

6-0 RETENTION/DETENTION SYSTEMS

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6-1 STORMWATER MANAGEMENT TODAY

Stringent environmental regulations and increasing land values have made finding an effective way to manage stormwater runoff – one that both protects groundwater quality *and* complies with agency regulations – a high priority for land developers and engineers. Typically, the stormwater management method selected involves some type of stormwater retention or detention system, and possibly other products that improve the effectiveness of the management method.

The purpose of a *stormwater retention system* is to capture stormwater runoff in a designated area where it can be allowed to percolate into the ground. The net effect is fairly rapid exfiltration of stormwater into the adjacent native soil. A *stormwater detention system*, on the other hand, slows and temporarily holds stormwater runoff so that it can be released into the environment at a controlled rate. An effective means of stormwater management can be retention, detention, or a combination of both.

Stormwater retention/detention systems vary widely in design, from open ponds to subsurface piping systems and underground vaults to gravel pits. The most frequently used designs are open ponds and subsurface piping and/or vault systems. Open ponds occupy a great deal of space, reducing the land available for facilities, such as parking lots, playgrounds, and landscape areas. In addition, they create safety risks and serve as a breeding ground for insects.

Subsurface systems, however, offer several advantages in addition to effective stormwater runoff management. Because they are below grade, subsurface systems increase the amount of usable land since some facilities, like recreational green areas or parking lots, can be built over them. Subsurface systems also decrease safety risks because they are inaccessible to the public, are more easily maintained, and are options in situations where high groundwater tables or small lot sizes make a pond impractical.

Subsurface retention/detention systems can be designed in almost any shape and size using a variety of materials. Plastics, especially high density polyethylene (HPDE) and polypropylene (PP) are an attractive, economical option for retention/detention stormwater management. They are often faster and more cost-effective to install than other systems, and are highly resistant to the damaging effects of salts, oils, fuels, and other chemicals, and freeze/thaw conditions. In aggressive conditions plastics can provide a long service life.

6-2 ADS[®] SUBSURFACE RETENTION/DETENTION PRODUCTS

A long-time leader in both water management and plastics technology, ADS offers different options for subsurface retention/detention systems to meet the management needs of practically any stormwater runoff situation. Retention/Detention systems are offered with a choice of N-12[®], N-12[®] ST IB, either solid or with perforations, or N-12[®] WT IB pipe.

RETENTION/DETENTION SYSTEMS

ADS corrugated polyethylene pipes are the building blocks of the retention/detention product line. N-12 pipes (see Specifications section) use a state-of-the-art design that incorporates a smooth inner wall and a corrugated outer wall. The smooth inner wall combines superior hydraulics and the ability to resist abrasion and corrosion. The corrugated outer wall provides the strength necessary to withstand heavy traffic loads with varying cover heights. See Figure 6-2 in this section for minimum recommended cover heights for standard installations.

N-12 ST pipe features a bell-and-spigot joint that promotes faster, easier installation. This joining method ensures joint alignment, improves joint reliability, and eliminates the need for glue, split couplers, or wire ties. N-12 ST joints meet or exceed a soil-tight level of performance. N-12 pipe requires coupling bands for soil-tight performance. The pipe itself is available with or without perforations. N-12 WT pipe features joints which provide a watertight level of performance that meets requirements set in ASTM D3212.

The ADS retention/detention system utilizes corrugated polyethylene pipe and specially designed manifolds and other fittings to provide a complete retention/detention system. ADS can assist the customer in laying out the actual system with all necessary components for each application. From the contractor's point of view, retention/detention components coupled with ADS technical assistance allows the products to fit together much like building blocks.

Table 1 summarizes the primary features and benefits of retention/detention systems, and how the ADS system meets the needs of the application.

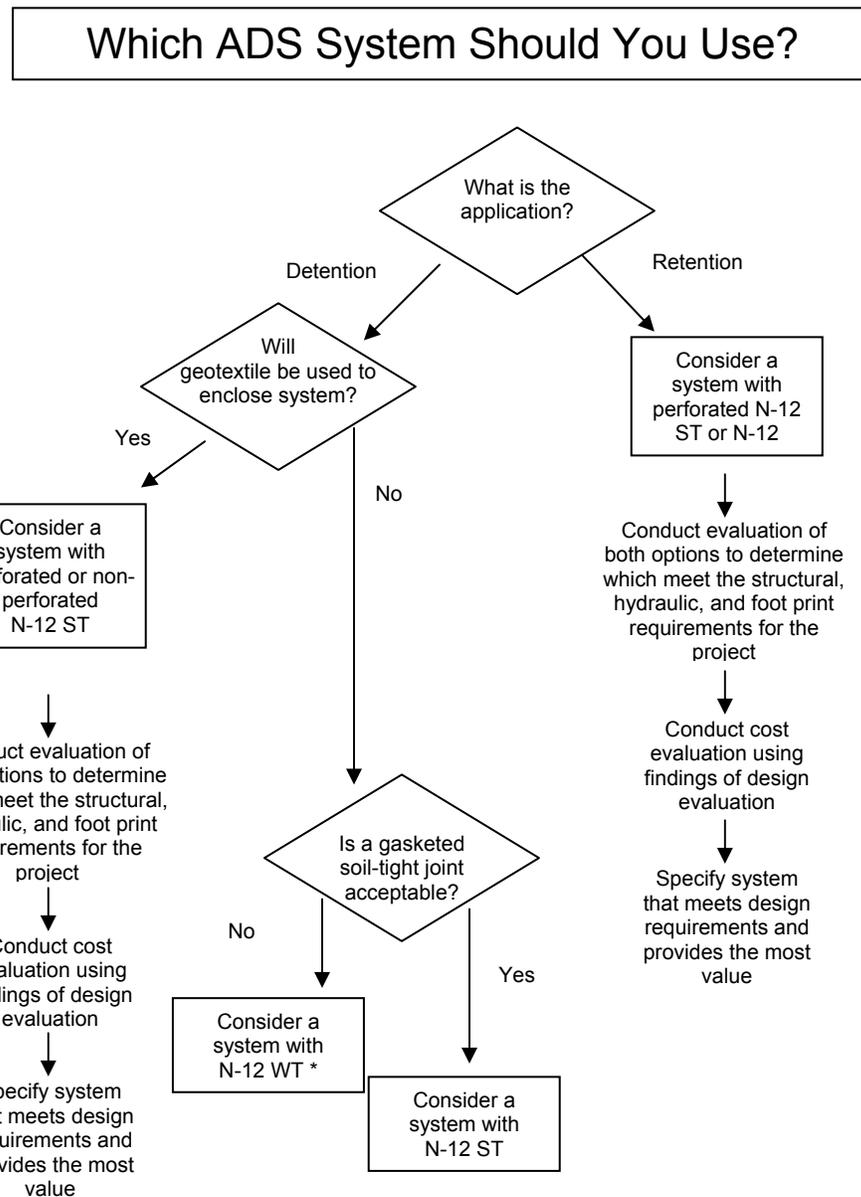
Table 6-1
Retention/Detention Systems Features and Benefits

Subsurface retention/detention design	<ul style="list-style-type: none"> • Increases the usable land available • Reduces hazards and safety risks • Reduces system maintenance costs • Recharges groundwater table more efficiently
Unique Manifold Designs	<ul style="list-style-type: none"> • Increased structural integrity • Increased versatility of manifold design options • Easier assembly and installation • Helps to reduce debris in laterals and allows for easy cleaning
Quality Plastic Composition	<ul style="list-style-type: none"> • Resists harmful effects of salts, oils, fuels, chemicals • Withstands repeated freeze/thaw cycles • Strong, yet light in weight – easier, safer, more cost-effective to install • Highly abrasion resistant for longer service life than metal or RCP • Unaffected by extremes in pH; won't rust or deteriorate
System options: <i>Retention/Detention with N-12, N-12 ST or N-12 WT pipe</i>	<ul style="list-style-type: none"> • High strength – withstands H-25 and HS-25 traffic loads under minimum cover • Meets specific application requirements: 4- to 60-inch (100 to 1500mm) diameters, lengths to 20 feet (6m), perforated or non-perforated, soil-tight or watertight joints, variety of manifold pipe designs
Variety of Fittings	<ul style="list-style-type: none"> • Promotes faster, more versatile system installations • Enables systems to meet specific application requirements • Reduces labor for system installation and/or modification
Custom product fabrication	<ul style="list-style-type: none"> • Meets unique/specialized application needs • Reduces labor for system installation and/or modification

6-3 CHOOSING THE CORRECT RETENTION/DETENTION SYSTEM

All retention/detention products are specifically designed for subsurface stormwater management systems. Figure 6-1 assists the specifier in selecting the correct product to use for a particular subsurface stormwater application.

Figure 6-1
Retention/Detention System Selection Guidelines



* ADS retention/detention systems are intended for storm sewer applications. For use of ADS products in applications requiring little to no leakage, please see ADS Technical Note 7.01: *Rain Harvesting with HDPE Pipe*.

6-4 DESIGNING A RETENTION/DETENTION SYSTEM

The following general guidelines provide a systematic approach to designing a retention/detention subsurface stormwater management system.

CHECK REGULATIONS

1 – Check with federal, state, and local agencies for regulations on subsurface stormwater retention/detention systems.

Key issues to resolve include: Should the system be a retention system, detention system, or a combination of both? Are water quality structures required? If so, which structures are approved? Is a soil-tight or watertight joint required?

CALCULATE STORAGE VOLUME REQUIRED

2 – Calculate the storage volume required for the specific site based on site conditions and local stormwater regulations.

The storage volume required for a given site is often regulated as the excess of stormwater runoff resulting from post-construction conditions. In essence, all new runoff and peak flows generated from a project site must be accounted for through adequate sizing of the stormwater system and/or onsite storage and dissipation of excess water. There are numerous ways and methods determining required storage volume and peak flows such as: Rational method, Unit Hydrographs, TR55 etc. The designer should choose a specific method based on their experience and those requirements as established by the local regulatory agency.

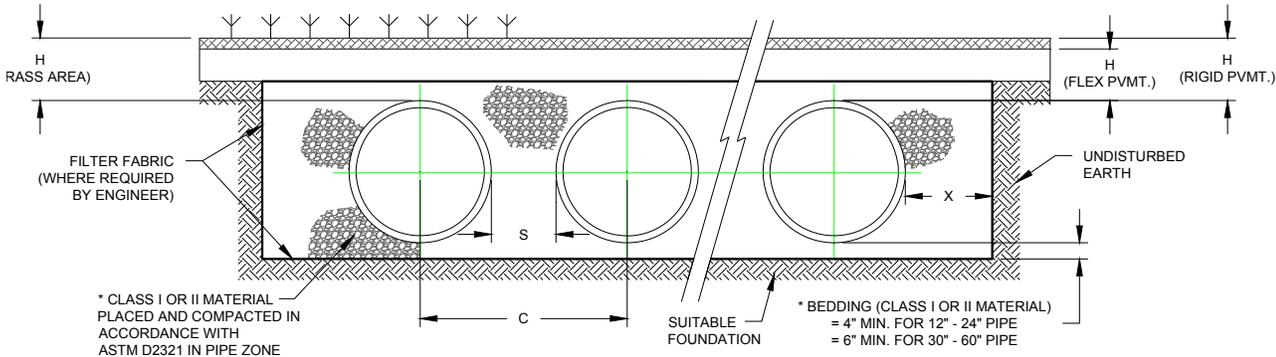
CALCULATE STORAGE CAPACITY

3 – Calculate the size, in feet or meters, of the system that will provide stormwater capacity requirements.

Retention/detention systems can achieve needed storage capacity by using either larger diameter corrugated polyethylene pipe and a shorter overall system length, or by using smaller diameter pipe and a longer system length. The final decision depends on the size of the site, its groundwater level, and cover requirements. Figure 6-2 shows a typical cross-section of a retention/detention system. Table 6-2 summarizes retention and detention volumes, pipe lengths, and surface area requirements based on this section; other system designs will result in different values.

Figure 6-2
Typical Retention/Detention Cross Section

Note: This is a typical cross section only. See Structures, Section 2, or Installation, Section 5, of the *Drainage Handbook* for specific installation guidelines.



MINIMUM H (FLEX PVMT), H (RIGID PVMT) = 12" FOR UP TO AND INCLUDING 36" HDPE PIPE
= 24" FOR 42" THROUGH 60" HDPE PIPE

* CLASS I BACKFILL REQUIRED AROUND 60" DIAMETER FITTINGS.

MAXIMUM FILL HEIGHT LIMITED TO 8-FT OVER FITTINGS FOR STANDARD INSTALLATIONS. CONTACT REPRESENTATIVE WHEN MAXIMUM FILL HEIGHTS EXCEED 8-FT FOR INSTALLATION CONSIDERATIONS.

Table 6-2
Storage Capacities of N-12[®], N-12[®] ST, and N-12[®] WT Pipes

Nominal Inside Diameter	Average Outside Diameter	"X" Spacing	"S" Spacing ¹	"C" Spacing ¹	Pipe Volume ²	Stone Void Volume ^{3,4,5}	Total Retention Storage	Retention Surface Area Required	Detention Surface Area Required
in. (mm)	in. (mm)	in. (mm)	in. (mm)	in. (mm)	ft ³ /ft (m ³ /m)	ft ³ /ft (m ³ /m)	ft ³ /ft (m ³ /m)	ft ² /ft ³ (m ² /m ³)	ft ² /ft ³ (m ² /m ³)
12 (300)	14.5 (368)	8 (200)	11 (279)	25.4 (645)	0.81 (0.07)	0.84 (0.08)	1.65 (0.15)	1.3 (4.3)	2.7 (9.0)
15 (375)	18 (457)	8 (200)	12 (305)	28.9 (734)	1.2 (0.11)	1.1 (0.10)	2.3 (0.21)	1.1 (3.7)	2.1 (7.0)
18 (450)	21 (533)	9 (230)	17 (434)	33.9 (862)	1.8 (0.16)	1.4 (0.13)	3.2 (0.29)	0.89 (3.0)	1.6 (5.3)
24 (600)	28 (711)	10 (250)	13 (330)	40.7 (1034)	3.1 (0.29)	2.0 (0.18)	5.1 (0.47)	0.67 (2.2)	1.1 (3.6)
30 (750)	36 (914)	18 (450)	18 (457)	53.1 (1347)	4.9 (0.46)	3.1 (0.28)	8.0 (0.74)	0.56 (1.9)	0.92 (3.1)
36 (900)	42 (1067)	18 (450)	22 (559)	63 (1600)	7.1 (0.66)	4.2 (0.39)	11.3 (1.05)	0.47 (1.6)	0.75 (2.5)
42 (1050)	48 (1219)	18 (450)	24 (610)	71.9 (1826)	9.3 (0.87)	5.8 (0.53)	15.1 (1.40)	0.40 (1.3)	0.64 (2.1)
48 (1200)	54 (1372)	18 (450)	25 (1219)	78.5 (1994)	12.4 (1.15)	6.7 (0.62)	19.1 (1.77)	0.34 (1.1)	0.53 (1.8)
60 (1500)	67 (1702)	18 (450)	24 (1524)	90 (2286)	19.3 (1.79)	8.5 (0.78)	27.8 (2.57)	0.27 (0.90)	0.39 (1.3)

Notes:

See Figure 6-2 for typical cross section used in volume calculations. Bedding depth assumed 4" for 12"-24" pipe and 6" for 30"-60" pipe.

1. Based on A-profile pipe.
2. Actual ID values used in calculation.
3. Stone Porosity assumed 40%.
4. Stone height above crown of pipe is not included in void volume calculations.
5. Calculation is based on the average OD of the pipe.

See "Design Aids" for a system design tool to calculate total HDPE pipe system storage with an example calculation.

DETERMINE SYSTEM LAYOUT

4 – Determine the most cost-effective system layout.

Fitting configuration can have a significant impact on overall system cost. A system with longer lateral runs and fewer manifold fittings is generally more cost effective than a wide system with short lateral runs. Additionally, placing a distribution manifold at one end of the system and simply placing end caps at the opposite end of each lateral can prove to be more cost effective than distribution manifolds at either end of the system.

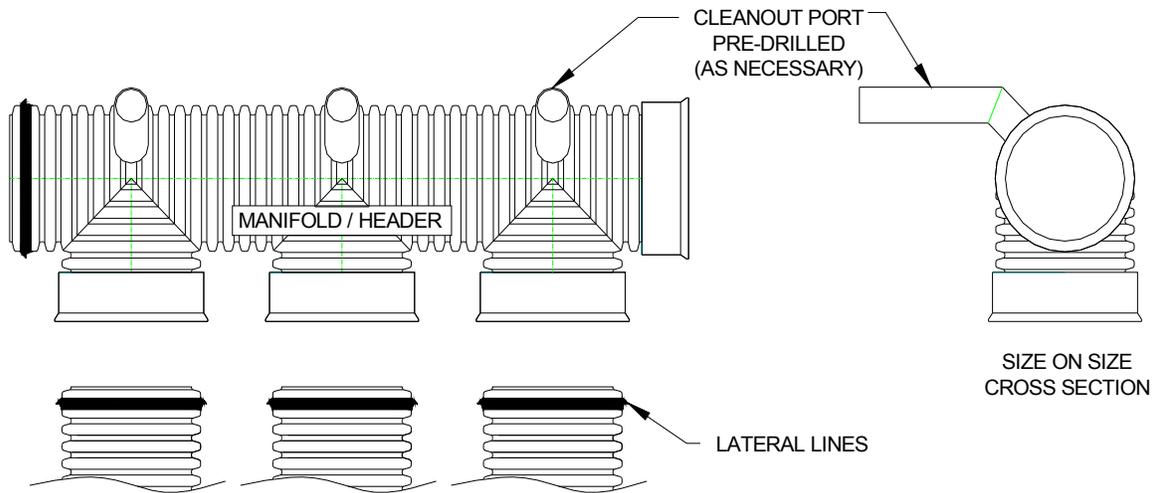
SELECT PRODUCTS

5 – Select the Retention/Detention components specifically suited for the system design (refer to Figure 6-1).

Manifold design alternatives are:

- Standard manifold with attached reducing connections to the laterals or standard manifold with size-on-size connections to the laterals. Manifold systems typically incorporate any combination of single component manifolds (i.e. one lateral), double component manifolds (i.e. two laterals), and triple component manifolds. Figure 6-3 shows a triple component manifold layout for size-on-size manifold systems; specific information regarding the sizes and manifold lengths are included in the Fittings section of this handbook or in the *ADS Fittings Manual*.
- Series of standard fittings including tees and elbows. The size of this layout will be affected by the fitting dimensions. The and Fittings section of this handbook and the *ADS Fittings Manual* contains more information.
- Custom manifolds with attached concentric or eccentric reducing connections to laterals. Custom manifolds are available for special site conditions. Custom fittings may require special installation considerations; contact your local ADS sales representative when using a custom fitting. It should be noted that minimum lateral spacing must be maintained for all manifold design alternatives. For custom manifolds, see the Technical Assistance section of this chapter.
- Maximum fill heights over manifold fittings are generally limited to less than 8-ft (2.4-m). Contact your local ADS sales representative for installation considerations for manifold fittings in excess of 8-ft.

Figure 6-3
Watertight Triple Component Retention/Detention Manifold with Size on Size Connections



NOTE: For Retention/Detention System size-on-size manifold dimensions refer to the Fittings section

In retention systems, perforation pattern options are:

- ASTM F2306 perforations. This is considered the ADS standard perforation pattern and is stocked at most manufacturing facilities. Table 3 provides more detail.
- Other perforation patterns may be available; please refer to Technical Note 1.01: *Dual Wall HDPE Perforation Patterns* for or consult with an ADS sales representative.

Table 6-3
Perforation Patterns

Nominal I.D.		Perforation Type	Maximum Diameter		Minimum Inlet Area	
in	mm		in	mm	in ² /ft	cm ² /m
12	300	Circular	0.375	10	1.5	30
15	375	Circular	0.375	10	1.5	30
18	450	Circular	0.375	10	1.5	30
24	600	Circular	0.375	10	2.0	40
30	750	Circular	0.375	10	2.0	40
36	900	Circular	0.375	10	2.0	40
42	1050	Circular	0.375	10	2.0	40
48	1200	Circular	0.375	10	2.0	40
54	1350	Circular	0.375	10	2.0	40
60	1500	Circular	0.375	10	2.0	40

EVALUATE MAINTENANCE REQUIREMENTS

6 – Evaluate system maintenance requirements.

Should stormwater debris be encouraged to settle in the system’s manifold pipe or be allowed to flow into the laterals? Does the system need such items as clean-out ports, catch basins with sump areas, settling basins, and water quality units? If so, how many are needed and where should they be located? Refer to Figures 6-5 through 6-9 as examples of products used for maintenance purposes.

- Concentric reducing manifold components (components where the reducing stub is positioned in the center of the main fitting ie: flow lines do not match) can promote trapping of debris and sediment in designated sections of the system.
- Clean-out stubs and jetting ports should be strategically placed to allow ease of maintenance (commonly located to push debris and sediment toward the downstream end of the system with clean-out positioned near or at the downstream outlet)
- Vent ports should be strategically positioned to prevent any airlocks in the manifold or lateral stubs.
- Water Quality Units may be used at the inlet end of the system to reduce debris or sediment entering the system. Units may also be used at the outlet end of the system as a final clarifying stage for the stormwater prior to discharge into the natural waterway or sewer system.

For additional information regarding inspection and maintenance of retention/detention systems, refer to Technical Note 6.01: *Retention/Detention System Maintenance*.

SELECT FITTINGS AND ACCESSORIES

7 – Select the related ADS fittings needed to assemble and connect the Retention/Detention system.

These include such products as tees, elbows, stubs, adapters, reducers, flared end sections, end caps, and prefabricated end plates. For a listing of commonly specified system accessories, refer to Technical Note 7.01: *Retention/Detention System Maintenance*. All available standard fittings and accessories are provided in the *ADS Fittings Manual*.

Figure 6-4
Retention/Detention Cleanout and Riser Ports

For additional detail see ADS Standard Detail #703

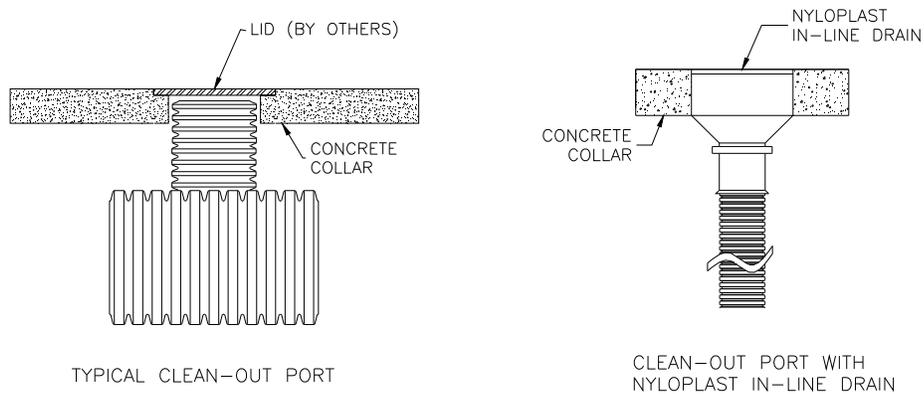
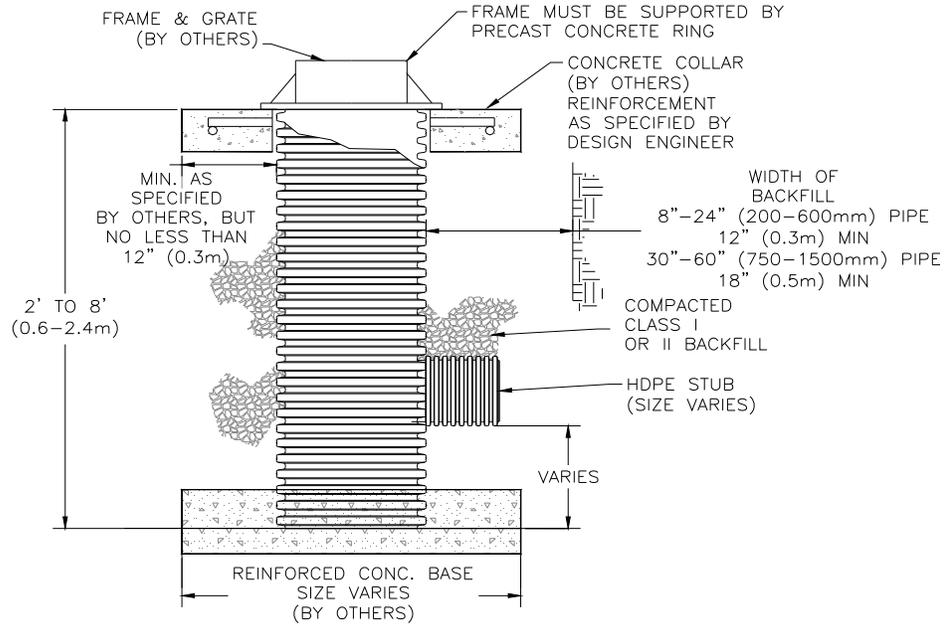


Figure 6-5
Typical Catch Basin (Non-Traffic Areas Only)

For additional detail see ADS Standard Detail #401



NOTE: For more information on this application, refer to the Vertical Installations topic in the Installation section (Section 5) of the Drainage Handbook.

Figure 6-6
Water Quality Unit

For additional detail see ADS Standard Details #501 & #502

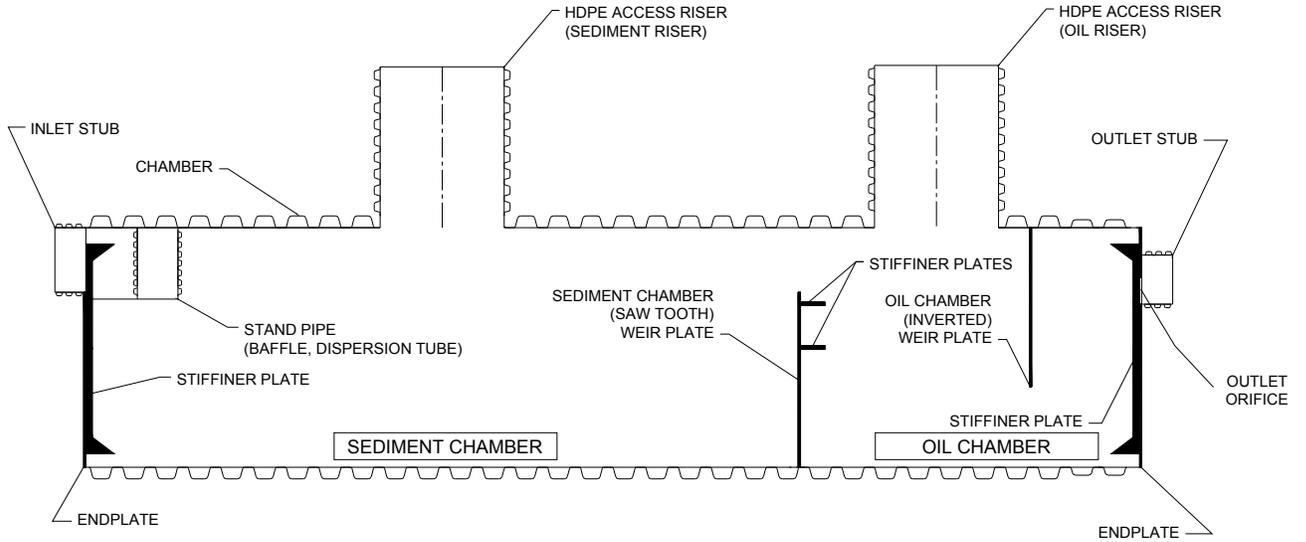
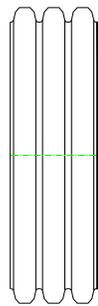
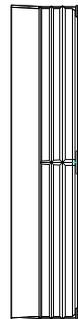


Figure 6-7
Typical End Cap Sections

For additional details see *ADS Fittings Manual*



SOIL-TIGHT



WATERTIGHT
(GASKET
INCLUDED)

Figure 6-8a
Roof Drain with Wye Cleanout

For additional detail see ADS Standard Details #1001 & #1003

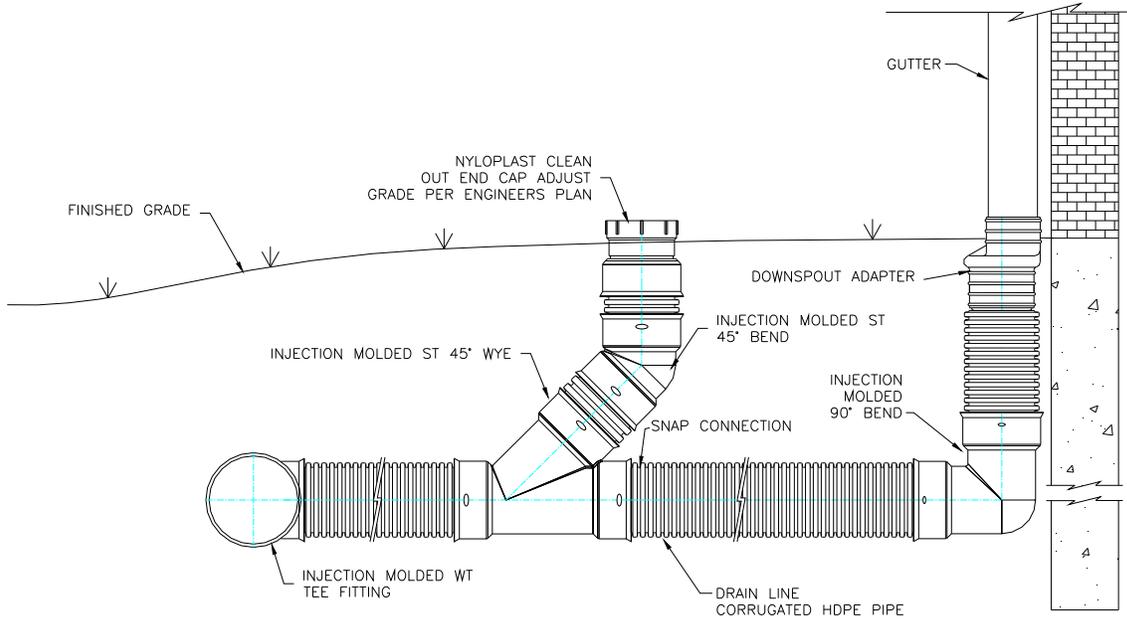
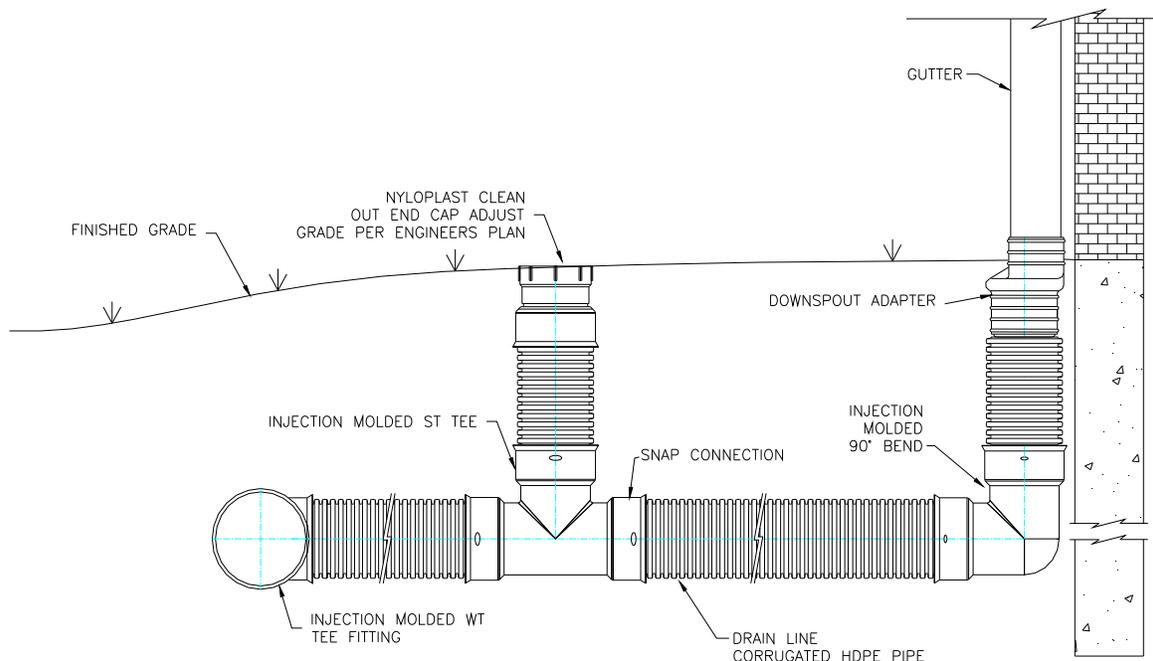


Figure 6-8b
Roof Drain with Tee Cleanout

For additional detail see ADS Standard Details #1002 & #1004



6-5 DESIGN AIDS

To aid in the design and layout of an HDPE pipe retention or detention system, a Retention/Detention sizing tool is available at www.ads-pipe.com or by contacting an ADS representative.

Figure 6-9 is a screen shot of the Retention/Detention sizing worksheet with example user inputs and the resulting information on the designed system. Some information provided for the designed system include: system storage (including stone storage, if applicable), system and excavation footprints, and estimated excavation. Also, a generic layout of the systems can be generated along with installation details for the system, risers, and cleanouts.

Figure 6-9
ADS Retention/Detention System Sizing Tool

Allows for user inputs with calculated results.



**STORMWATER RETENTION / DETENTION
PIPE SYSTEM SIZING WORKSHEET**

THE MOST ADVANCED NAME IN DRAINAGE SYSTEMS
Version 7.5

Enter or Select values in the Yellow fields ONLY

UNITS	
Unit of Measure	<input checked="" type="checkbox"/> Imperial (ft, in) <input type="checkbox"/> Metric (mm, m)

SYSTEM	
Joint Type	Plain End ST
Design Storage Volume	5240 CF
Average Cover Height ⁴	1.00 FT

Project Name: SAMPLE PROJECT

Location (City, State): U.S.A.

Prepared For: _____

Date Prepared: _____

Engineer: _____

Contractor: _____

Regional Engineer: _____

Area Sales Representative: _____

Surface Application: PARKING LOT

HEADER	
Header Diameter	36
Number of Headers	2
Perforate Headers?	No
Include Header(s) in Storage Volume?	Yes

LATERALS					
	Lateral Diameter (in)	Lateral Length (ft)	Number of Laterals	# of Sticks / Lateral	Approx. Length of End Stick
Group 1	36	96	7	5	18.2-ft
Group 2	12			0	0-ft
Group 3	12			0	0-ft

BACKFILL
A non-perforated system has been selected

STORAGE VOLUME				
	COMPONENT			Total System (CF)
	Product Volume (CF)	Stone (CF)	ASV (CF)	
Group 1	5,245	0	0	5,245
Group 2	0	0	0	0
Group 3	0	0	0	0
TOTALS	5,245	0	0	5,245

APPROXIMATE SYSTEM SIZE	
Width (FT)	Length (FT)
35	105
0	0
0	0

EXCAVATION						
Pipe Diameter (IN)	Width (FT)	Length (FT)	Disturbed Surface Area (SYD)	Excavation ² (CYD)	Estimated Backfill ⁵ (CYD)	ASV (CYD)
36	38	108	455	729	534	0
12	0	0	0	0	0	0
12	0	0	0	0	0	0
TOTALS			455	729	534	0

100.1% of the required storage

NOTES

1 - Full Stick: Assumed a standard lay length of 10'-8".

2 - Excavation: Based on manufacturer's recommended trench width and bedding depth. Estimated volumes assume a flat system based on the user-entered Average Cover Height.

3 - Backfill: Does not account for pipe corrugations - calculated for conservative quantities. Not for use with take-offs or ordering purposes.

4 - Cover Height: For traffic installations, 1-ft of minimum cover is required for diameters 12-36", 2-ft for 42-60". Maximum cover shall not exceed 8-ft without consulting Applications Engineering.

5 - Bill of Materials: Does not differentiate between ST and WT fittings or between A and H profile connections. Determined on a project-specific basis.

6 - Quantities: Assumes all Groups are same diameter. Run separate calculations to determine quantities and costs for different Group diameters.

This Excel spreadsheet is provided for rough estimating purposes only. This tool is intended to assist the design engineer in sizing stormwater management systems using ADS pipe and manifold components. As with any calculation aid, this tool should be used for estimating only; the engineer must verify the assumptions and methods to ensure they satisfy the project and local design criteria.

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6-6 BEST MANAGEMENT PRACTICES (BMP)

At ADS, managing our water resources is something close to our heart. For over a century, we have been an industry leader in environmental stewardship and protecting the quality of our water resources.

ADS is continually developing new, innovative ways to help municipalities, developers and contractors implement storm water management systems and meet EPA requirements. We offer a full line of Best Management Practices (BMP) products to manage the quality and quantity of storm water and meet increasing government regulations. Among our latest developments is the ADS Water Quality Unit offering outstanding performance in a lightweight unit. For more information related to BMPs or other drainage needs visit our website at www.ads-pipe.com.

6-7 TECHNICAL ASSISTANCE

Throughout system design, ADS, Inc. can assist you on a variety of technical issues, including:

- Product performance information and suggested product usage.
- Manifold pipe configuration and design.
- Number and spacing of system laterals (based on provided design storage).
- Existing product modifications; custom product fabrication.
- Suggestions to maximize cost effectiveness.

Please contact an ADS representative for further information.

6-8 OTHER TECHNICAL RESOURCES

ADS Technical Notes

Technical Note 1.01: *Perforation Patterns for Dual Wall HDPE*

Technical Note 6.01: *Retention/Detention System Maintenance*

Technical Note 7.01: *Rainwater Harvesting with HDPE Pipe*

ADS Standard Details

Standard Detail 7.01: *Typical Retention/Detention System Layout*

Standard Detail 7.02: *Typical Retention/Detention Cross Section*

Standard Detail 7.03: *Typical Riser and Cleanout*