THE CONTENTS OF THIS SECTION ARE
THE HIGHEST QUALITY AVAILABLE

INITIAL gj DATE 9/27/02

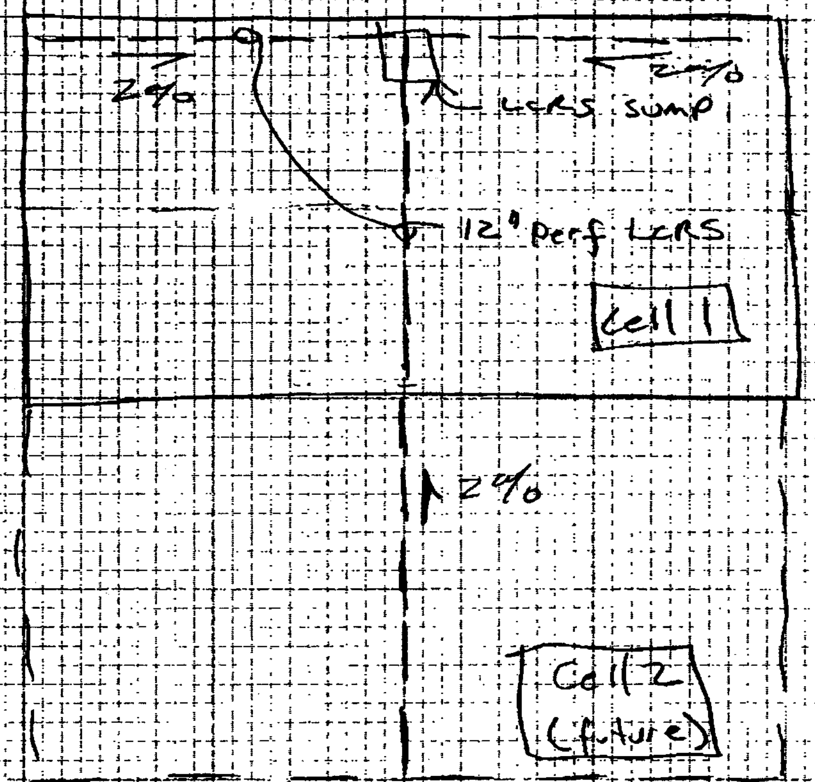
PAGE NUMBERING SEQUENCE IS INCONSISTENT

Appendix A

Leachate Collection System Components Calculations

A.1 Required Pipe Diameter Calculation

Subject: Flow Calculations for LCRS Collector Pipes



Max expected flow from LCRS Sump: 77 gpm, max pump rate expected per AELP Model & EDF 280 section 3.2

Check flow capacity of 12" SDR 11 pipe: I.D. = 10.4"

Use Manning Eqn. Nomograph. See attached Chart 7 from Driscopipe Systems Design Manual.

For 2 FT/100 FT slope (2%) and 10" pipe, Full Flow ≈ 600 gpm

Actual Flow Condition would be Partial flow, which is greater than Full Flow. However, Assume Full Flow Conservatively.

$F.S. = 600/77 = 7.8$

Note: 1.) No Single LCRS pipe would carry 77gpm, Actual flow/pipe << 77gpm.

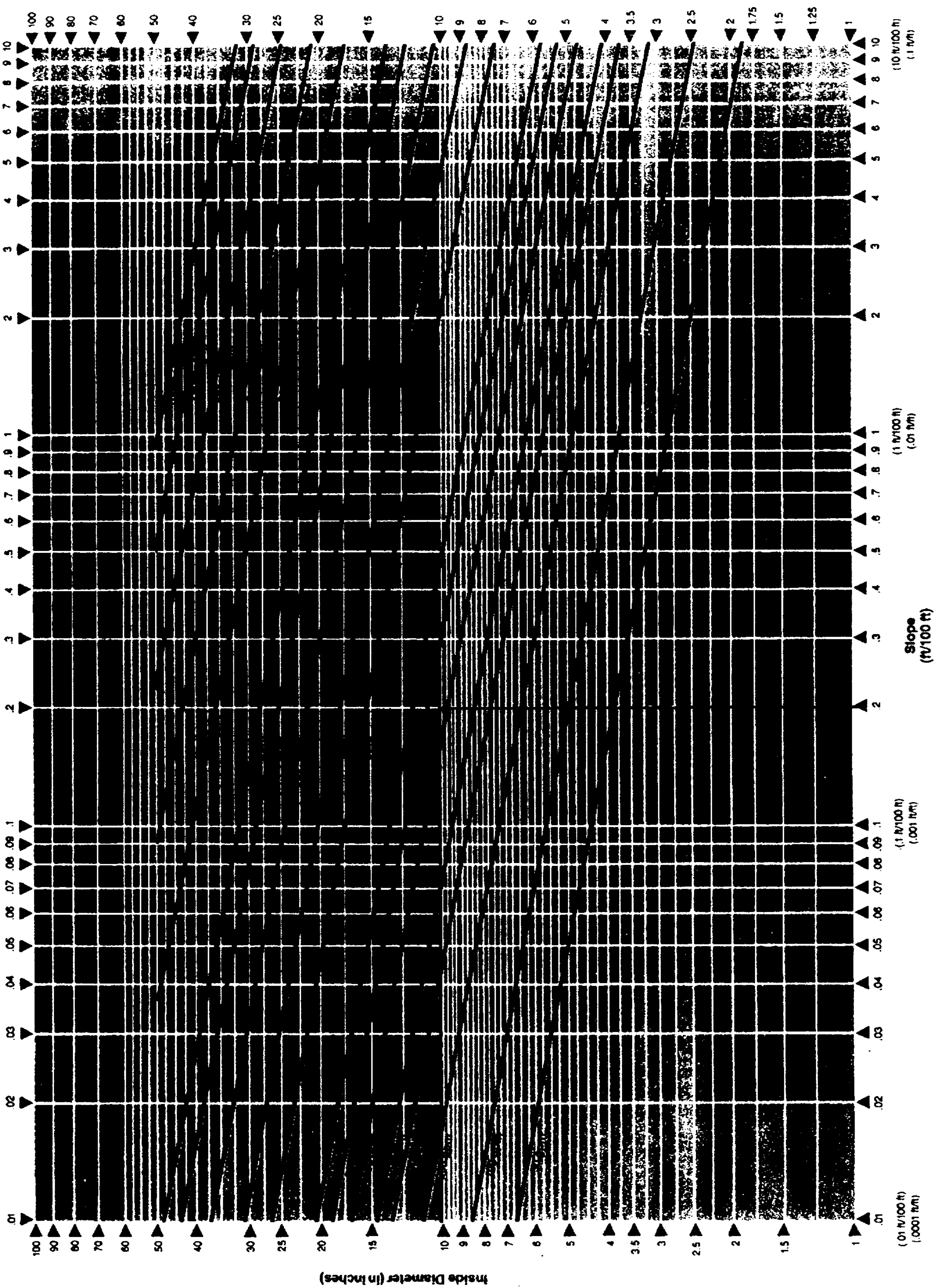
2.) 77gpm Flow is from sump, Actual flow thru LCRS pipe would be smaller component due to (1) and flow would be partially through LCRS gravel

3.) Pipe is perforated and may collect some fines from gravel; both would decrease flow efficiency. However, decrease in flow efficiency negligible compared to F.S. of 7.8

∴ 12" LCRS Pipe flow capacity is adequate.

Chart 7

Inside Diameter vs. Flow Rate at a Given Slope Gravity Full Flow: Water



A.2 Required Pipe Strength Calculation

CH2MHILL SUBJECT Pipe Loading During Operations, Cell 1 BY BT
SHEET NO. 1 of 2 DATE 9/01
PROJECT NO.

Pipe Loading During Operations:

Assume Min 3' Operations layer & H-20 loading

See Chart 20 from Driscopipe Systems Design Manual

H-20 loading meets or exceeds load of any vehicle expected/allowed in operations area.

Maximum load from chart: Approx 2000 psf combined Dead load (120 lb/ft³) + H20 Live Load & Impact with 16' of Cover.

Pipe Strength previously checked for full development of Cell 1. Pipe Strength was adequate for load

$P_T = 5{,}640$ psf

$$F.S. = \frac{5640}{2000} = 2.82$$

∴ Pipe Strength adequate for H-20 loading over operations layer

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Pipe loading During operations, Cell P   Page 2 of 2

wheel or axle weight should be increased by 50% to provide a pipe design with extra strength and endurance against the impact of these dynamic forces. The load at the top of the pipe caused by a superimposed dynamic load at point "A" is evaluated as:

$$P_B = \frac{3WZ^3}{2\pi R^5}$$

Where: W = 1½ times the superimposed dynamic load, pounds.

Z = Vertical distance from the point of load to the top of the pipe, feet.

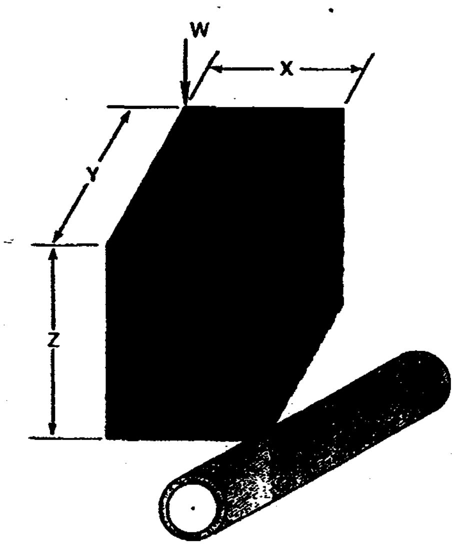
R = Straight line distance from point of load to the top of the pipe, feet.

$R = \sqrt{X^2 + Y^2 + Z^2}$

X and Y = Horizontal distances at 90° to each other from point of load to the top of the pipe, feet.

Unit underground pressures caused by a 1000 pound superimposed dynamic load is shown in Chart 28. Unit pressures for superimposed live loads can be obtained by multiplying the chart value by 1½ times the load ratio. Alternately, for heavy truck or railroad traffic, Charts 30 and 31 summarize the total pressure due to the weight of the soil alone together with the weight of the rolling vehicle. An allowance for impact is included in each of these two charts.

These graphs show that, beyond an optimum depth, the total pressure on the pipe increases due primarily to soil pressure. At shallower depths the load intensifies because it is nearer the rolling equipment and the live load is not as well distributed.



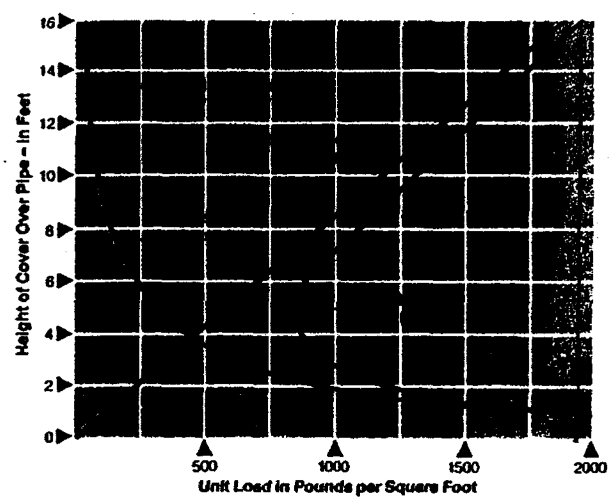
Note: If the live load pressure exceeds the capability of a specific SDR pipe for a specific traffic situation, the designer may want to consider the use of a steel or reinforced concrete casing to protect the pipeline.

P_i: Apparent External Pressure Due to Internal Vacuum:
Positive pressure generates a tensile hoop stress in the pipe wall. Under its influence the pipe will be trying to expand. The pressure of the soil around the pipe will be trying to crush the pipe as shown in this illustration.

In a positive pressure situation, the value of P_i is negative and theoretically should be subtracted from the other two external pressure components of P_t because it is counteracting the external soil pressure. However, a pipeline should not be designed such that internal pressure is required to support the pipeline to prevent collapse from soil pressure. At some point in the system's operations, the pipeline will be shut down. The support offered by positive pressure against collapse by external soil pressure should be viewed as a means of adding additional

Chart 30

H20 Highway Loading

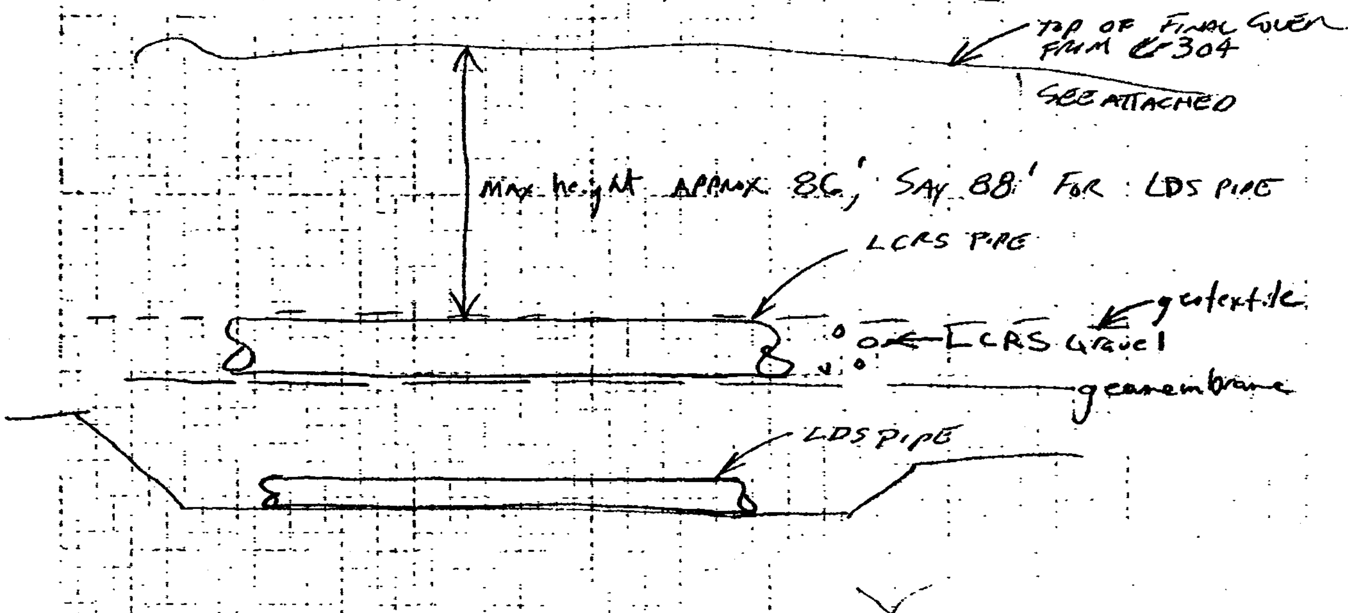


Note: The H20 live load assumes two 16,000 lb. concentrated loads applied to two 18" x 20" areas, one located over the point in question, and the other located at a distance of 72" away. In this manner, a truckload of 20 tons is simulated.

Source: American Iron and Steel Institute, Washington, D.C.

SUBJECT: PIPE LOADING CALCULATIONS FOR LDS & LCRS PIPING, CELL 1

USE DRISCOPIPE SYSTEMS DESIGN PROCEDURES



EXTERNAL PRESSURE ON PIPE

$P_T = P_S + P_L + P_i$; $P_S = P_D + P_W$, Assume water table ≈ 0, $P_w = 0$

P_S = STATIC PRESSURE. FROM MIKE REIMBOLD: HEAVIEST SOIL IS OPS LAYER - ALLUVIUM. WASTE LAYERS LIGHTER, BUT MAY CONTAIN SOME ALLUVIUM. CONSERVATIVELY, ASSUME 50% SOILS EQUIV TO OPS LAYER. FROM MIKE REIMBOLD:

OPS LAYER = 135 lb/CF @ MAX DENSITY & 5% MOISTURE

OTHER WASTE TOP SOILS = 117 lb/CF & 7% MOISTURE.

BOTH SOILS @ 80% MAX DENSITY

$P_S = \gamma h = \frac{1}{2}(88)(.80)[(1.05)(135)+(1.07)(117)]$ (FT)(lb/FT³)

$= 9396$ lb/FT² ⟹ 65.2 psi

P_L = LIVE LOAD, ASSUME ≈ 0 @ 88' DEPTH, ONLY VERY LIGHT VEHICLES ALLOWED ON FINAL COVER AND LOAD DISSIPATED AT 88 DEPTH

P_i - NO INTERNAL VACUUM.

$P_T = P_S = 65.2$ psi

Short Term Wall Crushing.

$S_A = \frac{(SDR-1)\,P_T}{2}$ Assume SDR = 11

$= \frac{(11-1)(65.2)}{2} = 326.2$ $FS = \frac{1500}{326.2}$ 4.6. (2.9)

∴ Wall Crush OK

Critical Collapse Pressure, P_C

$P_C = \frac{2.32E}{(SDR)^3}$

E = 24,000 From Chart 25, Drisco Assuming 50 yrs & SA = 320.
At Soil Temp = 50°F, E = 24,000 × 1.14 = 27,360 (Chart 33)

$P_C = \frac{2.32(27,360)}{(11)^3} = 47.7$ psi

For Deep Burial Applications, $P_T < \gamma H_i$ (Prism load)
Due to Significant Soil Arching Effects. Research By Selig on 24" HDPE Pipe w/ H=100' Indicated Vert Stress P Approx. 23% of Freefield Value, i.e. $P_T = .23\gamma H$. Conservatively Assume $P_T = .6\gamma H$ (F.S. = 2.6)

$P_T = .6(9,396) = 5,640$ psf.

Estimate E'

From Chart 26 w/ P_T = 5,640 psf And 85% of Standard Density,

$\varepsilon_s \triangleq 3.0$

$E' = \frac{5,640}{.03} = 188,000 = 1,305$ psi

$P_{CB} = 0.8\sqrt{(1,305)(47.7)} = 200.$

$F.S. = P_{CB}/P_T = 200/(5,640/144) = \underline{5.1}$ O.K.

Where: S_A = Actual compressive stress, psi
SDR = Standard Dimension Ratio
P_T = External Pressure, psi

Safety Factor = 1500 psi ÷ S_A where 1500 psi is the Compressive Yield Strength of Driscopipe.

Design by Wall Buckling: Local wall buckling is a longitudinal wrinkling of the pipe wall. Tests of *non-pressurized* Driscopipe show that buckling and collapse do not occur when the soil envelope is in full contact with the pipe and is compacted to a dense state. However, it can be forced to occur over the long term in *non-pressurized* pipe if the total external soil pressure, P_t, is allowed to exceed the pipe-soil system's critical buckling pressure, P_{cb}. If $P_t > P_{cb}$, gradual collapse may occur over the long term. A calculated, conservative value for the critical buckling pressure may be obtained by the following approximate formula. All pipe diameters with the same SDR in the same burial situation have the same critical collapse and critical buckling endurance

$$P_{cb} = 0.8\sqrt{E' \times P_c}$$

Where:

P_t = Total vertical soil pressure at the top of the pipe, psi

P_{cb} = Critical buckling soil pressure at the top of the pipe, psi

E' = Soil modulus in psi calculated as the ratio of the vertical soil pressure to vertical soil strain at a specified density

P_C = Hydrostatic, critical-collapse differential pressure, psi

$$P_C = \frac{2E\,(t/D)^3\,(D_{MIN}/D_{MAX})^3}{(1-\mu^2)}$$

$$P_c = \frac{2.32\,E'}{(SDR)^3}$$

Where: $(D_{MIN}/D_{MAX}) = .95$
μ = Poission's Ratio
μ = .45 for Driscopipe
E = stress and time dependent tensile modulus of elasticity, psi

In a direct burial pressurized pipeline, the internal pressure is usually great enough to exceed the external critical-buckling soil pressure. When a pressurized line is to be shut down for a period, wall buckling should be examined.

Design by Wall Buckling Guidelines:
Although wall buckling is seldom the limiting factor in the design of a Driscopipe system, a check of non-pressurized pipelines can be made according to the following steps to insure $P_t < P_{cb}$.

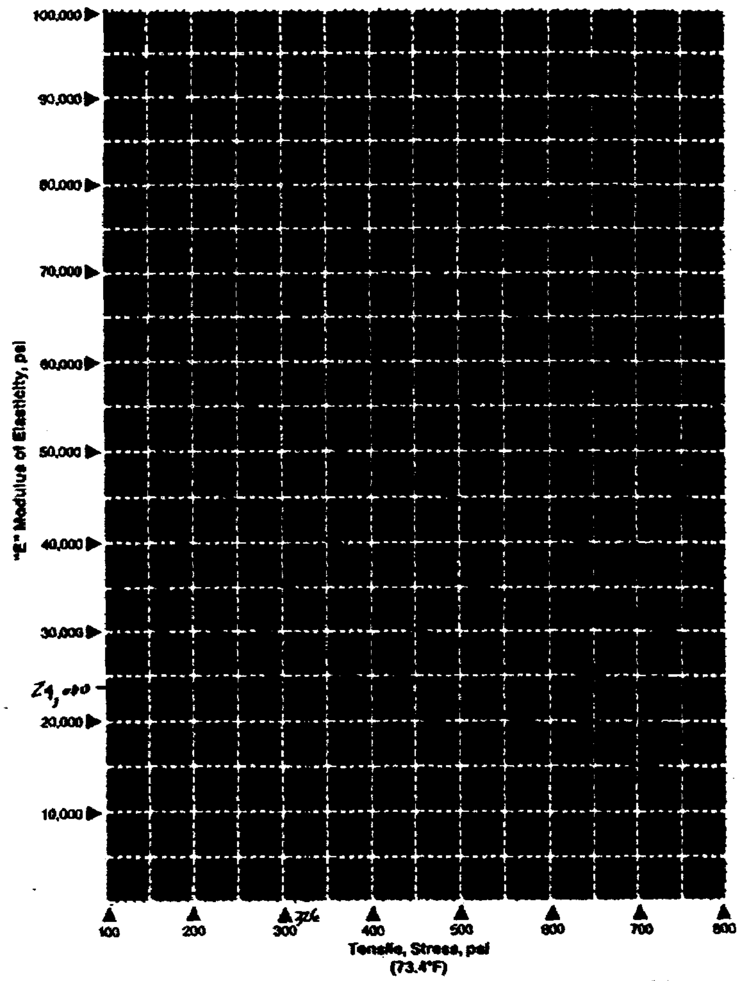
1. Calculate or estimate the total soil pressure, P_t, at the top of the pipe.
2. Calculate the stress "S_A" in the pipe wall according to the formula:

$$S_A = \frac{(SDR - 1)\,P_t}{2}$$

3. Based upon the stress "S_A" and the estimated time duration of non-pressurization, use Chart 25 to find the value of the pipe's modulus of elasticity, E, in psi.

Chart 25

Time Dependent Modulus of Elasticity for Polyethylene Pipe vs. Stress Intensity (73.4°F)



NOTE: The short term modulus of elasticity of Driscopipe per ASTM D 638 is approximately 100,000 psi. Due to the cold flow (creep) characteristic of the pipe material, this modulus is dependent upon the stress intensity and the time duration of the applied stress.

4. Based upon the pipe SDR and the value of the polyethylene modulus of elasticity, E, calculate the pipe's hydrostatic, critical-collapse differential pressure, P_C:

$$P_C = \frac{2.32\,(E)}{(SDR)^3}$$

5. Calculate the soil modulus, E', by plotting the total external soil pressure, P_t, against a specified soil density to derive the soil strain as shown in the example problem on Chart 26.
6. Calculate the critical buckling pressure at the top of the pipe by the formula:

$$P_{cb} = 0.8\sqrt{E' \times P_c}$$

7. Calculate the Safety Factor: S.F. $= P_{CB} \div P_t$
In burial applications, a safety factor of 1.0 may be considered a minimum because of the margin of safety provided by the arching action of the soil. However, Driscopipe endorses using a more conservative value approaching or exceeding a 2.0 safety factor.
8. The above procedures could be reversed to derive the minimum pipe SDR required for a given soil pressure and an estimated soil density. However, this procedure should permit the engineer to optimize the system design quickly by examining several combinations.

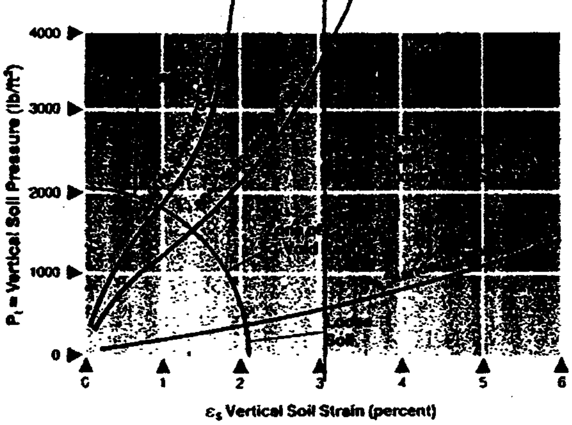
Chart 26

Plot of Vertical Stress-Strain Data for Typical Trench Backfill (Except Clay) from Actual Tests*

6000

5640

5000



EXAMPLE
Find: E' @ 2000 PSF and 80% Density
Formula: $E' = P_t/\varepsilon_s$
Calculations: E' = 2000 PSF / .018 = 111111 PSF = 771 psi

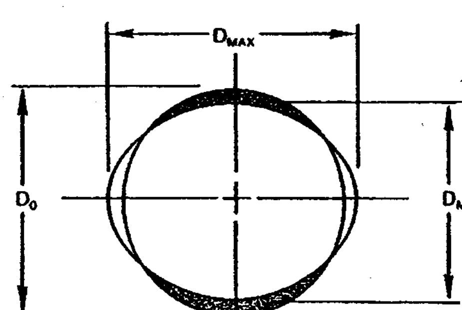
Note: The curves shown on this chart are sample curves for a granular soil. If other types of soil are used for backfill, such as clay or clay loam, curves should be developed from laboratory test data for the material used. Soil pressures greater than 4000 psf may be examined by extrapolating the slope of the curve or by generating curves by testing at those higher soil pressures. Probable error of curves is about half the distance between adjacent lines.

Design by Ring Deflection: Ring deflection is defined as the ratio of the vertical change in diameter to the original diameter. It is often expressed as a percentage. Ring deflection for buried Driscopipe is conservatively the same as (no more than) the vertical compression of the soil envelope around the pipe. Design by ring deflection matches the ability of Driscopipe to accommodate, without structural distress, the vertical compression of the soil enveloping the buried pipeline. *Design by ring deflection comprises a calculation of vertical soil strain to ensure it will be less than the allowable ring deflection of the pipe.* See Chart 27. The tabulation shows that with lower values of SDR, the allowable deflection is less. For installations which require this thicker wall to resist the external soil pressure, actual ring deflection can easily be limited to the tabular values by proper compaction of the backfill around the pipe. The recommended allowable deflection for the various SDRs are:

Chart 27

SDR	Allowable Ring Deflection
32.5	8.1%
26.0	6.5%
21.0	5.2%
19.0	4.7%
17.0	4.2%
15.5	3.9%
13.5	3.4%
11.0	2.7%

The allowable ring deflection of polyethylene pipe is a function of the allowable tangential strain in the outer surface of the pipe wall. A conservative limit of 1-1½% tangential strain in the outer surface of the pipe wall due to vertical deflection of the pipe "ring" by soil compression can be understood by comparing two pipes of the same diameter but different wall thickness.



$$\%\text{ Ring Deflection} = \left(1 - \frac{D_{MIN}}{D_0}\right) \times 100\%$$

NOTE: 5% deflection decreases flow-area by ¼%. 10% deflection decreases flow-area by 1%.

Type 4: Marine Pipelines

Introduction: The primary design criteria for submerged and weighted pipelines are (a) the critical collapse pressure for empty or partially full pipelines, (b) weight of the concrete anchor and (c) spacing of the concrete anchors. Even though a marine pipeline is sometimes buried in an underwater trench, any support that the pipeline receives from the backfill material should be ignored for design purposes.

Driscopipe can be buried, rest on the bottom or floated on the surface of lakes, rivers, marshes or oceans. Its characteristics of flexibility, light weight, inertness to saltwater and chemicals, continuous pipeline due to butt fusion and the ability to float even when full of water give polyethylene many advantages.

The design of the external weights for water installations is a matter of preference. The weights are normally made to order by precast concrete manufacturers or by the contractor at the job site. These weights can be designed to hold the pipe away from the bottom using weights as legs or in a trench or directly on the bottom. It is advisable for weights for pipes larger than 12" to have reinforcing steel for strength. It is also recommended that one turn of rubber gasketing material or 2 to 3 turns of 5 to 10 mil polyethylene sheet be wrapped around the pipe under the weight to act as a cushion and prevent damage to the pipe.

Critical Collapse Pressure: A marine pipeline does not receive any structural support from the surrounding water. Therefore, an empty or partially filled non-pressure pipeline is subject to long-term hydrostatic collapse. A marine pipeline that is full of water at all times, such as an outfall or intake line, is not subject to collapse because the internal pressure will equal the external pressure at any specific depth of water.

Chart 32, shown below, gives design levels for empty or partially filled marine pipelines. These pressures represent the safe maximum differential pressures which can be applied to Driscopipe without buckling or collapsing the pipe. These values are based on extensive long-term differential pressure test data on actual lengths of pipe. The collected test data were mathematically analyzed and used to calculate performance limits for all pipe SDRs considering various degrees of original ovality. The values in Charts 32 and 33 are the calculated lower tolerance limits derived from the test data and represent the level of external differential pressure at which the risk of pipe collapse becomes insignificant. Pipe collapse in this test work was defined as that point where the major deflected diameter was 20% greater than the original undeflected diameter. Copies of the test results and data analysis are available upon request.

Chart 33

Multiplier for Temperature Rerating External Pressure Differential

Temperature °F	Temperature °C	Multiplier
50	10	1.14
73.4	23	1.00
100	38	0.79
120	49	0.62
140	60	0.50

Anchor Weights: The dry land weight of the concrete anchors may be calculated from the following formula. The designer should note that concrete varies in density between 140 lbs./cu. ft. and 155 lbs./cu.ft. and the "K" constant is an anchor constant. Where K = 1.0, neutral buoyancy is achieved. Where K = 1.3, the pipe should be adequately anchored for lakes, ponds and streams. Where current or tides are encountered, the designer may want to increase the K value to nearly 1.5 depending upon design factors and his judgment.

$$Wt^{Conc} = \frac{L(Wt^{Driscopipe} + Wt^{Product}) - (K \times Den^{Water} \times V(out)^{Driscopipe} \times L)}{\left(\frac{K \times Den^{Water}}{Den^{Conc}}\right) - 1}$$

Chart 32

Maximum External Hydrostatic Pressure Differential (on Externally Unsupported Pipe)

Feet of Water Head @ 73.4°F

Service Life	Pipe SDR 7	9.3	11	15.5	17	19	21	26	32.5
1 day	437	337	202	83	65	48	36	18	10
1 month	249	192	147	54	34	28	22	10	6
1 year	232	180	111	50	32	23	17	10	5
50 years	204	159	97	44	29	22	17	9	4

Based on critical collapse testing of actual pipe samples.
Full Vacuum is 34 feet of water.

CH2MHILL SUBJECT Slot Size In LCRS/LDRS Piping — BY BT — SHEET NO. 1 of 1 DATE 9/01 — PROJECT NO. 162970

PIPE PERFORATION SIZE VS. LCRS/LDRS GRAVEL SIZE

PIPE SIZE PERFORATIONS

*d_{85} Filter mtl. > 1.2 slot width

where Filter material = Gravel mtl surrounding pipe.

d_{85} From LCRS/LDRS Gravel Analysis:

d_{85} = 40mm = 1.6"

$d_{85} > 1.2\ S_w$

Slot Size Max = 0.250"

1.6" > 1.2(.250")

1.6" > 0.30" O.K.

* Sharma & Lewis Waste Containment Systems

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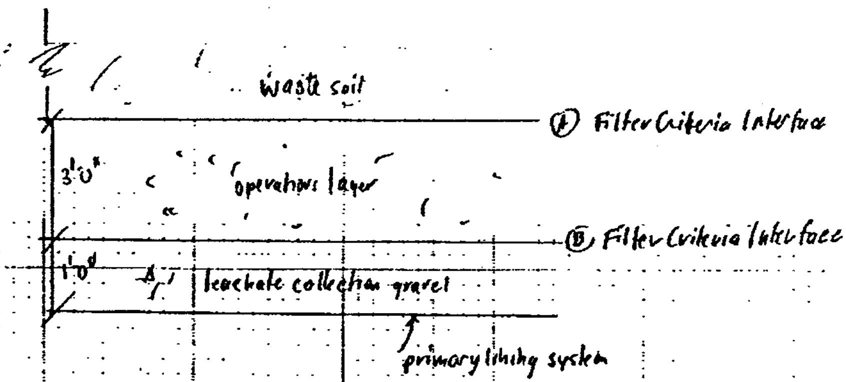
A.3 Filter Criteria Calculations

Determine: Review Filter Criteria of native alluvium with overlying waste soil and underlying LC gravel to determine need for separation geotextile shown in 30% design package

Given:



Properties of soil layers:

a) operations layer ⇒ native alluvium from ICDF landfill excavation
2 samples taken from excavation were tested for gradation:
(CC-07; 08) D_{85} = 35mm ; D_{15} = 0.42 mm

b) LC Gravel ⇒ native alluvium screened to plus #10 sieve (2.0mm)
Same 2 samples adjusted for + #10 sieve:
D_{85} = 37mm ; D_{15} = 5mm

c) Waste soil ⇒ most conservative assumption is to use silty surface soils placed immediately above ops layer.
- From geotech report (DOE-ID 10812, 2000) avg surface soils have P_{200} = 40% for this gradation D_{85} = 9mm ; D_{15} = 0.01 mm
- For most conservative using highest fines surface soil gradation
D_{85} = 1.5mm ; D_{15} = 0.003 mm

Approach: Using standard practice for graded filter criteria (NAVFAC 7.1-273)
2 criteria must be achieved:

(1) Avoid head loss in filter and sufficient permeability.

$$\frac{D_{15\,filter}}{D_{15\,soil}} \geq 4.0$$

(2) Retention of fine particles

$$\frac{D_{15\,filter}}{D_{85\,soil}} \leq 5.0$$

⇒ Filter interface (A) b/w waste soil (soil) and ops layer (filter):

(1) $\frac{D_{15\,filter}}{D_{15\,soil\text{-}avg}} = \frac{0.42\,mm}{0.01\,mm} = 42$ OK >> 4.0 ✓

$\frac{D_{15\,filter}}{D_{15\,soil\text{-}high\,fines}} = \frac{0.42}{0.003} = 140$ OK >> 4.0

(2) $\frac{D_{15\,filter}}{D_{85\,soil\text{-}avg}} = \frac{0.42}{9\,mm} = 0.05$ OK < 5.0

$\frac{D_{15\,filter}}{D_{85\,soil\text{-}high}} = \frac{0.42}{1.5} = 0.28$ OK << 5.0

⇒ Filter Interface (B) b/w ops layer (soil) and LC gravel (filter):

(1) $\frac{D_{15\,filter}}{D_{15\,soil}} = \frac{5.0}{0.42} = 11.9$ >> 4.0 OK

(2) $\frac{D_{15\,filter}}{D_{85\,soil}} = \frac{5.0}{35.0} = 0.14$ << 5.0 OK

→ Also check waste soil as base over LC gravel as filter:

① $\frac{D_{15f}}{D_{15\,soil-avg}} = \frac{5.0}{0.01} = 500 \gg 4.0$ OK

$\frac{D_{15f}}{D_{15\,soil-high}} = \frac{5.0}{0.003} = 1667 \gg 4.0$ OK

② $\frac{D_{15\,filter}}{D_{85\,soil\,avg}} = \frac{5.0}{9.0} = 0.56$ OK < 5.0

$\frac{D_{15\,filter}}{D_{85\,soil\,high}} = \frac{5.0}{1.5} = 3.33$ OK < 5.0

** Calculations show that native alluvium as ops layer and alluvium screened to + #10 for LC gravel meet graded filter criteria w/o need for separation geotextile. Even for the scenario with high fines waste soil directly on LC gravel as filter. (60%)

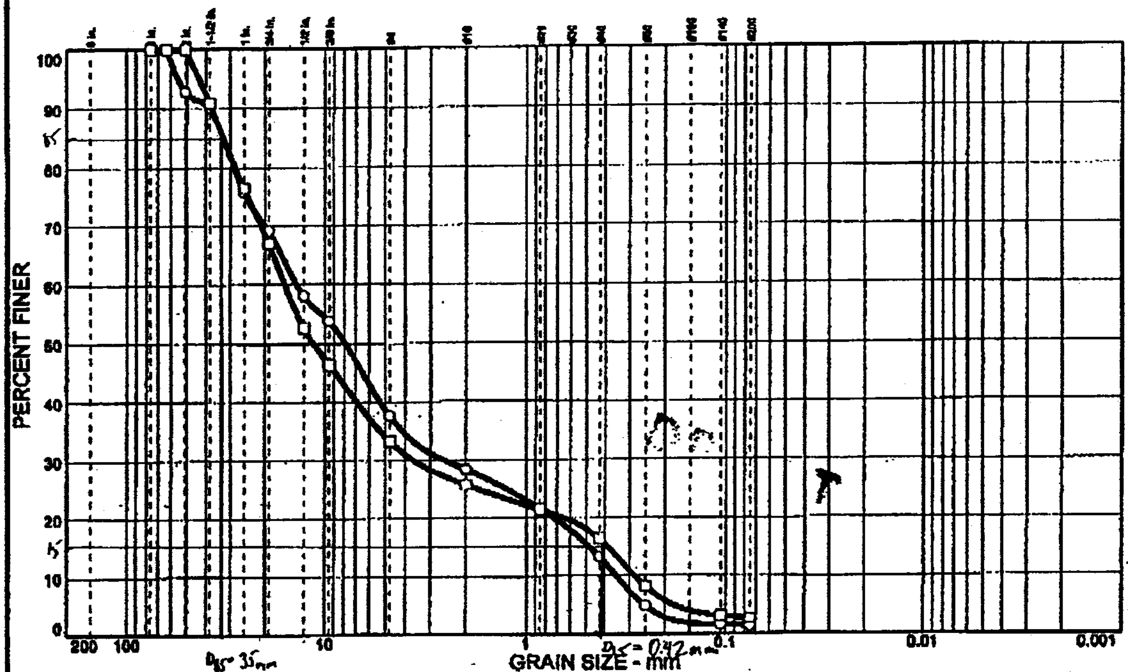
Recommend eliminating separation geotextile b/w ops layer and LC gravel with 2 conditions:

① continue to sample native alluvium during excav (1/2000cy) to verify gradations used for filter criteria analysis are representative

② limit high fines content of waste material placed in upper (first) 2 feet over ops layer. Recommend that material with fines percent (P200) greater than 50% for the first 2 feet above ops layer.

Alluvium - Ops Layer

Particle Size Distribution Report



	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
O		62.4	36.2	1.4		GW			
□	0.0	66.7	30.7	2.6		GW			

SIEVE inches size	PERCENT FINER O	PERCENT FINER □	
3	100.0	100.0	
2.5	100.0	100.0	
2	92.8	100.0	
1.5	90.0	90.8	
1	75.7	76.5	
.75	69.1	66.9	
.5	58.1	52.7	
.375	53.8	46.5	
	GRAIN SIZE		
D_{60}	13.8	15.8	
D_{30}	2.56	3.64	
D_{10}	0.350	0.283	
	COEFFICIENTS		
C_c	1.36	2.97	
C_u	39.38	55.94	

SIEVE number size	PERCENT FINER O	PERCENT FINER □	
#4	37.6	33.3	
#10	28.4	25.8	
#20	21.6	21.4	
#40	13.3	16.4	
#60	4.8	8.2	
#140	1.6	3.0	
#200	1.4	2.6	

SOIL DESCRIPTION

O Well-graded gravel with sand

□ Well-graded gravel with sand

REMARKS:

O classification based on grainsize only

□ classification based on grainsize only

O Source: CCI Sample No.: CCI-017

□ Source: CCI Sample No.: CCI-018

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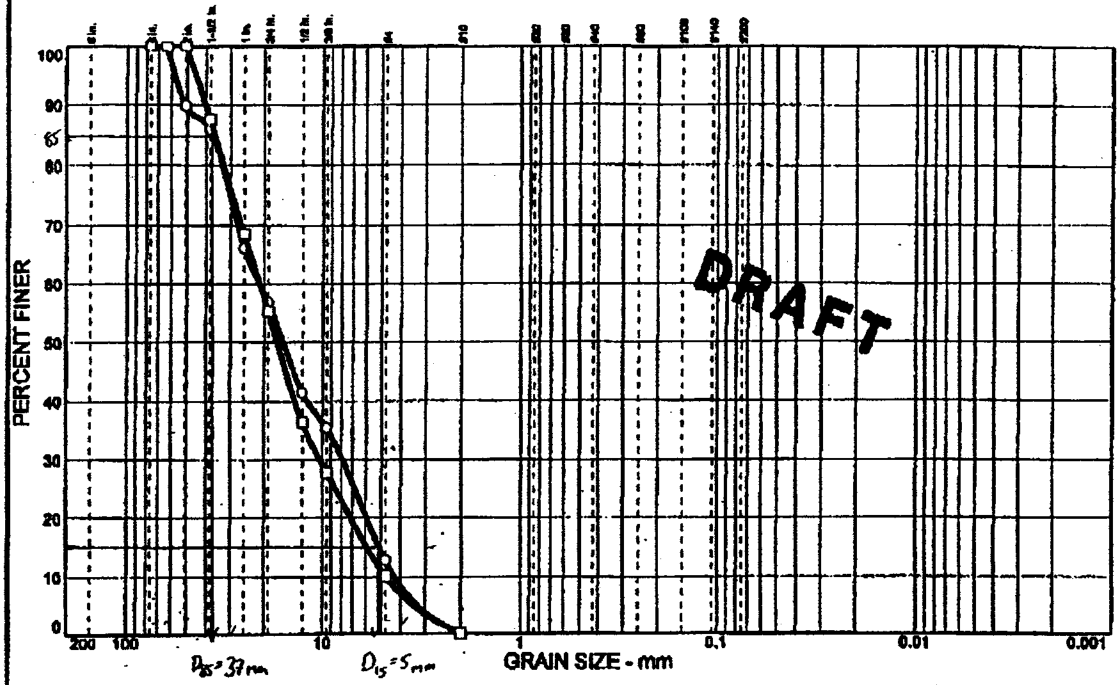
Client: CH2M HILL

Project: INEEL

Project No.: Plate 2

Alluvium + #10 - LC Gravel

Particle Size Distribution Report



	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
o	0.0	87.2	12.8	0.0	0.0	GW			
□		89.9	10.1	0.0	0.0	GW			

SIEVE inches size	PERCENT FINER o	PERCENT FINER □	
3	100.0	100.0	
2.5	100.0	100.0	
2	89.9	100.0	
1.5	86.0	87.6	
1	66.1	68.4	
.75	56.8	55.3	
.5	41.5	36.3	
.375	35.4	27.9	
GRAIN SIZE			
D_{60}	21.2	21.1	
D_{30}	7.85	10.3	
D_{10}	4.27	4.73	
COEFFICIENTS			
C_c	0.68	1.07	
C_u	4.96	4.46	

SIEVE number size	PERCENT FINER o	PERCENT FINER □	
#4	12.8	10.1	
#10	0.0	0.0	

SOIL DESCRIPTION
o

□

REMARKS:
o Gradation created by removing -#10 material(calculation)

□ Gradation created by removing -#10 material(calculation)

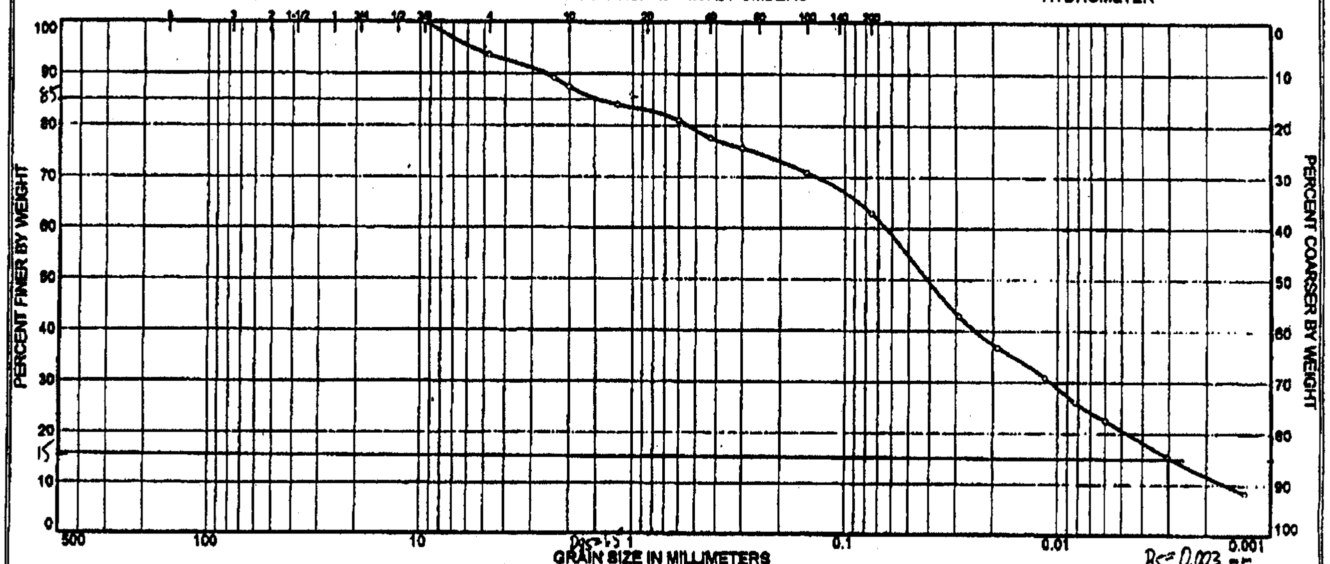
o Source: CCI Sample No.: CCI-017 plus #10
□ Source: CCI Sample No.: CCI-018 plus #10

SOIL TECHNOLOGY, INC.

Client: CH2M HILL
Project: INEEL
Project No.: Plate 3

Surface Soil- Waste (high fines)

PARTICLE SIZE DISTRIBUTION TEST REPORT



% + 3"	% GRAVEL		% SAND			% FINES	
	COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY
0.0	0.0	6.4	6.1	9.9	14.7	42.3	20.6

SOURCE	SAMPLE #	DEPTH/ELEV.	DATE SAMPLED	USCS	MATERIAL DESCRIPTION	NM %	LL	PL
ICDF SPT#1	SPT #1	0'-2.5'	10/02/00	CL	Sandy lean clay	6.8%	24	16
	Core #1							

Client Tom Borschel BBWI

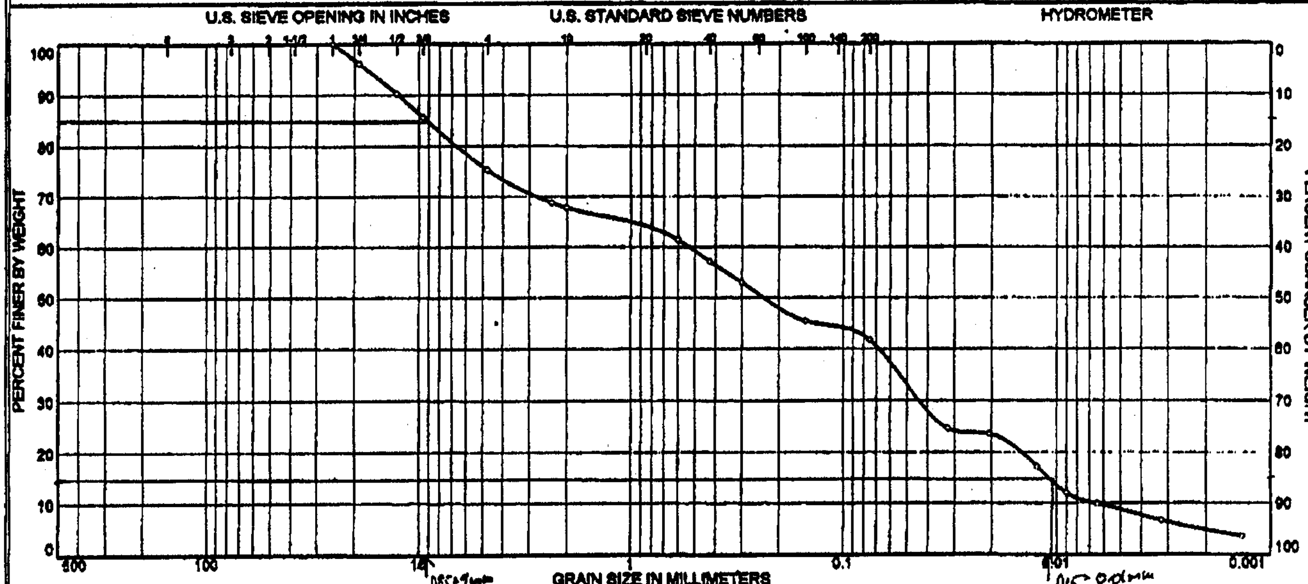
Project INEEL CERCLA Disposal Facility (ICDF)

Project No. 3XD710130 | Plate

INEL MATERIALS LAB

Surface Soil Waste (Avg fines)

PARTICLE SIZE DISTRIBUTION TEST REPORT



	% + 3"	% GRAVEL		% SAND			% FINES	
		COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY
o	0.0	3.9	20.7	7.6	10.7	15.4	32.9	8.8

	SOURCE	SAMPLE #	DEPTH/ELEV.	DATE SAMPLED	USCS	MATERIAL DESCRIPTION	NM %	LL	PL
o	ICDF GSB #2	GSB #2	0'-5'	9/8/00	SM	Silty sand with gravel	3.2%	22	20
		Core #1							

Client Tom Borschel BBWI

Project INEEL CERCLA Disposal Facility (ICDF)

Project No. 3XD710130 Plate

INEL MATERIALS LAB

A.4 LCRS Gravel Hydraulic Conductivity Tests

Table 3. Rigid wall hydraulic conductivity of remolded specimens.

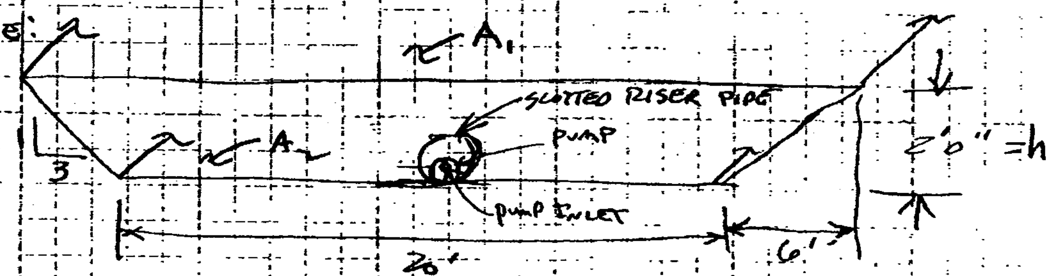
Sample Identification	Water Content %		Wet Density (Pcf)		Saturation[1]		Hydraulic Conductivity[2] (cm/sec)
	Before	After	Before	After	Before	After	
CCI-013	2	14	117	131	.09	.79	5×10^{-2}
CCI-017[3]	4	19	110	126	.19	.86	1×10^{-0}
CCI-018[3]	6	21	110	126	.26	.94	9×10^{-1}

1. Specific gravity assumed 2.7.
2. Average hydraulic conductivity using tap water.
3. Minus #10 material removed before testing.

A.5 Sump Volume/Pump Cycle Time

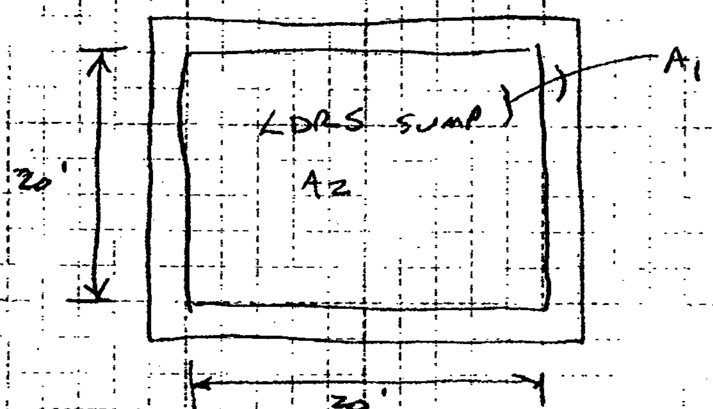
SUBJECT: LDRS SUMP VOLUME / PUMP CYCLE TIME

VOLUME:



SOURCE - DWGS. A-204

$$\text{VOLUME} = \left(A_1 + A_2 + \sqrt{A_1 A_2}\right) h/3$$

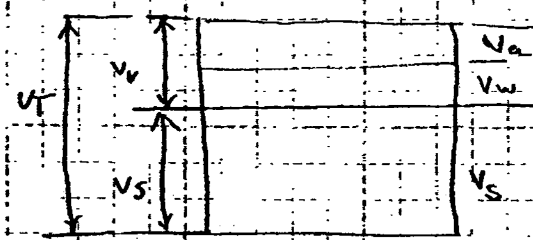


$A_1 = (20+6+6)^2 = 1{,}024 \text{ FT}^2$

$A_2 = (20)^2 = 400 \text{ FT}^2$

$V_T = \left(1{,}024 + 400 + \sqrt{(1024)(400)}\right) 2/3 = \underline{1{,}376 \text{ FT}^3}$

LDRS GRAVEL: POROSITY = 0.350 @ 85% compaction, reference Mike Reimbold.



porosity $n = \frac{V_v}{V_T}$ $V_v = nV_T$

Assuming 100% saturated, neglect voids on V_S.

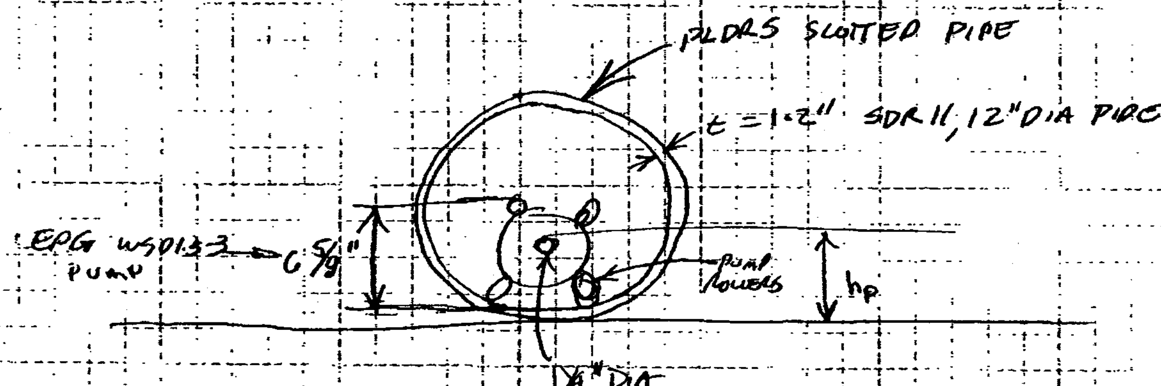
$V_a = 0$

$V_w = V_v = .350\ V_T$

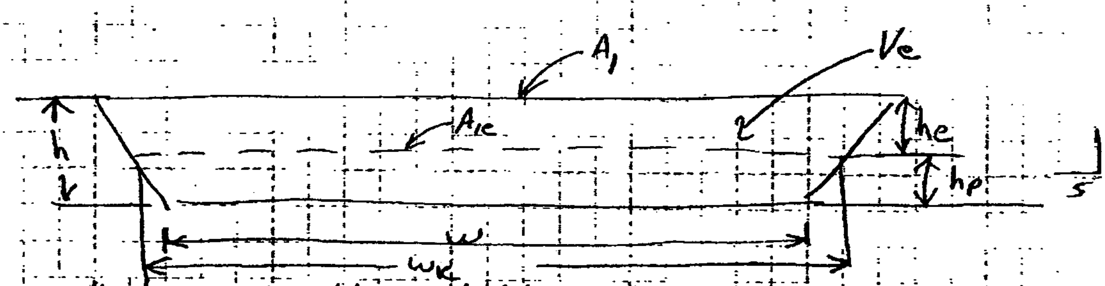
$V_w = (.350)(1376\ FT^3) = 482\ FT^3 \Rightarrow \underline{3,602\ gal}$

From "LDRS AND SLDRS WSD 1.5-3" Flow Rate From Pump = 6.9 gpm

VOLUME AVAILABLE TO PUMP – ABOVE PUMP INLET



$h_p = \frac{1}{2}(6\frac{5}{8}") + \frac{1}{2}(1\frac{1}{4}") + 1.2" = 5.14" = 0.428'$



h_e = effective height available above pump inlet

h_p = height to top of pump inlet

h = LDRS sump depth

$h_e = h - h_p$

$= 2.0' - 0.428'$

$= 1.57'$

$A_{1e} = (w_{1e})^2$ → square area

$w_{1e} = w + 2 h_p S$

S = slope

$w_{1e} = 20' + 2(0.428)(3)$

$= 22.6'$

$A_{1e} = 509.3 \text{ ft}^2$

$V_e = \left(A_1 + A_{1e} + \sqrt{A_1 A_{1e}}\right) h_e/3$

$= \left(1024 + 509.3 + \sqrt{(1024)509.3}\right) 1.57/3$

$= \underline{1,182 \text{ ft}^3} \Rightarrow \underline{8,840 \text{ gal}}$

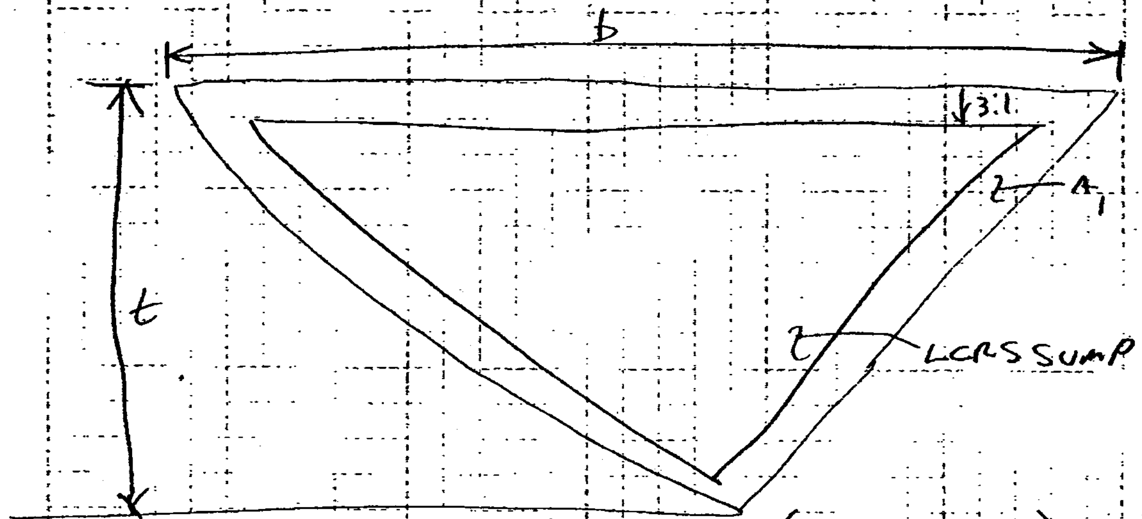
$V_{we} = (0.350)(8,840) = \underline{3,094 \text{ gal}}$

Pump Cycle time: T_P

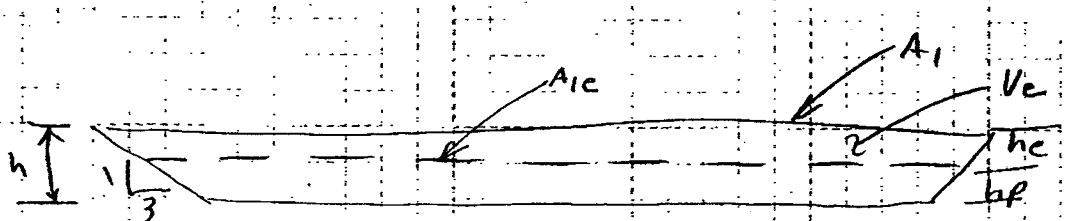
Volume Available / Pump Rate

$T_P = 3{,}094 \text{ gal} / 6.9 \text{ gal/min} = 448 \text{ min} \Rightarrow 7.5 \text{ hrs.}$

LCRS Sump Volume:



PLAN VIEW (DWG H-201)



$A = \frac{1}{2} b t$ $\quad b = 230'$, $t = 90'$

$A_1 = \frac{1}{2}(230)(90) = 10{,}350 \text{ FT}^2$

$A_{1e} = \frac{1}{2} b_e t_e$

$b_e \cong b - 2 h_e s$

$h_e = h - h_p$

$= 1.0 - 0.428 = 0.572'$

$b_e \cong 230' - 2(0.572)(3)$

$b_e \approx 226'$

$t_e \approx 90 - 2(0.572)(3)$

$\cong 87'$

$A_1 e = 1/2(226)(87) = 9,807 \text{ Ft}^2$

$V_e = \left(10,350 + 9,807 + \sqrt{(10,350)(9,807)}\right) 0.572'/3$

$V_e = 5,763 \text{ Ft}^3 \Rightarrow 43,106 \text{ gal}$

$V_{we} = (43,106 \text{ gal})(0.35) = 15,087 \text{ gal}$

Pump Cycle Time: T_p Low Flow Pump
SEE "LCRS Low Flow w/SD 1.5-3. Pump Rate = 7.4 gal/min
$T_p = 15,087 \text{ gal} / 7.4 \text{ gal/min} = 2039 \text{ min} \Rightarrow$ 34 hrs.

High Flow Pump Tp:

SEE "Cell 1 to Evap Pond High Flow w/ 17-2 Pump"

Pump Rate = 82 gal/min

$T_p = 15,087 \text{ gal} / 82 \text{ gpm} = 184 \text{ min} \Rightarrow$ 3 hrs.

Appendix B

Calculations of Total Dynamic Head at the Maximum Flow Rate and Pump Selection Calculations—Phase 1 Cell and Evaporation Pond Pump Selection

Calculation for High Flow Pump Rate Required for Cell 1

Greatest 24-Hour Precipitation Amount for CFA (Reference A Table D-4)

June = 1.73 in.

Largest Landfill Surface Area

Area = 306900 ft^2

Volume of water to be removed (depth x area)

Volume =44245 ft^3

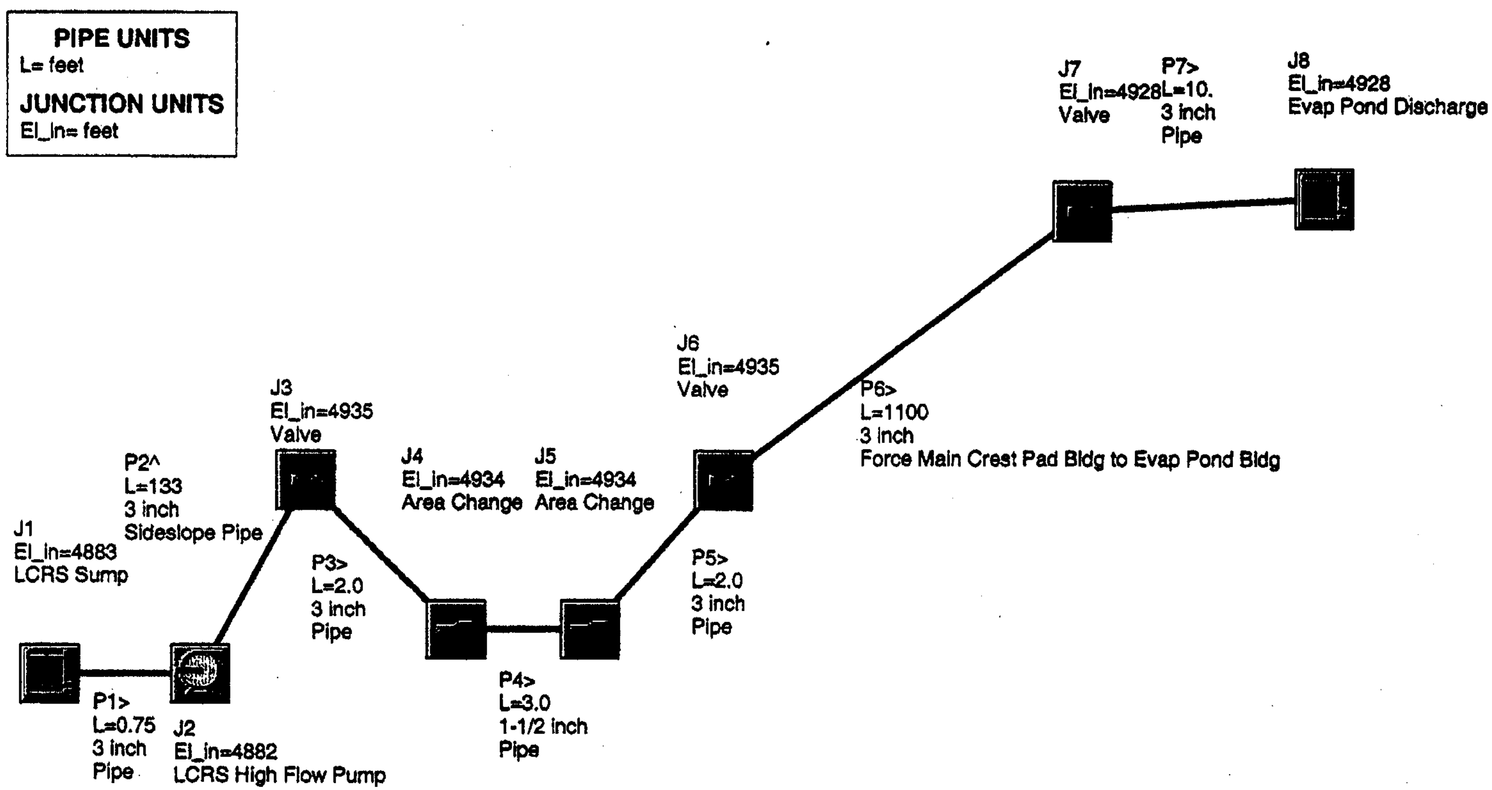
Volume =330951 gallons

Flow for 72 hour removal (volume/time) gpm

Flow =76.61 gpm

Pump Needed, 100 gpm

LCRS High Flow Pump EPG Series 17-2
\\Simba\Users\bthompso\INEEL\LCRSHigh Flow run2.fth
Cell 1 to Evap Pond High Flow/Cell 1 To Truck Load High Flow w17-2 Pump/Cell 1 to Evap Pond High Flow w17-2 Pump



Title: LCRS High Flow Pump EPG Series 17-2

Number Of Pipes= 7
Number Of Junctions= 8

Pressure/Head Tolerance= 0.0001 relative change
Flow Rate Tolerance= 0.0001 relative change
Temperature Tolerance= 0.0001 relative change
Flow Relaxation= (Automatic)
Pressure Relaxation= (Automatic)

Constant Fluid Property Model
Fluid Database: AFT Standard
Fluid: Water at 1 atm
Max Fluid Temperature Data= 212 deg. F
Min Fluid Temperature Data= 32 deg. F
Temperature= 50 deg. F
Density= 62.41296 lbm/ft3
Viscosity= 3.1854 lbm/hr-ft
Vapor Pressure= 0.17055 psia
Viscosity Model= Newtonian

Atmospheric Pressure= 1 atm
Gravitational Acceleration= 1 g
Turbulent Flow Above Reynolds Number= 4000
Laminar Flow Below Reynolds Number= 2300

=============== PIPES ===============
>>>>> Pipe 1 (Pipe) <<<<<
Pump Inlet
>>>>> Pipe 2 (Sideslope Pipe) <<<<<
Pipe up sideslope. 10 foot sections with joints.
>>>>> Pipe 3 (Pipe) <<<<<
Pipe between valve and reducer
>>>>> Pipe 4 (Pipe) <<<<<
Flow meter line section. Assume flow through dead branch for flow meter losses
>>>>> Pipe 5 (Pipe) <<<<<
Pipe from reducer to check valve. Check valve included in add'l losses
>>>>> Pipe 6 (Force Main Crest Pad Bldg to Evap Pond Bldg) <<<<<
Pipe from gate valve to evap crest pad building. Additional losses include fittings, globe valve at sump, and fittings up to valve in evap pond building. Length based on scaling from drawing L-201.
>>>>> Pipe 7 (Pipe) <<<<<
Pipe to evap pond discharge
=============== JUNCTIONS ===============
>>>>> Junction 1 (LCRS Sump) <<<<<
LCRS Sump. Inlet at center of pump, 0.5 feet below max sump depth under normal conditions. Conservatively assume minimal head over pump inlet
>>>>> Junction 2 (LCRS High Flow Pump) <<<<<
High Flow Pump, LPG Model 17-2
>>>>> Junction 3 (Valve) <<<<<
First control valve inside Crest Pad building.
>>>>> Junction 4 (Area Change) <<<<<
Transition from 3" to 1.5" flow meter section
>>>>> Junction 5 (Area Change) <<<<<
Transition from flow meter line to main size line
>>>>> Junction 7 (Valve) <<<<<
Valve at evap pond building just before check valve.
>>>>> Junction 8 (Evap Pond Discharge) <<<<<
Discharge Pipe at Evap pond

Pipe Input Table

Pipe	Name	Pipe Defined	Length	Length Units	Hydraulic Diameter	Hydraulic Diam. Units	Friction Data Set
1	Pipe	Yes	0.75	feet	3.088	inches	Standard
2	Sideslope Pipe	Yes	133	feet	3.088	inches	Standard

LCRS High Flow Pump EPG Series 17-2

Pipe	Name	Pipe Defined	Length	Length Units	Hydraulic Diameter	Hydraulic Diam. Units	Friction Data Set
3	Pipe	Yes	2	feet	3.088	inches	Standard
4	Pipe	Yes	3	feet	1.5	inches	Standard
5	Pipe	Yes	2	feet	3.088	inches	Standard
6	Force Main Crest Pad Bldg to Evap Pond Bldg	Yes	1100	feet	3.063529	inches	Standard
7	Pipe	Yes	10	feet	3.088	inches	Standard

Pipe	Roughness	Roughness Units	Losses (K)	Junctions (Up,Down)	Geometry	Material	Size	Type	Special Condition
1	0.000005	feet	0	1, 2	Cylindrical Pipe	PVC	3 inch	SDR17	None
2	0.000005	feet	2.73296	2, 3	Cylindrical Pipe	PVC	3 inch	SDR17	None
3	0.000005	feet	0.75648	3, 4	Cylindrical Pipe	PVC	3 inch	SDR17	None
4	0.000005	feet	0.08	4, 5	Cylindrical Pipe	PVC	1-1/2 inch	schedule 80	None
5	0.000005	feet	1.61208	5, 6	Cylindrical Pipe	PVC	3 inch	SDR17	None
6	0.000005	feet	6.456188	6, 7	Cylindrical Pipe	HDPE	3 inch	SDR 17	None
7	4.999999E-06	feet	2.41133	7, 8	Cylindrical Pipe	PVC	3 inch	SDR17	None

Pipe Loss Table

Pipe Losses	K Total	Standard Bends	Mitre Bends	Smooth Bends	Angle Valves	Ball Valves	Butterfly Valves	Cylinder Valves	Gate Valves	Globe Valves	Plug Valves	Poppet Valves
2	2.73			4 (1.43)								
3	0.76			2 (0.72)								
4	0.08											
5	1.61			2 (0.72)								
6	6.46			3 (1.08)					1 (0.2)	1 (4.0)		
7	2.41			4 (1.43)								

Pipe Losses	Three-way Valves	Swing Check Valves	Lift Check Valves	Tilting Disc Check Valves	Stop Check Valves	Sharp-edged Orifice	Long Orifice	Contractions
2						13 (1.3)		
3								
4								
5		1 (0.9)						
6								
7		1 (0.9)						

Pipe Losses	Expansions	Entrances	Exits	Differential Flowmeter	Honeycomb	Screen	Tee	Add'l Loss
2								
3							1 (0.04)	
4							2 (0.08)	
5								
6							3 (1.18)	
7	2 (0.0)						2 (0.08)	

Area Change Table

Area Change	Name	Object Defined	Inlet Elevation	Elevation Units	Type	Geometry	Angle	Loss Factor
4	Area Change	Yes	4934	feet	Conical	Unspecified	60.	4.851974
5	Area Change	Yes	4934	feet	Conical	Expansion	60.	0.5837658

Pump Table

LCRS High Flow Pump EPG Series 17-2

Pump	Name	Object Defined	Inlet Elevation	Elevation Units	Initial Pressure	Initial Pressure Units	Database Source	Special Condition
2	LCRS High Flow Pump	Yes	4882	feet				None

Pump	Pump Type	Design Flow Rate	Design Flow Rate Units	Current Configuration	Independent Variable	Ind. Variable Units	Dependent Variable	Dep. Variable Units
2	Pump Curve				Vol. Flow Rate	gal/min	Head Loss	feet

Pump	Pump Curve Constant a	Pump Curve Constant b	Pump Curve Constant c	Pump Curve Constant d	Pump Curve Constant e	Runout Flow Rate	Runout Flow Rate Units	Speed
2	108.4384	-1.688483E-02	-5.243598E-03	0	0	120	gal/min	100

Pump	Control Discharge	Control Discharge Units	Control When Exceeded Only	Heat Added To Fluid
2				0

Reservoir Table

Reservoir	Name	Object Defined	Inlet Elevation	Elevation Units	Initial Pressure	Initial Pressure Units	Database Source	Surface Pressure
1	LCRS Sump	Yes	4882.5	feet				1
8	Evap Pond Discharge	Yes	4928	feet				1

Reservoir	Surface Pressure Units	Balance Energy	Balance Concentration	(Pipe #1) K In, K Out	(Pipe #2) K In, K Out	(Pipe #3) K In, K Out	(Pipe #4) K In, K Out	(Pipe #5) K In, K Out
1	atm	No	No	(P1) 0, 0				
8	atm	No	No	(P7) 0, 0				

Reservoir	(Pipe #6) K In, K Out	(Pipe #7) K In, K Out	(Pipe #8) K In, K Out	(Pipe #9) K In, K Out	(Pipe #10) K In, K Out	(Pipe #11) K In, K Out	(Pipe #12) K In, K Out	(Pipe #13) K In, K Out	(Pipe #14) K In, K Out
1									
8									

Reservoir	(Pipe #15) K In, K Out	(Pipe #16) K In, K Out	(Pipe #17) K In, K Out	(Pipe #18) K In, K Out	(Pipe #19) K In, K Out	(Pipe #20) K In, K Out	(Pipe #21) K In, K Out	(Pipe #22) K In, K Out	(Pipe #23) K In, K Out
1									
8									

Reservoir	(Pipe #24) K In, K Out	(Pipe #25) K In, K Out	(Pipe #1) Depth	(Pipe #2) Depth	(Pipe #3) Depth	(Pipe #4) Depth	(Pipe #5) Depth	(Pipe #6) Depth	(Pipe #7) Depth	(Pipe #8) Depth
1			(P1) 0.5							
8			(P7) 0							

Reservoir	(Pipe #9) Depth	(Pipe #10) Depth	(Pipe #11) Depth	(Pipe #12) Depth	(Pipe #13) Depth	(Pipe #14) Depth	(Pipe #15) Depth	(Pipe #16) Depth	(Pipe #17) Depth
1									
8									

Reservoir	(Pipe #18) Depth	(Pipe #19) Depth	(Pipe #20) Depth	(Pipe #21) Depth	(Pipe #22) Depth	(Pipe #23) Depth	(Pipe #24) Depth	(Pipe #25) Depth	Pipe Depth Units
1									feet
8									feet

Valve Table

Valve	Name	Object Defined	Inlet Elevation	Elevation Units	Initial Pressure	Initial Pressure Units	Database Source	Special Condition	Exit Valve	Exit Pressure
3	Valve	Yes	4935	feet				None	No	
6	Valve	Yes	4935	feet				None	No	
7	Valve	Yes	4928	feet				None	No	

LCRS High Flow Pump EPG Series 17-2

Valve	Exit Pressure Units	Restricted Area	Restricted Area Units	Loss Model	Loss Value	Independent Variable	Ind. Variable Units	Dependent Variable	Dep. Variable Units
3				K Constant	0.7				
6				K Constant	0.7				
7				K Constant	0.7				

Valve	Loss Constant a	Loss Constant b	Loss Constant c	Loss Constant d	Loss Constant e
3					
6					
7					

Title: LCRS High Flow Pump EPG Series 17-2
Analysis run on: 03/20/2002 8:48:31 AM
Application version: AFT Fathom Version 5.0 (2001.10.15)
Input File: \\Simba\Users\bthompso\INEEL\LCRSHigh Flow run2.fth
Scenario: Cell 1 to Evap Pond High Flow/Cell 1 To Truck Load High Flow w17-2 Pump/Cell 1 to Evap Pond High Flow w17-2 Pump

Execution Time= 0.02 seconds
Total Number Of Head/Pressure Iterations= 0
Total Number Of Flow Iterations= 12
Total Number Of Temperature Iterations= 0
Number Of Pipes= 7
Number Of Junctions= 8
Matrix Method= Gaussian Elimination

Pressure/Head Tolerance= 0.0001 relative change
Flow Rate Tolerance= 0.0001 relative change
Temperature Tolerance= 0.0001 relative change
Flow Relaxation= (Automatic)
Pressure Relaxation= (Automatic)

Constant Fluid Property Model
Fluid Database: AFT Standard
Fluid: Water at 1 atm
Max Fluid Temperature Data= 212 deg. F
Min Fluid Temperature Data= 32 deg. F
Temperature= 50 deg. F
Density= 62.41296 lbm/ft3
Viscosity= 3.1854 lbm/hr-ft
Vapor Pressure= 0.17055 psia
Viscosity Model= Newtonian

Atmospheric Pressure= 1 atm
Gravitational Acceleration= 1 g
Turbulent Flow Above Reynolds Number= 4000
Laminar Flow Below Reynolds Number= 2300
Overall Delta Head = 45. feet
Overall Friction Head Loss = 27. feet
Overall Delta Pressure = -31. psid
Overall Frictional Pressure Loss = 12. psid
Total Inflow= 82. gal/min
Total Outflow= 82. gal/min
Maximum Pressure is 46. psia at Junction 2 Outlet
Minimum Pressure is 15. psia at Junction 8 Outlet

Pump Summary

Jct	Name	Vol. Flow (gal/min)	Mass Flow (lbm/sec)	DP (psid)	DH (feet)	Overall Efficiency (Percent)	Speed (Percent)	Overall Power (hp)	BEP (gal/min)	% of BEP (Percent)
2	LCRS High Flow Pump	82.	11.	31.	72.	100	100	1.5	N/A	N/A

Jct	NPSHA (feet)	NPSHR (feet)
2	34.	N/A

Valve Summary

Jct	Name	Valve Type	Vol. Flow (gal/min)	Mass Flow (lbm/sec)	DP (psid)	DH (feet)	P Inlet (psia)	Cv	K	Valve State
3	Valve	REGULAR	82.	11.	0.058	0.13	22.	340	0.70	Open
6	Valve	REGULAR	82.	11.	0.058	0.13	20.	340	0.70	Open
7	Valve	REGULAR	82.	11.	0.059	0.14	15.	335	0.70	Open

LCRS High Flow Pump EPG Series 17-2

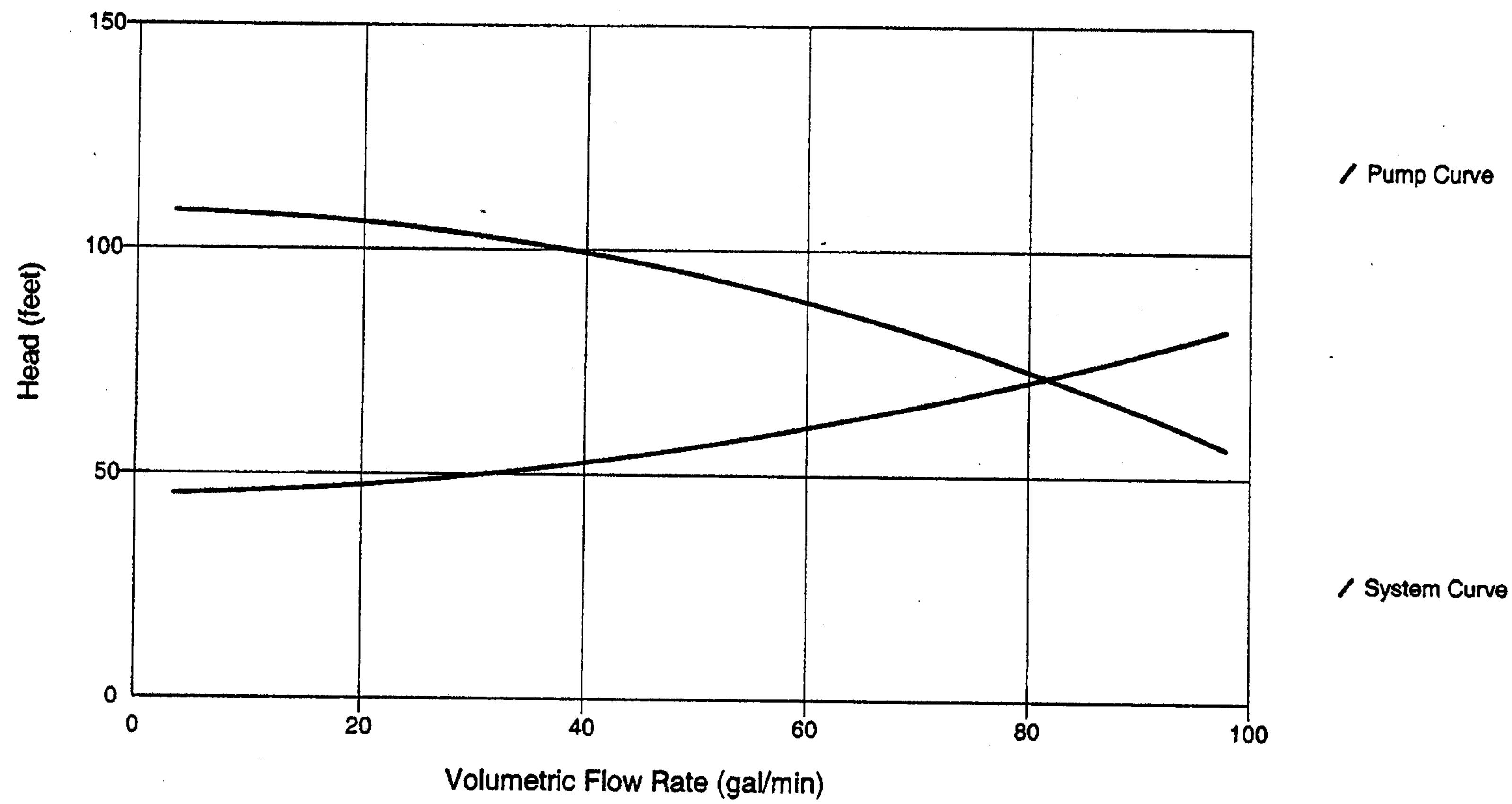
Pipe Output Table

Pipe	Vol. Flow (gal/min)	dH (feet)	P Static Max (psia)	P Static Min (psia)	Reynolds No.	Pipe Material	Length (feet)	Pipe Nominal Size	HGL Outlet (feet)
1	82.	0.011	15.	15.	6.3E+04	PVC	0.75	3 inch	4882
2	82.	2.472	46.	22.	6.3E+04	PVC	133.00	3 inch	4952
3	82.	0.173	22.	22.	6.3E+04	PVC	2.00	3 inch	4952
4	82.	1.687	21.	20.	1.3E+05	PVC	3.00	1-1/2 inch	4946
5	82.	0.335	20.	20.	6.3E+04	PVC	2.00	3 inch	4947
6	82.	18.052	20.	15.	6.4E+04	HDPE	1100.00	3 inch	4929
7	82.	0.618	15.	15.	6.3E+04	PVC	10.00	3 inch	4928

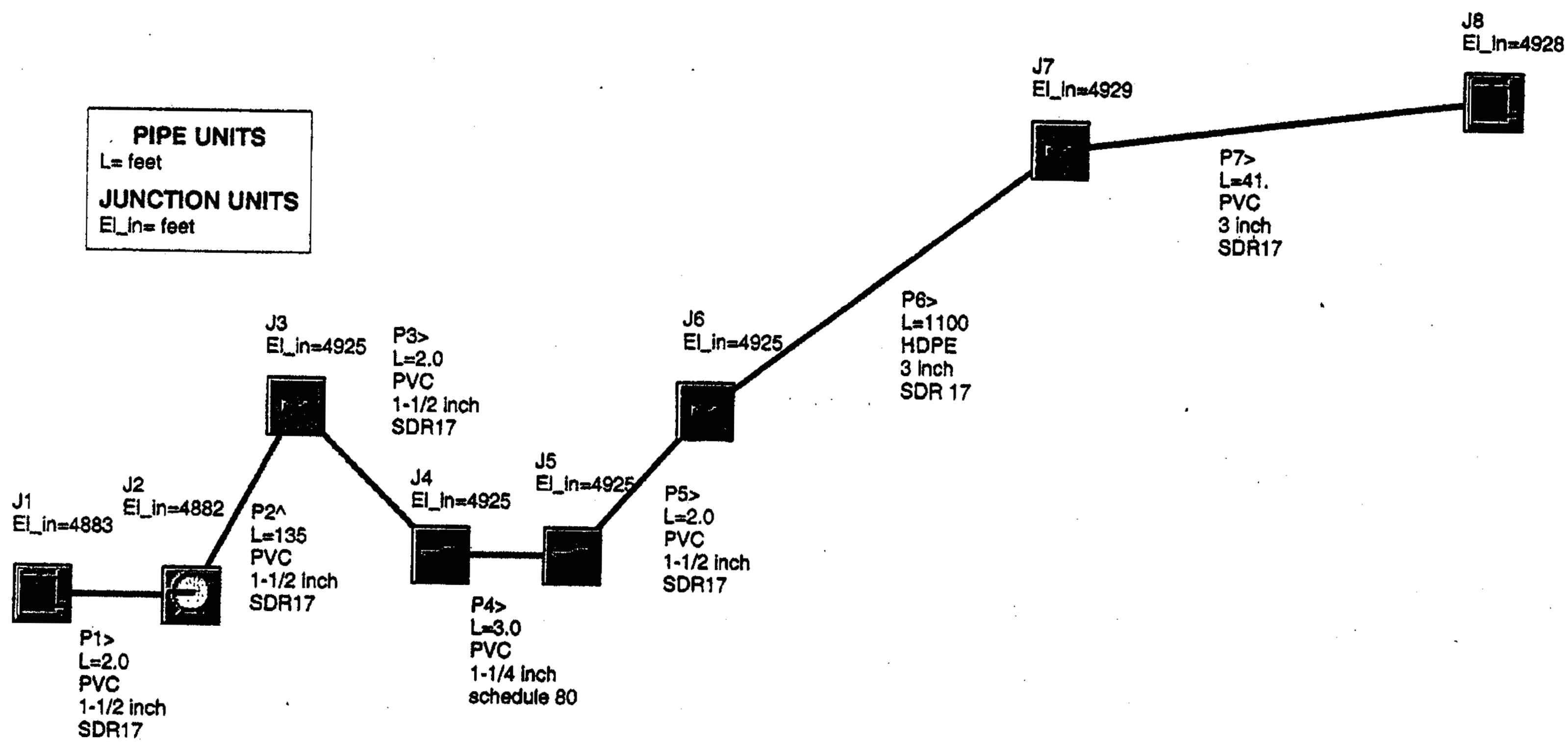
All Junction Table

Jct	Name	Elevation Inlet (feet)	Vol. Flow Into System (gal/min)	dH (feet)	HGL Inlet (feet)	EGL Inlet (feet)	P Static In (psia)	P Static Out (psia)	HGL Outlet (feet)	EGL Outlet (feet)
1	LCRS Sump	4883	82.	0.00	4883	4883	15.	15.	4883	4883
2	LCRS High Flow Pump	4882	0.	-72.16	4882	4882	15.	46.	4954	4955
3	Valve	4935	0.	0.13	4952	4952	22.	22.	4952	4952
4	Area Change	4934	0.	0.92	4952	4952	22.	21.	4948	4951
5	Area Change	4934	0.	1.99	4946	4949	20.	20.	4947	4947
6	Valve	4935	0.	0.13	4947	4947	20.	20.	4947	4947
7	Valve	4928	0.	0.14	4929	4929	15.	15.	4928	4929
8	Evap Pond Discharge	4928	-82.	0.00	4928	4928	15.	15.	4928	4928

17-2 Pump Curve vs. System Curve for Phase 1 Cell to Evap Pond



LCRS Low Flow Pump w/1.5" piping. Pump to Truck at Truck Load Pad. Pump WSD 1.5-3
\\Simba\USERS\bthompso\INEEL\LCRS Low Flow run3.fth
Base Scenario/LCRS Low Flow/LDRS AND SLDRS WSD 1.5-3/LCRS Low Flow WSD 1.5-3



Title: LCRS Low Flow Pump w/1.5" piping. Pump to Truck at Truck Load Pad. Pump WSD 1.5-3

Number Of Pipes= 7
Number Of Junctions= 8

Pressure/Head Tolerance= 0.0001 relative change
Flow Rate Tolerance= 0.0001 relative change
Flow Relaxation= (Automatic)
Pressure Relaxation= (Automatic)

Constant Fluid Property Model
Fluid Database: AFT Standard
Fluid: Water at 1 atm
Max Fluid Temperature Data= 212 deg. F
Min Fluid Temperature Data= 32 deg. F
Temperature= 50 deg. F
Density= 62.41296 lbm/ft3
Viscosity= 3.1854 lbm/hr-ft
Vapor Pressure= 0.17055 psia
Viscosity Model= Newtonian

Atmospheric Pressure= 1 atm
Gravitational Acceleration= 1 g
Turbulent Flow Above Reynolds Number= 4000
Laminar Flow Below Reynolds Number= 2300

============== PIPES ==============
>>>>> Pipe 6 (Pipe) <<<<<
Pipe from gate valve to evap crest pad building. Additional losses include fittings, globe valve at sump, and fittings up to valve in evap pond building.
============== JUNCTIONS ==============
>>>>> Junction 2 (Pump) <<<<<
WSD 1.5 -3 Pump to Evap Pond
>>>>> Junction 7 (Valve) <<<<<
Valve at evap pond building just before check valve.
>>>>> Junction 8 (Reservoir) <<<<<
Discharge Pipe to Evap pond

Pipe Input Table

Pipe	Name	Pipe Defined	Length	Length Units	Hydraulic Diameter	Hydraulic Diam. Units	Friction Data Set	Roughness	Roughness Units	Losses (K)
1	Pipe	Yes	2	feet	1.676	inches	Standard	4.999999E-06	feet	0
2	Pipe	Yes	135	feet	1.676	inches	Standard	0.000005	feet	0
3	Pipe	Yes	2	feet	1.676	inches	Standard	0.000005	feet	0
4	Pipe	Yes	3	feet	1.278	inches	Standard	0.000005	feet	0.08
5	Pipe	Yes	2	feet	1.676	inches	Standard	0.000005	feet	0
6	Pipe	Yes	1100	feet	3.063529	inches	Standard	0.000005	feet	6.097459
7	Pipe	Yes	41	feet	3.088	inches	Standard	0.000005	feet	2.40856

Pipe	Initial Flow	Initial Flow Units	Junctions (Up,Down)	Geometry	Material	Size	Type	Special Condition
1			1, 2	Cylindrical Pipe	PVC	1-1/2 inch	SDR17	None
2			2, 3	Cylindrical Pipe	PVC	1-1/2 inch	SDR17	None
3			3, 4	Cylindrical Pipe	PVC	1-1/2 inch	SDR17	None
4			4, 5	Cylindrical Pipe	PVC	1-1/4 inch	schedule 80	None
5			5, 6	Cylindrical Pipe	PVC	1-1/2 inch	SDR17	None
6			6, 7	Cylindrical Pipe	HDPE	3 inch	SDR 17	None
7			7, 8	Cylindrical Pipe	PVC	3 inch	SDR17	None

Pipe Loss Table

LCRS Low Flow Pump w/1.5" piping. Pump to Truck at Truck Load Pad. Pump WSD 1.5-3

Pipe Losses	K Total	Standard Bends	Mitre Bends	Smooth Bends	Angle Valves	Ball Valves	Butterfly Valves	Cylinder Valves	Gate Valves	Globe Valves	Plug Valves	Poppet Valves
4	0.08											
6	6.1			2 (0.72)					1 (0.2)	1 (4.0)		
7	2.41			4 (1.43)								

Pipe Losses	Three-way Valves	Swing Check Valves	Lift Check Valves	Tilting Disc Check Valves	Stop Check Valves	Sharp-edged Orifice	Long Orifice	Contractions
4								
6								
7		1 (0.9)						

Pipe Losses	Expansions	Entrances	Exits	Differential Flowmeter	Honeycomb	Screen	Tee	Add'l Loss
4							2 (0.08)	
6							3 (1.18)	
7							2 (0.08)	

Area Change Table

Area Change	Name	Object Defined	Inlet Elevation	Elevation Units	Database Source	Type	Geometry	Angle	Loss Factor
4	Area Change	Yes	4925	feet		Conical	Unspecified	60.	0.4376967
5	Area Change	Yes	4925	feet		Conical	Expansion	60.	0.1751827

Pump Table

Pump	Name	Object Defined	Inlet Elevation	Elevation Units	Initial Pressure	Initial Pressure Units	Database Source	Special Condition	Pump Type
2	Pump	Yes	4882	feet				None	Pump Curve

Pump	Design Flow Rate	Design Flow Rate Units	Current Configuration	Independent Variable	Ind. Variable Units	Dependent Variable	Dep. Variable Units	Pump Curve Constant a
2				Vol. Flow Rate	gal/min	Head Loss	feet	78.62441

Pump	Pump Curve Constant b	Pump Curve Constant c	Pump Curve Constant d	Pump Curve Constant e	Runout Flow Rate	Runout Flow Rate Units	Speed	Control Discharge
2	-2.201383	-0.3038763	0	0	10	gal/min	100	

Pump	Control Discharge Units	Control When Exceeded Only	Heat Added To Fluid
2			0

Reservoir Table

Reservoir	Name	Object Defined	Inlet Elevation	Elevation Units	Initial Pressure	Initial Pressure Units	Database Source	Surface Pressure	Surface Pressure Units
1	Reservoir	Yes	4883	feet				1	atm
8	Reservoir	Yes	4928	feet				1	atm

Reservoir	Balance Energy	Balance Concentration	(Pipe #1) K In, K Out	(Pipe #2) K In, K Out	(Pipe #3) K In, K Out	(Pipe #4) K In, K Out	(Pipe #5) K In, K Out	(Pipe #6) K In, K Out	(Pipe #7) K In, K Out
1	No	No	(P1) 0, 0						
8	No	No	(P7) 0, 0						

Reservoir	(Pipe #8) K In, K Out	(Pipe #9) K In, K Out	(Pipe #10) K In, K Out	(Pipe #11) K In, K Out	(Pipe #12) K In, K Out	(Pipe #13) K In, K Out	(Pipe #14) K In, K Out	(Pipe #15) K In, K Out	(Pipe #16) K In, K Out
1									
8									

LCRS Low Flow Pump w/1.5" piping. Pump to Truck at Truck Load Pad. Pump WSD 1.5-3

Reservoir	(Pipe #17) K In, K Out	(Pipe #18) K In, K Out	(Pipe #19) K In, K Out	(Pipe #20) K In, K Out	(Pipe #21) K In, K Out	(Pipe #22) K In, K Out	(Pipe #23) K In, K Out	(Pipe #24) K In, K Out	(Pipe #25) K In, K Out
1									
8									

Reservoir	(Pipe #1) Depth	(Pipe #2) Depth	(Pipe #3) Depth	(Pipe #4) Depth	(Pipe #5) Depth	(Pipe #6) Depth	(Pipe #7) Depth	(Pipe #8) Depth	(Pipe #9) Depth	(Pipe #10) Depth
1	(P1) 0									
8	(P7) 0									

Reservoir	(Pipe #11) Depth	(Pipe #12) Depth	(Pipe #13) Depth	(Pipe #14) Depth	(Pipe #15) Depth	(Pipe #16) Depth	(Pipe #17) Depth	(Pipe #18) Depth	(Pipe #19) Depth
1									
8									

Reservoir	(Pipe #20) Depth	(Pipe #21) Depth	(Pipe #22) Depth	(Pipe #23) Depth	(Pipe #24) Depth	(Pipe #25) Depth	Pipe Depth Units
1							feet
8							feet

Valve Table

Valve	Name	Object Defined	Inlet Elevation	Elevation Units	Initial Pressure	Initial Pressure Units	Database Source	Special Condition	Exit Valve	Exit Pressure
3	Valve	Yes	4925	feet				None	No	
6	Valve	Yes	4925	feet				None	No	
7	Valve	Yes	4929	feet				None	No	

Valve	Exit Pressure Units	Restricted Area	Restricted Area Units	Loss Model	Loss Value	Independent Variable	Ind. Variable Units	Dependent Variable	Dep. Variable Units
3				K Constant	0.7				
6				K Constant	0.7				
7				K Constant	0.7				

Valve	Loss Constant a	Loss Constant b	Loss Constant c	Loss Constant d	Loss Constant e
3					
6					
7					

Title: LCRS Low Flow Pump w/1.5" piping. Pump to Truck at Truck Load Pad. Pump WSD 1.5-3
Analysis run on: 03/17/2002 5:09:13 PM
Application version: AFT Fathom Version 5.0 (2001.10.15)
Input File: \\Simba\USERS\bthompso\INEEL\LCRS Low Flow run3.fth
Scenario: Base Scenario/LCRS Low Flow/LDRS AND SLDRS WSD 1.5-3/LCRS Low Flow WSD 1.5-3

Execution Time= 0.29 seconds
Total Number Of Head/Pressure Iterations= 0
Total Number Of Flow Iterations= 212
Total Number Of Temperature Iterations= 0
Number Of Pipes= 7
Number Of Junctions= 8
Matrix Method= Gaussian Elimination

Pressure/Head Tolerance= 0.0001 relative change
Flow Rate Tolerance= 0.0001 relative change
Flow Relaxation= (Automatic)
Pressure Relaxation= (Automatic)

Constant Fluid Property Model
Fluid Database: AFT Standard
Fluid: Water at 1 atm
Max Fluid Temperature Data= 212 deg. F
Min Fluid Temperature Data= 32 deg. F
Temperature= 50 deg. F
Density= 62.41296 lbm/ft3
Viscosity= 3.1854 lbm/hr-ft
Vapor Pressure= 0.17055 psia
Viscosity Model= Newtonian

Atmospheric Pressure= 1 atm
Gravitational Acceleration= 1 g
Turbulent Flow Above Reynolds Number= 4000
Laminar Flow Below Reynolds Number= 2300
Overall Delta Head = 45. feet
Overall Friction Head Loss = 0.91 feet
Overall Delta Pressure = -20. psid
Overall Frictional Pressure Loss = 0.39 psid
Total Inflow= 7.4 gal/min
Total Outflow= 7.4 gal/min
Maximum Pressure is 35. psia at Junction 2 Outlet
Minimum Pressure is 14. psia at Junction 7 Outlet

Pump Summary

Jct	Name	Vol. Flow (gal/min)	Mass Flow (lbm/sec)	DP (psid)	DH (feet)	Overall Efficiency (Percent)	Speed (Percent)	Overall Power (hp)	BEP (gal/min)	% of BEP (Percent)	NPSHA (feet)	NPSHR (feet)
2	Pump	7.4	1.0	20.	46.	100	100	0.086	N/A	N/A	35.	N/A

Valve Summary

Jct	Name	Valve Type	Vol. Flow (gal/min)	Mass Flow (lbm/sec)	DP (psid)	DH (feet)	P Inlet (psia)	Cv	K	Valve State
3	Valve	REGULAR	7.4	1.0	5.4E-03	0.0125	16.	100	0.70	Open
6	Valve	REGULAR	7.4	1.0	5.4E-03	0.0125	16.	100	0.70	Open
7	Valve	REGULAR	7.4	1.0	4.8E-04	0.0011	14.	335	0.70	Open

Pipe Output Table

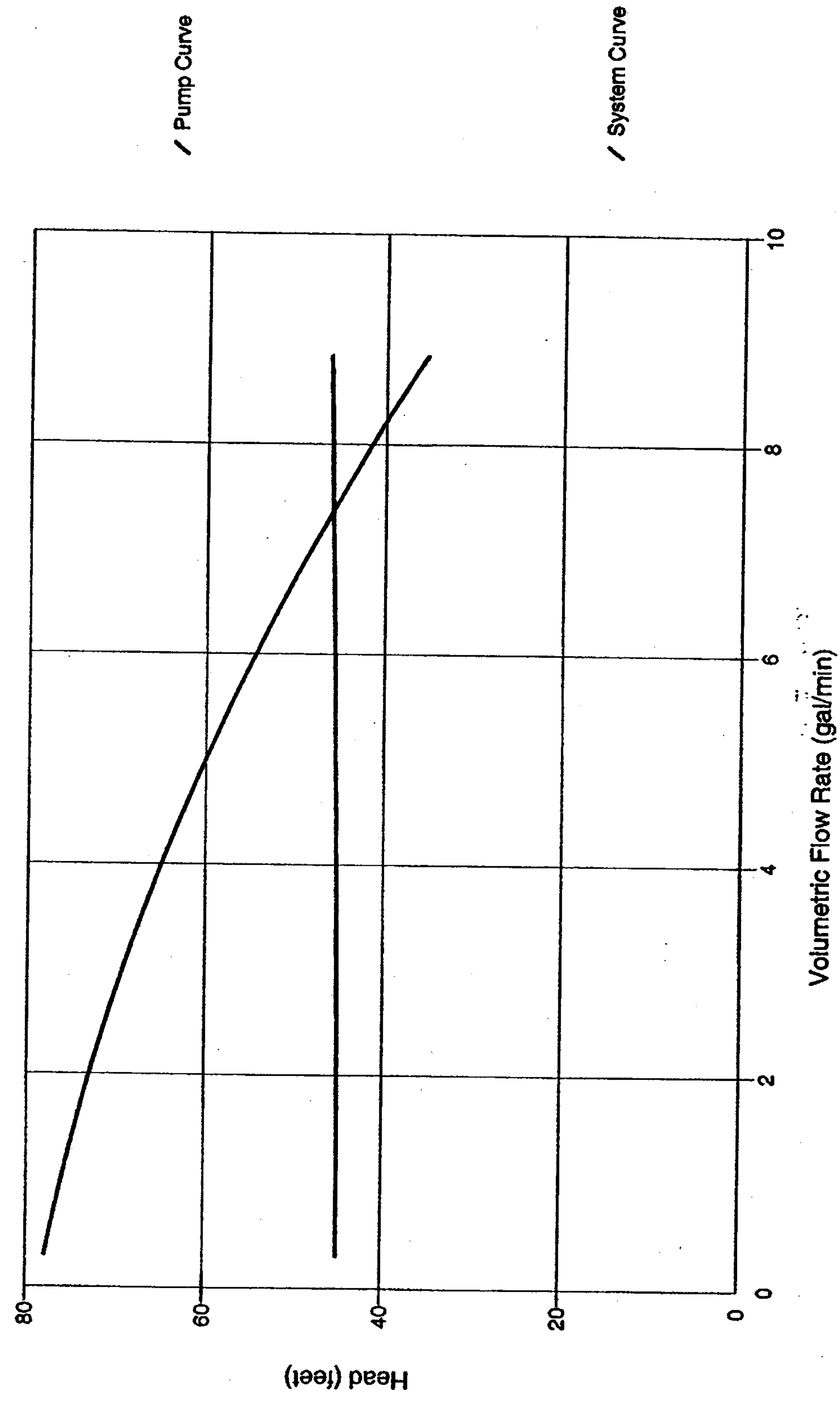
LCRS Low Flow Pump w/1.5" piping. Pump to Truck at Truck Load Pad. Pump WSD 1.5-3

Pipe	Vol. Flow (gal/min)	dH (feet)	P Static Max (psia)	P Static Min (psia)	Reynolds No.	Pipe Material	Length (feet)	Pipe Nominal Size	HGL Outlet (feet)
1	7.4	0.0078	15.	15.	1.1E+04	PVC	2.0	1-1/2 inch	4883
2	7.4	0.5263	35.	16.	1.1E+04	PVC	135.0	1-1/2 inch	4928
3	7.4	0.0078	16.	16.	1.1E+04	PVC	2.0	1-1/2 inch	4928
4	7.4	0.0466	16.	16.	1.4E+04	PVC	3.0	1-1/4 inch	4928
5	7.4	0.0078	16.	16.	1.1E+04	PVC	2.0	1-1/2 inch	4928
6	7.4	0.2572	16.	14.	5.8E+03	HDPE	1100.0	3 inch	4928
7	7.4	0.0134	15.	14.	5.7E+03	PVC	41.0	3 inch	4928

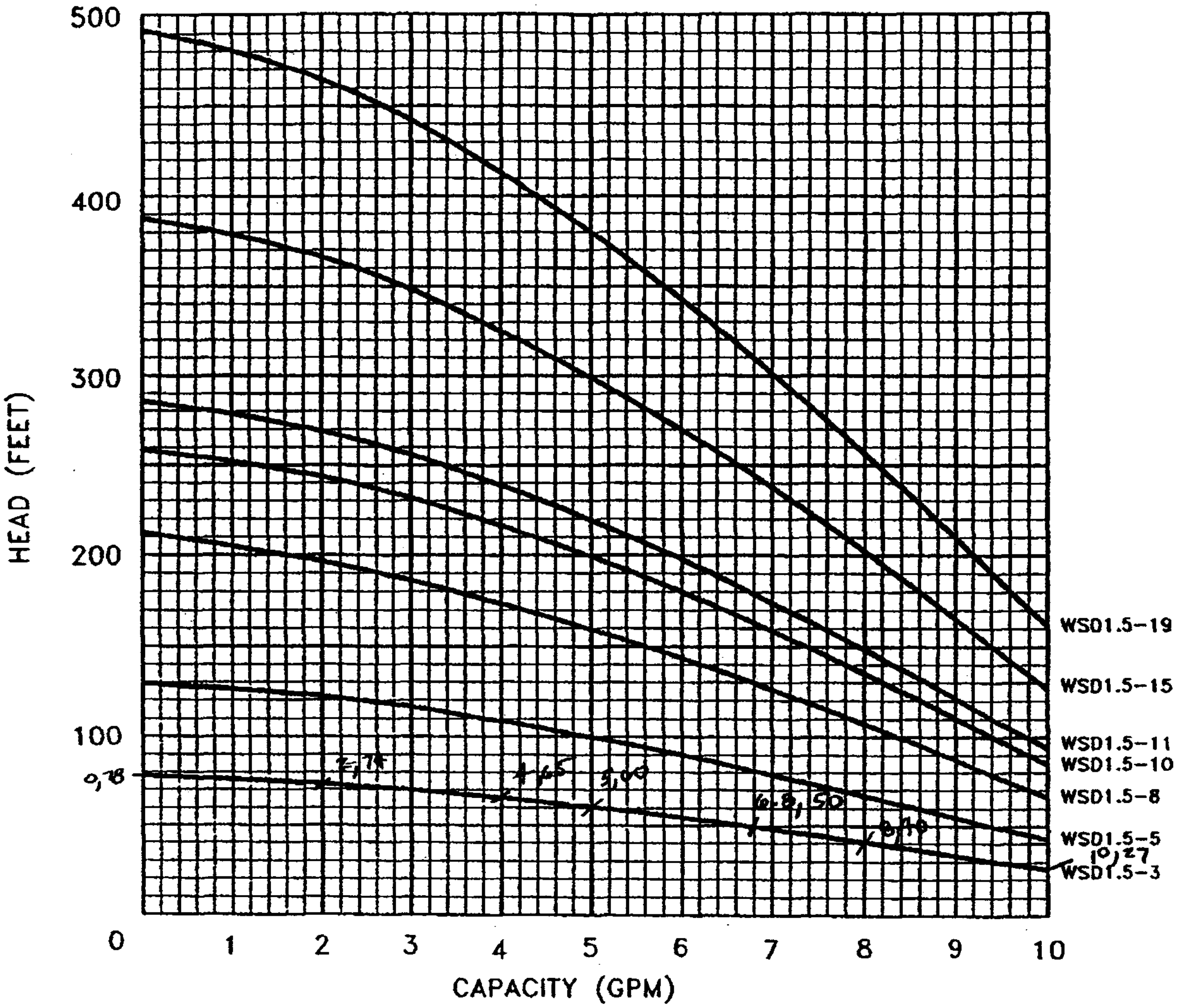
All Junction Table

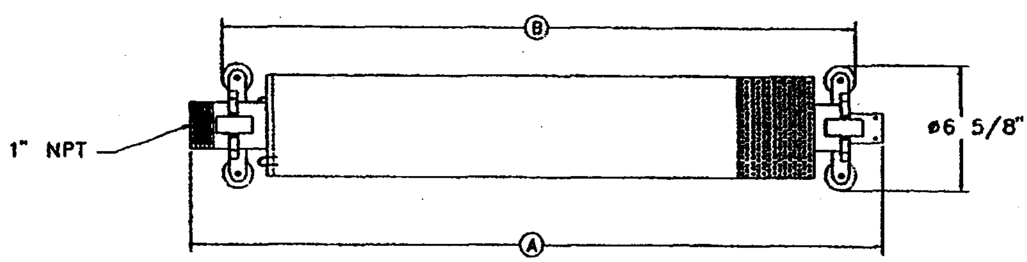
Jct	Name	Elevation Inlet (feet)	Vol. Flow Into System (gal/min)	dH (feet)	HGL Inlet (feet)	EGL Inlet (feet)	P Static In (psia)	P Static Out (psia)	HGL Outlet (feet)	EGL Outlet (feet)
1	Reservoir	4883	7.4	0.0000	4883	4883	15.	15.	4883	4883
2	Pump	4882	0.0	-45.9100	4883	4883	15.	35.	4929	4929
3	Valve	4925	0.0	0.0125	4928	4928	16.	16.	4928	4928
4	Area Change	4925	0.0	0.0078	4928	4928	16.	16.	4928	4928
5	Area Change	4925	0.0	0.0092	4928	4928	16.	16.	4928	4928
6	Valve	4925	0.0	0.0125	4928	4928	16.	16.	4928	4928
7	Valve	4929	0.0	0.0011	4928	4928	14.	14.	4928	4928
8	Reservoir	4928	-7.4	0.0000	4928	4928	15.	15.	4928	4928

WSD 1.5-3 Pump Curve vs. LCRS Low Flow Phase 1 Cell System Curve to Truck Load



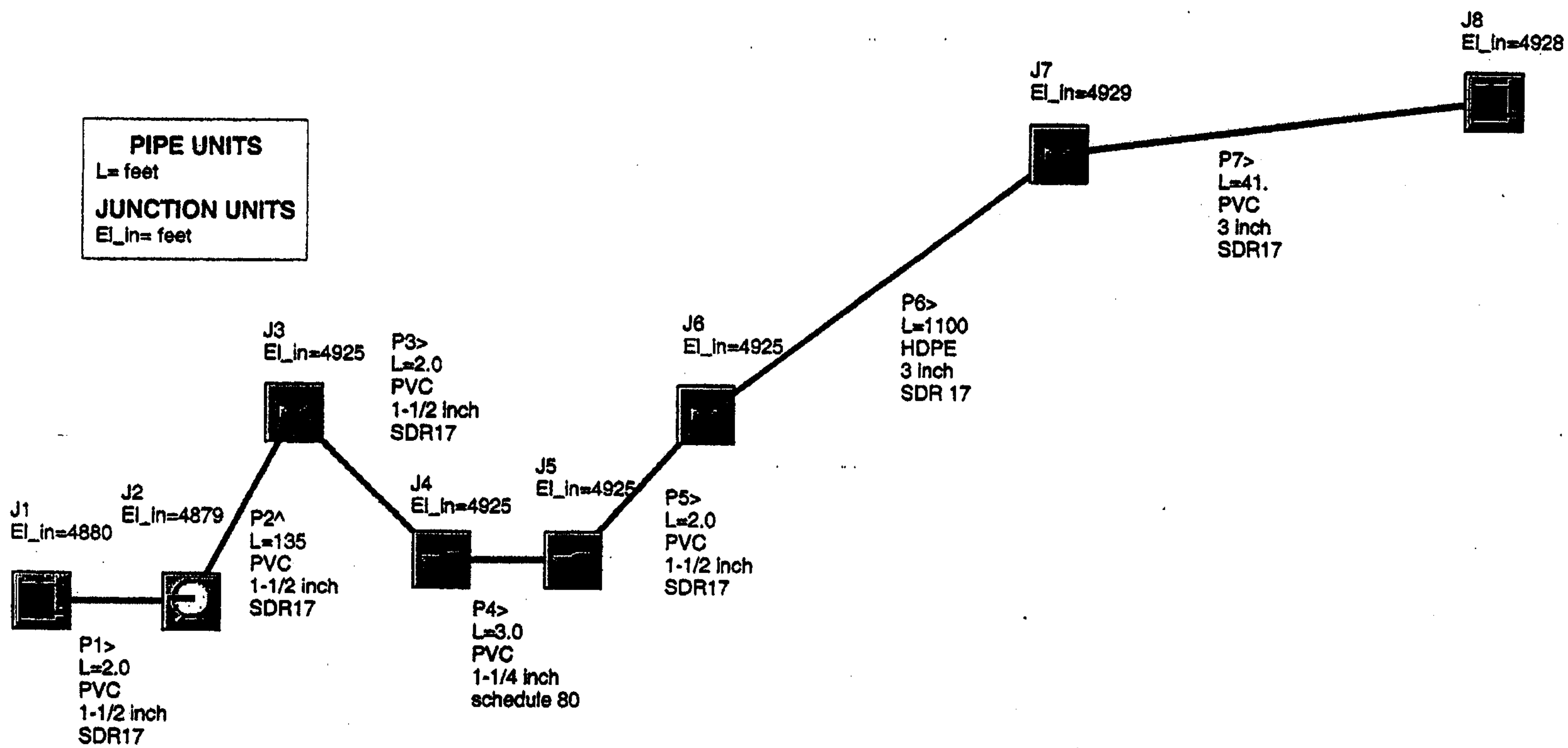
WSD1.5 SurePump™
WHEELED SUMP DRAINER





PUMP MODEL	SINGLE PHASE			THREE PHASE			SHIPPING WEIGHT (LBS)	
	MOTOR HP	A (in)	B (in)	MOTOR HP	A (in)	B (in)	1ø	3ø
WSD1.5-3	0.33	30.00	28.00	0.50	30.75	28.75	39.0	41.2
WSD1.5-5	0.33	31.75	29.75	0.50	32.25	30.25	41.0	43.2
WSD1.5-8	0.33	34.25	32.25	0.50	34.75	32.75	44.2	46.4
WSD1.5-10	0.50	36.50	34.50	0.50	36.50	34.50	48.5	48.5
WSD1.5-11	0.50	37.25	35.25	0.50	37.25	35.25	49.5	49.5
WSD1.5-15	0.75	41.75	39.75	0.75	41.75	39.75	56.0	56.0
WSD1.5-19	1.00	46.25	45.25	1.00	46.25	45.25	62.7	62.7

LDRS Pump w/1.5" piping. Flow to Truck at Truck Load Pad. Pump WSD 1.5-3
\\Simba\USERS\bthompso\INEEL\LCRS Low Flow run3.fth
Base Scenario/LCRS Low Flow/LDRS AND SLDRS WSD 1.5-3



Title: LDRS Pump w/1.5" piping. Flow to Truck at Truck Load Pad. Pump WSD 1.5-3

Number Of Pipes= 7
Number Of Junctions= 8

Pressure/Head Tolerance= 0.0001 relative change
Flow Rate Tolerance= 0.0001 relative change
Flow Relaxation= (Automatic)
Pressure Relaxation= (Automatic)

Constant Fluid Property Model
Fluid Database: AFT Standard
Fluid: Water at 1 atm
Max Fluid Temperature Data= 212 deg. F
Min Fluid Temperature Data= 32 deg. F
Temperature= 50 deg. F
Density= 62.41296 lbm/ft3
Viscosity= 3.1854 lbm/hr-ft
Vapor Pressure= 0.17055 psia
Viscosity Model= Newtonian

Atmospheric Pressure= 1 atm
Gravitational Acceleration= 1 g
Turbulent Flow Above Reynolds Number= 4000
Laminar Flow Below Reynolds Number= 2300

Pipe Input Table

Pipe	Name	Pipe Defined	Length	Length Units	Hydraulic Diameter	Hydraulic Diam. Units	Friction Data Set	Roughness	Roughness Units	Losses (K)
1	Pipe	Yes	2	feet	1.676	inches	Standard	4.999999E-06	feet	0
2	Pipe	Yes	135	feet	1.676	inches	Standard	4.999999E-06	feet	0
3	Pipe	Yes	2	feet	1.676	inches	Standard	0.000005	feet	0
4	Pipe	Yes	3	feet	1.278	inches	Standard	0.000005	feet	0.08
5	Pipe	Yes	2	feet	1.676	inches	Standard	0.000005	feet	0
6	Pipe	Yes	1100	feet	3.063529	inches	Standard	0.000005	feet	6.097459
7	Pipe	Yes	41	feet	3.088	inches	Standard	0.000005	feet	2.40856

Pipe	Initial Flow	Initial Flow Units	Junctions (Up,Down)	Geometry	Material	Size	Type	Special Condition
1			1, 2	Cylindrical Pipe	PVC	1-1/2 inch	SDR17	None
2			2, 3	Cylindrical Pipe	PVC	1-1/2 inch	SDR17	None
3			3, 4	Cylindrical Pipe	PVC	1-1/2 inch	SDR17	None
4			4, 5	Cylindrical Pipe	PVC	1-1/4 inch	schedule 80	None
5			5, 6	Cylindrical Pipe	PVC	1-1/2 inch	SDR17	None
6			6, 7	Cylindrical Pipe	HDPE	3 inch	SDR 17	None
7			7, 8	Cylindrical Pipe	PVC	3 inch	SDR17	None

Pipe Loss Table

Pipe Losses	K Total	Standard Bends	Mitre Bends	Smooth Bends	Angle Valves	Ball Valves	Butterfly Valves	Cylinder Valves	Gate Valves	Globe Valves	Plug Valves	Poppet Valves
4	0.08											
6	6.1			2 (0.72)					1 (0.2)	1 (4.0)		
7	2.41			4 (1.43)								

Pipe Losses	Three-way Valves	Swing Check Valves	Lift Check Valves	Tilting Disc Check Valves	Stop Check Valves	Sharp-edged Orifice	Long Orifice	Contractions
4								
6								
7		1 (0.9)						

LDRS Pump w/1.5" piping. Flow to Truck at Truck Load Pad. Pump WSD 1.5-3

Pipe Losses	Expansions	Entrances	Exits	Differential Flowmeter	Honeycomb	Screen	Tee	Add'l Loss
4							2 (0.08)	
6							3 (1.18)	
7							2 (0.08)	

Area Change Table

Area Change	Name	Object Defined	Inlet Elevation	Elevation Units	Database Source	Type	Geometry	Angle	Loss Factor
4	Area Change	Yes	4925	feet		Conical	Unspecified	60.	0.4376967
5	Area Change	Yes	4925	feet		Conical	Expansion	60.	0.1751827

Pump Table

Pump	Name	Object Defined	Inlet Elevation	Elevation Units	Initial Pressure	Initial Pressure Units	Database Source	Special Condition	Pump Type
2	Pump	Yes	4879	feet				None	Pump Curve

Pump	Design Flow Rate	Design Flow Rate Units	Current Configuration	Independent Variable	Ind. Variable Units	Dependent Variable	Dep. Variable Units	Pump Curve Constant a
2				Vol. Flow Rate	gal/min	Head Loss	feet	78.62441

Pump	Pump Curve Constant b	Pump Curve Constant c	Pump Curve Constant d	Pump Curve Constant e	Runout Flow Rate	Runout Flow Rate Units	Speed	Control Discharge
2	-2.201383	-0.3038763	0	0	10	gal/min	100	

Pump	Control Discharge Units	Control When Exceeded Only	Heat Added To Fluid
2			0

Reservoir Table

Reservoir	Name	Object Defined	Inlet Elevation	Elevation Units	Initial Pressure	Initial Pressure Units	Database Source	Surface Pressure	Surface Pressure Units
1	Reservoir	Yes	4880	feet				1	atm
8	Reservoir	Yes	4928	feet				1	atm

Reservoir	Balance Energy	Balance Concentration	(Pipe #1) K In, K Out	(Pipe #2) K In, K Out	(Pipe #3) K In, K Out	(Pipe #4) K In, K Out	(Pipe #5) K In, K Out	(Pipe #6) K In, K Out	(Pipe #7) K In, K Out
1	No	No	(P1) 0, 0						
8	No	No	(P7) 0, 0						

Reservoir	(Pipe #8) K In, K Out	(Pipe #9) K In, K Out	(Pipe #10) K In, K Out	(Pipe #11) K In, K Out	(Pipe #12) K In, K Out	(Pipe #13) K In, K Out	(Pipe #14) K In, K Out	(Pipe #15) K In, K Out	(Pipe #16) K In, K Out
1									
8									

Reservoir	(Pipe #17) K In, K Out	(Pipe #18) K In, K Out	(Pipe #19) K In, K Out	(Pipe #20) K In, K Out	(Pipe #21) K In, K Out	(Pipe #22) K In, K Out	(Pipe #23) K In, K Out	(Pipe #24) K In, K Out	(Pipe #25) K In, K Out
1									
8									

Reservoir	(Pipe #1) Depth	(Pipe #2) Depth	(Pipe #3) Depth	(Pipe #4) Depth	(Pipe #5) Depth	(Pipe #6) Depth	(Pipe #7) Depth	(Pipe #8) Depth	(Pipe #9) Depth	(Pipe #10) Depth
1	(P1) 0									
8	(P7) 0									

LDRS Pump w/1.5" piping. Flow to Truck at Truck Load Pad. Pump WSD 1.5-3

Reservoir	(Pipe #11) Depth	(Pipe #12) Depth	(Pipe #13) Depth	(Pipe #14) Depth	(Pipe #15) Depth	(Pipe #16) Depth	(Pipe #17) Depth	(Pipe #18) Depth	(Pipe #19) Depth
1									
8									

Reservoir	(Pipe #20) Depth	(Pipe #21) Depth	(Pipe #22) Depth	(Pipe #23) Depth	(Pipe #24) Depth	(Pipe #25) Depth	Pipe Depth Units
1							feet
8							feet

Valve Table

Valve	Name	Object Defined	Inlet Elevation	Elevation Units	Initial Pressure	Initial Pressure Units	Database Source	Special Condition	Exit Valve	Exit Pressure
3	Valve	Yes	4925	feet				None	No	
6	Valve	Yes	4925	feet				None	No	
7	Valve	Yes	4929	feet				None	No	

Valve	Exit Pressure Units	Restricted Area	Restricted Area Units	Loss Model	Loss Value	Independent Variable	Ind. Variable Units	Dependent Variable	Dep. Variable Units
3				K Constant	0.7				
6				K Constant	0.7				
7				K Constant	0.7				

Valve	Loss Constant a	Loss Constant b	Loss Constant c	Loss Constant d	Loss Constant e
3					
6					
7					

Title: LDRS Pump w/1.5" piping. Flow to Truck at Truck Load Pad. Pump WSD 1.5-3
Analysis run on: 03/17/2002 5:02:06 PM
Application version: AFT Fathom Version 5.0 (2001.10.15)
Input File: \\Simba\USERS\bthompso\INEEL\LCRS Low Flow run3.fth
Scenario: Base Scenario/LCRS Low Flow/LDRS AND SLDRS WSD 1.5-3

Execution Time= 0.36 seconds
Total Number Of Head/Pressure Iterations= 0
Total Number Of Flow Iterations= 232
Total Number Of Temperature Iterations= 0
Number Of Pipes= 7
Number Of Junctions= 8
Matrix Method= Gaussian Elimination

Pressure/Head Tolerance= 0.0001 relative change
Flow Rate Tolerance= 0.0001 relative change
Flow Relaxation= (Automatic)
Pressure Relaxation= (Automatic)

Constant Fluid Property Model
Fluid Database: AFT Standard
Fluid: Water at 1 atm
Max Fluid Temperature Data= 212 deg. F
Min Fluid Temperature Data= 32 deg. F
Temperature= 50 deg. F
Density= 62.41296 lbm/ft3
Viscosity= 3.1854 lbm/hr-ft
Vapor Pressure= 0.17055 psia
Viscosity Model= Newtonian

Atmospheric Pressure= 1 atm
Gravitational Acceleration= 1 g
Turbulent Flow Above Reynolds Number= 4000
Laminar Flow Below Reynolds Number= 2300
Overall Delta Head = 48. feet
Overall Friction Head Loss = 0.82 feet
Overall Delta Pressure = -21. psid
Overall Frictional Pressure Loss = 0.35 psid
Total Inflow= 6.9 gal/min
Total Outflow= 6.9 gal/min
Maximum Pressure is 36. psia at Junction 2 Outlet
Minimum Pressure is 14. psia at Junction 7 Outlet

Pump Summary

Jct	Name	Vol. Flow (gal/min)	Mass Flow (lbm/sec)	DP (psid)	DH (feet)	Overall Efficiency (Percent)	Speed (Percent)	Overall Power (hp)	BEP (gal/min)	% of BEP (Percent)	NPSHA (feet)	NPSHR (feet)
2	Pump	6.9	0.96	21.	49.	100	100	0.085	N/A	N/A	35.	N/A

Valve Summary

Jct	Name	Valve Type	Vol. Flow (gal/min)	Mass Flow (lbm/sec)	DP (psid)	DH (feet)	P Inlet (psia)	Cv	K	Valve State
3	Valve	REGULAR	6.9	0.96	4.8E-03	0.01103	16.	100	0.70	Open
6	Valve	REGULAR	6.9	0.96	4.8E-03	0.01103	16.	100	0.70	Open
7	Valve	REGULAR	6.9	0.96	4.3E-04	0.00099	14.	335	0.70	Open

Pipe Output Table

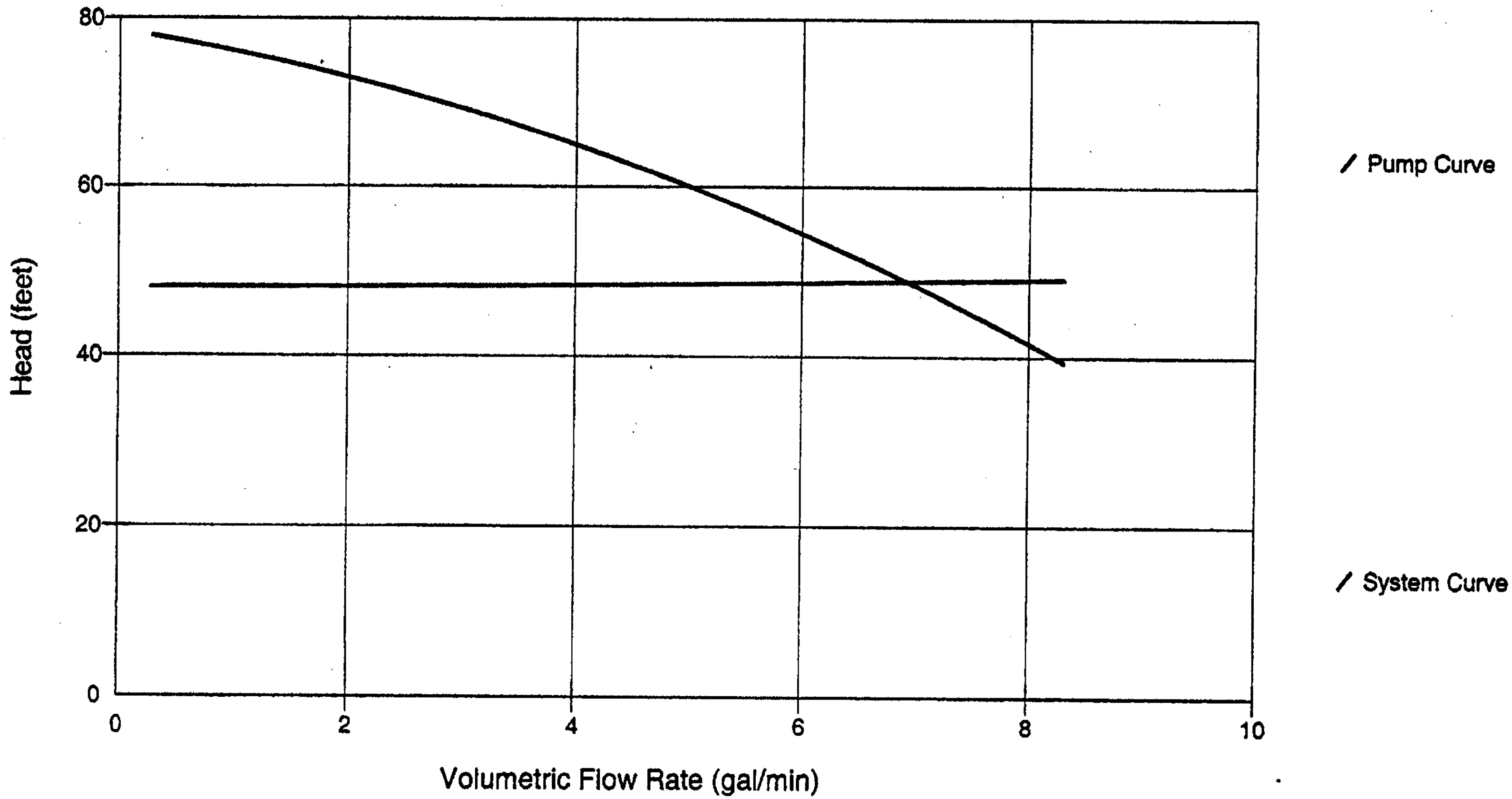
LDRS Pump w/1.5" piping. Flow to Truck at Truck Load Pad. Pump WSD 1.5-3

Pipe	Vol. Flow (gal/min)	dH (feet)	P Static Max (psia)	P Static Min (psia)	Reynolds No.	Pipe Material	Length (feet)	Pipe Nominal Size	HGL Outlet (feet)
1	6.9	0.0070	15.	15.	9.9E+03	PVC	2.0	1-1/2 inch	4880
2	6.9	0.4725	36.	16.	9.9E+03	PVC	135.0	1-1/2 inch	4928
3	6.9	0.0070	16.	16.	9.9E+03	PVC	2.0	1-1/2 inch	4928
4	6.9	0.0417	16.	16.	1.3E+04	PVC	3.0	1-1/4 inch	4928
5	6.9	0.0070	16.	16.	9.9E+03	PVC	2.0	1-1/2 inch	4928
6	6.9	0.2310	16.	14.	5.4E+03	HDPE	1100.0	3 inch	4928
7	6.9	0.0120	15.	14.	5.4E+03	PVC	41.0	3 inch	4928

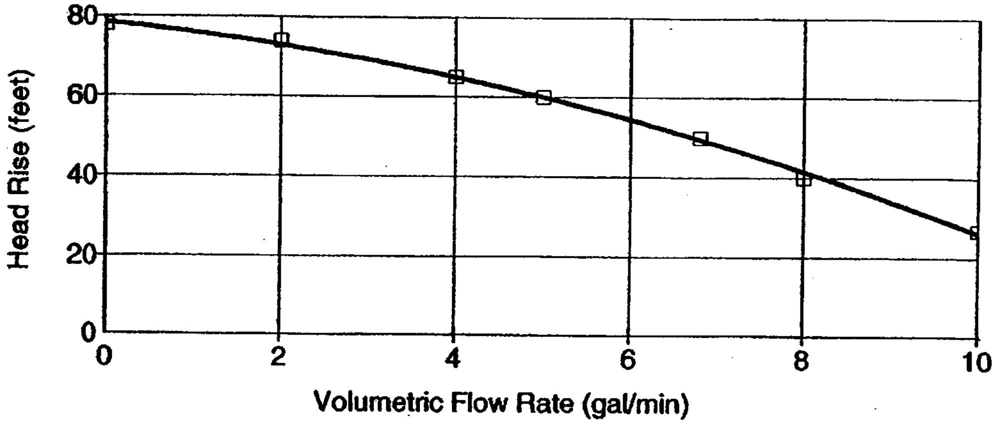
All Junction Table

Jct	Name	Elevation Inlet (feet)	Vol. Flow Into System (gal/min)	dH (feet)	HGL Inlet (feet)	EGL Inlet (feet)	P Static In (psia)	P Static Out (psia)	HGL Outlet (feet)	EGL Outlet (feet)
1	Reservoir	4880	6.9	0.00000	4880	4880	15.	15.	4880	4880
2	Pump	4879	0.0	-48.81629	4880	4880	15.	36.	4929	4929
3	Valve	4925	0.0	0.01103	4928	4928	16.	16.	4928	4928
4	Area Change	4925	0.0	0.00690	4928	4928	16.	16.	4928	4928
5	Area Change	4925	0.0	0.00816	4928	4928	16.	16.	4928	4928
6	Valve	4925	0.0	0.01103	4928	4928	16.	16.	4928	4928
7	Valve	4929	0.0	0.00099	4928	4928	14.	14.	4928	4928
8	Reservoir	4928	-6.9	0.00000	4928	4928	15.	15.	4928	4928

WSD 1.5-3 Pump Curve vs. System Curve for LDRS Evap Pond to Truck Load



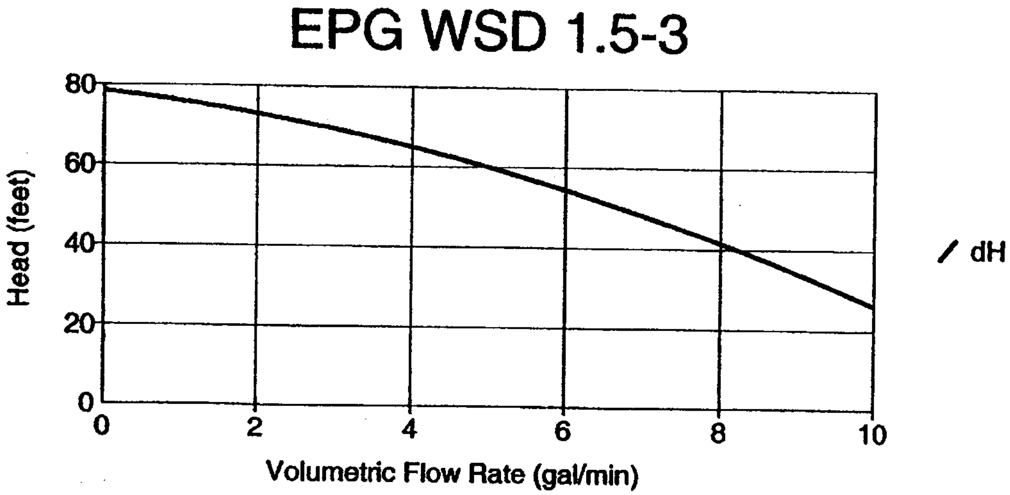
EPG WSD1.5-3



unction Name: Pump
unction Type: Pump

:quation:
H = a + bQ + cQ^2 + dQ^3 + eQ^4

:onstants for pump curve:
= 78.62441
= -2.201383
= -0.3038763

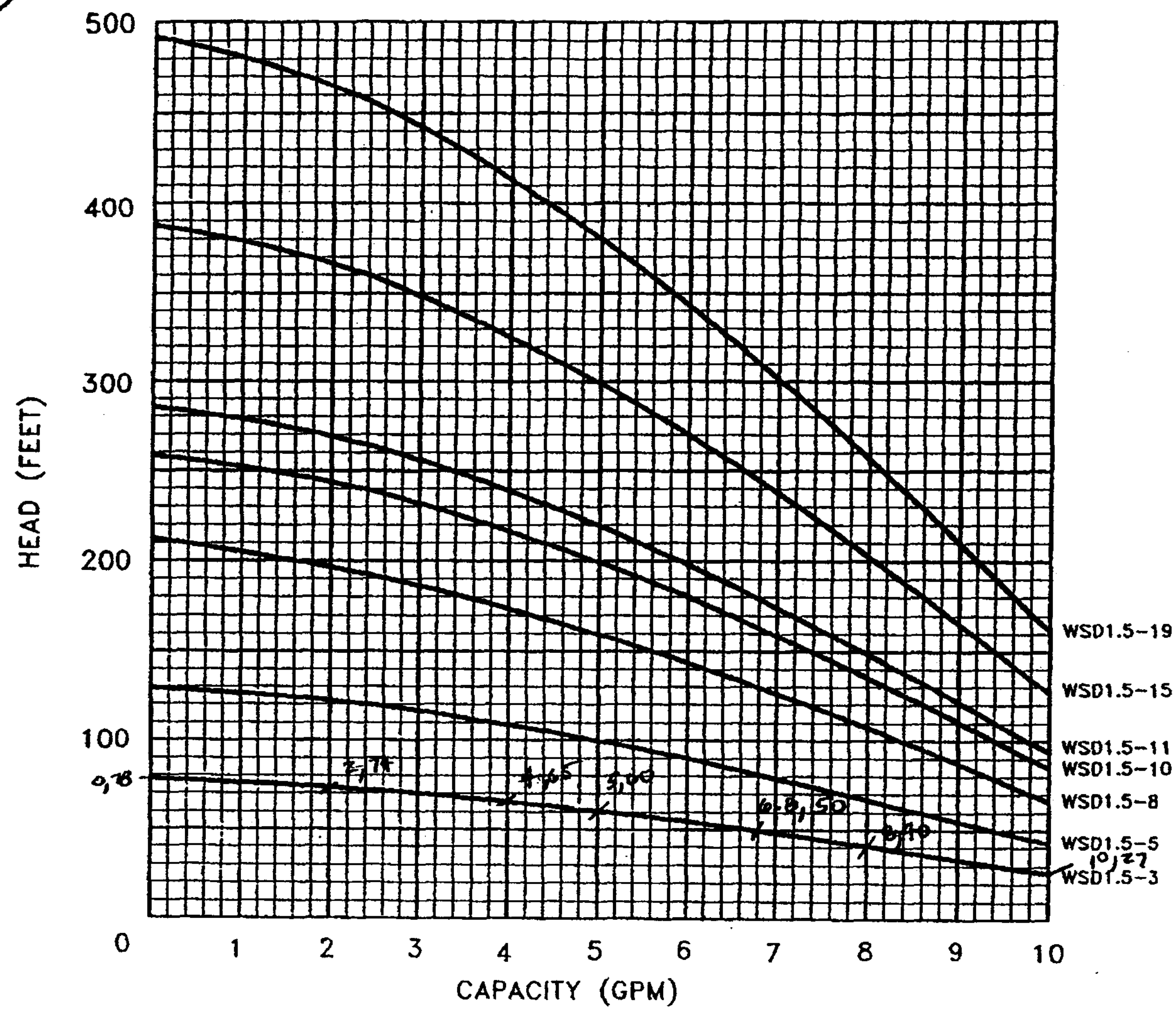


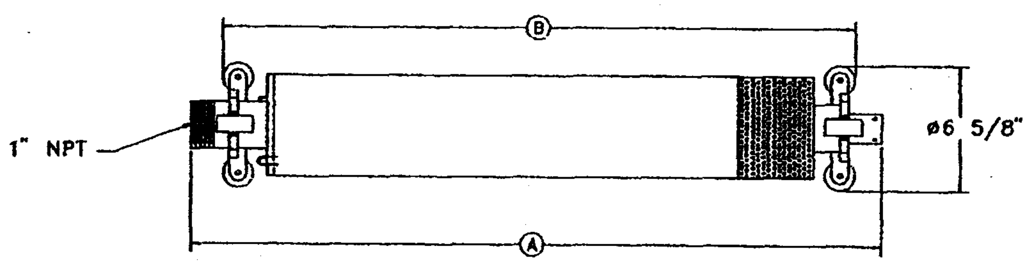
unction Name: Pump
unction Type: Pump

:quation:
H = a + bQ + cQ^2 + dQ^3 + eQ^4

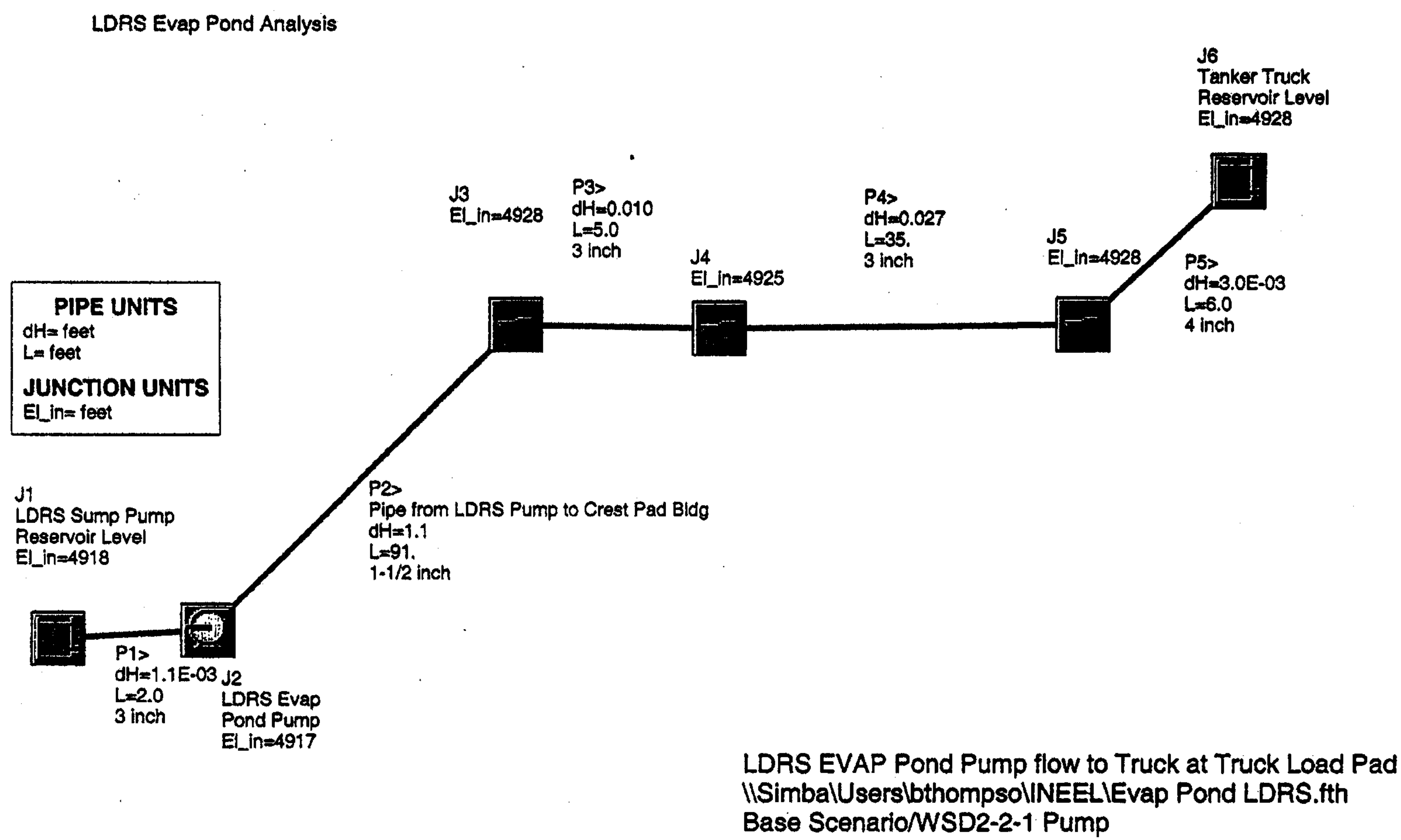
:onstants for pump curve:
= 78.62441
= -2.201383
= -0.3038763

WSD1.5 SurePump™ WHEELED SUMP DRAINER





PUMP MODEL	SINGLE PHASE			THREE PHASE			SHIPPING WEIGHT (LBS)	
	MOTOR HP	A (in)	B (in)	MOTOR HP	A (in)	B (in)	1ø	3ø
WSD1.5-3	0.33	30.00	28.00	0.50	30.75	28.75	39.0	41.2
WSD1.5-5	0.33	31.75	29.75	0.50	32.25	30.25	41.0	43.2
WSD1.5-8	0.33	34.25	32.25	0.50	34.75	32.75	44.2	46.4
WSD1.5-10	0.50	36.50	34.50	0.50	36.50	34.50	48.5	48.5
WSD1.5-11	0.50	37.25	35.25	0.50	37.25	35.25	49.5	49.5
WSD1.5-15	0.75	41.75	39.75	0.75	41.75	39.75	56.0	56.0
WSD1.5-19	1.00	46.25	45.25	1.00	46.25	45.25	62.7	62.7


LDRS Evap Pond Analysis
PIPE UNITS
dH= feet
L= feet
JUNCTION UNITS
El_in= feet
J1
LDRS Sump Pump
Reservoir Level
El_in=4918
P1>
dH=1.1E-03
L=2.0
3 inch
J2
LDRS Evap
Pond Pump
El_in=4917
P2>
Pipe from LDRS Pump to Crest Pad Bldg
dH=1.1
L=91.
1-1/2 inch
J3
El_in=4928
P3>
dH=0.010
L=5.0
3 inch
J4
El_in=4925
P4>
dH=0.027
L=35.
3 inch
J5
El_in=4928
P5>
dH=3.0E-03
L=6.0
4 inch
J6
Tanker Truck
Reservoir Level
El_in=4928
LDRS EVAP Pond Pump flow to Truck at Truck Load Pad
\\Simba\Users\bthompso\INEEL\Evap Pond LDRS.fth
Base Scenario/WSD2-2-1 Pump

Title: LDRS EVAP Pond Pump flow to Truck at Truck Load Pad

Number Of Pipes= 5
Number Of Junctions= 6

Pressure/Head Tolerance= 0.0001 relative change
Flow Rate Tolerance= 0.0001 relative change
Flow Relaxation= (Automatic)
Pressure Relaxation= (Automatic)

Constant Fluid Property Model
Fluid Database: AFT Standard
Fluid: Water at 1 atm
Max Fluid Temperature Data= 212 deg. F
Min Fluid Temperature Data= 32 deg. F
Temperature= 50 deg. F
Density= 62.41296 lbm/ft3
Viscosity= 3.1854 lbm/hr-ft
Vapor Pressure= 0.17055 psia
Viscosity Model= Newtonian

Atmospheric Pressure= 1 atm
Gravitational Acceleration= 1 g
Turbulent Flow Above Reynolds Number= 4000
Laminar Flow Below Reynolds Number= 2300

============= PIPES =============
>>>>> Pipe 1 (Pipe) <<<<<
PVC virtually same roughness as HDPE pipe, typ all HDPE pipe specificed as HDPE.
>>>>> Pipe 3 (Pipe) <<<<<
3" PVC piping on wall, to truck load
>>>>> Pipe 4 (Pipe) <<<<<
3" HDPE to truck load pad
============= JUNCTIONS =============
>>>>> Junction 1 (LDRS Sump Pump Reservoir Level) <<<<<
4919 low point elevation over liner. Assume 1' head over pump, approx. 4918 elev.
>>>>> Junction 2 (LDRS Evap Pond Pump) <<<<<
WSD2-2/1 Pump to truck load
>>>>> Junction 4 (Area Change) <<<<<
Transition from 3" PVC to 3" HDPE to truck load
>>>>> Junction 5 (Area Change) <<<<<
Transition from 4" HDPE to flex hose to truck
>>>>> Junction 6 (Tanker Truck Reservoir Level) <<<<<
Tanker truck. Assume 6 feet above truck load pad

Pipe Input Table

Pipe	Name	Pipe Defined	Length	Length Units	Hydraulic Diameter	Hydraulic Diam. Units	Friction Data Set	Roughness
1	Pipe	Yes	2	feet	3.088	inches	Standard	0.000005
2	Pipe from LDRS Pump to Crest Pad Bldg	Yes	91	feet	1.676	inches	Standard	0.000005
3	Pipe	Yes	5	feet	2.9	inches	Standard	0.000005
4	Pipe	Yes	35	feet	3.063529	inches	Standard	0.000005
5	Pipe	Yes	6	feet	3.938824	inches	Standard	0.000005

Pipe	Roughness Units	Losses (K)	Junctions (Up,Down)	Geometry	Material	Size	Type
1	feet	0	1, 2	Cylindrical Pipe	PVC	3 inch	SDR17
2	feet	3.66736	2, 3	Cylindrical Pipe	PVC	1-1/2 inch	SDR17
3	feet	1.16	3, 4	Cylindrical Pipe	PVC	3 inch	schedule 80
4	feet	1.600195	4, 5	Cylindrical Pipe	HDPE	3 inch	SDR 17
5	feet	0.6824471	5, 6	Cylindrical Pipe	HDPE	4 inch	SDR 17

LDRS EVAP Pond Pump flow to Truck at Truck Load Pad

Pipe Loss Table

Pipe Losses	K Total	Standard Bends	Mitre Bends	Smooth Bends	Angle Valves	Ball Valves	Butterfly Valves	Cylinder Valves	Gate Valves	Globe Valves	Plug Valves	Poppet Valves
2	3.67			3 (1.22)		2 (0.42)						
3	1.16					1 (0.02)						
4	1.6			5 (1.6)								
5	0.68			2 (0.68)								

Pipe Losses	Three-way Valves	Swing Check Valves	Lift Check Valves	Tilting Disc Check Valves	Stop Check Valves	Sharp-edged Orifice	Long Orifice	Contractions
2		1 (2.03)						
3								
4								
5								

Pipe Losses	Expansions	Entrances	Exits	Differential Flowmeter	Honeycomb	Screen	Tee	Add'l Loss
2								
3							2 (1.14)	
4								
5								

Area Change Table

Area Change	Name	Object Defined	Inlet Elevation	Elevation Units	Type	Geometry	Angle	Loss Factor
3	Area Change	Yes	4928	feet	Conical	Expansion	60.	0.4435503
4	Area Change	Yes	4925	feet	Conical	Expansion	60.	0.0107971
5	Area Change	Yes	4927.5	feet	Conical	Expansion	60.	0.156074

Pump Table

Pump	Name	Object Defined	Inlet Elevation	Elevation Units	Initial Pressure	Initial Pressure Units	Database Source	Special Condition
2	LDRS Evap Pond Pump	Yes	4917	feet				None

Pump	Pump Type	Design Flow Rate	Design Flow Rate Units	Current Configuration	Independent Variable	Ind. Variable Units	Dependent Variable	Dep. Variable Units
2	Pump Curve				Vol. Flow Rate	gal/min	Head Loss	feet

Pump	Pump Curve Constant a	Pump Curve Constant b	Pump Curve Constant c	Pump Curve Constant d	Pump Curve Constant e	Runout Flow Rate	Runout Flow Rate Units	Speed
2	28.80709	-0.8856563	-4.218518E-02	0	0	-		100

Pump	Control Discharge	Control Discharge Units	Control When Exceeded Only	Heat Added To Fluid
2				0

Reservoir Table

Reservoir	Name	Object Defined	Inlet Elevation	Elevation Units	Initial Pressure	Initial Pressure Units	Database Source
1	LDRS Sump Pump Reservoir Level	Yes	4918	feet			
6	Tanker Truck Reservoir Level	Yes	4928	feet			

Reservoir	Surface Pressure	Surface Pressure Units	Balance Energy	Balance Concentration	(Pipe #1) K In, K Out	(Pipe #2) K In, K Out	(Pipe #3) K In, K Out	(Pipe #4) K In, K Out
1	1	atm	No	No	(P1) 0, 0			
6	1	atm	No	No	(P5) 0, 0			

LDRS EVAP Pond Pump flow to Truck at Truck Load Pad

Reservoir	(Pipe #5) K In, K Out	(Pipe #6) K In, K Out	(Pipe #7) K In, K Out	(Pipe #8) K In, K Out	(Pipe #9) K In, K Out	(Pipe #10) K In, K Out	(Pipe #11) K In, K Out	(Pipe #12) K In, K Out	(Pipe #13) K In, K Out
1									
6									

Reservoir	(Pipe #14) K In, K Out	(Pipe #15) K In, K Out	(Pipe #16) K In, K Out	(Pipe #17) K In, K Out	(Pipe #18) K In, K Out	(Pipe #19) K In, K Out	(Pipe #20) K In, K Out	(Pipe #21) K In, K Out	(Pipe #22) K In, K Out
1									
6									

Reservoir	(Pipe #23) K In, K Out	(Pipe #24) K In, K Out	(Pipe #25) K In, K Out	(Pipe #1) Depth	(Pipe #2) Depth	(Pipe #3) Depth	(Pipe #4) Depth	(Pipe #5) Depth	(Pipe #6) Depth	(Pipe #7) Depth
1				(P1) 0						
6				(P5) 0						

Reservoir	(Pipe #8) Depth	(Pipe #9) Depth	(Pipe #10) Depth	(Pipe #11) Depth	(Pipe #12) Depth	(Pipe #13) Depth	(Pipe #14) Depth	(Pipe #15) Depth	(Pipe #16) Depth
1									
6									

Reservoir	(Pipe #17) Depth	(Pipe #18) Depth	(Pipe #19) Depth	(Pipe #20) Depth	(Pipe #21) Depth	(Pipe #22) Depth	(Pipe #23) Depth	(Pipe #24) Depth	(Pipe #25) Depth
1									
6									

Reservoir	Pipe Depth Units
1	feet
6	feet

Title: LDRS EVAP Pond Pump flow to Truck at Truck Load Pad
Analysis run on: 03/16/2002 7:45:01 PM
Application version: AFT Fathom Version 5.0 (2001.10.15)
Input File: \\Simba\Users\bthompso\INEEL\Evap Pond LDRS.fth
Scenario: Base Scenario/WSD2-2-1 Pump

Execution Time= 0.36 seconds
Total Number Of Head/Pressure Iterations= 0
Total Number Of Flow Iterations= 106
Total Number Of Temperature Iterations= 0
Number Of Pipes= 5
Number Of Junctions= 6
Matrix Method= Gaussian Elimination

Pressure/Head Tolerance= 0.0001 relative change
Flow Rate Tolerance= 0.0001 relative change
Flow Relaxation= (Automatic)
Pressure Relaxation= (Automatic)

Constant Fluid Property Model
Fluid Database: AFT Standard
Fluid: Water at 1 atm
Max Fluid Temperature Data= 212 deg. F
Min Fluid Temperature Data= 32 deg. F
Temperature= 50 deg. F
Density= 62.41296 lbm/ft3
Viscosity= 3.1854 lbm/hr-ft
Vapor Pressure= 0.17055 psia
Viscosity Model= Newtonian

Atmospheric Pressure= 1 atm
Gravitational Acceleration= 1 g
Turbulent Flow Above Reynolds Number= 4000
Laminar Flow Below Reynolds Number= 2300
Overall Delta Head = 10. feet
Overall Friction Head Loss = 1.1 feet
Overall Delta Pressure = -4.8 psid
Overall Frictional Pressure Loss = 0.50 psid
Total Inflow= 12. gal/min
Total Outflow= 12. gal/min
Maximum Pressure is 20. psia at Junction 2 Outlet
Minimum Pressure is 15. psia at Junction 6 Outlet

Pump Summary

Jct	Name	Vol. Flow (gal/min)	Mass Flow (lbm/sec)	DP (psid)	DH (feet)	Overall Efficiency (Percent)	Speed (Percent)	Overall Power (hp)	BEP (gal/min)	% of BEP (Percent)
2	LDRS Evap Pond Pump	12.	1.7	4.8	11.	100	100	0.035	N/A	N/A

Jct	NPSHA (feet)	NPSHR (feet)
2	35.	N/A

Pipe Output Table

Pipe	Vol. Flow (gal/min)	dH (feet)	P Static Max (psia)	P Static Min (psia)	Reynolds No.	Pipe Material	Length (feet)	Pipe Nominal Size	HGL Outlet (feet)
1	12.	0.0011	15.	15.	9.7E+03	PVC	2.0	3 inch	4918
2	12.	1.0812	20.	15.	1.8E+04	PVC	91.0	1-1/2 inch	4928
3	12.	0.0103	16.	15.	1.0E+04	PVC	5.0	3 inch	4928
4	12.	0.0270	16.	15.	9.8E+03	HDPE	35.0	3 inch	4928

LDRS EVAP Pond Pump flow to Truck at Truck Load Pad

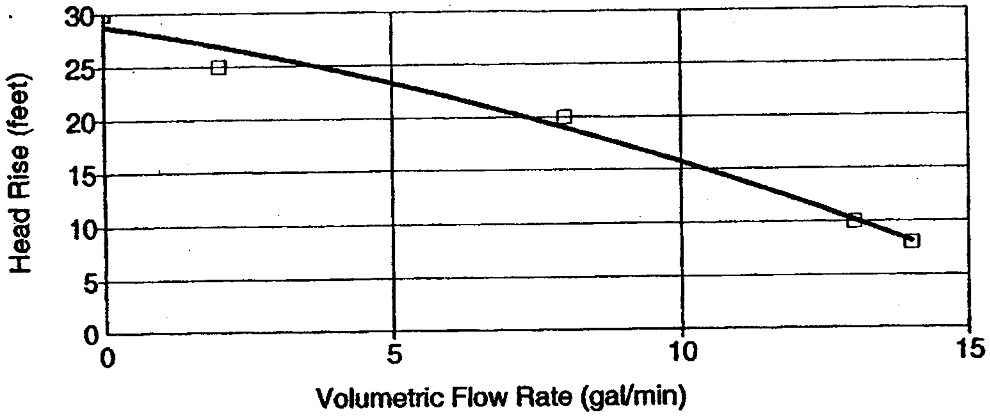
Pipe	Vol. Flow (gal/min)	dH (feet)	P Static Max (psia)	P Static Min (psia)	Reynolds No.	Pipe Material	Length (feet)	Pipe Nominal Size	HGL Outlet (feet)
5	12.	0.0030	15.	15.	7.6E+03	HDPE	6.0	4 inch	4928

All Junction Table

Jct	Name	Elevation Inlet (feet)	Vol. Flow Into System (gal/min)	dH (feet)	HGL Inlet (feet)	EGL Inlet (feet)	P Static In (psia)	P Static Out (psia)	HGL Outlet (feet)
1	LDRS Sump Pump Reservoir Level	4918	12.	0.000000	4918	4918	15.	15.	4918
2	LDRS Evap Pond Pump	4917	0.	-11.146123	4918	4918	15.	20.	4929
3	Area Change	4928	0.	0.022776	4928	4928	15.	15.	4928
4	Area Change	4925	0.	0.000062	4928	4928	16.	16.	4928
5	Area Change	4928	0.	0.000718	4928	4928	15.	15.	4928
6	Tanker Truck Reservoir Level	4928	-12.	0.000000	4928	4928	15.	15.	4928

Jct	EGL Outlet (feet)
1	4918
2	4929
3	4928
4	4928
5	4928
6	4928

EPG WSD2-1/1 PUMP

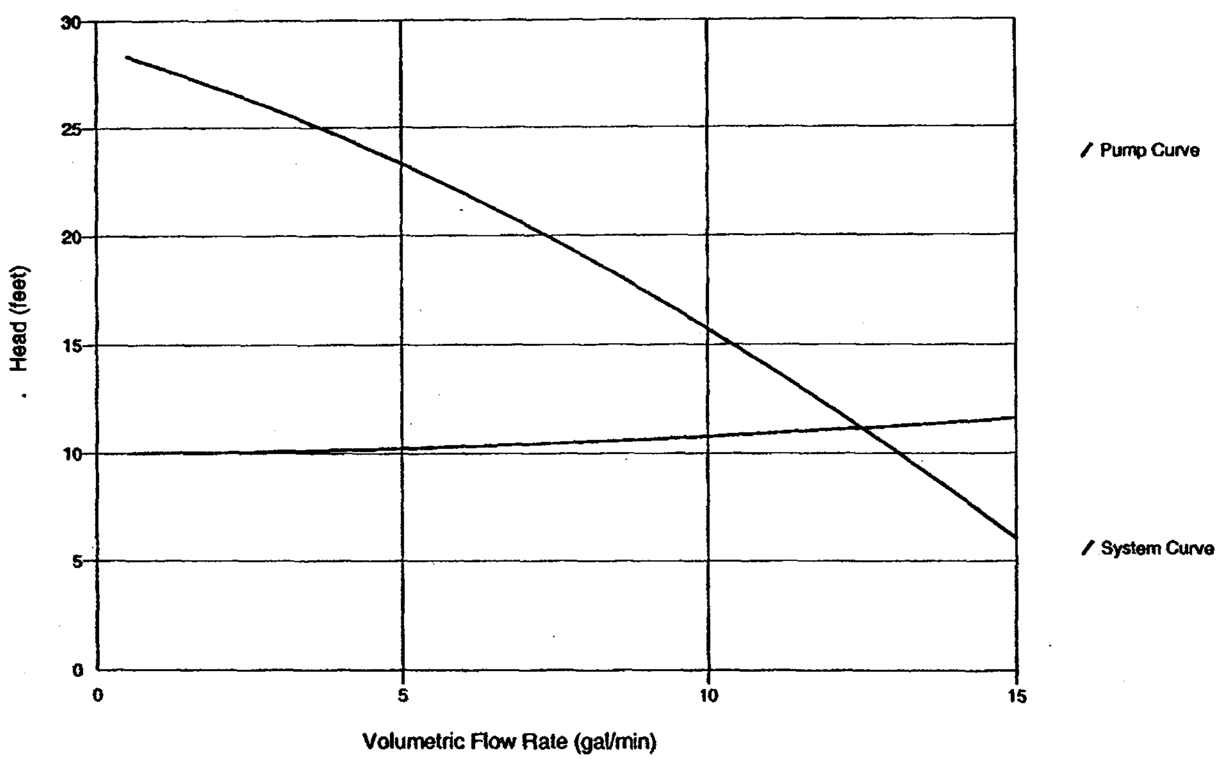


Junction Name: LDRS Evap Pond Pump
Junction Type: Pump

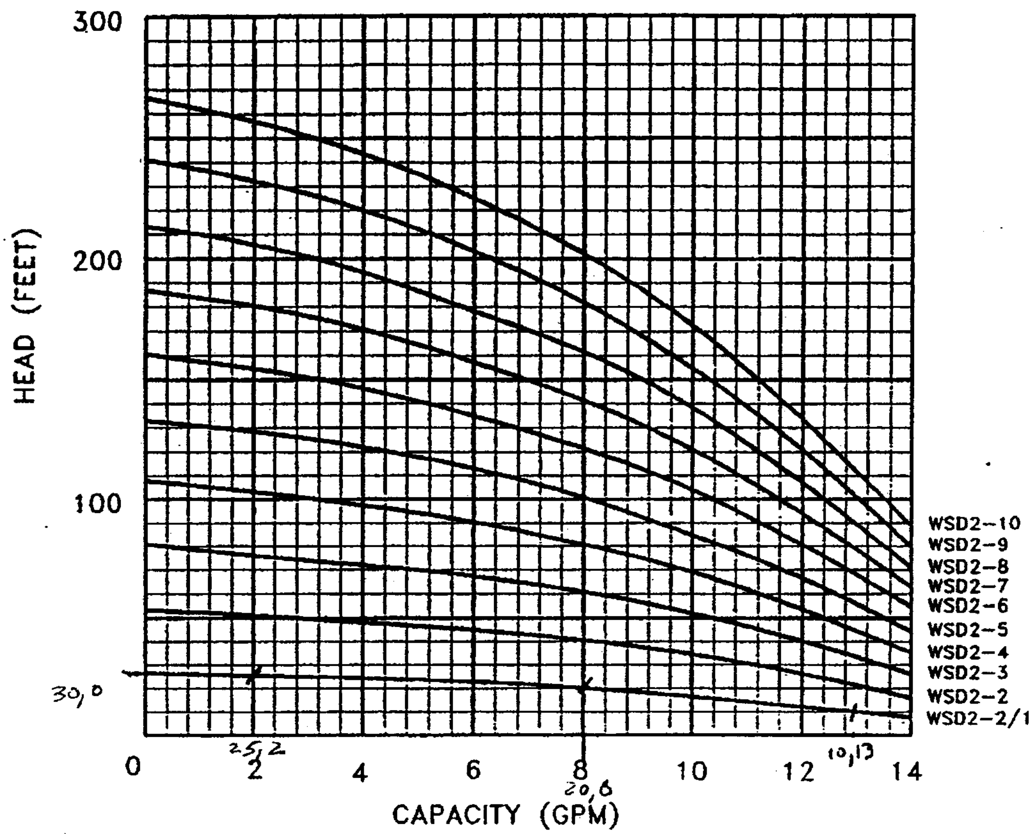
Equation:
dH = a + bQ + cQ^2 + dQ^3 + eQ^4

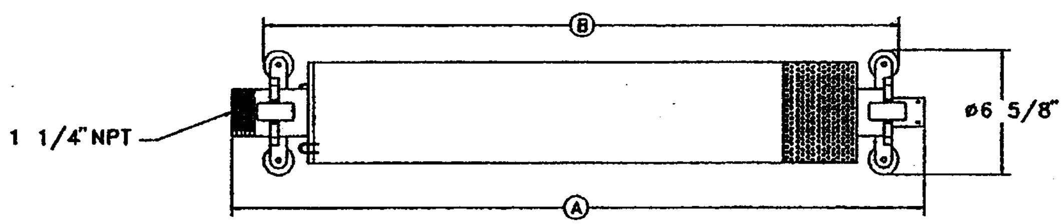
Constants for pump curve:
A = 28.80709
B = -0.8856563
C = -4.218518E-02

Pump Curve vs. System Curve Evap Pond to Truck Load. WSD2-2/1 Pump



WSD2 SurePump™ WHEELED SUMP DRAINER

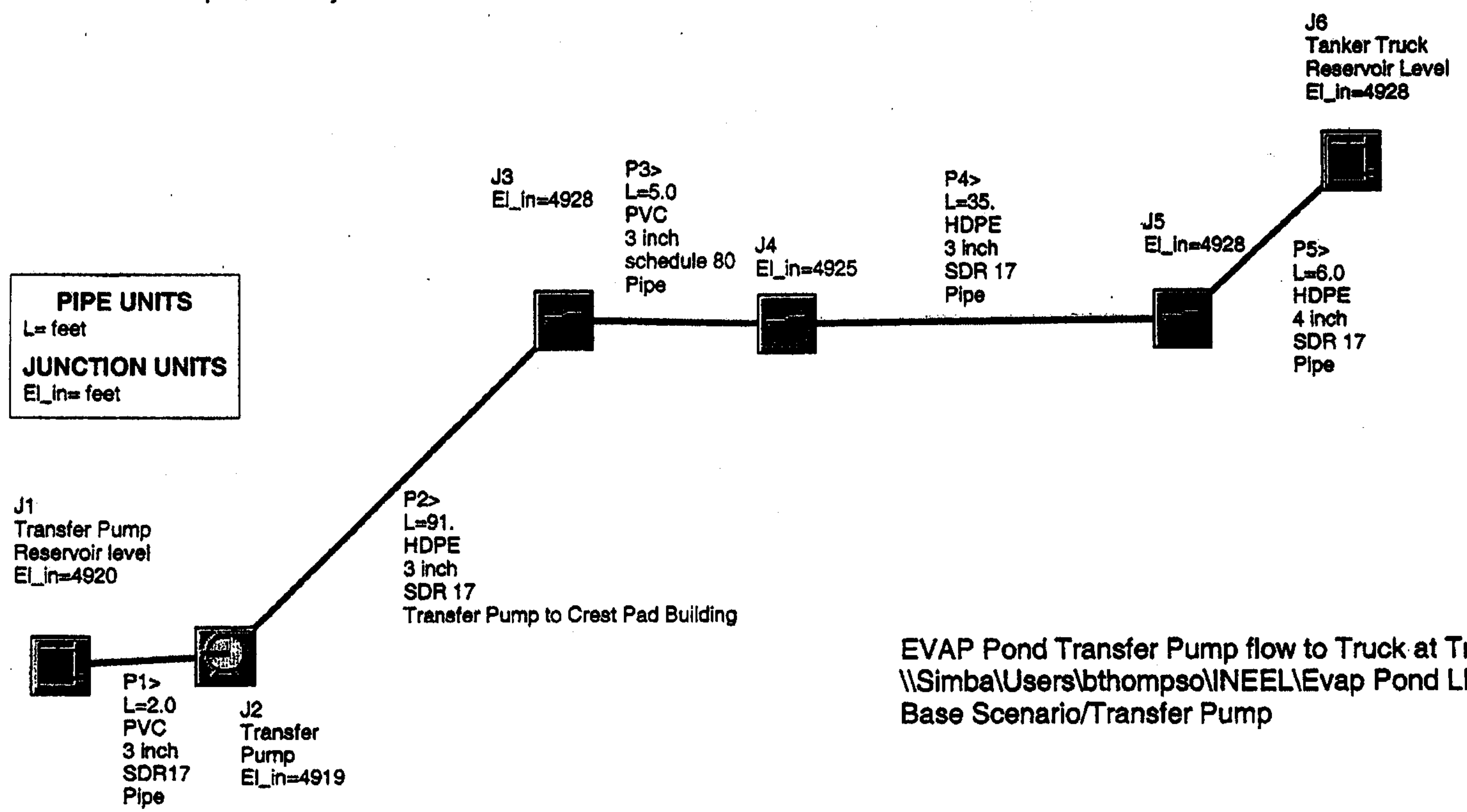




PUMP MODEL	SINGLE PHASE			THREE PHASE			SHIPPING WEIGHT (LBS)	
	MOTOR HP	A (in)	B (in)	MOTOR HP	A (in)	B (in)	1ø	3ø
WSD2-2/1	0.33	29.25	27.25	0.50	29.75	27.75	38.1	40.3
WSD2-2	0.33	29.25	27.25	0.50	29.75	27.75	38.1	40.3
WSD2-3	0.33	30.00	28.00	0.50	30.75	28.75	39.0	41.2
WSD2-4	0.33	31.00	29.00	0.50	31.50	29.50	40.0	42.2
WSD2-5	0.33	31.75	29.75	0.50	32.25	30.25	41.0	43.2
WSD2-6	0.50	33.25	31.25	0.50	33.25	31.25	44.3	44.3
WSD2-7	0.50	34.00	32.00	0.50	34.00	32.00	45.3	45.3
WSD2-8	0.50	34.75	32.75	0.50	34.75	32.75	46.4	46.4
WSD2-9	0.75	36.75	34.75	0.75	36.75	34.75	49.2	49.2
WSD2-10	0.75	37.50	35.50	0.75	37.50	35.50	50.2	50.2

SEE 0572-2 FOR HIGH HEAD MODELS.

LDRS Evap Pond Analysis



EVAP Pond Transfer Pump flow to Truck at Truck Load Pad
\\Simba\Users\bthompso\INEEL\Evap Pond LDRS.fth
Base Scenario/Transfer Pump

Title: EVAP Pond Transfer Pump flow to Truck at Truck Load Pad

Number Of Pipes= 5
Number Of Junctions= 6

Pressure/Head Tolerance= 0.0001 relative change
Flow Rate Tolerance= 0.0001 relative change
Flow Relaxation= (Automatic)
Pressure Relaxation= (Automatic)

Constant Fluid Property Model
Fluid Database: AFT Standard
Fluid: Water at 1 atm
Max Fluid Temperature Data= 212 deg. F
Min Fluid Temperature Data= 32 deg. F
Temperature= 50 deg. F
Density= 62.41296 lbm/ft3
Viscosity= 3.1854 lbm/hr-ft
Vapor Pressure= 0.17055 psia
Viscosity Model= Newtonian

Atmospheric Pressure= 1 atm
Gravitational Acceleration= 1 g
Turbulent Flow Above Reynolds Number= 4000
Laminar Flow Below Reynolds Number= 2300

============== PIPES ==============
>>>>> Pipe 1 (Pipe) <<<<<
PVC virtually same roughness as HDPE pipe, typ all HDPE pipe specificed as HDPE.
>>>>> Pipe 3 (Pipe) <<<<<
3" PVC piping on wall, to truck load
>>>>> Pipe 4 (Pipe) <<<<<
3" HDPE to truck load pad
============== JUNCTIONS ==============
>>>>> Junction 1 (Transfer Pump Reservoir level) <<<<<
4919 low point elevation over liner. Assume 1' head over pump, approx. 4920 elev.
>>>>> Junction 2 (Transfer Pump) <<<<<
Transfer Pump to truck load
>>>>> Junction 4 (Area Change) <<<<<
Transition from 3" PVC to 3" HDPE to truck load
>>>>> Junction 5 (Area Change) <<<<<
Transition from 4" HDPE to flex hose to truck
>>>>> Junction 6 (Tanker Truck Reservoir Level) <<<<<
Tanker truck. Assume 6 feet above truck load pad

Pipe Input Table

Pipe	Name	Pipe Defined	Length	Length Units	Hydraulic Diameter	Hydraulic Diam. Units	Friction Data Set	Roughness
1	Pipe	Yes	2	feet	3.068	inches	Standard	0.000005
2	Transfer Pump to Crest Pad Building	Yes	91	feet	3.063529	inches	Standard	0.000005
3	Pipe	Yes	5	feet	2.9	inches	Standard	0.000005
4	Pipe	Yes	35	feet	3.063529	inches	Standard	0.000005
5	Pipe	Yes	6	feet	3.938824	inches	Standard	0.000005

Pipe	Roughness Units	Losses (K)	Junctions (Up,Down)	Geometry	Material	Size	Type
1	feet	0	1, 2	Cylindrical Pipe	PVC	3 inch	SDR17
2	feet	3.289835	2, 3	Cylindrical Pipe	HDPE	3 inch	SDR 17
3	feet	1.16	3, 4	Cylindrical Pipe	PVC	3 inch	schedule 80
4	feet	1.600195	4, 5	Cylindrical Pipe	HDPE	3 inch	SDR 17
5	feet	0.6824471	5, 6	Cylindrical Pipe	HDPE	4 inch	SDR 17

EVAP Pond Transfer Pump flow to Truck at Truck Load Pad

Pipe Loss Table

Pipe Losses	K Total	Standard Bends	Mitre Bends	Smooth Bends	Angle Valves	Ball Valves	Butterfly Valves	Cylinder Valves	Gate Valves	Globe Valves	Plug Valves	Poppet Valves
2	3.29			3 (1.08)		2 (0.42)						
3	1.16					1 (0.02)						
4	1.6			5 (1.6)								
5	0.68			2 (0.68)								

Pipe Losses	Three-way Valves	Swing Check Valves	Lift Check Valves	Tilting Disc Check Valves	Stop Check Valves	Sharp-edged Orifice	Long Orifice	Contractions
2		1 (1.79)						
3								
4								
5								

Pipe Losses	Expansions	Entrances	Exits	Differential Flowmeter	Honeycomb	Screen	Tee	Add'l Loss
2								
3							2 (1.14)	
4								
5								

Area Change Table

Area Change	Name	Object Defined	Inlet Elevation	Elevation Units	Type	Geometry	Angle	Loss Factor
3	Area Change	Yes	4928	feet	Conical	Unspecified	60.	4.575139E-02
4	Area Change	Yes	4925	feet	Conical	Expansion	60.	0.0107971
5	Area Change	Yes	4927.5	feet	Conical	Expansion	60.	0.156074

Pump Table

Pump	Name	Object Defined	Inlet Elevation	Elevation Units	Initial Pressure	Initial Pressure Units	Database Source	Special Condition	Pump Type
2	Transfer Pump	Yes	4919	feet				None	Pump Curve

Pump	Design Flow Rate	Design Flow Rate Units	Current Configuration	Independent Variable	Ind. Variable Units	Dependent Variable	Dep. Variable Units	Pump Curve Constant a
2				Vol. Flow Rate	gal/min	Head Loss	feet	54.22766

Pump	Pump Curve Constant b	Pump Curve Constant c	Pump Curve Constant d	Pump Curve Constant e	Runout Flow Rate	Runout Flow Rate Units	Speed	Control Discharge
2	-6.86945E-03	-2.637844E-03	0	0			100	

Pump	Control Discharge Units	Control When Exceeded Only	Heat Added To Fluid
2			0

Reservoir Table

Reservoir	Name	Object Defined	Inlet Elevation	Elevation Units	Initial Pressure	Initial Pressure Units	Database Source
1	Transfer Pump Reservoir level	Yes	4920	feet			
6	Tanker Truck Reservoir Level	Yes	4928	feet			

Reservoir	Surface Pressure	Surface Pressure Units	Balance Energy	Balance Concentration	(Pipe #1) K In, K Out	(Pipe #2) K In, K Out	(Pipe #3) K In, K Out	(Pipe #4) K In, K Out
1	1	atm	No	No	(P1) 0, 0			
6	1	atm	No	No	(P5) 0, 0			

EVAP Pond Transfer Pump flow to Truck at Truck Load Pad

Reservoir	(Pipe #5) K In, K Out	(Pipe #6) K In, K Out	(Pipe #7) K In, K Out	(Pipe #8) K In, K Out	(Pipe #9) K In, K Out	(Pipe #10) K In, K Out	(Pipe #11) K In, K Out	(Pipe #12) K In, K Out	(Pipe #13) K In, K Out
1									
6									

Reservoir	(Pipe #14) K In, K Out	(Pipe #15) K In, K Out	(Pipe #16) K In, K Out	(Pipe #17) K In, K Out	(Pipe #18) K In, K Out	(Pipe #19) K In, K Out	(Pipe #20) K In, K Out	(Pipe #21) K In, K Out	(Pipe #22) K In, K Out
1									
6									

Reservoir	(Pipe #23) K In, K Out	(Pipe #24) K In, K Out	(Pipe #25) K In, K Out	(Pipe #1) Depth	(Pipe #2) Depth	(Pipe #3) Depth	(Pipe #4) Depth	(Pipe #5) Depth	(Pipe #6) Depth	(Pipe #7) Depth
1				(P1) 0						
6				(P5) 0						

Reservoir	(Pipe #8) Depth	(Pipe #9) Depth	(Pipe #10) Depth	(Pipe #11) Depth	(Pipe #12) Depth	(Pipe #13) Depth	(Pipe #14) Depth	(Pipe #15) Depth	(Pipe #16) Depth
1									
6									

Reservoir	(Pipe #17) Depth	(Pipe #18) Depth	(Pipe #19) Depth	(Pipe #20) Depth	(Pipe #21) Depth	(Pipe #22) Depth	(Pipe #23) Depth	(Pipe #24) Depth	(Pipe #25) Depth
1									
6									

Reservoir	Pipe Depth Units
1	feet
6	feet

Title: EVAP Pond Transfer Pump flow to Truck at Truck Load Pad
Analysis run on: 03/18/2002 1:28:55 PM
Application version: AFT Fathom Version 5.0 (2001.10.15)
Input File: \\Simba\Users\bthompso\INEEL\Evap Pond LDRS.fth
Scenario: Base Scenario/Transfer Pump

Execution Time= 0.11 seconds
Total Number Of Head/Pressure Iterations= 0
Total Number Of Flow Iterations= 5
Total Number Of Temperature Iterations= 0
Number Of Pipes= 5
Number Of Junctions= 6
Matrix Method= Gaussian Elimination

Pressure/Head Tolerance= 0.0001 relative change
Flow Rate Tolerance= 0.0001 relative change
Flow Relaxation= (Automatic)
Pressure Relaxation= (Automatic)

Constant Fluid Property Model
Fluid Database: AFT Standard
Fluid: Water at 1 atm
Max Fluid Temperature Data= 212 deg. F
Min Fluid Temperature Data= 32 deg. F
Temperature= 50 deg. F
Density= 62.41296 lbm/ft3
Viscosity= 3.1854 lbm/hr-ft
Vapor Pressure= 0.17055 psia
Viscosity Model= Newtonian

Atmospheric Pressure= 1 atm
Gravitational Acceleration= 1 g
Turbulent Flow Above Reynolds Number= 4000
Laminar Flow Below Reynolds Number= 2300
Overall Delta Head = 8.0 feet
Overall Friction Head Loss = 7.1 feet
Overall Delta Pressure = -6.6 psid
Overall Frictional Pressure Loss = 3.1 psid
Total Inflow= 120 gal/min
Total Outflow= 120 gal/min
Maximum Pressure is 21. psia at Junction 2 Outlet
Minimum Pressure is 15. psia at Junction 6 Outlet

Pump Summary

Jct	Name	Vol. Flow (gal/min)	Mass Flow (lbm/sec)	DP (psid)	DH (feet)	Overall Efficiency (Percent)	Speed (Percent)	Overall Power (hp)	BEP (gal/min)	% of BEP (Percent)	NPSHA (feet)
2	Transfer Pump	120	17.	6.6	15.	100	100	0.46	N/A	N/A	34.

Jct	NPSHR (feet)
2	N/A

Pipe Output Table

Pipe	Vol. Flow (gal/min)	dH (feet)	P Static Max (psia)	P Static Min (psia)	Reynolds No.	Pipe Material	Length (feet)	Pipe Nominal Size	HGL Outlet (feet)
1	120	0.059	15.	15.	9.4E+04	PVC	2.0	3 inch	4920
2	120	4.194	21.	16.	9.4E+04	HDPE	91.0	3 inch	4930
3	120	0.816	17.	16.	1.0E+05	PVC	5.0	3 inch	4930
4	120	1.756	17.	15.	9.4E+04	HDPE	35.0	3 inch	4928

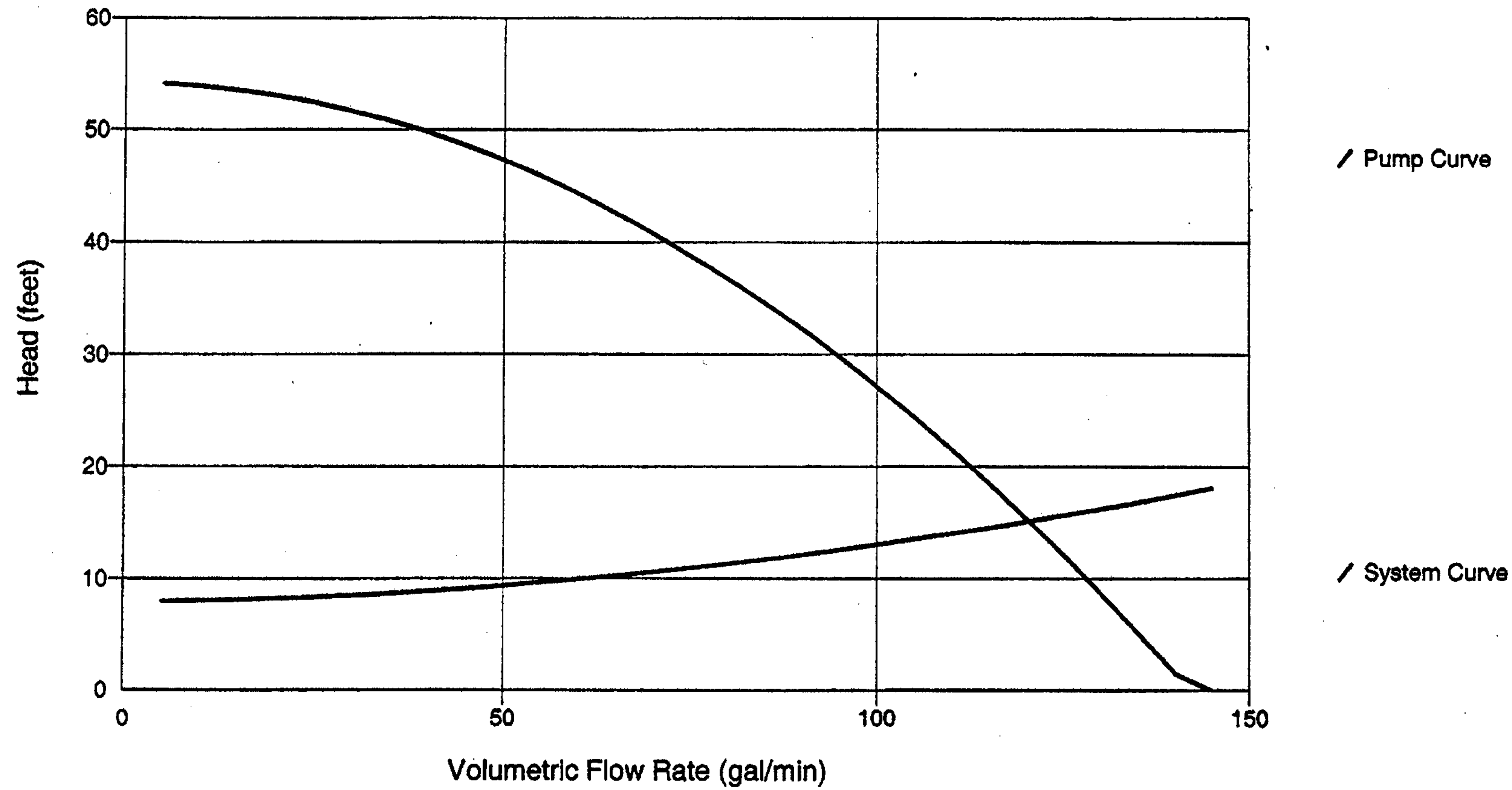
EVAP Pond Transfer Pump flow to Truck at Truck Load Pad

Pipe	Vol. Flow (gal/min)	dH (feet)	P Static Max (psia)	P Static Min (psia)	Reynolds No.	Pipe Material	Length (feet)	Pipe Nominal Size	HGL Outlet (feet)
5	120	0.218	15.	15.	7.3E+04	HDPE	6.0	4 inch	4928

All Junction Table

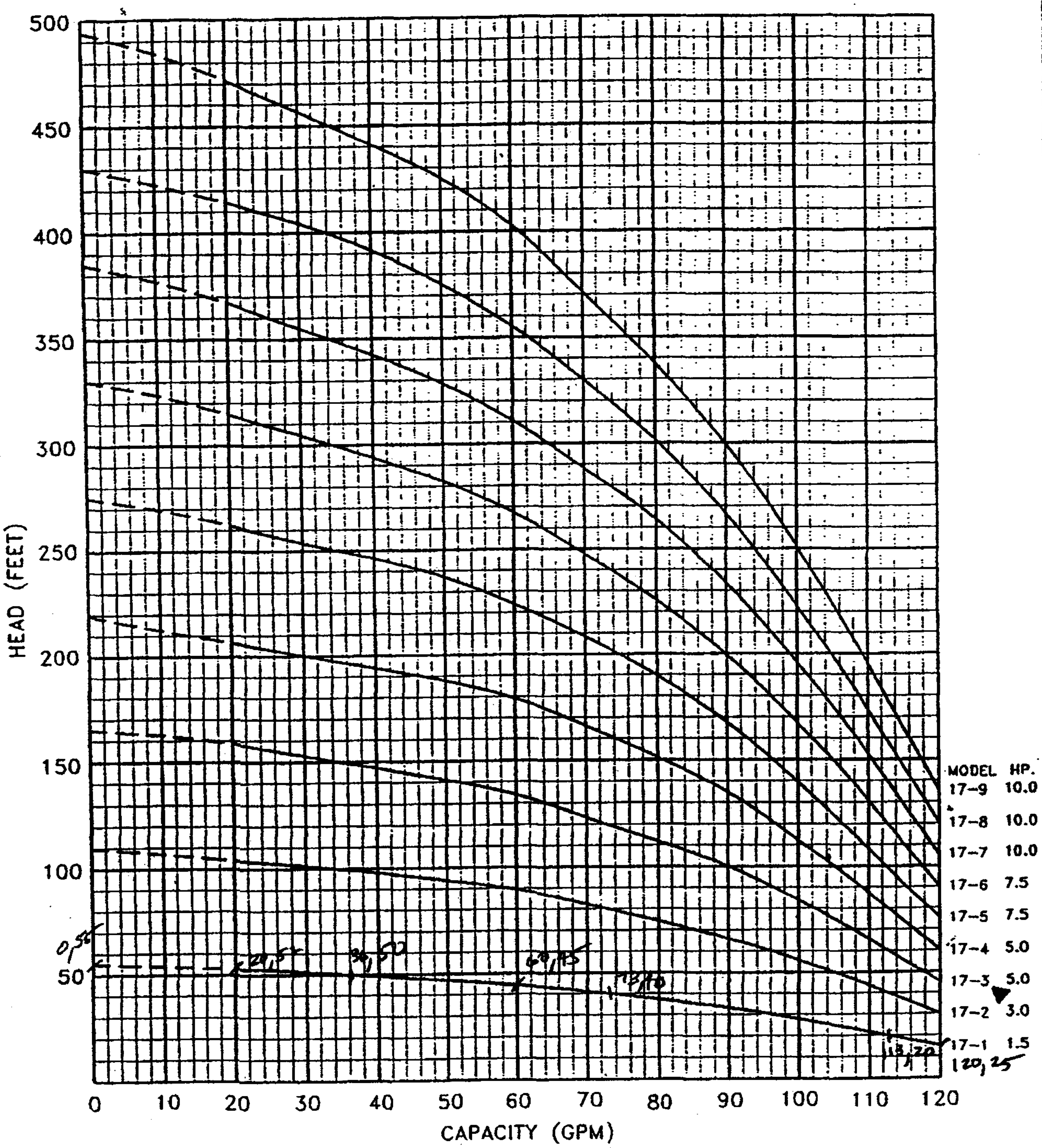
Jct	Name	Elevation Inlet (feet)	Vol. Flow Into System (gal/min)	dH (feet)	HGL Inlet (feet)	EGL Inlet (feet)	P Static In (psia)	P Static Out (psia)	HGL Outlet (feet)	EGL Outlet (feet)
1	Transfer Pump Reservoir level	4920	120	0.0000	4920	4920	15.	15.	4920	4920
2	Transfer Pump	4919	0	-15.1352	4920	4920	15.	21.	4935	4935
3	Area Change	4928	0	0.0195	4930	4931	16.	16.	4930	4931
4	Area Change	4925	0	0.0057	4930	4930	17.	17.	4930	4930
5	Area Change	4928	0	0.0667	4928	4928	15.	15.	4928	4928
6	Tanker Truck Reservoir Level	4928	-120	0.0000	4928	4928	15.	15.	4928	4928

17-1 Transfer Pump Curve vs. Evap Pond to Truck Load System Curve



SERIES 17 SurePump™

Flow Range 20~120 GPM



SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE