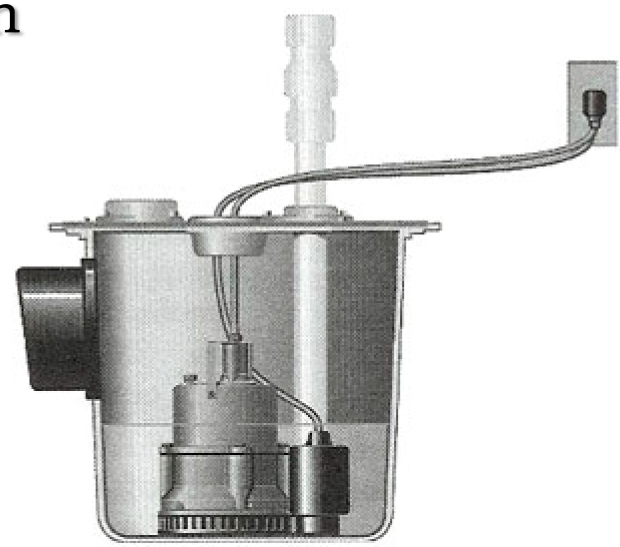
County of Los Angeles
Department of Public Works

Building and Safety Division
Grading and Drainage Section

Sump Pumps

Office procedures for the Drainage & Grading section



Introduction

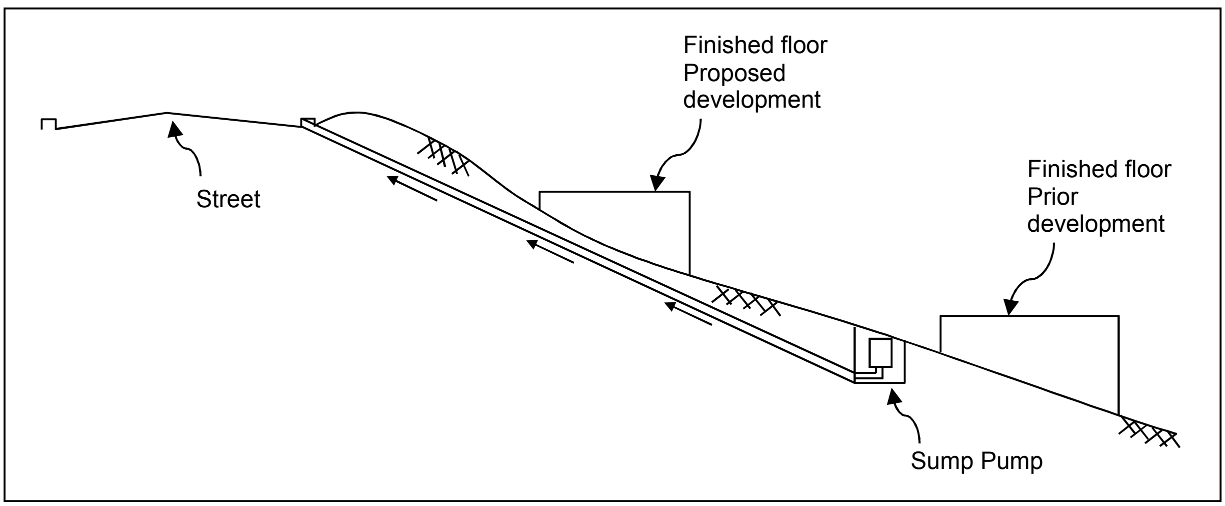
This manual provides office procedures for checking the design of sump pumps which may be proposed in conjunction with grading plans and/or building site drainage plans.

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

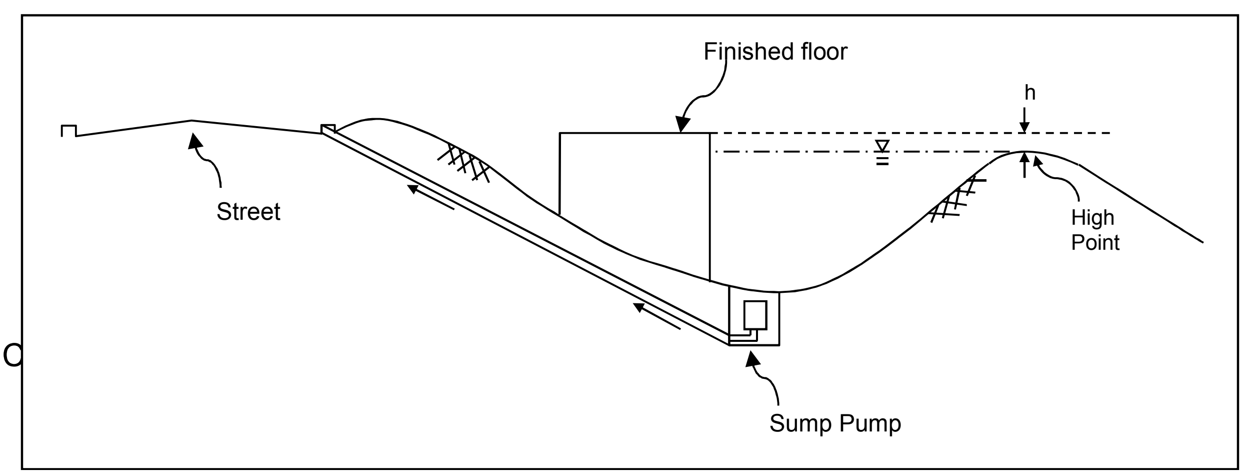
General Information

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 upstream area.



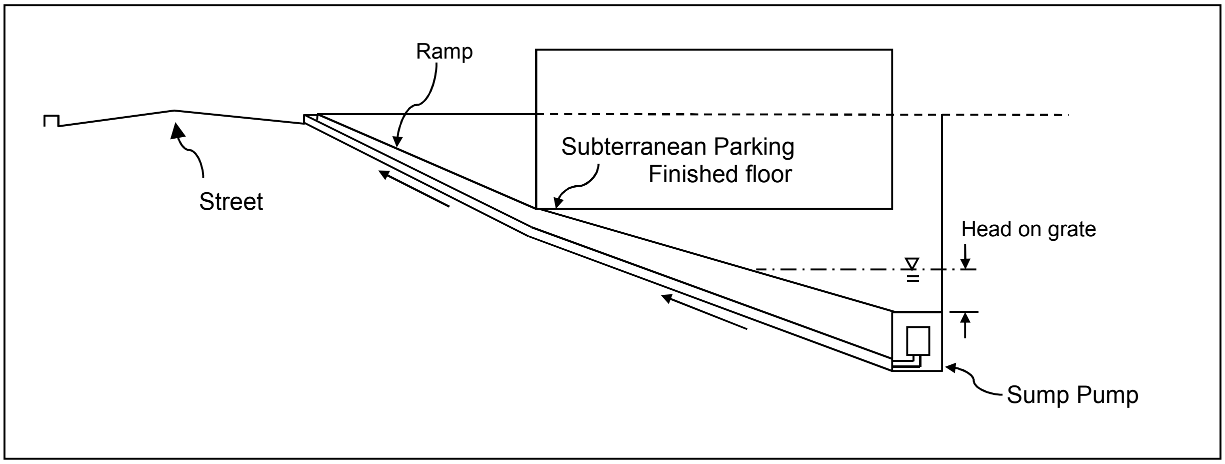
Case B:
The finished floor elevation of the proposed project is above the sump overflow elevations, but the ponding depth would exceed the maximum allowable



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

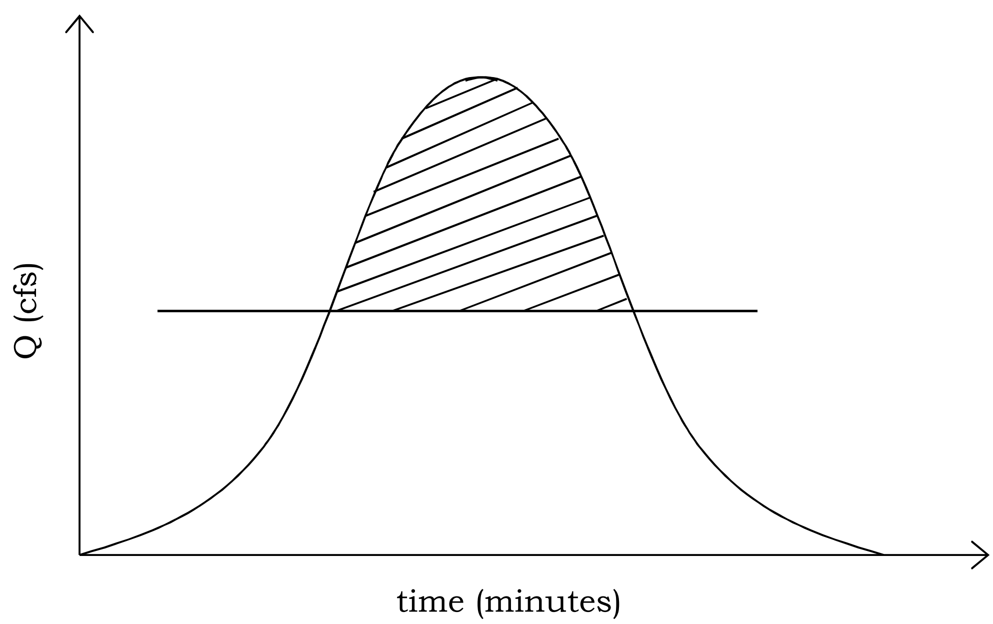
1. A hydrology study for the Q_{50} must be provided to determine the sump volume and pump requirements.

2. The grading or building site drainage plan must show sufficient offsite topography and elevations to define the drainage pattern.

3. The hydrology study needs to indicate design assumptions 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 HydroCalc Calculator 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

Using the HydroCalc Calculator for areas less than 10 acres

- The HydroCalc Calculator may be downloaded from the following websites:

  http://dpw.lacounty.gov/wrd/publication/

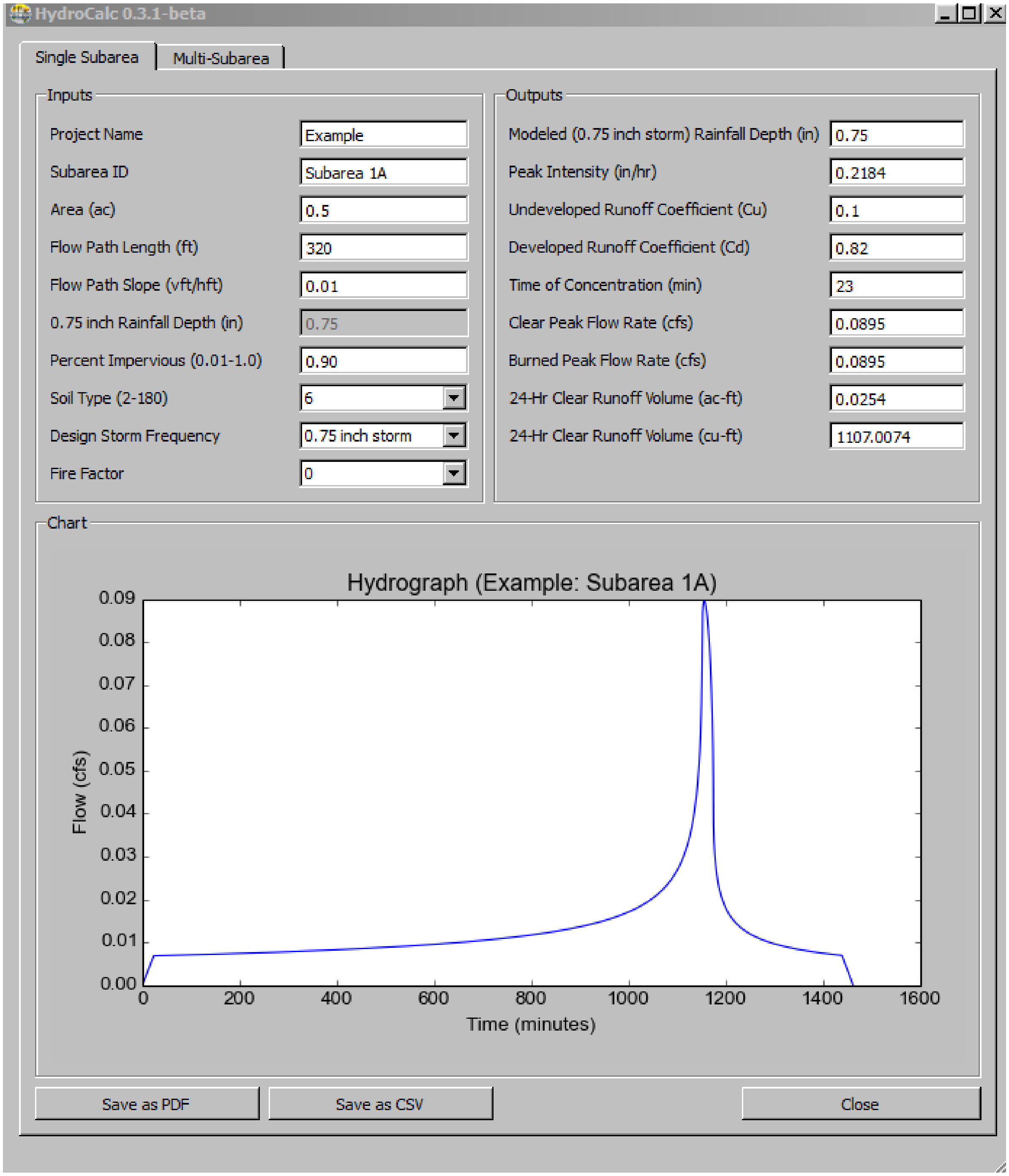
  http://dpw.lacounty.gov/wmd/dsp_LowImpactDevelopment.cfm

- The HydroCalc Calculator calculates the full modified rational runoff method yielding peak runoff rates and volumes. (The figure to below shows the interface for the HydroCalc calculator).

- To calculate the Q, fill out the boxes in the upper left hand corner of the calculator under "Input" and use the Q_{50} in inches as the Rainfall Isohyet. From the Design Storm Frequency input select the 50-yr storm frequency. The calculations are performed in real time and displayed on the upper right hand corner of the calculator under Output.

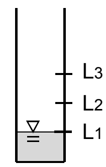
- To calculate multiple watershed subareas simultaneously, the HydroCalc calculator can also accept CSV files as input for a number of subareas. Please refer to the Hydrology Manual and HydroCalc Quickstart for more information.

- Once results have been obtained choose the CSV button to save the calculation results as individual CSV files in a software generated "CSV-Results" folder at a user's specified location or choose the PDF button to save the results in a single PDF file located at user specified location.


HydroCalc 0.3.1-beta
Single Subarea
Multi-Subarea
Inputs
Project Name
Example
Subarea ID
Subarea 1A
Area (ac)
0.5
Flow Path Length (ft)
320
Flow Path Slope (vft/hft)
0.01
0.75 inch Rainfall Depth (in)
0.75
Percent Impervious (0.01-1.0)
0.90
Soil Type (2-180)
6
Design Storm Frequency
0.75 inch storm
Fire Factor
0
Outputs
Modeled (0.75 inch storm) Rainfall Depth (in)
0.75
Peak Intensity (in/hr)
0.2184
Undeveloped Runoff Coefficient (Cu)
0.1
Developed Runoff Coefficient (Cd)
0.82
Time of Concentration (min)
23
Clear Peak Flow Rate (cfs)
0.0895
Burned Peak Flow Rate (cfs)
0.0895
24-Hr Clear Runoff Volume (ac-ft)
0.0254
24-Hr Clear Runoff Volume (cu-ft)
1107.0074
Chart
Hydrograph (Example: Subarea 1A)
Flow (cfs)
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0.00
0
200
400
600
800
1000
1200
1400
1600
Time (minutes)
Save as PDF
Save as CSV
Close

Residential Pump System Requirements

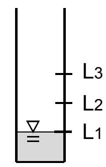
1. Must use at least 2 pumps.
    a. Exception: If approved by the building official, one pump is sufficient when no structures or neighboring properties would be affected if the pump system failed.
2. Q for each pump = F.S. x Q/2 (if using two pumps)
   Where:
   F.S. = Factor of Safety = 1.25
   Q = Peak flow rate from the hydrology study
3. Use a pumping system which activates both pumps, thus preventing one pump from standing idle to deteriorate.
   Example: Pump #1 starts when the water level rises to level L2 and shuts off when water recedes to level L1. When the water rises to level L3 pump #2 starts. Both pumps work until the water level recedes back to level L1.



4. No alternate power source is required.
5. 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.
6. Plans must include cross-sectional views through the sump indicating pump fittings, reinforcing, elevations, etc.
7. Provide details of the grated inlet. For analysis of the inlet capacity assume 50% clogged.
8. All grating, sump covers, etc. must be traffic weight if located within traffic areas.
9. The storm drain collection system upstream of the pump (pipe grates, etc.) should be designed for Q_{50}.
10. Maximum ponding depth at any given point is 24″. If ponding is located in parking stalls, the maximum allowed is 6″; this may be increased to 18″ within areas of trucking activity.
11. Ponding against buildings and retaining walls will only be allowed if ponding is acceptable by the Soils and Civil Engineer. A Geotechnical report which specifically addresses this issue is required and must be approved by the Department's Geotechnical and Materials Engineering Division. Elevation of ponding that is located adjacent to a structure must be a minimum of 2 feet below the finished floor. Any ponding must be temporary.
12. The sump shall be at least 15 inches in diameter and at least 18 inches in depth with a fitted cover. The capacity of the pumps shall not be less than 15 gpm. The discharge pipe shall be a minimum of 1-1/2 inches in diameter and have a union or other approved quick disconnect assembly to make the pump accessible for servicing. (Section 1101.5.2, 2013 California Plumbing Code)

Commercial and Multi-Family Pump System Requirements

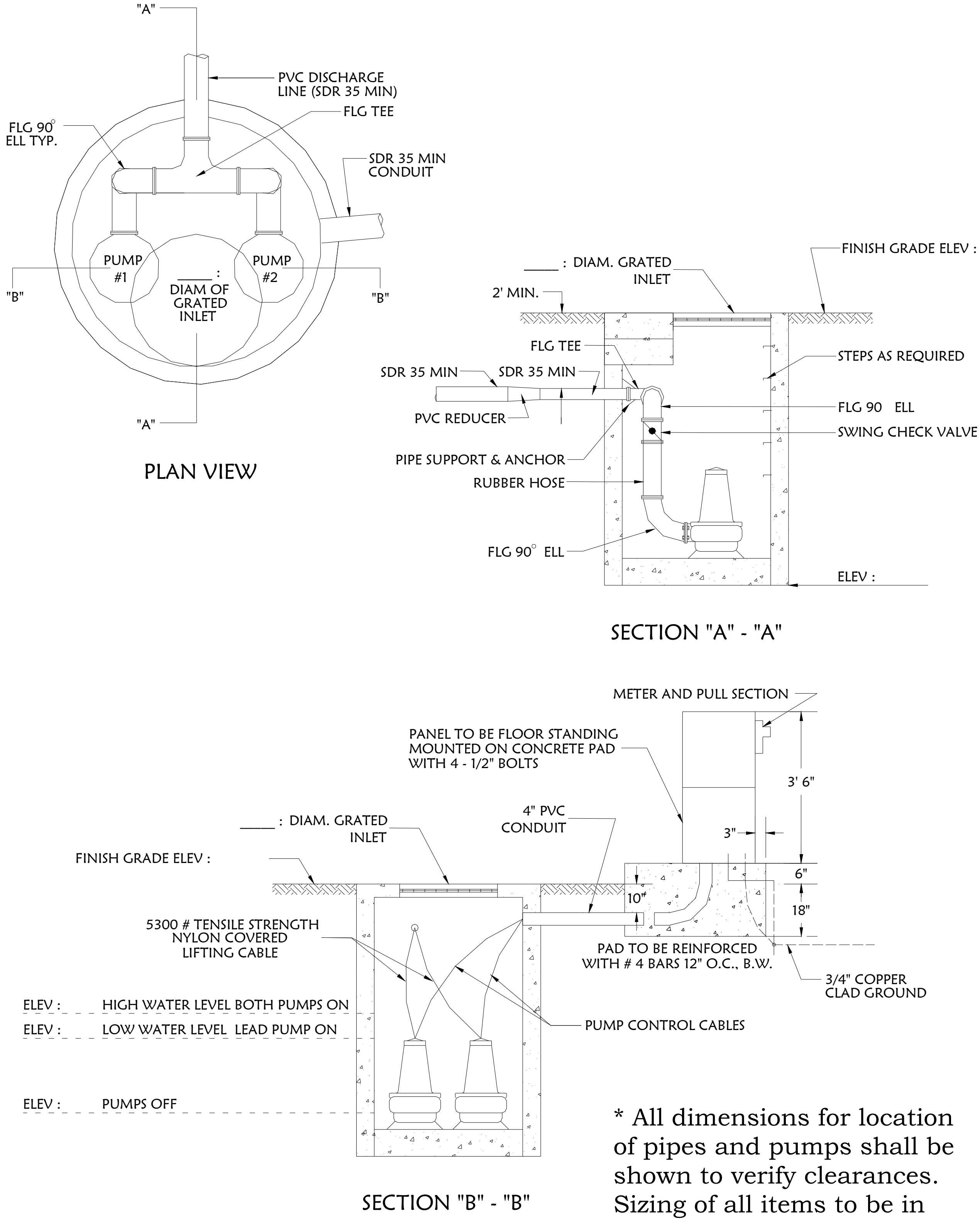
1. Must use at least 2 pumps. (Section 1101.13, 2013 CA Plumbing Code)
2. May use more than 2 pumps if the Q is too large to be handled by pumps of economical size.
3. Q for each pump = F.S. x Q/n
   Where:
   F.S. = Factor of Safety = 1.25
   Q = Peak flow rate from the hydrology study
   n = Number of pumps being used
4. Use a pumping system which activates both pumps, thus preventing one pump from standing idle to deteriorate.
   Example: Pump #1 starts when the water level rises to level L2 and shuts off when water recedes to level L1. When the water rises to level L3 pump #2 starts. Both pumps work until the water level recedes back to level L1.



5. An alternate power source may be required if the Building Official determines that failure of the Pump system could result in a health and safety concern.
6. 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.
7. Plans must include cross-sectional views through the sump indicating pump fittings, reinforcing, elevations, etc.
8. Provide details of the grated inlet. For analysis of the inlet capacity assume 50% clogged.
9. All grating, sump covers, etc. must be traffic weight if located within traffic areas.
10. The storm drain collection system upstream of the pump (pipe grates, etc.) should be designed for Q_{50}.
11. Maximum ponding depth at any given point is 24″. If ponding is located in parking stalls, the maximum allowed is 6″; this may be increased to 18″ within areas of trucking activity.
12. Ponding against buildings and retaining walls will only be allowed if ponding is acceptable by the Soils and Civil Engineer. A Geotechnical report which specifically addresses this issue is required and must be approved by the Department's Geotechnical and Materials Engineering Division. Elevation of ponding that is located adjacent to a structure must be a minimum of 2 feet below the finished floor. Any ponding must be temporary.
13. The sump shall be at least 15 inches in diameter and at least 18 inches in depth with a fitted cover. The capacity of the pumps shall not be less than 15 gpm. The discharge pipe shall be a minimum of 1-1/2 inches in diameter and have a union or other approved quick disconnect assembly to make the pump accessible for servicing. (Section 1101.5.3, 2007 California Plumbing Code)

Sample of Sump with 2 Pumps - Details to be Provided on Plans

(If only using one pump, modify detail to only show one pump)



* All dimensions for location of pipes and pumps shall be shown to verify clearances. Sizing of all items to be in accordance with 2013 Plumbing and Electrical Codes.

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. The discharge line must be made from materials which are pressure tested to handle the Q.
4. Maximum Q for discharge from a parkway drain = 9cfs
5. It is recommended that the system 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. Backwater valves are required. Show the location on the profile view.

Useful Definitions from the Pump Station Design Manual

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 operation 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.

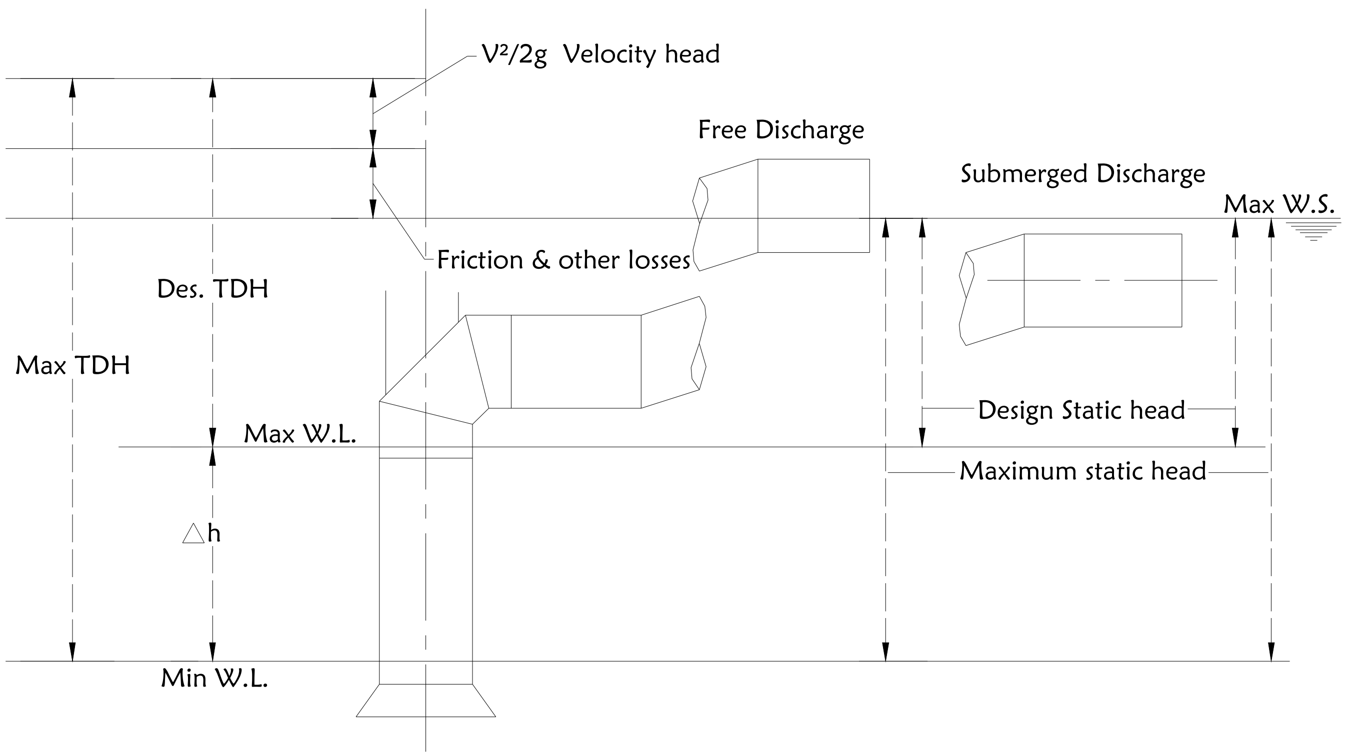
<u>Total Dynamic Head</u>

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 the maximum TDH will be obtained.

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

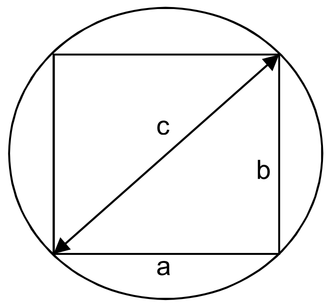
h_s (static head) is height water is to be raised
h_f (friction head) is head losses in the line
h_v (velocity head) is losses due to kinetic energy due to flow
h_p (column and elbow losses) is losses due to bends, flap gates, and other items within the system

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



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 be 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 the bars) by 2.

The information on the following pages will assist you in 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 gate.

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.
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) or 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 openings 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 the event that 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

$P = 2(a + b)$

$A = \eta \times a \times w$

# of spaces in grate