Inner Harbor Navigational Canal Lock, LOCKSIM Model Results: A Comparison of Lock Filling Times for Various Design Alternatives

[redacted]

New Orleans
District (MVN)
Hydraulic and

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1 Introduction

Project Features and History

The Inner Harbor Canal (IHNC) also locally referred to as the Industrial Canal Lock is a navigational structure in New Orleans, Louisiana. It is the only lock located along the east bank of the Mississippi River Mile 92.6 and is shown on location map **Figure 1- Location Map of IHNC Lock** in **Appendix A**. It is a ship class lock that serves as a connection for maritime traffic to access the Mississippi River from three major waterways- the Industrial Canal, the Gulf Intracoastal Waterway (GIWW) and the Mississippi River Gulf Outlet (MRGO). The lock also prevents the flooding of low areas east of the structure and provides passage of navigational traffic during high water events of the Mississippi River. The lock complex and canal connect the Mississippi River to Lake Pontchartrain.

The existing lock chamber is nominally 675 ft long (from pintle to pintle) by 75 ft wide with a chamber floor elevation of -31.50[1]. The original lock is designed based on a maximum differential head or design lift of 19.60 ft. The maximum design head was computed by referencing the Mississippi River and Tributary (MR&T) Project Design Flow line at the IHNC Lock (elevation 17.60) and the lowest historical stage (elevation -2.00) on the north (lake) side of the lock at the time of the original feasibility study which was completed in 1997. The lock embankment grade elevation (chamber wall height) was determined by adding the authorized freeboard of 4.6 ft to the design flow line elevation, which is 22.4[1]. The conversion between National Geodetic Vertical Datum of 1929 (NGVD29) to National American Vertical Datum of 1988 (NAVD88) is -0.30. The required embankment height is 22.1[2] in NAVD88.

Historical Stage Information

Water surface elevations upstream and downstream of the lock vary seasonally with the highest differential in water surface elevations occurring in the spring after snowmelt occurs. Normal operating conditions range from small head differentials of 2 ft or less to extreme cases in excess of 15 ft.

A gage analysis was completed as a part of this study to determine average, minimum, and maximum elevations at the lock. Gage information was obtained from USACE's website, Rivergages.com. The period of record analyzed was from October 25, 2006 to September 29, 2015. The upper pool and lower pool gages were referenced for this analysis; IHNC Lock Riverside 01340 and IHNC Lock Lakeside 76160. The average, minimum, and maximum elevations for both gages are shown below in **Table 1**, and **Table 2**.

[1] Elevations are in feet referenced to the National Geodetic Vertical Datum of 1929 (NGVD29).

[2] Elevations are in feet referenced to the National American Vertical Datum of 1988 (NAVD88).

Table 1: IHNC Gage Analysis Upper Gage (IHNC Lock Riverside 01340)

Average Elevation	Minimum Elevation	Minimum Elevation Date	Maximum Elevation	Maximum Elevation Date
5.86[2]	-2.63[2]	December 11, 2012	14.30	May 19, 2011

Table 2: IHNC Gage Analysis Upper Gage (IHNC Lock Lakeside 76160)

Average Elevation	Minimum Elevation	Minimum Elevation Date	Maximum Elevation	Maximum Elevation Date
0.46[2]	-2.27[2]	December 13, 2010	10.61	September 01, 2008

The maximum elevation on the riverside occurred during the historical Mississippi River flood event in May of 2011. The minimum elevation on the lakeside occurred in December of 2012. The maximum differential head of 14.62 occurred on April 16, 2008 during a historical flood event on the river. On this date, the upper gage and lower gage were 13.83 and -0.79, respectively.

The filling and emptying system is a sidewall filling system. It is configured with one longitudinal culvert in each lock wall that extends from upper pool to lower pool. It has side port culverts within the lock chamber that distribute flow transversely from the main culverts within the lock walls to the chamber. The lock has valves that distribute and regulate flow at the intake and between the manifold of the lock chamber ports. Details of the filling and emptying system are provided in **Figure 2 - Plan of IHNC Lock** and **Figure 3 -Profile of IHNC Lock**, in **Appendix A**. The culvert system is comprised of two main culverts (10.00 ft in height (h) x 8.00 ft in width (w)) located along the length of the each chamber wall with 15 side port culverts that are spaced at 28 ft on center by design, to minimize turbulence, cavitation and hawser forces in the chamber during filling and emptying operations. Reverse tainter valves control both the filling and emptying flow in the two main culverts. The flow then enters the chamber through the side port culverts which vary in size. Side port culverts 1 and 15 are 8.00 ft (h) x 4.00 ft (w) ; and side port culverts 2 through 14 are 4.00 ft (h) x 3.00 ft (w).

Purpose of Analysis

The existing IHNC Lock is approaching a 100 years of operation; it was originally designed for deep draft vessel traffic. Since its construction in the early 1900's deep vessel traffic trips have diminished. Although, the current lock shows signs of age, it is operable but not efficient. The original design vessel used to design the barge is not representative of modern vessels. The current lock geometry has a chamber length of 675 ft, which limits the available lockage space. The antiquated chamber is the main contributing factor to increased delays at the lock because of unusable space that cannot be used to house additional vessels.

[2] **Elevations are in feet referenced to the National American Vertical Datum of 1988 (NAVD88).**

Table 3, provides a summary of possible lock configurations and resulting dead space using an updated design vessel- a barge that is 195 ft x 35 ft which has a 11' draft. The updated design vessel is more representative of current maritime vessel traffic that utilizes the lock.

Table 3: Design Lock Configurations

Alternatives	Barge Length (ft)	Barge Width (ft)	Chamber Length (ft)	Chamber Width (ft)	Towboat Length (ft)	Remaining Lock Chamber Length (Dead space) (ft)	Inline Barge Configuration Based on Chamber Length	Maximum Number of Barges Based on Chamber Width	Total Number of Barges Based on Chamber Dimensions
Existing	195	35	675	75	200	85	2	2	4
A	195	35	900	75	200	115	3	2	6
B	195	35	900	110	200	115	3	3	9
C	195	35	1200	75	200	25	5	2	10
D	195	35	1200	110	200	25	5	3	15

Delays are also experienced at the lock because of its close proximity to a bridge structure- Claiborne Avenue bridge, also referred to as the Judge William Seeber Bridge, located north of the site as shown in **Figure 4- Looking North at IHNC Lock**, in **Appendix A**. Vessels experience a delay waiting to lock though the structure when there is also a delay at the bridge. The bridge is a vertical lift bridge that accommodates most maritime traffic but has to be raised to accommodate larger vessels which adds to the congestion at the lock. Although improvements at the bridge are warranted, the IHNC Lock study is not authorized to investigate improvements of the structures north of the lock. However, if a proposed lock alternative requires modifications to the upstream bridge, the improvements will be justified in the project cost.

In 2013, vessels traffic delays ranged from 10 to 13 hours, which equated to $20 million dollars in delay cost at the structure. The goal of the IHNC study is to improve navigational traffic through the corridor by replacing the existing lock with a new navigational structure designed for modern vessel traffic. The proposed more efficient lock design will reduce delay times and costs by allowing more vessels to lock through the complex.

If the number of lockages was the only variable required to select a preferred alternative, Alternative D, would be selected based on the lock configurations in **Table 3**. The chamber dimensions for Alternative D will accommodate the most design vessels. However, the number of lockages is not the only criteria that will be used to select the preferred plan. The associated chambering times for each alternative must also be determined which is the goal of the study. The study will investigate and examine benefits of various proposed lock

configurations based on chambering times (delay times) for each alternative as shown in **Table 7**.

The chamber time of each alterative will then be compared to the performance of the existing lock model results to compute the benefit-cost ratio and determine the resulting transportation cost savings. The various alternatives will be compared and a preferred plan, referred to as the tentatively selected plan (TSP), will be selected and recommended for further consideration in the next study phase, the design phase.

In order to compare the lock alternatives for TSP selection, a hydraulic evaluation was completed by MVN H&H staff members to develop filling times that will be used to estimate chambering times for the existing lock and proposed alternatives. The output from the H&H model will be used as an input to an economic model to quantify delay cost. The purpose of this report is to document the findings of the 1-D LOCKSIM (H&H) model developed for the IHNC study. The reminder of this report will summarize the efforts of the team to develop LOCKSIM models for the existing and alternative lock configurations.

2 Existing IHNC Lock Operations

Present Operating Schemes

Although the purpose of this study was not to replicate the existing lock operating schemes, the team did research the existing lock operations. MVN operations personnel provided information to the project delivery team (PDT) in regards to the current filling time under different head conditions. According to the lock personnel, the existing lock is observed to fill at a rate of 1.5 minutes for every 2 ft of head. Daily log information was not available at the time of the study.

Table 4 below summarizes the existing lock performance for various lifts based on the information provided by the operations personnel. The existing lock operation is based on a 1 to 2 minute (60-120 sec) valve time.

Table 4: Observed Existing IHNC Filling Times

Lift (ft)	Filling Times (min.)
2	3.00
4	6.00
6	9.00
8	12.00
10	15.00

3 Previous Model Studies

The H&H team members also researched existing data and models for use in developing the LOCKSIM models as summarized below.

Prior Hydraulic Physical Model Study

A 1:25 scale physical model was constructed to examine the performance of a Type 1 lock with a side port filling and emptying system. The model experiment methodology and results are summarized in the study report, ERDC/CHL TR-03-3, entitled, "Inner Harbor Navigational Canal Replacement Lock Filling and Emptying System, Inner Harbor Canal, New Orleans, Louisiana: Hydraulic Model Investigation", completed by Robert Hite in 2003. The lock geometry was modeled as both a Type 1 (1,360 ft long) and Type 2 (1,270 ft) lock. The length of the lock is measured from pintle to pintle. Both locks were modeled 110 ft wide with chamber floor elevations of -40.00. The physical model prototypes for both locks replicated the filling and emptying times for a symmetrical side port system with 2 main culverts, each 18.25 ft high by 15 ft wide. Each main culvert contained 28 side ports, each 3.75 ft by 2.54 ft. The lock design for the physical model study follows guidelines specified in Engineering Manual (EM) 1110-2-1604 (HQUSACE 1995).

As documented in the physical model report, more than 50 model and 10 prototype studies for filling and emptying times were researched to develop and refine the physical model parameters for the physical model study.

During the physical model similitude applications, kinematic and dynamic considerations were investigated. Kinematic (evaluation of inertial and gravitational forces) and dynamic (evaluation of inertial and viscous forces) similitude approach considerations are discussed in detail in the original model study.

The physical model study was completed by observing piezometers that were placed at points throughout the filling and emptying system culverts. The piezometers, which provide average pressures, were read during lock operations for various lock operating configurations. Pressure cells were also used to measure instantaneous pressures at selected locations in the culvert system and to record water surface in the lock chamber. The model study provided pressure data and lock filling and emptying times for various valve operations as well. Particular emphasis was given to valve operations and the resulting pressures in the culvert immediately downstream.

Model results are summarized in the Hite report for various lock elements - length, pressure, area, velocity, discharge, time and force, based on the results of the physical model filling and emptying times for various lifts. Lock

[1] **Elevations are in feet referenced to the National Geodetic Vertical Datum of 1929 (NGVD29).**

performance for the various lifts were evaluated in regards to hawser forces, water surface roughness, and the time to empty and fill the chamber. The model investigations were completed for the proposed lock alternatives to ensure hawser forces were kept below the acceptable limit of 5 tons.

Throughout all of the physical model simulations for the barge vessel, the lake side stage was maintained at an elevation -2.00[2] for the normal lift conditions for lifts of 3, 7, 11, and 19.6 ft with various gate valve speeds. A reverse lift of 9 ft was also evaluated. The lake stage in this report refers to the stage at Lake Ponchartrain; and the river stage is the stage at the Missisppi River. Normal lift conditions occur when the stage is higher on the river side in comparison to the stage on the lake side. The reverse lift condition occurs when the lake stage is higher than the river stage.

A similar analysis was also completed for the simulations for a ship vessel. The lake side stage was maintained at an elevation of +0.00[1] for all normal lift conditions and the river side gage varied to evaluate 3, 7, 9, 11, and 15 ft lifts. A reverse lift case of 9 ft was also investigated for the ship vessel as well.

The physical model report also modeled a Type 2 lock that was 1270 ft x 110 ft. The same simulations that were completed for the Type 1 lock were completed for the Type 2 lock for both the barge and ship vessel. The intake, side port culverts and chamber floor elevations were model the same as the Type 1 lock. The same reverse tainter gate filling curve was also used for the Type 2 lock. The results of the filling and emptying times from the physical model for various lifts are summarized in Chapter 3 for the Type 1 lock and Chapter 4 for the Type 2 lock in the Hite Report. Acceptable filling and empting times are provided in EM 1110-2-1604 Design of Navigation Locks (HQUSACE 2006).

Previous Numerical 1-D Model Simulation, H3520

The physical model that was developed for the previous feasibility study only investigated two alternatives. In order to cost effectively investigate the filling and emptying times for the proposed model alternatives and the existing lock, a 1-D computer model H3520, LOCK FILLING AND EMPTYING—SYMMETRICAL SYSTEMS (Hebler and Neilson 1976) was developed for several alternatives for different chamber sizes and lift conditions in the original study in 1997 for a deep draft lock. Reference feasibility study report for more details.

In this current study the lock was redesigned from a deep draft lock to a shallow lock. A new analysis was completed using the lock configurations and corresponding lifts as shown in **Table 5** in 2014 via an internal MVN H&H memo entitled "Hydraulic Findings for Inner Harbor Navigation Canal (IHNC) Lock Replacement Alternatives". A list of the previous alternatives and geometries from the 2014 report are listed in **Table 5** below. The H3520 model

[1] **Elevations are in feet referenced to the National Geodetic Vertical Datum of 1929 (NGVD29).**

[2] **Elevations are in feet referenced to the National American Vertical Datum of 1988 (NAVD88).**

was used to evaluate alternatives for various proposed lock configurations. **Table 5** also includes valve times used for the simulations. The model results are shown in the **Table 6**.

Table 5: Previous IHNC Lock Alternative Geometries

Alternatives	Draft Type	Chamber Dimensions Length (ft) * x Width	Chamber Elevation (ft)	Valve Times (min)
Existing, H3520	Deep	675 x 75	-32.00[2]	1-2
H3520-1	Shallow	1200 x 75	-22.00[2]	5-6
H3520-2	Shallow	1200 x 110	-22.00[2]	5-6
H3520-3	Shallow	900 x 75	-22.00[2]	7-8
H3520-4	Shallow	900 x 110	-22.00[2]	7-8

*** Length from pintle to pintle**

Table 6: H3520 Filling Times by Alternative

Lift (ft)	Exisitng Alternative	Filling Times (min.)	H3520 - 1	Filling Times (min.)	H3520 - 2	Filling Times (min.)	H3520 - 3	Filling Times (min.)	H3520 - 4	Filling Times (min.)
2		13.00		9.00		11.50		10.00		12.50
4		14.50		10.50		13.50		11.50		14.50
6		16.00		11.50		14.50		12.50		16.00
8		17.00		12.00		15.50		13.00		17.00
10		18.50		13.00		16.50		14.00		18.00

H3520 Numerical 1-D Model Limitations

Although, H3520 was widely accepted at the time of the feasibility study, it had limitations and required improvements. It did not accurately account for the discharge capability of the lock and was only suitable for symmetrical lock systems. The program doesn't take into account the free surface at the upper and lower approaches and within the lock chamber or the pressure and discharge in the emptying and filling manifolds. The model also has simple input and doesn't allow the user to easily validate results or calibrate the model to other accepted models.

Because of these limitations, the hydraulic modeling team decided in this restudy to use the newer model, LOCKSIM (LOCK SIMulator), developed by Dr. Gerald A. Schohl in 1999, Tennessee Valley Authority in collaboration with the USACE Engineer Research and Development Center (ERDC). It

[1] Elevations are in feet referenced to the National Geodetic Vertical Datum of 1929 (NGVD29).

[2] Elevations are in feet referenced to the National American Vertical Datum of 1988 (NAVD88).

corrected the limitations of the previous model. The newer model uses unsteady pressure-flow equations which are applicable to the conduits within

the system in combination with the free-surface equations and allows the user to describe the approach reservoirs, valve wells, and lock chamber. It computes pressures and flow distributions throughout the entire lock system. It also allows the user to input parameters from other studies to calibrate the model. Typical calibration and validation parameters include- lock coefficients, valve curves, etc.

The filling times presented in this report supersede the previous feasibility study. Therefore, the results from the H3520 program will not be used to calculate benefits for selection of the TSP. Furthermore, the model results between the two programs should also not be compared because of the differences between hydraulic methodologies. The LOCKSIM model will be used to evaluate the proposed alternatives. Several LOCKSIM models were developed by the team as described in the model development section for use in selecting the TSP.

4 LOCKSIM Model Program

The numerical flow model LOCKSIM serves as an evaluation tool for lock filling and emptying system designs. LOCKSIM couples the unsteady pressure-flow equations, which are applicable to the conduits within the system, with the free-surface equations describing the approach reservoirs, valve wells, and lock chamber. The model computes pressures and flow distributions throughout a lock system. LOCKSIM simulates closed-conduit components such as culverts, reverse tainter valves, pipe losses, tees, and manifolds. Free-surface components include prismatic open channels, riverine channels, and water storage components (which can represent reverse tainter valve wells). Individual components from these lists are connected together at nodes, where they share a common piezometric head.

Discharge and piezometric head in the pipe and free-surface channel components are computed by numerically solving partial differential equations for one-dimensional unsteady flow. The water storage component is governed by an ordinary differential equation describing conservation of mass. The relationships between discharge and piezometric head difference for valves, check valves, and pipe losses are described by algebraic energy equations. The position of a valve is prescribed as a function of simulation time using tabulated data. Functions are also used for tee and manifold components, which simulate combining and dividing flow, to describe the variation of the branch headloss coefficients with the ratios of the individual branch discharges to the combined discharge. Available time-varying numerical results include pressure, hydraulic grade line elevation, and discharge at all user-defined computational points. The stage, velocity, depth, top width, and channel area are provided at each computational point within the free-surface components, and the velocity, shear stress, and vapor cavity volume are given for each computational point within the closed conduit components. The minimum pressures and cavitation indices within the reverse tainter valves are also computed.

LOCKSIM is generally used in practice as a supplement to traditional physical models. LOCKSIM models are routinely developed using hydraulic parameters and information from the results of completed and accepted physical model studies. It is a simple reliable model that is used as a complement and cheaper alternative to the physical model to analyze additional alternatives for use in selecting a TSP. The selected TSP should be reevaluated using a physical model after the TSP is selected and before the design phase is started.

5 IHNC LOCKSIM Model Development and Validation

This study's principal objective was to construct a 1-D model of the proposed IHNC lock alternatives and then investigate the hydraulic conditions associated with various operational schemes using LOCKSIM as defined by the PDT.

Approach

The purpose of this General Revaluation Report (GRR) update was to determine filling times for various proposed lock alternatives and the existing IHNC lock. The physical study process included developing an existing 1-D LOCKSIM model of the physical model that was documented in the Hite report. A 1-D model was developed using the conditions associated with the 1:25 scale physical model for a Type I design (1,360 ft x 110 ft). Dimensions of the culverts from the intake and filling valve were obtained from Plate 73 of the published ERDC/CHL TR-03-3 Hite (2003). The LOCKSIM model simulated conditions on Plate 41 with an 11 ft lift The upper pool, river side, was set to an elevation of 9 and the lower pool, lake side was set at -2.00[1], the historical low at the time of the feasibility study. An 8-minute valve time was used to complete the simulation. The valve curve for the receiving tainter valve was obtained from Plate 33 of the Hite Report. The plates adopted from the physical model study are included in **Appendix A, - Figures 5 through 8**.

As part of the study simulations the team made adjustments to applicable coefficients to replicate similar conditions as observed in the physical model. Once the simulation was complete for the same lock geometry that was used in the physical model, another simulation was completed for a lock with the same chamber length but a smaller width was examined. The geometry was again

[1] **Elevations are in feet referenced to the National Geodetic Vertical Datum of 1929 (NGVD29).**

adopted from the physical model but the lock width was changed from 110 ft to 75 ft. The results of the physical model LOCKSIM models are included in **Appendix C.**

After the model was validated for the physical model, the team developed alternative models to investigate hydraulic conditions for various lift conditions. In the proposed models, the chamber sizes, intake culverts and side port culverts configurations were changed. However, the same approach configuration was used in the physical model. The alternative models were modeled as smaller, Type 2, locks with side port filling systems. **Appendix B**, summarizes the hydraulic parameters that were adopted from the physical model. The team also revised the lock chamber elevation to reflect a shallower chamber depth for all of the proposed alternatives. For each alternative, 5 lift conditions, 2, 4, 6, 8, and 10 ft, were also investigated. Preliminary plans for each alternative were also referenced as shown in **Figures 9 to 12 of Appendix A**.

The model geometries for the model study, existing and proposed lock alternatives are summarized in the **Table 7** below.

Table 7: IHNC Lock Alternative Geometries

Alternatives	Draft Type	Chamber Dimensions Length (ft) * x Width (ft)	Chamber Elevation (ft)	Main Culvert Height (ft) x Width (ft)	Sideport Culvert Height (ft) x Width (ft)	Number of Sideport Culverts	Top of Wall Elevation (ft)
Model Study 1	Deep	1360 x 110	-40.00[1]	18.25 x 15.00	3.75 x 2.54	28	22.40[1]
Model Study 2	Deep	1360 x 75	-40.00[1]	18.25 x 15.00	3.75 x 2.54	28	22.40[1]
Existing	Deep	675 x 75	-31.50[1]	10.00 x 8.00	See note**	15	25.00[1]
A	Shallow	970 x 75	-22.00[1]	14.50 x 14.50	3.75 x 2.50	21	22.40[1]
B	Shallow	970 x 110	-22.00[1]	14.50 x 14.50	3.75 x 2.50	21	22.40[1]
C	Shallow	1288 x 75	-22.00[1]	18.25 x 15.00	3.75 x2.50	28	24.50[1]
D	Shallow	1288 x 75	-22.00[1]	18.25 x 15.00	3.75 x2.50	28	24.50[1]

*** Length from pintle to pintle**
**** Culverts 1 and 15 are 8.00 ft x 4.00 ft and 2 through 14 are 4.00 ft x 3.00 ft**
[1] Elevations are in feet referenced to the National Geodetic Vertical Datum of 1929 (NGVD29).

Similarly, the team created a LOCKSIM model of the existing lock to determine filling times to compare to the proposed lock filling times for various operating scenarios. The approach (intake) configuration from the physical model was used for the existing model run. The chamber sizes, intake culverts, side port culverts configurations and chamber lock elevation were changed based on the existing lock geometry. The team completed models to investigate various hydraulic lift conditions and compute filling times for the 5 lift conditions. Available plans for the existing lock were also referenced as shown in **Figures 2 and Figures 3 in Appendix A.**

For each alternative, the team selected a valve time as recommended in guidance outlined in Miscellaneous Paper H-75-7, entitled, "Lock Design, Sidewall Port Filling and Emptying System", completed by Thomas Murphy dated July 1975. The paper recommends permissible valve operating times based on the lock geometry to limit hawser forces to less than 5 tons. The valve times were established based on information from prototype models. In the field, when the locks are in operation, the fill rate is about 9% faster than the fill rates observed in the physical model (1:25

scale model). The recommended valve times and selected valve times for the models are noted below in **Table 8, and Table 9** respectively.

Table 8: Recommended Valve Times from H-75-7

Chamber Dimensions Length (ft)* x Width (ft)	Valve Times (min.)
670 x 110	2.00
1270 x 110	4.00

*** Length from pintle to pintle**

Table 9: Selected Valve Times

Alternatives	Chamber Dimensions Length (ft)* x Width (ft)	Valve Times (min.)
Model Study 1	1360 x 110	8.00
Model Study 2	1360 x 75	8.00
Existing	675 x 75	2.00
A	970 x 75	4.00
B	970 x 110	4.00
C	1288 x 75	6.00
D	1288 x110	6.00

*** Length from pintle to pintle**

LOCKSIM and Study Datum

Although the study datum is in NAVD88, the LOCKSIM model was completed in the same datum for all alternatives, NGVD29 for consistency. The difference between the two is -0.30 as noted previously. It is important to note that unlike other H&H models (HEC-RAS, ADCIRC, etc) where the selected datum sets the study datum because the computed water surface elevations are computed from survey referenced to a specific datum, the LOCKSIM model computes filling and emptying times in minutes based on the difference in head differentials between the upper pool elevation and lower pool elevation and other parameters as noted in this report. If other parameters are the constant (culvert size, valve operating conditions), the filling and emptying times would not change regardless of the datum selected to complete the analysis, because the resulting head differential would be the same as shown in **Figure A** below.

[1] **Elevations NGVD29.**

[2] **Elevations NAVD88.**

FIGURE A. ELEVATION VIEW OF LOCK SHOWING CONSTANT HEAD DIFFERENTIAL FOR NGVD29 and NAVD88

Another benefit to using NGVD29 as the datum for the LOCKSIM model, was simplified model inputs (i.e 0.00 and -2.00 instead of -0.30 and -2.30 in NAVD88).

Although the filling and emptying times are independent of the study datum, the construction plans that indicate the sill elevation and top of wall reference need to be referenced to the project datum which is NAVD88. The study datum was established as NAVD88. For the purpose of the GRR, the sill elevation and top of wall elevation was set to -22.00, 22.10, respectively. Both elevations are referenced to NAVD88. The final sill elevation will be finalized in the Preconstruction, Engineering and Design Phase (PED) and will be probably be in the range of -22.00 and -24.00 NAVD88.

6 IHNC LOCKSIM Model Results

During the development of the LOCKSIM model, the team used the best available data at the time of the study to determine the filling times. The same approach conditions were used for all models, existing and proposed, as adopted from the physical model because at the time of this study pertinent information from the existing lock plans were not available to accurately code all of the existing lock features and proposed plans for each alternative were not finalized. Although, the approach configurations did not change, the chamber configurations were varied. Since the intake conditions were the same for all model runs, the resulting variations in filling times for all alternatives and the existing lock, are a function of the chamber configurations, design lifts, and selected valve speed. The team deemed this modeling approach acceptable, for screening alternatives to select the TSP at the feasibility study phase. In the next study phase, the design phase, refinements will be made to the lock geometry based on criteria specified in Miscellaneous Paper H-75-7 and applicable Engineering Manuals and Circulars.

The model results of the filling time computations for all model runs are summarized in **Table 10** below. The water surface elevations across the lock chamber at user specified computational nodes were averaged to determine the resulting water surface elevation that equaled the design lift for each alternative. The calculated average design lift elevation was then cross referenced to an associated model time step to determine the filling time for each design lift Reference

Appendix C- Determination of Fill Time Calculations Example, for design calculation example.

Table 10: LOCKSIM Filling Times by Alternative

Lift (ft)	Model Study 1	Filling Times (min.)	Model Study 2	Filling Times (min.)	Existing Lock	Filling Times (min.)	Alternative A	Filling Times (min.)	Alternative B	Filling Times (min.)	Alternative C	Filling Times (min.)	Alternative D	Filling Times (min.)
2		-		-		3.12		3.33		4.08		4.10		4.97
4		-		-		4.08		4.03		5.13		4.90		6.03
6		-		-		4.88		4.60		6.02		5.50		6.88
8		-		-		5.57		5.10		6.80		5.98		7.62
10		-		-		6.18		5.55		7.48		6.42		8.30
11		10.03		7.93		-		-		-		-		-

Note, in previous studies both filling and emptying times were provided to determine chambering times. In this restudy, using the LOCKSIM model only filling times were provided. The total chambering times were determined by doubling the calculated filling times for each of the alternatives for various lift conditions.

Appendix D contains sample input and output files for each alternative for a 2 ft design lift. The model naming convention is as follows:

INPUT FILE:
IHNC_A_B_C_D.sim
where,
A is the pintle to pintle distance
B is the lock width
C is the lift
D is the valve speed

The output files follow the same convention but with the .plt extension.

Example:

The files below are for a 900'x 75' lock with a 2' lift and 4 min valve speed.
IHNC_900_75_2_4.sim
IHNC_900_75_2_4.plt

The model study files are named as shown below:

Input file for Model Study 1 - IHNC_labscale.sim
Plot file Model Study 1- IHNC_labscale.plt
Input file for Model Study 2 - IHNC_labscale75.sim
Plot file Model Study 2- IHNC_labscale75w.plt

Appendix E contains filling curves for all model simulations.

7 Summary and Conclusions

This evaluation of the IHNC Lock existing and proposed models computes filling and emptying times for various operating schemes and lift conditions. The models were developed using the results of the physical model prototype study to create alternative models. Each model used the same intake approach configurations but the chamber configurations and valve times varied for each alternative.

The results indicate that under the variable lock configurations and valve operating times, as the design head increases and the chamber size increased, the filling time increased as shown in **Table 10**.

There was no significant difference between alternatives B & C for the 2' design lift The filling times were approximately the same. This is probably due to averaging the results of the water surface at user specified points throughout the lock chamber to determine the time in which the lock fills to the required design lift elevation. For this reason, the two alternatives, B and C have approximately the same filling times.

The results of the modeled alternatives, as shown in **Table 10**, for the existing lock show that the observed values, as shown in **Table 4**, for lifts of 4 ft or greater don't compare favorably with the observed values. The filling times from the model results are faster than the observed values. The difference in filling times may be the result of using a different intake configuration and valve curve than at the existing structure. However, at the time of the study, no detailed information was available to accurately model the existing lock or to verify the observed rates provided by operations personnel. The observed values will not be used to calculate the benfit-cost ratio for the project. Therefore, the observed values are presented in this report for information only. Nevertheless, the results of the models are still reliable. The resulting filling times are a function of the lock chamber size because the same valve curve and intake configuration were used for all alternatives. The purpose of the model study was not intended to replicate observed times but to compare alternatives using the best available data for use in providing inputs to the economic team to calculate the benefit-cost ratio. The H&H team deemed the results reliable for use in selecting the TSP in the future.

8 Future Study Refinements and Recommendations

Once the TSP is selected, MVN will finalize the design of the TSP by optimizing side culverts and intake culverts using guidelines in the EMs.The modeling team also recommends that a physical model be conducted to evaluate

the Hawser forces for the selected alternative in the future. The only way to accurately determine both transverse and longitudinal Hawser forces is with a physical model. The physical model should also be used to evaluate reverse load case which is not the normal operating condition but does occur at the lock. The LockSim model doesn't compute filling and emptying times for the reverse load cases. Also, the recommended sill elevation of -22.00 NAVD88 will also be refined in the PED phase based on theresults of the physical model.

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Appendices

Appendix A: Figures

Figure 1- Location Map of IHNC Lock

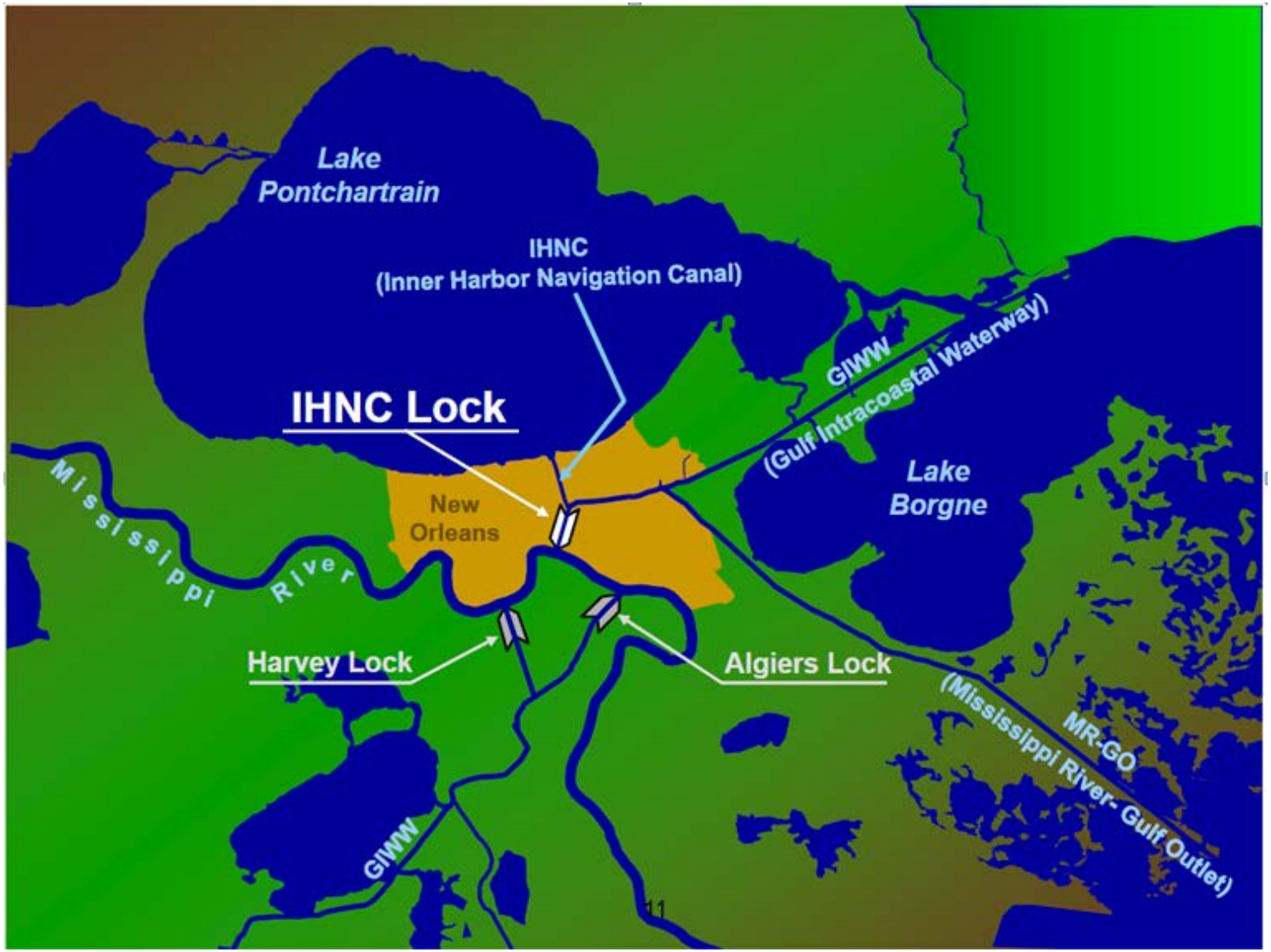


Figure 2: Plan of Existing IHNC Lock

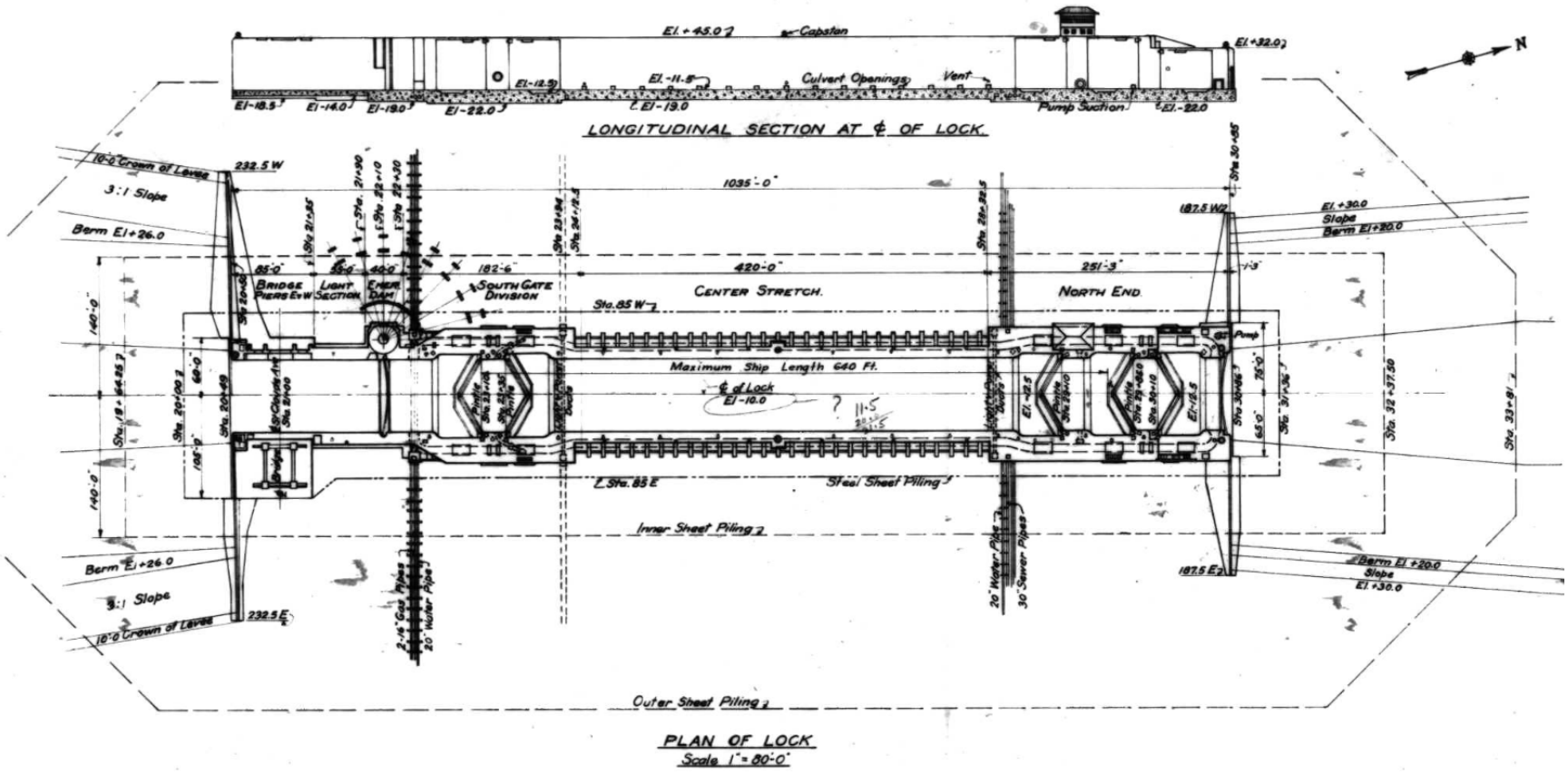


Figure 3: Profile of Existing IHNC Lock

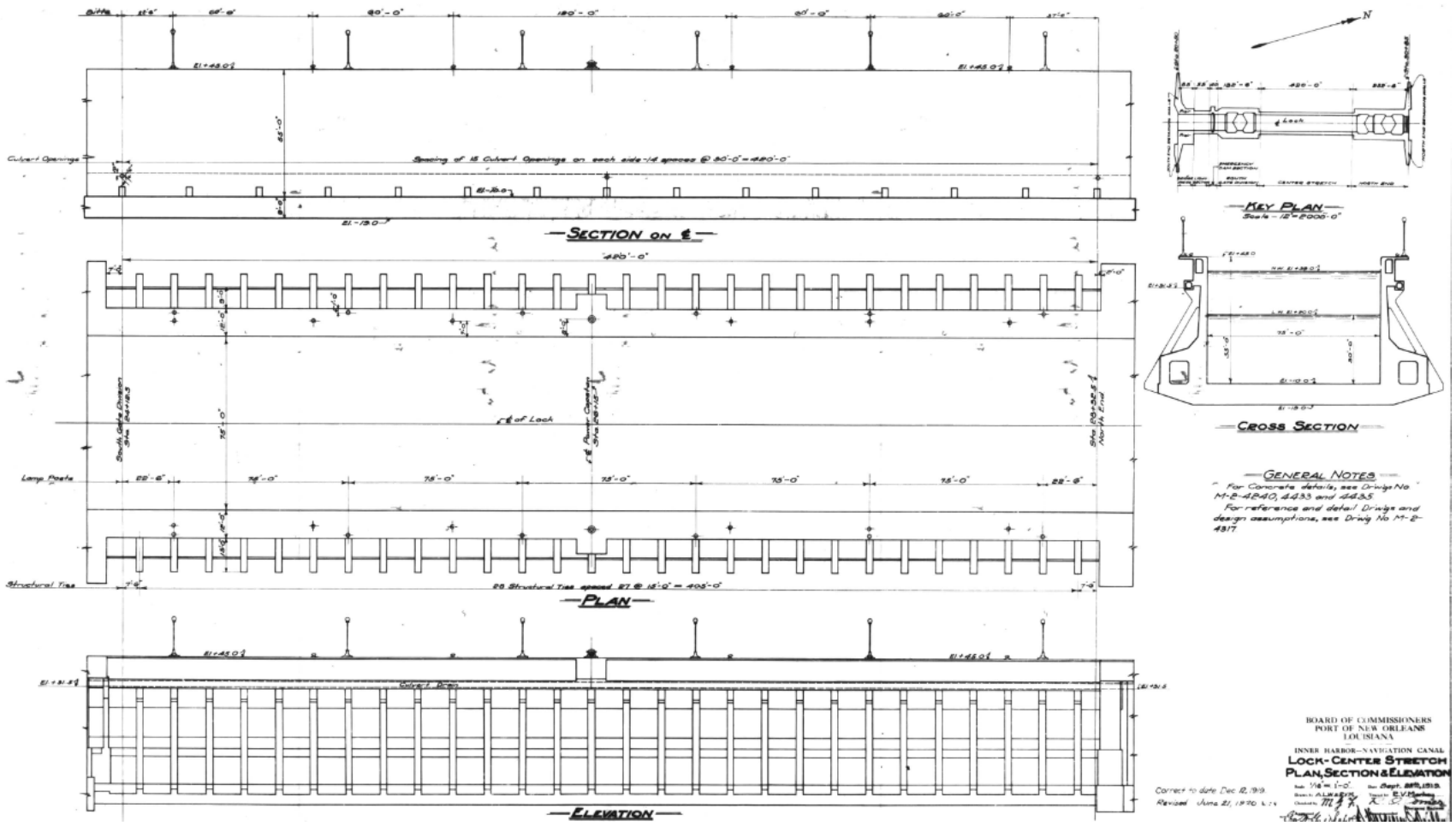
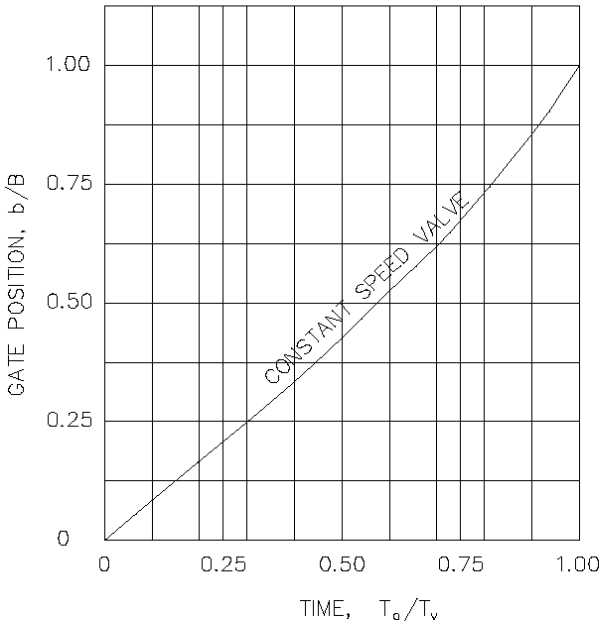


Figure 4: Looking North at IHNC Lock Complex

Figure 5: Hite Report -TR-03-3 Plate 33



T_o = TIME SINCE OPENING BEGAN

T_v = TIME TO OPEN FULL OR STOP

B = 18.25 FT

b = VERTICAL DIST. FROM LIP TO FLOOR

ORIGINAL VALVE CURVE
(CONSTANT SPEED)

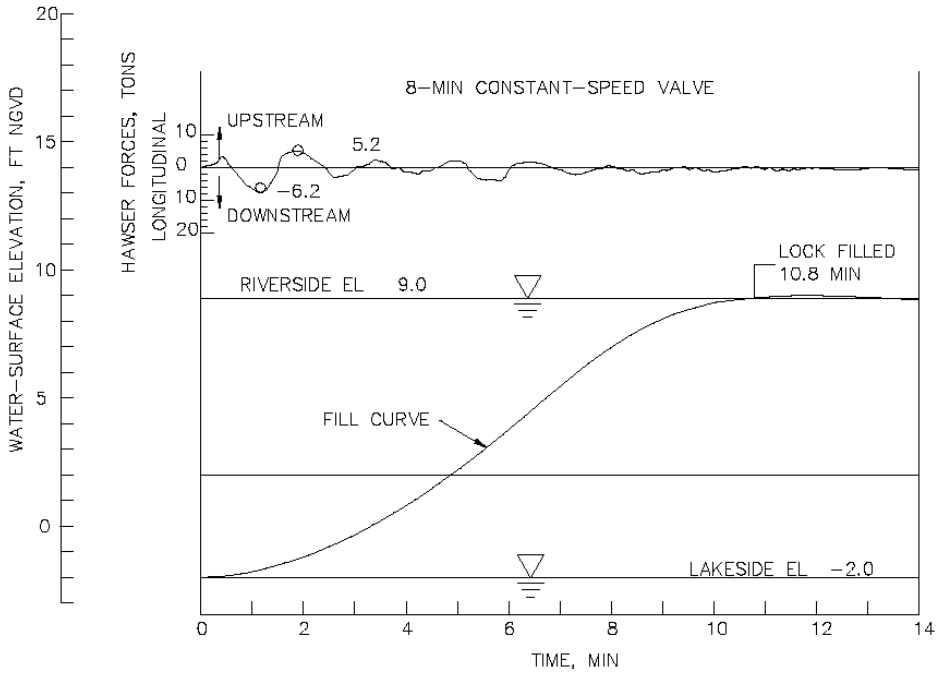
b/B	T_o/T_v
0	0
0.084	0.10
0.167	0.20
0.249	0.30
0.334	0.40
0.426	0.50
0.525	0.60
0.619	0.70
0.732	0.80
0.855	0.90
1.000	1.00

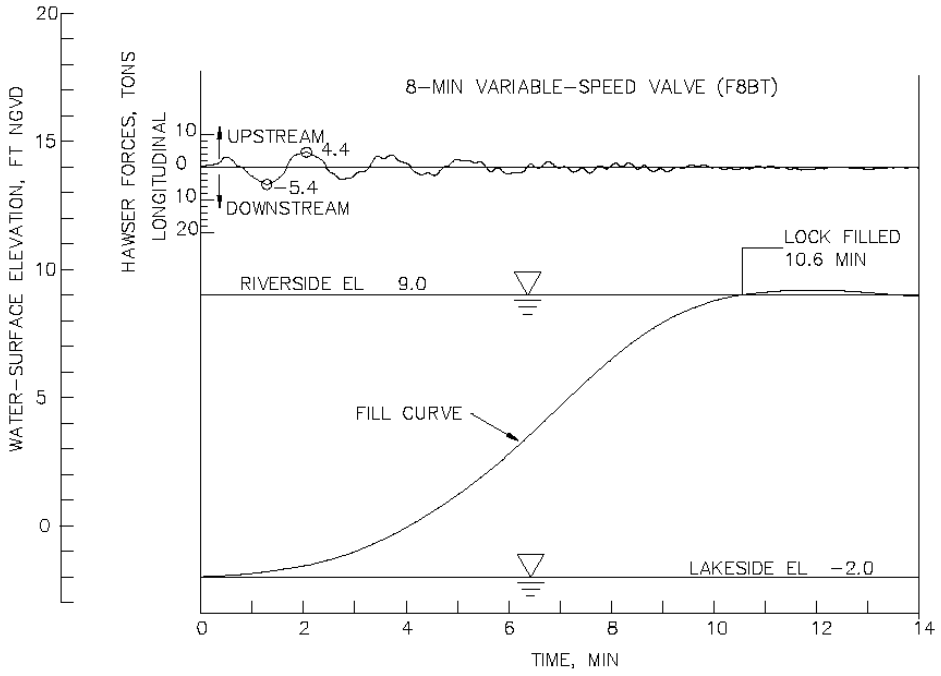
GATE POSITION DATA

b	% Open (Radially)
0	0
1.525	10
3.050	20
4.550	30
6.100	40
7.775	50
9.575	60
11.300	70
13.375	80
15.600	90
18.250	100

CONSTANT-SPEED VALVE CURVE

Plate 33

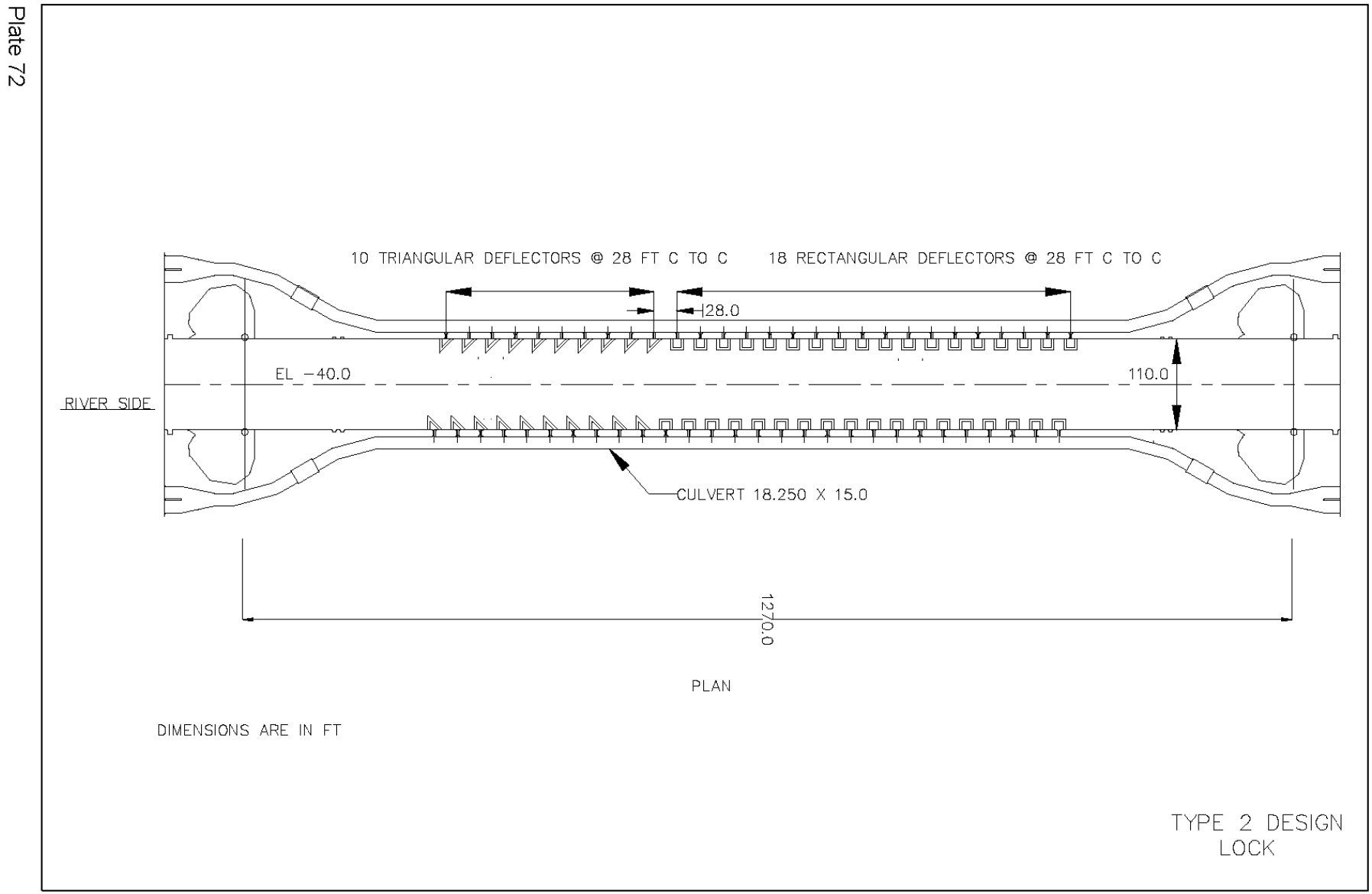


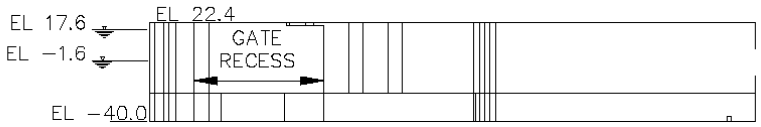


COMPARISON OF CHAMBER PERFORMANCE
SIDE PORT SYSTEM
DURING FILLING
ORIGINAL DESIGN
8-MIN CONSTANT AND VARIABLE-SPEED VALVES
3 X 6 BARGE, 11-FT DRAFT
11-FT LIFT

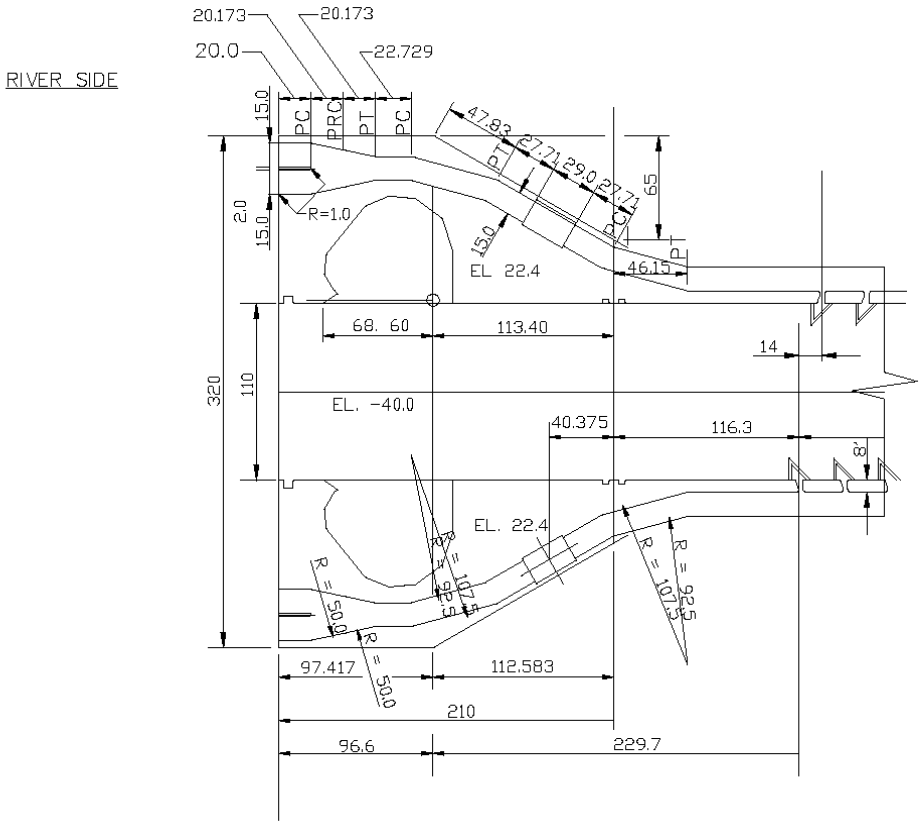
Figure 6: Hite Report -TR-03-3 Plate 41

Figure 7: Hite Report -TR-03-3 Plate 72





ELEVATION



PLAN

DIMENSIONS ARE IN FT

DETAILS
TYPE 2 DESIGN INTAKE

Plate 73

Figure 8: Hite Report -TR-03-3 Plate 73

Figure 9: Preliminary Plans for Alternatives A and B

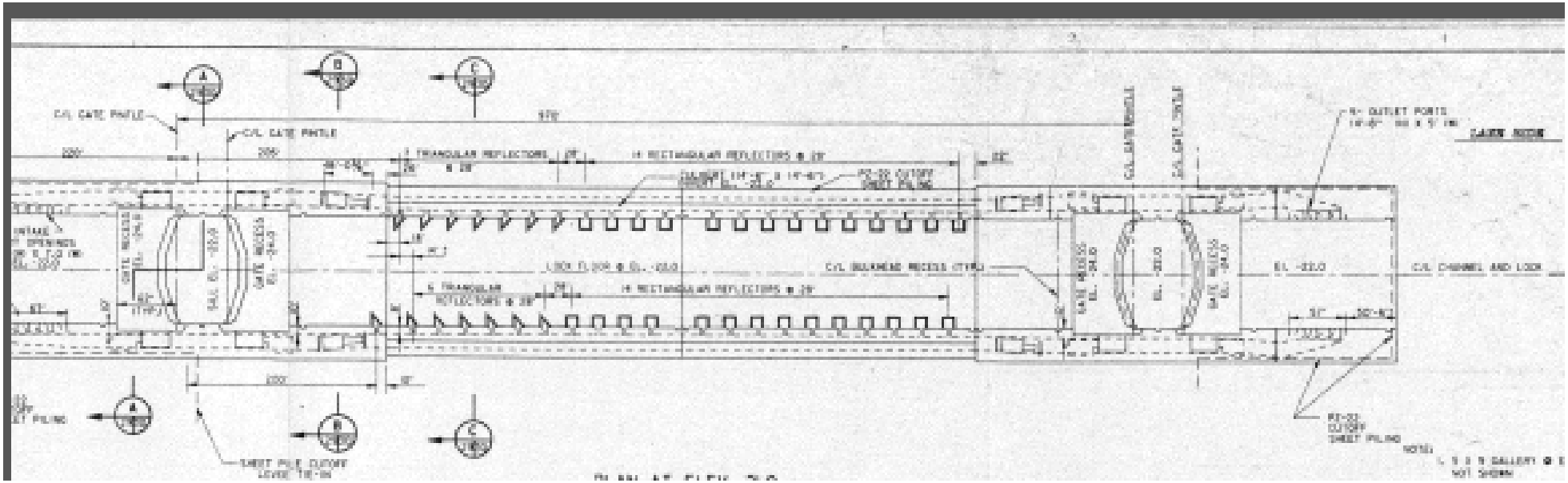


Figure 10: Preliminary Plans for Alternatives A and B

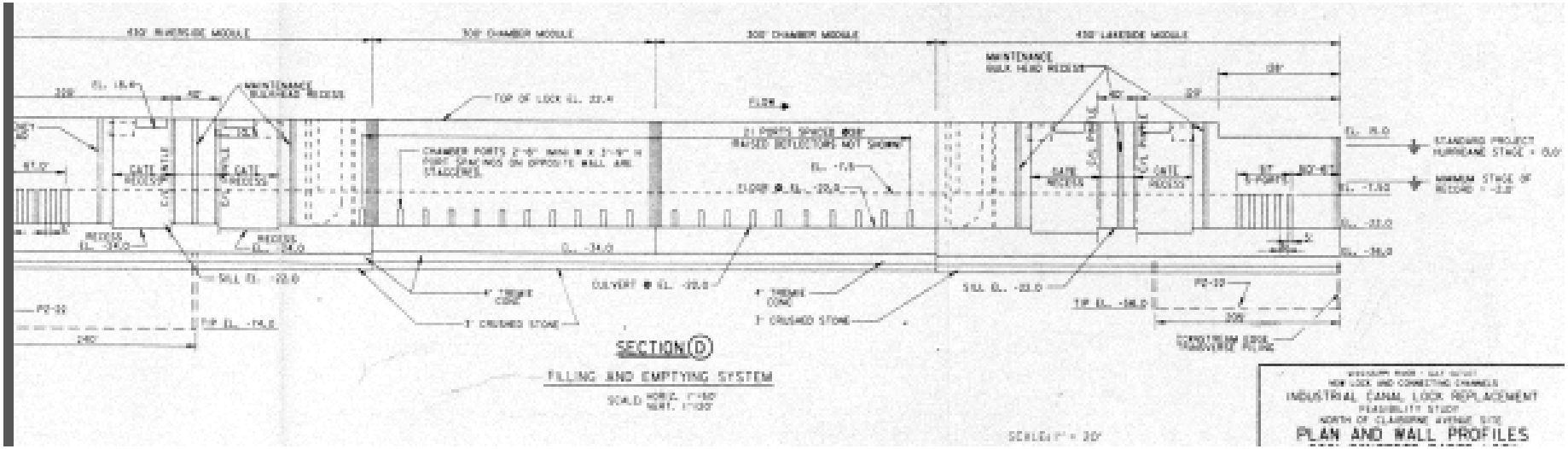


Figure 11: Preliminary Plans for Alternatives C and D

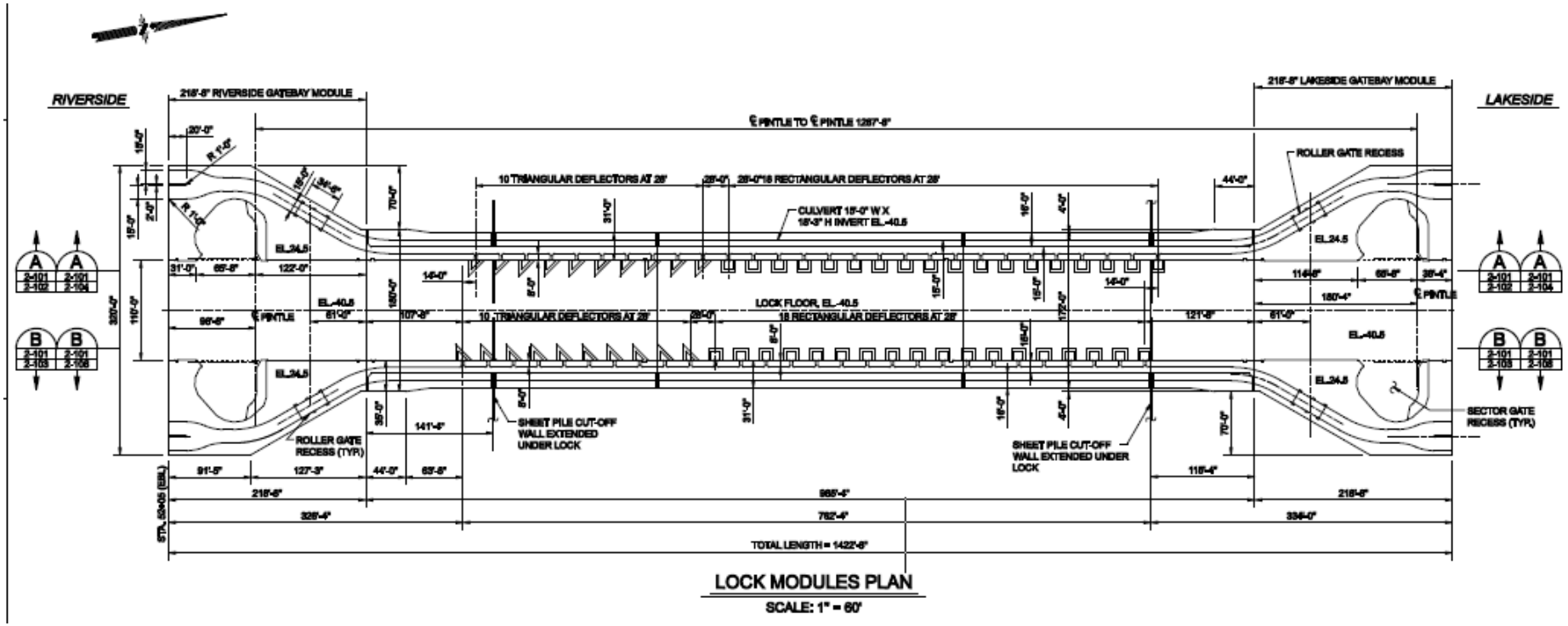


Figure 12: Preliminary Profile for Alternatives C and D

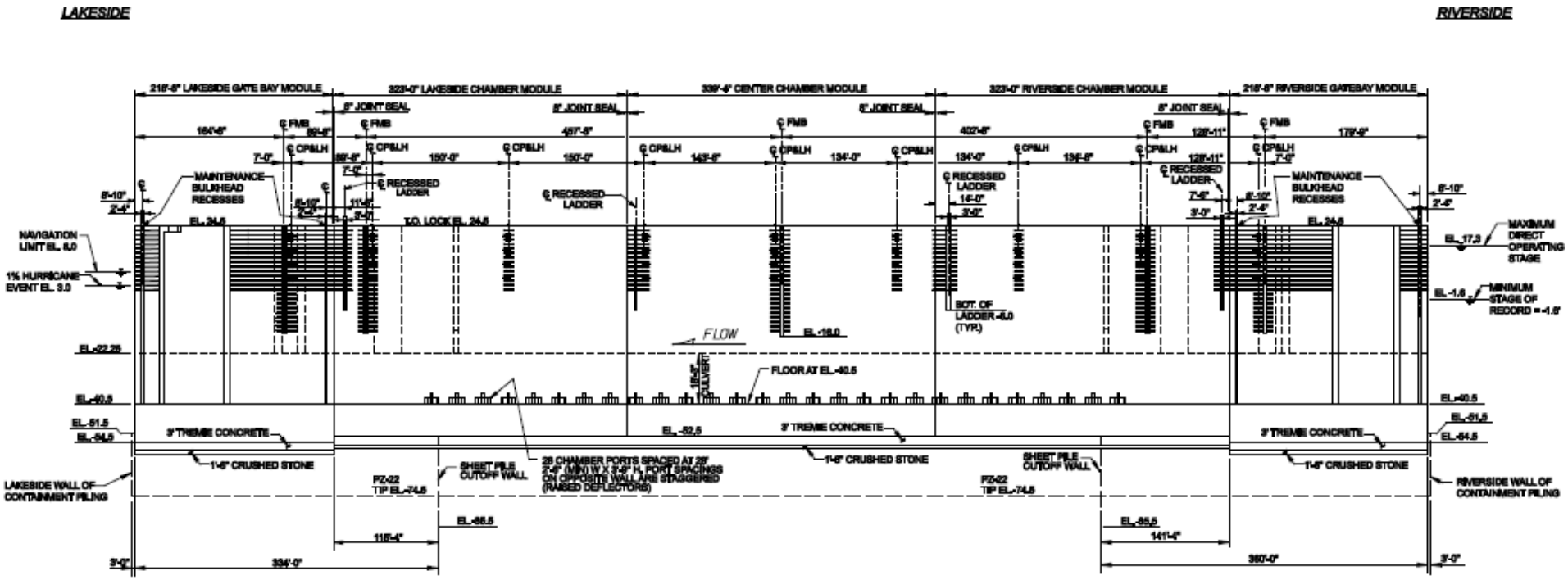
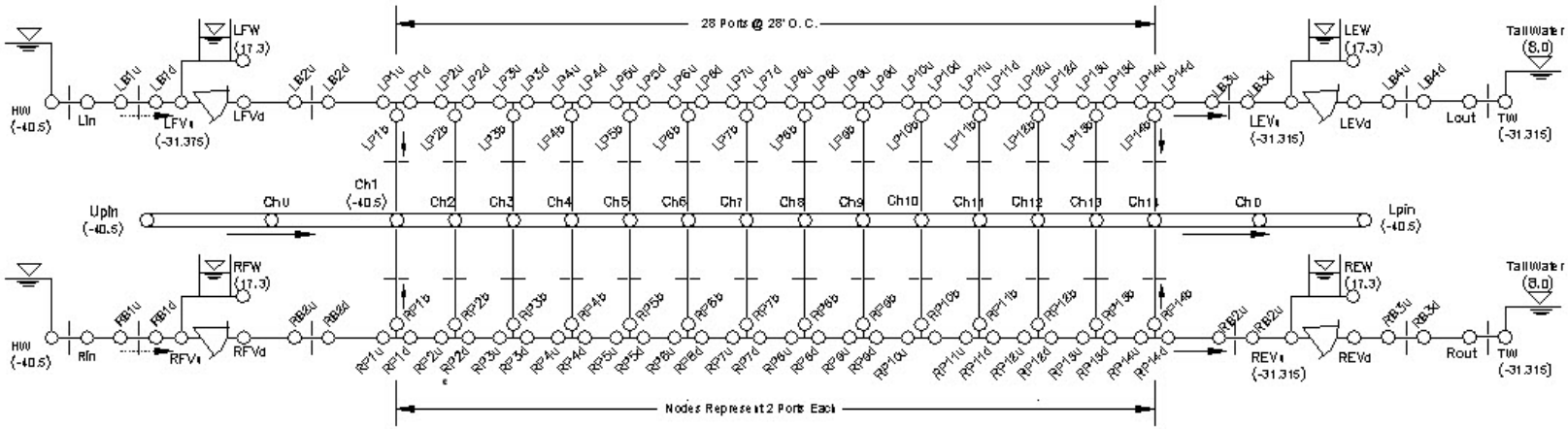
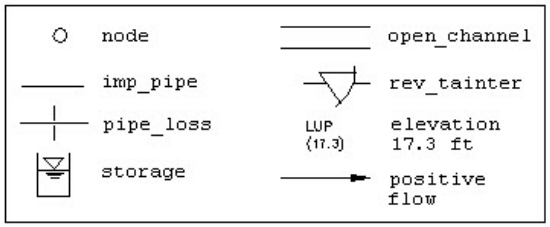


Figure 13: Schematic Representation of IHNC LOCKSIM Model





SCHEMATIC REPRESENTATION OF
IHNC Sidewall Port
LOCK FILLING AND EMPTYING SYSTEM

Appendix B: LOCKSIM Model Parameters and Validation to Physical Model

As described in the Approach section, the LOCKSIM models for the Revaluation Report were developed by using the hydraulic parameters from the physical model study. The LOCKSIM model allows the user to describe the lock chamber network as a collection of hydraulic features or interconnected components and nodes using the LOCKSIM model designated convention. The modeling team developed a schematic representation of the hydraulic network of the physical model study as shown in Figure 13 of **Appendix A**. The schematic illustrates how the nodes are connected, and assigns a name for each component to be used to code the model. Using the model schematic a LOCKSIM model was developed for the Model Study with a Type 2 lock by coding input data for each node or component as defined in Schohl 1999. Loss coefficients for the reverse tainter filling and emptying valves were adopted from the physical model and verified with published loss coefficient guidance (e.g. Miller 1990). Select coefficients were also adopted from the physical model study. In the LOCKSIM model the roughness coefficient was set to 0.02 to simulate the differences between laboratory and field scale Reynolds Numbers. The physical model data results showed a slight delay so the modelers used the xshift function in LOCKSIM to replicate the delay. Upon completion of the numerical model for the Type 2 lock, the results were compared to the physical model for validation purposes. The physical model filled in 10.8 minutes as shown in **Figure 6** in **Appendix A.** The numerical model (Model Study 1) filled in approximately 10 minutes as shown in the graphs in **Appendix E**. The results of the numerical model compared well to the physical model results.

After the model validation was complete the team completed the Type 2 lock model runs and alternative runs. For these runs the xshift delay function was removed and the roughness coefficient was changed to 0.003. Model input and output files and results are included in **Appendix D and E**, respectively.

Appendix C: Filling Time Calculation Example

The LOCKSIM program requires the user to post process the results to determine the filling time for each design lift It requires a user specified simulation file (.sim) as input. Once the simulation file is run, the program generates a results file (.plt) that requires post processing. The results file reports water surface elevations across the lock chamber at user specified computational nodes. Microsoft Excel was used to post process model results. The process was completed by averaging the water surface elevations at each computational node to determine the resulting water surface elevation that equal to the design lift for each alternative. The calculated average design lift elevation was then cross referenced to an associated model time step to determine the filling time for each design lift An example is provided below. The water surface at three locations in the chamber are averaged to compute the filling time required to fill the chamber with an upper pool elevation of 0.00 and lower pool of -2.00.

Fill Curve Existing Lock 2' Lift

Time	LFVD LEVD valve position	LFVu LFVd discharge	LFW head	Water Surface Elevation in Chamber			Average Water Surface Elevation
				Upin head	Ch8	Lpin head	
sec	b/B	cfs	ft	ft	ft	ft	ft
0	0.00	0.00	0.00	-2.00	-2.00	-2.00	**-2.00**
1	0.01	5.17	-0.01	-2.00	-2.00	-2.00	-2.00
2	0.01	11.04	-0.03	-2.00	-2.00	-2.00	-2.00
3	0.02	15.74	-0.07	-2.00	-2.00	-2.00	-2.00
4	0.03	20.99	-0.11	-2.00	-2.00	-2.00	-2.00
5	0.04	25.70	-0.15	-1.99	-2.00	-2.00	-2.00
6	0.04	30.39	-0.18	-1.99	-2.00	-2.00	-2.00
7	0.05	35.00	-0.19	-1.98	-2.00	-2.00	-1.99
8	0.06	39.59	-0.19	-1.98	-2.00	-2.00	-1.99
9	0.06	44.25	-0.17	-1.98	-1.99	-2.00	-1.99
10	0.07	48.98	-0.14	-1.97	-1.99	-2.00	-1.99
11	0.08	53.81	-0.11	-1.97	-1.99	-2.00	-1.99
12	0.08	58.65	-0.07	-1.97	-1.99	-2.00	-1.98
13	0.09	63.44	-0.05	-1.96	-1.98	-2.00	-1.98
14	0.10	68.06	-0.03	-1.96	-1.98	-2.00	-1.98
15	0.10	72.48	-0.03	-1.96	-1.98	-2.00	-1.98
16	0.11	76.63	-0.04	-1.95	-1.97	-2.00	-1.97
17	0.12	80.49	-0.06	-1.95	-1.97	-2.00	-1.97
18	0.13	84.09	-0.08	-1.94	-1.96	-2.00	-1.97
19	0.13	87.48	-0.11	-1.94	-1.96	-2.00	-1.97
20	0.14	90.73	-0.14	-1.94	-1.96	-1.99	-1.96
21	0.15	93.95	-0.15	-1.94	-1.95	-1.99	-1.96
22	0.15	97.21	-0.16	-1.93	-1.95	-1.98	-1.95
23	0.16	100.58	-0.16	-1.93	-1.94	-1.98	-1.95

Lower Pool Elevation

Fill Curve Existing Lock 2' Lift (Continued)

Time	LFVD LEVD valve position	LFVu LFVd discharge	LFW head	Water Surface Elevation in Chamber			Average Water Surface Elevation
				Upin head	Ch8	Lpin head	
sec	b/B	cfs	ft	ft	ft	ft	ft
24	0.17	104.10	-0.15	-1.93	-1.94	-1.97	-1.95
25	0.17	107.78	-0.13	-1.93	-1.94	-1.97	-1.94
26	0.18	111.58	-0.12	-1.92	-1.93	-1.96	-1.94
27	0.19	115.47	-0.10	-1.92	-1.93	-1.95	-1.93
28	0.19	119.40	-0.09	-1.92	-1.93	-1.94	-1.93
29	0.20	123.31	-0.09	-1.91	-1.92	-1.93	-1.92
30	0.21	127.17	-0.10	-1.91	-1.92	-1.92	-1.92
31	0.21	130.95	-0.11	-1.91	-1.92	-1.92	-1.91
32	0.22	134.65	-0.13	-1.91	-1.91	-1.91	-1.91
33	0.23	138.29	-0.15	-1.90	-1.91	-1.90	-1.90
34	0.24	141.91	-0.17	-1.90	-1.90	-1.89	-1.90
35	0.24	145.54	-0.18	-1.90	-1.89	-1.89	-1.89
36	0.25	149.24	-0.19	-1.89	-1.89	-1.88	-1.89
37	0.26	153.08	-0.19	-1.89	-1.88	-1.87	-1.88
38	0.26	157.08	-0.20	-1.89	-1.88	-1.87	-1.88
39	0.27	161.22	-0.19	-1.88	-1.87	-1.86	-1.87
40	0.28	165.48	-0.19	-1.88	-1.86	-1.85	-1.86
41	0.28	169.81	-0.19	-1.87	-1.85	-1.85	-1.86
42	0.29	174.16	-0.19	-1.87	-1.85	-1.84	-1.85
43	0.30	178.48	-0.19	-1.86	-1.84	-1.84	-1.84
44	0.31	182.74	-0.20	-1.85	-1.83	-1.83	-1.84
45	0.31	186.91	-0.21	-1.84	-1.82	-1.82	-1.83
46	0.32	190.97	-0.22	-1.83	-1.82	-1.82	-1.82
47	0.33	194.91	-0.23	-1.82	-1.81	-1.81	-1.81
48	0.33	198.77	-0.24	-1.81	-1.80	-1.80	-1.81
49	0.34	202.63	-0.25	-1.80	-1.80	-1.80	-1.80
50	0.35	206.53	-0.25	-1.79	-1.79	-1.79	-1.79
51	0.36	210.46	-0.26	-1.78	-1.78	-1.79	-1.78
52	0.36	214.41	-0.26	-1.77	-1.77	-1.78	-1.77
53	0.37	218.38	-0.27	-1.76	-1.76	-1.77	-1.76
54	0.38	222.35	-0.27	-1.74	-1.75	-1.77	-1.76
55	0.39	226.33	-0.28	-1.73	-1.75	-1.76	-1.75
56	0.40	230.32	-0.28	-1.72	-1.74	-1.75	-1.74
57	0.40	234.31	-0.29	-1.71	-1.73	-1.75	-1.73

Fill Curve Existing Lock 2' Lift (Continued)

Time	LFVD LEVD valve position	LFVu LFVd discharge	LFW head	Water Surface Elevation in Chamber			Average Water Surface Elevation
				Upin head	Ch8	Lpin head	
sec	b/B	cfs	ft	ft	ft	ft	ft
58	0.41	238.31	-0.30	-1.70	-1.72	-1.74	-1.72
59	0.42	242.30	-0.30	-1.69	-1.71	-1.73	-1.71
60	0.43	246.29	-0.31	-1.68	-1.70	-1.72	-1.70
61	0.43	250.33	-0.32	-1.68	-1.69	-1.71	-1.69
62	0.44	254.44	-0.33	-1.67	-1.68	-1.70	-1.68
63	0.45	258.59	-0.35	-1.66	-1.67	-1.69	-1.67
64	0.46	262.78	-0.36	-1.65	-1.65	-1.68	-1.66
65	0.47	266.99	-0.37	-1.64	-1.64	-1.67	-1.65
66	0.48	271.23	-0.38	-1.63	-1.63	-1.66	-1.64
67	0.48	275.50	-0.39	-1.62	-1.62	-1.65	-1.63
68	0.49	279.79	-0.39	-1.61	-1.61	-1.63	-1.62
69	0.50	284.11	-0.40	-1.60	-1.60	-1.62	-1.61
70	0.51	288.44	-0.41	-1.59	-1.59	-1.61	-1.60
71	0.52	292.78	-0.42	-1.58	-1.58	-1.59	-1.59
72	0.53	297.12	-0.43	-1.57	-1.57	-1.58	-1.57
73	0.53	301.40	-0.44	-1.56	-1.56	-1.56	-1.56
74	0.54	305.61	-0.45	-1.55	-1.55	-1.55	-1.55
75	0.55	309.73	-0.46	-1.54	-1.54	-1.53	-1.54
76	0.56	313.77	-0.47	-1.53	-1.53	-1.52	-1.53
77	0.56	317.73	-0.48	-1.52	-1.52	-1.50	-1.51
78	0.57	321.61	-0.49	-1.51	-1.50	-1.49	-1.50
79	0.58	325.42	-0.50	-1.50	-1.49	-1.48	-1.49
80	0.59	329.15	-0.50	-1.49	-1.48	-1.46	-1.48
81	0.60	332.81	-0.51	-1.48	-1.46	-1.45	-1.46
82	0.60	336.39	-0.52	-1.47	-1.45	-1.44	-1.45
83	0.61	339.89	-0.53	-1.46	-1.44	-1.42	-1.44
84	0.62	343.31	-0.53	-1.45	-1.42	-1.41	-1.43
85	0.63	346.71	-0.54	-1.43	-1.41	-1.40	-1.41
86	0.64	350.11	-0.55	-1.42	-1.39	-1.38	-1.40
87	0.65	353.49	-0.56	-1.40	-1.38	-1.37	-1.38
88	0.66	356.81	-0.57	-1.39	-1.37	-1.36	-1.37
89	0.67	360.07	-0.58	-1.37	-1.35	-1.34	-1.36
90	0.68	363.24	-0.59	-1.36	-1.34	-1.33	-1.34
91	0.68	366.30	-0.60	-1.34	-1.33	-1.32	-1.33
92	0.69	369.24	-0.60	-1.32	-1.31	-1.30	-1.31
93	0.70	372.05	-0.61	-1.31	-1.30	-1.29	-1.30
94	0.71	374.74	-0.62	-1.29	-1.28	-1.28	-1.28

Fill Curve Existing Lock 2' Lift (Continued)

Time	LFVD LEVD valve position	LFVu LFVd discharge	LFW head	Water Surface Elevation in Chamber			Average Water Surface Elevation
				Upin head	Ch8	Lpin head	
sec	b/B	cfs	ft	ft	ft	ft	ft
95	0.72	377.31	-0.62	-1.27	-1.27	-1.26	-1.27
96	0.73	379.77	-0.63	-1.25	-1.25	-1.25	-1.25
97	0.74	382.15	-0.63	-1.24	-1.24	-1.24	-1.24
98	0.75	384.47	-0.64	-1.22	-1.22	-1.22	-1.22
99	0.76	386.71	-0.64	-1.21	-1.21	-1.21	-1.21
100	0.77	388.87	-0.64	-1.19	-1.19	-1.20	-1.19
101	0.78	390.95	-0.65	-1.17	-1.18	-1.18	-1.18
102	0.79	392.92	-0.65	-1.16	-1.16	-1.17	-1.16
103	0.80	394.79	-0.66	-1.14	-1.15	-1.16	-1.15
104	0.81	396.56	-0.66	-1.13	-1.13	-1.14	-1.13
105	0.82	398.22	-0.67	-1.11	-1.11	-1.12	-1.12
106	0.83	399.77	-0.67	-1.10	-1.10	-1.11	-1.10
107	0.84	401.18	-0.68	-1.08	-1.08	-1.09	-1.09
108	0.86	402.46	-0.68	-1.07	-1.07	-1.08	-1.07
109	0.87	403.62	-0.68	-1.05	-1.05	-1.06	-1.05
110	0.88	404.69	-0.68	-1.04	-1.04	-1.04	-1.04
111	0.89	405.68	-0.68	-1.03	-1.02	-1.02	-1.02
112	0.90	406.61	-0.68	-1.01	-1.01	-1.00	-1.01
113	0.92	407.50	-0.68	-1.00	-0.99	-0.98	-0.99
114	0.93	408.33	-0.68	-0.98	-0.98	-0.97	-0.98
115	0.94	409.07	-0.69	-0.97	-0.96	-0.95	-0.96
116	0.95	409.69	-0.69	-0.96	-0.95	-0.93	-0.94
117	0.96	410.17	-0.69	-0.94	-0.93	-0.91	-0.93
118	0.98	410.49	-0.69	-0.93	-0.91	-0.89	-0.91
119	0.99	410.65	-0.69	-0.91	-0.90	-0.88	-0.90
120	1.00	410.66	-0.69	-0.90	-0.88	-0.86	-0.88
121	1.00	410.49	-0.68	-0.88	-0.87	-0.84	-0.86
122	1.00	410.12	-0.68	-0.87	-0.85	-0.82	-0.85
123	1.00	409.60	-0.68	-0.86	-0.83	-0.81	-0.83
124	1.00	408.93	-0.67	-0.84	-0.82	-0.79	-0.82
125	1.00	408.15	-0.66	-0.83	-0.80	-0.78	-0.80
126	1.00	407.24	-0.66	-0.81	-0.79	-0.76	-0.79
127	1.00	406.21	-0.65	-0.79	-0.77	-0.75	-0.77
128	1.00	405.05	-0.64	-0.78	-0.75	-0.73	-0.75
129	1.00	403.75	-0.64	-0.76	-0.74	-0.72	-0.74
130	1.00	402.30	-0.63	-0.74	-0.72	-0.70	-0.72
131	1.00	400.70	-0.62	-0.73	-0.71	-0.69	-0.71

Fill Curve Existing Lock 2' Lift (Continued)

Time	LFVD LEVD valve position	LFVu LFVd discharge	LFW head	Water Surface Elevation in Chamber			Average Water Surface Elevation
				Upin head	Ch8	Lpin head	
sec	b/B	cfs	ft	ft	ft	ft	ft
132	1.00	398.94	-0.62	-0.71	-0.69	-0.67	-0.69
133	1.00	397.03	-0.61	-0.69	-0.68	-0.66	-0.67
134	1.00	394.99	-0.60	-0.67	-0.66	-0.64	-0.66
135	1.00	392.83	-0.59	-0.66	-0.65	-0.63	-0.64
136	1.00	390.57	-0.58	-0.64	-0.63	-0.62	-0.63
137	1.00	388.22	-0.57	-0.62	-0.61	-0.60	-0.61
138	1.00	385.80	-0.56	-0.60	-0.60	-0.59	-0.60
139	1.00	383.31	-0.55	-0.59	-0.58	-0.58	-0.58
140	1.00	380.75	-0.54	-0.57	-0.57	-0.56	-0.57
141	1.00	378.12	-0.53	-0.55	-0.55	-0.55	-0.55
142	1.00	375.43	-0.52	-0.54	-0.54	-0.54	-0.54
143	1.00	372.67	-0.51	-0.52	-0.52	-0.52	-0.52
144	1.00	369.83	-0.50	-0.51	-0.51	-0.51	-0.51
145	1.00	366.94	-0.49	-0.49	-0.49	-0.50	-0.49
146	1.00	363.99	-0.48	-0.48	-0.48	-0.48	-0.48
147	1.00	361.00	-0.48	-0.47	-0.46	-0.47	-0.47
148	1.00	357.97	-0.47	-0.45	-0.45	-0.46	-0.45
149	1.00	354.90	-0.46	-0.44	-0.44	-0.44	-0.44
150	1.00	351.81	-0.45	-0.43	-0.42	-0.43	-0.43
151	1.00	348.70	-0.44	-0.41	-0.41	-0.41	-0.41
152	1.00	345.57	-0.43	-0.40	-0.40	-0.40	-0.40
153	1.00	342.42	-0.42	-0.39	-0.38	-0.38	-0.38
154	1.00	339.24	-0.41	-0.38	-0.37	-0.37	-0.37
155	1.00	336.05	-0.40	-0.36	-0.36	-0.35	-0.36
156	1.00	332.82	-0.39	-0.35	-0.35	-0.34	-0.34
157	1.00	329.58	-0.38	-0.34	-0.33	-0.32	-0.33
158	1.00	326.35	-0.37	-0.33	-0.32	-0.31	-0.32
159	1.00	323.19	-0.36	-0.32	-0.31	-0.29	-0.31
160	1.00	320.05	-0.36	-0.31	-0.30	-0.28	-0.29
161	1.00	316.86	-0.35	-0.29	-0.28	-0.26	-0.28
162	1.00	313.63	-0.34	-0.28	-0.27	-0.25	-0.27
163	1.00	310.36	-0.33	-0.27	-0.26	-0.24	-0.26
164	1.00	307.06	-0.32	-0.26	-0.25	-0.23	-0.25
165	1.00	303.72	-0.31	-0.25	-0.24	-0.21	-0.23
166	1.00	300.37	-0.31	-0.24	-0.22	-0.20	-0.22
167	1.00	297.00	-0.30	-0.23	-0.21	-0.19	-0.21
168	1.00	293.61	-0.29	-0.22	-0.20	-0.18	-0.20

Fill Curve Existing Lock 2' Lift (Continued)

Time	LFVD LEVD valve position	LFVu LFVd discharge	LFW head	Water Surface Elevation in Chamber			Average Water Surface Elevation
				Upin head	Ch8	Lpin head	
sec	b/B	cfs	ft	ft	ft	ft	ft
169	1.00	290.21	-0.28	-0.20	-0.19	-0.17	-0.19
170	1.00	286.78	-0.27	-0.19	-0.18	-0.16	-0.18
171	1.00	283.32	-0.26	-0.18	-0.17	-0.15	-0.16
172	1.00	279.82	-0.25	-0.17	-0.15	-0.14	-0.15
173	1.00	276.27	-0.24	-0.16	-0.14	-0.13	-0.14
174	1.00	272.67	-0.23	-0.14	-0.13	-0.12	-0.13
175	1.00	269.02	-0.23	-0.13	-0.12	-0.11	-0.12
176	1.00	265.32	-0.22	-0.12	-0.11	-0.10	-0.11
177	1.00	261.58	-0.21	-0.11	-0.10	-0.09	-0.10
178	1.00	257.81	-0.20	-0.09	-0.09	-0.08	-0.09
179	1.00	254.01	-0.19	-0.08	-0.08	-0.08	-0.08
180	1.00	250.19	-0.18	-0.07	-0.07	-0.07	-0.07
181	1.00	246.35	-0.17	-0.06	-0.06	-0.06	-0.06
182	1.00	242.51	-0.16	-0.05	-0.05	-0.05	-0.05
183	1.00	238.65	-0.16	-0.04	-0.04	-0.04	-0.04
184	1.00	234.78	-0.15	-0.03	-0.03	-0.03	-0.03
185	1.00	230.89	-0.14	-0.02	-0.02	-0.03	-0.02
186	1.00	227.00	-0.13	-0.01	-0.01	-0.02	-0.01
187	1.00	223.10	-0.13	0.00	-0.01	-0.01	**0.00**

Upper Pool Elevation

Appendix D: LOCKSIM Model-Input and Output Files

IHNC_labscale.sim

```
! Inner Harbor Navigation Channel Lock, New Orleans
!
! Conditions associated with Type 1 (Original) Design as tested in
!   1:25-scale physical model published in
!   ERDC/CHL TR-03-3 Hite (2003).  Plates numbers refer to Hite TR.
!
! Sidewall Port Filling and Emptying System with sector gates
!   Lock Width = 110'  Lock Length = 1360' Long Pintle-to-Pintle (Plate 28).
!   Dimensions of culvert from intake to filling valve taken from Plate 73.
! Simulating conditions of Plate 41, wherein...
! Upper Pool=9, Lower Pool=-2
! Culverts: 18.25' H x 15'W => Ac=273.75 sf
! Ports: 3.75' H x 2.54' W => Ap=9.53 sf, 28 ports per culvert
! 8-min Constant Speed Valve
!
! Flow at ports represented by diverging_tee
!
! Filename: IHNC_labscale.sim          Richard Stockstill August 2015

*CONSTANTS ==========================================================================
    io_units=English,  time_units=seconds
    time_step=1,   gravity=32.146, wf_time=0.55
    dQ_max=.001,   dh_max=.0001,   dx_max=.0001
    plot_field=11, plot_line=200,  plot_labels=row
    plot_file=IHNC_labscale.plt

*COMPONENTS =========================================================================

!  Modeling 1:25-scale model, increase hydraulic roughness by setting Darcy-Weisbach
!   friction factor to 0.02 which is more appropriate for phy model with peak Re=1e5
!  Change prototype simulations to 'rough=.003'

! --------------- Left Wall -----------------------------

! Intake
HW     LIn     pipe_loss  us_area=1e6, area=273.75, K+=0.5
LIn    LB1u    imp_pipe  dia=16.47, area=273.75, len=22.73, rough=.02, wave=3500
! The first bend on left culvert is LB1
LB1u   LB1d    pipe_loss  area=273.75  K+=0.07
                ! Kb for 30 degree Bend - HDC Chart 228-1 Re=2.5x10^5

LB1d   LFVu    imp_pipe  dia=16.47, area=273.75, len=27.71, rough=.02, wave=3500
LFVu   LFW     storage surface_area=435  max_wsel=22.4  ! Top of Wall=EL 22.4
                ! storage surface area is plan area of valve well (15'x29')

! Reverse Tainter Filling Valve
LFVu   LFVd    rev_tainter b=18.25, w=15, el_bottom=-40
                b/B_vs_t=OpenTainter_Hite
                Cc_vs_b/B=TainterCc
!                Kv+_vs_b/B=TainterKv
                Cdv+_vs_b/B=tainterCdv

LFVd   LB2u    imp_pipe  dia=16.47, area=273.75, len=27.71, rough=.02, wave=3500
! Second bend
LB2u   LB2d    pipe_loss  area=273.75  K+=0.07
! Straight reach of culvert US of manifold
LB2d   LP1u    imp_pipe  dia=16.47, area=273.75, len=84.15, rough=.02, wave=3500

! Sidewall Port Manifold
!  Port Connections to Chamber - Each Tee Represents 2 Ports
!  Each port is 2.54'W x 3.75'H = 9.525sf  Dh=4Rh=3.03'
!  Ports are spaced 28' OC, 2(28)=56' spacing form tees

LP1u   LP1d  LP1b  diverging_tee area1=area3=273.75 area2=19.05 angle1=0 angle2=90
LP1b   Ch1     pipe_loss area=19.05 ds_area=1e5 K+=1.80 K-=0.25

LP1d   LP2u    imp_pipe dia=16.47, area=273.75, len=56, rough=.02, wave=3500
```

```
LP2u   LP2d  LP2b  diverging_tee area1=area3=273.75 area2=19.05 angle1=0 angle2=90
LP2b   Ch2     pipe_loss area=19.05 ds_area=1e5 K+=1.80 K-=0.25

LP2d   LP3u    imp_pipe dia=16.47, area=273.75, len=56, rough=.02, wave=3500

LP3u   LP3d  LP3b  diverging_tee area1=area3=273.75 area2=19.05 angle1=0 angle2=90
LP3b   Ch3     pipe_loss area=19.05 ds_area=1e5 K+=1.80 K-=0.25

LP3d   LP4u    imp_pipe dia=16.47, area=273.75, len=56, rough=.02, wave=3500

LP4u   LP4d  LP4b  diverging_tee area1=area3=273.75 area2=19.05 angle1=0 angle2=90
LP4b   Ch4     pipe_loss area=19.05 ds_area=1e5 K+=1.80 K-=0.25

LP4d   LP5u    imp_pipe dia=16.47, area=273.75, len=56, rough=.02, wave=3500

LP5u   LP5d  LP5b  diverging_tee area1=area3=273.75 area2=19.05 angle1=0 angle2=90
LP5b   Ch5     pipe_loss area=19.05 ds_area=1e5 K+=1.80 K-=0.25

LP5d   LP6u    imp_pipe dia=16.47, area=273.75, len=56, rough=.02, wave=3500

LP6u   LP6d  LP6b  diverging_tee area1=area3=273.75 area2=19.05 angle1=0 angle2=90
LP6b   Ch6     pipe_loss area=19.05 ds_area=1e5 K+=1.80 K-=0.25

LP6d   LP7u    imp_pipe dia=16.47, area=273.75, len=56, rough=.02, wave=3500

LP7u   LP7d  LP7b  diverging_tee area1=area3=273.75 area2=19.05 angle1=0 angle2=90
LP7b   Ch7     pipe_loss area=19.05 ds_area=1e5 K+=1.80 K-=0.25

LP7d   LP8u    imp_pipe dia=16.47, area=273.75, len=56, rough=.02, wave=3500

LP8u   LP8d  LP8b  diverging_tee area1=area3=273.75 area2=19.05 angle1=0 angle2=90
LP8b   Ch8     pipe_loss area=19.05 ds_area=1e5 K+=1.80 K-=0.25

LP8d   LP9u    imp_pipe dia=16.47, area=273.75, len=56, rough=.02, wave=3500

LP9u   LP9d  LP9b  diverging_tee area1=area3=273.75 area2=19.05 angle1=0 angle2=90
LP9b   Ch9     pipe_loss area=19.05 ds_area=1e5 K+=1.80 K-=0.25

LP9d   LP10u   imp_pipe dia=16.47, area=273.75, len=56, rough=.02, wave=3500

LP10u  LP10d  LP10b  diverging_tee area1=area3=273.75 area2=19.05 angle1=0 angle2=90
LP10b  Ch10    pipe_loss area=19.05 ds_area=1e5 K+=1.80 K-=0.25

LP10d  LP11u  imp_pipe dia=16.47, area=273.75, len=56, rough=.02, wave=3500

LP11u  LP11d  LP11b  diverging_tee area1=area3=273.75 area2=19.05 angle1=0 angle2=90
LP11b  Ch11    pipe_loss area=19.05 ds_area=1e5 K+=1.80 K-=0.25

LP11d  LP12u  imp_pipe dia=16.47, area=273.75, len=56, rough=.02, wave=3500

LP12u  LP12d  LP12b  diverging_tee area1=area3=273.75 area2=19.05 angle1=0 angle2=90
LP12b  Ch12    pipe_loss area=19.05 ds_area=1e5 K+=1.80 K-=0.25

LP12d  LP13u  imp_pipe dia=16.47, area=273.75, len=56, rough=.02, wave=3500

LP13u  LP13d  LP13b  diverging_tee area1=area3=273.75 area2=19.05 angle1=0 angle2=90
LP13b  Ch13    pipe_loss area=19.05 ds_area=1e5 K+=1.80 K-=0.25

LP13d  LP14u  imp_pipe dia=16.47, area=273.75, len=56, rough=.02, wave=3500

LP14u  LP14d  LP14b  diverging_tee area1=area3=273.75 area2=19.05 angle1=0 angle2=90
LP14b  Ch14    pipe_loss area=19.05 ds_area=1e5 K+=1.80 K-=0.25

LP14d  LB3u   imp_pipe dia=16.47, area=273.75, len=84.15, rough=.02, wave=3500

! Culvert downstream of manifold ports
LB3u   LB3d    pipe_loss  area=273.75  K+=0.07
LB3d   LEVu    imp_pipe  dia=16.47, area=273.75, len=27.71, rough=.02, wave=3500
LEVu   LEW     storage  surface_area=435  max_wsel=22.4
!LEVu   LEVd    rev_tainter b=18.25  w=15  el_bottom=-40
```

```
!                b/B_vs_t=OpenTainter_Hite
!                Cc_vs_b/B=TainterCc  Kv+_vs_b/B=TainterKv
!                fixed_b/B=0
! --------------- Right Wall -----------------------------

! Intake
HW     RIn     pipe_loss  us_area=1e6  area=273.75  K+=0.5
RIn    RB1u    imp_pipe  dia=16.47  area=273.75  len=22.73  rough=.02  wave=3500
! The first bend on right culvert is RB1
RB1u   RB1d    pipe_loss  area=273.75  K+=0.07
                ! Kb for 30 degree Bend - HDC Chart 228-1 Re=2.5x10^5

RB1d   RFVu    imp_pipe  dia=16.47  area=273.75  len=27.71  rough=.02  wave=3500
RFVu   RFW     storage  surface_area=435  max_wsel=22.4
                ! storage surface area is plan area of valve well (15'x29')

! Reverse Tainter Filling Valve
RFVu   RFVd    rev_tainter b=18.25  w=15  el_bottom=-40
                b/B_vs_t=OpenTainter_Hite
                Cc_vs_b/B=TainterCc
!                Kv+_vs_b/B=TainterKv
                Cdv+_vs_b/B=tainterCdv

RFVd   RB2u    imp_pipe  dia=16.47  area=273.75  len=27.71  rough=.02  wave=3500
! Second bend
RB2u   RB2d    pipe_loss  area=273.75  K+=0.07
! Straight reach of culvert US of manifold
RB2d   RP1u    imp_pipe  dia=16.47  area=273.75  len=84.15  rough=.02  wave=3500

! Sidewall Port Manifold
!  Port Connections to Chamber - Each Tee Represents 2 Ports
!  Each port is 2.54'W x 3.75'H = 9.525sf  Dh=4Rh=3.03'
!  Ports are spaced 28' OC, 2(28)=56' spacing form tees

RP1u   RP1d  RP1b  diverging_tee area1=area3=273.75 area2=19.05 angle1=0 angle2=90
RP1b   Ch1     pipe_loss area=19.05 ds_area=1e5 K+=1.80 K-=0.25

RP1d   RP2u    imp_pipe dia=16.47, area=273.75, len=56, rough=.02, wave=3500

RP2u   RP2d  RP2b  diverging_tee area1=area3=273.75 area2=19.05 angle1=0 angle2=90
RP2b   Ch2     pipe_loss area=19.05 ds_area=1e5 K+=1.80 K-=0.25

RP2d   RP3u    imp_pipe dia=16.47, area=273.75, len=56, rough=.02, wave=3500

RP3u   RP3d  RP3b  diverging_tee area1=area3=273.75 area2=19.05 angle1=0 angle2=90
RP3b   Ch3     pipe_loss area=19.05 ds_area=1e5 K+=1.80 K-=0.25

RP3d   RP4u    imp_pipe dia=16.47, area=273.75, len=56, rough=.02, wave=3500

RP4u   RP4d  RP4b  diverging_tee area1=area3=273.75 area2=19.05 angle1=0 angle2=90
RP4b   Ch4     pipe_loss area=19.05 ds_area=1e5 K+=1.80 K-=0.25

RP4d   RP5u    imp_pipe dia=16.47, area=273.75, len=56, rough=.02, wave=3500

RP5u   RP5d  RP5b  diverging_tee area1=area3=273.75 area2=19.05 angle1=0 angle2=90
RP5b   Ch5     pipe_loss area=19.05 ds_area=1e5 K+=1.80 K-=0.25

RP5d   RP6u    imp_pipe dia=16.47, area=273.75, len=56, rough=.02, wave=3500

RP6u   RP6d  RP6b  diverging_tee area1=area3=273.75 area2=19.05 angle1=0 angle2=90
RP6b   Ch6     pipe_loss area=19.05 ds_area=1e5 K+=1.80 K-=0.25

RP6d   RP7u    imp_pipe dia=16.47, area=273.75, len=56, rough=.02, wave=3500

RP7u   RP7d  RP7b  diverging_tee area1=area3=273.75 area2=19.05 angle1=0 angle2=90
RP7b   Ch7     pipe_loss area=19.05 ds_area=1e5 K+=1.80 K-=0.25

RP7d   RP8u    imp_pipe dia=16.47, area=273.75, len=56, rough=.02, wave=3500

RP8u   RP8d  RP8b  diverging_tee area1=area3=273.75 area2=19.05 angle1=0 angle2=90
RP8b   Ch8     pipe_loss area=19.05 ds_area=1e5 K+=1.80 K-=0.25
```

```
RP8d   RP9u    imp_pipe dia=16.47, area=273.75, len=56, rough=.02, wave=3500

RP9u   RP9d  RP9b  diverging_tee area1=area3=273.75 area2=19.05 angle1=0 angle2=90
RP9b   Ch9     pipe_loss area=19.05 ds_area=1e5 K+=1.80 K-=0.25

RP9d   RP10u   imp_pipe dia=16.47, area=273.75, len=56, rough=.02, wave=3500

RP10u  RP10d  RP10b  diverging_tee area1=area3=273.75 area2=19.05 angle1=0 angle2=90
RP10b  Ch10    pipe_loss area=19.05 ds_area=1e5 K+=1.80 K-=0.25

RP10d  RP11u  imp_pipe dia=16.47, area=273.75, len=56, rough=.02, wave=3500

RP11u  RP11d  RP11b  diverging_tee area1=area3=273.75 area2=19.05 angle1=0 angle2=90
RP11b  Ch11    pipe_loss area=19.05 ds_area=1e5 K+=1.80 K-=0.25

RP11d  RP12u  imp_pipe dia=16.47, area=273.75, len=56, rough=.02, wave=3500

RP12u  RP12d  RP12b  diverging_tee area1=area3=273.75 area2=19.05 angle1=0 angle2=90
RP12b  Ch12    pipe_loss area=19.05 ds_area=1e5 K+=1.80 K-=0.25

RP12d  RP13u  imp_pipe dia=16.47, area=273.75, len=56, rough=.02, wave=3500

RP13u  RP13d  RP13b  diverging_tee area1=area3=273.75 area2=19.05 angle1=0 angle2=90
RP13b  Ch13    pipe_loss area=19.05 ds_area=1e5 K+=1.80 K-=0.25

RP13d  RP14u  imp_pipe dia=16.47, area=273.75, len=56, rough=.02, wave=3500

RP14u  RP14d  RP14b  diverging_tee area1=area3=273.75 area2=19.05 angle1=0 angle2=90
RP14b  Ch14    pipe_loss area=19.05 ds_area=1e5 K+=1.80 K-=0.25

RP14d  RB3u   imp_pipe dia=16.47, area=273.75, len=84.15, rough=.02, wave=3500

! Culvert downstream of manifold ports
RB3u   RB3d    pipe_loss  area=273.75  K+=0.07
RB3d   REVu    imp_pipe  dia=16.47  area=273.75  len=27.71  rough=.02  wave=3500
REVu   REW     storage  surface_area=435  max_wsel=22.4
!REVu   REVd    rev_tainter b=18.25  w=15  el_bottom=-40
!               b/B_vs_t=OpenTainter_Hite
!               Cc_vs_b/B=TainterCc  Kv+_vs_b/B=TainterKv
!               fixed_b/B=0

!------------ Lock chamber modeled as series of open channels ---------

! length is from pintle to halfway between the first ports (right and left)
! We want the reaches to be about the same length, so len/reach => along the chamber
! TR showed that the first port is located 229.7 ft downstream of riverside pintle.
! Ports are spaced 28' on center

Upin  ChU   open_channel  cross_section=chamber  len=118.35  reaches=4  iq=0
ChU   Ch1   open_channel  cross_section=chamber  len=118.35  reaches=4  iq=0
Ch1   Ch2   open_channel  cross_section=chamber  len=56   reaches=2  iq=0
Ch2   Ch3   open_channel  cross_section=chamber  len=56   reaches=2  iq=0
Ch3   Ch4   open_channel  cross_section=chamber  len=56   reaches=2  iq=0
Ch4   Ch5   open_channel  cross_section=chamber  len=56   reaches=2  iq=0
Ch5   Ch6   open_channel  cross_section=chamber  len=56   reaches=2  iq=0
Ch6   Ch7   open_channel  cross_section=chamber  len=56   reaches=2  iq=0
Ch7   Ch8   open_channel  cross_section=chamber  len=56   reaches=2  iq=0
Ch8   Ch9   open_channel  cross_section=chamber  len=56   reaches=2  iq=0
Ch9   Ch10  open_channel  cross_section=chamber  len=56   reaches=2  iq=0
Ch10  Ch11  open_channel  cross_section=chamber  len=56   reaches=2  iq=0
Ch11  Ch12  open_channel  cross_section=chamber  len=56   reaches=2  iq=0
Ch12  Ch13  open_channel  cross_section=chamber  len=56   reaches=2  iq=0
Ch13  Ch14  open_channel  cross_section=chamber  len=56   reaches=2  iq=0
Ch14  ChD   open_channel  cross_section=chamber  len=197.65   reaches=7  iq=0
ChD   Lpin  open_channel  cross_section=chamber  len=197.65   reaches=7  iq=0

*NODES ==========================================================================

HW        elev=-30.87     head=9  idemand=0
! ---Left Culvert---
```

```
LIn       elev=-30.87    ihead=9
LB1u      elev=-30.87    ihead=9
LB1d      elev=-30.87    ihead=9
LFVu      elev=-30.87    ihead=9
LFW       elev=-30.87    ihead=9   demand=0
LFVd      elev=-30.87    ihead=-2
LB2u      elev=-30.87    ihead=-2
LB2d      elev=-30.87    ihead=-2
LP1u      elev=-30.87    ihead=-2
LP1d      elev=-30.87    ihead=-2
LP1b      elev=-38.12    ihead=-2
LP2u      elev=-30.87    ihead=-2
LP2d      elev=-30.87    ihead=-2
LP2b      elev=-38.12    ihead=-2
LP3u      elev=-30.87    ihead=-2
LP3d      elev=-30.87    ihead=-2
LP3b      elev=-38.12    ihead=-2
LP4u      elev=-30.87    ihead=-2
LP4d      elev=-30.87    ihead=-2
LP4b      elev=-38.12    ihead=-2
LP5u      elev=-30.87    ihead=-2
LP5d      elev=-30.87    ihead=-2
LP5b      elev=-38.12    ihead=-2
LP6u      elev=-30.87    ihead=-2
LP6d      elev=-30.87    ihead=-2
LP6b      elev=-38.12    ihead=-2
LP7u      elev=-30.87    ihead=-2
LP7d      elev=-30.87    ihead=-2
LP7b      elev=-38.12    ihead=-2
LP8u      elev=-30.87    ihead=-2
LP8d      elev=-30.87    ihead=-2
LP8b      elev=-38.12    ihead=-2
LP9u      elev=-30.87    ihead=-2
LP9d      elev=-30.87    ihead=-2
LP9b      elev=-38.12    ihead=-2
LP10u     elev=-30.87    ihead=-2
LP10d     elev=-30.87    ihead=-2
LP10b     elev=-38.12    ihead=-2
LP11u     elev=-30.87    ihead=-2
LP11d     elev=-30.87    ihead=-2
LP11b     elev=-38.12    ihead=-2
LP12u     elev=-30.87    ihead=-2
LP12d     elev=-30.87    ihead=-2
LP12b     elev=-38.12    ihead=-2
LP13u     elev=-30.87    ihead=-2
LP13d     elev=-30.87    ihead=-2
LP13b     elev=-38.12    ihead=-2
LP14u     elev=-30.87    ihead=-2
LP14d     elev=-30.87    ihead=-2
LP14b     elev=-38.12    ihead=-2
LB3u      elev=-30.87    ihead=-2
LB3d      elev=-30.87    ihead=-2
LEVu      elev=-30.87    ihead=-2
LEW       elev=-30.87    ihead=-2    demand=0
! ---Right Culvert---
RIn       elev=-30.87    ihead=9
RB1u      elev=-30.87    ihead=9
RB1d      elev=-30.87    ihead=9
RFVu      elev=-30.87    ihead=9
RFW       elev=-30.87    ihead=9   demand=0
RFVd      elev=-30.87    ihead=-2
RB2u      elev=-30.87    ihead=-2
RB2d      elev=-30.87    ihead=-2
RP1u      elev=-30.87    ihead=-2
RP1d      elev=-30.87    ihead=-2
RP1b      elev=-38.12    ihead=-2
RP2u      elev=-30.87    ihead=-2
RP2d      elev=-30.87    ihead=-2
RP2b      elev=-38.12    ihead=-2
RP3u      elev=-30.87    ihead=-2
RP3d      elev=-30.87    ihead=-2
```

```
RP3b      elev=-38.12    ihead=-2
RP4u      elev=-30.87    ihead=-2
RP4d      elev=-30.87    ihead=-2
RP4b      elev=-38.12    ihead=-2
RP5u      elev=-30.87    ihead=-2
RP5d      elev=-30.87    ihead=-2
RP5b      elev=-38.12    ihead=-2
RP6u      elev=-30.87    ihead=-2
RP6d      elev=-30.87    ihead=-2
RP6b      elev=-38.12    ihead=-2
RP7u      elev=-30.87    ihead=-2
RP7d      elev=-30.87    ihead=-2
RP7b      elev=-38.12    ihead=-2
RP8u      elev=-30.87    ihead=-2
RP8d      elev=-30.87    ihead=-2
RP8b      elev=-38.12    ihead=-2
RP9u      elev=-30.87    ihead=-2
RP9d      elev=-30.87    ihead=-2
RP9b      elev=-38.12    ihead=-2
RP10u     elev=-30.87    ihead=-2
RP10d     elev=-30.87    ihead=-2
RP10b     elev=-38.12    ihead=-2
RP11u     elev=-30.87    ihead=-2
RP11d     elev=-30.87    ihead=-2
RP11b     elev=-38.12    ihead=-2
RP12u     elev=-30.87    ihead=-2
RP12d     elev=-30.87    ihead=-2
RP12b     elev=-38.12    ihead=-2
RP13u     elev=-30.87    ihead=-2
RP13d     elev=-30.87    ihead=-2
RP13b     elev=-38.12    ihead=-2
RP14u     elev=-30.87    ihead=-2
RP14d     elev=-30.87    ihead=-2
RP14b     elev=-38.12    ihead=-2
RB3u      elev=-30.87    ihead=-2
RB3d      elev=-30.87    ihead=-2
REVu      elev=-30.87    ihead=-2
REW       elev=-30.87    ihead=-2    demand=0
! ---Lock Chamber---
Upin      elev=-40       ihead=-2    demand=0
ChU       elev=-40       ihead=-2
Ch1       elev=-40       ihead=-2
Ch2       elev=-40       ihead=-2
Ch3       elev=-40       ihead=-2
Ch4       elev=-40       ihead=-2
Ch5       elev=-40       ihead=-2
Ch6       elev=-40       ihead=-2
Ch7       elev=-40       ihead=-2
Ch8       elev=-40       ihead=-2
Ch9       elev=-40       ihead=-2
Ch10      elev=-40       ihead=-2
Ch11      elev=-40       ihead=-2
Ch12      elev=-40       ihead=-2
Ch13      elev=-40       ihead=-2
Ch14      elev=-40       ihead=-2
ChD       elev=-40       ihead=-2
Lpin      elev=-40       ihead=-2    demand=0

*FUNCTIONS ========================================================================

! open tainter designated at top for b/B vs. time (xscale (valve time)) in
! seconds, b = valve opening, B = culvert height so, b/B is fraction opened.
! OpenTainter comes from Plate 33 of ERDC/CHL TR-03-3 Hite 2003
OpenTainter_Hite     discrete   interpolation=linear  xscale=480  xshift=10
   xy_pairs={ 0.00   0.000
              0.10   0.084
              0.20   0.167
              0.30   0.249
              0.40   0.334
              0.50   0.426
              0.60   0.525
```

```
              0.70   0.619
              0.80   0.732
              0.90   0.855
              1.00   1.000 }

! Kv vs b/B Relationship - Based on Nielson's WES Misc Paper H-76-13
! Equations D2 and D3
TainterKv  discrete interpolation=linear extrapolation=linear
   xy_pairs={   0.0010  1385376.875
                0.0020   346667.594
                0.0030   154218.391
                0.0040    86828.391
                0.0050    55621.793
                0.0060    38662.070
                0.0070    28431.086
                0.0080    21787.870
                0.0090    17230.836
                0.0100    13969.831
                0.0150     6237.299
                0.0200     3524.422
                0.0250     2265.772
                0.0300     1580.499
                0.0500      578.828
                0.0600      405.284
                0.0800      231.556
                0.1000      150.331
                0.1500       68.776
                0.2000       39.349
                0.2500       25.239
                0.3000       17.236
                0.3500       12.244
                0.4000        8.848
                0.4500        6.422
                0.5000        4.661
                0.5500        3.338
                0.6000        2.344
                0.7000        1.049
                0.8000        0.372
                0.9000        0.074
                1.0000        0.010  }

tainterCdv  discrete  interpolation=spline
  x_values={0,   0.05, 0.1, 0.15, 0.2, 0.25, 0.3, 0.35,
            0.4, 0.45, 0.5, 0.55, 0.6, 0.65, 0.7, 0.75,
            0.8, 0.85, 0.9, 0.95,   1}
  y_values={0, 0.0443, 0.0836, 0.1195, 0.1534, 0.196, 0.243, 0.295,
            0.349, 0.415, 0.494, 0.587, 0.69, 0.8165, 0.976, 1.155,
            1.387,  1.69,  2.02, 2.582, 3.162}

! Cc vs b/B Relationship - Gerald Schohl's polynomial which reproduces Fig
! D2 in WES Misc Paper H-76-13
! Cc=.85-1.12X+1.69X^2-.85X^3+.43X^4;  Where X=b/B
  TainterCc  polynomial coefficients={.85, -1.12, 1.69, -.85, .43}

*CROSS_SECTIONS ============================================================

   chamber TRAPEZOIDAL  MN_n=.02  bed_w=110  ! Lock Chamber

*PLOT VARIABLES ============================================================

LFVu   LFVd    valve_position
LFVu   LFVd    discharge
LFW    head

Upin   head
Ch8    head
Lpin   head

*END ========================================================================
```

IHNC_labscale.plt

sec Time	(-) "LFVu LFVd Valve Position sectno=0"	(cfs) "LFVu LFVd discharge sectno=0"	(f) "LFW head"	(f) "Upin head"	(f) "Ch8 head"	(f) "Lpin head"
0	0	0	9	-2	-2	-2
1	0	0	9	-2	-2	-2
2	0	0	9	-2	-2	-2
3	0	0	9	-2	-2	-2
4	0	0	9	-2	-2	-2
5	0	0	9	-2	-2	-2
6	0	0	9	-2	-2	-2
7	0	0	9	-2	-2	-2
8	0	0	9	-2	-2	-2
9	0	0	9	-2	-2	-2
10	0	0	9	-2	-2	-2
11	0.00175	11.43285	8.988164	-2	-2	-2
12	0.0035	23.02783	8.956978	-2	-2	-2
13	0.00525	34.18196	8.918331	-1.999999	-2	-2
14	0.007	45.70894	8.886343	-1.999991	-2	-2
15	0.00875	56.80315	8.872382	-1.999916	-1.999999	-2
16	0.0105	68.29622	8.880966	-1.999489	-1.999995	-2
17	0.01225	79.53303	8.908112	-1.997908	-1.999972	-2
18	0.014	91.03486	8.943325	-1.994312	-1.999868	-2
19	0.01575	102.3558	8.973375	-1.989631	-1.999502	-2
20	0.0175	113.7071	8.987485	-1.985895	-1.998491	-2
21	0.01925	124.8578	8.980933	-1.981938	-1.996314	-2
22	0.021	135.893	8.956704	-1.977713	-1.992681	-2
23	0.02275	146.7884	8.923967	-1.973519	-1.987994	-2
24	0.0245	157.628	8.894578	-1.969262	-1.98321	-2
25	0.02625	168.4921	8.87861	-1.964975	-1.97893	-2
26	0.028	179.4294	8.880793	-1.960606	-1.974923	-2
27	0.02975	190.4753	8.899036	-1.956254	-1.970915	-2
28	0.0315	201.5655	8.925543	-1.951887	-1.967041	-2
29	0.03325	212.6334	8.949957	-1.947569	-1.963248	-2
30	0.035	223.571	8.963235	-1.943235	-1.95955	-2
31	0.03675	234.3213	8.960839	-1.938887	-1.95594	-2
32	0.0385	244.8512	8.944103	-1.934534	-1.952348	-1.999999
33	0.04025	255.2048	8.919407	-1.930185	-1.948701	-1.999996
34	0.042	265.4661	8.89556	-1.925789	-1.94487	-1.999986
35	0.04375	275.7406	8.880462	-1.921358	-1.940726	-1.999954
36	0.0455	286.0925	8.878333	-1.916947	-1.936196	-1.99986
37	0.04725	296.5445	8.888434	-1.912574	-1.931366	-1.999617
38	0.049	307.0528	8.905684	-1.908227	-1.926428	-1.999045
39	0.05075	317.535	8.922799	-1.903911	-1.921555	-1.997842
40	0.0525	327.8862	8.933077	-1.899633	-1.916783	-1.995582
41	0.05425	338.0361	8.932757	-1.895382	-1.912056	-1.991804
42	0.056	347.9643	8.922129	-1.891127	-1.907349	-1.986209
43	0.05775	357.7063	8.905108	-1.886849	-1.902669	-1.978878
44	0.0595	367.339	8.887552	-1.882545	-1.897986	-1.970353
45	0.06125	376.9552	8.875001	-1.878228	-1.893259	-1.961428
46	0.063	386.6291	8.870721	-1.873934	-1.888473	-1.95275
47	0.06475	396.3894	8.87472	-1.869685	-1.883633	-1.944514
48	0.0665	406.2101	8.884035	-1.865477	-1.878762	-1.936537
49	0.06825	416.0247	8.894058	-1.861302	-1.873895	-1.928582
50	0.07	425.7534	8.900333	-1.857157	-1.869065	-1.920576
51	0.07175	435.3325	8.900138	-1.853037	-1.864303	-1.912534
52	0.0735	444.7312	8.893292	-1.848929	-1.859624	-1.904401
53	0.07525	453.9761	8.881982	-1.844816	-1.855026	-1.896049
54	0.077	463.1268	8.86974	-1.840683	-1.85049	-1.887343
55	0.07875	472.2521	8.860059	-1.836529	-1.845986	-1.878173
56	0.0805	481.4101	8.855155	-1.832373	-1.841476	-1.868482
57	0.08225	490.6267	8.855303	-1.828238	-1.836897	-1.858307
58	0.084	499.8919	8.858931	-1.824138	-1.832169	-1.847785
59	0.08572917	509.1017	8.863443	-1.820073	-1.827181	-1.8371
60	0.08745833	518.2247	8.866229	-1.816028	-1.8218	-1.826409
61	0.0891875	527.2541	8.8655	-1.81197	-1.81589	-1.815788
62	0.09091667	536.1596	8.860863	-1.807866	-1.809355	-1.805231
63	0.09264583	544.9523	8.85334	-1.803679	-1.802163	-1.794704
64	0.094375	553.6643	8.844847	-1.799382	-1.79438	-1.784197
65	0.09610417	562.3402	8.837415	-1.79498	-1.786173	-1.773726
66	0.09783333	571.0187	8.832453	-1.790502	-1.777757	-1.763313
67	0.0995625	579.7193	8.83032	-1.785984	-1.769321	-1.75297
68	0.1012917	588.4378	8.830321	-1.781465	-1.760978	-1.742709
69	0.1030208	597.1477	8.831075	-1.776979	-1.752742	-1.732546
70	0.10475	605.8118	8.831093	-1.772541	-1.744567	-1.722493

71	0.1064792	614.3963	8.829321	-1.768146	-1.736391	-1.712552
72	0.1082083	622.8828	8.825463	-1.763759	-1.72816	-1.702722
73	0.1099375	631.2734	8.819988	-1.759302	-1.719838	-1.692996
74	0.1116667	639.5878	8.813868	-1.754669	-1.711388	-1.683361
75	0.1133958	647.8547	8.808168	-1.749727	-1.70277	-1.673809
76	0.115125	656.1017	8.803649	-1.744319	-1.693948	-1.664334
77	0.1168542	664.3451	8.800544	-1.738266	-1.684912	-1.654937
78	0.1185833	672.5815	8.79854	-1.731386	-1.675678	-1.645625
79	0.1203125	680.7993	8.796971	-1.723522	-1.666284	-1.636402
80	0.1220417	688.9802	8.79509	-1.714578	-1.656783	-1.62727
81	0.1237708	697.1011	8.792358	-1.704554	-1.647223	-1.618228
82	0.1255	705.1468	8.788611	-1.693569	-1.637633	-1.609269
83	0.1272292	713.1131	8.78407	-1.68185	-1.628032	-1.600384
84	0.1289583	721.0053	8.779208	-1.669684	-1.618428	-1.591563
85	0.1306875	728.8348	8.774549	-1.657341	-1.608832	-1.5828
86	0.1324167	736.6114	8.770473	-1.645003	-1.599256	-1.57409
87	0.1341458	744.3406	8.767102	-1.63273	-1.58972	-1.565431
88	0.135875	752.0235	8.76429	-1.620492	-1.580238	-1.556821
89	0.1376042	759.6554	8.761709	-1.608213	-1.570813	-1.54826
90	0.1393333	767.227	8.758989	-1.59581	-1.56143	-1.53975
91	0.1410625	774.7297	8.755859	-1.583216	-1.552054	-1.531289
92	0.1427917	782.1588	8.75223	-1.570378	-1.542631	-1.522871
93	0.1445208	789.5142	8.748197	-1.557251	-1.533098	-1.514483
94	0.14625	796.8001	8.743984	-1.543808	-1.523377	-1.506111
95	0.1479792	804.0219	8.739844	-1.530049	-1.513393	-1.497743
96	0.1497083	811.1848	8.735972	-1.516007	-1.503073	-1.489371
97	0.1514375	818.294	8.732438	-1.501741	-1.492363	-1.480991
98	0.1531667	825.3525	8.729177	-1.487331	-1.481238	-1.4726
99	0.1548958	832.3606	8.726034	-1.472858	-1.469712	-1.464191
100	0.156625	839.3172	8.722825	-1.458387	-1.457839	-1.455763
101	0.1583542	846.2208	8.71941	-1.443954	-1.445709	-1.447308
102	0.1600833	853.0704	8.715736	-1.429573	-1.433427	-1.438825
103	0.1618125	859.8696	8.711842	-1.415251	-1.421092	-1.430309
104	0.1635417	866.6272	8.707825	-1.400996	-1.408771	-1.421763
105	0.1652708	873.3517	8.703795	-1.386823	-1.396492	-1.413192
106	0.167	880.051	8.699835	-1.372749	-1.384248	-1.404607
107	0.1687083	886.6965	8.696012	-1.358784	-1.372011	-1.396016
108	0.1704167	893.3005	8.692353	-1.344937	-1.359743	-1.387423
109	0.172125	899.8949	8.688779	-1.331213	-1.347414	-1.378817
110	0.1738333	906.4827	8.685151	-1.317614	-1.335	-1.37017
111	0.1755417	913.0656	8.681348	-1.304134	-1.322482	-1.36143
112	0.17725	919.6451	8.677311	-1.290764	-1.309852	-1.352521
113	0.1789583	926.2237	8.673055	-1.277499	-1.297107	-1.343346
114	0.1806667	932.8074	8.668649	-1.264334	-1.284253	-1.333792
115	0.182375	939.4041	8.664183	-1.251265	-1.271309	-1.323738
116	0.1840833	946.0213	8.659728	-1.238288	-1.258298	-1.313071
117	0.1857917	952.6653	8.655315	-1.225404	-1.245245	-1.301696
118	0.1875	959.3409	8.650931	-1.212613	-1.232173	-1.28955
119	0.1892083	966.0514	8.646529	-1.199907	-1.219098	-1.276619
120	0.1909167	972.7992	8.64205	-1.187281	-1.206026	-1.262943
121	0.192625	979.5862	8.637445	-1.17473	-1.192962	-1.248618
122	0.1943333	986.4147	8.63269	-1.16225	-1.179912	-1.233781
123	0.1960417	993.2881	8.627789	-1.149829	-1.166881	-1.218588
124	0.19775	1000.211	8.622769	-1.137459	-1.153878	-1.203183
125	0.1994583	1007.187	8.617661	-1.125131	-1.14091	-1.187669
126	0.2011667	1014.223	8.612489	-1.11284	-1.127983	-1.1721
127	0.202875	1021.32	8.607267	-1.100579	-1.1151	-1.156479
128	0.2045833	1028.478	8.601992	-1.088345	-1.102264	-1.140775
129	0.2062917	1035.695	8.596661	-1.07613	-1.089466	-1.124943
130	0.208	1042.967	8.591266	-1.063928	-1.076692	-1.108938
131	0.2097083	1050.293	8.585803	-1.051729	-1.063921	-1.092724
132	0.2114167	1057.668	8.580275	-1.039524	-1.051119	-1.076283
133	0.213125	1065.089	8.574687	-1.027304	-1.038244	-1.059611
134	0.2148333	1072.553	8.569048	-1.015057	-1.025247	-1.042719
135	0.2165417	1080.056	8.563364	-1.00278	-1.012076	-1.025636
136	0.21825	1087.595	8.557644	-0.9904671	-0.9986795	-1.008401
137	0.2199583	1095.165	8.551892	-0.9781174	-0.9850091	-0.9910627
138	0.2216667	1102.761	8.546111	-0.965731	-0.9710287	-0.9736686
139	0.223375	1110.38	8.540301	-0.9533097	-0.9567178	-0.9562599
140	0.2250833	1118.015	8.534466	-0.9408562	-0.9420759	-0.9388668
141	0.2267917	1125.661	8.528608	-0.9283736	-0.9271237	-0.921509
142	0.2285	1133.313	8.522733	-0.9158654	-0.9119006	-0.9041984
143	0.2302083	1140.965	8.516846	-0.9033351	-0.8964601	-0.8869426
144	0.2319167	1148.613	8.510953	-0.8907855	-0.8808605	-0.8697482
145	0.233625	1156.25	8.505059	-0.8782152	-0.8651551	-0.8526207
146	0.2353333	1163.875	8.499166	-0.8656166	-0.8493831	-0.8355639
147	0.2370417	1171.481	8.493274	-0.8529721	-0.8335645	-0.8185795
148	0.23875	1179.067	8.48738	-0.8402514	-0.8177011	-0.8016669
149	0.2404583	1186.63	8.48148	-0.8274092	-0.8017802	-0.7848239
150	0.2421667	1194.168	8.475569	-0.8143851	-0.7857821	-0.7680471
151	0.243875	1201.681	8.469645	-0.801105	-0.7696867	-0.7513325

152	0.2455833	1209.167	8.463704	-0.7874853	-0.7534784	-0.734676
153	0.2472917	1216.625	8.457745	-0.7734386	-0.7371491	-0.7180743
154	0.249	1224.055	8.45177	-0.7588823	-0.7206989	-0.7015247
155	0.2507708	1231.554	8.445682	-0.7437466	-0.7041363	-0.6850251
156	0.2525417	1239.116	8.43932	-0.7279843	-0.6874761	-0.6685743
157	0.2543125	1246.664	8.432693	-0.7115771	-0.6707376	-0.6521708
158	0.2560833	1254.188	8.425971	-0.694541	-0.6539424	-0.6358131
159	0.2578542	1261.686	8.419335	-0.6769249	-0.6371117	-0.6194983
160	0.259625	1269.159	8.41291	-0.658805	-0.6202639	-0.603223
161	0.2613958	1276.611	8.406717	-0.6402716	-0.6034126	-0.5869829
162	0.2631667	1284.039	8.400692	-0.6214166	-0.5865661	-0.5707729
163	0.2649375	1291.441	8.394721	-0.6023293	-0.5697265	-0.5545879
164	0.2667083	1298.812	8.388692	-0.5830853	-0.5528901	-0.5384223
165	0.2684792	1306.147	8.382532	-0.5637222	-0.5360472	-0.522271
166	0.27025	1313.444	8.376231	-0.5442499	-0.519183	-0.506129
167	0.2720208	1320.706	8.369823	-0.5246588	-0.5022777	-0.4899915
168	0.2737917	1327.933	8.363371	-0.5049261	-0.4853057	-0.4738533
169	0.2755625	1335.132	8.356933	-0.48503	-0.4682343	-0.457709
170	0.2773333	1342.306	8.350542	-0.4649547	-0.4510236	-0.4415528
171	0.2791042	1349.46	8.344198	-0.4446953	-0.4336328	-0.4253788
172	0.280875	1356.595	8.337875	-0.424259	-0.4160264	-0.4091823
173	0.2826458	1363.713	8.331533	-0.4036635	-0.3981767	-0.3929593
174	0.2844167	1370.812	8.325141	-0.3829356	-0.3800668	-0.3767078
175	0.2861875	1377.892	8.318683	-0.3621075	-0.3616933	-0.3604271
176	0.2879583	1384.954	8.312163	-0.3412141	-0.3430667	-0.3441183
177	0.2897292	1391.998	8.305598	-0.3202891	-0.3242101	-0.3277833
178	0.2915	1399.025	8.29901	-0.2993626	-0.3051562	-0.3114245
179	0.2932708	1406.037	8.292418	-0.2784587	-0.2859423	-0.2950438
180	0.2950417	1413.035	8.285829	-0.2575948	-0.2666065	-0.2786422
181	0.2968125	1420.02	8.279239	-0.2367827	-0.247182	-0.2622183
182	0.2985833	1426.994	8.272636	-0.2160309	-0.2276937	-0.2457678
183	0.3003542	1433.956	8.266007	-0.1953453	-0.2081551	-0.2292815
184	0.302125	1440.906	8.259342	-0.1747296	-0.1885684	-0.2127444
185	0.3038958	1447.844	8.252638	-0.1541861	-0.168927	-0.1961342
186	0.3056667	1454.767	8.245901	-0.1337156	-0.14922	-0.1794201
187	0.3074375	1461.675	8.239145	-0.1133173	-0.1294368	-0.1625626
188	0.3092083	1468.565	8.232385	-.09298913	-0.1095697	-0.1455134
189	0.3109792	1475.436	8.225632	-.07272819	-.08961557	-0.1282157
190	0.31275	1482.287	8.218893	-.05253115	-0.0695767	-0.1106062
191	0.3145208	1489.115	8.212169	-.03239468	-.04946001	-.09261846
192	0.3162917	1495.918	8.205456	-0.0123157	-.02927636	-.07418934
193	0.3180625	1502.692	8.198752	.007708541	-.00903927	-.05526653
194	0.3198333	1509.437	8.192055	0.02768057	0.01123635	-.03581502
195	0.3216042	1516.148	8.185366	0.04760288	0.03153546	-.01582121
196	0.323375	1522.824	8.17869	0.06747814	0.05184404	0.00470579
197	0.3251458	1529.462	8.172031	0.08730938	0.07214993	0.02573496
198	0.3269167	1536.06	8.165396	0.1071001	0.09244327	0.04721664
199	0.3286875	1542.618	8.158789	0.1268544	0.1127165	0.06908835
200	0.3304583	1549.131	8.152213	0.1465765	0.1329644	0.09128244
201	0.3322292	1555.6	8.145667	0.1662712	0.1531838	0.1137341
202	0.334	1562.022	8.139153	0.1859432	0.173374	0.1363887
203	0.3359167	1568.556	8.132501	0.2055974	0.1935374	0.1592062
204	0.3378333	1575.211	8.125421	0.2252383	0.2136807	0.182164
205	0.33975	1581.865	8.117883	0.2448706	0.2338155	0.2052548
206	0.3416667	1588.488	8.110139	0.2644984	0.2539585	0.2284824
207	0.3435833	1595.07	8.102507	0.2841264	0.2741308	0.2518551
208	0.3455	1601.613	8.095222	0.3037615	0.294358	0.2753798
209	0.3474167	1608.119	8.088367	0.323416	0.3146688	0.2990571
210	0.3493333	1614.588	8.081867	0.3431047	0.3350945	0.3228798
211	0.35125	1621.012	8.075558	0.3628286	0.3556674	0.3468321
212	0.3531667	1627.379	8.069265	0.3825742	0.3764187	0.3708911
213	0.3550833	1633.681	8.062868	0.4023401	0.3973747	0.3950292
214	0.357	1639.91	8.056335	0.4221237	0.4185534	0.4192162
215	0.3589167	1646.061	8.049713	0.4419214	0.4399607	0.4434222
216	0.3608333	1652.137	8.04309	0.4617322	0.4615914	0.4676198
217	0.36275	1658.141	8.036554	0.4815532	0.4834338	0.4917857
218	0.3646667	1664.077	8.030162	0.5013843	0.5054727	0.5159014
219	0.3665833	1669.948	8.02392	0.5212269	0.5276881	0.5399533
220	0.3685	1675.757	8.017795	0.5410869	0.5500537	0.5639323
221	0.3704167	1681.504	8.011737	0.5609753	0.5725422	0.5878326
222	0.3723333	1687.189	8.005696	0.5809099	0.595129	0.6116512
223	0.37425	1692.811	7.999642	0.6009157	0.617795	0.6353871
224	0.3761667	1698.373	7.993571	0.6210255	0.6405284	0.659041
225	0.3780833	1703.875	7.987498	0.6412791	0.6633248	0.6826149
226	0.38	1709.323	7.981443	0.6617231	0.6861861	0.7061119
227	0.3819167	1714.721	7.975424	0.6824085	0.7091174	0.729536
228	0.3838333	1720.074	7.969444	0.7033891	0.7321235	0.7528917
229	0.38575	1725.388	7.963497	0.7247174	0.7552052	0.7761836
230	0.3876667	1730.666	7.957565	0.7464415	0.7783581	0.799416
231	0.3895833	1735.912	7.951631	0.7685998	0.8015732	0.8225925
232	0.3915	1741.129	7.945679	0.7912178	0.8248392	0.8457156

233	0.3934167	1746.318	7.939705	0.8143046	0.8481433	0.868786
234	0.3953333	1751.483	7.933712	0.8378521	0.8714715	0.8918017
235	0.39725	1756.626	7.927707	0.8618354	0.8948102	0.9147586
236	0.3991667	1761.749	7.921698	0.8862161	0.9181478	0.9376515
237	0.4010833	1766.855	7.915691	0.9109464	0.9414758	0.9604766
238	0.403	1771.944	7.909688	0.9359746	0.9647903	0.9832339
239	0.4049167	1777.017	7.903688	0.9612504	0.9880923	1.005927
240	0.4068333	1782.074	7.89769	0.9867301	1.011388	1.028564
241	0.40875	1787.115	7.891693	1.012379	1.03469	1.05115
242	0.4106667	1792.138	7.885699	1.038174	1.058014	1.073692
243	0.4125833	1797.144	7.87971	1.064102	1.081382	1.096195
244	0.4145	1802.132	7.873728	1.090156	1.104817	1.118665
245	0.4164167	1807.102	7.867754	1.116334	1.128344	1.14111
246	0.4183333	1812.054	7.861789	1.142634	1.151991	1.16354
247	0.42025	1816.987	7.855832	1.16905	1.17578	1.185961
248	0.4221667	1821.901	7.849884	1.195571	1.199733	1.208381
249	0.4240833	1826.795	7.843947	1.222182	1.223865	1.230803
250	0.426	1831.668	7.838021	1.248859	1.248184	1.253229
251	0.4280625	1836.633	7.831991	1.27558	1.272692	1.275656
252	0.430125	1841.705	7.825643	1.302318	1.29738	1.298083
253	0.4321875	1846.804	7.81893	1.329047	1.322236	1.320508
254	0.43425	1851.905	7.812012	1.355745	1.347241	1.342933
255	0.4363125	1856.998	7.805107	1.382391	1.372373	1.365361
256	0.438375	1862.083	7.798396	1.408973	1.397609	1.387797
257	0.4404375	1867.161	7.791956	1.435485	1.422929	1.41025
258	0.4425	1872.232	7.785756	1.461927	1.448315	1.432733
259	0.4445625	1877.293	7.779694	1.488294	1.473757	1.455264
260	0.446625	1882.337	7.773652	1.514576	1.499248	1.477868
261	0.4486875	1887.354	7.767546	1.540771	1.524785	1.500574
262	0.45075	1892.336	7.761351	1.56688	1.550369	1.523419
263	0.4528125	1897.28	7.755095	1.592905	1.575994	1.546442
264	0.454875	1902.181	7.748839	1.618849	1.601656	1.569688
265	0.4569375	1907.041	7.742647	1.644715	1.627351	1.593204
266	0.459	1911.861	7.736557	1.670508	1.653074	1.617034
267	0.4610625	1916.642	7.730577	1.696229	1.678822	1.64122
268	0.463125	1921.384	7.724689	1.721881	1.704585	1.665797
269	0.4651875	1926.086	7.71886	1.747465	1.730354	1.69079
270	0.46725	1930.744	7.713063	1.772982	1.756116	1.71621
271	0.4693125	1935.357	7.707281	1.798433	1.78186	1.742058
272	0.471375	1939.923	7.701515	1.823815	1.807574	1.768321
273	0.4734375	1944.44	7.69578	1.849128	1.833253	1.794973
274	0.4755	1948.908	7.690095	1.874372	1.85889	1.821981
275	0.4775625	1953.328	7.684474	1.899545	1.884486	1.849307
276	0.479625	1957.699	7.678925	1.924651	1.910041	1.876909
277	0.4816875	1962.023	7.673445	1.949691	1.935557	1.904749
278	0.48375	1966.298	7.668029	1.974671	1.96104	1.932796
279	0.4858125	1970.523	7.662668	1.999597	1.986495	1.961021
280	0.487875	1974.699	7.657356	2.024475	2.011936	1.989405
281	0.4899375	1978.825	7.652089	2.049312	2.037377	2.01793
282	0.492	1982.902	7.646868	2.074113	2.062838	2.046583
283	0.4940625	1986.928	7.641698	2.098886	2.088338	2.075349
284	0.496125	1990.904	7.636585	2.123636	2.1139	2.104212
285	0.4981875	1994.827	7.631535	2.148366	2.139547	2.133153
286	0.50025	1998.699	7.626553	2.173082	2.1653	2.162155
287	0.5023125	2002.517	7.621642	2.197785	2.191179	2.191197
288	0.504375	2006.28	7.616805	2.222476	2.2172	2.220257
289	0.5064375	2009.985	7.612045	2.247155	2.243375	2.249312
290	0.5085	2013.629	7.607368	2.271821	2.269709	2.278337
291	0.5105625	2017.21	7.60278	2.296474	2.296202	2.307311
292	0.512625	2020.722	7.59829	2.321119	2.322849	2.336214
293	0.5146875	2024.165	7.593906	2.345759	2.349641	2.365031
294	0.51675	2027.533	7.589633	2.370405	2.376564	2.393754
295	0.5188125	2030.825	7.585478	2.39507	2.403602	2.422376
296	0.520875	2034.037	7.581443	2.41977	2.430739	2.450892
297	0.5229375	2037.167	7.577529	2.444528	2.457959	2.479301
298	0.525	2040.212	7.573739	2.469372	2.485251	2.5076
299	0.5269583	2043.119	7.570126	2.494334	2.512602	2.535787
300	0.5289167	2045.875	7.566796	2.519449	2.540002	2.563864
301	0.530875	2048.514	7.563777	2.544758	2.567444	2.591833
302	0.5328333	2051.048	7.561003	2.5703	2.594921	2.619695
303	0.5347917	2053.482	7.558373	2.596113	2.622423	2.647454
304	0.53675	2055.815	7.555803	2.622231	2.649944	2.675112
305	0.5387083	2058.045	7.553251	2.648679	2.677472	2.702672
306	0.5406667	2060.172	7.550727	2.675476	2.704998	2.730134
307	0.542625	2062.196	7.548275	2.702631	2.732509	2.7575
308	0.5445833	2064.119	7.545949	2.730151	2.759996	2.784769
309	0.5465417	2065.944	7.543791	2.758024	2.787447	2.811941
310	0.5485	2067.675	7.541818	2.786231	2.814857	2.839016
311	0.5504583	2069.311	7.540022	2.814746	2.84222	2.865994
312	0.5524167	2070.855	7.538378	2.843535	2.869536	2.892874
313	0.554375	2072.306	7.536859	2.872565	2.896809	2.91966

314	0.5563333	2073.664	7.535447	2.9018	2.924045	2.946353
315	0.5582917	2074.929	7.534132	2.931209	2.951251	2.972956
316	0.56025	2076.102	7.532917	2.960765	2.978443	2.999473
317	0.5622083	2077.184	7.531812	2.990444	3.005636	3.025908
318	0.5641667	2078.178	7.530824	3.020224	3.032848	3.052266
319	0.566125	2079.088	7.529957	3.050089	3.060097	3.078549
320	0.5680833	2079.914	7.529209	3.080019	3.087402	3.104762
321	0.5700417	2080.661	7.528571	3.109998	3.114778	3.130906
322	0.572	2081.33	7.528033	3.140005	3.14224	3.156983
323	0.5739583	2081.923	7.527586	3.170022	3.169798	3.182995
324	0.5759167	2082.442	7.527226	3.200027	3.197458	3.208941
325	0.577875	2082.889	7.52695	3.229999	3.22522	3.234822
326	0.5798333	2083.266	7.526758	3.259916	3.253083	3.260637
327	0.5817917	2083.574	7.526654	3.289757	3.281039	3.286387
328	0.58375	2083.815	7.526637	3.319502	3.309076	3.312076
329	0.5857083	2083.992	7.526707	3.349136	3.337179	3.337709
330	0.5876667	2084.105	7.526863	3.378643	3.365334	3.363297
331	0.589625	2084.156	7.527101	3.408014	3.393525	3.388855
332	0.5915833	2084.148	7.527416	3.437241	3.421738	3.414401
333	0.5935417	2084.08	7.527807	3.46632	3.44996	3.439958
334	0.5955	2083.955	7.52827	3.495248	3.478182	3.465551
335	0.5974583	2083.773	7.528805	3.524025	3.506395	3.49121
336	0.5994167	2083.536	7.529411	3.55265	3.534592	3.516966
337	0.601375	2083.244	7.530088	3.581124	3.562766	3.542854
338	0.6033333	2082.9	7.530834	3.609451	3.590909	3.568911
339	0.6052917	2082.505	7.531649	3.637631	3.619016	3.595171
340	0.60725	2082.059	7.53253	3.665669	3.647077	3.621668
341	0.6092083	2081.563	7.533476	3.693569	3.675084	3.648429
342	0.6111667	2081.018	7.534486	3.721332	3.703027	3.675475
343	0.613125	2080.426	7.535559	3.748961	3.730897	3.70282
344	0.6150833	2079.786	7.536692	3.776459	3.758684	3.730471
345	0.6170417	2079.101	7.537886	3.803827	3.786379	3.758424
346	0.619	2078.37	7.53914	3.831067	3.813976	3.786669
347	0.6213542	2077.707	7.540335	3.858181	3.841468	3.815188
348	0.6237083	2077.136	7.541248	3.88517	3.868855	3.843958
349	0.6260625	2076.589	7.541804	3.912038	3.896138	3.87295
350	0.6284167	2076.04	7.542129	3.938786	3.923324	3.902134
351	0.6307708	2075.478	7.542433	3.965419	3.950421	3.931481
352	0.633125	2074.903	7.5429	3.991944	3.97744	3.960962
353	0.6354792	2074.319	7.543626	4.018372	4.004396	3.990552
354	0.6378333	2073.73	7.5446	4.044716	4.031304	4.020227
355	0.6401875	2073.133	7.545735	4.07098	4.058181	4.049966
356	0.6425417	2072.525	7.546918	4.097157	4.085046	4.07975
357	0.6448958	2071.898	7.548063	4.123252	4.111918	4.10956
358	0.64725	2071.244	7.549137	4.149266	4.138814	4.139376
359	0.6496042	2070.556	7.550163	4.175199	4.165746	4.169179
360	0.6519583	2069.831	7.551199	4.201055	4.192727	4.198949
361	0.6543125	2069.067	7.552307	4.226833	4.219767	4.228666
362	0.6566667	2068.263	7.553534	4.252535	4.246876	4.258311
363	0.6590208	2067.417	7.554901	4.278162	4.274063	4.287864
364	0.661375	2066.526	7.5564	4.303717	4.301329	4.317309
365	0.6637292	2065.587	7.55801	4.329206	4.328672	4.346631
366	0.6660833	2064.593	7.55971	4.354638	4.356086	4.375817
367	0.6684375	2063.54	7.561489	4.380025	4.383564	4.404859
368	0.6707917	2062.42	7.56335	4.405386	4.411095	4.433749
369	0.6731458	2061.231	7.565308	4.430741	4.438669	4.462486
370	0.6755	2059.968	7.567382	4.456113	4.466276	4.491068
371	0.6778542	2058.629	7.569589	4.481532	4.493904	4.519497
372	0.6802083	2057.211	7.571937	4.507026	4.521542	4.547775
373	0.6825625	2055.712	7.574426	4.532626	4.549178	4.575905
374	0.6849167	2054.131	7.577051	4.558364	4.576798	4.603893
375	0.6872708	2052.467	7.579802	4.584272	4.604391	4.63174
376	0.689625	2050.716	7.582672	4.61038	4.631947	4.65945
377	0.6919792	2048.879	7.585657	4.636713	4.659456	4.687024
378	0.6943333	2046.953	7.588759	4.663291	4.686907	4.714458
379	0.6966875	2044.939	7.59198	4.690129	4.71429	4.741749
380	0.6990417	2042.836	7.595324	4.717233	4.741598	4.768894
381	0.7013958	2040.644	7.598794	4.744602	4.768821	4.795892
382	0.70375	2038.363	7.602389	4.772229	4.795953	4.822742
383	0.7061042	2035.994	7.606108	4.800098	4.82299	4.849447
384	0.7084583	2033.537	7.609945	4.828189	4.849932	4.87601
385	0.7108125	2030.994	7.613894	4.856477	4.876781	4.90243
386	0.7131667	2028.365	7.61795	4.884934	4.903542	4.92871
387	0.7155208	2025.652	7.622108	4.913531	4.930224	4.954854
388	0.717875	2022.856	7.626366	4.942241	4.956839	4.980865
389	0.7202292	2019.979	7.630722	4.971035	4.9834	5.006748
390	0.7225833	2017.022	7.635172	4.999887	5.009922	5.032509
391	0.7249375	2013.988	7.639715	5.028774	5.036423	5.058152
392	0.7272917	2010.879	7.644348	5.057673	5.062918	5.083679
393	0.7296458	2007.696	7.649065	5.086562	5.089422	5.109091
394	0.732	2004.442	7.653863	5.11542	5.115948	5.134387

395	0.7345625	2001.144	7.65871	5.144228	5.142507	5.159566
396	0.737125	1997.811	7.663551	5.172963	5.169104	5.184629
397	0.7396875	1994.428	7.668366	5.201606	5.195742	5.209577
398	0.74225	1990.992	7.673181	5.230139	5.222419	5.234411
399	0.7448125	1987.502	7.678042	5.258543	5.249129	5.259135
400	0.747375	1983.958	7.682994	5.286804	5.275864	5.283753
401	0.7499375	1980.365	7.688055	5.314909	5.302615	5.308274
402	0.7525	1976.723	7.693223	5.342849	5.329369	5.332706
403	0.7550625	1973.036	7.698472	5.370614	5.356116	5.357066
404	0.757625	1969.303	7.703773	5.398198	5.382842	5.381369
405	0.7601875	1965.525	7.7091	5.425596	5.409538	5.405638
406	0.76275	1961.701	7.714441	5.452807	5.43619	5.429897
407	0.7653125	1957.833	7.719799	5.479834	5.462787	5.454173
408	0.767875	1953.921	7.725185	5.506678	5.48932	5.478495
409	0.7704375	1949.966	7.730611	5.533343	5.515779	5.502893
410	0.773	1945.971	7.736085	5.559832	5.542157	5.527398
411	0.7755625	1941.938	7.74161	5.586147	5.568445	5.552038
412	0.778125	1937.868	7.747179	5.612291	5.594634	5.576841
413	0.7806875	1933.762	7.752784	5.638265	5.620716	5.601829
414	0.78325	1929.62	7.758417	5.664069	5.64668	5.62702
415	0.7858125	1925.444	7.764072	5.689702	5.67252	5.652426
416	0.788375	1921.233	7.769748	5.715165	5.698226	5.678054
417	0.7909375	1916.988	7.775447	5.740456	5.723794	5.703902
418	0.7935	1912.709	7.781173	5.765578	5.74922	5.729963
419	0.7960625	1908.398	7.786929	5.790533	5.774502	5.756224
420	0.798625	1904.055	7.792716	5.815323	5.799641	5.782667
421	0.8011875	1899.681	7.798531	5.839952	5.824639	5.80927
422	0.80375	1895.277	7.804373	5.864423	5.849501	5.836009
423	0.8063125	1890.842	7.810239	5.888741	5.874236	5.862858
424	0.808875	1886.374	7.816128	5.91291	5.898854	5.88979
425	0.8114375	1881.875	7.822045	5.936935	5.923369	5.916779
426	0.814	1877.341	7.827994	5.960819	5.947793	5.943798
427	0.8165625	1872.772	7.833981	5.984568	5.972143	5.970823
428	0.819125	1868.166	7.840011	6.008183	5.996433	5.99783
429	0.8216875	1863.521	7.846087	6.031666	6.02068	6.024795
430	0.82425	1858.836	7.852211	6.055018	6.044897	6.051699
431	0.8268125	1854.109	7.858386	6.078241	6.069097	6.078521
432	0.829375	1849.338	7.864613	6.101334	6.093291	6.105242
433	0.8319375	1844.519	7.870894	6.124299	6.117488	6.131843
434	0.8345	1839.65	7.877233	6.14714	6.141694	6.158306
435	0.8370625	1834.728	7.883634	6.169862	6.165914	6.184616
436	0.839625	1829.751	7.890102	6.19247	6.190147	6.210759
437	0.8421875	1824.717	7.89664	6.214975	6.214394	6.236725
438	0.84475	1819.622	7.903251	6.237389	6.238649	6.262503
439	0.8473125	1814.464	7.909937	6.259726	6.262907	6.288088
440	0.849875	1809.242	7.916698	6.282005	6.287158	6.313475
441	0.8524375	1803.953	7.923535	6.304247	6.311393	6.338661
442	0.855	1798.596	7.930446	6.326477	6.335601	6.363646
443	0.8580208	1793.191	7.937408	6.348719	6.359771	6.388431
444	0.8610417	1787.741	7.944378	6.371002	6.38389	6.413017
445	0.8640625	1782.236	7.951337	6.393353	6.407948	6.437407
446	0.8670833	1776.674	7.958298	6.415798	6.431932	6.461604
447	0.8701042	1771.055	7.965292	6.438363	6.45583	6.485609
448	0.873125	1765.38	7.972345	6.46107	6.479632	6.509425
449	0.8761458	1759.654	7.979468	6.483938	6.503329	6.533051
450	0.8791667	1753.881	7.986653	6.506983	6.526912	6.556488
451	0.8821875	1748.063	7.993876	6.530212	6.550374	6.579736
452	0.8852083	1742.204	8.001111	6.553626	6.573709	6.602796
453	0.8882292	1736.305	8.008339	6.57722	6.596914	6.625666
454	0.89125	1730.367	8.015549	6.600985	6.619986	6.64835
455	0.8942708	1724.392	8.022744	6.624909	6.642926	6.670847
456	0.8972917	1718.383	8.029933	6.648971	6.665736	6.693162
457	0.9003125	1712.341	8.037125	6.673151	6.688422	6.715295
458	0.9033333	1706.271	8.044328	6.697424	6.710992	6.737252
459	0.9063542	1700.172	8.051542	6.721767	6.733458	6.759036
460	0.909375	1694.046	8.058765	6.746152	6.755832	6.780649
461	0.9123958	1687.893	8.065994	6.770555	6.778126	6.802095
462	0.9154167	1681.71	8.073228	6.79495	6.800354	6.823378
463	0.9184375	1675.499	8.080468	6.819312	6.82253	6.844501
464	0.9214583	1669.257	8.087717	6.84362	6.844665	6.865465
465	0.9244792	1662.985	8.09498	6.86785	6.86677	6.886274
466	0.9275	1656.68	8.102259	6.891982	6.888855	6.906929
467	0.9305208	1650.344	8.109554	6.915997	6.910923	6.927434
468	0.9335417	1643.975	8.116866	6.939876	6.932978	6.947791
469	0.9365625	1637.573	8.124192	6.963601	6.955018	6.968006
470	0.9395833	1631.138	8.131529	6.987157	6.97704	6.988086
471	0.9426042	1624.669	8.138875	7.010529	6.999036	7.008039
472	0.945625	1618.166	8.14623	7.033708	7.020999	7.027876
473	0.9486458	1611.629	8.153593	7.056682	7.04292	7.04761
474	0.9516667	1605.058	8.160963	7.079445	7.064789	7.067256
475	0.9546875	1598.452	8.168342	7.101993	7.086594	7.086833

476	0.9577083	1591.811	8.17573	7.124322	7.108324	7.106361
477	0.9607292	1585.137	8.183128	7.146431	7.129969	7.125864
478	0.96375	1578.432	8.190529	7.168322	7.151518	7.145367
479	0.9667708	1571.697	8.197925	7.189994	7.172962	7.164897
480	0.9697917	1564.933	8.205311	7.211451	7.194291	7.184479
481	0.9728125	1558.142	8.212681	7.232695	7.215495	7.204138
482	0.9758333	1551.324	8.220035	7.253728	7.236566	7.223898
483	0.9788542	1544.48	8.227374	7.274552	7.257495	7.243778
484	0.981875	1537.612	8.234701	7.295169	7.278274	7.263796
485	0.9848958	1530.722	8.242016	7.315582	7.298897	7.283964
486	0.9879167	1523.81	8.249318	7.335793	7.319357	7.304289
487	0.9909375	1516.878	8.256606	7.355804	7.339651	7.324773
488	0.9939583	1509.927	8.263876	7.375616	7.359775	7.345412
489	0.9969792	1502.958	8.271124	7.395232	7.379729	7.366197
490	1	1495.973	8.278349	7.414654	7.399513	7.387113
491	1	1488.942	8.285579	7.433886	7.419131	7.408144
492	1	1481.86	8.292872	7.45293	7.438587	7.42927
493	1	1474.744	8.300251	7.471791	7.457888	7.450467
494	1	1467.604	8.307677	7.490472	7.477044	7.471712
495	1	1460.444	8.315088	7.508976	7.496064	7.492979
496	1	1453.266	8.322425	7.527307	7.514961	7.514244
497	1	1446.069	8.32966	7.545465	7.533747	7.535481
498	1	1438.851	8.336798	7.563452	7.552434	7.556668
499	1	1431.612	8.343871	7.581271	7.571037	7.577781
500	1	1424.355	8.350923	7.598927	7.589566	7.598798
501	1	1417.082	8.357984	7.616424	7.608035	7.619699
502	1	1409.796	8.365067	7.633766	7.626455	7.640463
503	1	1402.498	8.372163	7.650957	7.644836	7.661075
504	1	1395.189	8.379251	7.668002	7.663186	7.681516
505	1	1387.866	8.386308	7.684909	7.681509	7.701773
506	1	1380.528	8.393322	7.701687	7.699808	7.721833
507	1	1373.171	8.400293	7.718348	7.718081	7.741686
508	1	1365.795	8.407235	7.734906	7.736325	7.761324
509	1	1358.398	8.414163	7.751376	7.754536	7.78074
510	1	1350.98	8.421094	7.767776	7.772708	7.79993
511	1	1343.539	8.428034	7.784128	7.790832	7.818891
512	1	1336.076	8.434981	7.800451	7.808898	7.837621
513	1	1328.59	8.441926	7.81677	7.826897	7.856122
514	1	1321.079	8.448859	7.833108	7.844815	7.874393
515	1	1313.543	8.455771	7.849487	7.862643	7.892437
516	1	1305.98	8.46266	7.865931	7.88037	7.910254
517	1	1298.391	8.469526	7.882461	7.897985	7.927848
518	1	1290.773	8.476376	7.899092	7.915479	7.94522
519	1	1283.129	8.483213	7.91584	7.932845	7.962373
520	1	1275.459	8.490039	7.932714	7.950074	7.97931
521	1	1267.763	8.496852	7.949719	7.967162	7.996035
522	1	1260.041	8.503648	7.966856	7.984103	8.012554
523	1	1252.296	8.510421	7.984118	8.000895	8.02887
524	1	1244.525	8.517168	8.001499	8.017539	8.044987
525	1	1236.732	8.523885	8.018982	8.034035	8.06091
526	1	1228.914	8.530572	8.036553	8.050389	8.076641
527	1	1221.075	8.537231	8.054191	8.066604	8.092183
528	1	1213.213	8.543864	8.071875	8.08269	8.10754
529	1	1205.331	8.550469	8.08958	8.098655	8.122716
530	1	1197.429	8.557047	8.107284	8.114509	8.137715
531	1	1189.509	8.563595	8.124962	8.130262	8.15254
532	1	1181.571	8.570108	8.14259	8.145926	8.167192
533	1	1173.618	8.576583	8.160145	8.161509	8.181674
534	1	1165.648	8.583019	8.177606	8.177023	8.195989
535	1	1157.665	8.589414	8.194951	8.192473	8.210139
536	1	1149.669	8.595768	8.21216	8.207866	8.224128
537	1	1141.661	8.602079	8.229216	8.223204	8.237962
538	1	1133.644	8.608349	8.246102	8.238491	8.251646
539	1	1125.618	8.614574	8.262803	8.253725	8.265186
540	1	1117.585	8.620755	8.279306	8.268905	8.278592
541	1	1109.547	8.626886	8.295601	8.284027	8.291872
542	1	1101.504	8.632968	8.311679	8.299084	8.30504
543	1	1093.459	8.638999	8.327532	8.314071	8.318108
544	1	1085.413	8.644977	8.343156	8.328979	8.331094
545	1	1077.367	8.650902	8.358547	8.343798	8.344015
546	1	1069.322	8.656775	8.373704	8.35852	8.356891
547	1	1061.281	8.662595	8.388625	8.373136	8.369743
548	1	1053.243	8.668361	8.403312	8.387635	8.382592
549	1	1045.211	8.674073	8.417766	8.402009	8.395459
550	1	1037.186	8.679729	8.43199	8.416249	8.408366
551	1	1029.167	8.685331	8.445986	8.430347	8.421332
552	1	1021.157	8.690877	8.459758	8.444295	8.434374
553	1	1013.154	8.696371	8.47331	8.458086	8.447505
554	1	1005.161	8.701813	8.486646	8.471715	8.460737
555	1	997.1788	8.707203	8.499769	8.485177	8.474075
556	1	989.2072	8.712539	8.512685	8.498469	8.487524

557	1	981.242	8.717824	8.525399	8.511588	8.501079
558	1	973.2846	8.723067	8.537917	8.524533	8.514737
559	1	965.3396	8.728264	8.550242	8.537307	8.528487
560	1	957.4083	8.733408	8.562378	8.54991	8.542315
561	1	949.4913	8.738489	8.574329	8.56235	8.556205
562	1	941.5883	8.743501	8.586097	8.574632	8.570138
563	1	933.6991	8.748448	8.597688	8.586764	8.584093
564	1	925.8236	8.753335	8.609105	8.598756	8.598049
565	1	917.9621	8.758172	8.620354	8.610618	8.611983
566	1	910.115	8.762965	8.63144	8.62236	8.625873
567	1	902.2824	8.767718	8.642367	8.633992	8.639696
568	1	894.4645	8.772429	8.653136	8.645527	8.653432
569	1	886.6605	8.777096	8.663752	8.656975	8.66706
570	1	878.8693	8.781714	8.674218	8.668349	8.680561
571	1	871.0894	8.786284	8.684539	8.679658	8.693918
572	1	863.319	8.790809	8.69472	8.690911	8.707113
573	1	855.5561	8.795294	8.704769	8.702113	8.720133
574	1	847.799	8.799747	8.714693	8.713271	8.732965
575	1	840.0458	8.804172	8.724501	8.724386	8.745598
576	1	832.2944	8.808575	8.734204	8.735459	8.758022
577	1	824.5426	8.812955	8.743813	8.746488	8.770231
578	1	816.7877	8.817312	8.753344	8.757469	8.782218
579	1	809.027	8.821646	8.762812	8.768398	8.793981
580	1	801.2573	8.825957	8.772233	8.779267	8.805517
581	1	793.4758	8.830245	8.781625	8.79007	8.816827
582	1	785.6797	8.834516	8.791007	8.800798	8.827911
583	1	777.8663	8.83877	8.800397	8.811443	8.83877
584	1	770.0331	8.843011	8.809814	8.821994	8.849406
585	1	762.178	8.847238	8.819273	8.832443	8.859822
586	1	754.2987	8.851451	8.82879	8.84278	8.87002
587	1	746.3928	8.855648	8.838377	8.852997	8.880005
588	1	738.4568	8.859829	8.848044	8.863087	8.88978
589	1	730.488	8.863996	8.857795	8.873044	8.899351
590	1	722.4852	8.868152	8.867633	8.882863	8.908724
591	1	714.4478	8.872293	8.877557	8.89254	8.917903
592	1	706.3745	8.876416	8.887561	8.902075	8.926893
593	1	698.2641	8.880517	8.897636	8.911466	8.935698
594	1	690.1149	8.884592	8.90777	8.920715	8.944323
595	1	681.9224	8.888646	8.917944	8.929825	8.952771
596	1	673.6673	8.892706	8.92814	8.938801	8.961048
597	1	665.3456	8.896809	8.938338	8.947646	8.969155
598	1	656.9684	8.900963	8.94852	8.956369	8.977098
599	1	648.5394	8.905136	8.958663	8.964978	8.984879
600	1	640.0574	8.909278	8.968742	8.973481	8.992503
601	1	631.5175	8.913355	8.978731	8.981888	8.999972
602	1	622.9128	8.917359	8.988602	8.990205	9.007291
603	1	614.2362	8.921317	8.998329	8.998441	9.014463
604	1	605.4821	8.925273	9.007902	9.006599	9.02149
605	1	596.6316	8.929287	9.017308	9.014683	9.028378
606	1	587.6581	8.933438	9.026529	9.02269	9.035131
607	1	578.5474	8.937786	9.035545	9.030618	9.041754
608	1	569.2829	8.942352	9.044342	9.038465	9.048255
609	1	559.911	8.947047	9.052903	9.046235	9.054642
610	1	550.4157	8.95171	9.061211	9.053928	9.060924
611	1	540.7839	8.956227	9.069242	9.061538	9.067112
612	1	531.0802	8.960486	9.076971	9.069062	9.073218
613	1	521.3513	8.964348	9.08438	9.076493	9.079255
614	1	511.6244	8.96773	9.091465	9.083825	9.085239
615	1	501.9127	8.970659	9.098234	9.091045	9.091183
616	1	492.2257	8.973271	9.104719	9.098132	9.097104
617	1	482.5751	8.975757	9.110974	9.105059	9.103019
618	1	472.9765	8.978284	9.117042	9.111795	9.108942
619	1	463.4459	8.980934	9.12293	9.118314	9.114891
620	1	453.9908	8.983687	9.128641	9.124599	9.120879
621	1	444.6039	8.986459	9.13418	9.130655	9.126917
622	1	435.2637	8.989166	9.139545	9.136504	9.133011
623	1	425.9462	8.991771	9.144743	9.142163	9.139166
624	1	416.6322	8.994298	9.14978	9.147645	9.14538
625	1	407.3122	8.996801	9.154661	9.152957	9.15165
626	1	397.9935	8.999324	9.159391	9.158104	9.157967
627	1	388.697	9.00185	9.163969	9.163089	9.164324
628	1	379.4455	9.004296	9.168377	9.167912	9.170715
629	1	370.2544	9.006546	9.172588	9.172569	9.17713
630	1	361.1293	9.008515	9.17658	9.177049	9.183553
631	1	352.0688	9.010191	9.180358	9.181348	9.189966
632	1	343.0705	9.011644	9.183948	9.185465	9.196344
633	1	334.1361	9.012995	9.187387	9.189421	9.202655
634	1	325.2725	9.01436	9.19071	9.193252	9.208862
635	1	316.4885	9.015804	9.193937	9.196998	9.214918
636	1	307.79	9.017322	9.197077	9.20068	9.220775
637	1	299.1756	9.018852	9.200138	9.204301	9.226386

638	1	290.635	9.020319	9.203119	9.207863	9.231719
639	1	282.1523	9.021678	9.206014	9.211375	9.236758
640	1	273.7133	9.022935	9.208821	9.214848	9.241509
641	1	265.309	9.024132	9.21155	9.21829	9.245992
642	1	256.9373	9.025325	9.214216	9.221702	9.25023
643	1	248.602	9.026546	9.216824	9.225073	9.254239
644	1	240.3091	9.027788	9.219377	9.228387	9.258025
645	1	232.0641	9.029005	9.221863	9.231623	9.261586
646	1	223.8687	9.030135	9.224266	9.234766	9.264913
647	1	215.721	9.031132	9.226571	9.237819	9.267995
648	1	207.6167	9.031985	9.228791	9.240799	9.270819
649	1	199.5517	9.032726	9.230959	9.243724	9.273373
650	1	191.5243	9.033414	9.233113	9.2466	9.275655
651	1	183.5354	9.034107	9.235281	9.249424	9.277676
652	1	175.5879	9.034838	9.23748	9.252182	9.279464
653	1	167.6842	9.035603	9.239728	9.254852	9.281057
654	1	159.8235	9.036367	9.242037	9.257409	9.282489
655	1	152.0003	9.037086	9.244414	9.259827	9.283785
656	1	144.2056	9.037733	9.246864	9.262098	9.284949
657	1	136.4301	9.038309	9.249391	9.264219	9.285983
658	1	128.6672	9.038844	9.251991	9.266191	9.28689
659	1	120.915	9.039371	9.254656	9.268007	9.287678
660	1	113.1757	9.039914	9.257379	9.269655	9.288348
661	1	105.4537	9.040467	9.260157	9.271129	9.288889
662	1	97.75387	9.040994	9.262982	9.272436	9.289284
663	1	90.07991	9.041448	9.265832	9.273569	9.28952
664	1	82.43459	9.041788	9.268671	9.274557	9.289589
665	1	74.82028	9.041993	9.271461	9.275448	9.289484
666	1	67.24008	9.042071	9.274164	9.276235	9.289246
667	1	59.69838	9.042053	9.276755	9.276902	9.288937
668	1	52.20109	9.04198	9.279211	9.277462	9.28854
669	1	44.75503	9.041881	9.281512	9.277928	9.28806
670	1	37.36694	9.041767	9.283631	9.278311	9.287534
671	1	30.04206	9.041629	9.285542	9.278626	9.286964
672	1	22.78342	9.041443	9.287227	9.278889	9.286343
673	1	15.59192	9.041184	9.288678	9.279118	9.285671
674	1	8.46708	9.040843	9.289894	9.279323	9.284949
675	1	1.40887	9.040427	9.290883	9.279495	9.284178
676	1	-3.950411	9.038268	9.291652	9.27962	9.283359
677	1	-9.274462	9.033383	9.292213	9.279692	9.282489
678	1	-15.95536	9.028951	9.292574	9.27971	9.281558
679	1	-22.86861	9.028207	9.292757	9.279673	9.280557
680	1	-29.65717	9.031457	9.29285	9.279561	9.279479
681	1	-36.09427	9.036956	9.293082	9.279324	9.27833
682	1	-42.17334	9.041931	9.293679	9.278897	9.277129
683	1	-48.03612	9.043986	9.29423	9.278239	9.275906
684	1	-53.90069	9.042192	9.293634	9.27741	9.274692
685	1	-60.63411	9.038146	9.291853	9.276626	9.273512
686	1	-68.24787	9.035138	9.290233	9.27612	9.272387
687	1	-75.41171	9.034659	9.28876	9.275838	9.271328
688	1	-81.86934	9.035614	9.28699	9.275355	9.270343
689	1	-87.99252	9.036528	9.285144	9.27436	9.269436
690	1	-93.88403	9.036457	9.282971	9.273065	9.268607
691	1	-99.65452	9.035045	9.28022	9.271759	9.267852
692	1	-105.3771	9.032619	9.27719	9.270395	9.267164
693	1	-111.0783	9.029968	9.274792	9.269013	9.266528
694	1	-116.7291	9.027946	9.273372	9.26771	9.265927
695	1	-122.4134	9.02722	9.27167	9.26623	9.265339
696	1	-128.1993	9.028137	9.269077	9.26425	9.264743
697	1	-133.8154	9.030229	9.266477	9.26191	9.264119
698	1	-139.0235	9.032084	9.264019	9.259739	9.263441
699	1	-143.9412	9.032269	9.261347	9.257788	9.262677
700	1	-148.7611	9.030302	9.258564	9.255592	9.261794
701	1	-153.5841	9.026788	9.255683	9.25308	9.260788
702	1	-158.4424	9.02302	9.252513	9.250589	9.259705
703	1	-163.2843	9.020344	9.248924	9.248218	9.258645
704	1	-168.0022	9.019524	9.245337	9.245666	9.257713
705	1	-172.4931	9.020424	9.242574	9.242676	9.256927
706	1	-176.7582	9.022182	9.240333	9.239592	9.256157
707	1	-180.8867	9.023733	9.2375	9.236833	9.255165
708	1	-184.9048	9.024221	9.234207	9.234191	9.253765
709	1	-188.7998	9.023201	9.231141	9.231484	9.251959
710	1	-192.6341	9.020832	9.228176	9.228911	9.249923
711	1	-196.4949	9.017914	9.225186	9.226598	9.247818
712	1	-200.3689	9.015511	9.222327	9.224484	9.245647
713	1	-204.1533	9.014364	9.219536	9.222181	9.243282
714	1	-207.7628	9.014556	9.216556	9.219275	9.240598
715	1	-211.1614	9.015559	9.213158	9.21631	9.237565
716	1	-214.3566	9.016529	9.20964	9.213831	9.234263
717	1	-217.4117	9.016721	9.206751	9.211281	9.230841
718	1	-220.4248	9.01585	9.204444	9.208391	9.22741

719	1	-223.4685	9.014197	9.201719	9.205418	9.223927
720	1	-226.5427	9.012397	9.198549	9.202444	9.220245

IHNC_labscale75.sim

```
! Inner Harbor Navigation Channel Lock, New Orleans
!
! SENSITIVITY WIDTH-CHANGED FROM 110' TO 75'and pltscale file
! Conditions associated with Type 1 (Original) Design as tested in
!   1:25-scale physical model published in
!   ERDC/CHL TR-03-3 Hite (2003).  Plates numbers refer to Hite TR.
!
! Sidewall Port Filling and Emptying System with sector gates
!   Lock Width = 75'  Lock Length = 1360' Long Pintle-to-Pintle (Plate 28).
!   Dimensions of culvert from intake to filling valve taken from Plate 73.
! Simulating conditions of Plate 41, wherein...
! Upper Pool=9, Lower Pool=-2
! Culverts: 18.25' H x 15'W => Ac=273.75 sf
! Ports: 3.75' H x 2.54' W => Ap=9.53 sf, 28 ports per culvert
! 8-min Constant Speed Valve
!
! Flow at ports represented by diverging_tee
!
! Filename: IHNC_labscale75.sim          Richard Stockstill August 2015

*CONSTANTS ==========================================================================
    io_units=English,  time_units=seconds
    time_step=1,   gravity=32.146, wf_time=0.55
    dQ_max=.001,   dh_max=.0001,   dx_max=.0001
    plot_field=11, plot_line=200,  plot_labels=row
    plot_file=IHNC_labscale75.plt

*COMPONENTS ========================================================================

!  Modeling 1:25-scale model, increase hydraulic roughness by setting Darcy-Weisbach
!   friction factor to 0.02 which is more appropriate for phy model with peak Re=1e5
!  Change prototype simulations to 'rough=.003'

! --------------- Left Wall ------------------------------

! Intake
HW     LIn     pipe_loss  us_area=1e6, area=273.75, K+=0.5
LIn    LB1u    imp_pipe  dia=16.47, area=273.75, len=22.73, rough=.02, wave=3500
! The first bend on left culvert is LB1
LB1u   LB1d    pipe_loss  area=273.75  K+=0.07
                ! Kb for 30 degree Bend - HDC Chart 228-1 Re=2.5x10^5

LB1d   LFVu    imp_pipe  dia=16.47, area=273.75, len=27.71, rough=.02, wave=3500
LFVu   LFW     storage surface_area=435  max_wsel=22.4  ! Top of Wall=EL 22.4
                ! storage surface area is plan area of valve well (15'x29')

! Reverse Tainter Filling Valve
LFVu   LFVd    rev_tainter b=18.25, w=15, el_bottom=-40
                b/B_vs_t=OpenTainter_Hite
                Cc_vs_b/B=TainterCc
!                Kv+_vs_b/B=TainterKv
                Cdv+_vs_b/B=tainterCdv

LFVd   LB2u    imp_pipe  dia=16.47, area=273.75, len=27.71, rough=.02, wave=3500
! Second bend
LB2u   LB2d    pipe_loss  area=273.75  K+=0.07
! Straight reach of culvert US of manifold
LB2d   LP1u    imp_pipe  dia=16.47, area=273.75, len=84.15, rough=.02, wave=3500

! Sidewall Port Manifold
!  Port Connections to Chamber - Each Tee Represents 2 Ports
!  Each port is 2.54'W x 3.75'H = 9.525sf  Dh=4Rh=3.03'
!  Ports are spaced 28' OC, 2(28)=56' spacing form tees

LP1u   LP1d  LP1b  diverging_tee area1=area3=273.75 area2=19.05 angle1=0 angle2=90
LP1b   Ch1     pipe_loss area=19.05 ds_area=1e5 K+=1.80 K-=0.25
```

```
LP1d   LP2u    imp_pipe dia=16.47, area=273.75, len=56, rough=.02, wave=3500

LP2u   LP2d  LP2b  diverging_tee area1=area3=273.75 area2=19.05 angle1=0 angle2=90
LP2b   Ch2     pipe_loss area=19.05 ds_area=1e5 K+=1.80 K-=0.25

LP2d   LP3u    imp_pipe dia=16.47, area=273.75, len=56, rough=.02, wave=3500

LP3u   LP3d  LP3b  diverging_tee area1=area3=273.75 area2=19.05 angle1=0 angle2=90
LP3b   Ch3     pipe_loss area=19.05 ds_area=1e5 K+=1.80 K-=0.25

LP3d   LP4u    imp_pipe dia=16.47, area=273.75, len=56, rough=.02, wave=3500

LP4u   LP4d  LP4b  diverging_tee area1=area3=273.75 area2=19.05 angle1=0 angle2=90
LP4b   Ch4     pipe_loss area=19.05 ds_area=1e5 K+=1.80 K-=0.25

LP4d   LP5u    imp_pipe dia=16.47, area=273.75, len=56, rough=.02, wave=3500

LP5u   LP5d  LP5b  diverging_tee area1=area3=273.75 area2=19.05 angle1=0 angle2=90
LP5b   Ch5     pipe_loss area=19.05 ds_area=1e5 K+=1.80 K-=0.25

LP5d   LP6u    imp_pipe dia=16.47, area=273.75, len=56, rough=.02, wave=3500

LP6u   LP6d  LP6b  diverging_tee area1=area3=273.75 area2=19.05 angle1=0 angle2=90
LP6b   Ch6     pipe_loss area=19.05 ds_area=1e5 K+=1.80 K-=0.25

LP6d   LP7u    imp_pipe dia=16.47, area=273.75, len=56, rough=.02, wave=3500

LP7u   LP7d  LP7b  diverging_tee area1=area3=273.75 area2=19.05 angle1=0 angle2=90
LP7b   Ch7     pipe_loss area=19.05 ds_area=1e5 K+=1.80 K-=0.25

LP7d   LP8u    imp_pipe dia=16.47, area=273.75, len=56, rough=.02, wave=3500

LP8u   LP8d  LP8b  diverging_tee area1=area3=273.75 area2=19.05 angle1=0 angle2=90
LP8b   Ch8     pipe_loss area=19.05 ds_area=1e5 K+=1.80 K-=0.25

LP8d   LP9u    imp_pipe dia=16.47, area=273.75, len=56, rough=.02, wave=3500

LP9u   LP9d  LP9b  diverging_tee area1=area3=273.75 area2=19.05 angle1=0 angle2=90
LP9b   Ch9     pipe_loss area=19.05 ds_area=1e5 K+=1.80 K-=0.25

LP9d   LP10u   imp_pipe dia=16.47, area=273.75, len=56, rough=.02, wave=3500

LP10u  LP10d  LP10b  diverging_tee area1=area3=273.75 area2=19.05 angle1=0 angle2=90
LP10b  Ch10    pipe_loss area=19.05 ds_area=1e5 K+=1.80 K-=0.25

LP10d  LP11u  imp_pipe dia=16.47, area=273.75, len=56, rough=.02, wave=3500

LP11u  LP11d  LP11b  diverging_tee area1=area3=273.75 area2=19.05 angle1=0 angle2=90
LP11b  Ch11    pipe_loss area=19.05 ds_area=1e5 K+=1.80 K-=0.25

LP11d  LP12u  imp_pipe dia=16.47, area=273.75, len=56, rough=.02, wave=3500

LP12u  LP12d  LP12b  diverging_tee area1=area3=273.75 area2=19.05 angle1=0 angle2=90
LP12b  Ch12    pipe_loss area=19.05 ds_area=1e5 K+=1.80 K-=0.25

LP12d  LP13u  imp_pipe dia=16.47, area=273.75, len=56, rough=.02, wave=3500

LP13u  LP13d  LP13b  diverging_tee area1=area3=273.75 area2=19.05 angle1=0 angle2=90
LP13b  Ch13    pipe_loss area=19.05 ds_area=1e5 K+=1.80 K-=0.25

LP13d  LP14u  imp_pipe dia=16.47, area=273.75, len=56, rough=.02, wave=3500

LP14u  LP14d  LP14b  diverging_tee area1=area3=273.75 area2=19.05 angle1=0 angle2=90
LP14b  Ch14    pipe_loss area=19.05 ds_area=1e5 K+=1.80 K-=0.25

LP14d  LB3u   imp_pipe dia=16.47, area=273.75, len=84.15, rough=.02, wave=3500

! Culvert downstream of manifold ports
LB3u   LB3d    pipe_loss  area=273.75  K+=0.07
LB3d   LEVu    imp_pipe  dia=16.47, area=273.75, len=27.71, rough=.02, wave=3500
LEVu   LEW     storage  surface_area=435  max_wsel=22.4
```

```
!LEVu   LEVd    rev_tainter b=18.25  w=15  el_bottom=-40
!                b/B_vs_t=OpenTainter_Hite
!                Cc_vs_b/B=TainterCc  Kv+_vs_b/B=TainterKv
!                fixed_b/B=0

! --------------- Right Wall -----------------------------

! Intake
HW     RIn     pipe_loss  us_area=1e6  area=273.75  K+=0.5
RIn    RB1u    imp_pipe  dia=16.47  area=273.75  len=22.73  rough=.02  wave=3500
! The first bend on right culvert is RB1
RB1u   RB1d    pipe_loss  area=273.75  K+=0.07
                ! Kb for 30 degree Bend - HDC Chart 228-1 Re=2.5x10^5

RB1d   RFVu    imp_pipe  dia=16.47  area=273.75  len=27.71  rough=.02  wave=3500
RFVu   RFW     storage  surface_area=435  max_wsel=22.4
                ! storage surface area is plan area of valve well (15'x29')

! Reverse Tainter Filling Valve
RFVu   RFVd    rev_tainter b=18.25  w=15  el_bottom=-40
                b/B_vs_t=OpenTainter_Hite
                Cc_vs_b/B=TainterCc
!                Kv+_vs_b/B=TainterKv
                Cdv+_vs_b/B=tainterCdv

RFVd   RB2u    imp_pipe  dia=16.47  area=273.75  len=27.71  rough=.02  wave=3500
! Second bend
RB2u   RB2d    pipe_loss  area=273.75  K+=0.07
! Straight reach of culvert US of manifold
RB2d   RP1u    imp_pipe  dia=16.47  area=273.75  len=84.15  rough=.02  wave=3500

! Sidewall Port Manifold
!  Port Connections to Chamber - Each Tee Represents 2 Ports
!  Each port is 2.54'W x 3.75'H = 9.525sf  Dh=4Rh=3.03'
!  Ports are spaced 28' OC, 2(28)=56' spacing form tees

RP1u   RP1d  RP1b  diverging_tee area1=area3=273.75 area2=19.05 angle1=0 angle2=90
RP1b   Ch1     pipe_loss area=19.05 ds_area=1e5 K+=1.80 K-=0.25

RP1d   RP2u    imp_pipe dia=16.47, area=273.75, len=56, rough=.02, wave=3500

RP2u   RP2d  RP2b  diverging_tee area1=area3=273.75 area2=19.05 angle1=0 angle2=90
RP2b   Ch2     pipe_loss area=19.05 ds_area=1e5 K+=1.80 K-=0.25

RP2d   RP3u    imp_pipe dia=16.47, area=273.75, len=56, rough=.02, wave=3500

RP3u   RP3d  RP3b  diverging_tee area1=area3=273.75 area2=19.05 angle1=0 angle2=90
RP3b   Ch3     pipe_loss area=19.05 ds_area=1e5 K+=1.80 K-=0.25

RP3d   RP4u    imp_pipe dia=16.47, area=273.75, len=56, rough=.02, wave=3500

RP4u   RP4d  RP4b  diverging_tee area1=area3=273.75 area2=19.05 angle1=0 angle2=90
RP4b   Ch4     pipe_loss area=19.05 ds_area=1e5 K+=1.80 K-=0.25

RP4d   RP5u    imp_pipe dia=16.47, area=273.75, len=56, rough=.02, wave=3500

RP5u   RP5d  RP5b  diverging_tee area1=area3=273.75 area2=19.05 angle1=0 angle2=90
RP5b   Ch5     pipe_loss area=19.05 ds_area=1e5 K+=1.80 K-=0.25

RP5d   RP6u    imp_pipe dia=16.47, area=273.75, len=56, rough=.02, wave=3500

RP6u   RP6d  RP6b  diverging_tee area1=area3=273.75 area2=19.05 angle1=0 angle2=90
RP6b   Ch6     pipe_loss area=19.05 ds_area=1e5 K+=1.80 K-=0.25

RP6d   RP7u    imp_pipe dia=16.47, area=273.75, len=56, rough=.02, wave=3500
RP7u   RP7d  RP7b  diverging_tee area1=area3=273.75 area2=19.05 angle1=0 angle2=90
RP7b   Ch7     pipe_loss area=19.05 ds_area=1e5 K+=1.80 K-=0.25

RP7d   RP8u    imp_pipe dia=16.47, area=273.75, len=56, rough=.02, wave=3500

RP8u   RP8d  RP8b  diverging_tee area1=area3=273.75 area2=19.05 angle1=0 angle2=90
```

```
RP8b   Ch8     pipe_loss area=19.05 ds_area=1e5 K+=1.80 K-=0.25

RP8d   RP9u    imp_pipe dia=16.47, area=273.75, len=56, rough=.02, wave=3500

RP9u   RP9d  RP9b  diverging_tee area1=area3=273.75 area2=19.05 angle1=0 angle2=90
RP9b   Ch9     pipe_loss area=19.05 ds_area=1e5 K+=1.80 K-=0.25

RP9d   RP10u   imp_pipe dia=16.47, area=273.75, len=56, rough=.02, wave=3500

RP10u  RP10d  RP10b  diverging_tee area1=area3=273.75 area2=19.05 angle1=0 angle2=90
RP10b  Ch10    pipe_loss area=19.05 ds_area=1e5 K+=1.80 K-=0.25

RP10d  RP11u  imp_pipe dia=16.47, area=273.75, len=56, rough=.02, wave=3500

RP11u  RP11d  RP11b  diverging_tee area1=area3=273.75 area2=19.05 angle1=0 angle2=90
RP11b  Ch11    pipe_loss area=19.05 ds_area=1e5 K+=1.80 K-=0.25

RP11d  RP12u  imp_pipe dia=16.47, area=273.75, len=56, rough=.02, wave=3500

RP12u  RP12d  RP12b  diverging_tee area1=area3=273.75 area2=19.05 angle1=0 angle2=90
RP12b  Ch12    pipe_loss area=19.05 ds_area=1e5 K+=1.80 K-=0.25

RP12d  RP13u  imp_pipe dia=16.47, area=273.75, len=56, rough=.02, wave=3500

RP13u  RP13d  RP13b  diverging_tee area1=area3=273.75 area2=19.05 angle1=0 angle2=90
RP13b  Ch13    pipe_loss area=19.05 ds_area=1e5 K+=1.80 K-=0.25

RP13d  RP14u  imp_pipe dia=16.47, area=273.75, len=56, rough=.02, wave=3500

RP14u  RP14d  RP14b  diverging_tee area1=area3=273.75 area2=19.05 angle1=0 angle2=90
RP14b  Ch14    pipe_loss area=19.05 ds_area=1e5 K+=1.80 K-=0.25

RP14d  RB3u   imp_pipe dia=16.47, area=273.75, len=84.15, rough=.02, wave=3500

! Culvert downstream of manifold ports
RB3u   RB3d    pipe_loss  area=273.75  K+=0.07
RB3d   REVu    imp_pipe  dia=16.47  area=273.75  len=27.71  rough=.02  wave=3500
REVu   REW     storage  surface_area=435  max_wsel=22.4
!REVu   REVd    rev_tainter b=18.25  w=15  el_bottom=-40
!               b/B_vs_t=OpenTainter_Hite
!               Cc_vs_b/B=TainterCc  Kv+_vs_b/B=TainterKv
!               fixed_b/B=0

!------------ Lock chamber modeled as series of open channels ---------

! length is from pintle to halfway between the first ports (right and left)
! We want the reaches to be about the same length, so len/reach => along the chamber
! TR showed that the first port is located 229.7 ft downstream of riverside pintle.
! Ports are spaced 28' on center

Upin  ChU   open_channel  cross_section=chamber  len=118.35  reaches=4  iq=0
ChU   Ch1   open_channel  cross_section=chamber  len=118.35  reaches=4  iq=0
Ch1   Ch2   open_channel  cross_section=chamber  len=56   reaches=2  iq=0
Ch2   Ch3   open_channel  cross_section=chamber  len=56   reaches=2  iq=0
Ch3   Ch4   open_channel  cross_section=chamber  len=56   reaches=2  iq=0
Ch4   Ch5   open_channel  cross_section=chamber  len=56   reaches=2  iq=0
Ch5   Ch6   open_channel  cross_section=chamber  len=56   reaches=2  iq=0
Ch6   Ch7   open_channel  cross_section=chamber  len=56   reaches=2  iq=0
Ch7   Ch8   open_channel  cross_section=chamber  len=56   reaches=2  iq=0
Ch8   Ch9   open_channel  cross_section=chamber  len=56   reaches=2  iq=0
Ch9   Ch10  open_channel  cross_section=chamber  len=56   reaches=2  iq=0
Ch10  Ch11  open_channel  cross_section=chamber  len=56   reaches=2  iq=0
Ch11  Ch12  open_channel  cross_section=chamber  len=56   reaches=2  iq=0
Ch12  Ch13  open_channel  cross_section=chamber  len=56   reaches=2  iq=0
Ch13  Ch14  open_channel  cross_section=chamber  len=56   reaches=2  iq=0
Ch14  ChD   open_channel  cross_section=chamber  len=197.65   reaches=7  iq=0
ChD   Lpin  open_channel  cross_section=chamber  len=197.65   reaches=7  iq=0

*NODES ==========================================================================

HW        elev=-30.87     head=9  idemand=0
```

```
! ---Left Culvert---
LIn       elev=-30.87    ihead=9
LB1u      elev=-30.87    ihead=9
LB1d      elev=-30.87    ihead=9
LFVu      elev=-30.87    ihead=9
LFW       elev=-30.87    ihead=9   demand=0
LFVd      elev=-30.87    ihead=-2
LB2u      elev=-30.87    ihead=-2
LB2d      elev=-30.87    ihead=-2
LP1u      elev=-30.87    ihead=-2
LP1d      elev=-30.87    ihead=-2
LP1b      elev=-38.12    ihead=-2
LP2u      elev=-30.87    ihead=-2
LP2d      elev=-30.87    ihead=-2
LP2b      elev=-38.12    ihead=-2
LP3u      elev=-30.87    ihead=-2
LP3d      elev=-30.87    ihead=-2
LP3b      elev=-38.12    ihead=-2
LP4u      elev=-30.87    ihead=-2
LP4d      elev=-30.87    ihead=-2
LP4b      elev=-38.12    ihead=-2
LP5u      elev=-30.87    ihead=-2
LP5d      elev=-30.87    ihead=-2
LP5b      elev=-38.12    ihead=-2
LP6u      elev=-30.87    ihead=-2
LP6d      elev=-30.87    ihead=-2
LP6b      elev=-38.12    ihead=-2
LP7u      elev=-30.87    ihead=-2
LP7d      elev=-30.87    ihead=-2
LP7b      elev=-38.12    ihead=-2
LP8u      elev=-30.87    ihead=-2
LP8d      elev=-30.87    ihead=-2
LP8b      elev=-38.12    ihead=-2
LP9u      elev=-30.87    ihead=-2
LP9d      elev=-30.87    ihead=-2
LP9b      elev=-38.12    ihead=-2
LP10u     elev=-30.87    ihead=-2
LP10d     elev=-30.87    ihead=-2
LP10b     elev=-38.12    ihead=-2
LP11u     elev=-30.87    ihead=-2
LP11d     elev=-30.87    ihead=-2
LP11b     elev=-38.12    ihead=-2
LP12u     elev=-30.87    ihead=-2
LP12d     elev=-30.87    ihead=-2
LP12b     elev=-38.12    ihead=-2
LP13u     elev=-30.87    ihead=-2
LP13d     elev=-30.87    ihead=-2
LP13b     elev=-38.12    ihead=-2
LP14u     elev=-30.87    ihead=-2
LP14d     elev=-30.87    ihead=-2
LP14b     elev=-38.12    ihead=-2
LB3u      elev=-30.87    ihead=-2
LB3d      elev=-30.87    ihead=-2
LEVu      elev=-30.87    ihead=-2
LEW       elev=-30.87    ihead=-2    demand=0
! ---Right Culvert---
RIn       elev=-30.87    ihead=9
RB1u      elev=-30.87    ihead=9
RB1d      elev=-30.87    ihead=9
RFVu      elev=-30.87    ihead=9
RFW       elev=-30.87    ihead=9   demand=0
RFVd      elev=-30.87    ihead=-2
RB2u      elev=-30.87    ihead=-2
RB2d      elev=-30.87    ihead=-2
RP1u      elev=-30.87    ihead=-2
RP1d      elev=-30.87    ihead=-2
RP1b      elev=-38.12    ihead=-2
RP2u      elev=-30.87    ihead=-2
RP2d      elev=-30.87    ihead=-2
RP2b      elev=-38.12    ihead=-2
RP3u      elev=-30.87    ihead=-2
```

```
RP3d      elev=-30.87    ihead=-2
RP3b      elev=-38.12    ihead=-2
RP4u      elev=-30.87    ihead=-2
RP4d      elev=-30.87    ihead=-2
RP4b      elev=-38.12    ihead=-2
RP5u      elev=-30.87    ihead=-2
RP5d      elev=-30.87    ihead=-2
RP5b      elev=-38.12    ihead=-2
RP6u      elev=-30.87    ihead=-2
RP6d      elev=-30.87    ihead=-2
RP6b      elev=-38.12    ihead=-2
RP7u      elev=-30.87    ihead=-2
RP7d      elev=-30.87    ihead=-2
RP7b      elev=-38.12    ihead=-2
RP8u      elev=-30.87    ihead=-2
RP8d      elev=-30.87    ihead=-2
RP8b      elev=-38.12    ihead=-2
RP9u      elev=-30.87    ihead=-2
RP9d      elev=-30.87    ihead=-2
RP9b      elev=-38.12    ihead=-2
RP10u     elev=-30.87    ihead=-2
RP10d     elev=-30.87    ihead=-2
RP10b     elev=-38.12    ihead=-2
RP11u     elev=-30.87    ihead=-2
RP11d     elev=-30.87    ihead=-2
RP11b     elev=-38.12    ihead=-2
RP12u     elev=-30.87    ihead=-2
RP12d     elev=-30.87    ihead=-2
RP12b     elev=-38.12    ihead=-2
RP13u     elev=-30.87    ihead=-2
RP13d     elev=-30.87    ihead=-2
RP13b     elev=-38.12    ihead=-2
RP14u     elev=-30.87    ihead=-2
RP14d     elev=-30.87    ihead=-2
RP14b     elev=-38.12    ihead=-2
RB3u      elev=-30.87    ihead=-2
RB3d      elev=-30.87    ihead=-2
REVu      elev=-30.87    ihead=-2
REW       elev=-30.87    ihead=-2    demand=0
! ---Lock Chamber---
Upin      elev=-40       ihead=-2    demand=0
ChU       elev=-40       ihead=-2
Ch1       elev=-40       ihead=-2
Ch2       elev=-40       ihead=-2
Ch3       elev=-40       ihead=-2
Ch4       elev=-40       ihead=-2
Ch5       elev=-40       ihead=-2
Ch6       elev=-40       ihead=-2
Ch7       elev=-40       ihead=-2
Ch8       elev=-40       ihead=-2
Ch9       elev=-40       ihead=-2
Ch10      elev=-40       ihead=-2
Ch11      elev=-40       ihead=-2
Ch12      elev=-40       ihead=-2
Ch13      elev=-40       ihead=-2
Ch14      elev=-40       ihead=-2
ChD       elev=-40       ihead=-2
Lpin      elev=-40       ihead=-2    demand=0

*FUNCTIONS ========================================================================

! open tainter designated at top for b/B vs. time (xscale (valve time)) in
! seconds, b = valve opening, B = culvert height so, b/B is fraction opened.
! OpenTainter comes from Plate 33 of ERDC/CHL TR-03-3 Hite 2003
OpenTainter_Hite     discrete   interpolation=linear  xscale=480  xshift=10
   xy_pairs={ 0.00   0.000
              0.10   0.084
              0.20   0.167
              0.30   0.249
              0.40   0.334
              0.50   0.426
```

```
              0.60   0.525
              0.70   0.619
              0.80   0.732
              0.90   0.855
              1.00   1.000 }

! Kv vs b/B Relationship - Based on Nielson's WES Misc Paper H-76-13
! Equations D2 and D3
TainterKv  discrete interpolation=linear extrapolation=linear
   xy_pairs={   0.0010  1385376.875
                0.0020   346667.594
                0.0030   154218.391
                0.0040    86828.391
                0.0050    55621.793
                0.0060    38662.070
                0.0070    28431.086
                0.0080    21787.870
                0.0090    17230.836
                0.0100    13969.831
                0.0150     6237.299
                0.0200     3524.422
                0.0250     2265.772
                0.0300     1580.499
                0.0500      578.828
                0.0600      405.284
                0.0800      231.556
                0.1000      150.331
                0.1500       68.776
                0.2000       39.349
                0.2500       25.239
                0.3000       17.236
                0.3500       12.244
                0.4000        8.848
                0.4500        6.422
                0.5000        4.661
                0.5500        3.338
                0.6000        2.344
                0.7000        1.049
                0.8000        0.372
                0.9000        0.074
                1.0000        0.010  }

tainterCdv  discrete  interpolation=spline
  x_values={0,   0.05, 0.1, 0.15, 0.2, 0.25, 0.3, 0.35,
            0.4, 0.45, 0.5, 0.55, 0.6, 0.65, 0.7, 0.75,
            0.8, 0.85, 0.9, 0.95,   1}
  y_values={0, 0.0443, 0.0836, 0.1195, 0.1534, 0.196, 0.243, 0.295,
            0.349, 0.415, 0.494, 0.587, 0.69, 0.8165, 0.976, 1.155,
            1.387,  1.69,  2.02, 2.582, 3.162}

! Cc vs b/B Relationship - Gerald Schohl's polynomial which reproduces Fig
! D2 in WES Misc Paper H-76-13
! Cc=.85-1.12X+1.69X^2-.85X^3+.43X^4;  Where X=b/B
  TainterCc  polynomial coefficients={.85, -1.12, 1.69, -.85, .43}

*CROSS_SECTIONS ============================================================

   chamber TRAPEZOIDAL  MN_n=.02  bed_w=75 ! Lock Chamber

*PLOT VARIABLES ============================================================

LFVu   LFVd    valve_position
LFVu   LFVd    discharge
LFW    head

Upin   head
Ch8    head
Lpin   head

*END ========================================================================
```

IHNC_labscale75.plt

sec Time	(-) "LFVu LFVd Valve Position sectno=0"	(cfs) "LFVu LFVd discharge sectno=0"	(f) "LFW head"	(f) "Upin head"	(f) "Ch8 head"	(f) "Lpin head"
0	0	0	9	-2	-2	-2
1	0	0	9	-2	-2	-2
2	0	0	9	-2	-2	-2
3	0	0	9	-2	-2	-2
4	0	0	9	-2	-2	-2
5	0	0	9	-2	-2	-2
6	0	0	9	-2	-2	-2
7	0	0	9	-2	-2	-2
8	0	0	9	-2	-2	-2
9	0	0	9	-2	-2	-2
10	0	0	9	-2	-2	-2
11	0.00175	11.4323	8.988165	-2	-2	-2
12	0.0035	23.02626	8.95698	-2	-2	-2
13	0.00525	34.17861	8.918338	-1.999999	-2	-2
14	0.007	45.70249	8.886356	-1.999987	-2	-2
15	0.00875	56.79297	8.872404	-1.999878	-1.999998	-2
16	0.0105	68.28124	8.880998	-1.999256	-1.999988	-2
17	0.01225	79.51226	8.908153	-1.996954	-1.999936	-2
18	0.014	91.00733	8.943374	-1.991715	-1.999721	-2
19	0.01575	102.3206	8.973429	-1.984889	-1.999025	-2
20	0.0175	113.663	8.987543	-1.979423	-1.997256	-2
21	0.01925	124.8039	8.980995	-1.973641	-1.993732	-2
22	0.021	135.8281	8.95677	-1.967511	-1.988238	-2
23	0.02275	146.7108	8.924039	-1.961414	-1.981519	-2
24	0.0245	157.5358	8.894662	-1.955187	-1.97487	-2
25	0.02625	168.3826	8.878711	-1.948947	-1.968917	-2
26	0.028	179.301	8.880915	-1.942616	-1.963259	-2
27	0.02975	190.3268	8.899181	-1.936284	-1.957577	-2
28	0.0315	201.3943	8.92571	-1.929915	-1.952083	-2
29	0.03325	212.4384	8.950141	-1.923646	-1.946682	-2
30	0.035	223.3511	8.963431	-1.917368	-1.941391	-2
31	0.03675	234.0737	8.961042	-1.911063	-1.936179	-1.999999
32	0.0385	244.573	8.944314	-1.904759	-1.930938	-1.999997
33	0.04025	254.8957	8.91963	-1.898473	-1.925574	-1.999989
34	0.042	265.1252	8.895796	-1.892124	-1.919922	-1.999961
35	0.04375	275.3657	8.880716	-1.88573	-1.913828	-1.99988
36	0.0455	285.6814	8.87861	-1.879367	-1.90722	-1.999658
37	0.04725	296.0964	8.888738	-1.873059	-1.900231	-1.999116
38	0.049	306.5675	8.906014	-1.866791	-1.893114	-1.997924
39	0.05075	317.0094	8.923152	-1.860582	-1.88609	-1.995572
40	0.0525	327.318	8.933452	-1.854439	-1.879209	-1.99143
41	0.05425	337.4253	8.933152	-1.848326	-1.8724	-1.984936
42	0.056	347.3095	8.92254	-1.842199	-1.865614	-1.975898
43	0.05775	357.0047	8.905535	-1.836044	-1.85884	-1.964721
44	0.0595	366.5887	8.887999	-1.829862	-1.852016	-1.952343
45	0.06125	376.1558	8.875474	-1.823672	-1.845069	-1.939816
46	0.063	385.78	8.871222	-1.817516	-1.837984	-1.927775
47	0.06475	395.4889	8.875252	-1.811413	-1.830794	-1.916229
48	0.0665	405.2561	8.884602	-1.805363	-1.823569	-1.904832
49	0.06825	415.0159	8.89466	-1.79937	-1.816385	-1.89333
50	0.07	424.6883	8.900971	-1.793437	-1.809297	-1.881699
51	0.07175	434.2037	8.900814	-1.787543	-1.802348	-1.869962
52	0.0735	443.5397	8.894011	-1.78165	-1.795556	-1.858011
53	0.07525	452.7211	8.882741	-1.775735	-1.788902	-1.845664
54	0.077	461.8036	8.870537	-1.76979	-1.782342	-1.832764
55	0.07875	470.8575	8.860897	-1.763823	-1.775815	-1.819205
56	0.0805	479.9408	8.856041	-1.757855	-1.769232	-1.804964
57	0.08225	489.0826	8.85624	-1.751908	-1.762474	-1.790144
58	0.084	498.2729	8.85992	-1.745996	-1.755398	-1.774952
59	0.08572917	507.4069	8.864478	-1.740116	-1.747835	-1.759624
60	0.08745833	516.4497	8.867306	-1.734225	-1.739613	-1.744332
61	0.0891875	525.3971	8.866622	-1.728259	-1.730585	-1.729136
62	0.09091667	534.2193	8.862031	-1.722146	-1.720678	-1.714014
63	0.09264583	542.9248	8.854559	-1.715833	-1.70993	-1.698929
64	0.094375	551.5438	8.846129	-1.709314	-1.698501	-1.683881
65	0.09610417	560.119	8.838778	-1.702624	-1.686642	-1.668897
66	0.09783333	568.6877	8.833921	-1.695827	-1.674625	-1.654007
67	0.0995625	577.2693	8.831916	-1.689006	-1.662647	-1.639225
68	0.1012917	585.8589	8.832063	-1.682232	-1.650787	-1.624563
69	0.1030208	594.4293	8.832972	-1.675554	-1.639022	-1.610039

70	0.10475	602.9431	8.833146	-1.668975	-1.627274	-1.595667
71	0.1064792	611.3673	8.831524	-1.662441	-1.615462	-1.581454
72	0.1082083	619.6851	8.827804	-1.65584	-1.603535	-1.567394
73	0.1099375	627.9002	8.822454	-1.649018	-1.59145	-1.553477
74	0.1116667	636.0343	8.816446	-1.641793	-1.579156	-1.539687
75	0.1133958	644.1178	8.810849	-1.633954	-1.566603	-1.526015
76	0.115125	652.179	8.80643	-1.625262	-1.553758	-1.512458
77	0.1168542	660.2343	8.803427	-1.615485	-1.540623	-1.499024
78	0.1185833	668.2824	8.801533	-1.604425	-1.527228	-1.485718
79	0.1203125	676.3056	8.800085	-1.591951	-1.513629	-1.472546
80	0.1220417	684.2843	8.798348	-1.578037	-1.499889	-1.45951
81	0.1237708	692.1975	8.795785	-1.562794	-1.486063	-1.446601
82	0.1255	700.0283	8.792225	-1.546468	-1.472185	-1.433808
83	0.1272292	707.7721	8.787882	-1.529394	-1.458286	-1.421114
84	0.1289583	715.4339	8.783221	-1.511919	-1.444387	-1.408507
85	0.1306875	723.0247	8.77876	-1.494316	-1.430513	-1.395973
86	0.1324167	730.5559	8.774877	-1.476724	-1.416689	-1.383505
87	0.1341458	738.0335	8.771694	-1.45915	-1.402937	-1.371103
88	0.135875	745.4571	8.769068	-1.441517	-1.389258	-1.358765
89	0.1376042	752.823	8.766677	-1.42373	-1.375636	-1.346495
90	0.1393333	760.1247	8.764156	-1.405708	-1.362029	-1.334288
91	0.1410625	767.3544	8.761231	-1.387387	-1.348371	-1.322136
92	0.1427917	774.5073	8.757807	-1.36872	-1.334571	-1.310021
93	0.1445208	781.5833	8.753978	-1.349672	-1.320533	-1.297922
94	0.14625	788.5867	8.749968	-1.330231	-1.306157	-1.285818
95	0.1479792	795.5233	8.746032	-1.310421	-1.291349	-1.27369
96	0.1497083	802.3983	8.742365	-1.29031	-1.27604	-1.261524
97	0.1514375	809.2154	8.739042	-1.269989	-1.260197	-1.249307
98	0.1531667	815.978	8.736004	-1.24955	-1.243833	-1.237031
99	0.1548958	822.6872	8.733093	-1.229076	-1.227007	-1.224687
100	0.156625	829.3418	8.730126	-1.208633	-1.209818	-1.21227
101	0.1583542	835.9402	8.726957	-1.188256	-1.192389	-1.199778
102	0.1600833	842.4808	8.72353	-1.167961	-1.174845	-1.187213
103	0.1618125	848.9674	8.719884	-1.147758	-1.157282	-1.174583
104	0.1635417	855.4091	8.716114	-1.127659	-1.13975	-1.161903
105	0.1652708	861.8143	8.712333	-1.107686	-1.122256	-1.149192
106	0.167	868.1908	8.708626	-1.087865	-1.104767	-1.136464
107	0.1687083	874.511	8.705062	-1.06821	-1.087241	-1.123723
108	0.1704167	880.7871	8.701668	-1.048727	-1.069642	-1.110954
109	0.172125	887.0505	8.698365	-1.029421	-1.051941	-1.098115
110	0.1738333	893.304	8.695013	-1.010288	-1.034117	-1.085134
111	0.1755417	899.549	8.691493	-0.9913164	-1.016158	-1.071911
112	0.17725	905.7859	8.687745	-0.9724944	-0.9980607	-1.058319
113	0.1789583	912.0182	8.683786	-0.9538135	-0.9798275	-1.044214
114	0.1806667	918.2525	8.679683	-0.9352682	-0.9614687	-1.029444
115	0.182375	924.4954	8.675525	-0.9168538	-0.9430076	-1.01387
116	0.1840833	930.7541	8.671382	-0.8985658	-0.9244707	-0.9973771
117	0.1857917	937.0345	8.66729	-0.8804067	-0.9058819	-0.9798948
118	0.1875	943.3413	8.663237	-0.8623731	-0.8872611	-0.9614078
119	0.1892083	949.6775	8.659176	-0.8444533	-0.8686214	-0.9419646
120	0.1909167	956.0449	8.655049	-0.8266384	-0.8499718	-0.9216757
121	0.192625	962.4453	8.650807	-0.8089201	-0.8313212	-0.9006997
122	0.1943333	968.8804	8.646426	-0.7912852	-0.8126819	-0.8792184
123	0.1960417	975.3531	8.64191	-0.7737179	-0.7940685	-0.8574048
124	0.19775	981.8674	8.637284	-0.7562047	-0.7754955	-0.8353924
125	0.1994583	988.4283	8.63258	-0.7387336	-0.7569768	-0.8132567
126	0.2011667	995.0405	8.627823	-0.7212941	-0.7385219	-0.791016
127	0.202875	1001.707	8.623025	-0.7038766	-0.7201317	-0.7686464
128	0.2045833	1008.426	8.618185	-0.6864706	-0.7017958	-0.7461042
129	0.2062917	1015.197	8.613296	-0.6690637	-0.6834924	-0.7233447
130	0.208	1022.016	8.608354	-0.6516407	-0.6651875	-0.7003349
131	0.2097083	1028.881	8.603354	-0.6341847	-0.6468352	-0.6770584
132	0.2114167	1035.787	8.598299	-0.616678	-0.6283791	-0.6535163
133	0.213125	1042.732	8.593195	-0.5991052	-0.6097558	-0.6297257
134	0.2148333	1049.711	8.588052	-0.5814548	-0.5908984	-0.6057188
135	0.2165417	1056.722	8.582878	-0.56372	-0.5717422	-0.5815411
136	0.21825	1063.758	8.577683	-0.5458972	-0.5522308	-0.5572465
137	0.2199583	1070.816	8.572471	-0.527986	-0.5323217	-0.5328908
138	0.2216667	1077.89	8.567247	-0.509991	-0.5119923	-0.5085239
139	0.223375	1084.974	8.562015	-0.4919206	-0.4912437	-0.4841849
140	0.2250833	1092.063	8.556779	-0.4737859	-0.4701013	-0.4599007
141	0.2267917	1099.148	8.551542	-0.4555983	-0.4486115	-0.4356886
142	0.2285	1106.226	8.546311	-0.4373683	-0.4268353	-0.4115597
143	0.2302083	1113.289	8.54109	-0.419102	-0.4048388	-0.3875219
144	0.2319167	1120.332	8.535882	-0.4007984	-0.3826827	-0.363582
145	0.233625	1127.351	8.530691	-0.3824447	-0.3604123	-0.3397448
146	0.2353333	1134.343	8.525515	-0.3640132	-0.3380524	-0.3160127
147	0.2370417	1141.303	8.520351	-0.3454582	-0.3156068	-0.2923845
148	0.23875	1148.231	8.515192	-0.3267148	-0.2930637	-0.2688563
149	0.2404583	1155.124	8.510034	-0.3077004	-0.2704029	-0.2454216
150	0.2421667	1161.983	8.50487	-0.288318	-0.247604	-0.2220731

151	0.243875	1168.807	8.499697	-0.2684629	-0.224652	-0.1988041
152	0.2455833	1175.596	8.494513	-0.2480303	-0.2015405	-0.1756098
153	0.2472917	1182.35	8.48932	-0.2269252	-0.1782729	-0.1524864
154	0.249	1189.067	8.484124	-0.2050725	-0.1548615	-0.1294314
155	0.2507708	1195.839	8.478833	-0.182426	-0.1313263	-0.1064426
156	0.2525417	1202.662	8.4733	-0.1589756	-0.1076925	-.08351722
157	0.2543125	1209.462	8.467535	-0.1347501	-.08398803	-.06065176
158	0.2560833	1216.225	8.4617	-0.1098151	-0.0602405	-.03784113
159	0.2578542	1222.951	8.455972	-.08426508	-.03647379	-0.0150788
160	0.259625	1229.641	8.450469	-.05820949	-.01270574	.007643062
161	0.2613958	1236.297	8.445209	-.03175426	0.01105355	0.03033326
162	0.2631667	1242.919	8.440127	-.00498955	0.03480267	0.05300123
163	0.2649375	1249.503	8.435107	0.02200783	0.05854917	0.07565672
164	0.2667083	1256.045	8.43004	0.04917943	0.08230946	0.09830946
165	0.2684792	1262.541	8.424856	0.07650886	0.1061081	0.120969
166	0.27025	1268.99	8.419542	0.104001	0.1299761	0.1436448
167	0.2720208	1275.393	8.414137	0.1316698	0.1539491	0.1663464
168	0.2737917	1281.754	8.408701	0.1595321	0.1780667	0.1890838
169	0.2755625	1288.078	8.403294	0.187595	0.2023728	0.2118667
170	0.2773333	1294.369	8.397948	0.2158551	0.2269141	0.2347042
171	0.2791042	1300.631	8.392661	0.2442967	0.2517318	0.2576036
172	0.280875	1306.866	8.387409	0.2728937	0.2768533	0.2805701
173	0.2826458	1313.074	8.382154	0.3016125	0.3022914	0.3036055
174	0.2844167	1319.254	8.376867	0.3304153	0.3280431	0.3267089
175	0.2861875	1325.406	8.371533	0.3592623	0.3540896	0.3498764
176	0.2879583	1331.53	8.366155	0.3881158	0.3804	0.3731024
177	0.2897292	1337.627	8.36075	0.4169428	0.4069353	0.3963802
178	0.2915	1343.697	8.355341	0.4457172	0.4336531	0.4197036
179	0.2932708	1349.742	8.349943	0.4744201	0.4605135	0.4430685
180	0.2950417	1355.764	8.344564	0.5030371	0.4874835	0.4664749
181	0.2968125	1361.764	8.3392	0.5315582	0.5145398	0.4899295
182	0.2985833	1367.742	8.333839	0.5599767	0.5416692	0.5134472
183	0.3003542	1373.699	8.328468	0.5882883	0.5688695	0.5370534
184	0.302125	1379.634	8.323078	0.6164911	0.5961464	0.5607847
185	0.3038958	1385.546	8.317668	0.6445854	0.62351	0.5846893
186	0.3056667	1391.435	8.312244	0.6725735	0.6509695	0.6088253
187	0.3074375	1397.297	8.30682	0.7004596	0.6785306	0.6332592
188	0.3092083	1403.132	8.301411	0.7282487	0.7061939	0.6580627
189	0.3109792	1408.938	8.296029	0.7559465	0.7339547	0.6833096
190	0.31275	1414.713	8.290679	0.7835582	0.7618038	0.7090717
191	0.3145208	1420.455	8.285363	0.8110889	0.7897279	0.7354131
192	0.3162917	1426.16	8.280078	0.8385429	0.8177115	0.7623817
193	0.3180625	1431.827	8.27482	0.8659247	0.8457374	0.7900032
194	0.3198333	1437.453	8.269588	0.8932389	0.8737883	0.8182763
195	0.3216042	1443.035	8.264382	0.9204909	0.9018474	0.8471739
196	0.323375	1448.57	8.259207	0.947687	0.9298999	0.8766466
197	0.3251458	1454.057	8.254068	0.9748346	0.957933	0.906629
198	0.3269167	1459.494	8.24897	1.001942	0.9859364	0.9370467
199	0.3286875	1464.879	8.243917	1.029017	1.013903	0.967825
200	0.3304583	1470.211	8.238911	1.056069	1.041828	0.9988961
201	0.3322292	1475.487	8.233952	1.083108	1.069712	1.030205
202	0.334	1480.707	8.229039	1.110142	1.09756	1.061712
203	0.3359167	1486.016	8.224019	1.137179	1.125383	1.093393
204	0.3378333	1491.423	8.218624	1.164228	1.1532	1.125238
205	0.33975	1496.817	8.212824	1.191296	1.181036	1.157244
206	0.3416667	1502.168	8.206857	1.21839	1.208922	1.189409
207	0.3435833	1507.468	8.201019	1.245516	1.236895	1.22173
208	0.3455	1512.716	8.195532	1.272682	1.264993	1.254197
209	0.3474167	1517.918	8.190474	1.299905	1.293256	1.286789
210	0.3493333	1523.069	8.185775	1.327201	1.32172	1.319482
211	0.35125	1528.163	8.181278	1.354565	1.350419	1.352243
212	0.3531667	1533.189	8.176818	1.381975	1.379379	1.385039
213	0.3550833	1538.136	8.172282	1.409425	1.408617	1.417835
214	0.357	1542.995	8.167642	1.436906	1.438135	1.450598
215	0.3589167	1547.763	8.162945	1.464414	1.467918	1.4833
216	0.3608333	1552.439	8.15828	1.491946	1.497943	1.515917
217	0.36275	1557.026	8.153733	1.519501	1.52818	1.548431
218	0.3646667	1561.528	8.149358	1.547084	1.558605	1.580829
219	0.3665833	1565.949	8.145158	1.574706	1.589191	1.613101
220	0.3685	1570.291	8.141098	1.602388	1.619912	1.645244
221	0.3704167	1574.553	8.137124	1.630158	1.650742	1.677256
222	0.3723333	1578.737	8.133184	1.658057	1.681666	1.709136
223	0.37425	1582.843	8.129249	1.686133	1.712671	1.740888
224	0.3761667	1586.872	8.125314	1.714443	1.743754	1.772516
225	0.3780833	1590.828	8.121392	1.743048	1.774915	1.804026
226	0.38	1594.715	8.117506	1.77201	1.806155	1.835424
227	0.3819167	1598.539	8.113674	1.801387	1.837476	1.866717
228	0.3838333	1602.305	8.109902	1.831232	1.868873	1.897912
229	0.38575	1606.018	8.106183	1.861586	1.900336	1.929017
230	0.3876667	1609.681	8.102502	1.892474	1.931848	1.960039
231	0.3895833	1613.296	8.098843	1.923905	1.963389	1.990982

232	0.3915	1616.867	8.095196	1.955867	1.99494	2.021853
233	0.3934167	1620.394	8.091557	1.988332	2.026486	2.052653
234	0.3953333	1623.879	8.087931	2.021256	2.058011	2.083381
235	0.39725	1627.325	8.084326	2.054586	2.089505	2.114034
236	0.3991667	1630.732	8.080751	2.088264	2.120965	2.144608
237	0.4010833	1634.104	8.07721	2.122235	2.152392	2.175103
238	0.403	1637.441	8.073702	2.156446	2.183793	2.205525
239	0.4049167	1640.744	8.070224	2.190856	2.215185	2.235881
240	0.4068333	1644.014	8.066773	2.225434	2.246588	2.266184
241	0.40875	1647.251	8.063344	2.260156	2.278027	2.296442
242	0.4106667	1650.455	8.059938	2.295007	2.309531	2.326663
243	0.4125833	1653.626	8.056558	2.329976	2.34113	2.356854
244	0.4145	1656.764	8.053205	2.365051	2.372853	2.387025
245	0.4164167	1659.87	8.049882	2.400219	2.404727	2.417184
246	0.4183333	1662.944	8.046591	2.435461	2.436773	2.447341
247	0.42025	1665.984	8.043333	2.470755	2.469007	2.477502
248	0.4221667	1668.992	8.04011	2.506072	2.501436	2.507671
249	0.4240833	1671.965	8.036922	2.541384	2.53406	2.537847
250	0.426	1674.902	8.033771	2.576661	2.566869	2.568027
251	0.4280625	1677.902	8.030558	2.611873	2.599847	2.598207
252	0.430125	1680.977	8.027097	2.646995	2.632973	2.628385
253	0.4321875	1684.058	8.023351	2.682004	2.666225	2.658562
254	0.43425	1687.121	8.019462	2.716883	2.69958	2.688745
255	0.4363125	1690.16	8.015624	2.751619	2.733017	2.718948
256	0.438375	1693.174	8.011994	2.786207	2.766517	2.749189
257	0.4404375	1696.166	8.008637	2.820651	2.800068	2.779493
258	0.4425	1699.135	8.00552	2.854959	2.833662	2.809894
259	0.4445625	1702.079	8.002548	2.88913	2.867294	2.840431
260	0.446625	1704.991	7.999613	2.923155	2.900963	2.871149
261	0.4486875	1707.861	7.996639	2.957037	2.934668	2.9021
262	0.45075	1710.683	7.993606	2.990785	2.968403	2.933336
263	0.4528125	1713.451	7.990546	3.024402	3.002155	2.964908
264	0.454875	1716.164	7.987516	3.057897	3.035911	2.996863
265	0.4569375	1718.823	7.984577	3.091276	3.069657	3.029242
266	0.459	1721.428	7.981764	3.124546	3.103386	3.062075
267	0.4610625	1723.98	7.97908	3.15771	3.137087	3.09538
268	0.463125	1726.48	7.976506	3.190773	3.170748	3.12916
269	0.4651875	1728.926	7.974009	3.223737	3.204353	3.163405
270	0.46725	1731.315	7.971559	3.256606	3.237891	3.198091
271	0.4693125	1733.645	7.969143	3.289379	3.271352	3.233183
272	0.471375	1735.915	7.966764	3.322061	3.30473	3.268641
273	0.4734375	1738.122	7.964437	3.354651	3.338022	3.30442
274	0.4755	1740.268	7.962182	3.387154	3.371233	3.340475
275	0.4775625	1742.351	7.960013	3.419573	3.40437	3.376765
276	0.479625	1744.374	7.957935	3.451915	3.437446	3.413257
277	0.4816875	1746.335	7.955947	3.484186	3.470473	3.449919
278	0.48375	1748.235	7.954038	3.516396	3.503467	3.48673
279	0.4858125	1750.073	7.9522	3.548551	3.536448	3.523668
280	0.487875	1751.848	7.950427	3.580659	3.569442	3.560715
281	0.4899375	1753.559	7.948719	3.612727	3.602475	3.597848
282	0.492	1755.204	7.94708	3.64476	3.635575	3.63504
283	0.4940625	1756.783	7.94552	3.676764	3.668767	3.672262
284	0.496125	1758.294	7.944046	3.708741	3.702075	3.709479
285	0.4981875	1759.736	7.942666	3.740694	3.735518	3.746659
286	0.50025	1761.107	7.941384	3.772623	3.76911	3.783772
287	0.5023125	1762.405	7.940203	3.804527	3.802858	3.820791
288	0.504375	1763.627	7.939126	3.836405	3.836763	3.85769
289	0.5064375	1764.769	7.938154	3.868259	3.870821	3.894445
290	0.5085	1765.829	7.937294	3.900093	3.90502	3.931037
291	0.5105625	1766.802	7.936552	3.931919	3.939346	3.967449
292	0.512625	1767.685	7.935935	3.963749	3.973782	4.003673
293	0.5146875	1768.476	7.935447	3.995607	4.00831	4.039705
294	0.51675	1769.172	7.935092	4.027519	4.042913	4.075544
295	0.5188125	1769.771	7.934871	4.059517	4.077576	4.111193
296	0.520875	1770.27	7.934783	4.09164	4.112284	4.146654
297	0.5229375	1770.669	7.934825	4.123928	4.147027	4.18193
298	0.525	1770.965	7.934995	4.156425	4.181794	4.217023
299	0.5269583	1771.118	7.935334	4.189174	4.216575	4.251937
300	0.5289167	1771.118	7.93592	4.222217	4.25136	4.286678
301	0.530875	1770.993	7.936777	4.255588	4.286135	4.321249
302	0.5328333	1770.753	7.93785	4.289316	4.320886	4.355659
303	0.5347917	1770.401	7.939056	4.323417	4.355596	4.389912
304	0.53675	1769.938	7.940324	4.357897	4.390248	4.424012
305	0.5387083	1769.362	7.941623	4.392748	4.424824	4.457963
306	0.5406667	1768.671	7.942964	4.427949	4.459311	4.491769
307	0.542625	1767.867	7.944386	4.463477	4.493699	4.525432
308	0.5445833	1766.951	7.945938	4.499303	4.527979	4.558954
309	0.5465417	1765.927	7.947657	4.535391	4.56215	4.592339
310	0.5485	1764.797	7.949552	4.571702	4.596216	4.625589
311	0.5504583	1763.562	7.951612	4.608197	4.630188	4.658708
312	0.5524167	1762.226	7.953812	4.644839	4.66408	4.691701

313	0.554375	1760.787	7.956121	4.681597	4.697912	4.724573
314	0.5563333	1759.246	7.95852	4.71844	4.731701	4.757328
315	0.5582917	1757.605	7.961	4.755344	4.765468	4.789972
316	0.56025	1755.864	7.963565	4.792282	4.799235	4.822509
317	0.5622083	1754.027	7.966223	4.829231	4.833022	4.854943
318	0.5641667	1752.096	7.968984	4.866164	4.866845	4.887275
319	0.566125	1750.073	7.971852	4.903052	4.900717	4.919508
320	0.5680833	1747.962	7.974825	4.939865	4.934648	4.951641
321	0.5700417	1745.765	7.977895	4.976573	4.968639	4.983674
322	0.572	1743.484	7.981053	5.013147	5.00269	5.015607
323	0.5739583	1741.121	7.984289	5.04956	5.036793	5.047439
324	0.5759167	1738.677	7.987598	5.085786	5.070938	5.07917
325	0.577875	1736.155	7.990978	5.121805	5.105113	5.110805
326	0.5798333	1733.556	7.994431	5.1576	5.139302	5.142348
327	0.5817917	1730.881	7.997959	5.193157	5.17349	5.173812
328	0.58375	1728.132	8.001563	5.228466	5.207664	5.205215
329	0.5857083	1725.312	8.005243	5.26352	5.241809	5.236579
330	0.5876667	1722.422	8.008995	5.298318	5.275911	5.267935
331	0.589625	1719.464	8.012816	5.33286	5.30996	5.299317
332	0.5915833	1716.439	8.0167	5.367149	5.343947	5.330765
333	0.5935417	1713.348	8.020645	5.401189	5.37786	5.362318
334	0.5955	1710.193	8.024648	5.434984	5.411692	5.394014
335	0.5974583	1706.975	8.028709	5.46854	5.445431	5.42589
336	0.5994167	1703.695	8.032827	5.501862	5.479066	5.457982
337	0.601375	1700.354	8.037004	5.534957	5.512585	5.490318
338	0.6033333	1696.953	8.041238	5.567831	5.545974	5.522921
339	0.6052917	1693.494	8.045528	5.600492	5.579221	5.555805
340	0.60725	1689.976	8.049873	5.632944	5.612314	5.588973
341	0.6092083	1686.402	8.054271	5.665196	5.645241	5.62242
342	0.6111667	1682.772	8.05872	5.697251	5.677995	5.656129
343	0.613125	1679.087	8.063219	5.729116	5.710567	5.69008
344	0.6150833	1675.347	8.067765	5.760794	5.742954	5.724244
345	0.6170417	1671.553	8.072358	5.792293	5.775156	5.758591
346	0.619	1667.707	8.076998	5.823616	5.807175	5.793089
347	0.6213542	1663.885	8.081603	5.854771	5.839019	5.827705
348	0.6237083	1660.105	8.086021	5.885761	5.8707	5.862407
349	0.6260625	1656.323	8.090201	5.916593	5.902235	5.897164
350	0.6284167	1652.517	8.094236	5.947272	5.933642	5.931948
351	0.6307708	1648.681	8.098283	5.977804	5.964945	5.966731
352	0.633125	1644.814	8.10248	6.008197	5.996167	6.001486
353	0.6354792	1640.92	8.106896	6.038463	6.027333	6.036186
354	0.6378333	1637.001	8.111518	6.068612	6.058465	6.070804
355	0.6401875	1633.056	8.116271	6.098644	6.089585	6.105314
356	0.6425417	1629.079	8.121065	6.128552	6.120712	6.139686
357	0.6448958	1625.062	8.125833	6.158334	6.15186	6.173893
358	0.64725	1620.997	8.130554	6.187993	6.183038	6.207909
359	0.6496042	1616.878	8.135254	6.21753	6.214245	6.24171
360	0.6519583	1612.699	8.13999	6.246949	6.245479	6.275274
361	0.6543125	1608.46	8.144817	6.276257	6.276733	6.308585
362	0.6566667	1604.158	8.149774	6.305464	6.308002	6.341628
363	0.6590208	1599.793	8.154871	6.334582	6.339278	6.374395
364	0.661375	1595.362	8.160091	6.363629	6.370548	6.406879
365	0.6637292	1590.86	8.165407	6.392628	6.401799	6.439078
366	0.6660833	1586.285	8.170793	6.421608	6.433017	6.470993
367	0.6684375	1581.63	8.176233	6.4506	6.464188	6.502629
368	0.6707917	1576.893	8.181731	6.479639	6.495299	6.53399
369	0.6731458	1572.069	8.187299	6.50876	6.52634	6.565085
370	0.6755	1567.159	8.192955	6.537996	6.557298	6.595921
371	0.6778542	1562.16	8.198712	6.567378	6.588161	6.626509
372	0.6802083	1557.074	8.204572	6.596931	6.618916	6.656858
373	0.6825625	1551.899	8.21053	6.626678	6.649548	6.686976
374	0.6849167	1546.635	8.216574	6.65663	6.68004	6.716874
375	0.6872708	1541.282	8.222693	6.686794	6.710378	6.746559
376	0.689625	1535.839	8.228879	6.717168	6.74055	6.776035
377	0.6919792	1530.304	8.235129	6.747743	6.770545	6.805305
378	0.6943333	1524.677	8.241447	6.778503	6.800356	6.834368
379	0.6966875	1518.958	8.247837	6.809424	6.829978	6.863223
380	0.6990417	1513.148	8.254304	6.840481	6.85941	6.891871
381	0.7013958	1507.248	8.260848	6.871644	6.888656	6.920313
382	0.70375	1501.257	8.267467	6.902881	6.917723	6.948555
383	0.7061042	1495.178	8.274153	6.934162	6.946624	6.976602
384	0.7084583	1489.011	8.280899	6.965455	6.975371	7.004457
385	0.7108125	1482.758	8.287696	6.996728	7.003982	7.032123
386	0.7131667	1476.418	8.294541	7.027953	7.032475	7.059603
387	0.7155208	1469.993	8.301432	7.059101	7.060865	7.0869
388	0.717875	1463.487	8.308369	7.090141	7.089171	7.114018
389	0.7202292	1456.902	8.315345	7.121047	7.117405	7.140962
390	0.7225833	1450.242	8.322354	7.151791	7.14558	7.167733
391	0.7249375	1443.508	8.329389	7.182344	7.173705	7.194332
392	0.7272917	1436.703	8.336447	7.21268	7.201783	7.22076
393	0.7296458	1429.828	8.343526	7.242773	7.229816	7.247014

394	0.732	1422.886	8.350624	7.272598	7.257799	7.273097
395	0.7345625	1415.894	8.357727	7.302135	7.285725	7.299011
396	0.737125	1408.856	8.364806	7.331372	7.313584	7.324764
397	0.7396875	1401.767	8.371848	7.360294	7.341366	7.350366
398	0.74225	1394.623	8.37887	7.388893	7.369058	7.375832
399	0.7448125	1387.426	8.385899	7.417162	7.396646	7.401179
400	0.747375	1380.178	8.392959	7.445102	7.424117	7.426431
401	0.7499375	1372.879	8.400061	7.472715	7.45146	7.451612
402	0.7525	1365.534	8.407197	7.500006	7.478665	7.476751
403	0.7550625	1358.144	8.414351	7.526982	7.505719	7.501879
404	0.757625	1350.709	8.421499	7.553647	7.532612	7.527025
405	0.7601875	1343.23	8.428626	7.580012	7.559333	7.55222
406	0.76275	1335.707	8.435724	7.606086	7.585869	7.57749
407	0.7653125	1328.141	8.442799	7.631878	7.61221	7.602857
408	0.767875	1320.532	8.449859	7.6574	7.638343	7.628339
409	0.7704375	1312.882	8.456916	7.682658	7.664256	7.653949
410	0.773	1305.192	8.463976	7.707662	7.68994	7.679692
411	0.7755625	1297.465	8.471039	7.732418	7.715386	7.705565
412	0.778125	1289.702	8.478097	7.75693	7.740586	7.731562
413	0.7806875	1281.903	8.485142	7.781202	7.765538	7.757669
414	0.78325	1274.069	8.492167	7.805238	7.790238	7.783867
415	0.7858125	1266.199	8.499168	7.82904	7.814687	7.810133
416	0.788375	1258.295	8.506145	7.852612	7.83889	7.836443
417	0.7909375	1250.356	8.513103	7.875958	7.862856	7.862772
418	0.7935	1242.383	8.520045	7.899084	7.886596	7.889091
419	0.7960625	1234.376	8.526976	7.921993	7.910124	7.915372
420	0.798625	1226.337	8.533894	7.94469	7.933456	7.941587
421	0.8011875	1218.266	8.540798	7.967178	7.956609	7.967709
422	0.80375	1210.163	8.547685	7.989461	7.979601	7.99371
423	0.8063125	1202.026	8.554552	8.011543	8.002452	8.019562
424	0.808875	1193.856	8.5614	8.033427	8.025179	8.045238
425	0.8114375	1185.649	8.568232	8.055115	8.047797	8.070712
426	0.814	1177.406	8.575056	8.076609	8.070322	8.095955
427	0.8165625	1169.123	8.581877	8.097911	8.092763	8.120942
428	0.819125	1160.798	8.588701	8.119022	8.115128	8.14565
429	0.8216875	1152.43	8.59553	8.139947	8.137421	8.170059
430	0.82425	1144.016	8.602367	8.16069	8.159642	8.194152
431	0.8268125	1135.553	8.609211	8.181259	8.181789	8.217916
432	0.829375	1127.037	8.616062	8.201665	8.203856	8.241341
433	0.8319375	1118.466	8.622922	8.221922	8.225836	8.264421
434	0.8345	1109.837	8.629791	8.242049	8.247721	8.287154
435	0.8370625	1101.147	8.636671	8.262064	8.269499	8.309539
436	0.839625	1092.394	8.643563	8.281992	8.29116	8.33158
437	0.8421875	1083.575	8.650466	8.301856	8.312692	8.353281
438	0.84475	1074.689	8.657378	8.321683	8.334083	8.374651
439	0.8473125	1065.734	8.664298	8.341496	8.35532	8.395697
440	0.849875	1056.71	8.671222	8.361318	8.376389	8.416429
441	0.8524375	1047.614	8.678145	8.381171	8.397278	8.436855
442	0.855	1038.447	8.685066	8.401071	8.417974	8.456984
443	0.8580208	1029.214	8.691975	8.421029	8.438463	8.476825
444	0.8610417	1019.919	8.698854	8.441053	8.458733	8.496386
445	0.8640625	1010.553	8.705701	8.461144	8.478774	8.515676
446	0.8670833	1001.111	8.712533	8.481297	8.498576	8.534699
447	0.8701042	991.5944	8.71937	8.501503	8.518132	8.553461
448	0.873125	982.0106	8.726216	8.521748	8.537438	8.571967
449	0.8761458	972.3618	8.733058	8.542013	8.556493	8.59022
450	0.8791667	962.6497	8.739874	8.562278	8.575301	8.608223
451	0.8821875	952.875	8.746644	8.582512	8.593865	8.625981
452	0.8852083	943.038	8.753358	8.602686	8.612197	8.643496
453	0.8882292	933.1392	8.760015	8.622773	8.630308	8.660771
454	0.89125	923.1802	8.766624	8.642752	8.648209	8.67781
455	0.8942708	913.1629	8.773194	8.6626	8.66591	8.694615
456	0.8972917	903.0903	8.779734	8.682286	8.683423	8.711188
457	0.9003125	892.9651	8.786242	8.701783	8.700761	8.727531
458	0.9033333	882.7898	8.79271	8.721065	8.717936	8.743646
459	0.9063542	872.5658	8.799128	8.740104	8.734961	8.759535
460	0.909375	862.294	8.805487	8.758877	8.751842	8.775198
461	0.9123958	851.9746	8.811784	8.777358	8.768583	8.790639
462	0.9154167	841.6062	8.818022	8.795527	8.785185	8.805858
463	0.9184375	831.1862	8.824215	8.813365	8.801649	8.820861
464	0.9214583	820.715	8.830377	8.830855	8.817973	8.835652
465	0.9244792	810.1957	8.83651	8.847985	8.834151	8.850239
466	0.9275	799.6306	8.842608	8.864745	8.850176	8.864632
467	0.9305208	789.0103	8.848664	8.881128	8.866039	8.878845
468	0.9335417	778.3101	8.854707	8.89713	8.881731	8.892892
469	0.9365625	767.5305	8.860779	8.912749	8.897239	8.906793
470	0.9395833	756.6879	8.866875	8.92798	8.912554	8.920567
471	0.9426042	745.7871	8.872949	8.942825	8.927662	8.934236
472	0.945625	734.826	8.878945	8.95729	8.942555	8.947822
473	0.9486458	723.7978	8.884832	8.971376	8.957224	8.961346
474	0.9516667	712.6933	8.890618	8.985077	8.971662	8.974827

475	0.9546875	701.5036	8.896348	8.998397	8.985859	8.988281
476	0.9577083	690.1979	8.902105	9.011363	8.999803	9.001722
477	0.9607292	678.7409	8.908015	9.023994	9.013476	9.015164
478	0.96375	667.1154	8.914184	9.036293	9.026862	9.028614
479	0.9667708	655.2955	8.920657	9.048258	9.039951	9.042075
480	0.9697917	643.3479	8.927326	9.05989	9.052742	9.055546
481	0.9728125	631.2759	8.933942	9.071173	9.065242	9.06902
482	0.9758333	619.0734	8.940284	9.082082	9.077456	9.082485
483	0.9788542	606.8138	8.946157	9.092582	9.089386	9.095926
484	0.981875	594.542	8.951401	9.102656	9.101037	9.109328
485	0.9848958	582.28	8.955987	9.11231	9.112412	9.122667
486	0.9879167	570.0381	8.960046	9.121572	9.123503	9.135922
487	0.9909375	557.8273	8.963824	9.130522	9.134292	9.149068
488	0.9939583	545.664	8.967576	9.139269	9.144755	9.162079
489	0.9969792	533.5681	8.971471	9.147872	9.15487	9.174929
490	1	521.554	8.975537	9.156324	9.16462	9.187594
491	1	509.6135	8.979689	9.164618	9.174013	9.200049
492	1	497.7196	8.983813	9.172755	9.183094	9.212271
493	1	485.8353	8.987835	9.180733	9.19193	9.224238
494	1	473.9328	8.991756	9.188555	9.200575	9.235926
495	1	462.0051	8.995611	9.196222	9.209061	9.24731
496	1	450.0566	8.99943	9.203734	9.217407	9.258363
497	1	438.105	9.003198	9.211091	9.225623	9.269065
498	1	426.1757	9.006841	9.218269	9.233709	9.279401
499	1	414.2883	9.010253	9.225214	9.24165	9.289365
500	1	402.4509	9.013347	9.231869	9.249416	9.298955
501	1	390.6619	9.016111	9.238215	9.25697	9.308171
502	1	378.9168	9.018615	9.24431	9.264293	9.317004
503	1	367.2145	9.020986	9.25026	9.271396	9.32544
504	1	355.5582	9.023351	9.256138	9.27832	9.333454
505	1	343.9527	9.025786	9.261981	9.285111	9.341014
506	1	332.3984	9.028299	9.267821	9.29179	9.348079
507	1	320.8875	9.030838	9.273681	9.298343	9.354609
508	1	309.4046	9.033335	9.279568	9.304751	9.360578
509	1	297.9326	9.035739	9.285475	9.311001	9.365981
510	1	286.4594	9.038031	9.291398	9.317089	9.370849
511	1	274.9801	9.040219	9.297353	9.323003	9.375239
512	1	263.4981	9.042316	9.303357	9.32872	9.379224
513	1	252.0218	9.044324	9.309407	9.334202	9.382871
514	1	240.5615	9.046225	9.315469	9.339397	9.386222
515	1	229.0535	9.048066	9.321478	9.344267	9.389295
516	1	217.6129	9.049829	9.327359	9.348809	9.392086
517	1	206.2856	9.051318	9.333076	9.353059	9.394582
518	1	194.9894	9.052442	9.338645	9.357066	9.396764
519	1	183.7177	9.053307	9.344102	9.360864	9.398608
520	1	172.4693	9.05408	9.349467	9.364461	9.4001
521	1	161.2571	9.054914	9.354738	9.367848	9.401244
522	1	150.0956	9.055871	9.359903	9.371028	9.402081
523	1	138.9934	9.056913	9.364951	9.374036	9.402695
524	1	127.9526	9.05793	9.369863	9.3769	9.403203
525	1	116.9733	9.05879	9.374634	9.379537	9.403672
526	1	106.0525	9.059392	9.379272	9.381818	9.404052
527	1	95.18822	9.059704	9.383709	9.383759	9.404245
528	1	84.38153	9.059772	9.387852	9.385466	9.404266
529	1	73.64024	9.059686	9.391712	9.386948	9.404241
530	1	62.97847	9.059537	9.395301	9.388215	9.404209
531	1	52.41338	9.059375	9.398527	9.38931	9.404056
532	1	41.96066	9.05919	9.401315	9.390228	9.403688
533	1	31.63197	9.058925	9.40367	9.39097	9.403103
534	1	21.43422	9.058505	9.405623	9.39154	9.402267
535	1	11.37	9.057875	9.407216	9.391927	9.401195
536	1	1.438184	9.057032	9.408468	9.39213	9.399962
537	1	-6.248098	9.053838	9.409386	9.392142	9.398624
538	1	-13.97563	9.047208	9.409978	9.391928	9.397245
539	1	-23.43612	9.041429	9.410242	9.391459	9.395864
540	1	-33.06934	9.040538	9.410191	9.390751	9.394495
541	1	-42.47771	9.044703	9.409947	9.389841	9.393147
542	1	-51.38375	9.051559	9.409921	9.388715	9.391825
543	1	-59.80172	9.057535	9.410545	9.387311	9.39053
544	1	-68.62397	9.060374	9.411116	9.385605	9.389249
545	1	-78.37715	9.060452	9.409679	9.383751	9.387954
546	1	-87.68343	9.058249	9.406242	9.382121	9.38661
547	1	-96.32726	9.053408	9.403174	9.381018	9.385204
548	1	-104.9629	9.046979	9.400161	9.380191	9.383757
549	1	-113.5977	9.041255	9.396179	9.378837	9.382296
550	1	-122.1403	9.038146	9.39143	9.376534	9.380835
551	1	-130.3996	9.038292	9.386087	9.373884	9.379368
552	1	-138.2215	9.040787	9.381705	9.371561	9.37788
553	1	-145.8091	9.043938	9.379022	9.369344	9.376351
554	1	-153.416	9.046314	9.375747	9.366654	9.374759
555	1	-160.8439	9.046837	9.370724	9.363015	9.373073

556	1	-167.9336	9.044745	9.365693	9.358622	9.371255
557	1	-174.8851	9.040272	9.361138	9.354478	9.369258
558	1	-181.8276	9.034852	9.356483	9.350924	9.367036
559	1	-188.7043	9.030315	9.35184	9.347485	9.364558
560	1	-195.4146	9.027978	9.346799	9.344117	9.361809
561	1	-201.8234	9.028103	9.340936	9.340749	9.358803
562	1	-207.8768	9.02986	9.33511	9.336611	9.355597
563	1	-213.6536	9.031866	9.330678	9.331424	9.35231
564	1	-219.2409	9.03284	9.326987	9.326082	9.349114
565	1	-224.648	9.031994	9.32215	9.321159	9.346147
566	1	-229.909	9.02925	9.31655	9.316151	9.343372
567	1	-235.124	9.025362	9.311424	9.311049	9.340533
568	1	-240.3225	9.021621	9.306541	9.306528	9.337273
569	1	-245.413	9.019181	9.301624	9.302376	9.333402
570	1	-250.2843	9.018505	9.296591	9.297661	9.329029
571	1	-254.8741	9.019229	9.291063	9.292397	9.324395
572	1	-259.1702	9.020412	9.285205	9.287426	9.319548
573	1	-263.2412	9.021021	9.279936	9.282727	9.314256
574	1	-267.1926	9.020425	9.2757	9.277726	9.308326
575	1	-271.077	9.018602	9.271504	9.272534	9.301939
576	1	-274.8957	9.016031	9.266486	9.267574	9.295553
577	1	-278.6374	9.013448	9.261388	9.262804	9.289476
578	1	-282.2946	9.011563	9.256817	9.257312	9.283577
579	1	-285.8341	9.010786	9.252436	9.251223	9.277409
580	1	-289.1765	9.011004	9.248092	9.245967	9.270551
581	1	-292.2758	9.011616	9.243667	9.241166	9.262857
582	1	-295.1688	9.011879	9.238836	9.235921	9.25448
583	1	-297.9193	9.011293	9.233719	9.230662	9.245779
584	1	-300.5861	9.009798	9.229077	9.225834	9.237163
585	1	-303.2047	9.007766	9.225428	9.221205	9.22888
586	1	-305.7586	9.005778	9.221992	9.215906	9.22089
587	1	-308.1957	9.004324	9.2178	9.209911	9.213012
588	1	-310.4681	9.003591	9.21342	9.204138	9.205126
589	1	-312.5569	9.003437	9.209476	9.198616	9.197157
590	1	-314.4693	9.003502	9.205456	9.192994	9.189055
591	1	-316.2204	9.003375	9.201109	9.187338	9.180925
592	1	-317.8352	9.002765	9.196474	9.181395	9.172984
593	1	-319.3504	9.001625	9.191378	9.17559	9.165296
594	1	-320.7899	9.000164	9.185987	9.170215	9.157706
595	1	-322.1521	8.998732	9.180786	9.164089	9.150082
596	1	-323.4143	8.99764	9.176035	9.157502	9.142434
597	1	-324.5341	8.997005	9.171433	9.151444	9.134781
598	1	-325.467	8.996692	9.166547	9.14533	9.127153
599	1	-326.1907	8.996382	9.161509	9.138918	9.119707
600	1	-326.7171	8.995752	9.156628	9.132468	9.112607
601	1	-327.0887	8.994659	9.151753	9.125962	9.105785
602	1	-327.3469	8.993218	9.146674	9.119532	9.099006
603	1	-327.4939	8.991718	9.141364	9.113202	9.09217
604	1	-327.5017	8.990439	9.135705	9.10687	9.085332
605	1	-327.3466	8.989531	9.129575	9.101135	9.078486
606	1	-327.0121	8.988966	9.123086	9.095203	9.071592
607	1	-326.4833	8.988563	9.116566	9.088287	9.064809
608	1	-325.7566	8.988068	9.110234	9.081583	9.0584
609	1	-324.842	8.987275	9.103848	9.075218	9.052382
610	1	-323.7571	8.986118	9.097052	9.068787	9.046537
611	1	-322.518	8.984702	9.08999	9.062523	9.04074
612	1	-321.1304	8.983252	9.082976	9.056393	9.035035
613	1	-319.5876	8.982003	9.075886	9.050356	9.029428
614	1	-317.8778	8.981099	9.068507	9.044423	9.023813
615	1	-315.9932	8.980538	9.060887	9.038507	9.01815
616	1	-313.9324	8.980189	9.053096	9.032612	9.012599
617	1	-311.6958	8.979847	9.045212	9.026806	9.007369
618	1	-309.2864	8.979311	9.03735	9.021061	9.002492
619	1	-306.7199	8.978477	9.029545	9.015315	8.99781
620	1	-304.0199	8.977392	9.021833	9.009544	8.993195
621	1	-301.1973	8.976231	9.014343	9.003303	8.988653
622	1	-298.2449	8.975202	9.007217	8.997133	8.984179
623	1	-295.1482	8.97444	9.000409	8.991627	8.979694
624	1	-291.8926	8.973954	8.993663	8.986043	8.975155
625	1	-288.4712	8.973634	8.98686	8.980296	8.970526
626	1	-284.8906	8.97331	8.980196	8.97468	8.965729
627	1	-281.169	8.972844	8.973818	8.969103	8.960779
628	1	-277.3305	8.972198	8.967632	8.963598	8.955864
629	1	-273.393	8.971443	8.961585	8.95815	8.95116
630	1	-269.3595	8.97071	8.955733	8.95268	8.946648
631	1	-265.2182	8.970114	8.950077	8.947194	8.942204
632	1	-260.9553	8.969692	8.944627	8.941719	8.937796
633	1	-256.5686	8.969403	8.939418	8.936292	8.933458
634	1	-252.0668	8.969163	8.934446	8.930996	8.92914
635	1	-247.458	8.968892	8.929673	8.925897	8.924768
636	1	-242.7476	8.968535	8.925025	8.921021	8.920342

637	1	-237.9466	8.968087	8.920436	8.916462	8.915866
638	1	-233.0641	8.967595	8.915935	8.912037	8.911318
639	1	-228.1011	8.967134	8.911647	8.907558	8.906667
640	1	-223.0514	8.966761	8.907678	8.903359	8.901863
641	1	-217.9039	8.96648	8.903989	8.899427	8.896897
642	1	-212.6472	8.966239	8.900475	8.895443	8.89187
643	1	-207.272	8.965952	8.897143	8.891487	8.886929
644	1	-201.7722	8.965533	8.894079	8.887642	8.882093
645	1	-196.1429	8.964933	8.891255	8.883876	8.877221
646	1	-190.4538	8.964238	8.888575	8.880227	8.872217
647	1	-184.8249	8.963761	8.886035	8.876718	8.867128
648	1	-179.315	8.963915	8.88369	8.873372	8.862007
649	1	-173.9033	8.964917	8.881576	8.870212	8.856844
650	1	-168.5294	8.966586	8.879735	8.8672	8.851664
651	1	-163.152	8.968395	8.878167	8.864296	8.846535
652	1	-157.765	8.969721	8.87678	8.861492	8.84153
653	1	-152.3884	8.97014	8.875409	8.858792	8.836719
654	1	-147.0532	8.969613	8.873912	8.856214	8.83213
655	1	-141.784	8.9685	8.872271	8.853794	8.827731
656	1	-136.5712	8.96738	8.870575	8.851537	8.823509
657	1	-131.3754	8.966776	8.868912	8.849394	8.819531
658	1	-126.1707	8.966944	8.867284	8.847301	8.815862
659	1	-120.9517	8.967826	8.865615	8.845223	8.812461
660	1	-115.7246	8.969103	8.863863	8.843171	8.809243
661	1	-110.508	8.970344	8.862093	8.841174	8.80622
662	1	-105.3234	8.971176	8.860402	8.839249	8.803454
663	1	-100.1919	8.971424	8.858841	8.837394	8.800946
664	1	-95.13754	8.971171	8.85743	8.835611	8.798675
665	1	-90.15951	8.970702	8.856136	8.833915	8.796635
666	1	-85.22848	8.970344	8.854834	8.832308	8.794818
667	1	-80.3143	8.970315	8.853413	8.830772	8.793221
668	1	-75.3792	8.970636	8.851865	8.829282	8.791848
669	1	-70.39716	8.971139	8.850223	8.827819	8.790696
670	1	-65.37712	8.971569	8.848503	8.826373	8.789771
671	1	-60.34618	8.97174	8.846707	8.824945	8.789088
672	1	-55.33644	8.971623	8.844841	8.823555	8.788675
673	1	-50.36783	8.971345	8.842917	8.822234	8.788559
674	1	-45.43791	8.971106	8.840956	8.82101	8.788747
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676	1	-35.63666	8.971296	8.837099	8.818958	8.789893
677	1	-30.7342	8.971707	8.835273	8.818147	8.790733
678	1	-25.82042	8.972143	8.83349	8.817473	8.791686
679	1	-20.89914	8.972434	8.831658	8.816944	8.792748
680	1	-15.98253	8.972481	8.82969	8.816561	8.793939
681	1	-11.08475	8.972301	8.827584	8.8163	8.795286
682	1	-6.21641	8.972016	8.825402	8.816126	8.796806
683	1	-1.38545	8.971802	8.8232	8.81602	8.798508
684	1	3.20756	8.972021	8.821038	8.815987	8.800386
685	1	7.760357	8.972871	8.818974	8.816054	8.802413
686	1	12.4506	8.973927	8.81705	8.816235	8.804528
687	1	17.15519	8.974634	8.815308	8.816504	8.806656
688	1	21.82637	8.974746	8.813781	8.816839	8.808724
689	1	26.42179	8.974324	8.81248	8.817256	8.810691
690	1	31.09326	8.973504	8.81138	8.817786	8.81256
691	1	35.63904	8.97261	8.810505	8.818446	8.814362
692	1	39.97297	8.972276	8.809958	8.819235	8.81613
693	1	44.26588	8.972832	8.809712	8.820124	8.817895
694	1	48.54613	8.974068	8.809582	8.821085	8.819682
695	1	52.82455	8.975489	8.809642	8.822106	8.821501
696	1	57.07161	8.976559	8.810003	8.823174	8.823347
697	1	61.28438	8.976912	8.810517	8.824256	8.825216
698	1	65.40853	8.976504	8.810987	8.825318	8.8271
699	1	69.34468	8.975723	8.811526	8.826394	8.828985
700	1	73.10375	8.97517	8.812528	8.827613	8.830847
701	1	76.74926	8.975274	8.813915	8.829006	8.832662
702	1	80.31625	8.976111	8.815479	8.830522	8.834415
703	1	83.83397	8.977423	8.817306	8.832167	8.836113
704	1	87.31761	8.978741	8.819373	8.833925	8.837772
705	1	90.75188	8.979604	8.82161	8.835776	8.839398
706	1	94.07902	8.979802	8.823881	8.837749	8.840981
707	1	97.24118	8.979486	8.826072	8.839804	8.84251
708	1	100.2321	8.979059	8.828441	8.841818	8.843989
709	1	103.0789	8.978928	8.831163	8.843772	8.845431
710	1	105.8105	8.979329	8.834031	8.845767	8.846849
711	1	108.4578	8.980238	8.837001	8.847868	8.848245
712	1	111.0475	8.98139	8.840193	8.850138	8.849605
713	1	113.5785	8.982415	8.8436	8.852495	8.850912
714	1	116.0204	8.983032	8.847122	8.8548	8.852138
715	1	118.343	8.983178	8.8506	8.857102	8.853254
716	1	120.5338	8.983006	8.853997	8.859468	8.854273
717	1	122.5979	8.982791	8.857478	8.861971	8.855262

718	1	124.5508	8.982795	8.861063	8.864625	8.856301
719	1	126.4086	8.983162	8.864628	8.867273	8.857442
720	1	128.1922	8.983868	8.868198	8.869893	8.858719

IHNC_675_75_2_2.sim

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Inner Harbor Navigation Channel Lock, New Orleans


! ********TWO FEET LIFT********

*CONSTANTS ==========================================================================
    io_units=English,  time_units=seconds
    time_step=1,   gravity=32.146, wf_time=0.55
    dQ_max=.001,   dh_max=.0001,   dx_max=.0001
    plot_field=11, plot_line=200,  plot_labels=row
    plot_file=IHNC_675_75_2_2.sim.plt

*COMPONENTS =========================================================================
!  The following was adopted from the model study.
! (Modeling 1:25-scale model, increase hydraulic roughness by setting Darcy-Weisbach
!   friction factor to 0.02 which is more appropriate for phy model with peak Re=1e5
!  Change prototype simulations to 'rough=.003')

! --------------- Left Wall ------------------------------

! Intake

HW     LIn     pipe_loss  us_area=1e6, area=80.00, K+=0.5
LIn    LB1u    imp_pipe  dia=8.89, area=80.00, len=22.73, rough=.003, wave=3500!

! The first bend on left culvert is LB1

LB1u   LB1d    pipe_loss  area=80.00  K+=0.07
                ! Kb for 30 degree Bend - HDC Chart 228-1 Re=2.5x10^5
LB1d   LFVu    imp_pipe  dia=8.89, area=80.00, len=27.71, rough=.003, wave=3500!

LFVu   LFW     storage surface_area=290.00  max_wsel=25.00

! Reverse Tainter Filling Valve

LFVu   LFVd    rev_tainter b=10, w=8, el_bottom=-31.50
                b/B_vs_t=OpenTainter_Hite
                Cc_vs_b/B=TainterCc
!                Kv+_vs_b/B=TainterKv
                Cdv+_vs_b/B=tainterCdv
LFVd   LB2u    imp_pipe  dia=8.89, area=80.00, len=27.71, rough=.003, wave=3500!

! Second bend

LB2u   LB2d    pipe_loss  area=80.00  K+=0.07

! Straight reach of culvert US of manifold

LB2d   LP1u    imp_pipe  dia=8.89, area=80.00, len=77.67, rough=.003, wave=3500

! Sidewall Port Manifold

LP1u   LP1d  LP1b  diverging_tee area1=area3=80.00 area2=32.00 angle1=0 angle2=90
LP1b   Ch1     pipe_loss area=32.00 ds_area=1e5 K+=1.80 K-=0.25

LP1d   LP2u    imp_pipe dia=8.89, area=80.00, len=30.00, rough=.003, wave=3500

LP2u   LP2d  LP2b  diverging_tee area1=area3=80.00 area2=12.00 angle1=0 angle2=90
LP2b   Ch2     pipe_loss area=12.00 ds_area=1e5 K+=1.80 K-=0.25

LP2d   LP3u    imp_pipe dia=8.89, area=80.00, len=30.00, rough=.003, wave=3500

LP3u   LP3d  LP3b  diverging_tee area1=area3=80.00 area2=12.00 angle1=0 angle2=90
LP3b   Ch3     pipe_loss area=12.00 ds_area=1e5 K+=1.80 K-=0.25

LP3d   LP4u    imp_pipe dia=8.89, area=80.00, len=30.00, rough=.003, wave=3500
```

```
LP4u   LP4d  LP4b  diverging_tee area1=area3=80.00 area2=12.00 angle1=0 angle2=90
LP4b   Ch4     pipe_loss area=12.00 ds_area=1e5 K+=1.80 K-=0.25

LP4d   LP5u    imp_pipe dia=8.89, area=80.00, len=30.00, rough=.003, wave=3500

LP5u   LP5d  LP5b  diverging_tee area1=area3=80.00 area2=12.00 angle1=0 angle2=90
LP5b   Ch5     pipe_loss area=12.00 ds_area=1e5 K+=1.80 K-=0.25

LP5d   LP6u    imp_pipe dia=8.89, area=80.00, len=30.00, rough=.003, wave=3500

LP6u   LP6d  LP6b  diverging_tee area1=area3=80.00 area2=12.00 angle1=0 angle2=90
LP6b   Ch6     pipe_loss area=12.00 ds_area=1e5 K+=1.80 K-=0.25

LP6d   LP7u    imp_pipe dia=8.89, area=80.00, len=30.00, rough=.003, wave=3500

LP7u   LP7d  LP7b  diverging_tee area1=area3=80.00 area2=12.00 angle1=0 angle2=90
LP7b   Ch7     pipe_loss area=12.00 ds_area=1e5 K+=1.80 K-=0.25

LP7d   LP8u    imp_pipe dia=8.89, area=80.00, len=30.00, rough=.003, wave=3500

LP8u   LP8d  LP8b  diverging_tee area1=area3=80.00 area2=12.00 angle1=0 angle2=90
LP8b   Ch8     pipe_loss area=12.00 ds_area=1e5 K+=1.80 K-=0.25

LP8d   LP9u    imp_pipe dia=8.89, area=80.00, len=30.00, rough=.003, wave=3500

LP9u   LP9d  LP9b  diverging_tee area1=area3=80.00 area2=12.00 angle1=0 angle2=90
LP9b   Ch9     pipe_loss area=12.00 ds_area=1e5 K+=1.80 K-=0.25

LP9d   LP10u   imp_pipe dia=8.89, area=80.00, len=30.00, rough=.003, wave=3500

LP10u  LP10d  LP10b  diverging_tee area1=area3=80.00 area2=12.00 angle1=0 angle2=90
LP10b  Ch10    pipe_loss area=12.00 ds_area=1e5 K+=1.80 K-=0.25

LP10d  LP11u  imp_pipe dia=8.89, area=80.00, len=30.00, rough=.003, wave=3500

LP11u  LP11d  LP11b  diverging_tee area1=area3=80.00 area2=12.00 angle1=0 angle2=90
LP11b  Ch11    pipe_loss area=12.00 ds_area=1e5 K+=1.80 K-=0.25

LP11d  LP12u  imp_pipe dia=8.89, area=80.00, len=30.00, rough=.003, wave=3500

LP12u  LP12d  LP12b  diverging_tee area1=area3=80.00 area2=12.00 angle1=0 angle2=90
LP12b  Ch12    pipe_loss area=12.00 ds_area=1e5 K+=1.80 K-=0.25

LP12d  LP13u  imp_pipe dia=8.89, area=80.00, len=30.00, rough=.003, wave=3500

LP13u  LP13d  LP13b  diverging_tee area1=area3=80.00 area2=12.00 angle1=0 angle2=90
LP13b  Ch13    pipe_loss area=12.00 ds_area=1e5 K+=1.80 K-=0.25

LP13d  LP14u  imp_pipe dia=8.89, area=80.00, len=30.00, rough=.003, wave=3500

LP14u  LP14d  LP14b  diverging_tee area1=area3=80.00 area2=12.00 angle1=0 angle2=90
LP14b  Ch14    pipe_loss area=12.00 ds_area=1e5 K+=1.80 K-=0.25

LP14d  LP15u   imp_pipe dia=8.89, area=80.00, len=30.00, rough=.003, wave=3500

LP15u  LP15d  LP15b  diverging_tee area1=area3=80.00 area2=32.00 angle1=0 angle2=90
LP15b  Ch15    pipe_loss area=32.00 ds_area=1e5 K+=1.80 K-=0.25

LP15d  LB3u   imp_pipe dia=8.89, area=80.00, len=30.00, rough=.003, wave=3500

! Culvert downstream of manifold ports

LB3u   LB3d    pipe_loss  area=80.00  K+=0.07
LB3d   LEVu    imp_pipe  dia=8.89, area=80.00, len=27.71, rough=.003, wave=3500
LEVu   LEW     storage surface_area=290.00  max_wsel=25.00
!LEVu   LEVd    rev_tainter b=18.25  w=15  el_bottom=-22.00
!               b/B_vs_t=OpenTainter_Hite
!               Cc_vs_b/B=TainterCc  Kv+_vs_b/B=TainterKv
!               fixed_b/B=0
```

```
! --------------- Right Wall ------------------------------

! Intake
HW     RIn     pipe_loss  us_area=1e6  area=80.00  K+=0.5
RIn    RB1u    imp_pipe  dia=8.89  area=80.00  len=22.73  rough=.003  wave=3500
! The first bend on right culvert is RB1
RB1u   RB1d    pipe_loss  area=80.00  K+=0.07
                ! Kb for 30 degree Bend - HDC Chart 228-1 Re=2.5x10^5
RB1d   RFVu    imp_pipe  dia=8.89, area=80.00, len=27.71, rough=.003, wave=3500
RFVu   RFW     storage surface_area=290.00  max_wsel=25.00

! Reverse Tainter Filling Valve

RFVu   RFVd    rev_tainter b=10, w=8, el_bottom=-31.50
                b/B_vs_t=OpenTainter_Hite
                Cc_vs_b/B=TainterCc
!               Kv+_vs_b/B=TainterKv
                Cdv+_vs_b/B=tainterCdv
RFVd   RB2u    imp_pipe  dia=8.89  area=80.00  len=27.71  rough=.003  wave=3500

! Second bend

RB2u   RB2d    pipe_loss  area=80.00  K+=0.07

! Straight reach of culvert US of manifold

RB2d   RP1u    imp_pipe  dia=8.89  area=80.00  len=77.67  rough=.003  wave=3500

! Sidewall Port Manifold

RP1u   RP1d  RP1b  diverging_tee area1=area3=80.00 area2=32.00 angle1=0 angle2=90
RP1b   Ch1     pipe_loss area=32.00 ds_area=1e5 K+=1.80 K-=0.25

RP1d   RP2u    imp_pipe dia=8.89, area=80.00, len=30.00, rough=.003, wave=3500

RP2u   RP2d  RP2b  diverging_tee area1=area3=80.00 area2=12.00 angle1=0 angle2=90
RP2b   Ch2     pipe_loss area=12.00 ds_area=1e5 K+=1.80 K-=0.25

RP2d   RP3u    imp_pipe dia=8.89, area=80.00, len=30.00, rough=.003, wave=3500

RP3u   RP3d  RP3b  diverging_tee area1=area3=80.00 area2=12.00 angle1=0 angle2=90
RP3b   Ch3     pipe_loss area=12.00 ds_area=1e5 K+=1.80 K-=0.25

RP3d   RP4u    imp_pipe dia=8.89, area=80.00, len=30.00, rough=.003, wave=3500

RP4u   RP4d  RP4b  diverging_tee area1=area3=80.00 area2=12.00 angle1=0 angle2=90
RP4b   Ch4     pipe_loss area=12.00 ds_area=1e5 K+=1.80 K-=0.25

RP4d   RP5u    imp_pipe dia=8.89, area=80.00, len=30.00, rough=.003, wave=3500

RP5u   RP5d  RP5b  diverging_tee area1=area3=80.00 area2=12.00 angle1=0 angle2=90
RP5b   Ch5     pipe_loss area=12.00 ds_area=1e5 K+=1.80 K-=0.25

RP5d   RP6u    imp_pipe dia=8.89, area=80.00, len=30.00, rough=.003, wave=3500

RP6u   RP6d  RP6b  diverging_tee area1=area3=80.00 area2=12.00 angle1=0 angle2=90
RP6b   Ch6     pipe_loss area=12.00 ds_area=1e5 K+=1.80 K-=0.25

RP6d   RP7u    imp_pipe dia=8.89, area=80.00, len=30.00, rough=.003, wave=3500

RP7u   RP7d  RP7b  diverging_tee area1=area3=80.00 area2=12.00 angle1=0 angle2=90
RP7b   Ch7     pipe_loss area=12.00 ds_area=1e5 K+=1.80 K-=0.25

RP7d   RP8u    imp_pipe dia=8.89, area=80.00, len=30.00, rough=.003, wave=3500

RP8u   RP8d  RP8b  diverging_tee area1=area3=80.00 area2=12.00 angle1=0 angle2=90
RP8b   Ch8     pipe_loss area=12.00 ds_area=1e5 K+=1.80 K-=0.25

RP8d   RP9u    imp_pipe dia=8.89, area=80.00, len=30.00, rough=.003, wave=3500

RP9u   RP9d  RP9b  diverging_tee area1=area3=80.00 area2=12.00 angle1=0 angle2=90
```

```
RP9b   Ch9     pipe_loss area=12.00 ds_area=1e5 K+=1.80 K-=0.25

RP9d   RP10u   imp_pipe dia=8.89, area=80.00, len=30.00, rough=.003, wave=3500

RP10u  RP10d  RP10b diverging_tee area1=area3=80.00 area2=12.00 angle1=0 angle2=90
RP10b  Ch10    pipe_loss area=12.00 ds_area=1e5 K+=1.80 K-=0.25

RP10d  RP11u  imp_pipe dia=8.89, area=80.00, len=30.00, rough=.003, wave=3500

RP11u  RP11d  RP11b  diverging_tee area1=area3=80.00 area2=12.00 angle1=0 angle2=90
RP11b  Ch11    pipe_loss area=12.00 ds_area=1e5 K+=1.80 K-=0.25

RP11d  RP12u  imp_pipe dia=8.89, area=80.00, len=30.00, rough=.003, wave=3500

RP12u  RP12d  RP12b  diverging_tee area1=area3=80.00 area2=12.00 angle1=0 angle2=90
RP12b  Ch12    pipe_loss area=12.00 ds_area=1e5 K+=1.80 K-=0.25

RP12d  RP13u  imp_pipe dia=8.89, area=80.00, len=30.00, rough=.003, wave=3500

RP13u  RP13d  RP13b  diverging_tee area1=area3=80.00 area2=12.00 angle1=0 angle2=90
RP13b  Ch13    pipe_loss area=12.00 ds_area=1e5 K+=1.80 K-=0.25

RP13d  RP14u  imp_pipe dia=8.89, area=80.00, len=30.00, rough=.003, wave=3500

RP14u  RP14d  RP14b  diverging_tee area1=area3=80.00 area2=12.00 angle1=0 angle2=90
RP14b  Ch14    pipe_loss area=12.00 ds_area=1e5 K+=1.80 K-=0.25

RP14d  RB3u  imp_pipe dia=8.89, area=80.00, len=30.00, rough=.003, wave=3500

RP15u  RP15d  RP15b  diverging_tee area1=area3=80.00 area2=32.00 angle1=0 angle2=90
RP15b  Ch15    pipe_loss area=32.00 ds_area=1e5 K+=1.80 K-=0.25

RP15d  RB3u   imp_pipe dia=8.89, area=80.00, len=30.00, rough=.003, wave=3500

! Culvert downstream of manifold ports

RB3u   RB3d    pipe_loss  area=80.00  K+=0.0
RB3d   REVu    imp_pipe  dia=8.89  area=80.00  len=27.71  rough=.003  wave=3500
REVu   REW     storage surface_area=290.00  max_wsel=25.00
!REVu   REVd    rev_tainter b=18.25  w=15  el_bottom=-40
!               b/B_vs_t=OpenTainter_Hite
!               Cc_vs_b/B=TainterCc  Kv+_vs_b/B=TainterKv
!               fixed_b/B=0
!------------ Lock chamber modeled as series of open channels ---------

! length is from pintle to halfway between the first ports (right and left)

Upin  ChU   open_channel  cross_section=chamber  len=51.25  reaches=3  iq=0
ChU   Ch1   open_channel  cross_section=chamber  len=51.25  reaches=3  iq=0
Ch1   Ch2   open_channel  cross_section=chamber  len=30.00    reaches=2  iq=0
Ch2   Ch3   open_channel  cross_section=chamber  len=30.00    reaches=2  iq=0
Ch3   Ch4   open_channel  cross_section=chamber  len=30.00    reaches=2  iq=0
Ch4   Ch5   open_channel  cross_section=chamber  len=30.00    reaches=2  iq=0
Ch5   Ch6   open_channel  cross_section=chamber  len=30.00    reaches=2  iq=0
Ch6   Ch7   open_channel  cross_section=chamber  len=30.00    reaches=2  iq=0
Ch7   Ch8   open_channel  cross_section=chamber  len=30.00    reaches=2  iq=0
Ch8   Ch9   open_channel  cross_section=chamber  len=30.00    reaches=2  iq=0
Ch9   Ch10  open_channel  cross_section=chamber  len=30.00    reaches=2  iq=0
Ch10  Ch11  open_channel  cross_section=chamber  len=30.00    reaches=2  iq=0
Ch11  Ch12  open_channel  cross_section=chamber  len=30.00    reaches=2  iq=0
Ch12  Ch13  open_channel  cross_section=chamber  len=30.00    reaches=2  iq=0
Ch13  Ch14  open_channel  cross_section=chamber  len=30.00    reaches=2  iq=0
Ch14  Ch15  open_channel  cross_section=chamber  len=30.00    reaches=2  iq=0
Ch15  ChD   open_channel  cross_section=chamber  len=76.25    reaches=6  iq=0
ChD   Lpin  open_channel  cross_section=chamber  len=76.25   reaches=6  iq=0

*NODES ==========================================================================
! lin is -40+18.25/2 =30.875 model study
! PLAN=>> -31.50+10.00/2=-26.50 top of culvert
! PLAN=>> -31.50+8.00/2=-27.50 top of side port culverts=>1 and 15
! PLAN=>> -31.50+4.00/2=-29.50 top of side port culverts=>2 to 14
```

```
HW        elev=-26.50     head=0  idemand=0
! ---Left Culvert---
LIn       elev=-26.50    ihead=0
LB1u      elev=-26.50    ihead=0
LB1d      elev=-26.50    ihead=0
LFVu      elev=-26.50    ihead=0
LFW       elev=-26.50    ihead=0   demand=0
! wsel will change once you cross the valve
LFVd      elev=-26.50    ihead=-2
LB2u      elev=-26.50    ihead=-2
LB2d      elev=-26.50    ihead=-2
LP1u      elev=-26.50    ihead=-2
LP1d      elev=-26.50    ihead=-2
! at port
LP1b      elev=-27.50   ihead=-2
LP2u      elev=-26.50    ihead=-2
LP2d      elev=-26.50    ihead=-2
! at port
LP2b      elev=-29.50    ihead=-2
LP3u      elev=-26.50    ihead=-2
LP3d      elev=-26.50    ihead=-2
! at port
LP3b      elev=-29.50    ihead=-2
LP4u      elev=-26.50    ihead=-2
LP4d      elev=-26.50    ihead=-2
! at port
LP4b      elev=-29.50    ihead=-2
LP5u      elev=-26.50    ihead=-2
LP5d      elev=-26.50    ihead=-2
! at port
LP5b      elev=-29.50    ihead=-2
LP6u      elev=-26.50    ihead=-2
LP6d      elev=-26.50    ihead=-2
! at port
LP6b      elev=-29.50    ihead=-2
LP7u      elev=-26.50    ihead=-2
LP7d      elev=-26.50    ihead=-2
! at port
LP7b      elev=-29.50    ihead=-2
LP8u      elev=-26.50    ihead=-2
LP8d      elev=-26.50    ihead=-2
! at port
LP8b      elev=-29.50    ihead=-2
LP9u      elev=-26.50    ihead=-2
LP9d      elev=-26.50    ihead=-2
! at port
LP9b      elev=-29.50    ihead=-2
LP10u     elev=-26.50    ihead=-2
LP10d     elev=-26.50    ihead=-2
! at port
LP10b     elev=-29.50    ihead=-2
LP11u     elev=-26.50    ihead=-2
LP11d     elev=-26.50    ihead=-2
! at port
LP11b     elev=-29.50    ihead=-2
LP12u     elev=-26.50    ihead=-2
LP12d     elev=-26.50    ihead=-2
! at port
LP12b     elev=-29.50    ihead=-2
LP13u     elev=-26.50    ihead=-2
LP13d     elev=-26.50    ihead=-2
! at port
LP13b     elev=-29.50    ihead=-2
LP14u     elev=-26.50    ihead=-2
LP14d     elev=-26.50    ihead=-2
! at port
LP14b     elev=-29.50    ihead=-2
LP15u     elev=-26.50    ihead=-2
LP15d     elev=-26.50    ihead=-2
! at port
LP15b     elev=-27.50    ihead=-2
```

```
LB3u      elev=-26.50    ihead=-2
LB3d      elev=-26.50    ihead=-2
LEVu      elev=-26.50    ihead=-2
LEW       elev=-26.50    ihead=-2    demand=0
! ---Right Culvert---
RIn       elev=-26.50    ihead=0
RB1u      elev=-26.50    ihead=0
RB1d      elev=-26.50    ihead=0
RFVu      elev=-26.50    ihead=0
RFW       elev=-26.50    ihead=0     demand=0
! wsel will change once you cross the valve
RFVd      elev=-26.50    ihead=-2
RB2u      elev=-26.50    ihead=-2
RB2d      elev=-26.50    ihead=-2
RP1u      elev=-26.50    ihead=-2
RP1d      elev=-26.50    ihead=-2
! at port
RP1b      elev=-29.50    ihead=-2
RP2u      elev=-26.50    ihead=-2
RP2d      elev=-26.50    ihead=-2
! at port
RP2b      elev=-29.50    ihead=-2
RP3u      elev=-26.50    ihead=-2
RP3d      elev=-26.50    ihead=-2
! at port
RP3b      elev=-29.50    ihead=-2
RP4u      elev=-26.50    ihead=-2
RP4d      elev=-26.50    ihead=-2
! at port
RP4b      elev=-29.50    ihead=-2
RP5u      elev=-26.50    ihead=-2
RP5d      elev=-26.50    ihead=-2
! at port
RP5b      elev=-29.50    ihead=-2
RP6u      elev=-26.50    ihead=-2
RP6d      elev=-26.50    ihead=-2
! at port
RP6b      elev=-29.50    ihead=-2
RP7u      elev=-26.50    ihead=-2
RP7d      elev=-26.50    ihead=-2
! at port
RP7b      elev=-29.50    ihead=-2
RP8u      elev=-26.50    ihead=-2
RP8d      elev=-26.50    ihead=-2
! at port
RP8b      elev=-29.50    ihead=-2
RP9u      elev=-26.50    ihead=-2
RP9d      elev=-26.50    ihead=-2
! at port
RP9b      elev=-29.50    ihead=-2
RP10u     elev=-26.50    ihead=-2
RP10d     elev=-26.50    ihead=-2
! at port
RP10b     elev=-29.50    ihead=-2
RP11u     elev=-26.50    ihead=-2
RP11d     elev=-26.50    ihead=-2
! at port
RP11b     elev=-29.50    ihead=-2
RP12u     elev=-26.50    ihead=-2
RP12d     elev=-26.50    ihead=-2
! at port
RP12b     elev=-29.50    ihead=-2
RP13u     elev=-26.50    ihead=-2
RP13d     elev=-26.50    ihead=-2
! at port
RP13b     elev=-29.50    ihead=-2
RP14u     elev=-26.50    ihead=-2
RP14d     elev=-26.50    ihead=-2
! at port
RP14b     elev=-29.50    ihead=-2
RP15u     elev=-26.50    ihead=-2
```

```
RP15d     elev=-26.50    ihead=-2
! at port
RP15b     elev=-27.50    ihead=-2
RB3u      elev=-26.50    ihead=-2
RB3d      elev=-26.50    ihead=-2
REVu      elev=-26.50    ihead=-2
REW       elev=-26.50    ihead=-2    demand=0
! ---Lock Chamber---
Upin      elev=-31.50       ihead=-2    demand=0
ChU       elev=-31.50       ihead=-2
Ch1       elev=-31.50       ihead=-2
Ch2       elev=-31.50       ihead=-2
Ch3       elev=-31.50       ihead=-2
Ch4       elev=-31.50       ihead=-2
Ch5       elev=-31.50       ihead=-2
Ch6       elev=-31.50       ihead=-2
Ch7       elev=-31.50       ihead=-2
Ch8       elev=-31.50       ihead=-2
Ch9       elev=-31.50       ihead=-2
Ch10      elev=-31.50       ihead=-2
Ch11      elev=-31.50       ihead=-2
Ch12      elev=-31.50       ihead=-2
Ch13      elev=-31.50       ihead=-2
Ch14      elev=-31.50       ihead=-2
Ch15      elev=-31.50       ihead=-2
ChD       elev=-31.50       ihead=-2
Lpin      elev=-31.50       ihead=-2    demand=0

*FUNCTIONS ========================================================================

! open tainter designated at top for b/B vs. time (xscale (valve time)) in
! seconds, b = valve opening, B = culvert height so, b/B is fraction opened.
! OpenTainter comes from Plate 33 of ERDC/CHL TR-03-3 Hite 2003
OpenTainter_Hite     discrete   interpolation=linear  xscale=120  xshift=0
   xy_pairs={ 0.00   0.000
              0.10   0.084
              0.20   0.167
              0.30   0.249
              0.40   0.334
              0.50   0.426
              0.60   0.525
              0.70   0.619
              0.80   0.732
              0.90   0.855
              1.00   1.000 }

! Kv vs b/B Relationship - Based on Nielson's WES Misc Paper H-76-13
! Equations D2 and D3
TainterKv  discrete interpolation=linear extrapolation=linear
   xy_pairs={   0.0010  1385376.875
                0.0020   346667.594
                0.0030   154218.391
                0.0040    86828.391
                0.0050    55621.793
                0.0060    38662.070
                0.0070    28431.086
                0.0080    21787.870
                0.0090    17230.836
                0.0100    13969.831
                0.0150     6237.299
                0.0200     3524.422
                0.0250     2265.772
                0.0300     1580.499
                0.0500      578.828
                0.0600      405.284
                0.0800      231.556
                0.1000      150.331
                0.1500       68.776
                0.2000       39.349
                0.2500       25.239
                0.3000       17.236
```

```
                0.3500       12.244
                0.4000        8.848
                0.4500        6.422
                0.5000        4.661
                0.5500        3.338
                0.6000        2.344
                0.7000        1.049
                0.8000        0.372
                0.9000        0.074
                1.0000        0.010  }

tainterCdv  discrete  interpolation=spline
  x_values={0,   0.05, 0.1, 0.15, 0.2, 0.25, 0.3, 0.35,
            0.4, 0.45, 0.5, 0.55, 0.6, 0.65, 0.7, 0.75,
            0.8, 0.85, 0.9, 0.95,   1}
  y_values={0, 0.0443, 0.0836, 0.1195, 0.1534, 0.196, 0.243, 0.295,
            0.349, 0.415, 0.494, 0.587, 0.69, 0.8165, 0.976, 1.155,
            1.387,  1.69,  2.02, 2.582, 3.162}

! Cc vs b/B Relationship - Gerald Schohl's polynomial which reproduces Fig
! D2 in WES Misc Paper H-76-13
! Cc=.85-1.12X+1.69X^2-.85X^3+.43X^4;  Where X=b/B
  TainterCc  polynomial coefficients={.85, -1.12, 1.69, -.85, .43}

*CROSS_SECTIONS ==================================================================

   chamber TRAPEZOIDAL  MN_n=.02  bed_w=75 ! Lock Chamber

*PLOT VARIABLES ==================================================================

LFVu   LFVd    valve_position
LFVu   LFVd    discharge
LFW    head

Upin   head
Ch8   head
Lpin   head

*END =============================================================================
```

IHNC_675_75_2_2.plt

sec Time	(-) "LFVu LFVd Valve Position sectno=0"	(cfs) "LFVu discharge sectno=0"	(f) "LFW head"	(f) "Upin head"	(f) "Ch8 head"	(f) "Lpin head"
0	0	0	0	-2	-2	-2
1	0.007	5.168894	-.00850081	-1.999994	-2	-2
2	0.014	11.03906	-.03366008	-1.999906	-2	-2
3	0.021	15.74463	-.07036052	-1.999319	-1.999997	-2
4	0.028	20.99102	-0.111342	-1.997244	-1.999979	-2
5	0.035	25.70428	-0.1497629	-1.993033	-1.999887	-2
6	0.042	30.39097	-0.1784081	-1.98805	-1.999553	-2
7	0.049	34.99799	-0.1926177	-1.984138	-1.99867	-2
8	0.056	39.58946	-0.1903378	-1.980582	-1.996948	-2
9	0.063	44.24699	-0.1726494	-1.976667	-1.994469	-2
10	0.07	48.9818	-0.1434222	-1.973186	-1.991778	-2
11	0.077	53.80612	-0.1084546	-1.969643	-1.989343	-1.999999
12	0.084	58.65474	-.07429014	-1.966082	-1.986986	-1.999996
13	0.09091667	63.43856	-.04690489	-1.962573	-1.98423	-1.999984
14	0.09783333	68.0621	-.03065695	-1.958937	-1.980939	-1.999944
15	0.10475	72.47752	-.02766954	-1.955306	-1.977153	-1.999825
16	0.1116667	76.62672	-.03760969	-1.95167	-1.972863	-1.999519
17	0.1185833	80.4929	-.05787657	-1.948142	-1.968353	-1.998827
18	0.1255	84.09085	-.08423114	-1.944761	-1.964051	-1.997462
19	0.1324167	87.47809	-0.1116845	-1.941552	-1.960017	-1.995116
20	0.1393333	90.73286	-0.1354691	-1.93854	-1.956105	-1.991613
21	0.14625	93.94934	-0.1519006	-1.935726	-1.95226	-1.987064
22	0.1531667	97.2096	-0.1589736	-1.933069	-1.948519	-1.981874
23	0.1600833	100.5802	-0.156597	-1.930524	-1.944961	-1.97649
24	0.167	104.1031	-0.1464697	-1.928027	-1.941543	-1.971043
25	0.1738333	107.7794	-0.1316097	-1.925517	-1.938175	-1.965204
26	0.1806667	111.5828	-0.115673	-1.92295	-1.934842	-1.958481
27	0.1875	115.4742	-0.1022396	-1.920288	-1.931483	-1.950683
28	0.1943333	119.3993	-0.0941685	-1.917517	-1.927998	-1.942104
29	0.2011667	123.3085	-.09313509	-1.914659	-1.924283	-1.93328
30	0.208	127.1662	-.09944055	-1.911748	-1.920238	-1.924652
31	0.2148333	130.9501	-0.1120747	-1.90882	-1.915766	-1.916438
32	0.2216667	134.6537	-0.1289984	-1.905903	-1.910831	-1.908661
33	0.2285	138.2938	-0.147601	-1.903009	-1.905484	-1.901205
34	0.2353333	141.9076	-0.1652394	-1.900132	-1.899827	-1.893927
35	0.2421667	145.5409	-0.1797325	-1.897232	-1.893976	-1.886806
36	0.249	149.2406	-0.189722	-1.89423	-1.88798	-1.879921
37	0.2560833	153.0763	-0.1948978	-1.891006	-1.881784	-1.87329
38	0.2631667	157.0774	-0.195968	-1.887398	-1.875265	-1.866828
39	0.27025	161.2224	-0.1943365	-1.883222	-1.868353	-1.860468
40	0.2773333	165.48	-0.1917251	-1.87829	-1.861107	-1.854202
41	0.2844167	169.8083	-0.1898269	-1.87245	-1.853705	-1.84801
42	0.2915	174.1585	-0.1899919	-1.865647	-1.846338	-1.841844
43	0.2985833	178.4832	-0.1930095	-1.857955	-1.839108	-1.835668
44	0.3056667	182.7429	-0.1990222	-1.849537	-1.832008	-1.829476
45	0.31275	186.9087	-0.2075711	-1.840572	-1.824961	-1.82327
46	0.3198333	190.9652	-0.2177476	-1.831193	-1.817891	-1.817052
47	0.3269167	194.9141	-0.2284215	-1.821427	-1.810742	-1.810823
48	0.334	198.7738	-0.2384981	-1.811201	-1.803475	-1.804586
49	0.3416667	202.63	-0.2472351	-1.800452	-1.796042	-1.798345
50	0.3493333	206.5323	-0.2544003	-1.789238	-1.788384	-1.792095
51	0.357	210.464	-0.2601175	-1.777771	-1.780436	-1.785827
52	0.3646667	214.4144	-0.2647213	-1.766341	-1.772153	-1.779524
53	0.3723333	218.3783	-0.2686994	-1.755183	-1.763534	-1.773158
54	0.38	222.3522	-0.2726089	-1.744398	-1.754612	-1.766695
55	0.3876667	226.3339	-0.2769825	-1.733974	-1.745431	-1.76009
56	0.3953333	230.3222	-0.2822465	-1.723822	-1.736021	-1.753285
57	0.403	234.3135	-0.2886575	-1.713852	-1.726394	-1.74622
58	0.4106667	238.3062	-0.2962754	-1.704033	-1.716552	-1.738826
59	0.4183333	242.3005	-0.3049769	-1.694375	-1.706496	-1.731031
60	0.426	246.294	-0.3144926	-1.684882	-1.69625	-1.722748
61	0.43425	250.3317	-0.324538	-1.67553	-1.685878	-1.713886
62	0.4425	254.4371	-0.3349109	-1.666277	-1.67548	-1.704359
63	0.45075	258.5898	-0.3454208	-1.657072	-1.665151	-1.69411
64	0.459	262.7763	-0.3558587	-1.647874	-1.654946	-1.68313
65	0.46725	266.9899	-0.366051	-1.638653	-1.644867	-1.671457
66	0.4755	271.2295	-0.3759017	-1.629395	-1.634872	-1.659166
67	0.48375	275.4958	-0.3854111	-1.620107	-1.624892	-1.646344
68	0.492	279.7888	-0.3946681	-1.61079	-1.614857	-1.633059
69	0.50025	284.1061	-0.4038211	-1.601438	-1.604718	-1.619356
70	0.5085	288.4418	-0.4130378	-1.592052	-1.594441	-1.605263

71	0.51675	292.7849	-0.4224606	-1.582624	-1.583993	-1.590822
72	0.525	297.1194	-0.4321665	-1.573147	-1.573326	-1.57611
73	0.5328333	301.4034	-0.4421065	-1.56361	-1.562374	-1.561261
74	0.5406667	305.6081	-0.4520952	-1.553999	-1.551085	-1.546441
75	0.5485	309.7313	-0.4619088	-1.544292	-1.539434	-1.531803
76	0.5563333	313.7721	-0.471364	-1.534468	-1.52742	-1.517446
77	0.5641667	317.7311	-0.4803454	-1.524503	-1.515065	-1.503387
78	0.572	321.6115	-0.4888221	-1.514352	-1.502409	-1.489579
79	0.5798333	325.4169	-0.4968459	-1.503944	-1.489495	-1.475947
80	0.5876667	329.1492	-0.5045312	-1.493202	-1.476367	-1.462427
81	0.5955	332.8083	-0.5120226	-1.482054	-1.46306	-1.448987
82	0.6033333	336.3916	-0.5194594	-1.470417	-1.449599	-1.435622
83	0.6111667	339.8947	-0.5269459	-1.45822	-1.43601	-1.422336
84	0.619	343.3128	-0.5345325	-1.445416	-1.422327	-1.409121
85	0.6284167	346.7063	-0.5423188	-1.431982	-1.408596	-1.395944
86	0.6378333	350.1078	-0.5505044	-1.417918	-1.394868	-1.382766
87	0.64725	353.4859	-0.5592115	-1.403249	-1.381185	-1.369557
88	0.6566667	356.814	-0.5683789	-1.388014	-1.367557	-1.356313
89	0.6660833	360.0701	-0.5777985	-1.37226	-1.35396	-1.343047
90	0.6755	363.2358	-0.5871708	-1.356049	-1.340334	-1.329781
91	0.6849167	366.2976	-0.5961689	-1.339472	-1.326599	-1.316534
92	0.6943333	369.2404	-0.6044911	-1.322624	-1.312681	-1.303323
93	0.70375	372.0535	-0.6119023	-1.305595	-1.298532	-1.290154
94	0.7131667	374.7392	-0.6182837	-1.288491	-1.284134	-1.277022
95	0.7225833	377.3073	-0.623665	-1.271426	-1.269495	-1.263913
96	0.732	379.7684	-0.6282136	-1.254523	-1.254625	-1.250801
97	0.74225	382.1503	-0.6322223	-1.237886	-1.239523	-1.237655
98	0.7525	384.4678	-0.6360595	-1.221563	-1.224199	-1.224439
99	0.76275	386.7123	-0.6400501	-1.205558	-1.208679	-1.211106
100	0.773	388.8743	-0.6443908	-1.18984	-1.193002	-1.197599
101	0.78325	390.9452	-0.6491335	-1.174351	-1.177211	-1.183849
102	0.7935	392.9188	-0.6541991	-1.159035	-1.161351	-1.169775
103	0.80375	394.792	-0.659414	-1.143854	-1.145458	-1.155299
104	0.814	396.5625	-0.6645543	-1.128789	-1.129581	-1.14035
105	0.82425	398.2238	-0.6693812	-1.113834	-1.113773	-1.124882
106	0.8345	399.7662	-0.6736654	-1.098983	-1.098085	-1.10888
107	0.84475	401.1803	-0.6772124	-1.08423	-1.082555	-1.092355
108	0.855	402.459	-0.6798855	-1.069567	-1.067191	-1.075342
109	0.8670833	403.6208	-0.6816602	-1.054982	-1.051981	-1.057888
110	0.8791667	404.6888	-0.6826626	-1.040474	-1.036894	-1.040051
111	0.89125	405.6795	-0.6831334	-1.026045	-1.021884	-1.021898
112	0.9033333	406.6125	-0.6833768	-1.0117	-1.0069	-1.003505
113	0.9154167	407.4983	-0.6837023	-0.9974373	-0.9918866	-0.9849564
114	0.9275	408.3263	-0.6843334	-0.9832461	-0.9767956	-0.9663348
115	0.9395833	409.0686	-0.6853224	-0.9691182	-0.9615875	-0.9477227
116	0.9516667	409.6929	-0.6865235	-0.9550399	-0.9462247	-0.9292065
117	0.96375	410.1725	-0.687632	-0.9409887	-0.9306806	-0.9108776
118	0.9758333	410.4929	-0.6882702	-0.9269452	-0.914941	-0.8928251
119	0.9879167	410.6522	-0.6880877	-0.9128879	-0.8990073	-0.8751197
120	1	410.659	-0.6868448	-0.8987836	-0.882901	-0.8577994
121	1	410.485	-0.68439	-0.8845851	-0.8666579	-0.8408649
122	1	410.1209	-0.680635	-0.8702354	-0.8503221	-0.8242901
123	1	409.5963	-0.6756445	-0.8556793	-0.8339439	-0.8080376
124	1	408.9343	-0.6696611	-0.8408652	-0.8175732	-0.7920695
125	1	408.1482	-0.6630266	-0.8257371	-0.8012507	-0.7763523
126	1	407.242	-0.6560927	-0.8102388	-0.7850085	-0.7608577
127	1	406.2124	-0.6491421	-0.7943279	-0.7688747	-0.7455626
128	1	405.0518	-0.6423374	-0.7779882	-0.7528785	-0.7304469
129	1	403.7515	-0.6357041	-0.7612355	-0.7370463	-0.7154928
130	1	402.3046	-0.6291453	-0.7441151	-0.7213914	-0.7006851
131	1	400.7009	-0.6224693	-0.7266979	-0.7059107	-0.686016
132	1	398.9386	-0.6154387	-0.7090648	-0.6905833	-0.6714898
133	1	397.0284	-0.607846	-0.6912931	-0.6753758	-0.6571234
134	1	394.9852	-0.5995715	-0.6734661	-0.6602487	-0.6429396
135	1	392.8257	-0.5906054	-0.6556781	-0.6451627	-0.6289585
136	1	390.5664	-0.5810439	-0.638012	-0.6300841	-0.615189
137	1	388.2213	-0.5710632	-0.6205333	-0.6149878	-0.6016242
138	1	385.8005	-0.5608782	-0.6033135	-0.5998603	-0.5882417
139	1	383.3098	-0.5506969	-0.5864253	-0.5846983	-0.5750084
140	1	380.7513	-0.5406814	-0.569922	-0.5695113	-0.5618863
141	1	378.1249	-0.5309225	-0.5538361	-0.5543182	-0.5488345
142	1	375.4296	-0.5214324	-0.5381766	-0.5391437	-0.5358063
143	1	372.6653	-0.5121552	-0.522936	-0.524025	-0.5227467
144	1	369.8343	-0.5029905	-0.5080939	-0.5090075	-0.5095949
145	1	366.9413	-0.4938246	-0.4936143	-0.494133	-0.4962923
146	1	363.9932	-0.4845598	-0.4794575	-0.4794424	-0.48279
147	1	360.9984	-0.4751364	-0.4655931	-0.4649779	-0.4690521
148	1	357.9652	-0.4655423	-0.4519985	-0.450774	-0.4550566
149	1	354.9008	-0.4558115	-0.4386528	-0.43685	-0.4407957
150	1	351.8111	-0.4460113	-0.425533	-0.4232133	-0.4262774
151	1	348.6995	-0.4362249	-0.4126166	-0.4098611	-0.4115262

152	1	345.5677	-0.4265325	-0.3998913	-0.3967762	-0.396583
153	1	342.4157	-0.4169943	-0.3873578	-0.3839238	-0.3815033
154	1	339.2422	-0.4076401	-0.3750245	-0.3712621	-0.3663548
155	1	336.0457	-0.3984665	-0.3628995	-0.3587499	-0.3512124
156	1	332.8249	-0.3894413	-0.3509862	-0.3463434	-0.3361532
157	1	329.5794	-0.3805136	-0.3392904	-0.3339973	-0.3212518
158	1	326.3525	-0.3716977	-0.3278157	-0.3216741	-0.3065781
159	1	323.193	-0.3631528	-0.3165472	-0.3093506	-0.2921951
160	1	320.0484	-0.3550003	-0.3054495	-0.2970148	-0.2781584
161	1	316.8616	-0.3471345	-0.2944687	-0.2846615	-0.264514
162	1	313.6308	-0.3393284	-0.2835303	-0.2722955	-0.2512934
163	1	310.3599	-0.3313731	-0.2725553	-0.2599344	-0.2385106
164	1	307.055	-0.3231222	-0.2614977	-0.2476053	-0.2261608
165	1	303.7231	-0.314513	-0.2503588	-0.2353413	-0.2142232
166	1	300.3702	-0.3055699	-0.2391325	-0.2231839	-0.2026651
167	1	296.9996	-0.2963862	-0.2277636	-0.2111773	-0.1914491
168	1	293.6125	-0.2870957	-0.2161989	-0.1993521	-0.1805395
169	1	290.2081	-0.2778418	-0.2044234	-0.1877271	-0.169905
170	1	286.7806	-0.2687424	-0.1924409	-0.1763144	-0.159518
171	1	283.3206	-0.2598607	-0.1802881	-0.1651133	-0.1493556
172	1	279.819	-0.2511929	-0.1680173	-0.1541059	-0.1394026
173	1	276.2695	-0.2426785	-0.1556132	-0.1432712	-0.1296504
174	1	272.669	-0.2342247	-0.1430174	-0.1326046	-0.1200947
175	1	269.0182	-0.2257341	-0.130291	-0.1221208	-0.1107351
176	1	265.3209	-0.2171321	-0.1176213	-0.1118357	-0.101576
177	1	261.5826	-0.2083853	-0.1051247	-0.101731	-.09262453
178	1	257.8098	-0.1995094	-.09283957	-.09174334	-.08388506
179	1	254.0092	-0.1905654	-.08083147	-.08181449	-.07535213
180	1	250.1883	-0.1816498	-.06916463	-.07193593	-0.067006
181	1	246.3532	-0.1728782	-0.0578901	-.06212141	-.05881044
182	1	242.5064	-0.1643591	-0.0470622	-.05236653	-.05071471
183	1	238.6475	-0.1561688	-.03673046	-.04266235	-.04266096
184	1	234.7768	-0.1483399	-.02689497	-.03302779	-.03459467
185	1	230.8949	-0.1408619	-.01746118	-.02351299	-.02647483
186	1	227.0032	-0.1336896	-.008331	-.01417692	-.01828081
187	1	223.1043	-0.126757	.000466273	-.00505484	-.01001071
188	1	219.2018	-0.1199938	.008864358	.003845928	-.00166579
189	1	215.2998	-0.1133404	0.0169107	0.01251001	.006770702
190	1	211.4028	-0.1067585	0.02467289	0.02090743	0.01533852
191	1	207.5157	-0.1002381	0.03216119	0.02902439	0.02407801
192	1	203.6439	-.09379887	0.03939401	0.0368634	0.03299913
193	1	199.7911	-0.0874838	0.0463802	0.04442923	0.04207205
194	1	195.9578	-.08134349	0.05311281	0.05173497	0.05124546
195	1	192.1432	-.07542049	0.05959554	0.05880533	0.06046709
196	1	188.3465	-.06974045	0.06586617	0.06568458	0.0696814
197	1	184.5665	-.06430871	0.07199584	0.07243566	0.07881509
198	1	180.8019	-.05910975	0.07801214	0.0790945	0.0877813
199	1	177.0515	-.05411034	0.08386412	0.08565744	0.09650615
200	1	173.3139	-.04926595	0.0895093	0.09213027	0.104945

IHNC_900_75_2_4.sim

```
Inner Harbor Navigation Channel Lock, New Orleans

! ********TWO FEET LIFT********

*CONSTANTS ===========================================================================
    io_units=English,  time_units=seconds
    time_step=1,   gravity=32.146, wf_time=0.55
    dQ_max=.001,   dh_max=.0001,   dx_max=.0001
    plot_field=11, plot_line=200,  plot_labels=row
    plot_file=IHNC_900_75_2_4.plt

*COMPONENTS ==========================================================================

!  The following was adopted from the model study.
! (Modeling 1:25-scale model, increase hydraulic roughness by setting Darcy-Weisbach
!   friction factor to 0.02 which is more appropriate for phy model with peak Re=1e5
!  Change prototype simulations to 'rough=.003')

! --------------- Left Wall -----------------------------

! Intake

HW     LIn     pipe_loss  us_area=1e6, area=210.25, K+=0.5
LIn    LB1u    imp_pipe  dia=14.50, area=210.25, len=22.73, rough=.003, wave=3500

! The first bend on left culvert is LB1

LB1u   LB1d    pipe_loss  area=210.25  K+=0.07
                ! Kb for 30 degree Bend - HDC Chart 228-1 Re=2.5x10^5
LB1d   LFVu    imp_pipe  dia=14.50, area=210.25, len=27.71, rough=.003, wave=3500
LFVu   LFW     storage surface_area=420.50  max_wsel=22.4

! Reverse Tainter Filling Valve

LFVu   LFVd    rev_tainter b=14.50, w=14.50, el_bottom=-22.00
                b/B_vs_t=OpenTainter_Hite
                Cc_vs_b/B=TainterCc
!               Kv+_vs_b/B=TainterKv
                Cdv+_vs_b/B=tainterCdv
LFVd   LB2u    imp_pipe  dia=14.50, area=210.25, len=27.71, rough=.003, wave=3500

! Second bend

LB2u   LB2d    pipe_loss  area=210.25  K+=0.07

! Straight reach of culvert US of manifold

LB2d   LP1u    imp_pipe  dia=14.50, area=210.25, len=77.67, rough=.003, wave=3500

! Sidewall Port Manifold

LP1u   LP1d  LP1b  diverging_tee area1=area3=210.25 area2=9.375 angle1=0 angle2=90
LP1b   Ch1     pipe_loss area=9.375 ds_area=1e5 K+=1.80 K-=0.25

LP1d   LP2u    imp_pipe dia=14.50, area=210.25, len=28, rough=.003, wave=3500

LP2u   LP2d  LP2b  diverging_tee area1=area3=210.25 area2=9.375 angle1=0 angle2=90
LP2b   Ch2     pipe_loss area=9.375 ds_area=1e5 K+=1.80 K-=0.25

LP2d   LP3u    imp_pipe dia=14.50, area=210.25, len=28, rough=.003, wave=3500

LP3u   LP3d  LP3b  diverging_tee area1=area3=210.25 area2=9.375 angle1=0 angle2=90
LP3b   Ch3     pipe_loss area=9.375 ds_area=1e5 K+=1.80 K-=0.25

LP3d   LP4u    imp_pipe dia=14.50, area=210.25, len=28, rough=.003, wave=3500

LP4u   LP4d  LP4b  diverging_tee area1=area3=210.25 area2=9.375 angle1=0 angle2=90
```

```
LP4b   Ch4     pipe_loss area=9.375 ds_area=1e5 K+=1.80 K-=0.25

LP4d   LP5u    imp_pipe dia=14.50, area=210.25, len=28, rough=.003, wave=3500

LP5u   LP5d  LP5b  diverging_tee area1=area3=210.25 area2=9.375 angle1=0 angle2=90
LP5b   Ch5     pipe_loss area=9.375 ds_area=1e5 K+=1.80 K-=0.25

LP5d   LP6u    imp_pipe dia=14.50, area=210.25, len=28, rough=.003, wave=3500

LP6u   LP6d  LP6b  diverging_tee area1=area3=210.25 area2=9.375 angle1=0 angle2=90
LP6b   Ch6     pipe_loss area=9.375 ds_area=1e5 K+=1.80 K-=0.25

LP6d   LP7u    imp_pipe dia=14.50, area=210.25, len=28, rough=.003, wave=3500

LP7u   LP7d  LP7b  diverging_tee area1=area3=210.25 area2=9.375 angle1=0 angle2=90
LP7b   Ch7     pipe_loss area=9.375 ds_area=1e5 K+=1.80 K-=0.25

LP7d   LP8u    imp_pipe dia=14.50, area=210.25, len=28, rough=.003, wave=3500

LP8u   LP8d  LP8b  diverging_tee area1=area3=210.25 area2=9.375 angle1=0 angle2=90
LP8b   Ch8     pipe_loss area=9.375 ds_area=1e5 K+=1.80 K-=0.25

LP8d   LP9u    imp_pipe dia=14.50, area=210.25, len=28, rough=.003, wave=3500

LP9u   LP9d  LP9b  diverging_tee area1=area3=210.25 area2=9.375 angle1=0 angle2=90
LP9b   Ch9     pipe_loss area=9.375 ds_area=1e5 K+=1.80 K-=0.25

LP9d   LP10u   imp_pipe dia=14.50, area=210.25, len=28, rough=.003, wave=3500

LP10u  LP10d  LP10b  diverging_tee area1=area3=210.25 area2=9.375 angle1=0 angle2=90
LP10b  Ch10    pipe_loss area=9.375 ds_area=1e5 K+=1.80 K-=0.25

LP10d  LP11u  imp_pipe dia=14.50, area=210.25, len=28, rough=.003, wave=3500

LP11u  LP11d  LP11b  diverging_tee area1=area3=210.25 area2=9.375 angle1=0 angle2=90
LP11b  Ch11    pipe_loss area=9.375 ds_area=1e5 K+=1.80 K-=0.25

LP11d  LP12u  imp_pipe dia=14.50, area=210.25, len=28, rough=.003, wave=3500

LP12u  LP12d  LP12b  diverging_tee area1=area3=210.25 area2=9.375 angle1=0 angle2=90
LP12b  Ch12    pipe_loss area=9.375 ds_area=1e5 K+=1.80 K-=0.25

LP12d  LP13u  imp_pipe dia=14.50, area=210.25, len=28, rough=.003, wave=3500

LP13u  LP13d  LP13b  diverging_tee area1=area3=210.25 area2=9.375 angle1=0 angle2=90
LP13b  Ch13    pipe_loss area=9.375 ds_area=1e5 K+=1.80 K-=0.25

LP13d  LP14u  imp_pipe dia=14.50, area=210.25, len=28, rough=.003, wave=3500

LP14u  LP14d  LP14b  diverging_tee area1=area3=210.25 area2=9.375 angle1=0 angle2=90
LP14b  Ch14    pipe_loss area=9.375 ds_area=1e5 K+=1.80 K-=0.25

LP14d  LP15u  imp_pipe dia=14.50, area=210.25, len=28, rough=.003, wave=3500

LP15u  LP15d  LP15b  diverging_tee area1=area3=210.25 area2=9.375 angle1=0 angle2=90
LP15b  Ch15    pipe_loss area=9.375 ds_area=1e5 K+=1.80 K-=0.25

LP15d  LP16u  imp_pipe dia=14.50, area=210.25, len=28, rough=.003, wave=3500

LP16u  LP16d  LP16b  diverging_tee area1=area3=210.25 area2=9.375 angle1=0 angle2=90
LP16b  Ch16    pipe_loss area=9.375 ds_area=1e5 K+=1.80 K-=0.25

LP16d  LP17u  imp_pipe dia=14.50, area=210.25, len=28, rough=.003, wave=3500

LP17u  LP17d  LP17b  diverging_tee area1=area3=210.25 area2=9.375 angle1=0 angle2=90
LP17b  Ch17    pipe_loss area=9.375 ds_area=1e5 K+=1.80 K-=0.25

LP17d  LP18u  imp_pipe dia=14.50, area=210.25, len=28, rough=.003, wave=3500

LP18u  LP18d  LP18b  diverging_tee area1=area3=210.25 area2=9.375 angle1=0 angle2=90
LP18b  Ch18    pipe_loss area=9.375 ds_area=1e5 K+=1.80 K-=0.25
```

```
LP18d  LP19u  imp_pipe dia=14.50, area=210.25, len=28, rough=.003, wave=3500

LP19u  LP19d  LP19b  diverging_tee area1=area3=210.25 area2=9.375 angle1=0 angle2=90
LP19b  Ch19    pipe_loss area=9.375 ds_area=1e5 K+=1.80 K-=0.25

LP19d  LP20u  imp_pipe dia=14.50, area=210.25, len=28, rough=.003, wave=3500

LP20u  LP20d  LP20b  diverging_tee area1=area3=210.25 area2=9.375 angle1=0 angle2=90
LP20b  Ch20    pipe_loss area=9.375 ds_area=1e5 K+=1.80 K-=0.25

LP20d  LP21u  imp_pipe dia=14.50, area=210.25, len=28, rough=.003, wave=3500

LP21u  LP21d  LP21b  diverging_tee area1=area3=210.25 area2=9.375 angle1=0 angle2=90
LP21b  Ch21    pipe_loss area=9.375 ds_area=1e5 K+=1.80 K-=0.25

LP21d  LB3u  imp_pipe dia=14.50, area=210.25, len=28, rough=.003, wave=3500

! Culvert downstream of manifold ports

LB3u   LB3d    pipe_loss  area=210.25  K+=0.07
LB3d   LEVu    imp_pipe  dia=14.50, area=210.25, len=27.71, rough=.003, wave=3500
LEVu   LEW     storage surface_area=420.50  max_wsel=22.4
!LEVu   LEVd    rev_tainter b=18.25  w=15  el_bottom=-22.00
!                b/B_vs_t=OpenTainter_Hite
!                Cc_vs_b/B=TainterCc  Kv+_vs_b/B=TainterKv
!                fixed_b/B=0

! --------------- Right Wall -----------------------------

! Intake

HW     RIn     pipe_loss  us_area=1e6  area=210.25  K+=0.5
RIn    RB1u    imp_pipe  dia=14.50  area=210.25  len=22.73  rough=.003  wave=3500

! The first bend on right culvert is RB1

RB1u   RB1d    pipe_loss  area=210.25  K+=0.07
                ! Kb for 30 degree Bend - HDC Chart 228-1 Re=2.5x10^5
RB1d   RFVu    imp_pipe  dia=14.50, area=210.25, len=27.71, rough=.003, wave=3500
RFVu   RFW     storage surface_area=420.50  max_wsel=22.4

! Reverse Tainter Filling Valve

RFVu   RFVd    rev_tainter b=14.50  w=14.50  el_bottom=-22.00
               b/B_vs_t=OpenTainter_Hite
               Cc_vs_b/B=TainterCc
!               Kv+_vs_b/B=TainterKv
               Cdv+_vs_b/B=tainterCdv

RFVd   RB2u    imp_pipe  dia=14.50  area=210.25  len=27.71  rough=.003  wave=3500

! Second bend

RB2u   RB2d    pipe_loss  area=210.25  K+=0.07

! Straight reach of culvert US of manifold

RB2d   RP1u    imp_pipe  dia=14.50  area=210.25  len=77.67  rough=.003  wave=3500

! Sidewall Port Manifold

RP1u   RP1d  RP1b  diverging_tee area1=area3=210.25 area2=9.375 angle1=0 angle2=90
RP1b   Ch1     pipe_loss area=9.375 ds_area=1e5 K+=1.80 K-=0.25

RP1d   RP2u    imp_pipe dia=14.50, area=210.25, len=28, rough=.003, wave=3500

RP2u   RP2d  RP2b  diverging_tee area1=area3=210.25 area2=9.375 angle1=0 angle2=90
RP2b   Ch2     pipe_loss area=9.375 ds_area=1e5 K+=1.80 K-=0.25

RP2d   RP3u    imp_pipe dia=14.50, area=210.25, len=28, rough=.003, wave=3500
```

```
RP3u   RP3d  RP3b  diverging_tee area1=area3=210.25 area2=9.375 angle1=0 angle2=90
RP3b   Ch3     pipe_loss area=9.375 ds_area=1e5 K+=1.80 K-=0.25

RP3d   RP4u    imp_pipe dia=14.50, area=210.25, len=28, rough=.003, wave=3500

RP4u   RP4d  RP4b  diverging_tee area1=area3=210.25 area2=9.375 angle1=0 angle2=90
RP4b   Ch4     pipe_loss area=9.375 ds_area=1e5 K+=1.80 K-=0.25

RP4d   RP5u    imp_pipe dia=14.50, area=210.25, len=28, rough=.003, wave=3500

RP5u   RP5d  RP5b  diverging_tee area1=area3=210.25 area2=9.375 angle1=0 angle2=90
RP5b   Ch5     pipe_loss area=9.375 ds_area=1e5 K+=1.80 K-=0.25

RP5d   RP6u    imp_pipe dia=14.50, area=210.25, len=28, rough=.003, wave=3500

RP6u   RP6d  RP6b  diverging_tee area1=area3=210.25 area2=9.375 angle1=0 angle2=90
RP6b   Ch6     pipe_loss area=9.375 ds_area=1e5 K+=1.80 K-=0.25

RP6d   RP7u    imp_pipe dia=14.50, area=210.25, len=28, rough=.003, wave=3500

RP7u   RP7d  RP7b  diverging_tee area1=area3=210.25 area2=9.375 angle1=0 angle2=90
RP7b   Ch7     pipe_loss area=9.375 ds_area=1e5 K+=1.80 K-=0.25

RP7d   RP8u    imp_pipe dia=14.50, area=210.25, len=28, rough=.003, wave=3500

RP8u   RP8d  RP8b  diverging_tee area1=area3=210.25 area2=9.375 angle1=0 angle2=90
RP8b   Ch8     pipe_loss area=9.375 ds_area=1e5 K+=1.80 K-=0.25

RP8d   RP9u    imp_pipe dia=14.50, area=210.25, len=28, rough=.003, wave=3500

RP9u   RP9d  RP9b  diverging_tee area1=area3=210.25 area2=9.375 angle1=0 angle2=90
RP9b   Ch9     pipe_loss area=9.375 ds_area=1e5 K+=1.80 K-=0.25

RP9d   RP10u   imp_pipe dia=14.50, area=210.25, len=28, rough=.003, wave=3500

RP10u  RP10d  RP10b  diverging_tee area1=area3=210.25 area2=9.375 angle1=0 angle2=90
RP10b  Ch10    pipe_loss area=9.375 ds_area=1e5 K+=1.80 K-=0.25

RP10d  RP11u  imp_pipe dia=14.50, area=210.25, len=28, rough=.003, wave=3500

RP11u  RP11d  RP11b  diverging_tee area1=area3=210.25 area2=9.375 angle1=0 angle2=90
RP11b  Ch11    pipe_loss area=9.375 ds_area=1e5 K+=1.80 K-=0.25

RP11d  RP12u  imp_pipe dia=14.50, area=210.25, len=28, rough=.003, wave=3500

RP12u  RP12d  RP12b  diverging_tee area1=area3=210.25 area2=9.375 angle1=0 angle2=90
RP12b  Ch12    pipe_loss area=9.375 ds_area=1e5 K+=1.80 K-=0.25

RP12d  RP13u  imp_pipe dia=14.50, area=210.25, len=28, rough=.003, wave=3500

RP13u  RP13d  RP13b  diverging_tee area1=area3=210.25 area2=9.375 angle1=0 angle2=90
RP13b  Ch13    pipe_loss area=9.375 ds_area=1e5 K+=1.80 K-=0.25

RP13d  RP14u  imp_pipe dia=14.50, area=210.25, len=28, rough=.003, wave=3500

RP14u  RP14d  RP14b  diverging_tee area1=area3=210.25 area2=9.375 angle1=0 angle2=90
RP14b  Ch14    pipe_loss area=9.375 ds_area=1e5 K+=1.80 K-=0.25

RP14d  RP15u  imp_pipe dia=14.50, area=210.25, len=28, rough=.003, wave=3500

RP15u  RP15d  RP15b  diverging_tee area1=area3=210.25 area2=9.375 angle1=0 angle2=90
RP15b  Ch15    pipe_loss area=9.375 ds_area=1e5 K+=1.80 K-=0.25

RP15d  RP16u  imp_pipe dia=14.50, area=210.25, len=28, rough=.003, wave=3500

RP16u  RP16d  RP16b  diverging_tee area1=area3=210.25 area2=9.375 angle1=0 angle2=90
RP16b  Ch16    pipe_loss area=9.375 ds_area=1e5 K+=1.80 K-=0.25

RP16d  RP17u  imp_pipe dia=14.50, area=210.25, len=28, rough=.003, wave=3500
```

```
RP17u  RP17d  RP17b  diverging_tee area1=area3=210.25 area2=9.375 angle1=0 angle2=90
RP17b  Ch17    pipe_loss area=9.375 ds_area=1e5 K+=1.80 K-=0.25

RP17d  RP18u  imp_pipe dia=14.50, area=210.25, len=28, rough=.003, wave=3500

RP18u  RP18d  RP18b  diverging_tee area1=area3=210.25 area2=9.375 angle1=0 angle2=90
RP18b  Ch18    pipe_loss area=9.375 ds_area=1e5 K+=1.80 K-=0.25

RP18d  RP19u  imp_pipe dia=14.50, area=210.25, len=28, rough=.003, wave=3500

RP19u  RP19d  RP19b  diverging_tee area1=area3=210.25 area2=9.375 angle1=0 angle2=90
RP19b  Ch19    pipe_loss area=9.375 ds_area=1e5 K+=1.80 K-=0.25

RP19d  RP20u  imp_pipe dia=14.50, area=210.25, len=28, rough=.003, wave=3500

RP20u  RP20d  RP20b  diverging_tee area1=area3=210.25 area2=9.375 angle1=0 angle2=90
RP20b  Ch20    pipe_loss area=9.375 ds_area=1e5 K+=1.80 K-=0.25

RP20d  RP21u  imp_pipe dia=14.50, area=210.25, len=28, rough=.003, wave=3500

RP21u  RP21d  RP21b  diverging_tee area1=area3=210.25 area2=9.375 angle1=0 angle2=90
RP21b  Ch21    pipe_loss area=9.375 ds_area=1e5 K+=1.80 K-=0.25

RP21d  RB3u  imp_pipe dia=14.50, area=210.25, len=28, rough=.003, wave=3500

! Culvert downstream of manifold ports

RB3u   RB3d    pipe_loss  area=210.25  K+=0.07
RB3d   REVu    imp_pipe  dia=14.50  area=210.25  len=27.71  rough=.003  wave=3500
REVu   REW     storage  surface_area=420.50  max_wsel=22.4
!REVu   REVd    rev_tainter b=18.25  w=15  el_bottom=-40
!               b/B_vs_t=OpenTainter_Hite
!               Cc_vs_b/B=TainterCc  Kv+_vs_b/B=TainterKv
!               fixed_b/B=0

!------------ Lock chamber modeled as series of open channels ---------

! length is from pintle to halfway between the first ports (right and left)
Upin  ChU   open_channel  cross_section=chamber  len=88.50  reaches=6  iq=0
ChU   Ch1   open_channel  cross_section=chamber  len=88.50  reaches=6  iq=0
Ch1   Ch2   open_channel  cross_section=chamber  len=28.00    reaches=2  iq=0
Ch2   Ch3   open_channel  cross_section=chamber  len=28.00    reaches=2  iq=0
Ch3   Ch4   open_channel  cross_section=chamber  len=28.00    reaches=2  iq=0
Ch4   Ch5   open_channel  cross_section=chamber  len=28.00    reaches=2  iq=0
Ch5   Ch6   open_channel  cross_section=chamber  len=28.00    reaches=2  iq=0
Ch6   Ch7   open_channel  cross_section=chamber  len=28.00    reaches=2  iq=0
Ch7   Ch8   open_channel  cross_section=chamber  len=28.00    reaches=2  iq=0
Ch8   Ch9   open_channel  cross_section=chamber  len=28.00    reaches=2  iq=0
Ch9   Ch10  open_channel  cross_section=chamber  len=28.00    reaches=2  iq=0
Ch10  Ch11  open_channel  cross_section=chamber  len=28.00    reaches=2  iq=0
Ch11  Ch12  open_channel  cross_section=chamber  len=28.00    reaches=2  iq=0
Ch12  Ch13  open_channel  cross_section=chamber  len=28.00    reaches=2  iq=0
Ch13  Ch14  open_channel  cross_section=chamber  len=28.00    reaches=2  iq=0
Ch14  Ch15  open_channel  cross_section=chamber  len=28.00    reaches=2  iq=0
Ch15  Ch16  open_channel  cross_section=chamber  len=28.00    reaches=2  iq=0
Ch16  Ch17  open_channel  cross_section=chamber  len=28.00    reaches=2  iq=0
Ch17  Ch18  open_channel  cross_section=chamber  len=28.00    reaches=2  iq=0
Ch18  Ch19  open_channel  cross_section=chamber  len=28.00    reaches=2  iq=0
Ch19  Ch20  open_channel  cross_section=chamber  len=28.00    reaches=2  iq=0
Ch20  Ch21  open_channel  cross_section=chamber  len=28.00    reaches=2  iq=0
Ch21  ChD   open_channel  cross_section=chamber  len=116.50   reaches=8  iq=0
ChD   Lpin  open_channel  cross_section=chamber  len=116.50   reaches=8  iq=0

*NODES ==========================================================================
! lin is -40+18.25/2 =30.875 model study
! PLAN=>> -22.00+14.50/2=-14.750 top of culvert
! PLAN=>> -22.00+3.75/2=-20.125 top of side port culverts
HW        elev=-14.750     head=0  idemand=0
! ---Left Culvert---
LIn       elev=-14.750    ihead=0
LB1u      elev=-14.750    ihead=0
```

```
LB1d      elev=-14.750    ihead=0
LFVu      elev=-14.750    ihead=0
LFW       elev=-14.750    ihead=0   demand=0
! wsel will change once you cross the valve
LFVd      elev=-14.750    ihead=-2
LB2u      elev=-14.750    ihead=-2
LB2d      elev=-14.750    ihead=-2
LP1u      elev=-14.750    ihead=-2
LP1d      elev=-14.750    ihead=-2
! at port
LP1b      elev=-20.125    ihead=-2
LP2u      elev=-14.750    ihead=-2
LP2d      elev=-14.750    ihead=-2
! at port
LP2b      elev=-20.125    ihead=-2
LP3u      elev=-14.750    ihead=-2
LP3d      elev=-14.750    ihead=-2
! at port
LP3b      elev=-20.125    ihead=-2
LP4u      elev=-14.750    ihead=-2
LP4d      elev=-14.750    ihead=-2
! at port
LP4b      elev=-20.125    ihead=-2
LP5u      elev=-14.750    ihead=-2
LP5d      elev=-14.750    ihead=-2
! at port
LP5b      elev=-20.125    ihead=-2
LP6u      elev=-14.750    ihead=-2
LP6d      elev=-14.750    ihead=-2
! at port
LP6b      elev=-20.125    ihead=-2
LP7u      elev=-14.750    ihead=-2
LP7d      elev=-14.750    ihead=-2
! at port
LP7b      elev=-20.125    ihead=-2
LP8u      elev=-14.750    ihead=-2
LP8d      elev=-14.750    ihead=-2
! at port
LP8b      elev=-20.125    ihead=-2
LP9u      elev=-14.750    ihead=-2
LP9d      elev=-14.750    ihead=-2
! at port
LP9b      elev=-20.125    ihead=-2
LP10u     elev=-14.750    ihead=-2
LP10d     elev=-14.750    ihead=-2
! at port
LP10b     elev=-20.125    ihead=-2
LP11u     elev=-14.750    ihead=-2
LP11d     elev=-14.750    ihead=-2
! at port
LP11b     elev=-20.125    ihead=-2
LP12u     elev=-14.750    ihead=-2
LP12d     elev=-14.750    ihead=-2
! at port
LP12b     elev=-20.125    ihead=-2
LP13u     elev=-14.750    ihead=-2
LP13d     elev=-14.750    ihead=-2
! at port
LP13b     elev=-20.125    ihead=-2
LP14u     elev=-14.750    ihead=-2
LP14d     elev=-14.750    ihead=-2
! at port
LP14b     elev=-20.125    ihead=-2
LP15u     elev=-14.750    ihead=-2
LP15d     elev=-14.750    ihead=-2
! at port
LP15b     elev=-20.125    ihead=-2
LP16u     elev=-14.750    ihead=-2
LP16d     elev=-14.750    ihead=-2
! at port
LP16b     elev=-20.125    ihead=-2
```

```
LP17u     elev=-14.750    ihead=-2
LP17d     elev=-14.750    ihead=-2
! at port
LP17b     elev=-20.125    ihead=-2
LP18u     elev=-14.750    ihead=-2
LP18d     elev=-14.750    ihead=-2
! at port
LP18b     elev=-20.125    ihead=-2
LP19u     elev=-14.750    ihead=-2
LP19d     elev=-14.750    ihead=-2
! at port
LP19b     elev=-20.125    ihead=-2
LP20u     elev=-14.750    ihead=-2
LP20d     elev=-14.750    ihead=-2
! at port
LP20b     elev=-20.125    ihead=-2
LP21u     elev=-14.750    ihead=-2
LP21d     elev=-14.750    ihead=-2
! at port
LP21b     elev=-20.125    ihead=-2
LB3u      elev=-14.750    ihead=-2
LB3d      elev=-14.750    ihead=-2
LEVu      elev=-14.750    ihead=-2
LEW       elev=-14.750    ihead=-2    demand=0
! ---Right Culvert---
RIn       elev=-14.750    ihead=0
RB1u      elev=-14.750    ihead=0
RB1d      elev=-14.750    ihead=0
RFVu      elev=-14.750    ihead=0
RFW       elev=-14.750    ihead=0     demand=0
! wsel will change once you cross the valve
RFVd      elev=-14.750    ihead=-2
RB2u      elev=-14.750    ihead=-2
RB2d      elev=-14.750    ihead=-2
RP1u      elev=-14.750    ihead=-2
RP1d      elev=-14.750    ihead=-2
! at port
RP1b      elev=-20.125    ihead=-2
RP2u      elev=-14.750    ihead=-2
RP2d      elev=-14.750    ihead=-2
! at port
RP2b      elev=-20.125    ihead=-2
RP3u      elev=-14.750    ihead=-2
RP3d      elev=-14.750    ihead=-2
! at port
RP3b      elev=-20.125    ihead=-2
RP4u      elev=-14.750    ihead=-2
RP4d      elev=-14.750    ihead=-2
! at port
RP4b      elev=-20.125    ihead=-2
RP5u      elev=-14.750    ihead=-2
RP5d      elev=-14.750    ihead=-2
! at port
RP5b      elev=-20.125    ihead=-2
RP6u      elev=-14.750    ihead=-2
RP6d      elev=-14.750    ihead=-2
! at port
RP6b      elev=-20.125    ihead=-2
RP7u      elev=-14.750    ihead=-2
RP7d      elev=-14.750    ihead=-2
! at port
RP7b      elev=-20.125    ihead=-2
RP8u      elev=-14.750    ihead=-2
RP8d      elev=-14.750    ihead=-2
! at port
RP8b      elev=-20.125    ihead=-2
RP9u      elev=-14.750    ihead=-2
RP9d      elev=-14.750    ihead=-2
! at port
RP9b      elev=-20.125    ihead=-2
RP10u     elev=-14.750    ihead=-2
```

```
RP10d     elev=-14.750    ihead=-2
! at port
RP10b     elev=-20.125    ihead=-2
RP11u     elev=-14.750    ihead=-2
RP11d     elev=-14.750    ihead=-2
! at port
RP11b     elev=-20.125    ihead=-2
RP12u     elev=-14.750    ihead=-2
RP12d     elev=-14.750    ihead=-2
! at port
RP12b     elev=-20.125    ihead=-2
RP13u     elev=-14.750    ihead=-2
RP13d     elev=-14.750    ihead=-2
! at port
RP13b     elev=-20.125    ihead=-2
RP14u     elev=-14.750    ihead=-2
RP14d     elev=-14.750    ihead=-2
! at port
RP14b     elev=-20.125    ihead=-2
RP15u     elev=-14.750    ihead=-2
RP15d     elev=-14.750    ihead=-2
! at port
RP15b     elev=-20.125    ihead=-2
RP16u     elev=-14.750    ihead=-2
RP16d     elev=-14.750    ihead=-2
! at port
RP16b     elev=-20.125    ihead=-2
RP17u     elev=-14.750    ihead=-2
RP17d     elev=-14.750    ihead=-2
! at port
RP17b     elev=-20.125    ihead=-2
RP18u     elev=-14.750    ihead=-2
RP18d     elev=-14.750    ihead=-2
! at port
RP18b     elev=-20.125    ihead=-2
RP19u     elev=-14.750    ihead=-2
RP19d     elev=-14.750    ihead=-2
! at port
RP19b     elev=-20.125    ihead=-2
RP20u     elev=-14.750    ihead=-2
RP20d     elev=-14.750    ihead=-2
! at port
RP20b     elev=-20.125    ihead=-2
RP21u     elev=-14.750    ihead=-2
RP21d     elev=-14.750    ihead=-2
! at port
RP21b     elev=-20.125    ihead=-2
RB3u      elev=-14.750    ihead=-2
RB3d      elev=-14.750    ihead=-2
REVu      elev=-14.750    ihead=-2
REW       elev=-14.750    ihead=-2    demand=0
! ---Lock Chamber---
Upin      elev=-22.00       ihead=-2    demand=0
ChU       elev=-22.00       ihead=-2
Ch1       elev=-22.00       ihead=-2
Ch2       elev=-22.00       ihead=-2
Ch3       elev=-22.00       ihead=-2
Ch4       elev=-22.00       ihead=-2
Ch5       elev=-22.00       ihead=-2
Ch6       elev=-22.00       ihead=-2
Ch7       elev=-22.00       ihead=-2
Ch8       elev=-22.00       ihead=-2
Ch9       elev=-22.00       ihead=-2
Ch10      elev=-22.00       ihead=-2
Ch11      elev=-22.00       ihead=-2
Ch12      elev=-22.00       ihead=-2
Ch13      elev=-22.00       ihead=-2
Ch14      elev=-22.00       ihead=-2
Ch15      elev=-22.00       ihead=-2
Ch16      elev=-22.00       ihead=-2
Ch17      elev=-22.00       ihead=-2
```

```
Ch18      elev=-22.00       ihead=-2
Ch19      elev=-22.00       ihead=-2
Ch20      elev=-22.00       ihead=-2
Ch21      elev=-22.00       ihead=-2
ChD       elev=-22.00       ihead=-2
Lpin      elev=-22.00       ihead=-2    demand=0

*FUNCTIONS ========================================================================

! open tainter designated at top for b/B vs. time (xscale (valve time)) in
! seconds, b = valve opening, B = culvert height so, b/B is fraction opened.
! OpenTainter comes from Plate 33 of ERDC/CHL TR-03-3 Hite 2003
OpenTainter_Hite     discrete   interpolation=linear  xscale=240  xshift=0
   xy_pairs={ 0.00   0.000
              0.10   0.084
              0.20   0.167
              0.30   0.249
              0.40   0.334
              0.50   0.426
              0.60   0.525
              0.70   0.619
              0.80   0.732
              0.90   0.855
              1.00   1.000 }

! Kv vs b/B Relationship - Based on Nielson's WES Misc Paper H-76-13
! Equations D2 and D3
TainterKv  discrete interpolation=linear extrapolation=linear
   xy_pairs={   0.0010  1385376.875
                0.0020   346667.594
                0.0030   154218.391
                0.0040    86828.391
                0.0050    55621.793
                0.0060    38662.070
                0.0070    28431.086
                0.0080    21787.870
                0.0090    17230.836
                0.0100    13969.831
                0.0150     6237.299
                0.0200     3524.422
                0.0250     2265.772
                0.0300     1580.499
                0.0500      578.828
                0.0600      405.284
                0.0800      231.556
                0.1000      150.331
                0.1500       68.776
                0.2000       39.349
                0.2500       25.239
                0.3000       17.236
                0.3500       12.244
                0.4000        8.848
                0.4500        6.422
                0.5000        4.661
                0.5500        3.338
                0.6000        2.344
                0.7000        1.049
                0.8000        0.372
                0.9000        0.074
                1.0000        0.010  }

tainterCdv  discrete  interpolation=spline
  x_values={0,   0.05, 0.1, 0.15, 0.2, 0.25, 0.3, 0.35,
            0.4, 0.45, 0.5, 0.55, 0.6, 0.65, 0.7, 0.75,
            0.8, 0.85, 0.9, 0.95,   1}
  y_values={0, 0.0443, 0.0836, 0.1195, 0.1534, 0.196, 0.243, 0.295,
            0.349, 0.415, 0.494, 0.587, 0.69, 0.8165, 0.976, 1.155,
            1.387,  1.69,  2.02, 2.582, 3.162}

! Cc vs b/B Relationship - Gerald Schohl's polynomial which reproduces Fig
! D2 in WES Misc Paper H-76-13
```

```
! Cc=.85-1.12X+1.69X^2-.85X^3+.43X^4;  Where X=b/B
  TainterCc  polynomial coefficients={.85, -1.12, 1.69, -.85, .43}

*CROSS_SECTIONS ================================================================

   chamber TRAPEZOIDAL  MN_n=.02  bed_w=75 ! Lock Chamber

*PLOT VARIABLES ================================================================

LFVu   LFVd    valve_position
LFVu   LFVd    discharge
LFW    head

Upin   head
Ch10   head
Lpin   head

*END ===========================================================================
```

IHNC_900_75_2_4.plt

sec Time	(-) "LFVu LFVd Valve Position sectno=0"	(cfs) "LFVu discharge sectno=0"	(f) "LFW head"	(f) "Upin head"	(f) "Ch10 head"	(f) "Lpin head"
0	0	0	0	-2	-2	-2
1	0.0035	7.146776	-.00781315	-2	-2	-2
2	0.007	14.72491	-.02932113	-2	-2	-2
3	0.0105	21.27165	-.05737038	-1.999998	-2	-2
4	0.014	28.45968	-0.08324	-1.999979	-1.999996	-2
5	0.0175	34.99331	-.09942214	-1.999867	-1.999974	-2
6	0.021	41.881	-0.1010974	-1.999398	-1.999865	-2
7	0.0245	48.70661	-.08847188	-1.997989	-1.999457	-2
8	0.028	55.712	-.06578194	-1.99494	-1.998303	-2
9	0.0315	62.77737	-.04027626	-1.990215	-1.995805	-2
10	0.035	69.7997	-.01963348	-1.984917	-1.991632	-2
11	0.0385	76.66254	-.00969663	-1.980164	-1.986155	-2
12	0.042	83.23346	-.01277227	-1.975656	-1.980356	-2
13	0.0455	89.47617	-.02712975	-1.970684	-1.975099	-2
14	0.049	95.39944	-.04776171	-1.965595	-1.970474	-2
15	0.0525	101.1141	-.06809274	-1.960625	-1.966049	-2
16	0.056	106.7534	-.08208339	-1.95542	-1.961602	-2
17	0.0595	112.4748	-.08604137	-1.950201	-1.957294	-2
18	0.063	118.366	-.07959453	-1.945082	-1.95329	-2
19	0.0665	124.4519	-.06556176	-1.939952	-1.949548	-1.999999
20	0.07	130.6569	-.04885154	-1.935022	-1.945977	-1.999996
21	0.0735	136.8506	-.03478667	-1.93018	-1.942535	-1.999986
22	0.077	142.8817	-.02744847	-1.925465	-1.939108	-1.999957
23	0.0805	148.6325	-.02853594	-1.920832	-1.935501	-1.999875
24	0.084	154.0552	-.03705898	-1.916187	-1.931569	-1.999667
25	0.08745833	159.161	-.04985612	-1.911528	-1.927211	-1.999185
26	0.09091667	164.0519	-.06275252	-1.906796	-1.922406	-1.998175
27	0.094375	168.8887	-.07197724	-1.902025	-1.917291	-1.996257
28	0.09783333	173.8039	-.07528705	-1.897254	-1.912072	-1.992965
29	0.1012917	178.8821	-.07248838	-1.892536	-1.906942	-1.987876
30	0.10475	184.1399	-.06529567	-1.887934	-1.902006	-1.980787
31	0.1082083	189.5234	-.05660945	-1.883477	-1.89723	-1.97188
32	0.1116667	194.9263	-.04948989	-1.879158	-1.892532	-1.961729
33	0.115125	200.2332	-.04618878	-1.874951	-1.887854	-1.951101
34	0.1185833	205.3532	-.04753885	-1.87081	-1.883169	-1.940653
35	0.1220417	210.2448	-.05284577	-1.866679	-1.878409	-1.930686
36	0.1255	214.9251	-.06026717	-1.862513	-1.873484	-1.921134
37	0.1289583	219.459	-.06751075	-1.858296	-1.868361	-1.911766
38	0.1324167	223.9343	-.07259768	-1.854039	-1.863083	-1.902435
39	0.135875	228.4325	-.07444561	-1.849766	-1.85775	-1.893173
40	0.1393333	233.0014	-.07310484	-1.84552	-1.852476	-1.884082
41	0.1427917	237.6448	-.06961187	-1.841343	-1.847355	-1.875157
42	0.14625	242.3258	-.06555285	-1.837258	-1.84242	-1.866232
43	0.1497083	246.9784	-.06250122	-1.833256	-1.837643	-1.857079
44	0.1531667	251.5299	-.06151977	-1.82932	-1.832944	-1.847531
45	0.156625	255.9297	-0.0628892	-1.825421	-1.828204	-1.837519
46	0.1600833	260.1643	-.06612453	-1.821516	-1.823287	-1.827061
47	0.1635417	264.2543	-.07022753	-1.817569	-1.81805	-1.81624
48	0.167	268.2474	-.07406722	-1.813558	-1.812356	-1.805206
49	0.1704167	272.1903	-.07674397	-1.809469	-1.806095	-1.794133
50	0.1738333	276.1312	-.07784191	-1.805288	-1.799197	-1.783162
51	0.17725	280.1096	-.07752001	-1.801004	-1.791657	-1.772362
52	0.1806667	284.1319	-.07639454	-1.796607	-1.783536	-1.761729
53	0.1840833	288.1774	-.07527374	-1.792082	-1.774963	-1.751214
54	0.1875	292.2109	-.07486844	-1.787415	-1.766112	-1.740765
55	0.1909167	296.1969	-.07557382	-1.782613	-1.757165	-1.730351
56	0.1943333	300.1127	-.07738299	-1.777708	-1.748264	-1.719983
57	0.19775	303.9555	-.07994384	-1.77274	-1.739484	-1.709692
58	0.2011667	307.7425	-0.0827216	-1.767736	-1.730833	-1.69951
59	0.2045833	311.5039	-.08519924	-1.762682	-1.722276	-1.689464
60	0.208	315.2713	-.08704339	-1.757518	-1.713768	-1.679578
61	0.2114167	319.0698	-.08818731	-1.752131	-1.705276	-1.669874
62	0.2148333	322.9129	-.08881778	-1.746366	-1.696768	-1.66037
63	0.21825	326.8012	-.08928215	-1.74004	-1.688209	-1.651071
64	0.2216667	330.7239	-.08995346	-1.732967	-1.679548	-1.641961
65	0.2250833	334.6635	-.09110175	-1.724979	-1.670727	-1.633013
66	0.2285	338.6019	-.09281289	-1.715946	-1.6617	-1.624197
67	0.2319167	342.5251	-0.0949771	-1.705804	-1.652447	-1.615491
68	0.2353333	346.4263	-.09734292	-1.694573	-1.642986	-1.60688
69	0.23875	350.3048	-.09961109	-1.682373	-1.633362	-1.598357
70	0.2421667	354.1637	-0.1015338	-1.669408	-1.62363	-1.589925
71	0.2455833	358.0057	-0.1029861	-1.655939	-1.613843	-1.581588

72	0.249	361.829	-0.1039894	-1.642233	-1.604044	-1.57335
73	0.2525417	365.6559	-0.1047174	-1.628518	-1.594263	-1.565212
74	0.2560833	369.4795	-0.105432	-1.614941	-1.584509	-1.557163
75	0.259625	373.2645	-0.1063406	-1.601555	-1.574772	-1.549188
76	0.2631667	376.9876	-0.1075198	-1.588339	-1.565026	-1.541264
77	0.2667083	380.6382	-0.1089254	-1.575225	-1.55523	-1.533364
78	0.27025	384.218	-0.1104377	-1.562139	-1.545333	-1.525465
79	0.2737917	387.735	-0.1119205	-1.549019	-1.535277	-1.517543
80	0.2773333	391.2	-0.1132715	-1.53581	-1.525	-1.509582
81	0.280875	394.6228	-0.1144523	-1.522469	-1.514442	-1.501567
82	0.2844167	398.0125	-0.115494	-1.508961	-1.503554	-1.493488
83	0.2879583	401.3752	-0.1164808	-1.495269	-1.492304	-1.485338
84	0.2915	404.7111	-0.1175137	-1.481397	-1.480691	-1.477109
85	0.2950417	408.0164	-0.1186698	-1.467377	-1.468739	-1.468792
86	0.2985833	411.287	-0.1199769	-1.453264	-1.456497	-1.460381
87	0.302125	414.5213	-0.1214106	-1.439129	-1.444038	-1.451868
88	0.3056667	417.72	-0.1229103	-1.425042	-1.431449	-1.443247
89	0.3092083	420.8842	-0.1244009	-1.411053	-1.418825	-1.434514
90	0.31275	424.0146	-0.1258161	-1.397189	-1.406243	-1.425666
91	0.3162917	427.1114	-0.1271151	-1.383459	-1.393752	-1.416704
92	0.3198333	430.1748	-0.1282921	-1.369857	-1.381377	-1.407626
93	0.323375	433.2035	-0.1293736	-1.356377	-1.369114	-1.398434
94	0.3269167	436.1946	-0.1304052	-1.343023	-1.356938	-1.389119
95	0.3304583	439.1428	-0.131432	-1.3298	-1.344816	-1.37967
96	0.334	442.0413	-0.1324812	-1.316719	-1.332708	-1.370059
97	0.3378333	444.9297	-0.1336036	-1.30379	-1.320581	-1.360244
98	0.3416667	447.8161	-0.1348764	-1.291021	-1.308408	-1.350164
99	0.3455	450.6671	-0.1363023	-1.278418	-1.296168	-1.33974
100	0.3493333	453.4664	-0.1377859	-1.265981	-1.283846	-1.328885
101	0.3531667	456.2065	-0.1391927	-1.253706	-1.271438	-1.317507
102	0.357	458.8864	-0.1404051	-1.241585	-1.258954	-1.305523
103	0.3608333	461.5099	-0.1413664	-1.229607	-1.246408	-1.292872
104	0.3646667	464.0815	-0.1420981	-1.217753	-1.233818	-1.279525
105	0.3685	466.6027	-0.1426859	-1.206006	-1.221208	-1.265488
106	0.3723333	469.0719	-0.143244	-1.194358	-1.208597	-1.250811
107	0.3761667	471.4847	-0.1438739	-1.182808	-1.196	-1.23558
108	0.38	473.8362	-0.1446323	-1.171357	-1.183428	-1.219911
109	0.3838333	476.1226	-0.1455186	-1.159998	-1.170885	-1.203935
110	0.3876667	478.3432	-0.1464832	-1.148723	-1.158377	-1.187786
111	0.3915	480.5005	-0.1474516	-1.137523	-1.145905	-1.171581
112	0.3953333	482.6001	-0.1483549	-1.126383	-1.133473	-1.155407
113	0.3991667	484.6488	-0.1491536	-1.115287	-1.121086	-1.139315
114	0.403	486.6526	-0.1498478	-1.10422	-1.108747	-1.123317
115	0.4068333	488.6151	-0.1504717	-1.093161	-1.096457	-1.107397
116	0.4106667	490.5366	-0.1510755	-1.082094	-1.084209	-1.091523
117	0.4145	492.4149	-0.1517037	-1.071	-1.071985	-1.075661
118	0.4183333	494.2462	-0.152378	-1.059863	-1.05976	-1.059777
119	0.4221667	496.0266	-0.1530912	-1.048671	-1.047498	-1.043851
120	0.426	497.7529	-0.153811	-1.037411	-1.035156	-1.027875
121	0.430125	499.4517	-0.1545241	-1.026076	-1.022687	-1.011854
122	0.43425	501.1305	-0.1552523	-1.014661	-1.010048	-0.9958038
123	0.438375	502.7695	-0.1559944	-1.003166	-0.997201	-0.9797494
124	0.4425	504.3563	-0.1567066	-0.9915917	-0.9841197	-0.9637231
125	0.446625	505.8824	-0.1573275	-0.9799426	-0.9707927	-0.9477608
126	0.45075	507.3414	-0.1578017	-0.9682219	-0.9572235	-0.9318983
127	0.454875	508.7281	-0.1580975	-0.9564309	-0.9434303	-0.9161662
128	0.459	510.0376	-0.1582144	-0.9445679	-0.9294437	-0.9005876
129	0.463125	511.2641	-0.158179	-0.9326292	-0.915304	-0.8851773
130	0.46725	512.4014	-0.158033	-0.920611	-0.9010578	-0.8699426
131	0.471375	513.4427	-0.1578178	-0.9085077	-0.8867527	-0.8548858
132	0.4755	514.3816	-0.1575615	-0.8963051	-0.8724323	-0.8400071
133	0.479625	515.2134	-0.1572734	-0.8839774	-0.8581309	-0.8253064
134	0.48375	515.9357	-0.1569461	-0.8714896	-0.8438698	-0.8107855
135	0.487875	516.5484	-0.1565634	-0.8587978	-0.8296558	-0.7964474
136	0.492	517.0536	-0.1561101	-0.8458507	-0.815484	-0.7822952
137	0.496125	517.455	-0.155581	-0.8325935	-0.8013435	-0.7683302
138	0.50025	517.7567	-0.1549833	-0.8189733	-0.7872224	-0.7545504
139	0.504375	517.9624	-0.1543351	-0.8049438	-0.7731109	-0.7409495
140	0.5085	518.0746	-0.1536575	-0.7904722	-0.7590032	-0.7275174
141	0.512625	518.0943	-0.1529662	-0.7755441	-0.7448988	-0.7142413
142	0.51675	518.0211	-0.1522647	-0.7601676	-0.7308019	-0.7011073
143	0.520875	517.8538	-0.1515419	-0.7443747	-0.71672	-0.6881023
144	0.525	517.5907	-0.1507751	-0.7282207	-0.7026627	-0.6752149
145	0.5289167	517.2187	-0.1499234	-0.7117797	-0.6886402	-0.6624359
146	0.5328333	516.7323	-0.1489364	-0.6951379	-0.674662	-0.6497573
147	0.53675	516.1368	-0.147787	-0.6783855	-0.6607361	-0.6371718
148	0.5406667	515.434	-0.1464856	-0.6616078	-0.6468673	-0.6246715
149	0.5445833	514.6237	-0.1450684	-0.6448771	-0.6330555	-0.6122471
150	0.5485	513.704	-0.1435813	-0.6282476	-0.6192937	-0.5998882
151	0.5524167	512.672	-0.142063	-0.6117528	-0.6055679	-0.5875846
152	0.5563333	511.5245	-0.1405333	-0.5954071	-0.5918595	-0.5753275

153	0.56025	510.2574	-0.1389869	-0.579209	-0.5781474	-0.5631096
154	0.5641667	508.8734	-0.1374036	-0.5631458	-0.5644107	-0.5509262
155	0.5680833	507.3779	-0.135765	-0.5472001	-0.5506308	-0.5387737
156	0.572	505.776	-0.1340634	-0.5313579	-0.536794	-0.5266495
157	0.5759167	504.0728	-0.1323038	-0.5156132	-0.5228929	-0.5145516
158	0.5798333	502.2729	-0.1305015	-0.4999695	-0.5089299	-0.5024795
159	0.58375	500.3797	-0.1286765	-0.4844388	-0.4949156	-0.4904339
160	0.5876667	498.3941	-0.1268439	-0.4690389	-0.4808686	-0.4784175
161	0.5915833	496.3176	-0.1250088	-0.453789	-0.4668149	-0.4664338
162	0.5955	494.1537	-0.1231683	-0.4387073	-0.4527848	-0.4544858
163	0.5994167	491.9053	-0.1213158	-0.4238128	-0.4388102	-0.4425747
164	0.6033333	489.5749	-0.1194422	-0.4091257	-0.4249213	-0.4306992
165	0.60725	487.1652	-0.1175397	-0.3946641	-0.4111428	-0.4188543
166	0.6111667	484.6787	-0.1156037	-0.3804408	-0.3974924	-0.4070319
167	0.6150833	482.1179	-0.1136348	-0.3664658	-0.3839828	-0.3952195
168	0.619	479.4843	-0.1116371	-0.3527475	-0.3706213	-0.3834009
169	0.6237083	476.7989	-0.1096384	-0.3392904	-0.3574074	-0.3715557
170	0.6284167	474.0703	-0.1076894	-0.3260938	-0.344332	-0.3596591
171	0.633125	471.288	-0.1058158	-0.3131536	-0.3313822	-0.347682
172	0.6378333	468.4459	-0.1039969	-0.3004667	-0.3185452	-0.3355917
173	0.6425417	465.5411	-0.1021823	-0.2880318	-0.3058108	-0.3233536
174	0.64725	462.574	-0.1003149	-0.2758449	-0.2931742	-0.3109333
175	0.6519583	459.547	-.09835329	-0.2638978	-0.2806353	-0.2983006
176	0.6566667	456.4631	-.09628565	-0.2521798	-0.2681974	-0.2854326
177	0.661375	453.3239	-.09413033	-0.2406796	-0.2558664	-0.2723169
178	0.6660833	450.1286	-.09192488	-0.2293875	-0.2436498	-0.2589537
179	0.6707917	446.8721	-.08970664	-0.2182949	-0.2315561	-0.2453578
180	0.6755	443.551	-.08749928	-0.2073899	-0.2195964	-0.2315592
181	0.6802083	440.1637	-.08531055	-0.1966583	-0.2077827	-0.2176013
182	0.6849167	436.7072	-.08313153	-0.1860883	-0.1961253	-0.2035382
183	0.689625	433.1802	-.08094075	-0.1756693	-0.1846307	-0.18943
184	0.6943333	429.5825	-.07871415	-0.1653907	-0.1733024	-0.1753374
185	0.6990417	425.9151	-.07643448	-0.155243	-0.1621418	-0.1613162
186	0.70375	422.1789	-.07409736	-0.1452194	-0.1511492	-0.147414
187	0.7084583	418.3751	-.07171219	-0.1353121	-0.1403223	-0.1336678
188	0.7131667	414.5037	-.06929791	-0.1255118	-0.1296564	-0.120103
189	0.717875	410.5635	-.06687469	-0.1158105	-0.1191427	-0.1067346
190	0.7225833	406.5532	-.06445662	-0.1062048	-0.1087687	-.09356826
191	0.7272917	402.4725	-.06204961	-.09669295	-.09851794	-.08060283
192	0.732	398.3211	-.05965143	-.08727226	-.08837105	-.06783287
193	0.737125	394.1022	-.05725693	-.07794028	-.07830704	-.05525224
194	0.74225	389.8172	-.05486209	-.06869716	-.06830512	-.04285767
195	0.747375	385.464	-.05245973	-.05954524	-.05834602	-.03065102
196	0.7525	381.0409	-.05003866	-.05048911	-.04841325	-.01863928
197	0.757625	376.5434	-.04758472	-.04153427	-.03849504	-.00683304
198	0.76275	371.9627	-.04507688	-.03268421	-.02858516	.004755128
199	0.767875	367.2974	-.04249653	-.02393902	-.01868239	0.01611185
200	0.773	362.5494	-.03984436	-.01529572	-.00879092	0.02722367

IHNC_900_110_2_4.sim

```
 ! Inner Harbor Navigation Channel Lock, New Orleans

! ********TWO FEET LIFT********

*CONSTANTS ==========================================================================
    io_units=English,  time_units=seconds
    time_step=1,   gravity=32.146, wf_time=0.55
    dQ_max=.001,   dh_max=.0001,   dx_max=.0001
    plot_field=11, plot_line=200,  plot_labels=row
    plot_file=IHNC_900_110_2_4.plt

*COMPONENTS =========================================================================

!  The following was adopted from the model study.
! (Modeling 1:25-scale model, increase hydraulic roughness by setting Darcy-Weisbach
!   friction factor to 0.02 which is more appropriate for phy model with peak Re=1e5
!  Change prototype simulations to 'rough=.003')

! --------------- Left Wall -----------------------------

! Intake

HW     LIn     pipe_loss  us_area=1e6, area=210.25, K+=0.5
LIn    LB1u    imp_pipe  dia=14.50, area=210.25, len=22.73, rough=.003, wave=3500

! The first bend on left culvert is LB1

LB1u   LB1d    pipe_loss  area=210.25  K+=0.07
                ! Kb for 30 degree Bend - HDC Chart 228-1 Re=2.5x10^5
LB1d   LFVu    imp_pipe  dia=14.50, area=210.25, len=27.71, rough=.003, wave=3500
LFVu   LFW     storage surface_area=420.50  max_wsel=22.4

! Reverse Tainter Filling Valve

LFVu   LFVd    rev_tainter b=14.50, w=14.50, el_bottom=-22.00 !Shallow draft lock
bottom NAVD88, model study used deep draft lock bottom of -40 NAVD29
                b/B_vs_t=OpenTainter_Hite
                Cc_vs_b/B=TainterCc
!                Kv+_vs_b/B=TainterKv
                Cdv+_vs_b/B=tainterCdv
LFVd   LB2u    imp_pipe  dia=14.50, area=210.25, len=27.71, rough=.003, wave=3500

! Second bend

LB2u   LB2d    pipe_loss  area=210.25  K+=0.07

! Straight reach of culvert US of manifold

LB2d   LP1u    imp_pipe  dia=14.50, area=210.25, len=77.67, rough=.003, wave=3500


! Sidewall Port Manifold

LP1u   LP1d  LP1b  diverging_tee area1=area3=210.25 area2=9.375 angle1=0 angle2=90
LP1b   Ch1     pipe_loss area=9.375 ds_area=1e5 K+=1.80 K-=0.25

LP1d   LP2u    imp_pipe dia=14.50, area=210.25, len=28, rough=.003, wave=3500

LP2u   LP2d  LP2b  diverging_tee area1=area3=210.25 area2=9.375 angle1=0 angle2=90
LP2b   Ch2     pipe_loss area=9.375 ds_area=1e5 K+=1.80 K-=0.25

LP2d   LP3u    imp_pipe dia=14.50, area=210.25, len=28, rough=.003, wave=3500

LP3u   LP3d  LP3b  diverging_tee area1=area3=210.25 area2=9.375 angle1=0 angle2=90
LP3b   Ch3     pipe_loss area=9.375 ds_area=1e5 K+=1.80 K-=0.25

LP3d   LP4u    imp_pipe dia=14.50, area=210.25, len=28, rough=.003, wave=3500
```

```
LP4u   LP4d  LP4b  diverging_tee area1=area3=210.25 area2=9.375 angle1=0 angle2=90
LP4b   Ch4     pipe_loss area=9.375 ds_area=1e5 K+=1.80 K-=0.25

LP4d   LP5u    imp_pipe dia=14.50, area=210.25, len=28, rough=.003, wave=3500

LP5u   LP5d  LP5b  diverging_tee area1=area3=210.25 area2=9.375 angle1=0 angle2=90
LP5b   Ch5     pipe_loss area=9.375 ds_area=1e5 K+=1.80 K-=0.25

LP5d   LP6u    imp_pipe dia=14.50, area=210.25, len=28, rough=.003, wave=3500

LP6u   LP6d  LP6b  diverging_tee area1=area3=210.25 area2=9.375 angle1=0 angle2=90
LP6b   Ch6     pipe_loss area=9.375 ds_area=1e5 K+=1.80 K-=0.25

LP6d   LP7u    imp_pipe dia=14.50, area=210.25, len=28, rough=.003, wave=3500

LP7u   LP7d  LP7b  diverging_tee area1=area3=210.25 area2=9.375 angle1=0 angle2=90
LP7b   Ch7     pipe_loss area=9.375 ds_area=1e5 K+=1.80 K-=0.25

LP7d   LP8u    imp_pipe dia=14.50, area=210.25, len=28, rough=.003, wave=3500

LP8u   LP8d  LP8b  diverging_tee area1=area3=210.25 area2=9.375 angle1=0 angle2=90
LP8b   Ch8     pipe_loss area=9.375 ds_area=1e5 K+=1.80 K-=0.25

LP8d   LP9u    imp_pipe dia=14.50, area=210.25, len=28, rough=.003, wave=3500

LP9u   LP9d  LP9b  diverging_tee area1=area3=210.25 area2=9.375 angle1=0 angle2=90
LP9b   Ch9     pipe_loss area=9.375 ds_area=1e5 K+=1.80 K-=0.25

LP9d   LP10u   imp_pipe dia=14.50, area=210.25, len=28, rough=.003, wave=3500

LP10u  LP10d  LP10b  diverging_tee area1=area3=210.25 area2=9.375 angle1=0 angle2=90
LP10b  Ch10    pipe_loss area=9.375 ds_area=1e5 K+=1.80 K-=0.25

LP10d  LP11u  imp_pipe dia=14.50, area=210.25, len=28, rough=.003, wave=3500

LP11u  LP11d  LP11b  diverging_tee area1=area3=210.25 area2=9.375 angle1=0 angle2=90
LP11b  Ch11    pipe_loss area=9.375 ds_area=1e5 K+=1.80 K-=0.25

LP11d  LP12u  imp_pipe dia=14.50, area=210.25, len=28, rough=.003, wave=3500

LP12u  LP12d  LP12b  diverging_tee area1=area3=210.25 area2=9.375 angle1=0 angle2=90
LP12b  Ch12    pipe_loss area=9.375 ds_area=1e5 K+=1.80 K-=0.25

LP12d  LP13u  imp_pipe dia=14.50, area=210.25, len=28, rough=.003, wave=3500

LP13u  LP13d  LP13b  diverging_tee area1=area3=210.25 area2=9.375 angle1=0 angle2=90
LP13b  Ch13    pipe_loss area=9.375 ds_area=1e5 K+=1.80 K-=0.25

LP13d  LP14u  imp_pipe dia=14.50, area=210.25, len=28, rough=.003, wave=3500

LP14u  LP14d  LP14b  diverging_tee area1=area3=210.25 area2=9.375 angle1=0 angle2=90
LP14b  Ch14    pipe_loss area=9.375 ds_area=1e5 K+=1.80 K-=0.25

LP14d  LP15u  imp_pipe dia=14.50, area=210.25, len=28, rough=.003, wave=3500

LP15u  LP15d  LP15b  diverging_tee area1=area3=210.25 area2=9.375 angle1=0 angle2=90
LP15b  Ch15    pipe_loss area=9.375 ds_area=1e5 K+=1.80 K-=0.25

LP15d  LP16u  imp_pipe dia=14.50, area=210.25, len=28, rough=.003, wave=3500

LP16u  LP16d  LP16b  diverging_tee area1=area3=210.25 area2=9.375 angle1=0 angle2=90
LP16b  Ch16    pipe_loss area=9.375 ds_area=1e5 K+=1.80 K-=0.25

LP16d  LP17u  imp_pipe dia=14.50, area=210.25, len=28, rough=.003, wave=3500

LP17u  LP17d  LP17b  diverging_tee area1=area3=210.25 area2=9.375 angle1=0 angle2=90
LP17b  Ch17    pipe_loss area=9.375 ds_area=1e5 K+=1.80 K-=0.25

LP17d  LP18u  imp_pipe dia=14.50, area=210.25, len=28, rough=.003, wave=3500

LP18u  LP18d  LP18b  diverging_tee area1=area3=210.25 area2=9.375 angle1=0 angle2=90
```

```
LP18b  Ch18    pipe_loss area=9.375 ds_area=1e5 K+=1.80 K-=0.25

LP18d  LP19u  imp_pipe dia=14.50, area=210.25, len=28, rough=.003, wave=3500

LP19u  LP19d  LP19b  diverging_tee area1=area3=210.25 area2=9.375 angle1=0 angle2=90
LP19b  Ch19    pipe_loss area=9.375 ds_area=1e5 K+=1.80 K-=0.25

LP19d  LP20u  imp_pipe dia=14.50, area=210.25, len=28, rough=.003, wave=3500

LP20u  LP20d  LP20b  diverging_tee area1=area3=210.25 area2=9.375 angle1=0 angle2=90
LP20b  Ch20    pipe_loss area=9.375 ds_area=1e5 K+=1.80 K-=0.25

LP20d  LP21u  imp_pipe dia=14.50, area=210.25, len=28, rough=.003, wave=3500

LP21u  LP21d  LP21b  diverging_tee area1=area3=210.25 area2=9.375 angle1=0 angle2=90
LP21b  Ch21    pipe_loss area=9.375 ds_area=1e5 K+=1.80 K-=0.25

LP21d  LB3u  imp_pipe dia=14.50, area=210.25, len=28, rough=.003, wave=3500

! Culvert downstream of manifold ports

LB3u   LB3d    pipe_loss  area=210.25  K+=0.07
LB3d   LEVu    imp_pipe  dia=14.50, area=210.25, len=27.71, rough=.003, wave=3500
LEVu   LEW     storage surface_area=420.50  max_wsel=22.4
!LEVu   LEVd    rev_tainter b=18.25  w=15  el_bottom=-22.00
!               b/B_vs_t=OpenTainter_Hite
!               Cc_vs_b/B=TainterCc  Kv+_vs_b/B=TainterKv
!               fixed_b/B=0

! --------------- Right Wall -----------------------------

! Intake

HW     RIn     pipe_loss  us_area=1e6  area=210.25  K+=0.5
RIn    RB1u    imp_pipe  dia=14.50  area=210.25  len=22.73  rough=.003  wave=3500

! The first bend on right culvert is RB1

RB1u   RB1d    pipe_loss  area=210.25  K+=0.07
               ! Kb for 30 degree Bend - HDC Chart 228-1 Re=2.5x10^5
RB1d   RFVu    imp_pipe  dia=14.50, area=210.25, len=27.71, rough=.003,
wave=3500!len=x2
RFVu   RFW     storage surface_area=420.50  max_wsel=22.4

! Reverse Tainter Filling Valve

RFVu   RFVd    rev_tainter b=14.50  w=14.50  el_bottom=-22.00 !Shallow draft lock
bottom NAVD88, model study used deep draft lock bottom of -40 NAVD29
               b/B_vs_t=OpenTainter_Hite
               Cc_vs_b/B=TainterCc
!               Kv+_vs_b/B=TainterKv
               Cdv+_vs_b/B=tainterCdv

RFVd   RB2u    imp_pipe  dia=14.50  area=210.25  len=27.71  rough=.003  wave=3500

! Second bend

RB2u   RB2d    pipe_loss  area=210.25  K+=0.07

! Straight reach of culvert US of manifold

RB2d   RP1u    imp_pipe  dia=14.50  area=210.25  len=77.67  rough=.003  wave=3500

! Sidewall Port Manifold

RP1u   RP1d  RP1b  diverging_tee area1=area3=210.25 area2=9.375 angle1=0 angle2=90
RP1b   Ch1     pipe_loss area=9.375 ds_area=1e5 K+=1.80 K-=0.25

RP1d   RP2u    imp_pipe dia=14.50, area=210.25, len=28, rough=.003, wave=3500

RP2u   RP2d  RP2b  diverging_tee area1=area3=210.25 area2=9.375 angle1=0 angle2=90
```

```
RP2b   Ch2     pipe_loss area=9.375 ds_area=1e5 K+=1.80 K-=0.25

RP2d   RP3u    imp_pipe dia=14.50, area=210.25, len=28, rough=.003, wave=3500

RP3u   RP3d  RP3b  diverging_tee area1=area3=210.25 area2=9.375 angle1=0 angle2=90
RP3b   Ch3     pipe_loss area=9.375 ds_area=1e5 K+=1.80 K-=0.25

RP3d   RP4u    imp_pipe dia=14.50, area=210.25, len=28, rough=.003, wave=3500

RP4u   RP4d  RP4b  diverging_tee area1=area3=210.25 area2=9.375 angle1=0 angle2=90
RP4b   Ch4     pipe_loss area=9.375 ds_area=1e5 K+=1.80 K-=0.25

RP4d   RP5u    imp_pipe dia=14.50, area=210.25, len=28, rough=.003, wave=3500

RP5u   RP5d  RP5b  diverging_tee area1=area3=210.25 area2=9.375 angle1=0 angle2=90
RP5b   Ch5     pipe_loss area=9.375 ds_area=1e5 K+=1.80 K-=0.25

RP5d   RP6u    imp_pipe dia=14.50, area=210.25, len=28, rough=.003, wave=3500

RP6u   RP6d  RP6b  diverging_tee area1=area3=210.25 area2=9.375 angle1=0 angle2=90
RP6b   Ch6     pipe_loss area=9.375 ds_area=1e5 K+=1.80 K-=0.25

RP6d   RP7u    imp_pipe dia=14.50, area=210.25, len=28, rough=.003, wave=3500

RP7u   RP7d  RP7b  diverging_tee area1=area3=210.25 area2=9.375 angle1=0 angle2=90
RP7b   Ch7     pipe_loss area=9.375 ds_area=1e5 K+=1.80 K-=0.25

RP7d   RP8u    imp_pipe dia=14.50, area=210.25, len=28, rough=.003, wave=3500

RP8u   RP8d  RP8b  diverging_tee area1=area3=210.25 area2=9.375 angle1=0 angle2=90
RP8b   Ch8     pipe_loss area=9.375 ds_area=1e5 K+=1.80 K-=0.25

RP8d   RP9u    imp_pipe dia=14.50, area=210.25, len=28, rough=.003, wave=3500

RP9u   RP9d  RP9b  diverging_tee area1=area3=210.25 area2=9.375 angle1=0 angle2=90
RP9b   Ch9     pipe_loss area=9.375 ds_area=1e5 K+=1.80 K-=0.25

RP9d   RP10u   imp_pipe dia=14.50, area=210.25, len=28, rough=.003, wave=3500

RP10u  RP10d  RP10b  diverging_tee area1=area3=210.25 area2=9.375 angle1=0 angle2=90
RP10b  Ch10    pipe_loss area=9.375 ds_area=1e5 K+=1.80 K-=0.25

RP10d  RP11u  imp_pipe dia=14.50, area=210.25, len=28, rough=.003, wave=3500

RP11u  RP11d  RP11b  diverging_tee area1=area3=210.25 area2=9.375 angle1=0 angle2=90
RP11b  Ch11    pipe_loss area=9.375 ds_area=1e5 K+=1.80 K-=0.25

RP11d  RP12u  imp_pipe dia=14.50, area=210.25, len=28, rough=.003, wave=3500

RP12u  RP12d  RP12b  diverging_tee area1=area3=210.25 area2=9.375 angle1=0 angle2=90
RP12b  Ch12    pipe_loss area=9.375 ds_area=1e5 K+=1.80 K-=0.25

RP12d  RP13u  imp_pipe dia=14.50, area=210.25, len=28, rough=.003, wave=3500

RP13u  RP13d  RP13b  diverging_tee area1=area3=210.25 area2=9.375 angle1=0 angle2=90
RP13b  Ch13    pipe_loss area=9.375 ds_area=1e5 K+=1.80 K-=0.25

RP13d  RP14u  imp_pipe dia=14.50, area=210.25, len=28, rough=.003, wave=3500

RP14u  RP14d  RP14b  diverging_tee area1=area3=210.25 area2=9.375 angle1=0 angle2=90
RP14b  Ch14    pipe_loss area=9.375 ds_area=1e5 K+=1.80 K-=0.25

RP14d  RP15u  imp_pipe dia=14.50, area=210.25, len=28, rough=.003, wave=3500

RP15u  RP15d  RP15b  diverging_tee area1=area3=210.25 area2=9.375 angle1=0 angle2=90
RP15b  Ch15    pipe_loss area=9.375 ds_area=1e5 K+=1.80 K-=0.25

RP15d  RP16u  imp_pipe dia=14.50, area=210.25, len=28, rough=.003, wave=3500

RP16u  RP16d  RP16b  diverging_tee area1=area3=210.25 area2=9.375 angle1=0 angle2=90
RP16b  Ch16    pipe_loss area=9.375 ds_area=1e5 K+=1.80 K-=0.25
```

```
RP16d  RP17u  imp_pipe dia=14.50, area=210.25, len=28, rough=.003, wave=3500

RP17u  RP17d  RP17b  diverging_tee area1=area3=210.25 area2=9.375 angle1=0 angle2=90
RP17b  Ch17    pipe_loss area=9.375 ds_area=1e5 K+=1.80 K-=0.25

RP17d  RP18u  imp_pipe dia=14.50, area=210.25, len=28, rough=.003, wave=3500

RP18u  RP18d  RP18b  diverging_tee area1=area3=210.25 area2=9.375 angle1=0 angle2=90
RP18b  Ch18    pipe_loss area=9.375 ds_area=1e5 K+=1.80 K-=0.25

RP18d  RP19u  imp_pipe dia=14.50, area=210.25, len=28, rough=.003, wave=3500

RP19u  RP19d  RP19b  diverging_tee area1=area3=210.25 area2=9.375 angle1=0 angle2=90
RP19b  Ch19    pipe_loss area=9.375 ds_area=1e5 K+=1.80 K-=0.25

RP19d  RP20u  imp_pipe dia=14.50, area=210.25, len=28, rough=.003, wave=3500

RP20u  RP20d  RP20b  diverging_tee area1=area3=210.25 area2=9.375 angle1=0 angle2=90
RP20b  Ch20    pipe_loss area=9.375 ds_area=1e5 K+=1.80 K-=0.25

RP20d  RP21u  imp_pipe dia=14.50, area=210.25, len=28, rough=.003, wave=3500

RP21u  RP21d  RP21b  diverging_tee area1=area3=210.25 area2=9.375 angle1=0 angle2=90
RP21b  Ch21    pipe_loss area=9.375 ds_area=1e5 K+=1.80 K-=0.25

RP21d  RB3u  imp_pipe dia=14.50, area=210.25, len=28, rough=.003, wave=3500

! Culvert downstream of manifold ports

RB3u   RB3d    pipe_loss  area=210.25  K+=0.07
RB3d   REVu    imp_pipe  dia=14.50  area=210.25  len=27.71  rough=.003  wave=3500
!len=??
REVu   REW     storage  surface_area=420.50  max_wsel=22.4
!REVu   REVd    rev_tainter b=18.25  w=15  el_bottom=-40
!               b/B_vs_t=OpenTainter_Hite
!               Cc_vs_b/B=TainterCc  Kv+_vs_b/B=TainterKv
!               fixed_b/B=0

!------------ Lock chamber modeled as series of open channels ---------

! length is from pintle to halfway between the first ports (right and left)

Upin  ChU   open_channel  cross_section=chamber  len=88.50  reaches=6  iq=0
ChU   Ch1   open_channel  cross_section=chamber  len=88.50  reaches=6  iq=0
Ch1   Ch2   open_channel  cross_section=chamber  len=28.00    reaches=2  iq=0
Ch2   Ch3   open_channel  cross_section=chamber  len=28.00    reaches=2  iq=0
Ch3   Ch4   open_channel  cross_section=chamber  len=28.00    reaches=2  iq=0
Ch4   Ch5   open_channel  cross_section=chamber  len=28.00    reaches=2  iq=0
Ch5   Ch6   open_channel  cross_section=chamber  len=28.00    reaches=2  iq=0
Ch6   Ch7   open_channel  cross_section=chamber  len=28.00    reaches=2  iq=0
Ch7   Ch8   open_channel  cross_section=chamber  len=28.00    reaches=2  iq=0
Ch8   Ch9   open_channel  cross_section=chamber  len=28.00    reaches=2  iq=0
Ch9   Ch10  open_channel  cross_section=chamber  len=28.00    reaches=2  iq=0
Ch10  Ch11  open_channel  cross_section=chamber  len=28.00    reaches=2  iq=0
Ch11  Ch12  open_channel  cross_section=chamber  len=28.00    reaches=2  iq=0
Ch12  Ch13  open_channel  cross_section=chamber  len=28.00    reaches=2  iq=0
Ch13  Ch14  open_channel  cross_section=chamber  len=28.00    reaches=2  iq=0
Ch14  Ch15  open_channel  cross_section=chamber  len=28.00    reaches=2  iq=0
Ch15  Ch16  open_channel  cross_section=chamber  len=28.00    reaches=2  iq=0
Ch16  Ch17  open_channel  cross_section=chamber  len=28.00    reaches=2  iq=0
Ch17  Ch18  open_channel  cross_section=chamber  len=28.00    reaches=2  iq=0
Ch18  Ch19  open_channel  cross_section=chamber  len=28.00    reaches=2  iq=0
Ch19  Ch20  open_channel  cross_section=chamber  len=28.00    reaches=2  iq=0
Ch20  Ch21  open_channel  cross_section=chamber  len=28.00    reaches=2  iq=0
Ch21  ChD   open_channel  cross_section=chamber  len=116.50   reaches=8  iq=0
ChD   Lpin  open_channel  cross_section=chamber  len=116.50   reaches=8  iq=0

*NODES ==========================================================================
! lin is -40+18.25/2 =30.875 model study
! PLAN=>> -22.00+14.50/2=-14.750 top of culvert
```

```
! PLAN=>> -22.00+3.75/2=-20.125 top of side port culverts
HW        elev=-14.750     head=0  idemand=0
! ---Left Culvert---
LIn       elev=-14.750    ihead=0
LB1u      elev=-14.750    ihead=0
LB1d      elev=-14.750    ihead=0
LFVu      elev=-14.750    ihead=0
LFW       elev=-14.750    ihead=0   demand=0
! wsel will change once you cross the valve
LFVd      elev=-14.750    ihead=-2
LB2u      elev=-14.750    ihead=-2
LB2d      elev=-14.750    ihead=-2
LP1u      elev=-14.750    ihead=-2
LP1d      elev=-14.750    ihead=-2
! at port
LP1b      elev=-20.125    ihead=-2
LP2u      elev=-14.750    ihead=-2
LP2d      elev=-14.750    ihead=-2
! at port
LP2b      elev=-20.125    ihead=-2
LP3u      elev=-14.750    ihead=-2
LP3d      elev=-14.750    ihead=-2
! at port
LP3b      elev=-20.125    ihead=-2
LP4u      elev=-14.750    ihead=-2
LP4d      elev=-14.750    ihead=-2
! at port
LP4b      elev=-20.125    ihead=-2
LP5u      elev=-14.750    ihead=-2
LP5d      elev=-14.750    ihead=-2
! at port
LP5b      elev=-20.125    ihead=-2
LP6u      elev=-14.750    ihead=-2
LP6d      elev=-14.750    ihead=-2
! at port
LP6b      elev=-20.125    ihead=-2
LP7u      elev=-14.750    ihead=-2
LP7d      elev=-14.750    ihead=-2
! at port
LP7b      elev=-20.125    ihead=-2
LP8u      elev=-14.750    ihead=-2
LP8d      elev=-14.750    ihead=-2
! at port
LP8b      elev=-20.125    ihead=-2
LP9u      elev=-14.750    ihead=-2
LP9d      elev=-14.750    ihead=-2
! at port
LP9b      elev=-20.125    ihead=-2
LP10u     elev=-14.750    ihead=-2
LP10d     elev=-14.750    ihead=-2
! at port
LP10b     elev=-20.125    ihead=-2
LP11u     elev=-14.750    ihead=-2
LP11d     elev=-14.750    ihead=-2
! at port
LP11b     elev=-20.125    ihead=-2
LP12u     elev=-14.750    ihead=-2
LP12d     elev=-14.750    ihead=-2
! at port
LP12b     elev=-20.125    ihead=-2
LP13u     elev=-14.750    ihead=-2
LP13d     elev=-14.750    ihead=-2
! at port
LP13b     elev=-20.125    ihead=-2
LP14u     elev=-14.750    ihead=-2
LP14d     elev=-14.750    ihead=-2
! at port
LP14b     elev=-20.125    ihead=-2
LP15u     elev=-14.750    ihead=-2
LP15d     elev=-14.750    ihead=-2
! at port
```

```
LP15b     elev=-20.125    ihead=-2
LP16u     elev=-14.750    ihead=-2
LP16d     elev=-14.750    ihead=-2
! at port
LP16b     elev=-20.125    ihead=-2
LP17u     elev=-14.750    ihead=-2
LP17d     elev=-14.750    ihead=-2
! at port
LP17b     elev=-20.125    ihead=-2
LP18u     elev=-14.750    ihead=-2
LP18d     elev=-14.750    ihead=-2
! at port
LP18b     elev=-20.125    ihead=-2
LP19u     elev=-14.750    ihead=-2
LP19d     elev=-14.750    ihead=-2
! at port
LP19b     elev=-20.125    ihead=-2
LP20u     elev=-14.750    ihead=-2
LP20d     elev=-14.750    ihead=-2
! at port
LP20b     elev=-20.125    ihead=-2
LP21u     elev=-14.750    ihead=-2
LP21d     elev=-14.750    ihead=-2
! at port
LP21b     elev=-20.125    ihead=-2
LB3u      elev=-14.750    ihead=-2
LB3d      elev=-14.750    ihead=-2
LEVu      elev=-14.750    ihead=-2
LEW       elev=-14.750    ihead=-2    demand=0
! ---Right Culvert---
RIn       elev=-14.750    ihead=0
RB1u      elev=-14.750    ihead=0
RB1d      elev=-14.750    ihead=0
RFVu      elev=-14.750    ihead=0
RFW       elev=-14.750    ihead=0     demand=0
! wsel will change once you cross the valve
RFVd      elev=-14.750    ihead=-2
RB2u      elev=-14.750    ihead=-2
RB2d      elev=-14.750    ihead=-2
RP1u      elev=-14.750    ihead=-2
RP1d      elev=-14.750    ihead=-2
! at port
RP1b      elev=-20.125    ihead=-2
RP2u      elev=-14.750    ihead=-2
RP2d      elev=-14.750    ihead=-2
! at port
RP2b      elev=-20.125    ihead=-2
RP3u      elev=-14.750    ihead=-2
RP3d      elev=-14.750    ihead=-2
! at port
RP3b      elev=-20.125    ihead=-2
RP4u      elev=-14.750    ihead=-2
RP4d      elev=-14.750    ihead=-2
! at port
RP4b      elev=-20.125    ihead=-2
RP5u      elev=-14.750    ihead=-2
RP5d      elev=-14.750    ihead=-2
! at port
RP5b      elev=-20.125    ihead=-2
RP6u      elev=-14.750    ihead=-2
RP6d      elev=-14.750    ihead=-2
! at port
RP6b      elev=-20.125    ihead=-2
RP7u      elev=-14.750    ihead=-2
RP7d      elev=-14.750    ihead=-2
! at port
RP7b      elev=-20.125    ihead=-2
RP8u      elev=-14.750    ihead=-2
RP8d      elev=-14.750    ihead=-2
! at port
RP8b      elev=-20.125    ihead=-2
```

```
RP9u      elev=-14.750    ihead=-2
RP9d      elev=-14.750    ihead=-2
! at port
RP9b      elev=-20.125    ihead=-2
RP10u     elev=-14.750    ihead=-2
RP10d     elev=-14.750    ihead=-2
! at port
RP10b     elev=-20.125    ihead=-2
RP11u     elev=-14.750    ihead=-2
RP11d     elev=-14.750    ihead=-2
! at port
RP11b     elev=-20.125    ihead=-2
RP12u     elev=-14.750    ihead=-2
RP12d     elev=-14.750    ihead=-2
! at port
RP12b     elev=-20.125    ihead=-2
RP13u     elev=-14.750    ihead=-2
RP13d     elev=-14.750    ihead=-2
! at port
RP13b     elev=-20.125    ihead=-2
RP14u     elev=-14.750    ihead=-2
RP14d     elev=-14.750    ihead=-2
! at port
RP14b     elev=-20.125    ihead=-2
RP15u     elev=-14.750    ihead=-2
RP15d     elev=-14.750    ihead=-2
! at port
RP15b     elev=-20.125    ihead=-2
RP16u     elev=-14.750    ihead=-2
RP16d     elev=-14.750    ihead=-2
! at port
RP16b     elev=-20.125    ihead=-2
RP17u     elev=-14.750    ihead=-2
RP17d     elev=-14.750    ihead=-2
! at port
RP17b     elev=-20.125    ihead=-2
RP18u     elev=-14.750    ihead=-2
RP18d     elev=-14.750    ihead=-2
! at port
RP18b     elev=-20.125    ihead=-2
RP19u     elev=-14.750    ihead=-2
RP19d     elev=-14.750    ihead=-2
! at port
RP19b     elev=-20.125    ihead=-2
RP20u     elev=-14.750    ihead=-2
RP20d     elev=-14.750    ihead=-2
! at port
RP20b     elev=-20.125    ihead=-2
RP21u     elev=-14.750    ihead=-2
RP21d     elev=-14.750    ihead=-2
! at port
RP21b     elev=-20.125    ihead=-2
RB3u      elev=-14.750    ihead=-2
RB3d      elev=-14.750    ihead=-2
REVu      elev=-14.750    ihead=-2
REW       elev=-14.750    ihead=-2    demand=0
! ---Lock Chamber---
Upin      elev=-22.00       ihead=-2    demand=0
ChU       elev=-22.00       ihead=-2
Ch1       elev=-22.00       ihead=-2
Ch2       elev=-22.00       ihead=-2
Ch3       elev=-22.00       ihead=-2
Ch4       elev=-22.00       ihead=-2
Ch5       elev=-22.00       ihead=-2
Ch6       elev=-22.00       ihead=-2
Ch7       elev=-22.00       ihead=-2
Ch8       elev=-22.00       ihead=-2
Ch9       elev=-22.00       ihead=-2
Ch10      elev=-22.00       ihead=-2
Ch11      elev=-22.00       ihead=-2
Ch12      elev=-22.00       ihead=-2
```

```
Ch13      elev=-22.00       ihead=-2
Ch14      elev=-22.00       ihead=-2
Ch15      elev=-22.00       ihead=-2
Ch16      elev=-22.00       ihead=-2
Ch17      elev=-22.00       ihead=-2
Ch18      elev=-22.00       ihead=-2
Ch19      elev=-22.00       ihead=-2
Ch20      elev=-22.00       ihead=-2
Ch21      elev=-22.00       ihead=-2
ChD       elev=-22.00       ihead=-2
Lpin      elev=-22.00       ihead=-2    demand=0

*FUNCTIONS ========================================================================

! open tainter designated at top for b/B vs. time (xscale (valve time)) in
! seconds, b = valve opening, B = culvert height so, b/B is fraction opened.
! OpenTainter comes from Plate 33 of ERDC/CHL TR-03-3 Hite 2003
OpenTainter_Hite     discrete   interpolation=linear  xscale=240  xshift=0
   xy_pairs={ 0.00   0.000
              0.10   0.084
              0.20   0.167
              0.30   0.249
              0.40   0.334
              0.50   0.426
              0.60   0.525
              0.70   0.619
              0.80   0.732
              0.90   0.855
              1.00   1.000 }

! Kv vs b/B Relationship - Based on Nielson's WES Misc Paper H-76-13
! Equations D2 and D3
TainterKv  discrete interpolation=linear extrapolation=linear
   xy_pairs={   0.0010  1385376.875
                0.0020   346667.594
                0.0030   154218.391
                0.0040    86828.391
                0.0050    55621.793
                0.0060    38662.070
                0.0070    28431.086
                0.0080    21787.870
                0.0090    17230.836
                0.0100    13969.831
                0.0150     6237.299
                0.0200     3524.422
                0.0250     2265.772
                0.0300     1580.499
                0.0500      578.828
                0.0600      405.284
                0.0800      231.556
                0.1000      150.331
                0.1500       68.776
                0.2000       39.349
                0.2500       25.239
                0.3000       17.236
                0.3500       12.244
                0.4000        8.848
                0.4500        6.422
                0.5000        4.661
                0.5500        3.338
                0.6000        2.344
                0.7000        1.049
                0.8000        0.372
                0.9000        0.074
                1.0000        0.010  }

tainterCdv  discrete  interpolation=spline
  x_values={0,   0.05, 0.1, 0.15, 0.2, 0.25, 0.3, 0.35,
            0.4, 0.45, 0.5, 0.55, 0.6, 0.65, 0.7, 0.75,
            0.8, 0.85, 0.9, 0.95,   1}
  y_values={0, 0.0443, 0.0836, 0.1195, 0.1534, 0.196, 0.243, 0.295,
```

```
            0.349, 0.415, 0.494, 0.587, 0.69, 0.8165, 0.976, 1.155,
            1.387,  1.69,  2.02, 2.582, 3.162}

! Cc vs b/B Relationship - Gerald Schohl's polynomial which reproduces Fig
! D2 in WES Misc Paper H-76-13
! Cc=.85-1.12X+1.69X^2-.85X^3+.43X^4;  Where X=b/B
  TainterCc  polynomial coefficients={.85, -1.12, 1.69, -.85, .43}

*CROSS_SECTIONS ================================================================

   chamber TRAPEZOIDAL  MN_n=.02  bed_w=110 ! Lock Chamber

*PLOT VARIABLES ================================================================

LFVu   LFVd    valve_position
LFVu   LFVd    discharge
LFW    head

Upin   head
Ch10   head
Lpin   head

*END ===========================================================================
```

IHNC_900_110_2_4.plt

sec Time	(-) "LFVu LFVd Valve Position sectno=0"	(cfs) "LFVu discharge sectno=0"	(f) "LFW head"	(f) "Upin head"	(f) "Ch10 head"	(f) "Lpin head"
0	0	0	0	-2	-2	-2
1	0.0035	7.14809	-.00781459	-2	-2	-2
2	0.007	14.72889	-.02932791	-2	-2	-2
3	0.0105	21.28143	-0.0573897	-1.999998	-2	-2
4	0.014	28.47786	-.08328156	-1.999986	-1.999998	-2
5	0.0175	35.02174	-.09949389	-1.999909	-1.999989	-2
6	0.021	41.92308	-0.1012042	-1.999587	-1.999937	-2
7	0.0245	48.76418	-.08861424	-1.998619	-1.999729	-2
8	0.028	55.78769	-.06595526	-1.996526	-1.999091	-2
9	0.0315	62.8739	-.04047339	-1.993282	-1.997592	-2
10	0.035	69.91946	-0.0198467	-1.989644	-1.994879	-2
11	0.0385	76.80861	-.0099204	-1.986375	-1.991065	-2
12	0.042	83.40862	-.01300522	-1.983268	-1.986829	-2
13	0.0455	89.68361	-.02737519	-1.979841	-1.982928	-2
14	0.049	95.64324	-0.0480282	-1.976333	-1.979576	-2
15	0.0525	101.3987	-.06839307	-1.972905	-1.976463	-2
16	0.056	107.0829	-.08243133	-1.969311	-1.97335	-2
17	0.0595	112.854	-.08644854	-1.965707	-1.970323	-2
18	0.063	118.7992	-.08006774	-1.96217	-1.967523	-2
19	0.0665	124.9412	-.06609872	-1.958619	-1.964926	-2
20	0.07	131.2054	-.04944077	-1.955201	-1.962455	-1.999999
21	0.0735	137.4621	-.03541312	-1.951839	-1.960086	-1.999996
22	0.077	143.5603	-.02809894	-1.948557	-1.957746	-1.999986
23	0.0805	149.385	-0.0292061	-1.945324	-1.95529	-1.999956
24	0.084	154.8847	-.03775379	-1.942075	-1.952604	-1.999875
25	0.08745833	160.0713	-.05058549	-1.938811	-1.949607	-1.999677
26	0.09091667	165.0468	-.06352963	-1.935495	-1.946274	-1.999232
27	0.094375	169.9703	-.07281338	-1.932149	-1.942697	-1.998328
28	0.09783333	174.9747	-.07618791	-1.928798	-1.93903	-1.99666
29	0.1012917	180.1454	-0.0734548	-1.925478	-1.93542	-1.993881
30	0.10475	185.4962	-.06632202	-1.92223	-1.931948	-1.989709
31	0.1082083	190.9736	-.05768293	-1.919079	-1.928588	-1.984068
32	0.1116667	196.4747	-.05059846	-1.91602	-1.925286	-1.977197
33	0.115125	201.8832	-.04732744	-1.913034	-1.922013	-1.969615
34	0.1185833	207.108	-0.0487099	-1.910091	-1.918752	-1.961932
35	0.1220417	212.1092	-.05405954	-1.907152	-1.915479	-1.954589
36	0.1255	216.9028	-.06153998	-1.904189	-1.912145	-1.947702
37	0.1289583	221.5533	-.06885941	-1.901189	-1.908713	-1.941119
38	0.1324167	226.1488	-.07403542	-1.898161	-1.905186	-1.934631
39	0.135875	230.7703	-.07597939	-1.895124	-1.901595	-1.928161
40	0.1393333	235.468	-.07473647	-1.892101	-1.89799	-1.921775
41	0.1427917	240.2461	-.07134145	-1.889122	-1.894436	-1.915534
42	0.14625	245.0647	-.06737653	-1.886206	-1.890979	-1.909376
43	0.1497083	249.8596	-0.0644114	-1.883351	-1.88763	-1.903131
44	0.1531667	254.5621	-.06351406	-1.880542	-1.884359	-1.896633
45	0.156625	259.1193	-.06497315	-1.877761	-1.881107	-1.88979
46	0.1600833	263.5153	-.06830564	-1.874985	-1.877793	-1.882578
47	0.1635417	267.7727	-.07251349	-1.872195	-1.874324	-1.875031
48	0.167	271.9381	-.07646577	-1.86938	-1.870606	-1.867238
49	0.1704167	276.0566	-.07925916	-1.866539	-1.866543	-1.859337
50	0.1738333	280.1801	-.08047631	-1.863678	-1.862051	-1.851464
51	0.17725	284.3487	-.08028005	-1.860793	-1.857078	-1.843711
52	0.1806667	288.5713	-.07929285	-1.857879	-1.851618	-1.836102
53	0.1840833	292.8316	-0.0783336	-1.854921	-1.845723	-1.828612
54	0.1875	297.098	-.07812684	-1.851901	-1.839505	-1.821195
55	0.1909167	301.3381	-.07907906	-1.848797	-1.833109	-1.813813
56	0.1943333	305.5303	-.08118704	-1.845596	-1.826682	-1.806458
57	0.19775	309.6719	-.08409133	-1.842311	-1.820333	-1.799145
58	0.2011667	313.7794	-.08723988	-1.838967	-1.81411	-1.791895
59	0.2045833	317.8816	-0.0900927	-1.835583	-1.808002	-1.784726
60	0.208	322.0082	-.09229303	-1.832157	-1.801968	-1.777655
61	0.2114167	326.182	-0.093756	-1.828653	-1.795963	-1.770697
62	0.2148333	330.4144	-0.0946601	-1.824997	-1.789958	-1.76387
63	0.21825	334.7042	-.09535612	-1.821075	-1.783932	-1.757181
64	0.2216667	339.0393	-.09623113	-1.816744	-1.777854	-1.750624
65	0.2250833	343.4015	-.09757614	-1.811852	-1.771682	-1.744184
66	0.2285	347.773	-.09950053	-1.806259	-1.76537	-1.737843
67	0.2319167	352.1406	-0.1019154	-1.799851	-1.758887	-1.731583
68	0.2353333	356.4982	-0.1045822	-1.792568	-1.752231	-1.725391
69	0.23875	360.8459	-0.1072038	-1.784427	-1.74543	-1.719262
70	0.2421667	365.1877	-0.1095244	-1.775531	-1.738525	-1.713194
71	0.2455833	369.5272	-0.1114038	-1.766056	-1.731561	-1.707192

72	0.249	373.8641	-0.1128465	-1.756229	-1.724575	-1.70126
73	0.2525417	378.224	-0.1140148	-1.746277	-1.717596	-1.695398
74	0.2560833	382.6013	-0.1151682	-1.736383	-1.710638	-1.689601
75	0.259625	386.9595	-0.1165161	-1.726651	-1.703699	-1.683859
76	0.2631667	391.2744	-0.1181378	-1.717103	-1.696766	-1.678156
77	0.2667083	395.5352	-0.1199931	-1.707693	-1.689818	-1.672476
78	0.27025	399.7416	-0.1219654	-1.698347	-1.682829	-1.666801
79	0.2737917	403.899	-0.1239169	-1.688993	-1.675763	-1.661117
80	0.2773333	408.017	-0.1257408	-1.679576	-1.668579	-1.655415
81	0.280875	412.1049	-0.1273945	-1.670054	-1.661227	-1.649685
82	0.2844167	416.1716	-0.1289077	-1.660395	-1.653657	-1.643922
83	0.2879583	420.2234	-0.1303667	-1.650571	-1.645824	-1.638122
84	0.2915	424.2607	-0.1318773	-1.640563	-1.637696	-1.63228
85	0.2950417	428.2802	-0.133523	-1.630371	-1.629263	-1.62639
86	0.2985833	432.2772	-0.1353375	-1.620027	-1.620537	-1.620449
87	0.302125	436.2497	-0.1372988	-1.609591	-1.61156	-1.614451
88	0.3056667	440.198	-0.1393449	-1.599131	-1.602392	-1.608391
89	0.3092083	444.1233	-0.1413975	-1.588706	-1.593117	-1.602265
90	0.31275	448.0266	-0.143386	-1.578356	-1.583813	-1.596071
91	0.3162917	451.9082	-0.1452668	-1.568101	-1.57455	-1.589808
92	0.3198333	455.7674	-0.1470314	-1.55794	-1.565371	-1.583474
93	0.323375	459.6026	-0.1487037	-1.547866	-1.556292	-1.577067
94	0.3269167	463.4106	-0.1503284	-1.537873	-1.547303	-1.570583
95	0.3304583	467.1863	-0.1519519	-1.527958	-1.538375	-1.564015
96	0.334	470.9242	-0.1536063	-1.518123	-1.529468	-1.557354
97	0.3378333	474.6685	-0.1553537	-1.508377	-1.520552	-1.55058
98	0.3416667	478.4259	-0.1572833	-1.498728	-1.511598	-1.543664
99	0.3455	482.158	-0.1593968	-1.489184	-1.502582	-1.536563
100	0.3493333	485.8477	-0.1615862	-1.479751	-1.49349	-1.529219
101	0.3531667	489.4877	-0.1637031	-1.470429	-1.484312	-1.52156
102	0.357	493.0778	-0.1656205	-1.46122	-1.475048	-1.513507
103	0.3608333	496.6227	-0.1672792	-1.452114	-1.465707	-1.504982
104	0.3646667	500.1268	-0.1687046	-1.443102	-1.456309	-1.495919
105	0.3685	503.5918	-0.1699898	-1.43417	-1.446877	-1.486277
106	0.3723333	507.0157	-0.1712574	-1.42531	-1.437433	-1.476044
107	0.3761667	510.3948	-0.1726157	-1.416521	-1.427994	-1.465246
108	0.38	513.7246	-0.1741263	-1.4078	-1.418573	-1.453948
109	0.3838333	517.0023	-0.1757904	-1.399144	-1.409176	-1.442247
110	0.3876667	520.228	-0.177558	-1.390552	-1.399803	-1.430263
111	0.3915	523.4056	-0.1793533	-1.382018	-1.390454	-1.418118
112	0.3953333	526.5411	-0.1811047	-1.373535	-1.381125	-1.405924
113	0.3991667	529.6421	-0.1827696	-1.365094	-1.371819	-1.393763
114	0.403	532.7152	-0.1843458	-1.356686	-1.362537	-1.381679
115	0.4068333	535.7647	-0.185866	-1.348297	-1.353282	-1.369677
116	0.4106667	538.7914	-0.1873799	-1.339913	-1.344054	-1.357734
117	0.4145	541.7931	-0.1889325	-1.331522	-1.334847	-1.345808
118	0.4183333	544.7665	-0.1905463	-1.323111	-1.325651	-1.333857
119	0.4221667	547.7078	-0.1922154	-1.314671	-1.316445	-1.321845
120	0.426	550.6145	-0.1939093	-1.306195	-1.307203	-1.309747
121	0.430125	553.5194	-0.1956234	-1.297677	-1.297894	-1.297554
122	0.43425	556.4322	-0.1973938	-1.289113	-1.28848	-1.285268
123	0.438375	559.33	-0.1992265	-1.280498	-1.278923	-1.272902
124	0.4425	562.2001	-0.2010722	-1.271832	-1.269189	-1.260477
125	0.446625	565.0341	-0.2028583	-1.263115	-1.259249	-1.248024
126	0.45075	567.8267	-0.2045172	-1.254347	-1.249087	-1.235579
127	0.454875	570.5742	-0.2060087	-1.245526	-1.238695	-1.223178
128	0.459	573.2728	-0.2073297	-1.236651	-1.228082	-1.210854
129	0.463125	575.9181	-0.2085106	-1.227718	-1.21727	-1.198629
130	0.46725	578.5042	-0.2095994	-1.218727	-1.206293	-1.186517
131	0.471375	581.0243	-0.210644	-1.209675	-1.195195	-1.174521
132	0.4755	583.4713	-0.2116752	-1.200559	-1.184022	-1.16264
133	0.479625	585.8394	-0.2126999	-1.191366	-1.172818	-1.150872
134	0.48375	588.1247	-0.2137032	-1.182079	-1.161618	-1.139212
135	0.487875	590.3257	-0.2146583	-1.172671	-1.150443	-1.127661
136	0.492	592.4432	-0.2155395	-1.163109	-1.139298	-1.116221
137	0.496125	594.4798	-0.2163338	-1.153353	-1.128178	-1.104897
138	0.50025	596.4385	-0.2170456	-1.143354	-1.117069	-1.093689
139	0.504375	598.3224	-0.2176951	-1.133064	-1.105956	-1.082599
140	0.5085	600.1333	-0.2183101	-1.122432	-1.094823	-1.071621
141	0.512625	601.8719	-0.2189151	-1.111414	-1.083659	-1.060747
142	0.51675	603.5374	-0.2195219	-1.099979	-1.072459	-1.04997
143	0.520875	605.1285	-0.2201259	-1.088113	-1.061224	-1.039279
144	0.525	606.6437	-0.220707	-1.075823	-1.049959	-1.028666
145	0.5289167	608.0662	-0.2212194	-1.063142	-1.038672	-1.018123
146	0.5328333	609.3895	-0.2216	-1.050123	-1.027373	-1.007646
147	0.53675	610.6209	-0.2218115	-1.036841	-1.016075	-0.9972296
148	0.5406667	611.7631	-0.2218604	-1.023377	-1.004789	-0.9868702
149	0.5445833	612.8159	-0.2217838	-1.009815	-0.993524	-0.9765627
150	0.5485	613.7767	-0.2216301	-0.9962297	-0.9822848	-0.9663014
151	0.5524167	614.6415	-0.2214402	-0.9826808	-0.9710679	-0.9560796
152	0.5563333	615.4065	-0.2212344	-0.969205	-0.9598635	-0.945891

153	0.56025	616.0696	-0.2210102	-0.9558165	-0.9486559	-0.9357298
154	0.5641667	616.6306	-0.2207481	-0.942509	-0.9374251	-0.9255915
155	0.5680833	617.0914	-0.2204232	-0.9292621	-0.9261489	-0.9154719
156	0.572	617.4557	-0.2200171	-0.9160507	-0.9148051	-0.9053673
157	0.5759167	617.7281	-0.2195255	-0.9028532	-0.9033743	-0.8952741
158	0.5798333	617.9132	-0.2189601	-0.8896553	-0.8918421	-0.8851895
159	0.58375	618.0148	-0.2183436	-0.8764523	-0.8802011	-0.8751121
160	0.5876667	618.0356	-0.2177013	-0.8632497	-0.8684513	-0.8650416
161	0.5915833	617.9775	-0.2170519	-0.8500607	-0.8566002	-0.8549794
162	0.5955	617.8419	-0.2164026	-0.8369046	-0.8446636	-0.8449269
163	0.5994167	617.6301	-0.2157471	-0.8238044	-0.8326645	-0.834885
164	0.6033333	617.3438	-0.2150697	-0.8107845	-0.820631	-0.8248536
165	0.60725	616.9851	-0.2143518	-0.7978685	-0.8085944	-0.8148313
166	0.6111667	616.5557	-0.2135775	-0.7850771	-0.7965852	-0.8048148
167	0.6150833	616.0561	-0.2127366	-0.7724263	-0.7846301	-0.7947994
168	0.619	615.4893	-0.2118287	-0.7599276	-0.7727479	-0.7847775
169	0.6237083	614.8905	-0.2109007	-0.7475877	-0.7609476	-0.7747393
170	0.6284167	614.2718	-0.2100428	-0.735409	-0.7492301	-0.7646715
171	0.633125	613.6152	-0.2093055	-0.7233909	-0.7375876	-0.7545567
172	0.6378333	612.9104	-0.2086643	-0.7115321	-0.7260073	-0.7443726
173	0.6425417	612.1521	-0.2080443	-0.6998318	-0.7144745	-0.7340917
174	0.64725	611.3398	-0.2073564	-0.6882891	-0.7029765	-0.723682
175	0.6519583	610.4764	-0.206531	-0.6769007	-0.6915048	-0.7131084
176	0.6566667	609.5654	-0.2055406	-0.6656599	-0.6800562	-0.7023348
177	0.661375	608.609	-0.2044035	-0.6545594	-0.6686325	-0.6913269
178	0.6660833	607.6066	-0.2031703	-0.6435946	-0.657239	-0.6800558
179	0.6707917	606.555	-0.2019007	-0.6327623	-0.6458842	-0.6685013
180	0.6755	605.4492	-0.2006411	-0.6220562	-0.6345794	-0.6566555
181	0.6802083	604.2835	-0.1994094	-0.6114677	-0.623338	-0.6445247
182	0.6849167	603.0534	-0.1981921	-0.6009887	-0.6121727	-0.6321302
183	0.689625	601.7561	-0.1969534	-0.5906116	-0.6010931	-0.6195079
184	0.6943333	600.3905	-0.1956503	-0.5803291	-0.5901058	-0.6067052
185	0.6990417	598.9572	-0.1942493	-0.5701351	-0.5792152	-0.5937774
186	0.70375	597.4568	-0.1927359	-0.560024	-0.5684242	-0.5807824
187	0.7084583	595.8908	-0.1911189	-0.5499911	-0.5577337	-0.567775
188	0.7131667	594.2606	-0.1894263	-0.540032	-0.5471423	-0.5548016
189	0.717875	592.5662	-0.1876946	-0.5301421	-0.5366465	-0.5418964
190	0.7225833	590.8067	-0.1859558	-0.5203168	-0.5262406	-0.5290793
191	0.7272917	588.981	-0.1842271	-0.5105517	-0.5159161	-0.5163572
192	0.732	587.0881	-0.1825077	-0.500843	-0.5056616	-0.5037256
193	0.737125	585.1347	-0.1807891	-0.4911875	-0.4954627	-0.4911735
194	0.74225	583.1243	-0.1790638	-0.4815833	-0.4853027	-0.4786877
195	0.747375	581.054	-0.1773177	-0.4720288	-0.4751629	-0.4662569
196	0.7525	578.923	-0.1755301	-0.4625228	-0.4650237	-0.4538758
197	0.757625	576.7312	-0.1736833	-0.4530652	-0.4548657	-0.441546
198	0.76275	574.4791	-0.1717685	-0.4436566	-0.4446711	-0.4292763
199	0.767875	572.1666	-0.1697872	-0.434298	-0.4344247	-0.4170812
200	0.773	569.7931	-0.1677497	-0.4249888	-0.4241158	-0.4049794
201	0.778125	567.3571	-0.1656691	-0.4157278	-0.4137397	-0.3929913
202	0.78325	564.8563	-0.1635558	-0.4065129	-0.4032983	-0.3811376
203	0.788375	562.2881	-0.1614137	-0.3973405	-0.3928006	-0.3694371
204	0.7935	559.6502	-0.1592389	-0.3882047	-0.3822616	-0.3579052
205	0.798625	556.9404	-0.157022	-0.3790961	-0.3717015	-0.346553
206	0.80375	554.1572	-0.1547516	-0.370003	-0.3611433	-0.3353877
207	0.808875	551.2994	-0.1524191	-0.3609105	-0.3506103	-0.3244134
208	0.814	548.3657	-0.1500206	-0.3518005	-0.3401238	-0.3136325
209	0.819125	545.3549	-0.1475575	-0.3426519	-0.3297023	-0.3030462
210	0.82425	542.2658	-0.1450362	-0.3334408	-0.3193594	-0.2926547
211	0.829375	539.0978	-0.1424662	-0.3241412	-0.3091035	-0.2824566
212	0.8345	535.8505	-0.1398582	-0.3147262	-0.2989382	-0.2724492
213	0.839625	532.5239	-0.1372216	-0.3051698	-0.288863	-0.2626284
214	0.84475	529.1183	-0.1345635	-0.295449	-0.278875	-0.252989
215	0.849875	525.6347	-0.1318879	-0.2855462	-0.2689708	-0.2435248
216	0.855	522.0742	-0.1291959	-0.2754516	-0.2591478	-0.234229
217	0.8610417	518.4432	-0.1264924	-0.2651649	-0.2494049	-0.225094
218	0.8670833	514.7455	-0.1237881	-0.2546966	-0.2397429	-0.2161123
219	0.873125	510.9813	-0.1210902	-0.2440677	-0.2301646	-0.2072758
220	0.8791667	507.1519	-0.1183987	-0.2333091	-0.220674	-0.1985766
221	0.8852083	503.2589	-0.1157088	-0.2224596	-0.2112747	-0.1900067
222	0.89125	499.3039	-0.1130133	-0.2115624	-0.2019696	-0.1815584
223	0.8972917	495.2883	-0.1103054	-0.2006618	-0.1927596	-0.1732247
224	0.9033333	491.2135	-0.1075806	-0.1897993	-0.183643	-0.1649998
225	0.909375	487.0803	-0.1048376	-0.1790111	-0.1746155	-0.1568785
226	0.9154167	482.8884	-0.1020771	-0.1683263	-0.16567	-0.1488569
227	0.9214583	478.6371	-.09929976	-0.1577645	-0.1567963	-0.1409314
228	0.9275	474.3231	-.09650327	-0.1473354	-0.1479832	-0.1330993
229	0.9335417	469.9439	-.09368105	-0.1370399	-0.1392196	-0.1253585
230	0.9395833	465.5016	-.09082996	-0.1268744	-0.1304958	-0.1177076
231	0.945625	460.999	-.08795725	-0.1168341	-0.1218035	-0.110146
232	0.9516667	456.4376	-.08507755	-0.1069146	-0.113137	-0.1026738
233	0.9577083	451.8183	-.08220677	-.09711473	-0.1044943	-.09529199

234	0.96375	447.1425	-.07935787	-.08743837	-.09587815	-.08800139
235	0.9697917	442.4119	-.07653858	-.07789467	-.08729522	-.08080284
236	0.9758333	437.6268	-0.073749	-0.0684955	-.07875662	-.07369657
237	0.981875	432.7874	-.07098091	-0.0592532	-.07027701	-.06668178
238	0.9879167	427.8963	-.06822354	-.05018006	-.06187334	-.05975626
239	0.9939583	422.9569	-.06547059	-.04128971	-.05356245	-.05291585
240	1	417.9719	-.06272253	-.03259695	-.04535826	-0.0461541
241	1	412.9361	-.05997723	-.02411471	-0.0372709	-.03946194
242	1	407.847	-.05722508	-.01585266	-.02930798	-.03282757
243	1	402.6969	-.05444927	-.00781827	-.02147543	-.02623633
244	1	397.487	-.05163472	-1.6206E-5	-.01377623	-.01967079
245	1	392.2269	-.04879085	.007552037	-.00620967	-.01311111
246	1	386.9188	-.04594951	0.01488736	.001227735	-.00653559
247	1	381.5629	-0.0431451	0.02199191	0.00854137	7.84507E-5
248	1	376.1565	-.04039965	0.0288661	0.0157368	0.00675359
249	1	370.6929	-.03771019	0.0355071	0.02281643	0.01351093
250	1	365.1504	-.03502984	0.04191372	0.02977903	0.02036854

IHNC_1200_75_2_6.sim

```
! Inner Harbor Navigation Channel Lock, New Orleans

! ********TWO FEET LIFT********

*CONSTANTS ==========================================================================
    io_units=English,  time_units=seconds
    time_step=1,   gravity=32.146, wf_time=0.55
    dQ_max=.001,   dh_max=.0001,   dx_max=.0001
    plot_field=11, plot_line=200,  plot_labels=row
    plot_file=IHNC_1200_75_2_6.plt

*COMPONENTS =========================================================================

!  The following was adopted from the model study.
! (Modeling 1:25-scale model, increase hydraulic roughness by setting Darcy-Weisbach
!   friction factor to 0.02 which is more appropriate for phy model with peak Re=1e5
!  Change prototype simulations to 'rough=.003')

! --------------- Left Wall -----------------------------

! Intake

HW     LIn     pipe_loss  us_area=1e6, area=273.75, K+=0.5
LIn    LB1u    imp_pipe  dia=16.47, area=273.75, len=22.73, rough=.003, wave=3500

! The first bend on left culvert is LB1

LB1u   LB1d    pipe_loss  area=273.75  K+=0.07
                ! Kb for 30 degree Bend - HDC Chart 228-1 Re=2.5x10^5
LB1d   LFVu    imp_pipe  dia=16.47, area=273.75, len=27.71, rough=.003, wave=3500

LFVu   LFW     storage surface_area=435.00  max_wsel=24.50

! Reverse Tainter Filling Valve

LFVu   LFVd    rev_tainter b=18.25, w=15, el_bottom=-22.00
                b/B_vs_t=OpenTainter_Hite
                Cc_vs_b/B=TainterCc
!                Kv+_vs_b/B=TainterKv
                Cdv+_vs_b/B=tainterCdv
LFVd   LB2u    imp_pipe  dia=16.47, area=273.75, len=27.71, rough=.003, wave=3500

! Second bend

LB2u   LB2d    pipe_loss  area=273.75  K+=0.07

! Straight reach of culvert US of manifold

LB2d   LP1u    imp_pipe  dia=16.47, area=273.75, len=77.67, rough=.003, wave=3500

! Sidewall Port Manifold

LP1u   LP1d  LP1b  diverging_tee area1=area3=273.75 area2=18.75 angle1=0 angle2=90
LP1b   Ch1     pipe_loss area=18.75 ds_area=1e5 K+=1.80 K-=0.25

LP1d   LP2u    imp_pipe dia=16.47, area=273.75, len=56, rough=.003, wave=3500

LP2u   LP2d  LP2b  diverging_tee area1=area3=273.75 area2=18.75 angle1=0 angle2=90
LP2b   Ch2     pipe_loss area=18.75 ds_area=1e5 K+=1.80 K-=0.25

LP2d   LP3u    imp_pipe dia=16.47, area=273.75, len=56, rough=.003, wave=3500

LP3u   LP3d  LP3b  diverging_tee area1=area3=273.75 area2=18.75 angle1=0 angle2=90
LP3b   Ch3     pipe_loss area=18.75 ds_area=1e5 K+=1.80 K-=0.25

LP3d   LP4u    imp_pipe dia=16.47, area=273.75, len=56, rough=.003, wave=3500

LP4u   LP4d  LP4b  diverging_tee area1=area3=273.75 area2=18.75 angle1=0 angle2=90
```

```
LP4b   Ch4     pipe_loss area=18.75 ds_area=1e5 K+=1.80 K-=0.25

LP4d   LP5u    imp_pipe dia=16.47, area=273.75, len=56, rough=.003, wave=3500

LP5u   LP5d  LP5b  diverging_tee area1=area3=273.75 area2=18.75 angle1=0 angle2=90
LP5b   Ch5     pipe_loss area=18.75 ds_area=1e5 K+=1.80 K-=0.25

LP5d   LP6u    imp_pipe dia=16.47, area=273.75, len=56, rough=.003, wave=3500

LP6u   LP6d  LP6b  diverging_tee area1=area3=273.75 area2=18.75 angle1=0 angle2=90
LP6b   Ch6     pipe_loss area=18.75 ds_area=1e5 K+=1.80 K-=0.25

LP6d   LP7u    imp_pipe dia=16.47, area=273.75, len=56, rough=.003, wave=3500

LP7u   LP7d  LP7b  diverging_tee area1=area3=273.75 area2=18.75 angle1=0 angle2=90
LP7b   Ch7     pipe_loss area=18.75 ds_area=1e5 K+=1.80 K-=0.25

LP7d   LP8u    imp_pipe dia=16.47, area=273.75, len=56, rough=.003, wave=3500

LP8u   LP8d  LP8b  diverging_tee area1=area3=273.75 area2=18.75 angle1=0 angle2=90
LP8b   Ch8     pipe_loss area=18.75 ds_area=1e5 K+=1.80 K-=0.25

LP8d   LP9u    imp_pipe dia=16.47, area=273.75, len=56, rough=.003, wave=3500

LP9u   LP9d  LP9b  diverging_tee area1=area3=273.75 area2=18.75 angle1=0 angle2=90
LP9b   Ch9     pipe_loss area=18.75 ds_area=1e5 K+=1.80 K-=0.25

LP9d   LP10u   imp_pipe dia=16.47, area=273.75, len=56, rough=.003, wave=3500

LP10u  LP10d  LP10b  diverging_tee area1=area3=273.75 area2=18.75 angle1=0 angle2=90
LP10b  Ch10    pipe_loss area=18.75 ds_area=1e5 K+=1.80 K-=0.25

LP10d  LP11u  imp_pipe dia=16.47, area=273.75, len=56, rough=.003, wave=3500

LP11u  LP11d  LP11b  diverging_tee area1=area3=273.75 area2=18.75 angle1=0 angle2=90
LP11b  Ch11    pipe_loss area=18.75 ds_area=1e5 K+=1.80 K-=0.25

LP11d  LP12u  imp_pipe dia=16.47, area=273.75, len=56, rough=.003, wave=3500

LP12u  LP12d  LP12b  diverging_tee area1=area3=273.75 area2=18.75 angle1=0 angle2=90
LP12b  Ch12    pipe_loss area=18.75 ds_area=1e5 K+=1.80 K-=0.25

LP12d  LP13u  imp_pipe dia=16.47, area=273.75, len=56, rough=.003, wave=3500

LP13u  LP13d  LP13b  diverging_tee area1=area3=273.75 area2=18.75 angle1=0 angle2=90
LP13b  Ch13    pipe_loss area=18.75 ds_area=1e5 K+=1.80 K-=0.25

LP13d  LP14u  imp_pipe dia=16.47, area=273.75, len=56, rough=.003, wave=3500

LP14u  LP14d  LP14b  diverging_tee area1=area3=273.75 area2=18.75 angle1=0 angle2=90
LP14b  Ch14    pipe_loss area=18.75 ds_area=1e5 K+=1.80 K-=0.25

LP14d  LB3u   imp_pipe dia=16.47, area=273.75, len=77.67, rough=.003, wave=3500

! Culvert downstream of manifold ports

LB3u   LB3d    pipe_loss  area=273.75  K+=0.07
LB3d   LEVu    imp_pipe  dia=16.47, area=273.75, len=27.71, rough=.003, wave=3500
LEVu   LEW     storage surface_area=435.00  max_wsel=24.50
!LEVu   LEVd    rev_tainter b=18.25  w=15  el_bottom=-22.00
!               b/B_vs_t=OpenTainter_Hite
!               Cc_vs_b/B=TainterCc  Kv+_vs_b/B=TainterKv
!               fixed_b/B=0

! --------------- Right Wall -----------------------------

! Intake

HW     RIn     pipe_loss  us_area=1e6  area=273.75  K+=0.5
RIn    RB1u    imp_pipe  dia=16.47  area=273.75  len=22.73  rough=.003  wave=3500
```

```
! The first bend on right culvert is RB1

RB1u   RB1d    pipe_loss  area=273.75  K+=0.07
                ! Kb for 30 degree Bend - HDC Chart 228-1 Re=2.5x10^5
RB1d   RFVu    imp_pipe  dia=16.47, area=273.75, len=27.71, rough=.003, wave=3500
RFVu   RFW     storage surface_area=435.00  max_wsel=24.50

! Reverse Tainter Filling Valve

RFVu   RFVd    rev_tainter b=18.25  w=15  el_bottom=-22.00
                b/B_vs_t=OpenTainter_Hite
                Cc_vs_b/B=TainterCc
!               Kv+_vs_b/B=TainterKv
                Cdv+_vs_b/B=tainterCdv

RFVd   RB2u    imp_pipe  dia=16.47  area=273.75  len=27.71  rough=.003  wave=3500

! Second bend

RB2u   RB2d    pipe_loss  area=273.75  K+=0.07

! Straight reach of culvert US of manifold

RB2d   RP1u    imp_pipe  dia=16.47  area=273.75  len=77.67  rough=.003  wave=3500

! Sidewall Port Manifold

RP1u   RP1d  RP1b  diverging_tee area1=area3=273.75 area2=18.75 angle1=0 angle2=90
RP1b   Ch1     pipe_loss area=18.75 ds_area=1e5 K+=1.80 K-=0.25

RP1d   RP2u    imp_pipe dia=16.47, area=273.75, len=56, rough=.003, wave=3500

RP2u   RP2d  RP2b  diverging_tee area1=area3=273.75 area2=18.75 angle1=0 angle2=90
RP2b   Ch2     pipe_loss area=18.75 ds_area=1e5 K+=1.80 K-=0.25

RP2d   RP3u    imp_pipe dia=16.47, area=273.75, len=56, rough=.003, wave=3500

RP3u   RP3d  RP3b  diverging_tee area1=area3=273.75 area2=18.75 angle1=0 angle2=90
RP3b   Ch3     pipe_loss area=18.75 ds_area=1e5 K+=1.80 K-=0.25

RP3d   RP4u    imp_pipe dia=16.47, area=273.75, len=56, rough=.003, wave=3500

RP4u   RP4d  RP4b  diverging_tee area1=area3=273.75 area2=18.75 angle1=0 angle2=90
RP4b   Ch4     pipe_loss area=18.75 ds_area=1e5 K+=1.80 K-=0.25

RP4d   RP5u    imp_pipe dia=16.47, area=273.75, len=56, rough=.003, wave=3500

RP5u   RP5d  RP5b  diverging_tee area1=area3=273.75 area2=18.75 angle1=0 angle2=90
RP5b   Ch5     pipe_loss area=18.75 ds_area=1e5 K+=1.80 K-=0.25

RP5d   RP6u    imp_pipe dia=16.47, area=273.75, len=56, rough=.003, wave=3500

RP6u   RP6d  RP6b  diverging_tee area1=area3=273.75 area2=18.75 angle1=0 angle2=90
RP6b   Ch6     pipe_loss area=18.75 ds_area=1e5 K+=1.80 K-=0.25

RP6d   RP7u    imp_pipe dia=16.47, area=273.75, len=56, rough=.003, wave=3500

RP7u   RP7d  RP7b  diverging_tee area1=area3=273.75 area2=18.75 angle1=0 angle2=90
RP7b   Ch7     pipe_loss area=18.75 ds_area=1e5 K+=1.80 K-=0.25

RP7d   RP8u    imp_pipe dia=16.47, area=273.75, len=56, rough=.003, wave=3500

RP8u   RP8d  RP8b  diverging_tee area1=area3=273.75 area2=18.75 angle1=0 angle2=90
RP8b   Ch8     pipe_loss area=18.75 ds_area=1e5 K+=1.80 K-=0.25

RP8d   RP9u    imp_pipe dia=16.47, area=273.75, len=56, rough=.003, wave=3500

RP9u   RP9d  RP9b  diverging_tee area1=area3=273.75 area2=18.75 angle1=0 angle2=90
RP9b   Ch9     pipe_loss area=18.75 ds_area=1e5 K+=1.80 K-=0.25

RP9d   RP10u   imp_pipe dia=16.47, area=273.75, len=56, rough=.003, wave=3500
```

```
RP10u  RP10d  RP10b  diverging_tee area1=area3=273.75 area2=18.75 angle1=0 angle2=90
RP10b  Ch10    pipe_loss area=18.75 ds_area=1e5 K+=1.80 K-=0.25

RP10d  RP11u  imp_pipe dia=16.47, area=273.75, len=56, rough=.003, wave=3500

RP11u  RP11d  RP11b  diverging_tee area1=area3=273.75 area2=18.75 angle1=0 angle2=90
RP11b  Ch11    pipe_loss area=18.75 ds_area=1e5 K+=1.80 K-=0.25

RP11d  RP12u  imp_pipe dia=16.47, area=273.75, len=56, rough=.003, wave=3500

RP12u  RP12d  RP12b  diverging_tee area1=area3=273.75 area2=18.75 angle1=0 angle2=90
RP12b  Ch12    pipe_loss area=18.75 ds_area=1e5 K+=1.80 K-=0.25

RP12d  RP13u  imp_pipe dia=16.47, area=273.75, len=56, rough=.003, wave=3500

RP13u  RP13d  RP13b  diverging_tee area1=area3=273.75 area2=18.75 angle1=0 angle2=90
RP13b  Ch13    pipe_loss area=18.75 ds_area=1e5 K+=1.80 K-=0.25

RP13d  RP14u  imp_pipe dia=16.47, area=273.75, len=56, rough=.003, wave=3500

RP14u  RP14d  RP14b  diverging_tee area1=area3=273.75 area2=18.75 angle1=0 angle2=90
RP14b  Ch14    pipe_loss area=18.75 ds_area=1e5 K+=1.80 K-=0.25

RP14d  RB3u   imp_pipe dia=16.47, area=273.75, len=77.67, rough=.003, wave=3500

! Culvert downstream of manifold ports

RB3u   RB3d    pipe_loss  area=273.75  K+=0.07
RB3d   REVu    imp_pipe  dia=16.47  area=273.75  len=27.71  rough=.003  wave=3500
!len=??
REVu   REW     storage  surface_area=435  max_wsel=24.50
!REVu   REVd    rev_tainter b=18.25  w=15  el_bottom=-40
!               b/B_vs_t=OpenTainter_Hite
!               Cc_vs_b/B=TainterCc  Kv+_vs_b/B=TainterKv
!               fixed_b/B=0

!------------ Lock chamber modeled as series of open channels ---------

! length is from pintle to halfway between the first ports (right and left)

Upin  ChU   open_channel  cross_section=chamber  len=114.835  reaches=4  iq=0
ChU   Ch1   open_channel  cross_section=chamber  len=114.835  reaches=4  iq=0
Ch1   Ch2   open_channel  cross_section=chamber  len=58.65    reaches=2  iq=0
Ch2   Ch3   open_channel  cross_section=chamber  len=58.64    reaches=2  iq=0
Ch3   Ch4   open_channel  cross_section=chamber  len=58.64    reaches=2  iq=0
Ch4   Ch5   open_channel  cross_section=chamber  len=58.64    reaches=2  iq=0
Ch5   Ch6   open_channel  cross_section=chamber  len=58.64    reaches=2  iq=0
Ch6   Ch7   open_channel  cross_section=chamber  len=58.64    reaches=2  iq=0
Ch7   Ch8   open_channel  cross_section=chamber  len=58.64    reaches=2  iq=0
Ch8   Ch9   open_channel  cross_section=chamber  len=58.64    reaches=2  iq=0
Ch9   Ch10  open_channel  cross_section=chamber  len=58.64    reaches=2  iq=0
Ch10  Ch11  open_channel  cross_section=chamber  len=58.64    reaches=2  iq=0
Ch11  Ch12  open_channel  cross_section=chamber  len=58.64    reaches=2  iq=0
Ch12  Ch13  open_channel  cross_section=chamber  len=58.64    reaches=2  iq=0
Ch13  Ch14  open_channel  cross_section=chamber  len=58.65    reaches=2  iq=0
Ch14  ChD   open_channel  cross_section=chamber  len=147.83   reaches=7  iq=0
ChD   Lpin  open_channel  cross_section=chamber  len=147.83   reaches=7  iq=0

*NODES ==========================================================================
! lin is -40+18.25/2 =30.875 model study
! PLAN=>> -22.00+18.25/2=-12.875 top of culvert
! PLAN=>> -22.00+3.75/2=-20.125 top of side port culverts
HW        elev=-12.875     head=0  idemand=0
! ---Left Culvert---
LIn       elev=-12.875    ihead=0
LB1u      elev=-12.875    ihead=0
LB1d      elev=-12.875    ihead=0
LFVu      elev=-12.875    ihead=0
LFW       elev=-12.875    ihead=0   demand=0
! wsel will change once you cross the valve
```

```
LFVd      elev=-12.875    ihead=-2
LB2u      elev=-12.875    ihead=-2
LB2d      elev=-12.875    ihead=-2
LP1u      elev=-12.875    ihead=-2
LP1d      elev=-12.875    ihead=-2
! at port
LP1b      elev=-20.125    ihead=-2
LP2u      elev=-12.875    ihead=-2
LP2d      elev=-12.875    ihead=-2
! at port
LP2b      elev=-20.125    ihead=-2
LP3u      elev=-12.875    ihead=-2
LP3d      elev=-12.875    ihead=-2
! at port
LP3b      elev=-20.125    ihead=-2
LP4u      elev=-12.875    ihead=-2
LP4d      elev=-12.875    ihead=-2
! at port
LP4b      elev=-20.125    ihead=-2
LP5u      elev=-12.875    ihead=-2
LP5d      elev=-12.875    ihead=-2
! at port
LP5b      elev=-20.125    ihead=-2
LP6u      elev=-12.875    ihead=-2
LP6d      elev=-12.875    ihead=-2
! at port
LP6b      elev=-20.125    ihead=-2
LP7u      elev=-12.875    ihead=-2
LP7d      elev=-12.875    ihead=-2
! at port
LP7b      elev=-20.125    ihead=-2
LP8u      elev=-12.875    ihead=-2
LP8d      elev=-12.875    ihead=-2
! at port
LP8b      elev=-20.125    ihead=-2
LP9u      elev=-12.875    ihead=-2
LP9d      elev=-12.875    ihead=-2
! at port
LP9b      elev=-20.125    ihead=-2
LP10u     elev=-12.875    ihead=-2
LP10d     elev=-12.875    ihead=-2
! at port
LP10b     elev=-20.125    ihead=-2
LP11u     elev=-12.875    ihead=-2
LP11d     elev=-12.875    ihead=-2
! at port
LP11b     elev=-20.125    ihead=-2
LP12u     elev=-12.875    ihead=-2
LP12d     elev=-12.875    ihead=-2
! at port
LP12b     elev=-20.125    ihead=-2
LP13u     elev=-12.875    ihead=-2
LP13d     elev=-12.875    ihead=-2
! at port
LP13b     elev=-20.125    ihead=-2
LP14u     elev=-12.875    ihead=-2
LP14d     elev=-12.875    ihead=-2
! at port
LP14b     elev=-20.125    ihead=-2
LB3u      elev=-12.875    ihead=-2
LB3d      elev=-12.875    ihead=-2
LEVu      elev=-12.875    ihead=-2
LEW       elev=-12.875    ihead=-2    demand=0
! ---Right Culvert---
RIn       elev=-12.875    ihead=0
RB1u      elev=-12.875    ihead=0
RB1d      elev=-12.875    ihead=0
RFVu      elev=-12.875    ihead=0
RFW       elev=-12.875    ihead=0     demand=0
! wsel will change once you cross the valve
RFVd      elev=-12.875    ihead=-2
```

```
RB2u      elev=-12.875    ihead=-2
RB2d      elev=-12.875    ihead=-2
RP1u      elev=-12.875    ihead=-2
RP1d      elev=-12.875    ihead=-2
! at port
RP1b      elev=-20.125    ihead=-2
RP2u      elev=-12.875    ihead=-2
RP2d      elev=-12.875    ihead=-2
! at port
RP2b      elev=-20.125    ihead=-2
RP3u      elev=-12.875    ihead=-2
RP3d      elev=-12.875    ihead=-2
! at port
RP3b      elev=-20.125    ihead=-2
RP4u      elev=-12.875    ihead=-2
RP4d      elev=-12.875    ihead=-2
! at port
RP4b      elev=-20.125    ihead=-2
RP5u      elev=-12.875    ihead=-2
RP5d      elev=-12.875    ihead=-2
! at port
RP5b      elev=-20.125    ihead=-2
RP6u      elev=-12.875    ihead=-2
RP6d      elev=-12.875    ihead=-2
! at port
RP6b      elev=-20.125    ihead=-2
RP7u      elev=-12.875    ihead=-2
RP7d      elev=-12.875    ihead=-2
! at port
RP7b      elev=-20.125    ihead=-2
RP8u      elev=-12.875    ihead=-2
RP8d      elev=-12.875    ihead=-2
! at port
RP8b      elev=-20.125    ihead=-2
RP9u      elev=-12.875    ihead=-2
RP9d      elev=-12.875    ihead=-2
! at port
RP9b      elev=-20.125    ihead=-2
RP10u     elev=-12.875    ihead=-2
RP10d     elev=-12.875    ihead=-2
! at port
RP10b     elev=-20.125    ihead=-2
RP11u     elev=-12.875    ihead=-2
RP11d     elev=-12.875    ihead=-2
! at port
RP11b     elev=-20.125    ihead=-2
RP12u     elev=-12.875    ihead=-2
RP12d     elev=-12.875    ihead=-2
! at port
RP12b     elev=-20.125    ihead=-2
RP13u     elev=-12.875    ihead=-2
RP13d     elev=-12.875    ihead=-2
! at port
RP13b     elev=-20.125    ihead=-2
RP14u     elev=-12.875    ihead=-2
RP14d     elev=-12.875    ihead=-2
! at port
RP14b     elev=-20.125    ihead=-2
RB3u      elev=-12.875    ihead=-2
RB3d      elev=-12.875    ihead=-2
REVu      elev=-12.875    ihead=-2
REW       elev=-12.875    ihead=-2    demand=0
! ---Lock Chamber---
Upin      elev=-22.00       ihead=-2    demand=0
ChU       elev=-22.00       ihead=-2
Ch1       elev=-22.00       ihead=-2
Ch2       elev=-22.00       ihead=-2
Ch3       elev=-22.00       ihead=-2
Ch4       elev=-22.00       ihead=-2
Ch5       elev=-22.00       ihead=-2
Ch6       elev=-22.00       ihead=-2
```

```
Ch7       elev=-22.00       ihead=-2
Ch8       elev=-22.00       ihead=-2
Ch9       elev=-22.00       ihead=-2
Ch10      elev=-22.00       ihead=-2
Ch11      elev=-22.00       ihead=-2
Ch12      elev=-22.00       ihead=-2
Ch13      elev=-22.00       ihead=-2
Ch14      elev=-22.00       ihead=-2
ChD       elev=-22.00       ihead=-2
Lpin      elev=-22.00       ihead=-2    demand=0

*FUNCTIONS ========================================================================

! open tainter designated at top for b/B vs. time (xscale (valve time)) in
! seconds, b = valve opening, B = culvert height so, b/B is fraction opened.
! OpenTainter comes from Plate 33 of ERDC/CHL TR-03-3 Hite 2003
OpenTainter_Hite     discrete   interpolation=linear  xscale=360  xshift=0
   xy_pairs={ 0.00   0.000
              0.10   0.084
              0.20   0.167
              0.30   0.249
              0.40   0.334
              0.50   0.426
              0.60   0.525
              0.70   0.619
              0.80   0.732
              0.90   0.855
              1.00   1.000 }

! Kv vs b/B Relationship - Based on Nielson's WES Misc Paper H-76-13
! Equations D2 and D3
TainterKv  discrete interpolation=linear extrapolation=linear
   xy_pairs={   0.0010  1385376.875
                0.0020   346667.594
                0.0030   154218.391
                0.0040    86828.391
                0.0050    55621.793
                0.0060    38662.070
                0.0070    28431.086
                0.0080    21787.870
                0.0090    17230.836
                0.0100    13969.831
                0.0150     6237.299
                0.0200     3524.422
                0.0250     2265.772
                0.0300     1580.499
                0.0500      578.828
                0.0600      405.284
                0.0800      231.556
                0.1000      150.331
                0.1500       68.776
                0.2000       39.349
                0.2500       25.239
                0.3000       17.236
                0.3500       12.244
                0.4000        8.848
                0.4500        6.422
                0.5000        4.661
                0.5500        3.338
                0.6000        2.344
                0.7000        1.049
                0.8000        0.372
                0.9000        0.074
                1.0000        0.010  }

tainterCdv  discrete  interpolation=spline
  x_values={0,   0.05, 0.1, 0.15, 0.2, 0.25, 0.3, 0.35,
            0.4, 0.45, 0.5, 0.55, 0.6, 0.65, 0.7, 0.75,
            0.8, 0.85, 0.9, 0.95,   1}
  y_values={0, 0.0443, 0.0836, 0.1195, 0.1534, 0.196, 0.243, 0.295,
            0.349, 0.415, 0.494, 0.587, 0.69, 0.8165, 0.976, 1.155,
```

```
            1.387,  1.69,  2.02, 2.582, 3.162}

! Cc vs b/B Relationship - Gerald Schohl's polynomial which reproduces Fig
! D2 in WES Misc Paper H-76-13
! Cc=.85-1.12X+1.69X^2-.85X^3+.43X^4;  Where X=b/B
  TainterCc  polynomial coefficients={.85, -1.12, 1.69, -.85, .43}

*CROSS_SECTIONS ================================================================

   chamber TRAPEZOIDAL  MN_n=.02  bed_w=75 ! Lock Chamber

*PLOT VARIABLES ================================================================

LFVu   LFVd    valve_position
LFVu   LFVd    discharge
LFW    head

Upin   head
Ch8    head
Lpin   head

*END ============================================================================
```

IHNC_1200_75_2_6.plt

sec Time	(-) "LFVu LFVd Valve Position sectno=0"	(cfs) "LFVu discharge sectno=0"	(f) "LFW head"	(f) "Upin head"	(f) "Ch8 head"	(f) "Lpin head"
0	0	0	0	-2	-2	-2
1	.002333333	6.33348	-.00655657	-2	-2	-2
2	.004666667	12.9289	-.02401108	-2	-2	-2
3	0.007	18.86177	-.04545061	-2	-2	-2
4	.009333333	25.26897	-.06287873	-2	-2	-2
5	0.01166667	31.19494	-.07010412	-2	-2	-2
6	0.014	37.50344	-.06467055	-2.000001	-2	-2
7	0.01633333	43.70634	-.04915429	-1.999982	-1.999999	-2
8	0.01866667	50.07843	-.02951082	-2.000312	-1.999996	-2
9	0.021	56.40018	-.01311544	-1.998015	-1.999982	-2
10	0.02333333	62.62186	-.00572594	-1.99385	-1.999934	-2
11	0.02566667	68.65166	-.00957274	-1.989706	-1.999764	-2
12	0.028	74.44491	-.02264492	-1.985529	-1.999336	-2
13	0.03033333	80.06557	-.03968034	-1.981397	-1.998268	-2
14	0.03266667	85.59926	-.05428031	-1.977167	-1.99637	-2
15	0.035	91.18753	-.06133083	-1.972952	-1.993165	-2
16	0.03733333	96.91414	-0.0588177	-1.96854	-1.988949	-2
17	0.03966667	102.8078	-0.0483569	-1.963957	-1.984456	-2
18	0.042	108.7979	-.03435097	-1.959406	-1.979959	-2
19	0.04433333	114.7757	-.02217659	-1.955011	-1.975607	-2
20	0.04666667	120.5978	-.01613955	-1.950667	-1.971412	-2
21	0.049	126.1691	-.01796715	-1.94628	-1.967338	-2
22	0.05133333	131.4623	-.02638208	-1.941905	-1.963356	-2
23	0.05366667	136.5332	-.03780821	-1.937603	-1.959506	-2
24	0.056	141.492	-.04787031	-1.93329	-1.955806	-2
25	0.05833333	146.4763	-.05308003	-1.928872	-1.952214	-2
26	0.06066667	151.5875	-.05205807	-1.924386	-1.948667	-2
27	0.063	156.8556	-0.0458546	-1.919933	-1.945132	-1.999999
28	0.06533333	162.2291	-.03733395	-1.91554	-1.941596	-1.999997
29	0.06766667	167.6015	-.02994117	-1.911192	-1.938013	-1.999989
30	0.07	172.8531	-.02637046	-1.906926	-1.934385	-1.999968
31	0.07233333	177.9029	-.02764612	-1.902803	-1.930693	-1.999912
32	0.07466667	182.7299	-.03291283	-1.898802	-1.92684	-1.999772
33	0.077	187.3773	-.03993634	-1.894832	-1.922772	-1.999451
34	0.07933333	191.9358	-.04607056	-1.890829	-1.918512	-1.998777
35	0.08166667	196.5096	-.04928758	-1.886791	-1.914122	-1.997483
36	0.084	201.1761	-.04887217	-1.882726	-1.909656	-1.995228
37	0.08630556	205.9358	-.04552539	-1.878638	-1.905148	-1.991666
38	0.08861111	210.7519	-.04094257	-1.874564	-1.90061	-1.986573
39	0.09091667	215.5695	-.03710856	-1.870565	-1.89603	-1.979962
40	0.09322222	220.3117	-.03553142	-1.866674	-1.891399	-1.972135
41	0.09552778	224.9197	-.03671444	-1.862876	-1.886729	-1.963584
42	0.09783333	229.3773	-.04007594	-1.859126	-1.882042	-1.9548
43	0.1001389	233.7139	-0.0442907	-1.855394	-1.877341	-1.946065
44	0.1024444	237.9913	-0.0478756	-1.851672	-1.872612	-1.937447
45	0.10475	242.2774	-.04976869	-1.847952	-1.867842	-1.928922
46	0.1070556	246.6189	-.04967895	-1.844217	-1.863035	-1.920481
47	0.1093611	251.0261	-.04810122	-1.840467	-1.858204	-1.912149
48	0.1116667	255.4736	-0.0460323	-1.836727	-1.853366	-1.903955
49	0.1139722	259.9126	-.04453129	-1.833028	-1.848548	-1.895895
50	0.1162778	264.2916	-.04430954	-1.829392	-1.843786	-1.88793
51	0.1185833	268.5752	-.04550274	-1.825814	-1.839109	-1.880014
52	0.1208889	272.7555	-.04769062	-1.822277	-1.834535	-1.872096
53	0.1231944	276.8486	-.05012415	-1.818764	-1.830071	-1.864119
54	0.1255	280.8898	-0.0520524	-1.81525	-1.825705	-1.856014
55	0.1278056	284.9186	-.05301614	-1.811714	-1.821398	-1.847711
56	0.1301111	288.9591	-.05298896	-1.808148	-1.817083	-1.839148
57	0.1324167	293.0129	-.05232896	-1.80456	-1.812668	-1.830286
58	0.1347222	297.062	-.05159006	-1.800957	-1.808046	-1.821133
59	0.1370278	301.0766	-.05128237	-1.79735	-1.803113	-1.811748
60	0.1393333	305.029	-.05168056	-1.793742	-1.797777	-1.80221
61	0.1416389	308.9041	-.05275073	-1.790128	-1.791974	-1.79259
62	0.1439444	312.7028	-.05420567	-1.786496	-1.785677	-1.782933
63	0.14625	316.4381	-.05564785	-1.782821	-1.778909	-1.773262
64	0.1485556	320.1288	-.05673531	-1.779078	-1.771734	-1.763592
65	0.1508611	323.7901	-.05730379	-1.775254	-1.76425	-1.753937
66	0.1531667	327.4265	-.05740264	-1.771343	-1.756568	-1.74432
67	0.1554722	331.0335	-.05724659	-1.767333	-1.748793	-1.734763
68	0.1577778	334.5989	-0.0571135	-1.76322	-1.740998	-1.725288
69	0.1600833	338.1052	-.05722806	-1.75901	-1.733225	-1.715903
70	0.1623889	341.5368	-.05768003	-1.754718	-1.725493	-1.706608
71	0.1646944	344.8858	-.05840771	-1.750366	-1.717814	-1.697393

72	0.167	348.1532	-.05924405	-1.745979	-1.7102	-1.688249
73	0.1692778	351.3372	-.05998748	-1.741583	-1.702661	-1.679169
74	0.1715556	354.4493	-.06048585	-1.737195	-1.695197	-1.670157
75	0.1738333	357.5096	-0.0607108	-1.732821	-1.687799	-1.661222
76	0.1761111	360.5277	-.06076027	-1.728447	-1.680442	-1.652375
77	0.1783889	363.5067	-.06080042	-1.724045	-1.673095	-1.64363
78	0.1806667	366.446	-.06099296	-1.719564	-1.665721	-1.634998
79	0.1829444	369.3457	-.06143477	-1.714932	-1.658285	-1.626486
80	0.1852222	372.2091	-0.0621311	-1.710057	-1.650758	-1.618094
81	0.1875	375.0446	-.06300769	-1.704843	-1.643124	-1.609812
82	0.1897778	377.8643	-0.0639508	-1.699188	-1.635377	-1.601621
83	0.1920556	380.6814	-.06485591	-1.692991	-1.627524	-1.593503
84	0.1943333	383.5087	-.06566591	-1.686169	-1.619579	-1.585444
85	0.1966111	386.3546	-.06638467	-1.678658	-1.611563	-1.57744
86	0.1988889	389.2226	-.06706382	-1.670429	-1.603491	-1.569495
87	0.2011667	392.1118	-.06777252	-1.661494	-1.595376	-1.56162
88	0.2034444	395.0181	-.06856413	-1.651911	-1.587224	-1.553824
89	0.2057222	397.9352	-.06945257	-1.641776	-1.579043	-1.546114
90	0.208	400.8573	-.07040758	-1.631213	-1.570838	-1.538488
91	0.2102778	403.7802	-.07136946	-1.620352	-1.562619	-1.530944
92	0.2125556	406.7014	-0.072275	-1.609308	-1.554394	-1.523473
93	0.2148333	409.6192	-.07308208	-1.598172	-1.54617	-1.516069
94	0.2171111	412.5309	-.07378313	-1.587003	-1.537956	-1.508727
95	0.2193889	415.4329	-.07440364	-1.575837	-1.529757	-1.501446
96	0.2216667	418.3203	-.07498824	-1.564693	-1.521578	-1.494226
97	0.2239444	421.1876	-.07558166	-1.553578	-1.513416	-1.48707
98	0.2262222	424.0304	-.07621275	-1.542486	-1.505271	-1.479981
99	0.2285	426.8456	-0.0768872	-1.531404	-1.497138	-1.472955
100	0.2307778	429.6323	-0.0775902	-1.520311	-1.489012	-1.465987
101	0.2330556	432.3896	-.07829489	-1.509184	-1.480881	-1.459065
102	0.2353333	435.117	-.07897297	-1.497998	-1.47273	-1.452173
103	0.2376111	437.8187	-.07960985	-1.48673	-1.464537	-1.445296
104	0.2398889	440.4983	-0.0802133	-1.475361	-1.456276	-1.438421
105	0.2421667	443.1556	-.08080515	-1.46388	-1.447912	-1.431537
106	0.2444444	445.789	-.08140754	-1.452282	-1.43941	-1.424638
107	0.2467222	448.3964	-.08203288	-1.440575	-1.430735	-1.417722
108	0.249	450.9756	-.08267921	-1.428775	-1.421856	-1.410784
109	0.2513611	453.5499	-.08335798	-1.416906	-1.412752	-1.403821
110	0.2537222	456.1228	-.08409595	-1.404996	-1.403411	-1.396829
111	0.2560833	458.6744	-.08488158	-1.393072	-1.393838	-1.389801
112	0.2584444	461.198	-.08566012	-1.381153	-1.38405	-1.38273
113	0.2608056	463.6944	-0.0863754	-1.369259	-1.374071	-1.37561
114	0.2631667	466.166	-.08699907	-1.357405	-1.36394	-1.368434
115	0.2655278	468.6143	-.08753959	-1.345606	-1.353698	-1.361198
116	0.2678889	471.0389	-.08803394	-1.333877	-1.343385	-1.353899
117	0.27025	473.4376	-.08852915	-1.322221	-1.333039	-1.346535
118	0.2726111	475.8075	-.08906212	-1.310642	-1.32269	-1.339103
119	0.2749722	478.1459	-.08964648	-1.299151	-1.31236	-1.331602
120	0.2773333	480.4513	-.09027057	-1.287753	-1.302055	-1.324026
121	0.2796944	482.7236	-.09090539	-1.276457	-1.29178	-1.316372
122	0.2820556	484.9644	-.09151914	-1.265267	-1.281535	-1.308628
123	0.2844167	487.1767	-.09209189	-1.254177	-1.271315	-1.300784
124	0.2867778	489.3634	-.09262338	-1.243187	-1.261112	-1.292823
125	0.2891389	491.5262	-.09313069	-1.232298	-1.250916	-1.284724
126	0.2915	493.6634	-.09363648	-1.221512	-1.240714	-1.276461
127	0.2938611	495.7744	-.09415818	-1.210828	-1.230496	-1.268002
128	0.2962222	497.8597	-.09470453	-1.200244	-1.220248	-1.259313
129	0.2985833	499.9193	-.09527346	-1.189757	-1.209961	-1.250354
130	0.3009444	501.9531	-.09585306	-1.179361	-1.199627	-1.241084
131	0.3033056	503.9617	-.09642696	-1.16905	-1.189244	-1.231467
132	0.3056667	505.9451	-.09698041	-1.158821	-1.178814	-1.221469
133	0.3080278	507.9033	-.09750489	-1.148675	-1.168341	-1.211065
134	0.3103889	509.8358	-.09799999	-1.138612	-1.157831	-1.200241
135	0.31275	511.7415	-.09847191	-1.128631	-1.147292	-1.189
136	0.3151111	513.6187	-.09892928	-1.118725	-1.136732	-1.177356
137	0.3174722	515.4645	-.09937801	-1.108891	-1.126159	-1.16534
138	0.3198333	517.2761	-0.0998181	-1.099127	-1.115583	-1.152996
139	0.3221944	519.0519	-0.1002446	-1.089428	-1.105012	-1.140376
140	0.3245556	520.7899	-0.1006505	-1.079789	-1.094454	-1.127539
141	0.3269167	522.4886	-0.1010292	-1.070207	-1.083913	-1.114544
142	0.3292778	524.1464	-0.1013768	-1.060675	-1.073396	-1.101444
143	0.3316389	525.7617	-0.1016929	-1.051188	-1.062904	-1.088286
144	0.334	527.3327	-0.1019804	-1.041743	-1.052442	-1.075101
145	0.3365556	528.8915	-0.1022785	-1.032337	-1.042009	-1.061911
146	0.3391111	530.4447	-0.1026574	-1.022969	-1.031604	-1.048726
147	0.3416667	531.9663	-0.1031329	-1.013635	-1.021223	-1.035552
148	0.3442222	533.4439	-0.1036446	-1.004331	-1.010858	-1.022389
149	0.3467778	534.8736	-0.1041024	-0.995048	-1.0005	-1.009235
150	0.3493333	536.256	-0.1044327	-0.9857767	-0.990138	-0.996085
151	0.3518889	537.5935	-0.10461	-0.9765086	-0.9797568	-0.9829332
152	0.3544444	538.8871	-0.104662	-0.9672359	-0.9693396	-0.9697737

153	0.357	540.1349	-0.1046523	-0.9579409	-0.9588679	-0.9566018
154	0.3595556	541.3326	-0.1046499	-0.9486119	-0.9483226	-0.9434155
155	0.3621111	542.4746	-0.1047003	-0.9392491	-0.9376854	-0.9302164
156	0.3646667	543.5558	-0.1048094	-0.9298518	-0.9269411	-0.9170094
157	0.3672222	544.5736	-0.1049472	-0.9204201	-0.9160777	-0.9038031
158	0.3697778	545.5279	-0.1050654	-0.9109544	-0.9050871	-0.8906082
159	0.3723333	546.4206	-0.10512	-0.9014544	-0.8939655	-0.877437
160	0.3748889	547.2541	-0.1050892	-0.8919203	-0.8827152	-0.8643025
161	0.3774444	548.0295	-0.1049787	-0.8823536	-0.8713469	-0.8512175
162	0.38	548.7459	-0.1048146	-0.8727569	-0.8598774	-0.8381943
163	0.3825556	549.4005	-0.1046287	-0.8631335	-0.8483269	-0.825244
164	0.3851111	549.9894	-0.1044435	-0.8534862	-0.8367171	-0.8123763
165	0.3876667	550.5087	-0.1042633	-0.843817	-0.8250696	-0.799599
166	0.3902222	550.9554	-0.1040744	-0.8341262	-0.8134054	-0.7869184
167	0.3927778	551.3281	-0.1038536	-0.8244123	-0.8017437	-0.7743398
168	0.3953333	551.6264	-0.1035793	-0.8146708	-0.7901006	-0.7618673
169	0.3978889	551.8508	-0.1032408	-0.8048941	-0.7784885	-0.7495048
170	0.4004444	552.0017	-0.1028421	-0.7950728	-0.766915	-0.7372553
171	0.403	552.0792	-0.1023988	-0.7851954	-0.7553837	-0.725121
172	0.4055556	552.0824	-0.1019307	-0.7752479	-0.7438941	-0.7131037
173	0.4081111	552.0101	-0.1014531	-0.7652144	-0.7324429	-0.7012047
174	0.4106667	551.8614	-0.1009714	-0.755076	-0.7210248	-0.689425
175	0.4132222	551.6363	-0.1004818	-0.7448116	-0.7096339	-0.6777649
176	0.4157778	551.3359	-.09997443	-0.7343982	-0.6982639	-0.6662239
177	0.4183333	550.9623	-.09944008	-0.7238126	-0.6869095	-0.6548005
178	0.4208889	550.518	-.09887474	-0.7130324	-0.6755671	-0.6434928
179	0.4234444	550.0054	-.09828135	-0.7020378	-0.6642355	-0.6322983
180	0.426	549.4262	-.09766791	-0.6908128	-0.6529156	-0.6212145
181	0.42875	548.8006	-.09706302	-0.679347	-0.6416103	-0.6102391
182	0.4315	548.1349	-.09651046	-0.6676362	-0.6303239	-0.5993697
183	0.43425	547.4169	-.09602086	-0.6556837	-0.6190619	-0.5886038
184	0.437	546.6404	-.09555707	-0.6434999	-0.6078304	-0.5779392
185	0.43975	545.8034	-.09506019	-0.6311028	-0.5966362	-0.5673746
186	0.4425	544.9068	-.09447866	-0.6185171	-0.5854864	-0.5569094
187	0.44525	543.9524	-.09378961	-0.6057731	-0.5743876	-0.546543
188	0.448	542.9409	-.09300467	-0.5929046	-0.5633457	-0.536274
189	0.45075	541.8705	-.09215995	-0.5799416	-0.5523651	-0.5261
190	0.4535	540.7362	-.09129575	-0.5669163	-0.5414485	-0.5160174
191	0.45625	539.5303	-.09043549	-0.5538639	-0.5305967	-0.5060224
192	0.459	538.2488	-.08957915	-0.5408141	-0.5198089	-0.4961113
193	0.46175	536.8908	-.08871125	-0.5277905	-0.5090823	-0.4862803
194	0.4645	535.4556	-.08781068	-0.5148108	-0.4984128	-0.4765254
195	0.46725	533.9441	-.08686025	-0.5018865	-0.487795	-0.4668421
196	0.47	532.3576	-.08585452	-0.4890251	-0.4772222	-0.4572252
197	0.47275	530.6973	-.08480161	-0.4762316	-0.4666885	-0.4476685
198	0.4755	528.9639	-.08371892	-0.4635106	-0.4561873	-0.4381653
199	0.47825	527.1575	-.08262525	-0.4508684	-0.4457109	-0.4287091
200	0.481	525.2777	-.08153337	-0.4383076	-0.4352507	-0.4192934
201	0.48375	523.3247	-.08044601	-0.4258271	-0.4247974	-0.4099127
202	0.4865	521.299	-.07935665	-0.4134275	-0.4143425	-0.4005627
203	0.48925	519.2022	-.07825415	-0.4011112	-0.4038787	-0.3912404
204	0.492	517.0358	-.07712811	-0.3888816	-0.3934013	-0.3819442
205	0.49475	514.8007	-.07597212	-0.3767437	-0.3829088	-0.3726736
206	0.4975	512.4981	-.07478566	-0.3647042	-0.3724016	-0.3634286
207	0.50025	510.1304	-.07357557	-0.352771	-0.3618819	-0.3542096
208	0.503	507.699	-.07235375	-0.3409524	-0.3513535	-0.3450174
209	0.50575	505.2043	-.07113096	-0.3292572	-0.3408229	-0.3358527
210	0.5085	502.6461	-.06991157	-0.3176939	-0.3302992	-0.3267165
211	0.51125	500.0242	-.06869208	-0.3062701	-0.3197929	-0.3176093
212	0.514	497.3391	-.06746358	-0.2949916	-0.3093156	-0.3085308
213	0.51675	494.5915	-.06621625	-0.2838624	-0.2988793	-0.2994797
214	0.5195	491.7824	-.06494386	-0.2728896	-0.2884964	-0.2904533
215	0.52225	488.909	-.06364208	-0.2620824	-0.2781779	-0.281447
216	0.525	485.9689	-.06230645	-0.2514445	-0.2679334	-0.2724543
217	0.5276111	482.9596	-.06093401	-0.2409751	-0.2577715	-0.2634671
218	0.5302222	479.8816	-.05952713	-0.2306742	-0.2476975	-0.2544758
219	0.5328333	476.7387	-0.058099	-0.220543	-0.237711	-0.2454693
220	0.5354444	473.532	-.05666914	-0.2105831	-0.2278107	-0.236436
221	0.5380556	470.2611	-.05525222	-0.2007954	-0.2179959	-0.227364
222	0.5406667	466.9255	-.05385185	-0.1911794	-0.208266	-0.2182414
223	0.5432778	463.5254	-0.0524607	-0.1817382	-0.1986214	-0.2090559
224	0.5458889	460.0617	-.05106532	-0.1724757	-0.1890603	-0.1997954
225	0.5485	456.5358	-.04965289	-0.1633897	-0.1795799	-0.1904484
226	0.5511111	452.9494	-.04821669	-0.1544743	-0.1701792	-0.1810044
227	0.5537222	449.3035	-.04675799	-0.145724	-0.160858	-0.1714556
228	0.5563333	445.5979	-.04528338	-0.1371346	-0.1516177	-0.1617977
229	0.5589444	441.8323	-.04380085	-0.1287025	-0.1424644	-0.1520299
230	0.5615556	437.9949	-.04230517	-0.1204263	-0.1334052	-0.1421556
231	0.5641667	434.0814	-.04077597	-0.1123086	-0.1244441	-0.1321816
232	0.5667778	430.0995	-.03920531	-0.1043494	-0.1155844	-0.1221182
233	0.5693889	426.053	-.03760851	-.09654348	-0.1068291	-0.1119791

234	0.572	421.9426	-.03601091	-.08888602	-0.0981816	-0.1017809
235	0.5746111	417.7663	-.03443263	-.08137157	-.08964467	-.09154317
236	0.5772222	413.5206	-.03287773	-.07399453	-.08122009	-.08128736
237	0.5798333	409.2022	-0.0313322	-.06675651	-0.0729094	-.07103607
238	0.5824444	404.807	-0.0297692	-.05967599	-.06471322	-.06081224
239	0.5850556	400.3221	-.02814942	-.05276195	-.05663195	-.05063815
240	0.5876667	395.7409	-.02643224	-.04599702	-.04866533	-.04053448
241	0.5902778	391.064	-.02460362	-.03936355	-.04081036	-.03051928
242	0.5928889	386.2864	-.02268112	-.03285356	-.03306062	-.02060713
243	0.5955	381.4295	-.02072748	-.02646236	-.02540966	-.01080883
244	0.5981111	376.4891	-0.018828	-.02018871	-.01785575	-.00113219
245	0.6007222	371.449	-.01702117	-.01403358	-.01039783	.008416498
246	0.6033333	366.3229	-.01530579	-.00799982	-.00303152	0.01783156
247	0.6059444	361.1289	-.01367941	-.00210225	.004249495	0.02710787
248	0.6085556	355.8827	-.01214305	.003644913	0.01145375	0.03624123
249	0.6111667	350.596	-.01069563	.009240938	0.01859088	0.04522837
250	0.6137778	345.2766	-.00932749	0.01468244	0.02566859	0.05406633

IHNC_1200_110_2_6.sim

```
Inner Harbor Navigation Channel Lock, New Orleans

! ********TWO FEET LIFT********

*CONSTANTS ==========================================================================
    io_units=English,  time_units=seconds
    time_step=1,   gravity=32.146, wf_time=0.55
    dQ_max=.001,   dh_max=.0001,   dx_max=.0001
    plot_field=11, plot_line=200,  plot_labels=row
    plot_file=IHNC_1200_110_2_6.plt

*COMPONENTS =========================================================================

!  The following was adopted from the model study.
! (Modeling 1:25-scale model, increase hydraulic roughness by setting Darcy-Weisbach
!   friction factor to 0.02 which is more appropriate for phy model with peak Re=1e5
!  Change prototype simulations to 'rough=.003')

! --------------- Left Wall -----------------------------

! Intake

HW     LIn     pipe_loss  us_area=1e6, area=273.75, K+=0.5
LIn    LB1u    imp_pipe  dia=16.47, area=273.75, len=22.73, rough=.003, wave=3500

! The first bend on left culvert is LB1

LB1u   LB1d    pipe_loss  area=273.75  K+=0.07
                ! Kb for 30 degree Bend - HDC Chart 228-1 Re=2.5x10^5
LB1d   LFVu    imp_pipe  dia=16.47, area=273.75, len=27.71, rough=.003, wave=3500
LFVu   LFW     storage surface_area=435.00  max_wsel=24.50

! Reverse Tainter Filling Valve

LFVu   LFVd    rev_tainter b=18.25, w=15, el_bottom=-22.0
                b/B_vs_t=OpenTainter_Hite
                Cc_vs_b/B=TainterCc
!                Kv+_vs_b/B=TainterKv
                Cdv+_vs_b/B=tainterCdv
LFVd   LB2u    imp_pipe  dia=16.47, area=273.75, len=27.71, rough=.003, wave=3500

! Second bend

LB2u   LB2d    pipe_loss  area=273.75  K+=0.07

! Straight reach of culvert US of manifold

LB2d   LP1u    imp_pipe  dia=16.47, area=273.75, len=77.67, rough=.003, wave=3500

! Sidewall Port Manifold

LP1u   LP1d  LP1b  diverging_tee area1=area3=273.75 area2=18.75 angle1=0 angle2=90
LP1b   Ch1     pipe_loss area=18.75 ds_area=1e5 K+=1.80 K-=0.25

LP1d   LP2u    imp_pipe dia=16.47, area=273.75, len=56, rough=.003, wave=3500

LP2u   LP2d  LP2b  diverging_tee area1=area3=273.75 area2=18.75 angle1=0 angle2=90
LP2b   Ch2     pipe_loss area=18.75 ds_area=1e5 K+=1.80 K-=0.25

LP2d   LP3u    imp_pipe dia=16.47, area=273.75, len=56, rough=.003, wave=3500

LP3u   LP3d  LP3b  diverging_tee area1=area3=273.75 area2=18.75 angle1=0 angle2=90
LP3b   Ch3     pipe_loss area=18.75 ds_area=1e5 K+=1.80 K-=0.25

LP3d   LP4u    imp_pipe dia=16.47, area=273.75, len=56, rough=.003, wave=3500

LP4u   LP4d  LP4b  diverging_tee area1=area3=273.75 area2=18.75 angle1=0 angle2=90
LP4b   Ch4     pipe_loss area=18.75 ds_area=1e5 K+=1.80 K-=0.25
```

```
LP4d   LP5u    imp_pipe dia=16.47, area=273.75, len=56, rough=.003, wave=3500

LP5u   LP5d  LP5b  diverging_tee area1=area3=273.75 area2=18.75 angle1=0 angle2=90
LP5b   Ch5     pipe_loss area=18.75 ds_area=1e5 K+=1.80 K-=0.25

LP5d   LP6u    imp_pipe dia=16.47, area=273.75, len=56, rough=.003, wave=3500

LP6u   LP6d  LP6b  diverging_tee area1=area3=273.75 area2=18.75 angle1=0 angle2=90
LP6b   Ch6     pipe_loss area=18.75 ds_area=1e5 K+=1.80 K-=0.25

LP6d   LP7u    imp_pipe dia=16.47, area=273.75, len=56, rough=.003, wave=3500

LP7u   LP7d  LP7b  diverging_tee area1=area3=273.75 area2=18.75 angle1=0 angle2=90
LP7b   Ch7     pipe_loss area=18.75 ds_area=1e5 K+=1.80 K-=0.25

LP7d   LP8u    imp_pipe dia=16.47, area=273.75, len=56, rough=.003, wave=3500

LP8u   LP8d  LP8b  diverging_tee area1=area3=273.75 area2=18.75 angle1=0 angle2=90
LP8b   Ch8     pipe_loss area=18.75 ds_area=1e5 K+=1.80 K-=0.25

LP8d   LP9u    imp_pipe dia=16.47, area=273.75, len=56, rough=.003, wave=3500

LP9u   LP9d  LP9b  diverging_tee area1=area3=273.75 area2=18.75 angle1=0 angle2=90
LP9b   Ch9     pipe_loss area=18.75 ds_area=1e5 K+=1.80 K-=0.25

LP9d   LP10u   imp_pipe dia=16.47, area=273.75, len=56, rough=.003, wave=3500

LP10u  LP10d  LP10b  diverging_tee area1=area3=273.75 area2=18.75 angle1=0 angle2=90
LP10b  Ch10    pipe_loss area=18.75 ds_area=1e5 K+=1.80 K-=0.25

LP10d  LP11u  imp_pipe dia=16.47, area=273.75, len=56, rough=.003, wave=3500

LP11u  LP11d  LP11b  diverging_tee area1=area3=273.75 area2=18.75 angle1=0 angle2=90
LP11b  Ch11    pipe_loss area=18.75 ds_area=1e5 K+=1.80 K-=0.25

LP11d  LP12u  imp_pipe dia=16.47, area=273.75, len=56, rough=.003, wave=3500

LP12u  LP12d  LP12b  diverging_tee area1=area3=273.75 area2=18.75 angle1=0 angle2=90
LP12b  Ch12    pipe_loss area=18.75 ds_area=1e5 K+=1.80 K-=0.25

LP12d  LP13u  imp_pipe dia=16.47, area=273.75, len=56, rough=.003, wave=3500

LP13u  LP13d  LP13b  diverging_tee area1=area3=273.75 area2=18.75 angle1=0 angle2=90
LP13b  Ch13    pipe_loss area=18.75 ds_area=1e5 K+=1.80 K-=0.25

LP13d  LP14u  imp_pipe dia=16.47, area=273.75, len=56, rough=.003, wave=3500

LP14u  LP14d  LP14b  diverging_tee area1=area3=273.75 area2=18.75 angle1=0 angle2=90
LP14b  Ch14    pipe_loss area=18.75 ds_area=1e5 K+=1.80 K-=0.25

LP14d  LB3u   imp_pipe dia=16.47, area=273.75, len=77.67, rough=.003, wave=3500

! Culvert downstream of manifold ports

LB3u   LB3d    pipe_loss  area=273.75  K+=0.07
LB3d   LEVu    imp_pipe  dia=16.47, area=273.75, len=27.71, rough=.003, wave=3500
LEVu   LEW     storage surface_area=435.00  max_wsel=24.50
!LEVu   LEVd    rev_tainter b=18.25  w=15  el_bottom=-22.0
!               b/B_vs_t=OpenTainter_Hite
!               Cc_vs_b/B=TainterCc  Kv+_vs_b/B=TainterKv
!               fixed_b/B=0

! --------------- Right Wall -----------------------------

! Intake

HW     RIn     pipe_loss  us_area=1e6  area=273.75  K+=0.5
RIn    RB1u    imp_pipe  dia=16.47  area=273.75  len=22.73  rough=.003  wave=3500

! The first bend on right culvert is RB1
```

```
RB1u   RB1d    pipe_loss  area=273.75  K+=0.07
                ! Kb for 30 degree Bend - HDC Chart 228-1 Re=2.5x10^5
RB1d   RFVu    imp_pipe  dia=16.47, area=273.75, len=27.71, rough=.003, wave=3500
RFVu   RFW     storage surface_area=435.00  max_wsel=24.50

! Reverse Tainter Filling Valve

RFVu   RFVd    rev_tainter b=18.25  w=15  el_bottom=-22.0
                b/B_vs_t=OpenTainter_Hite
                Cc_vs_b/B=TainterCc
!                Kv+_vs_b/B=TainterKv
                Cdv+_vs_b/B=tainterCdv
RFVd   RB2u    imp_pipe  dia=16.47  area=273.75  len=27.71  rough=.003  wave=3500

! Second bend

RB2u   RB2d    pipe_loss  area=273.75  K+=0.07

! Straight reach of culvert US of manifold

RB2d   RP1u    imp_pipe  dia=16.47  area=273.75  len=77.67  rough=.003  wave=3500

! Sidewall Port Manifold

RP1u   RP1d  RP1b  diverging_tee area1=area3=273.75 area2=18.75 angle1=0 angle2=90
RP1b   Ch1     pipe_loss area=18.75 ds_area=1e5 K+=1.80 K-=0.25

RP1d   RP2u    imp_pipe dia=16.47, area=273.75, len=56, rough=.003, wave=3500

RP2u   RP2d  RP2b  diverging_tee area1=area3=273.75 area2=18.75 angle1=0 angle2=90
RP2b   Ch2     pipe_loss area=18.75 ds_area=1e5 K+=1.80 K-=0.25

RP2d   RP3u    imp_pipe dia=16.47, area=273.75, len=56, rough=.003, wave=3500

RP3u   RP3d  RP3b  diverging_tee area1=area3=273.75 area2=18.75 angle1=0 angle2=90
RP3b   Ch3     pipe_loss area=18.75 ds_area=1e5 K+=1.80 K-=0.25

RP3d   RP4u    imp_pipe dia=16.47, area=273.75, len=56, rough=.003, wave=3500

RP4u   RP4d  RP4b  diverging_tee area1=area3=273.75 area2=18.75 angle1=0 angle2=90
RP4b   Ch4     pipe_loss area=18.75 ds_area=1e5 K+=1.80 K-=0.25

RP4d   RP5u    imp_pipe dia=16.47, area=273.75, len=56, rough=.003, wave=3500

RP5u   RP5d  RP5b  diverging_tee area1=area3=273.75 area2=18.75 angle1=0 angle2=90
RP5b   Ch5     pipe_loss area=18.75 ds_area=1e5 K+=1.80 K-=0.25

RP5d   RP6u    imp_pipe dia=16.47, area=273.75, len=56, rough=.003, wave=3500

RP6u   RP6d  RP6b  diverging_tee area1=area3=273.75 area2=18.75 angle1=0 angle2=90
RP6b   Ch6     pipe_loss area=18.75 ds_area=1e5 K+=1.80 K-=0.25

RP6d   RP7u    imp_pipe dia=16.47, area=273.75, len=56, rough=.003, wave=3500

RP7u   RP7d  RP7b  diverging_tee area1=area3=273.75 area2=18.75 angle1=0 angle2=90
RP7b   Ch7     pipe_loss area=18.75 ds_area=1e5 K+=1.80 K-=0.25

RP7d   RP8u    imp_pipe dia=16.47, area=273.75, len=56, rough=.003, wave=3500

RP8u   RP8d  RP8b  diverging_tee area1=area3=273.75 area2=18.75 angle1=0 angle2=90
RP8b   Ch8     pipe_loss area=18.75 ds_area=1e5 K+=1.80 K-=0.25

RP8d   RP9u    imp_pipe dia=16.47, area=273.75, len=56, rough=.003, wave=3500

RP9u   RP9d  RP9b  diverging_tee area1=area3=273.75 area2=18.75 angle1=0 angle2=90
RP9b   Ch9     pipe_loss area=18.75 ds_area=1e5 K+=1.80 K-=0.25

RP9d   RP10u   imp_pipe dia=16.47, area=273.75, len=56, rough=.003, wave=3500

RP10u  RP10d  RP10b  diverging_tee area1=area3=273.75 area2=18.75 angle1=0 angle2=90
RP10b  Ch10    pipe_loss area=18.75 ds_area=1e5 K+=1.80 K-=0.25
```

```
RP10d  RP11u  imp_pipe dia=16.47, area=273.75, len=56, rough=.003, wave=3500

RP11u  RP11d  RP11b  diverging_tee area1=area3=273.75 area2=18.75 angle1=0 angle2=90
RP11b  Ch11    pipe_loss area=18.75 ds_area=1e5 K+=1.80 K-=0.25

RP11d  RP12u  imp_pipe dia=16.47, area=273.75, len=56, rough=.003, wave=3500

RP12u  RP12d  RP12b  diverging_tee area1=area3=273.75 area2=18.75 angle1=0 angle2=90
RP12b  Ch12    pipe_loss area=18.75 ds_area=1e5 K+=1.80 K-=0.25

RP12d  RP13u  imp_pipe dia=16.47, area=273.75, len=56, rough=.003, wave=3500

RP13u  RP13d  RP13b  diverging_tee area1=area3=273.75 area2=18.75 angle1=0 angle2=90
RP13b  Ch13    pipe_loss area=18.75 ds_area=1e5 K+=1.80 K-=0.25

RP13d  RP14u  imp_pipe dia=16.47, area=273.75, len=56, rough=.003, wave=3500

RP14u  RP14d  RP14b  diverging_tee area1=area3=273.75 area2=18.75 angle1=0 angle2=90
RP14b  Ch14    pipe_loss area=18.75 ds_area=1e5 K+=1.80 K-=0.25

RP14d  RB3u   imp_pipe dia=16.47, area=273.75, len=77.67, rough=.003, wave=3500

! Culvert downstream of manifold ports
RB3u   RB3d    pipe_loss  area=273.75  K+=0.07
RB3d   REVu    imp_pipe  dia=16.47  area=273.75  len=27.71  rough=.003  wave=3500
!len=??
REVu   REW     storage  surface_area=435  max_wsel=24.50
!REVu   REVd    rev_tainter b=18.25  w=15  el_bottom=-40
!               b/B_vs_t=OpenTainter_Hite
!               Cc_vs_b/B=TainterCc  Kv+_vs_b/B=TainterKv
!               fixed_b/B=0

!------------ Lock chamber modeled as series of open channels ---------

! length is from pintle to halfway between the first ports (right and left)

Upin  ChU   open_channel  cross_section=chamber  len=114.835  reaches=4  iq=0
ChU   Ch1   open_channel  cross_section=chamber  len=114.835  reaches=4  iq=0
Ch1   Ch2   open_channel  cross_section=chamber  len=58.65    reaches=2  iq=0
Ch2   Ch3   open_channel  cross_section=chamber  len=58.64    reaches=2  iq=0
Ch3   Ch4   open_channel  cross_section=chamber  len=58.64    reaches=2  iq=0
Ch4   Ch5   open_channel  cross_section=chamber  len=58.64    reaches=2  iq=0
Ch5   Ch6   open_channel  cross_section=chamber  len=58.64    reaches=2  iq=0
Ch6   Ch7   open_channel  cross_section=chamber  len=58.64    reaches=2  iq=0
Ch7   Ch8   open_channel  cross_section=chamber  len=58.64    reaches=2  iq=0
Ch8   Ch9   open_channel  cross_section=chamber  len=58.64    reaches=2  iq=0
Ch9   Ch10  open_channel  cross_section=chamber  len=58.64    reaches=2  iq=0
Ch10  Ch11  open_channel  cross_section=chamber  len=58.64    reaches=2  iq=0
Ch11  Ch12  open_channel  cross_section=chamber  len=58.64    reaches=2  iq=0
Ch12  Ch13  open_channel  cross_section=chamber  len=58.64    reaches=2  iq=0
Ch13  Ch14  open_channel  cross_section=chamber  len=58.65    reaches=2  iq=0
Ch14  ChD   open_channel  cross_section=chamber  len=147.83   reaches=7  iq=0
ChD   Lpin  open_channel  cross_section=chamber  len=147.83   reaches=7  iq=0

*NODES ==========================================================================
! lin is -40+18.25/2 =30.875 model study
! PLAN=>> -22.0+18.25/2=-12.875 top of culvert
! PLAN=>> -22.0+3.75/2=-20.125 top of side port culverts
HW        elev=-12.875     head=0  idemand=0
! ---Left Culvert---
LIn       elev=-12.875    ihead=0
LB1u      elev=-12.875    ihead=0
LB1d      elev=-12.875    ihead=0
LFVu      elev=-12.875    ihead=0
LFW       elev=-12.875    ihead=0   demand=0
! wsel will change once you cross the valve
LFVd      elev=-12.875    ihead=-2
LB2u      elev=-12.875    ihead=-2
LB2d      elev=-12.875    ihead=-2
LP1u      elev=-12.875    ihead=-2
```

```
LP1d      elev=-12.875    ihead=-2
! at port
LP1b      elev=-20.125    ihead=-2
LP2u      elev=-12.875    ihead=-2
LP2d      elev=-12.875    ihead=-2
! at port
LP2b      elev=-20.125    ihead=-2
LP3u      elev=-12.875    ihead=-2
LP3d      elev=-12.875    ihead=-2
! at port
LP3b      elev=-20.125    ihead=-2
LP4u      elev=-12.875    ihead=-2
LP4d      elev=-12.875    ihead=-2
! at port
LP4b      elev=-20.125    ihead=-2
LP5u      elev=-12.875    ihead=-2
LP5d      elev=-12.875    ihead=-2
! at port
LP5b      elev=-20.125    ihead=-2
LP6u      elev=-12.875    ihead=-2
LP6d      elev=-12.875    ihead=-2
! at port
LP6b      elev=-20.125    ihead=-2
LP7u      elev=-12.875    ihead=-2
LP7d      elev=-12.875    ihead=-2
! at port
LP7b      elev=-20.125    ihead=-2
LP8u      elev=-12.875    ihead=-2
LP8d      elev=-12.875    ihead=-2
! at port
LP8b      elev=-20.125    ihead=-2
LP9u      elev=-12.875    ihead=-2
LP9d      elev=-12.875    ihead=-2
! at port
LP9b      elev=-20.125    ihead=-2
LP10u     elev=-12.875    ihead=-2
LP10d     elev=-12.875    ihead=-2
! at port
LP10b     elev=-20.125    ihead=-2
LP11u     elev=-12.875    ihead=-2
LP11d     elev=-12.875    ihead=-2
! at port
LP11b     elev=-20.125    ihead=-2
LP12u     elev=-12.875    ihead=-2
LP12d     elev=-12.875    ihead=-2
! at port
LP12b     elev=-20.125    ihead=-2
LP13u     elev=-12.875    ihead=-2
LP13d     elev=-12.875    ihead=-2
! at port
LP13b     elev=-20.125    ihead=-2
LP14u     elev=-12.875    ihead=-2
LP14d     elev=-12.875    ihead=-2
! at port
LP14b     elev=-20.125    ihead=-2
LB3u      elev=-12.875    ihead=-2
LB3d      elev=-12.875    ihead=-2
LEVu      elev=-12.875    ihead=-2
LEW       elev=-12.875    ihead=-2    demand=0
! ---Right Culvert---
RIn       elev=-12.875    ihead=0
RB1u      elev=-12.875    ihead=0
RB1d      elev=-12.875    ihead=0
RFVu      elev=-12.875    ihead=0
RFW       elev=-12.875    ihead=0     demand=0
! wsel will change once you cross the valve
RFVd      elev=-12.875    ihead=-2
RB2u      elev=-12.875    ihead=-2
RB2d      elev=-12.875    ihead=-2
RP1u      elev=-12.875    ihead=-2
RP1d      elev=-12.875    ihead=-2
```

```
! at port
RP1b      elev=-20.125    ihead=-2
RP2u      elev=-12.875    ihead=-2
RP2d      elev=-12.875    ihead=-2
! at port
RP2b      elev=-20.125    ihead=-2
RP3u      elev=-12.875    ihead=-2
RP3d      elev=-12.875    ihead=-2
! at port
RP3b      elev=-20.125    ihead=-2
RP4u      elev=-12.875    ihead=-2
RP4d      elev=-12.875    ihead=-2
! at port
RP4b      elev=-20.125    ihead=-2
RP5u      elev=-12.875    ihead=-2
RP5d      elev=-12.875    ihead=-2
! at port
RP5b      elev=-20.125    ihead=-2
RP6u      elev=-12.875    ihead=-2
RP6d      elev=-12.875    ihead=-2
! at port
RP6b      elev=-20.125    ihead=-2
RP7u      elev=-12.875    ihead=-2
RP7d      elev=-12.875    ihead=-2
! at port
RP7b      elev=-20.125    ihead=-2
RP8u      elev=-12.875    ihead=-2
RP8d      elev=-12.875    ihead=-2
! at port
RP8b      elev=-20.125    ihead=-2
RP9u      elev=-12.875    ihead=-2
RP9d      elev=-12.875    ihead=-2
! at port
RP9b      elev=-20.125    ihead=-2
RP10u     elev=-12.875    ihead=-2
RP10d     elev=-12.875    ihead=-2
! at port
RP10b     elev=-20.125    ihead=-2
RP11u     elev=-12.875    ihead=-2
RP11d     elev=-12.875    ihead=-2
! at port
RP11b     elev=-20.125    ihead=-2
RP12u     elev=-12.875    ihead=-2
RP12d     elev=-12.875    ihead=-2
! at port
RP12b     elev=-20.125    ihead=-2
RP13u     elev=-12.875    ihead=-2
RP13d     elev=-12.875    ihead=-2
! at port
RP13b     elev=-20.125    ihead=-2
RP14u     elev=-12.875    ihead=-2
RP14d     elev=-12.875    ihead=-2
! at port
RP14b     elev=-20.125    ihead=-2
RB3u      elev=-12.875    ihead=-2
RB3d      elev=-12.875    ihead=-2
REVu      elev=-12.875    ihead=-2
REW       elev=-12.875    ihead=-2    demand=0
! ---Lock Chamber---
Upin      elev=-22.00       ihead=-2    demand=0
ChU       elev=-22.00       ihead=-2
Ch1       elev=-22.00       ihead=-2
Ch2       elev=-22.00       ihead=-2
Ch3       elev=-22.00       ihead=-2
Ch4       elev=-22.00       ihead=-2
Ch5       elev=-22.00       ihead=-2
Ch6       elev=-22.00       ihead=-2
Ch7       elev=-22.00       ihead=-2
Ch8       elev=-22.00       ihead=-2
Ch9       elev=-22.00       ihead=-2
Ch10      elev=-22.00       ihead=-2
```

```
Ch11      elev=-22.00       ihead=-2
Ch12      elev=-22.00       ihead=-2
Ch13      elev=-22.00       ihead=-2
Ch14      elev=-22.00       ihead=-2
ChD       elev=-22.00       ihead=-2
Lpin      elev=-22.00       ihead=-2    demand=0

*FUNCTIONS ========================================================================

! open tainter designated at top for b/B vs. time (xscale (valve time)) in
! seconds, b = valve opening, B = culvert height so, b/B is fraction opened.
! OpenTainter comes from Plate 33 of ERDC/CHL TR-03-3 Hite 2003
OpenTainter_Hite     discrete   interpolation=linear  xscale=360  xshift=0
   xy_pairs={ 0.00   0.000
              0.10   0.084
              0.20   0.167
              0.30   0.249
              0.40   0.334
              0.50   0.426
              0.60   0.525
              0.70   0.619
              0.80   0.732
              0.90   0.855
              1.00   1.000 }

! Kv vs b/B Relationship - Based on Nielson's WES Misc Paper H-76-13
! Equations D2 and D3
TainterKv  discrete interpolation=linear extrapolation=linear
   xy_pairs={   0.0010  1385376.875
                0.0020   346667.594
                0.0030   154218.391
                0.0040    86828.391
                0.0050    55621.793
                0.0060    38662.070
                0.0070    28431.086
                0.0080    21787.870
                0.0090    17230.836
                0.0100    13969.831
                0.0150     6237.299
                0.0200     3524.422
                0.0250     2265.772
                0.0300     1580.499
                0.0500      578.828
                0.0600      405.284
                0.0800      231.556
                0.1000      150.331
                0.1500       68.776
                0.2000       39.349
                0.2500       25.239
                0.3000       17.236
                0.3500       12.244
                0.4000        8.848
                0.4500        6.422
                0.5000        4.661
                0.5500        3.338
                0.6000        2.344
                0.7000        1.049
                0.8000        0.372
                0.9000        0.074
                1.0000        0.010  }

tainterCdv  discrete  interpolation=spline
  x_values={0,   0.05, 0.1, 0.15, 0.2, 0.25, 0.3, 0.35,
            0.4, 0.45, 0.5, 0.55, 0.6, 0.65, 0.7, 0.75,
            0.8, 0.85, 0.9, 0.95,   1}
  y_values={0, 0.0443, 0.0836, 0.1195, 0.1534, 0.196, 0.243, 0.295,
            0.349, 0.415, 0.494, 0.587, 0.69, 0.8165, 0.976, 1.155,
            1.387,  1.69,  2.02, 2.582, 3.162}

! Cc vs b/B Relationship - Gerald Schohl's polynomial which reproduces Fig
! D2 in WES Misc Paper H-76-13
```

```
! Cc=.85-1.12X+1.69X^2-.85X^3+.43X^4;  Where X=b/B
  TainterCc  polynomial coefficients={.85, -1.12, 1.69, -.85, .43}

*CROSS_SECTIONS ================================================================

   chamber TRAPEZOIDAL  MN_n=.02  bed_w=110 ! Lock Chamber

*PLOT VARIABLES ================================================================

LFVu   LFVd    valve_position
LFVu   LFVd    discharge
LFW    head

Upin   head
Ch8    head
Lpin   head

*END ============================================================================
```

IHNC_1200_110_2_6.plt

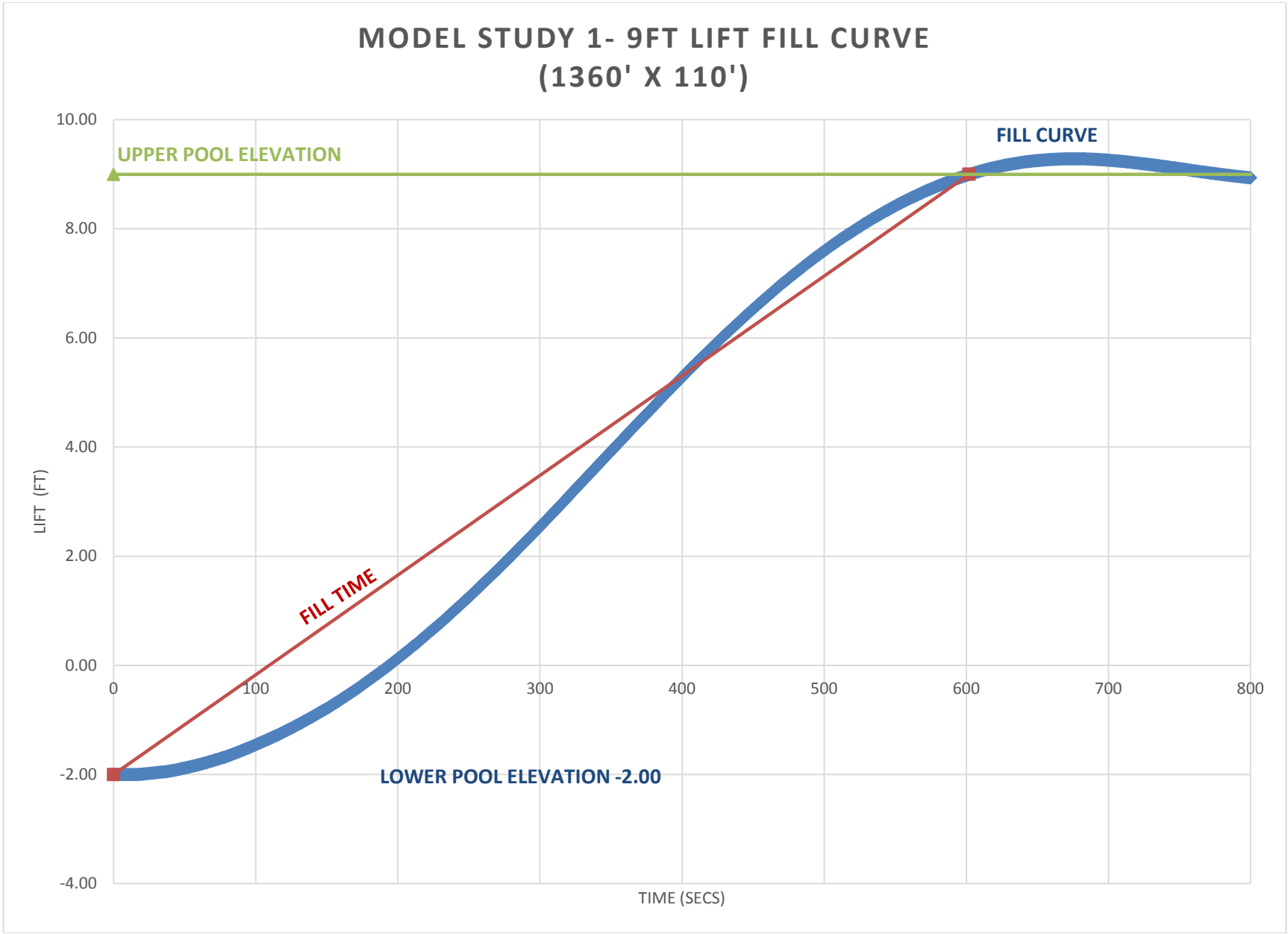
sec Time	(-) "LFVu LFVd Valve Position sectno=0"	(cfs) "LFVu LFVd discharge sectno=0"	(f) "LFW head"	(f) "Upin head"	(f) "Ch8 head"	(f) "Lpin head"
0	0	0	0	-2	-2	-2
1	.002333333	6.334887	-.00655803	-2	-2	-2
2	.004666667	12.93292	-0.0240176	-2	-2	-2
3	0.007	18.86912	-.04546591	-2	-2	-2
4	.009333333	25.28258	-.06290704	-2	-2	-2
5	0.01166667	31.21696	-.07015023	-2	-2	-2
6	0.014	37.53518	-.06473637	-2	-2	-2
7	0.01633333	43.74982	-.04923818	-1.999987	-2	-2
8	0.01866667	50.13635	-.02960974	-2.000215	-1.999999	-2
9	0.021	56.47452	-0.0132261	-1.998635	-1.999996	-2
10	0.02333333	62.71412	-.00584478	-1.995741	-1.999985	-2
11	0.02566667	68.76375	-.00969717	-1.992868	-1.999932	-2
12	0.028	74.57985	-.02277584	-1.990026	-1.999785	-2
13	0.03033333	80.22594	-.03982252	-1.987222	-1.999318	-2
14	0.03266667	85.78635	-.05443897	-1.984293	-1.998376	-2
15	0.035	91.40281	-0.0615088	-1.981341	-1.996471	-2
16	0.03733333	97.15939	-.05901518	-1.978286	-1.993646	-2
17	0.03966667	103.0859	-.04857306	-1.975146	-1.990436	-2
18	0.042	109.1134	-.03458726	-1.972011	-1.987143	-2
19	0.04433333	115.1324	-.02243726	-1.968958	-1.983925	-2
20	0.04666667	121.0002	-.01643006	-1.965938	-1.980823	-2
21	0.049	126.621	-.01829217	-1.962898	-1.977837	-2
22	0.05133333	131.9662	-.02674195	-1.959862	-1.974934	-2
23	0.05366667	137.0942	-.03820049	-1.956872	-1.972119	-2
24	0.056	142.1132	-.04829176	-1.953883	-1.96941	-2
25	0.05833333	147.1595	-.05352504	-1.950822	-1.9668	-2
26	0.06066667	152.3355	-.05252092	-1.947697	-1.96425	-2
27	0.063	157.6712	-0.0463326	-1.944571	-1.961729	-2
28	0.06533333	163.1149	-.03782853	-1.941486	-1.959228	-2
29	0.06766667	168.5611	-.03045802	-1.938441	-1.956723	-1.999999
30	0.07	173.8892	-.02691736	-1.93545	-1.954222	-1.999996
31	0.07233333	179.0161	-.02822716	-1.93254	-1.951706	-1.999986
32	0.07466667	183.9228	-.03352711	-1.929706	-1.949088	-1.999958
33	0.077	188.6549	-.04058348	-1.926893	-1.946305	-1.999885
34	0.07933333	193.3024	-.04675296	-1.924054	-1.943364	-1.999705
35	0.08166667	197.967	-.05000683	-1.921188	-1.94031	-1.999304
36	0.084	202.7244	-.04962482	-1.918306	-1.937193	-1.998489
37	0.08630556	207.5762	-.04630417	-1.91541	-1.93405	-1.996995
38	0.08861111	212.4901	-0.041745	-1.912513	-1.930889	-1.994534
39	0.09091667	217.4079	-.03793888	-1.909656	-1.927699	-1.990899
40	0.09322222	222.2486	-.03639138	-1.906872	-1.924466	-1.986087
41	0.09552778	226.9567	-.03760189	-1.904156	-1.921206	-1.980355
42	0.09783333	231.518	-.04099137	-1.901479	-1.917946	-1.974125
43	0.1001389	235.9633	-.04524111	-1.898812	-1.914704	-1.967768
44	0.1024444	240.3532	-.04887243	-1.896139	-1.911478	-1.961473
45	0.10475	244.7528	-0.0508201	-1.89346	-1.908259	-1.955287
46	0.1070556	249.2088	-.05078498	-1.890773	-1.905033	-1.949204
47	0.1093611	253.7334	-.04925619	-1.888077	-1.90179	-1.943221
48	0.1116667	258.3019	-.04723005	-1.885394	-1.89852	-1.937349
49	0.1139722	262.8662	-.04576915	-1.882742	-1.895222	-1.931594
50	0.1162778	267.3745	-.04558963	-1.880123	-1.891909	-1.925941
51	0.1185833	271.7918	-.04683152	-1.87754	-1.888606	-1.920364
52	0.1208889	276.1105	-.04907771	-1.87499	-1.885345	-1.914828
53	0.1231944	280.3501	-.05158319	-1.87246	-1.882152	-1.909297
54	0.1255	284.5461	-0.0536006	-1.869931	-1.879043	-1.903723
55	0.1278056	288.7301	-.05466106	-1.86739	-1.876015	-1.89805
56	0.1301111	292.9266	-.05471902	-1.864832	-1.873044	-1.892213
57	0.1324167	297.1413	-.05412361	-1.862265	-1.870083	-1.886153
58	0.1347222	301.3562	-.05343222	-1.859704	-1.867069	-1.879845
59	0.1370278	305.5422	-.05316531	-1.857156	-1.863929	-1.873308
60	0.1393333	309.6714	-.05361092	-1.85462	-1.860585	-1.866602
61	0.1416389	313.7261	-.05474316	-1.852092	-1.856968	-1.859788
62	0.1439444	317.7047	-.05627254	-1.849563	-1.853015	-1.852916
63	0.14625	321.6213	-.05779393	-1.847024	-1.848691	-1.84601
64	0.1485556	325.4966	-.05896019	-1.844467	-1.84399	-1.839086
65	0.1508611	329.3484	-.05960768	-1.841882	-1.838947	-1.832157
66	0.1531667	333.1849	-.05979336	-1.839264	-1.833633	-1.825237
67	0.1554722	337.0036	-.05974325	-1.836614	-1.828138	-1.818346
68	0.1577778	340.7912	-.05974097	-1.833927	-1.822551	-1.811503
69	0.1600833	344.5323	-.06000996	-1.831196	-1.816937	-1.804722
70	0.1623889	348.2152	-.06063766	-1.828413	-1.811339	-1.79801

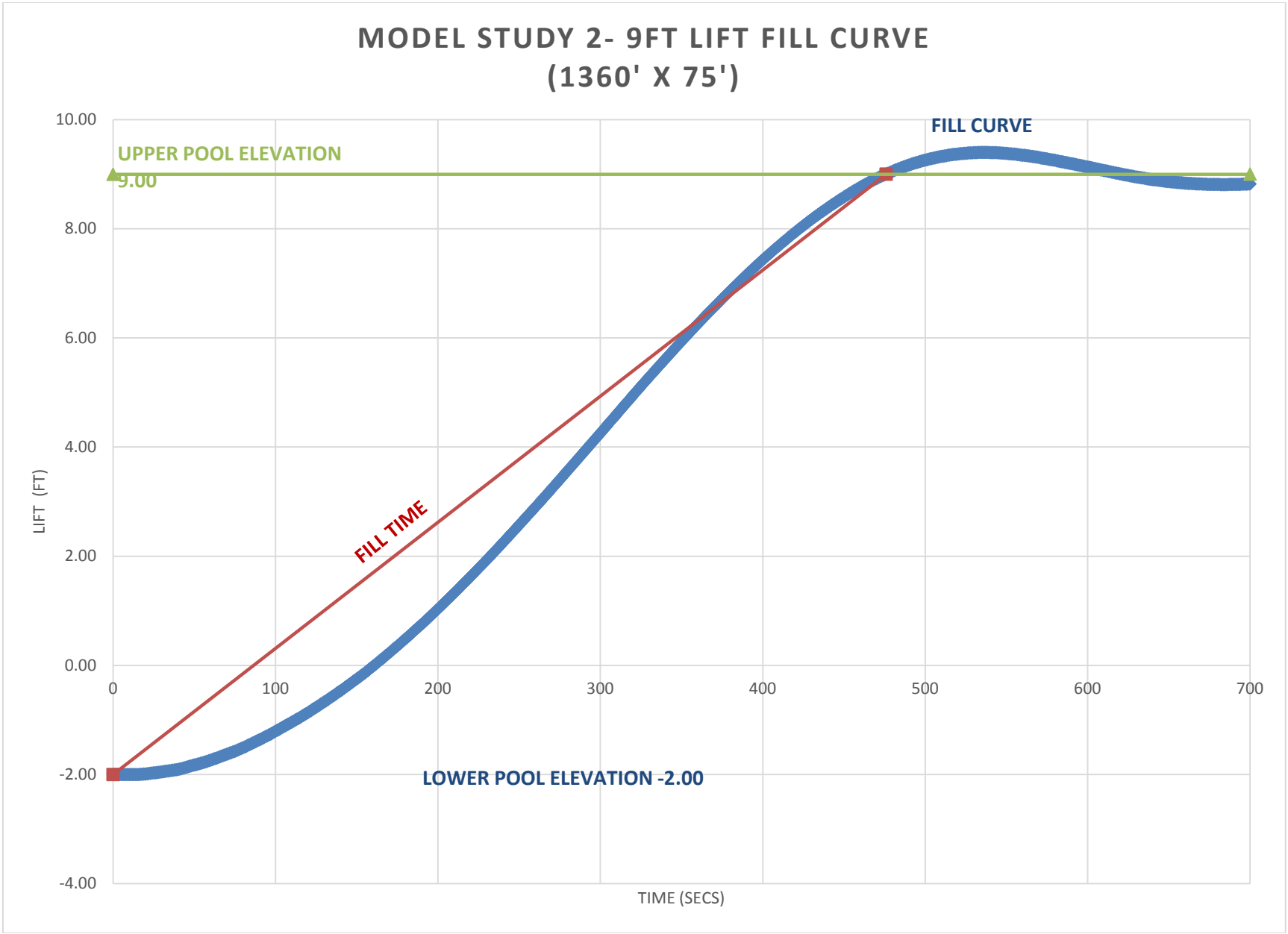
71	0.1646944	351.8336	-.06155999	-1.825576	-1.805779	-1.791363
72	0.167	355.3901	-.06260608	-1.822689	-1.800269	-1.784772
73	0.1692778	358.8823	-.06356828	-1.819758	-1.794819	-1.778226
74	0.1715556	362.3211	-.06428638	-1.816797	-1.789436	-1.771716
75	0.1738333	365.7251	-.06472398	-1.813822	-1.784117	-1.76524
76	0.1761111	369.102	-.06497246	-1.810852	-1.778849	-1.758808
77	0.1783889	372.4525	-.06519376	-1.807897	-1.773612	-1.752431
78	0.1806667	375.7734	-.06554811	-1.804951	-1.768381	-1.746127
79	0.1829444	379.0619	-.06613375	-1.801988	-1.763128	-1.739906
80	0.1852222	382.3195	-.06695995	-1.798973	-1.757828	-1.733773
81	0.1875	385.553	-.06795842	-1.795854	-1.752458	-1.727727
82	0.1897778	388.7737	-.06902271	-1.792565	-1.747005	-1.721756
83	0.1920556	391.9959	-.07005657	-1.789025	-1.741465	-1.715844
84	0.1943333	395.233	-.07101056	-1.785148	-1.735841	-1.709978
85	0.1966111	398.4947	-.07189373	-1.780846	-1.730146	-1.704147
86	0.1988889	401.7862	-.07275938	-1.776039	-1.724393	-1.69835
87	0.2011667	405.1082	-.07367514	-1.770664	-1.718594	-1.692594
88	0.2034444	408.4586	-.07469087	-1.764692	-1.712759	-1.686889
89	0.2057222	411.8329	-.07581679	-1.758135	-1.706894	-1.681244
90	0.208	415.2273	-.07702017	-1.751056	-1.701006	-1.675665
91	0.2102778	418.6391	-.07824075	-1.743555	-1.695102	-1.67015
92	0.2125556	422.0668	-.07941622	-1.735749	-1.68919	-1.664693
93	0.2148333	425.5092	-.08050557	-1.727751	-1.683274	-1.659285
94	0.2171111	428.9638	-.08150113	-1.719653	-1.677363	-1.653921
95	0.2193889	432.4264	-.08242608	-1.711519	-1.671458	-1.648596
96	0.2216667	435.8911	-.08332043	-1.703391	-1.665559	-1.643311
97	0.2239444	439.3513	-.08422289	-1.695292	-1.659663	-1.638071
98	0.2262222	442.8009	-0.0851563	-1.687228	-1.65377	-1.632879
99	0.2285	446.2355	-.08612238	-1.679195	-1.647878	-1.627739
100	0.2307778	449.6532	-.08710611	-1.671181	-1.641991	-1.622651
101	0.2330556	453.0522	-.08808449	-1.663168	-1.636109	-1.617609
102	0.2353333	456.4314	-.08903564	-1.655135	-1.630233	-1.612605
103	0.2376111	459.7938	-.08995122	-1.647057	-1.624359	-1.607627
104	0.2398889	463.1422	-.09084287	-1.638909	-1.618479	-1.602667
105	0.2421667	466.4761	-.09173329	-1.630669	-1.612577	-1.597715
106	0.2444444	469.794	-.09264305	-1.622318	-1.606632	-1.592766
107	0.2467222	473.0938	-.09358163	-1.613848	-1.600612	-1.587818
108	0.249	476.3735	-.09454433	-1.605257	-1.594487	-1.582867
109	0.2513611	479.6592	-.09554373	-1.596558	-1.588222	-1.577913
110	0.2537222	482.9548	-.09661144	-1.587772	-1.581785	-1.572951
111	0.2560833	486.2395	-.09773888	-1.57892	-1.57515	-1.567977
112	0.2584444	489.5059	-.09887027	-1.570021	-1.568305	-1.562984
113	0.2608056	492.7535	-.09994467	-1.561095	-1.561248	-1.557967
114	0.2631667	495.985	-0.1009281	-1.55216	-1.553995	-1.55292
115	0.2655278	499.2024	-0.1018262	-1.543232	-1.54657	-1.547838
116	0.2678889	502.4055	-0.1026769	-1.534327	-1.539012	-1.542718
117	0.27025	505.5921	-0.10353	-1.525453	-1.531359	-1.537558
118	0.2726111	508.7589	-0.1044263	-1.516618	-1.523652	-1.532353
119	0.2749722	511.9032	-0.1053827	-1.507832	-1.515921	-1.527103
120	0.2773333	515.0236	-0.1063889	-1.499098	-1.508187	-1.521803
121	0.2796944	518.1203	-0.1074165	-1.490422	-1.500467	-1.516449
122	0.2820556	521.1947	-0.1084324	-1.481806	-1.492769	-1.51104
123	0.2844167	524.2488	-0.109413	-1.473251	-1.485098	-1.50557
124	0.2867778	527.285	-0.1103528	-1.464754	-1.477452	-1.500038
125	0.2891389	530.3055	-0.1112657	-1.456317	-1.469828	-1.494438
126	0.2915	533.3109	-0.1121771	-1.447942	-1.462216	-1.488766
127	0.2938611	536.3007	-0.1131115	-1.43963	-1.454605	-1.483011
128	0.2962222	539.2741	-0.1140823	-1.431385	-1.446981	-1.477156
129	0.2985833	542.2305	-0.1150875	-1.423208	-1.439333	-1.471181
130	0.3009444	545.1684	-0.1161113	-1.415098	-1.431649	-1.465057
131	0.3033056	548.0888	-0.1171318	-1.407052	-1.423921	-1.45875
132	0.3056667	550.9939	-0.1181327	-1.399067	-1.416144	-1.45222
133	0.3080278	553.8844	-0.1191087	-1.391138	-1.408318	-1.445427
134	0.3103889	556.7596	-0.1200638	-1.383266	-1.400448	-1.43833
135	0.31275	559.6179	-0.1210064	-1.375448	-1.392535	-1.430893
136	0.3151111	562.4571	-0.1219447	-1.367681	-1.384586	-1.423087
137	0.3174722	565.275	-0.1228829	-1.359965	-1.376605	-1.414899
138	0.3198333	568.0698	-0.1238197	-1.3523	-1.3686	-1.406331
139	0.3221944	570.8395	-0.1247495	-1.344687	-1.360576	-1.397405
140	0.3245556	573.5826	-0.1256645	-1.337125	-1.352542	-1.388159
141	0.3269167	576.2977	-0.126558	-1.329608	-1.344501	-1.378645
142	0.3292778	578.9833	-0.1274263	-1.322134	-1.336462	-1.368921
143	0.3316389	581.6374	-0.1282692	-1.3147	-1.328429	-1.359046
144	0.334	584.258	-0.1290887	-1.307301	-1.320404	-1.349072
145	0.3365556	586.8839	-0.1299301	-1.299937	-1.312391	-1.339039
146	0.3391111	589.5228	-0.1308759	-1.292604	-1.304391	-1.328978
147	0.3416667	592.1444	-0.1319447	-1.285302	-1.296404	-1.318908
148	0.3442222	594.7347	-0.1330663	-1.278031	-1.288429	-1.308839
149	0.3467778	597.2891	-0.1341362	-1.270791	-1.280465	-1.298772
150	0.3493333	599.8086	-0.1350693	-1.26358	-1.272508	-1.288706
151	0.3518889	602.2957	-0.1358351	-1.256391	-1.264554	-1.278634

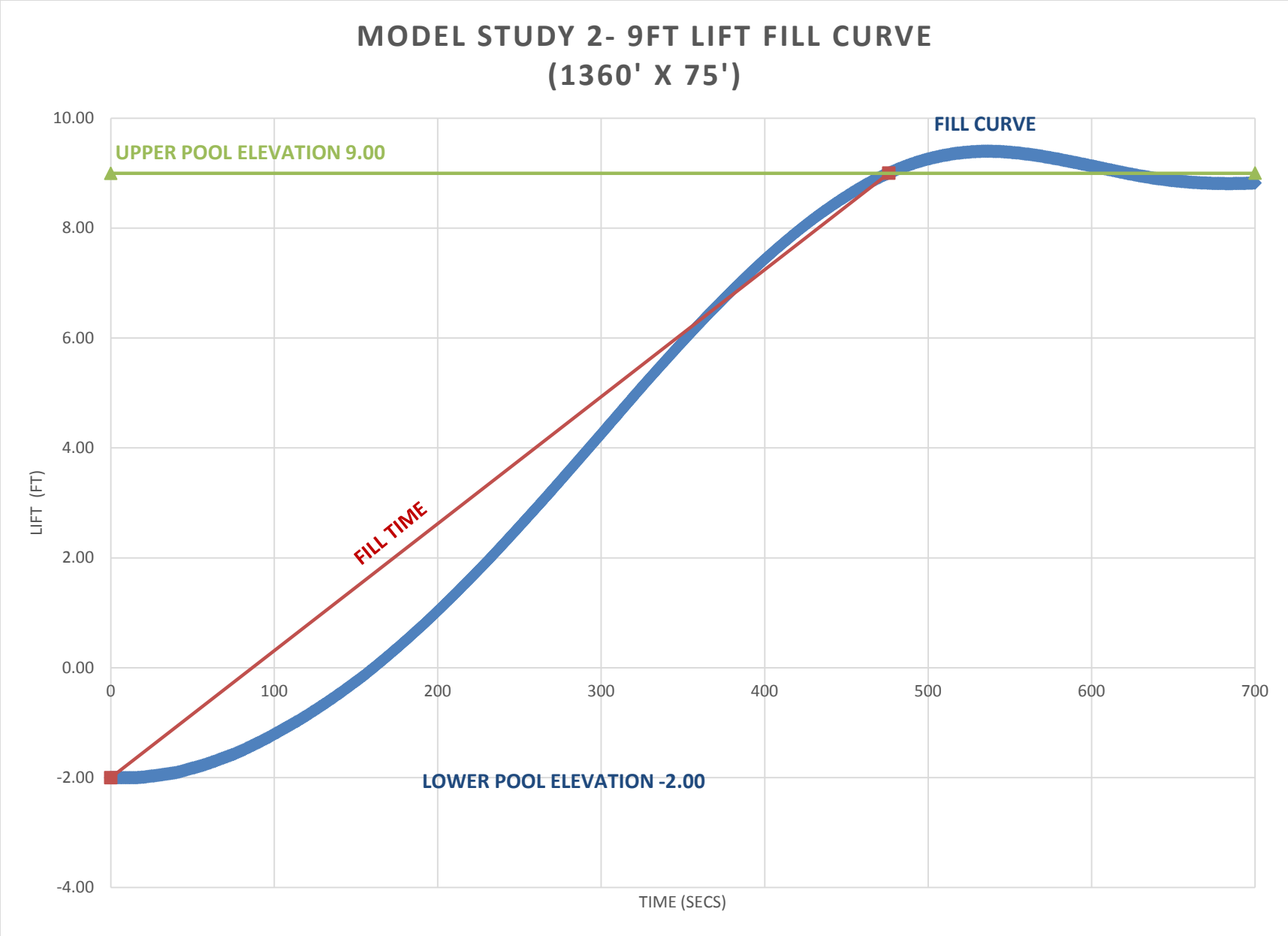
152	0.3544444	604.7514	-0.1364645	-1.249217	-1.256597	-1.268546
153	0.357	607.174	-0.1370297	-1.242045	-1.248627	-1.25843
154	0.3595556	609.559	-0.1376102	-1.234865	-1.240633	-1.248277
155	0.3621111	611.9006	-0.1382592	-1.227677	-1.2326	-1.238078
156	0.3646667	614.1939	-0.1389864	-1.220479	-1.22451	-1.227826
157	0.3672222	616.4366	-0.1397608	-1.213267	-1.216346	-1.217522
158	0.3697778	618.6297	-0.1405298	-1.20604	-1.208089	-1.207168
159	0.3723333	620.7762	-0.1412453	-1.198795	-1.199721	-1.196772
160	0.3748889	622.8799	-0.1418826	-1.191529	-1.191229	-1.186343
161	0.3774444	624.9433	-0.1424476	-1.184242	-1.182603	-1.175892
162	0.38	626.9671	-0.1429695	-1.176933	-1.173844	-1.165432
163	0.3825556	628.9499	-0.1434843	-1.169601	-1.164955	-1.154975
164	0.3851111	630.889	-0.1440183	-1.162249	-1.155947	-1.144533
165	0.3876667	632.7815	-0.1445781	-1.154877	-1.146835	-1.134117
166	0.3902222	634.6256	-0.14515	-1.147484	-1.137638	-1.123738
167	0.3927778	636.4206	-0.1457082	-1.14007	-1.128377	-1.113404
168	0.3953333	638.167	-0.1462274	-1.132633	-1.119076	-1.103122
169	0.3978889	639.8657	-0.1466927	-1.125172	-1.109755	-1.092896
170	0.4004444	641.5172	-0.1471044	-1.117683	-1.100432	-1.082732
171	0.403	643.1215	-0.1474755	-1.110163	-1.091118	-1.072632
172	0.4055556	644.677	-0.1478238	-1.102609	-1.081822	-1.062598
173	0.4081111	646.1815	-0.1481632	-1.095014	-1.072548	-1.052631
174	0.4106667	647.6328	-0.1484982	-1.087371	-1.063296	-1.042735
175	0.4132222	649.0296	-0.1488231	-1.07967	-1.054063	-1.032909
176	0.4157778	650.3714	-0.1491269	-1.071899	-1.044842	-1.023157
177	0.4183333	651.6588	-0.1493991	-1.064041	-1.035626	-1.013478
178	0.4208889	652.8932	-0.1496352	-1.056078	-1.026409	-1.003874
179	0.4234444	654.0759	-0.1498387	-1.047987	-1.017184	-0.9943445
180	0.426	655.2084	-0.1500196	-1.039746	-1.007946	-0.9848892
181	0.42875	656.3176	-0.1502168	-1.031329	-0.9986922	-0.9755065
182	0.4315	657.4116	-0.1504915	-1.022713	-0.9894211	-0.9661946
183	0.43425	658.4741	-0.1508614	-1.013873	-0.9801331	-0.9569517
184	0.437	659.4978	-0.151282	-1.004791	-0.9708302	-0.947776
185	0.43975	660.4812	-0.1516804	-0.9954534	-0.9615161	-0.938667
186	0.4425	661.4263	-0.1519922	-0.985854	-0.9521959	-0.9296255
187	0.44525	662.336	-0.1521881	-0.9759963	-0.9428753	-0.9206526
188	0.448	663.2121	-0.1522808	-0.9658934	-0.9335605	-0.9117491
189	0.45075	664.0532	-0.1523132	-0.9555624	-0.9242572	-0.9029147
190	0.4535	664.8552	-0.1523348	-0.9450309	-0.9149708	-0.8941477
191	0.45625	665.6127	-0.1523791	-0.9343361	-0.9057055	-0.8854459
192	0.459	666.3201	-0.1524512	-0.923516	-0.8964643	-0.8768066
193	0.46175	666.9737	-0.1525292	-0.9126071	-0.8872491	-0.8682271
194	0.4645	667.5718	-0.1525773	-0.9016416	-0.8780609	-0.8597049
195	0.46725	668.1144	-0.1525632	-0.8906454	-0.8688991	-0.8512371
196	0.47	668.6024	-0.1524712	-0.8796382	-0.8597624	-0.8428209
197	0.47275	669.0363	-0.1523071	-0.868634	-0.8506499	-0.8344529
198	0.4755	669.4159	-0.1520931	-0.8576419	-0.8415599	-0.8261288
199	0.47825	669.74	-0.1518573	-0.8466665	-0.8324896	-0.817844
200	0.481	670.0072	-0.1516214	-0.8357089	-0.8234343	-0.809593
201	0.48375	670.216	-0.1513936	-0.8247678	-0.8143877	-0.8013701
202	0.4865	670.3658	-0.1511676	-0.8138399	-0.8053417	-0.7931698
203	0.48925	670.4575	-0.150928	-0.8029213	-0.7962873	-0.7849871
204	0.492	670.4926	-0.1506589	-0.7920084	-0.7872153	-0.7768182
205	0.49475	670.4735	-0.1503512	-0.7810988	-0.7781156	-0.7686597
206	0.4975	670.4021	-0.1500056	-0.7701927	-0.7689789	-0.7605091
207	0.50025	670.28	-0.1496316	-0.7592925	-0.7597957	-0.7523642
208	0.503	670.1078	-0.1492416	-0.7484034	-0.7505581	-0.7442235
209	0.50575	669.8853	-0.1488453	-0.7375326	-0.7412598	-0.7360858
210	0.5085	669.6121	-0.1484454	-0.7266883	-0.731898	-0.7279505
211	0.51125	669.2878	-0.1480366	-0.7158792	-0.7224734	-0.7198175
212	0.514	668.9082	-0.1476048	-0.7051144	-0.7129902	-0.7116871
213	0.51675	668.4742	-0.1471334	-0.6944023	-0.7034561	-0.7035595
214	0.5195	667.9897	-0.1466172	-0.6837508	-0.6938816	-0.6954345
215	0.52225	667.4553	-0.1460637	-0.6731675	-0.6842797	-0.6873114
216	0.525	666.871	-0.1454858	-0.6626591	-0.6746639	-0.6791887
217	0.5276111	666.226	-0.1448848	-0.6522314	-0.6650477	-0.671064
218	0.5302222	665.5158	-0.1442452	-0.6418894	-0.6554432	-0.6629338
219	0.5328333	664.7462	-0.1435583	-0.6316373	-0.6458604	-0.654794
220	0.5354444	663.9198	-0.1428317	-0.6214812	-0.6363072	-0.6466397
221	0.5380556	663.0381	-0.1420817	-0.6114246	-0.6267887	-0.6384653
222	0.5406667	662.1012	-0.1413241	-0.6014664	-0.6173082	-0.630265
223	0.5432778	661.1084	-0.1405675	-0.5916065	-0.6078668	-0.6220316
224	0.5458889	660.0593	-0.1398097	-0.5818459	-0.5984635	-0.6137564
225	0.5485	658.9539	-0.1390404	-0.5721873	-0.5890965	-0.6054285
226	0.5511111	657.7931	-0.1382467	-0.5626325	-0.5797636	-0.5970352
227	0.5537222	656.5778	-0.1374189	-0.5531811	-0.5704628	-0.5885618
228	0.5563333	655.3096	-0.1365544	-0.5438322	-0.5611912	-0.5799932
229	0.5589444	653.9896	-0.1356585	-0.5345848	-0.5519464	-0.5713138
230	0.5615556	652.6184	-0.1347412	-0.5254377	-0.542727	-0.5625085
231	0.5641667	651.1959	-0.1338123	-0.5163899	-0.5335334	-0.5535632
232	0.5667778	649.7209	-0.132876	-0.5074405	-0.5243671	-0.5444658

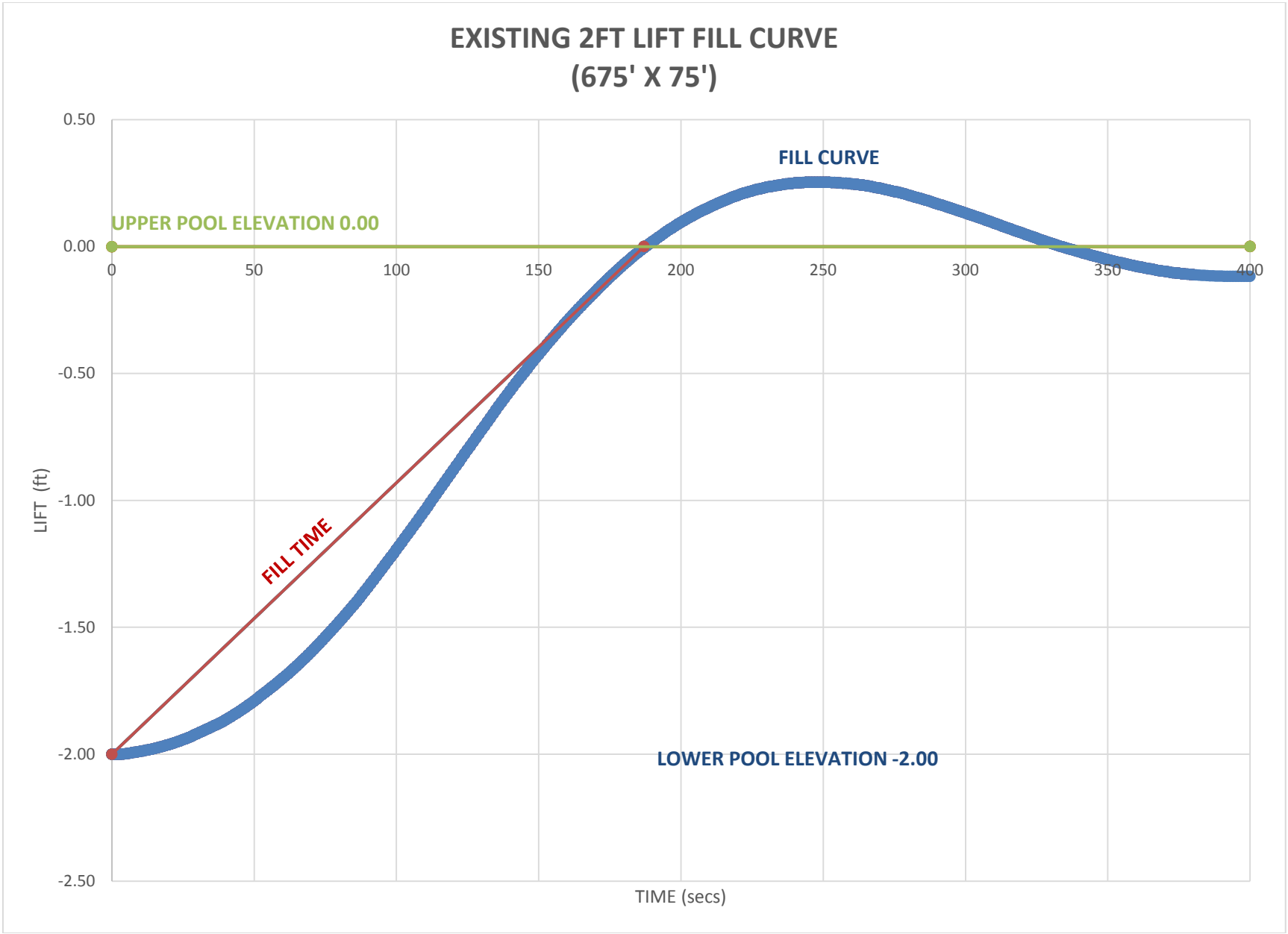
233	0.5693889	648.1928	-0.1319295	-0.4985882	-0.5152304	-0.5352068
234	0.572	646.6127	-0.1309669	-0.4898321	-0.5061267	-0.5257811
235	0.5746111	644.9819	-0.1299834	-0.4811709	-0.4970595	-0.516188
236	0.5772222	643.3012	-0.128977	-0.4726035	-0.4880321	-0.506433
237	0.5798333	641.5717	-0.1279489	-0.4641285	-0.4790483	-0.4965268
238	0.5824444	639.7937	-0.1269023	-0.4557438	-0.4701121	-0.4864859
239	0.5850556	637.9677	-0.1258411	-0.4474474	-0.4612268	-0.4763309
240	0.5876667	636.0937	-0.1247678	-0.4392368	-0.4523952	-0.4660856
241	0.5902778	634.1718	-0.1236828	-0.4311107	-0.4436197	-0.4557751
242	0.5928889	632.2023	-0.1225848	-0.423068	-0.4349012	-0.4454238
243	0.5955	630.1855	-0.1214714	-0.4151054	-0.4262402	-0.4350542
244	0.5981111	628.1221	-0.1203408	-0.4072172	-0.4176376	-0.4246857
245	0.6007222	626.0127	-0.1191926	-0.3993984	-0.4090926	-0.4143344
246	0.6033333	623.8577	-0.118028	-0.3916443	-0.4006027	-0.404013
247	0.6059444	621.6576	-0.1168491	-0.3839503	-0.3921641	-0.3937305
248	0.6085556	619.4128	-0.1156583	-0.376312	-0.3837731	-0.3834937
249	0.6111667	617.1235	-0.1144571	-0.3687249	-0.3754249	-0.3733066
250	0.6137778	614.7899	-0.1132456	-0.3611848	-0.3671137	-0.3631721
251	0.6163889	612.4123	-0.1120231	-0.3536878	-0.358833	-0.3530916
252	0.619	609.9909	-0.110788	-0.3462304	-0.3505755	-0.3430662
253	0.6221389	607.5432	-0.1095567	-0.3388101	-0.3423334	-0.3330966
254	0.6252778	605.0755	-0.1083644	-0.3314246	-0.3340992	-0.323184
255	0.6284167	602.5772	-0.1072232	-0.3240723	-0.3258658	-0.3133304
256	0.6315556	600.0418	-0.1061068	-0.3167519	-0.3176267	-0.3035392
257	0.6346944	597.4668	-0.1049696	-0.3094631	-0.309377	-0.2938148
258	0.6378333	594.8522	-0.1037702	-0.3022056	-0.3011129	-0.2841623
259	0.6409722	592.1995	-0.10249	-0.2949795	-0.2928331	-0.2745875
260	0.6441111	589.5093	-0.1011382	-0.287785	-0.2845381	-0.2650958
261	0.64725	586.7805	-.09974452	-0.2806184	-0.2762306	-0.255693
262	0.6503889	584.0098	-0.0983425	-0.2734774	-0.2679154	-0.2463847
263	0.6535278	581.1924	-.09695404	-0.2663633	-0.2595997	-0.2371761
264	0.6566667	578.3235	-.09558033	-0.2592763	-0.2512918	-0.2280722
265	0.6598056	575.399	-.09420329	-0.2522152	-0.2430008	-0.2190777
266	0.6629444	572.4165	-0.0927955	-0.2451777	-0.234736	-0.2101965
267	0.6660833	569.3752	-.09133323	-0.2381597	-0.2265053	-0.2014323
268	0.6692222	566.2745	-.08980643	-0.2311563	-0.2183157	-0.1927883
269	0.6723611	563.1137	-.08822147	-0.2241623	-0.210174	-0.1842671
270	0.6755	559.8911	-.08659632	-0.217172	-0.2020862	-0.1758703
271	0.6786389	556.6017	-0.0849491	-0.2101791	-0.1940566	-0.1675988
272	0.6817778	553.2415	-.08328892	-0.2031765	-0.1860876	-0.159453
273	0.6849167	549.8088	-.08161644	-0.1961559	-0.1781805	-0.151433
274	0.6880556	546.3027	-.07992734	-0.1891081	-0.1703355	-0.1435388
275	0.6911944	542.7225	-.07821512	-0.1820223	-0.1625527	-0.13577
276	0.6943333	539.0682	-.07647459	-0.1748877	-0.1548323	-0.128126
277	0.6974722	535.34	-.07470469	-0.1676934	-0.1471747	-0.1206057
278	0.7006111	531.5385	-.07290947	-0.1604295	-0.1395806	-0.1132079
279	0.70375	527.6644	-.07109689	-0.1530895	-0.1320512	-0.1059311
280	0.7068889	523.7181	-.06927589	-0.1456686	-0.1245879	-0.0987736
281	0.7100278	519.7	-.06745323	-0.1381622	-0.1171923	-.09173358
282	0.7131667	515.6103	-.06563126	-0.1305682	-0.1098666	-0.0848091
283	0.7163056	511.4495	-.06380779	-0.1228888	-0.1026128	-.07799808
284	0.7194444	507.2183	-.06197778	-0.1151294	-.09543358	-.07129824
285	0.7225833	502.9175	-0.060136	-0.1072992	-.08833244	-.06470703
286	0.7257222	498.5477	-.05827921	-.09941084	-.08131356	-.05822167
287	0.7288611	494.1095	-.05640714	-.09148056	-.07438019	-.05183922
288	0.732	489.6028	-.05452194	-.08352725	-.06753419	-.04555662
289	0.7354167	485.0302	-.05262946	-.07557012	-.06077666	-.03937063
290	0.7388333	480.3915	-.05073727	-.06762764	-.05410802	-.03327773
291	0.74225	475.6828	-0.0488456	-.05971754	-.04752795	-.02727423
292	0.7456667	470.9008	-.04694439	-.05185623	-0.0410355	-.02135648
293	0.7490833	466.0298	-.04500525	-0.0440583	-.03462911	-.01552126
294	0.7525	461.0635	-.04298851	-.03633608	-.02830645	-.00976591
295	0.7559167	456.0102	-.04088206	-.02869959	-.02206441	-.00408804
296	0.7593333	450.8738	-.03871477	-.02115667	-.01589913	.001514733
297	0.76275	445.6533	-.03653494	-.01371284	-.00980606	0.00704486
298	0.7661667	440.3432	-.03438271	-.0063721	-.00377995	0.01250467
299	0.7695833	434.935	-.03226905	.00086239	.002184797	0.01789607
300	0.773	429.4131	-.03016267	.007984299	.008093516	0.02322042

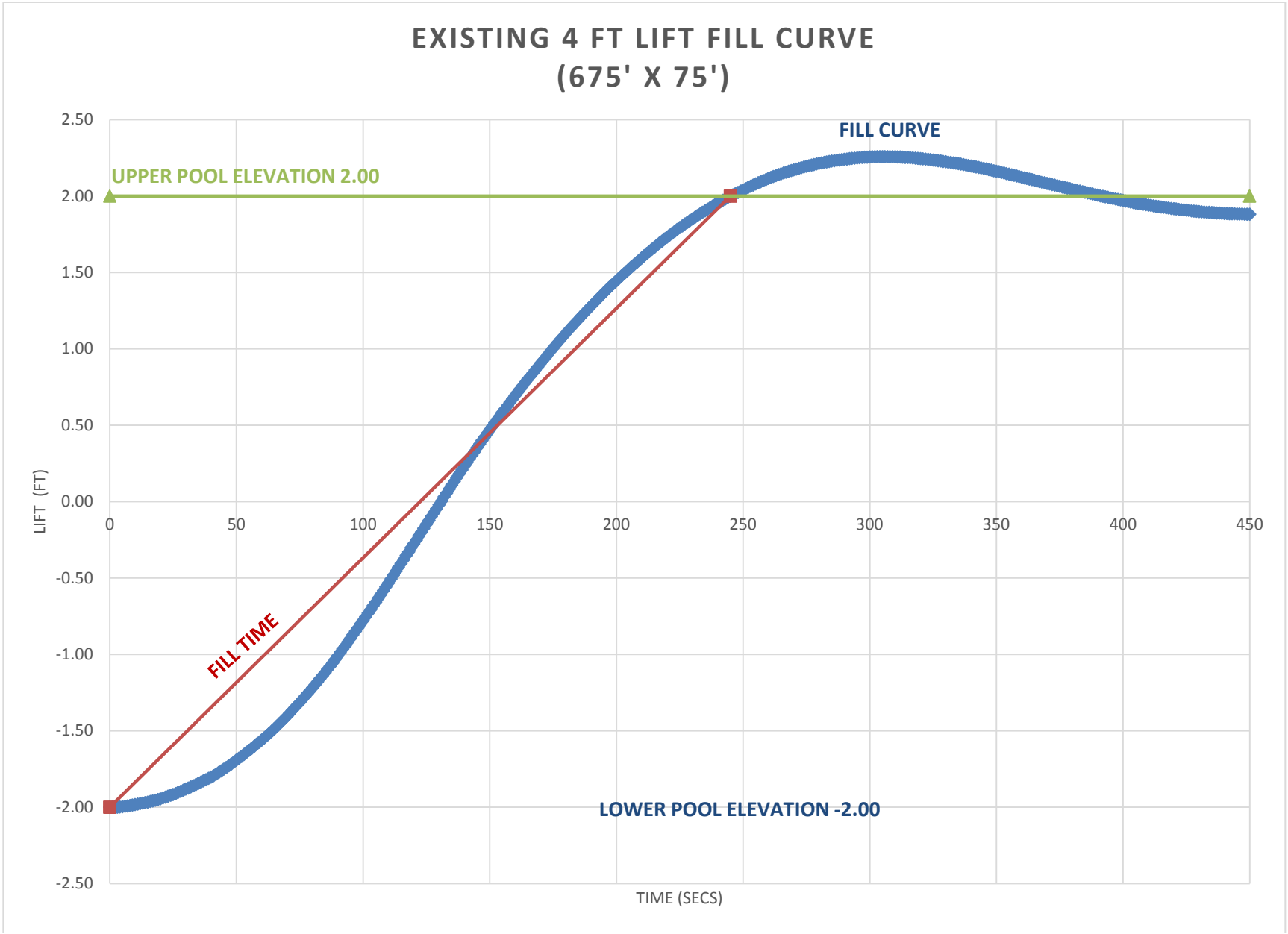
Appendix E: Fill Curves for Model Study, Existing and Proposed Alternatives

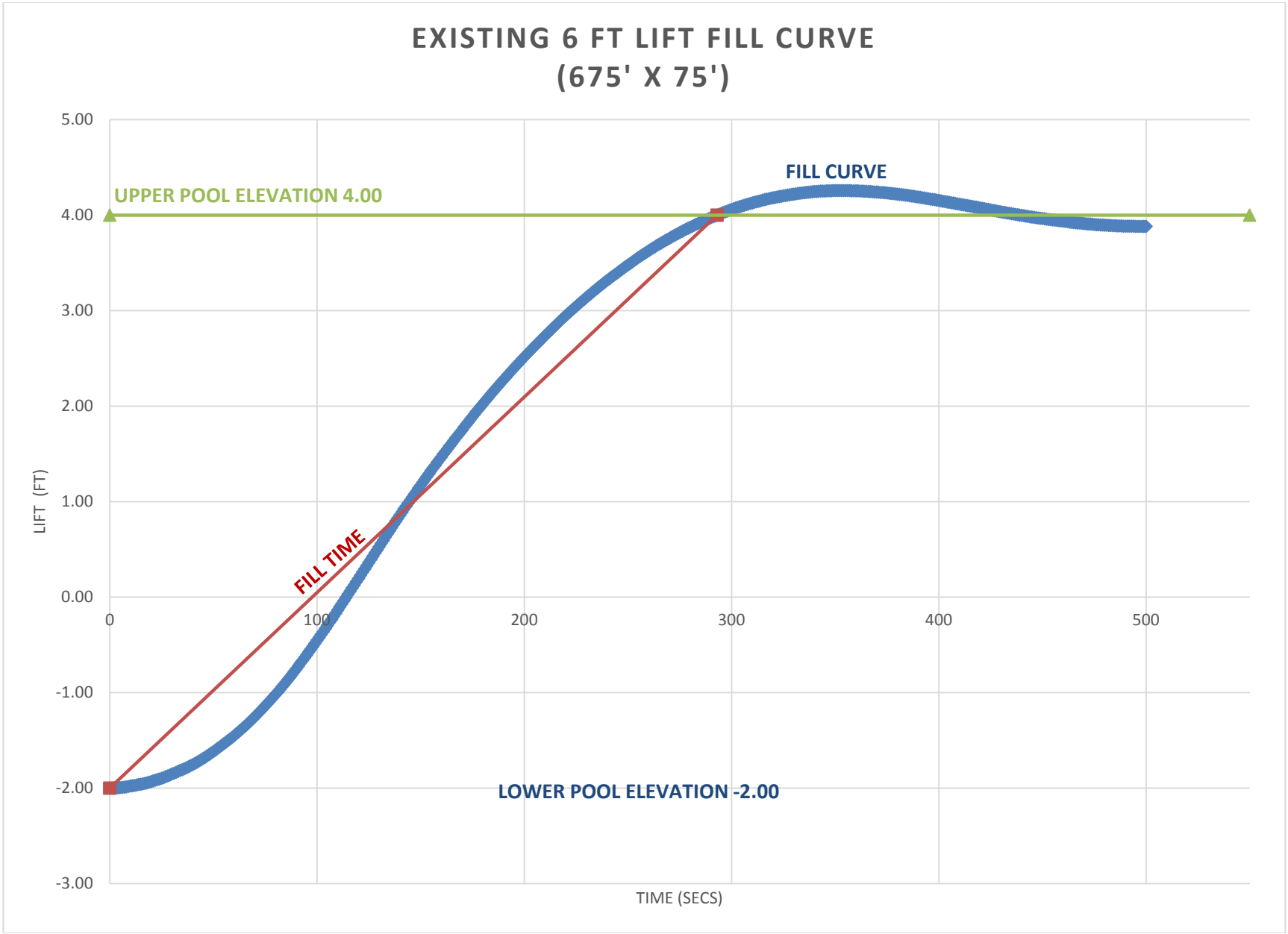

MODEL STUDY 1- 9FT LIFT FILL CURVE
(1360' X 110')
10.00
8.00
6.00
4.00
2.00
0.00
-2.00
-4.00
LIFT (FT)
0
100
200
300
400
500
600
700
800
TIME (SECS)
UPPER POOL ELEVATION
FILL CURVE
FILL TIME
LOWER POOL ELEVATION -2.00

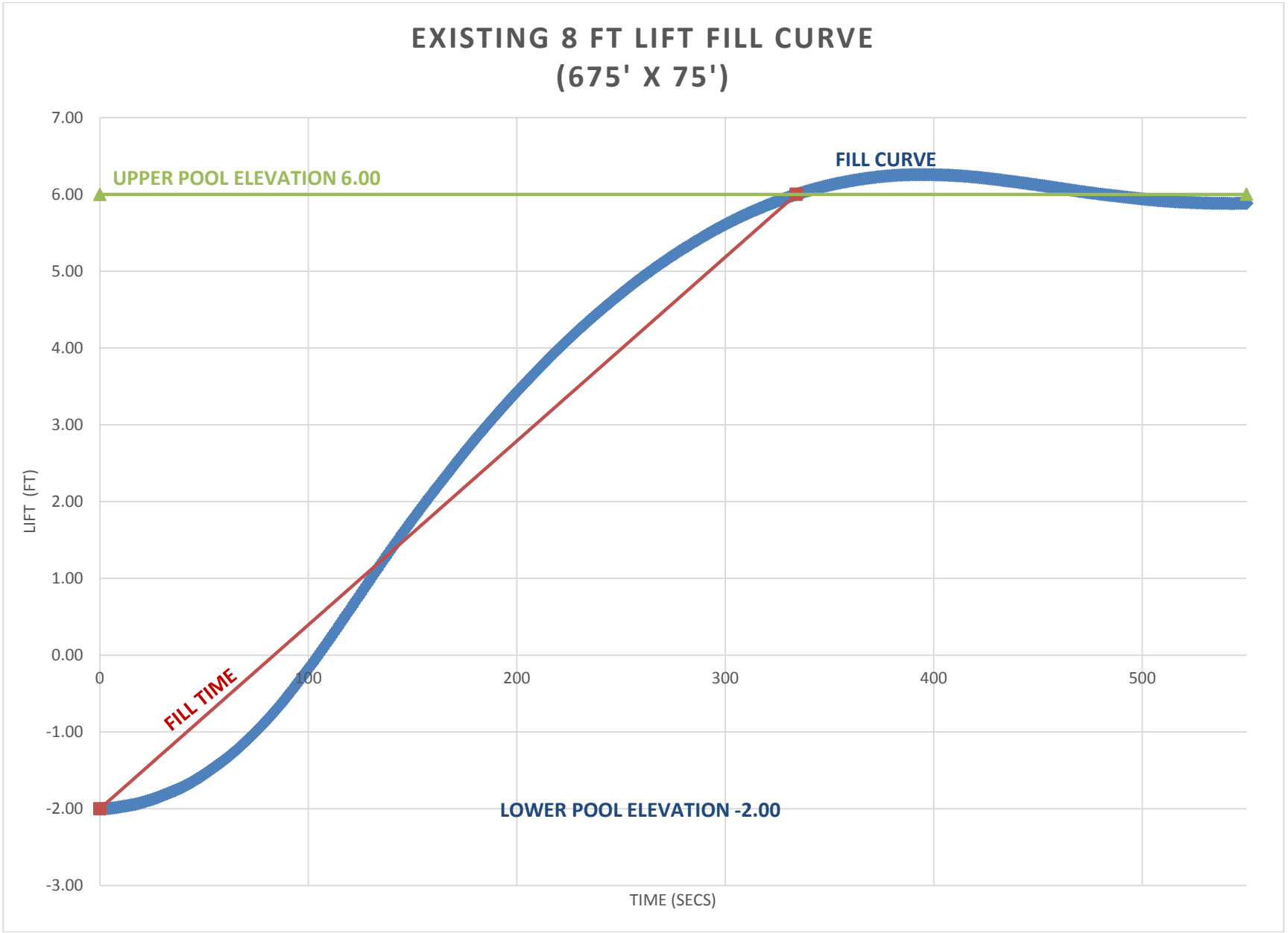

MODEL STUDY 2- 9FT LIFT FILL CURVE
(1360' X 75')
10.00
8.00
6.00
4.00
2.00
0.00
-2.00
-4.00
LIFT (FT)
0
100
200
300
400
500
600
700
TIME (SECS)
UPPER POOL ELEVATION
9.00
FILL CURVE
FILL TIME
LOWER POOL ELEVATION -2.00

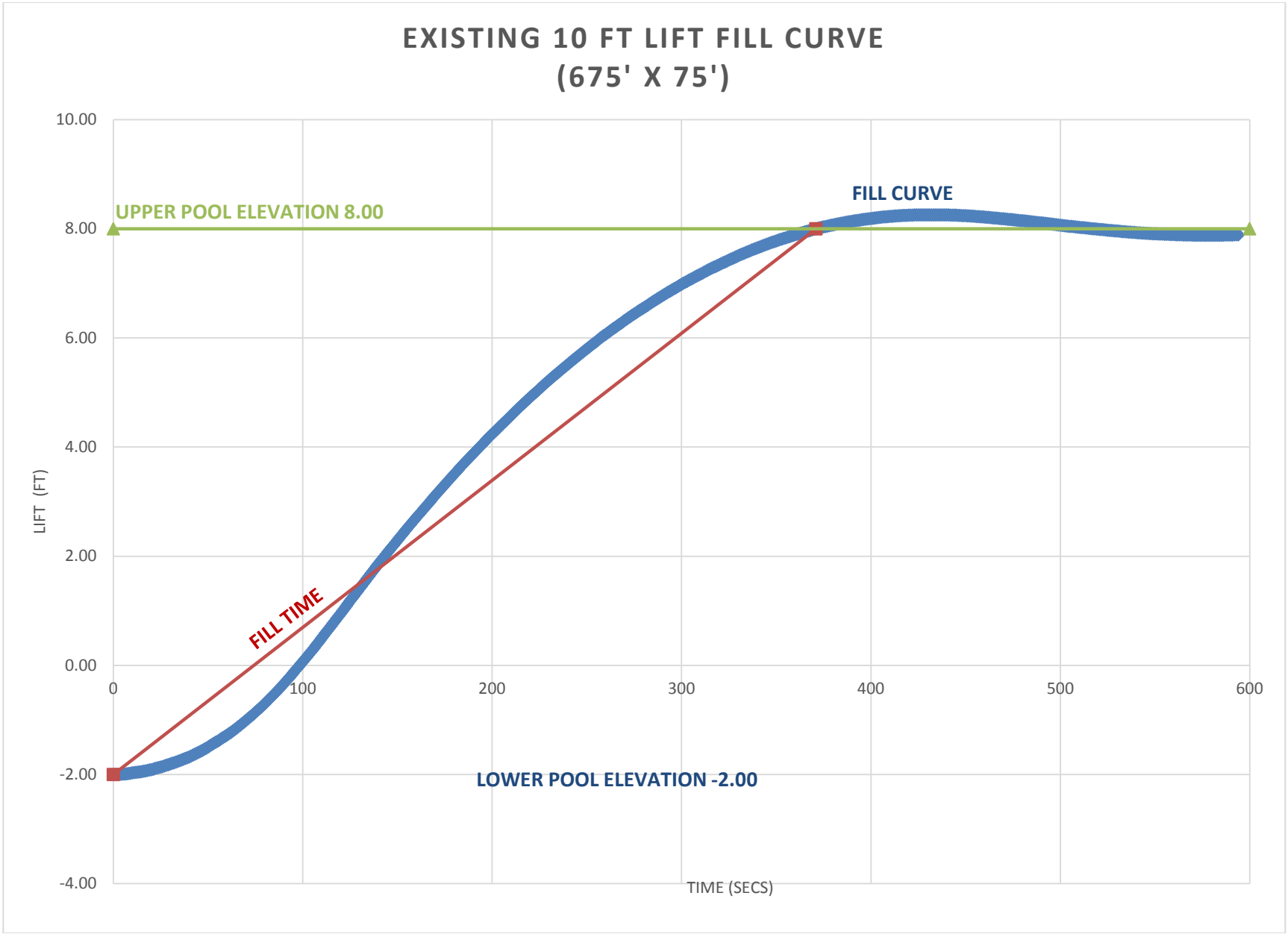

MODEL STUDY 2- 9FT LIFT FILL CURVE
(1360' X 75')
10.00
8.00
6.00
4.00
2.00
0.00
-2.00
-4.00
LIFT (FT)
0
100
200
300
400
500
600
700
TIME (SECS)
UPPER POOL ELEVATION 9.00
FILL CURVE
FILL TIME
LOWER POOL ELEVATION -2.00

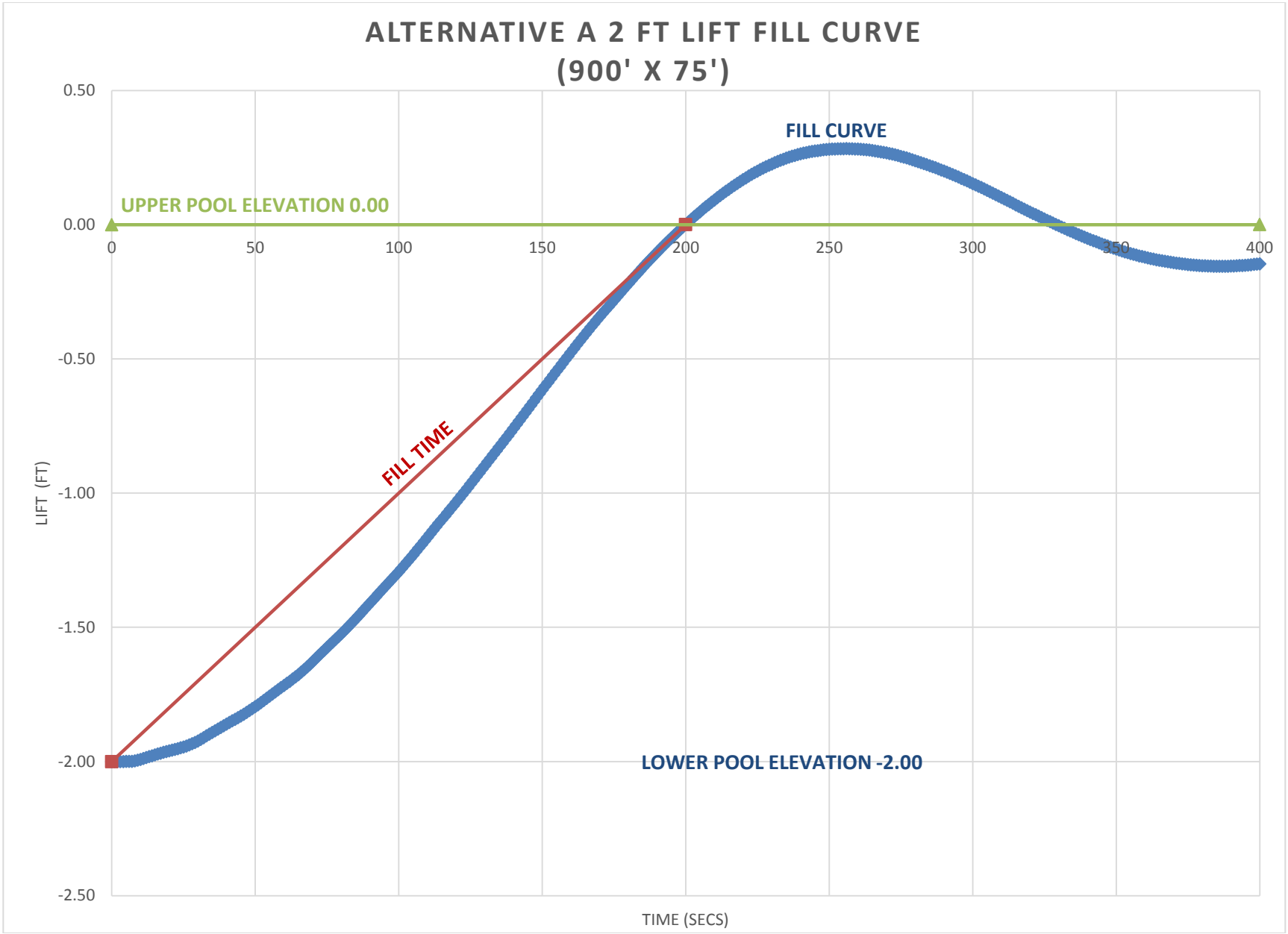

EXISTING 2FT LIFT FILL CURVE
(675' X 75')
0.50
0.00
-0.50
-1.00
-1.50
-2.00
-2.50
LIFT (ft)
0
50
100
150
200
250
300
350
400
TIME (secs)
FILL CURVE
UPPER POOL ELEVATION 0.00
FILL TIME
LOWER POOL ELEVATION -2.00

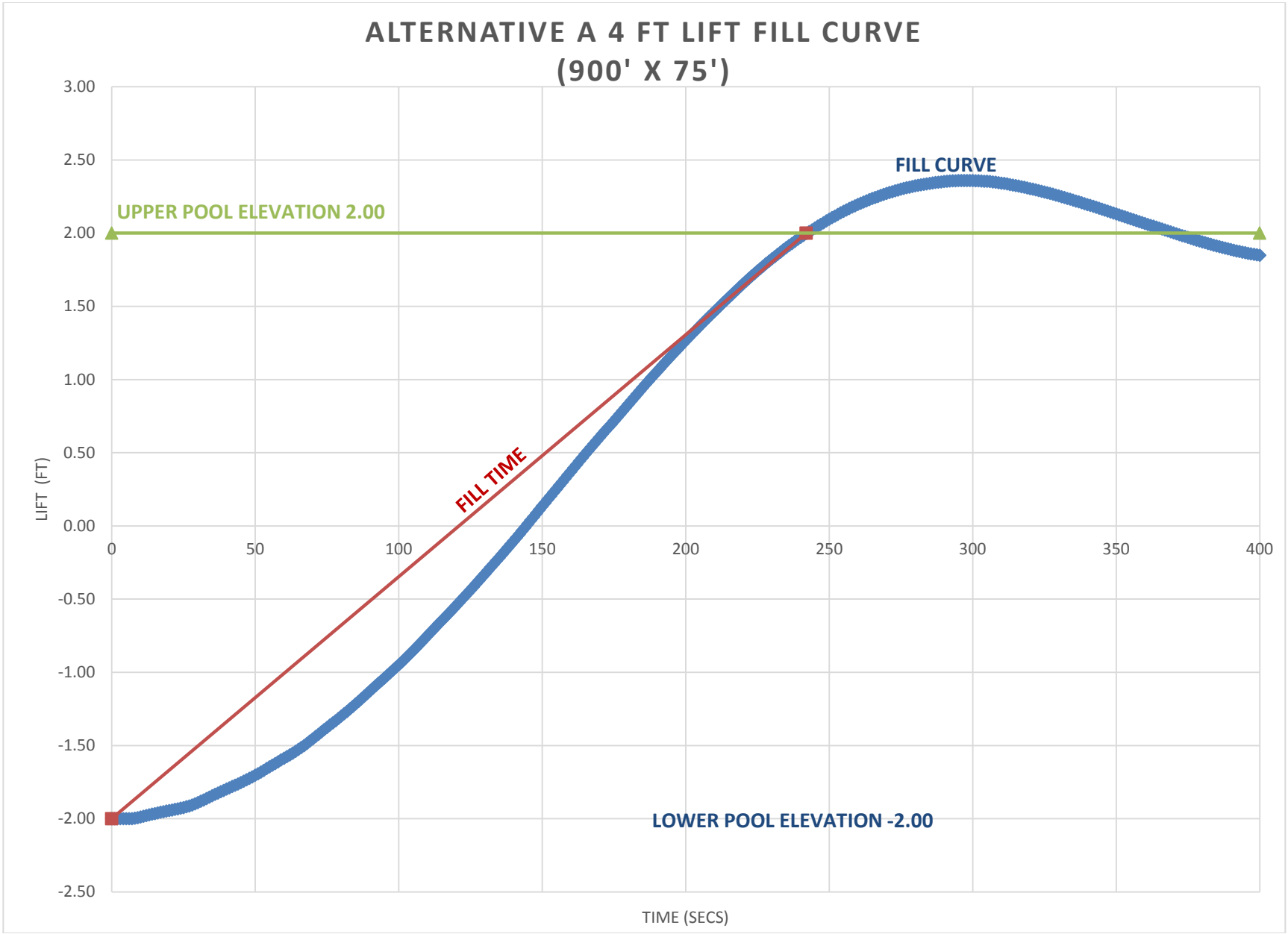

EXISTING 4 FT LIFT FILL CURVE
(675' X 75')
FILL CURVE
UPPER POOL ELEVATION 2.00
FILL TIME
LOWER POOL ELEVATION -2.00
LIFT (FT)
TIME (SECS)
2.50
2.00
1.50
1.00
0.50
0.00
-0.50
-1.00
-1.50
-2.00
-2.50
0
50
100
150
200
250
300
350
400
450

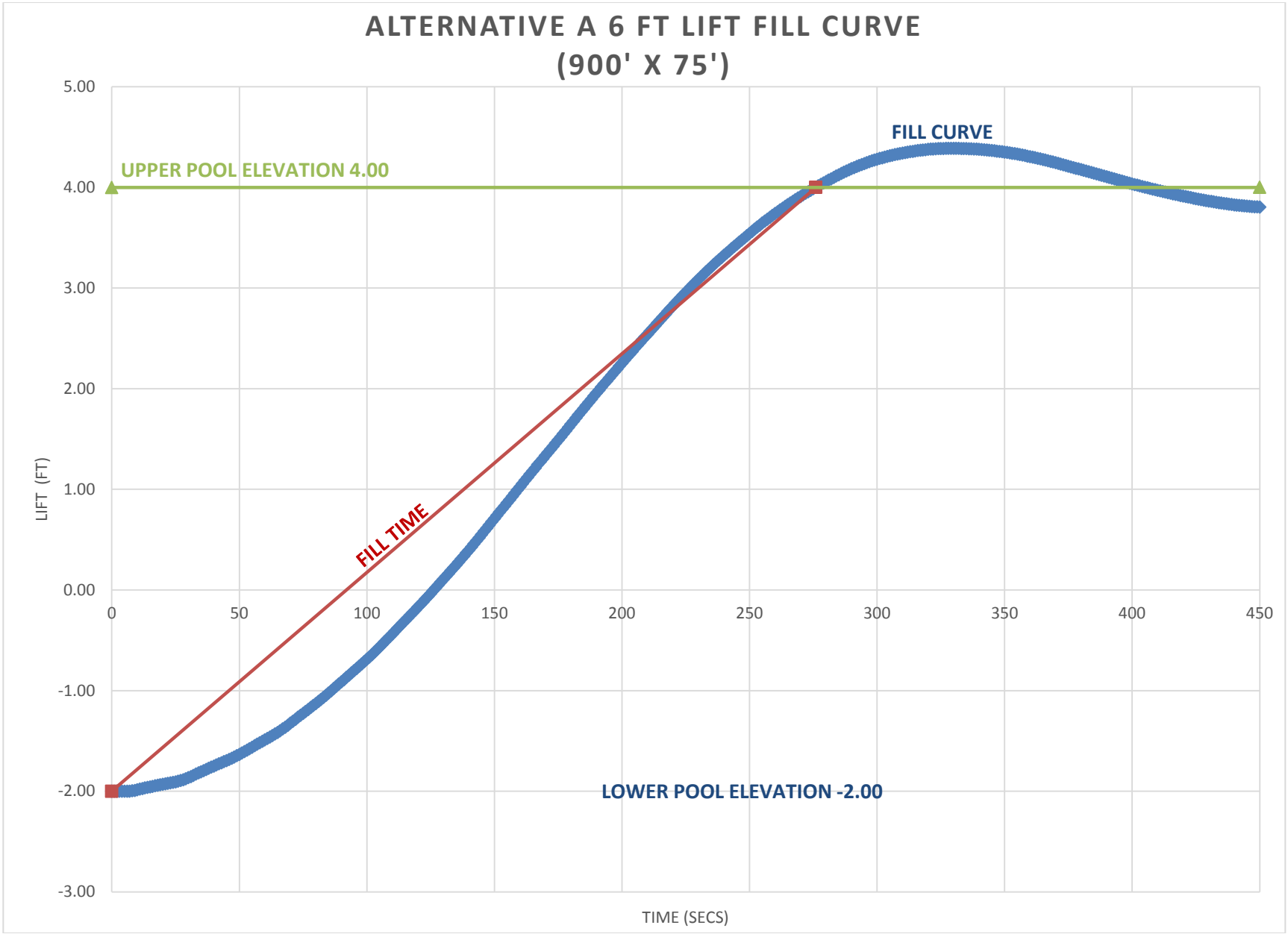

EXISTING 6 FT LIFT FILL CURVE
(675' X 75')
5.00
4.00
3.00
2.00
1.00
0.00
-1.00
-2.00
-3.00
LIFT (FT)
0
100
200
300
400
500
TIME (SECS)
UPPER POOL ELEVATION 4.00
FILL CURVE
FILL TIME
LOWER POOL ELEVATION -2.00

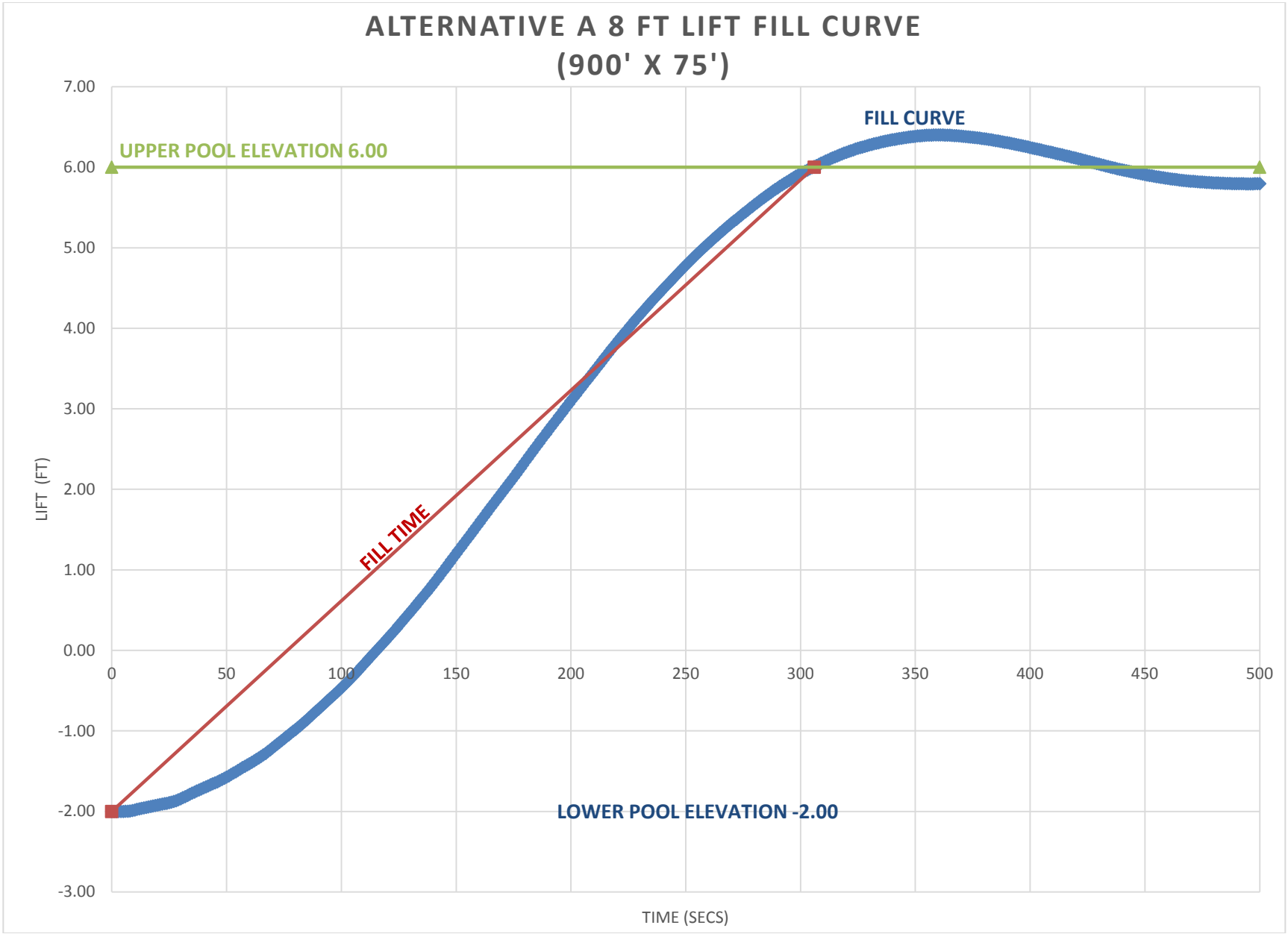

EXISTING 8 FT LIFT FILL CURVE
(675' X 75')
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
-1.00
-2.00
-3.00
LIFT (FT)
0
100
200
300
400
500
TIME (SECS)
UPPER POOL ELEVATION 6.00
FILL CURVE
FILL TIME
LOWER POOL ELEVATION -2.00

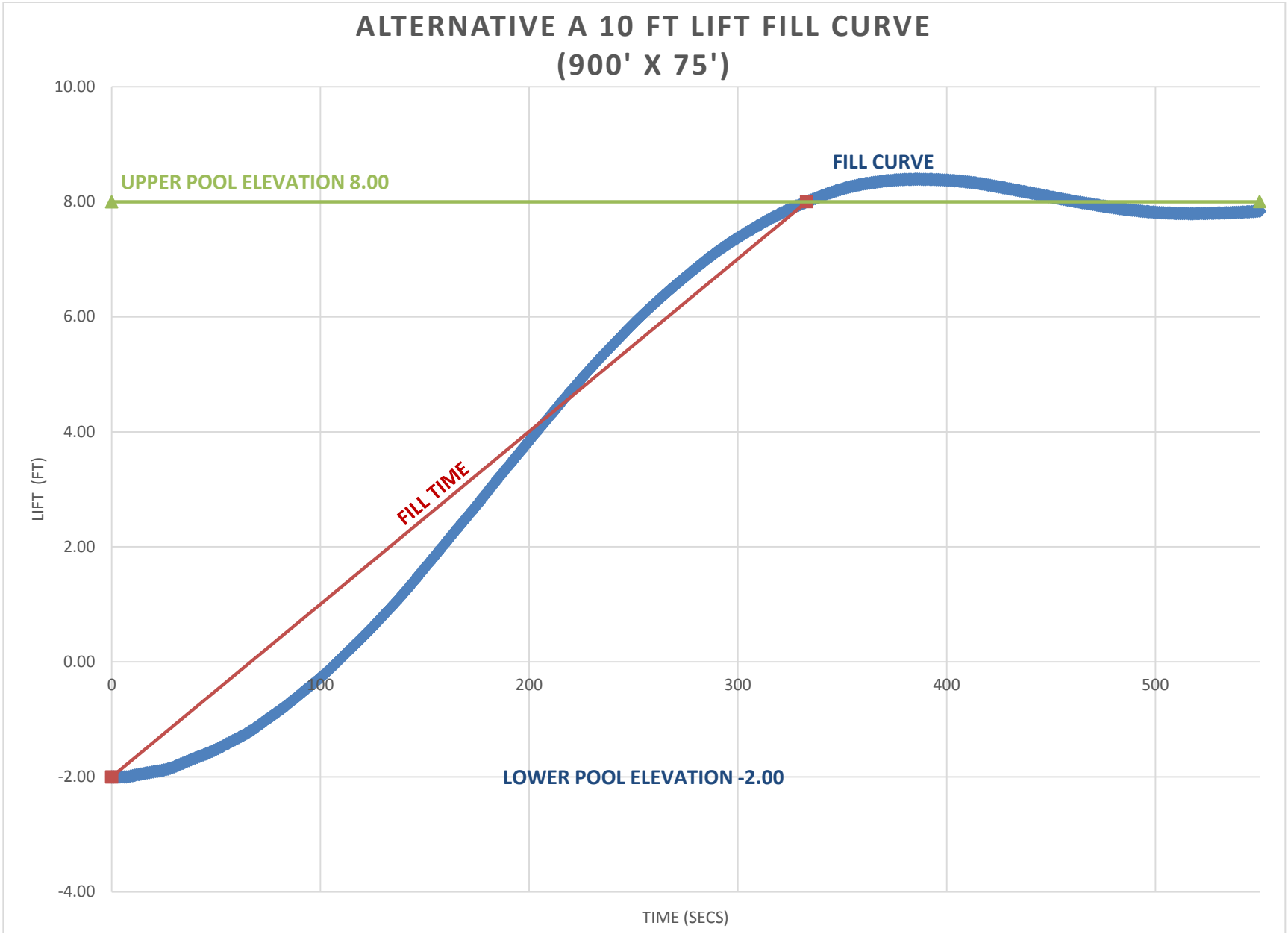

EXISTING 10 FT LIFT FILL CURVE
(675' X 75')
10.00
8.00
6.00
4.00
2.00
0.00
-2.00
-4.00
LIFT (FT)
0
100
200
300
400
500
600
TIME (SECS)
UPPER POOL ELEVATION 8.00
FILL CURVE
FILL TIME
LOWER POOL ELEVATION -2.00

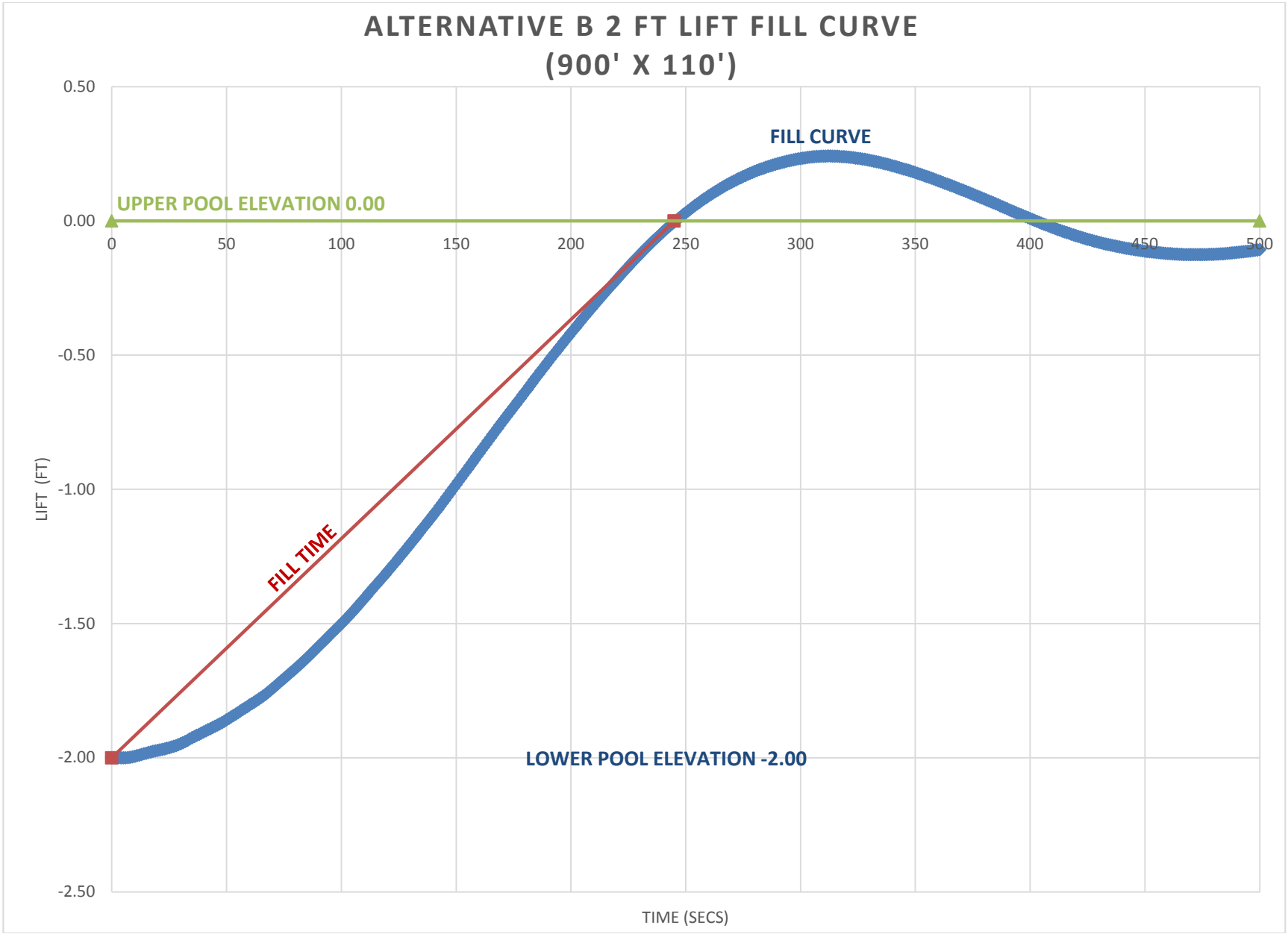

ALTERNATIVE A 2 FT LIFT FILL CURVE
(900' X 75')
0.50
0.00
-0.50
-1.00
-1.50
-2.00
-2.50
LIFT (FT)
0
50
100
150
200
250
300
350
400
TIME (SECS)
FILL CURVE
UPPER POOL ELEVATION 0.00
FILL TIME
LOWER POOL ELEVATION -2.00

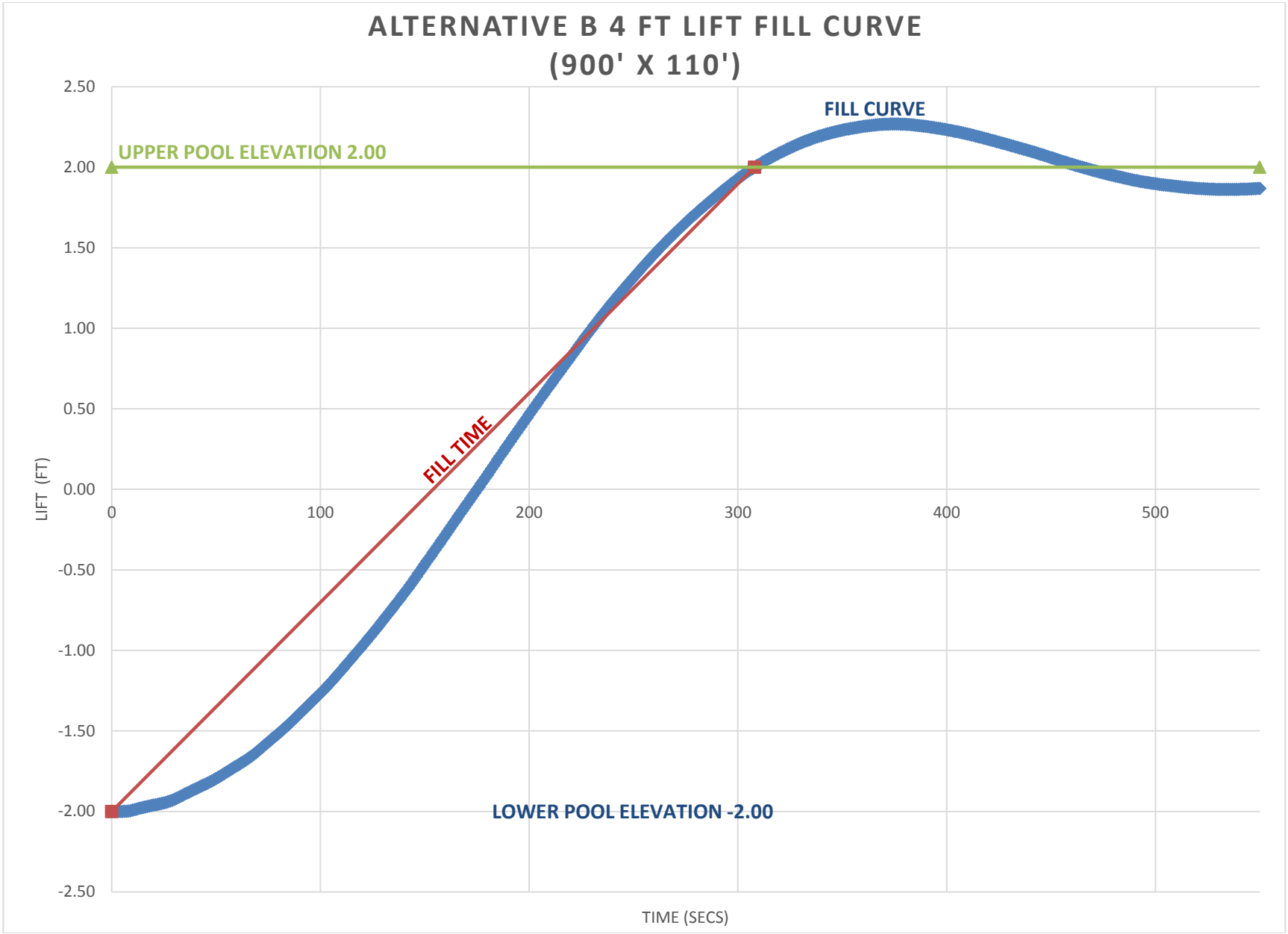

ALTERNATIVE A 4 FT LIFT FILL CURVE
(900' X 75')
3.00
2.50
2.00
1.50
1.00
0.50
0.00
-0.50
-1.00
-1.50
-2.00
-2.50
LIFT (FT)
0
50
100
150
200
250
300
350
400
TIME (SECS)
UPPER POOL ELEVATION 2.00
FILL CURVE
FILL TIME
LOWER POOL ELEVATION -2.00

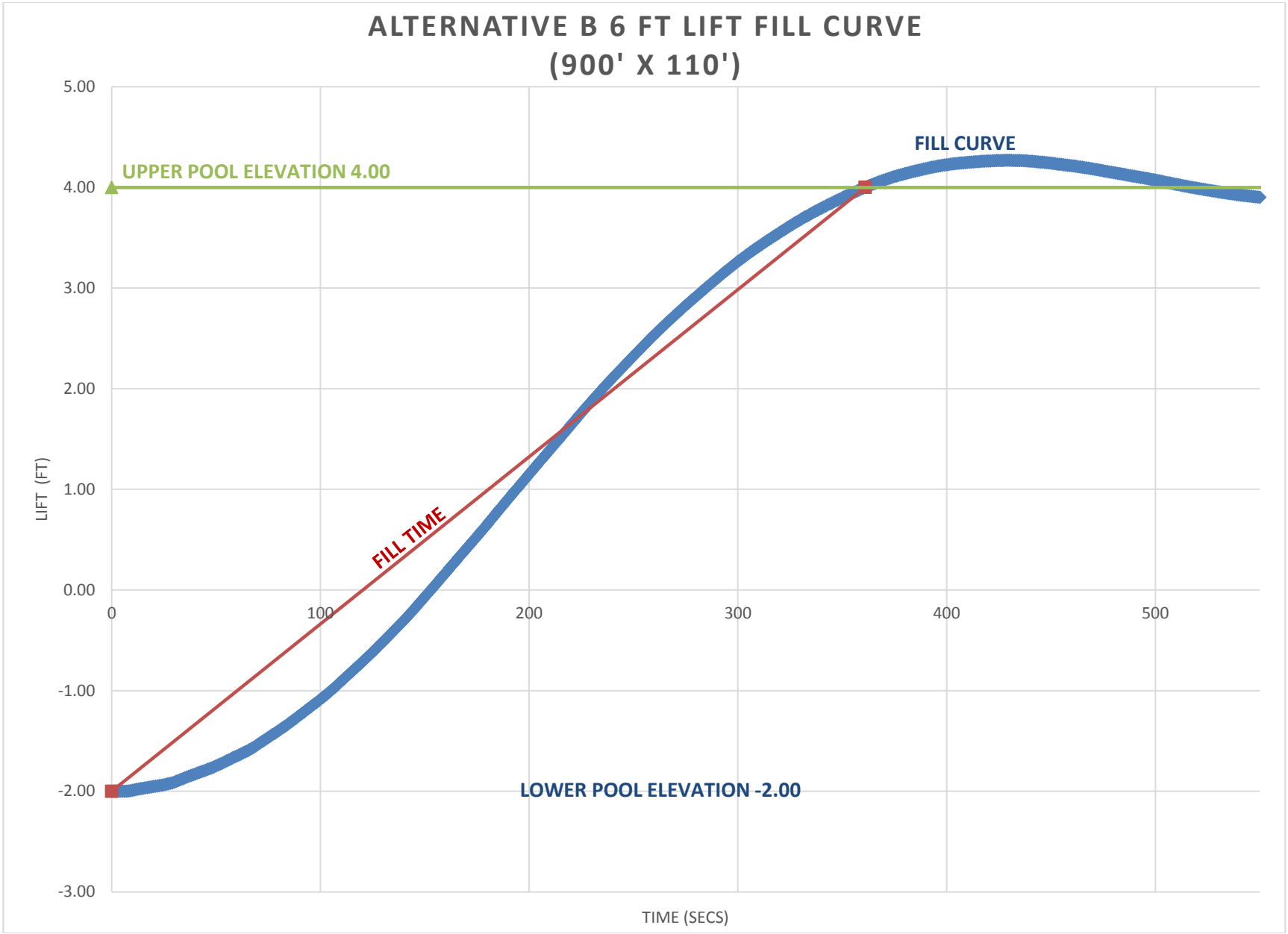

ALTERNATIVE A 6 FT LIFT FILL CURVE
(900' X 75')
5.00
4.00
3.00
2.00
1.00
0.00
-1.00
-2.00
-3.00
LIFT (FT)
0
50
100
150
200
250
300
350
400
450
TIME (SECS)
UPPER POOL ELEVATION 4.00
FILL CURVE
FILL TIME
LOWER POOL ELEVATION -2.00

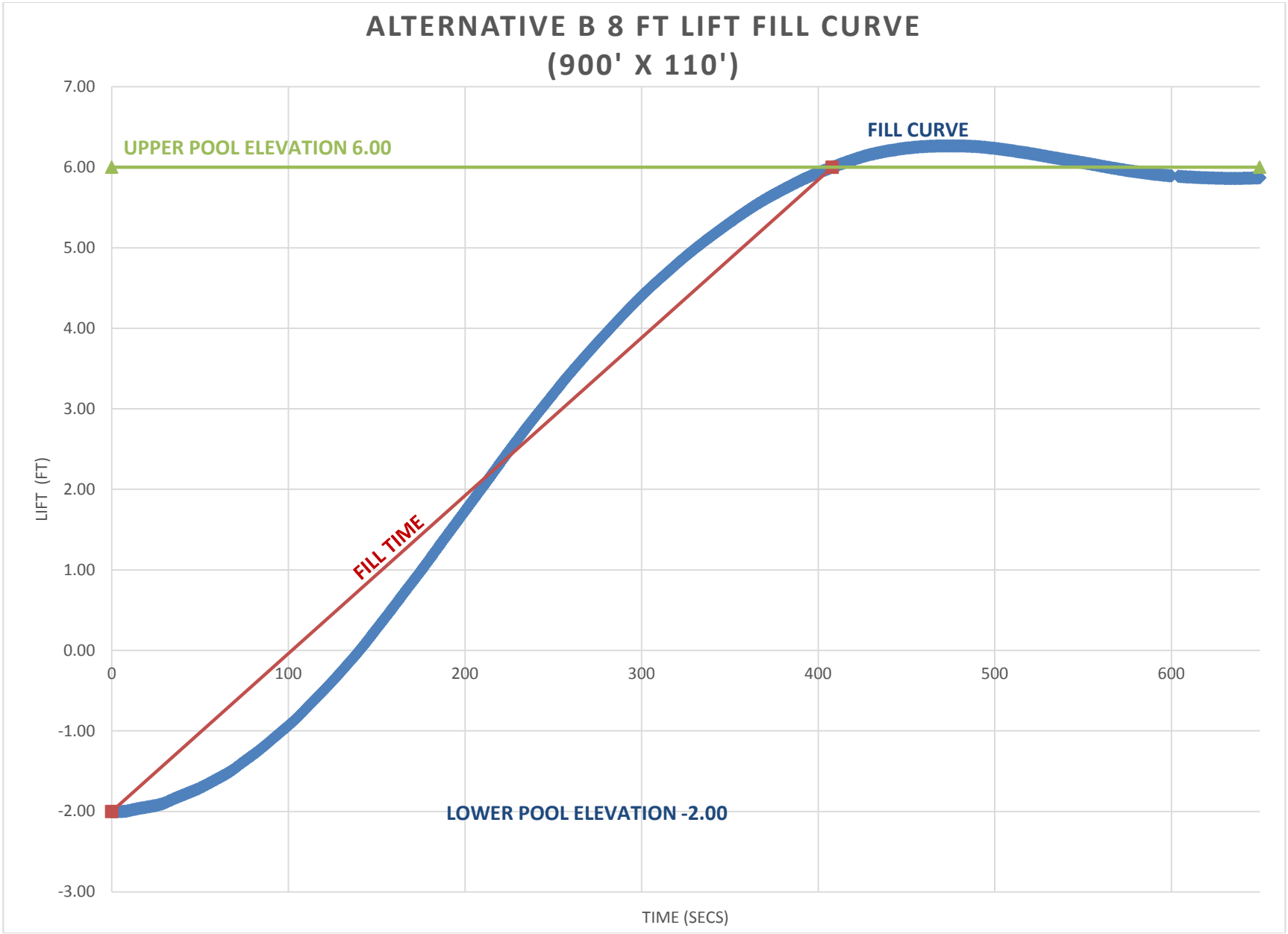

ALTERNATIVE A 8 FT LIFT FILL CURVE
(900' X 75')
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
-1.00
-2.00
-3.00
LIFT (FT)
0
50
100
150
200
250
300
350
400
450
500
TIME (SECS)
UPPER POOL ELEVATION 6.00
FILL CURVE
FILL TIME
LOWER POOL ELEVATION -2.00

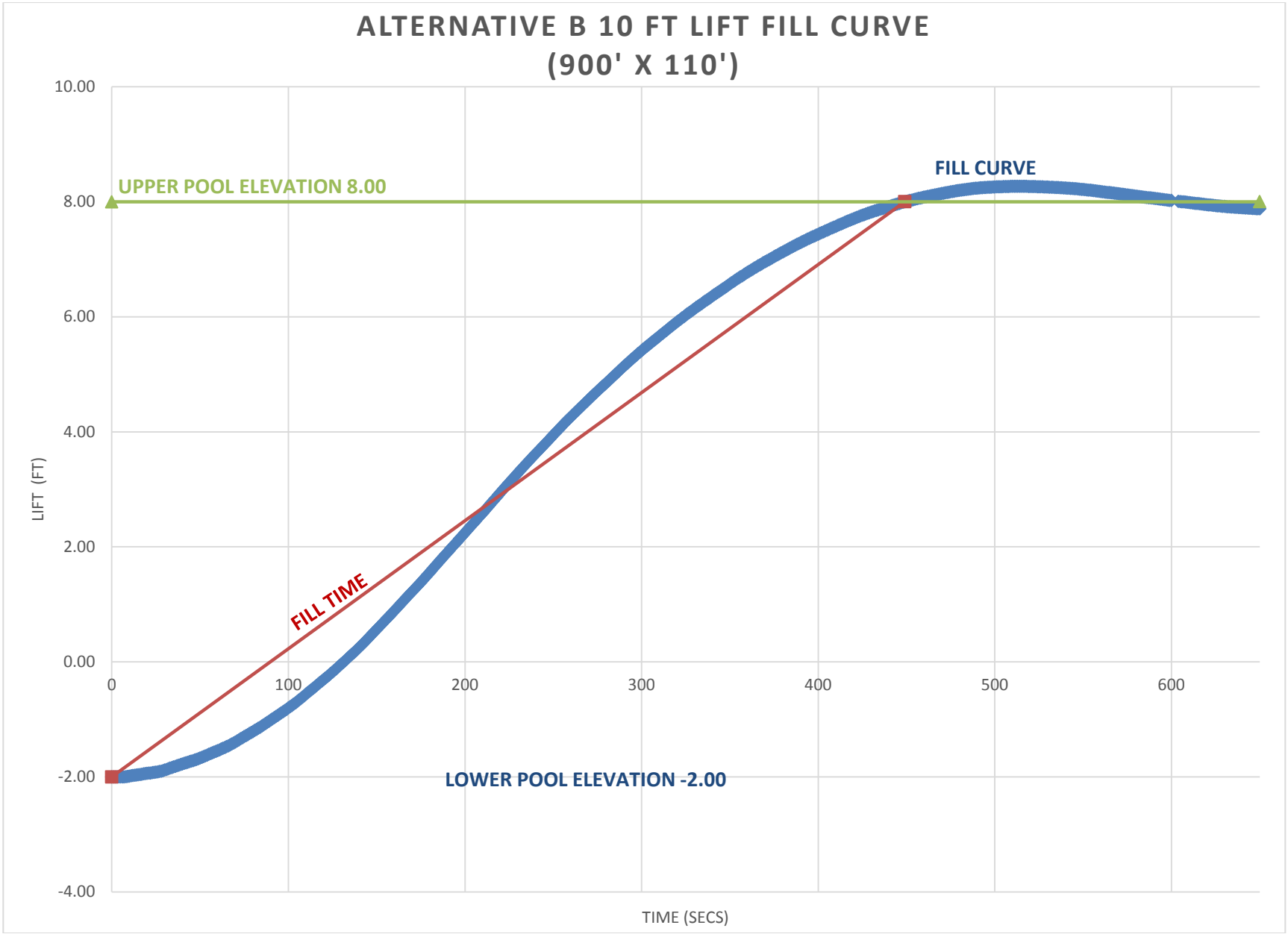

ALTERNATIVE A 10 FT LIFT FILL CURVE
(900' X 75')
10.00
8.00
6.00
4.00
2.00
0.00
-2.00
-4.00
LIFT (FT)
0
100
200
300
400
500
TIME (SECS)
UPPER POOL ELEVATION 8.00
FILL CURVE
FILL TIME
LOWER POOL ELEVATION -2.00

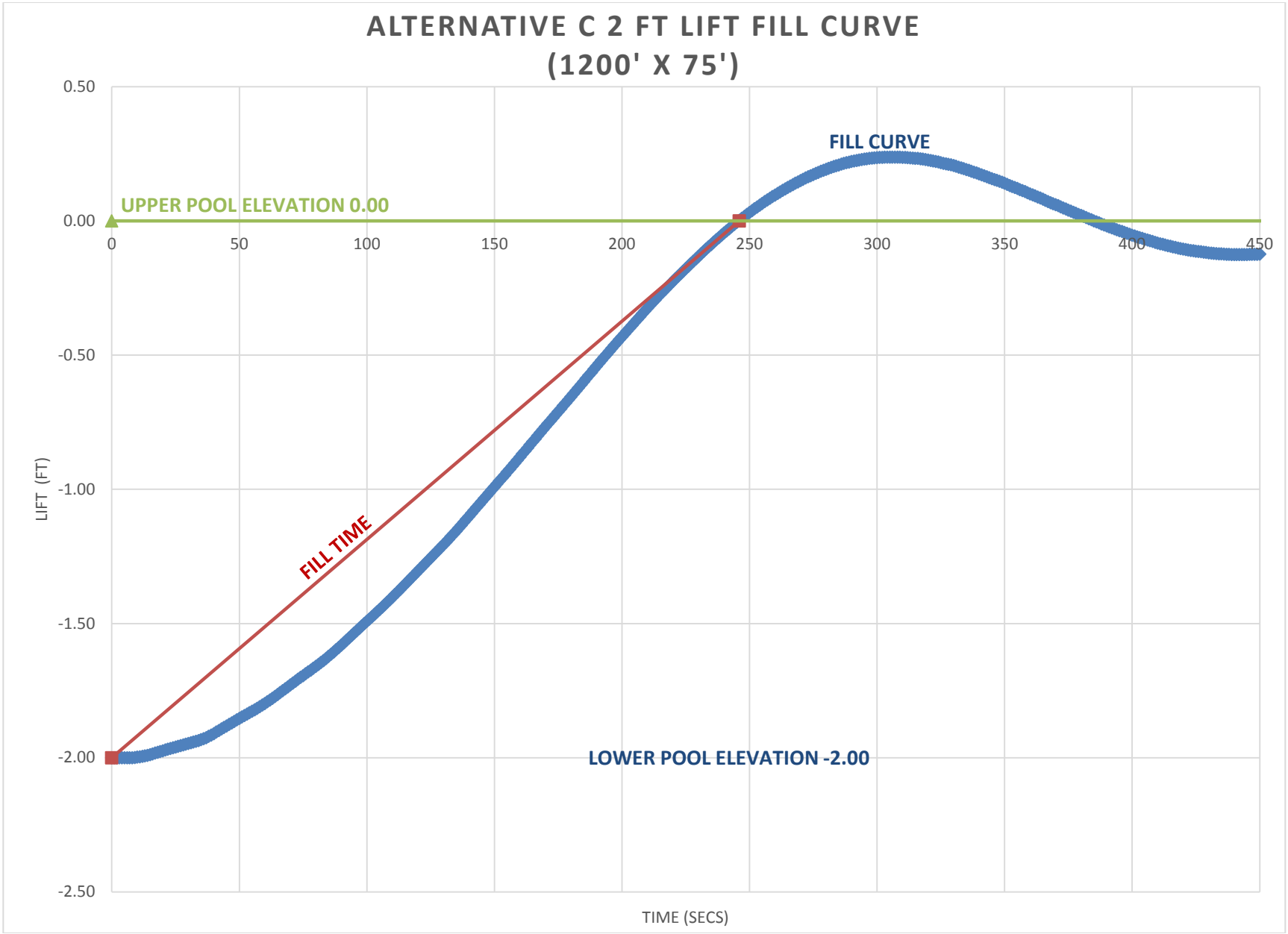

ALTERNATIVE B 2 FT LIFT FILL CURVE
(900' X 110')
0.50
0.00
-0.50
-1.00
-1.50
-2.00
-2.50
LIFT (FT)
0
50
100
150
200
250
300
350
400
450
500
TIME (SECS)
FILL CURVE
UPPER POOL ELEVATION 0.00
FILL TIME
LOWER POOL ELEVATION -2.00

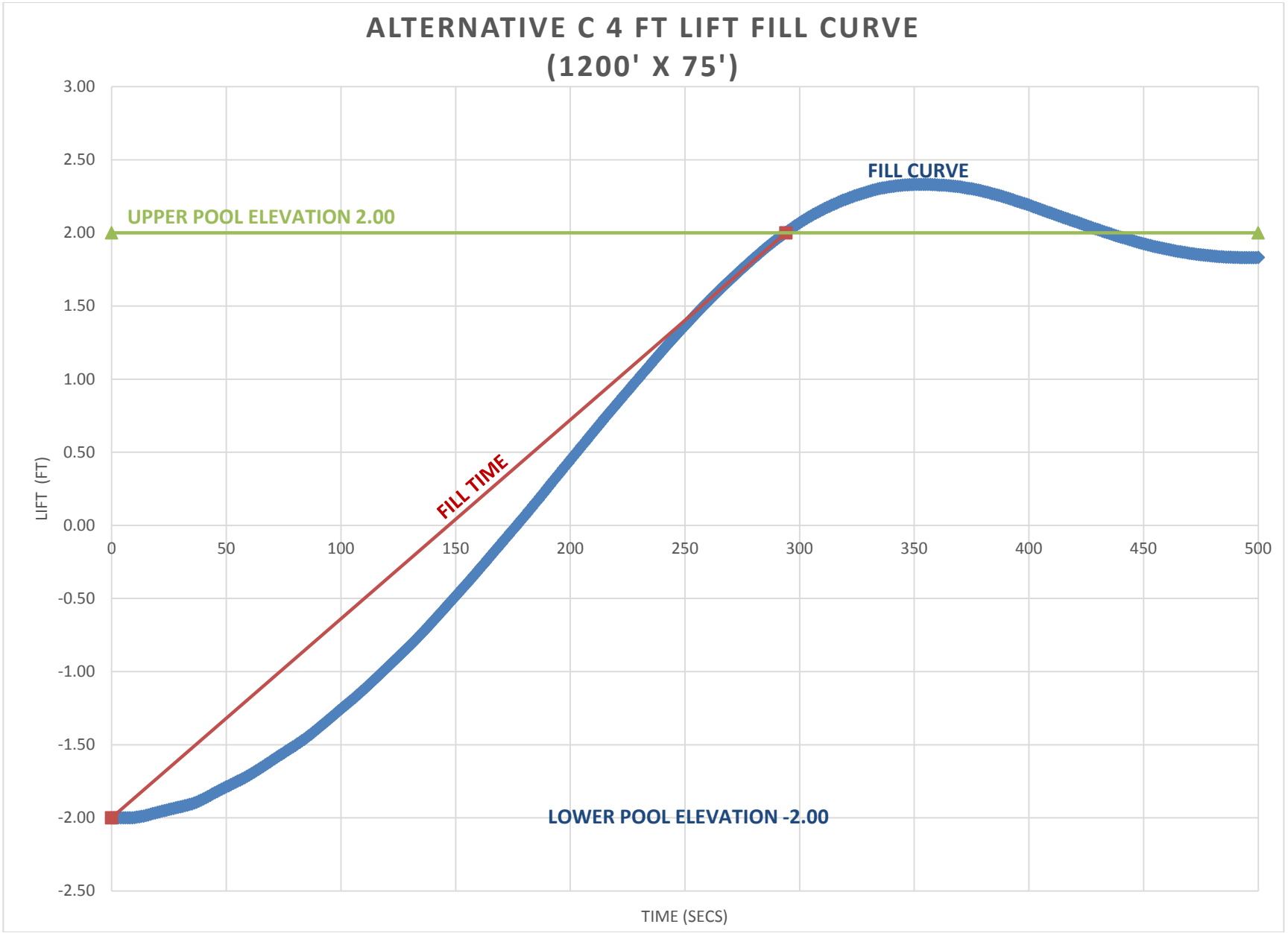

ALTERNATIVE B 4 FT LIFT FILL CURVE
(900' X 110')
2.50
2.00
1.50
1.00
0.50
0.00
-0.50
-1.00
-1.50
-2.00
-2.50
LIFT (FT)
0
100
200
300
400
500
TIME (SECS)
UPPER POOL ELEVATION 2.00
FILL CURVE
FILL TIME
LOWER POOL ELEVATION -2.00

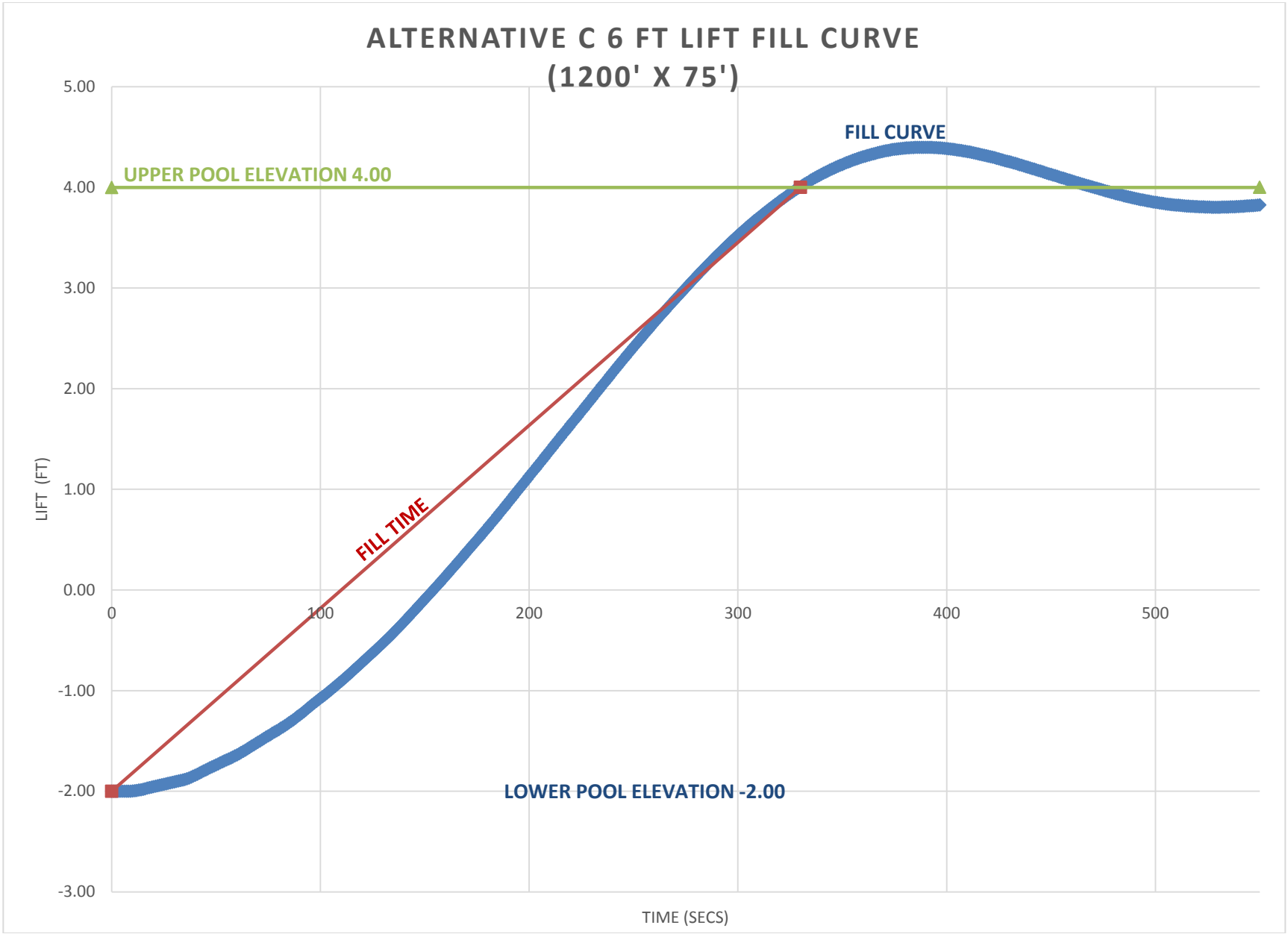

ALTERNATIVE B 6 FT LIFT FILL CURVE
(900' X 110')
5.00
4.00
3.00
2.00
1.00
0.00
-1.00
-2.00
-3.00
LIFT (FT)
0
100
200
300
400
500
TIME (SECS)
UPPER POOL ELEVATION 4.00
FILL CURVE
FILL TIME
LOWER POOL ELEVATION -2.00

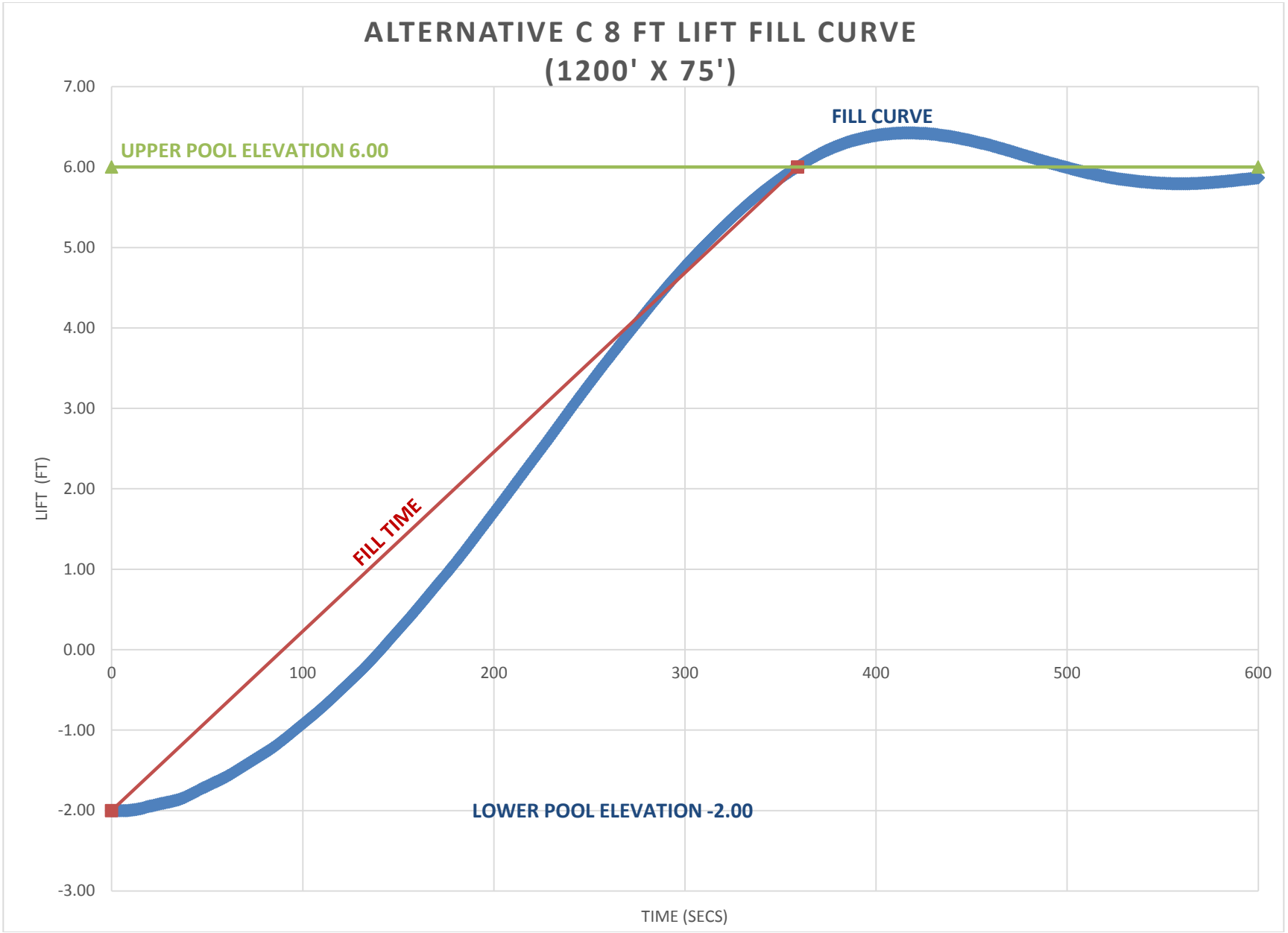

ALTERNATIVE B 8 FT LIFT FILL CURVE
(900' X 110')
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
-1.00
-2.00
-3.00
LIFT (FT)
0
100
200
300
400
500
600
TIME (SECS)
UPPER POOL ELEVATION 6.00
FILL CURVE
FILL TIME
LOWER POOL ELEVATION -2.00

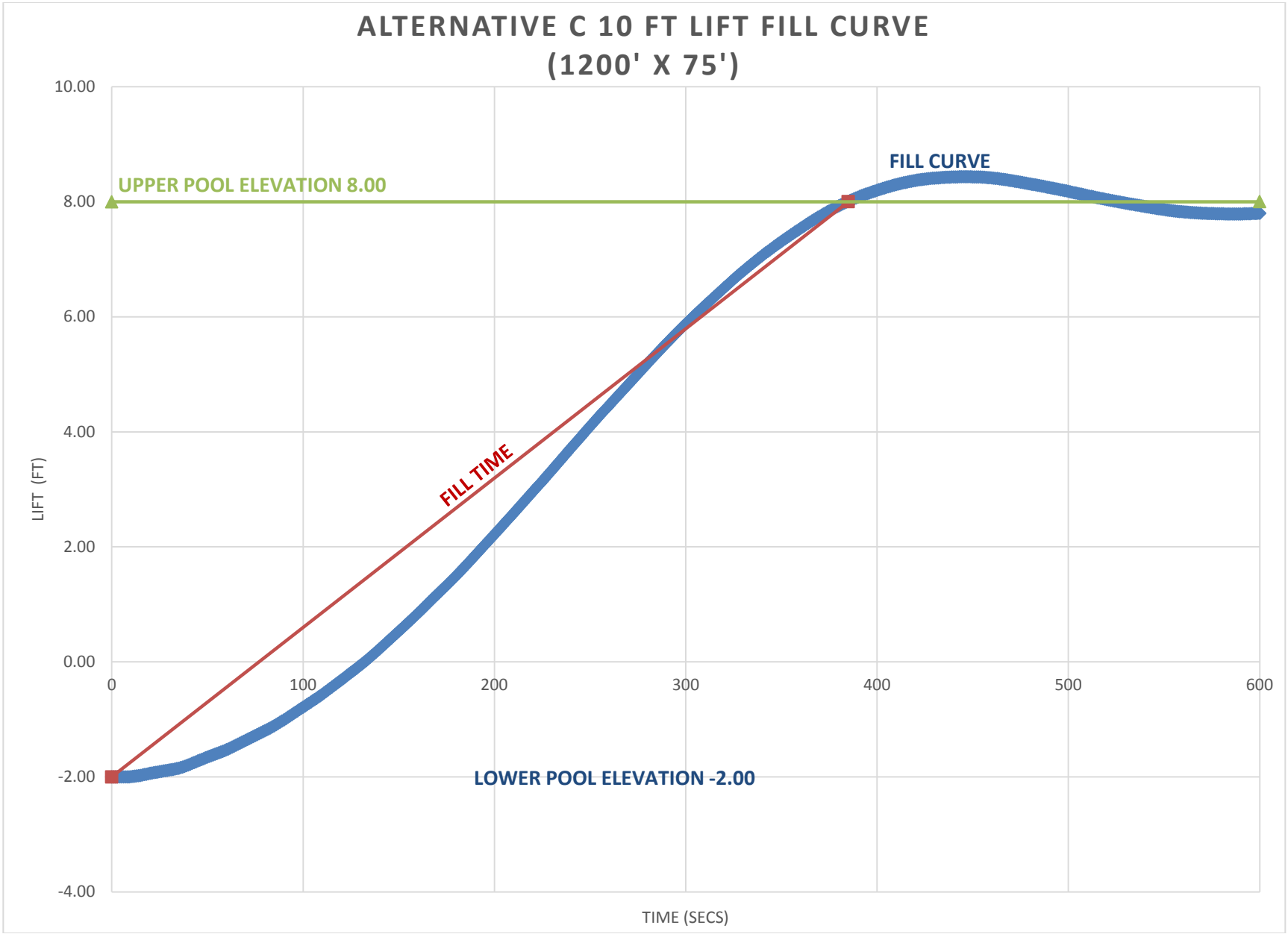

ALTERNATIVE B 10 FT LIFT FILL CURVE
(900' X 110')
10.00
8.00
6.00
4.00
2.00
0.00
-2.00
-4.00
LIFT (FT)
0
100
200
300
400
500
600
TIME (SECS)
UPPER POOL ELEVATION 8.00
FILL CURVE
FILL TIME
LOWER POOL ELEVATION -2.00

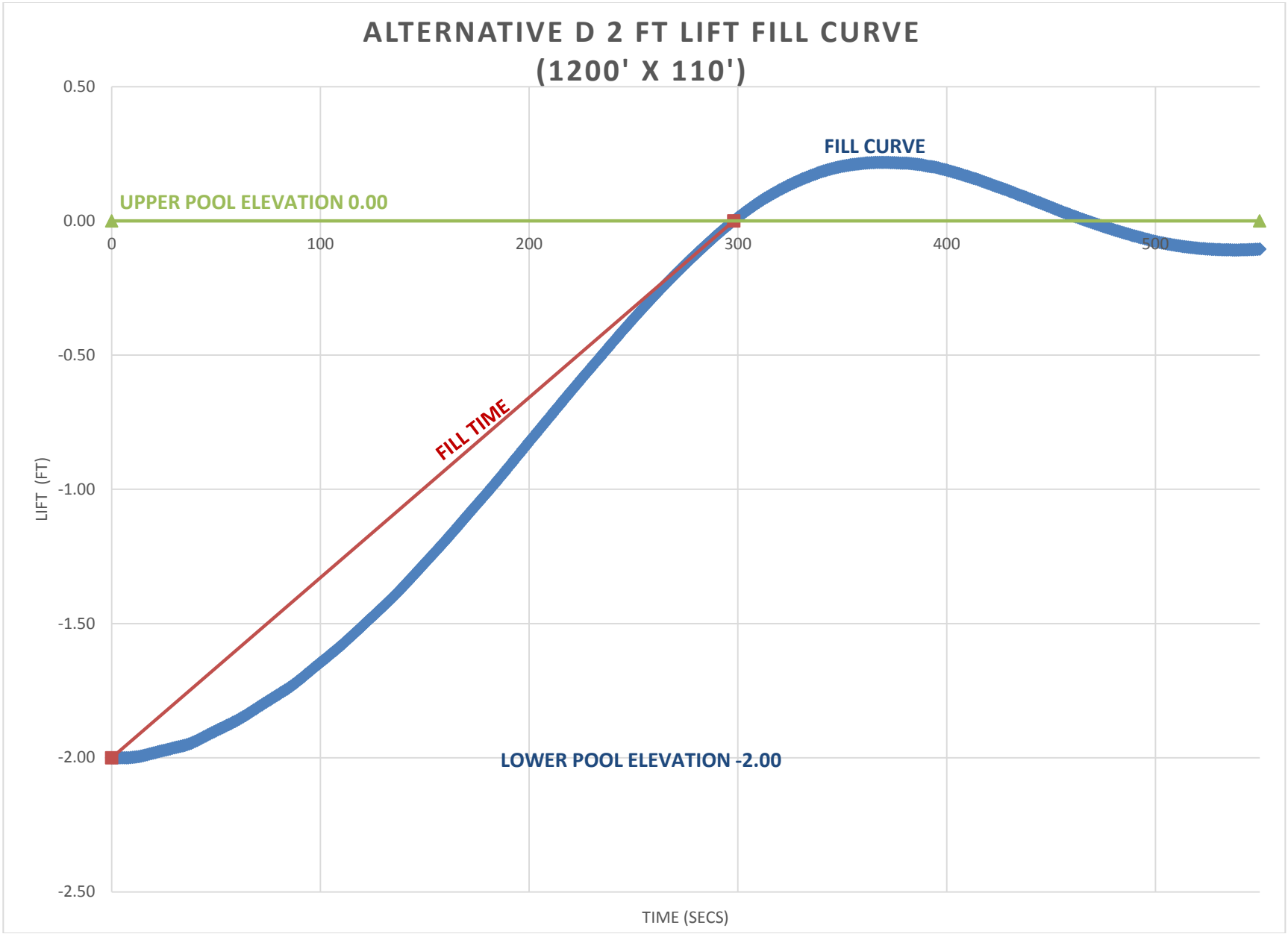

ALTERNATIVE C 2 FT LIFT FILL CURVE
(1200' X 75')
0.50
0.00
-0.50
-1.00
-1.50
-2.00
-2.50
LIFT (FT)
0
50
100
150
200
250
300
350
400
450
TIME (SECS)
FILL CURVE
UPPER POOL ELEVATION 0.00
FILL TIME
LOWER POOL ELEVATION -2.00

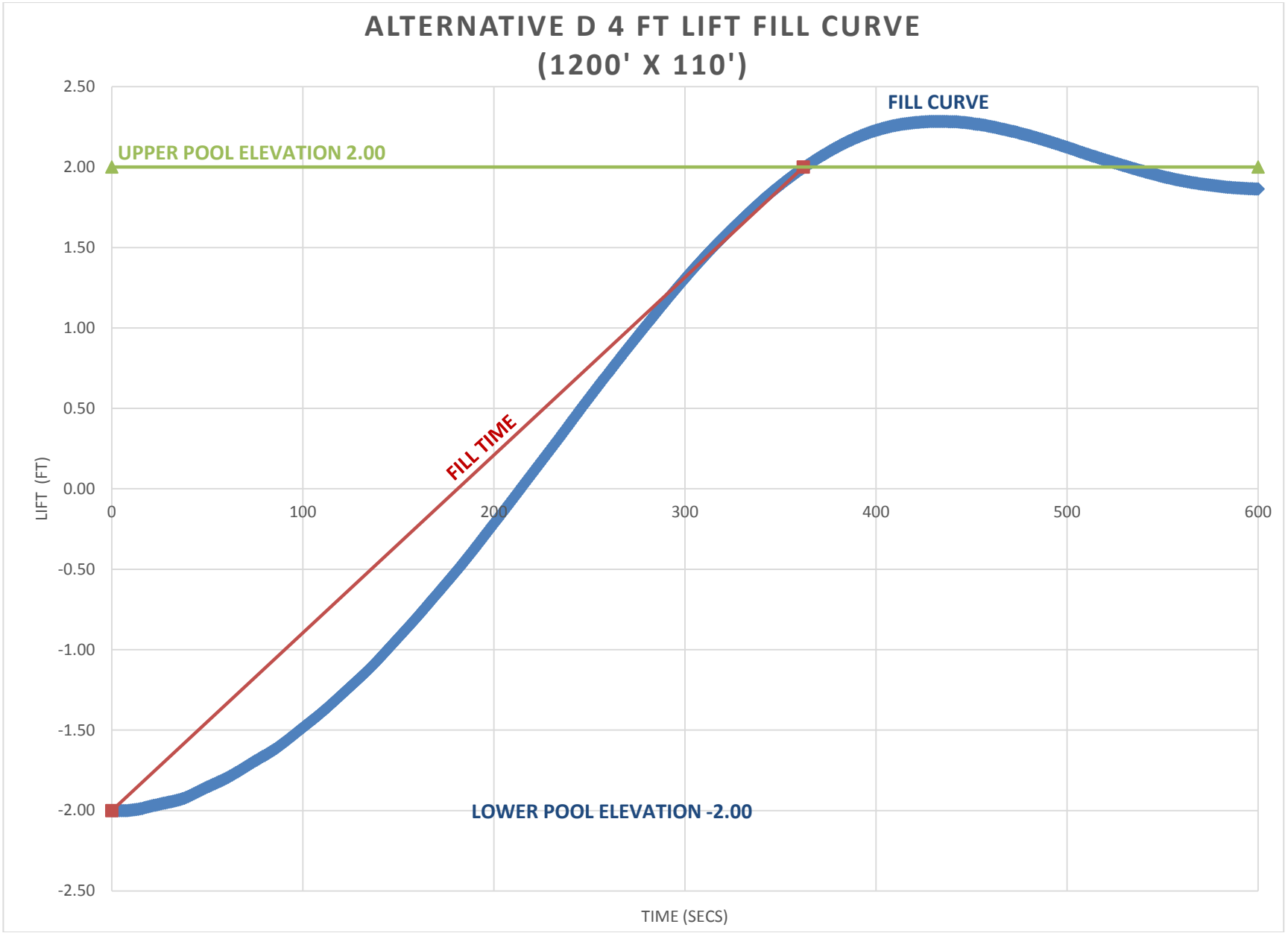

ALTERNATIVE C 4 FT LIFT FILL CURVE
(1200' X 75')
3.00
2.50
2.00
1.50
1.00
0.50
0.00
-0.50
-1.00
-1.50
-2.00
-2.50
LIFT (FT)
0
50
100
150
200
250
300
350
400
450
500
TIME (SECS)
FILL CURVE
UPPER POOL ELEVATION 2.00
FILL TIME
LOWER POOL ELEVATION -2.00

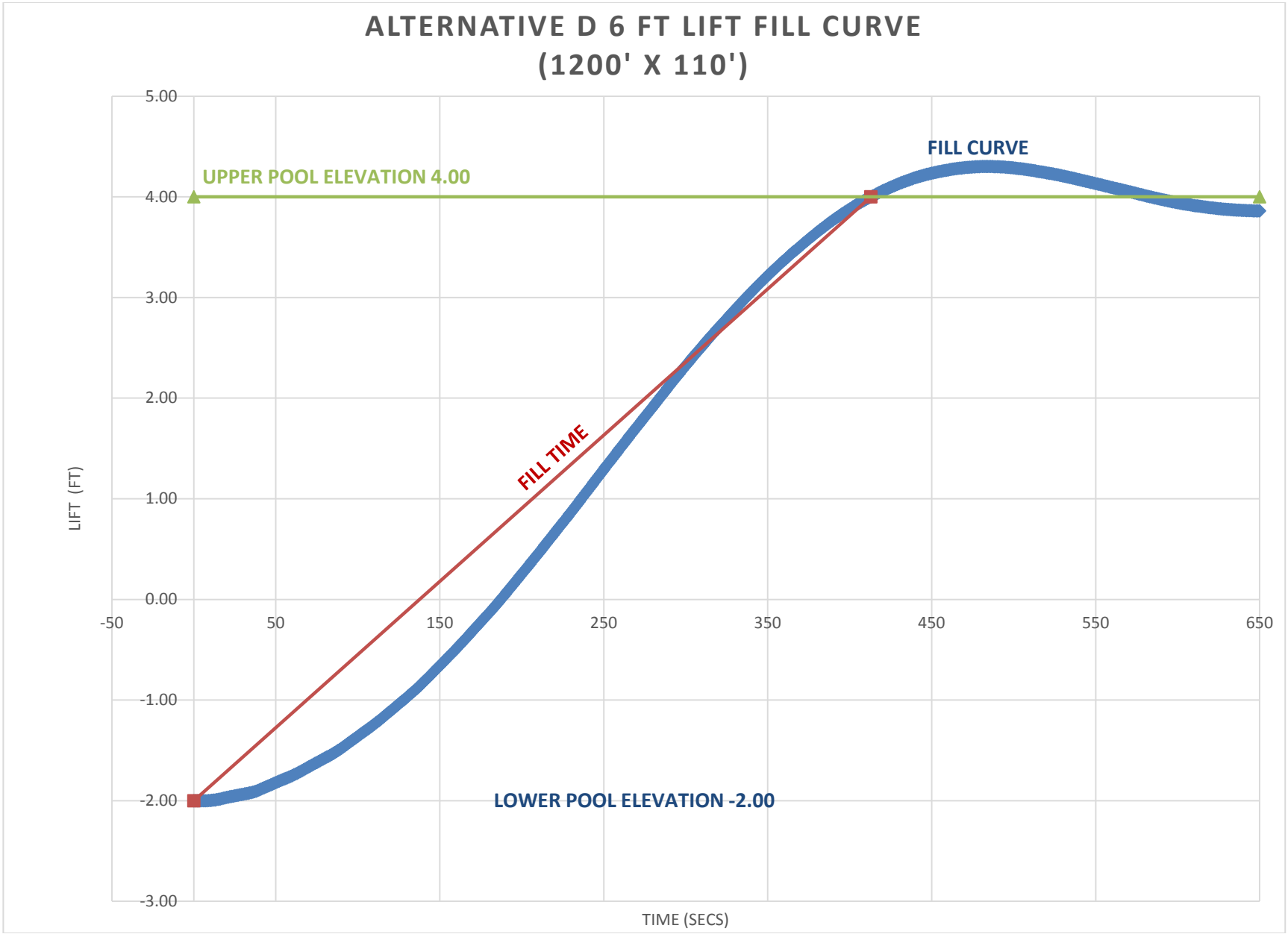

ALTERNATIVE C 6 FT LIFT FILL CURVE
(1200' X 75')
5.00
4.00
3.00
2.00
1.00
0.00
-1.00
-2.00
-3.00
LIFT (FT)
0
100
200
300
400
500
TIME (SECS)
UPPER POOL ELEVATION 4.00
FILL CURVE
FILL TIME
LOWER POOL ELEVATION -2.00

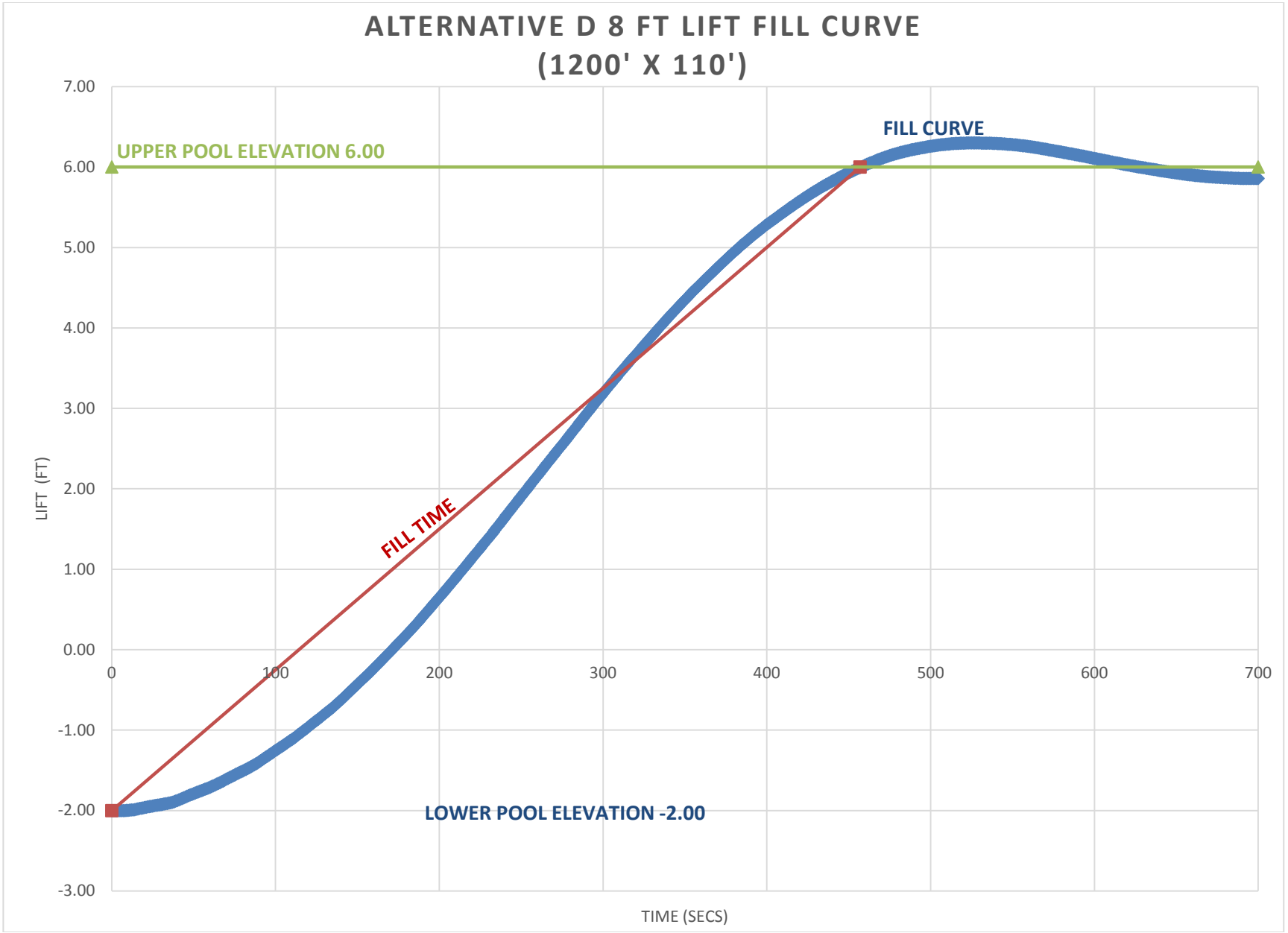

ALTERNATIVE C 8 FT LIFT FILL CURVE
(1200' X 75')
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
-1.00
-2.00
-3.00
LIFT (FT)
0
100
200
300
400
500
600
TIME (SECS)
FILL CURVE
UPPER POOL ELEVATION 6.00
FILL TIME
LOWER POOL ELEVATION -2.00

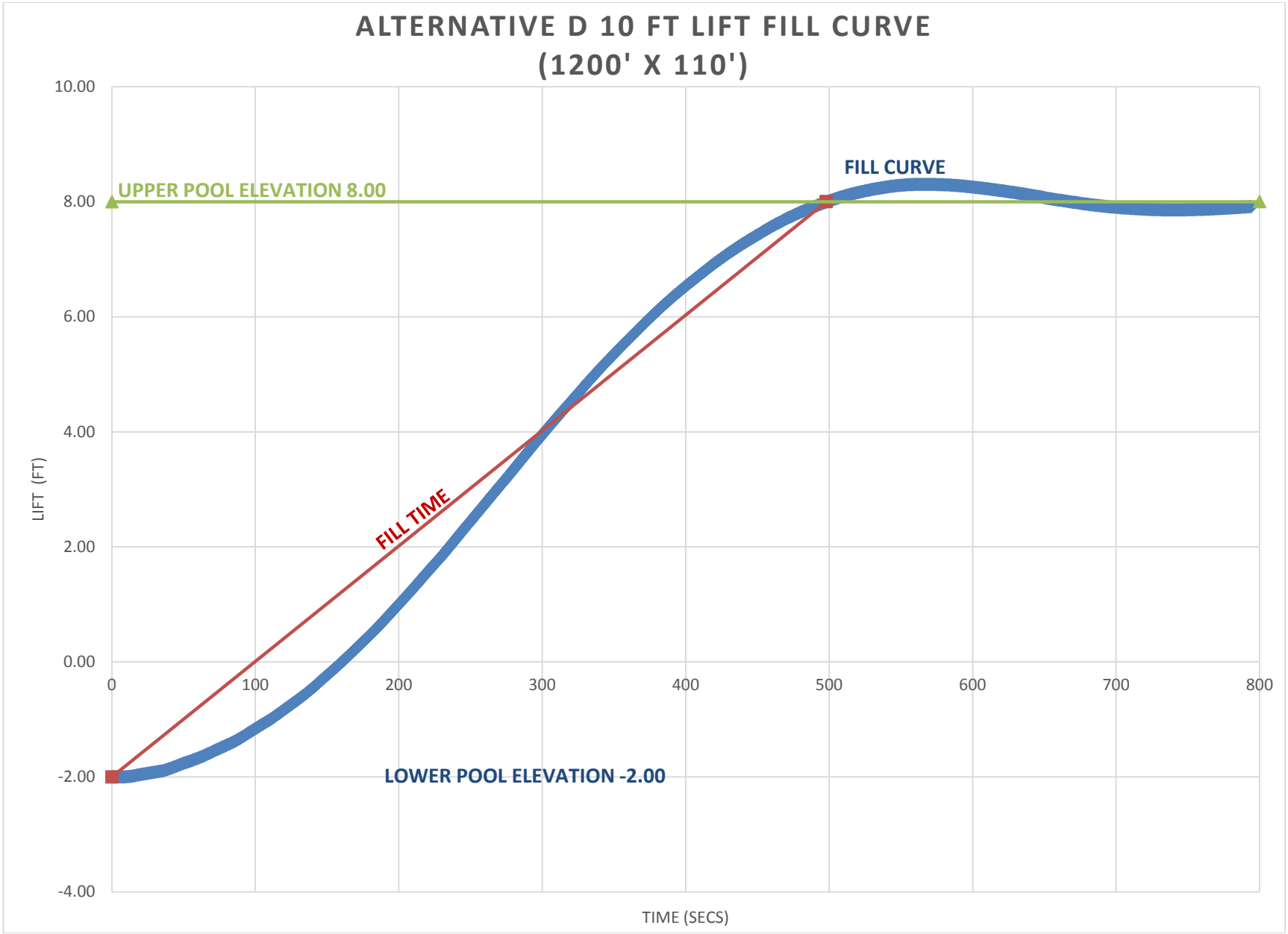

ALTERNATIVE C 10 FT LIFT FILL CURVE
(1200' X 75')
10.00
8.00
6.00
4.00
2.00
0.00
-2.00
-4.00
LIFT (FT)
0
100
200
300
400
500
600
TIME (SECS)
UPPER POOL ELEVATION 8.00
FILL CURVE
FILL TIME
LOWER POOL ELEVATION -2.00


ALTERNATIVE D 2 FT LIFT FILL CURVE
(1200' X 110')
0.50
0.00
-0.50
-1.00
-1.50
-2.00
-2.50
LIFT (FT)
0
100
200
300
400
500
TIME (SECS)
FILL CURVE
UPPER POOL ELEVATION 0.00
FILL TIME
LOWER POOL ELEVATION -2.00


ALTERNATIVE D 4 FT LIFT FILL CURVE
(1200' X 110')
FILL CURVE
UPPER POOL ELEVATION 2.00
FILL TIME
LOWER POOL ELEVATION -2.00
LIFT (FT)
TIME (SECS)
2.50
2.00
1.50
1.00
0.50
0.00
-0.50
-1.00
-1.50
-2.00
-2.50
0
100
200
300
400
500
600


ALTERNATIVE D 6 FT LIFT FILL CURVE
(1200' X 110')
5.00
4.00
3.00
2.00
1.00
0.00
-1.00
-2.00
-3.00
LIFT (FT)
-50
50
150
250
350
450
550
650
TIME (SECS)
UPPER POOL ELEVATION 4.00
FILL CURVE
FILL TIME
LOWER POOL ELEVATION -2.00


ALTERNATIVE D 8 FT LIFT FILL CURVE
(1200' X 110')
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
-1.00
-2.00
-3.00
LIFT (FT)
0
100
200
300
400
500
600
700
TIME (SECS)
UPPER POOL ELEVATION 6.00
FILL CURVE
FILL TIME
LOWER POOL ELEVATION -2.00


ALTERNATIVE D 10 FT LIFT FILL CURVE
(1200' X 110')
10.00
8.00
6.00
4.00
2.00
0.00
-2.00
-4.00
LIFT (FT)
0
100
200
300
400
500
600
700
800
TIME (SECS)
UPPER POOL ELEVATION 8.00
FILL CURVE
FILL TIME
LOWER POOL ELEVATION -2.00