Introduction

Shaped trench bottoms are commonly used in agricultural drainage systems, taking advantage of the undisturbed native soil to help support the pipe. This technical note outlines best practices for shaped trench installations in typical agricultural applications. They should only be used when in situ soil conditions allow the trench to be formed to the desired shape without sloughing. For information on other applications, such as storm sewers or culverts, refer to Prinsco's *Stormwater Installation Guide*.

Soil conditions during installation should be considered and accounted for to ensure that the long-term performance of the system is achieved. This includes but is not limited to:

- Dewatering as necessary
- Removal of rock or other unyielding material
- Replacing unstable soils beneath the pipe zone to ensure a suitable foundation
- Avoid placing frozen or large clumps of backfill around the pipe

Flat Bottom Trench

A flat bottom trench is suitable for all pipe diameters and is typically used for applications involving poor native soil support, deep burial depths, or consistent traffic loading. Flat bottom trench installations typically require non-native backfill beneath and surrounding the pipe to provide proper soil support. More information on flat bottom trench installation and burial depths can be found in Prinsco's *Stormwater Installation Guide* and *Minimum and Maximum Burial Depth Technical Notes*.

Fittings and lateral connections should be installed with a flat bottom trench. Imported backfill (Class 1 or 2) is recommended around fittings to ensure proper soil support.

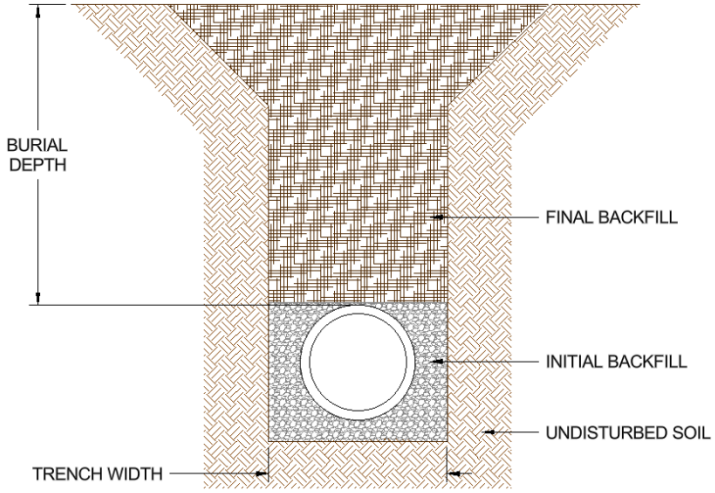

Figure 1: Typical Flat-bottom Trench Configuration

V-Bottom Trench

A V-bottom trench is typically used for diameters up to 8" and are commonly achieved with a tile plow. The V-shape shall form a 90-degree angle in the native soil with the pipe centered in the bottom of the trench as described in ASTM F449 – *Standard Practice for Subsurface Installation of Corrugated Polyethylene Pipe for Agricultural Drainage or Water Table Control*. Native soil is typically used as backfill surrounding the pipe. For V-bottom trenches, burial depths should be limited to 8-feet.

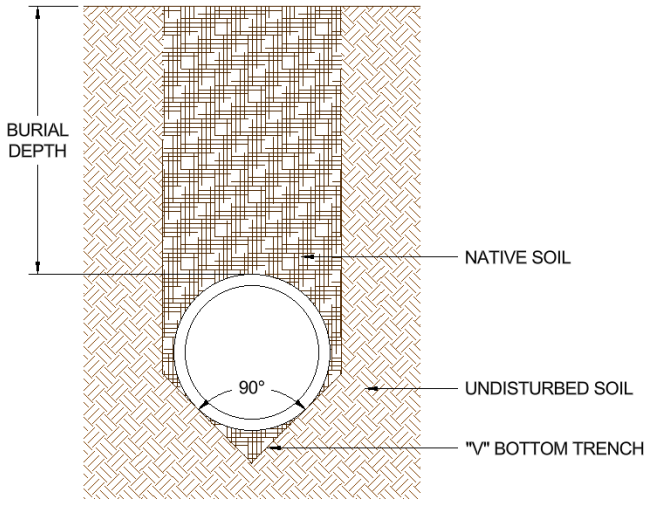

Figure 2: Typical V-Bottom Trench Configuration

Rounded Trench

Rounded or “spoon” trench bottoms may be suitable for all pipe diameters up to 60” and are typically achieved by excavator bucket attachments. The use of rounded trench bottoms depends on the native soil being capable of having stable sidewalls and forming the rounded shape in supportive soil. The rounded bottom shall be shaped as closely to the outside diameter of the pipe as possible; a maximum gap of 1-inch is allowed between the rounded trench and the pipe. The rounded shape shall extend at a minimum up to the springline of the pipe where the bottom half of the pipe is completely supported. Initial backfill shall extend at minimum to the top of the pipe and completely surround the pipe. See Figure 3 and Table 1 for trench shape configuration and dimensions.

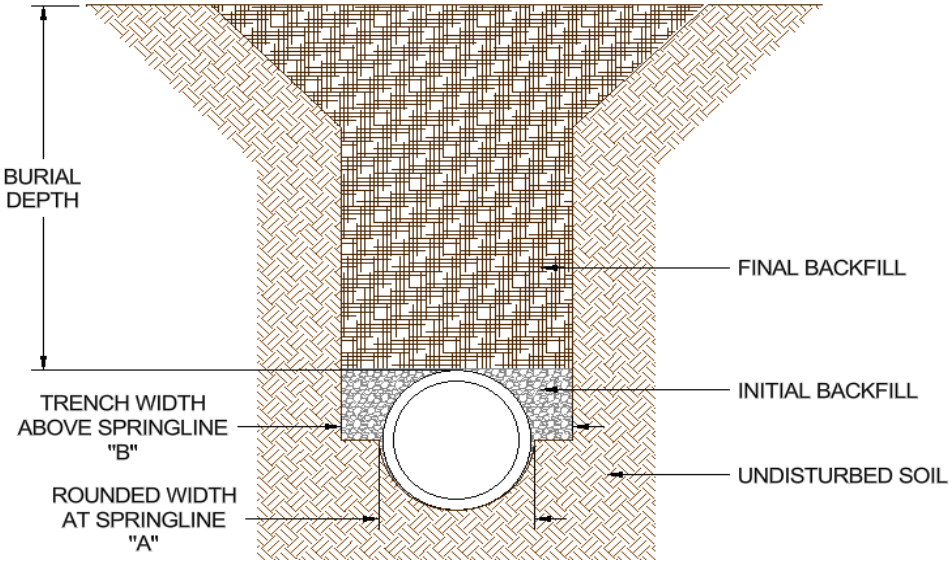

Figure 3: Rounded or "Spoon" Shaped Trench Configuration

Table 1: Rounded Trench Configuration Dimensions, in. (mm)

Pipe Diameter	Rounded Width (Pipe OD) “A”	Max. Rounded Width at Springline “A”	Max. Trench Width above Springline “B”
12 (300)	14.4 (366)	16.4 (417)	26.4 (671)
15 (375)	17.6 (447)	19.6 (498)	29.6 (752)
18 (450)	21.4 (544)	23.4 (594)	33.4 (848)
24 (600)	28.3 (719)	30.3 (770)	40.3 (1020)
30 (750)	34.7 (881)	36.7 (932)	50.7 (1290)
36 (900)	40.6 (1030)	42.6 (1080)	58.6 (1490)
42 (1050)	47.8 (1210)	49.8 (1270)	67.8 (1720)
48 (1200)	54.2 (1380)	56.2 (1430)	74.2 (1890)
60 (1500)	66.8 (1700)	68.8 (1750)	91.8 (2330)

Minimum Cover

The minimum cover for shaped trenches in agricultural applications is 2-feet to limit deflection from live machinery loading. Minimum cover should be increased if the pipe is installed in organic soil or heavy construction loads are anticipated.

Maximum Cover

The maximum burial depth of plastic pipe is significantly influenced by the type of backfill (Table 2) surrounding the pipe and its level of compaction. Table 3 outlines the maximum burial depths as measured from the top of the pipe to the ground surface, for rounded trench bottoms with various initial backfill types:

- Class 1 – Uncompacted angular rock
- Class 2 (SW-85% SPD) – Uncompacted gravel or sand
- Class 4 (CL-85% SPD) – Uncompacted native soil

These burial depths assume initial backfill is uniform and evenly placed around the pipe with no voids or large clumps. The undisturbed, native soil is assumed to be a CL soil at 100% compaction.

Table 2: Typical Backfill and Soil Classification

Backfill Description	Soil Classification	
	ASTM D2321	ASTM D2487
Graded or crushed stone; Crushed Gravel	Class 1	-
Well-graded sand, gravel, and gravel/sand mixtures; Poorly graded sand, gravel, and gravel/sand mixtures; Little or no fines	Class 2	GW, GP, SW, SP
Silty or clayey gravel, gravel/sand/silt, or gravel/clay mixtures, silty or clayey sands, sand/clay or sand/silt mixtures	Class 3	GM GC SM SC
Inorganic silts and low to medium plasticity clays; gravelly, sandy, or silty clays; some fine sands	Class 4A	ML CL

Table 3: Maximum Burial Depth for GOLDFLO & GOLDPRO Storm Using Rounded Trench Bottom, ft (m)

	GOLDFLO (HDPE)			GOLDPRO STORM (PP)		
Pipe Diameter	Class 1	Class 2	Class 4	Class 1	Class 2	Class 4
in. (mm)	*STONE*[4]	*(SW-85%)*	*(CL-85%)*	*STONE*[4]	*(SW-85%)*	*(CL-85%)*
12 (300)	28 (8.5)	17 (5.2)	13 (4.0)	29 (8.8)	18 (5.5)	15 (4.6)
15 (375)	25 (7.6)	14 (4.3)	12 (3.7)	26 (7.9)	15 (4.6)	13 (4.0)
18 (450)	23 (7.0)	12 (3.7)	10 (3.1)	23 (7.0)	12 (3.7)	10 (3.1)
24 (600)	24 (7.3)	13 (4.0)	11 (3.4)	24 (7.3)	14 (4.3)	11 (3.4)
30 (750)	23 (7.0)	13 (4.0)	11 (3.4)	23 (7.0)	14 (4.3)	11 (3.4)
36 (900)	22 (6.7)	11 (3.4)	9 (2.7)	23 (7.0)	13 (4.0)	10 (3.1)
42 (1050)	20 (6.1)	10 (3.1)	8 (2.4)	20 (6.1)	11 (3.4)	8 (2.4)
48 (1200)	19 (5.8)	10 (3.1)	8 (2.4)	19 (5.8)	11 (3.4)	9 (2.7)
60 (1500)	16 (4.9)	8 (2.4)	6 (1.8)	16 (4.9)	9 (2.7)	6 (1.8)

Notes:

1) Burial depths utilize CANDE (Culvert Analysis and Design) models and assume no hydrostatic pressure and a density of 120pcf (1922 kg/m3) for overburden material. Hydrostatic pressure may result in a reduction of allowable burial depths.
2) Final backfill above the pipe is assumed to be a well-consolidated Native Soil (CL-95%) to represent soil conditions after years of consolidation.
3) Initial backfill is assumed to extend 3” above the crown of the pipe in CANDE models.
4) Stone backfill used in CANDE is a custom, user-defined material used to represent a coarse aggregate, or crushed angular stone.
5) Backfill materials are defined by ASTM D2321 and compaction levels are standard proctor densities.
6) For installations exceeding the burial depths listed in this table, or for installations using a lower quality backfill material or lower compaction levels, pipe deflection may exceed the design limit. Contact your local Prinsco Representative for additional design considerations.
7) Although the use of native material for initial backfill can be used successfully to achieve the listed burial depths with proper installation and compaction, this technical note does not confirm that all native material is suitable for initial backfill. Ensure all parties verify that site conditions allow for shaped trench installation with the respective backfill.