5 Management of Sensitive Features

Sensitive features are defined in the Edwards Aquifer rules as permeable geologic or manmade feature located on the recharge zone or transition zone where:

- a potential for hydraulic interconnectedness between the surface and the Edwards Aquifer exists, and
- rapid infiltration to the subsurface may occur

Sensitive features may be identified during the Geological Assessment or may be encountered during construction activities.

5.1 Protection of Sensitive Features Identified in the Geological Assessment

5.1.1 Small Depressions with Earthen Bottoms

This category of feature includes small depressions with generally limited catchment areas that have an earthen bottom. These features have been found to have infiltration rates that are comparable to background levels and are not a substantial source of recharge to the aquifer (Havorka, pers. communication). Consequently, these depressions are not considered to be sensitive features under the definition in the Rules. Disturbance of the soils within these depressions may accelerate the rate of infiltration into the subsurface and allow pollutants to reach the aquifer. Consequently, some protection of these features is warranted.

The soil in the bottom of these depressions appears to provide substantial treatment to any runoff entering the feature. Protection of the function of these features is based on not reducing the soil depth. The preferred option for protection is to avoid any excavation within 50 feet of the feature. It is likely that any excavation in the area of a closed depression will encounter solution features in the subsurface that will increase project costs and delay construction activities until the TCEQ is notified.

The second option is to fill and cover these small depressions. Fill material should be low permeability soil or base material that will not allow ponding within the pore spaces of the depression fill. If the project engineer determines that the area is structurally sound, construction of roads, parking lots, or other structures over the features can be considered.

When submitting the WPAP, a description of how these features will be considered during design and construction should be included. This will reduce the possibility that through grading or other land disturbance, they will become pathways for the infiltration of contaminated runoff. Restrictions on excavation and site grading activities which could expose subsurface voids or otherwise create additional avenues of recharge within the construction area are recommended. Such measures as plugging of sinkholes may be appropriate in certain cases.

5.1.2 Sensitive Features

Sensitive features comprise a large variety of types including caves, solution cavities, solution enlarged fractures, sinkholes or other karst surface expression that meet the definition for sensitive in the "Instructions to Geologists for Geological Assessments" (Form TCEQ-0585). Sensitive features should be identified before the tract is subdivided and proposed locations for roads or structures defined so that they may be avoided. The sensitive features identified in the Geological Assessment should not be sealed, but instead protected from the potential impacts of stormwater runoff from any new development in the area. These features are analogous to icebergs in that the surface expression represents only a fraction of the spatial extent of the feature that exists just below the soil profile. Because these features can accept recharge over a substantial area, providing treatment of runoff only within the depression may lead to degradation of water quality in the aquifer.

Native vegetation, particularly live oak trees, should be preserved within the catchment area of caves or sinkholes. Stemflow occurring along the branches and trunks of large trees may enhance infiltration by channeling rainfall to the root zone (Thurow et al., 1987). Introduction of ornamental turf or landscaping within the catchment area is not recommended because it will probably require soil amendments, frequent maintenance, and application of fertilizers, pesticides and herbicides. The existing soil structure and vegetation are compatible with pre-existing recharge conditions and should require little maintenance.

Consequently, the best protection of these features is provided by a natural buffer area sized based on the drainage area for the feature. The drainage area for a cave or sinkhole frequently will include a well-defined bowl-shaped depression, which may be a few feet to many yards across and which represents the local collapse zone over a subterranean cavity. The sharp slope break present at the perimeter of such a collapse zone should constitute the edge of the feature for the purposes of calculating setbacks, since the steep slopes within such a bowl usually provide little or no water quality filtration.

> The natural buffer around a feature should extend a minimum of 50 feet in all directions. Where the boundary of the drainage area to the feature lies more than 50 feet from the feature, the buffer should extend to the boundary of the drainage area or 200 feet, whichever is less.

In some cases where several point recharge features occur in close proximity setback provisions may be applied collectively or setbacks may overlap, provided that the minimum standard setback for each feature is retained. No stormwater conveyance systems (storm drains, roadside swales, etc.) that would bring runoff from outside the existing drainage area should have outfalls where the runoff would be directed to a sensitive feature by the natural topography.

It is recommended that the buffers around a point recharge feature or cluster of contiguous point recharge features be maintained in a natural state to the maximum practical extent. This implies a construction-free zone. Activities and structures allowed within buffer zones are limited. Hiking trails may be located in buffer zones as long as they are at least 50 feet from the feature. When all or a portion of the buffer for a sensitive feature is located within the yard of a residential tract, it should be separated by a barrier, such as a fence, from conventional landscaping and maintained in the natural state. The "natural state" of a buffer will typically be a combination of dense native grasses and forbs in a mosaic of shrubs and trees.

Temporary runoff protection measures should be installed according to the recommendations presented in Chapter 1 during any construction activities within drainage area of the feature. Temporary erosion control measures should be placed as near the construction as possible to minimize disturbance within the buffer zones and drainage areas.

Where extenuating circumstances exist and development over a significant point recharge feature and its catchment is proposed, the developer can consider demonstrating that no feasible alternatives to construction over the sensitive feature exist. Feasibility of alternatives should be based primarily on technical, engineering and environmental criteria. Feasibility should not be based predominantly on marketing or economic considerations or special or unique conditions which are created as a result of the method by which a person voluntarily subdivides or develops land.

Where extenuating circumstances are approved by the TCEQ, the developer should provide alternatives to make up for the loss of recharge to the aquifer. Measures shall be taken to assure that the quality of enhanced or induced recharge is adequate to protect groundwater quality, and is consistent with the requirements to protect “improved sinkholes” as directed in 30 TAC 331 (Underground Injection Control).

5.1.3 Caves

Openings of caves are sensitive features that should have natural buffers as described above. In addition, the size of the opening creates the opportunities for other pollutants to enter the aquifer. Many caves in the Edwards were historically used for trash, debris, and garbage disposal. The material found in caves often includes paint, solvents, and other toxic/hazardous materials. Runoff entering the caves can leach toxic compounds and convey them to the aquifer. Consequently, caves that are identified in the geological assessment and that have openings large enough to accommodate a person should be secured with cave gates. Other proposed methods will be reviewed on a case by case basis by the Executive Director. The cave openings may not be sealed in such a way as to prevent surface runoff from entering the feature.

A typical cave gate is shown in Figure 5-1. The gate has two main purposes. The first is to reduce access to the cave and prevent the disposal of wastes in these sensitive features. The second purpose is to prevent untrained individuals from accessing the cave where they might potentially become trapped. Many of these caves are habitat for endangered species; consequently, the gate should provide for free exchange of air, water, organic debris, and small mammals that are important components of the cave ecosystem. The gate should also provide a lockable access for qualified individuals to perform hydrogeological or biological studies. The discussion of cave gates below is modified from Warton (2002).

In Central Texas, the most common type of cave entrance occurs as a sinkhole, often found along rock joints. Entrance openings are usually positioned on semi-flat ground or along hillside slopes. The orientation of entrance openings is usually vertical. Horizontal development within caves may occur at shallow depths. In this type of cave structure, the key position of a prospective cave gate is usually horizontal, with some degree of recess in to the entrance.

Figure 5-1 Typical Cave Gate with Secure Entrance (Mike Warton, PBS&J)

The concept of gate "transparency" implies specifically that the gate is a non-solid covering that will not impede, block, or prevent the vertical fall of air, water, or natural organic materials from entering the cave similar to what occurs naturally. Thus, the transparent gate is semi-open for these functions. In the cave entrance ecosystem, surface related and nocturnal invertebrate species may regularly pass through the gate in a manner not significantly altered by the presence of the gate. In Texas, endangered invertebrate species are troglobitic in nature, never leave the cave environment, and never use or access the gate. They are critically dependent on the gate's ability to allow un-impeded wash-in, or transport of organic food source materials to enter and replenish the cave. Up to seven common types of ground mammals also frequent Texas caves and have important natural roles in the cave ecosystem. Their points of access and egress through the cave gate are specific in location. The gate must facilitate their easiest points of access. The access portal design and size are set to an eight-inch diameter or square opening as shown in Figure 5-2.

Figure 5-2 Mammal Access Portals Along Edge of Gate

Gate Construction

Prior to gate construction, the cave's entrance may require certain preparations for acceptance of the gate. In welded construction where gates are custom built and fitted on site, commercially made welding blanket mats should be draped across the entrance opening in basket position in order to prevent contamination of the cave by slag and welding residues. The gate is a level horizontal grid cover constructed from 2-inch by 2-inch by 3/8-inch steel angle. The most important structural component is the supporting sub-structured arrangement of cross beams and drilled anchor points. Anchors are usually 1/4-inch to 1 -inch diameter rebar from 8-inches to 10-inches in length (Figure 5-3).

Horizontal beam supports are built by welding together two pieces of angle iron to form a box-shaped beam that is solid welded to the point set anchors. Once the substructure is completed, the grid panel arrangement of bar angles may begin. The bar angles are placed on their edge sides, with angle peak pointed either to the left or to the right (all pointed in the same direction throughout the gate). By placing the angles on their edge side, the barrier thickness aspect of the gate panel becomes almost three inches thick, instead of the 3/8-inch thickness of the angle. Bar spacing throughout the gate and across the panel are set to provide a clear opening of 1.5 inches if the cave is not used by bats, otherwise the opening should be 5.75 inches. The direction of airflow exchange to and from the cave's entrance may determine the left or right pointing positions of angle peaks. The angle shape would be turned to such a position that "cups" and promotes the best airflow exchange. It should provide the level of airflow conductivity that is a substantial or prominent characteristic of the cave. In this construction, the location and position of the gate's access and egress door is pre-determined. The access door assembly is: (1) typically 30 inches square; (2) transparent in design; (3) a hinged door; and (4) contains a concealed lock mechanism and access point as shown in Figure 5-4. The round hole in the gate is sized so that a person can reach through the gate to access the lock which is concealed below the gate. The concealed lock box location in these gates prevents any direct attack. The lock box is designed to house a 2-inch wide lock with 3/8-inch shackle.

Figure 5-3 Example of Anchor Rebar

Figure 5-4 Example Cave Gate Access

After the access door is installed, the last stage of the construction is usually the placement of horizontal stiffeners across angle expanses. One-inch or 2-inch wide by 3/8-inch thick flat bar stock is used for the stiffeners. Stiffener spacing usually does not exceed a distance of five feet. Following the completion of all welding, the last stage of gate completion is to apply a protective metal coating with a high quality rust inhibitive paint. This is carefully hand brushed on instead of sprayed. Following gate completion, the under hanging blanket basket is removed and the site should be thoroughly cleaned of any foreign materials.

5.2 Protection of Features Identified During Construction

Many sensitive features, such as solution cavities and caves, are not identified during the Geological Assessment, but are discovered by excavation during the construction phase of a project. This is especially common during utility trenching. The features encountered at this phase of a project must be protected to ensure that water quality and the stability of the utility installation are protected.

If any sensitive feature is discovered during construction all regulated activities near the sensitive feature must be suspended immediately. The holder of an approved Edwards Aquifer protection plan must immediately notify the appropriate regional office of any sensitive features encountered during construction, per 30 TAC 213.5(f)(2). This notice must be given before continuing construction. Regulated activities near the sensitive feature may not proceed until the executive director has reviewed and approved the methods proposed to protect the sensitive feature and the Edwards Aquifer from potentially adverse impacts to water quality.

To describe, assess, and provide a proposed method of protection for the feature, use Form 10256, available from the TCEQ's main web page (Forms and Publications). The attachments for Form 10256 are:

a. Plan, profile, cross section sketches, and photos for each feature.
b. Geologic Assessment Table (if applicable).
c. Drawings and narrative descriptions of the proposed protection measures.
d. If the discovery is related to a sewage collection system, a Texas Registered Professional Engineer is required to submit the protection plan.

Table 5-1 describes the various types of features and the minimum treatment required for each. There are two main strategies for dealing with these features depending on their extent. Small, isolated solution cavities may be completely filled with concrete. An example of the proper method of dealing with this type of feature is shown in Figure 5-5. The feature is completely filled with concrete and typical bedding and backfill material is used in the trench. In this and other examples in this section, the concrete used to fill openings is shown as 2500 psi. This is the minimum strength acceptable, and stronger concrete may be used at the discretion of the design engineer.

Table 5-1 Minimum Protective Standards for Sewer and Storm Drain Trenches

(from Edwards Aquifer Guidance Document 96.004, Effective 8/11/98)				
Case	Description	Concern	Treatment	Notification/Approval
1	Sensitive feature is less than or equal to six (6) inches in all directions and is located above the embedment of the pipe. All rock within and surrounding the feature is sound.	Not environ-mental nor pipe integrity	No abatement required.	None required.
2	Sensitive feature is either larger than six (6) inches in at least one direction or is located within the level of the pipe embedment. No portion of the sensitive feature may intersect the plane of trench floor. All rock within and surrounding the feature is sound.	Environmental	The sensitive feature shall be filled with concrete. Gravel to "fist sized" rock or sacks of gravel may be placed in feature prior to placement of the concrete as long as a minimum of eighteen (18) inches of concrete is used to close the feature).	Requires notification and prior **written** approval from TCEQ.
3	Sensitive feature intersects the plane of the trench floor is less than four (4) feet in any direction. All rock within and surrounding the feature is sound.	Environmental	Sensitive feature shall be filled with concrete. Gravel to "fist sized" rock or sacks of gravel may be placed in feature prior to placement of concrete at least eighteen (18) inches of concrete is used to close the feature. The sewer line or storm sewer lines shall be concrete encased for width of the sensitive feature plus a minimum of five (5) feet on either end. The encasement shall provide a minimum of six (6) inches of concrete on all sides of the pipe and shall have a compression strength of at least two thousand five hundred (2,500) psi (28-day strength). The concrete may be steel reinforced.	Requires notification and prior **written** approval from TCEQ.
4	Sensitive feature intersects the plane of the trench floor and any opening in trench floor is greater than four (4) feet in any direction or the trench floor is unstable.	Environmental & Structural	Requires an engineered resolution at least as protective as Case 3 above. Additional protective measures, including rerouting of line, may be required.	Requires notification and prior **written** approval from TCEQ.

All plans submitted to the TCEQ regional office shall have a signed and dated seal of a Texas licensed Professional Engineer. All plans will be reviewed on a case-by-case basis and additional protective measures or additional information may be required.

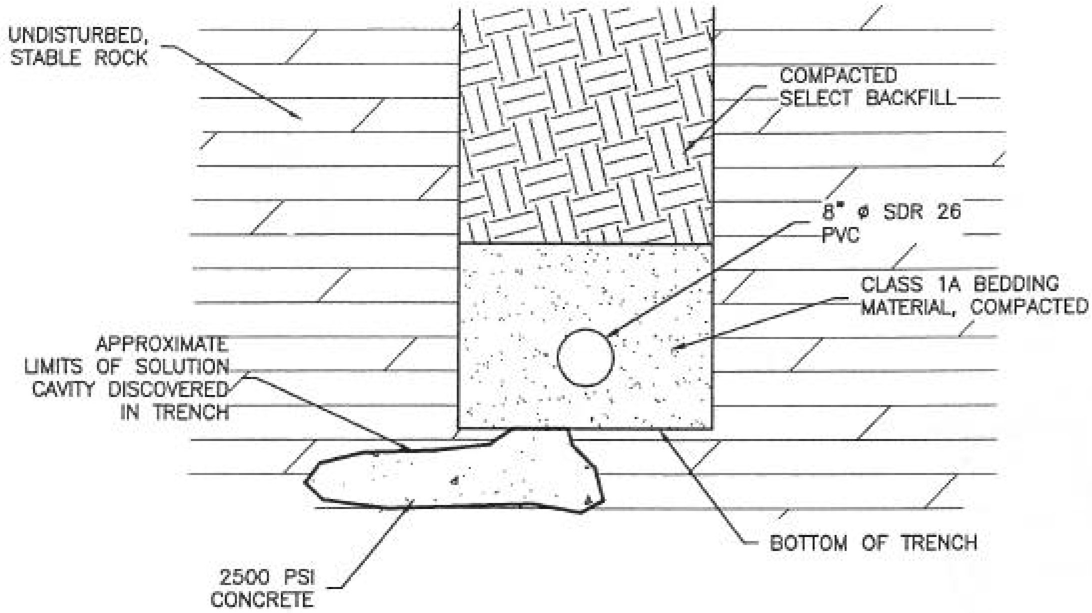

Figure 5-5 Filled Solution Feature (courtesy Kathryn Woodlee)

Other features discovered during trenching operations are much more extensive and filling of the feature is neither possible nor desirable. In cases where there does not appear to be substantial, active flow in the feature, it may be possible to isolate the section in the vicinity of the trench from the rest of the cave system. An example of this type of installation is shown in Figure 5-6. Sand bags are installed to restrict fill to the vicinity of the trench and concrete is used to fill the lower part of the trench and support the pipe.

In some cases, it might not be desirable to permanently encase the utility pipe in concrete, especially where the pipe may need to be removed for repair or replacement. In those circumstances an outer steel encasement pipe can be installed and the utility pipe installed inside of it. Section and profile views of this type of installation are shown in Figure 5-7 and Figure 5-8.

When a larger feature appears be an active conduit for flow, it may be appropriate to maintain hydrologic connectivity across the trench excavation. This can be accomplished by installing a 3-inch Schedule 40 PVC pipe between the two isolated cave sections. An example of this type of installation is shown in Figure 5-9.

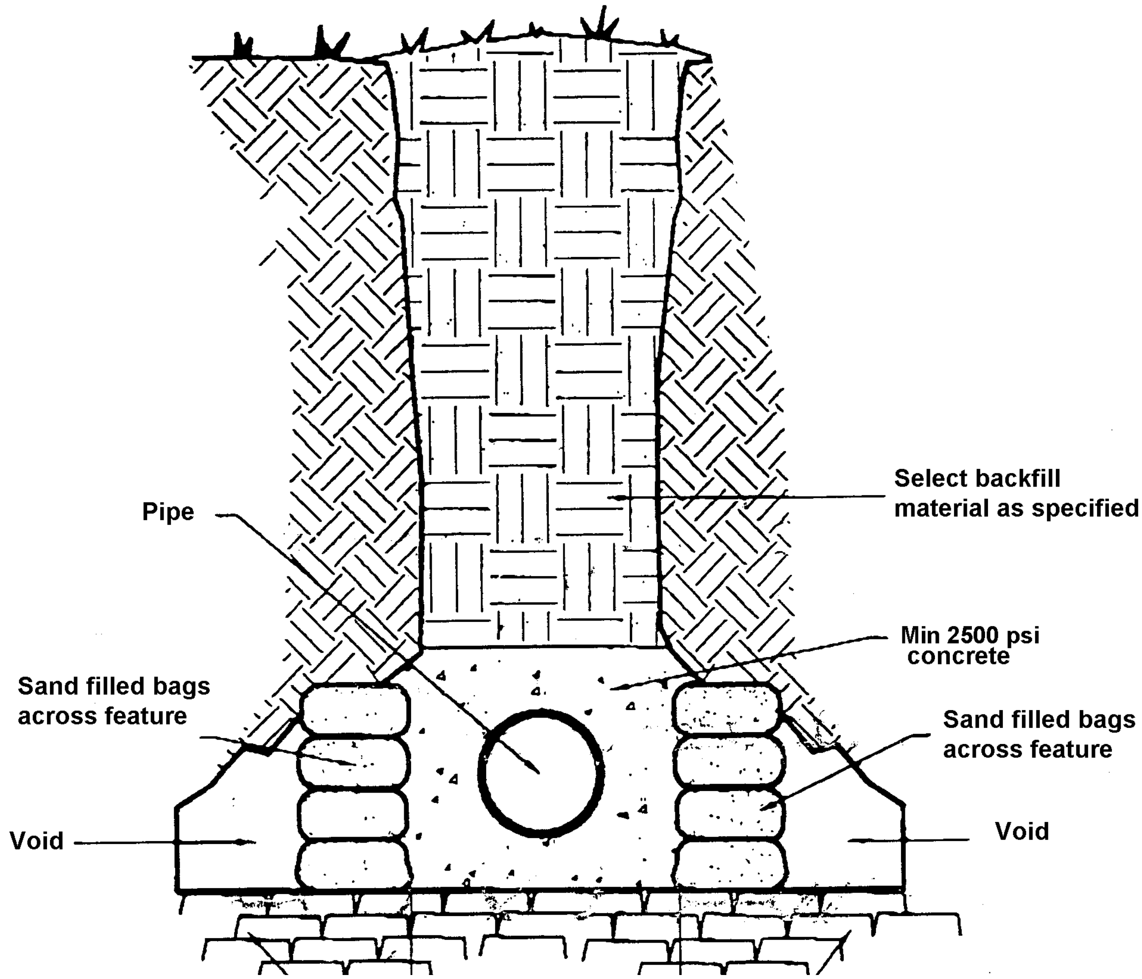

Figure 5-6 Example of Filled Void in Trench Excavation (courtesy Donald Bayes)

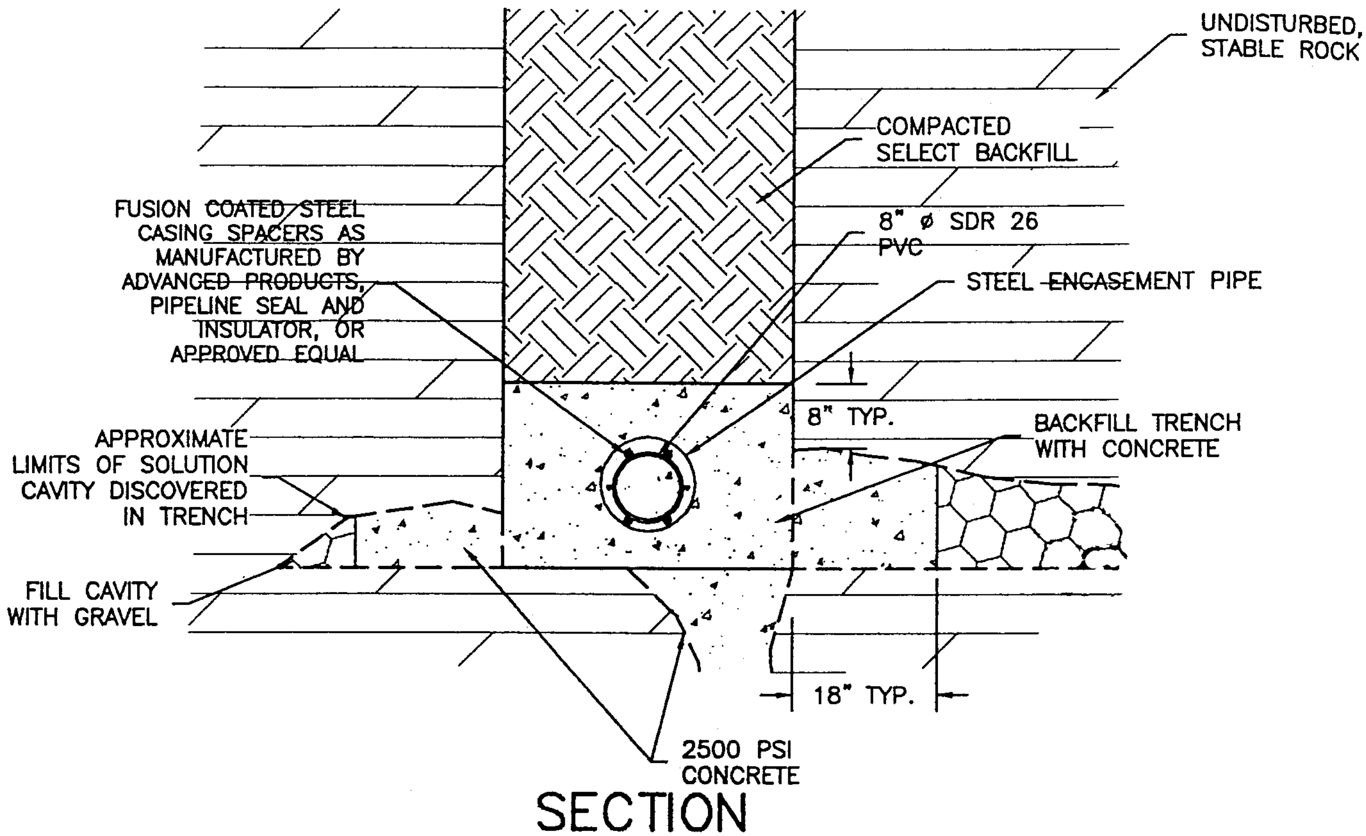

Figure 5-7 Utility Pipe Encased in External Steel Pipe (courtesy of Kathryn Woodlee)

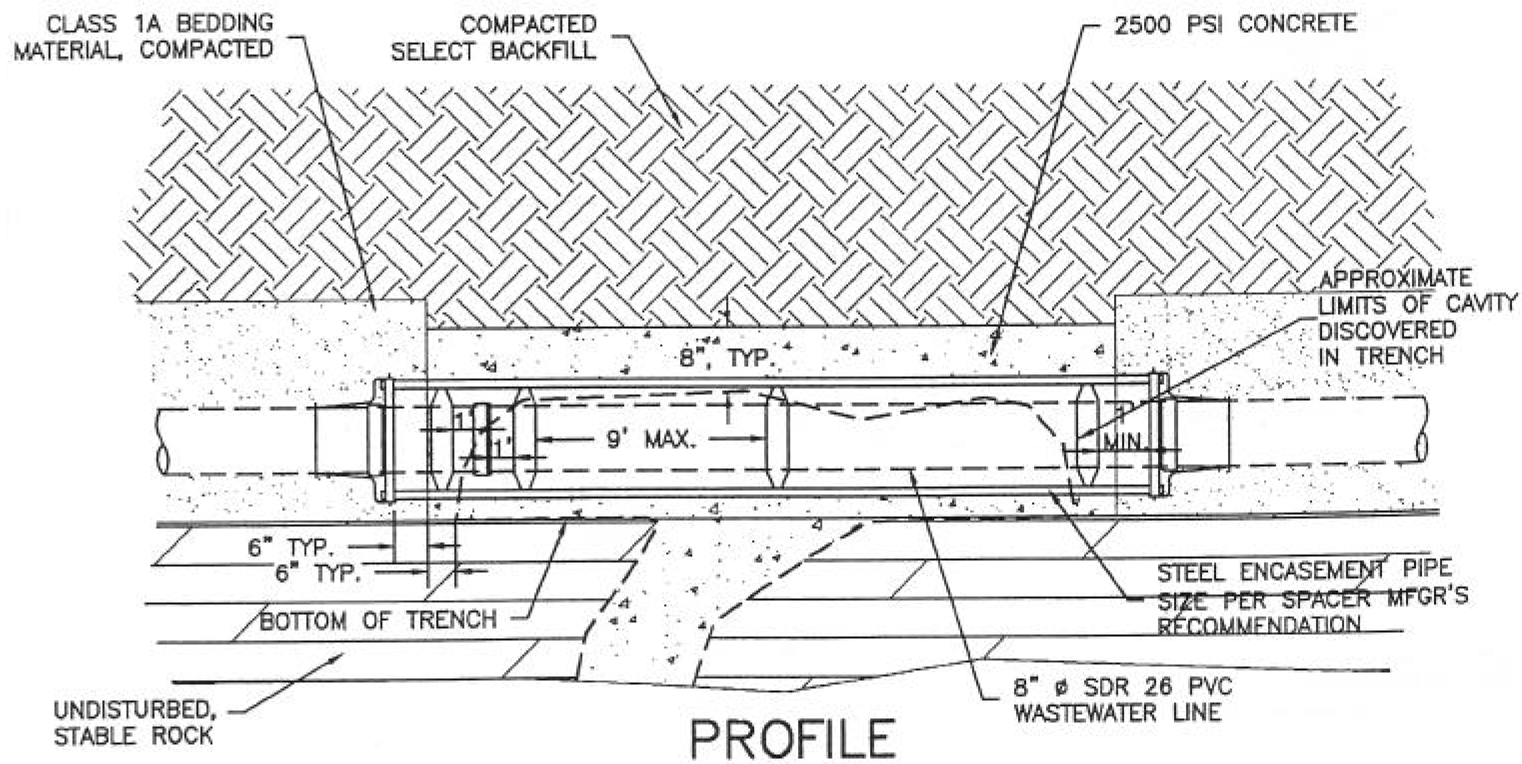

Figure 5-8 Profile View of Encased Utility Pipe (courtesy of Kathryn Woodlee)

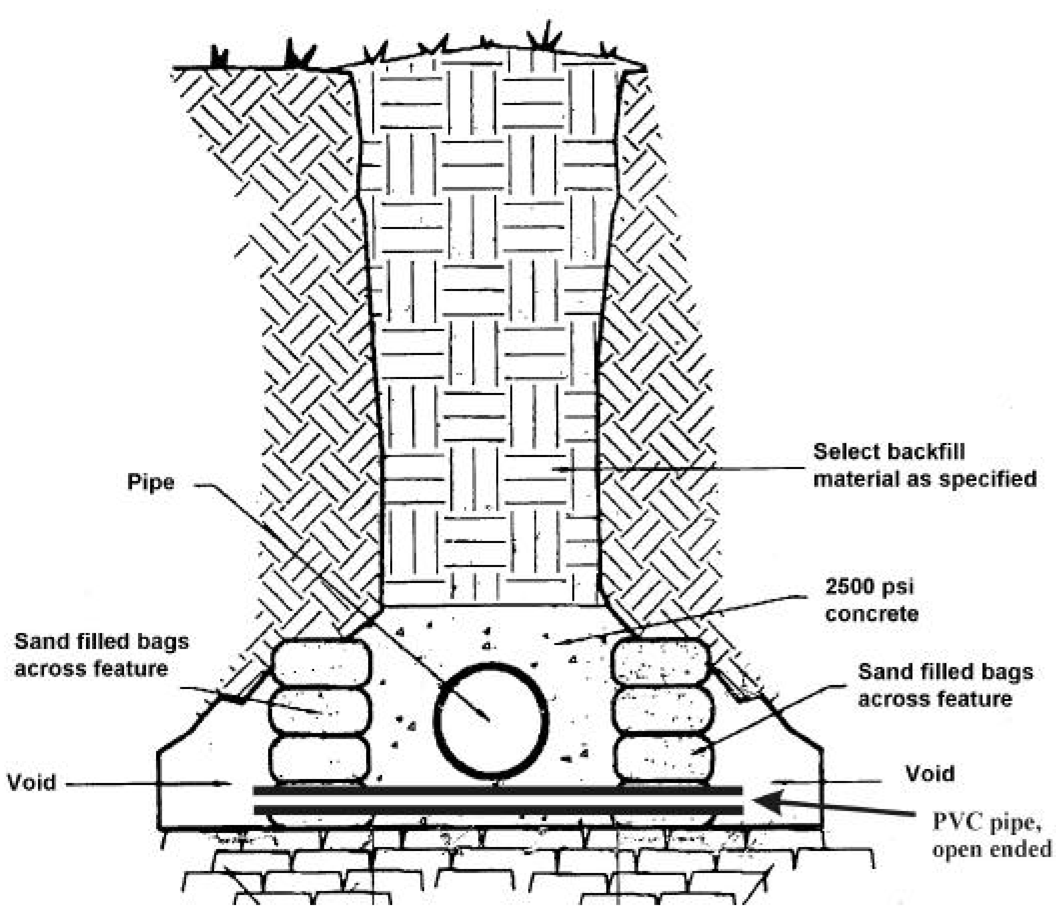

Figure 5-9 Cavity fill with Pipe to Preserve Hydrologic Connectivity