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Section 4:

Drainage Structures

SECTION 4 – DRAINAGE STRUCTURES

4.1 GENERAL *(rev. 06-15-26)*

The construction of well built structures that will adequately accommodate drainage, both surface and subsurface, is an important responsibility. Failure in our road surfaces and complaints from property owners along the highway will result if the construction of proper drainage structures is not given careful attention.

If time permits, the PEMS should obtain a copy of the drainage design calculations and check for errors or discrepancies in information, such as land use. An examination of existing structures after a heavy rain or reviews of local inquiries as to the adequacy of the existing structures are two sources of valuable information. District Maintenance is a good source to obtain past drainage complaints from the public.

If Construction recommends drainage revisions, those recommended revisions should be reviewed with the Designer, through the PM, and any changes agreed upon should be implemented by Change Order.

4.1.1 Structure Sump Requirements

IDEM requires drainage structures to be constructed so that after construction native stream bed material will be naturally deposited along the flowline of the stream within the structure limits.

To achieve this requirement, pipe structures, box culverts, and 3-sided culvert structures are designed with a specified sump depth. The sump depth is a defined depth below the designed flowline elevation and the invert for pipes or top of scour protection for culverts. Figure 4.1 shows a typical section through a 3-sided culvert that includes the sump depth. The PEMS should review the plans and Standard Drawings for a better understanding of the sump depth and for the specific depth requirement for each structure.

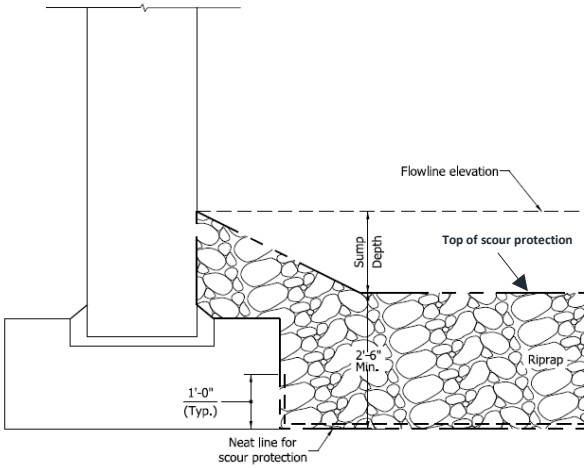


Figure 4.1. Sump Depth Indication for 3-Sided Culvert

Since the intention is that natural stream bed material is desired to be deposited along the stream channel, the PEMS should ensure that the sump depth of a structure is constructed correctly. Upon completion of the work, this will leave the structure in a condition that accumulates water in the sump area. This is the intent. During the contract, no material should be placed to fill the sump unless otherwise directed.

4.1.2 Precast Reinforced Concrete Box Structure Joints and Waterproofing

Precast reinforced concrete box structure joints must be sealed to provide a watertight joint and reduce the potential for infiltration. Pipe joint sealant is required to be applied, in accordance with the manufacturer's recommendations, to the bell or spigot end of the structure sections prior to joining the sections. Unless indicated on the plans, joints are covered using a joint membrane in accordance with the Standard Drawings and 907.07 of the SS. The sealer system or membrane material is centered across the joint and rolled to avoid wrinkling. Three inches of overlap are required if the roll of geotextile or membrane material does not cover the full length of the joint.

If specified within the plans and contract documents, a waterproofing membrane will be required to be applied to joints, exterior vertical surfaces, and the exterior top horizontal surface of the structure in their entirety. A Type 2 waterproofing membrane is to be used for all external vertical surfaces. When asphalt is to be placed directly on top of the waterproofing membrane, Type 3 waterproofing membrane is to be used. Otherwise, the use of Type 2 waterproofing membrane is appropriate.

Concrete surfaces must be clean and dry, free of dust and loose materials, and be smooth and free from projections and holes. The PEMS must verify that all joints and exterior corners are prepared in accordance with the waterproofing membrane manufacturer's recommendations. Waterproofing membrane is to be applied when the ambient temperature is 40^{o}F and rising in accordance with the SS. Prior to placing Type 2 waterproofing membrane, a manufacturer's recommended prime coat is applied to all exterior surfaces receiving the membrane.

Waterproofing membrane must be placed from bottom to top of the vertical surfaces. Waterproofing membrane placed on the top horizontal surface must overlap the membrane on the exterior vertical surfaces by a minimum of 12 inches. The installation of Type 2 or Type 3 waterproofing membrane are to follow the methods described within the SS and the manufacturer's recommendations.

4.2 COUNTY DITCHES

Legal drains, whether open ditches or piped, have legal flow lines that have been established by the county authorities.

Before any structures under the roadway are staked, the location of the county ditches and the legal flow lines thereof should be obtained from the County Surveyor. Where a legal flow line can be established, the datum on the county ditch should be equated to that on the road plans. The flow lines of pipes or boxes should be placed at or below the legal flow lines.

4.3 STAKING STRUCTURES

Structures should be staked at plan location and flow line. Minor changes are frequently necessary to fit existing ground conditions and should be approved by the PEMS prior to installation. The upstream end of structures under the roadway should be 0.2 ft to 0.5 ft below the lowest ground, ditch, or tile ditch to be drained. The grade then should be approximately straight to the point where the water will leave the right-of-way. The minimum distance from the edge of pavement to the inner face of headwalls on boxes, and under fill slab tops are required to meet clear zone requirements. Headwalls and handrails should be parallel to the pavement. If they are visible to traffic, the top should be parallel to the grade of the pavement. Pipe structures parallel to the centerline at intersecting roads shall be constructed according to the standards for the type of intersection shown on the plans.

4.4 FOUNDATIONS

Structures should be placed on stable foundations. The SS state that unstable material excavated below the planned foundation of the structure be paid for at three times the bid price for the class of excavation involved, providing the additional amount involved at the structure exceeds 10 cu yd. This additional excavation should usually be backfilled with B Borrow and paid as a separate item.

Tests should be made on the stability of foundations for slab top culverts. If the foundation is unstable, piling will be required unless the unsuitable material is shallow enough that it may be excavated and the footing lowered. If large quantities of unstable material are encountered, the AE should be contacted for approval of the method required to stabilize the structure foundation.

Follow recommended procedures for structural foundations found within the Geotechnical report for the contract.

Structures should never be placed or foundations built on frozen ground.

4.5 BUILDING FORMS AND PLACING STEEL

Before each concrete pour, both forms and reinforcing steel should be carefully and thoroughly checked. Forms should be checked for stability and strength as well as dimension. All lumber in contact with the concrete shall be free from knot holes, splits, warps, and other defects. Forms for the portion of the structure that is to be finished by rubbing should be lined with plywood or other approved material that will leave a surface free of board marks. Exposed edges should be checked for correct size of bevel or chamfer strips.

The SS provide that forms are tied together with a combination tie and strut, the outside 1 in. of which can be removed, and its hole filled with mortar. A wall form properly tied will not need wood struts. Wire ties shall not be used.

Footings or floors should be thoroughly cleaned before abutment or wall concrete is placed on them.

Reinforcing steel should be secured so that it will not shift during the placing of concrete. Steel

which has a detrimental scale or rust shall be cleaned. In no case shall steel be used which is rusted deeply or pitted. New steel can be maintained in good condition by storing it on skids and covering it as described by the SS. Any dirt or other foreign material should be removed from the reinforcing steel before placing concrete.

4.6 CONSTRUCTION JOINTS

Horizontal and vertical construction joints shall only be placed as shown on the plans or as approved by the Designer.

4.7 PLACING STRUCTURAL CONCRETE

The Contractor should not be allowed to start a concrete pour until forms and steel have been checked by the PEMS.

The SS require a slump between 1 and 6 in., except otherwise indicated within the contract documents. Between these limits the concrete should have as low a slump as will flow into a mass which is free of honeycombing. A higher slump will be required for thin box walls rather than for footings of a slabtop.

In order that concrete can be properly consolidated, the SS require that wall sections be placed no greater than 24 in. layers. Each succeeding layer should be placed before the previous one has initial set. The SS require the use of vibrators for consolidation. The vibrator should follow immediately behind the placing of each lift of concrete, being lowered and directly lifted out at about one foot intervals. Vibrators should not rest against the forms or reinforcing steel and should not be dragged through the mix. Vibrations transmitted to partially set concrete seriously impair its strength. Vibrators left running in the mix must be avoided.

Foundation seals are to be constructed from Class A concrete with the thickness as shown on the plans, or as requested by the Contractor and approved by the Department.

The SS should be followed for testing and acceptance of cast-in-place structures.

4.8 PLACING STRUCTURAL CONCRETE - COLD WEATHER

The SS require concrete mixing water, aggregate, or both to be heated when concrete is placed or cured at or below a specific atmospheric temperature. It also states that suitable enclosures and heating devices shall be provided. This entails heating the concrete both before and after placing. The temperature to be maintained is specified in 702 of the SS.

The Contractor should keep a watchman on the job, during the heating period, to ensure the maintenance of proper temperature. The Contractor should also maintain appropriate fire protection equipment at the job site during heating operations. Any concrete placed when the air temperature is at or below the SS specified cold weather concrete temperature will be at the Contractor's risk.

The use of admixtures to prevent freezing of the concrete are not permitted.

4.9 FINISHING

All concrete surfaces must be given a finish in accordance with the SS after removal of forms. Attention should be paid to filling air holes and irregularities. All joints and chamfers must be power ground to a smooth finish.

4.10 SKEWED STRUCTURES

Where box culverts are placed on a skew, the dimensions of the box, as shown on the plans, are measured perpendicular to the centerline of the structure. On skewed slab top structures, the span, as shown on the plans, is measured parallel to the road centerline.

4.11 PIPE CULVERTS *(rev. 06-01-26)*

The trench in which the pipe is to be laid shall be cut to conform to the bottom of the pipe thus ensuring a uniform and even bearing on solid compacted material. The bedding at the bell end must be recessed into the bedding so no bearing occurs on the bell end.

The Contractor must use proper construction methods when laying pipe culverts. It is important that Department personnel inspecting this work are familiar with the requirements of the SS and see that the methods outlined therein are met.

Under certain conditions, corrugated metal pipe must be strutted. Refer to the SS to determine the applicable provisions for strutting. This strutting is performed prior to shipment of the pipe and should be left in place until the entire backfill for the pipe is in place and compacted.

Before the final inspection of the contract, all pipe structures must be inspected for damage to the bituminous coating or paved invert, when these types of pipes are specified.

4.11.1 Inspection of Pipes

All pipes, except underdrains, must be visually inspected no earlier than 30 days after completion of the backfill for indications of joint failures, excessive deflection, or other damage. If a pipe cannot be visually inspected, the Contractor must provide for video inspection of the pipe.

The PEMS should review the contract quantity for the video inspection pay item and use the quantity to provide inspection for those sections of pipe that present the most risk for joint failure, excessive deflection, or other damage. Video inspection of pipes is covered in 715 of the SS.

For more information regarding the items below and pipe inspection, refer to the *Inspection Manual for Pipe* found on the M&T website.

- Pipe Structures
- Pipe Placement
- Measurements of Pipe Items
- Manholes, Inlets, and Catch Basins
- Structure Backfill and Inspection
- Relining Existing Pipe Structures

- Calculating Pipe Lengths
- Concrete Pipe
- High Density Polyethylene (HDPE) Pipe
- Metal Pipe
- Metal Pipe Structures
- Polypropylene Pipe
- Polyvinylchloride (PVC) Pipe
- Reinforced Thermosetting Resin Pipe
- Utility Pipe.

4.11.2 Mandrel Testing of Thermoplastic Pipe

For the purposes of these instructions as well as the SS, the terms nominal diameter, pipe pay item diameter, and pipe pay diameter are synonymous. The SS requires that thermoplastic pipe be in accordance with either AASHTO or ASTM specifications. The nominal pipe size or nominal pipe diameter, the AASHTO or ASTM designation, as well as other identifying information, (the product marking line) is required to be stamped on the pipe at regular intervals. The PEMS should use this information to ensure that the correct material is being used on the contract.

Thermoplastic pipe must be mandrel tested after the visual or video inspection has been completed and reviewed. The pipes material types requiring mandrel testing are indicated within 715.09 of the SS. The pipe materials that fall into the thermoplastic pipe category that require mandrel testing include corrugated polyethylene, corrugated polypropylene, and profile wall polyvinyl chloride pipes that are in accordance with SS 907.17(b), 907.19, and 907.22.

A mandrel is a device with arms or prongs that is pulled by hand through a pipe to check that the pipe does not exceed the maximum deflection criteria allowed by the SS. Prior to a mandrel test, the inspector must check the mandrel to ensure that the diameter of the mandrel is 95% of the nominal pipe diameter that is stamped on the pipe. The mandrel test is a pass or fail test.

Form IC 715, Mandrel Testing of Pipe Structures, is to be used by field personnel to document mandrel testing of thermoplastic pipes. A copy of this form available on the Department's website.

The following procedure is to be followed for mandrel testing:

- Determine which pipe structures will require mandrel testing and note them on an IC 715 along with the pipe material specification reference (i.e. – 907.19), nominal/pipe pay diameter and pipe structure length.

- Note the date that the backfill is completed for each structure.

- Visually inspect the pipe no earlier than 30 days after backfill has been completed. Look for obvious damage, such as excessive deflection or joint failures.

- If the pipe cannot be visually inspected, require the Contractor to perform a video inspection of the pipe. Review the results of the video inspection for damage.

- After the visual or video inspection, require the Contractor to perform the mandrel test. Note the mandrel requirements in the SS and check the mandrel to ensure that it has a diameter that is no less than 95% of the nominal/pipe pay diameter.

- Note the date of the mandrel test on the IC 715.

- Have the Contractor pull the mandrel through the pipe by hand.

- Record the result, either pass or fail, on the IC 715 for each structure tested.

If the pipe fails the mandrel test or the mandrel causes obvious damage to the pipe, require the Contractor to remove and replace the deficient portion of the pipe. The deficient portion should be removed and replaced to the nearest pipe joint or structure, such as a manhole or inlet.

Lengths of pipe replaced must be mandrel tested in accordance with the procedure outlined above. A note should be made on the IC 715 that the test is being made for a replacement pipe.

All IC 715 forms are to be kept in the project file and a copy sent to CM.

4.11.3 Thermoplastic Slip Lining Existing Pipe

In certain situations, the plans may indicated that existing pipes be rehabilitated by slip lining with a thermoplastic liner rather than replacing the structure. The plans will indicate whether a circular or deformed liner will be used as well as the maximum number of joints and the corresponding maximum length of each section of liner pipe.

The Contractor may submit a written request to use a liner pipe that is longer than indicated in the plans. The Contractor's written request must also address the change in the number of joints associated with the requested liner length. The Contractor must select the liner pipe from the Department's list of approved Plastic Pipe and Pipe Liner Sources, or provide a certification, in accordance with 907.25 and 4.23 or 4.24 of ITM 804, for liner pipes not on the approved sources list. All liner pipe must be submitted for review prior to installation.

(a) Materials

When circular liner pipe is shown on the plans, the choices for lining the existing pipe structure include:

- solid wall HDPE liner pipe,
- profile wall HDPE liner pipe, or

- profile wall PVC liner pipe.

When deformed liner pipe is shown on the plans, the only choices for lining the existing pipe include:

- solid wall HDPE liner pipe or
- profile wall HDPE liner pipe.

The cellular grout used for the filling of the annular space between the inside of existing pipe and the outside of the liner is accepted in accordance with the Frequency Manual under the heading of Cellular Concrete Grout.

(b) Quality Control

The Contractor is required to submit a QCP, in accordance with ITM 803, for acceptance by the PEMS prior to the start of the lining operation. The QCP should be contract specific and contain a description of the proposed work for the lining operation including:

1. Name of the QCP Manager, their qualifications, contact information, and duties.
2. Sequence of the pipe lining operation.
3. Equipment and method used to deform the liner pipe.
4. Destructive test method for welded, butt-fused, or joined liners.
5. Method used to calibrate the cellular grout pump gauges.
6. Methods used to achieve proper placement of the cellular grout.
7. Identification of potential problems with the lining operations, including possible grout leakage, and the proposed resolutions.

A QC representative is required to be on-site for the initial testing of the first welding or fusing of the liner pipe at each installation location and for the joining, welding, or fusing of the liner pipe at each location.

(c) Joints

Liner pipes have the option to be joined using a variety of methods including:

- Bell and spigot
- Screw type
- Grooved press-on
- Butt fused

- Extrusion weld
- Other joint as recommended by the liner pipe manufacturer.

Welded liners shall have a continuous weld bead both inside and out. The welding bead shall be smooth, protrude no more than 3/8 in. into the interior of the liner, and not adversely affect the hydraulic capacity of the liner.

The operators performing welding, butt-fusing, or joining for the liner pipe shall be trained and certified by either the liner pipe manufacturer or the welding, butt-fusing, or joining equipment manufacturer. The PEMS shall be provided a copy of the operator's current and valid certification prior to the beginning of any joint work.

A demonstration of the method described within the QCP for destructive testing of the joint should be performed by the operator for all welded, butt-fused, and joined liner pipe. The operator shall perform the destructive test at the beginning of each day's joint operations.

All pipe liner joints shall be in accordance with the manufacturer's recommended procedures, and be visually inspected before acceptance. Any joints that do not pass the visual inspection should be removed and a new joint should be fabricated. The re-fabricated joint will be visually inspected prior to acceptance.

(d) Installation

Installation of the liner pipe begins with the cleaning of the interior of the existing structure and the repair of all deformities. After cleaning, a walk through should be performed in order to visually assess the condition of the existing structure. If a walk through cannot be performed, the Contractor is required to perform a video inspection. The PEMS should receive a copy of the video. If the Contractor believes that the work cannot be performed as planned after the visual inspection, the PEMS must be informed immediately and discussions with the Designer must occur.

The Contractor may desire additional area for their installation operations beyond the right-of-way limits provided in the contract. In this situation, the Contractor is responsible to pursue agreements from adjacent property owners in accordance with 107.14.

After cleaning of the existing pipe, the Contractor should check the size of the liner pipe to verify that the required cross-sectional area can successfully be placed inside the existing structure. If problems are found to exist before the installation, the Contractor must submit a substitute liner pipe plan to the PEMS for approval. If problems are not discovered until installation has begun, the Contractor is required to remove the portion of the liner pipe already installed and submit a substitute liner pipe plan to the PEMS for approval.

All visible and obvious cavities outside the existing structure should be filled with non-removable backfill, in accordance with 213, prior to the start of the lining operation. If the Contractor's QCP indicates that the cavities are to be filled in conjunction with the grouting operation, cellular concrete grout should be used in lieu of non-removable backfill.

Prior to filling the annular space between the existing structure and the liner pipe with cellular grout, bulkheads should be built on each end of the structure. The bulkheads should be free of leaks and should be strong enough to withstand the pressure of the injected grout. The bulkheads should extend from the end of the existing structure inward to a minimum thickness of 18 in. The exterior surfaces of the bulkheads should be given a smooth troweled finish.

The injection method used to place the cellular grout is required to be explained within the Contractor's QCP and should be monitored during placement so that the grout completely fills the annular space between the existing structure and the liner pipe. The grout injection methods must not cause distortion of the liner pipe, nor cause the liner pipe to float. Within the QCP, the Contractor must explain the methods to be used to regulate and maintain injection pressure. These methods should be based on the liner pipe manufacturer's recommendations.

Any stormwater management features installed, including pump arounds, should be monitored during the cellular grout injection operation. Grout will follow the path of least resistance in its attempt to fill existing voids and reduce injection pressure. If the grout is found to be leaking into any adjacent body of water or other potential problematic areas, operations should be stopped. Any leakage should be identified and corrected prior to re-starting the operation. After the restart, all adjacent areas should continue to be monitored for grout leakage.

Any existing drainage structures connected to the structure being lined must be perpetuated and kept free of the injected cellular grout.

(e) Payment

Payment for the total length of thermoplastic liner pipe will include the measured length of the existing pipe that has been lined plus a maximum of 8 in. beyond the end of the existing structure.

> *For example, if a thermoplastic liner pipe is used to line an existing 20 ft cross structure with 10 in. extensions on either end of the liner, the total payment for the liner would include the measured length of the existing cross structure plus the maximum 8 in. length extending beyond each end of the existing pipe*

$$20\ ft + \frac{(2 \times 8\ in.)}{12\frac{in}{ft}} = 21.33\ ft.$$

In some cases, the design may indicate that specific types of end sections are to be installed on the liner pipe. These specific end sections may be indicated as a separate pay item. For the special situations in which a separate pay item has been included for the end sections, payment should be made for the specified end sections in addition to the payment of the liner pipe.

Payment for the liner pipe is intended to be all inclusive, except when end sections are identified to be installed as described above. The payment should take into account all necessary work and all incidentals for the work required. Perpetuation of existing structures connected to the existing pipe are required to be paid separately for each pipe perpetuated.

4.12 PRIVATE ENTRANCE STRUCTURES

Private entrance structures shall be placed where such structures are shown on the plans, where private entrances or drives existed prior to the award of the contract, and where drainage structures are identified to be needed.

Approaches at private drives or entrances shall not be graded at Department expense beyond the right-of-way unless specifically indicated in the plans. Approach grading is discussed further in Section 19 of these instructions. It is the policy of the Department to perpetuate access to all properties, although the plans may not provide for the same number or same location of drives.

If any property is not being given access or existing drives are shown to be eliminated, contact your AE to determine how to proceed. Any changes in locations of private drives to satisfy the property owner should be requested in writing by the property owner. Discuss such requests with the AE if the change is in contradiction with the special provisions of the right-of-way grant or could otherwise become a controversial matter.

4.13 TILE DRAINS

Accurately locate all tile drains crossing the contract or affected by the construction and make adequate provision for taking care of them. This can be accomplished only by consulting with the property owners and by making a careful study of the ground. The study of the ground is necessary because property owners frequently do not know the tile location, particularly when tile drains were placed by former owners.

Where farm drains cross the road, every precaution should be taken to preserve them in their original state of efficiency. Tile drains shown on the plans to be left in place and damaged by the Contractor, must be replaced by the Contractor at no additional cost to the Department. Tile drains, which are discovered before any work is performed and are not shown on the plans, should be marked on the As-Built plans. In general, farm tile located under the roadway, with a diameter of 6 to 10 in., and located 4 ft or less under the ground surface should be replaced with sewer pipe. Farm tiles located under the roadway and are 12 in. or larger in diameter should always be replaced with pipe that meets the SS for structures under pavement.

Drain tile paralleling the roadway, but not located under it, may be replaced in kind.

When a farm tile is intercepted by ditches that provide adequate drainage for the tile, at least two sections of sewer pipe and a sod collar should be placed on the outlet end. The balance of the tile under the road shall be removed and replaced in accordance with the information described above and the SS.

If it is necessary to excavate for the purpose of locating underground drainage, the accepted cubic yards involved will be paid for as per 203 of the SS.

Drain tile may be encountered which appears to be abandoned or no longer used for drainage purposes. Do not assume the tile is “abandoned” or does not need replacement until a thorough

investigation has been made to determine its status.

4.14 SUBSURFACE DRAINAGE

The locations of subsurface drains are shown on the plans. The grades for these drains may also be shown on the plans. It is necessary to coordinate the subsurface drain grades with the grades of culverts located under the pavement. Wherever practicable, the cross structures should be low enough to outlet the subsurface drains. Otherwise the subsurface drain should be low enough that the culvert will not lay directly upon it.

On some projects GS makes specific recommendations for subsurface drainage, other than the subbase drain through cuts referred above. These recommendations, along with the conditions observed as cuts are opened, should be reviewed with the AE based on anticipated modification and actual field conditions.

Perforated subsurface drainage pipe is placed with the perforations down. This assists in the prevention of infiltration of silts, gravel and other solids that might clog the line and destroy the effectiveness of the system. It is important that the perforated lower portion of the subsurface drain is placed so the rows of holes are symmetrical with respect to the vertical axis of the pipe.

The laying of pipe or drain tile and its backfilling is adequately covered in the SS. The provisions should be carefully followed. In addition, care must be taken to ensure that the top of the backfill is clean and free of any foreign material when the subbase material is placed over the subsurface drain backfill material.

4.15 GEOTEXTILES USED WITH UNDERDRAINS

Filter fabric, or geotextile, is normally used where silty soil is encountered within the immediate subgrade. The geotextile, when specified, should be placed along the sides and bottom of the trench before placing any subsurface drain aggregate backfill. Geotextile should not be used on the top of the trench unless indicated in the plans or approved through GS.

Storage and handling of geotextiles should be in accordance with the manufacturer's recommendations, except in no case should the geotextile be exposed to direct sunlight, ultraviolet rays, temperature greater than 140°F, mud, dirt, dust and debris, to the extent that its strength, toughness, or permeability requirements are diminished. Each geotextile roll shall be labeled or tagged to provide product identification sufficient for inventory and quality control purposes. At the time of installation, the geotextile should be rejected and replaced with no additional payment if defects, rips, flaws, deterioration, or damage incurred during manufacture, transportation, or storage is evident.

The surface on which the geotextile is to be placed should be excavated to design grade to provide a smooth, graded surface free of debris and large cavities. After excavating to design grade, the geotextile should be cut to a width to provide for a loose, no wrinkle placement in trenches and overlaps of the ends of adjacent rolls.

The geotextile should be placed with the machine direction (length) in the direction of water flow

in the drainage system. It should be placed loosely, but with no wrinkles or folds. The ends and edges of subsequent rolls and parallel rolls should be overlapped a minimum of 1 ft. The upstream geotextile should always be overlapped over the downstream. Either sewing or overlapping shall join seams required in the longitudinal direction. Overlapped seams shall have a minimum overlap equal to the width of the trench.

Care should be taken during construction to avoid contamination of the geotextile. If it becomes contaminated, it must be removed and replaced with new material.

Placement of drainage aggregate should proceed immediately following the placement of the geotextile, when specified, and the underdrain.

4.16 STORM SEWERS *(rev. 06-15-26)*

In general, manholes are placed at the junction of storm sewers and at every change in grade or alignment of the storm sewer. This means that sewers should ordinarily be constructed with straight pipe runs between manholes to facilitate inspection and repairs.

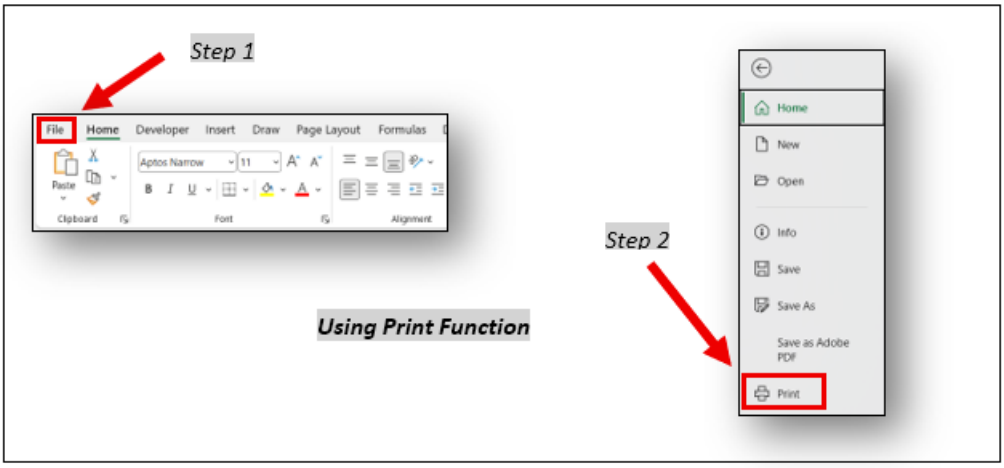
Since the survey crew cannot always determine the exact location and elevation of existing storm sewers, utilities, and other underground installations, it is imperative that the PEMS make additional investigations as necessary. With these additional investigations, it is possible to avoid costly delays or revisions in storm sewer installation. Do not postpone investigating the underground installations until sewer construction actually begins.

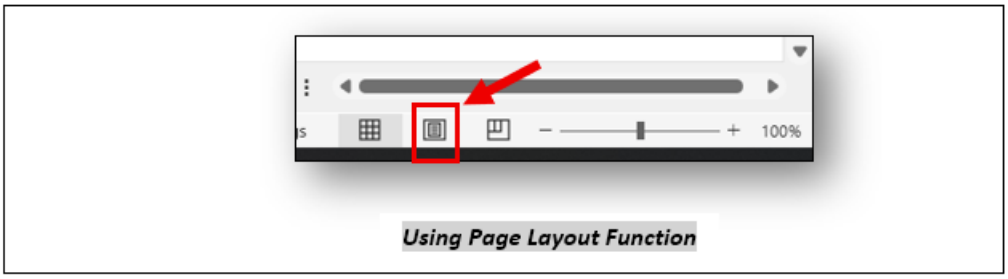
Catch basins and curb inlets are provided for receiving stormwater from the surface into the underground storm sewer system. The plans must be followed when installing catch basins and curb inlets to manholes within the storm sewer system.

For pipe backfill calculations quantities, use the **Pipe-Backfill Calculation Software** available on the Department's **Construction Information** webpage under the **Construction Applications and Tools** heading. The software is a downloadable Excel spreadsheet. The spreadsheet allows:

- All structure information to be entered on a single input sheet.
- Output to provide user feedback on inadequate cover or potential errors in input or design. The output can be compared with the original structure data sheet within the plans.
- Color coding for user guidance to input and output information tabs at the bottom of the spreadsheet.
- Explanation and graphical pop-ups provide quick visual reference within the Structural Data input area by hovering over the column heading.
- An output report is generated automatically as project and structural information are added. Users should navigate to the Output tab at the bottom of the

spreadsheet and select "Print" from the File menu located at the top left of the screen or use the Page Layout selection at the bottom right on the screen.





- The Help tab provides solutions to questions about the system. It also allows for specific email submitted questions.

Example calculations for backfill for circular pipe (9 example calculations) have been included within the Input tab of the spreadsheet. Circular, box, arch, and elliptical shapes are available for selection within the spreadsheet application from a drop-down menu.

1. Examples include calculations for Backfill Methods 1, 2, and 3 (through drop-down menu selection).

2. Each calculation provides a link for the standard drawing series 715-BKFL. The Standard Drawing link is referenced in the sample calculation header.

3. The Backfill/Trench Data input area includes explanation and graphical pop-up representation of the variables (when hovering over a column heading), a step-by-step guide to computing areas and volumes, and examples of inputs and outputs.

4. Example inputs have been entered into the spreadsheet to show how the spreadsheet computations determine outputs.

4.17 SEPTIC TANK DRAINS

In small towns and rural communities, frequent requests are made from property owners for the privilege of connecting septic tank drains to the Department's storm drainage system, underground or surface. In some instances, our improvement eliminates an open ditch formerly used for such purpose, and the property owner assumes they have the right to perpetuate the arrangement.

The normal type of septic tank used in residential applications does little more than liquefy the sewage. A filter bed or soil filter is needed before the effluent is safe in an open ditch. However, the local public health official is better qualified to pass judgment on the efficiency of such treatment and the purity of the effluent. The Department does not permit septic tank drainage into our storm sewers or side ditches. If you find that sewage is drained onto Department right-of-way, contact the AE and the appropriate local public health official for further investigation and action.

4.18 EARTH DITCH TYPE CATCH BASINS AND INLETS

On rural projects earth ditch type catch basins or standard pipe catch basins are often specified.

Except in special cases, these catch basins should not be located in the line of existing drain tile. They should be offset to one side of the drain tile and connected to the tile by means of a "Y" or "T" connection.

The outlet of pipe catch basins should be of smaller diameter than the catch basin. The outlet for a 2 ft diameter concrete catch basin should not be larger than 15 in. Where a larger outlet pipe is required a 4 ft diameter concrete catch basin should be used.

It is not Department policy to place catch basins or inlets on private drain tile lines, nor to carry surface drainage into private drain tile systems. When special cases are encountered, requiring deviation from this policy, those cases should be discussed with the AE.

4.19 STRUCTURE REMOVAL

Normally, no payment is made for removal of existing structures unless the contract contains an item for "Removal of Structures and Obstructions." If a contract price is not listed within the CIB, a USP should have been included within the CIB stating the cost of removal is to be included in various pay items of the contract.

4.20 RECORD OF STRUCTURES

Complete documentation of a structure installation will consist of information indicating the exact location of the structure, cuts furnished by the Contractor, and a record of all pay quantities placed in the structure. All metal pipe is required to be produced by manufacturers listed on the QPL. This documentation shall be provided by the Contractor if they are performing construction engineering, otherwise they must be performed by the PEMS.

A record of the concrete required and the concrete used should be included. The amount of

structure backfill used and paid for should be entered in the structure documentation. The payment for the installation is stored within the current construction records application. Revisions to structures should be included within the As-Builts and must include all structures or parts of structures that are not built to standard designs.

In order for Department maintenance personnel to have a record of underdrain outlet locations, the PEMS is to prepare a table when the project is complete that shows the stationing of each underdrain outlet. The best method for preparing the table is to use the underdrain table in the plans and indicate the as-built locations of the outlets. A copy of the as-built table is to be submitted to the District Highway Maintenance Director when the FCR is submitted.

Additionally, when culvert modifications, repairs, linings, or replacements are performed as part of construction contract work, communicate the culvert changes through email to the appropriate Senior District Bridge Inspection Engineer (for large culverts) or District Small Culvert Engineer (for small culverts).

Refer to Operations Memo 13-02 for additional information. Contact the District Bridge Inspection team for further information or questions.