INDIANA DEPARTMENT OF TRANSPORTATION

Driving Indiana's Economic Growth

Design Memorandum No. 13-04
Technical Advisory

March 4, 2013

TO: **All Design, Operations, and District Personnel, and Consultants**

FROM: ***/s/ Crystal M. Weaver***
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Division of Bridges

SUBJECT: **Flowline Elevation**
Pipe Material Selection

REVISES: ***Indiana Design Manual*** **Section 203-2.02(10) and Sections 201-1.05 through 201-1.08**

EFFECTIVE: **Immediately**

Flowline Elevation

Due to natural changes in channel flowline elevation between the time of project survey and construction, some structures are not being sumped appropriately. In order to maintain the intended sump, plans for all sumped structures should include the following note:

> Contractor shall verify the existing flowline elevation to set the appropriate sump depth.

This note should be placed with the alternate structure note (where applicable) on the General Plan for bridge plans, and on the Structure Details and General Notes sheets for road plans.

Designers should coordinate with the Office of Hydraulics to determine the necessary adjustments to invert and top of footing elevations. Typically, if the difference between the flowline elevation shown on the plans and existing flowline is half the sump depth or greater, the structure elevations should be lowered accordingly to provide the sump as shown on the plans. If the existing flowline elevation is higher than the flowline elevation shown on the plans, no changes are required to the structure elevations.

Pipe Material Selection Process

The Pipe Material Selection Process was omitted from the rewritten Hydraulics chapter of the *Indiana Design Manual.* It has been added to Sections 201-1.05 through 201-1.08.

Revisions to Section 203-2.02(10) and Sections 201-1.05 through 201-1.08 are attached to this memo.

CMW:ewp

203-2.02(10) Culvert Sumping [Rev. Mar. 2013]

Sumping consists of placing the structure-invert elevation and scour protection at a specified depth below the waterway or stream flowline to satisfy the IDEM Water Quality Section 401 permit requirements. Sumping allows the natural movement of stream-bed material through the structure. Sumping should be provided for each structure over Waters of the United States and Waters of the State.

1. Three-Sided Structure. The sump depth should be 18 in. for a stream bed of sand, 12 in. for a stream bed of other soil, or 3 in. for a stream bed of rock or till. The stream bed and scour protection should be as shown on the INDOT *Standard Drawings*. A base slab should be used only if the geotechnical report identifies flowline-area soil that will not support riprap. No increase in structure size is required due to sumping. The sump area will not require backfill as part of the contract work, but will be allowed to fill in naturally over time.

2. Pipe or Box Structure. Such a structure should be sumped as shown on the INDOT *Standard Drawings* and Figure 203-2E, Pipe- or Box-Structure Sump Requirement.

If the required sump exceeds 3 in., the structure diameter or rise may need to be increased by the sump value. The structure's design capacity should be checked to determine if such increase is required. If a pipe end section or riprap is required, these should be sumped to the same depth as the structure. The sump area of the structure and end section or riprap will not require backfill as part of the contract work, but will be allowed to fill in naturally over time.

Changes to the flowline elevation can occur between the initial project survey and construction. Significant changes to the flowline elevation may require an adjustment to the invert or top of footing elevation to ensure the appropriate sump is constructed. Where sumping is required, a note should be placed on the General Plan sheet for Bridge Plans or Structure Details and General Notes sheets for Road Plans as follows:

Contractor shall verify the existing flowline elevation to set the appropriate sump depth.

The designer should coordinate with the Office of Hydraulics to determine the necessary elevation adjustments. Typically, if the difference between the flowline elevation shown on the plans and existing flowline is half the sump depth or greater, the structure elevations should be lowered accordingly to provide the sump as shown on the plans. If the existing flowline elevation is higher than the flowline elevation shown on the plans, no changes are required to the structure elevations.

Scour-protection limits should be shown on the plans. Quantities for geotextile and riprap, or a base slab intended for scour protection, should be determined and identified as such in the Structure Data table for each applicable structure. Appropriate columns have been incorporated into the Structure Data table.

201-1.05 Pipe Material Selection [Added Mar. 2013]

Pipe Materials Selection Software has been developed to perform the required material selection analysis for Type 1, 2, 3, or 5 pipe. Unless otherwise specified, material selection analysis is not required for a Type 4 pipe. The Pipe Material Selection software uses structure site information to determine the acceptable pipe materials for each structure for the specific site conditions. Input requirements are shown below. See Section 201-1.06, Structure Site Analysis for additional input information.

201-1.05(01) Pipe Material Selection Software Input

The input required for the Pipe-Material-Selection software includes the following:

1. required pipe type (see INDOT *Standard Specifications*);
2. required pipe-interior designation (smooth or corrugated), if applicable;
3. pipe size;
4. cover;
5. required service-life duration;
6. abrasive or non-abrasive site designation; and
7. structure pH

201-1.05(02) Pipe Material Selection Software Output

Software output may include the following:

1. Software Indicates No Acceptable Materials for Structure. If this occurs, the cause is likely to be incorrect-input-data entry. If a review of the input reveals that there are no errors, the designer must contact the INDOT Hydraulics Team for additional instructions.

2. Software Indicates Only One Acceptable Material for Structure. By definition, a pipe-type designation indicates that a contractor may select from a list of materials that have been determined to be acceptable for an individual structure. If the list includes only one acceptable material, the pipe-type designation is meaningless. If this occurs, the structure cannot refer to a pipe type.

3. Software Indicates Two or More Materials are Acceptable for Structure. By definition, a pipe-type designation remains appropriate for this structure. The protective coating or invert treatment for each corrugated metal pipe is considered to define a unique material. For example, a materials list indicating both zinc-coated corrugated steel pipe and zinc-

coated corrugated steel pipe with bituminous-paved invert as acceptable is considered to include two materials.

4. Software Indicates More than One Corrugation Profile and Material Thickness Combination is Acceptable for Structure. If the Pipe-Material-Selection Software may indicates that more than one corrugation profile and material thickness combination is acceptable for a structure, then it is necessary to determine the optimum corrugation profile. The procedure for determining the optimum corrugation profile is as follows:

   a. Select the Profile with the Minimum Thickness. If the acceptable corrugation profiles require different material thicknesses, select the profile with the minimum thickness.

   b. Select the Smallest Profile. If all acceptable corrugation profiles require the same material thickness, select the smallest profile. By definition, a 2⅔" x ½" corrugation profile is considered smaller than a 3" x 1" profile.

201-1.06 Structure Site Analysis [Added Mar. 2013]

A Structure Site Analysis is required for each type 1, 2, 3, or 5 pipe structure. Unless otherwise specified, the analysis is not required for a type 4 pipe. The scope of the analysis is discussed in the following sections and is used as input for the Pipe Material Selection Software. See Section 201.-1.05 for additional information.

201-1.06(01) Cover

Cover is discussed in Section 203-202(09).

201-1.06(02) Pipe-Service-Life Duration

This indicates the desired length of service for the drainage structure. The duration is based on the functional classification of the mainline roadway. If the mainline roadway is a freeway or expressway, or is functionally classified as an arterial, the required service-life duration for each type 1, 2, 3, or 5 pipe structure is 75 years. If the mainline roadway is functionally classified as a collector or local road, the required service-life duration for each such structure is 50 years.

201-1.06(03) Abrasive or Non-Abrasive Site Designation

A site is considered abrasive if it is probable that runoff will transmit material which can damage the pipe. Each mainline culvert site or each site where a public-road-approach or drive culvert is installed in a natural channel is considered abrasive.

A storm-drain site or public-road-approach or drive culvert site on a constructed side-ditch line is considered non-abrasive. However, the designer must use judgment to confirm that abrasive elements are not likely to impact such a site. If the designer concludes that a storm-drain- or side-ditch-culvert site can have abrasive materials transported by runoff, an abrasive site designation must be assigned to each affected structure.

201-1.06(04) Structure pH

Acidic runoff may have contributed to service-life problems with a pipe structure. To mitigate these problems, the designer must determine a pH value for each type 1, 2, 3, or 5 pipe structure. The pH data may be provided in the Engineer's or Geotechnical Reports. The data should include the stream pH-test result for each type of existing structure as follows:

1. mainline culvert;
2. public-road-approach or drive culvert in a natural channel;
3. storm-drain-system outlet pipe; or
4. the most-downstream culvert on each constructed ditch line.

The designer will use the following guidelines to establish each proposed structure's pH value.

1. Culvert. Assign the data provided for each existing mainline culvert to the corresponding proposed pipe structure. Likewise, assign the data associated with each existing public-road-approach or drive culvert located in a natural channel to the corresponding proposed structure. Each proposed public-road-approach or drive culvert installed on a constructed ditch line should be assigned the report's pH value for the most-downstream culvert on the corresponding existing ditch line.

2. Storm Drain. If a proposed storm-drain system will replace an existing system, assign the pH value obtained at the existing system's outlet pipe to each pipe structure in the proposed system. If the proposed system is replacing an existing open-drainage system, apply the pH value collected at the most-downstream existing side-ditch culvert to each structure in the proposed system.

The final structure pH is the lowest of the following values.

1. Preliminary Field Check Plans pH Value. This value is obtained from one of the following sources.

   a. Engineer's Report.

   b. pH Testing. If pH data is not available from the Engineer's Report, the designer is required to perform pH testing of water samples taken at the structure. The scope of the testing required is below and is illustrated by the flowcharts included in the following figures.

201-1A	Structure pH Determination Procedure for Proposed Mainline Culvert or Other Culvert in Natural Channel (Area Where Map pH = 7.0)
201-1B	Structure pH Determination Procedure for Proposed Storm-Drain Structure (Area Where Map pH = 7.0)
201-1C	Structure pH Determination Procedure for Proposed Side-Ditch Culvert (Area Where Map pH = 7.0)
201-1D	Structure pH Determination Procedure for Proposed Mainline Culvert or Other Culvert in Natural Channel (Area Where Map pH < 7.0)
201-1E	Structure pH Determination Procedure for Proposed Storm-Drain Structure (Area Where Map pH < 7.0)
201-1F	Structure pH Determination Procedure for Proposed Side-Ditch Culvert (Area Where Map pH < 7.0)

   c. pH Map. If the Engineer's Report does not provide structure pH data, and pH testing is not appropriate, Figure 201-1G, pH Map, is used to determine the Preliminary Field Check pH value.

2. Final Check Prints pH Value. This value is obtained from one of the following sources.

   a. Geotechnical Report.

   b. pH Testing. If a structure pH value is not available from the Geotechnical Report and testing is appropriate (see Item 1.b. above), pH testing of a water sample taken from the corresponding existing structure site is required.

   c. pH Map. Use of the pH map is appropriate only if a structure pH value is not available from the two sources listed above.

3. Final Tracings pH Value. If the pH values from Items 1 and 2 for a structure are not within 0.5 of each other, a third value must be obtained for comparison. The third value is obtained from one of these two sources.

a. pH Testing. If pH testing is appropriate, testing of water samples at the corresponding existing structure is required.

b. pH Map. If pH testing is not appropriate, the pH map is the appropriate source for the third pH value.

Before pH testing is performed, the project location must be determined from Figure 201-1G, pH Map. If the project is located in a county with a posted 7.0 pH value, the testing scope is as follows:

1. Identify Structure Requiring Testing. The structure type to be considered for testing is as follows:

a. mainline culvert;
b. public-road-approach or drive culvert located in a natural channel;
c. outlet pipe of storm-drain system; or
d. the most downstream culvert on a constructed ditch line.

2. Structure Inspection. The testing process begins by inspecting the structure. If an existing structure does not show signs of corrosion, pH testing is not required. If the structure shows signs of corrosion, a water sample at the structure must be obtained and the pH of the sample must be determined.

If the project is located in a county with a pH map value < 7.0, the structure-inspection step described in Item 2 does not apply. Each structure identified in Item 1 requires obtaining a water sample for pH determination.

The following apply to the determination of a structure pH value, regardless of the source of the data.

1. Maximum Structure pH Value. The pH value for a structure cannot exceed the map pH value for the project location. If the pH value obtained from a report on pH testing is greater than the map pH value, the obtained value is ignored and the map value is used for the structure.

2. Precision of pH Value. The pH value is expressed to the nearest 0.5. If a report or pH testing yields a value that is more precise, the structure pH is rounded to the next lower 0.5.

3. Lack of Sample Availability. If pH testing is required, but a sample is not available at a structure site, the structure pH value will equal the value for the nearest adjacent structure. If a water sample is not available at an appropriate structure within the project limits, the pH map value is used for all structures.

4. Storm-Drain-Structure pH Determination. The structure pH assigned to the outlet pipe of a storm-drain system is assigned to each structure in the proposed system.

5. Side-Ditch-Culvert Structure pH Determination. The structure pH assigned to the most downstream pipe in a segment of side ditch is assigned to each culvert installed in that ditch line segment.

201-1.07 Pipe-Extension Structure [Added Mar. 2013]

By definition, a pipe-extension structure is a structure that involves attaching a new pipe to an existing pipe. A pipe extension requires the selection of a specific material. If possible, the selected material should match the existing pipe material. However, the material thickness and coating combination or material-strength classification must satisfy the cover and service-life-criteria requirements.

201-1.08 Draintile Structure [Added Mar. 2013]

If it is known that the proposed construction will require the removal of existing field tile, the drainage will be perpetuated in the following manner.

1. Tile Replacement Within Temporary Right of Way. Type 4 pipe is used to perpetuate the drainage. The pipe size will match the existing tile and must be perforated in accordance with the INDOT *Standard Specifications*.

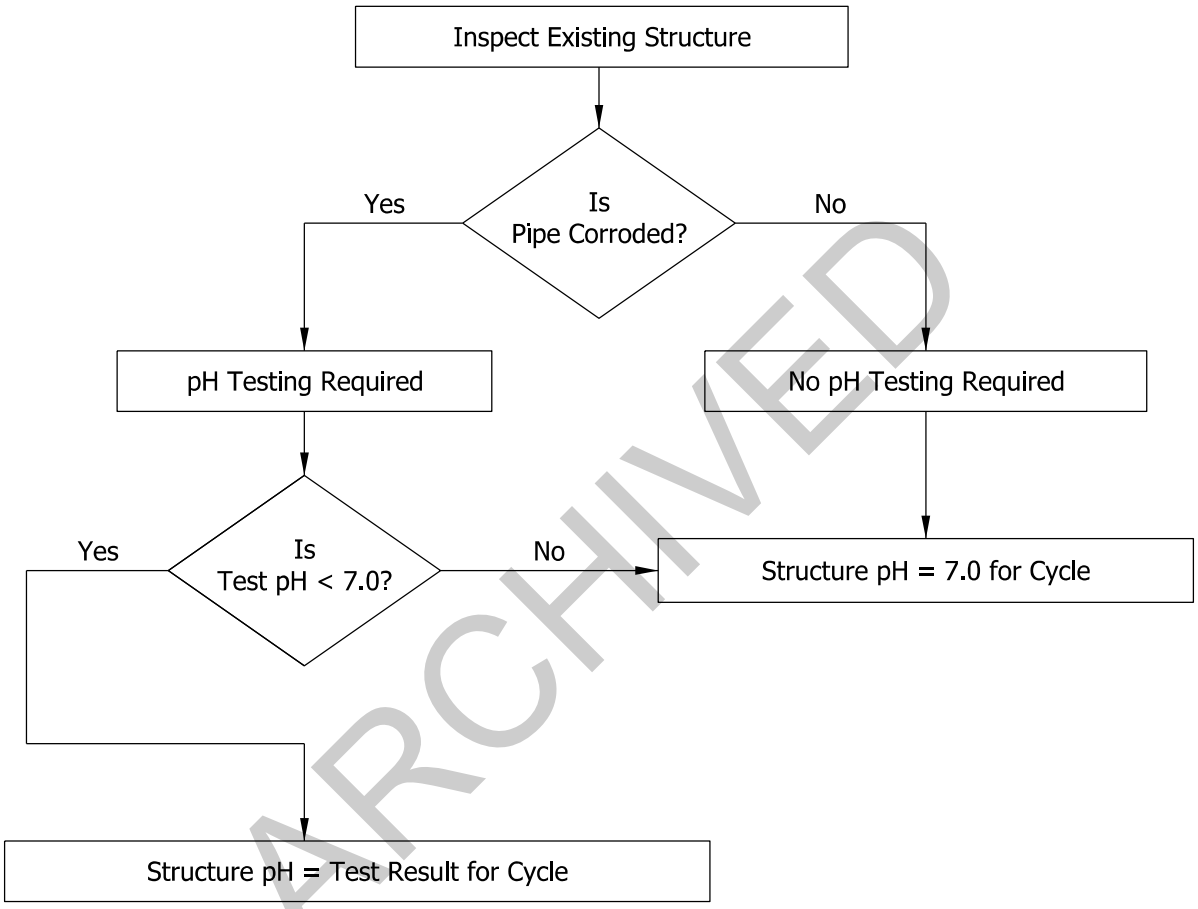
2. Tile Outlet in Ditch Prior to Crossing Mainline Pavement. Type 4 non-perforated pipe and a 10-ft long segment of draintile terminal section are required between the right-of-way line and the proposed outlet. If necessary, a concrete collar is used to connect to the existing pipe at the right-of-way line, and a rodent screen is required at the terminal-section outlet. Revetment riprap or other gradation [as required to satisfy the clear-zone criteria (see Chapter 49)] is required between the tile outlet and the ditch flow line to prevent erosion.

3. Tile Outlet in Ditch After Crossing Mainline Pavement. Type 1 pipe is required between the right-of-way line and the proposed outlet. The concrete collar, rodent screen, and

riprap requirements described in Item 2 above will apply to the type 1 pipe installation. The acceptable type 1 pipe materials must satisfy the cover and service-life criteria. The site is assumed to be non-abrasive and the map pH can be assigned to the structure.

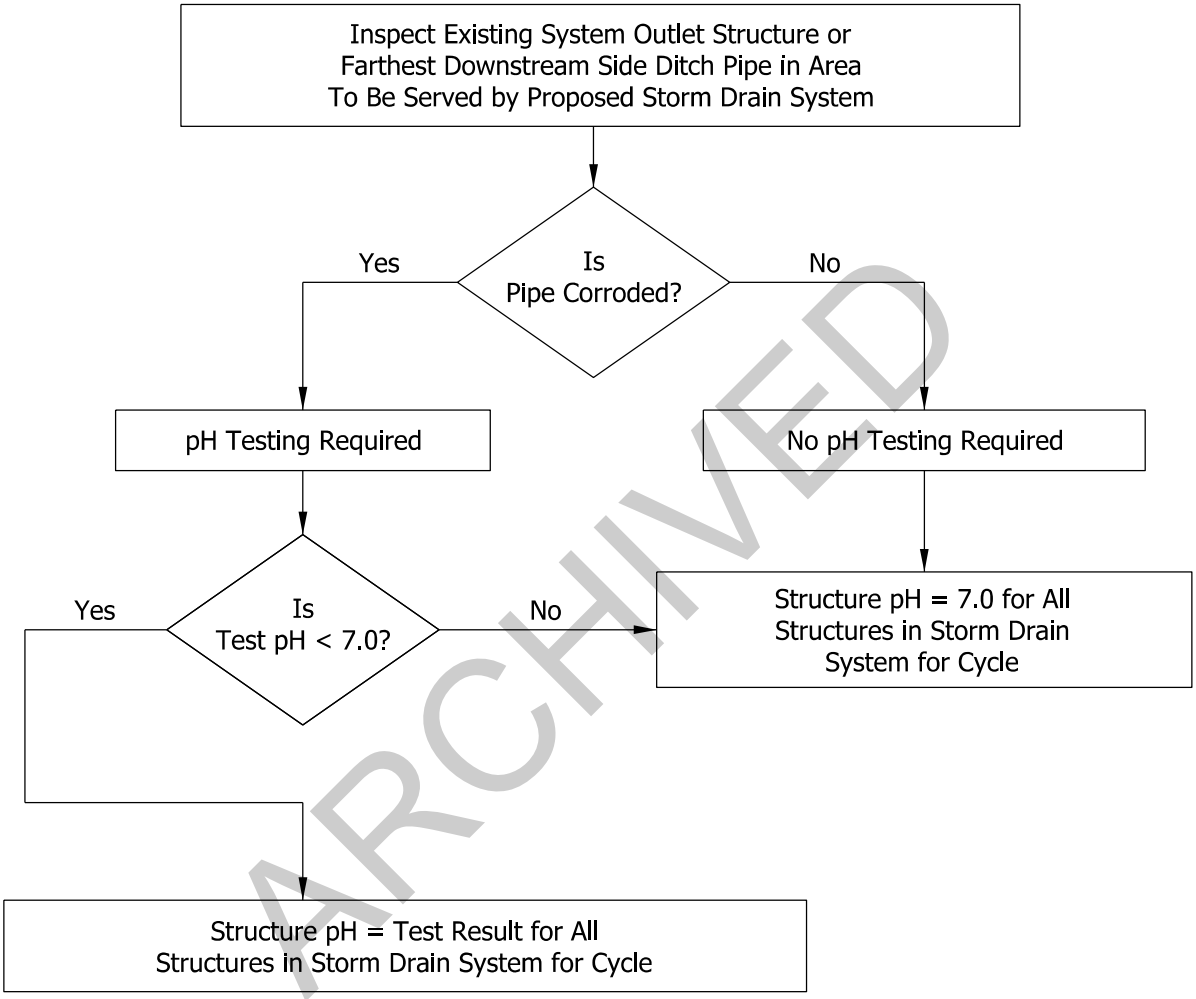
4. Tile Outlet in Storm Drain System. Type 2 pipe is required between the right-of-way line and the outlet location. A concrete collar is required. The acceptable type 2 pipe materials must satisfy the cover and service-life criteria. The site is assumed to be non-abrasive, and the structure pH must match the value for the storm-drain structure that serves as the tile outlet.

5. Tile is Perpetuated Across Right of Way. Type 1 pipe is required from right-of-way line to right-of-way line. A concrete collar is required. The acceptable type 1 pipe materials must satisfy the cover and service-life criteria. The site is assumed to be non-abrasive, and the pH map value for the project location is assigned to the structure.



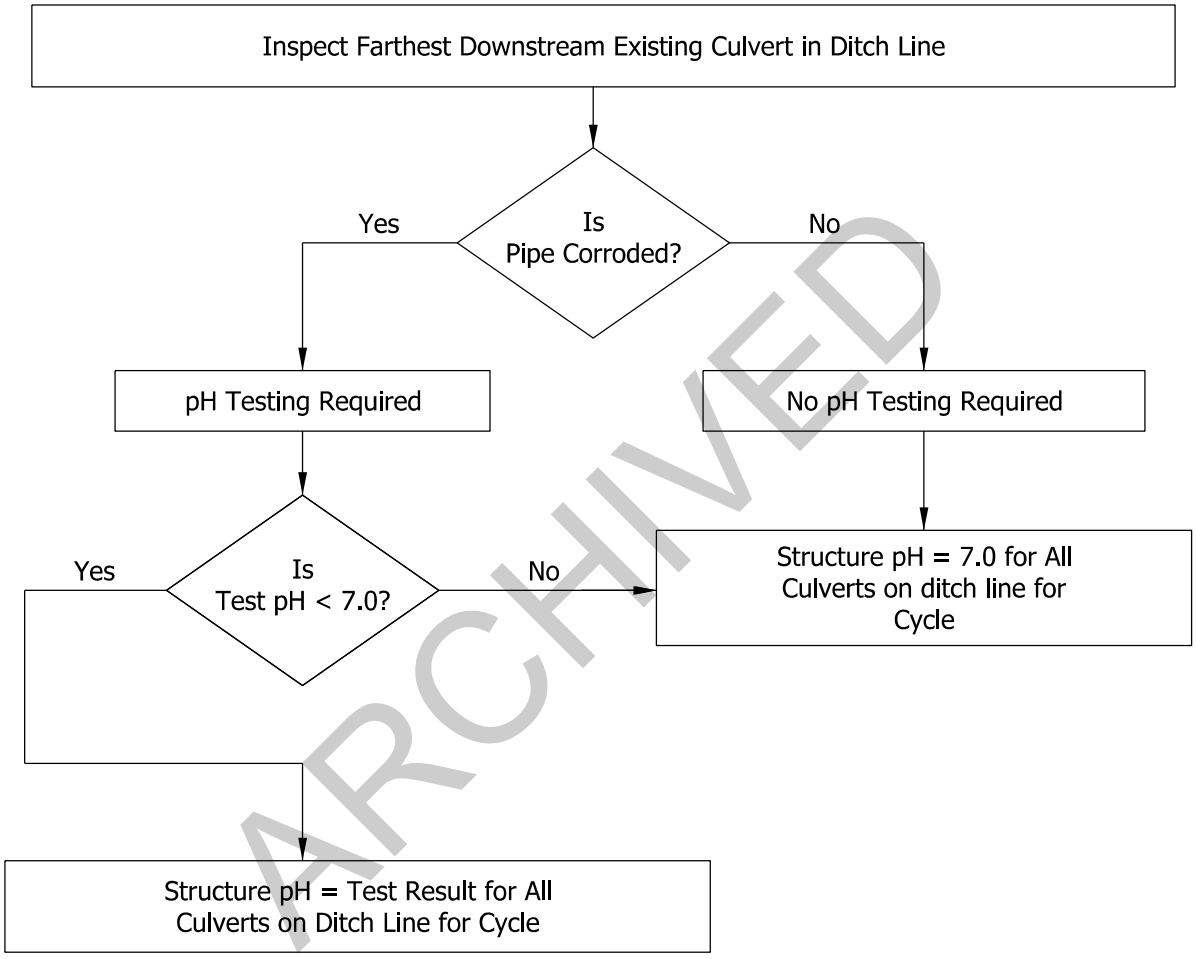
STRUCTURE pH DETERMINATION PROCEDURE
Proposed Mainline Culverts and Other Culverts in Natural Channels
Project in Area Where Map pH = 7.0

Figure 201-1A



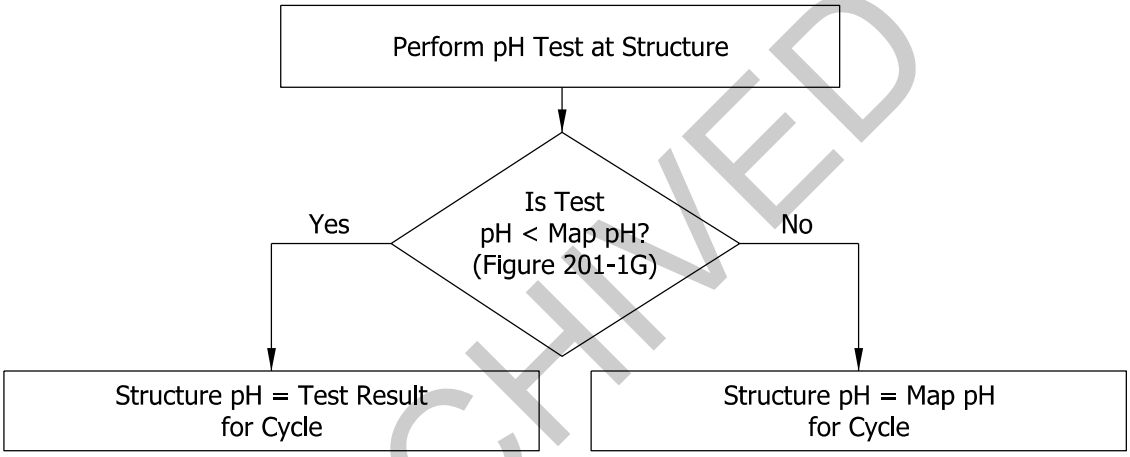
STRUCTURE pH DETERMINATION PROCEDURE
Proposed Storm Drain Structures
Project in Area Where Map pH = 7.0

Figure 201-1B



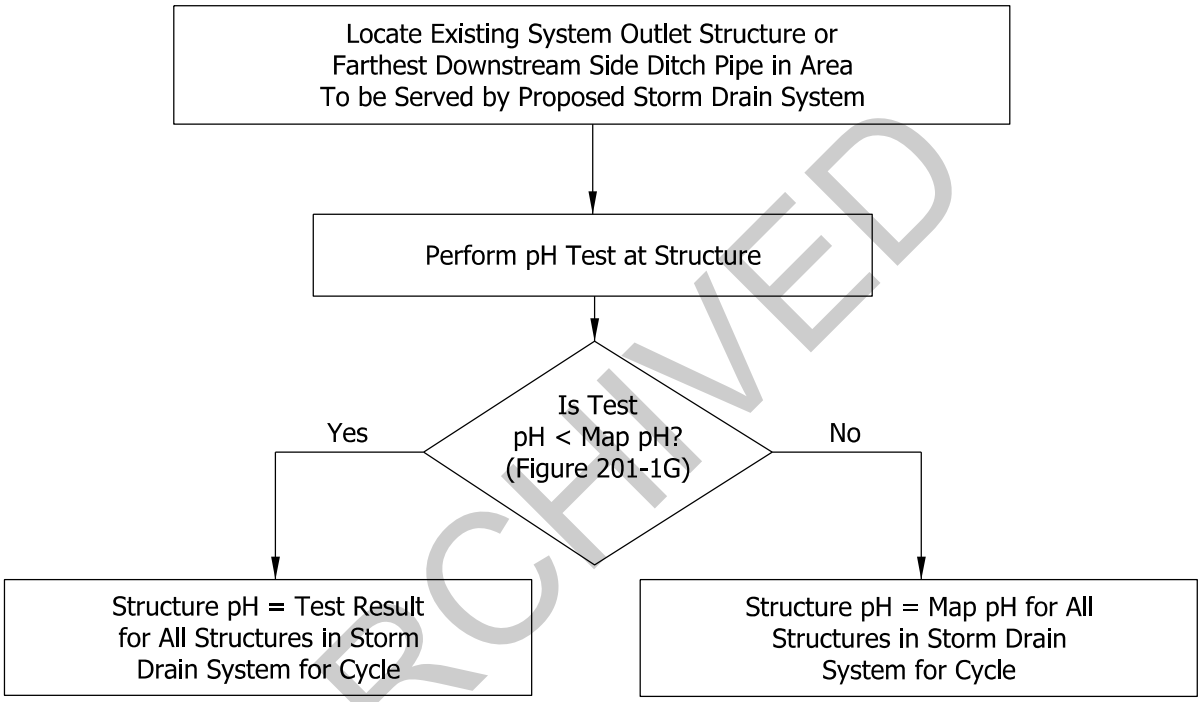
STRUCTURE pH DETERMINATION PROCEDURE
Proposed Side Ditch Culverts
Project in Area Where Map pH = 7.0

Figure 201-1C



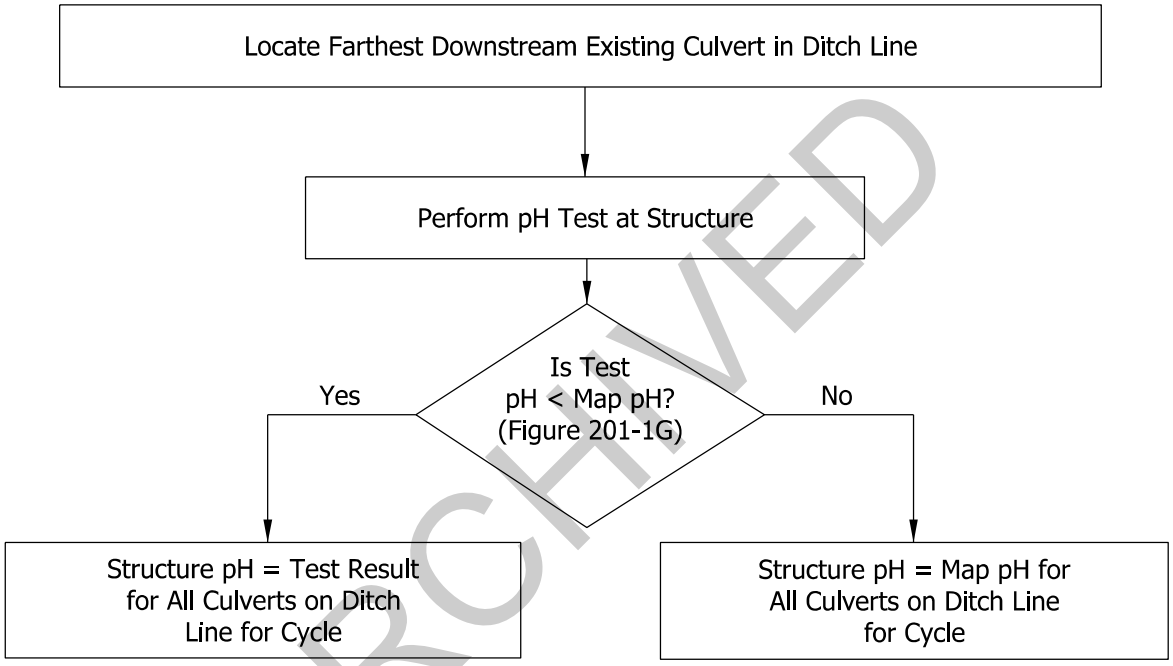
STRUCTURE pH DETERMINATION PROCEDURE
Proposed Mainline Culverts and Other Culverts in Natural Channels
Project in Area Where Map pH = 7.0

Figure 201-1D



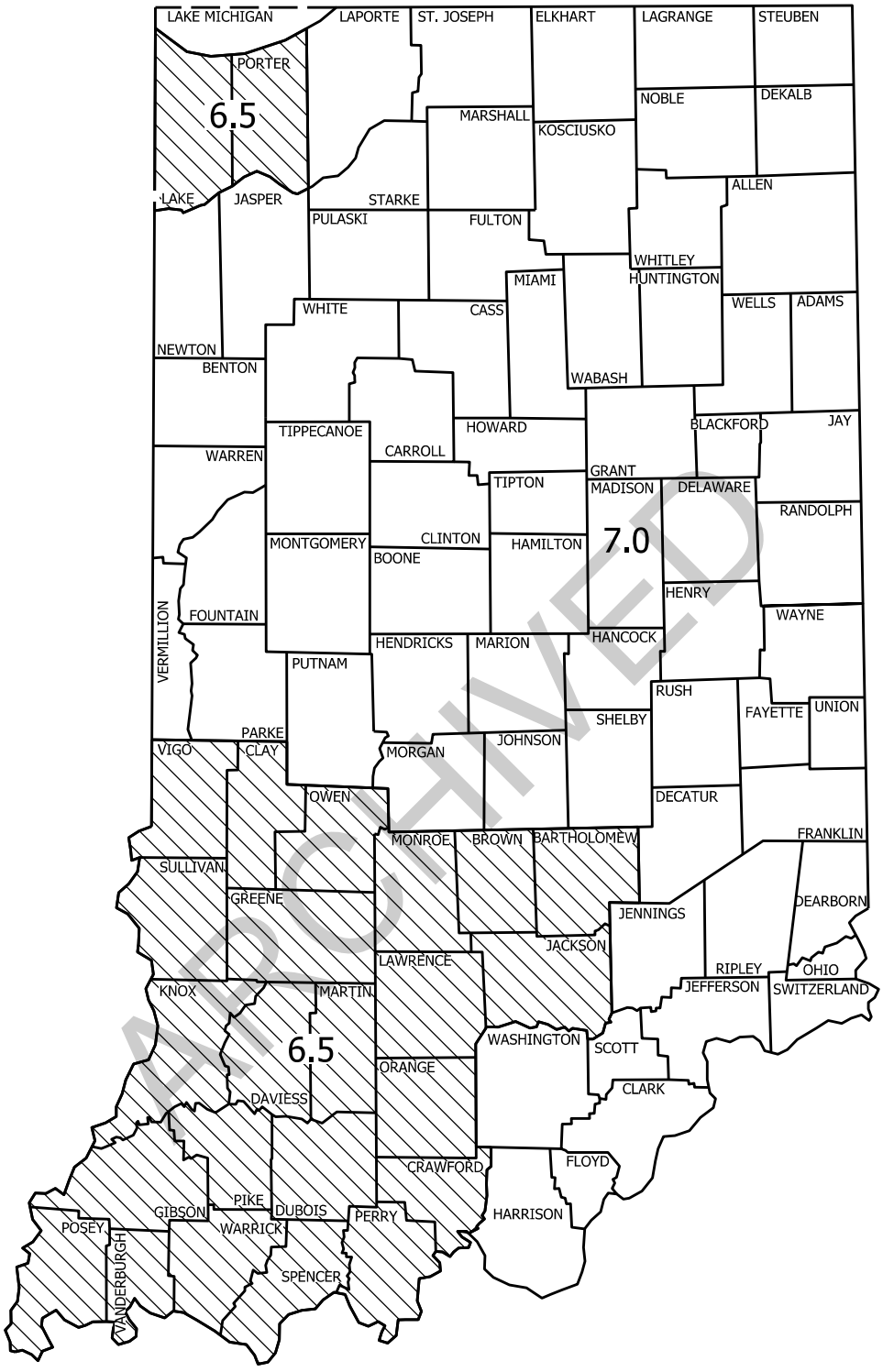
STRUCTURE pH DETERMINATION PROCEDURE
Proposed Storm Drain Structures
Project in Area Where Map pH = 7.0

Figure 201-1E



STRUCTURE pH DETERMINATION PROCEDURE
Proposed Side Ditch Culverts
Project in Area Where Map pH = 7.0

Figure 201-1F



pH MAP

Figure 201-1G