3.01 Storm Drain Design Standards

A. General Requirements

1. All developments shall meet the UPDES MS4 permit, Salem City SWMP, Salem City Storm Drain Master Plan, and the requirements in this section.
2. Storm drain systems shall be designed to reasonably protect water quality, human life, and property, and mirror as closely as possible predevelopment conditions.
3. New developments and redevelopments shall meet the following requirements:
    a. Retain the 80th percentile storm on site.
    b. Retain the 100 year 24 hour event at a minimum using the NRCS Nested Distribution.
    c. Detention is authorized in accordance with the "Salem City Allowable Discharge Map" if an acceptable downstream waterway for discharge exists or is developed with the project.
    d. Provide for safe overtopping to prevent significant damage downstream.
    e. The City Engineer may require greater retention if the design storm is insufficient to meet the aims of the storm drain system.
    f. Conveyance systems shall be designed for the peak flow from a 25 year 3 hour event using the Farmer Fletcher Storm Distribution. The remaining flow from the design storm may flow in street with no curb overtopping.
4. Existing storm drain systems not meeting the standard and causing excessive, dangerous, or damaging off-site discharge, as determined by the City Engineer, shall be retrofitted with any significant remodel or redevelopment of the serviced property at the owner's expense to meet the new development and redevelopment standard.
5. Underground retention basins shall not be placed in the roadway unless specifically approved in writing by the City Engineer.
6. Manufactured storm drain facilities shall be installed as per manufactures recommendations which may require these to be installed prior to concrete installation.
7. Site design shall protect sensitive environmental features including but not limited to the following:
    a. Riparian areas
    b. Wetlands
    c. Steep slopes.
8. Rainfall data shall be taken from NOAA Atlas 14.
9. Salem City reserves the right to require additional engineering studies and storm drainage infrastructure for special conditionals such as steep slopes, burn areas, debris flow hazards, etc.

B. Low Impact Development

1. Implementation of Low Impact Development (LID) is required by the City and the UPDES MS4 permit as the first choice in stormwater management.

a. Developer should implement appropriate best management practices that infiltrate, evapo-transpire, or harvest and use storm water. See “Salem City Low Impact Development Best Management Practices Manual”.

2. The selection and design of post-construction controls should consider the following at a minimum:
   a. Site soil characteristics
   b. Clogging or obstruction issues
   c. Freeze-thaw problems
   d. Effect on slope and stability
   e. Groundwater
   f. The ability to effectively maintain the control.

C. Calculations

1. Must show that proposed storm water management is in compliance with the Storm Drain Master Plan and has the capability to handle the design storm.
2. Include the following in the calculations at a minimum:
   a. Project size
   b. Drainage area size and location
   c. Locations of stormwater runoff discharge
   d. Land use
   e. Design storm frequency, duration, and intensity
   f. Time of concentration
   g. Soil curve numbers or runoff coefficients
   h. Peak runoff rates on and off-site
   i. Total runoff volume on and off-site
   j. Infiltration rates
   k. Stormwater conveyance capacities
   l. Flow velocities
   m. Documentation of sources for computation methods and field test results
   n. Other soils and geotechnical information
   o. Other information requirements identified by the City Engineer.

D. Soils/Geotechnical Information

1. If infiltration is used as a stormwater control measure, the following soils and geotechnical information must be provided in the stormwater calculations.
   a. Soil type
   b. Groundwater level
   c. Infiltration/percolation rates
   d. Geotechnical hazards
      i. Slope instability
      ii. Expansive soils
      iii. Collapsible soils
      iv. Liquefaction
      v. Other hazards as identified by the City Engineer

e. All other applicable soils data.

E. Stormwater Inlets

1. Inlet boxes shall be spaced to ensure that there will be no curb overtopping during the design storm event.
2. Maximum spacing along curb and gutter shall not exceed the distances in Table 7, or as required by City Engineer.

Table 1: Maximum Storm Drain Inlet Spacing

Slope of Street (%)	Maximum Inlet Spacing (ft)
0.0 - 3.0	350
3.1 - 5.0	300
5.1 - 8.0	250
8.1 - 10	200

3. Street slopes greater than 5% require greater grate capacity.
   a. Double inlets and upsized inlet grates are suggested methods.
   b. Increased grate capacity may be required by the City Engineer regardless of street slope.
4. Inlet grates shall be set 2” below grade, and the apron shall have a continuous slope between grade and the top of grate.
5. Must have snout type grease trap, or approved equal, over the outlet of the box.
6. Inlets shall be designed to intercept a minimum 85% of the peak flow in the design storm.
   a. Calculations shall assume 50% blockage of inlets.
   b. The bypassed flow must be included in the calculations downstream.
   c. No excess runoff is allowed to flow out of the phase or subdivision.
7. Inlet boxes shall provide for pretreatment as well as allow for maintenance, combination boxes may be required.
8. No inlet box shall be placed in pedestrian ramps.
9. Curb cuts may replace traditional inlet boxes with the following requirements:
   a. Cut must be lower than the gutter flow path in order to capture runoff
   b. Pretreatment of stormwater must happen before reaching the primary management technique
   c. Curb cuts must function with the management technique
   d. Curb cuts must be specifically approved in writing by the City Engineer.
10. See standard drawing.

F. Storm Drain Piping

1. Minimum transmission pipe size shall be 15” diameter.
   a. 24” and smaller pipe may be ADS.
   b. Larger than 24” pipe shall be RCP.
   c. Do not decrease pipe diameter in the downstream direction.

2. Storm drain shall not be designed as a pressurized system.
3. Storm drain manholes shall not be more than 400' apart.
    a. Manholes shall be 5' diameter minimum.
4. Circular manholes are required when in the asphalt.
5. Pipe slope shall not be less than the slope in Table 8, or as required by City Engineer.

Table 2: Minimum Storm Drain Pipe Slope

Pipe Size (in)	Min Slope (ft/ft)
15	0.0015
18	0.0012
21	0.00095
24	0.00078
30	0.00058
36	0.00046

G. Detention/Retention Basins

1. Retention Basins are required. Detention Basins may be permitted with written approval of the City Engineer.
2. Basins shall be on a separate lot, within the street ROW, or in a dedicated easement.
    a. No flag lots.
    b. Must have adequate frontage for maintenance on an improved public road.
3. Basins shall be designed with an emergency overflow into an approved facility.
4. City approved landscaping is required for all basins.
5. Basins shall meet the following requirements:
    a. Designed to hold at least the 100 year 24 hour storm event
    b. Minimum 1' of free board
    c. Berms shall have a minimum top width of 3'
    d. Maximum side slope
        i. Grass: 5:1
        ii. Stabilized slope 3:1
        iii. Retaining wall: max height: 30 inches for public area
        iv. variations can be approved in writing by City Engineer
    e. Maximum water depth of 30"
    f. Underground structure for nuisance water abatement
    g. All water for the design storm must be infiltrated or in the nuisance abatement structure within 48 hours.
6. Detention basins additionally shall meet the following requirements:
    a. Approved release rate in accordance with "Salem City Allowable Discharge Map"
    b. Approved release structure
    c. Shall have a designated, permanent discharge location.
    d. Shall be designed to minimize detention time.

Salem City Low Impact Development Best Management Practices Manual

Overview

This manual provides guidance for the approved Best Management Practices (BMPs) to meet the Low Impact Development (LID) requirements of the MS4 program. All BMPs must be designed for each site and require approval by the City Engineer. Where appropriate, these BMPs may be enlarged to also satisfy the flood prevention portion of Salem City's storm water requirements. Any one project may have any number of different BMPs, and many of these BMPs work well together as a system. For each BMP type, this manual gives an overview, appropriate uses, and limitations. There are six BMP types covered in this manual, although others may be approved by the City Engineer on a case-by-case basis.

1. Underground Basins
    a. StormBrixx
    b. StormTech
    c. Rock Galleries
2. Infiltration Trenches
3. Sumps (Dry Wells)
4. Retention or Bioretention Basins
5. Rain Gardens
6. Conveyance and Prefiltration
    a. Bioswales
    b. Vegetated Filter Strips

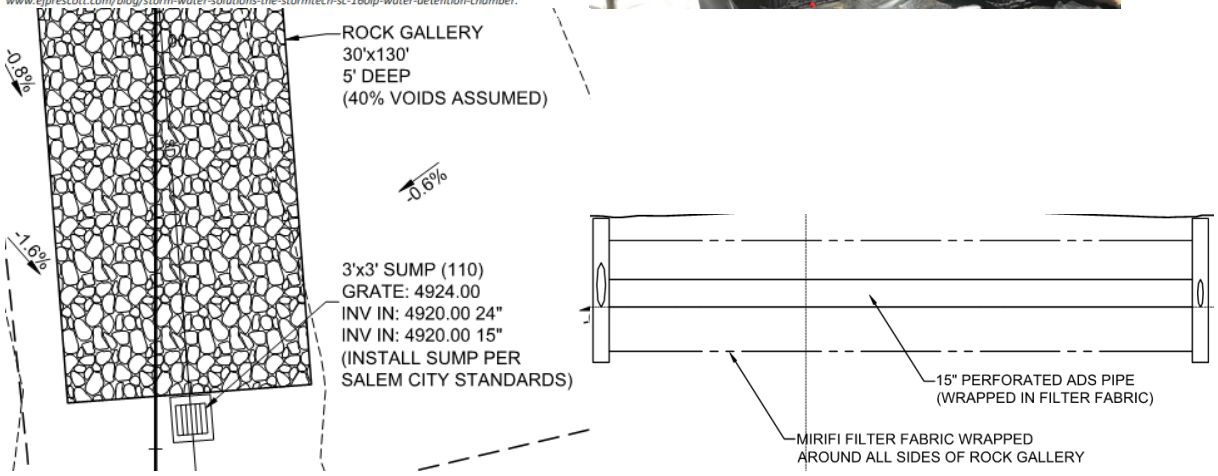
1. Underground Basins

a. Overview: Underground stormwater basins are typically designed as retention and infiltration basins underneath landscaped areas. Storm water reaches the basins through pipes from catch basins with snouts or other prefiltration methods. Three approved versions of underground basins are ACO StormBrixx, ADS StormTech Chambers, and rock galleries. For manufactured basins, Salem City requires Developer/Contractor to submit and follow the manufacturer's recommendations for design and construction.

b. Uses: Underground basins maybe sized for the LID or flood prevention storm event. Public facilities must be on public property such as planter strips or under a public retention basin. Private facilities such as for an HOA or commercial/institutional property must be on private property such as under a private retention basin, landscaping, or parking lot.

c. Limitations: Underground stormwater basins should be installed above groundwater level and not in water source protection areas, or areas of likely ground water contamination. The basins must be laid perfectly flat, even under steep slopes. When designed as infiltration basins, they may not function well in soils with low percolation rates. All underground basins must be wrapped in filter fabric to prevent sedimentation of the basins. Greater pretreatment may be required for basins without the ability to be cleaned.

Prescott, Everett J. "Storm Water Solutions." Waterworks Services & Products for Professionals, EJP, 19 Oct. 2016, www.ejprescott.com/blog/storm-water-solutions-the-stormtech-sc-160lp-water-detention-chamber.

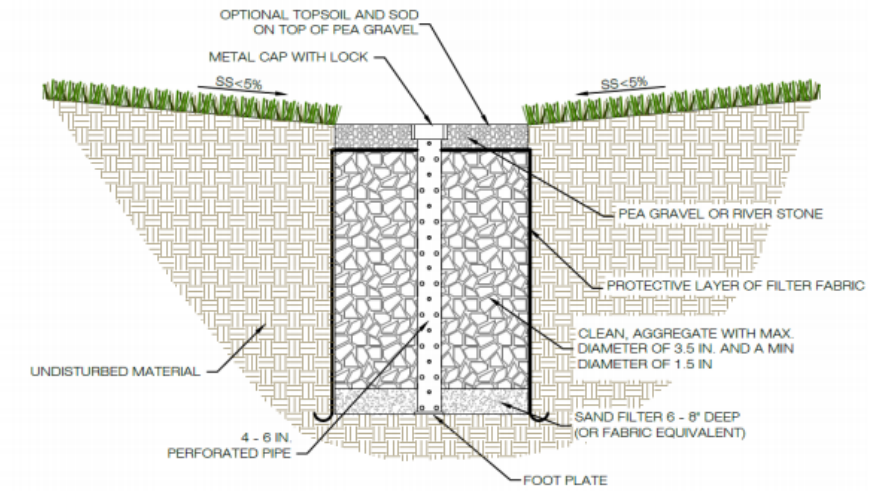


2. Infiltration Trenches

a. Overview: Infiltration trenches are open air rock galleries that temporarily store and infiltrate stormwater. Stormwater reaches this BMP through surface flow with some pretreatment for sediment. These trenches require observation wells and may include some additional perforated pipe inside the rock gallery to increase capacity.

b. Uses: Infiltration trenches should be used to drain impervious areas with low sediment and grease loads such as rooftops and small areas of parking lot. This BMP fits best for commercial/institutional applications or along roadways with little slope.

c. Limitations: Infiltration trenches should be installed above groundwater level and not in water source protection areas, or areas of likely ground water contamination. These trenches will not function well in soils with low percolation rates. Infiltration trenches require nonconventional pretreatment to remove sediment prior to the trench. Trenches must have 10’ of sheet flow area through grass or some other vegetated filtration. If installed in the public ROW, designed curb cuts must be included in the submittal.

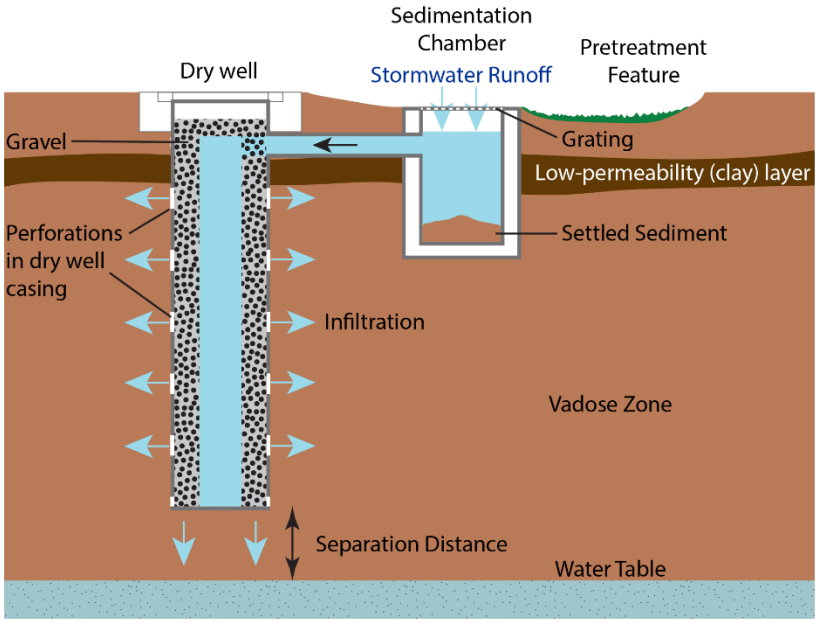


3. Sumps (Dry Wells)

a. Overview: Sumps, or dry wells, are retention and infiltration systems built by burying a perforated manhole surrounded by a rock gallery. They differ from underground basins in that sumps are typically much deeper. Storm water enters sumps through pipes connected to catch basins.

b. Uses: Sumps are best used for relatively small areas of storm water runoff, and are useful when horizontal space is limited.

c. Limitations: Sumps should be installed above ground water level and not in water source protection areas, or areas of likely ground water contamination. They will not function well in soils with low percolation rates. Pretreatment to remove sediment is required. Sumps are considered Class V injection well and must be submitted to the Utah Department of Environmental Quality. See the Salem City Construction Standard Drawings.

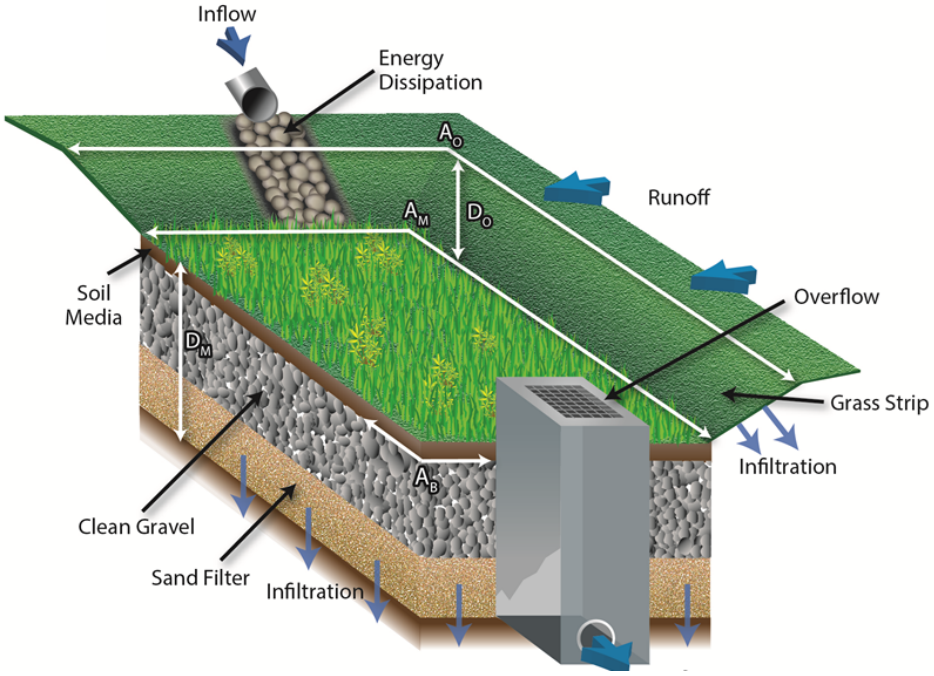


4. Retention or Bioretention Basins

a. Overview: Retention and bio retention basins are engineered depressions in the ground designed to temporarily retain and infiltrate storm water. These basins receive storm water through "bubble up" systems from curb boxes and buried pipes. Bioretention basins can also receive runoff through surface flow.

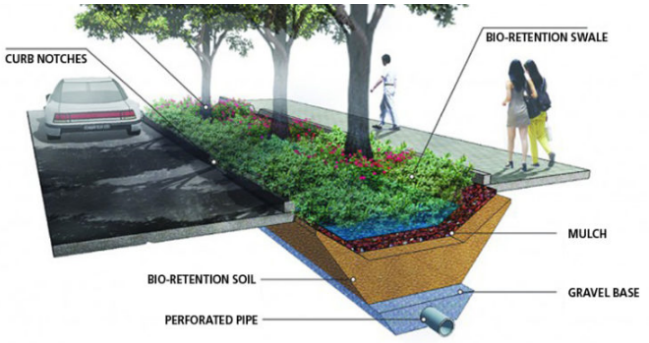
b. Uses: Retention and bioretention basins lend well to being sized for flood prevention not just LID requirements. They work well for residential and commercial/institutional stormwater systems. This BMP may be publicly or privately owned.

c. Limitations: Retention/bioretention basins should be installed above ground water level and not in water source protection areas, or areas of likely ground water contamination. Both types of basins require pretreatment to remove sediment and must be designed so that nuisance water does not stay and become stagnant. The storm drain design standards include additional requirements.



5. Rain Gardens

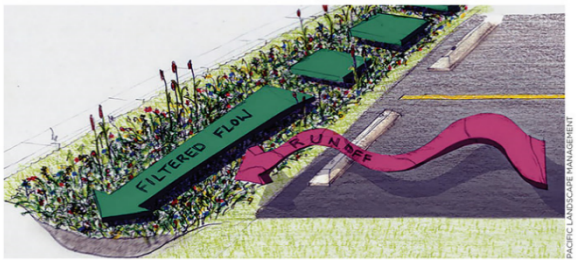
a. Overview: Rain gardens are shallow depressions with vegetation for collecting stormwater, similar to bioretention basins; however, rain gardens focus heavily on evapotranspiration as well as infiltration for the primary method of stormwater dispersion. Rain gardens also tend to be much smaller and have a greater emphasis on aesthetics. Roof downspouts, surface flow, and "bubble ups" are all possible methods to convey stormwater to rain gardens.
b. Uses: Rain gardens are best used to meet the LID requirements of stormwater management. They function well in small commercial/institutional developments, or any larger development in conjunction with a flood prevention technique, such as a rain garden connected to a bioretention basin. This BMP may be publicly or privately owned. Because of the reliance on vegetation, rain gardens can be built on top of soils with lower permeability.
c. Limitations: The vegetation is an integral part of rain gardens, so they require in-depth landscape designs that must be followed precisely like the design for any other piece of stormwater infrastructure, and if the vegetation dies, it must be replaced in a timely fashion.



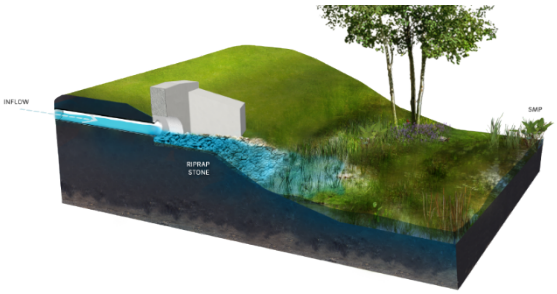
6. Conveyance and Prefiltration

a. Overview and uses: LID techniques can be used in conveyance and prefiltration to replace or supplement a traditional storm sewer system. BMPs used for this can filter, convey, infiltrate, and slow the time of concentration. These are not stand-alone stormwater solutions, but they should be used in conjunction with other BMPs. The boundary between the prefiltration, conveyance, and final BMP may not be clear. They can be used in any type or size of development. Bioswales and vegetated filter strips are examples of such BMPs.

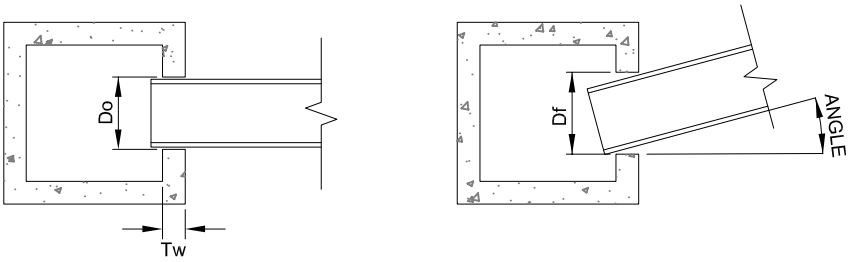
b. Limitations: Theses BMPs should be above the level of ground water, and not have any standing water in them for longer than 48 hours. Slope is the greatest limiting factor for these BMPs. While the specific slopes may vary, generally a slope of 1-3% is optimal and slopes in the flow path exceeding 3% require check dams.



BIOSWALES NATURALLY TREAT WATER as it is filtered through their sloped sides, which also slow down the flow of water so it doesn't overburden other stormwater systems.



STORM BOX SIZING GUIDELINES



D_o : THE ORIGINAL DIAMETER OF THE INLET OR THE OUTER DIAMETER (OD) OF THE PIPE IF THE PIPE IS PURPENDICULAR TO THE INLET BOX.

D_f : THE FINAL ADJUSTED SIZE OF THE INLET WHEN THE PIPE IS SKEWED.

T_w : THE THICKNESS OF THE WALL (6" FOR THE TABLE BELOW).

ANGLE: THE ANGLE AT WHICH THE PIPE IS SKEWED.

FORMULA:

$D_f = (OD \times 1/COS(ANGLE)) + (TAN(ANGLE) \times T_w)$

CONCRETE PIPE OUTER DIAMETERS BASED ON 6" CLEANOUT WALL THICKNESS AND PIPE ANGLE AT CLEANOUT

ANGLE OF PIPE ENTERING BOX	0°	5°	10°	15°	20°	30°	45°
INSIDE DIAMETER (ID)	OUTSIDE BARREL DIAMETER (OD)	Df	Df	Df	Df	Df	Df
12.0"	16.5"	17.1"	17.8"	18.7"	19.7"	22.5"	29.3"
15.0"	19.8"	20.4"	21.1"	22.1"	23.2"	26.3"	33.9"
18.0"	23.0"	23.6"	24.4"	25.4"	26.7"	30.0"	38.5"
21.0"	27.0"	27.6"	28.5"	29.6"	30.9"	34.6"	44.2"
24.0"	30.0"	30.6"	31.5"	32.7"	34.1"	38.1"	48.4"
27.0"	35.0"	35.7"	36.6"	37.8"	39.4"	43.9"	55.5"
30.0"	38.3"	38.9"	39.9"	41.2"	42.9"	47.6"	60.1"
36.0"	45.9"	46.6"	47.6"	49.1"	51.0"	56.4"	
42.0"	52.2"	53.0"	54.1"	55.7"	57.8"	63.8"	
48.0"	59.4"	60.2"	61.4"	63.1"			
54.0"							
60.0"							
66.0"							
72.0"							
84.0"							
90.0"							
96.0"							

NOTES:

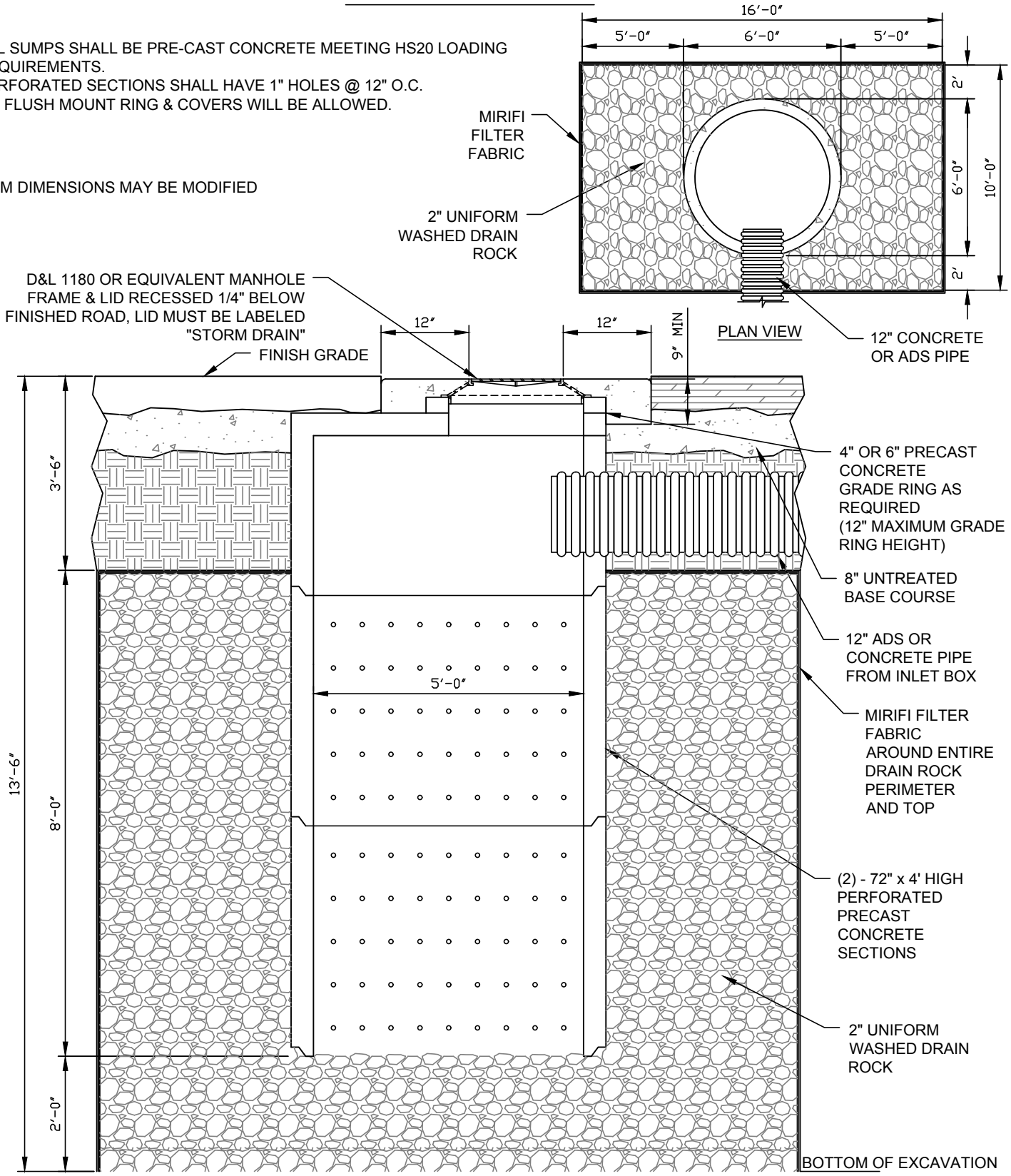
1. TABLE IS BASED ON A 6" WALL THICKNESS AND PIPE ANGLE AT CLEANOUT.
2. SHADED AREAS BELOW THE DARK LINE INDICATE PIPE SIZES AND ANGLES THAT WILL NOT FIT WITHIN A STANDARD 6' WALL BOX. SPECIAL BOX SIZES ARE NECESSARY FOR THESE CONDITIONS.
3. USE OF THIS TABLE (INCLUDING DESIGN & DIMENSIONS) SHOULD BE ANALYZED AND CHECKED BY THE USER'S ENGINEER TO ENSURE ADEQUACY FOR THE INTENDED USE.
4. ALL BOXES SHALL HAVE A MINIMUM OF 6" OF SURROUNDING CONCRETE BOX COVERAGE.

City of SALEM	SALEM CITY CONSTRUCTION STANDARDS	STORM DRAIN COLLECTION
		STORM BOX SIZING
		SCALE: NONE
		DATE: 1-20-21
		SECTION: 2.6
		REV DATE: 1-20-21

MANHOLE SUMP

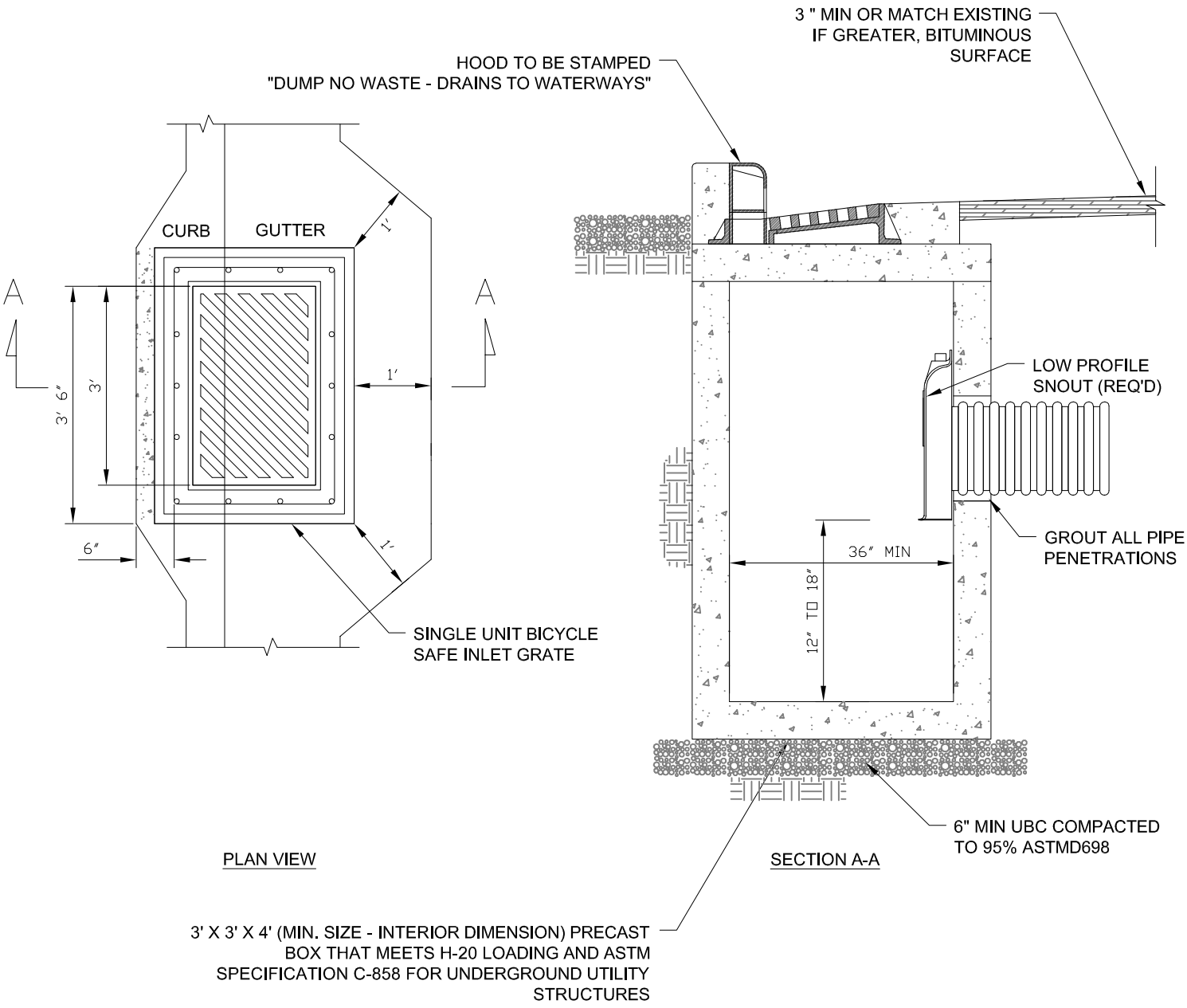
NOTES:
1. ALL SUMPS SHALL BE PRE-CAST CONCRETE MEETING HS20 LOADING REQUIREMENTS.
2. PERFORATED SECTIONS SHALL HAVE 1" HOLES @ 12" O.C.
3. NO FLUSH MOUNT RING & COVERS WILL BE ALLOWED.

NOTE:
MINIMUM DIMENSIONS MAY BE MODIFIED



	SALEM CITY CONSTRUCTION STANDARDS	STORM DRAIN COLLECTION
		MANHOLE SUMP
		SCALE: NONE
		DATE: 1-9-18
		SECTION: 2.2
		REV DATE: 1-9-18

CURB INLET BOX ASSEMBLY



NOTE:
1. INLET GRATES SHALL BE SET 2" BELOW GRADE, AND THE APRON SHALL HAVE A CONTINUOUS SLOPE BETWEEN GRADE AND THE TOP OF GRATE.

	SALEM CITY CONSTRUCTION STANDARDS	STORM DRAIN COLLECTION
		CURB INLET BOX ASSEMBLY
		SCALE: NONE
		DATE: 1-9-18
		SECTION: 2.1
		REV DATE: 1-20-21