

Chapter amendments approved:	OMPC	Owensboro	Daviess Co.	Whitesville
Re-adoption of Public Improvement Specifications	24-Mar-77	01-Apr-77	20-Apr-77	?
Revised Public Improvement Specifications	18-Apr-81	22-May-81	26-May-81	06-Jul-81
2002 Revised Public Improvement Specifications	08-Aug-02	No action required by legislative bodies		
Revisions to Public Improvement Specifications	09-Apr-09	No action required by legislative bodies		

**8.0 PURPOSE.** The purpose of this chapter is to outline the standard requirements for the design and construction of new storm water drainage ditches, channels, and detention basins. This chapter shall also be used if the Engineer deems improvements to existing streams, ditches, channels, and any other drainage system within the development appropriate.

**8.1 GENERAL.** The property owner is responsible for surface and sub-surface drainage to his/her lands, and shall provide for such drainage in a manner as to properly relieve storm waters from their land, without obstructing existing drainage patterns or significantly increasing runoff onto adjacent properties.

All construction activities shall have storm water control. All construction activities that require a site plan, preliminary subdivision plat or development plan to be considered by the OMPC, shall have an adequate storm water plan prepared by a Professional Engineer licensed in the State of Kentucky. The items to be considered in a storm water plan are drainage ditches or channels, detention basins, detention lakes, and sediment control. One (1) copy of the design and calculations shall be submitted to the Engineer for approval.

**8.2 DRAINAGE DITCHES AND CHANNELS DESIGN CRITERIA.** Adequately designed and maintained drainage ditches are an acceptable method of controlling drainage provided they do not compound or create downstream drainage problems.

**8.2.1 Design Criteria.** The ditches shall be designed according to standard open channel methods approved by the Engineer. At a minimum, ditches shall be designed for a 10-year return period. However, if the structure is part of the trunk system as defined in the “Storm Water Master Plan”, the system shall be designed upon a return period to be determined by the Engineer. Major drainage channels and structures may warrant hydraulic designs based upon a larger storm event. For the determination of the rainfall intensity, the design Engineer shall use the Frequency Estimate curves as published in NOAA Atlas 14, Volume 2, current edition. The duration to be used

shall be 8 minutes, unless the Time of Concentration is calculated to be longer.

For any development inside the floodplain, the Computed Water Surface Elevation (CWSEL) shall be determined in the receiving ditch, both upstream and downstream of the proposed development for the 2, 10, 25 and 100 year events. This requirement may be waived by the Engineer if it is demonstrated to the satisfaction of the Engineer that no significant impact to the floodplain is expected to occur as a result of the development. At no location where this analysis is required shall the proposed development result in an increase in the CWSEL for any of the above storm events greater than 0.1’.

The Rational Method shall be used to determine the flow rates for any drainage area up to 200 acres. For any area larger than 200 acres, an appropriate regression model shall be employed.

All proposed drainage ditches that have earthen side slopes should be three (3) to one (1) or flatter. Earthen side slopes of two (2) to one (1) or steeper shall have slope stabilization.

All proposed drainage ditches with less than one (1) foot of drop per 100 feet of length shall be paved. All proposed drainage ditches with more than four (4) feet of drop per 100 feet shall be paved unless satisfactory engineering data is provided to the Engineer demonstrating that paving is not warranted. However, if the grade of a ditch varies and parts of it require paving, then continuous paving, energy dissipators, or other measures may be required in those sections where ditch grade is between a one (1) and four (4) foot drop per 100 feet.

**8.2.2 Paved Ditches.** All paved ditches shall have a minimum of one-foot (1) width at the bottom plus one-foot (1) return on the side slope. Standard side slope shall be two (2) to one (1). The paved ditches shall be Class “A” 3500-psi. 28-day strength concrete reinforced with 6 X 6 X 10/10 wire mesh or fiber mesh. See Chapter 13 “Concrete Specifications Materials and Methods.”

Ditches with a bottom width less than four (4) feet shall be 4 inches thick, bottom widths four (4) feet or more

shall be six (6) inches thick. Paved ditches with a one (1) percent grade or flatter and a bottom width of 30 inches wide or more shall have a “V” bottom. See Exhibits 8-1 and 8-2 “Typical Paved Ditch Details” for illustration of typical paved ditch. There shall be sawed transverse joints at 15-foot intervals.

Paved ditches with four (4) percent grade or steeper shall have an anti-seep collar at 100 foot intervals dug into the earth eight (8) inches wide and eight (8) inches deep below the bottom side of the concrete of the paved ditch, to prevent tunneling that may cause settlement of the ditch.

**8.2.3 Drainage Ditch Slope Protection.** Drainage ditches with slope steeper than two (2) to one (1) may use gabion slope stabilization. See Exhibit 8-3 “Detention Basin and Storm Channel Details” for typical design. Other methods may be used, such as reinforced concrete walls, stone riprap, and manufactured retaining wall stone. The Engineer shall approve all methods. Earthen side slopes shall be grass lined as set forth in Chapter 10 of these specifications.

**8.2.4 Construction Requirements.** Earthwork for ditches and channels shall consist of clearing, stripping, excavation, fill, backfill, grading and disposal of excess excavated material.

- a. **Stripping.** When stripping is indicated on the plans or otherwise specified by the Engineer, the Contractor shall strip the soil from the designated areas to the depths specified. The material obtained from stripping shall be disposed of away from the site unless otherwise specified.
- b. **Excavation.** Channel excavation shall be performed in an open cut according to the lines shown on the plans or as specified by the Engineer. The faces of the excavation should be firm, hard and unyielding and should stand or be made to stand without sloughing. Where it becomes necessary to excavate beyond the normal lines of excavation in order to remove boulders or other interfering objects the excavation shall be backfilled and properly compacted. During the progress of the excavation, if material is encountered which the Engineer deems unsuitable, the contractor shall remove it below the lines shown on the plans. This excavation shall be backfilled with suitable material as set out in 8.2.4c.
- c. **Fill and Backfill.** Unless otherwise specified, the material obtained from the project excavation will be suitable for fill or backfill, provided that all organic material, rubbish, debris and other objectionable material contained therein are first

removed. The relative compaction of all fill and backfill shall be 95% (as determined by Standard Proctor Density) unless otherwise specified by the Engineer.

- d. **Grading.** Grading of the unlined channels shall conform to the following tolerances: A vertical tolerance of zero above and three inches below the specified grade will be allowed for:

- (1) The channel bottom.
- (2) The channel side slopes in both cut and fill. Regardless of the construction tolerance specified, the excavation and grading shall be performed so that the finished surfaces are in uniform planes with no abrupt breaks in the surface.

**8.3 STORM WATER DETENTION.** Generally, detention is required when the receiving stream or drainage structure is not capable of discharging the increased runoff generated by land development, and when post development runoff is determined to exceed pre development runoff.

Storm water detention shall be required for all new development/redevelopment where the post-development peak rate of runoff from the watershed exceeds the pre-development rate of runoff. However, detention requirements may be waived at the discretion of the Engineer if the proposed development’s peak discharge falls in the rising leg of the hydrograph for the watershed. The limits of the watershed to be analyzed shall be approved by the Engineer. Projects of limited scope having a net increase in impervious area of 11,000 square feet (1/4 acre or less) inside the Municipal Separate Storm Sewer System, (MS4) may not require storm water retention unless runoff from such project is deemed to have a detrimental effect downstream as determined by the Engineer. Projects within the limits of the Combined Sewer System (CSS) shall provide detention in flow rate. The net increase in impervious areas shall be defined as “the total accumulative net increase in impervious area constructed after the effective date of these specifications. This exemption shall not be construed to allow the piecemeal phasing of development activities to circumvent the requirement for storm water detention. Any impervious areas that have been demolished within the three (3) years prior to the submittal of the plan can be included in the Predevelopment calculations as impervious areas. Any impervious areas that have been demolished earlier than three (3) years prior to the submittal of the plan can not be included as impervious areas in the runoff calculations, but shall instead be designated as pervious areas.

**8.3.1 Storm Water Detention Design Criteria.** Unless otherwise warranted, storm water detention

design shall be based upon the 2-year and 100-year storm water runoff event. The post-development peak rate of runoff shall not exceed the pre-development peak rate of runoff from the watershed for the respective design storm. Minimum storage volume shall be equal to or greater than the increase in volume resulting from a 100-year rainfall event. The proposed development may implement such measures as rain gardens, pervious pavements (pervious concrete or pervious asphalt, but not gravel), and other methods to recharge the groundwater table in order to minimize the required volume of the detention basins.

Storm water routing calculations shall be performed for all storm water detention facilities having storage requirements of one (1) acre-foot or greater. Smaller systems having a drainage area of less than 2 acres and requiring less than one (1) acre-foot of storage may be designed by a non-routing method whereby the required storage volume is based upon the increase in volume resulting from a 100-year rainfall event and the outflow structure is designed for the 2-year pre-development peak rate of runoff. The Rational Method shall be acceptable for this application, up to 200 acre watersheds.

**8.3.2 Flood Plain/Flood Hazard Areas.** The Engineer will require additional means and measures as deemed necessary for any development affecting any portion of a flood plain or other flood hazard areas, such as mitigation of the volume of fill in the floodplain. The mitigation of fill in the floodplain is for the storage of the backwaters, it shall be required even if a No-Rise certification for the headwater is signed.

**8.4 DETENTION BASINS.** A detention basin is a place for temporary storage of storm runoff where peak flows need to be reduced. Normally, the basin will be dry and may be used for park areas, recreation, parking automobiles, etc. The esthetic appeal of a permanent pool may be obtained by raising the low flow outlet to a point higher than the bottom of the basin. During early stages of development and construction where erosion is occurring, the basin should be used for a sediment trap. A detention basin shall not be installed within a roadway buffer described in Article 13 of the Zoning Ordinance.

**8.4.1 Detention Basin Design Criteria.** A Professional Engineer licensed in the State of Kentucky shall design all detention basins. One complete set of the design calculations for the detention basins shall be provided, which at the request of the Engineer, shall include a copy of all rainfall and streamflow data, basin storage curves,

stream inflow and outflow curves. Exhibits 8-4 through 8-6 show typical detention basin layouts.

When a detention basin is used for sediment storage, the sediment shall not occupy more than 20% of the designed capacity for storm water. When a detention basin is small and inadequate to handle storm water and sediment storage, the basin shall be undercut for sediment storage. After erosion is under control, the sediment shall be removed and the basin restored to the designed capacity for storm water.

- a. **Detention Dam.** The dam shall be of sufficient height to provide the necessary storm water detention. It shall consist of an inlet structure, low flow pipe, emergency spillway and energy dissipator if required for control of discharge through the dam.
- b. **Side Slopes.** Unless otherwise approved by the Engineer, earthen side slopes shall be in accordance with the following:

<u>Depth</u>	<u>Maximum Slope</u>
<3 feet	2:1
3 feet to 6 feet	3:1
>6 feet	4:1

- c. **Basin Floor.** The basin floor shall have paved trapezoidal ditches with a minimum of one (1) foot bottom and a minimum of one (1) foot return on the side slope running from all basin inlet structures to the low flow outlet structure. The basin floor shall have a minimum of two (2) percent grade, where possible, to facilitate positive drainage. Lesser slopes may be used for the paved ditches within the basin. To prevent erosion where the storm sewers empty into the basin onto the paved ditches there shall be an impact dam designed by the Design Engineer and shown on the storm water plan. During early stages of development and construction where erosion is occurring and sediment is being trapped in the basin, the low flow outlet structure shall have a sediment trap installed on the upstream side. Methods that may be used are described in Chapter 11 Erosion and Sediment Control of these specifications.
- d. **Low Flow Outlet.** Consists of a pipe installed under the dam with an inlet structure upstream and an outlet structure downstream. The pipe shall have pressure resistant joints to avert "tunneling" along the exterior pipe surface. Detention basins in excess of about five feet tend to induce a flow net

through the dam itself which can be detrimental unless the dam is carefully compacted to 95% Standard Proctor Density. In such instances one or more antiseep collars should be poured around the pipe to prevent "tunneling".

- e. **Inlet Structure.** A bar rack shall be provided on the upstream end of the low flow outlet to prevent stoppage during detention periods. A sloped bar rack is usually desirable so that most debris floats up with the pool level. Bar racks should always have at least triple the conduit area so as to minimize design flow disruption from nonfloating debris. For a detail of the inlet structure see Exhibit 8-7.
- f. **Outlet Structure.** When outlet velocities are not a problem the downstream end of the low flow outlet shall consist of a sloped concrete apron with curbs, which will disperse the flow from the pipe.
- g. **Energy Dissipators.** Where outlet velocities exceed four (4) feet per second, a dissipator or impact basin (See Exhibit 8-7) shall be installed to protect the downstream channel from erosion. The impact basin shall be soundly constructed of Class "A", 3500-psi concrete and chamfered edges to resist continual abrasive actions from water as well as debris.
- h. **Spillway.** Any earthen dam shall be provided with a spillway to be constructed of either concrete or riprap, as specified by the Engineer, for erosion protection, unless it can be shown that 100-year flows will not cause erosion over the spillway. Spillway design should be predicated on at least the 100-year storm. There shall be a minimum freeboard of at least one-foot between the spillway design water surface and the top of the dam unless backwater overtops a low dam before headwater would overtop.

**8.4.2 Construction Requirements.** Earthwork for dams and basins shall include clearing, stripping, excavation, fill, backfill, grading and disposal of excess excavated material.

- a. **Clearing and Grubbing.** Unless otherwise specified, the entire area of all rights-of-way shall be cleared of all trees and brush by cutting at the ground surface. All main root clusters shall be entirely removed from areas upon which improvements are to be constructed, and in addition, those areas upon which compacted fills

for dams are to be constructed shall be grubbed as follows:

Individual roots of diameters between 1/2 inch and 1- 1/2 inches shall be removed to a depth of not less than one foot below natural ground. Larger roots shall be removed down to the level at which the root diameter is 1 1/2 inches or less. Regardless of diameter, no roots need to be removed to a depth greater than three feet.

All bulking of soil resulting from the grubbing operations shall be compacted and holes filled to the subgrade level for subsequent compacted fills.

- b. **Stripping.** Stripping shall be accomplished as set out in section 8.2.4a.
- c. **Basin Excavation.** Unless otherwise specified, material obtained from the basin excavation shall be used for compacted fills. The Engineer will designate the limits of basin excavation and the depths thereof in order to obtain a material suitable for use in the compacted fills. Rocks over six inches in the greatest dimension will not be permitted in compacted fills and shall be disposed of away from the site of the work unless otherwise specified.
- d. **Compacted Fills.** Compacted fills may be constructed of materials obtained from the on site excavation, unless otherwise specified by the Engineer. The relative compaction of all fills shall be at least 95% Standard Proctor Density (ASTM 698).

Before placing the materials for the compacted fills, the subgrade shall be moistened, compacted, and scarified in accordance with the requirements set forth hereinafter. The Engineer may determine the locations at which each load of fill shall be placed in order to obtain the best possible blending of materials. The fill material shall be placed in approximately horizontal, evenly distributed layers not exceeding 12 inches in depth, except that where the contractor clearly demonstrates that he can attain the required relative density with the type of equipment being used, a greater lift may be authorized. Unless otherwise permitted by the Engineer, each layer of fill material shall cover the full length and width of the entire area to be filled before the next higher layer of material is placed, and each layer shall be sufficiently scarified, after compaction, to provide bond with the succeeding layer. The top surface of each layer shall have

sufficient crown to provide adequate drainage for storm water at all times during the construction period.

Before rolling or tamping, sufficient water may be evenly applied to each layer of loose material to provide the proper moisture content for satisfactory compaction to the specified relative compaction (see section 3.4.2c). The material shall be disc harrowed, or otherwise similarly worked, as the water is applied. In case any layer of fill shall prove to be too wet to achieve the specified relative compaction, the compacting work shall be delayed until the material has dried sufficiently to permit the attainment of said relative compaction.

After each layer has been spread, worked and properly moistened, it shall be compacted by approved tamping or sheepsfoot rollers, pneumatic tire rollers, mechanically operated hand tampers, or other mechanical means acceptable to the Engineer, to such extent that it will produce the specified relative density.

- e. **Control of Debris** Per the Phase II stormwater requirements, a mechanical system shall be installed to control the debris released into the waters of Kentucky. This unit shall be installed at the most downstream point prior to any release into the existing waterway. This mechanical unit could include, but is not limited to a vortex type unit, or a trapped inlet/manhole as shown in Exhibit 5-16. If the unit is to remain private, it is to be inspected and cleaned on a yearly basis.

**8.4.3 Typical Design Computations.** Exhibits 8-8 through 8-12 show design computations for inflow-outflow in detention basin design. These sample computations are shown in a commonly utilized format that is meant only as a guide for the design engineer.

**8.4.4 Detention Basin Maintenance.** The Contractor or Developer shall be responsible for removing sediment, restoring bottom to drain, reseeding bottom, and mowing until upstream erosion is under control and vegetation is restored. After erosion and sediment is under control and vegetation is restored, the developer's engineer, at the request of the Engineer, shall perform an as built survey of all basins and shall certify the basins have been constructed according to the plan dimensions. After the Engineer receives this certification and bond has been released, the

maintenance shall be the responsibility of the City/County/Owner/ or Homeowners Association.

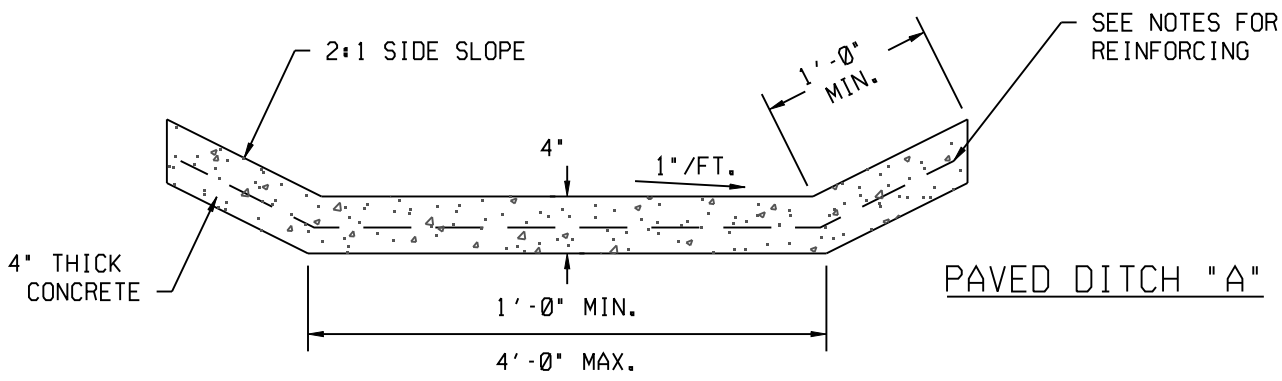
## 8.5 BUILDING DRAINS

**8.5.1 Roof Drains.** Roof drains shall outlet onto the ground just beyond the building's foundation trench the discharge shall sheet flow onto the property owner's land for a minimum of 20 feet unless it is not physically possible. In no case shall a pipe discharge be directed onto an adjacent property. Pipe discharges shall not be allowed just behind the sidewalk or curb nor through the curb, unless specifically approved by the review engineer in writing. Roof drains shall not be connected to sanitary or combined sewer laterals.

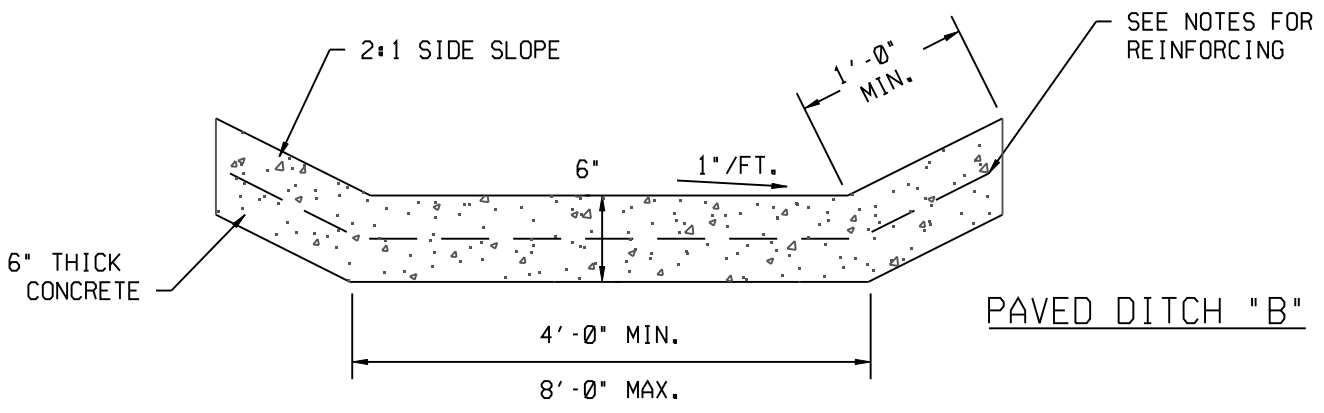
**8.5.2 Foundation Drains.** Foundation drains shall be brought to daylight as close to the building as possible. Pipe discharges shall not be allowed just behind the sidewalk or curb. Pipe discharges may be brought through the curb face if an only if there is no other surface location on the property that is more than 2 feet below the first floor elevation and a proper curb modification is completed. Foundation drains shall not be connected to sanitary or combined sewer laterals.

If foundation and/or basement floor drains are pumped, they shall discharge to the surface, or if necessary, be taken to a storm structure. Discharges shall be in a manner so as not to cause winter freezing or other nuisances to sidewalks or other public facilities.

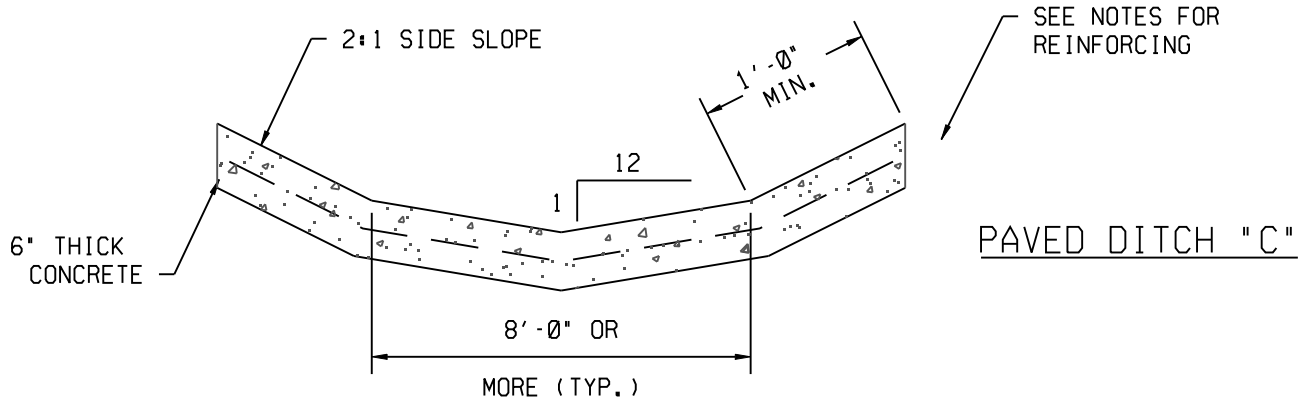
**8.6 OFFSITE DRAINAGE IMPROVEMENTS.** The Developer's Engineer may be required to evaluate deficiencies and/or adequacy of downstream and/or bordering drainage facilities. Offsite drainage improvements may be required in addition to or in lieu of onsite drainage improvements.



"A" TYPICAL PAVED DITCH WITH A BOTTOM WIDTH LESS THAN 4'-0"



"B" TYPICAL PAVED DITCH WITH A BOTTOM WIDTH OF 4'-0" OR MORE

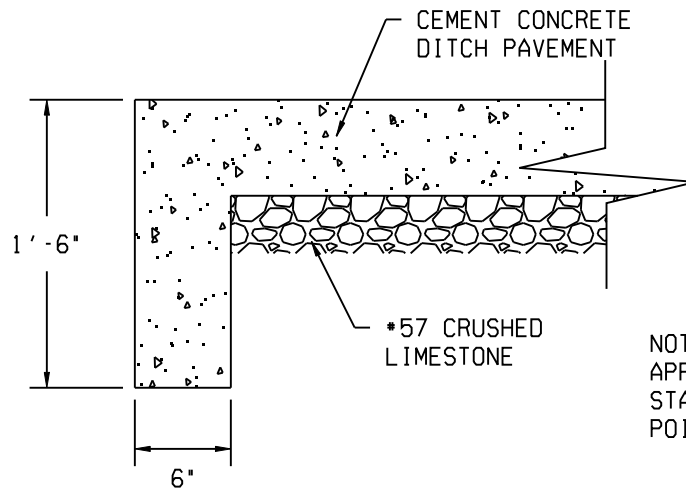


"C" TYPICAL PAVED DITCH WITH A BOTTOM WIDTH OF 2'-6" OR MORE

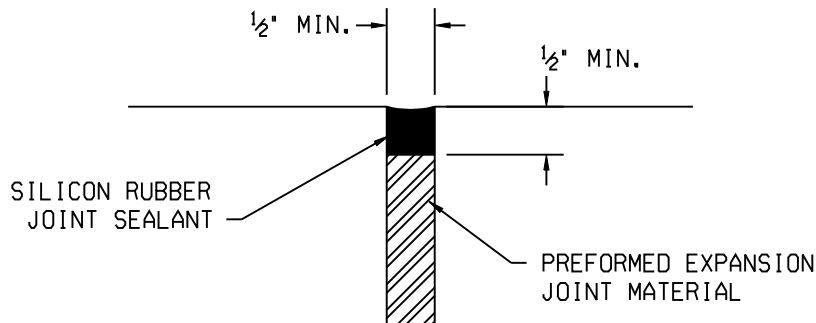
**NOTE:**  
 ALL CONCRETE PAVED DITCHES TO RECEIVE ONE LAYER OF CONTINUOUS 6X6 W.W.F. OR FIBER MESH REINFORCING.

IF FIBER MESH IS USED THE CEMENT SHALL HAVE INCORPORATED INTO IT A MATRIX OF 100% VIRGIN POLYPROPYLENE FIBERS AS MANUFACTURED BY DURAFIBER, OR EQUAL. THE FIBERS SHALL BE APPLIED AT A RATE OF 1.5 POUNDS PER CUBIC YARD OF CONCRETE, AND THE FIBERS SHALL BE 3/4" IN LENGTH.

OWENSBORO METROPOLITAN PUBLIC IMPROVEMENT SPECIFICATIONS
CHAPTER 8 SURFACE DRAINAGE
TYPICAL PAVED DITCH DETAILS
EXHIBIT NO. 8-1 NOT TO SCALE



APRON WALL DETAIL



EXPANSION JOINT DETAIL  
(TYPICAL FOR ALL PAVED DITCHES)

NOTE:  
APRON TO BE USED AT ALL  
STARTING AND ENDING  
POINTS OF PAVED DITCH.

NOTE:  
CONSTRUCT EXPANSION JOINT WHERE  
DITCH PAVEMENT ABUTS OTHER  
STRUCTURES AND AT SPACING NOT  
TO EXCEED 50 L.F.

**CONCRETE:**

USE CLASS "A" CEMENT CONCRETE WITH A 28 DAY COMPRESSIVE STRENGTH OF 3500 PSI. THE CEMENT SHALL HAVE INCORPORATED INTO IT A MATRIX OF 100% VIRGIN POLYPROPYLENE FIBERS AS MANUFACTURED BY DURAFIBER, OR ITS EQUAL. THE FIBERS SHALL BE APPLIED AT A RATE OF 1.5 POUNDS PER CUBIC YARD OF CONCRETE, AND THE FIBERS SHALL BE 3/4" IN LENGTH.

**CONCRETE PLACEMENT:**

THE PAVED DITCHES SHALL BE FLOATED, TROWELED, AND LIGHTLY BROOMED FOR FINISH.

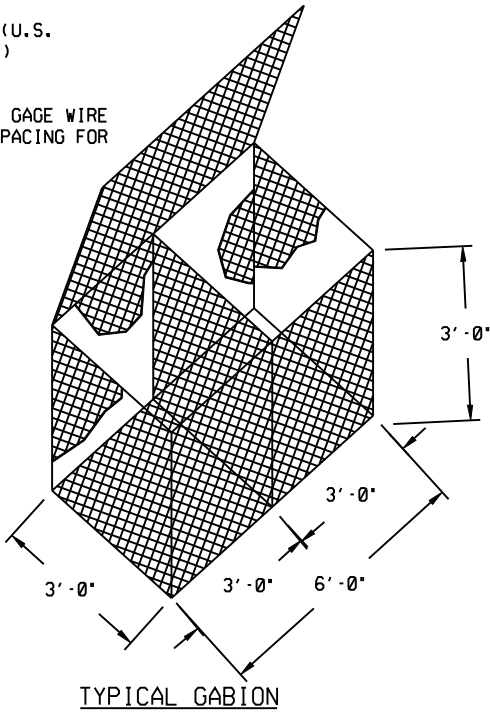
**CONCRETE CONSTRUCTION JOINTS:**

CONSTRUCTION JOINTS SHALL BE SAWN AS INDICATED ON THE PLANS AT A SPACING NOT TO EXCEED 15 FEET IN ANY DIRECTION. ALL CONSTRUCTION JOINTS SHALL BE SAWN WITHIN 24 HOURS OF CONCRETE PLACEMENT SO AS TO SERVE AS A SHRINKAGE CRACK CONTROL. EARLY ENTRY JOINTS CUT WITHIN 5 HOURS OF CONCRETE PLACEMENT SHALL BE 1" DEEP. ALL OTHER SAW JOINTS SHALL BE 1/4 OF THE DEPTH OF THE SLAB. THE CONTRACTOR MAY OPTION TO HAND GROOVE JOINTS AT TIME OF CONCRETE PLACEMENT. EXPANSION JOINTS WITH PREFORMED EXPANSION MATERIAL SHALL BE PLACED WHERE PAVED DITCH PAVEMENT ABUTS OTHER STRUCTURES AND AT A SPACING NOT TO EXCEED 50 LINEAR FEET. (SEE DETAILS THIS PAGE).

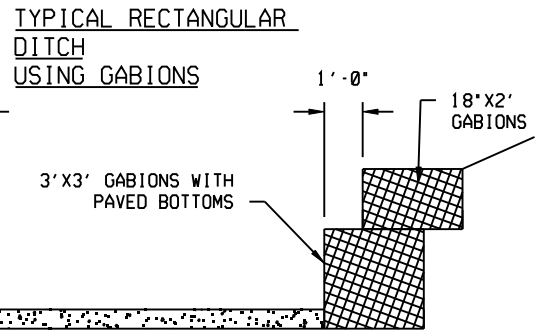
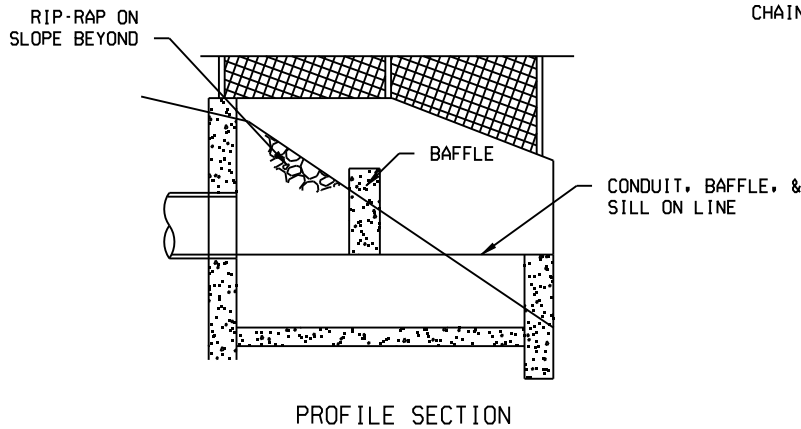
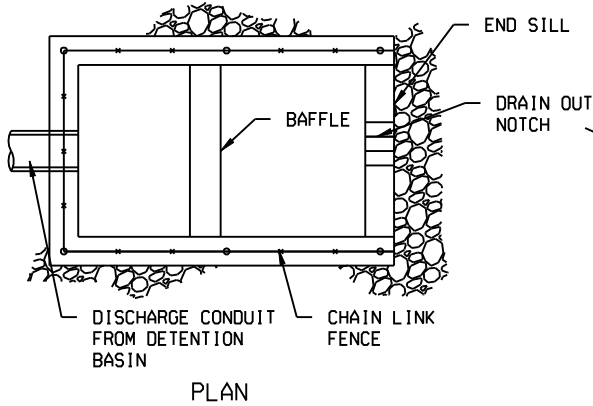
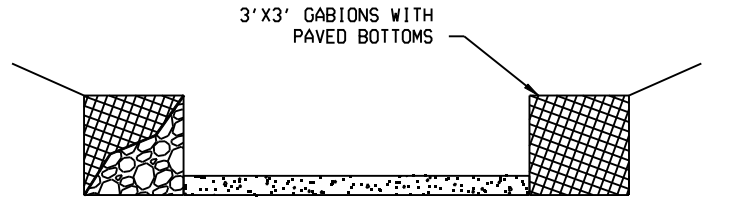
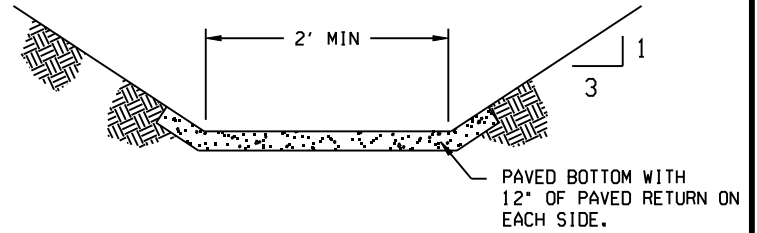
OWENSBORO METROPOLITAN PUBLIC IMPROVEMENT SPECIFICATIONS
CHAPTER 8 SURFACE DRAINAGE
TYPICAL PAVED DITCH DETAILS
EXHIBIT NO. 8-2 NOT TO SCALE

\*9 MIN. GAGE (U.S. STANDARD GAGE) WIRE FABRIC.

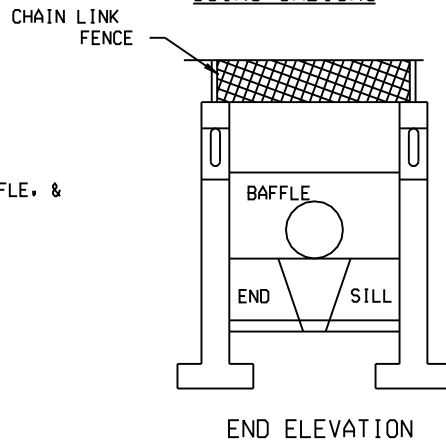
PROVIDE HEAVY GAGE WIRE TIES AT 10" SPACING FOR TOP.



NOTE: FOR PAVED DITCHES: PROVIDE 1/4" X 1 1/2" DEEP SAWED TRANSVERSE JOINT AT MAXIMUM 25' SPACING, AT ALL CHANGES IN HORIZ. OR VERTICAL ALIGNMENT.



TYPICAL STEPPED DITCH USING GABIONS



TYPICAL IMPACT BASIN

NOTE:

ALL DIMENSIONS ARE VARIABLES DEPENDING ON DISCHARGE, HEAD OF DISCHARGE, AND CONDUIT DIAMETER. EXAMPLE IS SHOWN TO PORTRAY ONE METHOD OF ENERGY CONTROL, AND SHOULD NOT BE SCALED.

OWENSBORO METROPOLITAN PUBLIC IMPROVEMENT SPECIFICATIONS
CHAPTER 8 SURFACE DRAINAGE
DETENTION BASIN AND STORM CHANNEL DETAILS
EXHIBIT NO. 8-3 NOT TO SCALE



CULVERT SIZED TO INDUCE DETENTION

ROADWAY

FRONT PROPERTY LINE

SLOPED INLET HEADWALL

RESIDENCE

DRIVE

LANDSCAPING OFF OF EASEMENT FOR EASE OF SLOPE MAINTENANCE

DETENTION EASEMENT

RESIDENCE

PROPERTY LINE

DRIVE

DRAINAGE EASEMENT ON SIDE PROPERTY LINE TO CONVEY STREET STORMWATER TO DETENTION BASIN.

SODDED 3:1 SLOPE  
PAVED BOTTOM  
SODDED 3:1 SLOPE

### PLAN VIEW OF TRAPEZOIDAL DETENTION BASIN

OWENSBORO METROPOLITAN  
PUBLIC IMPROVEMENT SPECIFICATIONS

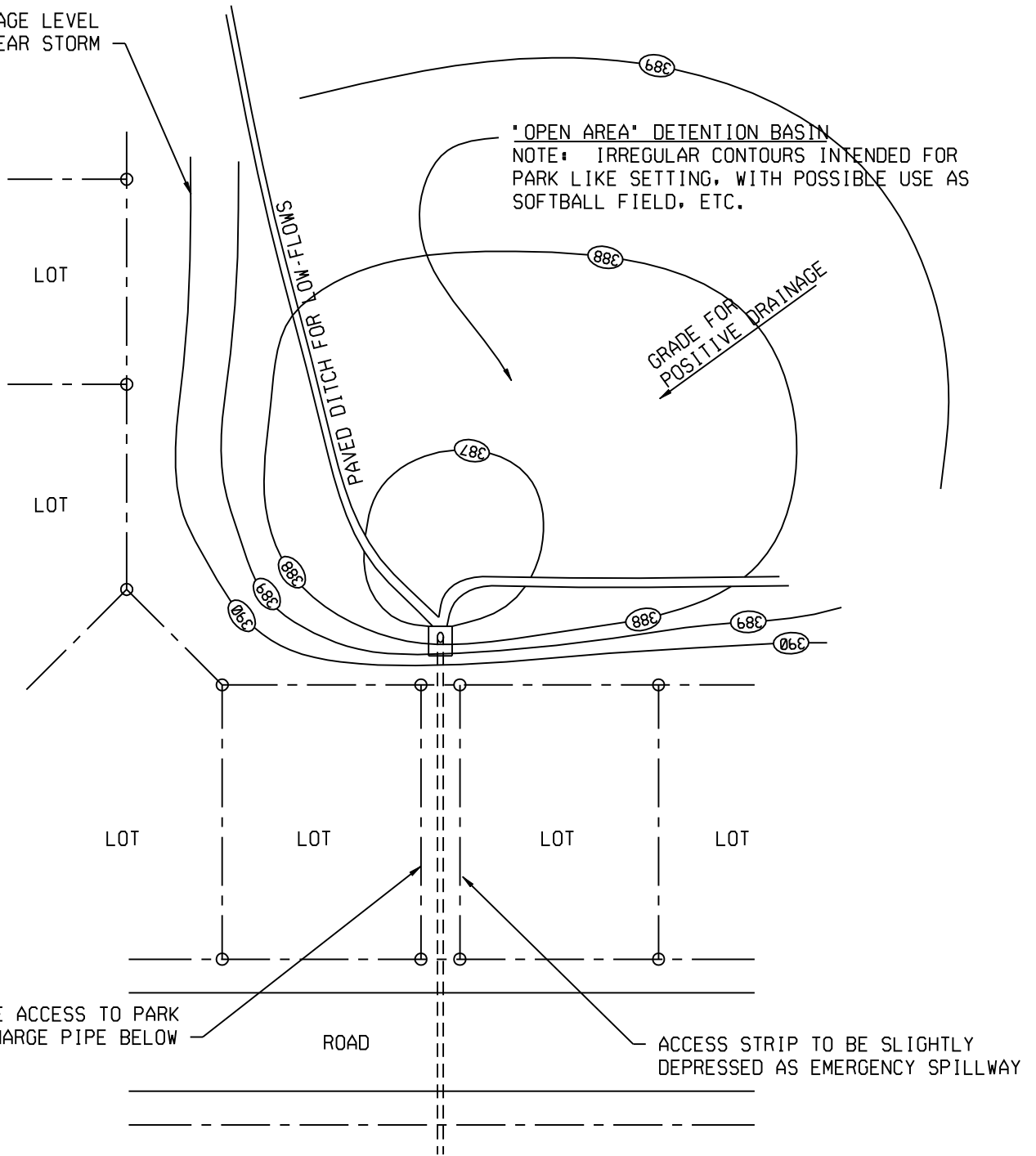
CHAPTER 8  
SURFACE DRAINAGE

PLAN VIEW OF  
TRAPEZOIDAL DITCH DETENTION

EXHIBIT NO. 8-4

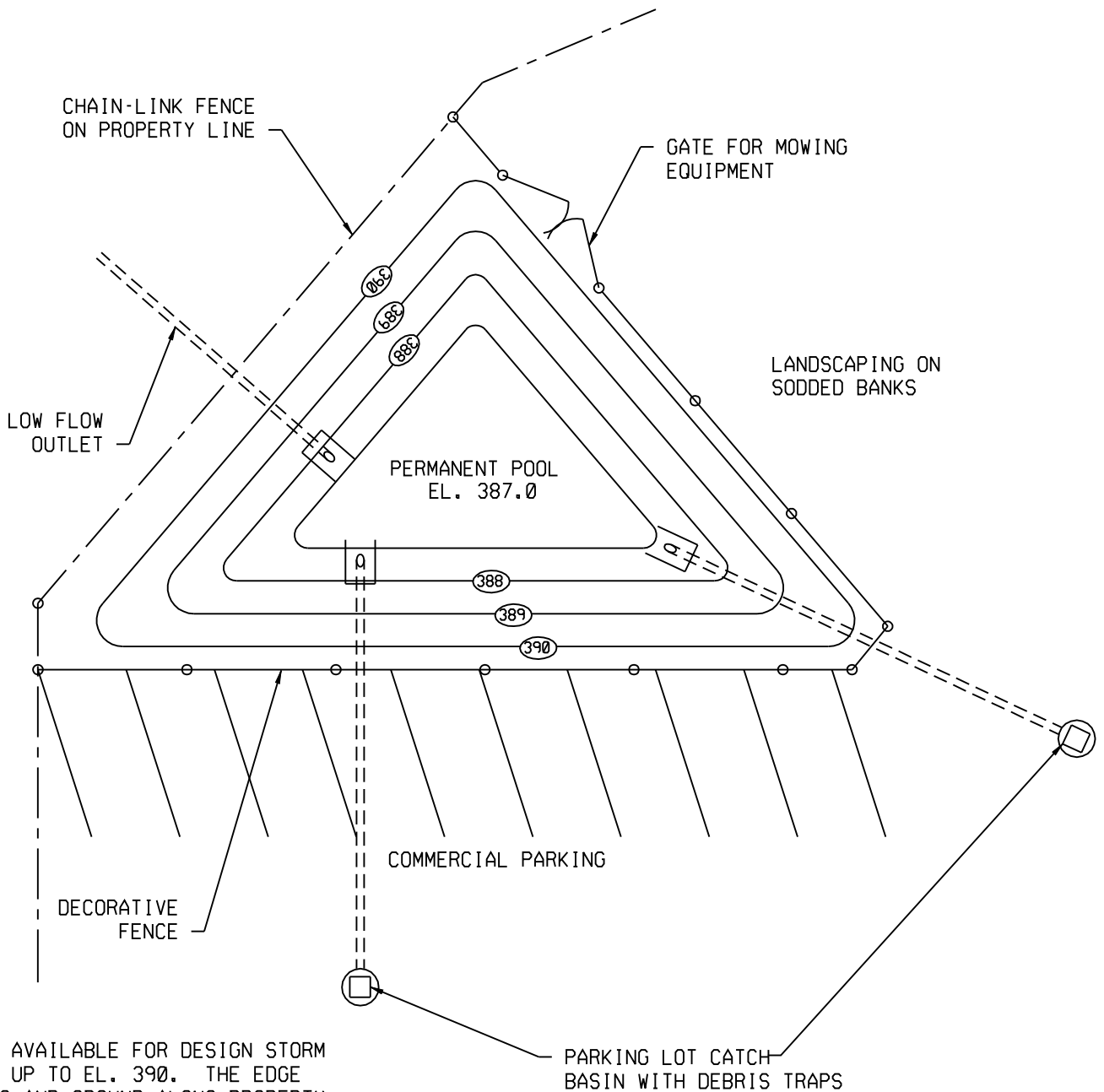
NOT TO SCALE

MAXIMUM PONDAGE LEVEL  
FOR 100-YEAR STORM



PARTIAL PLAN VIEW OF  
RESIDENTIAL-TYPE DETENTION BASIN

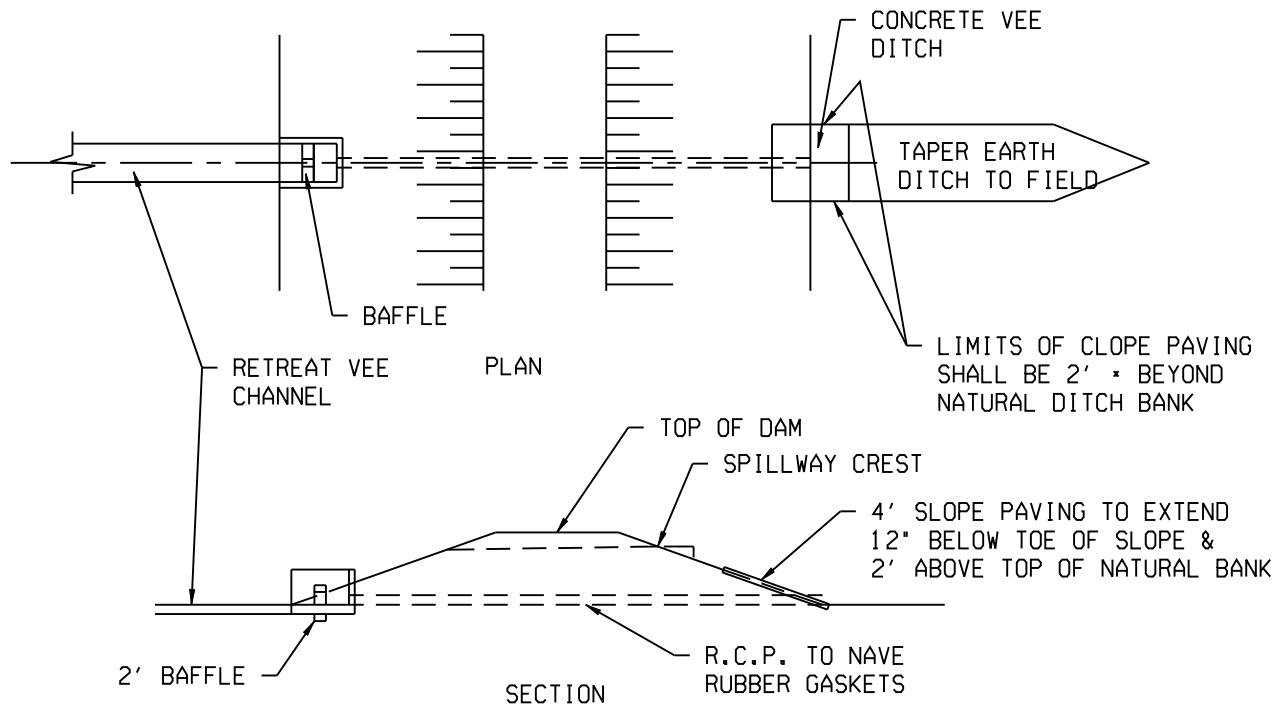
OWENSBORO METROPOLITAN PUBLIC IMPROVEMENT SPECIFICATIONS
CHAPTER 8 SURFACE DRAINAGE
PLAN VIEW OF RESIDENTIAL TYPE DETENTION BASIN
EXHIBIT NO. 8-5 NOT TO SCALE



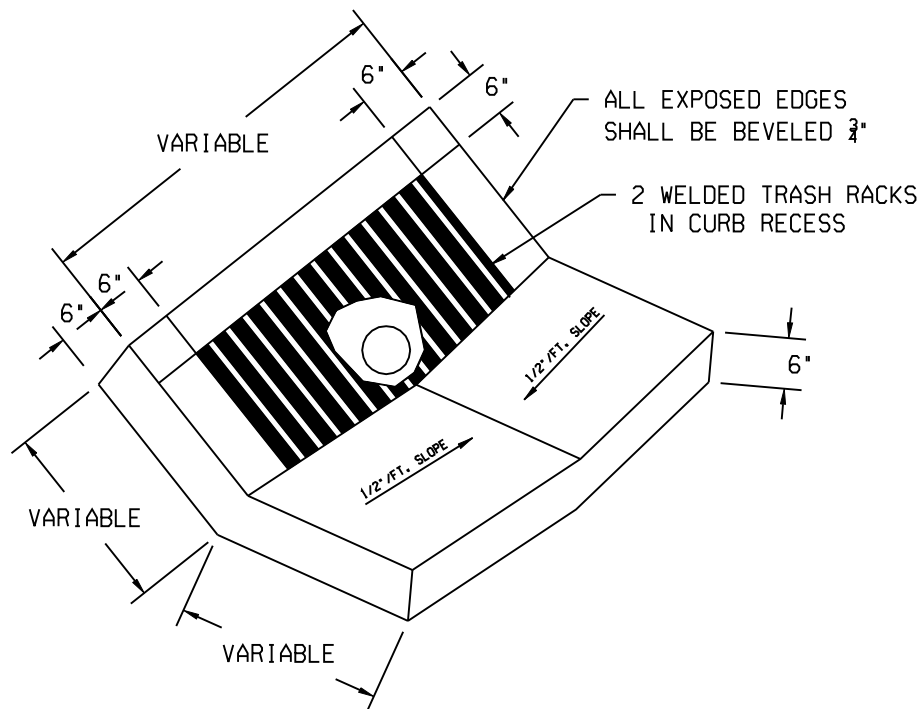
NOTE: 3' AVAILABLE FOR DESIGN STORM RETENTION UP TO EL. 390. THE EDGE OF PARKING AND GROUND ALONG PROPERTY LINE SHOULD BE 1' HIGHER FOR FREEBOARD.

PLAN VIEW OF PERMANENT  
POOL TYPE RETENTION BASIN

OWENSBORO METROPOLITAN PUBLIC IMPROVEMENT SPECIFICATIONS
CHAPTER 8 SURFACE DRAINAGE
PLAN VIEW OF PERMANENT POOL TYPE RETENTION BASIN
EXHIBIT NO. 8-6 NOT TO SCALE

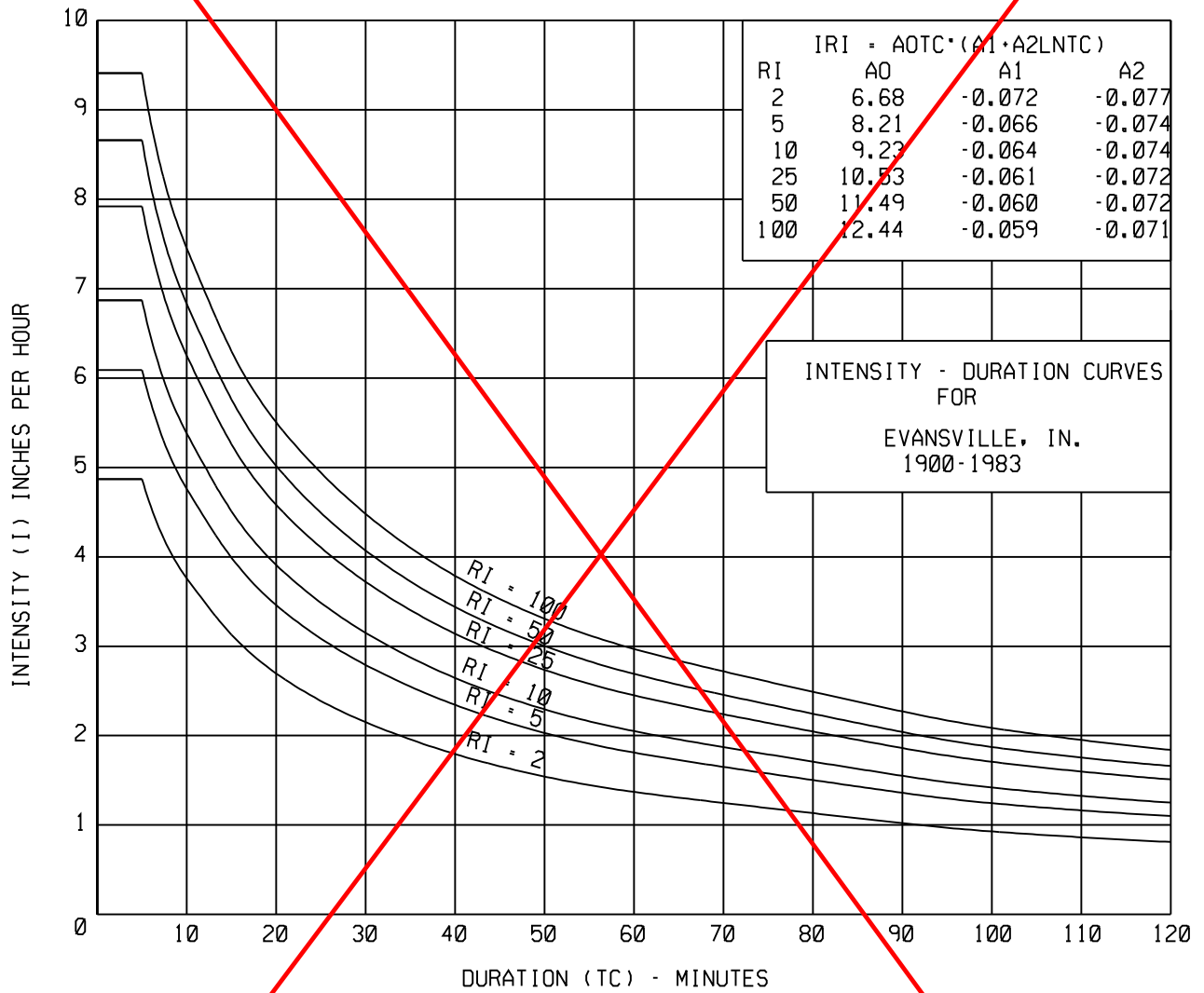


TYPICAL DETENTION BASIN



TYPICAL TRASH STRUCTURE

OWENSBORO METROPOLITAN PUBLIC IMPROVEMENT SPECIFICATIONS
CHAPTER 8 SURFACE DRAINAGE
TRASH STRUCTURE DETAILS
EXHIBIT NO. 8-7 NOT TO SCALE



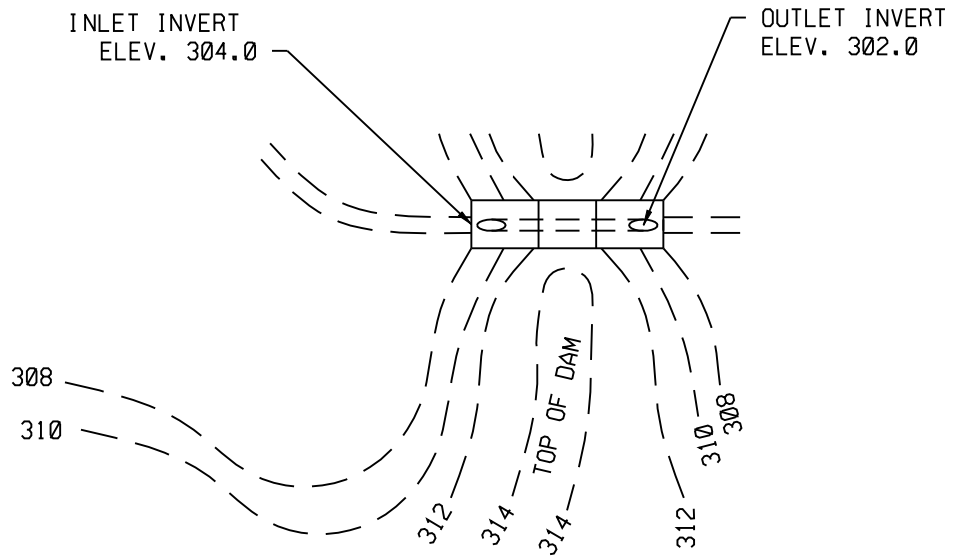
OWENSBORO METROPOLITAN  
PUBLIC IMPROVEMENT SPECIFICATIONS

CHAPTER 8  
SURFACE DRAINAGE

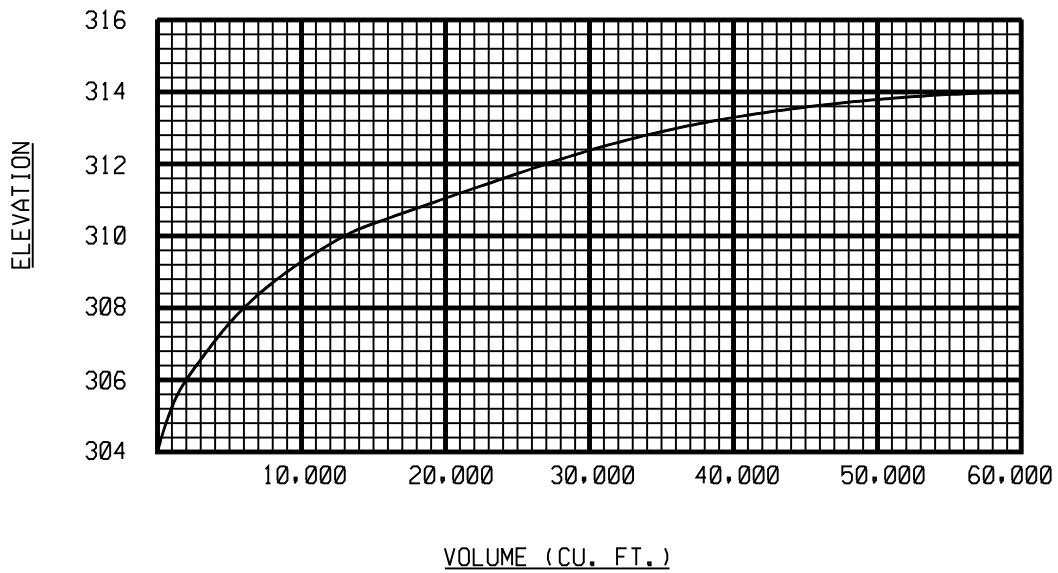
RAINFALL INTENSITY  
OWENSBORO, KENTUCKY

EXHIBIT NO. 8-8

NOT TO SCALE



PARTIAL PLAN OF A DETENTION  
BASIN OUTLET



OWENSBORO METROPOLITAN  
PUBLIC IMPROVEMENT SPECIFICATIONS

CHAPTER 8  
SURFACE DRAINAGE

ROUTING PROCEDURE  
STORAGE CURVE

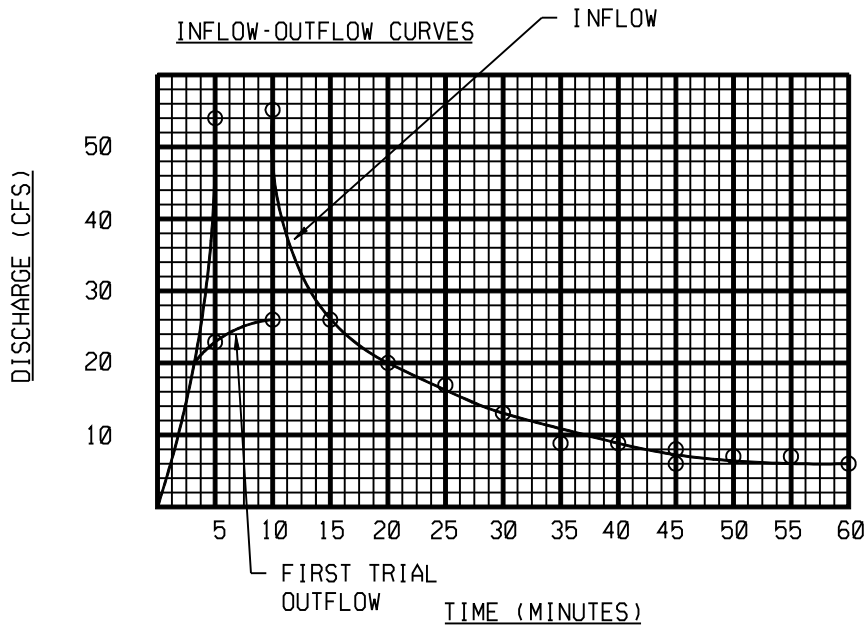
EXHIBIT NO. 8-9

NOT TO SCALE

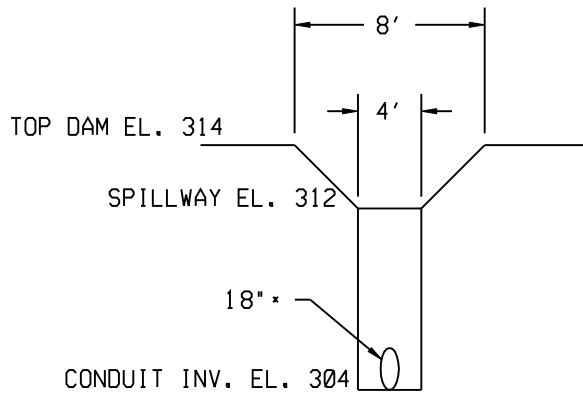
INFLOW HYDROGRAPH DETERMINATION FOR SMALL AREA (10 ACRE WATERSHED)

TIME MINUTES	INTENSITY INCHES/HR	TOTAL RAINFAL INCHES	INCRE. RAINFAL INCHES	$Q = \frac{CAI}{300 \times 12} \times$ CFS
5	7.40	.61	.61	44
10	7.40	1.23	.62	45
15	6.50	1.62	.39	26
20	5.68	1.89	.27	20
25	5.10	2.12	.23	17
30	4.60	2.30	.18	13
35	4.17	2.43	.13	9
40	3.82	2.55	.12	9
45	3.54	2.66	.11	8
50	3.31	2.76	.10	7
55	3.10	2.85	.09	7
60	2.93	2.93	.08	6

\*  $C = 0.60$   
 $A = 10 \times 43560 = 435,600$   
 $\frac{CA}{300 \times 12} = 72.6$   
 $Q =$  AVERAGE  
 5 MINUTES FLOW C.F.S.

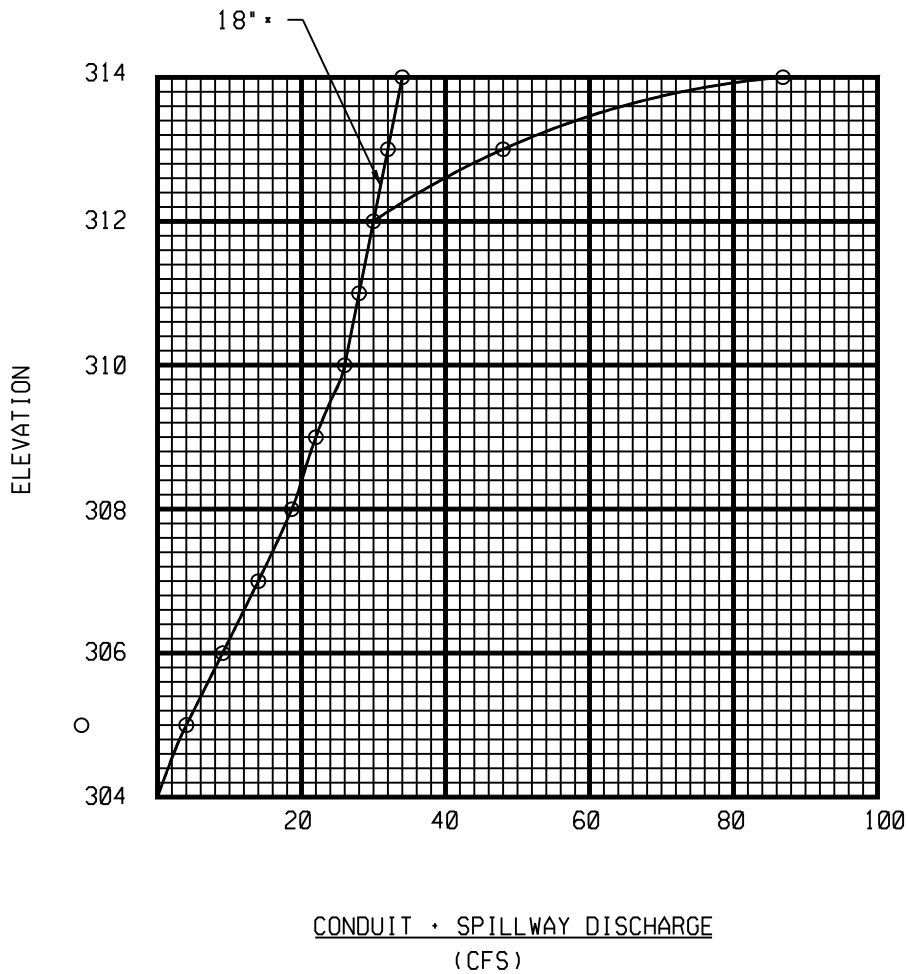


OWENSBORO METROPOLITAN  
 PUBLIC IMPROVEMENT SPECIFICATIONS  
 CHAPTER 8  
 SURFACE DRAINAGE  
 ROUTING PROCEDURE  
 INFLOW-OUTFLOW CURVES  
 EXHIBIT NO. 8-10  
 NOT TO SCALE



SPILLWAY RATING

C	L	H	$Q = CLH^{3/2}$	DEPTH
3.08	5'	1.0	15.4	1.0
3.08	6'	2.0	52.3	2.0



OWENSBORO METROPOLITAN PUBLIC IMPROVEMENT SPECIFICATIONS
CHAPTER 8 SURFACE DRAINAGE
OUTLET RATING
EXHIBIT NO. 8-11 NOT TO SCALE



TIME	BASIN INFLOW		DEPTH IN BASIN	1ST. LEVEL CONDUIT		2ND. LEVEL CONDUIT		SPILLWAY		TOTAL OUTFLOW	ΔS	S	
	INSTANTANEOUS	AVERAGE		D	Q	D	Q	D	Q	Q			
MINUTES	CFS	CFS	FEET	FEET	CFS	FEET	CFS	FEET	CFS	CFS	CU.FT.	CU.FT.	
5		44											
			5.19	5.19	23.2	N/A	N/A	0	0	23.2		9725	
10		45											
			6.36	6.36	26.7	N/A	N/A	0	0	26.7		15,737	
15		26											
20		20	NOTE: LEVEL IN BASIN WILL START RECEDING BECAUSE OUTFLOW OF 26.7 CFS EXCEEDS INFLOW. THE DAM SHOULD NOW BE REVISED FOR ANOTHER TRIAL. EITHER REDUCE CONDUIT SIZE OR LOWER TOP OF DAM.										
25		17											
30		13											
35		9											
40		9											
45		8											
50		7											
55		7											
60		6											

1ST LEVEL CONDUIT... 18" -----  
 2ND. LEVEL CONDUIT... -----  
 SPILLWAY... 4' WIDE LESS SIDE SLOPES

STORM..... 100-YEAR -----  
 PROJECT... EXAMPLE -----  
 DATE..... -----

OWENSBORO METROPOLITAN PUBLIC IMPROVEMENT SPECIFICATIONS
CHAPTER 8 SURFACE DRAINAGE
BASIN DESIGN TABLE
EXHIBIT NO. 8-12 NOT TO SCALE