Sump Pumps

Office procedures for the Drainage & Grading Section

Introduction

This manual provides office procedures for checking the design of sump pumps which may be proposed in conjunction with grading plans.

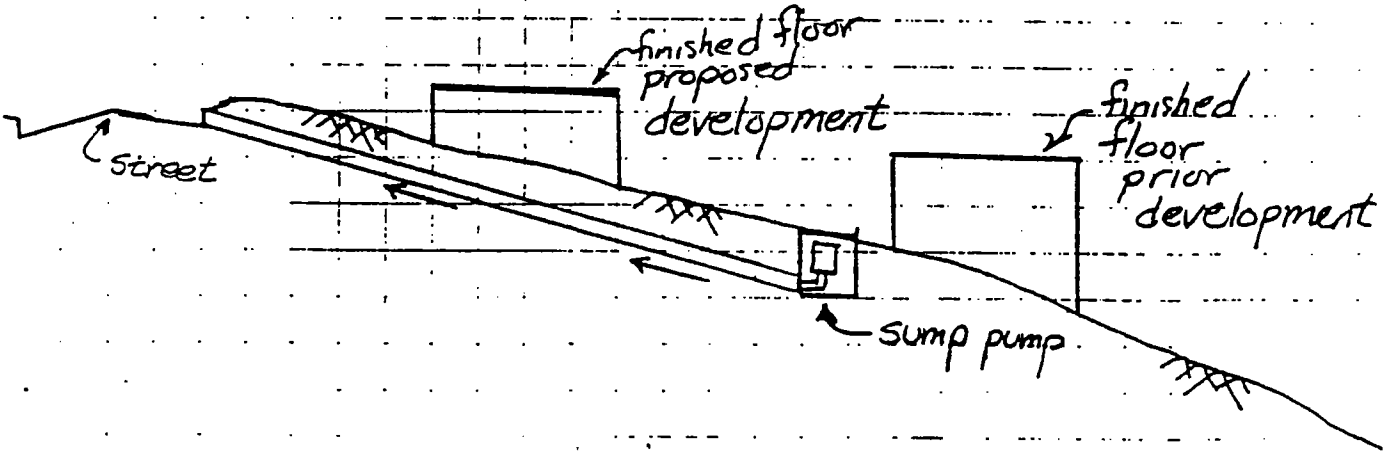
Generally, these systems are to be maintained by homeowners associations or some other type of private maintenance.

General Information

A sump is defined as a low area which prevents the free passage of water, and results in flooding of streets or private property. Generally gravity flow drainage facilities may be installed for sumps; however, there are some drainage situations which would require the use of a sump pump.

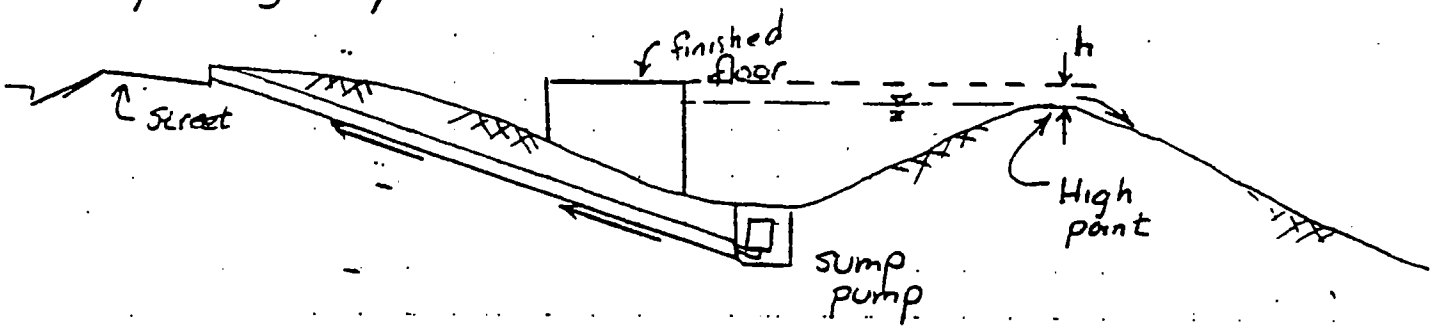
Case A:

The flows would naturally travel to downstream property. However, due to prior development there are no drainage facilities to accept flow from the upstream area.



Case B:

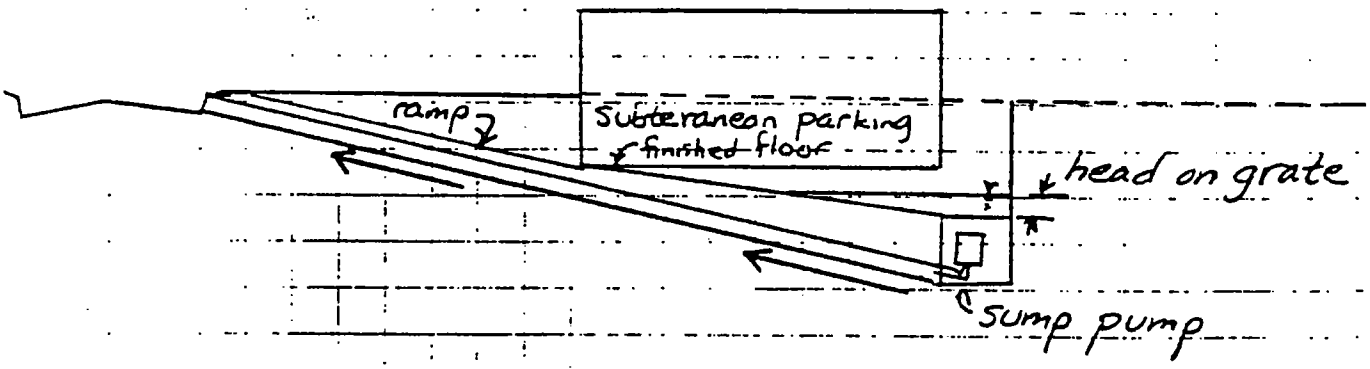
The finished floor elevation of the proposed project is above the sump overflow elevation, but the ponding depth would exceed the maximum allowable.



Case C:

The finished floor elevation of the proposed project is below the sump overflow elevation, such as a condo complex with subterranean parking.

note: A single building with subterranean parking which is accessed by a driveway ramp is reviewed by Building and Safety Division, not Land Development Division. The only flows which would enter the building would be from rainfall on the driveway ramp.



DESIGN HYDROLOGY

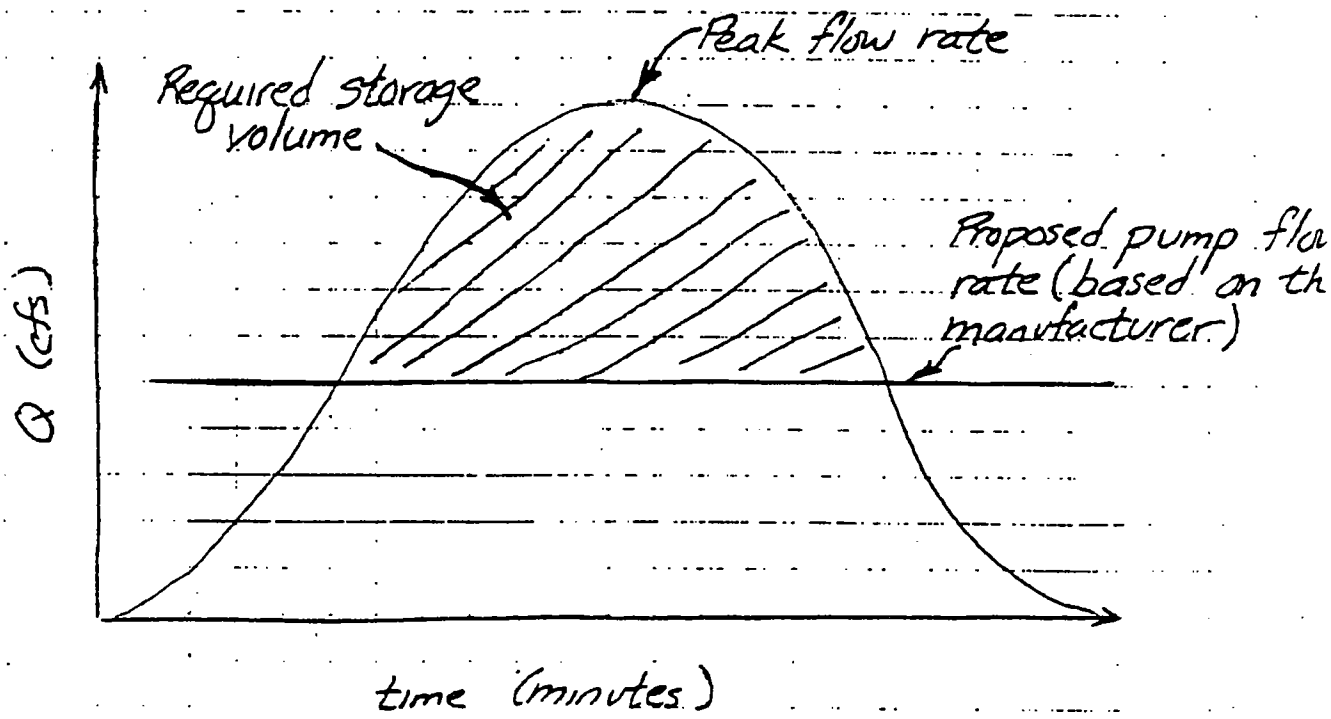
1. A hydrology study for the Q_{50} must be provided to determine the sump volume and pump requirements.

2. The grading plan must show sufficient offsite topograph and elevations to define the drainage pattern.

3. The hydrology study needs to indicate design assumption such as if the roof flows will be included in the contributory area, or if the roof flows will drain directly to the street.

4. If the drainage area is 10 acres or less, use the Chart Method to calculate the Q.

5. Provide a hydrograph to determine if there will be any required storage (detention) during pump operation.



6. Note: 1 cfs = 448.8 gpm

To determine the Q for drainage areas of 10 acres or less

Use the Chart Method

What you'll need to know:

1. The drainage area size in acres.
2. The Runoff Coefficient Curve Number (also known as the Soil Classification Number or Soil Type)
3. The Rainfall Zone (I, J, K, L, or M)

note: Items 2 and 3 are from the hydrologic maps in the L.A.C.D.P.W. Hydrology Manual (Section C).

How to use the Chart Method:

1. From page 1, find the Group Letter (G) which corresponds to your Runoff Coefficient (R.C.). The Group Letter will be either "A" or "B".

2. If your site has Group Letter "A" use the chart on page 2
   If your site has Group Letter "B" use the chart on page 3

3. Read the Q_{50} from the box on the chart which corresponds to your Area and Rainfall Zone.

Runoff Coefficient Groups

RC	G	RC	G	RC	G	RC	G	RC	G	RC	G	RC	G	RC	G	RC	G
1	-	21	B	41	B	61	B	81	A	101	B	121	B	141	A	161	B
2	A	22	A	42	A	62	A	82	A	102	A	122	B	142	A	162	A
3	B	23	A	43	B	63	A	83	-	103	A	123	A	143	B	163	A
4	A	24	B	44	A	64	A	84	B	104	A	124	B	144	B	164	A
5	A	25	A	45	B	65	A	85	B	105	A	125	B	145	B	165	A
6	A	26	B	46	B	66	A	86	B	106	B	126	B	146	A	166	B
7	A	27	B	47	A	67	B	87	B	107	A	127	B	147	A	167	A
8	A	28	B	48	A	68	A	88	B	108	A	128	B	148	B	168	B
9	A	29	A	49	A	69	B	89	A	109	A	129	B	149	B	169	B
10	B	30	B	50	A	70	A	90	A	110	A	130	B	150	B	170	B
11	A	31	B	51	A	71	A	91	A	111	A	131	B	151	A	171	B
12	A	32	A	52	B	72	A	92	A	112	A	132	B	152	A	172	B
13	A	33	A	53	B	73	A	93	A	113	A	133	A	153	B		
14	A	34	A	54	A	74	B	94	A	114	A	134	B	154	A		
15	B	35	B	55	A	75	B	95	A	115	A	135	A	155	A		
16	A	36	A	56	A	76	B	96	B	116	B	136	B	156	A		
17	A	37	B	57	B	77	A	97	A	117	A	137	A	157	B		
18	B	38	A	58	A	78	B	98	A	118	A	138	B	158	B		
19	B	39	A	59	A	79	A	99	A	119	B	139	A	159	A		
20	B	40	A	60	B	80	A	100	A	120	A	140	A	160	B		

RC ALSO = SOIL TYPE

RC = Runoff Coefficient Curve Number
G = Group Letter (See Pages 2 & 3)

Los Angeles County
Department of Public Wor

NOT for use for Areas Greater
***
than 10 Acres

Capital Flood Q's For Small
Developed Drainage Areas
-
Runoff Coefficient Group
Definition

Area (Acres)	Q in cfs for a 50-Year Rainfall and Zone:				
	I	J	K	L	M
0.5	2.0	1.5	2.3	2.8	3.3
1.0	4.0	2.9	4.5	5.6	6.5
1.5	5.9	4.4	6.8	8.4	9.8
2.0	7.9	5.9	9.1	11.0	13.0
2.5	9.9	7.4	11.0	14.0	16.0
3.0	12.0	8.8	14.0	17.0	20.0
3.5	14.0	10.0	16.0	19.0	23.0
4.0	16.0	12.0	18.0	22.0	26.0
4.5	18.0	13.0	20.0	25.0	29.0
5.0	20.0	15.0	23.0	28.0	33.0
5.5	22.0	16.0	25.0	31.0	36.0
6.0	24.0	18.0	27.0	33.0	39.0
6.5	26.0	19.0	29.0	36.0	42.0
7.0	28.0	21.0	32.0	39.0	46.0
7.5	30.0	22.0	34.0	42.0	49.0
8.0	32.0	24.0	36.0	45.0	52.0
8.5	34.0	25.0	39.0	47.0	56.0
9.0	36.0	26.0	41.0	50.0	59.0
9.5	38.0	28.0	43.0	53.0	62.0
10.0	40.0	29.0	45.0	55.0	65.0

NOT for use for Areas Greater Than 10 Acres.

Frequency Adjustment	
Frequency	Factor
10 Yrs.	0.696
25 Yrs.	0.855

To Adjust from a 50 Year Frequency to a 10 or 25 Year Frequency, Multiply the Table Q by the Factor.

Los Angeles County
Department of Public Works

Capital Flood Q's For Small Developed Drainage Areas

Runoff Coefficient Group **A**

Area (Acres)	Q in cfs for a 50-Year Rainfall and Zone:				
	I	J	K	L	M
0.5	1.8	1.4	2.1	2.6	3.0
1.0	3.3	2.6	4.0	4.9	5.7
1.5	4.8	3.7	5.8	7.1	8.2
2.0	6.2	4.9	7.6	9.2	11.0
2.5	7.6	6.0	9.4	11.0	13.0
3.0	8.9	7.0	11.0	13.0	15.0
3.5	10.0	8.1	13.0	15.0	18.0
4.0	12.0	9.2	14.0	17.0	20.0
4.5	13.0	10.0	16.0	19.0	22.0
5.0	14.0	11.0	18.0	21.0	24.0
5.5	15.0	12.0	19.0	23.0	27.0
6.0	17.0	13.0	21.0	25.0	29.0
6.5	18.0	14.0	23.0	27.0	31.0
7.0	19.0	15.0	24.0	29.0	33.0
7.5	20.0	16.0	26.0	31.0	35.0
8.0	21.0	17.0	27.0	33.0	37.0
8.5	23.0	18.0	29.0	35.0	40.0
9.0	24.0	19.0	30.0	36.0	42.0
9.5	25.0	20.0	32.0	38.0	44.0
10.0	26.0	21.0	34.0	40.0	46.0

NOT for use for Areas Greater Than 10 Acres.

Frequency Adjustment	
Frequency	Factor
10 Yrs.	0.696
25 Yrs.	0.855

To Adjust from a 50 Year Frequency to a 10 or 25 Year Frequency, Multiply the Table Q by the Factor.

Los Angeles County
Department of Public Work

Capital Flood Q's For Small Developed Drainage Areas
–
Runoff Coefficient Group B

Pump System Requirements

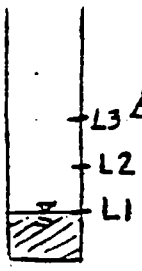
1. Must use at least 2 pumps.

2. Single pump systems are not allowed

3. May use more than 2 pumps if the Q is too large to be handled by pumps of economical size.

4. Q for each pump = F.S. × Q/2
   where
   F.S. = Factor of Safety = 1.25
   Q = Peak flow rate from the hydrology study

5. Use a pumping system which activates both pumps, thus preventing one pump from standing idle to deterio.



Example: Pump #1 starts when water rises to level L2 and shuts off when recedes to level L1. When water rises to level L3 Pump #2 starts. Both pumps work until water recedes to level L1

6. No alternate power source is required.

7. Include the manufacturer's pump specifications (horsepower HP and total dynamic head TDH) on the plan and attach a copy of the manufacturer's brochure.

8. Plans must include cross sectional views through the sump, indicating pump fittings, reinforcing, elevations, etc

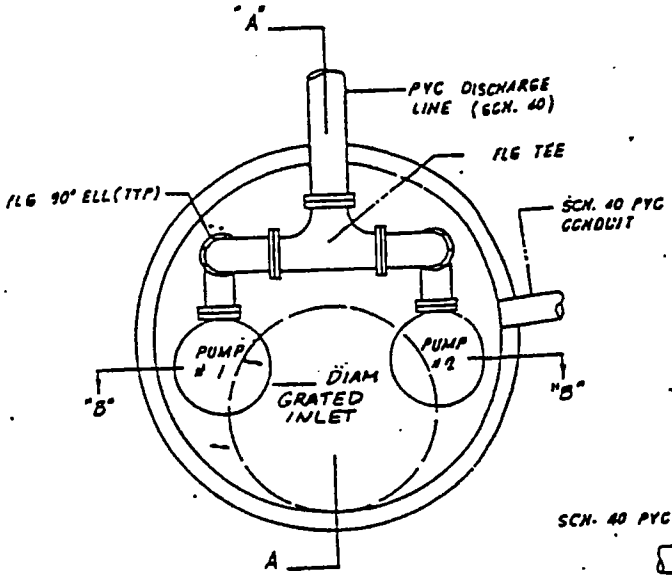
9. Provide details of the grated inlet. For analysis of the inlet capacity assume 50% clogged.

10. All grating, sump covers, etc must be traffic weight if located within traffic areas

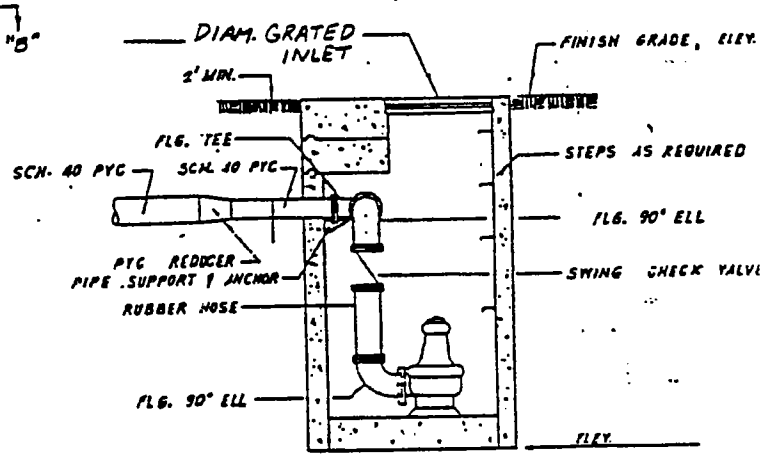
11. The storm drain collecting system upstream of the pump (pipe grates, etc) should be designed for Q50

12. Maximum ponded depth at grated inlet = 3".

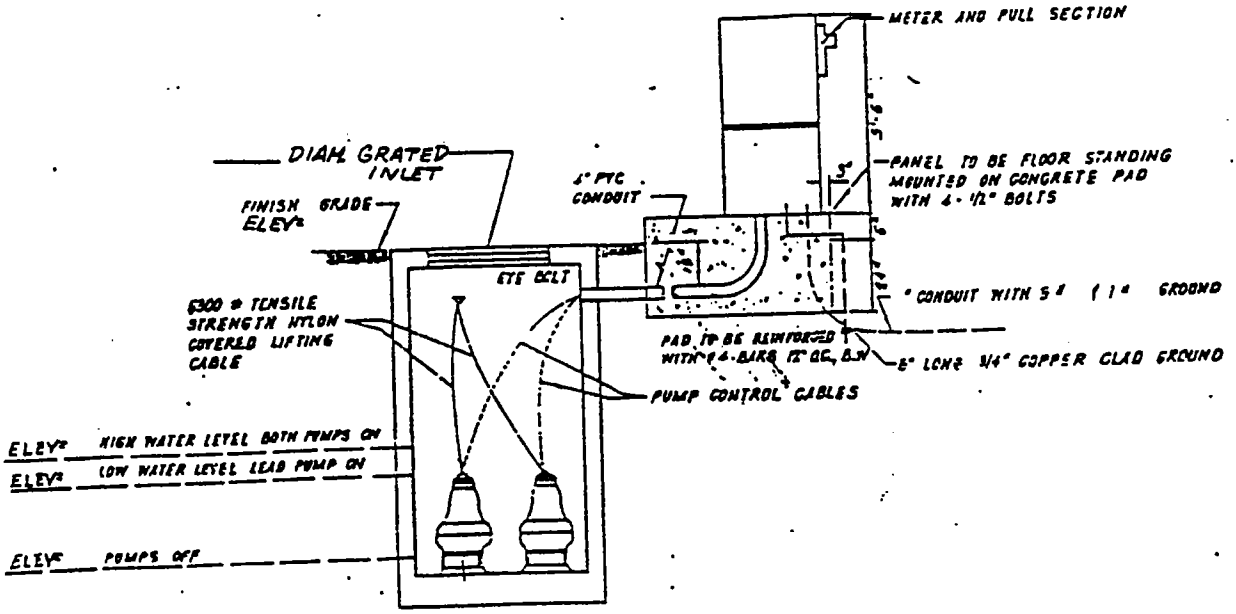
Sample Sump Pump Details to Provide on Plans



PLAN VIEW



SECTION "A"-"A"



SECTION "B"-"B"

DISCHARGE LINE REQUIREMENTS

1. Provide a detailed profile view (with elevations) from the pump to the outlet.

2. Connect the discharge line to an existing storm drain if available. The street may also act as a suitable outlet.

3. Discharge line must be made from materials which ar pressure tested to handle the Q.

4. Maximum Q for discharge from a parkway drain ≐ 9 cfs

5. Recommend system to have gravity flow if the outlet is a parkway drain.

6. Discharge velocity should be low, in order to prevent a hazard in the street.

7. Minimum slope = 2%

8. ~~Minimum~~ MIN. pipe size of discharge line = 6"

9. Backwater valves are required. Show the location on the profile view.

Useful Definitions from the Pump Station Design Manu

Maximum Static Head

The pump must be able to develop enough head so that the intersection of the pump curve and system curve based upon maximum static head (operating point) is within the normal operating range of the pump according to the manufacturer's published performance curve. This is the point where maximum power is required in most cases (for a propeller pump) and the driver should be sized for this operating condition.

Minimum Static Head

The capacity of the pump station is greatest at the minimum static head (maximum water level). The pump curve must intersect the system curve reflecting minimum static head at the rated capacity of the pump. Superimposing published pump performance curves over the system curve will define a pump which satisfies this requirement. At this point of minimum head, the horsepower required will be a minimum for propeller and mixed flow pumps, in most cases.

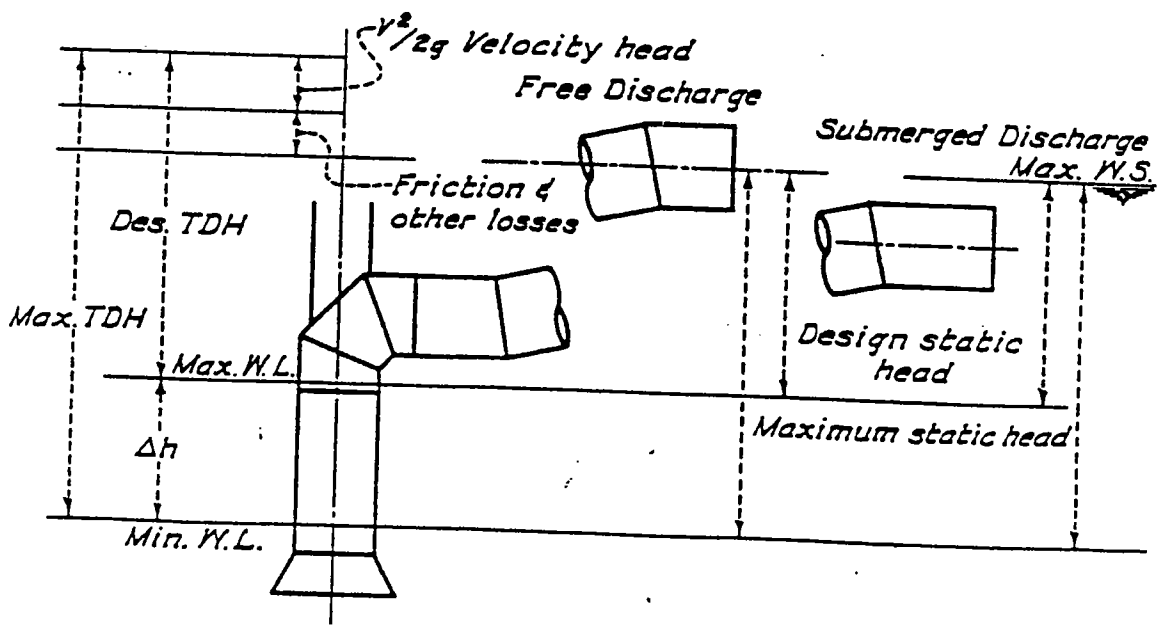
TOTAL DYNAMIC HEAD (TDH)

The Total Dynamic Head (TDH) is the total height which the pump can raise the flow. Every pump has various friction heads and losses. The TDH at which a pump is rated should be calculated using the maximum water level for calculating the static head. Each pump TDH should be calculated in a manner so that maximum TDH will be obtained.

$$TDH = h_s + h_f + h_v + h_p$$

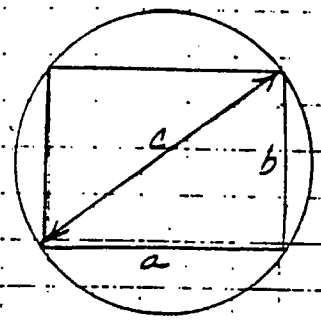
h_s (static head) is height water is to be raised
h_f (friction head) is head losses in the line
h_v (velocity head) is losses due to kinetic energy due to flow
h_p (column and elbow losses) is losses due to bends, flap gates, and other items within the system.

$$h_f = f\frac{L}{D}\frac{V^2}{2g} \; ; \; h_v = \frac{V^2}{2g} \; ; \; h_p = \sum K\frac{V^2}{2g}$$



Grated Inlet Design

The LACDPW Road Design Manual (plate 2.6-0658) provides the procedure for calculating the inlet capacity of a rectangular grated inlet. If a circular grated inlet is proposed, the inlet capacity should be based on the capacity of a rectangular inlet circumscribed by the circular dimension.



For all grated inlets (rectangular or circular), your analysis should assume partial clogging of the grates. Therefore, divide the total area of clear opening (excluding the area taken up by bars, by 2).

The chart on the following page will assist your analysis.

This plate applies only when the grate is located in a low point or sump where the water will pond at the grate.

The capacity of the grate depends upon the area of the openings and the depth of water at the grate. Recent experiments have determined that a grate will act as a weir and follow the weir formula for depths (heads) on the grate up to 0.4 ft. It will act as an orifice and follow the orifice formula for heads of 1.4 ft. and over. For heads between 0.4 ft. and 1.4 ft. the operation is indefinite because of vortices and eddies over the grate.

In the usual problem the following are given:

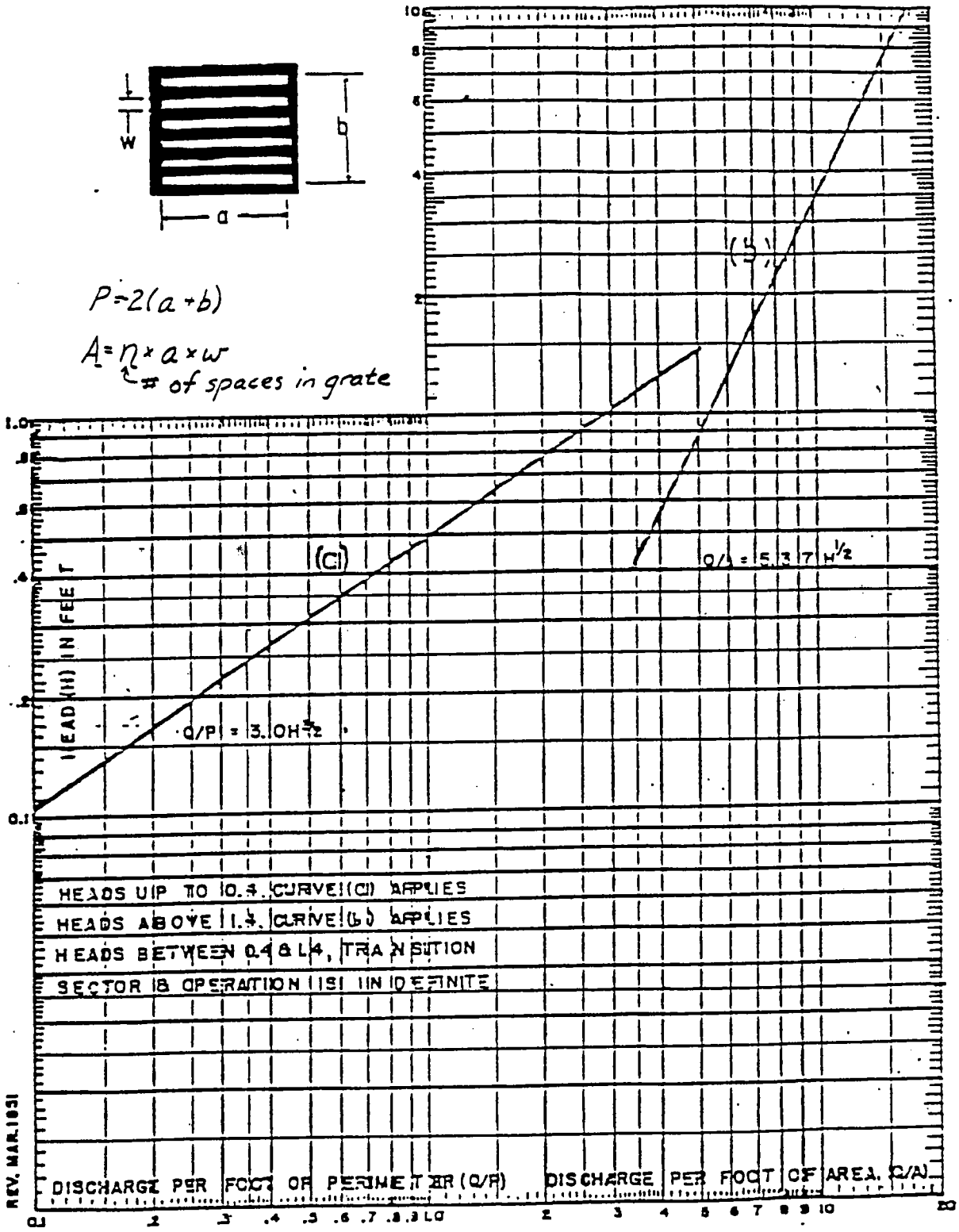
1. A particular design of grate with dimensions.
2. A design discharge (Q) or information as to drainage area, rainfall intensities and runoff coefficients from which a discharge can be estimated.

Procedure:

1. Compute the perimeter of the grate opening (P) ignoring the bars and omitting any side over which the water does not enter, such as when one side is against the face of a curb. Divide the result by 2. This allows for partial clogging of the grate by assuming that only half of the perimeter will be effective. P/2
2. Compute the Q/P ratio.
3. Compute the total area of clear opening (A), excluding area taken up by bars, and divide by 2. This allows for partial clogging of the grate by assuming that only half of the area will be effective.
4. Compute the Q/A ratio.
5. Enter the chart at the bottom scale using line (a) with the Q/P value and line (b) with the Q/A value and read the required head in feet at the left margin.
6. If the required head falls below 0.4 ft., (a) only will apply. This is the usual case.
7. If the required head falls above 1.4 ft., (b) only will apply.
8. If the required head falls between 0.4 ft. and 1.4 ft. the actual head may be anywhere between (a) and (b). Use the value that gives the most conservative result, being sure to use line (a) with Q/P and line (b) with Q/A.
9. If the inlet is a combination type with grate and curb opening the recommended procedure is the same as with a grate alone except the perimeter and area are not divided by 2. The reason for this is that the curb opening will serve as a relief in event the grate becomes clogged. With the grate operating freely it is questionable whether much water will get to the curb opening until the discharge is sufficient to submerge the entire grate.
10. If the grate has an appreciable cross slope so the side away from the curb is higher than that next to the curb the inflow over the side should be determined separately from that over the ends. Use the depth at the middle of the grate for end inflow and depth at edge away from the curb for side inflow.

INLET CAPACITY OF GRATE AT SAG

Plate 2.6-0658



INLET CAPACITY OF GRATE AT SAG

Plate 2.6-0658

Weil SPECIFICATIONS

TYPICAL SPECIFICATIONS
WEIL PUMP COMPANY SERIES '2500'
SUBMERSIBLE SEWAGE EJECTORS

Furnish and install where shown on the plans, one Weil Pump Company (Simplex/Duplex) submersible sewage ejector system.

Pump(s):

Pump(s) shall be Weil Series 2500 Submersible type, model _____ for sewage service and each pump shall be rated to provide 140 GPM at 35 ft. TDH.

The pump casing shall be one piece cast iron constructed with tripod support legs that provide an even distribution of weight.

The mating surfaces between the motor end bell, the motor shell and the seal chamber shall be sealed by means of "X" section QUAD RINGS. Designs using conventional circular 'O' rings or rectangular cross sectional gaskets shall not be considered equal.

Motor(s):

Pump motor shall be vertical, NEMA-6 and not less than 7½ HP, ~~(Single Phase, 115-230-200 or~~ Three Phase, 208-230/460 volts) (specify operating voltage), 60 Cycle, AC, 1150 RPM and of an air filled, hermetically sealed design for premium efficiency. Oil filled shell shall not be considered equal.

Motor end bell shall be cast iron, designed as a terminal box and separated from the motor shell by a combination bearing support and inspection plate.

The motor shall be housed within a water tight, heavy duty cast iron shell with integral extended cooling fins. Motor shall have Class 'F' insulation and permanently lubricated, double sealed ball bearings having a minimum life of 17,500 hours. Motors using sleeve type bearings shall not be considered equal.

Motor shaft shall be 300 series stainless steel with keyway for positive positioning of impeller. Motors using carbon steel shafts or stainless stub shafts shall not be considered equal.

Impeller:

Impeller shall be multi-vane, (open/semi-open/closed) design, constructed of (phenolic/cast iron/bronze/stainless steel), accurately machined and dynamically balanced to the job site conditions. The impeller shall not require the use of wearing rings to insure proper operation and shall be capable of passing _____ in. minimum solids.

Mechanical Seal:

A double mechanical seal system shall be furnished and housed in a machined cast iron seal chamber filled with clean dielectric oil, providing constant lubrication. Lower seal surfaces shall be of solid silicon carbide to provide longer life. Carbon ceramic, tungsten carbide or systems that allow the lower seal surfaces to come in contact with the pumped media, shall not be considered equal.

Computerized Test Procedure:

Each pump shall be tested and a computer generated report will be kept in file and made available upon request. The reported test data shall consist of six duty points of various heads and capacities, one of which will be the design point and shall include actual efficiencies and horsepower requirements.

OPTIONAL MOISTURE SENSOR — shall be installed as a means of detecting a combination of mechanical seal failure and entry of moisture into the motor shell or oil seal chamber. The system shall consist of a moisture sensing electrode probe installed in the mechanical seal chamber, _____ ft. of sensor cable and one (1) NEMA 4X test station with an electrode relay, seal failure light, test button and contacts for a remote signal.

OPTIONAL TEMPERATURE LIMITER — shall be provided and installed on the stator windings to disengage the motor starter when the internal motor temperature exceeds the insulation rating. An indicator light shall illuminate on the panel and/or sound an alarm, when specified. The temperature limiter assembly will reset automatically when the motor temperature drops to a safe operating limit.

Limited 5 Year Pump Warranty

The pump manufacturer shall warrant the pump being supplied to the owner against defects in workmanship and materials for a period of five (5) years under normal use, operation and service. Repairs or replacement parts that may be needed after initial SIXTEEN MONTHS, will be made and the cost (F.O.B. factory) pro-rated for the period of time the pump has been in operation. The warranty shall be in published form and apply to all similar units.

SAMPLE OF A MANUFACTURER'S BROCHURE

pump performance

SERIES 2500

SUBMERSIBLE SEWAGE EJECTOR

DISCHARGE SIZE - 6" SOLID SIZE - 4¼"

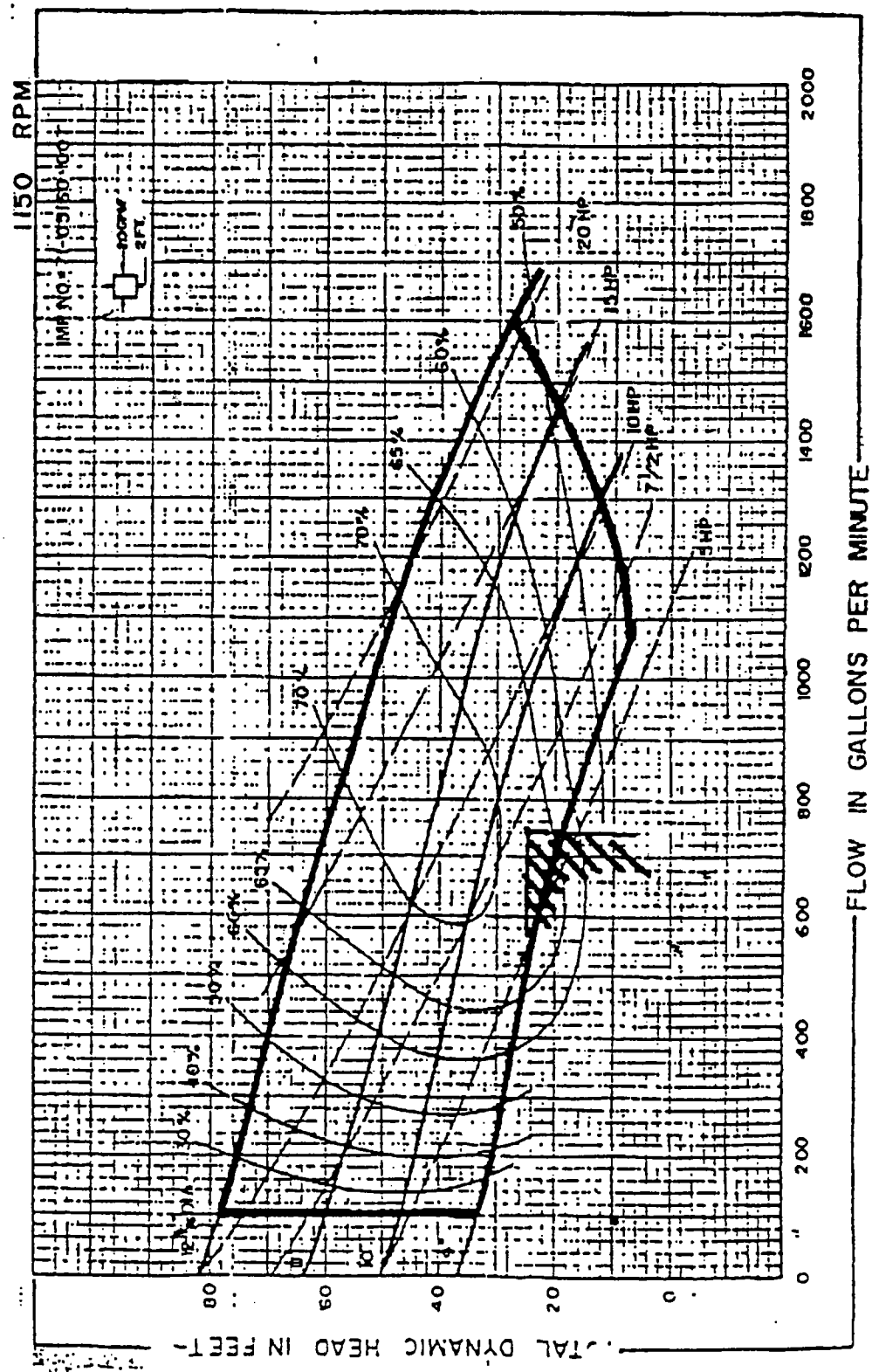
IMPELLER TYPE - OPEN

C-2506

April, 1979

Formerly, C-2506

SAMPLE OF A MANUFACTURER'S BROCHURE

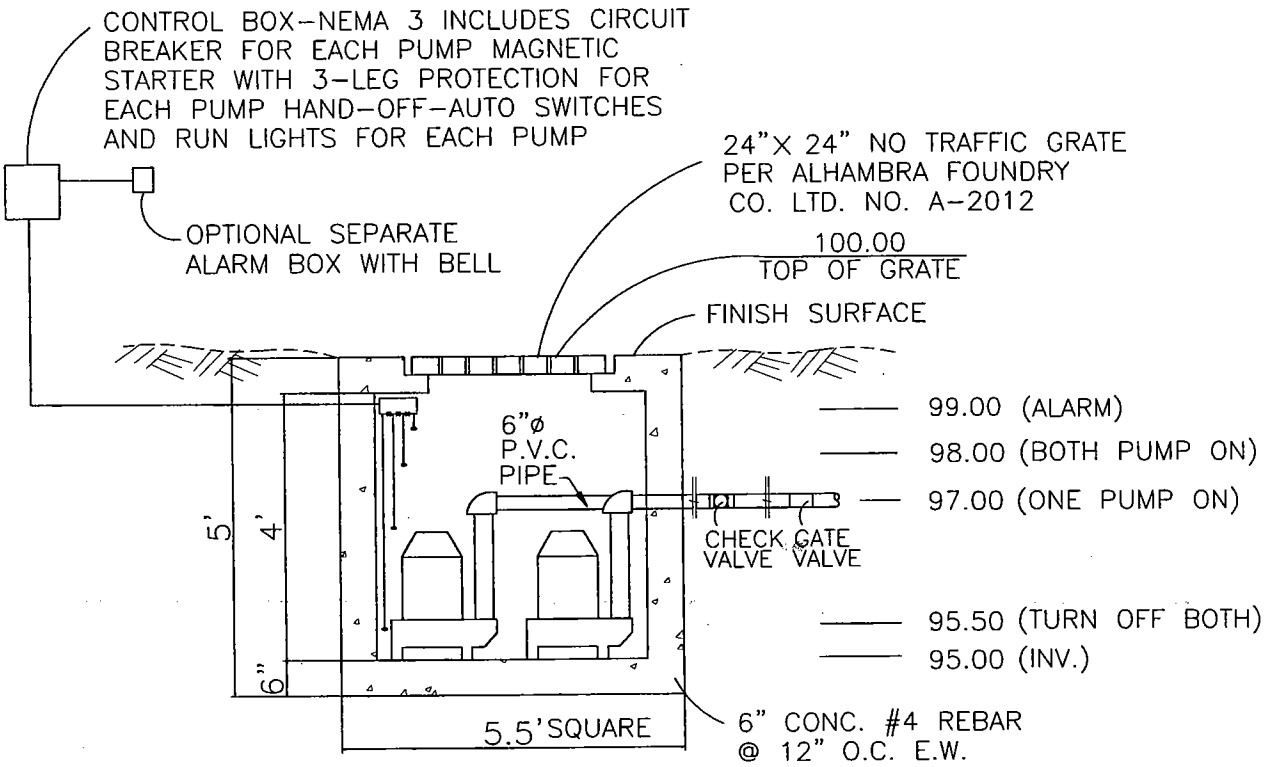


740 GPM @ 25 FT HD

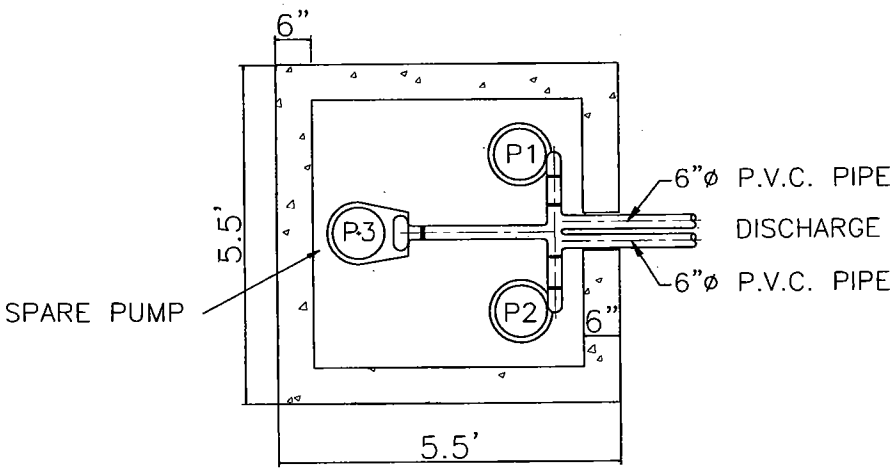
● RECOMMENDED PUMPING RANGE IS SHOWN BETWEEN HEAVY LINES.

PERFORMANCE SHOWN BASED ON

Weil PUMP COMPANY



SECTION



PLAN

Qp = 200 GPM / EA. PUMP
TDH = 9.32 FT

USE "BARNES PUMPS, INC."
NON-CLOG PUMPS
MODEL NO. 3SE1074L
OR EQUAL

PUMP DATA

1.0	HP
220/240	VOLT
1	PH
1,750	RPM

CONTACT JACK WANG OF
"MULTI W SYSTEMS, INC."
TEL: (818) 401-2627
FAX: (818) 442-0839

SAMPLE

CATCH BASIN & SUMP PUMP DETAIL

NOT TO SCALE

* PUMP SHALL BE IN DUPLEX WITH AUTOMATIC ALTERNATING DEVICE