

ECOLOGY TOOLKIT

Culvert Conditions

OVERVIEW

For projects that involve new culvert construction within a perennial stream, or replacement or extension of an existing culvert within a perennial stream, the Ecologist must address US Army Corps of Engineers (USACE) Savannah District permit conditions for culverts (hereafter, referred to as “culvert conditions”) within the Section 404 Preconstruction Notification (PCN) or Individual Permit Application (IPA).

BACKGROUND

Where a roadway intersects a stream, a crossing such as a bridge or culvert is required to pass stream flow. Poorly designed or degraded stream crossings—culverts, in particular—can fragment aquatic habitats, alter hydrology, and impact water quality. Additionally, these crossings can fail outright during extreme weather events. To combat these issues, the USACE Savannah District has developed regulations requiring permittees to ensure new or replacement culverts proposed within perennial streams are designed in close accordance with existing stream slope, cross-sectional dimensions, and flow rate. These same regulations also require permittees to assess proposed culvert extensions for their ability to accommodate or improve aquatic organism passage (AOP) and, when not practicable to achieve this, encourage replacement instead of extension. Proper design of new stream crossings and, where possible, replacing or retrofitting deficient crossings, aim to maintain AOP, improve stream health, protect public safety, and ensure stream crossings are resilient to flooding. For more information, please see the [Georgia Stream Crossing Handbook](#).

REGULATIONS AND GUIDANCE

USACE Savannah District Culvert Conditions

The USACE Savannah District [2021 Nationwide Permit \(NWP\) Regional Conditions \(RCs\)](#) include RC E.3. and E.4., which respectively address installation of new or replacement culverts and culvert extensions in perennial streams. Key requirements relating to these conditions are summarized below. For more detail, see the above linked RCs. Note, identical culvert conditions appear in the USACE Savannah District [2023 Regional Permits \(RGPs\) 30, 31, 32, 33, 34, and 35 for Public Transportation Projects within the State of Georgia](#). (RGPs are the preferred type of General Permit for GDOT projects.) These conditions must also be addressed when applying for an Individual Permit.

Installation of New or Replacement Culverts in Perennial Streams

- Culvert Width – for all types of culverts, the overall width shall be approximately equal to, but not narrower than, the typical (i.e., representative) bankfull width of the stream channel.
- Culvert Size – culverts shall be of adequate size to accommodate flows exceeding bankfull in a manner that does not cause flooding of associated uplands or disruption of hydrologic characteristics.
- Culvert Embedment – the upstream and downstream invert of culverts, excluding arch-span, shall be buried/embedded to a depth of 20% of the culvert height.
- Culvert Slope – the culvert slope shall be set within 25% of the streambed slope. Where culvert slope exceeds 4%, interior baffles on the bottom of the culvert or other measures shall be used.
- Permit Information – the following diagrams are required in the PCN/IPA:

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- Plan view diagram of the existing and proposed conditions,
- Longitudinal profile diagram of the existing stream channel,
- Longitudinal profile diagram of the proposed culvert,
- Representative cross-section diagram of the existing stream channel, and
- Cross-sectional diagrams of the proposed culvert inlet and outlet.

Installation of Culvert Extensions in Perennial Streams

- Justification for any culvert that will be extended instead of replaced that does not accommodate aquatic life passage.
- Documentation of baffles or other corrective measures assessed and implemented, where practicable, to improve aquatic connectivity.

GDOT Guidance

GDOT Design has developed two guidance documents pertaining to culvert conditions which may also be useful to the Ecologist. These documents can be accessed through GDOT's website via [Design Manuals and Guides](#) beneath the "Roadway" heading.

- *Perennial Stream Culvert Design Workflow* – this document describes the iterative process of designing new and replacement culverts on perennial streams to comply with culvert conditions, as well as GDOT design requirements. The workflow outlines actions and decision points for Design, in collaboration with the Ecologist, that should occur during Concept, Preliminary Design, and Final Design.
- *Perennial Stream Culvert Diagrams (Section 39 Plans) Guidance* – this document describes information relating to diagrams for new and replacement culverts on perennial streams which must be created to meet culvert conditions. These diagrams will be developed by Design, in collaboration with the Ecologist, and will appear in Section 39 of GDOT's Lockdown Plan set.

CULVERT CONDITIONS SURVEY

During resource identification, the Ecologist should collect field measurements, observations, photos, and GPS data (hereafter, referred to as a "culvert conditions survey") on perennial streams where a culvert action (i.e., new construction, replacement, or extension) is anticipated to be necessary. This can take place during the initial field visit, a separate, follow-up field visit, or in conjunction with a protected species survey, if applicable. At the time of resource identification, potential culvert actions and their exact locations and/or extents will likely be unknown; however, evaluation of the project type and available mapping resources can narrow down possibilities. Larger, complex project types where roadway capacity is added or access is modified (e.g., new location roadways, widenings, passing lanes, interchange improvements, etc.) have a high probability of requiring culvert actions and often require multiple culvert actions. Smaller, simpler project types (e.g., bridge replacements, roundabouts, pedestrian/bike facilities, etc.) have a lower likelihood of culvert actions and rarely require multiple, if any, culvert actions.

In addition, reviewing available map resources prior to the resource identification survey is important for identifying potential perennial streams and their proximity to anticipated project activities. For example, potential perennial streams occurring near the edge of the Environmental Survey Boundary (ESB) and flowing away from the project are unlikely candidates for culvert actions. Such instances may be reasonably ruled out

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in terms of needing a culvert conditions survey. Alternatively, where potential perennial streams intersect and/or flow through existing culverts within the anticipated project area, these streams should be flagged for field investigation and a culvert conditions survey when confirmed as perennial. (Note, perennial streams where proposed bridges are anticipated are excluded from the requirements of culvert conditions.) For streams flagged as needing field investigation, the Ecologist should generate bankfull width and depth estimates prior to survey (see below). These estimates can be used as a starting point when identifying bankfull width in the field.

Map Resources

Assess the following map resources for the ESB to identify potential perennial streams to flag for field investigation:

- US Fish and Wildlife Service (USFWS) [National Wetland Inventory](#) (NWI),
- USGS [National Hydrography Dataset](#) (NHD), and
- USGS 7.5-minute topographic quadrangles.

Bankfull Estimation

Bankfull data for a stream can be estimated through regression equations, which commonly vary by ecoregion and which utilize drainage area to predict corresponding channel characteristics such as width and depth. Georgia is divided into five ecoregions for the purposes of bankfull estimation: Piedmont, Blue Ridge, Valley and Ridge, Appalachian Plateau, and Coastal Plain (see *Georgia Ecoregions Map* available on the [Ecology Section SharePoint](#)¹ site). A stream's drainage area can be determined through the US Geological Survey (USGS) [StreamStats](#) website or by requesting this information from Design.

GDOT projects outside of the Coastal Plain can utilize equations within StreamStats to predict bankfull width and depth. This can be done by delineating the stream basin, which also produces the drainage area, and then selecting "Bankfull Statistics" from the Regression Based Scenarios. Several results will display; however, those beneath the associated ecoregion (e.g., Piedmont, Blue Ridge, etc.) should be referenced. For projects within the Coastal Plain, an Excel file (see [Regional Curve Equation Calculator](#)) available on the Ecology Section SharePoint site should be used for estimating bankfull dimensions. The calculator requires inputting the stream's drainage area to estimate width and depth values. The calculator also contains equations for the other ecoregions that duplicate those used in StreamStats. These may be used in scenarios, occurring after the resource identification survey, where StreamStats does not allow for delineation of a stream basin and corresponding bankfull estimates.

Gear, Equipment, and Data Form

Gear, equipment, and data form required to complete a culvert conditions survey are listed below. Additional personal equipment needed may include but is not limited to rubber (waterproof) boots, notebook and pencil, insect repellent, sunscreen, first aid kit, food, and water.

- Tape measure (minimum 50 feet), pins and clamps (for stabilizing tape), and pocket level for measuring bankfull width,

¹ See instructions for accessing SharePoint on the [Office of Environmental Services Guidebooks website](#).

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- Pocket rod or folding ruler (minimum 6 feet) for measuring maximum bankfull depth,
- Digital camera,
- GPS unit capable of sub-meter accuracy, set to GA State Plane, NAD83 coordinates and US survey feet units (an external antenna and range pole can assist with reception in dense canopy cover), and
- Data form: *Culvert Conditions Survey Form for Perennial Streams*, available on the Ecology Section SharePoint site.

Field Procedures

Identify Representative Location(s)

Culvert conditions survey data should be collected at representative locations within the ESB on perennial streams anticipated to have a culvert action. According to USACE Savannah District culvert conditions, the following guidelines should be prioritized, where possible, when identifying representative locations:

- The representative location should correspond to the head, or top, of a stable riffle (or a ripple in Coastal Plain streams), when present.
- If culverts exist within the stream, the representative location should be approximately 100 feet upstream (preferably) or 100 feet downstream of the culverts, to be away from the influence of such structures, if possible. (If neither is possible, document the reasons for this and select the furthest possible location less than 100 feet away from the structures).
- Typically, one representative location per stream should be satisfactory; however, highly variable streams could warrant additional locations.

Additional best practices include:

- Where riffles/ripples are not present, the head of a run is preferred.
- Stream reaches containing pools, bends, significant incision, and/or heavy erosion or disturbance should be avoided.
- Areas immediately upstream or downstream of beaver dams or impoundments should not be utilized.
- Where multiple culvert actions may occur along the same stream, collecting data at several locations is preferred.

While it may be infeasible to meet all the above considerations, selecting locations that meet as many of the listed criteria as possible is the goal when identifying representative locations. Additionally, any unusual or challenging circumstances should be noted in the data form.

Collect Culvert Conditions Survey Data

The Ecologist should utilize the *Culvert Conditions Survey Form for Perennial Streams* to collect necessary data at each identified representative location. The form is divided into sections for general project information, existing stream information (including bankfull width/depth field measurements), and existing culvert information, if applicable. Note, it is important to complete the portions of the form on additional information relating to the existing stream and/or culvert when unique circumstances are present (e.g., impoundments, beaver activity, channel impairments or alterations, culvert deficiencies, etc.). In addition to completing the

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form, the Ecologist should take a GPS point at the representative location, as well as photos of the stream and culvert as directed on the form.

Bankfull stage, where the Ecologist will measure width and depth, is defined as the stream's dominant channel-forming flow, typically falling between the 1- and 2-year storm events. The USACE Savannah District has further indicated that bankfull stage usually has a recurrence interval corresponding to the 1.5-year storm event. Identification of bankfull stage in the field can be challenging, as indicators may or may not be present or obvious. Within a natural, unimpaired stream, bankfull stage corresponds to the level at which a stream is at the top of its banks and any further rise would result in water moving into the floodplain. However, such circumstances are uncommon on GDOT projects where streams are more likely to be impaired or altered (e.g., entrenched or channelized). Given these circumstances, bankfull stage often occurs within the confines of one or both banks, making it more difficult to distinguish.

As a result, using estimated bankfull width and depth values (i.e., those values previously generated from StreamsStats and/or the Excel calculator) is important to reduce effort by establishing a starting point for field identification of bankfull stage. The Ecologist should begin their evaluation by measuring out the estimated bankfull width across the channel and/or using the estimated bankfull depth to measure the corresponding width. From there, field indicators (e.g., change in bank slope, depositional features, change in particle size or vegetation, scour features, etc.) should be utilized to refine the width measurement as appropriate for the stream. Once bankfull width has been identified and measured, the bankfull depth (at maximum) can also be measured.

Accessibility and Safety Concerns

Most streams requiring a culvert conditions survey are likely to be smaller-order perennials where access or safety concerns should not be an issue. However, where access is challenging or unsafe, discrete estimates (i.e., not a range of values) for bankfull width and depth are allowable. All other data including a GPS location and photos should be collected.

Post-Field Procedures

A quality control review of all *Culvert Conditions Survey Forms*, as well as associated GPS points and photos, should be completed following the field effort to ensure accuracy and proper labeling. Subsequently, this information should be provided to Design via email. When feasible, the forms, GPS points, and photos should be transmitted at the same time as the general survey delineation files (see *Ecology Resource Survey* guidebook for more information). Otherwise, the data should be sent to Design in advance of the Avoidance and Minimization Measures Meeting (A3M). The Ecologist should clearly indicate that the provided information is related to permit requirements for potential new or replacement culverts and/or culvert extensions within perennial streams. It is also recommended that the Ecologist refer Design to the *Perennial Stream Culvert Design Workflow* for further guidance on the GDOT design process for addressing USACE Savannah District culvert conditions. This will ensure Design has the necessary context and tools to prepare for A3M discussions on culvert conditions.

Ecology Environmental Procedures Guidebooks,
GDOT Office of Environmental Services

COMMUNICATION MILESTONES

There are three communication milestones when the Ecologist should coordinate with Design regarding culvert conditions.

Avoidance and Minimization Measures Meeting (A3M)

During A3M, the Ecologist shall discuss with Design if there will be new culvert construction, replacement, and/or extension within a perennial stream for the proposed project. If so, the project team shall review the requirements associated with the USACE Savannah District culvert conditions (i.e., culvert width, slope, and embedment). Where extensions are proposed, Ecology and Design should provide their perspectives on extension versus replacement. Ecology perspectives should include discussion of the existing culvert's state (e.g.: Is it embedded or bottomless? Are there barriers to AOP such as perched ends or the culvert being too wide or too narrow?) and whether the presence of protected aquatic species and/or their habitat may enhance the need for AOP improvements. The outcome of this discussion should be a consensus on how to proceed. If an extension is the result, the team should summarize and document considerations for this decision, as well as any potential corrective measures that may be applied to the existing culvert to improve AOP. This information will be later utilized in the PCN/IPA.

Where a replacement is the outcome, or in cases where a new or replacement culvert is initially proposed on a perennial stream, Ecology and Design should review available bankfull width data (i.e., Ecologist field measurements and StreamStats and/or Excel calculator estimates). If the field data and estimated values are similar and in alignment with GDOT design criteria, the proposed culvert width can be selected using Table 2 in the *Perennial Stream Culvert Design Workflow* document. Otherwise, following A3M, Design should proceed with hydraulic modeling, as described in the workflow document, to generate a third bankfull width value for consideration. Additional coordination between Ecology and Design will be necessary to reach an agreement on bankfull width and the corresponding proposed culvert width. Note, the project team should recognize the challenging and complex nature of establishing bankfull width. The practical goal should be a thoughtful, reasoned determination supported by a combination of available bankfull information (i.e., field measurements, StreamStats and Excel estimates, and/or hydraulic modeling). Furthermore, it is critical that an agreement on bankfull and culvert width, which will meet regulatory requirements, is reached prior to the project advancing to Preliminary Field Plan Review (PFPR). Once plan development has progressed to PFPR, altering structures such as culverts becomes increasingly challenging as it can trigger modification of other, adjacent roadway elements. Reaching an agreement prior to PFPR will help avoid costly schedule delays that could result from late-stage design changes.

In addition to width, culvert slope and embedment requirements should be reviewed at A3M to ensure these items will be addressed by Design. Lastly, in scenarios where the project team cannot resolve conflicts between the USACE Savannah District culvert conditions and GDOT design criteria, refer to the Troubleshooting section of this toolkit.

Preliminary Plans

Upon receiving preliminary plans, the Ecologist should review available culvert design information on the 13-series (i.e., Mainline) and 22-series (i.e., Drainage Profiles) plan sheets for consistency with culvert conditions. (Note, permit-specific diagrams for new and replacement culverts [i.e., 39-series, Special Design Box Culverts]

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are not currently a requirement for Design at this stage of plan development.) Items which should be feasible to review include proposed culvert width and embedment for new and/or replacement culverts. If culvert embedment is not indicated on the plans, the Ecologist should request this information from Design. Additionally, justifications for culvert extensions and proposed corrective measures, where practicable, can be confirmed with Design at this time. Where conflicts with the culvert conditions are newly identified, or continue to persist, consult the Troubleshooting section of this toolkit.

Lockdown Plans

Upon receiving lockdown plans, the Ecologist should confirm the presence of 39-series plan sheets for each new and/or replacement culvert, ensure required information is provided on those diagrams, and verify culvert conditions are being met.

Specifically, the Ecologist should review the following:

- All diagrams are included for each crossing in the correct order and contain required information as stipulated in the *Perennial Stream Culvert Diagrams (Section 39 Plans) Guidance* document:
 - Plan view diagram of existing and proposed conditions,
 - Longitudinal profile diagram of the existing stream channel,
 - Longitudinal profile diagram of the proposed culvert,
 - Representative cross-section diagram(s) of the existing stream channel, and
 - Cross-section diagrams of the proposed culvert inlet and outlet.
- Information is clearly and accurately presented, for example:
 - Can the stream delineation, flow direction, and associated culvert be easily identified?
 - Should any plan information be hidden for improved clarity (e.g., intermediate contour lines)?
 - Are existing culverts subject to removal identified?
 - Are labels and notes provided with correct information?
 - Do the points for calculating existing streambed slope seem correctly placed on the longitudinal profile, and is the slope % validated by the diagram (i.e., station numbering and elevations)?
 - Do bankfull width and embedment measure correctly on the cross-section diagrams?
- Diagrams demonstrate adherence to bankfull width, slope, and embedment requirements as described above in the Regulations and Guidance section of this toolkit.

Where unique circumstances are present and challenging to interpret on the diagrams (e.g., excavation or channel relocation required to tie in the culvert with the existing stream, significant skew of the culvert from the stream alignment, etc.), plan notes should be added to provide context and clarity. The Ecologist shall request revisions to the diagrams as necessary to resolve deficiencies. For any culvert extension, the Ecologist shall locate the relevant 13- and 22-series plan sheets displaying the culvert and finalize information related to the justification statement and documentation of corrective measures. As previously stated, where conflicts with the culvert conditions are noted or persist, consult the Troubleshooting section of this toolkit.

DOCUMENTATION

Ecology Reports

The Ecologist shall follow instructions in the latest *Ecology General Project Report Template and Guidance*, available on the Ecology Section SharePoint, within the tabular portion of the “Federal Aquatic Resources” section for entering perennial stream bankfull dimensions, as well as details on existing aquatic connectivity barriers for associated culverts. This information will primarily come from the culvert conditions survey and is populated at the time of the Ecology Resource Survey Report. (Note, where refinement of bankfull values occurs through coordination with Design [e.g., due to A3M discussions], dimensions should be correspondingly updated in subsequent reports.) For the Assessment of Effect Reports (AOER), the Ecologist should also provide a written statement under the Impact Discussion/Avoidance and Minimization Measures (AMM) portion that stipulates culvert conditions will apply to relevant culvert actions in perennial streams (extension, replacement, new). Project-specific information on culvert conditions should not be indicated as this may change over the course of project development. Instead, such details will be provided to the USACE through the PCN/IPA.

Pre-Construction Notification/Individual Permit Application

For PCNs and IPAs, the Ecologist should complete a standardized form for each culvert action which includes a table, photographs, and plan sheets. Unique form templates for new/replacement culverts and culvert extensions are available through the Ecology Section SharePoint site (see “Culvert Conditions”) and contain detailed instructions on what information must be provided. Consult the PCN Checklist or the IPA Template for further directions on how to include these forms in the respective application type. The PCN Checklist and IPA Template can be found within the “USACE Guidance and Documents” folder on the Ecology Section SharePoint site.

TROUBLESHOOTING

Exceptions to culvert conditions are rarely granted by the USACE Savannah District, even when unusual circumstances may be present. As a result, the project team should make every effort to find solutions that will satisfy the conditions, as well as other design criteria, prior to engaging the USACE about an exception.

Where conflicts with the conditions cannot be resolved, the project team may request pre-application coordination with the USACE Savannah District pursuant to NWP RC E.2 (also mirrored in the RGPs) which states, “in cases where a proposed project cannot be constructed as required by a RC, there may be an acceptable alternative construction technique that could be used to ensure impacts to aquatic resources remain minimal.” This RC further requires: (a) detailed discussion of why the activity-specific RC cannot be met, and (b) adequate scientific or engineering information necessary to document that the proposed alternative construction technique would achieve equal or better aquatic resource impact avoidance as the RC. Therefore, the project team should be prepared to provide a robust justification supported by additional information (e.g., hydrology and/or hydraulic studies, floodplain analysis, etc.) when coordinating with the USACE to discuss alternatives to culvert conditions.

Pre-application coordination on culvert conditions can be a lengthy process; therefore, it is important to engage the USACE as early as possible to minimize the potential for schedule delays. The goal of this coordination is to present project constraints relating to culvert conditions, as well as proposed alternatives, and request input from the USACE on additional steps or information that may be necessary to support the request for an

exception. An official determination on whether the proposed alternative(s) will comply with the RC will not be provided by the USACE until the PCN/IPA is submitted for their review. However, pre-application coordination should improve the likelihood of success and ensure proper documentation is provided in the subsequent PCN/IPA.

OTHER CONSIDERATIONS

Protected Species

This toolkit focuses on culvert conditions as they pertain to Section 404 permitting requirements. However, the application of culvert conditions should also be considered when evaluating effects to protected aquatic species where culvert work is proposed on perennial streams. If AOP is anticipated to improve through proposed culvert extensions and/or replacements, or would be maintained at new location culverts, such outcomes should be indicated in the AOER and/or Addendum when addressing AMMs for protected aquatic species.

TOOLKIT REVISION HISTORY

Revision Description	Relevant Sections	Revision Date
Initial Publication	All	10/1/2024
Content Review (no changes)	All	1/22/2025