Concept Plan

Design Manual
Chapter 4
Drainage
Originally Issued: 09-01-95
Revised: 09-13-12

CADD: See Section 4A-52, Starting a GEOPAK Drainage Project, and Section 4A-53, GEOPAK Drainage-Structures, for instructions on setting up a drainage project, placing intakes, and information about individual intake features.

This section addresses the following:

- Preliminary intake locations,
- Storm sewer piping,
- Outfall,
- Preliminary Manhole locations,
- Overland drainage swales, and
- Concept plan.

After considering the preliminary base map and the general desired storm system components (open drainage system locations, closed drainage system locations, determined need for detention or other control devices), a conceptual storm drainage plan is prepared.

Preliminary Intake Locations

The primary goal in locating intakes is to limit storm water encroachment onto the pavement so vehicular and pedestrian traffic will not be forced to travel through water. However, intakes also need to be located so they do not interfere with vehicular or pedestrian traffic or utilities.

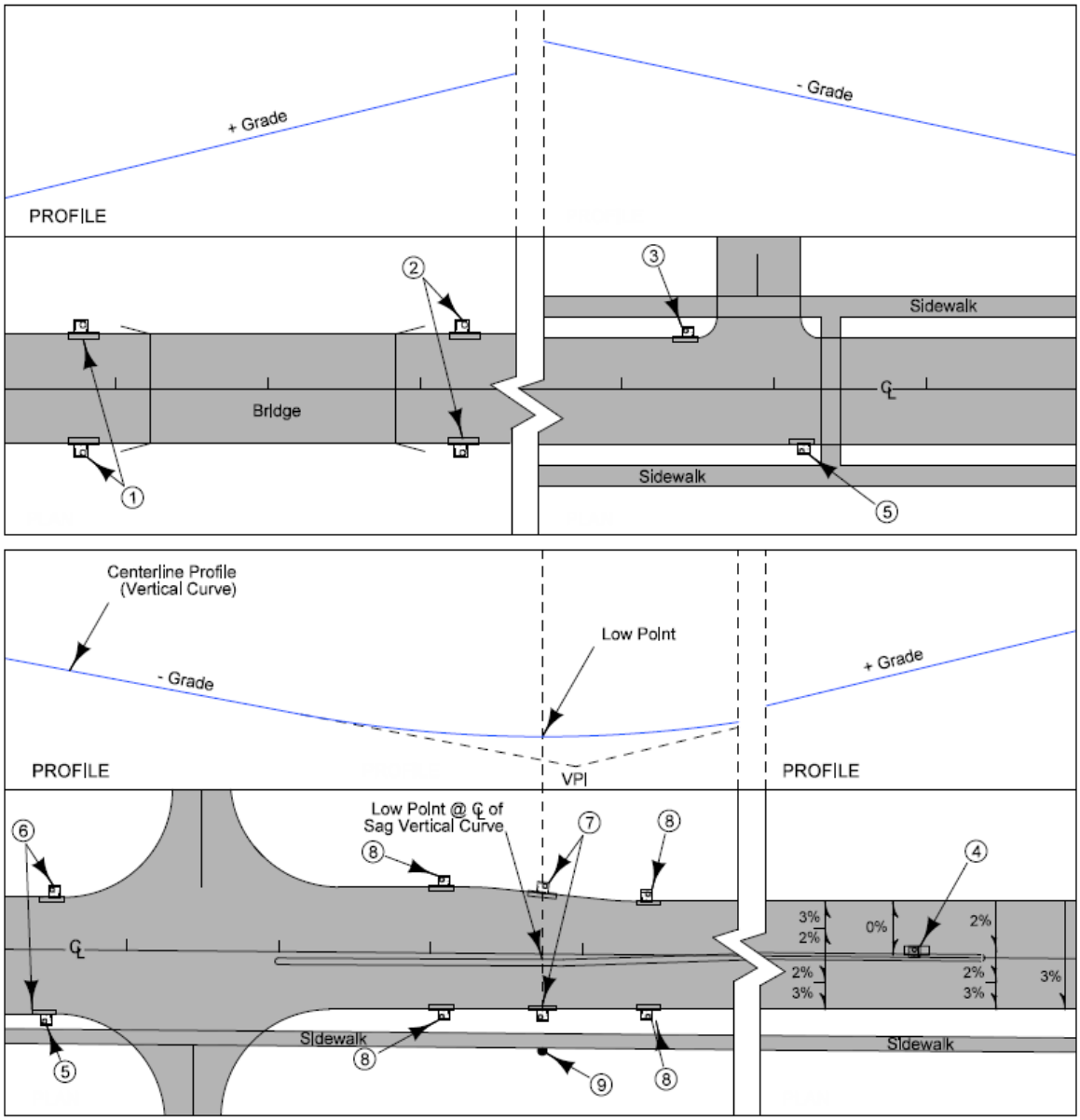
Preliminary Intake Placement

Figure 1 demonstrates areas to consider for preliminary intake placement. They include:

- Low points in the gutter grade.
- Upstream of crosswalks, intersections, and entrance/exit ramp gore areas.
- Upstream and downstream of bridges.
- Upgrade of cross slope reversals.
- Behind curbs, shoulders, or sidewalks to drain low areas.

Areas to avoid placing intakes include:

- Middle of intersections (Refer to Section 4A-3 for “Drainage at Intersections”).
- Street returns.
- Crosswalks.
- On top of existing utilities.



	LOCATION	PURPOSE
①	Downstream of bridges	To collect water coming off bridge with no bridge end drains. See Section 4C-2, Bridge End Drains.
②	Upgrade of bridges	To avoid water running onto bridge.
③	Upstream from entrances	To collect water before it crosses or enters the entrance.
④	Upgrade from cross slope reversals	To collect water in gutter before it crosses the pavement.
⑤	Upstream from cross walks	To keep pedestrians out of water.
⑥	Upstream from intersections	To collect water before it enters an intersection.
⑦	At all low points	To collect water before it ponds. Use GEOPAK COGO to find the exact location of the low point. Note: the low point of a taper may not match the low point of the mainline.
⑧	On each side of the low point (Flanking Intakes)	To act in relief should the intake at the low point become clogged with debris or otherwise inundated.
⑨	Low area behind sidewalk	When needed to collect overland flow back of curb.

Figure 1: Plan and profile view of common intake locations.

Other Considerations

Storm sewer pipe size restricts spacing between intakes, see Table 1 below. Limit preliminary intake spacing to 400 ft (125 m).

Often, unusual situations warrant additional intakes or other drainage devices. The following are guidelines to consider:

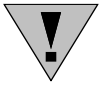
- Intercept major water flows before they reach pavement. Possible drainage devices to consider include ditches, intakes, and culverts.
- Intercept springs, subdrains, and tile lines. Possible drainage devices to consider include ditches and intakes.
- Within a project, area intakes may be needed in non-paved areas.

On major highways, interstates, freeways, and other roadways on the National Highway System (NHS), flanking intakes are required on each side of sag intakes. See Section 4A-6 for more information regarding flanking intakes.

After preliminary intake location has been completed, lay out piping between structures.

Storm Sewer Piping

Table 1 provides maximum spacing for intakes and manholes based on pipe size. Maintenance operations may further limit intake and manhole spacing. Maintenance authority limitations should be documented according to Section 4A-2. When laying out preliminary piping, start by assuming a 15 inch (375 mm) pipe diameter.



Use a minimum 15 inch (375 mm) diameter pipe for all urban storm sewer systems draining the NHS.

Refer to the Storm Sewer Design section for additional pipe sizing criteria.

Table 1: Intake and manhole maximum spacing.

English		metric	
pipe diameter in	maximum spacing* ft	pipe diameter mm	maximum spacing* m
15 to 24	400	375 to 600	125
30 to 54	500	750 to 1400	150
≥ 60	1000	≥ 1500	300

*Maintenance constraints may require closer spacing.

Preliminary Manhole Locations

Manholes are needed in storm sewer systems to allow access for maintenance and cleaning. In order to design the most economic and efficient storm sewer system, tentatively locate manholes where intakes are not required and:

- Two or more pipes join together.
- Pipe shape or size changes.
- Pipe direction changes.
- Pipe grade changes.
- Pipe elevation changes.

On long tangents where none of the above conditions exist, locate manholes at intermediate points. For maximum spacing, see Table 1 above.

Avoid locating manholes in the following locations:

- Over existing utilities.

- In intersections or thru lanes.
- In the path of a potential sidewalk or multi-use trail.

If locating a manhole within a roadway cannot be avoided, attempt to place it in the shoulder or median.

Outfall

Stormwater runoff conveyed by piping should be transported to a discharge point to which it would have naturally flowed. Do not relocate runoff from one watershed to another without a drainage engineer's evaluation of hazard and liability. Outfall locations should not create or increase erosion or flooding potential downstream. Outfalls may need to be located sufficiently upstream of the right-of-way line or receiving stream to allow for adequate energy dissipation and sediment control.

Overland Drainage Swales

Do not relocate runoff from one watershed to another without a drainage engineer's evaluation of hazard and liability.

Evaluate the need for and location of surface flowage easements and ponding easements for major design storm flows. Surface flowage easements are required to help reduce potential for grading or building within the proposed overland flow drainage system. Surface flowage easement should be obtained all the way to a permanent discharge location. Ponding easements are required where it is known that upstream ponding will occur to reduce the potential for grading or building within the potential ponding area.

Detention and Storage

Evaluate the need for detention and storage for interim design sediment control and for final design permanent water quality purposes. Detention and storage could range from designed sediment basins along a project, to detention basins used to reduce peak storm water discharges from a project. Detention basins used for peak discharge reduction generally serve as sediment basins during construction until erosion control is fully established.

Other Considerations

Other items to consider include, but are not limited to:

- Deep cuts.
- Utility avoidance.
- Traffic control.
- Staged drainage design, e.g. a trunk main may be needed on each side of the roadway versus one single one on one side of the roadway.

Concept Plan

After all intakes and manholes have been tentatively located, number the system to aid in the process of design and construction. Use the following tips when numbering a storm sewer system:

- Begin numbering at the upstream end of the drainage system and work downstream.
- Number the drainage area the same as the inlet or intake within it. For more on drainage areas, see Section 4A-5.
- Once a number is assigned to a drainage area, intake, or manhole it should not change in future revisions.
- During the preliminary design, leave extra numbers in order to add structures later (e.g., only use odd numbers).

- Number the storm sewer pipe based on the upstream structure it drains.
- Off- and on-site pipes and overland point flow sources not associated with another manhole or intake should be numbered with an A, B, C, etc. (e.g., a culvert pipe that drains into an intake).

Figure 2 demonstrates an example.

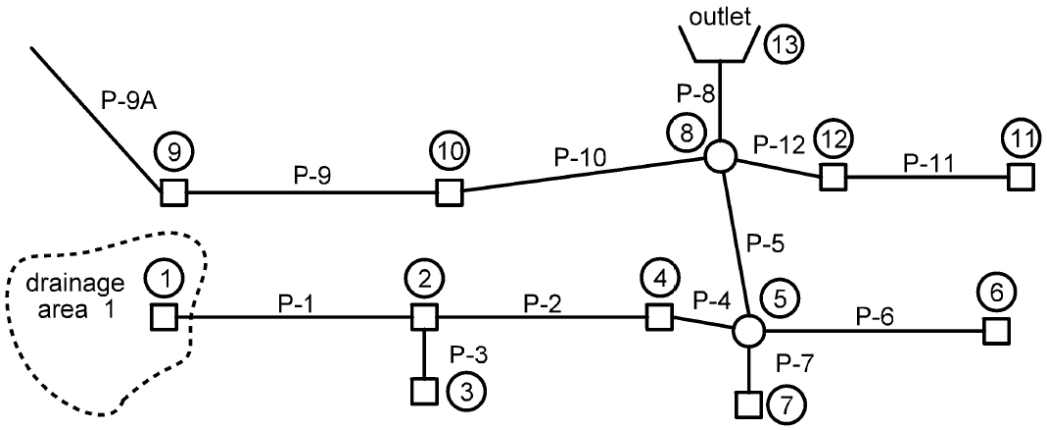


Figure 2: Sample numbering system for a typical storm sewer system.

Chronology of Changes to Design Manual Section:

004A-004 Concept Plan

9/13/2012 Revised
Revised Figure 1 (had intake located at VPI).

12/10/2010 Revised
changed the minimum storm sewer pipe diameter size from 24 inches to 15 inches

10/29/2010 Revised
Updated material from old 4A-3. Material in old 4A-4 moved to 4A-5 and 4A-6.