
 LATERAL 4389.1055 MAIN
 SLOPE 0.003400 MAIN 0.000500 OUTLET 0.000500
 MANHOLE DROP : MAIN 1.460 LATERAL 6.000

A2.1

POSITION ALONG PIPE(CM)	PIEZOMETER READING CM
120.6	47.350
176.5	47.300
242.6	47.290
303.5	47.230
364.5	47.240
425.5	47.240
486.4	47.170
510.0	3.620
547.4	47.200
563.2	47.200
578.5	47.200
593.7	47.200
606.4	47.200
608.9	47.200
624.2	47.200
639.5	45.150
750.3	45.150
780.9	45.100
811.3	44.820
872.3	44.210
972.5	51.050
304.5	50.960
365.7	50.450
435.7	50.000
496.6	49.250
557.6	2.530
583.7	48.920
588.1	48.860
618.5	48.550
633.8	2.500
644.4	48.480
649.0	48.300
664.3	47.830
679.5	45.150
730.3	45.100
780.8	44.820
811.3	44.210
872.3	44.210
972.6	2208.7119

FLOW RATE(CUBIC CENTIMETERS PER SECOND)
LATERAL 3822.7729MAIN
SLOPE 0.003400MAIN 0.000500OUTLET 0.000500
MANHOLE DROP :MAIN 1.480LATERAL 6.000

A.2.2

POSITION ALONG PIPE (CM)	PIEZOMETER READING CM
120.6	45.770
176.5	45.770
242.6	45.680
303.5	45.610
364.5	45.530
425.5	45.510
486.4	2.970
510.0	45.470
547.4	45.470
563.2	45.470
578.5	45.470
593.7	3.110
606.4	45.410
608.9	45.410
624.2	45.360
639.5	44.000
750.3	43.850
750.8	43.700
811.3	43.440
872.3	42.950
972.6	47.910
304.5	48.700
365.5	48.240
435.7	48.040
496.6	47.380
557.6	1.790
593.7	47.100
588.1	46.820
618.5	46.700
633.8	1.740
644.4	46.620
649.0	46.650
664.3	46.130
679.5	44.000
750.3	43.850
780.8	43.700
811.3	43.440
872.3	42.950
972.6	
FLOW RATE (CUBIC CENTIMETERS PER SECOND)	2208.7119
LATERAL	2180.3555 MAIN
SLOPE	0.003400 MAIN 0.000500 CUTLET 0.000500
LATERAL	1.480 LATERAL
MANHOLE DROP : MAIN	6.000

142.3

POSITION ALONG PIPE (CM)	PIEZOMETER	READING	CM
120.6	1	45.300	
176.5	2	45.260	
242.6	3	45.170	
303.5	4	45.170	
364.5	5	45.120	
425.5	6	45.040	
486.4	7	44.980	
510.0	8	2.740	
547.4	9	44.930	
563.2	10	44.940	
578.5	11	44.940	
593.7	12	44.940	
606.4	13	2.770	
608.9	14	44.900	
624.2	15	44.860	
639.5	16	44.860	
750.3	17	43.610	
780.8	18	43.470	
811.3	19	43.330	
872.6	20	43.070	
972.6	21	42.550	
304.5	22	47.370	
365.5	23	47.800	
435.7	24	47.540	
496.6	25	47.250	
557.6	26	46.760	
583.7	27	1.530	
588.1	28	46.400	
618.5	29	46.180	
633.8	30	46.090	
644.4	31	1.500	
649.0	32	45.950	
664.3	33	45.920	
679.5	34	45.620	
750.3	35	43.610	
780.8	36	43.470	
811.3	37	43.330	
872.6	38	43.070	
972.6	39	42.550	
FLOW RATE (CUBIC CENTIMETERS PER SECOND)		2208.7119	
LATERAL		1699.0103	MAIN
SLOPE	0.003400	MAIN	0.000500
LATERAL	0.000500	OUTLET	0.000500
MANHOLE DROP	1.420	LATERAL	6.000

A2.4

POSITION ALONG PIPE (CM)	PIEZOMETER READING CM	FLOW RATE (CUBIC CENTIMETERS PER SECOND)
120.6	44.400	
176.5	44.300	
242.6	44.180	
303.5	44.080	
364.5	43.890	
425.5	43.730	
486.4	43.580	
510.0	2.170	
547.4	43.500	
563.2	43.460	
578.5	43.430	
593.7	43.360	
606.4	2.140	
608.9	43.300	
624.2	43.240	
659.5	43.130	
750.3	42.240	
780.8	42.200	
811.3	42.060	
872.3	41.840	
972.6	41.450	
304.5	45.320	
365.5	45.360	
435.7	45.210	
496.6	45.020	
557.6	44.600	
583.7	0.690	
588.1	44.320	
618.5	44.130	
633.8	44.020	
644.4	0.680	
649.0	43.910	
664.3	43.830	
679.5	43.710	
750.3	42.240	
780.8	42.200	
811.3	42.060	
872.3	41.840	
972.6	41.450	

FLOW RATE (CUBIC CENTIMETERS PER SECOND) 2208.7119
 LATERAL 382.2771 MAIN
 SLOPE 0.003400 MAIN 0.000500 OUTLET 0.000500
 LATERAL 1.480 LATERAL 6.000
 MANHOLE DROP : MAIN

A2.5

POSITION ALONG PIPE (CM)	PIEZOMETER	READING CM
120.6	1	46.320
176.5	2	46.280
242.6	3	46.270
303.5	4	46.250
364.5	5	46.220
425.5	6	46.180
486.4	7	46.140
510.0	8	3.260
547.4	9	46.140
563.2	10	46.130
578.5	11	46.120
593.7	12	46.110
606.4	13	3.260
608.9	14	46.100
624.2	15	46.100
639.5	16	46.090
750.3	17	44.500
780.8	18	44.460
811.3	19	44.310
872.3	20	43.950
972.6	21	43.490
304.5	22	48.790
365.5	23	49.230
435.7	24	48.800
496.6	25	48.130
557.6	26	2.140
582.7	27	47.850
588.1	28	47.650
618.5	29	47.580
633.8	30	2.100
644.4	31	47.440
649.0	32	47.360
664.3	33	46.910
679.5	34	44.500
750.3	35	44.460
780.8	36	44.310
811.3	37	43.950
872.3	38	43.490
972.6	39	

FLOW RATE (CUBIC CENTIMETERS PER SECOND) 2208.7119

LATERAL SLOPE 0.003400 MAIN 0.000500 OUTLET 0.000500
LATERAL DROP : MAIN 1.480 LATERAL 6.000

A2.6

POSITION ALONG PIPE (CM)	PIEZOMETER	READING	CM
120.6	1	44.390	
176.6	2	44.240	
242.6	3	44.100	
303.5	4	43.990	
364.5	5	43.860	
425.5	6	43.650	
486.4	7	43.520	
510.0	8	43.410	
547.4	9	43.380	
582.2	10	43.310	
578.5	11	43.250	
553.7	12	43.080	
606.4	13	43.170	
608.9	14	43.100	
624.2	15	42.970	
639.5	16	41.800	
750.3	17	41.800	
780.8	18	41.660	
811.3	19	41.470	
872.3	20	41.100	
972.6	21	0.0	
304.5	22	0.0	
365.5	23	0.0	
435.7	24	0.0	
496.6	25	0.0	
557.6	26	0.0	
583.7	27	0.0	
588.1	28	0.0	
618.5	29	0.0	
633.8	30	0.0	
644.4	31	0.0	
649.0	32	0.0	
664.3	33	0.0	
679.5	34	0.0	
750.3	35	0.0	
780.8	36	0.0	
811.3	37	0.0	
872.3	38	0.0	
972.6	39	0.0	
FLOW RATE (CUBIC CENTIMETERS PER SECOND)			2208.7119
LATERAL	0.0		MAIN
SLOPE	0.003400	MAIN	0.000500
LATERAL	0.000500	OUTLET	0.000500
MANHOLE DROP : MAIN	1.480	LATERAL	6.000

A2.7

[illegible]

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X2: LATERAL LOSS COEFF W.F.T. OUTLET VELOCITY
X3: MAIN LOSS COEFFICIENT W.R.T. OUTLET VELOCITY
X2L: W.R.T. LATERAL INLET VELOCITY
X3M: W.R.T. MAIN INLET VELOCITY
X2J: LATERAL ENERGY LOSS DUE TO JUNCTION
X3J: MAIN ENERGY LOSS DUE TO JUNCTION
TELM: TOTAL ENERGY LOSS THROUGH JUNCTION
RATIO OF LATERAL FLOW TO TOTAL FLOW
VELIN: VELOCITY INLET AND OUTLET VELOCITIES
RATIO2: LATERAL FLOW TO MAIN FLOW
XC: COMBINED JUNCTION LOSS COEFFICIENT
K3RUS : BASED ON RUSSIAN PREDICTION EQUATION --FOR COMPARISON

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POWER LOSS

MAIN POWER		LATERAL POWER		OUT POWER		POWER LOSS RATIO	
241987.4375	500416.8750	719513.8750	0.0308				
241175.0625	432598.1875	655129.1250	0.0277				
238181.1875	241151.3125	469899.6875	0.0178				
236452.1875	186768.4375	415675.1250	0.0115				
233751.1875	140891.6875	271484.4375	0.0159				
238837.7500	215333.2891	266065.3125	0.0				
0.0	0.0	0.0	0.0				

A2

POSITION ALONG PIPE (CM)	PIEZOMETER	READING	ICM
120.6	1	47.850	
176.5	2	47.850	
242.6	3	47.850	
303.5	4	47.820	
364.5	5	47.820	
425.5	6	47.820	
486.4	7	47.750	
510.0	8	3.880	
547.4	9	47.750	
563.2	10	47.750	
578.5	11	47.700	
593.7	12	47.700	
606.4	13	3.915	
608.5	14	47.700	
624.2	15	47.700	
639.5	16	47.660	
750.3	17	45.780	
780.8	18	45.780	
811.3	19	45.580	
872.3	20	45.270	
972.6	21	44.600	
304.5	22	51.760	
365.5	23	51.760	
435.7	24	51.100	
496.6	25	50.850	
557.6	26	49.800	
583.7	27	2.825	
618.1	28	49.500	
633.8	29	49.250	
644.4	30	49.200	
649.0	31	2.753	
664.3	32	49.130	
679.5	33	49.000	
750.3	34	48.350	
780.8	35	45.780	
811.3	36	45.780	
872.3	37	45.580	
972.6	38	45.270	
972.6	39	44.600	

FLOW RATE (CUBIC CENTIMETERS PER SECOND) 2208.7119
 LATERAL 4332.4727 MAIN
 SLOPE 0.003400 MAIN 0.000500 OUTLET 0.000500
 MANHOLE DROP : MAIN 1.480 LATERAL 6.000

93.1

POSITION ALONG PIPE (CM)	PIEZOMETER READING CM
120.6	46.700
176.5	46.700
242.6	46.700
303.5	46.620
364.5	46.620
425.5	46.520
486.4	46.520
510.0	3.380
547.4	46.520
563.2	46.520
578.5	46.450
593.7	46.450
606.4	3.410
608.9	46.450
624.2	46.450
639.5	46.450
750.3	44.800
780.8	44.800
811.3	44.650
872.3	44.300
972.6	43.740
304.5	50.120
365.5	49.650
435.7	49.140
496.6	48.480
557.6	48.120
583.7	2.260
618.5	47.900
633.8	47.800
644.4	47.730
649.0	2.230
664.3	47.690
679.5	47.650
750.3	47.200
790.8	44.940
811.3	44.800
872.3	44.800
972.6	44.300
972.6	43.740

FLOW RATE (CUBIC CENTIMETERS PER SECOND) 2208.7119

LATERAL 3114.8511 MAIN

SLOPE 0.003400 MAIN 0.000500 OUTLET 0.000500

LATERAL DROP : MAIN 1.480 LATERAL 6.000

A3.2

POSITION ALONG PIPE (CM)	PIEZOMETER READING CM	FLOW RATE (CUBIC CENTIMETERS PER SECOND)
120.6	46.200	2605.1477MAIN
176.5	46.120	
242.6	46.120	
303.5	46.090	
364.5	46.090	
425.5	46.040	
486.4	46.010	
510.0	3.150	
547.4	45.965	
563.2	45.965	
578.5	45.965	
593.7	45.960	
606.4	3.185	
608.9	45.930	
624.2	45.910	
639.5	45.910	
750.3	44.460	
780.8	44.340	
811.3	44.150	
872.3	43.870	
972.6	43.290	
304.5	48.430	
365.5	49.400	
435.7	48.810	
496.6	48.500	
557.6	47.880	
583.7	1.960	
598.1	47.560	
618.5	47.260	
633.8	47.170	
644.4	1.925	
649.0	47.040	
664.3	46.970	
679.5	46.650	
750.3	44.460	
780.8	44.340	
811.3	44.150	
872.3	43.870	
972.6	43.290	

FLOW RATE (CUBIC CENTIMETERS PER SECOND) 2208.7119
 LATEPAL 2605.1477MAIN
 SLOPE
 LATERAL 0.003400MAIN 0.000500OUTLET 0.000500
 MANHOLE DROP :MAIN 1.480LATERAL 6.000

43.3

POSITION ALONG PIPE (CM)	PIEZOMETER READING CM
120.6	45.780
176.6	45.620
242.6	45.560
303.5	45.450
364.5	45.430
425.5	45.360
486.4	45.300
510.0	2.850
547.4	45.250
563.2	45.250
578.5	45.190
593.7	2.900
606.4	45.190
608.9	45.190
624.2	45.190
635.5	43.760
750.3	43.670
780.8	43.500
811.3	43.210
872.5	42.730
972.6	47.530
304.5	48.150
365.5	47.780
435.7	47.550
496.6	47.000
557.6	1.615
583.7	46.660
588.1	46.400
618.5	46.270
633.6	1.575
644.4	46.170
649.0	46.100
664.3	45.830
675.5	43.760
750.3	43.670
780.8	43.500
811.3	43.210
872.5	42.730
972.6	

FLOW RATE (CURRIC CENTIMETERS PER SECOND) 2208.7119
 LATERAL 1840.6945MAIN
 SLOPE 0.003400MAIN 0.000500OUTLET 0.000500
 LATERAL 1.480LATERAL 6.000
 MANHOLE DROP :MAIN

A3.4

POSITION ALONG PIPE (CM)	PIEZOMETER READING CM
120.6	45.000
176.5	44.960
242.5	44.870
303.5	44.810
364.5	44.730
425.5	44.630
486.4	44.570
510.0	2.585
547.4	44.550
563.2	44.550
578.5	44.550
593.7	44.490
606.4	2.620
608.9	44.490
624.2	44.430
639.5	44.430
750.3	43.200
780.8	43.100
811.3	42.930
872.3	42.880
904.5	42.780
972.0	46.800
304.5	46.850
365.5	46.600
435.7	46.100
496.6	1.310
557.6	45.790
593.7	45.540
588.1	45.450
618.5	1.265
633.8	45.350
644.4	45.230
649.0	45.110
664.3	43.200
679.5	43.100
750.3	42.930
780.8	42.740
811.3	42.280
872.3	
972.6	

FLOW RATE (CUBIC CENTIMETERS PER SECOND) 2208.7119
 LATERAL 1274.2576 MAIN
 SLOPE 0.003400 MAIN 0.000500 OUTLET 0.000500
 MANHOLE DROP : MAIN 1.480 LATERAL 6.000

43.5

A3.6

POSITION ALONG PIPE(CM)	PIEZOMETER	READING	CM
120.6	1	48.250	
176.5	2	48.250	
242.6	3	48.250	
302.5	4	48.250	
364.5	5	48.230	
425.5	6	48.230	
486.4	7	48.230	
510.0	8	4.060	
547.4	9	48.230	
563.2	10	48.230	
578.5	11	48.000	
593.7	12	48.190	
606.4	13	4.100	
624.2	14	48.180	
639.5	15	48.160	
750.3	16	45.700	
780.8	17	45.520	
811.3	18	45.300	
872.3	19	44.940	
972.6	20	44.300	
304.5	21	51.150	
365.5	22	51.210	
435.7	23	50.610	
496.6	24	50.100	
557.6	25	49.400	
593.7	26	2.585	
618.5	27	49.000	
633.8	28	48.780	
644.4	29	48.720	
649.0	30	2.595	
664.3	31	48.660	
679.5	32	48.560	
750.3	33	48.300	
780.8	34	45.700	
811.3	35	45.520	
872.6	36	45.300	
972.6	37	44.940	
	38	44.300	
	39		

FLOW RATE(CUBIC CENTIMETERS PER SECOND) 2208.7119
 LATERAL 3964.3569MAIN
 SLOPE 0.003400MAIN 0.000500OUTLET 0.000500
 MANHOLE DROP :MAIN 1.480LATERAL 6.000

A4.1

POSITION ALONG PIPE (CV)	PIEZOMETER	READING	CM
120.6	1	47.340	
176.5	2	47.330	
242.6	3	47.310	
303.4	4	47.260	
364.5	5	47.220	
425.5	6	47.190	
486.4	7	47.190	
510.0	8	3.640	
547.4	9	47.150	
562.2	10	47.150	
578.5	11	47.150	
593.7	12	47.150	
606.4	13	3.685	
608.9	14	47.130	
624.2	15	47.100	
639.5	16	47.100	
750.3	17	44.970	
780.8	18	44.850	
811.3	19	44.600	
872.3	20	44.320	
972.6	21	43.740	
304.5	22	49.970	
365.5	23	50.100	
435.7	24	49.580	
496.6	25	49.120	
557.6	26	48.460	
583.7	27	2.210	
588.1	28	48.080	
618.5	29	47.840	
633.8	30	47.750	
644.4	31	2.185	
649.0	32	47.650	
664.3	33	47.600	
679.5	34	47.350	
750.3	35	44.970	
780.8	36	44.850	
811.3	37	44.600	
872.3	38	44.320	
972.6	39	43.740	

FLOW RATE (CUBIC CENTIMETERS PER SECOND) 2208.7119
 LATERAL 3053.2180 MAIN
 SLOPE 0.003400 MAIN 0.0005000 LEFT 0.000500
 MANHOLE DROP : MAIN 1.480 LATERAL 6.000

A4.2

POSITION	ALONG PIPE (CM)	PIEZOMETER	READING	CM
	120.6	1	46.530	
	176.5	2	46.530	
	242.6	3	46.470	
	303.5	4	46.440	
	364.5	5	46.410	
	425.5	6	46.390	
	486.4	7	46.350	
	510.0	8	3.300	
	547.4	9	46.330	
	563.2	10	46.330	
	578.5	11	46.270	
	593.7	12	46.220	
	606.4	13	3.340	
	608.5	14	46.220	
	624.2	15	46.220	
	639.3	16	46.220	
	750.3	17	44.310	
	780.8	18	44.160	
	811.3	19	43.970	
	872.3	20	43.700	
	972.6	21	43.160	
	304.5	22	48.150	
	365.5	23	48.850	
	435.7	24	48.480	
	496.6	25	48.180	
	557.6	26	47.560	
	583.7	27	1.880	
	588.1	28	46.970	
	614.5	29	46.830	
	633.8	30	46.760	
	644.4	31	1.820	
	649.0	32	46.680	
	664.3	33	46.680	
	679.5	34	46.500	
	750.3	35	44.310	
	780.8	36	44.160	
	811.3	37	43.970	
	872.3	38	43.700	
	972.6	39	43.160	
FLOW RATE (CUBIC CENTIMETERS PER SECOND)				2208.7119
LATERAL	2350.2559	MAIN		
SLOPE	0.003400	OUTLET	0.000500	
LATERAL	0.003400	MAIN	0.000500	
MANHOLE	1.480	LATERAL	6.000	

A4.3

POSITION	ALONG PIPE (CM)	PIEZOMETER	READING	CM
	120.6	1	45.120	
	176.5	2	45.070	
	242.6	3	45.000	
	303.5	4	44.910	
	364.5	5	44.870	
	425.5	6	44.760	
	486.4	7	44.730	
	510.0	8	2.680	
	547.4	9	44.660	
	563.2	10	44.660	
	578.5	11	44.660	
	593.7	12	44.660	
	606.4	13	2.660	
	608.9	14	44.610	
	624.2	15	44.610	
	639.5	16	44.610	
	750.3	17	43.160	
	780.8	18	43.050	
	811.3	19	42.900	
	872.3	20	42.690	
	972.6	21	42.230	
	304.5	22	46.650	
	365.5	23	46.760	
	435.7	24	46.700	
	496.6	25	46.480	
	557.6	26	46.000	
	593.7	27	1.295	
	618.5	28	45.610	
	633.8	29	45.470	
	644.4	30	45.360	
	649.0	31	1.295	
	664.3	32	45.250	
	679.5	33	45.230	
	750.3	34	45.050	
	780.8	35	43.160	
	811.3	36	43.050	
	872.3	37	42.900	
	972.6	38	42.690	
		39	42.230	
FLOW RATE (CUBIC CENTIMETERS PER SECOND)			2208.7119	
LATERAL	1245.9409MAIN			
SLOPE	0.003400MAIN	0.000500OUTLET	0.000500	
LATERAL	0.003400MAIN	1.480LATERAL	6.000	
MANHOLE	DROP : MAIN			

A44

POSITION ALONG PIPE (CM)	PIEZOMETER READING CM
120.6	44.880
176.5	44.750
242.5	44.700
303.5	44.550
364.5	44.580
425.5	44.460
486.4	44.400
510.0	2.510
547.4	44.380
563.2	44.330
578.5	44.320
593.7	2.560
606.4	44.300
608.9	44.260
624.2	44.240
639.5	42.900
750.3	42.750
790.8	42.650
811.3	42.430
872.3	42.000
972.6	46.240
304.5	46.330
365.5	46.050
435.7	45.610
496.6	1.100
557.6	45.310
583.7	45.080
588.1	45.010
618.3	1.085
633.8	44.870
644.4	44.830
649.0	44.720
664.3	42.900
679.5	42.750
750.3	42.650
780.8	42.430
811.3	42.000
872.3	
972.6	

FLOW RATE (CUBIC CENTIMETERS PER SECOND) 2208.7119
 LATERAL 962.7725 MAIN
 SLOPE 0.003400 MAIN 0.000500 OUTLET 0.000500
 LATERAL 1.480 LATERAL 6.000
 MANHOLE DROP : MAIN

A4.5

NO	K2	K3	K2L	K3W	LELJ	MELJ	TELL	TELM	K2RUS	K2LRUS	K3RUS	K3MRUS	KC	CELJ
1	3.17	0.97	1.52	9.64	4.53	1.38	10.53	2.86	1.57	0.73	-0.46	-3.59	2.36	3.40
2	3.27	0.97	1.55	6.75	4.16	1.24	10.16	2.72	1.33	0.75	-0.26	-1.50	2.31	2.94
3	3.46	0.98	1.45	4.79	3.95	1.12	9.95	2.60	1.07	0.77	-0.09	-0.39	2.26	2.58
4	3.32	0.94	1.48	2.18	3.30	0.94	9.30	2.42	0.44	0.65	0.17	0.42	1.80	1.79
5	3.24	1.07	1.52	2.21	3.07	1.01	9.07	2.49	0.22	0.45	0.22	0.45	1.73	1.64
MAIN FLOW														
2208.712		3964.357	0.64	1.79	17.03	17.03	80.90	52.93	10.639	9.171	10.540	9.537		
2208.712		3058.218	0.58	1.38	19.30	19.30	78.19	49.94	9.782	7.945	9.998	8.688		
2208.712		2350.296	0.52	1.06	21.40	21.40	75.34	47.30	9.050	6.998	7.194	6.955		
2208.712		1245.941	0.36	0.56	29.11	29.11	77.08	44.20	7.734	5.036	7.194			
2208.712		962.772	0.30	0.44	30.93	30.93	66.71	43.08	7.421	4.489	6.955			

K2: LATERAL LOSS COEF W.P.T. OUTLET VELOCITY
 K3: MAIN LOSS COEFFICIENT W.P.T. OUTLET VELOCITY
 K2L: W.P.T. LATERAL INLET VELOCITY
 K3W: W.P.T. MAIN INLET VELOCITY
 LELJ: LATERAL ENERGY LOSS DUE TO JUNCTION
 MELJ: MAIN ENERGY LOSS THROUGH JUNCTION
 TELM: TOTAL ENERGY LOSS THROUGH JUNCTION
 TEL: OF LATERAL FLOW TO TOTAL FLOW
 VELIN: VELOCITY INLET AND OUTLET VELOCITIES
 VELIN: LATERAL FLOW TO MAIN FLOW
 RATIO2: LATERAL FLOW TO MAIN FLOW
 K2RUS: COMBINED JUNCTION LOSS COEFFICIENT
 K3RUS: BASED ON RUSSIAN PREDICTION EQUATION -FOR COMPARISON

POWER LOSS

MAIN POWER	LATERAL POWER	OUT POWER	POWER LOSS RATIO
243300.1250	449178.5625	671474.6875	0.0303
241086.2500	342762.5625	568395.1875	0.0265
239212.1875	261194.6250	488664.8125	0.0235
235914.1875	136021.6875	365746.3125	0.0166
235387.1250	104580.9375	334776.0000	0.0153

A4

POSITION ALONG PIPE (CM)	PIEZOMETER	READING	CM
120.6	1	47.380	
116.5	2	47.380	
112.4	3	47.250	
108.5	4	47.250	
104.5	5	47.220	
100.5	6	47.190	
96.4	7	47.150	
92.4	8	3.670	
88.4	9	47.150	
84.4	10	47.150	
80.4	11	47.150	
76.4	12	47.150	
72.4	13	3.690	
68.4	14	47.150	
64.4	15	47.150	
60.4	16	47.090	
56.4	17	45.410	
52.4	18	45.620	
48.4	19	45.500	
44.4	20	45.170	
40.4	21	44.525	
36.4	22	52.090	
32.4	23	52.000	
28.4	24	51.100	
24.4	25	50.450	
20.4	26	49.750	
16.4	27	2.760	
12.4	28	49.430	
8.4	29	49.100	
4.4	30	49.050	
0.4	31	2.710	
	32	48.950	
	33	48.740	
	34	47.860	
	35	45.410	
	36	45.620	
	37	45.500	
	38	45.170	
	39	44.525	

FLOW RATE (CUBIC CENTIMETERS PER SECOND) 2208.7119
 LATERAL 4278.6719 MAIN
 SLOPE 0.003400 MAIN 0.000500 CUTLET 0.000500
 LATERAL DROP 1.480 LATERAL 6.000
 MANHOLE

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POSITION ALONG PIPE (CM)	PIEZOMETER	READING	CM
120.6	1	46.670	
176.5	2	46.600	
242.6	3	46.570	
303.5	4	46.520	
364.5	5	46.500	
425.5	6	46.500	
486.4	7	3.360	
510.0	8	46.450	
547.4	9	46.450	
563.2	10	46.450	
578.5	11	46.430	
593.7	12	3.380	
606.4	13	46.430	
608.9	14	46.430	
624.2	15	46.400	
639.3	16	46.360	
750.3	17	44.990	
780.3	18	44.860	
811.3	19	44.580	
872.3	20	43.940	
972.6	21	50.580	
304.5	22	49.950	
365.5	23	49.950	
435.7	24	48.810	
496.6	25	2.380	
557.6	26	48.450	
583.7	27	48.190	
588.1	28	48.100	
618.5	29	2.295	
633.8	30	47.940	
644.4	31	47.820	
649.0	32	47.180	
664.3	33	44.990	
679.5	34	44.990	
750.3	35	44.860	
780.8	36	44.580	
811.3	37	43.940	
872.3	38		
972.6	39		

FLOW RATE (CUBIC CENTIMETERS PER SECOND) 2208.71
 LATERAL 3398.0190 MAIN
 SLOPE 0.003400 MAIN 0.000500 OUTLET 0.000500
 LATERAL 0.003400 MAIN 1.480 LATERAL 6.000
 MANHOLE DROP : MAIN

A5.2

POSITION ALONG PIPE (CM)	PIEZOMETER READING	CM
120.6	45.920	
176.5	45.860	
242.6	45.860	
303.5	45.770	
364.5	45.730	
425.5	45.680	
486.4	45.660	
510.0	3.025	
547.4	45.630	
563.2	45.620	
578.5	45.580	
593.7	45.570	
606.4	3.615	
608.9	45.570	
624.2	45.570	
639.5	45.570	
750.3	44.280	
780.8	44.130	
811.3	44.040	
872.3	43.780	
972.6	43.240	
1011.3	43.240	
1072.3	43.240	
1111.3	43.240	
1121.2	43.240	
1131.3	43.240	
1141.4	43.240	
1151.5	43.240	
1161.6	43.240	
1171.7	43.240	
1181.8	43.240	
1191.9	43.240	
1201.0	43.240	
1211.1	43.240	
1221.2	43.240	
1231.3	43.240	
1241.4	43.240	
1251.5	43.240	
1261.6	43.240	
1271.7	43.240	
1281.8	43.240	
1291.9	43.240	
1301.0	43.240	
1311.1	43.240	
1321.2	43.240	
1331.3	43.240	
1341.4	43.240	
1351.5	43.240	
1361.6	43.240	
1371.7	43.240	
1381.8	43.240	
1391.9	43.240	
1401.0	43.240	
1411.1	43.240	
1421.2	43.240	
1431.3	43.240	
1441.4	43.240	
1451.5	43.240	
1461.6	43.240	
1471.7	43.240	
1481.8	43.240	
1491.9	43.240	
1501.0	43.240	
1511.1	43.240	
1521.2	43.240	
1531.3	43.240	
1541.4	43.240	
1551.5	43.240	
1561.6	43.240	
1571.7	43.240	
1581.8	43.240	
1591.9	43.240	
1601.0	43.240	
1611.1	43.240	
1621.2	43.240	
1631.3	43.240	
1641.4	43.240	
1651.5	43.240	
1661.6	43.240	
1671.7	43.240	
1681.8	43.240	
1691.9	43.240	
1701.0	43.240	
1711.1	43.240	
1721.2	43.240	
1731.3	43.240	
1741.4	43.240	
1751.5	43.240	
1761.6	43.240	
1771.7	43.240	
1781.8	43.240	
1791.9	43.240	
1801.0	43.240	
1811.1	43.240	
1821.2	43.240	
1831.3	43.240	
1841.4	43.240	
1851.5	43.240	
1861.6	43.240	
1871.7	43.240	
1881.8	43.240	
1891.9	43.240	
1901.0	43.240	
1911.1	43.240	
1921.2	43.240	
1931.3	43.240	
1941.4	43.240	
1951.5	43.240	
1961.6	43.240	
1971.7	43.240	
1981.8	43.240	
1991.9	43.240	
2001.0	43.240	

45.2

POSITION ALONG PIPE (CM)	PIEZOMETER	READING	CM
120.6	1	45.300	
176.5	2	45.250	
242.6	3	45.200	
303.5	4	45.140	
364.5	5	45.100	
425.5	6	45.020	
486.4	7	44.960	
510.0	8	2.730	
547.4	9	44.900	
563.2	10	44.900	
578.5	11	44.900	
593.7	12	2.740	
606.4	13	44.900	
608.5	14	44.900	
624.2	15	44.860	
639.5	16	43.670	
750.3	17	43.560	
780.8	18	43.360	
811.3	19	43.130	
872.3	20	42.690	
972.6	21	47.460	
304.5	22	48.000	
365.5	23	47.700	
435.7	24	47.460	
496.6	25	46.880	
557.6	26	1.600	
583.7	27	46.530	
618.5	28	46.250	
633.8	29	46.140	
644.4	30	1.560	
649.0	31	46.000	
664.3	32	45.960	
679.5	33	45.610	
750.3	34	43.670	
780.8	35	43.560	
811.3	36	43.360	
872.3	37	43.130	
972.6	38	42.690	
1840.5545 MAIN	39		
2208.7119			

FLOW RATE (CUBIC CENTIMETERS PER SECOND)
 LATERAL 1840.5545 MAIN
 SLOPE 0.003400 MAIN 0.000500 CUTLET 0.000500
 LATERAL 1.480 LATERAL 6.000
 MANHOLE DROP : MAIN

A 5.4

POSITION ALONG PIPE (CM)	PIFZC METER READING	CM
120.6	44.980	
176.5	44.920	
242.6	44.830	
303.5	44.760	
364.5	44.670	
425.5	44.600	
486.4	44.550	
510.0	2.570	
547.4	44.500	
563.2	44.460	
578.5	44.450	
593.7	2.550	
606.4	44.400	
608.9	44.400	
624.2	44.380	
639.5	43.250	
750.3	43.170	
790.8	42.920	
811.3	42.750	
872.3	42.350	
972.6	47.200	
304.5	46.930	
365.5	47.060	
435.7	46.780	
496.6	46.290	
557.6	1.380	
593.7	46.000	
588.1	45.680	
618.5	45.600	
633.4	1.350	
644.4	45.480	
649.0	45.300	
664.3	45.180	
679.5	43.250	
750.3	43.170	
780.8	42.920	
811.3	42.750	
872.3	42.350	
972.6		

FLOW RATE (CUBIC CENTIMETERS PER SECOND) 2208.7113
 LATEAL 1387.5249 MAIN
 SLOPE 0.003400 MAIN 0.000500 OUTLET 0.000500
 LATERAL 1.480 LATERAL 5.000
 MANHOLE DROP : MAIN

A 5.5

POSITION ALONG PIPE (CM)	PIEZOMETER	READING	CM
120.6	1	44.570	
176.5	2	44.500	
242.6	3	44.390	
303.5	4	44.290	
364.5	5	44.150	
425.5	6	44.010	
486.4	7	43.950	
510.0	8	2.335	
547.4	9	43.870	
563.2	10	43.820	
578.5	11	43.790	
593.7	12	43.750	
606.4	13	2.310	
608.9	14	43.680	
624.2	15	43.630	
639.5	16	42.850	
750.3	17	42.750	
780.8	18	42.600	
811.3	19	42.390	
872.3	20	41.930	
972.6	21	46.250	
304.5	22	46.230	
365.5	23	46.270	
435.7	24	46.030	
496.6	25	45.610	
557.6	26	1.095	
583.7	27	45.300	
588.1	28	45.090	
618.5	29	44.940	
633.8	30	1.060	
644.4	31	44.810	
649.0	32	44.750	
664.3	33	44.560	
679.5	34	42.850	
750.3	35	42.750	
780.8	36	42.600	
811.3	37	42.390	
872.3	38	41.930	
972.6	39		

FLOW RATE (CUBIC CENTIMETERS PER SECOND) 2208.7119
 LATERAL 976.9309 MAIN
 SLOPE 0.003400 MAIN 0.000500 OUTLET 0.000500
 LATERAL 1.480 LATERAL 6.000
 MANHOLE DROP : MAIN

45.6

POSITION	ALONG PIPE (CM)	PIEZOMETER	READING	CM
	120.6	1	47.800	
	176.5	2	47.780	
	242.6	3	47.750	
	303.5	4	47.720	
	364.3	5	47.700	
	425.5	6	47.680	
	486.4	7	47.660	
	510.0	8	3.860	
	547.4	9	47.640	
	563.2	10	47.630	
	578.5	11	47.630	
	593.7	12	47.630	
	606.4	13	3.925	
	608.5	14	47.630	
	624.2	15	47.630	
	639.5	16	47.630	
	700.3	17	45.520	
	780.8	18	45.710	
	811.3	19	45.500	
	872.3	20	45.220	
	972.6	21	44.560	
	304.5	22	51.720	
	365.5	23	51.720	
	435.7	24	51.040	
	496.6	25	50.430	
	557.7	26	49.840	
	593.7	27	2.775	
	588.1	28	49.450	
	618.5	29	49.140	
	633.8	30	49.020	
	644.4	31	2.725	
	645.0	32	49.000	
	664.3	33	48.900	
	679.5	34	48.300	
	750.3	35	45.520	
	790.3	36	45.710	
	811.3	37	45.500	
	872.3	38	45.220	
	972.6	39	44.560	
FLOW RATE (CUBIC CENTIMETERS PER SECOND)	4247.5234 MAIN		2208.7119	
LATERAL				
SLOPE	0.003400 MAIN		0.000500 OUTLET	
LATERAL				
MANHOLE DROP : MAIN	1.460 LATERAL		6.000	

A 6.1

POSITION	ALONG PIPE	PIEZOMETER	READING	CM
120.6	1	46.870		
176.5	2	45.870		
242.0	3	46.860		
303.5	4	46.810		
364.5	5	46.740		
425.5	6	46.730		
486.4	7	46.710		
510.0	8	3.450		
547.4	9	46.700		
563.2	10	46.680		
578.5	11	46.650		
593.7	12	3.540		
606.4	13	46.650		
608.9	14	46.650		
624.2	15	46.600		
639.5	16	44.700		
750.3	17	44.900		
780.3	18	44.730		
811.3	19	44.400		
872.3	20	43.800		
972.0	21	50.070		
304.5	22	50.150		
365.5	23	49.650		
435.7	24	49.140		
496.6	25	48.440		
557.6	26	2.245		
583.7	27	48.070		
588.1	28	47.340		
618.5	29	47.750		
633.3	30	2.205		
644.4	31	47.660		
649.0	32	47.590		
664.3	33	47.230		
679.5	34	44.700		
750.3	35	44.900		
780.3	36	44.720		
811.3	37	44.400		
872.3	38	43.800		
972.0	39			

FLOW RATE (CUBIC CENTIMETERS PER SECOND) 2208.7119
 LATERAL 3313.0696 MAIN
 SLOPE 0.003400 MAIN 0.000500 OUTLET 0.000500
 LATERAL 1.430 LATERAL 6.000
 MANHOLE GRCP : MAIN

11012

POSITION	ALONG PIPE(CV)	PIEZOMETER	READING	CM
	120.6	1	46.450	
	174.5	2	46.430	
	242.6	3	46.400	
	303.5	4	46.350	
	364.5	5	46.330	
	425.5	6	46.290	
	486.4	7	46.250	
	510.0	8	3.250	
	547.4	9	46.230	
	563.2	10	46.210	
	578.3	11	46.180	
	593.7	12	46.180	
	608.4	13	3.300	
	624.2	14	46.180	
	639.5	15	46.180	
	750.3	16	46.180	
	811.3	17	46.180	
	872.3	18	46.180	
	934.3	19	46.180	
	996.3	20	46.180	
	1058.3	21	46.180	
	1120.3	22	46.180	
	1182.3	23	46.180	
	1244.3	24	46.180	
	1306.3	25	46.180	
	1368.3	26	46.180	
	1430.3	27	46.180	
	1492.3	28	46.180	
	1554.3	29	46.180	
	1616.3	30	46.180	
	1678.3	31	46.180	
	1740.3	32	46.180	
	1802.3	33	46.180	
	1864.3	34	46.180	
	1926.3	35	46.180	
	1988.3	36	46.180	
	2050.3	37	46.180	
	2112.3	38	46.180	
	2174.3	39	46.180	
	2236.3	40	46.180	
	2298.3	41	46.180	
	2360.3	42	46.180	
	2422.3	43	46.180	
	2484.3	44	46.180	
	2546.3	45	46.180	
	2608.3	46	46.180	
	2670.3	47	46.180	
	2732.3	48	46.180	
	2794.3	49	46.180	
	2856.3	50	46.180	
	2918.3	51	46.180	
	2980.3	52	46.180	
	3042.3	53	46.180	
	3104.3	54	46.180	
	3166.3	55	46.180	
	3228.3	56	46.180	
	3290.3	57	46.180	
	3352.3	58	46.180	
	3414.3	59	46.180	
	3476.3	60	46.180	
	3538.3	61	46.180	
	3600.3	62	46.180	
	3662.3	63	46.180	
	3724.3	64	46.180	
	3786.3	65	46.180	
	3848.3	66	46.180	
	3910.3	67	46.180	
	3972.3	68	46.180	
	4034.3	69	46.180	
	4096.3	70	46.180	
	4158.3	71	46.180	
	4220.3	72	46.180	
	4282.3	73	46.180	
	4344.3	74	46.180	
	4406.3	75	46.180	
	4468.3	76	46.180	
	4530.3	77	46.180	
	4592.3	78	46.180	
	4654.3	79	46.180	
	4716.3	80	46.180	
	4778.3	81	46.180	
	4840.3	82	46.180	
	4902.3	83	46.180	
	4964.3	84	46.180	
	5026.3	85	46.180	
	5088.3	86	46.180	
	5150.3	87	46.180	
	5212.3	88	46.180	
	5274.3	89	46.180	
	5336.3	90	46.180	
	5398.3	91	46.180	
	5460.3	92	46.180	
	5522.3	93	46.180	
	5584.3	94	46.180	
	5646.3	95	46.180	
	5708.3	96	46.180	
	5770.3	97	46.180	
	5832.3	98	46.180	
	5894.3	99	46.180	
	5956.3	100	46.180	
	6018.3	101	46.180	
	6080.3	102	46.180	
	6142.3	103	46.180	
	6204.3	104	46.180	
	6266.3	105	46.180	
	6328.3	106	46.180	
	6390.3	107	46.180	
	6452.3	108	46.180	
	6514.3	109	46.180	
	6576.3	110	46.180	
	6638.3	111	46.180	
	6700.3	112	46.180	
	6762.3	113	46.180	
	6824.3	114	46.180	
	6886.3	115	46.180	
	6948.3	116	46.180	
	7010.3	117	46.180	
	7072.3	118	46.180	
	7134.3	119	46.180	
	7196.3	120	46.180	
	7258.3	121	46.180	
	7320.3	122	46.180	
	7382.3	123	46.180	
	7444.3	124	46.180	
	7506.3	125	46.180	
	7568.3	126	46.180	
	7630.3	127	46.180	
	7692.3	128	46.180	
	7754.3	129	46.180	
	7816.3	130	46.180	
	7878.3	131	46.180	
	7940.3	132	46.180	
	8002.3	133	46.180	
	8064.3	134	46.180	
	8126.3	135	46.180	
	8188.3	136	46.180	
	8250.3	137	46.180	
	8312.3	138	46.180	
	8374.3	139	46.180	
	8436.3	140	46.180	
	8498.3	141	46.180	
	8560.3	142	46.180	
	8622.3	143	46.180	
	8684.3	144	46.180	
	8746.3	145	46.180	
	8808.3	146	46.180	
	8870.3	147	46.180	
	8932.3	148	46.180	
	8994.3	149	46.180	
	9056.3	150	46.180	
	9118.3	151	46.180	
	9180.3	152	46.180	
	9242.3	153	46.180	
	9304.3	154	46.180	
	9366.3	155	46.180	
	9428.3	156	46.180	
	9490.3	157	46.180	
	9552.3	158	46.180	
	9614.3	159	46.180	
	9676.3	160	46.180	
	9738.3	161	46.180	
	9800.3	162	46.180	
	9862.3	163	46.180	
	9924.3	164	46.180	
	9986.3	165	46.180	
	10048.3	166	46.180	
	10110.3	167	46.180	
	10172.3	168	46.180	
	10234.3	169	46.180	
	10296.3	170	46.180	
	10358.3	171	46.180	
	10420.3	172	46.180	
	10482.3	173	46.180	
	10544.3	174	46.180	
	10606.3	175	46.180	
	10668.3	176	46.180	
	10730.3	177	46.180	
	10792.3	178	46.180	
	10854.3	179	46.180	
	10916.3	180	46.180	
	10978.3	181	46.180	
	11040.3	182	46.180	
	11102.3	183	46.180	
	11164.3	184	46.180	
	11226.3	185	46.180	
	11288.3	186	46.180	
	11350.3	187	46.180	
	11412.3	188	46.180	
	11474.3	189	46.180	
	11536.3	190	46.180	
	11598.3	191	46.180	
	11660.3	192	46.180	
	11722.3	193	46.180	
	11784.3	194	46.180	
	11846.3	195	46.180	
	11908.3	196	46.180	
	11970.3	197	46.180	
	12032.3	198	46.180	
	12094.3	199	46.180	
	12156.3	200	46.180	
	12218.3	201	46.180	
	12280.3	202	46.180	
	12342.3	203	46.180	
	12404.3	204	46.180	
	12466.3	205	46.180	
	12528.3	206	46.180	
	12590.3	207	46.180	
	12652.3	208	46.180	
	12714.3	209	46.180	
	12776.3	210	46.180	
	12838.3	211	46.180	
	12900.3	212	46.180	
	12962.3	213	46.180	
	13024.3	214	46.180	
	13086.3	215	46.180	
	13148.3	216	46.180	
	13210.3	217	46.180	
	13272.3	218	46.180	
	13334.3	219	46.180	
	13396.3	220	46.180	
	13458.3	221	46.180	
	13520.3	222	46.180	
	13582.3	223	46.180	
	13644.3	224	46.180	
	13706.3	225	46.180	
	13768.3	226	46.180	
	13830.3	227	46.180	
	13892.3	228	46.180	
	13954.3	229	46.180	
	14016.3	230	46.180	
	14078.3	231	46.180	
	14140.3	232	46.180	
	14202.3	233	46.180	
	14264.3	234	46.180	
	14326.3	235	46.180	
	14388.3	236	46.180	
	14450.3	237	46.180	
	14512.3	238	46.180	
	14574.3	239	46.180	
	14636.3	240	46.180	
	14698.3	241	46.180	
	14760.3	242	46.180	
	14822.3	243	46.180	
	14884.3	244	46.180	
	14946.3	245	46.180	
	15008.3	246	46.180	
	15070.3	247	46.180	
	15132.3	248	46.180	
	15194.3	249	46.180	
	15256.3	250	46.180	
	15318.3	251	46.180	
	15380.3	252	46.180	
	15442.3	253	46.180	
	15504.3	254	46.180	
	15566.3	255	46.180	
	15628.3	256	46.180	
	15690.3	257	46.180	
	15752.3	258	46.180	
	15814.3	259	46.180	
	15876.3	260	46.180	
	15938.3	261	46.180	
	16000.3	262	46.180	
	16062.3	263	46.180	
	16124.3	264	46.180	
	16186.3	265	46.180	
	16248.3	266	46.180	
	16310.3	267	46.180	
	16372.3	268	46.180	
	16434.3	269	46.180	
	16496.3	270	46.180	
	16558.3	271	46.180	
	16620.3	272	46.180	
	16682.3	273	46.180	
	16744.3	274	46.180	
	16806.3	275	46.180	
	16868.3	276	46.180	
	16930.3	277	46.180	
	16992.3	278	46.180	
	17054.3	279	46.180	
	17116.3	280	46.180	
	17178.3	281	46.180	
	17240.3	282	46.180	
	17302.3	283	46.180	
	17364.3	284	46.180	
	17426.3	285	46.180	
	17488.3	286	46.180	

POSITION ALONG PIPE (CM)	PIEZOMETER READING CM
120.6	45.860
176.5	45.840
242.6	45.800
303.5	45.740
364.5	45.700
425.5	45.640
486.4	45.620
510.0	3.100
547.4	45.590
563.2	45.560
578.5	45.550
593.7	45.550
608.4	45.550
624.2	45.520
639.5	45.520
750.3	43.900
780.8	43.750
811.3	43.650
872.3	43.270
972.6	42.830
304.5	47.600
365.5	47.820
435.7	47.480
496.6	46.910
557.6	1.640
583.7	46.530
598.1	46.320
618.5	46.220
637.8	1.600
644.4	46.110
645.0	46.050
664.3	45.880
679.5	43.900
750.3	43.750
780.8	43.650
811.3	43.270
872.3	42.830
972.6	2208.7119
FLOW RATE (CUBIC CENTIMETERS PER SECOND)	
LATERAL	1840.5545 MAIN
SLOPE	0.003400 MAIN 0.000500 OUTLET 0.000500
LATERAL	1.480 LATERAL 6.000
MANHOLE DROP	

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POSITION ALONG PIPE (CM)	PIEZOMETER READING CM
120.6	45.170
176.5	45.120
242.5	45.070
303.5	44.990
364.5	44.910
425.5	44.830
486.4	44.770
510.0	2.650
547.4	44.740
563.2	44.740
578.5	44.700
593.7	2.665
606.4	44.680
608.9	44.680
624.2	44.630
635.5	43.160
750.7	43.060
780.8	42.880
811.3	42.630
872.3	42.170
972.6	46.340
304.5	46.360
365.5	46.360
435.7	46.140
496.6	45.670
557.6	1.140
583.7	45.400
598.1	45.150
618.5	45.150
633.8	1.150
644.4	44.920
649.0	44.860
664.7	44.750
675.5	43.160
750.3	43.060
780.8	42.880
811.3	42.630
872.3	42.170
972.6	

FLOW RATE (CUBIC CENTIMETERS PER SECOND) 2208.7119
 LATERAL 1104.3564 MAIN
 SLOPE 0.00340 MAIN 0.00500 CUTLET 0.000500
 MANHOLE DRCD : MAIN 1.480 LATERAL 6.000

POSITION ALONG PIPE (CM)

POSITION ALONG PIPE (CM)	PIEZOMETER READING CM
120.6	44.620
176.5	44.500
242.6	44.400
303.5	44.330
364.5	44.230
425.5	44.040
496.4	43.970
510.0	2.350
547.4	43.870
563.2	43.860
578.5	43.820
593.7	43.800
606.4	2.340
608.9	43.750
624.2	43.720
639.5	43.670
750.3	42.350
780.8	42.330
811.3	42.180
872.3	42.000
872.6	41.600
904.5	45.250
935.5	45.340
935.7	45.150
936.6	44.930
957.6	44.480
963.7	0.690
982.1	44.200
982.5	44.000
982.5	43.940
982.5	0.690
982.5	43.940
982.5	43.790
982.5	43.710
982.5	42.380
982.5	42.330
982.5	42.180
982.5	42.000
982.5	41.600

FLOW RATE (CURIC CENTIMETERS PER SECOND) 2208.7119
 LATEFAL 438.9106 MAIN
 SLOPE 0.003400 MAIN 0.000500 CUTLET 0.000500
 LATERAL 1.420 LATERAL 6.000
 MANHOLE CROP : MAIN

POSITION	ALONG PIPE (CM)	PIEZOMETER	READING	CM
	120.5	1	46.990	
	176.5	2	46.950	
	242.6	3	46.940	
	303.5	4	46.890	
	364.5	5	46.850	
	425.5	6	46.820	
	486.4	7	46.820	
	510.0	8	3.480	
	547.4	9	46.820	
	578.2	10	46.820	
	593.7	11	46.760	
	606.4	12	46.760	
	608.9	13	3.515	
	624.2	14	46.760	
	635.5	15	46.760	
	750.2	16	45.350	
	780.8	17	45.700	
	811.3	18	45.630	
	872.3	19	45.310	
	972.6	20	44.040	
	304.5	21	51.760	
	365.5	22	51.530	
	435.7	23	50.800	
	496.6	24	50.240	
	557.6	25	49.600	
	583.7	26	2.670	
	588.1	27	49.250	
	618.5	28	48.950	
	633.8	29	48.900	
	644.4	30	2.630	
	649.0	31	48.820	
	664.2	32	48.730	
	679.5	33	48.500	
	750.3	34	45.350	
	780.8	35	45.700	
	811.3	36	45.630	
	872.3	37	45.310	
	972.6	38	44.640	
	972.6	39		
FLOW RATE (CUBIC CENTIMETERS PER SECOND)			2208.7119	
LATERAL	3964.3569	MAIN		
SLCPE	0.003400	MAIN	0.000500	OUTLET
LATERAL	1.480	LATERAL	6.000	
MANHOLE	DRCP	MAIN		

ENERGY LOSS COEFFICIENTS

NO	K2	K3	K2L	K3M	LELJ	MELJ	TELL	TELM	K2RUS	K2LRUS	K3RUS	K3MRUS	KC	CELJ
1	2.69	-0.16	1.51	-1.25	4.32	-0.26	10.32	1.22	1.57	0.73	-0.46	-3.59	1.67	2.69
MAIN FLOW LATERAL FLOW RATIO RATIO2 VELINM VELINL VELOUT														
2208.712 3964.357 0.64 1.79 20.09 79.32 56.15 10.842 9.166 9.105														

K2: LATERAL LOSS COEF W.R.T. OUTLET VELOCITY
 K3: MAIN LOSS COEFFICIENT W.R.T. OUTLET VELOCITY
 K2L: W.R.T. MAIN INLET VELOCITY
 K3M: W.R.T. MAIN INLET VELOCITY
 LELJ: LATERAL ENERGY LOSS DUE TO JUNCTION
 MELJ: MAIN ENERGY LOSS THROUGH JUNCTION
 TELM: TOTAL ENERGY LOSS TO TOTAL FLOW
 RATIO: OF LATERAL FLOW AND OUTLET VELOCITIES
 VELIN: VELOCITY INLET TO MAIN FLOW
 RATIO2: LATERAL JUNCTION LOSS COEFFICIENT
 KC: COMBINED JUNCTION LOSS PREDICTION EQUATION -FOR COMPARISON
 K3RUS: BASED ON RUSSIAN PREDICTION EQUATION

POWER LOSS

MAIN POWER	LATERAL POWER	OUT POWER	POWER LOSS RATIO
240132.1250	449162.1875	672725.6875	0.0240

POSITION ALONG PIPE (CM)	PIEZOMETER READING CM
120.6	46.800
176.5	46.800
242.6	46.740
303.5	46.710
364.5	46.660
425.5	46.640
486.4	46.620
510.0	3.400
547.4	46.600
563.2	46.580
578.5	46.510
593.7	46.500
606.4	3.410
608.9	46.580
624.2	46.540
635.5	45.460
750.3	45.510
780.8	45.380
811.3	45.100
872.3	44.460
972.6	51.150
304.5	51.030
365.5	50.600
435.7	50.170
456.6	49.290
557.6	2.590
583.7	49.040
588.1	48.770
618.5	48.670
637.8	2.560
644.4	48.600
649.0	48.440
664.3	47.650
679.5	45.460
750.3	45.510
780.8	45.380
811.3	45.100
872.3	44.460
972.6	

FLOW RATE (CUBIC CENTIMETERS PER SECOND) 2208.7119
 LATERAL 4077.6248 MAIN
 SLOPE 0.003400 MAIN 0.000500 OUTLET 0.000500
 LATERAL 1.480 LATERAL 6.000
 MANHOLE DROP : MAIN

ENERGY LOSS COEFFICIENTS

NO	K2	K3	K2L	K3M	LELJ	MELJ	TELL	TELM	K2RUS	K2LRUS	K3RUS	K3MRUS	KC	CELJ
1	2.84	-0.25	1.40	-1.81	4.74	-0.42	10.74	1.06	1.60	0.73	-0.48	-3.90	1.76	2.93
MAIN FLOW LATERAL FLOW RATIO RATIO2 VELINM 20.94														
2208.712 4077.625 0.65 1.85 99.20 57.18 10.675 9.413 8.773														

K2:LATERAL LOSS COEF W.R.T. OUTLET VELOCITY
 K3: MAIN LOSS COEFFICIENT W.R.T. OUTLET VELOCITY
 K2L: W.R.T. LATERAL INLET VELOCITY
 K3M: W.R.T. MAIN INLET VELOCITY
 LELJ: LATERAL ENERGY LOSS DUE TO JUNCTION
 MELJ: MAIN ENERGY LOSS DUE TO JUNCTION
 TELM: TOTAL ENERGY LOSS THROUGH JUNCTION
 RATIO OF LATERAL FLOW TO TOTAL FLOW
 VELIN: VELOCITY INLET AND OUTLET VELOCITIES
 RATIO2: LATERAL FLOW TO MAIN FLOW
 KC: COMBINED JUNCTION LOSS COEFFICIENT
 K3RUS : BASED ON RUSSIAN PREDICTION EQUATION -FOR COMPARISON

POWER LOSS

MAIN POWER	LATERAL POWER	OUT POWER	POWER LOSS RATIO
239399.0625	463002.3125	684018.9375	0.0262

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POSITION ALONG PIPE (CM)	PIEZOMETER READING CM
120.6	46.430
176.5	46.430
242.6	46.380
303.5	46.350
364.5	46.320
425.5	46.280
486.4	46.250
510.0	3.260
547.4	46.220
563.2	46.200
593.7	46.180
606.4	3.290
608.9	46.180
624.2	46.180
639.5	46.180
750.3	43.690
780.8	42.940
811.3	42.800
872.3	42.670
972.6	43.090
304.5	51.240
365.5	50.190
435.7	50.600
496.6	50.200
557.6	49.440
583.7	2.610
588.1	49.060
618.5	48.720
633.8	48.700
644.4	2.560
649.0	48.640
664.3	48.490
679.5	47.540
750.3	43.690
780.8	42.940
811.3	42.800
872.3	42.670
972.6	43.090

FLOW RATE (CUBIC CENTIMETERS PER SECOND) 2208.7119
 LATERAL 4077.6248 MAIN
 SLOPE 0.003400 MAIN 0.000500 OUTLET 0.000500
 LATERAL 1.480 LATERAL 6.000
 MANHOLE DROP : MAIN

A9.1

ENERGY LOSS COEFFICIENTS

NO	K2	K3	K2L	K3M	L2J	MELJ	TELL	TELM	K2RUS	K2LRUS	K3RUS	K3MRUS	KC	CELJ
1	1.87	-0.07	1.54	-0.83	1.22	-0.20	11.22	1.28	1.60	0.73	-0.48	-3.90	1.19	3.31
MAIN FLOW LATERAL FLOW RATIO RATIO2 VELINM VELINL VELOUT														
2208.712 4077.625 0.65 1.85 21.89 99.20 73.97 10.253 9.472 8.572														

K2: LATERAL LOSS COEF W.R.T. OUTLET VELOCITY
 K3: MAIN LOSS COEFFICIENT W.R.T. OUTLET VELOCITY
 K2L: W.R.T. LATERAL INLET VELOCITY
 K3M: W.R.T. MAIN INLET VELOCITY
 L2J: LATERAL ENERGY LOSS DUE TO JUNCTION
 MELJ: MAIN ENERGY LOSS DUE TO JUNCTION
 TELM: TOTAL ENERGY LOSS THROUGH JUNCTION
 TELM: TOTAL ENERGY LOSS TO TOTAL FLOW
 RATIO OF LATERAL FLOW TO TOTAL FLOW
 VELIN: VELOCITY INLET AND OUTLET VELOCITIES
 RATIO2: LATERAL FLOW TO MAIN FLOW
 VELINL: LATERAL JUNCTION LOSS COEFFICIENT
 VELOUT: COMBINED JUNCTION LOSS COEFFICIENT
 K3RUS: BASED ON RUSSIAN PREDICTION EQUATION -FOR COMPARISON

POWER LOSS

MAIN POWER	LATERAL POWER	OUT POWER	POWER LOSS RATIO
238955.3750	463240.2500	681371.8125	0.0297

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POSITION ALONG PIPE (CM)	PIEZOMETER READING CM
120.6	50.860
176.5	50.790
242.6	50.720
303.5	50.630
364.5	50.580
425.5	50.450
486.4	50.370
510.0	50.340
547.4	50.300
563.2	50.280
578.5	50.250
593.7	50.250
606.4	50.250
608.9	50.220
624.2	50.220
639.5	47.660
750.3	47.660
780.8	47.680
811.3	47.430
872.6	47.070
972.6	46.000
304.5	50.850
365.5	50.660
425.7	50.300
495.6	50.170
557.6	50.100
583.7	50.060
618.5	50.100
673.2	50.180
644.4	50.100
649.0	50.050
664.3	50.050
679.5	47.660
750.3	47.680
780.8	47.430
811.3	47.030
872.6	46.000
972.6	46.000

FLU. RATE (CURRIC CENTIMETERS PER SECOND) 5663.3672
 LATERAL 3398.0190 MAIN
 SLOPE 3.003400 MAIN 3.000000 LEFT 0.000500
 MANHOLE DROP : MAIN 1.480 LATERAL 6.000

B1.1

POSITION ALONG PIPE (CM)	PIEZOMETER READING CM
120.0	50.300
176.5	50.200
242.6	50.080
303.5	49.950
364.5	49.900
425.5	49.800
486.4	49.700
510.0	49.640
547.4	49.650
563.2	49.650
578.5	49.620
593.7	49.570
606.4	49.530
608.4	49.530
624.2	49.530
639.5	47.210
750.3	47.210
780.8	47.000
811.3	46.540
872.3	45.790
972.6	45.790
557.6	2.690
583.7	49.320
548.1	49.320
618.5	49.360
623.8	2.600
644.4	49.760
649.0	49.760
664.3	49.360
670.5	47.210
750.3	47.210
790.8	47.000
811.3	46.540
872.3	45.790
972.6	45.790

FLOW RATE (CUBIC CENTIMETERS PER SECOND) 5663.3672

FLCPE LATERAL 0.003400 MAIN 0.000500 OUTLET 0.000500
 LATERAL DROP : MAIN 1.480 LATERAL 6.000

B1.2

POSITION	ALONG PIPE (CM)	PIEZOMETER	READING	CM
	120.6	1	49.310	
	176.5	2	49.160	
	242.5	3	49.050	
	303.5	4	48.910	
	364.5	5	48.760	
	425.5	6	48.650	
	486.4	7	48.620	
	516.0	8	48.160	
	547.4	9	48.450	
	563.2	10	48.420	
	578.5	11	48.360	
	593.7	12	48.310	
	606.4	13	48.120	
	624.2	14	48.310	
	639.5	15	48.310	
	750.3	16	46.320	
	786.8	17	46.440	
	811.3	18	46.280	
	872.6	19	45.860	
	924.5	20	45.220	
	972.5	21	47.190	
	304.5	22	47.990	
	365.5	23	47.990	
	435.7	24	48.020	
	496.6	25	48.020	
	557.6	26	48.020	
	583.7	27	48.020	
	618.5	28	48.020	
	633.8	29	48.020	
	644.4	30	48.020	
	664.3	31	48.020	
	679.5	32	48.020	
	750.3	33	46.320	
	786.8	34	46.440	
	811.3	35	46.280	
	872.6	36	45.860	
	972.5	37	45.220	

FLOW RATE (CUBIC CENTIMETERS PER SECOND) 5663.3672
 LATERAL 1529.1091 MAIN
 SLCPF 0.000500 OUTLET 0.000500
 LATERAL 1.480 LATERAL 5.000
 MANHOLE DROP : MAIN 1.480 LATERAL 5.000

B1.3

POSITION ALONG PIPE (CM)	PIEZOMETER READING CM
1200.6	49.510
1766.5	49.370
2420.6	49.300
3030.5	49.170
3640.5	49.050
4250.5	48.930
4860.4	48.820
5100.0	48.760
5470.4	48.760
5630.2	48.760
5780.5	48.700
5930.7	48.300
6060.4	48.700
6080.9	48.640
6240.2	48.590
6390.5	48.550
7500.7	48.630
7300.8	48.510
8110.3	48.050
8720.3	48.430
9720.6	47.560
9720.6	48.500
3650.5	48.340
4350.7	48.340
4960.6	48.340
5570.6	48.350
5830.7	48.400
5980.1	48.420
6160.5	48.420
6320.3	48.495
6440.4	48.430
6490.0	48.430
6640.3	48.430
6750.5	48.550
7500.3	48.630
7800.8	48.510
8110.3	48.050
8720.3	48.430
9720.6	48.430

FLCW RATE (CURRIC CENTIMETERS PER SECOND) 5663.3672

LATERAL 1840.5945 MAIN
 SLOPE 0.0050 OUTLET 0.0000
 LATERAL 300.340 MAIN 1.480 LATERAL 6.000
 MANHOLE DROP

B1.4

POSITION	ALONG PIPE (CM)	PIEZOMETER	READING	CM
	120.6	1	48.960	
	176.5	2	48.910	
	242.6	3	48.680	
	303.5	4	48.470	
	364.5	5	48.370	
	425.5	6	48.170	
	486.4	7	48.040	
	510.0	8	3.960	
	547.4	9	7.900	
	563.2	10	47.900	
	578.5	11	47.800	
	593.7	12	47.760	
	606.4	13	3.920	
	608.9	14	47.760	
	624.2	15	47.760	
	639.3	16	47.630	
	750.3	17	45.980	
	780.9	18	46.030	
	811.3	19	45.940	
	872.3	20	45.530	
	972.6	21	44.760	
	304.5	22	47.210	
	365.5	23	47.410	
	435.7	24	47.330	
	496.6	25	47.330	
	557.6	26	1.940	
	587.7	27	47.330	
	618.9	28	47.330	
	633.9	29	47.350	
	644.4	30	2.220	
	649.4	31	47.350	
	664.3	32	47.350	
	679.5	33	47.350	
	750.3	34	45.980	
	780.8	35	46.030	
	811.3	36	45.930	
	872.3	37	45.530	
	972.6	38	44.760	
	934.4556	39	5663.3672	

FLOW RATE (CUBIC CENTIMETERS PER SECOND)
 LATERAL 0.00500 CUTLET 0.00500
 SUCPE 0.01340 MAIN 1.480 LATERAL 6.000
 MANHOLE DROP : MAIN 1.480 LATERAL 6.000

B1.5

POSITION ALONG PIPE (CM)	PIEZOMETER	READING	CM
120.6	1	48.660	
176.5	2	48.330	
242.6	3	48.240	
303.5	4	48.660	
364.5	5	47.870	
425.5	6	47.610	
486.4	7	47.520	
510.0	8	3.750	
547.4	9	47.350	
563.2	10	47.310	
578.5	11	47.230	
593.7	12	47.160	
606.4	13	3.670	
608.9	14	47.100	
624.2	15	47.050	
639.5	16	46.910	
750.3	17	45.930	
780.3	18	45.650	
811.3	19	45.550	
872.0	20	45.240	
972.0	21	44.590	
304.5	22	46.550	
365.5	23	46.550	
435.7	24	46.500	
496.6	25	46.420	
557.6	26	46.420	
587.7	27	1.610	
588.1	28	46.420	
618.5	29	46.420	
633.5	30	46.500	
644.4	31	1.720	
649.0	32	46.500	
679.5	33	46.520	
750.3	34	46.530	
780.3	35	45.650	
811.3	36	45.550	
872.0	37	45.240	
972.0	38	44.580	
972.6	39	44.580	

FLOW RATE (CUBIC CENTIMETERS PER SECOND) 5663.3672
 LATERAL 0.00350 OUTLET 0.0000500
 LATERAL 1.480 LATERAL 6.000
 MANHOLE DROP : MAIN

B 1.6

POSITION	ALONG PIPE (CM)	PIEZOMETER	READING	CM
	120.6	1	48.450	
	176.5	2	48.240	
	242.6	3	48.030	
	363.5	4	47.850	
	364.5	5	47.670	
	425.5	6	47.430	
	486.4	7	47.250	
	510.0	8	3.650	
	547.4	9	47.100	
	563.5	10	47.030	
	578.5	11	46.910	
	593.7	12	46.840	
	606.4	13	3.520	
	608.9	14	46.770	
	624.2	15	46.700	
	639.5	16	46.500	
	750.3	17	45.390	
	780.8	18	45.170	
	811.3	19	45.170	
	872.3	20	44.560	
	972.6	21	45.820	
	304.5	22	45.820	
	365.5	23	45.820	
	435.7	24	45.820	
	496.6	25	45.820	
	557.6	26	45.820	
	583.7	27	1.220	
	585.1	28	45.820	
	618.5	29	45.820	
	633.8	30	45.820	
	644.4	31	1.470	
	649.2	32	45.820	
	679.5	33	45.820	
	750.3	34	45.390	
	780.8	35	45.390	
	811.3	36	45.390	
	872.3	37	45.170	
	972.6	38	44.560	
		39		

FLOW RATE (CURRIC CENTIMETERS PER SECOND) 5663.3672
 LATERAL 226.5146 MAIN
 SLOPE 0.0000 OUTLET 0.0000
 LATERAL 1.480 LATERAL 6.000
 MANHOLE DROP MAIN

B17

POSITION ALONG PIPE(CM)	PIEZOMETER READING CM
122.6	51.130
176.5	51.050
242.6	40.950
303.5	50.850
364.5	50.790
425.5	50.680
486.4	50.610
510.0	50.000
547.4	50.570
563.2	50.570
578.5	50.570
593.7	50.570
606.4	50.450
624.2	50.450
639.5	47.730
750.3	47.800
780.8	47.540
811.3	47.320
872.6	46.300
930.4	51.020
965.5	50.620
435.7	50.370
496.6	50.300
557.6	3.160
583.7	50.300
588.1	50.300
618.5	50.300
633.8	5.270
644.4	50.300
649.0	50.300
664.3	50.300
679.5	47.730
750.3	47.800
780.8	47.540
811.3	47.230
872.6	46.300
972.6	

FLOW RATE(CUBIC CENTIMETERS PER SECOND) 5663.3672

PIPE SIZE 3535,6050 MAIN
 LATERAL 0.00050 OUTLET 0.00050
 MANHOLE PROP: MAIN 1.480 LATERAL 6.00

B212

POSITION ALONG PIPE (CM)	PIEZOMETER	READING	CM
120.6	2	50.170	
176.5	3	50.000	
242.6	4	49.883	
303.5	5	49.780	
364.5	6	49.660	
425.5	7	49.600	
486.4	8	4.600	
510.0	9	49.530	
547.4	10	49.510	
563.2	11	49.470	
578.5	12	49.470	
593.7	13	4.570	
606.4	14	49.450	
608.9	15	49.450	
624.2	16	49.347	
639.3	17	47.060	
750.3	18	47.030	
780.8	19	46.790	
811.3	20	46.440	
872.3	21	45.500	
972.6	22	49.200	
972.6	23	49.200	
972.6	24	49.200	
972.6	25	49.200	
972.6	26	49.200	
972.6	27	49.200	
972.6	28	49.200	
972.6	29	49.200	
972.6	30	49.200	
972.6	31	49.200	
972.6	32	49.200	
972.6	33	49.200	
972.6	34	49.200	
972.6	35	49.200	
972.6	36	49.200	
972.6	37	49.200	
972.6	38	49.200	
972.6	39	49.200	
972.6	40	49.200	
972.6	41	49.200	
972.6	42	49.200	
972.6	43	49.200	
972.6	44	49.200	
972.6	45	49.200	
972.6	46	49.200	
972.6	47	49.200	
972.6	48	49.200	
972.6	49	49.200	
972.6	50	49.200	
972.6	51	49.200	
972.6	52	49.200	
972.6	53	49.200	
972.6	54	49.200	
972.6	55	49.200	
972.6	56	49.200	
972.6	57	49.200	
972.6	58	49.200	
972.6	59	49.200	
972.6	60	49.200	
972.6	61	49.200	
972.6	62	49.200	
972.6	63	49.200	
972.6	64	49.200	
972.6	65	49.200	
972.6	66	49.200	
972.6	67	49.200	
972.6	68	49.200	
972.6	69	49.200	
972.6	70	49.200	
972.6	71	49.200	
972.6	72	49.200	
972.6	73	49.200	
972.6	74	49.200	
972.6	75	49.200	
972.6	76	49.200	
972.6	77	49.200	
972.6	78	49.200	
972.6	79	49.200	
972.6	80	49.200	
972.6	81	49.200	
972.6	82	49.200	
972.6	83	49.200	
972.6	84	49.200	
972.6	85	49.200	
972.6	86	49.200	
972.6	87	49.200	
972.6	88	49.200	
972.6	89	49.200	
972.6	90	49.200	
972.6	91	49.200	
972.6	92	49.200	
972.6	93	49.200	
972.6	94	49.200	
972.6	95	49.200	
972.6	96	49.200	
972.6	97	49.200	
972.6	98	49.200	
972.6	99	49.200	
972.6	100	49.200	

B2.2

POSITION ALONG PIPE(CM)	PIEZOMETER	READING	CM
120.6	1	49.340	
176.5	2	49.180	
242.6	3	49.050	
303.5	4	48.900	
364.5	5	48.750	
425.5	6	48.580	
486.4	7	48.490	
510.0	8	48.150	
547.4	9	48.400	
563.2	10	48.360	
578.5	11	48.280	
593.7	12	48.280	
606.4	13	48.290	
624.2	14	48.280	
639.5	15	48.280	
750.3	16	46.300	
780.8	17	46.320	
811.3	18	46.220	
872.3	19	45.750	
972.6	20	45.340	
304.5	21	47.140	
365.7	22	48.040	
435.7	23	48.040	
496.6	24	48.040	
557.6	25	48.040	
583.7	26	2.190	
598.1	27	48.040	
618.5	28	48.040	
633.8	29	48.040	
644.4	30	2.350	
649.0	31	48.040	
664.3	32	48.040	
679.5	33	48.040	
750.3	34	46.300	
780.8	35	46.350	
811.3	36	46.220	
872.3	37	45.750	
972.6	38	45.340	
972.6	39	45.340	

FLOW RATE(CUBIC CENTIMETERS PER SECOND) 5663.3672

LATERAL 1500.7925MAIN
SLOPE 0.003400MAIN 0.000500OUTLET 0.000500
LATERAL 1.483LATERAL 6.000
MANHOLE DROP : MAIN

B2.3

POSITION ALONG PIPE (CM)	PIEZOMETER	READING	CM
120.6	1	48.770	
176.5	2	48.550	
242.4	3	48.350	
303.5	4	48.200	
364.5	5	48.030	
425.5	6	47.830	
486.4	7	47.680	
510.4	8	3.850	
547.4	9	47.560	
563.2	10	47.560	
578.5	11	47.420	
593.7	12	47.420	
606.4	13	3.870	
608.9	14	47.320	
624.2	15	47.200	
639.5	16	47.200	
750.3	17	45.820	
780.0	18	45.820	
811.3	19	45.840	
872.0	20	45.550	
972.6	21	44.850	
972.6	22	44.850	
972.6	23	44.850	
972.6	24	44.850	
972.6	25	44.850	
972.6	26	44.850	
972.6	27	44.850	
972.6	28	44.850	
972.6	29	44.850	
972.6	30	44.850	
972.6	31	44.850	
972.6	32	44.850	
972.6	33	44.850	
972.6	34	44.850	
972.6	35	44.850	
972.6	36	44.850	
972.6	37	44.850	
972.6	38	44.850	
972.6	39	44.850	
972.6	40	44.850	
972.6	41	44.850	
972.6	42	44.850	
972.6	43	44.850	
972.6	44	44.850	
972.6	45	44.850	
972.6	46	44.850	
972.6	47	44.850	
972.6	48	44.850	
972.6	49	44.850	
972.6	50	44.850	
972.6	51	44.850	
972.6	52	44.850	
972.6	53	44.850	
972.6	54	44.850	
972.6	55	44.850	
972.6	56	44.850	
972.6	57	44.850	
972.6	58	44.850	
972.6	59	44.850	
972.6	60	44.850	
972.6	61	44.850	
972.6	62	44.850	
972.6	63	44.850	
972.6	64	44.850	
972.6	65	44.850	
972.6	66	44.850	
972.6	67	44.850	
972.6	68	44.850	
972.6	69	44.850	
972.6	70	44.850	
972.6	71	44.850	
972.6	72	44.850	
972.6	73	44.850	
972.6	74	44.850	
972.6	75	44.850	
972.6	76	44.850	
972.6	77	44.850	
972.6	78	44.850	
972.6	79	44.850	
972.6	80	44.850	
972.6	81	44.850	
972.6	82	44.850	
972.6	83	44.850	
972.6	84	44.850	
972.6	85	44.850	
972.6	86	44.850	
972.6	87	44.850	
972.6	88	44.850	
972.6	89	44.850	
972.6	90	44.850	
972.6	91	44.850	
972.6	92	44.850	
972.6	93	44.850	
972.6	94	44.850	
972.6	95	44.850	
972.6	96	44.850	
972.6	97	44.850	
972.6	98	44.850	
972.6	99	44.850	
972.6	100	44.850	

B2.4

POSITION ALONG PIPE (CM)	PIEZOMETER	READING	CM
120.6	1	48.560	
176.5	2	48.350	
242.6	3	48.150	
303.5	4	48.000	
364.5	5	47.780	
425.5	6	47.560	
486.4	7	47.400	
512.4	8	47.200	
547.4	9	47.270	
567.2	10	47.170	
578.5	11	47.100	
593.7	12	47.050	
606.4	13	46.980	
624.2	14	46.850	
639.3	15	46.750	
750.3	16	45.560	
780.8	17	45.710	
811.3	18	45.570	
872.5	19	45.320	
972.5	20	44.680	
304.5	21	45.680	
365.7	22	46.420	
435.7	23	46.420	
496.6	24	46.420	
557.6	25	46.420	
583.7	26	46.420	
613.5	27	46.420	
633.6	28	46.420	
644.4	29	46.420	
644.4	30	46.420	
664.3	31	46.420	
679.3	32	45.560	
750.3	33	45.710	
780.8	34	45.570	
811.3	35	45.320	
872.5	36	44.680	
972.5	37		
	38		

FLOW RATE (CUBIC CENTIMETERS PER SECOND) 5663.3672
 LATERAL 509.7029 MAIN
 SLCP 340 MAIN 600.0500 OUTLET 6.000
 LATERAL DRCP : MAIN 1.480 LATERAL
 MANHOLE

B.2.5

POSITION ALONG PIPE(CM)	PIEZOMETER READING CM
120.6	48.370
176.5	48.160
242.6	47.990
303.5	47.810
364.5	47.630
425.5	47.380
486.4	47.210
510.0	47.070
547.4	46.930
563.2	46.890
578.5	46.780
593.7	46.750
606.4	46.600
608.9	46.430
624.2	46.310
639.5	45.450
750.3	45.400
780.8	45.140
811.3	44.560
872.3	44.560
972.6	44.560
304.5	45.730
365.5	45.730
435.7	45.730
496.6	45.730
557.6	45.730
583.7	45.730
598.1	45.730
618.5	45.730
633.8	45.730
644.4	45.730
649.0	45.730
664.3	45.730
679.5	45.730
750.3	45.730
780.8	45.730
811.3	45.730
872.3	45.730
972.6	45.730

FLOW RATE(CUBIC CENTIMETERS PER SECOND) 5663.3672
 LATERAL 226.5346MAIN
 SLCP 0.000000OUTLET 0.000000
 MANHOLE DROP :MAIN 1.48LATERAL 5.00C.

B2.6

ENERGY LOSS COEFFICIENTS

NC	K2	K3	K2L	K3M	LELJ	MELJ	TELL	TELM	K2RUS	K2LRUS	K3RUS	K3MRUS	KC	CEL
1	0.67	0.72	1.21	2.35	1.75	1.46	7.75	2.94	0.54	0.70	0.14	0.38	0.78	1.57
2	0.62	0.73	1.05	1.77	1.16	1.36	7.16	2.84	0.24	0.48	0.21	0.45	0.70	1.30
3	0.20	0.70	0.54	1.23	0.34	1.20	6.34	2.68	-0.16	0.70	0.23	0.37	0.59	1.02
4	-0.30	0.74	-1.44	0.99	-0.44	1.19	5.56	2.58	-0.47	-5.13	0.19	0.25	0.61	0.90
5	-0.53	0.80	-4.76	0.95	-0.79	1.22	5.21	2.67	-0.67	-18.74	0.14	0.16	0.69	1.03
6	-0.99	0.83	-23.65	0.86	-1.45	1.22	4.55	2.70	-0.85	-109.14	0.07	0.08	0.76	1.12
MAIN FLOW														
5663.367		3539.605	0.38	0.63	35.27	38.79	52.15	63.03	13.526	9.281	13.508	0.38		
5663.367		2548.515	0.31	0.45	43.68	47.66	44.99	60.39	12.490	7.646	12.332	0.45		
5663.367		1500.792	0.21	0.26	51.51	54.88	33.27	58.14	11.612	5.948	11.090	0.37		
5663.367		863.663	0.13	0.15	16.88	10.06	23.27	53.93	10.810	4.839	10.522	0.25		
5663.367		509.703	0.08	0.09			16.88	53.95	10.530	3.079	10.268	0.16		
5663.367		226.535	0.04	0.04			10.06	53.57	10.530			0.08		

K2: LATERAL LOSS COEFF W.R.T. OUTLET VELOCITY
 K3: MAIN LOSS COEFFICIENT W.R.T. OUTLET VELOCITY
 K2L: W.P.T. LATERAL INLET VELOCITY
 K3M: W.P.T. MAIN INLET VELOCITY
 LELJ: LATERAL ENERGY LOSS DUE TO JUNCTION
 MELJ: MAIN ENERGY LOSS THROUGH JUNCTION
 TELJ: TOTAL ENERGY LOSS TO TOTAL FLOW
 TELM: TOTAL LATERAL FLOW AND OUTLET VELOCITIES
 K2RUS: LATERAL LOSS COEFFICIENT BASED ON RUSSIAN PREDICTION EQUATION -FOR COMPARISON
 K2LRUS: LATERAL LOSS COEFFICIENT BASED ON RUSSIAN PREDICTION EQUATION -FOR COMPARISON
 K3RUS: MAIN LOSS COEFFICIENT BASED ON RUSSIAN PREDICTION EQUATION -FOR COMPARISON
 K3MRUS: MAIN LOSS COEFFICIENT BASED ON RUSSIAN PREDICTION EQUATION -FOR COMPARISON
 KC: COMBINED JUNCTION LOSS COEFFICIENT
 CEL: COMBINED JUNCTION LOSS COEFFICIENT

POWER LOSS

MAIN POWER	LATERAL POWER	OUT POWER	POWER LOSS RATIO
646650.7500	401443.0375	1627611.5625	0.0139
634201.7500	284874.4750	878440.9375	0.0116
628332.2500	165212.3125	786245.8750	0.0092
625923.5625	94117.1875	714169.2500	0.0082
623745.3750	55126.9570	672527.3125	0.0093
622308.0000	24288.1211	640028.6250	0.0102

POSITION	ALONG PIPE (CM)	PIEZOMETER	READING	CM
	120.6	2	51.21	
	176.5	3	51.110	
	242.6	4	51.020	
	303.5	5	50.940	
	364.5	6	50.840	
	425.5	7	50.760	
	486.4	8	50.700	
	510.0	9	50.100	
	547.4	10	50.650	
	563.2	11	50.660	
	578.5	12	50.620	
	593.7	13	50.620	
	600.4	14	50.620	
	608.9	15	50.620	
	624.2	16	50.590	
	639.5	17	47.250	
	757.3	18	47.540	
	781.8	19	47.250	
	811.3	20	46.800	
	872.3	21	51.020	
	972.6	22	50.910	
	304.5	23	50.760	
	365.5	24	50.640	
	435.7	25	50.640	
	496.6	26	3.235	
	557.6	27	50.640	
	583.7	28	50.640	
	598.1	29	50.640	
	618.5	30	3.430	
	633.8	31	50.640	
	644.4	32	50.640	
	649.0	33	50.640	
	664.3	34	50.640	
	679.5	35	47.250	
	750.3	36	47.540	
	780.8	37	47.250	
	811.3	38	46.800	
	872.3	39	45.880	
FLOW RATE (CUBIC CENTIMETERS PER SECOND)	972.6		563.7672	
LATERAL	2973.2668			
SLCPE	0.0050			
LATERAL	0.0050			
MANHOLE DROP : MAIN	1.480			
	1.480			

B31

POSITION	ALONG PIPE (CM)	PIEZOMETER	READING	CM
	120.6	1	50.640	
	176.5	2	50.540	
	242.6	3	50.450	
	303.5	4	50.320	
	364.5	5	50.230	
	425.5	6	50.120	
	486.4	7	50.050	
	510.0	8	49.750	
	547.4	9	49.950	
	563.2	10	49.950	
	578.5	11	49.910	
	593.7	12	49.910	
	606.4	13	49.785	
	608.9	14	49.890	
	624.2	15	49.890	
	639.5	16	49.820	
	750.3	17	46.950	
	780.8	18	47.110	
	811.3	19	46.860	
	872.6	20	46.450	
	904.5	21	45.660	
	935.5	22	50.100	
	966.6	23	50.100	
	997.7	24	50.100	
	1028.8	25	50.100	
	1059.9	26	50.100	
	1090.0	27	50.100	
	1121.1	28	50.100	
	1152.2	29	50.100	
	1183.3	30	50.100	
	1214.4	31	50.100	
	1245.5	32	50.100	
	1276.6	33	50.100	
	1307.7	34	50.100	
	1338.8	35	50.100	
	1369.9	36	50.100	
	1400.0	37	50.100	
	1431.1	38	50.100	
	1462.2	39	50.100	
	1493.3	40	50.100	
	1524.4	41	50.100	
	1555.5	42	50.100	
	1586.6	43	50.100	
	1617.7	44	50.100	
	1648.8	45	50.100	
	1679.9	46	50.100	
	1710.0	47	50.100	
	1741.1	48	50.100	
	1772.2	49	50.100	
	1803.3	50	50.100	
	1834.4	51	50.100	
	1865.5	52	50.100	
	1896.6	53	50.100	
	1927.7	54	50.100	
	1958.8	55	50.100	
	1989.9	56	50.100	
	2020.0	57	50.100	
	2051.1	58	50.100	
	2082.2	59	50.100	
	2113.3	60	50.100	
	2144.4	61	50.100	
	2175.5	62	50.100	
	2206.6	63	50.100	
	2237.7	64	50.100	
	2268.8	65	50.100	
	2299.9	66	50.100	
	2330.0	67	50.100	
	2361.1	68	50.100	
	2392.2	69	50.100	
	2423.3	70	50.100	
	2454.4	71	50.100	
	2485.5	72	50.100	
	2516.6	73	50.100	
	2547.7	74	50.100	
	2578.8	75	50.100	
	2609.9	76	50.100	
	2640.0	77	50.100	
	2671.1	78	50.100	
	2702.2	79	50.100	
	2733.3	80	50.100	
	2764.4	81	50.100	
	2795.5	82	50.100	
	2826.6	83	50.100	
	2857.7	84	50.100	
	2888.8	85	50.100	
	2919.9	86	50.100	
	2950.0	87	50.100	
	2981.1	88	50.100	
	3012.2	89	50.100	
	3043.3	90	50.100	
	3074.4	91	50.100	
	3105.5	92	50.100	
	3136.6	93	50.100	
	3167.7	94	50.100	
	3198.8	95	50.100	
	3229.9	96	50.100	
	3260.0	97	50.100	
	3291.1	98	50.100	
	3322.2	99	50.100	
	3353.3	100	50.100	

B3.2

POSITION	ALONG PIPE(CM)	PIEZOMETER	READING	CM
	120.6	1	49.700	
	176.5	2	49.520	
	242.6	3	49.430	
	303.5	4	49.300	
	364.5	5	49.170	
	425.5	6	49.030	
	486.4	7	48.960	
	510.0	8	48.880	
	547.4	9	48.800	
	563.2	10	48.760	
	578.5	11	48.700	
	593.7	12	48.660	
	606.4	13	48.600	
	624.2	14	48.550	
	639.5	15	48.500	
	750.3	16	48.460	
	750.3	17	48.420	
	811.3	18	48.380	
	872.3	19	48.350	
	972.6	20	48.300	
	304.5	21	48.260	
	335.7	22	48.220	
	435.7	23	48.180	
	495.6	24	48.140	
	557.6	25	48.100	
	583.1	26	48.060	
	618.5	27	48.020	
	633.8	28	47.980	
	644.4	29	47.940	
	649.0	30	47.900	
	664.3	31	47.860	
	679.5	32	47.820	
	750.3	33	47.780	
	780.9	34	47.740	
	811.3	35	47.700	
	872.3	36	47.660	
	972.6	37	47.620	
		38	47.580	
		39	47.540	

FLOW RATE(CUBIC CENTIMETERS PER SECOND) 5663.3672
 LATERAL 1302.5745MAIN
 SLCD 0.00500
 LATERAL 0.00500
 MAIN DROP : MAIN 1.480 LATERAL 6.000

B3.3

POSITION ALONG PIPE (CM)	PIEZOMETER	READING	CM
120.6	1	49.210	
170.5	2	49.060	
242.6	3	48.920	
303.5	4	48.800	
364.5	5	48.610	
425.5	6	48.460	
486.4	7	48.380	
510.0	8	48.090	
547.4	9	48.260	
563.2	10	48.250	
578.5	11	48.200	
593.7	12	48.180	
606.4	13	48.070	
608.9	14	48.150	
624.2	15	48.070	
639.3	16	48.070	
750.3	17	48.520	
780.8	18	48.600	
811.3	19	48.800	
872.7	20	48.760	
972.6	21	48.030	
304.5	22	48.030	
365.5	23	47.960	
435.7	24	47.960	
496.6	25	47.960	
557.6	26	2.190	
583.7	27	47.960	
588.1	28	47.960	
618.5	29	47.960	
633.4	30	47.960	
644.4	31	2.330	
649.0	32	47.960	
664.3	33	47.960	
679.3	34	47.960	
750.3	35	45.520	
780.8	36	46.000	
811.3	37	45.800	
872.7	38	45.410	
972.6	39	44.760	

FLOW RATE (CUBIC CENTIMETERS PER SECOND) 5663.3672
 LATERAL 849.5049 MAIN
 SLOPE 0.00340 MAIN 0.00650 OUTLET 0.006500
 MANHOLE DROP : MAIN 1.480 LATERAL 6.000

B3.4

POSITION ALONG PIPE (CM)	PIEZOMETER	READING	CM
120.6	1	48.910	
176.5	2	48.770	
242.6	3	48.620	
303.5	4	48.450	
364.5	5	48.300	
425.5	6	48.110	
486.4	7	47.990	
510.0	8	47.910	
547.4	9	47.890	
563.2	10	47.850	
578.5	11	47.760	
593.7	12	47.710	
606.4	13	47.710	
608.0	14	47.710	
624.2	15	47.710	
639.5	16	47.700	
750.3	17	45.200	
780.8	18	45.720	
811.3	19	45.550	
872.0	20	44.600	
904.5	21	44.600	
972.6	22	47.460	
304.5	23	47.480	
365.5	24	47.480	
435.7	25	47.480	
496.6	26	47.480	
557.6	27	1.980	
583.7	28	47.480	
588.1	29	47.480	
618.5	30	47.480	
633.8	31	2.100	
644.4	32	47.480	
649.3	33	47.480	
664.3	34	47.480	
679.5	35	45.200	
750.3	36	45.720	
780.8	37	45.550	
811.3	38	45.200	
872.0	39	44.600	
972.6			

FLOW RATE (CUBIC CENTIMETERS PER SECOND) 5663.3672
 LATERAL 495.5664 MAIN
 SLOPE 0.0034 MAIN 0.0050 OUTLET 0.0050
 LATERAL 1.480 LATERAL 6.000
 MANHOLE DROP : MAIN

B3.5

POSITION	ALONG	PIPE(CM)	PIEZOMETER	READING	CM
	120.6		1	48.570	
	176.6		2	48.360	
	242.6		3	48.200	
	303.5		4	48.000	
	364.5		5	47.700	
	425.5		6	47.540	
	486.4		7	47.390	
	547.4		8	47.220	
	563.2		9	47.190	
	578.5		10	47.130	
	593.7		11	47.130	
	606.4		12	47.040	
	608.9		13	47.020	
	624.2		14	46.920	
	639.3		15	46.800	
	750.3		16	46.870	
	780.8		17	45.440	
	811.3		18	45.310	
	872.3		19	45.010	
	972.6		20	44.480	
	304.5		21	46.650	
	305.5		22	46.650	
	335.7		23	46.550	
	435.6		24	46.550	
	496.6		25	46.550	
	557.6		26	46.550	
	587.7		27	46.550	
	608.1		28	46.550	
	618.5		29	46.550	
	637.8		30	46.550	
	644.4		31	46.550	
	664.7		32	46.550	
	679.5		33	46.550	
	750.3		34	46.550	
	780.8		35	45.440	
	811.3		36	45.310	
	872.3		37	45.010	
	972.6		38	44.480	
			39	44.480	
FLOW RATE(CUBIC CENTIMETERS PER SECOND)				5663.3672	
LATERAL					
SCUPE					
LATERAL					
MANHOLE					
DEGP					
MAIN					
1.480					
LATERAL					
6.000					

B3.6

ENERGY LOSS COEFFICIENTS

NO	K2	K3	K9L	K3M	LEJ	MELJ	TELL	TELM	K2RUS	K2LRUS	K3RUS	K3MRUS	KC	CELJ
1	1.05	1.00	2.42	3.13	2.03	1.94	8.03	3.42	0.038	0.061	0.19	0.44	1.02	1.97
2	1.05	1.17	2.17	2.79	1.70	1.03	7.70	3.41	0.027	0.19	0.23	0.43	1.02	1.83
3	1.05	1.16	2.17	2.79	1.92	1.70	6.92	3.27	-0.025	-1.37	0.23	0.25	0.96	1.55
4	0.27	1.04	2.26	1.76	0.45	1.71	6.45	3.13	-0.048	-1.36	0.13	0.16	0.96	1.55
5	0.11	1.03	1.86	1.53	0.16	1.65	5.15	2.96	-0.078	-50.50	0.10	0.11	0.91	1.53
6	0.11	0.98	-9.81	1.33	-0.43	1.48	5.57	2.96	-0.078	-50.50	0.10	0.11	0.91	1.53
MAIN FLOW	2973.267	2067.128	0.34	0.52	34.91	36.87	42.39	61.66	13.082	8.084	13.841	546		
LATERAL FLOW	2067.128	1362.574	0.27	0.36	41.03	36.87	31.57	56.85	12.387	6.510	11.900	316		
5663.367	5663.367	1362.574	0.19	0.23	43.68	41.03	24.64	56.92	11.084	5.969	10.979	844		
5663.367	5663.367	495.544	0.13	0.15	45.96	43.68	18.84	56.02	10.808	4.407	10.844			
5663.367	5663.367	325.644	0.06	0.09	39.31	36.87	12.35	54.47	10.941					
5663.367	5663.367		0.06	0.09			9.27							

KE: LATERAL LOSS COEFFICIENT W.R.T. OUTLET VELOCITY
 KE: MAIN LOSS COEFFICIENT W.R.T. OUTLET VELOCITY
 K9L: W.R.T. MAIN INLET VELOCITY
 K3M: W.R.T. MAIN INLET VELOCITY
 LEJ: MAIN ENERGY LOSS DUE TO JUNCTION
 MELJ: MAIN ENERGY LOSS THROUGH JUNCTION
 TELJ: TOTAL ENERGY LOSS TO TOTAL FLOW
 TELM: TOTAL ENERGY LOSS TO TOTAL FLOW
 K2RUS: LATERAL FLOW INLET AND OUTLET VELOCITIES
 K2LRUS: LATERAL FLOW INLET AND OUTLET VELOCITIES
 K3RUS: LATERAL FLOW INLET AND OUTLET VELOCITIES
 K3MRUS: LATERAL FLOW INLET AND OUTLET VELOCITIES
 KC: COMBINED JUNCTION LOSS COEFFICIENT
 CELJ: COMBINED JUNCTION LOSS COEFFICIENT
 K3DUS: BASED ON RUSSIAN PREDICTION EQUATION - FOR COMPARISON

POWER LOSS

MAIN POWER	LATERAL POWER	OUT POWER	POWER LOSS RATIO
640360.2500	336778.6875	960539.1250	0.0174
636375.7500	231969.4375	864386.0000	0.0166
631547.2500	144123.5000	764332.8750	0.0146
628242.4375	93167.1625	711331.2500	0.0140
626335.9375	34066.1250	67976.9375	0.0139
62557.41250	3334.63672	65261.5000	0.0125

POSITION ALONG PIPE (CM)	PIEZOMETER READING CM
120.6	51.560
176.5	51.450
242.6	51.440
304.5	51.350
356.5	51.240
408.4	51.150
460.4	51.100
512.4	51.095
564.4	51.047
616.4	51.000
668.4	51.000
720.4	50.990
772.4	50.930
824.4	50.930
876.4	50.930
928.4	50.930
980.4	50.930
1032.4	50.930
1084.4	50.930
1136.4	50.930
1188.4	50.930
1240.4	50.930
1292.4	50.930
1344.4	50.930
1396.4	50.930
1448.4	50.930
1500.4	50.930
1552.4	50.930
1604.4	50.930
1656.4	50.930
1708.4	50.930
1760.4	50.930
1812.4	50.930
1864.4	50.930
1916.4	50.930
1968.4	50.930
2020.4	50.930
2072.4	50.930
2124.4	50.930
2176.4	50.930
2228.4	50.930
2280.4	50.930
2332.4	50.930
2384.4	50.930
2436.4	50.930
2488.4	50.930
2540.4	50.930
2592.4	50.930
2644.4	50.930
2696.4	50.930
2748.4	50.930
2800.4	50.930
2852.4	50.930
2904.4	50.930
2956.4	50.930
3008.4	50.930
3060.4	50.930
3112.4	50.930
3164.4	50.930
3216.4	50.930
3268.4	50.930
3320.4	50.930
3372.4	50.930
3424.4	50.930
3476.4	50.930
3528.4	50.930
3580.4	50.930
3632.4	50.930
3684.4	50.930
3736.4	50.930
3788.4	50.930
3840.4	50.930
3892.4	50.930
3944.4	50.930
3996.4	50.930
4048.4	50.930
4100.4	50.930
4152.4	50.930
4204.4	50.930
4256.4	50.930
4308.4	50.930
4360.4	50.930
4412.4	50.930
4464.4	50.930
4516.4	50.930
4568.4	50.930
4620.4	50.930
4672.4	50.930
4724.4	50.930
4776.4	50.930
4828.4	50.930
4880.4	50.930
4932.4	50.930
4984.4	50.930
5036.4	50.930
5088.4	50.930
5140.4	50.930
5192.4	50.930
5244.4	50.930
5296.4	50.930
5348.4	50.930
5400.4	50.930
5452.4	50.930
5504.4	50.930
5556.4	50.930
5608.4	50.930
5660.4	50.930
5712.4	50.930
5764.4	50.930
5816.4	50.930
5868.4	50.930
5920.4	50.930
5972.4	50.930
6024.4	50.930
6076.4	50.930
6128.4	50.930
6180.4	50.930
6232.4	50.930
6284.4	50.930
6336.4	50.930
6388.4	50.930
6440.4	50.930
6492.4	50.930
6544.4	50.930
6596.4	50.930
6648.4	50.930
6700.4	50.930
6752.4	50.930
6804.4	50.930
6856.4	50.930
6908.4	50.930
6960.4	50.930
7012.4	50.930
7064.4	50.930
7116.4	50.930
7168.4	50.930
7220.4	50.930
7272.4	50.930
7324.4	50.930
7376.4	50.930
7428.4	50.930
7480.4	50.930
7532.4	50.930
7584.4	50.930
7636.4	50.930
7688.4	50.930
7740.4	50.930
7792.4	50.930
7844.4	50.930
7896.4	50.930
7948.4	50.930
8000.4	50.930
8052.4	50.930
8104.4	50.930
8156.4	50.930
8208.4	50.930
8260.4	50.930
8312.4	50.930
8364.4	50.930
8416.4	50.930
8468.4	50.930
8520.4	50.930
8572.4	50.930
8624.4	50.930
8676.4	50.930
8728.4	50.930
8780.4	50.930
8832.4	50.930
8884.4	50.930
8936.4	50.930
8988.4	50.930
9040.4	50.930
9092.4	50.930
9144.4	50.930
9196.4	50.930
9248.4	50.930
9300.4	50.930
9352.4	50.930
9404.4	50.930
9456.4	50.930
9508.4	50.930
9560.4	50.930
9612.4	50.930
9664.4	50.930
9716.4	50.930
9768.4	50.930
9820.4	50.930
9872.4	50.930
9924.4	50.930
9976.4	50.930
10028.4	50.930
10080.4	50.930
10132.4	50.930
10184.4	50.930
10236.4	50.930
10288.4	50.930
10340.4	50.930
10392.4	50.930
10444.4	50.930
10496.4	50.930
10548.4	50.930
10600.4	50.930
10652.4	50.930
10704.4	50.930
10756.4	50.930
10808.4	50.930
10860.4	50.930
10912.4	50.930
10964.4	50.930
11016.4	50.930
11068.4	50.930
11120.4	50.930
11172.4	50.930
11224.4	50.930
11276.4	50.930
11328.4	50.930
11380.4	50.930
11432.4	50.930
11484.4	50.930
11536.4	50.930
11588.4	50.930
11640.4	50.930
11692.4	50.930
11744.4	50.930
11796.4	50.930
11848.4	50.930
11900.4	50.930
11952.4	50.930
12004.4	50.930
12056.4	50.930
12108.4	50.930
12160.4	50.930
12212.4	50.930
12264.4	50.930
12316.4	50.930
12368.4	50.930
12420.4	50.930
12472.4	50.930
12524.4	50.930
12576.4	50.930
12628.4	50.930
12680.4	50.930
12732.4	50.930
12784.4	50.930
12836.4	50.930
12888.4	50.930
12940.4	50.930
12992.4	50.930
13044.4	50.930
13096.4	50.930
13148.4	50.930
13200.4	50.930
13252.4	50.930
13304.4	50.930
13356.4	50.930
13408.4	50.930
13460.4	50.930
13512.4	50.930
13564.4	50.930
13616.4	50.930
13668.4	50.930
13720.4	50.930
13772.4	50.930
13824.4	50.930
13876.4	50.930
13928.4	50.930
13980.4	50.930
14032.4	50.930
14084.4	50.930
14136.4	50.930
14188.4	50.930
14240.4	50.930
14292.4	50.930
14344.4	50.930
14396.4	50.930
14448.4	50.930
14500.4	50.930
14552.4	50.930
14604.4	50.930
14656.4	50.930
14708.4	50.930
14760.4	50.930
14812.4	50.930
14864.4	50.930
14916.4	50.930
14968.4	50.930
15020.4	50.930
15072.4	50.930
15124.4	50.930
15176.4	50.930
15228.4	50.930
15280.4	50.930
15332.4	50.930
15384.4	50.930
15436.4	50.930
15488.4	50.930
15540.4	50.930
15592.4	50.930
15644.4	50.930
15696.4	50.930
15748.4	50.930
15800.4	50.930
15852.4	50.930
15904.4	50.930
15956.4	50.930
16008.4	50.930
16060.4	50.930
16112.4	50.930
16164.4	50.930
16216.4	50.930
16268.4	50.930
16320.4	50.930
16372.4	50.930
16424.4	50.930
16476.4	50.930
16528.4	50.930
16580.4	50.930
16632.4	50.930
16684.4	50.930
16736.4	50.930
16788.4	50.930
16840.4	50.930
16892.4	50.930
16944.4	50.930
16996.4	50.930
17048.4	50.930
17100.4	50.930
17152.4	50.930
17204.4	50.930
17256.4	50.930
17308.4	50.930
17360.4	50.930
17412.4	50.930
17464.4	50.930
17516.4	50.930
17568.4	50.930
17620.4	50.930
17672.4	50.930
17724.4	50.930
17776.4	50.930
17828.4	50.930
17880.4	50.930
17932.4	50.930
17984.4	50.930
18036.4	50.930
18088.4	50.930
18140.4	50.930
18192.4	50.930
18244.4	50.930
18296.4	50.930
18348.4	50.930
18400.4	50.930
18452.4	50.930
18504.4	50.930
18556.4	50.930
18608.4	50.930
18660.4	50.930
18712.4	50.930
18764.4	50.930
18816.4	50.930
18868.4	50.930
18920.4	50.930
18972.4	50.930
19024.4	50.930
19076.4	50.930
19128.4	50.930
19180.4	50.930
19232.4	50.930
19284.4	50.930
19336.4	50.930
19388.4	50.930
19440.4	50.930
19492.4	50.930
19544.4	50.930
19596.4	50.930
19648.4	50.930
19700.4	50.930
19752.4	50.930
19804.4	50.930
19856.4	50.930
19908.4	50.930
19960.4	50.930
20012.4	50.930
20064.4	50.930
20116.4	50.930
20168.4	50.930
20220.4	50.930
20272.4	50.930
20324.4	50.930
20376.4	50.930
20428.4	50.930
20480.4	50.930
20532.4	50.930
20584.4	50.930
20636.4	50.930
20688.4	50.930
20740.4	50.930
20792.4	50.930
20844.4	50.930
20896.4	50.930
20948.4	50.930
21000.4	50.930
21052.4	50.930
21104.4	50.930
21156.4	50.930
21208.4	50.930
21260.4	50.930
21312.4	50.930
21364.4	50.930
21416.4	50.930
21468.4	50.930
21520.4	50.930
21572.4	50.930
21624.4	50.930
21676.4	50.930
21728.4	50.930
21780.4	50.930
21832.4	50.930
21884.4	50.930
21936.4	50.930
21988.4	50.930
22040.4	50.930
22092.4	50.930
22144.4	50.930
22196.4	50.930
22248.4	50.930
22300.4	50.930
22352.4	50.930
22404.4	50.930
22456.4	50.930
22508.4	50.930
22560.4	50.930
22612.4	50.930
22664.4	50.930
22716.4	50.930
22768.4	50.930
22820.4	50.930
22872.4	50.930
22924.4	50.930
22976.4	50.930
23028.4	50.930
23080.4	50.930
23132.4	50.930
23184.4	50.930
23236.4	50.930
23288.4	50.930
23340.4	50.930

POSITION	ALONG PIPE (CM)	PIEZOMETER	READING	CM
1	120.6	1	50.930	
2	176.6	2	50.900	
3	242.6	3	50.810	
4	303.5	4	50.710	
5	364.5	5	50.610	
6	425.5	6	50.510	
7	486.4	7	50.470	
8	510.0	8	4.960	
9	547.4	9	50.380	
10	563.2	10	50.310	
11	578.5	11	50.280	
12	593.7	12	4.970	
13	606.4	13	50.280	
14	608.9	14	50.240	
15	624.2	15	46.940	
16	639.5	16	47.400	
17	750.3	17	47.230	
18	787.8	18	45.780	
19	811.3	19	50.700	
20	872.6	20	50.700	
21	972.6	21	50.400	
22	364.5	22	50.330	
23	365.7	23	50.330	
24	425.7	24	3.140	
25	496.6	25	50.290	
26	537.7	26	50.290	
27	583.1	27	50.290	
28	618.5	28	50.290	
29	672.5	29	50.290	
30	673.4	30	50.290	
31	644.4	31	50.290	
32	640.7	32	50.290	
33	664.3	33	46.940	
34	679.5	34	47.400	
35	750.3	35	47.230	
36	787.8	36	46.780	
37	811.3	37	45.780	
38	872.6	38		
39	972.6	39		

FLOW RATE (CUBIC CENTIMETERS PER SECOND) 5663.3672
 LATERAL 288.8315 MAIN
 SLOPE 0.000500
 LATERAL 0.000500
 MANHOLE DROP : MAIN 1.480 LATERAL 6.000

B412

POSITION	ALONG PIPE (CM)	PIEZOMETER	READING
	120.6	1	49.910
	176.5	2	49.800
	242.0	3	49.670
	303.5	4	49.510
	364.5	5	49.310
	425.5	6	49.220
	486.4	7	49.220
	510.0	8	49.150
	547.4	9	49.070
	563.2	10	49.070
	578.5	11	49.020
	593.7	12	49.020
	606.4	13	49.020
	608.9	14	48.950
	624.2	15	48.950
	639.5	16	48.950
	750.3	17	48.950
	780.8	18	48.950
	811.3	19	48.950
	872.5	20	48.950
	872.5	21	48.950
	872.5	22	48.950
	872.5	23	48.950
	872.5	24	48.950
	872.5	25	48.950
	872.5	26	48.950
	872.5	27	48.950
	872.5	28	48.950
	872.5	29	48.950
	872.5	30	48.950
	872.5	31	48.950
	872.5	32	48.950
	872.5	33	48.950
	872.5	34	48.950
	872.5	35	48.950
	872.5	36	48.950
	872.5	37	48.950
	872.5	38	48.950
	872.5	39	48.950
	872.5	40	48.950
	872.5	41	48.950
	872.5	42	48.950
	872.5	43	48.950
	872.5	44	48.950
	872.5	45	48.950
	872.5	46	48.950
	872.5	47	48.950
	872.5	48	48.950
	872.5	49	48.950
	872.5	50	48.950
	872.5	51	48.950
	872.5	52	48.950
	872.5	53	48.950
	872.5	54	48.950
	872.5	55	48.950
	872.5	56	48.950
	872.5	57	48.950
	872.5	58	48.950
	872.5	59	48.950
	872.5	60	48.950
	872.5	61	48.950
	872.5	62	48.950
	872.5	63	48.950
	872.5	64	48.950
	872.5	65	48.950
	872.5	66	48.950
	872.5	67	48.950
	872.5	68	48.950
	872.5	69	48.950
	872.5	70	48.950
	872.5	71	48.950
	872.5	72	48.950
	872.5	73	48.950
	872.5	74	48.950
	872.5	75	48.950
	872.5	76	48.950
	872.5	77	48.950
	872.5	78	48.950
	872.5	79	48.950
	872.5	80	48.950
	872.5	81	48.950
	872.5	82	48.950
	872.5	83	48.950
	872.5	84	48.950
	872.5	85	48.950
	872.5	86	48.950
	872.5	87	48.950
	872.5	88	48.950
	872.5	89	48.950
	872.5	90	48.950
	872.5	91	48.950
	872.5	92	48.950
	872.5	93	48.950
	872.5	94	48.950
	872.5	95	48.950
	872.5	96	48.950
	872.5	97	48.950
	872.5	98	48.950
	872.5	99	48.950
	872.5	100	48.950

B4.3

POSITION ALONG PIPE (CM)	PIEZOMETER	READING	CM
120.6	1	49.420	
176.5	2	49.230	
242.6	3	49.120	
303.5	4	48.970	
364.5	5	48.830	
425.5	6	48.710	
486.4	7	48.700	
510.0	8	48.170	
547.4	9	48.530	
563.2	10	48.530	
578.5	11	48.450	
593.7	12	48.430	
606.4	13	48.430	
608.9	14	48.340	
624.2	15	48.340	
639.5	16	48.770	
750.3	17	46.260	
780.8	18	46.150	
811.3	19	45.810	
872.0	20	45.160	
904.5	21	48.260	
935.5	22	48.330	
965.7	23	48.200	
996.6	24	48.200	
1027.6	25	48.200	
1058.1	26	2.275	
1088.5	27	48.200	
1118.8	28	48.200	
1149.1	29	48.200	
1179.4	30	2.440	
1209.7	31	48.220	
1240.0	32	48.220	
1270.3	33	48.220	
1300.6	34	45.770	
1330.9	35	45.770	
1361.2	36	46.260	
1391.5	37	46.150	
1421.8	38	45.810	
1452.1	39	45.160	

FLOW RATE (CUBIC CENTIMETERS PER SECOND) 5663.3672
 LATERAL 155C, 208C MAIN
 SLOPE 1.3400 MAIN 6.0000 OUTLET 6.0000
 LATERAL 1.4800 LATERAL 6.0000
 MANHOLE 1.4800 LATERAL 6.0000

B4.4

POSITION ALONG PIPE (CM)	PIEZOMETER READING CM
120.6	48.750
176.5	48.550
242.6	48.400
303.5	48.210
364.5	48.000
425.5	47.880
486.4	47.900
510.0	48.790
547.4	47.790
563.2	47.660
578.5	47.660
593.7	3.875
606.4	47.660
608.9	47.660
624.2	47.500
639.5	45.220
750.5	45.800
785.8	45.610
811.3	45.460
872.3	44.840
972.6	47.380
304.5	47.350
365.5	47.260
435.7	47.260
496.6	47.260
557.6	1.865
583.7	47.260
588.1	47.260
618.5	47.260
633.8	2.260
644.4	47.260
649.0	47.260
664.3	47.260
679.5	45.220
750.5	45.800
780.4	45.610
811.3	45.460
872.3	44.840
972.6	5663.3672

FLOW RATE (CUBIC CENTIMETERS PER SECOND)
 LATERAL 877.821 (MAIN)
 SLICE 0.000 (OUTLET)
 LATERAL 1.480 (LATERAL)
 MANHOLE DROP : MAIN 6.000

84.5

POSITION	ALONG PIPE (CM)	PIEZOMETER	READING	CM
	120.6	1	48.567	
	176.5	2	48.550	
	242.6	3	48.150	
	303.5	4	47.960	
	364.5	5	47.750	
	425.5	6	47.510	
	486.4	7	47.380	
	516.0	8	3.650	
	547.4	9	47.230	
	563.2	10	47.180	
	578.5	11	47.070	
	593.7	12	47.000	
	606.4	13	3.640	
	608.9	14	46.950	
	624.2	15	46.900	
	639.5	16	46.770	
	750.3	17	44.970	
	780.8	18	45.500	
	811.3	19	45.320	
	872.2	20	45.150	
	972.0	21	44.620	
	304.5	22	45.370	
	365.5	23	45.370	
	432.7	24	45.370	
	496.6	25	45.370	
	557.6	26	45.370	
	583.7	27	1.550	
	588.1	28	45.370	
	618.5	29	45.370	
	633.8	30	45.370	
	644.4	31	1.715	
	649.0	32	45.370	
	664.5	33	45.370	
	679.5	34	44.930	
	750.3	35	45.500	
	780.8	36	45.330	
	811.3	37	45.130	
	872.0	38	44.620	
	972.6	39		

FLOW RATE (CUBIC CENTIMETERS PER SECOND) 5663.3672
 LATERAL 352.9604 MAIN
 LATERAL 0.0050 OUTLET 0.000500
 MANHOLE DRCP : MAIN 1.480 LATERAL 6.000

B4.6

POSITION	ALONG PIPE (CM)	PIEZOMETER	READING	CM
120.0	1	51.04		
176.5	2	51.060		
242.6	3	50.950		
303.5	4	50.840		
364.5	5	50.740		
425.5	6	50.680		
486.0	7	50.610		
547.4	8	50.510		
563.2	9	50.510		
579.5	10	50.490		
593.7	11	50.410		
606.9	12	50.300		
608.9	13	50.500		
624.2	14	50.450		
639.5	15	47.730		
750.8	16	47.630		
791.3	17	47.350		
811.3	18	47.010		
872.3	19	45.970		
972.6	20	51.050		
504.5	21	51.000		
504.5	22	50.730		
505.7	23	50.580		
496.6	24	50.500		
557.6	25	3.200		
583.7	26	50.500		
588.1	27	50.420		
618.5	28	50.420		
633.6	29	50.420		
644.4	30	50.420		
649.0	31	50.420		
664.3	32	50.420		
679.3	33	47.730		
750.8	34	47.630		
791.3	35	47.350		
811.3	36	47.010		
872.3	37	45.970		
972.6	38			
	39			

FLOW RATE (CUBIC CENTIMETERS PER SECOND) 5663.3672

LATERAL 3313.0 (695 MAIN)
 SLOPE 0.0050 OUTLET 0.00500
 LATERAL 0.0050 MAIN 1.0000 LATERAL 6.000
 MANHOLE DROP : MAIN 1.0000 LATERAL 6.000

B5.1

POSITION	ALONG PIPE (CM)	PIEZOMETER	READING	CM
	120.6	1	50.640	
	176.5	2	50.500	
	242.6	3	50.370	
	303.5	4	50.240	
	364.5	5	50.180	
	425.5	6	50.070	
	486.4	7	50.020	
	510.0	8	49.780	
	547.0	9	49.950	
	563.2	10	49.900	
	578.5	11	49.900	
	593.7	12	49.900	
	606.4	13	49.760	
	608.9	14	49.900	
	624.2	15	49.820	
	639.5	16	49.780	
	750.3	17	47.150	
	780.5	18	47.280	
	811.3	19	46.920	
	872.3	20	46.450	
	972.0	21	45.750	
	304.5	22	50.100	
	365.7	23	50.060	
	435.7	24	49.810	
	466.6	25	49.800	
	557.6	26	49.800	
	587.7	27	2.930	
	588.1	28	49.800	
	618.5	29	49.800	
	633.8	30	49.800	
	644.4	31	49.800	
	649.0	32	3.050	
	664.3	33	49.800	
	679.5	34	49.800	
	750.3	35	47.120	
	780.5	36	47.280	
	811.3	37	46.920	
	872.3	38	46.450	
	972.6	39	45.750	

FLOW RATE (CUBIC CENTIMETERS PER SECOND) 5663.3672
 LATERAL 2483.5637 MAIN
 SLOPE 0.00346 MAIN 0.00050 OUTLET 0.00050
 LATERAL 0.00346 MAIN 1.480 LATERAL 6.000
 MANHOLE 0.00346 MAIN 1.480 LATERAL 6.000

B5.2

POSITION ALONG PIPE (CM)	PIEZOMETER READING CM	FLOW RATE (CUBIC CENTIMETERS PER SECOND)
127.6	50.180	5667.3672
176.5	49.930	
242.6	49.800	
303.5	49.690	
364.5	49.600	
425.5	49.470	
486.4	49.360	
510.0	49.300	
547.4	49.260	
563.2	49.260	
578.5	49.260	
593.7	49.260	
606.4	49.260	
608.9	49.260	
624.2	49.260	
639.5	49.210	
750.3	49.180	
780.8	49.100	
811.3	49.100	
872.6	49.100	
972.6	49.100	
1044.4	49.100	
1116.7	49.100	
1189.1	49.100	
1261.5	49.100	
1333.9	49.100	
1406.3	49.100	
1478.7	49.100	
1551.1	49.100	
1623.5	49.100	
1695.9	49.100	
1768.3	49.100	
1840.7	49.100	
1913.1	49.100	
1985.5	49.100	
2057.9	49.100	
2130.3	49.100	
2202.7	49.100	
2275.1	49.100	
2347.5	49.100	
2419.9	49.100	
2492.3	49.100	
2564.7	49.100	
2637.1	49.100	
2709.5	49.100	
2781.9	49.100	
2854.3	49.100	
2926.7	49.100	
2999.1	49.100	
3071.5	49.100	
3143.9	49.100	
3216.3	49.100	
3288.7	49.100	
3361.1	49.100	
3433.5	49.100	
3505.9	49.100	
3578.3	49.100	
3650.7	49.100	
3723.1	49.100	
3795.5	49.100	
3867.9	49.100	
3940.3	49.100	
4012.7	49.100	
4085.1	49.100	
4157.5	49.100	
4229.9	49.100	
4302.3	49.100	
4374.7	49.100	
4447.1	49.100	
4519.5	49.100	
4591.9	49.100	
4664.3	49.100	
4736.7	49.100	
4809.1	49.100	
4881.5	49.100	
4953.9	49.100	
5026.3	49.100	
5098.7	49.100	
5171.1	49.100	
5243.5	49.100	
5315.9	49.100	
5388.3	49.100	
5460.7	49.100	
5533.1	49.100	
5605.5	49.100	
5677.9	49.100	
5750.3	49.100	
5822.7	49.100	
5895.1	49.100	
5967.5	49.100	
6039.9	49.100	
6112.3	49.100	
6184.7	49.100	
6257.1	49.100	
6329.5	49.100	
6401.9	49.100	
6474.3	49.100	
6546.7	49.100	
6619.1	49.100	
6691.5	49.100	
6763.9	49.100	
6836.3	49.100	
6908.7	49.100	
6981.1	49.100	
7053.5	49.100	
7125.9	49.100	
7198.3	49.100	
7270.7	49.100	
7343.1	49.100	
7415.5	49.100	
7487.9	49.100	
7560.3	49.100	
7632.7	49.100	
7705.1	49.100	
7777.5	49.100	
7849.9	49.100	
7922.3	49.100	
7994.7	49.100	
8067.1	49.100	
8139.5	49.100	
8211.9	49.100	
8284.3	49.100	
8356.7	49.100	
8429.1	49.100	
8501.5	49.100	
8573.9	49.100	
8646.3	49.100	
8718.7	49.100	
8791.1	49.100	
8863.5	49.100	
8935.9	49.100	
9008.3	49.100	
9080.7	49.100	
9153.1	49.100	
9225.5	49.100	
9297.9	49.100	
9370.3	49.100	
9442.7	49.100	
9515.1	49.100	
9587.5	49.100	
9659.9	49.100	
9732.3	49.100	
9804.7	49.100	
9877.1	49.100	
9949.5	49.100	
10021.9	49.100	
10094.3	49.100	
10166.7	49.100	
10239.1	49.100	
10311.5	49.100	
10383.9	49.100	
10456.3	49.100	
10528.7	49.100	
10601.1	49.100	
10673.5	49.100	
10745.9	49.100	
10818.3	49.100	
10890.7	49.100	
10963.1	49.100	
11035.5	49.100	
11107.9	49.100	
11180.3	49.100	
11252.7	49.100	
11325.1	49.100	
11397.5	49.100	
11469.9	49.100	
11542.3	49.100	
11614.7	49.100	
11687.1	49.100	
11759.5	49.100	
11831.9	49.100	
11904.3	49.100	
11976.7	49.100	
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12121.5	49.100	
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12266.3	49.100	
12338.7	49.100	
12411.1	49.100	
12483.5	49.100	
12555.9	49.100	
12628.3	49.100	
12700.7	49.100	
12773.1	49.100	
12845.5	49.100	
12917.9	49.100	
13000.3	49.100	
13072.7	49.100	
13145.1	49.100	
13217.5	49.100	
13289.9	49.100	
13362.3	49.100	
13434.7	49.100	
13507.1	49.100	
13579.5	49.100	
13651.9	49.100	
13724.3	49.100	
13796.7	49.100	
13869.1	49.100	
13941.5	49.100	
14013.9	49.100	
14086.3	49.100	
14158.7	49.100	
14231.1	49.100	
14303.5	49.100	
14375.9	49.100	
14448.3	49.100	
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14593.1	49.100	
14665.5	49.100	
14737.9	49.100	
14810.3	49.100	
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14955.1	49.100	
15027.5	49.100	
15100.0	49.100	
15172.4	49.100	
15244.8	49.100	
15317.2	49.100	
15389.6	49.100	
15462.0	49.100	
15534.4	49.100	
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15679.2	49.100	
15751.6	49.100	
15824.0	49.100	
15896.4	49.100	
15968.8	49.100	
16041.2	49.100	
16113.6	49.100	
16186.0	49.100	
16258.4	49.100	
16330.8	49.100	
16403.2	49.100	
16475.6	49.100	
16548.0	49.100	
16620.4	49.100	
16692.8	49.100	
16765.2	49.100	
16837.6	49.100	
16910.0	49.100	
16982.4	49.100	
17054.8	49.100	
17127.2	49.100	
17200.0	49.100	
17272.4	49.100	
17344.8	49.100	
17417.2	49.100	
17489.6	49.100	
17562.0	49.100	
17634.4	49.100	
17706.8	49.100	
17779.2	49.100	
17851.6	49.100	
17924.0	49.100	
18000.0	49.100	

B5.3

B5.4

POSITION ALONG PIPE (CM)	PIEZOMETER READING CM
120.6	49.000
176.5	48.860
242.5	48.700
303.5	48.500
364.5	48.350
425.5	48.160
486.4	48.010
510.0	47.890
547.4	47.770
563.2	47.770
578.5	47.770
593.7	47.770
606.4	47.770
624.2	47.650
639.5	47.520
750.3	47.490
780.8	47.490
811.7	47.490
872.3	47.490
972.6	47.490
1072.9	47.490
1173.2	47.490
1273.5	47.490
1373.8	47.490
1474.1	47.490
1574.4	47.490
1674.7	47.490
1775.0	47.490
1875.3	47.490
1975.6	47.490
2075.9	47.490
2176.2	47.490
2276.5	47.490
2376.8	47.490
2477.1	47.490
2577.4	47.490
2677.7	47.490
2778.0	47.490
2878.3	47.490
2978.6	47.490
3078.9	47.490
3179.2	47.490
3279.5	47.490
3379.8	47.490
3480.1	47.490
3580.4	47.490
3680.7	47.490
3781.0	47.490
3881.3	47.490
3981.6	47.490
4081.9	47.490
4182.2	47.490
4282.5	47.490
4382.8	47.490
4483.1	47.490
4583.4	47.490
4683.7	47.490
4784.0	47.490
4884.3	47.490
4984.6	47.490
5084.9	47.490
5185.2	47.490
5285.5	47.490
5385.8	47.490
5486.1	47.490
5586.4	47.490
5686.7	47.490
5787.0	47.490
5887.3	47.490
5987.6	47.490
6087.9	47.490
6188.2	47.490
6288.5	47.490
6388.8	47.490
6489.1	47.490
6589.4	47.490
6689.7	47.490
6790.0	47.490
6890.3	47.490
6990.6	47.490
7090.9	47.490
7191.2	47.490
7291.5	47.490
7391.8	47.490
7492.1	47.490
7592.4	47.490
7692.7	47.490
7793.0	47.490
7893.3	47.490
7993.6	47.490
8093.9	47.490
8194.2	47.490
8294.5	47.490
8394.8	47.490
8495.1	47.490
8595.4	47.490
8695.7	47.490
8796.0	47.490
8896.3	47.490
8996.6	47.490
9096.9	47.490
9197.2	47.490
9297.5	47.490
9397.8	47.490
9498.1	47.490
9598.4	47.490
9698.7	47.490
9799.0	47.490
9899.3	47.490
9999.6	47.490
10000.0	47.490

FLOW RATE (CUBIC CENTIMETERS PER SECOND) 5663.3672
 LATERAL 0.00050 OUTLET 0.00050
 LATERAL DRCP : MAIN 1.48 CL LATERAL 5.000

B.5.5

POSITION	ALONG PIPE (CM)	PIEZOMETER	READING	CM
	120.6	1	48.600	
	176.5	2	48.380	
	242.6	3	48.180	
	303.5	4	48.010	
	364.5	5	47.800	
	425.5	6	47.560	
	486.4	7	47.430	
	510.0	8	3.685	
	547.4	9	47.300	
	563.2	10	47.210	
	578.5	11	47.160	
	593.7	12	3.730	
	606.4	13	47.080	
	608.9	14	47.020	
	624.2	15	46.900	
	639.5	16	45.560	
	750.3	17	45.620	
	780.3	18	45.530	
	811.3	19	45.200	
	872.3	20	44.630	
	972.6	21	46.630	
	304.5	22	46.630	
	365.5	23	46.630	
	435.7	24	46.630	
	496.6	25	46.630	
	557.6	26	1.700	
	587.7	27	46.630	
	588.1	28	46.630	
	618.5	29	46.630	
	633.8	30	46.630	
	644.4	31	1.760	
	649.0	32	46.630	
	664.3	33	46.630	
	679.5	34	45.560	
	750.3	35	45.560	
	780.3	36	45.560	
	811.3	37	45.200	
	872.3	38	44.630	
	972.6	39	5663.3672	

FLOW RATE (CUBIC CENTIMETERS PER SECOND) 5663.3672
 LATERAL 504.0396 MAIN
 SLOPE 0.00340 MAIN 0.000500 OUTLET 0.000500
 LATERAL 1.480 LATERAL 6.000
 MANHOLE CRCP : MAIN 1.480 LATERAL 6.000

B56

[illegible]

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K2: LATERAL LOSS COEF W.R.T. OUTLET VELOCITY
K3: MAIN LOSS COEFFICIENT W.R.T. OUTLET VELOCITY
K4L: W.R.T. LATERAL INLET VELOCITY
K5M: W.R.T. MAIN INLET VELOCITY TO JUNCTION
LFLJ: LATERAL ENERGY LOSS TO JUNCTION
LELJ: MAIN ENERGY LOSS THROUGH JUNCTION
TELM: TOTAL ENERGY LOSS TO TOTAL FLOW
RATIO OF LATERAL FLOW AND OUTLET VELOCITIES
VELIN: VELOCITY INLET
VELJ: VELOCITY MAIN FLOW
RATIO: LATERAL FLOW TO MAIN FLOW
K10: COMBINED JUNCTION LOSS COEFFICIENT
K100US: BASED ON RUSSIAN PREDICTION EQUATION -FOR COMPARISON

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POWER LOSS

MAIN POWER	LATERAL POWER	CUT POWER	POWER LOSS RATIO
639578.37500	375147.36250	999634.3125	0.0149
636384.50000	376336.00000	999517.1875	0.0144
633470.12500	150954.00000	771859.1875	0.0166
630173.31250	1206894.56250	827912.00000	0.0109
626989.68750	104628.68750	721269.43750	0.0141
624733.68750	546784.10000	672607.68750	0.0100

POSITION ALONG PIPE (CM)	PIEZOMETER READING CM
120.6	51.140
176.5	51.030
242.5	50.930
303.5	50.850
364.5	50.760
425.5	50.680
496.4	50.620
510.0	50.570
547.4	50.560
563.2	50.540
575.5	50.510
593.7	50.450
606.4	50.450
608.9	50.450
624.2	47.600
639.5	47.500
750.3	47.310
780.8	47.270
811.3	46.620
872.3	46.020
972.3	51.130
972.6	51.000
365.5	50.620
435.7	50.450
496.6	50.450
557.6	50.160
583.7	50.350
588.1	50.400
618.5	50.400
633.8	50.270
644.4	50.400
649.0	50.400
664.3	47.600
679.5	47.500
750.3	47.310
780.8	47.270
811.3	46.020
872.3	46.020

FLOW RATE (CUBIC CENTIMETERS PER SECOND) 5663.3672
 LATERAL 3482.9702 MAIN
 ELCP 0.0034 OUTLET 0.000500
 LATERAL ORCP : MAIN 1.480 LATERAL 6.000

B6.1

POSITION ALONG PIPE(CM)	PIEZOMETER	READING	CM
120.6	1	51.450	
176.5	2	51.360	
242.6	3	51.220	
303.5	4	51.130	
364.5	5	51.080	
425.5	6	50.990	
486.4	7	50.950	
510.0	8	50.130	
547.4	9	50.890	
563.2	10	50.800	
578.5	11	50.800	
593.7	12	50.170	
606.4	13	50.780	
606.4	14	50.780	
624.2	15	50.780	
639.5	16	50.780	
754.3	17	47.950	
780.8	18	47.700	
811.3	19	47.280	
872.3	20	47.100	
972.6	21	46.060	
304.5	22	51.530	
365.5	23	51.300	
435.7	24	50.950	
496.6	25	50.880	
557.6	26	50.810	
583.7	27	3.300	
588.1	28	50.770	
618.5	29	50.770	
633.8	30	50.770	
644.4	31	3.420	
649.0	32	50.770	
664.3	33	50.770	
679.3	34	50.770	
750.3	35	47.850	
780.8	36	47.700	
811.3	37	47.360	
872.3	38	47.100	
972.6	39	46.060	

FLOW RATE(CUBIC CENTIMETERS PER SECOND) 5663.3672

LATERAL SLOPE 0.0340 MAIN 0.0050 OUTLET 0.000500
MANHOLE DROP : MAIN 1.480 LATERAL 6.000

B6.2

POSITION ALONG PIPE (CM)	PIEZOMETER READING	CM
120.6	50.660	
176.5	50.550	
242.6	50.430	
303.5	50.290	
364.5	50.210	
425.5	50.150	
486.4	50.080	
510.0	4.775	
547.4	50.020	
563.2	49.990	
578.5	49.970	
593.7	49.900	
606.4	4.790	
608.9	49.900	
624.2	49.900	
639.5	49.850	
750.3	47.300	
780.8	47.220	
811.3	46.940	
872.3	46.520	
911.3	45.800	
972.6	50.240	
304.5	50.150	
336.5	49.950	
435.7	49.880	
496.6	49.880	
557.6	2.850	
583.7	49.880	
618.5	49.880	
633.8	3.040	
644.3	49.880	
679.5	49.880	
750.3	47.300	
780.8	47.220	
811.3	46.940	
872.3	46.520	
972.6	45.800	

FLOW RATE (CUBIC CENTIMETERS PER SECOND) 5663.3672
 LATERAL 2718.4153 MAIN
 SLOPE 3.003400 MAIN 0.000500 OUTLET 0.000500
 MANHOLE DROP : MAIN 1.480 LATERAL 6.000

B6.3

POSITION ALONG PIPE(CM)	PIEZOMETER	READING	CM
120.6	1	49.630	
176.5	2	49.730	
242.5	3	49.600	
303.5	4	49.500	
364.5	5	49.440	
425.5	6	49.270	
486.4	7	49.170	
510.0	8	49.120	
547.4	9	49.040	
578.5	10	49.040	
603.7	11	49.040	
606.4	12	49.040	
608.9	13	49.040	
624.2	14	49.040	
639.5	15	49.040	
730.3	16	49.040	
780.8	17	49.040	
811.3	18	49.040	
872.5	19	49.040	
972.6	20	49.040	
304.5	21	49.040	
340.5	22	49.040	
365.5	23	49.040	
435.7	24	49.040	
496.6	25	49.040	
557.6	26	49.040	
583.7	27	49.040	
618.5	28	49.040	
633.8	29	49.040	
644.4	30	49.040	
649.7	31	49.040	
664.1	32	49.040	
679.3	33	49.040	
750.3	34	49.040	
780.8	35	49.040	
811.3	36	49.040	
872.5	37	49.040	
972.6	38	49.040	
120.6	39	49.040	

FLOW RATE(CUBIC CENTIMETERS PER SECOND) 5663.3672
 LATERAL 1868.9109MAIN
 SLCPF 0.003400MAIN 0.000500OUTLET 0.000500
 LATERAL 1.480LATERAL 6.000
 MANHOLE DROP : MAIN

B6.4

POSITION ALONG PIPE (CM)	PIEZOMETER	READING	CM
120.6	1	49.200	
176.5	2	49.100	
242.6	3	48.980	
303.5	4	48.820	
364.5	5	48.630	
426.5	6	48.510	
486.4	7	48.430	
510.0	8	48.085	
547.4	9	48.320	
563.2	10	48.320	
578.5	11	48.320	
593.7	12	48.130	
606.4	13	48.240	
618.9	14	48.240	
624.2	15	48.100	
639.3	16	46.250	
750.3	17	46.250	
750.3	18	46.050	
811.3	19	45.770	
872.6	20	45.070	
972.6	21	45.070	
972.6	22	48.080	
972.6	23	48.080	
972.6	24	48.080	
972.6	25	48.080	
972.6	26	48.080	
972.6	27	2.190	
972.6	28	48.080	
972.6	29	48.080	
972.6	30	48.080	
972.6	31	2.335	
972.6	32	48.080	
972.6	33	48.080	
972.6	34	48.080	
972.6	35	46.250	
972.6	36	46.250	
972.6	37	46.050	
972.6	38	45.770	
972.6	39	45.070	

FLOW RATE (CUBIC CENTIMETERS PER SECOND) 5663.3672
 LATERAL 1245.9409 MAIN
 LATERAL 0.0000 OUTLET (0.0000)
 MANHOLE DROP : MAIN 1.480 LATERAL 6.000

B6.5

POSITION	ALONG PIPE (CM)	PIEZOMETER	READING	CM
120.6	1		48.690	
176.5	2		48.560	
242.6	3		48.350	
303.5	4		48.130	
364.5	5		48.020	
425.6	6		47.740	
486.4	7		47.620	
510.0	8		3.810	
547.4	9		47.550	
563.2	10		47.450	
578.5	11		47.450	
593.7	12		3.750	
606.4	13		47.450	
608.9	14		47.320	
624.2	15		47.280	
639.5	16		47.210	
750.3	17		45.580	
780.8	18		45.620	
811.3	19		45.530	
872.6	20		45.120	
904.5	21		44.570	
935.7	22		47.050	
966.6	23		47.050	
997.6	24		47.050	
1028.7	25		47.050	
1059.7	26		47.050	
1090.7	27		1.845	
1121.7	28		47.050	
1152.7	29		47.050	
1183.7	30		47.050	
1214.7	31		2.030	
1245.7	32		47.050	
1276.7	33		47.050	
1307.7	34		47.050	
1338.7	35		45.580	
1369.7	36		45.620	
1400.7	37		45.530	
1431.7	38		45.120	
1462.7	39		44.570	
1493.7	40			
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5740.7				
5771.7				
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8902.7				
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9057.7				
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9150.7				
9181.7				
9212.7				
9243.7				
9274.7				
9305.7				
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9894.7				
9925.7				
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10018.7				
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10142.7				
10173.7				
10204.7				
10235.7				
10266.7				
10297.7				
10328.7				
10359.7				
10390.7				
10421.7				
10452.7				
10483.7				
10514.7				
10545.7				
10576.7				
10607.7				
10638.7				
10669.7				
10700.7				
10731.7				
10762.7				
10793.7				
10824.7				
10855.7				
10886.7				
10917.7				
10948.7				
10979.7				
11010.7				
11041.7				
11072.7				
11103.7				
11134.7				
11165.7				
11196.7				
11227.7				
11258.7				
11289.7				
11320.7				
11351.7				
11382.7				
11413.7				
11444.7				</

POSITION ALONG PIPE(CM)	PIEZOMETER	READING	CM
120.6	1	48.930	
176.5	2	48.740	
242.6	3	48.600	
303.5	4	48.420	
364.0	5	48.230	
425.5	6	48.080	
486.4	7	48.000	
510.0	8	5.900	
547.4	9	47.880	
563.2	10	47.880	
578.5	11	47.750	
593.7	12	47.750	
606.4	13	3.910	
624.2	14	47.750	
639.5	15	47.750	
730.8	16	47.650	
780.8	17	45.900	
811.3	18	45.990	
872.3	19	45.720	
904.5	20	45.370	
935.7	21	44.800	
966.6	22	47.470	
972.6	23	47.470	
983.7	24	47.470	
988.1	25	47.470	
993.8	26	47.470	
999.0	27	2.000	
1004.4	28	47.470	
1009.0	29	47.470	
1014.4	30	47.470	
1019.0	31	2.180	
1024.4	32	47.470	
1029.0	33	47.470	
1034.4	34	47.470	
1039.0	35	45.900	
1044.4	36	45.990	
1049.0	37	45.720	
1054.4	38	45.370	
1059.0	39	44.800	

FLOW RATE(CUBIC CENTIMETERS PER SECOND) 5463.3672
 LATERAL 835.3464MAIN
 SLCP 0.00340CMAIN 0.00050OUTLET 0.000500
 LATERAL DROP :MAIN 1.480LATP 6.000

B6.7

NO	K2	K3	K2L	K3M	LELJ	MELJ	TELL	TELM	K2RUS	K2LRUS	K3RUS	K3MRUS	KC	CELJ
1	1.11	0.92	1.71	3.00	2.16	1.80	8.16	3.28	0.53	0.69	0.15	0.39	0.99	1.93
2	0.99	0.80	1.44	2.57	1.97	1.60	7.97	3.08	0.53	0.69	0.15	0.39	0.87	1.74
3	0.88	0.89	1.64	2.32	1.60	1.61	7.60	3.09	0.30	0.54	0.20	0.45	0.88	1.35
4	0.53	0.91	1.38	1.86	0.88	1.51	6.88	2.99	-0.01	-0.02	0.24	0.43	0.87	1.28
5	0.28	0.95	1.12	1.61	0.44	1.47	6.44	2.95	-0.28	-0.12	0.20	0.27	0.81	1.03
6	-0.10	0.73	-0.45	1.10	-0.17	1.23	5.83	2.71	-0.43	-0.61	0.19	0.25	0.61	1.24
7	0.02	0.93	0.14	1.31	0.03	1.42	6.03	2.90	-0.49	-0.61	0.19	0.25	0.61	1.24
MAIN FLOW														
LATERAL FLOW														
5663.367	3482.970	0.38	0.61	34.24	48.64	61.82	13.408	9.563	13.724	9.563	13.724	13.724		
5663.367	3482.970	0.38	0.61	34.24	48.64	61.82	13.408	9.563	13.724	9.563	13.724	13.724		
5663.367	2718.415	0.32	0.48	36.87	50.73	62.64	13.370	9.342	13.489	9.342	13.489	13.489		
5663.367	1868.911	0.25	0.37	39.86	42.62	59.84	12.703	8.306	12.084	8.306	12.084	12.084		
5663.367	1245.941	0.18	0.22	43.68	34.12	57.15	12.053	5.931	11.466	5.931	11.466	11.466		
5663.367	934.456	0.14	0.16	45.96	26.49	55.11	11.476	4.840	10.764	4.840	10.764	10.764		
5663.367	835.346	0.13	0.15	20.83	20.83	54.69	11.044	5.078	10.979	5.078	10.979	10.979		

K2: LATERAL LOSS COEFF W.R.T. OUTLET VELOCITY
 K3: MAIN LOSS COEFFICIENT W.R.T. OUTLET VELOCITY
 K2L: LATERAL INLET VELOCITY
 K3M: MAIN INLET VELOCITY
 LELJ: LATERAL ENERGY LOSS DUE TO JUNCTION
 MELJ: MAIN ENERGY LOSS DUE TO JUNCTION
 TELJ: TOTAL ENERGY LOSS THROUGH JUNCTION
 TELM: TOTAL ENERGY LOSS THROUGH JUNCTION
 K2RUS: LATERAL FLOW TO TOTAL FLOW
 K2LRUS: LATERAL FLOW TO TOTAL FLOW
 K3RUS: MAIN FLOW TO TOTAL FLOW
 K3MRUS: MAIN FLOW TO TOTAL FLOW
 KC: COMBINED JUNCTION LOSS COEFFICIENT
 CELJ: COMBINED JUNCTION LOSS COEFFICIENT
 K2CUS: BASED ON RUSSIAN PREDICTION EQUATION -FOR COMPARISON

POWER LOSS

MAIN POWER	LATERAL POWER	OUT POWER	POWER LOSS RATIO
641.570	356002.0375	1020203.875	0.0170
643.542	355233.4375	1019854.5625	0.0154
636.315	305659.4375	929020.750	0.0143
632.589	267572.875	829967.9375	0.0121
629.093	137114.9375	757339.875	0.0116
625.114	101832.5625	720132.8125	0.0094
626335.9375	91230.8125	709527.1250	0.0112

B6

POSITION	ALONG	PIPE(CM)	PIEZOMETER	READING	CM
FLW RATE(CUBIC	120.6	1	50.810	5663.3672	
LATERAL	170.5	2	50.710		
SLOPE	242.0	3	50.610		
LATERAL	303.5	4	50.510		
MANHOLE DROP :MAIN	364.5	5	50.460		
	425.5	6	50.350		
	486.4	7	50.250		
	510.0	8	50.150		
	547.4	9	50.050		
	563.2	10	50.000		
	578.5	11	50.000		
	593.7	12	50.000		
	606.4	13	50.000		
	608.9	14	50.000		
	624.2	15	50.000		
	639.5	16	50.000		
	750.3	17	50.000		
	780.8	18	50.000		
	811.3	19	50.000		
	872.3	20	50.000		
	972.6	21	50.000		
		22	50.000		
		23	50.000		
		24	50.000		
		25	50.000		
		26	50.000		
		27	50.000		
		28	50.000		
		29	50.000		
		30	50.000		
		31	50.000		
		32	50.000		
		33	50.000		
		34	50.000		
		35	50.000		
		36	50.000		
		37	50.000		
		38	50.000		
		39	50.000		
		40	50.000		
		41	50.000		
		42	50.000		
		43	50.000		
		44	50.000		
		45	50.000		
		46	50.000		
		47	50.000		
		48	50.000		
		49	50.000		
		50	50.000		

87.1

POSITION ALONG PIPE (CM)	PIEZOMETER	READING	CM
120.6	1	50.100	
176.5	2	50.030	
242.6	3	49.910	
303.5	4	49.760	
364.5	5	49.690	
425.5	6	49.600	
486.4	7	49.520	
510.0	8	49.575	
547.4	9	49.460	
563.2	10	49.450	
578.5	11	49.440	
593.7	12	49.420	
606.4	13	49.580	
608.9	14	49.360	
624.2	15	49.360	
639.5	16	49.310	
750.3	17	47.300	
780.8	18	47.270	
811.3	19	47.230	
872.6	20	46.670	
972.6	21	45.910	
972.6	22	50.110	
972.6	23	50.130	
972.6	24	49.630	
972.6	25	49.570	
972.6	26	49.510	
972.6	27	2.840	
972.6	28	49.620	
972.6	29	49.620	
972.6	30	49.620	
972.6	31	2.960	
972.6	32	49.620	
972.6	33	49.620	
972.6	34	47.310	
972.6	35	47.270	
972.6	36	47.230	
972.6	37	46.670	
972.6	38	45.910	
972.6	39		

FLOW RATE (CUBIC CENTIMETERS PER SECOND) 5663.3672
 LATERAL 2846.3174 MAIN
 SLOPE 0.003400 MAIN 0.000500 OUTLET 0.000500
 MANHOLE DROP : MAIN 1.483 LATERAL 6.000

B7.2

POSITION ALONG PIPE (CM)	PIEZOMETER	READING	CM
120.6	1	49.540	
176.5	2	49.420	
242.6	3	49.280	
303.5	4	49.140	
364.5	5	49.040	
425.5	6	48.910	
486.4	7	48.840	
510.4	8	48.750	
547.4	9	48.740	
563.2	10	48.690	
578.5	11	48.690	
593.7	12	48.290	
606.4	13	48.690	
608.9	14	48.690	
624.2	15	48.570	
639.5	16	48.900	
750.3	17	46.800	
780.3	18	46.650	
811.3	19	46.270	
872.6	20	45.540	
972.6	21	45.540	
972.6	22	45.540	
972.6	23	45.540	
972.6	24	45.540	
972.6	25	45.540	
972.6	26	45.540	
972.6	27	45.540	
972.6	28	45.540	
972.6	29	45.540	
972.6	30	45.540	
972.6	31	45.540	
972.6	32	45.540	
972.6	33	45.540	
972.6	34	45.540	
972.6	35	45.540	
972.6	36	45.540	
972.6	37	45.540	
972.6	38	45.540	
972.6	39	45.540	

FLOW RATE (CUBIC CENTIMETERS PER SECOND) 5663.3672
 LATERAL 0.00340 MAIN 0.00050 CUTLET 0.000500
 SLOPE 0.00340 MAIN 1.480 LATERAL 6.000
 HOLE DROP : MAIN

87.3

POSITION ALONG PIPE (CM)	PIEZOMETER READING CM
126.6	49.000
176.6	48.850
242.6	48.680
303.5	48.540
364.5	48.400
425.5	48.220
486.4	48.110
510.0	48.980
547.4	48.020
563.2	47.980
578.5	47.910
593.7	47.900
606.4	3.950
608.9	47.870
624.2	47.820
639.5	47.770
750.3	46.420
780.8	46.320
811.3	46.160
872.2	45.850
972.6	47.220
304.5	48.200
335.7	48.080
433.6	48.100
496.6	48.100
537.6	48.100
583.7	2.230
588.1	48.100
618.5	48.100
633.9	48.100
644.4	2.320
649.0	48.100
664.3	48.100
679.5	46.420
750.3	46.320
780.8	46.160
811.3	45.860
872.2	45.150
972.6	

FLOW RATE (CUBIC CENTIMETERS PER SECOND) 5663.3672
 LATERAL 1670.6934 MAIN
 SLOPE 0.0340 MAIN 0.0650 OUTLET 0.000500
 LATERAL 1.480 LATERAL 6.000
 MANHOLE DROP : MAIN

B7.4

POSITION	ALONG PIPE(CM)	PIEZOMETER	READING	CM
	120.6	1	48.320	
	176.5	2	48.100	
	242.6	3	47.920	
	303.5	4	47.710	
	364.5	5	47.750	
	425.5	6	47.210	
	486.4	7	46.960	
	510.0	8	46.560	
	547.4	9	46.810	
	563.2	10	46.720	
	578.5	11	46.620	
	593.7	12	46.560	
	606.4	13	46.540	
	628.9	14	46.470	
	624.2	15	46.360	
	639.5	16	46.170	
	750.2	17	44.920	
	780.8	18	45.200	
	811.1	19	45.170	
	872.6	20	44.970	
	972.6	21	44.550	
	304.5	22	45.240	
	365.5	23	45.380	
	435.7	24	45.150	
	496.6	25	44.100	
	557.6	26	44.440	
	583.7	27	44.680	
	598.1	28	44.200	
	618.5	29	44.530	
	633.0	30	44.540	
	644.0	31	44.945	
	649.0	32	44.540	
	664.3	33	44.540	
	679.5	34	44.540	
	750.3	35	44.920	
	780.8	36	45.200	
	811.3	37	45.170	
	872.3	38	44.970	
	972.6	39	44.550	

FLOW RATE(CUBIC CENTIMETERS PER SECOND) 5663.3672
 LATERAL 368.1187MAIN
 SLOPE 0.0034/MAIN 0.0050/OUTLET 0.0050
 MANHOLE DROP:MAIN 1.480LATERAL 6.000

B7.5

POSITION ALONG PIPE (CM)	PIEZOMETER	READING	CM
120.0	1	48.350	
176.5	2	48.180	
242.6	3	48.000	
303.5	4	47.790	
364.5	5	47.550	
425.5	6	47.400	
486.4	7	47.250	
510.0	8	47.150	
547.4	9	47.100	
563.2	10	47.000	
578.5	11	46.880	
593.7	12	45.950	
606.4	13	45.750	
624.2	14	45.490	
639.3	15	44.840	
750.3	16	44.520	
780.8	17	47.310	
811.1	18	47.310	
872.3	19	47.310	
972.6	20	47.310	
364.5	21	47.310	
365.7	22	47.310	
435.7	23	47.310	
496.6	24	47.310	
557.6	25	47.310	
583.7	26	47.310	
598.1	27	47.310	
618.5	28	47.310	
633.4	29	47.310	
644.4	30	47.310	
649.0	31	47.310	
664.3	32	47.310	
679.5	33	45.930	
750.3	34	45.790	
730.8	35	45.790	
811.1	36	45.490	
872.3	37	44.840	
972.6	38		

FLOW RATE (CUBIC CENTIMETERS PER SECOND) 5663.3672
 LATERAL 1146.8318 MAIN
 SLICE 340 MAIN 6000500
 LATERAL 1.480 LATERAL 6.700
 MANHOLE DROP : MAIN

B7.6

ENERGY LOSS	COEFFICIENTS	OUTLET VELOCITY	INLET VELOCITY	LOSS DUE TO JUNCTION	LOSS THROUGH JUNCTION	LOSS TO TOTAL FLOW	INLET AND OUTLET VELOCITIES	LOSS COEFFICIENT	FOR COMPARISON
K2	K3	K2L	K3M	LELJ	MELJ	TELL	TELM	K2RUS	K2LRUS
0.39	0.47	1.13	1.47	1.78	0.95	7.78	2.43	0.55	0.72
0.69	0.48	1.09	1.21	1.32	0.91	7.32	2.39	0.35	0.59
0.50	0.49	0.91	1.03	0.89	0.88	6.88	2.36	0.14	0.34
0.28	0.50	0.67	0.83	0.49	0.87	6.49	2.35	-0.07	-0.32
-1.34	0.76	-5.51	0.90	-2.06	1.16	3.94	2.64	-0.76	-38.72
-0.64	-0.02	0.77	-0.01	0.84	5.99	54.44	2.32	-0.33	-2.19
MAIN FLOW	LATERAL FLOW	RATIO	RATIO2	VELINM	VELINL	VELOUT	E1P	E2P	E3P
5663.367	3737.822	0.40	0.56	35.64	47.21	62.73	13.696	9.477	13.166
5663.367	2888.317	0.34	0.51	38.79	42.09	61.05	12.970	8.287	12.398
5663.367	2265.347	0.29	0.40	41.65	36.27	59.22	12.323	7.209	11.726
5663.367	1670.693	0.23	0.29	45.96	24.08	58.49	11.694	6.182	11.079
5663.367	368.119	0.06	0.06	53.70	28.59	54.86	10.683	2.622	10.367
5663.367	1146.832	0.17	0.20	49.50		55.27	11.321	5.310	10.680

K2: LATERAL LOSS COEFFICIENT W.R.T. OUTLET VELOCITY
 K3: MAIN LOSS COEFFICIENT W.R.T. OUTLET VELOCITY
 K2L: W.R.T. MAIN INLET VELOCITY
 K3M: W.R.T. MAIN INLET VELOCITY
 LELJ: LATERAL ENERGY LOSS DUE TO JUNCTION
 MELJ: MAIN ENERGY LOSS DUE TO JUNCTION
 TELJ: TOTAL ENERGY LOSS THROUGH JUNCTION
 TELM: TOTAL ENERGY LOSS THROUGH JUNCTION
 VELIN: VELOCITY OF LATERAL FLOW TO TOTAL FLOW
 VELINM: VELOCITY OF LATERAL FLOW TO TOTAL FLOW
 VELINL: VELOCITY OF LATERAL FLOW TO TOTAL FLOW
 VELOUT: VELOCITY OF LATERAL FLOW TO TOTAL FLOW
 K2RUS: LATERAL LOSS COEFFICIENT BASED ON RUSSIAN PREDICTION EQUATION -FOR COMPARISON
 K2LRUS: LATERAL LOSS COEFFICIENT BASED ON RUSSIAN PREDICTION EQUATION -FOR COMPARISON
 K3RUS: MAIN LOSS COEFFICIENT BASED ON RUSSIAN PREDICTION EQUATION -FOR COMPARISON
 K3LRUS: MAIN LOSS COEFFICIENT BASED ON RUSSIAN PREDICTION EQUATION -FOR COMPARISON
 E1P: LOSS DUE TO JUNCTION
 E2P: LOSS THROUGH JUNCTION
 E3P: LOSS TO TOTAL FLOW
 KC: LOSS COEFFICIENT
 CELJ: LOSS COEFFICIENT

MAIN POWER	LATERAL POWER	OUT POWER	POWER LOSS RATIO
638714.6250	424654.3750	1051336.0000	0.0113
634364.5625	324706.6250	951132.6250	0.0093
630360.6250	252231.5625	875785.7500	0.0079
626899.8750	184305.7125	805495.8750	0.0070
622867.8750	39299.6875	656237.7500	0.0088
624642.0625	125515.3750	745419.8125	0.0063

B7

POSITION ALONG PIPE (CM)	PIEZOMETER READING	CM
120.6	51.270	
176.5	51.190	
242.6	51.160	
303.5	51.100	
364.5	50.940	
425.5	50.830	
486.4	50.780	
510.0	50.710	
547.4	50.690	
563.2	50.690	
578.5	50.690	
593.7	50.690	
606.4	50.690	
608.9	50.690	
624.2	50.690	
639.5	50.690	
750.3	50.690	
780.3	50.690	
811.3	50.690	
872.6	50.690	
972.6	50.690	

FLOW RATE (CUBIC CENTIMETERS PER SECOND) 5663.3672
 LATERAL 4247.5234 MAIN
 SLEEVE 0.00340 MAIN 0.000500 OUTLET 0.000500
 MANHOLE DROP : MAIN 1.480 LATERAL 5.000

B.1

ENERGY LOSS COEFFICIENTS
 NO K2 K3 K2L K3M LELJ MELJ TELJ TELM K2RUS K2LRUS K3RUS K3MRUS KC CELJ
 1 0.94 0.40 1.04 1.37 1.95 0.83 7.95 2.31 0.72 0.74 0.08 0.25 0.63 1.31
 MAIN FLOW LATERAL FLOW PATIO RATIO2 VELINM VELINL VELOUT EJP E2P E3P
 5663.367 4247.523 0.43 0.75 34.91 59.94 63.78 14.230 10.176 13.584

K2: LATERAL LOSS COEFF. W.R.T. OUTLET VELOCITY
 K3: MAIN LOSS COEFFICIENT W.R.T. OUTLET VELOCITY
 K2L: W.R.T. LATERAL INLET VELOCITY
 K3M: W.R.T. MAIN INLET VELOCITY
 LELJ: LATERAL ENERGY LOSS DUE TO JUNCTION
 MELJ: MAIN ENERGY LOSS DUE TO JUNCTION
 TELJ: TOTAL ENERGY LOSS THROUGH JUNCTION
 TELM: TOTAL ENERGY LOSS TO TOTAL FLOW
 PATIO: OF LATERAL FLOW TO INLET AND OUTLET VELOCITIES
 RATIO2: LATERAL FLOW TO MAIN FLOW
 VELIN: VELOCITY INLET
 VELINM: VELOCITY INLET AND OUTLET VELOCITIES
 PATIO2: LATERAL FLOW TO MAIN FLOW
 KC: COMBINED JUNCTION LOSS COEFFICIENT
 K3RUS: BASED ON RUSSELIAN PREDICTION EQUATION - FOR COMPARISON

POWER LOSS

MAIN POWER LATERAL POWER OUT POWER POWER LOSS RATIO
 641061.750 485529.125 1113623.000 0.0115

B.8

POSITION	ALONG	PIPE(CM)	PIEZOMETER	READING	CM
	125.6		1	51.000	
	176.5		2	50.900	
	242.0		3	50.830	
	303.5		4	50.730	
	364.5		5	50.660	
	425.5		6	50.560	
	486.4		7	50.520	
	510.0		8	4.990	
	547.4		9	50.480	
	563.2		10	50.430	
	578.5		11	50.420	
	593.7		12	50.400	
	608.4		13	4.980	
	624.2		14	50.370	
	639.5		15	50.330	
	750.3		16	48.120	
	780.8		17	47.960	
	811.3		18	47.690	
	872.3		19	47.560	
	904.5		20	46.560	
	935.7		21	51.740	
	966.6		22	51.410	
	997.6		23	51.020	
	1028.6		24	50.760	
	1059.6		25	50.620	
	1090.6		26	50.620	
	1121.6		27	3.250	
	1152.6		28	50.500	
	1183.6		29	50.580	
	1214.6		30	50.570	
	1245.6		31	3.380	
	1276.6		32	50.570	
	1307.6		33	50.570	
	1338.6		34	50.490	
	1369.6		35	48.120	
	1400.6		36	47.960	
	1431.6		37	47.690	
	1462.6		38	47.560	
	1493.6		39	46.560	
	1524.6		40	5663.3672	

B9.1

ENERGY LOSS COEFFICIENTS
 NO K2 K3 K2L K3M LELJ MELJ TELJ TELM K2RUS K2LRUS K3RUS K3MRUS KC CEL
 1 0.97 0.45 1.13 1.51 2.08 0.98 8.08 2.46 0.68 0.74 0.10 0.29 0.67 1.44
 MAIN FLOW LATERAL FLOW RATIO RATIO2 VELINM VELINM VELINM VELINM
 5653.367 4077.625 0.42 0.72 35.64 59.39 65.00 13.768 9.851 13.268

K2: LATERAL LOSS COEF W.P.T. OUTLET VELOCITY
 K3: MAIN LOSS COEFFICIENT W.P.T. OUTLET VELOCITY
 K2L: W.P.T. LATERAL INLET VELOCITY
 K3M: W.P.T. MAIN INLET VELOCITY
 LELJ: LATERAL ENERGY LOSS DUE TO JUNCTION
 MELJ: MAIN ENERGY LOSS DUE TO JUNCTION
 TELM: TOTAL ENERGY LOSS THROUGH JUNCTION
 TELM: CF LATERAL FLOW TO TOTAL FLOW
 RATIO: CF LATERAL FLOW TO TOTAL FLOW
 VELIN: VELOCITY INLET AND OUTLET VELOCITIES
 RATIO2: LATERAL FLOW TO MAIN FLOW
 KC: COMBINED JUNCTION LOSS COEFFICIENT
 K3RUS: BASED ON RUSSIAN PREDICTION EQUATION - FOR COMPARISON

POWER LOSS

MAIN POWER LATERAL POWER OUT POWER POWER LOSS RATIO
 639289.6875 464783.4125 1090038.0000 0.0127

ENERGY LOSS COEFFICIENTS
 NC K2 K3 K2L K3M LELJ MELJ TELL TELM K2RUS K2LRUS K3RUS K3MRUS KC CELJ
 1 0.73 0.29 1.00 1.33 2.41 3.97 8.41 2.45 0.68 E1P 0.74 E2P 0.10 E3P 0.29 0.48 1.57
 MAIN FLOW LATERAL FLOW RATIO RATIO2 VELINL VELOUT 80.49 13.071 9.485 12.560
 563.367 4077.625 0.42 0.72 37.79 66.64

K2: LATERAL LOSS COEFF. W.R.T. OUTLET VELOCITY
 K3: MAIN LOSS COEFFICIENT W.R.T. OUTLET VELOCITY
 K2L: W.R.T. LATERAL INLET VELOCITY
 K3M: W.R.T. MAIN INLET VELOCITY
 LELJ: LATERAL ENERGY LOSS DUE TO JUNCTION
 MELJ: MAIN ENERGY LOSS DUE TO JUNCTION
 TELM: TOTAL ENERGY LOSS THROUGH JUNCTION
 RATIO: TOTAL ENERGY LOSS TO TOTAL FLOW
 RATIO2: LATERAL FLOW TO TOTAL FLOW
 VELINL: INLET AND OUTLET VELOCITIES
 VELOUT: LATERAL FLOW TO MAIN FLOW
 KC: COMBINED JUNCTION LOSS COEFFICIENT
 K2RUS: BASED ON RUSSIAN PREDICTION EQUATION - FOR COMPARISON

POWER LOSS

MAIN POWER LATERAL POWER OUT POWER POWER LOSS RATIO
 6152210.5750 403232.5825 108251.0000 0.0139

B10

POSITION ALONG PIPE(CM)

PIEZOMETER READING CM

120.6	1	44.820
117.6	2	44.190
114.6	3	44.050
111.6	4	43.900
108.6	5	43.740
105.6	6	43.530
102.6	7	43.370
99.6	8	43.210
96.6	9	43.050
93.6	10	42.890
90.6	11	42.730
87.6	12	42.570
84.6	13	42.410
81.6	14	42.250
78.6	15	42.090
75.6	16	41.930
72.6	17	41.770
69.6	18	41.610
66.6	19	41.450
63.6	20	41.290
60.6	21	41.130
57.6	22	40.970
54.6	23	40.810
51.6	24	40.650
48.6	25	40.490
45.6	26	40.330
42.6	27	40.170
39.6	28	39.970
36.6	29	39.770
33.6	30	39.570
30.6	31	39.370
27.6	32	39.170
24.6	33	38.970
21.6	34	38.770
18.6	35	38.570
15.6	36	38.370
12.6	37	38.170
9.6	38	37.970
6.6	39	37.770
3.6	40	37.570
0.6	41	37.370
	42	37.170
	43	36.970
	44	36.770
	45	36.570
	46	36.370
	47	36.170
	48	35.970
	49	35.770
	50	35.570
	51	35.370
	52	35.170
	53	34.970
	54	34.770
	55	34.570
	56	34.370
	57	34.170
	58	33.970
	59	33.770
	60	33.570
	61	33.370
	62	33.170
	63	32.970
	64	32.770
	65	32.570
	66	32.370
	67	32.170
	68	31.970
	69	31.770
	70	31.570
	71	31.370
	72	31.170
	73	30.970
	74	30.770
	75	30.570
	76	30.370
	77	30.170
	78	29.970
	79	29.770
	80	29.570
	81	29.370
	82	29.170
	83	28.970
	84	28.770
	85	28.570
	86	28.370
	87	28.170
	88	27.970
	89	27.770
	90	27.570
	91	27.370
	92	27.170
	93	26.970
	94	26.770
	95	26.570
	96	26.370
	97	26.170
	98	25.970
	99	25.770
	100	25.570

FLOW RATE(CUINCH CNTMETERS PER SECOND)
LATERAL 0.000000
SLOPE 0.003400
LATERAL DROP : MAIN 1.480
LATERAL 0.000500
MAIN 6.000

M2.2

ENERGY LOSS COEFFICIENTS

NO	K2	K3	K2L	K3M	LELJ	MELJ	TELL	TELM	K2RUS	K2LRUS	K3RUS	K3MRUS	KC	CELJ
1	0.00	0.53	0.00	1.42	0.00	2.09	0.00	3.57	UUUUUUUUUU	UUUUUUUUUU	0.00	0.00	0.53	2.09
2	0.00	0.57	0.00	2.07	0.00	1.65	0.00	3.13	UUUUUUUUUU	UUUUUUUUUU	0.00	0.00	0.57	1.65
MAIN FLOW	5663.367	0.000	0.00	0.00	0.00	56.13	0.00	87.58	UUUUUUUUUU	UUUUUUUUUU	10.18	0.00		
LATERAL	2208.714	0.000	0.00	0.00	0.00	41.13	0.00	75.62	UUUUUUUUUU	UUUUUUUUUU	6.17	0.00		

K2: LATERAL LOSS COEFFICIENT W.R.T. OUTLET VELOCITY
 K3: MAIN LOSS COEFFICIENT W.R.T. OUTLET VELOCITY
 K2L: W.R.T. MAIN INLET VELOCITY
 K3M: W.R.T. MAIN INLET VELOCITY
 LELJ: LATERAL ENERGY LOSS DUE TO JUNCTION
 MELJ: MAIN ENERGY LOSS THROUGH JUNCTION
 TELJ: TOTAL ENERGY LOSS TO TOTAL FLOW
 TELM: TOTAL ENERGY LOSS TO TOTAL FLOW
 VELLIN: VELOCITY INLET AND OUTLET VELOCITIES
 VELLIN: LATERAL FLOW TO MAIN FLOW
 RATIO2: LATERAL FLOW LOSS COEFFICIENT EQUATION -FOR COMPARISON
 KC: COMBINED BASED ON RUSSIAN PREDICTION EQUATION -FOR COMPARISON
 K3RUS :

POWER LOSS

MAIN POWER	LATERAL POWER	OUT POWER	POWER LOSS RATIO
0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000

M2

POSITION ALONG PIPE (CH.)	PIEZOMETER	READING	CM
120.6	1	0.0000	
117.6	2	0.0000	
124.2	3	0.0000	
330.3	4	0.0000	
336.4	5	0.0000	
425.5	6	0.0000	
486.4	7	0.0000	
510.0	8	0.0000	
547.0	9	0.0000	
563.3	10	0.0000	
578.3	11	0.0000	
593.3	12	0.0000	
606.4	13	0.0000	
624.2	14	0.0000	
639.2	15	0.0000	
750.0	16	0.0000	
780.0	17	0.0000	
811.2	18	0.0000	
872.2	19	0.0000	
972.2	20	0.0000	
304.5	21	0.0000	
336.5	22	0.0000	
435.5	23	0.0000	
496.6	24	0.0000	
557.7	25	0.0000	
588.8	26	0.0000	
618.8	27	0.0000	
633.3	28	0.0000	
649.4	29	0.0000	
664.4	30	0.0000	
679.5	31	0.0000	
750.0	32	0.0000	
780.0	33	0.0000	
811.2	34	0.0000	
872.2	35	0.0000	
972.2	36	0.0000	
396.4	37	0.0000	
356.0	38	0.0000	
396.4	39	0.0000	
356.0	40	0.0000	

FLOW RATE (CUBIC CENTIMETERS PER SECOND) 0.0000
 LATERAL 396.4
 SLOPE 0.00340 MAIN 0.00500
 LATERAL 1.480 LATERAL 6.000
 MANHOLE DROP : MAIN 1.480 LATERAL 6.000

L2.1

POSITION ALONG PIPE(CM)

PIEZOMETER READING CM

124.6	1	0.0000
176.5	2	0.0000
242.5	3	0.0000
303.5	4	0.0000
364.5	5	0.0000
425.5	6	0.0000
486.5	7	0.0000
547.5	8	0.0000
563.5	9	0.0000
578.5	10	0.0000
593.5	11	0.0000
608.5	12	0.0000
624.5	13	0.0000
639.5	14	0.0000
654.5	15	0.0000
670.5	16	0.0000
685.5	17	0.0000
700.5	18	0.0000
715.5	19	0.0000
730.5	20	0.0000
745.5	21	0.0000
760.5	22	0.0000
775.5	23	0.0000
790.5	24	0.0000
805.5	25	0.0000
820.5	26	0.0000
835.5	27	0.0000
850.5	28	0.0000
865.5	29	0.0000
880.5	30	0.0000
895.5	31	0.0000
910.5	32	0.0000
925.5	33	0.0000
940.5	34	0.0000
955.5	35	0.0000
970.5	36	0.0000
985.5	37	0.0000
1000.5	38	0.0000
1015.5	39	0.0000
1030.5	40	0.0000

FLOW RATE(CUBIC CENTIMETERS PER SECOND) 0.0000

LATERAL 1003400MAIN 0.00500OUTLET 0.000500
SLOPE 1.480LATERAL 6.000
MANHOLE DR3P:MAIN

L2.2

ENERGY LOSS COEFFICIENTS
 NO K2 K3 K2L K2L2 K3M LELJ MELJ TELJ TELM K2RUS K2LRUS K3RUS K3MRUS KC CELJ
 1 5.96 0.00 2.45 0.00 6.55 0.00 12.55 0.00 3.01 0.57 0.00 0.00 5.00 6.01
 2 15.96 0.00 4.13 0.00 6.01 0.00 12.01 0.00 3.01 0.57 0.00 0.00 15.96 6.01
 MAIN FLOW LATERAL FLOW RATIO RATIO2 VELIN VELINL VELOUT K2RUS E1P E2P E3P
 0.0000 3964.357 1.00 0.00 0.00 46.99 50.72 4.304 9.231 10.170
 0.0000 1005.248 1.00 0.00 0.00 46.58 27.16 4.304 9.231 6.170

K2: LATERAL LOSS COEFFICIENTS
 K3: MAIN LOSS COEFFICIENTS
 K2L: MAIN LATERAL LOSS COEFFICIENTS
 K3M: MAIN LATERAL LOSS COEFFICIENTS
 LELJ: MAIN LATERAL LOSS COEFFICIENTS
 MELJ: MAIN LATERAL LOSS COEFFICIENTS
 TELJ: MAIN LATERAL LOSS COEFFICIENTS
 TELM: MAIN LATERAL LOSS COEFFICIENTS
 K2RUS: MAIN LATERAL LOSS COEFFICIENTS
 K2LRUS: MAIN LATERAL LOSS COEFFICIENTS
 K3RUS: MAIN LATERAL LOSS COEFFICIENTS
 K3MRUS: MAIN LATERAL LOSS COEFFICIENTS
 KC: COMBINED BASED ON RUSSIAN PREDICTION EQUATION - FOR COMPARISON
 CELJ: MAIN LATERAL LOSS COEFFICIENTS

POWER LOSS
 MAIN POWER LATERAL POWER OUT POWER POWER LOSS RATIO
 0.0000 0.0000 0.0000 0.0000 0.0000
 0.0000 0.0000 0.0000 0.0000 0.0000

L2

POSITION ALONG PIPE (CM)

PIEZOMETER READING CM

120.6	1	48.650
176.5	2	48.600
242.6	3	48.500
303.5	4	48.500
364.5	5	48.450
425.5	6	48.400
486.4	7	48.400
510.0	8	48.400
547.4	9	48.370
578.2	10	48.370
593.7	11	48.370
608.9	12	48.370
624.2	13	48.370
639.5	14	48.370
750.3	15	48.370
780.3	16	48.370
811.3	17	48.370
872.3	18	48.370
972.3	19	48.370
	20	48.370
	21	48.370
	22	48.370
	23	48.370
	24	48.370
	25	48.370
	26	48.370
	27	48.370
	28	48.370
	29	48.370
	30	48.370
	31	48.370
	32	48.370
	33	48.370
	34	48.370
	35	48.370
	36	48.370
	37	48.370
	38	48.370
	39	48.370
	40	48.370
	41	48.370
	42	48.370
	43	48.370
	44	48.370
	45	48.370
	46	48.370
	47	48.370
	48	48.370
	49	48.370
	50	48.370
	51	48.370
	52	48.370
	53	48.370
	54	48.370
	55	48.370
	56	48.370
	57	48.370
	58	48.370
	59	48.370
	60	48.370
	61	48.370
	62	48.370
	63	48.370
	64	48.370
	65	48.370
	66	48.370
	67	48.370
	68	48.370
	69	48.370
	70	48.370
	71	48.370
	72	48.370
	73	48.370
	74	48.370
	75	48.370
	76	48.370
	77	48.370
	78	48.370
	79	48.370
	80	48.370
	81	48.370
	82	48.370
	83	48.370
	84	48.370
	85	48.370
	86	48.370
	87	48.370
	88	48.370
	89	48.370
	90	48.370
	91	48.370
	92	48.370
	93	48.370
	94	48.370
	95	48.370
	96	48.370
	97	48.370
	98	48.370
	99	48.370
	100	48.370

FLOW RATE (CM³/HR) 5663.3670

LATERAL 3539.6040 MAIN

C1

K2: LATERAL LOSS COEFF W.R.T. OUTLET VELOCITY
K3: MAIN LOSS COEFFICIENT W.R.T. OUTLET VELOCITY
K2LJ: W.R.T. MAIN INLET VELOCITY
K3LJ: W.R.T. MAIN INLET VELOCITY
MELJ: LATERAL ENERGY LOSS DUE TO JUNCTION
TELM: MAIN ENERGY LOSS THROUGH JUNCTION
RATIO: TOTAL ENERGY LOSS 10 TOTAL FLOW
RATIO OF LATERAL FLOW 10 TOTAL FLOW
VELOCITY: INLET AND OUTLET VELOCITIES
RATIO2: LATERAL FLOW TO MAIN FLOW
KC: COMBINED JUNCTION LOSS COEFFICIENT
K3RUS: BASED ON RUSSIAN PREDICTION EQUATION. -FOR COMPARISON

POWELL LOSS

MAIN POWER	LATERAL POWER	OUT POWER	POWER LOSS RATIO
625.27.0000	391670.0000	107121.0000	0.0096

۵

POSITION ALONG PIPE (CM)

PIEZOMETER READING CM

120.0	1	48.300
176.5	2	48.250
242.6	3	48.190
303.5	4	48.160
364.5	5	48.100
425.5	6	48.070
486.4	7	48.040
510.0	8	48.070
547.4	9	48.070
556.3	10	48.070
578.2	11	48.070
593.7	12	48.070
608.4	13	48.070
624.9	14	48.070
639.3	15	48.070
650.0	16	48.070
675.0	17	48.070
710.0	18	48.070
811.1	19	48.070
872.2	20	48.070
972.6	21	48.070
583.7	22	48.070
557.6	23	48.070
496.0	24	48.070
365.7	25	48.070
304.5	26	48.070
272.5	27	48.070
257.1	28	48.070
238.0	29	48.070
229.0	30	48.070
218.0	31	48.070
203.0	32	48.070
183.0	33	48.070
164.0	34	48.070
144.0	35	48.070
124.0	36	48.070
104.0	37	48.070
84.0	38	48.070
64.0	39	48.070
44.0	40	48.070
24.0	41	48.070
4.0	42	48.070

FLOW RATE (CUBIC CENTIMETERS PER SECOND) 563.3670

LATERAL SLOPE 0.01600 MAIN 0.00500 OUTLET 0.005000
LATERAL DROP : MAIN -0.160 LATERAL 5.240
MANHOLE

C2

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K2: LATERAL LOSS COEFF.  $M_R$  1. OUTLET VELOCITY
K3: MAIN LOSS COEFFICIENT  $M_R$  1. OUTLET VELOCITY
K3L:  $M_R$  1. MAIN INLET VELOCITY
K3M:  $M_R$  1. MAIN ENERGY LOSS DUE TO JUNCTION
K3MJ: MAIN ENERGY LOSS THROUGH FLOW
HELW: TOTAL LATERAL INLET AND OUTLET VELOCITIES
RATIO: TOTAL LATERAL INLET AND OUTLET VELOCITIES
VELIN: VELOCITY FLOW TO MAIN FLOW
VELOUT: VELOCITY FLOW TO MAIN FLOW
K102: LATERAL JUNCTION LOSS COEFFICIENT EQUATION
K3COMB: COMBINED BASED ON RUSSIAN PREDICTION EQUATION -FOR COMPARISON
K3RUS:

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22

POSITION ALONG PIPE (CM)

PIEZOMETER READING CM

120.4	1	48.620
116.5	2	48.600
112.6	3	48.550
108.7	4	48.510
104.8	5	48.460
100.9	6	48.420
97.0	7	48.420
93.1	8	48.420
89.2	9	48.420
85.3	10	48.420
81.4	11	48.420
77.5	12	48.420
73.6	13	48.420
69.7	14	48.420
65.8	15	48.420
61.9	16	48.420
58.0	17	48.420
54.1	18	48.420
50.2	19	48.420
46.3	20	48.420
42.4	21	48.420
38.5	22	48.420
34.6	23	48.420
30.7	24	48.420
26.8	25	48.420
22.9	26	48.420
19.0	27	48.420
15.1	28	48.420
11.2	29	48.420
7.3	30	48.420
3.4	31	48.420
0.5	32	48.420
0.6	33	48.420
0.7	34	48.420
0.8	35	48.420
0.9	36	48.420
1.0	37	48.420
1.1	38	48.420
1.2	39	48.420
1.3	40	48.420
1.4	41	48.420
1.5	42	48.420
1.6	43	48.420
1.7	44	48.420
1.8	45	48.420
1.9	46	48.420
2.0	47	48.420
2.1	48	48.420
2.2	49	48.420
2.3	50	48.420
2.4	51	48.420
2.5	52	48.420
2.6	53	48.420
2.7	54	48.420
2.8	55	48.420
2.9	56	48.420
3.0	57	48.420
3.1	58	48.420
3.2	59	48.420
3.3	60	48.420
3.4	61	48.420
3.5	62	48.420
3.6	63	48.420
3.7	64	48.420
3.8	65	48.420
3.9	66	48.420
4.0	67	48.420
4.1	68	48.420
4.2	69	48.420
4.3	70	48.420
4.4	71	48.420
4.5	72	48.420
4.6	73	48.420
4.7	74	48.420
4.8	75	48.420
4.9	76	48.420
5.0	77	48.420
5.1	78	48.420
5.2	79	48.420
5.3	80	48.420
5.4	81	48.420
5.5	82	48.420
5.6	83	48.420
5.7	84	48.420
5.8	85	48.420
5.9	86	48.420
6.0	87	48.420
6.1	88	48.420
6.2	89	48.420
6.3	90	48.420
6.4	91	48.420
6.5	92	48.420
6.6	93	48.420
6.7	94	48.420
6.8	95	48.420
6.9	96	48.420
7.0	97	48.420
7.1	98	48.420
7.2	99	48.420
7.3	100	48.420
7.4	101	48.420
7.5	102	48.420
7.6	103	48.420
7.7	104	48.420
7.8	105	48.420
7.9	106	48.420
8.0	107	48.420
8.1	108	48.420
8.2	109	48.420
8.3	110	48.420
8.4	111	48.420
8.5	112	48.420
8.6	113	48.420
8.7	114	48.420
8.8	115	48.420
8.9	116	48.420
9.0	117	48.420
9.1	118	48.420
9.2	119	48.420
9.3	120	48.420
9.4	121	48.420
9.5	122	48.420
9.6	123	48.420
9.7	124	48.420
9.8	125	48.420
9.9	126	48.420
10.0	127	48.420
10.1	128	48.420
10.2	129	48.420
10.3	130	48.420
10.4	131	48.420
10.5	132	48.420
10.6	133	48.420
10.7	134	48.420
10.8	135	48.420
10.9	136	48.420
11.0	137	48.420
11.1	138	48.420
11.2	139	48.420
11.3	140	48.420
11.4	141	48.420
11.5	142	48.420
11.6	143	48.420
11.7	144	48.420
11.8	145	48.420
11.9	146	48.420
12.0	147	48.420
12.1	148	48.420
12.2	149	48.420
12.3	150	48.420
12.4	151	48.420
12.5	152	48.420
12.6	153	48.420
12.7	154	48.420
12.8	155	48.420
12.9	156	48.420
13.0	157	48.420
13.1	158	48.420
13.2	159	48.420
13.3	160	48.420
13.4	161	48.420
13.5	162	48.420
13.6	163	48.420
13.7	164	48.420
13.8	165	48.420
13.9	166	48.420
14.0	167	48.420
14.1	168	48.420
14.2	169	48.420
14.3	170	48.420
14.4	171	48.420
14.5	172	48.420
14.6	173	48.420
14.7	174	48.420
14.8	175	48.420
14.9	176	48.420
15.0	177	48.420
15.1	178	48.420
15.2	179	48.420
15.3	180	48.420
15.4	181	48.420
15.5	182	48.420
15.6	183	48.420
15.7	184	48.420
15.8	185	48.420
15.9	186	48.420
16.0	187	48.420
16.1	188	48.420
16.2	189	48.420
16.3	190	48.420
16.4	191	48.420
16.5	192	48.420
16.6	193	48.420
16.7	194	48.420
16.8	195	48.420
16.9	196	48.420
17.0	197	48.420
17.1	198	48.420
17.2	199	48.420
17.3	200	48.420
17.4	201	48.420
17.5	202	48.420
17.6	203	48.420
17.7	204	48.420
17.8	205	48.420
17.9	206	48.420
18.0	207	48.420
18.1	208	48.420
18.2	209	48.420
18.3	210	48.420
18.4	211	48.420
18.5	212	48.420
18.6	213	48.420
18.7	214	48.420
18.8	215	48.420
18.9	216	48.420
19.0	217	48.420
19.1	218	48.420
19.2	219	48.420
19.3	220	48.420
19.4	221	48.420
19.5	222	48.420
19.6	223	48.420
19.7	224	48.420
19.8	225	48.420
19.9	226	48.420
20.0	227	48.420
20.1	228	48.420
20.2	229	48.420
20.3	230	48.420
20.4	231	48.420
20.5	232	48.420
20.6	233	48.420
20.7	234	48.420
20.8	235	48.420
20.9	236	48.420
21.0	237	48.420
21.1	238	48.420
21.2	239	48.420
21.3	240	48.420
21.4	241	48.420
21.5	242	48.420
21.6	243	48.420
21.7	244	48.420
21.8	245	48.420
21.9	246	48.420
22.0	247	48.420
22.1	248	48.420
22.2	249	48.420
22.3	250	48.420
22.4	251	48.420
22.5	252	48.420
22.6	253	48.420
22.7	254	48.420
22.8	255	48.420
22.9	256	48.420
23.0	257	48.420
23.1	258	48.420
23.2	259	48.420
23.3	260	48.420
23.4	261	48.420
23.5	262	48.420
23.6	263	48.420
23.7	264	48.420
23.8	265	48.420
23.9	266	48.420
24.0	267	48.420
24.1	268	48.420
24.2	269	48.420
24.3	270	48.420
24.4	271	48.420
24.5	272	48.420
24.6	273	48.420
24.7	274	48.420
24.8	275	48.420
24.9	276	48.420
25.0	277	48.420
25.1	278	48.420
25.2	279	48.420
25.3	280	48.420
25.4	281	48.420
25.5	282	48.420
25.6	283	48.420
25.7	284	48.420
25.8	285	48.420
25.9	286	48.420
26.0	287	48.420
26.1	288	48.420
26.2	289	48.420
26.3	290	48.420
26.4	291	48.420
26.5	292	48.420
26.6	293	48.420
26.7	294	48.420
26.8	295	48.420
26.9	296	48.420
27.0	297	48.420
27.1	298	48.420
27.2	299	48.420
27.3	300	48.420
27.4	301	48.420
27.5	302	48.420
27.6	303	48.420
27.7	304	48.420
27.8	305	48.420
27.9	306	48.420
28.0	307	48.420
28.1	308	48.420
28.2	309	48.420
28.3	310	48.420
28.4	311	48.420
28.5	312	48.420
28.6	313	48.420
28.7	314	48.420
28.8	315	48.420
28.9	316	48.420
29.0	317	48.420
29.1	318	48.420
29.2	319	48.420
29.3	320	48.420
29.4	321	48.420
29.5	322	48.420
29.6	323	48.420
29.7	324	48.420
29.8	325	48.420
29.9	326	48.420
30.0	327	48.420
30.1	328	48.420
30.2	329	48.420
30.3	330	48.420
30.4	331	48.420
30.5	332	48.420
30.6	333	48.420
30.7	334	48.420
30.8	335	48.420
30.9	336	48.420
31.0	337	48.420
31.1	338	48.420
31.2	339	48.420
31.3	340	48.420
31.4	341	48.420
31.5	342	48.420
31.6	343	48.420
31.7	344	48.420
31.8	345	48.420
31.9	346	48.420
32.0	347	48.420
32.1	348	48.420
32.2	349	48.420
32.3	350	48.420
32.4	351	48.420
32.5	352	48.420
32.6	353	48.420
32.7	354	48.420
32.8	355	48.420
32.9	356	48.420
33.0	357	48.420
33.1	358	48.420
33.2	359	48.420
33.3	360	48.420
33.4	361	48.420
33.5	362	48.420
33.6	363	48.420
33.7	364	48.420
33.8	365	48.420
33.9	366	48.420
34.0	367	48.420
34.1	368	48.420
34.2	369	48.420
34.3	370	48.420
34.4	371	48.420
34.5	372	48.420
34.6	373	48.420
34.7	374	48.420
34.8	375	48.420
34.9	376	48.420
35.0	377	48.420
35.1	378	48.420
35.2	379	48.420
35.3	380	48.420
35.4	381	48.420
35.5	382	48.420
35.6	383	48.420
35.7	384	48.420
35.8	385	48.420
35.9	386	48.420
36.0	387	48.420
36.1	388	48.420
36.2	389	48.420
36.3	390	48.420

ENERGY LOSS COEFFICIENTS
 NO K2 K3 K2L K3L K3M LELJ MELJ TELJ TELM K2RUS K2LRUS K3RUS K3MRUS KC CELJ
 1 0.29 0.29 0.33 1.57 0.91 0.91 6.15 0.75 0.54 0.70 0.14 0.38 0.29 0.91
 MAIN FLOW LATERAL FLOW RATIO RATIO RATIO RATIO RATIO RATIO RATIO RATIO RATIO RATIO RATIO RATIO RATIO RATIO RATIO
 5663.367 3539.605 0.38 0.65 33.36 52.15 78.91 12.755 0.428 13.024

K2: LATERAL LOSS COEFFICIENT W.R.T. OUTLET VELOCITY
 K3: MAIN LOSS COEFFICIENT W.R.T. OUTLET VELOCITY
 K2L: MAIN LATERAL INLET VELOCITY
 K3L: MAIN LATERAL INLET VELOCITY
 K3M: MAIN LATERAL ENERGY LOSS DUE TO JUNCTION
 LELJ: MAIN LATERAL ENERGY LOSS THROUGH JUNCTION
 MELJ: MAIN LATERAL ENERGY LOSS THROUGH JUNCTION
 TELJ: TOTAL LATERAL FLOW TO TOTAL FLOW
 TELM: TOTAL LATERAL FLOW AND OUTLET VELOCITIES
 K2RUS: LATERAL FLOW TO MAIN FLOW
 K2LRUS: LATERAL FLOW TO MAIN FLOW
 K3RUS: LATERAL FLOW TO MAIN FLOW
 K3MRUS: LATERAL FLOW TO MAIN FLOW
 KC: COMBINED BASED ON RUSSIAN PREDICTION EQUATION -FOR COMPARISON

POWER LOSS

MAIN POWER LATERAL POWER OUT POWER POWER LOSS RATIO
 625371.1000 390872.8000 107863.0000 0.0082

POSITION ALONG PIPE(CM) PIEZOMETER READING CM

120.0	1	48.140
117.6	2	48.075
115.2	3	48.075
112.8	4	48.000
110.4	5	48.000
108.0	6	48.000
105.6	7	48.000
103.2	8	48.000
100.8	9	48.000
98.4	10	48.000
96.0	11	48.000
93.6	12	48.000
91.2	13	48.000
88.8	14	48.000
86.4	15	48.000
84.0	16	48.000
81.6	17	48.000
79.2	18	48.000
76.8	19	48.000
74.4	20	48.000
72.0	21	48.000
69.6	22	48.000
67.2	23	48.000
64.8	24	48.000
62.4	25	48.000
60.0	26	48.000
57.6	27	48.000
55.2	28	48.000
52.8	29	48.000
50.4	30	48.000
48.0	31	48.000
45.6	32	48.000
43.2	33	48.000
40.8	34	48.000
38.4	35	48.000
36.0	36	48.000
33.6	37	48.000
31.2	38	48.000
28.8	39	48.000
26.4	40	48.000
24.0	41	48.000
21.6	42	48.000
19.2	43	48.000
16.8	44	48.000
14.4	45	48.000
12.0	46	48.000
9.6	47	48.000
7.2	48	48.000
4.8	49	48.000
2.4	50	48.000
0.0	51	48.000

FLOW RATE(CUBIC CENTIMETERS PER SECOND) 5663.3670

LATERAL 2548.5140MAIN
SLOPE 0.005000OUTLET 0.005000
MANHOLE DROP :MAIN -0.160LATERAL 5.240

C4

ENERGY LOSS COEFFICIENTS

NO	K2	K3	K2L37	K3M	LELJ	MELJ	TELL	TELM	K2RUS	K2LRUS	K3RUS	K3MRUS	KC	CELJ
1	0.49	0.53	1.0	2.51	1.25	1.30	0.49	1.34	0.24	0.48	0.21	0.45	0.50	1.42
MAIN FLOW	LATERAL FLOW	INLET FLOW	OUTLET FLOW	INLET FLOW	OUTLET FLOW	INLET FLOW	OUTLET FLOW	INLET FLOW	OUTLET FLOW	INLET FLOW	OUTLET FLOW	INLET FLOW	OUTLET FLOW	INLET FLOW
5663.367	2548.515	0.31	0.45	33.93	37.99	74.69	11.865	7.872	13.527					

K2: LATERAL LOSS COEFFICIENT MAIN T. OUTLET VELOCITY
 K3: MAIN LOSS COEFFICIENT MAIN T. OUTLET VELOCITY
 K2L37: MAIN INLET VELOCITY
 K3M: MAIN INLET VELOCITY
 LELJ: MAIN ENERGY LOSS DUE TO JUNCTION
 MELJ: MAIN ENERGY LOSS THROUGH JUNCTION
 TELM: TOTAL ENERGY LOSS TO OUTLET VELOCITIES
 RATIO: OF LATERAL FLOW AND MAIN FLOW
 RATIO2: LATERAL FLOW TO MAIN COEFFICIENT
 KC: COMBINED BASED ON RUSSIAN PREDICTION EQUATION -FOR COMPARISON
 K3RUS:

POWER LOSS

MAIN POWER 623688.3000
 LATERAL POWER 280011.5000
 OUT POWER 892023.8000
 POWER LOSS RATIO 0.0129

C4

POSITION ALONG PIPE(CM)

PIEZOMETER READING CM

120.6	1	47.700
176.5	2	47.670
242.5	3	47.600
303.5	4	47.560
364.5	5	47.510
425.5	6	47.510
486.5	7	47.510
547.5	8	47.715
510.5	9	47.510
563.5	10	47.510
578.5	11	47.510
593.5	12	47.510
606.5	13	47.510
608.5	14	47.510
624.5	15	47.510
639.5	16	47.510
750.5	17	43.350
780.5	18	42.400
811.5	19	42.410
872.5	20	42.560
972.5	21	42.560
557.5	22	42.560
543.5	23	42.560
496.5	24	42.560
435.5	25	42.560
365.5	26	42.560
304.5	27	42.560
243.5	28	42.560
182.5	29	42.560
121.5	30	42.560
60.5	31	42.560
0.5	32	42.560
0.5	33	42.560
0.5	34	42.560
0.5	35	42.560
0.5	36	42.560
0.5	37	42.560
0.5	38	42.560
0.5	39	42.560
0.5	40	42.560
0.5	41	42.560
0.5	42	42.560
0.5	43	42.560
0.5	44	42.560
0.5	45	42.560
0.5	46	42.560
0.5	47	42.560
0.5	48	42.560
0.5	49	42.560
0.5	50	42.560
0.5	51	42.560
0.5	52	42.560
0.5	53	42.560
0.5	54	42.560
0.5	55	42.560
0.5	56	42.560
0.5	57	42.560
0.5	58	42.560
0.5	59	42.560
0.5	60	42.560
0.5	61	42.560
0.5	62	42.560
0.5	63	42.560
0.5	64	42.560
0.5	65	42.560
0.5	66	42.560
0.5	67	42.560
0.5	68	42.560
0.5	69	42.560
0.5	70	42.560
0.5	71	42.560
0.5	72	42.560
0.5	73	42.560
0.5	74	42.560
0.5	75	42.560
0.5	76	42.560
0.5	77	42.560
0.5	78	42.560
0.5	79	42.560
0.5	80	42.560
0.5	81	42.560
0.5	82	42.560
0.5	83	42.560
0.5	84	42.560
0.5	85	42.560
0.5	86	42.560
0.5	87	42.560
0.5	88	42.560
0.5	89	42.560
0.5	90	42.560
0.5	91	42.560
0.5	92	42.560
0.5	93	42.560
0.5	94	42.560
0.5	95	42.560
0.5	96	42.560
0.5	97	42.560
0.5	98	42.560
0.5	99	42.560
0.5	100	42.560

CS

ENRGY LOSS COEFFICIENTS
 NO K2 K3 K2L K2L71 K3M LELJ MELJ TEL TELM TELM K2RUS K2LRUS K3RUS K3MRUS K3P K3P K3C
 1 26 32 71 48 82 98 80 82 0.24 0.48 0.21 0.45 0.30
 MAIN FLOW LATERAL FLOW RATIO RATIO2 VEL1 VEL2 VELINL VELOUT VEL1P VEL2P VEL3P
 5663.367 2548.515 0.31 0.45 35.27 41.65 77.87 11.801 7.377 12.943 0.93

K2: LATERAL LOSS COEF. M.R.T. OUTLET VELOCITY
 K3: MAIN LOSS COEFFICIENT M.R.T. OUTLET VELOCITY
 K2L: LATERAL INLET VELOCITY
 K3M: MAIN INLET VELOCITY
 LELJ: LATERAL ENERGY LOSS DUE TO JUNCTION
 MELJ: MAIN ENERGY LOSS DUE TO JUNCTION
 TEL: TOTAL ENERGY LOSS THROUGH JUNCTION
 TELM: TOTAL ENERGY LOSS TO TOTAL FLOW
 RATIO: OF LATERAL FLOW TO TOTAL FLOW
 RATIO2: OF LATERAL FLOW TO TOTAL FLOW
 VELIN: INLET VELOCITY
 VELOUT: OUTLET VELOCITY
 VEL1: LATERAL FLOW TO MAIN FLOW
 VEL2: LATERAL FLOW TO MAIN FLOW
 VELINL: LATERAL FLOW TO MAIN FLOW
 VELOUT: LATERAL FLOW TO MAIN FLOW
 VEL1P: LATERAL FLOW TO MAIN FLOW
 VEL2P: LATERAL FLOW TO MAIN FLOW
 VEL3P: LATERAL FLOW TO MAIN FLOW
 KC: COMBINED BASED ON RUSSIAN PREDICTION EQUATION - FOR COMPARISON

POWER LOSS

MAIN POWER 620585.5000 LATERAL POWER 278749.5000 OUT POWER 891494.5000 POWER LOSS RATIO 0.0085

POSITION ALONG PIPE (CM)

PIEZOMETER READING CM

120.6	1	48.100
176.5	2	48.060
242.5	3	48.000
303.5	4	47.960
364.5	5	47.920
425.5	6	47.900
486.5	7	47.850
547.5	8	47.900
608.5	9	47.900
669.5	10	47.900
730.5	11	47.900
791.5	12	47.900
852.5	13	47.900
913.5	14	47.900
974.5	15	47.900
1035.5	16	47.900
1096.5	17	47.900
1157.5	18	47.900
1218.5	19	47.900
1279.5	20	47.900
1340.5	21	47.900
1401.5	22	47.900
1462.5	23	47.900
1523.5	24	47.900
1584.5	25	47.900
1645.5	26	47.900
1706.5	27	47.900
1767.5	28	47.900
1828.5	29	47.900
1889.5	30	47.900
1950.5	31	47.900
2011.5	32	47.900
2072.5	33	47.900
2133.5	34	47.900
2194.5	35	47.900
2255.5	36	47.900
2316.5	37	47.900
2377.5	38	47.900
2438.5	39	47.900
2499.5	40	47.900
2560.5	41	47.900
2621.5	42	47.900
2682.5	43	47.900
2743.5	44	47.900
2804.5	45	47.900
2865.5	46	47.900
2926.5	47	47.900
2987.5	48	47.900
3048.5	49	47.900
3109.5	50	47.900
3170.5	51	47.900
3231.5	52	47.900
3292.5	53	47.900
3353.5	54	47.900
3414.5	55	47.900
3475.5	56	47.900
3536.5	57	47.900
3597.5	58	47.900
3658.5	59	47.900
3719.5	60	47.900
3780.5	61	47.900
3841.5	62	47.900
3902.5	63	47.900
3963.5	64	47.900
4024.5	65	47.900
4085.5	66	47.900
4146.5	67	47.900
4207.5	68	47.900
4268.5	69	47.900
4329.5	70	47.900
4390.5	71	47.900
4451.5	72	47.900
4512.5	73	47.900
4573.5	74	47.900
4634.5	75	47.900
4695.5	76	47.900
4756.5	77	47.900
4817.5	78	47.900
4878.5	79	47.900
4939.5	80	47.900
5000.5	81	47.900
5061.5	82	47.900
5122.5	83	47.900
5183.5	84	47.900
5244.5	85	47.900
5305.5	86	47.900
5366.5	87	47.900
5427.5	88	47.900
5488.5	89	47.900
5549.5	90	47.900
5610.5	91	47.900
5671.5	92	47.900
5732.5	93	47.900
5793.5	94	47.900
5854.5	95	47.900
5915.5	96	47.900
5976.5	97	47.900
6037.5	98	47.900
6098.5	99	47.900
6159.5	100	47.900
6220.5	101	47.900
6281.5	102	47.900
6342.5	103	47.900
6403.5	104	47.900
6464.5	105	47.900
6525.5	106	47.900
6586.5	107	47.900
6647.5	108	47.900
6708.5	109	47.900
6769.5	110	47.900
6830.5	111	47.900
6891.5	112	47.900
6952.5	113	47.900
7013.5	114	47.900
7074.5	115	47.900
7135.5	116	47.900
7196.5	117	47.900
7257.5	118	47.900
7318.5	119	47.900
7379.5	120	47.900
7440.5	121	47.900
7501.5	122	47.900
7562.5	123	47.900
7623.5	124	47.900
7684.5	125	47.900
7745.5	126	47.900
7806.5	127	47.900
7867.5	128	47.900
7928.5	129	47.900
7989.5	130	47.900
8050.5	131	47.900
8111.5	132	47.900
8172.5	133	47.900
8233.5	134	47.900
8294.5	135	47.900
8355.5	136	47.900
8416.5	137	47.900
8477.5	138	47.900
8538.5	139	47.900
8599.5	140	47.900
8660.5	141	47.900
8721.5	142	47.900
8782.5	143	47.900
8843.5	144	47.900
8904.5	145	47.900
8965.5	146	47.900
9026.5	147	47.900
9087.5	148	47.900
9148.5	149	47.900
9209.5	150	47.900
9270.5	151	47.900
9331.5	152	47.900
9392.5	153	47.900
9453.5	154	47.900
9514.5	155	47.900
9575.5	156	47.900
9636.5	157	47.900
9697.5	158	47.900
9758.5	159	47.900
9819.5	160	47.900
9880.5	161	47.900
9941.5	162	47.900
10002.5	163	47.900
10063.5	164	47.900
10124.5	165	47.900
10185.5	166	47.900
10246.5	167	47.900
10307.5	168	47.900
10368.5	169	47.900
10429.5	170	47.900
10490.5	171	47.900
10551.5	172	47.900
10612.5	173	47.900
10673.5	174	47.900
10734.5	175	47.900
10795.5	176	47.900
10856.5	177	47.900
10917.5	178	47.900
10978.5	179	47.900
11039.5	180	47.900
11100.5	181	47.900
11161.5	182	47.900
11222.5	183	47.900
11283.5	184	47.900
11344.5	185	47.900
11405.5	186	47.900
11466.5	187	47.900
11527.5	188	47.900
11588.5	189	47.900
11649.5	190	47.900
11710.5	191	47.900
11771.5	192	47.900
11832.5	193	47.900
11893.5	194	47.900
11954.5	195	47.900
12015.5	196	47.900
12076.5	197	47.900
12137.5	198	47.900
12198.5	199	47.900
12259.5	200	47.900
12320.5	201	47.900
12381.5	202	47.900
12442.5	203	47.900
12503.5	204	47.900
12564.5	205	47.900
12625.5	206	47.900
12686.5	207	47.900
12747.5	208	47.900
12808.5	209	47.900
12869.5	210	47.900
12930.5	211	47.900
12991.5	212	47.900
13052.5	213	47.900
13113.5	214	47.900
13174.5	215	47.900
13235.5	216	47.900
13296.5	217	47.900
13357.5	218	47.900
13418.5	219	47.900
13479.5	220	47.900
13540.5	221	47.900
13601.5	222	47.900
13662.5	223	47.900
13723.5	224	47.900
13784.5	225	47.900
13845.5	226	47.900
13906.5	227	47.900
13967.5	228	47.900
14028.5	229	47.900
14089.5	230	47.900
14150.5	231	47.900
14211.5	232	47.900
14272.5	233	47.900
14333.5	234	47.900
14394.5	235	47.900
14455.5	236	47.900
14516.5	237	47.900
14577.5	238	47.900
14638.5	239	47.900
14699.5	240	47.900
14760.5	241	47.900
14821.5	242	47.900
14882.5	243	47.900
14943.5	244	47.900
15004.5	245	47.900
15065.5	246	47.900
15126.5	247	47.900
15187.5	248	47.900
15248.5	249	47.900
15309.5	250	47.900
15370.5	251	47.900
15431.5	252	47.900
15492.5	253	47.900
15553.5	254	47.900
15614.5	255	47.900
15675.5	256	47.900
15736.5	257	47.900
15797.5	258	47.900
15858.5	259	47.900
15919.5	260	47.900
15980.5	261	47.900
16041.5	262	47.900
16102.5	263	47.900
16163.5	264	47.900
16224.5	265	47.900
16285.5	266	47.900
16346.5	267	47.900
16407.5	268	47.900
16468.5	269	47.900
16529.5	270	47.900
16590.5	271	47.900
16651.5	272	47.900
16712.5	273	47.900
16773.5	274	47.900
16834.5	275	47.900
16895.5	276	47.900
16956.5	277	47.900
17017.5	278	47.900
17078.5	279	47.900
17139.5	280	47.900
17200.5	281	47.900
17261.5	282	47.900
17322.5	283	47.900
17383.5	284	47.900
17444.5	285	47.900
17505.5	286	47.900
17566.5	287	47.900
17627.5	288	47.900
17688.5	289	47.900
17749.5	290	47.900
17810.5	291	47.900
17871.5	292	47.900
17932.5	293	47.900
17993.5	294	47.900
18054.5	295	47.900
18115.5	296	47.900
18176.5	297	47.900
18237.5	298	47.900
18298.5	299	47.900
18359.5	300	47.900
18420.5	301	47.900
18481.5	302	47.900
18542.5	303	47.900
18603.5	304	47.900
18664.5	305	47.900
18725.5	306	47.900
18786.5	307	47.900
18847.5	308	47.900
18908.5	309	47.900
18969.5	310	47.900
19030.5	311	47.900
19091.5	312	47.900
19152.5	313	47.900
19213.5	314	47.900
19274.5	315	47.900
19335.5	316	47.900
19396.5	317	47.900
19457.5	318	47.900
19518.5	319	47.900
19579.5	320	47.900
19640.5	321	47.900
19701.5	322	47.900
19762.5	323	47.900
19823.5	324	47.900
19884.5	325	47.900
19945.5	326	47.900
20006.5	327	47.900
20067.5	328	47.900
20128.5	329	47.900
20189.5	330	47.900
20250.5	331	47.900
20311.5	332	47.900
20372.5	333	47.900
20433.5	334	47.900
20494.5	335	47.900
20555.5	336	47.900
20616.5	337	47.900
20677.5	338	47.900
20738.5	339	47.900
20799.5	340	47.900
20860.5	341	47.900
20921.5	342	47.900
20982.5	343	47.900
21043.5	344	47.900
21104.5	345	47.900
21165.5	346	47.900
21226.5	347	47.900
21287.5	348	47.900
21348.5	349	47.900
21409.5	350	47.900
21470.5	351	47.900
21531.5	352	47.900
21592.5	353	47.900
21653.5	354	47.900
21714.5	355	47.900
21775.5	356	47.900
21836.5	357	47.900
21897.5	358	47.900
21958.5	359	47.900

ENERGY LOSS COEFFICIENTS

NO	K2	K3	K2L	K3M	LELJ	MELJ	TELL	TELM	K2RUS	K2LRUS	K3RUS	K3MRUS	KC	CELJ
1	0.42	0.11	0.34	0.77	1.86	0.47	6.86	0.55	0.59	0.72	0.13	0.35	0.23	1.02
MAIN FLOW	LATERAL FLOW	LATERAL FLOW	RATIO	RATIO	VEL IN	VEL IN	VEL IN	VELOUT	13.007	9.870	13.398			
5663.367	3737.823	0.40	0.66		34.24	53.85								

K2: LATERAL LOSS COEFFICIENT W.R.T. OUTLET VELOCITY
 K3: MAIN LOSS COEFFICIENT W.R.T. INLET VELOCITY
 K2L: W.R.T. MAIN INLET VELOCITY
 K3M: W.R.T. MAIN ENERGY LOSS DUE TO JUNCTION
 LELJ: LATERAL ENERGY LOSS THROUGH JUNCTION
 MELJ: MAIN ENERGY LOSS THROUGH JUNCTION
 TELJ: TOTAL ENERGY LOSS TO TOTAL FLOW
 TELL: TOTAL LATERAL FLOW TO TOTAL FLOW
 RATIO: OF LATERAL FLOW TO INLET AND OUTLET VELOCITIES
 VELOUT: VELOCITY OF MAIN FLOW
 VELOIN: LATERAL FLOW LOSS COEFFICIENT PREDICTION EQUATION - FOR COMPARISON
 K2RUS: BASED ON RUSSIAN PREDICTION EQUATION - FOR COMPARISON
 K3RUS: BASED ON RUSSIAN PREDICTION EQUATION - FOR COMPARISON

POWER LOSS

MAIN POWER LATERAL POWER OUT POWER POWER LOSS RATIO
 622950.1000 416356.0000 1029486.0000 0.0093

POSITION ALONG PIPE (CM)

PIEZOMETER READING CM

120.6	1	48.260
176.5	2	48.230
242.5	3	48.190
303.5	4	48.120
364.5	5	48.060
425.5	6	48.060
486.5	7	48.060
510.0	8	48.060
547.0	9	48.060
557.0	10	48.060
578.0	11	48.060
593.0	12	48.060
606.0	13	48.060
624.0	14	48.060
639.0	15	48.060
650.0	16	48.060
670.0	17	48.060
780.0	18	48.060
811.0	19	48.060
872.0	20	48.060
972.0	21	48.060
972.0	22	48.060
972.0	23	48.060
972.0	24	48.060
972.0	25	48.060
972.0	26	48.060
972.0	27	48.060
972.0	28	48.060
972.0	29	48.060
972.0	30	48.060
972.0	31	48.060
972.0	32	48.060
972.0	33	48.060
972.0	34	48.060
972.0	35	48.060
972.0	36	48.060
972.0	37	48.060
972.0	38	48.060
972.0	39	48.060
972.0	40	48.060
972.0	41	48.060
972.0	42	48.060
972.0	43	48.060
972.0	44	48.060
972.0	45	48.060
972.0	46	48.060
972.0	47	48.060
972.0	48	48.060
972.0	49	48.060
972.0	50	48.060
972.0	51	48.060
972.0	52	48.060
972.0	53	48.060
972.0	54	48.060
972.0	55	48.060
972.0	56	48.060
972.0	57	48.060
972.0	58	48.060
972.0	59	48.060
972.0	60	48.060
972.0	61	48.060
972.0	62	48.060
972.0	63	48.060
972.0	64	48.060
972.0	65	48.060
972.0	66	48.060
972.0	67	48.060
972.0	68	48.060
972.0	69	48.060
972.0	70	48.060
972.0	71	48.060
972.0	72	48.060
972.0	73	48.060
972.0	74	48.060
972.0	75	48.060
972.0	76	48.060
972.0	77	48.060
972.0	78	48.060
972.0	79	48.060
972.0	80	48.060
972.0	81	48.060
972.0	82	48.060
972.0	83	48.060
972.0	84	48.060
972.0	85	48.060
972.0	86	48.060
972.0	87	48.060
972.0	88	48.060
972.0	89	48.060
972.0	90	48.060
972.0	91	48.060
972.0	92	48.060
972.0	93	48.060
972.0	94	48.060
972.0	95	48.060
972.0	96	48.060
972.0	97	48.060
972.0	98	48.060
972.0	99	48.060
972.0	100	48.060

FLOW RATE (CM³/H) 3681.180 MAIN
LATERAL 3681.180 MAIN
SLOPE 0.0160 MAIN 0.005000 LIFT 0.005000
LATERAL 0.0160 MAIN 0.005000 LIFT 0.005000
MANHOLE DROP : MAIN 0.005000 LATERAL 5.000

27.1

Q

POSITION ALONG PIPE (CM)

PIEZOMETER READING CM

120.5	1	47.260
116.5	2	47.090
112.5	3	47.070
108.5	4	47.040
104.5	5	46.950
100.5	6	46.950
96.5	7	46.950
92.5	8	46.950
88.5	9	46.950
84.5	10	46.950
80.5	11	46.950
76.5	12	46.950
72.5	13	46.950
68.5	14	46.950
64.5	15	46.950
60.5	16	46.950
56.5	17	46.950
52.5	18	46.950
48.5	19	46.950
44.5	20	46.950
40.5	21	46.950
36.5	22	46.950
32.5	23	46.950
28.5	24	46.950
24.5	25	46.950
20.5	26	46.950
16.5	27	46.950
12.5	28	46.950
8.5	29	46.950
4.5	30	46.950
0.5	31	46.950
	32	46.950
	33	46.950
	34	46.950
	35	46.950
	36	46.950
	37	46.950
	38	46.950
	39	46.950
	40	46.950
	41	46.950
	42	46.950
	43	46.950
	44	46.950
	45	46.950
	46	46.950
	47	46.950
	48	46.950
	49	46.950
	50	46.950
	51	46.950
	52	46.950
	53	46.950
	54	46.950
	55	46.950
	56	46.950
	57	46.950
	58	46.950
	59	46.950
	60	46.950
	61	46.950
	62	46.950
	63	46.950
	64	46.950
	65	46.950
	66	46.950
	67	46.950
	68	46.950
	69	46.950
	70	46.950
	71	46.950
	72	46.950
	73	46.950
	74	46.950
	75	46.950
	76	46.950
	77	46.950
	78	46.950
	79	46.950
	80	46.950
	81	46.950
	82	46.950
	83	46.950
	84	46.950
	85	46.950
	86	46.950
	87	46.950
	88	46.950
	89	46.950
	90	46.950
	91	46.950
	92	46.950
	93	46.950
	94	46.950
	95	46.950
	96	46.950
	97	46.950
	98	46.950
	99	46.950
	100	46.950

FLOW RATE (CUBIC CENTIMETERS PER SECOND) 5663.3670

LATERAL 2605.1490 MAIN
 LATERAL 1160 MAIN 1160 LATERAL 5.00
 MANHOLE ORP : MAIN 1160 LATERAL 5.00

c7.2

POSITION ALONG PIPE (CM.)	PIEZOMETER READING	CM
120.6	44.820	
116.5	44.790	
112.5	44.760	
108.5	44.730	
104.5	44.700	
100.5	44.670	
96.5	44.640	
92.5	44.610	
88.5	44.580	
84.5	44.550	
80.5	44.520	
76.5	44.490	
72.5	44.460	
68.5	44.430	
64.5	44.400	
60.5	44.370	
56.5	44.340	
52.5	44.310	
48.5	44.280	
44.5	44.250	
40.5	44.220	
36.5	44.190	
32.5	44.160	
28.5	44.130	
24.5	44.100	
20.5	44.070	
16.5	44.040	
12.5	44.010	
8.5	43.980	
4.5	43.950	
0.5	43.920	
0.0	43.890	
0.0	43.860	
0.0	43.830	
0.0	43.800	
0.0	43.770	
0.0	43.740	
0.0	43.710	
0.0	43.680	
0.0	43.650	
0.0	43.620	
0.0	43.590	
0.0	43.560	
0.0	43.530	
0.0	43.500	
0.0	43.470	
0.0	43.440	
0.0	43.410	
0.0	43.380	
0.0	43.350	
0.0	43.320	
0.0	43.290	
0.0	43.260	
0.0	43.230	
0.0	43.200	
0.0	43.170	
0.0	43.140	
0.0	43.110	
0.0	43.080	
0.0	43.050	
0.0	43.020	
0.0	42.990	
0.0	42.960	
0.0	42.930	
0.0	42.900	
0.0	42.870	
0.0	42.840	
0.0	42.810	
0.0	42.780	
0.0	42.750	
0.0	42.720	
0.0	42.690	
0.0	42.660	
0.0	42.630	
0.0	42.600	
0.0	42.570	
0.0	42.540	
0.0	42.510	
0.0	42.480	
0.0	42.450	
0.0	42.420	
0.0	42.390	
0.0	42.360	
0.0	42.330	
0.0	42.300	
0.0	42.270	
0.0	42.240	
0.0	42.210	
0.0	42.180	
0.0	42.150	
0.0	42.120	
0.0	42.090	
0.0	42.060	
0.0	42.030	
0.0	42.000	
0.0	41.970	
0.0	41.940	
0.0	41.910	
0.0	41.880	
0.0	41.850	
0.0	41.820	
0.0	41.790	
0.0	41.760	
0.0	41.730	
0.0	41.700	
0.0	41.670	
0.0	41.640	
0.0	41.610	
0.0	41.580	
0.0	41.550	
0.0	41.520	
0.0	41.490	
0.0	41.460	
0.0	41.430	
0.0	41.400	
0.0	41.370	
0.0	41.340	
0.0	41.310	
0.0	41.280	
0.0	41.250	
0.0	41.220	
0.0	41.190	
0.0	41.160	
0.0	41.130	
0.0	41.100	
0.0	41.070	
0.0	41.040	
0.0	41.010	
0.0	40.980	
0.0	40.950	
0.0	40.920	
0.0	40.890	
0.0	40.860	
0.0	40.830	
0.0	40.800	
0.0	40.770	
0.0	40.740	
0.0	40.710	
0.0	40.680	
0.0	40.650	
0.0	40.620	
0.0	40.590	
0.0	40.560	
0.0	40.530	
0.0	40.500	
0.0	40.470	
0.0	40.440	
0.0	40.410	
0.0	40.380	
0.0	40.350	
0.0	40.320	
0.0	40.290	
0.0	40.260	
0.0	40.230	
0.0	40.200	
0.0	40.170	
0.0	40.140	
0.0	40.110	
0.0	40.080	
0.0	40.050	
0.0	40.020	
0.0	39.990	
0.0	39.960	
0.0	39.930	
0.0	39.900	
0.0	39.870	
0.0	39.840	
0.0	39.810	
0.0	39.780	
0.0	39.750	
0.0	39.720	
0.0	39.690	
0.0	39.660	
0.0	39.630	
0.0	39.600	
0.0	39.570	
0.0	39.540	
0.0	39.510	
0.0	39.480	
0.0	39.450	
0.0	39.420	
0.0	39.390	
0.0	39.360	
0.0	39.330	
0.0	39.300	
0.0	39.270	
0.0	39.240	
0.0	39.210	
0.0	39.180	
0.0	39.150	
0.0	39.120	
0.0	39.090	
0.0	39.060	
0.0	39.030	
0.0	39.000	
0.0	38.970	
0.0	38.940	
0.0	38.910	
0.0	38.880	
0.0	38.850	
0.0	38.820	
0.0	38.790	
0.0	38.760	
0.0	38.730	
0.0	38.700	
0.0	38.670	
0.0	38.640	
0.0	38.610	
0.0	38.580	
0.0	38.550	
0.0	38.520	
0.0	38.490	
0.0	38.460	
0.0	38.430	
0.0	38.400	
0.0	38.370	
0.0	38.340	
0.0	38.310	
0.0	38.280	
0.0	38.250	
0.0	38.220	
0.0	38.190	
0.0	38.160	
0.0	38.130	
0.0	38.100	
0.0	38.070	
0.0	38.040	
0.0	38.010	
0.0	37.980	
0.0	37.950	
0.0	37.920	
0.0	37.890	
0.0	37.860	
0.0	37.830	
0.0	37.800	
0.0	37.770	
0.0	37.740	
0.0	37.710	
0.0	37.680	
0.0	37.650	
0.0	37.620	
0.0	37.590	
0.0	37.560	
0.0	37.530	
0.0	37.500	
0.0	37.470	
0.0	37.440	
0.0	37.410	
0.0	37.380	
0.0	37.350	
0.0	37.320	
0.0	37.290	
0.0	37.260	
0.0	37.230	
0.0	37.200	
0.0	37.170	
0.0	37.140	
0.0	37.110	
0.0	37.080	
0.0	37.050	
0.0	37.020	
0.0	36.990	
0.0	36.960	
0.0	36.930	
0.0	36.900	
0.0	36.870	
0.0	36.840	
0.0	36.810	
0.0	36.780	
0.0	36.750	
0.0	36.720	
0.0	36.690	
0.0	36.660	
0.0	36.630	
0.0	36.600	
0.0	36.570	
0.0	36.540	
0.0	36.510	
0.0	36.480	
0.0	36.450	
0.0	36.420	
0.0	36.390	
0.0	36.360	
0.0	36.330	
0.0	36.300	
0.0	36.270	
0.0	36.240	
0.0	36.210	
0.0	36.180	
0.0	36.150	
0.0	36.120	
0.0	36.090	
0.0	36.060	
0.0	36.030	
0.0	36.000	
0.0	35.970	
0.0	35.940	
0.0	35.910	
0.0	35.880	
0.0	35.850	
0.0	35.820	
0.0	35.790	
0.0	35.760	
0.0	35.730	
0.0	35.700	
0.0	35.670	
0.0	35.640	
0.0	35.610	
0.0	35.580	
0.0	35.550	
0.0	35.520	
0.0	35.490	
0.0	35.460	
0.0	35.430	
0.0	35.400	
0.0	35.370	
0.0	35.340	
0.0	35.310	
0.0	35.280	
0.0	35.250	
0.0	35.220	
0.0	35.190	
0.0	35.160	
0.0	35.130	
0.0	35.100	
0.0	35.070	
0.0	35.040	
0.0	35.010	
0.0	34.980	
0.0	34.950	
0.0	34.920	
0.0	34.890	
0.0	34.860	
0.0	34.830	
0.0	34.800	
0.0	34.770	
0.0	34.740	
0.0	34.710	
0.0	34.680	
0.0	34.650	
0.0	34.620	
0.0	34.590	
0.0	34.560	
0.0	34.530	
0.0	34.500	
0.0	34.470	
0.0	34.440	
0.0	34.410	
0.0	34.380	
0.0	34.350	
0.0	34.320	
0.0	34.290	
0.0	34.260	
0.0	34.230	
0.0	34.200	
0.0	34.170	
0.0	34.140	
0.0	34.110	
0.0	34.080	
0.0	34.050	
0.0	34.020	
0.0	33.990	
0.0	33.960	
0.0	33.930	
0.0	33.900	
0.0	33.870	
0.0	33.840	
0.0	33.810	
0.0	33.780	
0.0	33.750	
0.0	33.720	
0.0	33.690	
0.0	33.660	
0.0	33.630	
0.0	33.600	
0.0	33.570	
0.0	33.540	
0.0	33.510	
0.0	33.480	
0.0	33.450	
0.0	33.420	
0.0	33.390	
0.0	33.360	
0.0	33.330	
0.0	33.300	
0.0	33.270	
0.0	33.240	
0.0	33.210	
0.0	33.180	
0.0	33.150	
0.0	33.120	
0.0	33.090	
0.0	33.060	
0.0	33.030	
0.0	33.000	
0.0	32.970	
0.0	32.940	
0.0	32.910	
0.0	32.880	
0.0	32.850	
0.0	32.820	
0.0	32.790	
0.0	32.760	
0.0	32.730	
0.0	32.700	
0.0	32.670	
0.0	32.640	
0.0	32.610	
0.0	32.580	
0.0	32.550	
0.0	32.520	
0.0	32.490	
0.0	32.460	
0.0	32.430	
0.0	32.400	
0.0	32.370	
0.0	32.340	
0.0	32.310	
0.0	32.280	
0.0	32.250	
0.0	32.220	
0.0	32.190	
0.0	32.160	
0.0	32.130	
0.0	32.100	
0.0	32.070	
0.0	32.040	
0.0	32.010	
0.0	31.980	
0.0	31.950	
0.0	31.920	
0.0	31.890	
0.0	31.860	
0.0	31.830	
0.0	31.800	
0.0	31.770	
0.0	31.740	
0.0	31.710	
0		

ENERGY LOSS COEFFICIENTS

NO	K2	K3	K2L	K3M	LELJ	MELJ	TELJ	TELM	K2RUS	K2LRUS	K3RUS	K3MRUS	K5	CELJ
1	0.33	0.23	0.32	1.49	1.25	0.89	6.25	10.97	0.58	0.71	0.13	0.36	0.27	1.03
2	0.12	0.17	0.37	0.05	0.44	0.60	5.44	0.68	0.26	0.50	0.21	0.45	0.15	0.55
3	0.02	0.16	0.11	0.58	0.06	0.53	4.94	0.61	0.16	0.70	0.23	0.37	0.41	0.41
MAIN FLOW	367	189	11	0.32	0.46	0.93	51.95	86.77	0.01	10.914	13.36	12.47		
LATERAL FLOW	367	189	11	0.32	0.46	0.93	51.95	86.77	0.01	10.914	13.36	12.47		
MAIN FLOW	5663.367	2605.149	0.21	0.26										
LATERAL FLOW	5663.367	2605.149	0.21	0.26										

K2: LATERAL LOSS COEFFICIENT
 K3: MAIN LOSS COEFFICIENT
 K2L: LATERAL INLET VELOCITY
 K3M: MAIN INLET VELOCITY
 LELJ: LATERAL ENERGY LOSS DUE TO JUNCTION
 MELJ: MAIN ENERGY LOSS DUE TO JUNCTION
 TELJ: TOTAL ENERGY LOSS THROUGH JUNCTION
 TELM: TOTAL ENERGY LOSS THROUGH JUNCTION
 RATIO OF LATERAL FLOW TO TOTAL FLOW
 VELIN: VELOCITY INLET TO MAIN FLOW
 VELOUT: VELOCITY OUTLET VELOCITIES
 RATIO OF LATERAL FLOW TO MAIN FLOW
 K2RUS: LATERAL JUNCTION COEFFICIENT EQUATION - FOR COMPARISON
 K3RUS: MAIN JUNCTION COEFFICIENT EQUATION - FOR COMPARISON

POWER LOSS

MAIN POWER	LATERAL POWER	OUT POWER	POWER LOSS RATIO
62358.5000	436686.0000	1020649.0000	0.0094
617714.8000	283721.9000	896891.3000	0.0050
611443.5000	161142.1000	769686.5000	0.0038

C7

POSITION ALONG PIPE (CM)

PIEZOMETER READING CM

120.0	1	44.550
116.5	2	44.480
112.0	3	44.050
108.5	4	43.720
105.0	5	43.610
101.5	6	43.210
98.0	7	42.670
94.5	8	42.640
91.0	9	42.000
87.5	10	41.750
84.0	11	41.650
80.5	12	41.500
77.0	13	41.410
73.5	14	41.340
70.0	15	41.060
66.5	16	40.840
63.0	17	40.550
59.5	18	39.900
56.0	19	39.000
52.5	20	38.000
49.0	21	37.000
45.5	22	36.000
42.0	23	35.000
38.5	24	34.000
35.0	25	33.000
31.5	26	32.000
28.0	27	31.000
24.5	28	30.000
21.0	29	29.000
17.5	30	28.000
14.0	31	27.000
10.5	32	26.000
7.0	33	25.000
3.5	34	24.000
0.0	35	23.000
0.0	36	22.000
0.0	37	21.000
0.0	38	20.000
0.0	39	19.000
0.0	40	18.000
0.0	41	17.000
0.0	42	16.000
0.0	43	15.000
0.0	44	14.000
0.0	45	13.000
0.0	46	12.000
0.0	47	11.000
0.0	48	10.000
0.0	49	9.000
0.0	50	8.000
0.0	51	7.000
0.0	52	6.000
0.0	53	5.000
0.0	54	4.000
0.0	55	3.000
0.0	56	2.000
0.0	57	1.000
0.0	58	0.000
0.0	59	0.000
0.0	60	0.000
0.0	61	0.000
0.0	62	0.000
0.0	63	0.000
0.0	64	0.000
0.0	65	0.000
0.0	66	0.000
0.0	67	0.000
0.0	68	0.000
0.0	69	0.000
0.0	70	0.000
0.0	71	0.000
0.0	72	0.000
0.0	73	0.000
0.0	74	0.000
0.0	75	0.000
0.0	76	0.000
0.0	77	0.000
0.0	78	0.000
0.0	79	0.000
0.0	80	0.000
0.0	81	0.000
0.0	82	0.000
0.0	83	0.000
0.0	84	0.000
0.0	85	0.000
0.0	86	0.000
0.0	87	0.000
0.0	88	0.000
0.0	89	0.000
0.0	90	0.000
0.0	91	0.000
0.0	92	0.000
0.0	93	0.000
0.0	94	0.000
0.0	95	0.000
0.0	96	0.000
0.0	97	0.000
0.0	98	0.000
0.0	99	0.000
0.0	100	0.000

5663.3670

M3

ENERGY LOSS COEFFICIENTS
 NO K2 K3 K2L K3M LELJ MELJ TELJ TELM K2RUS K2LRUS K3RUS K3MRUS KC
 1 0.00 -0.11 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
 MAIN FLOW LATERAL FLOW RATIO RATIO RATIO RATIO VELIN VELIN VELIN VELIN VELIN VELIN
 5663.367 0.000 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
 74.63 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
 70.42 9.710000000 9.352 -0.11 -0.28

K2: LATERAL LOSS COEFFICIENT
 K3: MAIN LOSS COEFFICIENT
 K2L: W.R.T. LATERAL INLET VELOCITY
 K3M: W.R.T. MAIN INLET VELOCITY
 LELJ: MAIN LATERAL ENERGY LOSS DUE TO JUNCTION
 MELJ: MAIN MAIN ENERGY LOSS DUE TO JUNCTION
 TELJ: TOTAL ENERGY LOSS THROUGH JUNCTION
 TELM: TOTAL ENERGY LOSS THROUGH JUNCTION
 RATIO: OF LATERAL FLOW TO TOTAL FLOW
 VELIN: VELOCITY INLET AND OUTLET VELOCITIES
 RATIO2: LATERAL FLOW TO MAIN FLOW
 KC: COMBINED BASED ON RUSSIAN PRFDIGITION EQUATION -FOR COMPARISON
 K3RUS :

POWER LOSS

MAIN POWER LATERAL POWER OUT POWER POWER LOSS RATIO
 2.0000 0.0000 0.0000 0.0000

POSITION ALONG PIPE(CM)

PIEZOMETER READING CM

120.6	1	0.0000
176.5	2	0.0000
242.5	3	0.0000
303.5	4	0.0000
364.5	5	0.0000
425.5	6	0.0000
486.4	7	0.0000
510.4	8	0.0000
547.4	9	0.0000
563.2	10	0.0000
578.7	11	0.0000
593.7	12	0.0000
608.4	13	0.0000
624.2	14	0.0000
639.3	15	0.0000
650.3	16	0.0000
670.0	17	0.0000
681.1	18	0.0000
692.2	19	0.0000
704.5	20	0.0000
720.5	21	0.0000
734.5	22	0.0000
750.5	23	0.0000
765.7	24	0.0000
780.6	25	0.0000
796.6	26	0.0000
811.7	27	0.0000
827.7	28	0.0000
843.1	29	0.0000
858.8	30	0.0000
874.3	31	0.0000
889.8	32	0.0000
904.4	33	0.0000
919.4	34	0.0000
934.4	35	0.0000
949.3	36	0.0000
964.3	37	0.0000
979.3	38	0.0000
994.3	39	0.0000
1009.3	40	0.0000
1024.3	41	0.0000
1039.3	42	0.0000
1054.3	43	0.0000
1069.3	44	0.0000
1084.3	45	0.0000
1099.3	46	0.0000
1114.3	47	0.0000
1129.3	48	0.0000
1144.3	49	0.0000
1159.3	50	0.0000
1174.3	51	0.0000
1189.3	52	0.0000
1204.3	53	0.0000
1219.3	54	0.0000
1234.3	55	0.0000
1249.3	56	0.0000
1264.3	57	0.0000
1279.3	58	0.0000
1294.3	59	0.0000
1309.3	60	0.0000
1324.3	61	0.0000
1339.3	62	0.0000
1354.3	63	0.0000
1369.3	64	0.0000
1384.3	65	0.0000
1399.3	66	0.0000
1414.3	67	0.0000
1429.3	68	0.0000
1444.3	69	0.0000
1459.3	70	0.0000
1474.3	71	0.0000
1489.3	72	0.0000
1504.3	73	0.0000
1519.3	74	0.0000
1534.3	75	0.0000
1549.3	76	0.0000
1564.3	77	0.0000
1579.3	78	0.0000
1594.3	79	0.0000
1609.3	80	0.0000
1624.3	81	0.0000
1639.3	82	0.0000
1654.3	83	0.0000
1669.3	84	0.0000
1684.3	85	0.0000
1699.3	86	0.0000
1714.3	87	0.0000
1729.3	88	0.0000
1744.3	89	0.0000
1759.3	90	0.0000
1774.3	91	0.0000
1789.3	92	0.0000
1804.3	93	0.0000
1819.3	94	0.0000
1834.3	95	0.0000
1849.3	96	0.0000
1864.3	97	0.0000
1879.3	98	0.0000
1894.3	99	0.0000
1909.3	100	0.0000

13.1

POSITION ALONG PIPE (CM)	PIEZOMETER	READING	CM
120.0	1	0.0000	
176.5	2	0.0000	
242.5	3	0.0000	
303.5	4	0.0000	
320.5	5	0.0000	
425.5	6	0.0000	
486.4	7	0.0000	
510.7	8	0.0000	
547.0	9	0.0000	
556.5	10	0.0000	
578.7	11	0.0000	
593.4	12	0.0000	
608.4	13	0.0000	
624.2	14	0.0000	
639.2	15	0.0000	
750.3	16	0.0000	
780.8	17	0.0000	
811.3	18	0.0000	
872.3	19	0.0000	
972.6	20	0.0000	
557.7	21	0.0000	
588.1	22	0.0000	
618.5	23	0.0000	
633.8	24	0.0000	
644.4	25	0.0000	
649.0	26	0.0000	
679.5	27	0.0000	
750.3	28	0.0000	
811.3	29	0.0000	
872.3	30	0.0000	
972.6	31	0.0000	
557.7	32	0.0000	
588.1	33	0.0000	
618.5	34	0.0000	
633.8	35	0.0000	
644.4	36	0.0000	
649.0	37	0.0000	
679.5	38	0.0000	
750.3	39	0.0000	
811.3	40	0.0000	
872.3	41	0.0000	
972.6	42	0.0000	
557.7	43	0.0000	
588.1	44	0.0000	
618.5	45	0.0000	
633.8	46	0.0000	
644.4	47	0.0000	
649.0	48	0.0000	
679.5	49	0.0000	
750.3	50	0.0000	
811.3	51	0.0000	
872.3	52	0.0000	
972.6	53	0.0000	
557.7	54	0.0000	
588.1	55	0.0000	
618.5	56	0.0000	
633.8	57	0.0000	
644.4	58	0.0000	
649.0	59	0.0000	
679.5	60	0.0000	
750.3	61	0.0000	
811.3	62	0.0000	
872.3	63	0.0000	
972.6	64	0.0000	
557.7	65	0.0000	
588.1	66	0.0000	
618.5	67	0.0000	
633.8	68	0.0000	
644.4	69	0.0000	
649.0	70	0.0000	
679.5	71	0.0000	
750.3	72	0.0000	
811.3	73	0.0000	
872.3	74	0.0000	
972.6	75	0.0000	
557.7	76	0.0000	
588.1	77	0.0000	
618.5	78	0.0000	
633.8	79	0.0000	
644.4	80	0.0000	
649.0	81	0.0000	
679.5	82	0.0000	
750.3	83	0.0000	
811.3	84	0.0000	
872.3	85	0.0000	
972.6	86	0.0000	
557.7	87	0.0000	
588.1	88	0.0000	
618.5	89	0.0000	
633.8	90	0.0000	
644.4	91	0.0000	
649.0	92	0.0000	
679.5	93	0.0000	
750.3	94	0.0000	
811.3	95	0.0000	
872.3	96	0.0000	
972.6	97	0.0000	
557.7	98	0.0000	
588.1	99	0.0000	
618.5	100	0.0000	

FLOW RATE (CUBIC CENTIMETERS PER SECOND) 0.0000
 LATERAL 0.005000 OUTLET 5.000
 LATERAL 0.005000 OUTLET 5.000
 MANHOLE DRIP : MAIN 0.00 LATERAL 5.00

L3.2

3

ENERGY LOSS COEFFICIENTS

NO	K2	K3	K2L	K3M	LFLL	MELJ	TELL	TELM	K2RUS	K2LRUS	K3RUS	K3MRUS	KC	CELJ
1	4.15	0.00	1.68	0.00	6.11	0.00	11.11	0.00	3.01	0.57	0.00	0.00	4.13	6.11
2	4.26	0.00	1.53	0.00	6.38	0.00	11.38	0.00	3.01	0.57	0.00	0.00	4.26	6.38
MAIN FLOW	0.300	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
LATERAL FLOW	0.000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
		3624.556	1.00	0.00	0.00	0.00	82.22	54.18	7.624	9.006	0.000	0.000		

K2: LATERAL LOSS COEFFICIENT WRT OUTLET VELOCITY
 K3: MAIN LOSS COEFFICIENT WRT OUTLET VELOCITY
 K2L: MAIN LATERAL INLET VELOCITY
 K3M: MAIN LATERAL ENERGY LOSS DUE TO JUNCTION
 LFLJ: MAIN LATERAL ENERGY LOSS THROUGH JUNCTION
 MELJ: MAIN LATERAL ENERGY LOSS TO TOTAL FLOW
 TELJ: TOTAL ENERGY LOSS TO TOTAL FLOW
 TELM: TOTAL ENERGY LOSS TO OUTLET VELOCITIES
 K2RUS: LATERAL FLOW AND OUTLET VELOCITIES
 K2LRUS: LATERAL FLOW AND OUTLET VELOCITIES
 K3RUS: LATERAL FLOW AND OUTLET VELOCITIES
 KC: COMBINED BASED ON RUSSIAN PREDICTION EQUATION - FOR COMPARISON

POWER LOSS

MAIN POWER	LATERAL POWER	OUT POWER	POWER LOSS RATIO
0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000

L3

POSITION ALONG PIPE(CM)	PIEZOMETER	READING	CM
120.5	1	46.800	
176.5	2	46.735	
242.5	3	46.750	
303.5	4	46.775	
364.5	5	46.771	
425.5	6	46.690	
486.5	7	46.710	
510.0	8	46.330	
547.0	9	46.740	
557.0	10	46.760	
578.0	11	46.730	
593.0	12	46.680	
606.0	13	46.730	
624.0	14	46.770	
639.0	15	46.770	
650.0	16	41.590	
672.0	17	41.420	
700.0	18	41.280	
711.0	19	41.280	
722.0	20	41.280	
735.0	21	41.280	
750.0	22	41.280	
772.0	23	41.280	
811.0	24	41.280	
827.0	25	41.280	
835.0	26	41.280	
857.0	27	41.280	
872.0	28	41.280	
883.0	29	41.280	
918.0	30	41.280	
933.0	31	41.280	
944.0	32	41.280	
964.0	33	41.280	
979.0	34	41.280	
980.0	35	41.280	
981.0	36	41.280	
982.0	37	41.280	
983.0	38	41.280	
984.0	39	41.280	
985.0	40	41.280	
986.0	41	41.280	
987.0	42	41.280	
988.0	43	41.280	
989.0	44	41.280	
990.0	45	41.280	
991.0	46	41.280	
992.0	47	41.280	
993.0	48	41.280	
994.0	49	41.280	
995.0	50	41.280	
996.0	51	41.280	
997.0	52	41.280	
998.0	53	41.280	
999.0	54	41.280	
1000.0	55	41.280	

FLOW RATE(CUBIC CENTIMETERS PER SECOND) 5663.3670
 LATERAL 3681.1880MAIN
 SLOPE 0.012000MAIN 0.005000OUTLET 0.005000
 LATERAL 1.430LATERAL 6.000
 MANHOLE DRIP :MAIN

D1.1

POSITION ALONG PIP (CM)	PIEZOMETER READING	CH
120.6	44.740	
176.5	44.740	
242.5	44.200	
303.5	43.870	
364.5	43.720	
425.5	43.500	
486.5	43.500	
547.5	43.500	
510.0	43.500	
547.4	43.500	
578.7	43.500	
593.7	43.500	
606.9	43.500	
624.2	43.500	
639.2	43.500	
750.3	43.500	
780.3	43.500	
811.3	43.500	
872.6	43.500	
972.6	43.500	

FLOW RATE (CURRIC CENTIMETERS PER SECOND)	5663, 3670
LATERAL	2011.4940 MAIN
SLOPE	0.312000 MAIN
LATERAL	0.005000 OUTLET
MANHOLE DROP	1.430 LATERAL

D1.2

POSITION ALONG PIPE(CM)

PIEZOMETER READING CM

120.6	1	46.810
176.5	2	46.990
242.5	3	46.550
303.5	4	46.630
364.5	5	46.740
425.5	6	46.610
486.5	7	46.340
510.4	8	46.490
547.4	9	47.060
563.2	10	47.000
578.7	11	47.000
593.7	12	47.745
606.4	13	47.000
624.9	14	47.000
639.3	15	47.000
650.3	16	47.970
672.3	17	42.650
681.1	18	42.550
697.2	19	42.830
711.3	20	47.780
722.3	21	47.780
730.5	22	47.780
735.5	23	47.780
745.5	24	47.780
757.6	25	47.780
763.7	26	47.780
768.1	27	47.780
773.5	28	47.780
779.4	29	47.780
783.4	30	47.780
788.4	31	47.780
793.3	32	47.780
799.3	33	47.780
804.3	34	47.780
811.3	35	47.780
817.3	36	47.780
822.3	37	47.780
827.3	38	47.780
832.3	39	47.780
837.3	40	47.780
842.3	41	47.780
847.3	42	47.780
852.3	43	47.780
857.3	44	47.780
862.3	45	47.780
867.3	46	47.780
872.3	47	47.780
877.3	48	47.780
882.3	49	47.780
887.3	50	47.780
892.3	51	47.780
897.3	52	47.780
902.3	53	47.780
907.3	54	47.780
912.3	55	47.780
917.3	56	47.780
922.3	57	47.780
927.3	58	47.780
932.3	59	47.780
937.3	60	47.780
942.3	61	47.780
947.3	62	47.780
952.3	63	47.780
957.3	64	47.780
962.3	65	47.780
967.3	66	47.780
972.3	67	47.780
977.3	68	47.780
982.3	69	47.780
987.3	70	47.780
992.3	71	47.780
997.3	72	47.780
1002.3	73	47.780
1007.3	74	47.780
1012.3	75	47.780
1017.3	76	47.780
1022.3	77	47.780
1027.3	78	47.780
1032.3	79	47.780
1037.3	80	47.780
1042.3	81	47.780
1047.3	82	47.780
1052.3	83	47.780
1057.3	84	47.780
1062.3	85	47.780
1067.3	86	47.780
1072.3	87	47.780
1077.3	88	47.780
1082.3	89	47.780
1087.3	90	47.780
1092.3	91	47.780
1097.3	92	47.780
1102.3	93	47.780
1107.3	94	47.780
1112.3	95	47.780
1117.3	96	47.780
1122.3	97	47.780
1127.3	98	47.780
1132.3	99	47.780
1137.3	100	47.780

FLOW RATE(CUBIC CENTIMETERS PER SECOND) 7787.1280
LATERAL 2010.4940MAIN
SLOPE 0.012000MAIN 0.005000OUTLET 0.005000
LATERAL DROP :MAIN 1.43LATERAL 6.000
MANHOLE

D1.3

POSITION ALONG PIPE (CM)

PIEZOMETER READING CM

120.0	1	44.090
176.5	2	44.060
242.6	3	44.060
303.5	4	44.060
364.5	5	44.060
425.5	6	44.060
486.5	7	44.060
547.5	8	44.060
578.5	9	44.060
593.5	10	44.060
608.5	11	44.060
624.5	12	44.060
639.5	13	44.060
654.5	14	44.060
670.5	15	44.060
685.5	16	44.060
700.5	17	44.060
715.5	18	44.060
730.5	19	44.060
745.5	20	44.060
760.5	21	44.060
775.5	22	44.060
790.5	23	44.060
805.5	24	44.060
820.5	25	44.060
835.5	26	44.060
850.5	27	44.060
865.5	28	44.060
880.5	29	44.060
895.5	30	44.060
910.5	31	44.060
925.5	32	44.060
940.5	33	44.060
955.5	34	44.060
970.5	35	44.060
985.5	36	44.060
1000.5	37	44.060
1015.5	38	44.060
1030.5	39	44.060
1045.5	40	44.060
1060.5	41	44.060
1075.5	42	44.060
1090.5	43	44.060
1105.5	44	44.060
1120.5	45	44.060
1135.5	46	44.060
1150.5	47	44.060
1165.5	48	44.060
1180.5	49	44.060
1195.5	50	44.060
1210.5	51	44.060
1225.5	52	44.060
1240.5	53	44.060
1255.5	54	44.060
1270.5	55	44.060
1285.5	56	44.060
1300.5	57	44.060
1315.5	58	44.060
1330.5	59	44.060
1345.5	60	44.060
1360.5	61	44.060
1375.5	62	44.060
1390.5	63	44.060
1405.5	64	44.060
1420.5	65	44.060
1435.5	66	44.060
1450.5	67	44.060
1465.5	68	44.060
1480.5	69	44.060
1495.5	70	44.060
1510.5	71	44.060
1525.5	72	44.060
1540.5	73	44.060
1555.5	74	44.060
1570.5	75	44.060
1585.5	76	44.060
1600.5	77	44.060
1615.5	78	44.060
1630.5	79	44.060
1645.5	80	44.060
1660.5	81	44.060
1675.5	82	44.060
1690.5	83	44.060
1705.5	84	44.060
1720.5	85	44.060
1735.5	86	44.060
1750.5	87	44.060
1765.5	88	44.060
1780.5	89	44.060
1795.5	90	44.060
1810.5	91	44.060
1825.5	92	44.060
1840.5	93	44.060
1855.5	94	44.060
1870.5	95	44.060
1885.5	96	44.060
1900.5	97	44.060
1915.5	98	44.060
1930.5	99	44.060
1945.5	100	44.060

D1.4

ENERGY LOSS COEFFICIENTS
 NO K2 K3 K2L K2LJ MELJ TEL TELM K2RUS K2LRUS K3RUS K3MRUS K37 CEL
 1 0.59 0.23 0.54 1.33 2.46 8.46 2.46 0.58 0.71 0.43 0.36
 2 0.23 0.17 0.49 0.56 0.74 6.74 2.79 0.18 0.14 0.37 0.38
 3 0.42 0.42 0.49 0.52 0.19 4.19 0.79 1.60 0.73 0.48 0.43
 4 1.42 0.18 0.05 0.02 5.02 11.19 0.79 1.79 0.45 0.37 0.38
 MAIN FLOW LATERAL FLOW FLOW FLOW FLOW FLOW FLOW FLOW FLOW FLOW FLOW FLOW
 5663.367 3681.189 2010.495 0.39 0.35 44.20 22.05 0.55 0.81 0.23 0.43
 7787.129 2010.495 0.21 0.26 0.65 28.66 0.79 0.52 0.73 0.48 0.37
 2463.565 4530.691 0.65 1.84 0.87 90.66 84.57 11.15 10.34 12.32 10.03
 1.56 1.56 1.56 1.56 1.56 1.56 1.56 1.56 1.56 1.56 1.56 1.56

K2: LATERAL LOSS COEFFICIENT INLET VELOCITY
 K3: MAIN LOSS COEFFICIENT INLET VELOCITY
 K2L: MAIN LOSS COEFFICIENT INLET VELOCITY
 K3M: MAIN LOSS COEFFICIENT INLET VELOCITY
 K2LRUS: MAIN LOSS COEFFICIENT INLET VELOCITY
 K3MRUS: MAIN LOSS COEFFICIENT INLET VELOCITY
 K37: MAIN LOSS COEFFICIENT INLET VELOCITY
 CEL: MAIN LOSS COEFFICIENT INLET VELOCITY
 TEL: MAIN LOSS COEFFICIENT INLET VELOCITY
 TELM: MAIN LOSS COEFFICIENT INLET VELOCITY
 K2RUS: MAIN LOSS COEFFICIENT INLET VELOCITY
 K2LRUS: MAIN LOSS COEFFICIENT INLET VELOCITY
 K3RUS: MAIN LOSS COEFFICIENT INLET VELOCITY
 K3MRUS: MAIN LOSS COEFFICIENT INLET VELOCITY
 K37: MAIN LOSS COEFFICIENT INLET VELOCITY
 CEL: MAIN LOSS COEFFICIENT INLET VELOCITY

POWER LOSS

MAIN POWER LATERAL POWER OUT POWER POWER LOSS RATIO
 616877.1000 426460.2000 1008793.0000 0.0142
 607429.0000 218806.4000 818284.0000 0.0096
 854276.3000 219300.8000 1061483.0000 0.0113
 264361.6000 585227.0000 743688.1000 0.0286

POSITION ALONG PIPE (CM)	PIEZOMETER READING CM	FLOW RATE (CUBIC CM)	TIME (SECONDS)	PERCENTAGE
120.0	47.550	5663.3670	100	100
117.6	47.480		99	99
115.2	47.420		98	98
112.8	47.400		97	97
110.4	47.400		96	96
108.0	47.400		95	95
105.6	47.400		94	94
103.2	47.400		93	93
100.8	47.400		92	92
98.4	47.400		91	91
96.0	47.400		90	90
93.6	47.400		89	89
91.2	47.400		88	88
88.8	47.400		87	87
86.4	47.400		86	86
84.0	47.400		85	85
81.6	47.400		84	84
79.2	47.400		83	83
76.8	47.400		82	82
74.4	47.400		81	81
72.0	47.400		80	80
69.6	47.400		79	79
67.2	47.400		78	78
64.8	47.400		77	77
62.4	47.400		76	76
60.0	47.400		75	75
57.6	47.400		74	74
55.2	47.400		73	73
52.8	47.400		72	72
50.4	47.400		71	71
48.0	47.400		70	70
45.6	47.400		69	69
43.2	47.400		68	68
40.8	47.400		67	67
38.4	47.400		66	66
36.0	47.400		65	65
33.6	47.400		64	64
31.2	47.400		63	63
28.8	47.400		62	62
26.4	47.400		61	61
24.0	47.400		60	60
21.6	47.400		59	59
19.2	47.400		58	58
16.8	47.400		57	57
14.4	47.400		56	56
12.0	47.400		55	55
9.6	47.400		54	54
7.2	47.400		53	53
4.8	47.400		52	52
2.4	47.400		51	51
0.0	47.400		50	50

FLOW RATE (CUBIC CM) 5663.3670
 LATERAL 1.43
 SLOPE 1.43
 LATERAL 1.43
 HANDHOLE 1.43

D2.1

ENERGY LOSS COEFFICIENTS

NO	K2	K3	K2L	K3M	LELJ	MELJ	TELJ	TELM	K2RUS	K2LRUS	K3RUS	K3MRUS	KC	CEL
1	1.05	0.30	0.48	1.21	2.82	0.80	8.82	2.23	0.68	0.74	0.10	0.29	0.61	1.65
MAIN FLOW	1.05	0.30	0.48	1.21	2.82	0.80	8.82	2.23	0.68	0.74	0.10	0.29	0.61	1.65
LATERAL FLOW	0.30	0.48	1.21	2.82	0.80	8.82	2.23	0.68	0.74	0.10	0.29	0.61	1.65	
MAIN FLOW	1.05	0.30	0.48	1.21	2.82	0.80	8.82	2.23	0.68	0.74	0.10	0.29	0.61	1.65
LATERAL FLOW	0.30	0.48	1.21	2.82	0.80	8.82	2.23	0.68	0.74	0.10	0.29	0.61	1.65	
MAIN FLOW	1.05	0.30	0.48	1.21	2.82	0.80	8.82	2.23	0.68	0.74	0.10	0.29	0.61	1.65
LATERAL FLOW	0.30	0.48	1.21	2.82	0.80	8.82	2.23	0.68	0.74	0.10	0.29	0.61	1.65	

K2: LATERAL LOSS COEFFICIENTS
 K3: MAIN LOSS COEFFICIENTS
 K2L: LATERAL LOSS COEFFICIENTS
 K3M: MAIN LOSS COEFFICIENTS
 LELJ: LATERAL ENERGY LOSS DUE TO JUNCTION
 MELJ: MAIN ENERGY LOSS DUE TO JUNCTION
 TELJ: TOTAL ENERGY LOSS THROUGH JUNCTION
 TELM: TOTAL ENERGY LOSS THROUGH JUNCTION
 RATIO: OF LATERAL FLOW TO TOTAL FLOW
 VELIN: VELOCITY INLET TO MAIN FLOW
 VELOUT: VELOCITY OUTLET TO MAIN FLOW
 RATIO2: LATERAL FLOW TO MAIN FLOW
 VELIN2: VELOCITY INLET TO MAIN FLOW
 VELOUT2: VELOCITY OUTLET TO MAIN FLOW
 K3RUS: COMBINED BASED ON RUSSIAN PREDICTION EQUATION -FOR COMPARISON

POWER LOSS

MAIN POWER	LATERAL POWER	OUT POWER	POWER LOSS RATIO
620385.5000	454937.8000	1059293.0000	0.0149

POSITION ALONG PIPE (CM)	PIEZOMETER READING CM	FLOW RATE (CUBIC CENTIMETERS PER SECOND)
120.0	46.830	5663.3670
117.6	46.840	
115.2	46.770	
112.8	46.770	
110.4	46.770	
108.0	46.770	
105.6	46.770	
103.2	46.770	
100.8	46.770	
98.4	46.770	
96.0	46.770	
93.6	46.770	
91.2	46.770	
88.8	46.770	
86.4	46.770	
84.0	46.770	
81.6	46.770	
79.2	46.770	
76.8	46.770	
74.4	46.770	
72.0	46.770	
69.6	46.770	
67.2	46.770	
64.8	46.770	
62.4	46.770	
60.0	46.770	
57.6	46.770	
55.2	46.770	
52.8	46.770	
50.4	46.770	
48.0	46.770	
45.6	46.770	
43.2	46.770	
40.8	46.770	
38.4	46.770	
36.0	46.770	
33.6	46.770	
31.2	46.770	
28.8	46.770	
26.4	46.770	
24.0	46.770	
21.6	46.770	
19.2	46.770	
16.8	46.770	
14.4	46.770	
12.0	46.770	
9.6	46.770	
7.2	46.770	
4.8	46.770	
2.4	46.770	
0.0	46.770	

FLOW RATE (CUBIC CENTIMETERS PER SECOND)
 LATERAL 0.005 IN OUTLET 0.005 IN
 LATERAL 1.430 LATERAL 6.000
 MANHOLE DROP : MAIN 1.430 LATERAL 6.000

D3

POSITION ALONG PIPE(CM) PIEZOMETER READING CM

120.6	1	46.630
176.5	2	46.490
242.6	3	46.490
303.5	4	46.490
364.5	5	46.490
425.4	6	46.490
486.4	7	46.490
510.0	8	46.490
547.4	9	46.490
578.2	10	46.490
593.7	11	46.490
606.4	12	46.490
624.9	13	46.490
639.5	14	46.490
650.3	15	46.490
672.2	16	46.490
687.2	17	46.490
711.3	18	46.490
750.3	19	46.490
811.3	20	46.490
872.2	21	46.490
972.2	22	46.490
304.5	23	46.490
365.7	24	46.490
435.7	25	46.490
496.6	26	46.490
557.6	27	46.490
583.7	28	46.490
588.5	29	46.490
618.8	30	46.490
633.8	31	46.490
644.4	32	46.490
649.4	33	46.490
664.3	34	46.490
679.5	35	46.490
750.3	36	46.490
780.3	37	46.490
811.3	38	46.490
872.2	39	46.490
972.2	40	46.490

FLOW RATE(CUBIC CENTIMETERS PER SECOND) 5663.3670
LATERAL 4077.6240MAIN
SLOPE 0.012000MAIN 0.005000OUTLET 0.005000
LATERAL 1.430LATERAL 6.000
MANHOLE DRIP : MAIN

D4

ENERGY LOSS COEFFICIENTS
 NO K2 K3 K2L K3M LELJ MELJ TELJ TELM K2RUS K2LRUS K3RUS K3MRUS KC CEL
 1 0.99 0.99 0.51 0.12 2.95 0.09 8.95 1.52 0.68 0.74 0.10 0.29 0.43 1.26
 MAIN FLOW LATERAL FLOW RATIO RATIO2 VEL INM VEL INL VEL OUT EIP ESP E3P
 5663.367 4077.625 0.42 0.72 83.21 76.37 13.496 10.451 12.159

K2: LATERAL LOSS COEFFICIENT M.R.T. OUTLET VELOCITY
 K3: MAIN LOSS COEFFICIENT M.R.T. OUTLET VELOCITY
 K2L: LATERAL LOSS COEFFICIENT M.R.T. OUTLET VELOCITY
 K3M: MAIN INLET LOSS COEFFICIENT M.R.T. OUTLET VELOCITY
 LELJ: LATERAL ENERGY LOSS DUE TO JUNCTION
 MELJ: MAIN ENERGY LOSS DUE TO JUNCTION
 TELJ: TOTAL ENERGY LOSS THROUGH JUNCTION
 TELM: TOTAL ENERGY LOSS TO JUNCTION
 K2RUS: OF LATERAL FLOW TO TOTAL FLOW
 K2LRUS: LATERAL FLOW AND OUTLET VELOCITIES
 K3RUS: RATIO2: LATERAL FLOW TO MAIN FLOW
 K3MRUS: RATIO: LATERAL FLOW TO MAIN FLOW
 KC: COMBINED BASED ON RUSSIAN PREDICTION EQUATION -FOR COMPARISON

POWER LOSS

MAIN POWER LATERAL POWER OUT POWER POWER LOSS RATIO
 615947.2000 455145.6000 1058527.0000 0.0117

D4

POSITION ALONG PIPE (CM)

PIEZOMETER READING CM

120.6	1	46.190
176.5	2	46.190
242.5	3	46.250
303.5	4	46.250
364.5	5	46.250
425.5	6	46.250
486.5	7	46.250
547.5	8	46.250
608.5	9	46.250
669.5	10	46.250
730.5	11	46.250
791.5	12	46.250
852.5	13	46.250
913.5	14	46.250
974.5	15	46.250
1035.5	16	46.250
1096.5	17	46.250
1157.5	18	46.250
1218.5	19	46.250
1279.5	20	46.250
1340.5	21	46.250
1401.5	22	46.250
1462.5	23	46.250
1523.5	24	46.250
1584.5	25	46.250
1645.5	26	46.250
1706.5	27	46.250
1767.5	28	46.250
1828.5	29	46.250
1889.5	30	46.250
1950.5	31	46.250
2011.5	32	46.250
2072.5	33	46.250
2133.5	34	46.250
2194.5	35	46.250
2255.5	36	46.250
2316.5	37	46.250
2377.5	38	46.250
2438.5	39	46.250
2499.5	40	46.250

FLOW RATE (CUBIC CENTIMETERS PER SECOND) 5663.3670

LATERAL SLOPE 0.012000 MAIN 0.005000 OUTLET 0.005000
LATERAL DROP : MAIN 1.430 LATERAL 6.000

D5

ENERGY LOSS COEFFICIENTS

NO	K2	K3	K2L	K3M	LELJ	MELJ	TEL	TELM	K2RUS	K2LRUS	K3RUS	K3MRUS	KC	CEL
1	1.13	2.10	0.52	0.38	3.36	0.31	9.36	1.12	0.68	0.74	0.10	0.29	0.41	1.23
MAIN FLOW	LATERAL FLOW	RATIO	RATIO	VELIN	VELIN	VELIN	VELIN	VELOUT	EIP	E2P	E3P			
5663.367	4077.625	0.42	0.72	39.31	81.59	76.37	13.507	10.870	11.771					

K2: LATERAL LOSS COEF. M.R.T. OUTLET VELOCITY
 K3: MAIN LOSS COEFFICIENT M.R.T. OUTLET VELOCITY
 K2L: M.R.T. MAIN INLET VELOCITY
 K3M: M.R.T. MAIN ENERGY LOSS DUE TO JUNCTION
 LELJ: LATERAL ENERGY LOSS DUE TO JUNCTION
 MELJ: MAIN ENERGY LOSS THROUGH JUNCTION
 TELM: TOTAL ENERGY FLOW TO TOTAL FLOW
 RATIO: OF LATERAL FLOW TO TOTAL FLOW
 VELIN, VELOUT: INLET AND OUTLET VELOCITIES
 RATIO2: LATERAL FLOW TO MAIN FLOW
 KC: COMBINED JUNCTION LOSS COEFFICIENT EQUATION - FOR COMPARISON
 K3RUS: BASED ON RUSSIAN PREDICTION EQUATION

POWER LOSS

MAIN POWER	LATERAL POWER	OUT POWER	POWER LOSS RATIO
613747.3000	456855.2000	1038633.0000	0.0112

DS

POSITION ALONG PIP (CM)	PIEZOMETER READING CM
120.6	48.050
117.6	48.000
114.6	48.000
111.6	48.000
108.6	48.000
105.6	48.000
102.6	48.000
99.6	48.000
96.6	48.000
93.6	48.000
90.6	48.000
87.6	48.000
84.6	48.000
81.6	48.000
78.6	48.000
75.6	48.000
72.6	48.000
69.6	48.000
66.6	48.000
63.6	48.000
60.6	48.000
57.6	48.000
54.6	48.000
51.6	48.000
48.6	48.000
45.6	48.000
42.6	48.000
39.6	48.000
36.6	48.000
33.6	48.000
30.6	48.000
27.6	48.000
24.6	48.000
21.6	48.000
18.6	48.000
15.6	48.000
12.6	48.000
9.6	48.000
6.6	48.000
3.6	48.000
0.6	48.000

FLOW RATE (CUBIC C.M. METERS PER SECOND) 5663.3670
 LATERAL 4377.6240 MAIN
 SLOPE 0.012000 MAIN 0.005000 OUTLET 0.005000
 LATERAL 1.430 LATERAL 6.000
 MANHOLE DRIP : MAIN

D6.1

POSITION ALONG PIPE (CM)	PIEZOMETER	READING	CM
120.0	1	47.990	
117.6	2	47.960	
114.2	3	47.930	
110.8	4	47.900	
107.4	5	47.870	
104.0	6	47.840	
100.6	7	47.810	
97.2	8	47.780	
93.8	9	47.750	
90.4	10	47.720	
87.0	11	47.690	
83.6	12	47.660	
80.2	13	47.630	
76.8	14	47.600	
73.4	15	47.570	
70.0	16	47.540	
66.6	17	47.510	
63.2	18	47.480	
59.8	19	47.450	
56.4	20	47.420	
53.0	21	47.390	
49.6	22	47.360	
46.2	23	47.330	
42.8	24	47.300	
39.4	25	47.270	
36.0	26	47.240	
32.6	27	47.210	
29.2	28	47.180	
25.8	29	47.150	
22.4	30	47.120	
19.0	31	47.090	
15.6	32	47.060	
12.2	33	47.030	
8.8	34	47.000	
5.4	35	46.970	
2.0	36	46.940	
	37	46.910	
	38	46.880	
	39	46.850	
	40	46.820	
	41	46.790	
	42	46.760	
	43	46.730	
	44	46.700	
	45	46.670	
	46	46.640	
	47	46.610	
	48	46.580	
	49	46.550	
	50	46.520	
	51	46.490	
	52	46.460	
	53	46.430	
	54	46.400	
	55	46.370	
	56	46.340	
	57	46.310	
	58	46.280	
	59	46.250	
	60	46.220	
	61	46.190	
	62	46.160	
	63	46.130	
	64	46.100	
	65	46.070	
	66	46.040	
	67	46.010	
	68	45.980	
	69	45.950	
	70	45.920	
	71	45.890	
	72	45.860	
	73	45.830	
	74	45.800	
	75	45.770	
	76	45.740	
	77	45.710	
	78	45.680	
	79	45.650	
	80	45.620	
	81	45.590	
	82	45.560	
	83	45.530	
	84	45.500	
	85	45.470	
	86	45.440	
	87	45.410	
	88	45.380	
	89	45.350	
	90	45.320	
	91	45.290	
	92	45.260	
	93	45.230	
	94	45.200	
	95	45.170	
	96	45.140	
	97	45.110	
	98	45.080	
	99	45.050	
	100	45.020	

FLOW RATE (CUBIC CENTIMETERS PER SECOND) 5663.3670
 LATERAL 0.00500 OUTLET 2.005000
 SLOPE 0.00500 MAIN 1.430 LATERAL 6.000
 MANHOLE DROP : MAIN 1.430 LATERAL 6.000

D62

POSITION ALONG PIPE(CM)

PIEZOMETER READING CM

120.6	1	43.470
176.5	2	42.880
242.5	3	42.080
303.5	4	44.000
364.5	5	45.030
425.5	6	45.130
486.5	7	45.200
510.0	8	45.750
547.0	9	45.310
556.5	10	45.310
578.5	11	45.310
593.7	12	45.310
606.4	13	45.310
608.9	14	45.310
624.2	15	45.310
630.5	16	45.310
750.0	17	45.310
750.0	18	45.310
811.0	19	45.310
872.0	20	45.310
972.6	21	45.310
304.5	22	45.310
365.5	23	45.310
435.7	24	45.310
496.6	25	45.310
557.6	26	45.310
583.1	27	45.310
618.5	28	45.310
653.8	29	45.310
644.4	30	45.310
644.4	31	45.310
679.5	32	45.310
750.0	33	45.310
780.0	34	45.310
811.0	35	45.310
872.6	36	45.310
972.6	37	45.310
2690.100	38	45.310
2690.100	39	45.310
2690.100	40	45.310
2690.100	41	45.310
2690.100	42	45.310
2690.100	43	45.310
2690.100	44	45.310
2690.100	45	45.310
2690.100	46	45.310
2690.100	47	45.310
2690.100	48	45.310
2690.100	49	45.310
2690.100	50	45.310
2690.100	51	45.310
2690.100	52	45.310
2690.100	53	45.310
2690.100	54	45.310
2690.100	55	45.310
2690.100	56	45.310
2690.100	57	45.310
2690.100	58	45.310
2690.100	59	45.310
2690.100	60	45.310
2690.100	61	45.310
2690.100	62	45.310
2690.100	63	45.310
2690.100	64	45.310
2690.100	65	45.310
2690.100	66	45.310
2690.100	67	45.310
2690.100	68	45.310
2690.100	69	45.310
2690.100	70	45.310
2690.100	71	45.310
2690.100	72	45.310
2690.100	73	45.310
2690.100	74	45.310
2690.100	75	45.310
2690.100	76	45.310
2690.100	77	45.310
2690.100	78	45.310
2690.100	79	45.310
2690.100	80	45.310
2690.100	81	45.310
2690.100	82	45.310
2690.100	83	45.310
2690.100	84	45.310
2690.100	85	45.310
2690.100	86	45.310
2690.100	87	45.310
2690.100	88	45.310
2690.100	89	45.310
2690.100	90	45.310
2690.100	91	45.310
2690.100	92	45.310
2690.100	93	45.310
2690.100	94	45.310
2690.100	95	45.310
2690.100	96	45.310
2690.100	97	45.310
2690.100	98	45.310
2690.100	99	45.310
2690.100	100	45.310

E1

ENERGY LOSS COEFFICIENTS

NO	K2	K3	K21	K3M	LELJ	MELJ	TELLJ	TELM	K2RUS	K2LRUS	K3RUS	K3MRUS	KC	CEI
1	0.92	0.66	0.39	2.06	2.24	1.59	7.63	1.90	0.20	0.53	0.21	0.45	0.74	1.81
MAIN FLOW LATERAL FLOW RATIO														
5663.367	2690.101	0.32	0.48	33.66	38.35	69.02	11.975	8.829	13.259					

K2: LATERAL LOSS COEFFICIENT, OUTLET VELOCITY
 K3: MAIN LOSS COEFFICIENT, INLET VELOCITY
 K21: MAIN INLET VELOCITY
 K3M: MAIN MAIN INLET VELOCITY
 LELJ: LATERAL ENERGY LOSS DUE TO JUNCTION
 MELJ: MAIN ENERGY LOSS THROUGH JUNCTION
 TELM: TOTAL ENERGY LOSS TO TOTAL FLOW
 RATIO: OF LATERAL FLOW AND OUTLET VELOCITIES
 K2RUS: LATERAL JUNCTION LOSS COEFFICIENT
 K2LRUS: BASED ON RUSSIAN PREDICTION EQUATION - FOR COMPARISON
 K3RUS: BASED ON RUSSIAN PREDICTION EQUATION - FOR COMPARISON
 K3MRUS: BASED ON RUSSIAN PREDICTION EQUATION - FOR COMPARISON
 KC: COMBINED

POWER LOSS

MAIN POWER LATERAL POWER OUT POWER POWER LOSS RATIO
 6m3207.9m00 288272.8000 876428.5000 0.0169

E1

POSITION ALONG PIPE(CM)

PIEZOMETER READING CM

120.6	1	43.500
176.5	2	42.940
242.6	3	42.090
303.5	4	41.340
364.5	5	41.360
425.5	6	44.470
486.4	7	44.550
510.4	8	44.770
547.4	9	44.810
578.5	10	44.810
593.7	11	44.810
606.4	12	44.810
624.2	13	44.810
639.5	14	44.810
650.8	15	44.810
672.3	16	44.810
750.3	17	44.810
780.8	18	44.810
811.3	19	44.810
872.6	20	44.810
972.6	21	44.810
304.5	22	44.810
365.7	23	44.810
435.7	24	44.810
496.6	25	44.810
557.7	26	44.810
588.1	27	44.810
618.5	28	44.810
633.4	29	44.810
644.4	30	44.810
649.4	31	44.810
664.3	32	44.810
679.3	33	44.810
750.3	34	44.810
780.8	35	44.810
811.3	36	44.810
872.6	37	44.810
972.6	38	44.810
2690.1000MAIN	39	44.810
5663.3670		

FLOW RATE(CUBIC CENTIMETERS PER SECOND)

LATERAL 0.01820MAIN 0.01000OUTLET 0.010000
LATERAL 0.31MAIN 0.31LATERAL 5.390
MANHOLE DROP : MAIN

E2

ENERGY LOSS COEFFICIENTS
 NO K2 K3 K2L K3M LELJ MELJ TELJ TELM K2RUS K2LRUS K3RUS K3LRUS KC CE
 1 0.67 0.52 0.34 2.812 1.68 1.132 7.07 1.63 0.29 0.53 0.21 0.45 0.57 1.4
 MAIN FLOW LATERAL FLOW RATIO RATIO2 VELIN VELINL VELOUT EIP E2P E3P
 5663.367 2690.101 0.32 0.48 33.93 39.63 70.29 12.011 0.305 1.3017

K2: LATERAL LOSS COEFFICIENT W.R.T. OUTLET VELOCITY
 K3: MAIN LOSS COEFFICIENT W.R.T. OUTLET VELOCITY
 K2L: W.R.T. MAIN INLET VELOCITY
 K3M: W.R.T. MAIN ENERGY LOSS DUE TO JUNCTION
 LELJ: LATERAL ENERGY LOSS THROUGH JUNCTION
 MELJ: TOTAL ENERGY LOSS TO TOTAL FLOW
 TELJ: OF LATERAL FLOW TO OUTLET VELOCITIES
 TELM: TOTAL ENERGY LOSS TO MAIN FLOW
 RATIO: INLET AND OUTLET VELOCITIES
 RATIO2: LATERAL FLOW TO MAIN FLOW
 VELIN: INLET VELOCITY
 VELINL: LATERAL FLOW VELOCITY
 VELOUT: OUTLET VELOCITY
 EIP: COMBINED BASED ON RUSSIAN PREDICTION EQUATION - FOR COMPARISON
 E2P: K3RUS
 E3P: K3LRUS

POWER LOSS
 MAIN POWER LATERAL POWER OUT POWER POWER LOSS RATIO
 601842.0000 286863.4000 876729.1000 0.0135

E2

POSITION ALONG PIPE(CM)

PIEZOMETER READING CM

120.6	1	43.5520
176.6	2	42.9300
242.5	3	42.3000
303.5	4	41.7750
364.5	5	41.1500
425.5	6	40.5250
486.5	7	40.0000
547.5	8	40.0000
608.5	9	40.0000
669.5	10	40.0000
730.5	11	40.0000
791.5	12	40.0000
852.5	13	40.0000
913.5	14	40.0000
974.5	15	40.0000
1035.5	16	40.0000
1096.5	17	40.0000
1157.5	18	40.0000
1218.5	19	40.0000
1279.5	20	40.0000
1340.5	21	40.0000
1401.5	22	40.0000
1462.5	23	40.0000
1523.5	24	40.0000
1584.5	25	40.0000
1645.5	26	40.0000
1706.5	27	40.0000
1767.5	28	40.0000
1828.5	29	40.0000
1889.5	30	40.0000
1950.5	31	40.0000
2011.5	32	40.0000
2072.5	33	40.0000
2133.5	34	40.0000
2194.5	35	40.0000
2255.5	36	40.0000
2316.5	37	40.0000
2377.5	38	40.0000
2438.5	39	40.0000

FLOW RATE(CUBIC CENTIMETERS PER SECOND) 5663.3670

LATERAL 2690.1000MAIN
SLOPE 0.018200MAIN 0.010000
HANDHOLE DROP :MAIN 0.310LATERAL 5.390

E3.1

ENRGY LOSS COEFFICIENTS
 NO K2 K3 K2L K3M LELJ MELJ TELJ TELM K2RUS K2LRUS K3RUS K3MRUS KC CEI
 1 0.89 0.25 0.39 0.23 0.62 7.62 0.93 0.29 0.53 0.21 0.45 1.1
 MAIN FLOW LATERAL FLOW RATIO 0.32 0.48 4.3 97 70.29 11.982 8.824 12.296
 5663.367 2692.101

K2: LATERAL LOSS COEFFICIENT
 K3: MAIN LOSS COEFFICIENT
 K2L: LATERAL INLET VELOCITY
 K3M: MAIN INLET VELOCITY
 LELJ: LATERAL ENERGY LOSS DUE TO JUNCTION
 MELJ: MAIN ENERGY LOSS DUE TO JUNCTION
 TELM: TOTAL ENERGY LOSS THROUGH JUNCTION
 RATIO: OF LATERAL FLOW TO TOTAL FLOW
 RATIO2: LATERAL FLOW AND OUTLET VELOCITIES
 KC: COMBINED JUNCTION LOSS COEFFICIENT
 K3RUS: BASED ON RUSSIAN PREDICTION EQUATION -FOR COMPARISON

E3

POWER LOSS

MAIN POWER LATERAL POWER OUT POWER POWER LOSS RATIO
 597755.6000 288260.0000 876484.8000 0.0108

POSITION ALONG PIPE (CM)	PIEZOMETER	READING	CM
126.6	1	43.510	
176.6	2	42.930	
242.5	3	42.100	
303.5	4	41.310	
364.5	5	40.730	
425.5	6	40.980	
486.5	7	40.330	
510.0	8	40.530	
547.0	9	40.550	
570.0	10	40.600	
606.0	11	40.640	
648.0	12	40.640	
682.0	13	40.640	
715.0	14	40.540	
750.0	15	40.280	
780.0	16	39.750	
811.3	17	42.060	
872.0	18	41.420	
972.0	19	41.740	
304.5	20	40.940	
365.5	21	41.800	
435.5	22	43.540	
496.0	23	40.280	
557.0	24	42.060	
588.5	25	41.420	
618.5	26	41.740	
644.0	27	40.940	
664.0	28	41.800	
679.5	29	43.540	
750.0	30	40.280	
780.0	31	42.060	
811.3	32	41.420	
872.0	33	41.740	
972.0	34	40.940	
304.5	35	41.800	
365.5	36	43.540	
435.5	37	40.280	
496.0	38	42.060	
557.0	39	41.420	
588.5	40	41.740	
618.5	41	40.940	
644.0	42	41.800	
664.0	43	43.540	
679.5	44	40.280	
750.0	45	42.060	
780.0	46	41.420	
811.3	47	41.740	
872.0	48	40.940	
972.0	49	41.800	
304.5	50	43.540	
365.5	51	40.280	
435.5	52	42.060	
496.0	53	41.420	
557.0	54	41.740	
588.5	55	40.940	
618.5	56	41.800	
644.0	57	43.540	
664.0	58	40.280	
679.5	59	42.060	
750.0	60	41.420	
780.0	61	41.740	
811.3	62	40.940	
872.0	63	41.800	
972.0	64	43.540	
304.5	65	40.280	
365.5	66	42.060	
435.5	67	41.420	
496.0	68	41.740	
557.0	69	40.940	
588.5	70	41.800	
618.5	71	43.540	
644.0	72	40.280	
664.0	73	42.060	
679.5	74	41.420	
750.0	75	41.740	
780.0	76	40.940	
811.3	77	41.800	
872.0	78	43.540	
972.0	79	40.280	
304.5	80	42.060	
365.5	81	41.420	
435.5	82	41.740	
496.0	83	40.940	
557.0	84	41.800	
588.5	85	43.540	
618.5	86	40.280	
644.0	87	42.060	
664.0	88	41.420	
679.5	89	41.740	
750.0	90	40.940	
780.0	91	41.800	
811.3	92	43.540	
872.0	93	40.280	
972.0	94	42.060	
304.5	95	41.420	
365.5	96	41.740	
435.5	97	40.940	
496.0	98	41.800	
557.0	99	43.540	
588.5	100	40.280	

FLOW RATE (CURRIC CENTIMETERS PER SECOND) 5663.3670
 LATERAL 2690.1000 MAIN
 SLOPE 0.018200 MAIN 0.010000 LATERAL 0.010000
 LATERAL 0.018200 MAIN 0.010000 LATERAL 0.010000
 HANHOLE DROP : MAIN 0.310 LATERAL 5.390

E4.1

[illegible]

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22: LATERAL LOSS COEFF W.R.T. W. R. T. OUTLET VELOCITY
23: MAIN LATERAL INLET VELOCITY
24: W. R. T. MAIN INLET VELOCITY TO JUNCTION
25: W. R. T. MAIN ENERGY LOSS THROUGH JUNCTION
26: W. R. T. MAIN ENERGY LOSS THROUGH JUNCTION
27: W. R. T. TOTAL ENERGY LOSS TO TOTAL FLOW
28: W. R. T. LATERAL FLOW AND OUTLET VELOCITIES
29: W. R. T. LATERAL FLOW AND MAIN FLOW
30: W. R. T. LATERAL JUNCTION LOSS COEFFICIENT EQUATION -
31: COMBINED LOSS ON RUSSIAN PREDICTION EQUATION -
32: CRUS :

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POWER LOSS

MAIN POWER	59945W.300W
LATERAL POWER	288320,1000
DUT POWER	877278,1000
POWER LOSS RATIO	0.0118

下山

POSITION ALONG PIPE (CM)	PIEZOMETER READING CM
120.6	43.470
176.5	42.860
242.6	42.020
303.5	44.280
364.5	40.640
425.5	43.440
486.4	44.070
510.4	44.360
547.4	44.250
563.2	44.300
576.5	44.370
593.7	44.965
608.4	44.370
624.9	44.400
639.2	44.430
655.3	39.460
750.3	39.000
780.3	38.500
811.3	37.840
872.3	37.530
912.3	36.530
972.6	

FLOW RATE (CUBIC CENTIMETERS PER SECOND) 5663.3670
 LATERAL 3482.9710 MAIN
 SLOPE 0.310200 MAIN 0.010000 OUTLET 0.010000
 LATERAL 0.310 LATERAL 5.390
 MANHOLE DROP : MAIN

ES

ENERGY LOSS COEFFICIENTS

NO	K2	K3	K2L53	K3M	LELJ	MELJ	TELL	TELM	K2RUS	K2LRUS	K3RUS	K3MRUS	KC	CE
1	1.19	0.10	0.53	0.53	0.38	0.35	9.77	0.66	0.53	0.69	0.15	0.39	0.51	1.8
MAIN FLOW LATERAL FLOW RATIO														
5663.367	3482.972	0.38	0.62	34.55	71.08	84.93	12.649	11.640	12.690					

K2: LATERAL LOSS COEFFICIENT W.R.T. OUTLET VELOCITY
 K3: MAIN LOSS COEFFICIENT W.R.T. OUTLET VELOCITY
 K2L: MAIN LATERAL INLET VELOCITY
 K3M: MAIN MAIN INLET VELOCITY
 LELJ: LATERAL ENERGY LOSS DUE TO JUNCTION
 MELJ: MAIN ENERGY LOSS THROUGH JUNCTION
 TELM: TOTAL ENERGY LOSS TO TOTAL FLOW
 RATIO: OF LATERAL FLOW TO TOTAL FLOW
 VELIN: VELOCITY INLET TO MAIN FLOW
 VELOUT: VELOCITY OUTLET TO MAIN FLOW
 K2RUS: LATERAL JUNCTION LOSS COEFFICIENT
 K3RUS: COMBINED JUNCTION LOSS COEFFICIENT
 KC: COMBINED JUNCTION LOSS COEFFICIENT
 CE: BASED ON RUSSIAN PREDICTION EQUATION - FOR COMPARISON

-POWER LOSS

MAIN POWER	LATERAL POWER	OUT POWER	POWER LOSS RATIO
599987.3000	383022.8000	965772.0000	0.0175

ES

POSITION ALONG PIPE (CM)

PIEZOMETER READING CM

POSITION ALONG PIPE (CM)	PIEZOMETER READING CM
120.0	43.390
117.6	42.800
114.2	41.920
110.8	41.210
107.4	40.640
104.0	40.550
100.6	40.690
97.2	40.890
93.8	40.890
90.4	40.890
87.0	40.890
83.6	40.890
80.2	40.890
76.8	40.890
73.4	40.890
70.0	40.890
66.6	40.890
63.2	40.890
59.8	40.890
56.4	40.890
53.0	40.890
49.6	40.890
46.2	40.890
42.8	40.890
39.4	40.890
36.0	40.890
32.6	40.890
29.2	40.890
25.8	40.890
22.4	40.890
19.0	40.890
15.6	40.890
12.2	40.890
8.8	40.890
5.4	40.890
2.0	40.890
0.0	40.890

FLOW RATE (CUBIC CENTIMETERS PER SECOND) 5665.3670

LATERAL 0.21823 MAIN 0.01000 OUTLET 5.390
LATERAL 0.310 LATERAL 5.390
MANHOLE DROP : MAIN

E6.1

POSITION ALONG PIPE (CM)	PIEZOMETER READING CM	FLOW RATE (CUBIC CENTIMETERS PER SECOND)
120.0	45.2200	1146.8310 MAIN
176.5	44.6000	7503.9600
242.5	44.6000	
308.5	44.6000	
364.5	44.6000	
420.5	44.6000	
480.5	44.6000	
540.5	44.6000	
596.5	44.6000	
652.5	44.6000	
708.5	44.6000	
764.5	44.6000	
820.5	44.6000	
876.5	44.6000	
932.5	44.6000	
988.5	44.6000	
1044.5	44.6000	
1100.5	44.6000	
1156.5	44.6000	
1212.5	44.6000	
1268.5	44.6000	
1324.5	44.6000	
1380.5	44.6000	
1436.5	44.6000	
1492.5	44.6000	
1548.5	44.6000	
1604.5	44.6000	
1660.5	44.6000	
1716.5	44.6000	
1772.5	44.6000	
1828.5	44.6000	
1884.5	44.6000	
1940.5	44.6000	
1996.5	44.6000	
2052.5	44.6000	
2108.5	44.6000	
2164.5	44.6000	
2220.5	44.6000	
2276.5	44.6000	
2332.5	44.6000	
2388.5	44.6000	
2444.5	44.6000	
2500.5	44.6000	
2556.5	44.6000	
2612.5	44.6000	
2668.5	44.6000	
2724.5	44.6000	
2780.5	44.6000	
2836.5	44.6000	
2892.5	44.6000	
2948.5	44.6000	
3004.5	44.6000	
3060.5	44.6000	
3116.5	44.6000	
3172.5	44.6000	
3228.5	44.6000	
3284.5	44.6000	
3340.5	44.6000	
3396.5	44.6000	
3452.5	44.6000	
3508.5	44.6000	
3564.5	44.6000	
3620.5	44.6000	
3676.5	44.6000	
3732.5	44.6000	
3788.5	44.6000	
3844.5	44.6000	
3900.5	44.6000	
3956.5	44.6000	
4012.5	44.6000	
4068.5	44.6000	
4124.5	44.6000	
4180.5	44.6000	
4236.5	44.6000	
4292.5	44.6000	
4348.5	44.6000	
4404.5	44.6000	
4460.5	44.6000	
4516.5	44.6000	
4572.5	44.6000	
4628.5	44.6000	
4684.5	44.6000	
4740.5	44.6000	
4796.5	44.6000	
4852.5	44.6000	
4908.5	44.6000	
4964.5	44.6000	
5020.5	44.6000	
5076.5	44.6000	
5132.5	44.6000	
5188.5	44.6000	
5244.5	44.6000	
5300.5	44.6000	
5356.5	44.6000	
5412.5	44.6000	
5468.5	44.6000	
5524.5	44.6000	
5580.5	44.6000	
5636.5	44.6000	
5692.5	44.6000	
5748.5	44.6000	
5804.5	44.6000	
5860.5	44.6000	
5916.5	44.6000	
5972.5	44.6000	
6028.5	44.6000	
6084.5	44.6000	
6140.5	44.6000	
6196.5	44.6000	
6252.5	44.6000	
6308.5	44.6000	
6364.5	44.6000	
6420.5	44.6000	
6476.5	44.6000	
6532.5	44.6000	
6588.5	44.6000	
6644.5	44.6000	
6700.5	44.6000	
6756.5	44.6000	
6812.5	44.6000	
6868.5	44.6000	
6924.5	44.6000	
6980.5	44.6000	
7036.5	44.6000	
7092.5	44.6000	
7148.5	44.6000	
7204.5	44.6000	
7260.5	44.6000	
7316.5	44.6000	
7372.5	44.6000	
7428.5	44.6000	
7484.5	44.6000	
7540.5	44.6000	
7596.5	44.6000	
7652.5	44.6000	
7708.5	44.6000	
7764.5	44.6000	
7820.5	44.6000	
7876.5	44.6000	
7932.5	44.6000	
7988.5	44.6000	
8044.5	44.6000	
8100.5	44.6000	
8156.5	44.6000	
8212.5	44.6000	
8268.5	44.6000	
8324.5	44.6000	
8380.5	44.6000	
8436.5	44.6000	
8492.5	44.6000	
8548.5	44.6000	
8604.5	44.6000	
8660.5	44.6000	
8716.5	44.6000	
8772.5	44.6000	
8828.5	44.6000	
8884.5	44.6000	
8940.5	44.6000	
8996.5	44.6000	
9052.5	44.6000	
9108.5	44.6000	
9164.5	44.6000	
9220.5	44.6000	
9276.5	44.6000	
9332.5	44.6000	
9388.5	44.6000	
9444.5	44.6000	
9500.5	44.6000	
9556.5	44.6000	
9612.5	44.6000	
9668.5	44.6000	
9724.5	44.6000	
9780.5	44.6000	
9836.5	44.6000	
9892.5	44.6000	
9948.5	44.6000	
10004.5	44.6000	

E6.3

ENERGY LOSS COEFFICIENTS

NO	K2	K3	K2L	K3M	LELJ	MELJ	TELJ	TELM	K2RUS	K2LRUS	K3RUS	K3MRUS	KC	CI
1	-0.41	-0.10	-0.50	-0.59	-1.20	-0.83	-0.06	-0.68	-0.66	-2.19	0.10	0.30	-0.40	-1.1
2	-0.41	-0.28	-0.99	-0.20	-1.20	-0.83	4.19	-0.92	-0.33	0.19	0.22	0.31	-0.30	-0.1
3	-0.20	-0.46	-2.53	-0.34	-0.55	-1.23	4.84	0.92	0.47	5.10	0.19	0.25	-0.42	-1.1
MAIN FLOW	55663.367	3992.674	0.41	0.70	102	33.93	86.67	84.39	13.730	11.41	13.004	0.04	-0.42	-1.1
LATERAL FLOW	5663.367	1146.832	0.17	0.20	102	33.93	86.67	84.39	13.730	11.41	13.004	0.04	-0.42	-1.1
7503.961	1146.832	0.13	0.15	102	33.93	86.67	84.39	13.730	11.41	13.004	0.04	-0.42	-1.1	

K2: LATERAL LOSS COEFFICIENT WRT. OUTLET VELOCITY
 K3: MAIN LOSS COEFFICIENT WRT. OUTLET VELOCITY
 K2L: MAIN LATERAL INLET VELOCITY
 K3M: MAIN LATERAL INLET VELOCITY
 LELJ: LATERAL ENERGY LOSS DUE TO JUNCTION
 MELJ: MAIN ENERGY LOSS DUE TO JUNCTION
 TELM: TOTAL ENERGY LOSS THROUGH JUNCTION
 RATIO OF LATERAL FLOW TO TOTAL FLOW
 VELIN: LATERAL INLET FLOW TO MAIN FLOW VELOCITIES
 RATIO2: LATERAL FLOW TO MAIN FLOW VELOCITIES
 KC: COMBINED LOSS COEFFICIENT EQUATION -FOR COMPARISON
 K3RUS: BASED ON RUSSIAN PREDICTION EQUATION

POWER LOSS

MAIN POWER	LATERAL POWER	OUT POWER	POWER LOSS RATIO
602219.4000	437764.5000	1023252.0000	0.0161
582452.0000	117518.8000	706032.0000	-0.0087
780845.6000	120123.0000	910830.5000	-0.0109

POSITION ALONG PIPE (CM)	PIEZOMETER	READING	CM
120.6	1	0.0000	
176.5	2	0.0000	
242.6	3	0.0000	
303.5	4	0.0000	
364.5	5	0.0000	
425.5	6	0.0000	
486.4	7	0.0000	
510.0	8	0.0000	
547.4	9	0.0000	
563.2	10	0.0000	
578.5	11	0.0000	
593.7	12	0.0000	
606.4	13	0.0000	
608.9	14	0.0000	
624.2	15	0.0000	
639.5	16	0.0000	
750.3	17	0.0000	
780.0	18	0.0000	
811.3	19	0.0000	
872.3	20	0.0000	
907.2	21	0.0000	
930.4	22	0.0000	
972.5	23	0.0000	
305.5	24	44.9500	
335.7	25	44.9500	
435.5	26	44.9500	
496.0	27	44.9500	
557.6	28	44.9500	
583.7	29	44.9500	
588.1	30	44.9500	
618.5	31	44.9500	
633.8	32	44.9500	
644.4	33	44.9500	
649.0	34	44.9500	
679.3	35	44.9500	
750.8	36	44.9500	
780.8	37	44.9500	
811.3	38	44.9500	
872.3	39	44.9500	
972.6	40	44.9500	

FLOW RATE (CURBIC CENTIMETERS PER SECOND) 0.0000
 LATERAL 1146.8310 MAIN
 SLOPE 0.018200 MAIN 0.010000 OUTLET 0.010000
 LATERAL 0.31 LATERAL 5.390
 MANHOLE DROP : MAIN 0.31 LATERAL 5.390

L4.1

POSITION ALONG PIPE (CM)	PIEZOMETER	READING	CM
120.6	1	0.000	
176.5	2	0.000	
242.6	3	0.000	
303.5	4	0.000	
364.5	5	0.000	
425.5	6	0.000	
486.4	7	0.000	
510.0	8	0.000	
547.4	9	0.000	
563.5	10	0.000	
578.7	11	0.000	
593.7	12	0.000	
606.4	13	0.000	
608.9	14	0.000	
624.2	15	0.000	
639.5	16	0.000	
750.3	17	0.000	
780.3	18	0.000	
811.3	19	0.000	
872.3	20	0.000	
972.6	21	0.000	
972.6	22	0.000	
972.6	23	0.000	
972.6	24	0.000	
972.6	25	0.000	
972.6	26	0.000	
972.6	27	0.000	
972.6	28	0.000	
972.6	29	0.000	
972.6	30	0.000	
972.6	31	0.000	
972.6	32	0.000	
972.6	33	0.000	
972.6	34	0.000	
972.6	35	0.000	
972.6	36	0.000	
972.6	37	0.000	
972.6	38	0.000	
972.6	39	0.000	
972.6	40	0.000	
972.6	41	0.000	
972.6	42	0.000	
972.6	43	0.000	
972.6	44	0.000	
972.6	45	0.000	
972.6	46	0.000	
972.6	47	0.000	
972.6	48	0.000	
972.6	49	0.000	
972.6	50	0.000	
972.6	51	0.000	
972.6	52	0.000	
972.6	53	0.000	
972.6	54	0.000	
972.6	55	0.000	
972.6	56	0.000	
972.6	57	0.000	
972.6	58	0.000	
972.6	59	0.000	
972.6	60	0.000	
972.6	61	0.000	
972.6	62	0.000	
972.6	63	0.000	
972.6	64	0.000	
972.6	65	0.000	
972.6	66	0.000	
972.6	67	0.000	
972.6	68	0.000	
972.6	69	0.000	
972.6	70	0.000	
972.6	71	0.000	
972.6	72	0.000	
972.6	73	0.000	
972.6	74	0.000	
972.6	75	0.000	
972.6	76	0.000	
972.6	77	0.000	
972.6	78	0.000	
972.6	79	0.000	
972.6	80	0.000	
972.6	81	0.000	
972.6	82	0.000	
972.6	83	0.000	
972.6	84	0.000	
972.6	85	0.000	
972.6	86	0.000	
972.6	87	0.000	
972.6	88	0.000	
972.6	89	0.000	
972.6	90	0.000	
972.6	91	0.000	
972.6	92	0.000	
972.6	93	0.000	
972.6	94	0.000	
972.6	95	0.000	
972.6	96	0.000	
972.6	97	0.000	
972.6	98	0.000	
972.6	99	0.000	
972.6	100	0.000	

L4.2

ENERGY LOSS COEFFICIENTS

NO	K2	K3	K2L	K3M	LELJ	MELJ	TEL	TELM	K2RUS	K2LRUS	K3RUS	K3MRUS	KC	CE
1	7.25	0.30	1.79	0.00	6.51	0.00	11.90	0.00	3.01	0.57	0.10	0.30	7.25	6.0
2	15.84	0.00	4.92	0.00	4.47	0.00	9.86	0.00	0.01	0.00	0.22	0.31	15.84	4.0
MAIN FLOW	0.0000	1146.832	1.00	0.00	0.00	0.00	40.58	0.00	41.95	0.989	5.422	13.592		
LATERAL FLOW	0.0000	2690.101	1.00	0.00	0.00	0.00	0.00	0.00	23.51	8.064	13.592			

K2: LATERAL LOSS COEFFICIENT W.R.T. OUTLET VELOCITY
 K3: MAIN LOSS COEFFICIENT W.R.T. OUTLET VELOCITY
 K2L: MAIN LATERAL INLET VELOCITY
 K3M: MAIN LATERAL ENERGY LOSS DUE TO JUNCTION
 LELJ: MAIN LATERAL ENERGY LOSS THROUGH JUNCTION
 MELJ: MAIN LATERAL ENERGY LOSS TO TOTAL FLOW VELOCITIES
 TEL: TOTAL LATERAL FLOW TO TOTAL FLOW VELOCITIES
 TELM: TOTAL LATERAL FLOW TO TOTAL FLOW VELOCITIES
 K2RUS: LATERAL INLET LOSS COEFFICIENT EQUATION -FOR COMPARISON
 K2LRUS: LATERAL INLET LOSS COEFFICIENT EQUATION -FOR COMPARISON
 K3RUS: LATERAL INLET LOSS COEFFICIENT EQUATION -FOR COMPARISON
 K3MRUS: LATERAL INLET LOSS COEFFICIENT EQUATION -FOR COMPARISON
 KC: COMBINED LOSS COEFFICIENT EQUATION -FOR COMPARISON
 CE: COMBINED LOSS COEFFICIENT EQUATION -FOR COMPARISON

POWER LOSS

L4

MAIN POWER LATERAL POWER OUT POWER POWER LOSS RATIO

MAIN POWER	LATERAL POWER	OUT POWER	POWER LOSS RATIO
0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000

[illegible]

MAIN POWER	LATERAL POWER	OUT POWER	POWER LOSS RATIO
637596.6000	355011.8000	984928.8000	0.0077

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ENERGY LOSS COEFFICIENTS

NO	K2	K3	K2L	K3L	LELJ	MELJ	TELL	TELM	K2RUS	K2LRUS	K3RUS	K3MRUS	KC	CE
1	0.00	-0.07	0.00	0.00	0.00	-0.23	0.00	0.00	3.01	0.57	0.00	0.00	-0.07	-0.2
MAIN FLOW							VELINL	VELOUT	E1P	E2P	E3P			
5663.367						90.68	0.00	79.30	9.915	5.422	9.376			

K2: LATERAL LOSS COEFFICIENT
 K3: MAIN LOSS COEFFICIENT
 K2L: MAIN LATERAL INLET VELOCITY
 K3L: MAIN LATERAL INLET VELOCITY
 LELJ: MAIN LATERAL ENERGY LOSS DUE TO JUNCTION
 MELJ: MAIN LATERAL ENERGY LOSS THROUGH JUNCTION
 TELJ: TOTAL ENERGY LOSS TO TOTAL FLOW
 TELM: TOTAL ENERGY LOSS TO TOTAL FLOW
 K2RUS: OF LATERAL FLOW TO TOTAL FLOW
 K2LRUS: RATIO OF LATERAL FLOW TO TOTAL FLOW
 K3RUS: RATIO OF LATERAL FLOW TO TOTAL FLOW
 K3MRUS: RATIO OF LATERAL FLOW TO TOTAL FLOW
 KC: COMBINED BASED ON RUSSIAN PREDICTION EQUATION - FOR COMPARISON

POWER LOSS

MAIN POWER	LATERAL POWER	OUT POWER	POWER LOSS RATIO
0.0000	0.0000	0.0000	0.0000

POSITION ALONG PIPE (CM)

PIEZOMETER READING, CM

120.0	1	43.410
170.0	2	42.800
242.0	3	41.910
303.0	4	41.100
330.0	5	40.560
425.0	6	39.940
486.0	7	39.260
510.0	8	38.280
547.0	9	38.030
569.0	10	37.200
578.0	11	36.530
593.0	12	35.240
600.0	13	34.660
624.0	14	34.270
659.0	15	33.770
750.0	16	33.150
811.0	17	32.670
872.0	18	32.150
972.0	19	31.620
304.0	20	31.350
336.0	21	30.620
435.0	22	29.950
496.0	23	29.350
557.0	24	28.850
583.0	25	28.100
618.0	26	27.200
633.0	27	26.910
644.0	28	26.300
649.0	29	25.800
679.0	30	25.410
750.0	31	24.350
780.0	32	23.770
811.0	33	23.150
872.0	34	22.670
972.0	35	22.150

FLOW RATE (CUBIC CENTIMETERS PER SECOND) 5665.3670

FLUTE LATERAL N. 019000MAIN N. 010000UTILL N. 010000
MANHOLE DROP : MAIN 1.580 LATERAL 6.050

F1.1

FL-2

K2: LATERAL LOSS COEFF. $\lambda_{R,T}$ OUTLET VELOCITY
K3: MAIN LOSS COEFFICIENT $\lambda_{R,T}$ OUTLET VELOCITY
K2L: $\lambda_{R,T}$ LATERAL INLET VELOCITY
K3M: $\lambda_{R,T}$ MAIN INLET VELOCITY
LELU: LATERAL ENERGY LOSS DUE TO JUNCTION
TELM: MAIN ENERGY LOSS DUE TO JUNCTION
TELM: TOTAL ENERGY LOSS THROUGH JUNCTION
RAVLO: TOTAL LATERAL FLOW TO TOTAL FLOW
RAVLO: OF FLOW IN INLET AND OUTLET VELOCITIES
VELLO2: LATERAL FLOW TO MAIN FLOW
K3COMB: COMBINED JUNCTION LOSS COEFFICIENT
K3RUS: BASED ON RUSSIAN PREDICTION EQUATION -FOR COMPARISON

MAIN POWER	1	ALIKAL POWER	UI POWER	POWER	LOSS RATIO
590287.6000		451083.3000	1026131.0000	.	0.0146
747034.4000		403109.2000	1075983.0000		0.0645

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POSITION ALONG PIPE (CM)	PIEZOMETER READING CM
120.0	43.430
176.5	42.860
242.0	42.000
303.5	41.230
364.5	43.500
425.5	44.310
486.4	44.480
514.0	44.500
547.4	44.640
563.2	44.670
578.7	44.670
593.4	44.820
608.9	44.820
624.2	44.670
639.2	44.670
650.3	44.820
750.3	44.820
780.3	44.820
811.3	44.820
872.3	44.820
972.0	44.820

FLOW RATE (CUBIC CENTIMETERS PER SECOND) 5663.3670
 LATERAL 4530.6910 MAIN
 SLOPE 0.019000 MAIN 0.010000 LATERAL
 HANDBE DROP MAIN 1.580 LATERAL 6.050

F2

ENERGY LOSS COEFFICIENTS
 NU K2 K3 K2L K3M KLLJ MELJ TELL TELM KC CELJ
 1 2.03 -0.10 0.60 -0.49 10.83 -0.34 12.84 1.24 0.84 2.85
 MAIN FLOW LATERAL FLOW RATIO KATIO2 VELLIN VELLINL VELLOU EIP E2P E3P
 5663.367 453M.691 0.44 M.80 35.64 72.00 81.30 14.270 15.049 12.353

K3: LATERAL LOSS COEFF. M.R.T. OUTLET VELOCITY
 K3L: MAIN LOSS COEFFICIENT M.R.T. INLET VELOCITY
 K3M: M.R.T. MAIN INLET VELOCITY
 MELJ: LATERAL ENERGY LOSS DUE TO JUNCTION
 TELJ: MAIN ENERGY LOSS DUE THROUGH JUNCTION
 TELM: TOTAL ENERGY LOSS TO TOTAL FLOW
 RATIO OF LATERAL FLOW TO TOTAL FLOW
 VELLIN: VELOCITY INLET AND OUTLET VELOCITIES
 RATIO2: LATERAL FLOW TO MAIN FLOW
 KC: COMBINED JUNCTION LOSS COEFFICIENT
 K3RUS: BASED ON RUSSIAN PREDICTION EQUATION -FOR COMPARISON

POWER LOSS

MAIN POWER LATERAL POWER OUT POWER POWER LOSS RATIO
 598079.0000 510910.0000 1079981.0000 0.0262

F2

POSITION ALONG PIPE (CM)

POSITION ALONG PIPE (CM)	PLEZOMETER READING CM
120.6	43.43
117.6	42.88
114.2	41.98
110.5	41.24
106.5	40.65
102.5	40.00
98.4	39.28
94.4	38.50
90.4	37.80
86.4	37.10
82.4	36.40
78.4	35.70
74.4	35.00
70.4	34.30
66.4	33.60
62.4	32.90
58.4	32.20
54.4	31.50
50.4	30.80
46.4	30.10
42.4	29.40
38.4	28.70
34.4	28.00
30.4	27.30
26.4	26.60
22.4	25.90
18.4	25.20
14.4	24.50
10.4	23.80
6.4	23.10
2.4	22.40
0.6	21.70

FLUX RATE (CUBIC CENTIMETERS PER SECOND) 5663.3670

LATERAL 4530.6910 MAIN
SLOPE 0.019000 MAIN 0.010000 OUTLET 0.010000
MANHOLE DROP : MAIN 1.580 LATERAL 6.050

FS

ENERGY LOSS COEFFICIENTS
 NO K2 K3 K2L K3M LELJ HELJ TELJ TELM K2RUS K2LRUS K3RUS K3MRUS KC CEL
 1 1.54 -0.23 0.60 -0.89 5.39 -0.79 11.44 0.79 0.78 0.75 0.05 0.17 0.56 1.96
 MAIN FLOW LATERAL FLOW RATIO RATIO2 VELIN VELIN VELIN VELOUT VELOUT
 5663.367 4530.691 0.44 0.88 38.79 94.34 82.73 13.665 13.005 11.298

K2: LATERAL LOSS COEFF W.R.T. OUTLET VELOCITY
 K3: MAIN LOSS COEFFICIENT W.R.T. OUTLET VELOCITY
 K2L: W.R.T. LATERAL INLET VELOCITY
 K3M: W.R.T. MAIN INLET VELOCITY
 LELJ: LATERAL ENERGY LOSS DUE TO JUNCTION
 HELJ: MAIN ENERGY LOSS THROUGH JUNCTION
 TELJ: TOTAL ENERGY LOSS TO TOTAL FLOW
 TELM: TOTAL LATERAL FLOW AND OUTLET VELOCITIES
 RATIO: LATERAL FLOW TO MAIN FLOW
 RATIO2: LATERAL FLOW TO MAIN FLOW
 VELIN: INLET VELOCITY
 VELOUT: OUTLET VELOCITY
 KC: COMBINED JUNCTION LOSS COEFFICIENT
 CEL: BASED ON RUSSIAN PREDICTION EQUATION - FOR COMPARISON

POWER LOSS

MAIN POWER LATERAL POWER OUT POWER POWER LOSS RATIO
 592108.8000 501660.6000 1073815.0000 0.0182

POSITION	ALONG PIP (CM)	PIEZOMETER	READING	CM
	120.6	1	43.400	
	176.5	2	42.840	
	242.5	3	41.940	
	303.5	4	41.200	
	364.5	5	40.640	
	425.5	6	40.000	
	486.5	7	39.270	
	547.5	8	38.530	
	578.5	9	38.140	
	593.7	10	38.090	
	606.4	11	37.720	
	624.9	12	37.860	
	639.2	13	37.590	
	654.3	14	37.440	
	670.3	15	37.840	
	687.2	16	37.490	
	704.2	17	37.730	
	721.3	18	37.920	
	738.3	19	37.700	
	755.3	20	37.830	
	772.3	21	37.480	
	789.3	22	37.490	
	806.3	23	37.730	
	823.3	24	37.730	
	840.3	25	37.730	
	857.3	26	37.730	
	874.3	27	37.730	
	891.3	28	37.730	
	908.3	29	37.730	
	925.3	30	37.730	
	942.3	31	37.730	
	959.3	32	37.730	
	976.3	33	37.730	
	993.3	34	37.730	
	1010.3	35	37.730	
	1027.3	36	37.730	
	1044.3	37	37.730	
	1061.3	38	37.730	
	1078.3	39	37.730	
	1095.3	40	37.730	
	1112.3	41	37.730	
	1129.3	42	37.730	
	1146.3	43	37.730	
	1163.3	44	37.730	
	1180.3	45	37.730	
	1197.3	46	37.730	
	1214.3	47	37.730	
	1231.3	48	37.730	
	1248.3	49	37.730	
	1265.3	50	37.730	
	1282.3	51	37.730	
	1299.3	52	37.730	
	1316.3	53	37.730	
	1333.3	54	37.730	
	1350.3	55	37.730	
	1367.3	56	37.730	
	1384.3	57	37.730	
	1401.3	58	37.730	
	1418.3	59	37.730	
	1435.3	60	37.730	
	1452.3	61	37.730	
	1469.3	62	37.730	
	1486.3	63	37.730	
	1503.3	64	37.730	
	1520.3	65	37.730	
	1537.3	66	37.730	
	1554.3	67	37.730	
	1571.3	68	37.730	
	1588.3	69	37.730	
	1605.3	70	37.730	
	1622.3	71	37.730	
	1639.3	72	37.730	
	1656.3	73	37.730	
	1673.3	74	37.730	
	1690.3	75	37.730	
	1707.3	76	37.730	
	1724.3	77	37.730	
	1741.3	78	37.730	
	1758.3	79	37.730	
	1775.3	80	37.730	
	1792.3	81	37.730	
	1809.3	82	37.730	
	1826.3	83	37.730	
	1843.3	84	37.730	
	1860.3	85	37.730	
	1877.3	86	37.730	
	1894.3	87	37.730	
	1911.3	88	37.730	
	1928.3	89	37.730	
	1945.3	90	37.730	
	1962.3	91	37.730	
	1979.3	92	37.730	
	1996.3	93	37.730	
	2013.3	94	37.730	
	2030.3	95	37.730	
	2047.3	96	37.730	
	2064.3	97	37.730	
	2081.3	98	37.730	
	2098.3	99	37.730	
	2115.3	100	37.730	

F4

ENERGY LOSS COEFFICIENTS

NO	K2	K3	K2L59	K3M	LELJ	MELJ	TELL	TELM	K2RUS	K2LRUS	K3RUS	K3MRUS	KC	CEL
1	1.46	-0.92	0.59	-1.11	4.76	-2.80	10.81	-1.22	0.78	0.75	0.05	0.17	0.17	0.56
MAIN FLOW	LATRAL FLOW	RATIO	RATIO	RATIO	VELIN	VELIN	VELIN	VELOUT	13.500	12.200	9.123			
5663.567	4530.691	0.44	0.88		42.97	100.51	79.92							

K2: LATERAL LOSS COEFFICIENT W.R.T. OUTLET VELOCITY
 K3: MAIN LOSS COEFFICIENT W.R.T. OUTLET VELOCITY
 K2L: W.R.T. LATERAL INLET VELOCITY
 K3M: W.R.T. MAIN INLET VELOCITY
 LELJ: LATERAL ENERGY LOSS DUE TO JUNCTION
 MELJ: MAIN ENERGY LOSS DUE THROUGH JUNCTION
 TELJ: TOTAL ENERGY LOSS TO TOTAL FLOW
 TELM: TOTAL ENERGY LOSS TO TOTAL FLOW
 RATIO: OF LATERAL FLOW TO MAIN FLOW
 VELIN: INLET AND OUTLET VELOCITIES
 VELOUT: LATERAL FLOW TO MAIN FLOW
 RATIO: LATERAL FLOW TO MAIN FLOW
 KC: COMBINED BASED ON RUSSIAN PREDICTION EQUATION - FOR COMPARISON
 K3RUS: BASED ON RUSSIAN PREDICTION EQUATION - FOR COMPARISON

POWER LOSS

MAIN POWER	LATERAL POWER	OUT POWER	POWER LOSS RATIO
579797.8000	498050.1000	1072128.0000	0.0053

F4

-(CM)

PIEZOMETER READING CM

1	43.390
2	42.830
3	41.850
4	41.210
5	40.620
6	39.980
7	39.270
8	40.240
9	40.770
10	41.180
11	42.580
12	42.760
13	42.760
14	42.760
15	42.760
16	42.760
17	42.760
18	42.760
19	42.760
20	42.760
21	42.760
22	42.760
23	42.760
24	42.760
25	42.760
26	42.760
27	42.760
28	42.760
29	42.760
30	42.760
31	42.760
32	42.760
33	42.760
34	42.760
35	42.760
36	42.760
37	42.760
38	42.760
39	42.760

INETERS PFR SECOND) 5663.3670

30.6910MAIN
IN 0.010000ULT 0.010000
1.580LATERAL 6.050

F5

EFFICIENTS K3M LELJ MELJ TEL TELM K2RUS K2LRUS K3RUS K3MRUS KC -CELJ
 37 K2L 0.60 1.832 5.71 1.29 11.76 0.29 0.78 0.75 0.05 0.17 0.52 1.82
 RAL FLOW RATIO 0.44 0.80 40.43 112.96 82.73 13.779 13.440 10.913
 153M.091

F M R T. OUTLET VELOCITY
 ICIENT VELOCITY
 ET VELOCITY
 Y LOSS DUE TO JUNCTION
 LOSS THROUGH JUNCTION
 LOSS TO TOTAL FLOW
 ET AND OUTLET VELOCITIES.
 ET TO MAIN FLOW
 RUSSIAN COEFFICIENT EQUATION -FOR COMPARISON

LATERAL POWER OUT POWER POWER LOSS RATIO
 503628.6000 1074979.0000 0.0170

F5

F.

POSITION ALONG PIPE (CM)	PIEZOMETER READING CM	FLOW RATE (CUBIC CENTIMETERS PER SECOND)
120.6	43.430	5663.3670
176.6	42.870	
242.6	41.950	
303.5	41.250	
364.5	40.720	
425.5	40.050	
486.5	44.330	
547.1	44.480	
510.1	44.520	
578.5	44.520	
593.7	44.520	
606.4	44.520	
624.2	44.520	
639.5	44.520	
750.3	38.160	
780.8	37.050	
811.2	37.050	
872.5	35.720	
904.5	46.800	
936.5	45.390	
957.7	42.860	
972.6	42.190	
548.1	41.630	
618.5	41.330	
633.4	41.000	
644.4	41.060	
649.3	43.690	
679.3	39.630	
750.3	38.160	
760.3	37.650	
811.3	37.050	
872.3	35.720	
972.6		

FLOW RATE (CUBIC CENTIMETERS PER SECOND) 5663.3670
 LATERAL 4530.6910 MAIN
 SLOPE 0.019000 MAIN 0.010000 OUTLET 0.010000
 LATERAL 1.580 LATERAL 6.050
 MANHOLE DROP : MAIN

F6

ENERGY LOSS COEFFICIENTS
 NO K2 K3 K2L K3M LELJ MELJ TELJ TELM K2RUS K2LRUS K3RUS K3MRUS KC
 1 1.86 0.05 0.63 0.27 6.73 0.18 12.78 1.76 0.78 0.75 0.05 0.17 0.86
 MAIN FLOW LATERAL FLOW RATIO RATIO2 VELIN VELINL VELOUT EIP ESP EIP
 5663.367 4530.691 0.44 0.82 35.64 73.00 84.23 15.774 14.454 12.378 3.08

K2: LATERAL LOSS COEFF W.R.1. OUTLET VELOCITY
 K3: MAIN LOSS COEFFICIENT W.R.1. OUTLET VELOCITY
 K2L: MAIN LATERAL INLET VELOCITY
 K3M: MAIN LATERAL INLET VELOCITY
 LELJ: LATERAL ENERGY LOSS DUE TO JUNCTION
 MELJ: MAIN ENERGY LOSS THROUGH JUNCTION
 TELJ: TOTAL ENERGY LOSS TO TOTAL FLOW
 TELM: TOTAL ENERGY LOSS AND OUTLET VELOCITIES
 RATIO: OF LATERAL FLOW TO MAIN FLOW
 VELIN: LATERAL FLOW TO MAIN FLOW
 VELINL: LATERAL FLOW TO MAIN FLOW
 VELOUT: LATERAL FLOW TO MAIN FLOW
 RATIO2: LATERAL FLOW TO MAIN FLOW
 KC: COMBINED BASED ON RUSSIAN PREDICTION EQUATION -FOR COMPARISON
 K3RUS:

POWER LOSS

MAIN POWER LATERAL POWER OUT POWER POWER LOSS RATIO
 598222.8000 508219.9000 1074920.0000 0.0285

F6

POSITION ALONG PIPE (CM)	PIEZOMETER READING CM	FLOW RATE (CURRIC CENTIMETERS PER SECOND)
120.6	43.4000	5663.3670
176.5	42.8000	
242.5	41.9100	
303.5	41.9100	
364.5	40.9100	
425.5	39.9100	
486.5	38.9100	
547.5	37.9100	
578.5	36.9100	
593.7	35.9100	
608.4	34.9100	
624.0	33.9100	
639.0	32.9100	
650.0	31.9100	
670.0	30.9100	
681.1	29.9100	
692.2	28.9100	
704.0	27.9100	
715.0	26.9100	
726.0	25.9100	
737.0	24.9100	
748.0	23.9100	
759.0	22.9100	
770.0	21.9100	
781.0	20.9100	
792.0	19.9100	
803.0	18.9100	
814.0	17.9100	
825.0	16.9100	
836.0	15.9100	
847.0	14.9100	
858.0	13.9100	
869.0	12.9100	
880.0	11.9100	
891.0	10.9100	
902.0	9.9100	
913.0	8.9100	
924.0	7.9100	
935.0	6.9100	
946.0	5.9100	
957.0	4.9100	
968.0	3.9100	
979.0	2.9100	
990.0	1.9100	
1000.0	0.9100	

ENERGY LOSS COEFFICIENTS
 NO. K2 K3 K2L K2M LELJ MELJ TEL TELM K2RUS K2LRUS K3RUS K3MRUS KC CEL
 1 5M -0.26 0.65 -0.24 0.83 11.48 219 0.69 0.74 0.09 0.27 0.48 1.56
 MAIN FLOW LATERAL FLOW RATIO 0.42 0.73 11.44 VELOUT 79.52 13.262 11.439 9.411
 5663.367 4134.258

K2: LATERAL LOSS COEFFICIENT M.R.T. OUTLET VELOCITY
 K3: MAIN LOSS COEFFICIENT M.R.T. OUTLET VELOCITY
 K2L: M.R.T. LATERAL INLET VELOCITY
 K3M: M.R.T. MAIN INLET VELOCITY
 LELJ: LATERAL ENERGY LOSS DUE TO JUNCTION
 MELJ: MAIN ENERGY LOSS DUE TO JUNCTION
 TELM: INITIAL ENERGY LOSS THROUGH JUNCTION
 TEL: INITIAL ENERGY LOSS TO TOTAL FLOW
 RATIO: OF LATERAL FLOW TO OUTLET VELOCITIES
 VELOIN: VELOCITY INLET TO MAIN FLOW
 VELOUT: VELOCITY OUTLET TO MAIN FLOW
 K2RUS: LATERAL FLOW LOSS COEFFICIENT
 K3RUS: MAIN FLOW LOSS COEFFICIENT
 K2LRUS: LATERAL FLOW LOSS COEFFICIENT
 K3MRUS: MAIN FLOW LOSS COEFFICIENT
 KC: COMBINED BASED ON RUSSIAN PREDICTION EQUATION -FOR COMPARISON

POWER LOSS

MAIN POWER LATERAL POWER OUT POWER POWER LOSS RATIO
 581425.3000 447821.2000 101402.0000 0.0148

POSITION ALONG PIPE (CM)

PIEZOMETER READING CM

120.0	1	43.430
176.5	2	42.830
242.5	3	41.970
303.5	4	41.220
364.5	5	40.000
425.5	6	39.320
486.5	7	38.660
547.5	8	37.110
570.5	9	36.030
593.7	10	35.040
606.4	11	34.080
629.2	12	33.260
652.0	13	32.580
675.0	14	31.970
698.0	15	31.430
721.0	16	30.870
744.0	17	30.350
767.0	18	29.810
790.0	19	29.350
813.0	20	28.860
836.0	21	28.410
859.0	22	27.910
882.0	23	27.400
905.0	24	26.870
928.0	25	26.350
951.0	26	25.810
974.0	27	25.350
997.0	28	24.860
1020.0	29	24.410
1043.0	30	23.900
1066.0	31	23.400
1089.0	32	22.870
1112.0	33	22.350
1135.0	34	21.810
1158.0	35	21.350
1181.0	36	20.860
1204.0	37	20.410
1227.0	38	19.900
1250.0	39	19.400
1273.0	40	18.870
1296.0	41	18.350
1319.0	42	17.810
1342.0	43	17.350
1365.0	44	16.860
1388.0	45	16.410
1411.0	46	15.900
1434.0	47	15.400
1457.0	48	14.870
1480.0	49	14.350
1503.0	50	13.810
1526.0	51	13.350
1549.0	52	12.860
1572.0	53	12.410
1595.0	54	11.900
1618.0	55	11.400
1641.0	56	10.870
1664.0	57	10.350
1687.0	58	9.810
1710.0	59	9.350
1733.0	60	8.860
1756.0	61	8.410
1779.0	62	7.900
1802.0	63	7.400
1825.0	64	6.870
1848.0	65	6.350
1871.0	66	5.810
1894.0	67	5.350
1917.0	68	4.860
1940.0	69	4.410
1963.0	70	3.900
1986.0	71	3.400
2009.0	72	2.870
2032.0	73	2.350
2055.0	74	1.810
2078.0	75	1.350
2101.0	76	0.860
2124.0	77	0.410
2147.0	78	0.000
2170.0	79	0.000
2193.0	80	0.000
2216.0	81	0.000
2239.0	82	0.000
2262.0	83	0.000
2285.0	84	0.000
2308.0	85	0.000
2331.0	86	0.000
2354.0	87	0.000
2377.0	88	0.000
2400.0	89	0.000
2423.0	90	0.000
2446.0	91	0.000
2469.0	92	0.000
2492.0	93	0.000
2515.0	94	0.000
2538.0	95	0.000
2561.0	96	0.000
2584.0	97	0.000
2607.0	98	0.000
2630.0	99	0.000
2653.0	100	0.000

FLOW RATE (CUBIC CENTIMETERS PER SECOND) 5663.3670
LATERAL 4134.2570 MAIN
LATERAL 3.019000 MAIN 3.019000 UTILITY 3.019000
MANHOLE DROP : 441.4 3.020 LATERAL 6.650

G-2

ENERGY LOSS COEFFICIENTS
 NO K2 K3 K2L K3M LELJ MELJ TELJ TELM K2RUS K2LRUS K3RUS K3MRUS KC CEL
 1 1.84 0.13 0.68 0.35 0.37 0.38 12.82 3.40 0.69 0.74 0.09 0.27 0.85 2.49
 MAIN FLOW LATERAL FLOW RATIO RATIO2 VELINH 41.03 VELINL 84.37 VELOUT 75.56 E1P 13.122 E2P 10.484
 5663.367 4134.258 0.42 0.73

K2: LATERAL LOSS COEFF W.R.T. OUTLET VELOCITY
 K3: MAIN LOSS COEFFICIENT W.R.T. OUTLET VELOCITY
 K2L: MAIN LATERAL INLET VELOCITY
 K3M: MAIN INLET VELOCITY
 LELJ: LATERAL ENERGY LOSS DUE TO JUNCTION
 MELJ: MAIN ENERGY LOSS DUE TO JUNCTION
 TELJ: TOTAL ENERGY LOSS THROUGH JUNCTION
 TELM: TOTAL ENERGY LOSS TO TOTAL FLOW
 RATIO: OF LATERAL FLOW TO TOTAL FLOW
 RATIO2: OF LATERAL INLET AND OUTLET VELOCITIES
 VELIN: INLET FLOW TO MAIN FLOW
 VELINL: LATERAL FLOW TO MAIN FLOW
 VELOUT: FLOW TO MAIN FLOW
 RATIOCOMBINED: BASIC ON RUSSIAN PREDICTION EQUATION -FOR COMPARISON
 KC3RUS:

POWER LOSS

MAIN POWER LATERAL POWER OUT POWER POWER LOSS RATIO
 587502.10MW 449488.3000 1012639.0000 0.0235

G2

POSITION ALONG PIPE (CM)	PIEZOMETER READING CM
120.6	43.360
176.5	42.770
242.5	41.900
303.5	41.170
364.5	40.570
425.5	39.940
486.4	39.270
510.4	38.550
547.4	38.360
563.2	38.100
578.5	37.980
593.7	37.230
616.4	37.760
648.9	37.570
659.2	37.430
750.3	36.780
780.8	36.540
811.3	36.740
872.3	36.000
972.0	35.560

FLOW RATE (CUBIC CENTIMETERS PER SECOND)	TIME (MINUTES)	TIME (HOURS)
4389.1050	0.1000	0.0000
4389.1050	0.2000	0.0000
4389.1050	0.3000	0.0000
4389.1050	0.4000	0.0000
4389.1050	0.5000	0.0000
4389.1050	0.6000	0.0000
4389.1050	0.7000	0.0000
4389.1050	0.8000	0.0000
4389.1050	0.9000	0.0000
4389.1050	1.0000	0.0000
4389.1050	1.1000	0.0000
4389.1050	1.2000	0.0000
4389.1050	1.3000	0.0000
4389.1050	1.4000	0.0000
4389.1050	1.5000	0.0000
4389.1050	1.6000	0.0000
4389.1050	1.7000	0.0000
4389.1050	1.8000	0.0000
4389.1050	1.9000	0.0000
4389.1050	2.0000	0.0000
4389.1050	2.1000	0.0000
4389.1050	2.2000	0.0000
4389.1050	2.3000	0.0000
4389.1050	2.4000	0.0000
4389.1050	2.5000	0.0000
4389.1050	2.6000	0.0000
4389.1050	2.7000	0.0000
4389.1050	2.8000	0.0000
4389.1050	2.9000	0.0000
4389.1050	3.0000	0.0000
4389.1050	3.1000	0.0000
4389.1050	3.2000	0.0000
4389.1050	3.3000	0.0000
4389.1050	3.4000	0.0000
4389.1050	3.5000	0.0000
4389.1050	3.6000	0.0000
4389.1050	3.7000	0.0000
4389.1050	3.8000	0.0000
4389.1050	3.9000	0.0000
4389.1050	4.0000	0.0000
4389.1050	4.1000	0.0000
4389.1050	4.2000	0.0000
4389.1050	4.3000	0.0000
4389.1050	4.4000	0.0000
4389.1050	4.5000	0.0000
4389.1050	4.6000	0.0000
4389.1050	4.7000	0.0000
4389.1050	4.8000	0.0000
4389.1050	4.9000	0.0000
4389.1050	5.0000	0.0000
4389.1050	5.1000	0.0000
4389.1050	5.2000	0.0000
4389.1050	5.3000	0.0000
4389.1050	5.4000	0.0000
4389.1050	5.5000	0.0000
4389.1050	5.6000	0.0000
4389.1050	5.7000	0.0000
4389.1050	5.8000	0.0000
4389.1050	5.9000	0.0000
4389.1050	6.0000	0.0000
4389.1050	6.1000	0.0000
4389.1050	6.2000	0.0000
4389.1050	6.3000	0.0000
4389.1050	6.4000	0.0000
4389.1050	6.5000	0.0000
4389.1050	6.6000	0.0000
4389.1050	6.7000	0.0000
4389.1050	6.8000	0.0000
4389.1050	6.9000	0.0000
4389.1050	7.0000	0.0000
4389.1050	7.1000	0.0000
4389.1050	7.2000	0.0000
4389.1050	7.3000	0.0000
4389.1050	7.4000	0.0000
4389.1050	7.5000	0.0000
4389.1050	7.6000	0.0000
4389.1050	7.7000	0.0000
4389.1050	7.8000	0.0000
4389.1050	7.9000	0.0000
4389.1050	8.0000	0.0000
4389.1050	8.1000	0.0000
4389.1050	8.2000	0.0000
4389.1050	8.3000	0.0000
4389.1050	8.4000	0.0000
4389.1050	8.5000	0.0000
4389.1050	8.6000	0.0000
4389.1050	8.7000	0.0000
4389.1050	8.8000	0.0000
4389.1050	8.9000	0.0000
4389.1050	9.0000	0.0000
4389.1050	9.1000	0.0000
4389.1050	9.2000	0.0000
4389.1050	9.3000	0.0000
4389.1050	9.4000	0.0000
4389.1050	9.5000	0.0000
4389.1050	9.6000	0.0000
4389.1050	9.7000	0.0000
4389.1050	9.8000	0.0000
4389.1050	9.9000	0.0000
4389.1050	10.0000	0.0000

G-3

ENERGY LOSS COEFFICIENTS
 NO K2 K3 K2L K3M LELJ MELJ TEL TELM K2RUS K2LRUS K3RUS K3MRUS KC CEI
 1 0.86 0.45 0.51 0.57 4.56 2.39 11.21 0.63 0.75 0.75 0.07 0.21 0.12 0.61
 MAIN FLOW LATERAL FLOW RATIO RATIO RATIO VELIN VELINL VELOUT EIP ESP E3P
 5663.367 4389.105 0.44 0.77 94.01 120.55 101.89 14.936 12.850 9.530

K2: LATERAL LOSS COEFFICIENT M.R.T. OUTLET VELOCITY
 K3: MAIN LOSS COEFFICIENT M.R.T. OUTLET VELOCITY
 K2L: M.R.T. MAIN INLET VELOCITY
 K3M: M.R.T. MAIN INLET VELOCITY
 LELJ: LATERAL ENERGY LOSS DUE TO JUNCTION
 MELJ: MAIN ENERGY LOSS THROUGH JUNCTION
 TELM: TOTAL ENERGY LOSS TO TOTAL FLOW
 TEL: OF LATERAL FLOW TO TOTAL FLOW
 VELIN: VELOCITY INLET AND OUTLET VELOCITIES
 VELINL: LATERAL FLOW TO MAIN FLOW
 VELOUT: LATERAL FLOW TO MAIN FLOW
 RATIO2: LATERAL FLOW TO MAIN FLOW
 RATIO: COMBINED BASED ON RUSSIAN PREDICTION EQUATION - FOR COMPARISON
 K3RUS :

POWER LOSS

MAIN POWER LATERAL POWER OUT POWER POWER LOSS RATIO
 382298.5000 481616.9000 1057206.0000 1.00001

POSITION ALONG PIPE (CM)	PIEZOMETER READING CM
120.6	43.310
176.5	42.740
242.6	41.850
303.5	41.120
364.5	40.550
425.5	39.900
486.4	39.160
510.4	38.430
547.4	38.210
563.2	38.000
578.7	37.800
593.7	37.500
608.9	37.340
624.2	37.130
639.3	36.900
650.8	36.600
672.0	36.300
687.3	36.000
702.5	35.700
717.7	35.400
732.9	35.100
748.1	34.800
763.3	34.500
778.5	34.200
793.7	33.900
808.9	33.600
824.2	33.300
839.3	33.000
854.5	32.700
869.6	32.400
884.8	32.100
899.9	31.800
915.1	31.500
930.3	31.200
945.5	30.900
960.7	30.600
975.9	30.300
991.1	30.000
1006.3	29.700
1021.5	29.400
1036.7	29.100
1051.9	28.800
1067.1	28.500
1082.3	28.200
1097.5	27.900
1112.7	27.600
1127.9	27.300
1143.1	27.000
1158.3	26.700
1173.5	26.400
1188.7	26.100
1203.9	25.800
1219.1	25.500
1234.3	25.200
1249.5	24.900
1264.7	24.600
1279.9	24.300
1295.1	24.000
1310.3	23.700
1325.5	23.400
1340.7	23.100
1355.9	22.800
1371.1	22.500
1386.3	22.200
1401.5	21.900
1416.7	21.600
1431.9	21.300
1447.1	21.000
1462.3	20.700
1477.5	20.400
1492.7	20.100
1507.9	19.800
1523.1	19.500
1538.3	19.200
1553.5	18.900
1568.7	18.600
1583.9	18.300
1599.1	18.000
1614.3	17.700
1629.5	17.400
1644.7	17.100
1659.9	16.800
1675.1	16.500
1690.3	16.200
1705.5	15.900
1720.7	15.600
1735.9	15.300
1751.1	15.000
1766.3	14.700
1781.5	14.400
1796.7	14.100
1811.9	13.800
1827.1	13.500
1842.3	13.200
1857.5	12.900
1872.7	12.600
1887.9	12.300
1903.1	12.000
1918.3	11.700
1933.5	11.400
1948.7	11.100
1963.9	10.800
1979.1	10.500
1994.3	10.200
2009.5	9.900
2024.7	9.600
2039.9	9.300
2055.1	9.000
2070.3	8.700
2085.5	8.400
2100.7	8.100
2115.9	7.800
2131.1	7.500
2146.3	7.200
2161.5	6.900
2176.7	6.600
2191.9	6.300
2207.1	6.000
2222.3	5.700
2237.5	5.400
2252.7	5.100
2267.9	4.800
2283.1	4.500
2298.3	4.200
2313.5	3.900
2328.7	3.600
2343.9	3.300
2359.1	3.000
2374.3	2.700
2389.5	2.400
2404.7	2.100
2419.9	1.800
2435.1	1.500
2450.3	1.200
2465.5	0.900
2480.7	0.600
2495.9	0.300
2511.1	0.000
2526.3	-0.300
2541.5	-0.600
2556.7	-0.900
2571.9	-1.200
2587.1	-1.500
2602.3	-1.800
2617.5	-2.100
2632.7	-2.400
2647.9	-2.700
2663.1	-3.000
2678.3	-3.300
2693.5	-3.600
2708.7	-3.900
2723.9	-4.200
2739.1	-4.500
2754.3	-4.800
2769.5	-5.100
2784.7	-5.400
2799.9	-5.700
2815.1	-6.000
2830.3	-6.300
2845.5	-6.600
2860.7	-6.900
2875.9	-7.200
2891.1	-7.500
2906.3	-7.800
2921.5	-8.100
2936.7	-8.400
2951.9	-8.700
2967.1	-9.000
2982.3	-9.300
2997.5	-9.600
3012.7	-9.900
3027.9	-10.200
3043.1	-10.500
3058.3	-10.800
3073.5	-11.100
3088.7	-11.400
3103.9	-11.700
3119.1	-12.000
3134.3	-12.300
3149.5	-12.600
3164.7	-12.900
3179.9	-13.200
3195.1	-13.500
3210.3	-13.800
3225.5	-14.100
3240.7	-14.400
3255.9	-14.700
3271.1	-15.000
3286.3	-15.300
3301.5	-15.600
3316.7	-15.900
3331.9	-16.200
3347.1	-16.500
3362.3	-16.800
3377.5	-17.100
3392.7	-17.400
3407.9	-17.700
3423.1	-18.000
3438.3	-18.300
3453.5	-18.600
3468.7	-18.900
3483.9	-19.200
3499.1	-19.500
3514.3	-19.800
3529.5	-20.100
3544.7	-20.400
3559.9	-20.700
3575.1	-21.000
3590.3	-21.300
3605.5	-21.600
3620.7	-21.900
3635.9	-22.200
3651.1	-22.500
3666.3	-22.800
3681.5	-23.100
3696.7	-23.400
3711.9	-23.700
3727.1	-24.000
3742.3	-24.300
3757.5	-24.600
3772.7	-24.900
3787.9	-25.200
3803.1	-25.500
3818.3	-25.800
3833.5	-26.100
3848.7	-26.400
3863.9	-26.700
3879.1	-27.000
3894.3	-27.300
3909.5	-27.600
3924.7	-27.900
3939.9	-28.200
3955.1	-28.500
3970.3	-28.800
3985.5	-29.100
4000.7	-29.400
4015.9	-29.700
4031.1	-30.000
4046.3	-30.300
4061.5	-30.600
4076.7	-30.900
4091.9	-31.200
4107.1	-31.500
4122.3	-31.800
4137.5	-32.100
4152.7	-32.400
4167.9	-32.700
4183.1	-33.000
4198.3	-33.300
4213.5	-33.600
4228.7	-33.900
4243.9	-34.200
4259.1	-34.500
4274.3	-34.800
4289.5	-35.100
4304.7	-35.400
4319.9	-35.700
4335.1	-36.000
4350.3	-36.300
4365.5	-36.600
4380.7	-36.900
4395.9	-37.200
4411.1	-37.500
4426.3	-37.800
4441.5	-38.100
4456.7	-38.400
4471.9	-38.700
4487.1	-39.000
4502.3	-39.300
4517.5	-39.600
4532.7	-39.900
4547.9	-40.200
4563.1	-40.500
4578.3	-40.800
4593.5	-41.100
4608.7	-41.400
4623.9	-41.700
4639.1	-42.000
4654.3	-42.300
4669.5	-42.600
4684.7	-42.900
4699.9	-43.200
4715.1	-43.500
4730.3	-43.800
4745.5	-44.100
4760.7	-44.400
4775.9	-44.700
4791.1	-45.000
4806.3	-45.300
4821.5	-45.600
4836.7	-45.900
4851.9	-46.200
4867.1	-46.500
4882.3	-46.800
4897.5	-47.100
4912.7	-47.400
4927.9	-47.700
4943.1	-48.000
4958.3	-48.300
4973.5	-48.600
4988.7	-48.900
5003.9	-49.200
5019.1	-49.500
5034.3	-49.800
5049.5	-50.100
5064.7	-50.400
5079.9	-50.700
5095.1	-51.000
5110.3	-51.300
5125.5	-51.600
5140.7	-51.900
5155.9	-52.200
5171.1	-52.500
5186.3	-52.800
5201.5	-53.100
5216.7	-53.400
5231.9	-53.700
5247.1	-54.000
5262.3	-54.300
5277.5	-54.600
5292.7	-54.900
5307.9	-55.200
5323.1	-55.500
5338.3	-55.800
5353.5	-56.100
5368.7	-56.400
5383.9	-56.700
5399.1	-57.000
5414.3	-57.300
5429.5	-57.600
5444.7	-57.900
5459.9	-58.200
5475.1	-58.500
5490.3	-58.800
5505.5	-59.100
5520.7	-59.400
5535.9	-59.700
5551.1	-60.000
5566.3	-60.300
5581.5	-60.600
5596.7	-60.900
5611.9	-61.200
5627.1	-61.500
5642.3	-61.800
5657.5	-62.100
5672.7	-62.400
5687.9	-62.700
5703.1	-63.000
5718.3	-63.300
5733.5	-63.600
5748.7	-63.900
5763.9	-64.200
5779.1	-64.500
5794.3	-64.800
5809.5	-65.100
5824.7	-65.400
5839.9	-65.700
5855.1	-66.000
5870.3	-66.300
5885.5	-66.600
5900.7	-66.900
5915.9	-67.200
5931.1	-67.500
5946.3	-67.800
5961.5	-68.100
5976.7	-68.400
5991.9	-68.700
6007.1	-69.000
6022.3	-69.300
6037.5	-69.600
6052.7	-69.900
6067.9	-70.200
6083.1	-70.500
6098.3	-70.800
6113.5	-71.100
6128.7	-71.400
6143.9	-71.700
6159.1	-72.000
6174.3	-72.300
6189.5	-72.600
6204.7	-72.900
6219.9	-73.200
6235.1	-73.500
6250.3	-73.800
6265.5	-74.100
6280.7	-74.400
6295.9	-74.700
6311.1	-75.000
6326.3	-75.300
6341.5	-75.600
6356.7	-75.900
6371.9	-76.200
6387.1	-76.500
6402.3	-76.800
6417.5	-77.100
6432.7	-77.400
6447.9	-77.700
6463.1	-78.000
6478.3	-78.300
6493.5	-78.600
6508.7	-78.900
6523.9	-79.200
6539.1	-79.500
6554.3	-79.800
6569.5	-80.100
6584.7	-80.400
6599.9	-80.700
6615.1	-81.000
6630.3	-81.300
6645.5	-81.600
6660.7	-81.900
6675.9	-82.200
6691.1	-82.500
6706.3	-82.800
6721.5	-83.100
6736.7	-83.400
6751.9	-83.700
6767.1	-84.000
6782.3	-84.300
6797.5	-84.600
6812.7	-84.900
6827.9	-85.200
6843.1	-85.500
6858.3	-85.800
6873.5	-86.100
6888.7	-86.400
6903.9	-86.700
6919.1	-87.000
6934.3	-87.300
6949.5	-87.600
6964.7	-87.900
6979.9	-88.200
6995.1	-88.500
7010.3	-88.800
7025.5	-89.100
7040.7	-89.400
7055.9	-89.700
7071.1	-90.000
7086.3	-90.300
7101.5	-90.600
7116.7	-90.900
7131.9	-91.200
7147.1	-91.500
7162.3	-91.800
7177.5	-92.100
7192.7	-92.400
7207.9	-92.700
7223.1	-93.000
7238.3	-93.300
7253.5	-93.600
7268.7	-93.900
7283.9	-94.200
7299.1	-94.500
7314.3	-94.800
7329.5	-95.100
7344.7	-95.400
7359.9	-95.700
7375.1	-96.000
7390.3	-96.300
7405.5	-96.600</

ENRGY LOSS COEFFICIENTS
 NO K2 K3 K2L K3H LELJ MELJ TELJ TELM K2RUS K2LRUS K3RUS K3MRUS KC
 1 0.87 0.19 0.58 0.23 4.40 0.95 11.05 2.07 0.64 0.73 0.11 0.32 0.25
 MAIN FLOW LATERAL FLOW RATIO RATIO2 VELINL VELOUT 99.31 15.549 11.290 9.580
 5663.367 3907.724 0.41 0.69 114.45 99.31 15.549 11.290 9.580

K2: LATERAL LOSS COEFFICIENT M.R.T. OUTLET VELOCITY
 K3: MAIN LOSS COEFFICIENT M.R.T. OUTLET VELOCITY
 K2L: M.R.T. MAIN INLET VELOCITY
 K3H: M.R.T. MAIN INLET VELOCITY
 LELJ: LATERAL ENERGY LOSS DUE TO JUNCTION
 MELJ: MAIN ENERGY LOSS THROUGH JUNCTION
 TELJ: TOTAL ENERGY LOSS TO TOTAL FLOW
 TELM: TOTAL ENERGY LOSS TO TOTAL FLOW
 RATIO OF LATERAL FLOW TO MAIN FLOW
 RATIO2: LATERAL FLOW TO MAIN FLOW
 VELINL: INLET TO MAIN FLOW VELOCITIES
 VELOUT: OUTLET TO MAIN FLOW VELOCITIES
 KC: COMBINED BASED ON RUSSIAN PREDICTION EQUATION -FOR COMPARISON
 K3RUS :

POWER LOSS

MAIN POWER LATERAL POWER OUT POWER POWER LOSS RATIO
 582386.0000 422735.0000 993310.3000 0.0118

G-4

POSITION ALONG PIPE(CM)

PIEZOMETER READING CM

120.6	1	50.200
176.5	2	50.110
242.5	3	50.040
303.5	4	49.970
364.5	5	49.900
425.5	6	49.820
480.4	7	49.790
510.4	8	49.970
547.4	9	49.760
563.3	10	49.760
578.5	11	49.760
593.7	12	49.760
600.9	13	49.760
600.9	14	49.760
624.2	15	49.950
639.3	16	49.870
750.3	17	45.300
780.3	18	45.300
811.3	19	45.300
872.6	20	48.840
972.6	21	49.200
304.5	22	50.000
365.5	23	50.000
435.5	24	50.000
496.6	25	50.000
557.7	26	50.000
583.7	27	50.000
610.8	28	50.000
633.8	29	50.000
644.4	30	50.000
649.0	31	50.000
679.3	32	50.000
750.3	33	50.000
780.3	34	50.000
811.3	35	50.000
872.6	36	50.000
972.6	37	50.000
3539.6	38	50.000
6040.0	39	50.000

CLIMILERS PER SECOND

FLOW RAIL(CUBIC CLIMILERS PER SECOND)
LATERAL 3539.60400
SLOPE 0.00/800MAIN 0.0024300
LATERAL 0.00/800LATERAL 5.000
MANHOLE DROP : MAIN 0.00

H.I.1

POSITION ALONG PIPE (CM)	PIEZOMETER READING CM
120.6	48.200
176.5	48.020
242.6	47.910
303.5	47.800
364.5	47.710
425.4	47.560
486.4	47.490
547.4	47.050
510.4	47.510
563.5	47.510
578.7	47.510
593.4	47.510
606.4	47.510
608.9	47.510
624.5	47.510
639.5	47.510
750.3	47.510
780.3	47.510
811.3	47.510
872.3	47.510
904.5	47.510
935.7	47.510
996.6	47.510
543.7	47.510
557.6	47.510
583.7	47.510
518.1	47.510
618.5	47.510
633.8	47.510
644.4	47.510
649.4	47.510
679.5	47.510
750.5	47.510
780.5	47.510
811.5	47.510
872.5	47.510
972.6	47.510

FLOW RATE (CUBIC CENTIMETERS PER SECOND) 5663.3670
 LATCPAL 1506.455 MAIN
 SLOPE 0.00200 UTILITY 0.002000
 LATERAL 0.00200 LATERAL 5.000
 MANHOLE DROP : MAIN 0.00200 LATERAL 5.000

H1.2

POSITION ALONG PIPE(CM)

PIEZOMETER READING CM

120.6	1	50.430
176.5	2	50.260
242.5	3	50.030
303.5	4	49.890
364.5	5	49.750
425.5	6	49.550
486.5	7	49.450
547.5	8	49.350
510.5	9	49.350
563.5	10	49.350
578.5	11	49.350
593.5	12	49.350
608.5	13	49.350
624.5	14	49.350
639.5	15	49.350
654.5	16	49.350
670.5	17	49.350
685.5	18	49.350
700.5	19	49.350
715.5	20	49.350
730.5	21	49.350
745.5	22	49.350
760.5	23	49.350
775.5	24	49.350
790.5	25	49.350
805.5	26	49.350
820.5	27	49.350
835.5	28	49.350
850.5	29	49.350
865.5	30	49.350
880.5	31	49.350
895.5	32	49.350
910.5	33	49.350
925.5	34	49.350
940.5	35	49.350
955.5	36	49.350
970.5	37	49.350
985.5	38	49.350
1000.5	39	49.350
1015.5	40	49.350
1030.5	41	49.350
1045.5	42	49.350
1060.5	43	49.350
1075.5	44	49.350
1090.5	45	49.350
1105.5	46	49.350
1120.5	47	49.350
1135.5	48	49.350
1150.5	49	49.350
1165.5	50	49.350
1180.5	51	49.350
1195.5	52	49.350
1210.5	53	49.350
1225.5	54	49.350
1240.5	55	49.350
1255.5	56	49.350
1270.5	57	49.350
1285.5	58	49.350
1300.5	59	49.350
1315.5	60	49.350
1330.5	61	49.350
1345.5	62	49.350
1360.5	63	49.350
1375.5	64	49.350
1390.5	65	49.350
1405.5	66	49.350
1420.5	67	49.350
1435.5	68	49.350
1450.5	69	49.350
1465.5	70	49.350
1480.5	71	49.350
1495.5	72	49.350
1510.5	73	49.350
1525.5	74	49.350
1540.5	75	49.350
1555.5	76	49.350
1570.5	77	49.350
1585.5	78	49.350
1600.5	79	49.350
1615.5	80	49.350

H13

ENERGY LOSS COEFFICIENTS

NO	K2	K3	K2L	K3M	LLJ	MELJ	TELL	TELM	KC	CELL
1	0.41	0.26	1.17	1.76	1.66	1.95	6.74	1.05	0.32	1.28
2	0.05	0.23	0.36	0.86	0.19	0.74	5.27	0.74	0.17	0.63
3	0.15	0.44	1.05	1.26	0.42	1.25	5.30	0.25	0.39	1.00
MAIN FLOW	3539.605	3539.605	3539.605	3539.605	3539.605	3539.605	3539.605	3539.605	3539.605	3539.605
5663.367	1506.456	1506.456	1506.456	1506.456	1506.456	1506.456	1506.456	1506.456	1506.456	1506.456
7079.207	1614.060	1614.060	1614.060	1614.060	1614.060	1614.060	1614.060	1614.060	1614.060	1614.060

K2: LATERAL LOSS COEFFICIENT K2L: LATERAL LOSS COEFFICIENT
 K3: MAIN LOSS COEFFICIENT K3M: MAIN LOSS COEFFICIENT
 K2L: LATERAL LOSS COEFFICIENT K2L: LATERAL LOSS COEFFICIENT
 K3M: MAIN LOSS COEFFICIENT K3M: MAIN LOSS COEFFICIENT
 LLJ: LATERAL LOSS COEFFICIENT LLJ: LATERAL LOSS COEFFICIENT
 MELJ: MAIN LOSS COEFFICIENT MELJ: MAIN LOSS COEFFICIENT
 TELL: LATERAL LOSS COEFFICIENT TELL: LATERAL LOSS COEFFICIENT
 TELM: MAIN LOSS COEFFICIENT TELM: MAIN LOSS COEFFICIENT
 KC: LATERAL LOSS COEFFICIENT KC: LATERAL LOSS COEFFICIENT
 CELL: MAIN LOSS COEFFICIENT CELL: MAIN LOSS COEFFICIENT
 E1P: LATERAL LOSS COEFFICIENT E1P: LATERAL LOSS COEFFICIENT
 E2P: MAIN LOSS COEFFICIENT E2P: MAIN LOSS COEFFICIENT
 E3P: LATERAL LOSS COEFFICIENT E3P: LATERAL LOSS COEFFICIENT
 K3RUS: COMBINED JUNCTION LOSS COEFFICIENT K3RUS: COMBINED JUNCTION LOSS COEFFICIENT
 HASFD ON RUSSIAN PREDICTION EQUATION -FOR COMPARISON

PUMK LOSS

MAIN POWER	LATERAL POWER	OUT POWER	POWER LOSS RATIO
635985.8000	399639.9000	1025816.0000	0.0114
624663.4000	165336.6000	785510.7000	0.0057
795067.7000	179938.8000	905501.8000	0.0097

H1

POSITION	ALONG PIPE (CM)	PIEZOMETER	READING	CM
120.0	5.0	1	50.590	
176.0	5.0	2	50.520	
242.0	5.0	3	50.450	
303.0	5.0	4	50.345	
364.0	5.0	5	50.260	
425.0	5.0	6	50.230	
486.0	5.0	7	50.170	
510.0	5.0	8	50.120	
547.0	5.0	9	50.150	
563.0	5.0	10	50.150	
578.0	5.0	11	50.1340	
593.0	5.0	12	50.1150	
606.0	5.0	13	50.1150	
624.0	5.0	14	50.1150	
639.0	5.0	15	50.1150	
750.0	5.0	16	47.190	
780.0	5.0	17	47.240	
811.0	5.0	18	46.570	
872.0	5.0	19	45.470	
972.0	5.0	20	49.350	
304.0	5.0	21	49.350	
305.0	5.0	22	49.350	
435.0	5.0	23	50.240	
496.0	5.0	24	50.410	
557.0	5.0	25	50.410	
583.0	5.0	26	50.410	
618.0	5.0	27	50.330	
633.0	5.0	28	50.330	
644.0	5.0	29	50.330	
649.0	5.0	30	50.330	
679.0	5.0	31	50.250	
750.0	5.0	32	50.250	
811.0	5.0	33	47.190	
872.0	5.0	34	46.570	
972.0	5.0	35	45.470	

FLOW RATE (CUBIC CENTIMETERS PER SECOND) 5665.3670
 LATERAL 4077.6240 MAIN
 SLOPE 0.007000 MAIN 0.002000
 LATERAL 0.002000 OUTLET 0.002000
 MANHOLE DROP: MAIN 0.00 LATERAL 5.00

H2

[illegible]

PUMPER LOSS

MAIN POWER	ATT'RAL POWER	OUT POWER	POWER LOSS
637884.1000	462891.0000	1092163.0000	0.00/8

42

POSITION ALONG PIPE (CM)	PIEZOMETER READING CM	FLUM RATE (CUBIC CENTIMETERS PER SECOND)
120.5	50.780	5665.3670
170.5	50.700	
242.5	50.650	
303.5	50.500	
364.5	50.420	
425.5	50.380	
486.5	50.350	
510.0	50.330	
547.0	50.330	
563.2	50.330	
578.5	50.330	
593.7	50.330	
606.4	50.330	
608.9	50.330	
624.2	50.330	
639.5	50.330	
750.3	50.330	
760.8	50.330	
811.3	50.330	
872.3	50.330	
972.3	50.330	
304.5	50.330	
335.7	50.330	
433.5	50.330	
496.6	50.330	
57.6	50.330	
583.7	50.330	
618.5	50.330	
633.0	50.330	
644.0	50.330	
649.0	50.330	
664.3	50.330	
679.3	50.330	
750.3	50.330	
780.3	50.330	
811.3	50.330	
872.3	50.330	
972.3	50.330	

FLUM RATE (CUBIC CENTIMETERS PER SECOND) 5665.3670
 LATERAL. 0.007800 MAIN 0.002000 ULT. 0.002000
 LATERAL 0.007800 MAIN 0.002000 ULT. 0.002000
 MANHOLE DROP : MAIN 0.000 LATERAL 5.000

H3

ENERGY LOSS COEFFICIENTS
 NO K2 K3 K2L K3L LFLJ MFLJ TELJ TELM KC CELJ
 1 W.49 0.22 0.83 1.17 1.46 0.66 0.54 1.00 E2P E3P
 MAIN FLOW LATERAL FLOW RATIO RATIO VLLIN VLLIN VLLIN VLLIN VLLIN
 5663.367 4077.625 0.42 0.72 33.10 50.44 76.37 13.529 9.910 14.192

K2: LATERAL LOSS COEFFICIENT OUTLET VELOCITY
 K3: MAIN LOSS COEFFICIENT INLET VELOCITY
 K2L: W.R.T. LATERAL INLET VELOCITY
 K3L: W.R.T. MAIN INLET VELOCITY
 LFLJ: LATERAL ENERGY LOSS DUE TO JUNCTION
 MFLJ: MAIN ENERGY LOSS DUE TO JUNCTION
 TELJ: TOTAL ENERGY LOSS THROUGH JUNCTION
 TELM: TOTAL ENERGY LOSS TO TOTAL FLOW
 RATIO: OF LATERAL FLOW TO TOTAL FLOW
 VLLIN: VELOCITY INLET AND OUTLET VELOCITIES
 RATIO2: LATERAL FLOW TO MAIN FLOW
 KC: COMBINED JUNCTION LOSS COEFFICIENT
 K3RUS: BASED ON RUSSIAN PREDICTION EQUATION -FOR COMPARISON

POWER LOSS

MAIN POWER LATERAL POWER OUT POWER POWER LOSS RATIO
 -638833.8000 463212.8000 1092337.0000 0.0000

H3

POSITION ALONG PIPE (CM) PIEZOMETER READING CM

120.0	1	50.670
176.5	2	50.580
242.5	3	50.470
303.5	4	50.350
364.5	5	50.270
425.5	6	50.220
486.0	7	50.190
510.0	8	50.140
547.0	9	50.100
563.5	10	50.100
578.5	11	50.100
593.5	12	50.100
606.0	13	50.100
624.0	14	50.100
639.0	15	50.100
654.0	16	50.100
675.0	17	50.100
712.0	18	50.100
780.0	19	50.100
812.0	20	50.100
872.0	21	50.100
904.0	22	50.100
935.0	23	50.100
966.0	24	50.100
997.0	25	50.100
1028.0	26	50.100
1059.0	27	50.100
1090.0	28	50.100
1121.0	29	50.100
1152.0	30	50.100
1183.0	31	50.100
1214.0	32	50.100
1245.0	33	50.100
1276.0	34	50.100
1307.0	35	50.100
1338.0	36	50.100
1369.0	37	50.100
1400.0	38	50.100
1431.0	39	50.100
1462.0	40	50.100
1493.0	41	50.100
1524.0	42	50.100
1555.0	43	50.100
1586.0	44	50.100
1617.0	45	50.100
1648.0	46	50.100
1679.0	47	50.100
1710.0	48	50.100
1741.0	49	50.100
1772.0	50	50.100

FLOW RATE (CUBIC CENTIMETERS PER SECOND) 5663.3670
 LATERAL 0.007800 MAIN 0.002000 OUTLET 0.002000
 LATERAL 0.000000 MAIN 0.000000 LATERAL 0.000000
 MANHOLE 0.000000 MAIN 0.000000 LATERAL 0.000000

H4

POSITION ALONG PIPE (CM)	PIEZOMETER READING CM	FLOW RATE (CUBIC CENTIMETERS PER SECOND)
120.6	47.260	5946.5350
176.5	47.800	
242.6	46.800	
303.5	46.610	
364.5	45.420	
425.5	45.160	
486.4	44.975	
547.4	44.330	
556.3	44.200	
578.7	44.040	
606.9	43.960	
624.2	43.830	
639.3	43.810	
750.3	43.530	
780.3	43.430	
811.3	43.430	
872.6	43.000	
904.5	43.000	
935.7	43.000	
966.0	43.000	
997.0	43.000	
1028.0	43.000	
1059.0	43.000	
1090.0	43.000	
1121.0	43.000	
1152.0	43.000	
1183.0	43.000	
1214.0	43.000	
1245.0	43.000	
1276.0	43.000	
1307.0	43.000	
1338.0	43.000	
1369.0	43.000	
1400.0	43.000	
1431.0	43.000	
1462.0	43.000	
1493.0	43.000	
1524.0	43.000	
1555.0	43.000	
1586.0	43.000	
1617.0	43.000	
1648.0	43.000	
1679.0	43.000	
1710.0	43.000	
1741.0	43.000	
1772.0	43.000	
1803.0	43.000	
1834.0	43.000	
1865.0	43.000	
1896.0	43.000	
1927.0	43.000	
1958.0	43.000	
1989.0	43.000	
2020.0	43.000	
2051.0	43.000	
2082.0	43.000	
2113.0	43.000	
2144.0	43.000	
2175.0	43.000	
2206.0	43.000	
2237.0	43.000	
2268.0	43.000	
2299.0	43.000	
2330.0	43.000	
2361.0	43.000	
2392.0	43.000	
2423.0	43.000	
2454.0	43.000	
2485.0	43.000	
2516.0	43.000	
2547.0	43.000	
2578.0	43.000	
2609.0	43.000	
2640.0	43.000	
2671.0	43.000	
2702.0	43.000	
2733.0	43.000	
2764.0	43.000	
2795.0	43.000	
2826.0	43.000	
2857.0	43.000	
2888.0	43.000	
2919.0	43.000	
2950.0	43.000	
2981.0	43.000	
3012.0	43.000	
3043.0	43.000	
3074.0	43.000	
3105.0	43.000	
3136.0	43.000	
3167.0	43.000	
3198.0	43.000	
3229.0	43.000	
3260.0	43.000	
3291.0	43.000	
3322.0	43.000	
3353.0	43.000	
3384.0	43.000	
3415.0	43.000	
3446.0	43.000	
3477.0	43.000	
3508.0	43.000	
3539.0	43.000	
3570.0	43.000	
3601.0	43.000	
3632.0	43.000	
3663.0	43.000	
3694.0	43.000	
3725.0	43.000	
3756.0	43.000	
3787.0	43.000	
3818.0	43.000	
3849.0	43.000	
3880.0	43.000	
3911.0	43.000	
3942.0	43.000	
3973.0	43.000	
4004.0	43.000	
4035.0	43.000	
4066.0	43.000	
4097.0	43.000	
4128.0	43.000	
4159.0	43.000	
4190.0	43.000	
4221.0	43.000	
4252.0	43.000	
4283.0	43.000	
4314.0	43.000	
4345.0	43.000	
4376.0	43.000	
4407.0	43.000	
4438.0	43.000	
4469.0	43.000	
4500.0	43.000	
4531.0	43.000	
4562.0	43.000	
4593.0	43.000	
4624.0	43.000	
4655.0	43.000	
4686.0	43.000	
4717.0	43.000	
4748.0	43.000	
4779.0	43.000	
4810.0	43.000	
4841.0	43.000	
4872.0	43.000	
4903.0	43.000	
4934.0	43.000	
4965.0	43.000	
4996.0	43.000	
5027.0	43.000	
5058.0	43.000	
5089.0	43.000	
5120.0	43.000	
5151.0	43.000	
5182.0	43.000	
5213.0	43.000	
5244.0	43.000	
5275.0	43.000	
5306.0	43.000	
5337.0	43.000	
5368.0	43.000	
5399.0	43.000	
5430.0	43.000	
5461.0	43.000	
5492.0	43.000	
5523.0	43.000	
5554.0	43.000	
5585.0	43.000	
5616.0	43.000	
5647.0	43.000	
5678.0	43.000	
5709.0	43.000	
5740.0	43.000	
5771.0	43.000	
5802.0	43.000	
5833.0	43.000	
5864.0	43.000	
5895.0	43.000	
5926.0	43.000	
5957.0	43.000	
5988.0	43.000	
6019.0	43.000	
6050.0	43.000	
6081.0	43.000	
6112.0	43.000	
6143.0	43.000	
6174.0	43.000	
6205.0	43.000	
6236.0	43.000	
6267.0	43.000	
6298.0	43.000	
6329.0	43.000	
6360.0	43.000	
6391.0	43.000	
6422.0	43.000	
6453.0	43.000	
6484.0	43.000	
6515.0	43.000	
6546.0	43.000	
6577.0	43.000	
6608.0	43.000	
6639.0	43.000	
6670.0	43.000	
6701.0	43.000	
6732.0	43.000	
6763.0	43.000	
6794.0	43.000	
6825.0	43.000	
6856.0	43.000	
6887.0	43.000	
6918.0	43.000	
6949.0	43.000	
6980.0	43.000	
7011.0	43.000	
7042.0	43.000	
7073.0	43.000	
7104.0	43.000	
7135.0	43.000	
7166.0	43.000	
7197.0	43.000	
7228.0	43.000	
7259.0	43.000	
7290.0	43.000	
7321.0	43.000	
7352.0	43.000	
7383.0	43.000	
7414.0	43.000	
7445.0	43.000	
7476.0	43.000	
7507.0	43.000	
7538.0	43.000	
7569.0	43.000	
7600.0	43.000	
7631.0	43.000	
7662.0	43.000	
7693.0	43.000	
7724.0	43.000	
7755.0	43.000	
7786.0	43.000	
7817.0	43.000	
7848.0	43.000	
7879.0	43.000	
7910.0	43.000	
7941.0	43.000	
7972.0	43.000	
8003.0	43.000	
8034.0	43.000	
8065.0	43.000	
8096.0	43.000	
8127.0	43.000	
8158.0	43.000	
8189.0	43.000	
8220.0	43.000	
8251.0	43.000	
8282.0	43.000	
8313.0	43.000	
8344.0	43.000	
8375.0	43.000	
8406.0	43.000	
8437.0	43.000	
8468.0	43.000	
8499.0	43.000	
8530.0	43.000	
8561.0	43.000	
8592.0	43.000	
8623.0	43.000	
8654.0	43.000	
8685.0	43.000	
8716.0	43.000	
8747.0	43.000	
8778.0	43.000	
8809.0	43.000	
8840.0	43.000	
8871.0	43.000	
8902.0	43.000	
8933.0	43.000	
8964.0	43.000	
8995.0	43.000	
9026.0	43.000	
9057.0	43.000	
9088.0	43.000	
9119.0	43.000	
9150.0	43.000	
9181.0	43.000	
9212.0	43.000	
9243.0	43.000	
9274.0	43.000	
9305.0	43.000	
9336.0	43.000	
9367.0	43.000	
9398.0	43.000	
9429.0	43.000	
9460.0	43.000	
9491.0	43.000	
9522.0	43.000	
9553.0	43.000	
9584.0	43.000	
9615.0	43.000	
9646.0	43.000	
9677.0	43.000	
9708.0	43.000	
9739.0	43.000	
9770.0	43.000	
9801.0	43.000	
9832.0	43.000	
9863.0	43.000	
9894.0	43.000	
9925.0	43.000	
9956.0	43.000	
9987.0	43.000	
10018.0	43.000	
10049.0	43.000	
10080.0	43.000	
10111.0	43.000	
10142.0	43.000	
10173.0	43.000	
10204.0	43.000	
10235.0	43.000	
10266.0	43.000	
10297.0	43.000	
10328.0	43.000	
10359.0	43.000	
10390.0	43.000	
10421.0	43.000	
10452.0	43.000	
10483.0	43.000	
10514.0	43.000	
10545.0	43.000	
10576.0	43.000	
10607.0	43.000	
10638.0	43.000	
10669.0	43.000	
10700.0	43.000	
10731.0	43.000	
10762.0	43.000	
10793.0	43.000	
10824.0	43.000	
10855.0	43.000	
10886.0	43.000	
10917.0	43.000	
10948.0	43.000	
10979.0	43.000	
11010.0	43.000	
11041.0	43.000	
11072.0	43.000	
11103.0	43.000	
11134.0	43.000	
11165.0	43.000	
11196.0	43.000	
11227.0	43.000	
11258.0	43.000	
11289.0	43.000	
11320.0	43.000	
11351.0	43.000	
11382.0	43.000	
11413.0	43.000	
11444.0	43.000	
11475.0	43.000	
11506.0	43.000	
11537.0	43.000	
11568.0	43.000	
11599.0	43.000	
11630.0	43.000	
11661.0	43.000	
11692.0	43.000	
11723.0	43.000	
11754.0	43.000	
11785.0	43.000	
11816.0	43.000	
11847.0	43.000	
11878.0	43.000	
11909.0	43.000	
11940.0	43.000	
11971.0	43.000	
12002.0	43.000	
12033.0	43.000	
12064.0	43.000	
12095.0	43.000	
12126.0	43.000	
12157.0	43.000	
12188.0	43.000	
12219.0	43.000	
12250.0	43.000	
12281.0	43.000	
12312.0	43.000	
12343.0	43.000	
12374.0	43.000	
12405.0	43.000	
12436.0	43.000	
12467.0	43.000	
12498.0	43.000	
12529.0	43.000	
12560.0	43.000	
125		

[illegible]

	MAIN POWER	LATRAL ^{Left} POWER	OUT POWER	POWER LOSS RATIO
.	0.0000	9.0000	0.0000	2.0000
.	0.0000	0.0000	0.0000	0.0000

MS

POSITION ALONG PIPE (CH)

PIEZOMETER READING CH

122.5	1	0.000
175.5	2	0.000
242.5	3	0.000
303.5	4	0.000
342.5	5	0.000
425.5	6	0.000
486.4	7	0.000
510.4	8	0.000
547.4	9	0.000
563.4	10	0.000
578.7	11	0.000
593.4	12	0.000
608.4	13	0.000
624.4	14	0.000
639.4	15	0.000
750.3	16	0.000
780.3	17	0.000
814.3	18	0.000
872.3	19	0.000
972.3	20	0.000
304.5	21	0.000
365.5	22	0.000
435.5	23	0.000
496.5	24	0.000
557.5	25	0.000
583.7	26	0.000
618.5	27	0.000
644.4	28	0.000
669.4	29	0.000
679.4	30	0.000
750.3	31	0.000
780.3	32	0.000
814.3	33	0.000
872.3	34	0.000
972.3	35	0.000
1614.059	36	0.000
1614.059	37	0.000
1614.059	38	0.000
1614.059	39	0.000
1614.059	40	0.000
1614.059	41	0.000
1614.059	42	0.000
1614.059	43	0.000
1614.059	44	0.000
1614.059	45	0.000
1614.059	46	0.000
1614.059	47	0.000
1614.059	48	0.000
1614.059	49	0.000
1614.059	50	0.000
1614.059	51	0.000
1614.059	52	0.000
1614.059	53	0.000
1614.059	54	0.000
1614.059	55	0.000
1614.059	56	0.000
1614.059	57	0.000
1614.059	58	0.000
1614.059	59	0.000
1614.059	60	0.000
1614.059	61	0.000
1614.059	62	0.000
1614.059	63	0.000
1614.059	64	0.000
1614.059	65	0.000
1614.059	66	0.000
1614.059	67	0.000
1614.059	68	0.000
1614.059	69	0.000
1614.059	70	0.000
1614.059	71	0.000
1614.059	72	0.000
1614.059	73	0.000
1614.059	74	0.000
1614.059	75	0.000
1614.059	76	0.000
1614.059	77	0.000
1614.059	78	0.000
1614.059	79	0.000
1614.059	80	0.000
1614.059	81	0.000
1614.059	82	0.000
1614.059	83	0.000
1614.059	84	0.000
1614.059	85	0.000
1614.059	86	0.000
1614.059	87	0.000
1614.059	88	0.000
1614.059	89	0.000
1614.059	90	0.000
1614.059	91	0.000
1614.059	92	0.000
1614.059	93	0.000
1614.059	94	0.000
1614.059	95	0.000
1614.059	96	0.000
1614.059	97	0.000
1614.059	98	0.000
1614.059	99	0.000
1614.059	100	0.000

FLUM RATE (CURRIC C. IN LITERS PER SECOND)
LATERAL 0.002800
LATERAL 0.002800
LATERAL 0.002800
MANHOLE DROP : MAIN 0.002800
LATERAL 0.002800

LS

ENERGY LOSS COEFFICIENTS

NO	K2	K3	K2L	K3M	LELJ	MELJ	TELL	TELM	KC	CELJ	E2P	E3P
1	5.56	0.00	2.81	0.00	5.40	0.00	10.48	0.00	5.56	5.40	5.399	9.783
MAIN FLOW	0.000	LATERAL FLOW	1.00	0.00	0.00	0.00	39.27	43.62	5.003	5.399	9.783	

K2: LATERAL LOSS COEFFICIENT W.R.T. OUTLET VELOCITY
 K3: MAIN LOSS COEFFICIENT W.R.T. INLET VELOCITY
 K2L: W.R.T. LATERAL INLET VELOCITY
 K3M: W.R.T. MAIN INLET VELOCITY
 LELJ: LATERAL ENERGY LOSS DUE TO JUNCTION
 MELJ: MAIN ENERGY LOSS DUE TO JUNCTION
 TELM: TOTAL ENERGY LOSS THROUGH JUNCTION
 RATIO OF LATERAL FLOW TO TOTAL FLOW
 RATIO OF LATERAL FLOW TO INLET VELOCITIES
 RATIO OF LATERAL FLOW TO MAIN FLOW
 KC: COMBINED JUNCTION LOSS COEFFICIENT
 K3RUS: BASED ON RUSSIAN PREDICTION EQUATION - FOR COMPARISON

POWER LOSS

MAIN POWER 0.0000 LATERAL POWER 0.0000 OUT POWER 0.0000 POWER LOSS RATIO 0.0000

25

POSITION ALONG PIPE (CM)	PIEZO-ELECTRIC READING CM
124.5	50.390
176.5	50.310
242.5	50.210
313.5	50.120
364.5	50.060
425.5	49.980
486.5	49.940
510.0	5.030
547.0	49.900
563.4	49.900
578.5	49.900
593.7	49.900
608.0	49.900
624.2	49.900
650.5	49.900
750.5	49.900
780.8	49.900
811.3	49.900
872.3	49.900
972.5	49.900
365.7	49.900
435.7	49.900
496.6	49.900
537.6	49.900
563.7	49.900
588.1	49.900
616.5	49.900
633.8	49.900
644.4	49.900
679.3	49.900
750.5	49.900
780.8	49.900
811.3	49.900
872.3	49.900
972.5	49.900

FLOW RATE (CUBIC CENTIMETERS PER SECOND) 5663.3670
 LATERAL 3058.2180 MAIN
 SLOPE 0.00/800 MAIN 0.00/2000 OUTLET 0.00/2000
 LATERAL 0.00/100 LATERAL 5.00/0
 MANHOLE DROP : MAIN 0.00 LATERAL 5.00

I 1.1

II.1.2

ENERGY LOSS COEFFICIENTS

NO	K2	K3	K2L	K3M	LELJ	HELJ	TELL	TELM	K2RUS	K2LRUS	K3RUS	K3MRUS	KC	CEL
1	0.37	0.35	1.02	1.84	1.14	1.08	6.22	1.08	0.40	0.63	0.18	0.43	0.36	1.10
2	-0.15	-0.22	-1.03	0.62	-0.38	0.57	4.70	0.57	-0.33	-2.29	0.22	0.31	0.16	0.41
MAIN FLOW LATERAL FLOW RATIO														
5663.367	3058.218	0.35	0.35	0.54	33.93	41.65	24.08	70.51	12.71	8.77	5.48	11.51		
5663.367	1132.673	0.17	0.22											

K2: LATERAL LOSS COEFFICIENT MAIN INLET VELOCITY
 K3: MAIN LOSS COEFFICIENT MAIN INLET VELOCITY
 K2L: MAIN LATERAL LOSS COEFFICIENT MAIN INLET VELOCITY
 K3M: MAIN LATERAL LOSS COEFFICIENT MAIN INLET VELOCITY
 LELJ: LATERAL ENERGY LOSS DUE TO JUNCTION
 HELJ: MAIN ENERGY LOSS THROUGH JUNCTION
 TELM: TOTAL ENERGY LOSS TO TOTAL FLOW
 TEL: OF LATERAL FLOW AND OUTLET VELOCITIES
 RATIO: LATERAL FLOW TO MAIN FLOW
 K2RUS: LATERAL LOSS COEFFICIENT RUSSIAN PRODUCTION EQUATION -FOR COMPARISON
 K2LRUS: LATERAL LOSS COEFFICIENT RUSSIAN PRODUCTION EQUATION -FOR COMPARISON
 K3RUS: LATERAL LOSS COEFFICIENT RUSSIAN PRODUCTION EQUATION -FOR COMPARISON
 K3MRUS: LATERAL LOSS COEFFICIENT RUSSIAN PRODUCTION EQUATION -FOR COMPARISON
 KC: COMBINED BASED ON RUSSIAN PRODUCTION EQUATION -FOR COMPARISON
 CEL: COMBINED BASED ON RUSSIAN PRODUCTION EQUATION -FOR COMPARISON

POWER LOSS

MAIN POWER	LATERAL POWER	OUT POWER	POWER LOSS RATIO
636572.0000	343936.8000	970916.3000	0.0098
623675.1000	123662.4000	744562.2000	0.0037

POSITION ALONG PIP (CM)	PIEZOMETER READING CM
120.5	49.960
170.5	49.890
242.6	49.780
343.5	49.690
364.5	49.620
425.5	49.570
486.4	49.510
510.0	49.482
547.4	49.460
563.2	49.460
578.7	49.460
593.7	49.460
600.4	49.460
608.9	49.460
624.2	49.460
639.5	49.460
750.3	49.460
780.8	49.460
811.3	49.460
872.3	49.460
912.6	49.460
972.6	49.460
1033.1	49.460
1093.6	49.460
1154.1	49.460
1214.6	49.460
1275.1	49.460
1335.6	49.460
1396.1	49.460
1456.6	49.460
1517.1	49.460
1577.6	49.460
1638.1	49.460
1698.6	49.460
1759.1	49.460
1819.6	49.460
1880.1	49.460
1940.6	49.460
2001.1	49.460
2061.6	49.460
2122.1	49.460
2182.6	49.460
2243.1	49.460
2303.6	49.460
2364.1	49.460
2424.6	49.460
2485.1	49.460
2545.6	49.460
2606.1	49.460
2666.6	49.460
2727.1	49.460
2787.6	49.460
2848.1	49.460
2908.6	49.460
2969.1	49.460
3029.6	49.460
3090.1	49.460
3150.6	49.460
3211.1	49.460
3271.6	49.460
3332.1	49.460
3392.6	49.460
3453.1	49.460
3513.6	49.460
3574.1	49.460
3634.6	49.460
3695.1	49.460
3755.6	49.460
3816.1	49.460
3876.6	49.460
3937.1	49.460
3997.6	49.460
4058.1	49.460
4118.6	49.460
4179.1	49.460
4239.6	49.460
4300.1	49.460
4360.6	49.460
4421.1	49.460
4481.6	49.460
4542.1	49.460
4602.6	49.460
4663.1	49.460
4723.6	49.460
4784.1	49.460
4844.6	49.460
4905.1	49.460
4965.6	49.460
5026.1	49.460
5086.6	49.460
5147.1	49.460
5207.6	49.460
5268.1	49.460
5328.6	49.460
5389.1	49.460
5449.6	49.460
5510.1	49.460
5570.6	49.460
5631.1	49.460
5691.6	49.460
5752.1	49.460
5812.6	49.460
5873.1	49.460
5933.6	49.460
5994.1	49.460
6054.6	49.460
6115.1	49.460
6175.6	49.460
6236.1	49.460
6296.6	49.460
6357.1	49.460
6417.6	49.460
6478.1	49.460
6538.6	49.460
6599.1	49.460
6659.6	49.460
6720.1	49.460
6780.6	49.460
6841.1	49.460
6901.6	49.460
6962.1	49.460
7022.6	49.460
7083.1	49.460
7143.6	49.460
7204.1	49.460
7264.6	49.460
7325.1	49.460
7385.6	49.460
7446.1	49.460
7506.6	49.460
7567.1	49.460
7627.6	49.460
7688.1	49.460
7748.6	49.460
7809.1	49.460
7869.6	49.460
7930.1	49.460
7990.6	49.460
8051.1	49.460
8111.6	49.460
8172.1	49.460
8232.6	49.460
8293.1	49.460
8353.6	49.460
8414.1	49.460
8474.6	49.460
8535.1	49.460
8595.6	49.460
8656.1	49.460
8716.6	49.460
8777.1	49.460
8837.6	49.460
8898.1	49.460
8958.6	49.460
9019.1	49.460
9079.6	49.460
9140.1	49.460
9200.6	49.460
9261.1	49.460
9321.6	49.460
9382.1	49.460
9442.6	49.460
9503.1	49.460
9563.6	49.460
9624.1	49.460
9684.6	49.460
9745.1	49.460
9805.6	49.460
9866.1	49.460
9926.6	49.460
9987.1	49.460
10047.6	49.460
10108.1	49.460
10168.6	49.460
10229.1	49.460
10289.6	49.460
10350.1	49.460
10410.6	49.460
10471.1	49.460
10531.6	49.460
10592.1	49.460
10652.6	49.460
10713.1	49.460
10773.6	49.460
10834.1	49.460
10894.6	49.460
10955.1	49.460
11015.6	49.460
11076.1	49.460
11136.6	49.460
11197.1	49.460
11257.6	49.460
11318.1	49.460
11378.6	49.460
11439.1	49.460
11499.6	49.460
11560.1	49.460
11620.6	49.460
11681.1	49.460
11741.6	49.460
11802.1	49.460
11862.6	49.460
11923.1	49.460
11983.6	49.460
12044.1	49.460
12104.6	49.460
12165.1	49.460
12225.6	49.460
12286.1	49.460
12346.6	49.460
12407.1	49.460
12467.6	49.460
12528.1	49.460
12588.6	49.460
12649.1	49.460
12709.6	49.460
12770.1	49.460
12830.6	49.460
12891.1	49.460
12951.6	49.460
13012.1	49.460
13072.6	49.460
13133.1	49.460
13193.6	49.460
13254.1	49.460
13314.6	49.460
13375.1	49.460
13435.6	49.460
13496.1	49.460
13556.6	49.460
13617.1	49.460
13677.6	49.460
13738.1	49.460
13798.6	49.460
13859.1	49.460
13919.6	49.460
13980.1	49.460
14040.6	49.460
14101.1	49.460
14161.6	49.460
14222.1	49.460
14282.6	49.460
14343.1	49.460
14403.6	49.460
14464.1	49.460
14524.6	49.460
14585.1	49.460
14645.6	49.460
14706.1	49.460
14766.6	49.460
14827.1	49.460
14887.6	49.460
14948.1	49.460
15008.6	49.460
15069.1	49.460
15129.6	49.460
15190.1	49.460
15250.6	49.460
15311.1	49.460
15371.6	49.460
15432.1	49.460
15492.6	49.460
15553.1	49.460
15613.6	49.460
15674.1	49.460
15734.6	49.460
15795.1	49.460
15855.6	49.460
15916.1	49.460
15976.6	49.460
16037.1	49.460
16097.6	49.460
16158.1	49.460
16218.6	49.460
16279.1	49.460
16339.6	49.460
16400.1	49.460
16460.6	49.460
16521.1	49.460
16581.6	49.460
16642.1	49.460
16702.6	49.460
16763.1	49.460
16823.6	49.460
16884.1	49.460
16944.6	49.460
17005.1	49.460
17065.6	49.460
17126.1	49.460
17186.6	49.460
17247.1	49.460
17307.6	49.460
17368.1	49.460
17428.6	49.460
17489.1	49.460
17549.6	49.460
17610.1	49.460
17670.6	49.460
17731.1	49.460
17791.6	49.460
17852.1	49.460
17912.6	49.460
17973.1	49.460
18033.6	49.460
18094.1	49.460
18154.6	49.460
18215.1	49.460
18275.6	49.460
18336.1	49.460
18396.6	49.460
18457.1	49.460
18517.6	49.460
18578.1	49.460
18638.6	49.460
18699.1	49.460
18759.6	49.460
18820.1	49.460
18880.6	49.460
18941.1	49.460
19001.6	49.460
19062.1	49.460
19122.6	49.460
19183.1	49.460
19243.6	49.460
19304.1	49.460
19364.6	49.460
19425.1	49.460
19485.6	49.460
19546.1	49.460
19606.6	49.460
19667.1	49.460
19727.6	49.460
19788.1	49.460
19848.6	49.460
19909.1	49.460
19969.6	49.460
20030.1	49.460
20090.6	49.460
20151.1	49.460
20211.6	49.460
20272.1	49.460
20332.6	49.460
20393.1	49.460
20453.6	49.460
20514.1	49.460
20574.6	49.460
20635.1	49.460
20695.6	49.460
20756.1	49.460
20816.6	49.460
20877.1	49.460
20937.6	49.460
21000.0	49.460

I2

ENERGY LOSS COEFFICIENTS
 NO K2 K3 K2L K3M LELJ MELJ TELJ TELM K2RUS K2LRUS K3RUS K3MRUS KC CEL
 1 0.34 0.25 0.98 1.47 1.11 0.93 6.19 0.93 0.38 0.61 0.19 0.44 0.27 1.00
 MAIN FLOW LATERAL FLOW RATIO RATIO2 VELIN VELINL VELOUT
 5663.367 2073.269 0.34 0.53 34.91 44.32 45.58 12.456 8.470 13.370

K2: LATERAL LOSS COEFFICIENT RATIO OUTLET VELOCITY
 K3: MAIN LOSS COEFFICIENT RATIO OUTLET VELOCITY
 K2L: LATERAL INLET VELOCITY
 K3M: MAIN INLET VELOCITY
 LELJ: LATERAL ENERGY LOSS DUE TO JUNCTION
 MELJ: MAIN ENERGY LOSS DUE TO JUNCTION
 TELM: TOTAL ENERGY LOSS THROUGH JUNCTION
 RATIO: OF LATERAL FLOW TO TOTAL FLOW
 RATIO2: OF LATERAL FLOW TO TOTAL FLOW
 VELIN: INLET FLOW TO MAIN FLOW
 VELINL: LATERAL FLOW TO MAIN FLOW
 VELOUT: OUTLET FLOW
 K2RUS: BASED ON RUSSIAN PREDICTION EQUATION -FOR COMPARISON
 K3RUS: BASED ON RUSSIAN PREDICTION EQUATION -FOR COMPARISON

POWER LOSS

MAIN POWER LATERAL POWER OUT POWER POWER LOSS RATIO
 634178.5000 333478.8000 959760.1000 0.0089

POSITION ALONG PIPE (CM)

PIEZOMETER READING CM

120.6	1	50.02M
117.6.5	2	52.0000
114.2.5	3	49.8800
110.3.5	4	49.8800
106.4.5	5	49.7300
102.5.5	6	49.6600
98.6.4	7	49.6000
94.7.2	8	49.5800
90.8.2	9	49.5800
86.9.4	10	49.5800
83.0.5	11	49.5800
79.1.5	12	49.5800
75.2.5	13	49.5800
71.3.5	14	49.5800
67.4.5	15	49.5800
63.5.5	16	49.5800
59.6.5	17	49.5800
55.7.5	18	49.5800
51.8.5	19	49.5800
47.9.5	20	49.5800
44.0.5	21	49.5800
40.1.5	22	49.5800
36.2.5	23	49.5800
32.3.5	24	49.5800
28.4.5	25	49.5800
24.5.5	26	49.5800
20.6.5	27	49.5800
16.7.5	28	49.5800
12.8.5	29	49.5800
8.9.5	30	49.5800
5.0.5	31	49.5800
1.1.5	32	49.5800
	33	49.5800
	34	49.5800
	35	49.5800
	36	49.5800
	37	49.5800
	38	49.5800
	39	49.5800
	40	49.5800
	41	49.5800
	42	49.5800
	43	49.5800
	44	49.5800
	45	49.5800
	46	49.5800
	47	49.5800
	48	49.5800
	49	49.5800
	50	49.5800
	51	49.5800
	52	49.5800
	53	49.5800
	54	49.5800
	55	49.5800
	56	49.5800
	57	49.5800
	58	49.5800
	59	49.5800
	60	49.5800
	61	49.5800
	62	49.5800
	63	49.5800
	64	49.5800
	65	49.5800
	66	49.5800
	67	49.5800
	68	49.5800
	69	49.5800
	70	49.5800
	71	49.5800
	72	49.5800
	73	49.5800
	74	49.5800
	75	49.5800
	76	49.5800
	77	49.5800
	78	49.5800
	79	49.5800
	80	49.5800
	81	49.5800
	82	49.5800
	83	49.5800
	84	49.5800
	85	49.5800
	86	49.5800
	87	49.5800
	88	49.5800
	89	49.5800
	90	49.5800
	91	49.5800
	92	49.5800
	93	49.5800
	94	49.5800
	95	49.5800
	96	49.5800
	97	49.5800
	98	49.5800
	99	49.5800
	100	49.5800

FLOW RATE (CUBIC CENTIMETERS PER SECOND) 5663.3670
LATERAL 2973.2680MAIN
LATERAL 0.002000OUTLET 2.002000
MANHOLE ORDP : MAIN 0.00LATERAL 5.080

I3.1

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K2: LATERAL LOSS COEFF W.R.T. OUTLET VELOCITY
K3: MAIN LOSS COEFFICIENT W.R.T. OUTLET VELOCITY
K3L: W.R.T. LATERAL INLET VELOCITY
K3M: W.R.T. MAIN INLET VELOCITY
LELJ: LATERAL ENERGY LOSS DUE TO JUNCTION
LELM: MAIN ENERGY LOSS DUE TO JUNCTION
TELM: TOTAL ENERGY LOSS THROUGH JUNCTION
RATIO OF LATERAL FLOW TO TOTAL FLOW
RATIO OF LATERAL INLET AND OUTLET VELOCITIES
VELIN: VELOCITY INLET TO MAIN FLOW
RATIO2: LATERAL JUNCTION LOSS COEFFICIENT
KC: COMBINED JUNCTION LOSS COEFFICIENT EQUATION -FOR COMPARISON
K3RMS: BASED ON RUSSIAN PREDICTION

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POWER LOSS	WATT POWER	LATERAL POWER	OUT POWER	POWER LOSS RATIO
0.54069	0.0000	333633.5000	957509.5000	0.0115

H
W.

POSITION ALONG PIPE (CM)

PIEZOMETER READING CM

FLOW RATE (CURRIC) (CENTIMETERS PER SECOND)
LATERAL 2973.268 MAIN 5663.5670
SLOPE 0.002000 OUTLET 0.002000
LATERAL 0.002000 LATERAL 0.002000
MANHOLE 0.002000 MAIN 0.002000

120.6	1	50.250
176.5	2	50.170
242.6	3	50.060
303.5	4	49.960
364.5	5	49.910
425.5	6	49.830
486.4	7	49.790
510.4	8	49.760
547.4	9	49.760
563.2	10	49.760
578.2	11	49.760
593.7	12	49.760
606.4	13	49.760
624.2	14	49.760
639.3	15	49.760
650.3	16	49.760
670.3	17	49.760
681.3	18	49.760
692.3	19	49.760
703.3	20	49.760
714.3	21	49.760
725.3	22	49.760
736.3	23	49.760
747.3	24	49.760
758.3	25	49.760
769.3	26	49.760
780.3	27	49.760
791.3	28	49.760
802.3	29	49.760
813.3	30	49.760
824.3	31	49.760
835.3	32	49.760
846.3	33	49.760
857.3	34	49.760
868.3	35	49.760
879.3	36	49.760
890.3	37	49.760
901.3	38	49.760
912.3	39	49.760
923.3	40	49.760
934.3	41	49.760
945.3	42	49.760
956.3	43	49.760
967.3	44	49.760
978.3	45	49.760
989.3	46	49.760
1000.3	47	49.760
1011.3	48	49.760
1022.3	49	49.760
1033.3	50	49.760
1044.3	51	49.760
1055.3	52	49.760
1066.3	53	49.760
1077.3	54	49.760
1088.3	55	49.760
1099.3	56	49.760
1110.3	57	49.760
1121.3	58	49.760
1132.3	59	49.760
1143.3	60	49.760
1154.3	61	49.760
1165.3	62	49.760
1176.3	63	49.760
1187.3	64	49.760
1198.3	65	49.760
1209.3	66	49.760
1220.3	67	49.760
1231.3	68	49.760
1242.3	69	49.760
1253.3	70	49.760
1264.3	71	49.760
1275.3	72	49.760
1286.3	73	49.760
1297.3	74	49.760
1308.3	75	49.760
1319.3	76	49.760
1330.3	77	49.760
1341.3	78	49.760
1352.3	79	49.760
1363.3	80	49.760
1374.3	81	49.760
1385.3	82	49.760
1396.3	83	49.760
1407.3	84	49.760
1418.3	85	49.760
1429.3	86	49.760
1440.3	87	49.760
1451.3	88	49.760
1462.3	89	49.760
1473.3	90	49.760
1484.3	91	49.760
1495.3	92	49.760
1506.3	93	49.760
1517.3	94	49.760
1528.3	95	49.760
1539.3	96	49.760
1550.3	97	49.760
1561.3	98	49.760
1572.3	99	49.760
1583.3	100	49.760

I-4


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K2: LATERAL LOSS COEF W.R.T. OUTLET VELOCITY
K3: MAIN LOSS COEFFICIENT W.R.T. OUTLET VELOCITY
K3L: W.R.T. MAIN INLET VELOCITY
K3M: W.R.T. MAIN ENERGY LOSS DUE TO JUNCTION
K3MJ: LATERAL ENERGY LOSS THROUGH JUNCTION
K3MJ: MAIN ENERGY LOSS THROUGH JUNCTION
TELM: TOTAL ENERGY LOSS TO TOTAL FLOW
RATIO: OF LATERAL FLOW TO TOTAL FLOW
VEELIN: VELOCITY INLET AND OUTLET VELOCITIES
RATIO2: LATERAL FLOW TO MAIN FLOW
K3C: COMBINED JUNCTION LOSS COEFFICIENT
K3RUS: BASED ON RUSSIAN PREDICTION EQUATION -FOR COMPARISON

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MAIN POWER	LATURAL POWER	OUT POWER	POWER LOSS RATIO
635985.8W	353981.18W	957912.50W	0.8124

H
4

POSITION ALONG PIPE (CM)

PIEZOMETER READING CM

120.5	1	47.210
176.5	2	46.980
242.5	3	46.710
303.5	4	46.530
364.5	5	46.340
425.5	6	46.000
486.4	7	45.840
510.4	8	45.400
547.4	9	45.880
563.2	10	45.880
578.7	11	45.880
593.7	12	45.520
608.4	13	45.880
624.2	14	45.880
639.3	15	45.780
750.3	16	45.230
780.8	17	44.240
811.3	18	44.170
872.3	19	44.600
972.6	20	41.880
304.5	21	41.390
365.5	22	47.930
435.7	23	47.330
496.6	24	46.610
577.6	25	45.900
583.7	26	45.930
588.1	27	45.500
618.5	28	45.160
633.8	29	44.960
644.4	30	44.890
644.4	31	44.780
664.3	32	44.640
679.3	33	45.130
750.3	34	44.230
780.8	35	44.170
811.3	36	44.600
872.3	37	41.880
972.6	38	
	39	

FLOW RATE (CM³/HIC) 5663.3670
LATERAL 3.58.2180MAIN
SLOPE 3.002000OUTLET 3.002000
MANHOLE DROP : MAIN 3.060LATERAL 7.150

51

ENERGY LOSS COEFFICIENTS K2 K3 K2L K2R K2RUS K3RUS K3MRUS KC CEL
 NO. K2 K3 K2L K2R K2RUS K3RUS K3MRUS KC CEL
 1 0.61 0.39 0.71 1.13 1.09 1.53 10.24 5.49 0.40 0.63 0.18 0.30 2.08
 MAIN FLOW LATERAL FLOW RATIO RATIO2 VELINM 52.59 VELI.L 78.19 VELOUT 99.95 12.603 8.546 10.177
 5663.367 3358.718 0.35 0.54

K2: LATERAL LOSS COEFFICIENT K2R: OUTLET VELOCITY
 K3: MAIN LOSS COEFFICIENT K3R: INLET VELOCITY
 K2L: LATERAL INLET VELOCITY
 K3MR: MAIN ENERGY LOSS DUE TO JUNCTION
 K3RUS: LATERAL ENERGY LOSS DUE TO JUNCTION
 TELM: MAIN ENERGY LOSS THROUGH JUNCTION
 TELM: TOTAL ENERGY LOSS TO TOTAL FLOW
 RATIO: OF LATERAL FLOW TO TOTAL FLOW
 RATIO2: OF LATERAL FLOW TO MAIN FLOW
 VELINM: LATERAL FLOW INLET VELOCITY
 VELI.L: LATERAL FLOW INLET VELOCITY
 VELOUT: LATERAL FLOW OUTLET VELOCITY
 K3RUS: COMBINED BASFD ON RUSSIAN PREDICTION EQUATION -FOR COMPARISON

51

POWER LOSS
 MAIN POWER LATERAL POWER OUT POWER POWER LOSS RATIO
 616124.2000 337461.5000 955428.1000 0.0190

2
POSITION ALONG PIPE (CM)

PIEZOMETER READING CM

120.6	1	47.230
176.5	2	47.000
242.6	3	46.740
333.5	4	46.610
384.5	5	46.440
425.5	6	46.120
486.4	7	46.000
510.4	8	46.000
547.4	9	46.000
563.2	10	46.000
578.5	11	46.000
593.7	12	46.000
608.4	13	46.000
624.2	14	46.000
639.3	15	46.000
650.8	16	46.000
670.3	17	46.000
780.8	18	46.000
811.3	19	46.000
872.3	20	46.000
972.6	21	46.000
3058.2180MAIN	22	46.000
3058.2180MAIN	23	46.000
3058.2180MAIN	24	46.000
3058.2180MAIN	25	46.000
3058.2180MAIN	26	46.000
3058.2180MAIN	27	46.000
3058.2180MAIN	28	46.000
3058.2180MAIN	29	46.000
3058.2180MAIN	30	46.000
3058.2180MAIN	31	46.000
3058.2180MAIN	32	46.000
3058.2180MAIN	33	46.000
3058.2180MAIN	34	46.000
3058.2180MAIN	35	46.000
3058.2180MAIN	36	46.000
3058.2180MAIN	37	46.000
3058.2180MAIN	38	46.000
3058.2180MAIN	39	46.000
3058.2180MAIN	40	46.000
3058.2180MAIN	41	46.000
3058.2180MAIN	42	46.000
3058.2180MAIN	43	46.000
3058.2180MAIN	44	46.000
3058.2180MAIN	45	46.000
3058.2180MAIN	46	46.000
3058.2180MAIN	47	46.000
3058.2180MAIN	48	46.000
3058.2180MAIN	49	46.000
3058.2180MAIN	50	46.000
3058.2180MAIN	51	46.000
3058.2180MAIN	52	46.000
3058.2180MAIN	53	46.000
3058.2180MAIN	54	46.000
3058.2180MAIN	55	46.000
3058.2180MAIN	56	46.000
3058.2180MAIN	57	46.000
3058.2180MAIN	58	46.000
3058.2180MAIN	59	46.000
3058.2180MAIN	60	46.000
3058.2180MAIN	61	46.000
3058.2180MAIN	62	46.000
3058.2180MAIN	63	46.000
3058.2180MAIN	64	46.000
3058.2180MAIN	65	46.000
3058.2180MAIN	66	46.000
3058.2180MAIN	67	46.000
3058.2180MAIN	68	46.000
3058.2180MAIN	69	46.000
3058.2180MAIN	70	46.000
3058.2180MAIN	71	46.000
3058.2180MAIN	72	46.000
3058.2180MAIN	73	46.000
3058.2180MAIN	74	46.000
3058.2180MAIN	75	46.000
3058.2180MAIN	76	46.000
3058.2180MAIN	77	46.000
3058.2180MAIN	78	46.000
3058.2180MAIN	79	46.000
3058.2180MAIN	80	46.000
3058.2180MAIN	81	46.000
3058.2180MAIN	82	46.000
3058.2180MAIN	83	46.000
3058.2180MAIN	84	46.000
3058.2180MAIN	85	46.000
3058.2180MAIN	86	46.000
3058.2180MAIN	87	46.000
3058.2180MAIN	88	46.000
3058.2180MAIN	89	46.000
3058.2180MAIN	90	46.000
3058.2180MAIN	91	46.000
3058.2180MAIN	92	46.000
3058.2180MAIN	93	46.000
3058.2180MAIN	94	46.000
3058.2180MAIN	95	46.000
3058.2180MAIN	96	46.000
3058.2180MAIN	97	46.000
3058.2180MAIN	98	46.000
3058.2180MAIN	99	46.000
3058.2180MAIN	100	46.000

52.1

POSITION	ALONG	PIPT (CM)	PIEZOMETER	READING	CM
1	120.6	1	49.010		
2	176.5	2	48.910		
3	242.5	3	48.810		
4	304.5	4	48.700		
5	425.5	5	48.710		
6	486.4	6	48.610		
7	510.4	7	48.550		
8	547.4	8	48.540		
9	563.5	9	48.520		
10	593.7	10	48.520		
11	606.4	11	48.520		
12	624.2	12	48.520		
13	639.5	13	48.520		
14	650.8	14	48.520		
15	672.3	15	48.520		
16	687.2	16	48.520		
17	701.1	17	48.520		
18	715.0	18	48.520		
19	729.9	19	48.520		
20	744.8	20	48.520		
21	759.7	21	48.520		
22	774.6	22	48.520		
23	789.5	23	48.520		
24	804.4	24	48.520		
25	819.3	25	48.520		
26	834.2	26	48.520		
27	849.1	27	48.520		
28	864.0	28	48.520		
29	878.9	29	48.520		
30	893.8	30	48.520		
31	908.7	31	48.520		
32	923.6	32	48.520		
33	938.5	33	48.520		
34	953.4	34	48.520		
35	968.3	35	48.520		
36	983.2	36	48.520		
37	998.1	37	48.520		
38	1013.0	38	48.520		
39	1027.9	39	48.520		
40	1042.8	40	48.520		
41	1057.7	41	48.520		
42	1072.6	42	48.520		
43	1087.5	43	48.520		
44	1102.4	44	48.520		
45	1117.3	45	48.520		
46	1132.2	46	48.520		
47	1147.1	47	48.520		
48	1162.0	48	48.520		
49	1176.9	49	48.520		
50	1191.8	50	48.520		
51	1206.7	51	48.520		
52	1221.6	52	48.520		
53	1236.5	53	48.520		
54	1251.4	54	48.520		
55	1266.3	55	48.520		
56	1281.2	56	48.520		
57	1296.1	57	48.520		
58	1311.0	58	48.520		
59	1325.9	59	48.520		
60	1340.8	60	48.520		
61	1355.7	61	48.520		
62	1370.6	62	48.520		
63	1385.5	63	48.520		
64	1400.4	64	48.520		
65	1415.3	65	48.520		
66	1430.2	66	48.520		
67	1445.1	67	48.520		
68	1460.0	68	48.520		
69	1474.9	69	48.520		
70	1489.8	70	48.520		
71	1504.7	71	48.520		
72	1519.6	72	48.520		
73	1534.5	73	48.520		
74	1549.4	74	48.520		
75	1564.3	75	48.520		
76	1579.2	76	48.520		
77	1594.1	77	48.520		
78	1609.0	78	48.520		
79	1623.9	79	48.520		
80	1638.8	80	48.520		
81	1653.7	81	48.520		
82	1668.6	82	48.520		
83	1683.5	83	48.520		
84	1698.4	84	48.520		
85	1713.3	85	48.520		
86	1728.2	86	48.520		
87	1743.1	87	48.520		
88	1758.0	88	48.520		
89	1772.9	89	48.520		
90	1787.8	90	48.520		
91	1802.7	91	48.520		
92	1817.6	92	48.520		
93	1832.5	93	48.520		
94	1847.4	94	48.520		
95	1862.3	95	48.520		
96	1877.2	96	48.520		
97	1892.1	97	48.520		
98	1907.0	98	48.520		
99	1921.9	99	48.520		
100	1936.8	100	48.520		

FLOW RATE (CUBIC CENTIMETERS PER SECOND) 5663.3670
 LATERAL 5521.781 MAIN
 SLOPE 0.0098 MAIN 0.0022 LATERAL 0.0022
 LATERAL 3.96 LATERAL 7.15
 MANHOLE DROP : MAIN 3.96 LATERAL 7.15

J2.2

POSITION ALONG PIPE (CM)

PIEZOMETER READING CM

120.6	1	48.092
176.5	2	47.910
242.6	3	47.780
303.5	4	47.690
364.5	5	47.580
425.5	6	47.450
486.4	7	47.370
510.4	8	47.350
527.4	9	47.370
578.7	10	47.370
593.7	11	47.370
608.4	12	47.370
624.2	13	47.370
639.5	14	47.370
650.3	15	47.370
672.3	16	47.370
687.2	17	47.370
700.3	18	47.370
711.3	19	47.370
722.3	20	47.370
733.3	21	47.370
744.3	22	47.370
755.3	23	47.370
766.3	24	47.370
777.3	25	47.370
788.3	26	47.370
799.3	27	47.370
810.3	28	47.370
821.3	29	47.370
832.3	30	47.370
843.3	31	47.370
854.3	32	47.370
865.3	33	47.370
876.3	34	47.370
887.3	35	47.370
898.3	36	47.370
909.3	37	47.370
920.3	38	47.370
931.3	39	47.370
942.3	40	47.370
953.3	41	47.370
964.3	42	47.370
975.3	43	47.370
986.3	44	47.370
997.3	45	47.370
1008.3	46	47.370
1019.3	47	47.370
1030.3	48	47.370
1041.3	49	47.370
1052.3	50	47.370
1063.3	51	47.370
1074.3	52	47.370
1085.3	53	47.370
1096.3	54	47.370
1107.3	55	47.370
1118.3	56	47.370
1129.3	57	47.370
1140.3	58	47.370
1151.3	59	47.370
1162.3	60	47.370
1173.3	61	47.370
1184.3	62	47.370
1195.3	63	47.370
1206.3	64	47.370
1217.3	65	47.370
1228.3	66	47.370
1239.3	67	47.370
1250.3	68	47.370
1261.3	69	47.370
1272.3	70	47.370
1283.3	71	47.370
1294.3	72	47.370
1305.3	73	47.370
1316.3	74	47.370
1327.3	75	47.370
1338.3	76	47.370
1349.3	77	47.370
1360.3	78	47.370
1371.3	79	47.370
1382.3	80	47.370
1393.3	81	47.370
1404.3	82	47.370
1415.3	83	47.370
1426.3	84	47.370
1437.3	85	47.370
1448.3	86	47.370
1459.3	87	47.370
1470.3	88	47.370
1481.3	89	47.370
1492.3	90	47.370
1503.3	91	47.370
1514.3	92	47.370
1525.3	93	47.370
1536.3	94	47.370
1547.3	95	47.370
1558.3	96	47.370
1569.3	97	47.370
1580.3	98	47.370
1591.3	99	47.370
1602.3	100	47.370

FLOW RATE (CUBIC CENTIMETERS PER SECOND) 5663.3670

LATERAL SLOPE 0.0020
LATERAL MANHOLE DROP : MAIN 3.9601
LATERAL MANHOLE DROP : MAIN 7.150

53

POSITION ALONG PIPE (CM)

PIEZOMETER READING CM

120.0	1	48.550
116.0	2	48.410
112.0	3	48.350
108.0	4	48.220
104.0	5	48.160
100.0	6	48.040
96.0	7	47.990
92.0	8	47.970
88.0	9	47.970
84.0	10	47.970
80.0	11	47.970
76.0	12	47.970
72.0	13	47.970
68.0	14	47.970
64.0	15	47.970
60.0	16	47.970
56.0	17	47.970
52.0	18	47.970
48.0	19	47.970
44.0	20	47.970
40.0	21	47.970
36.0	22	47.970
32.0	23	47.970
28.0	24	47.970
24.0	25	47.970
20.0	26	47.970
16.0	27	47.970
12.0	28	47.970
8.0	29	47.970
4.0	30	47.970

FLUM RATE (CUMIC CTN) METERS PER SECOND) 5663.3670

LATERAL 3936.000 MAIN 3.00200 OUTLET 7.150
SLOPE 1.00000 MAIN 3.960 LATERAL 3.00200
MANHOLE DROP : MAIN 3.960 LATERAL 3.00200

54

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K2:LATERAL LOSS COEFF *R.T. OUTLET VELOCITY  
K3:MAIN LOSS COEFFICIENT *R.T. OUTLET VELOCITY  
K3L:W.R.T. MAIN INLET VELOCITY  
K3M:W.R.T. MAIN ENERGY LOSS DUE TO JUNCTION  
LELUJ:MAIN ENERGY LOSS THROUGH JUNCTION  
TELMH:TOTAL ENERGY FLOW TO TOTAL FLOW  
RATIO OF LATERAL FLOW TO OUTLET VELOCITIES  
RAVELIN:VELOCITY FLOW TO MAIN FLOW  
VELIN2:LATEMAL FLOW TO MAIN FLOW  
KC:COMBINED JUNCTION LOSS COEFFICIENT  
K3RUS:BASED ON RUSSIAN PREDICTION EQUATION -FOR COMPARISON
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MAIN POWER	LATERAL POWER	OUT POWER	POWER LOSS RATIO
624525.5810	458994.7400	1058525.0000	W.0235

49

POSITION ALONG PIPE (CM)

PIEZOMETER READING CM

120.0	1	48.860
116.5	2	48.860
113.0	3	48.860
109.5	4	48.860
106.0	5	48.860
102.5	6	48.860
99.0	7	48.860
95.5	8	48.860
92.0	9	48.860
88.5	10	48.860
85.0	11	48.860
81.5	12	48.860
78.0	13	48.860
74.5	14	48.860
71.0	15	48.860
67.5	16	48.860
64.0	17	48.860
60.5	18	48.860
57.0	19	48.860
53.5	20	48.860
50.0	21	48.860
46.5	22	48.860
43.0	23	48.860
39.5	24	48.860
36.0	25	48.860
32.5	26	48.860
29.0	27	48.860
25.5	28	48.860
22.0	29	48.860
18.5	30	48.860
15.0	31	48.860
11.5	32	48.860
8.0	33	48.860
4.5	34	48.860
1.0	35	48.860
0.0	36	48.860
0.0	37	48.860
0.0	38	48.860
0.0	39	48.860
0.0	40	48.860
0.0	41	48.860
0.0	42	48.860
0.0	43	48.860
0.0	44	48.860
0.0	45	48.860
0.0	46	48.860
0.0	47	48.860
0.0	48	48.860
0.0	49	48.860
0.0	50	48.860
0.0	51	48.860
0.0	52	48.860
0.0	53	48.860
0.0	54	48.860
0.0	55	48.860
0.0	56	48.860
0.0	57	48.860
0.0	58	48.860
0.0	59	48.860
0.0	60	48.860
0.0	61	48.860
0.0	62	48.860
0.0	63	48.860
0.0	64	48.860
0.0	65	48.860
0.0	66	48.860
0.0	67	48.860
0.0	68	48.860
0.0	69	48.860
0.0	70	48.860
0.0	71	48.860
0.0	72	48.860
0.0	73	48.860
0.0	74	48.860
0.0	75	48.860
0.0	76	48.860
0.0	77	48.860
0.0	78	48.860
0.0	79	48.860
0.0	80	48.860
0.0	81	48.860
0.0	82	48.860
0.0	83	48.860
0.0	84	48.860
0.0	85	48.860
0.0	86	48.860
0.0	87	48.860
0.0	88	48.860
0.0	89	48.860
0.0	90	48.860
0.0	91	48.860
0.0	92	48.860
0.0	93	48.860
0.0	94	48.860
0.0	95	48.860
0.0	96	48.860
0.0	97	48.860
0.0	98	48.860
0.0	99	48.860
0.0	100	48.860

FLOW RATE (CUBIC CENTIMETERS PER SECOND) 5663.3670

LATERAL 3624.5550MAIN

SLOPE 0.1160MAIN 0.3050OUTLET 0.005000

LATERAL 0.1160MAIN 0.3050OUTLET 0.005000

MANHOLE DROP: MAIN 0.00LATERAL 5.080

K1

ENRKY. LOSS COEFFICIENTS
 NO K2 K3 K2L K3M LELJ MELJ TEL TELM K2RUS K2LRUS K3RUS K3LRUS KC
 1 0.24 0.23 0.64 1.06 1.09 1.05 6.11 1.05 0.56 0.71 0.14 0.37 0.24
 MAIN FLOW LATERAL FLOW RATIO RATIO VELLIN VEL VELOUT VELOUT EIP E2P E3P
 5603.367 3624.556 0.39 0.60 33.10 5.17 94.14 12.937 8.948 13.992 1.07

K2: LATERAL LOSS COEFFICIENT RATIO OUTLET VELOCITY
 K3: MAIN LOSS COEFFICIENT RATIO OUTLET VELOCITY
 K2L: MAIN LATERAL INLET VELOCITY
 K3M: MAIN LATERAL INLET VELOCITY
 LELJ: MAIN LATERAL ENERGY LOSS DUE TO JUNCTION
 MELJ: MAIN LATERAL ENERGY LOSS DUE TO JUNCTION
 TELM: TOTAL ENERGY LOSS THROUGH JUNCTION
 RATIO OF LATERAL FLOW TO TOTAL FLOW
 VELLIN: VELOCITY OF LATERAL FLOW AND OUTLET VELOCITIES
 RATIO OF LATERAL FLOW TO MAIN FLOW
 RATIO OF LATERAL FLOW TO TOTAL FLOW
 KC: COMBINED JUNCTION LOSS COEFFICIENT
 K3RUS: BASED ON RUSSIAN PREDICTION EQUATION - FOR COMPARISON

POWER LOSS

MAIN POWER LATERAL POWER OUT POWER POWER LOSS RATIO
 626520.744 400978.0000 1017577.0000 0.0097



POSITION ALONG PIPE (CM)	PIEZO AFTER READING CM
120.0	48.770
117.0	48.770
114.0	48.770
111.0	48.770
108.0	48.770
105.0	48.770
102.0	48.770
99.0	48.770
96.0	48.770
93.0	48.770
90.0	48.770
87.0	48.770
84.0	48.770
81.0	48.770
78.0	48.770
75.0	48.770
72.0	48.770
69.0	48.770
66.0	48.770
63.0	48.770
60.0	48.770
57.0	48.770
54.0	48.770
51.0	48.770
48.0	48.770
45.0	48.770
42.0	48.770
39.0	48.770
36.0	48.770
33.0	48.770
30.0	48.770
27.0	48.770
24.0	48.770
21.0	48.770
18.0	48.770
15.0	48.770
12.0	48.770
9.0	48.770
6.0	48.770
3.0	48.770
0.0	48.770

FLOW RATE (CURRIC) 3624.5550 MAIN
 LATERAL 0.005000 OUTLET 0.005000
 LATERAL 0.005000 MAIN 0.005000
 MANHOLE DROP MAIN 0.005000

5663.3670
 5663.3670

K2

PIEZOMETER READING CM

天

EFFICIENCY K3M LELJ MELJ TELJ TELM K2RUS K2LRUS K3RUS K3MRUS KC CELJ
 K2L 1.64 1.25 0.93 0.33 0.93 0.56 0.71 0.14 0.37 0.22 1.05
 RAL FLOW RATIO 0.39 0.64 0.93 0.33 0.93 0.56 0.71 0.14 0.37 0.22 1.05
 624.556 0.39 0.64 0.93 0.33 0.93 0.56 0.71 0.14 0.37 0.22 1.05

F W R T OUTLET VELOCITY
 ICIENT W R T OUTLET VELOCITY
 I VELOCITY
 Y LOSS DUE TO JUNCTION
 S DUE TO JUNCTION
 LOSS THROUGH JUNCTION
 IOW TO TOTAL FLOW
 FT AND OUTLET VELOCITIES
 TO MAIN FLOW
 LOSS COEFFICIENT
 RUSSIAN PREDICTION EQUATION FOR COMPARISON

K3

LATERAL POWER OUT POWER POWER LOSS RATIO
 411884.0000 1018277.0000 0.0095

K3

POSITION ALONG PIPE (CM)	PIEZOMETER READING CM
120.0	48.340
117.6	48.300
114.2	48.260
110.8	48.240
107.4	48.160
104.0	48.160
100.6	48.160
97.2	48.160
93.8	48.160
90.4	48.160
87.0	48.160
83.6	48.160
80.2	48.160
76.8	48.160
73.4	48.160
70.0	48.160
66.6	48.160
63.2	48.160
59.8	48.160
56.4	48.160
53.0	48.160
49.6	48.160
46.2	48.160
42.8	48.160
39.4	48.160
36.0	48.160
32.6	48.160
29.2	48.160
25.8	48.160
22.4	48.160
19.0	48.160
15.6	48.160
12.2	48.160
8.8	48.160
5.4	48.160
2.0	48.160
0.0	48.160

FLOW RATE (CUBIC FEET PER SECOND) 5663.3670
 LATERAL 2548.5140 MAIN
 SLOPE 0.005000 UNTIL 4.005000
 MANHOLE DROP : MAIN 0.000 LATERAL 5.080

K4

ENERGY LOSS COEFFICIENTS

NO	K2	K3	K2L	K3M	LELJ	MELJ	TELL	TELM	K2RUS	K2LRUS	K3RUS	K3MRUS	KC	CELJ
1	0.20	0.29	1.02	0.31	0.45	1.24	5.95	1.24	0.24	0.48	0.21	0.45	0.26	1.15
MAIN FLOW LATERAL FLOW MAIN FLOW MAIN FLOW MAIN FLOW MAIN FLOW MAIN FLOW MAIN FLOW MAIN FLOW MAIN FLOW MAIN FLOW MAIN FLOW MAIN FLOW MAIN FLOW MAIN FLOW														
5663.467 2548.515 0.31 0.45 1.24 5.95 1.24 0.24 0.48 0.21 0.45 0.26 1.15														

K2: LATERAL LOSS COEFFICIENT W.R.T. OUTLET VELOCITY
 K3: MAIN LOSS COEFFICIENT W.R.T. OUTLET VELOCITY
 K2L: MAIN LATERAL INLET VELOCITY
 K3M: MAIN LATERAL ENERGY LOSS DUE TO JUNCTION
 LELJ: MAIN LATERAL ENERGY LOSS THROUGH JUNCTION
 MELJ: MAIN LATERAL ENERGY LOSS THROUGH JUNCTION
 TELJ: MAIN LATERAL ENERGY LOSS THROUGH JUNCTION
 TELM: MAIN LATERAL ENERGY LOSS THROUGH JUNCTION
 K2RUS: MAIN LATERAL ENERGY LOSS THROUGH JUNCTION
 K2LRUS: MAIN LATERAL ENERGY LOSS THROUGH JUNCTION
 K3RUS: MAIN LATERAL ENERGY LOSS THROUGH JUNCTION
 K3MRUS: MAIN LATERAL ENERGY LOSS THROUGH JUNCTION
 KC: MAIN LATERAL ENERGY LOSS THROUGH JUNCTION
 CELJ: MAIN LATERAL ENERGY LOSS THROUGH JUNCTION
 K4: MAIN LATERAL ENERGY LOSS THROUGH JUNCTION

POWER LOSS

MAIN POWER LATERAL POWER OJ1 POWER POWER LOSS RATIO
 622959.1000 279398.3000 893117.9000 0.0102

K4

POSITION ALONG PIPE(CM)

PIEZOMETER READING CM

120.6	1	47.250
176.5	2	47.210
242.5	3	47.160
303.5	4	47.150
364.5	5	47.130
425.5	6	47.110
486.4	7	47.110
510.4	8	47.110
547.4	9	47.110
556.3	10	47.110
557.8	11	47.110
593.7	12	47.110
606.4	13	47.110
608.9	14	47.110
624.2	15	47.110
639.3	16	47.110
750.3	17	47.110
780.3	18	47.110
811.3	19	47.110
872.3	20	47.110
972.3	21	47.110
972.3	22	47.110
972.3	23	47.110
972.3	24	47.110
972.3	25	47.110
972.3	26	47.110
972.3	27	47.110
972.3	28	47.110
972.3	29	47.110
972.3	30	47.110
972.3	31	47.110
972.3	32	47.110
972.3	33	47.110
972.3	34	47.110
972.3	35	47.110
972.3	36	47.110
972.3	37	47.110
972.3	38	47.110
972.3	39	47.110
972.3	40	47.110
972.3	41	47.110
972.3	42	47.110
972.3	43	47.110
972.3	44	47.110
972.3	45	47.110
972.3	46	47.110
972.3	47	47.110
972.3	48	47.110
972.3	49	47.110
972.3	50	47.110
972.3	51	47.110
972.3	52	47.110
972.3	53	47.110
972.3	54	47.110
972.3	55	47.110
972.3	56	47.110
972.3	57	47.110
972.3	58	47.110
972.3	59	47.110
972.3	60	47.110
972.3	61	47.110
972.3	62	47.110
972.3	63	47.110
972.3	64	47.110
972.3	65	47.110
972.3	66	47.110
972.3	67	47.110
972.3	68	47.110
972.3	69	47.110
972.3	70	47.110
972.3	71	47.110
972.3	72	47.110
972.3	73	47.110
972.3	74	47.110
972.3	75	47.110
972.3	76	47.110
972.3	77	47.110
972.3	78	47.110
972.3	79	47.110
972.3	80	47.110
972.3	81	47.110
972.3	82	47.110
972.3	83	47.110
972.3	84	47.110
972.3	85	47.110
972.3	86	47.110
972.3	87	47.110
972.3	88	47.110
972.3	89	47.110
972.3	90	47.110
972.3	91	47.110
972.3	92	47.110
972.3	93	47.110
972.3	94	47.110
972.3	95	47.110
972.3	96	47.110
972.3	97	47.110
972.3	98	47.110
972.3	99	47.110
972.3	100	47.110

FLOW RATE(CUBIC CENTIMETERS PER SECOND)
LATERAL 4177.6240MAIN 5663.3670
SLOPE 0.0050MAIN 0.0050
LATERAL 1.700LATERAL 6.150
MANHOLE DROP :MAIN

N1

ENERGY LOSS COEFFICIENTS

NO	K2	K3	K2L	K3M	LELJ	MEELJ	TELL	TELM	K2RUS	K2LRUS	K3RUS	K3MRUS	KC	CEL
1	0.57	0.30	0.40	0.37	0.53	0.39	10.64	0.69	0.68	0.74	0.10	0.29	0.06	0.51
MAIN FLOW	1	AT FLOW	1	RATIO	1	RATIO	1	VELIN	1	VELOUT	1	EIP	1	E3P
5663.367	46077.625	0.42	0.72	36.87	63.93	124.63	16.511	14.889	12.420					

K2: LATERAL LOSS COEFFICIENT W.R.T. OUTLET VELOCITY
 K3: MAIN LOSS COEFFICIENT W.R.T. OUTLET VELOCITY
 K2L: W.R.T. LATERAL INLET VELOCITY
 K3M: W.R.T. MAIN INLET VELOCITY
 LELJ: LATERAL ENERGY LOSS DUE TO JUNCTION
 MEELJ: MAIN ENERGY LOSS THROUGH JUNCTION
 TELM: TOTAL ENERGY LOSS TO TOTAL FLOW
 RATIO OF LATERAL FLOW TO TOTAL FLOW
 VELIN: INLET FLOW TO MAIN FLOW
 VELOUT: LATERAL FLOW TO MAIN FLOW
 RATIO2: LATERAL FLOW TO MAIN FLOW
 KC: COMBINED BASED ON RUSSIAN PREDICTION EQUATION - FOR COMPARISON
 K3RUS :

POWER LOSS

MAIN POWER LATERAL POWER OUT POWER POWER LOSS RATIO
 617425.3333 472747.5000 1055245.0000 0.0045

NI

POSITION ALONG PIPE(CM)

PIEZOMETER READING CM

120.6	1	44.370
176.5	2	44.430
242.5	3	45.760
303.5	4	45.820
364.5	5	45.820
425.5	6	45.840
486.4	7	45.840
510.9	8	45.840
547.4	9	45.930
563.2	10	45.930
578.7	11	45.930
593.7	12	45.930
606.4	13	45.930
618.9	14	45.930
624.2	15	45.930
639.3	16	45.930
650.3	17	45.930
750.8	18	45.930
811.3	19	45.930
872.3	20	45.930
972.6	21	45.930
972.6	22	45.930
972.6	23	45.930
972.6	24	45.930
972.6	25	45.930
972.6	26	45.930
972.6	27	45.930
972.6	28	45.930
972.6	29	45.930
972.6	30	45.930
972.6	31	45.930
972.6	32	45.930
972.6	33	45.930
972.6	34	45.930
972.6	35	45.930
972.6	36	45.930
972.6	37	45.930
972.6	38	45.930
972.6	39	45.930
972.6	40	45.930
972.6	41	45.930
972.6	42	45.930
972.6	43	45.930
972.6	44	45.930
972.6	45	45.930
972.6	46	45.930
972.6	47	45.930
972.6	48	45.930
972.6	49	45.930
972.6	50	45.930
972.6	51	45.930
972.6	52	45.930
972.6	53	45.930
972.6	54	45.930
972.6	55	45.930
972.6	56	45.930
972.6	57	45.930
972.6	58	45.930
972.6	59	45.930
972.6	60	45.930
972.6	61	45.930
972.6	62	45.930
972.6	63	45.930
972.6	64	45.930
972.6	65	45.930
972.6	66	45.930
972.6	67	45.930
972.6	68	45.930
972.6	69	45.930
972.6	70	45.930
972.6	71	45.930
972.6	72	45.930
972.6	73	45.930
972.6	74	45.930
972.6	75	45.930
972.6	76	45.930
972.6	77	45.930
972.6	78	45.930
972.6	79	45.930
972.6	80	45.930
972.6	81	45.930
972.6	82	45.930
972.6	83	45.930
972.6	84	45.930
972.6	85	45.930
972.6	86	45.930
972.6	87	45.930
972.6	88	45.930
972.6	89	45.930
972.6	90	45.930
972.6	91	45.930
972.6	92	45.930
972.6	93	45.930
972.6	94	45.930
972.6	95	45.930
972.6	96	45.930
972.6	97	45.930
972.6	98	45.930
972.6	99	45.930
972.6	100	45.930

FLOW RATE(CUBIC CENTIMETERS PER SECOND)
LATERAL 4077.6240MAIN
SLOPE 2.13720MAIN 2.05000OUTLET 2.05000
LATERAL 1.780LATERAL 6.150
MANHOLE DROP :MAIN

N2

ENERGY LOSS COEFFICIENTS
 NO K2 K3 K2L K3M LELJ MELJ TEL TELM K2RUS K2LRUS K3RUS K3MRUS XC CE
 1 0.47 -0.37 0.39 -4.38 4.80 -3.76 10.95 -2.06 0.68 0.74 0.10 0.29 -0.02 -0.11
 MAIN FLOW LATERAL FLOW RATIO RATIO2 VELINM 40.43 84.90 140.90 16.999 15.653 11.539
 5663.367 4077.625 0.42 0.72

K2: LATERAL LOSS COEFFICIENT M.R.T. OUTLET VELOCITY
 K3: MAIN LOSS COEFFICIENT M.R.T. OUTLET VELOCITY
 K2L: M.R.T. MAIN INLET VELOCITY
 K3M: M.R.T. MAIN ENERGY LOSS DUE TO JUNCTION
 LELJ: MAIN ENERGY LOSS THROUGH JUNCTION
 MELJ: TOTAL ENERGY LOSS TO TOTAL FLOW
 TEL: TOTAL LATERAL FLOW AND OUTLET VELOCITIES
 TELM: LATERAL FLOW TO MAIN FLOW
 K2RUS: LATERAL JUNCTION LOSS COEFFICIENT
 K2LRUS: BASED ON RUSSIAN PREDICTION EQUATION -FOR COMPARISON
 K3RUS: BASED ON RUSSIAN PREDICTION EQUATION -FOR COMPARISON

N2

POWER LOSS

MAIN POWER LATERAL POWER OUT POWER POWER LOSS RATIO
 612437.7000 475857.7000 1090005.0000 -0.0016

POSITION ALONG PIPE(CM)	PIEZOWFETER READING CM	FLOW RATE(CUBIC CENTIMETERS PER SECOND)
120.5	44.370	5663.3670
176.5	44.620	
242.5	45.760	
303.5	45.010	
364.5	45.010	
425.5	45.010	
486.5	45.010	
547.5	45.015	
608.5	45.940	
669.5	45.940	
730.5	45.940	
791.5	45.940	
852.5	45.940	
913.5	45.940	
974.5	45.940	
1035.5	45.940	
1096.5	45.940	
1157.5	45.940	
1218.5	45.940	
1279.5	45.940	
1340.5	45.940	
1401.5	45.940	
1462.5	45.940	
1523.5	45.940	
1584.5	45.940	
1645.5	45.940	
1706.5	45.940	
1767.5	45.940	
1828.5	45.940	
1889.5	45.940	
1950.5	45.940	
2011.5	45.940	
2072.5	45.940	
2133.5	45.940	
2194.5	45.940	
2255.5	45.940	
2316.5	45.940	
2377.5	45.940	
2438.5	45.940	
2499.5	45.940	
2560.5	45.940	
2621.5	45.940	
2682.5	45.940	
2743.5	45.940	
2804.5	45.940	
2865.5	45.940	
2926.5	45.940	
2987.5	45.940	
3048.5	45.940	
3109.5	45.940	
3170.5	45.940	
3231.5	45.940	
3292.5	45.940	
3353.5	45.940	
3414.5	45.940	
3475.5	45.940	
3536.5	45.940	
3597.5	45.940	
3658.5	45.940	
3719.5	45.940	
3780.5	45.940	
3841.5	45.940	
3902.5	45.940	
3963.5	45.940	
4024.5	45.940	
4085.5	45.940	
4146.5	45.940	
4207.5	45.940	
4268.5	45.940	
4329.5	45.940	
4390.5	45.940	
4451.5	45.940	
4512.5	45.940	
4573.5	45.940	
4634.5	45.940	
4695.5	45.940	
4756.5	45.940	
4817.5	45.940	
4878.5	45.940	
4939.5	45.940	
5000.5	45.940	
5061.5	45.940	
5122.5	45.940	
5183.5	45.940	
5244.5	45.940	
5305.5	45.940	
5366.5	45.940	
5427.5	45.940	
5488.5	45.940	
5549.5	45.940	
5610.5	45.940	
5671.5	45.940	
5732.5	45.940	
5793.5	45.940	
5854.5	45.940	
5915.5	45.940	
5976.5	45.940	
6037.5	45.940	
6098.5	45.940	
6159.5	45.940	
6220.5	45.940	
6281.5	45.940	
6342.5	45.940	
6403.5	45.940	
6464.5	45.940	
6525.5	45.940	
6586.5	45.940	
6647.5	45.940	
6708.5	45.940	
6769.5	45.940	
6830.5	45.940	
6891.5	45.940	
6952.5	45.940	
7013.5	45.940	
7074.5	45.940	
7135.5	45.940	
7196.5	45.940	
7257.5	45.940	
7318.5	45.940	
7379.5	45.940	
7440.5	45.940	
7501.5	45.940	
7562.5	45.940	
7623.5	45.940	
7684.5	45.940	
7745.5	45.940	
7806.5	45.940	
7867.5	45.940	
7928.5	45.940	
7989.5	45.940	
8050.5	45.940	
8111.5	45.940	
8172.5	45.940	
8233.5	45.940	
8294.5	45.940	
8355.5	45.940	
8416.5	45.940	
8477.5	45.940	
8538.5	45.940	
8599.5	45.940	
8660.5	45.940	
8721.5	45.940	
8782.5	45.940	
8843.5	45.940	
8904.5	45.940	
8965.5	45.940	
9026.5	45.940	
9087.5	45.940	
9148.5	45.940	
9209.5	45.940	
9270.5	45.940	
9331.5	45.940	
9392.5	45.940	
9453.5	45.940	
9514.5	45.940	
9575.5	45.940	
9636.5	45.940	
9697.5	45.940	
9758.5	45.940	
9819.5	45.940	
9880.5	45.940	
9941.5	45.940	
10002.5	45.940	
10063.5	45.940	
10124.5	45.940	
10185.5	45.940	
10246.5	45.940	
10307.5	45.940	
10368.5	45.940	
10429.5	45.940	
10490.5	45.940	
10551.5	45.940	
10612.5	45.940	
10673.5	45.940	
10734.5	45.940	
10795.5	45.940	
10856.5	45.940	
10917.5	45.940	
10978.5	45.940	
11039.5	45.940	
11100.5	45.940	
11161.5	45.940	
11222.5	45.940	
11283.5	45.940	
11344.5	45.940	
11405.5	45.940	
11466.5	45.940	
11527.5	45.940	
11588.5	45.940	
11649.5	45.940	
11710.5	45.940	
11771.5	45.940	
11832.5	45.940	
11893.5	45.940	
11954.5	45.940	
12015.5	45.940	
12076.5	45.940	
12137.5	45.940	
12198.5	45.940	
12259.5	45.940	
12320.5	45.940	
12381.5	45.940	
12442.5	45.940	
12503.5	45.940	
12564.5	45.940	
12625.5	45.940	
12686.5	45.940	
12747.5	45.940	
12808.5	45.940	
12869.5	45.940	
12930.5	45.940	
12991.5	45.940	
13052.5	45.940	
13113.5	45.940	
13174.5	45.940	
13235.5	45.940	
13296.5	45.940	
13357.5	45.940	
13418.5	45.940	
13479.5	45.940	
13540.5	45.940	
13601.5	45.940	
13662.5	45.940	
13723.5	45.940	
13784.5	45.940	
13845.5	45.940	
13906.5	45.940	
13967.5	45.940	
14028.5	45.940	
14089.5	45.940	
14150.5	45.940	
14211.5	45.940	
14272.5	45.940	
14333.5	45.940	
14394.5	45.940	
14455.5	45.940	
14516.5	45.940	
14577.5	45.940	
14638.5	45.940	
14699.5	45.940	
14760.5	45.940	
14821.5	45.940	
14882.5	45.940	
14943.5	45.940	
15004.5	45.940	
15065.5	45.940	
15126.5	45.940	
15187.5	45.940	
15248.5	45.940	
15309.5	45.940	
15370.5	45.940	
15431.5	45.940	
15492.5	45.940	
15553.5	45.940	
15614.5	45.940	
15675.5	45.940	
15736.5	45.940	
15797.5	45.940	
15858.5	45.940	
15919.5	45.940	
15980.5	45.940	
16041.5	45.940	
16102.5	45.940	
16163.5	45.940	
16224.5	45.940	
16285.5	45.940	
16346.5	45.940	
16407.5	45.940	
16468.5	45.940	
16529.5	45.940	
16590.5	45.940	
16651.5	45.940	
16712.5	45.940	
16773.5	45.940	
16834.5	45.940	
16895.5	45.940	
16956.5	45.940	
17017.5	45.940	
17078.5	45.940	
17139.5	45.940	
17200.5	45.940	
17261.5	45.940	
17322.5	45.940	
17383.5	45.940	
17444.5	45.940	
17505.5	45.940	
17566.5	45.940	
17627.5	45.940	
17688.5	45.940	
17749.5	45.940	
17810.5	45.940	
17871.5	45.940	
17932.5	45.940	
17993.5	45.940	
18054.5	45.940	
18115.5	45.940	
18176.5	45.940	
18237.5	45.940	
18298.5	45.940	
18359.5	45.940	
18420.5	45.940	
18481.5	45.940	
18542.5	45.940	
18603.5	45.940	
18664.5	45.940	
18725.5	45.940	
18786.5	45.940	
18847.5	45.940	
18908.5	45.940	
18969.5	45.940	
19030.5	45.940	
19091.5	45.940	
19152.5	45.940	
19213.5	45.940	
19274.5	45.940	
19335.5	45.940	
19396.5	45.940	
19457.5	45.940	
19518.5	45.940	
19579.5	45.940	
19640.5	45.940	
19701.5	45.940	
19762.5	45.940	
19823.5	45.940	
19884.5	45.940	
19945.5	45.940	
20006.5	45.940	
20067.5	45.940	
20128.5	45.940	
20189.5	45.940	
20250.5	45.940	
20311.5	45.940	
20372.5	45.940	
20433.5	45.940	
20494.5	45.940	
20555.5	45.940	
20616.5	45.940	
20677.5	45.940	
20738.5	45.940	
20799.5	45.940	
20860.5	45.940	
20921.5	45.940	
20982.5	45.940	
21043.5	45.940	
21104.5	45.940	
21165.5	45.940	
21226.5	45.940	
21287.5	45.940	
21348.5	45.940	
21409.5	45.940	
21470.5	45.940	
21531.5	45.940	
21592.5	45.940	
21653.5	45.940	
21714.5	45.940	
21775.5	45.940	
21836.5	45.940	
21897.5	45.940	
21958.5	45.940	
22019.5	45.940	
22080.5	45.940	
22141.5	45.940	
22202.5	45.940	
22263.5	45.940	
22324.5	45.940	
22385.5	45.940	
22446.5	45.940	
22507.5	45.940	
22568.5	45.940	
22629.5	45.940	
22690.5	45.940	
22751.5	45.940	
22812.5	45.940	
22873.5	45.940	
22934.5	45.940	
22995.5	45.940	
23056.5	45.940	
23117.5	45.940	
23178.5	45.940	
23239.5	45.940	
23300.5	45.940	
23361.5	45.940	
23422.5	45.940	
23483.5	45.940	
23544.5	45.940	
23605.5	45.940	
23666.5	45.940	
23727.5	45.940	
23788.5	45.940	
23849.5		

ENERGY LOSS COEFFICIENTS
 NO K2 K3 K2L K3M LELJ MELJ TELJ TELM K2RUS K2LRUS K3RUS K3MRUS KC CEL
 1 0.39 0.27 0.37 -3.47 3.74 -2.56 9.85 -0.86 0.68 0.74 0.10 0.29 0.01 4.06
 MAIN FLOW LATERAL FLOW RATIO RATIO2 VELINM VELINL VELOUT EIP ESP 156.40 16.004 13.855 11.743
 5663.367 4077.625 0.42 0.72 39.31 83.21

K2: LATERAL LOSS COEFF. W.R.T. OUTLET VELOCITY
 K3: MAIN LOSS COEFFICIENT W.R.T. OUTLET VELOCITY
 K2L: MAIN LATERAL INLET VELOCITY
 K3M: MAIN INLET VELOCITY
 LELJ: LATERAL ENERGY LOSS DUE TO JUNCTION
 MELJ: MAIN ENERGY LOSS DUE TO JUNCTION
 TELJ: TOTAL ENERGY LOSS THROUGH JUNCTION
 TELM: TOTAL ENERGY LOSS THROUGH JUNCTION
 RATIO: OF LATERAL FLOW TO TOTAL FLOW
 RATIO2: OF LATERAL FLOW TO TOTAL FLOW
 VELIN: INLET AND OUTLET VELOCITIES
 VELINM: MAIN INLET VELOCITY
 VELINL: LATERAL INLET VELOCITY
 VELOUT: OUTLET VELOCITY
 EIP: INLET VELOCITY
 ESP: OUTLET VELOCITY
 K3RUS: COMBINED LOSS COEFFICIENT EQUATION FOR RUSSIAN PREDICTION
 K2LRUS: LATERAL LOSS COEFFICIENT EQUATION FOR RUSSIAN PREDICTION
 K3MRUS: MAIN LOSS COEFFICIENT EQUATION FOR RUSSIAN PREDICTION

POWER LOSS

MAIN POWER LATERAL POWER OUT POWER POWER LOSS RATIO
 613592.1000 467314.3000 1040316.8000 0.0005



43

POSITION ALONG PIPE (CM)

PIEZOMETER READING CM

120.6	1	44.350
117.6	2	44.320
114.2	3	44.500
110.3	4	45.400
106.5	5	45.490
102.5	6	45.550
98.6	7	45.610
94.7	8	45.610
90.8	9	45.610
86.9	10	45.610
83.0	11	45.610
79.1	12	45.610
75.2	13	45.610
71.3	14	45.610
67.4	15	45.610
63.5	16	45.610
59.6	17	45.610
55.7	18	45.610
51.8	19	45.610
47.9	20	45.610
44.0	21	45.610
40.1	22	45.610
36.2	23	45.610
32.3	24	45.610
28.4	25	45.610
24.5	26	45.610
20.6	27	45.610
16.7	28	45.610
12.8	29	45.610
8.9	30	45.610
5.0	31	45.610
1.1	32	45.610
	33	45.610
	34	45.610
	35	45.610
	36	45.610
	37	45.610
	38	45.610
	39	45.610
	40	45.610
	41	45.610
	42	45.610
	43	45.610
	44	45.610
	45	45.610
	46	45.610
	47	45.610
	48	45.610
	49	45.610
	50	45.610
	51	45.610
	52	45.610
	53	45.610
	54	45.610
	55	45.610
	56	45.610
	57	45.610
	58	45.610
	59	45.610
	60	45.610
	61	45.610
	62	45.610
	63	45.610
	64	45.610
	65	45.610
	66	45.610
	67	45.610
	68	45.610
	69	45.610
	70	45.610
	71	45.610
	72	45.610
	73	45.610
	74	45.610
	75	45.610
	76	45.610
	77	45.610
	78	45.610
	79	45.610
	80	45.610
	81	45.610
	82	45.610
	83	45.610
	84	45.610
	85	45.610
	86	45.610
	87	45.610
	88	45.610
	89	45.610
	90	45.610
	91	45.610
	92	45.610
	93	45.610
	94	45.610
	95	45.610
	96	45.610
	97	45.610
	98	45.610
	99	45.610
	100	45.610

FLOW RATE (CUBIC CENTIMETERS PER SECOND)

566343670

LATERAL SLOPE 0.31370 MAIN 0.00500 OUTLET 0.00500
MANHOLE DROP : MAIN 1.700 LATERAL 6.150

N4

ENRGY LOSS COEFFICIENTS
 NO K2 K3 K2L K3M LELJ MELJ TEL TELM K2RUS K2LRUS K3RUS K3MRUS KC CEL
 1 0.46 0.30 0.41 -3.21 4.41 -2.84 10.56 -1.14 0.68 0.74 0.10 0.29 0.02 0.19
 MAIN FLOW LATERAL FLOW RATIO RATIO2 VELINM 41.03 84.90 136.40 15.953 14.212 11.413
 5663.367 4077.625 0.42 0.72

K2: LATERAL LOSS COEFFICIENT RATIO OUTLET VELOCITY
 K3: MAIN LOSS COEFFICIENT RATIO OUTLET VELOCITY
 K2L: MAIN LATERAL INLET VELOCITY
 K3M: MAIN MAIN INLET VELOCITY
 LELJ: LATERAL ENERGY LOSS DUE TO JUNCTION
 MELJ: MAIN ENERGY LOSS DUE TO JUNCTION
 TELM: TOTAL ENERGY LOSS THROUGH JUNCTION
 RATIO2: TOTAL LATERAL FLOW TO TOTAL FLOW
 VELINM: INLET FLOW AND OUTLET VELOCITIES
 RATIO2: LATERAL FLOW TO MAIN FLOW
 VELINM: LATERAL FLOW TO MAIN FLOW
 KC: COMBINED BASED ON RUSSIAN PREDICTION EQUATION -FOR COMPARISON
 K3RUS:

POWER LOSS
 MAIN POWER LATERAL POWER OUT POWER POWER LOSS RATIO
 611722.0000 469988.0000 1079820.0000 0.0017

N4

POSITION ALONG PIPE(CM)

PIEZOMETER READING CM

120.0	1	45.950
176.0	2	45.950
242.0	3	46.110
303.0	4	46.230
364.0	5	46.230
425.0	6	46.230
486.0	7	46.230
547.0	8	46.150
593.0	9	46.280
578.0	10	46.280
593.0	11	46.280
646.0	12	46.280
646.0	13	46.280
624.0	14	46.280
639.0	15	46.280
750.0	16	46.280
770.0	17	46.280
811.0	18	46.280
872.0	19	46.280
912.0	20	46.280
934.0	21	46.280
949.0	22	46.280
957.0	23	46.280
957.0	24	46.280
957.0	25	46.280
957.0	26	46.280
957.0	27	46.280
957.0	28	46.280
957.0	29	46.280
957.0	30	46.280
957.0	31	46.280
957.0	32	46.280
957.0	33	46.280
957.0	34	46.280
957.0	35	46.280
957.0	36	46.280
957.0	37	46.280
957.0	38	46.280
957.0	39	46.280
957.0	40	46.280
957.0	41	46.280
957.0	42	46.280
957.0	43	46.280
957.0	44	46.280
957.0	45	46.280
957.0	46	46.280
957.0	47	46.280
957.0	48	46.280
957.0	49	46.280
957.0	50	46.280
957.0	51	46.280
957.0	52	46.280
957.0	53	46.280
957.0	54	46.280
957.0	55	46.280
957.0	56	46.280
957.0	57	46.280
957.0	58	46.280
957.0	59	46.280
957.0	60	46.280
957.0	61	46.280
957.0	62	46.280
957.0	63	46.280
957.0	64	46.280
957.0	65	46.280
957.0	66	46.280
957.0	67	46.280
957.0	68	46.280
957.0	69	46.280
957.0	70	46.280
957.0	71	46.280
957.0	72	46.280
957.0	73	46.280
957.0	74	46.280
957.0	75	46.280
957.0	76	46.280
957.0	77	46.280
957.0	78	46.280
957.0	79	46.280
957.0	80	46.280
957.0	81	46.280
957.0	82	46.280
957.0	83	46.280
957.0	84	46.280
957.0	85	46.280
957.0	86	46.280
957.0	87	46.280
957.0	88	46.280
957.0	89	46.280
957.0	90	46.280
957.0	91	46.280
957.0	92	46.280
957.0	93	46.280
957.0	94	46.280
957.0	95	46.280
957.0	96	46.280
957.0	97	46.280
957.0	98	46.280
957.0	99	46.280
957.0	100	46.280

5663.3670

NS

ENERGY LOSS COEFFICIENTS

NO	K2	K3	K2L	K3M	LELJ	MELJ	TELL	TELM	K2RUS	K2LRUS	K3RUS	K3MRUS	KC	CEL
1	-0.46	-0.39	0.58	-0.50	0.498	-0.19	11.13	-2.49	0.68	0.74	0.10	0.29	-0.03	-0.35
MAIN FLOW	LATERAL FLOW	RATIO	PA102	VELIN	39.31	VELIN	80.04	VELOUT	145.61	17.658	16.472	11.743		
5663.367	4077.625	0.42	0.72											

K2: LATERAL LOSS COEFF. W.R.T. OUTLET VELOCITY
 K3: MAIN LOSS COEFFICIENT W.R.T. OUTLET VELOCITY
 K2L: W.R.T. LATERAL INLET VELOCITY
 K3M: W.R.T. MAIN INLET VELOCITY
 LELJ: LATERAL ENERGY LOSS DUE TO JUNCTION
 MELJ: MAIN ENERGY LOSS THROUGH JUNCTION
 TELJ: TOTAL ENERGY LOSS TO JUNCTION
 TELM: OF LATERAL FLOW TO TOTAL FLOW
 RATIO: OF LATERAL FLOW TO TOTAL FLOW
 VELIN: INLET AND OUTLET VELOCITIES
 PA102: LATERAL FLOW TO MAIN FLOW
 KC: COMBINED LOSS COEFFICIENT
 K3RUS: BASED ON RUSSIAN PREDICTION EQUATION -FOR COMPARISON

POWER LOSS

MAIN POWER LATERAL POWER OUT POWER POWER LOSS RATIO
 613592.1000 479197.0000 -1096223.0000 -0.0031