Georgia Department of Transportation

# POST-CONSTRUCTION STORMWATER REPORT

PI Number: 0013549
Project Name: SR-21 Pedestrian Bridge
City/County: Chatham
District: 5

Submittal Date: 03/09/2016
Consultant: Arcadis
Let Date: 06/17/2016
Contact Phone: 770-731-8666

**Milestone Submittal**: ☒ PFPR ☐ FFPR

**General Project Information**:

Is there a Project Level Exclusion that applies to this project: ☐ Yes ☒ No

If yes, please indicate which of the following exclusions apply:

- ☐ Roadway not owned or operated by GDOT
- ☐ Project not located within an MS4 area
- ☐ Maintenance or safety project (multiple unconnected sites disturbing < 1 acre)
- ☐ Project with environmental documents approved or R/W plans submitted on or before June 30th, 2012
- ☐ Road project disturbing < 1 acre or site development project adding < 5,000 ft² of impervious area

Is there an Outfall Level Exclusion that applies to this project: ☒ Yes ☐ No

If yes, please indicate in Attachments B and C

**Disturbed Area of Site: 0.79 acres**
**Impervious Area Added**: **0.33 acres**
**Net Length of Project**: **0.15 miles**
**Existing Cross-Section: Rural**
**Proposed Cross-Section: Rural**
**AADT (Design Year):** _____

**Submittal Requirements**:

| Yes | No | |
|---|---|---|
| ☒ | ☐ | GDOT LID / GI Checklist (Attachment A) |
| ☒ | ☐ | GDOT Post-Construction BMP Summary (Attachment B) |
| ☒ | ☐ | MS4 Infeasibility & Outfall Level Exclusion Report (Attachment C) |
| ☒ | | Milestone Plan Submittal Checklist (Attachment D) |

# Attachment A
# GDOT Low Impact Development (LID) / Green Infrastructure (GI) Checklist

**Design Considerations**

☒ The following site considerations were considered, where applicable, and incorporated into an LID/GI approach: safety, ease of maintenance, available right-of-way, soils, terrain slope, pollutants of concern, existing utilities and other infrastructure details

☒ Where applicable, the following site-specific environmental components have been clearly identified on the project site: wetlands, impaired waters, environmentally sensitive areas, applicable buffers

**Design Documentation**

List any site-specific limitations or constraints that will have an effect on the utilization of feasible post-construction stormwater LID and/or GI practices. _____

_____

_____

☒ The following LID/GI practices were used. For those that were not used, explain why it was infeasible for this project.

| Yes | No | |
|---|---|---|
| ☒ | ☐ | Avoidance (Planning around environmentally sensitive areas): _____ |
| ☒ | ☐ | Minimization: _____ |
| ☒ | ☐ | Footprint reduction: _____ |
| ☒ | ☐ | Incorporating WQ early in planning process by: _____ |
| ☒ | ☐ | Rural road section in place of urban |
| ☒ | ☐ | Landscaping areas outside of clear-zone w/ trees: _____ |
| ☒ | ☐ | Adjusting the design to natural terrain |
| ☐ | ☒ | Porous Pavements (OGFC): No new pavement is proposed for this project. |
| ☒ | ☐ | Post-construction BMPs that allow for: infiltration, evapotranspiration, and stormwater reuse |
| ☒ | ☐ | Using recycled materials such as asphalt and concrete: _____ |

☒ The LID/GI practices shown on the plans address all GDOT and MS4 permit requirements

☒ A cost estimate has been provided to GDOT at the milestone review (preliminary estimate for PFPR and a detailed estimate for FFPR)

**Inspection and Maintenance Responsibility (select one)**

☐ Dedicated to City or County (indicate which) of: _____

☐ Private Entity Responsibility: name responsible entity here: _____

☒ GDOT Responsibility

**Attachment B**
**GDOT Post-Construction BMP Summary**

| Drainage Area Characteristics | | | | | Applicable MS4 Requirements | | | | | Planning Considerations | | | Location and Identification | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Outfall Area (Drainage Basin) | Receiving Water | Impaired (Yes/No) | Impairment | Is there a TMDL approved? | $WQ_v$ | $CP_v$ | $Q_{P25}$ | $Q_f$ | Outfall Level Exclusion (Yes/No) (If yes, see Note 2) | BMP | LID or GI? | Infeasible (Yes/No) | Station (Begin - End) | Offset (Left/Right) | Plan Sheet |
| 1A | Little Hearst Branch | No | N/A | No | ✓ | X | X | X | Yes (3) | N/A | N/A | N/A | N/A | N/A | 1 |
| 1B | Little Hearst Branch | No | N/A | No | ✓ | X | X | X | Yes (6) | N/A | N/A | N/A | N/A | N/A | 1,2 |
| 1C | Little Hearst Branch | No | N/A | No | ✓ | X | X | X | Yes (6) | N/A | N/A | N/A | N/A | N/A | 1,2 |
| 1D | Little Hearst Branch | No | N/A | No | ✓ | X | X | X | Yes (6) | N/A | N/A | N/A | N/A | N/A | 2,3 |
| 2A | Little Hearst Branch | No | N/A | No | ✓ | X | X | X | Yes (6) | N/A | N/A | N/A | N/A | N/A | 2,3 |
| 2B | Little Hearst Branch | No | N/A | No | ✓ | X | X | X | Yes (6) | N/A | N/A | N/A | N/A | N/A | 2,3 |

**NOTE 1:** If a BMP is identified as infeasible, a completed infeasibility & outfall level exclusion report (Attachment C) must be submitted at or before PFPR.

**NOTE 2:** Indicate whichMS4 requirements are applicable by a checkmark and if an Outfall Level Exclusion can be claimed. If an Outfall Level Exclusion is claimed, include the exclusion number (as listed in the Post-Construction Stormwater Guidance document) and provide supporting evidence in Attachment C.

**NOTE 3:** ✓ means applicable, **X** means not applicable.

# Attachment C

# Georgia Department of Transportation

# Preliminary MS4 Feasibility Assessment for

# SR 21 @ CS 705/Parkside Blvd Pedestrian Bridge

# In Port Wentworth

PI No.0013549

Chatham County

April 15, 2016

Prepared By:

ARCADIS

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GEORGIA REGISTERED No. 30568 PROFESSIONAL 4/15/16 ENGINEER WILLIAM EDWARD DIAL III

William Dial, PE
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## Executive Summary

In January 2012, the Environmental Protection Division (EPD) of the Georgia Department of Natural Resources issued the Georgia Department of Transportation's (GDOT's) first Municipal Separate Storm Sewer System (MS4) Permit (General NPDES Permit No. GAR041000) (Permit) for discharges from its MS4 designated areas.

The Permit regulates new and existing point source discharges of stormwater from roadways owned and operated by GDOT to waters of the State of Georgia. The SR 21 @ CS 705/Parkside Blvd Pedestrian Bridge In Port Wentworth project must meet the requirements of the Permit, which include incorporating permanent water quality control and detention measures (best management practices [BMPs]) into the design where appropriate, where those BMPs have not been determined to be infeasible based on the exclusion and infeasibility criteria identified in Section 1.2 and Section 1.4 of the GDOT Guidelines for Design of Post-Construction BMPs (GDOT Guidelines) issued June 12, 2014, and where required in accordance with the GDOT Guidelines.

To assist with the development of final design for the project and meet Permit requirements, ARCADIS performed a preliminary analysis of the project in accordance with the guidance and criteria discussed above and below to identify and size feasible post-construction stormwater BMPs that must be implemented and those that may be eliminated.

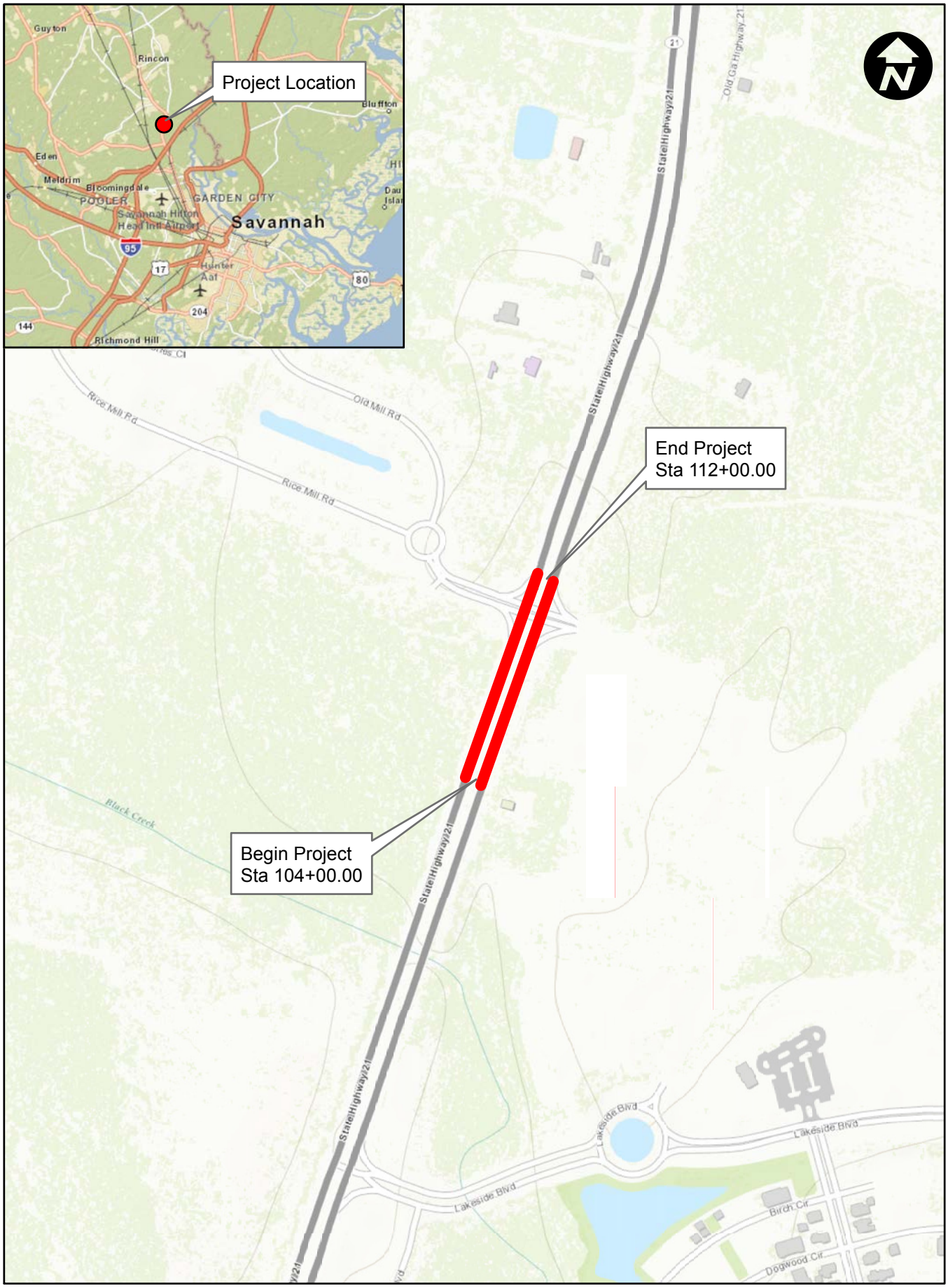
This report documents the applicable guidance and criteria, analysis performed, and results and conclusions. The analysis is based on current design and cost of the improvements. Feasibility of the post-construction BMPs will need to be revisited during the final design by the design-build team and revised based on the revised project design or refined cost estimates.

## Project Description

GDOT proposes construction of a pedestrian bridge over SR 21 in Port Wentworth at Rice Elementary School. The proposed project also includes construction of a sidewalk to the nearby intersection of Rice Mill Rd and SR 21. Refer to the location map on the following page illustrating the approximate project limits.

This project is divided into 2 proposed drainage basins. Refer to Appendix A for drainage area delineations.

# Project Location Map



## Definitions

The definition of a MS4 outfall which includes discussion of other MS4 system points of interest that do not meet the definition of a MS4 outfall as defined in the Permit is as follows:

**MS4 Outfall** – The MS4 outfall is the most downstream point on an MS4 drainage area where it discharges to waters of the State. It does not include cross-drain structures or culverts installed under a road that function only to maintain the natural flow of surface waters and drainage. However, a structure that collects or diverts drainage that has contacted road surfaces for discharge into waters of the State is considered an outfall under this Permit. In addition, wherever a water feature leaves the right-of-way (ROW) prior to entering waters of the State, the point at which the water feature leaves the ROW is considered the MS4 outfall for the purpose of this report.

## Design and Infeasibility Criteria

To the extent feasible, BMPs were designed in accordance with the Permit requirements, GDOT Guidelines, the Georgia Stormwater Management Manual (GSMM) dated August 2001, and the current edition of the GDOT Drainage Manual. (September 2014)

A summary of the standard design criteria from the GDOT Guidelines is as follows:

**Stormwater Runoff Quality and Reduction** (Water Quality) – Demonstrate 80 percent removal of total suspended solids (TSS) from runoff generated by a 1.2-inch rainfall event. The GDOT Drainage Manual refers to this design criterion as Stormwater Runoff Quality Reduction. The volume of water to be treated is referred to as the water quality volume ($WQ_V$).

**Stream Channel Protection** (Channel Protection) – Detain the 1-year, 24-hour rainfall event. The GDOT Drainage Manual refers to this design criterion as Stream Channel / Aquatic Resource Protection. The volume of water detained is referred to as the channel protection volume ($CP_V$).

**Overbank Protection** ($Q_{P25}$) – Calculated post-construction peak discharge rate that is less than or equal to pre-construction rates for the 25-year, 24-hour rainfall event. The GDOT Drainage Manual refers to this design criterion as Overbank Flood Protection.

**Extreme Flood Protection** ($Q_f$) – Control the 100-year, 24-hour flood such that flooding is not exacerbated. The GDOT Drainage Manual refers to this design criterion as Extreme Flood Protection.

**Project and Outfall Level Exclusions**

MS4 post-construction stormwater requirements that involve the design and installation of post-construction BMPs that are not deemed applicable to a project can be excluded from the project entirely if one of the "Project Level Exclusions" is met. If a project does not meet a Project Level Exclusion, specific outfall drainage areas within a project may meet an "Outfall Level Exclusion" (specific only to an area of the project). Both Project Level and Outfall Level Exclusions are defined below:

**Project Level Exclusions**

1. Roadways that are not owned or operated (maintained) by GDOT may not require post-construction BMPs. Coordinate with the appropriate local government or entity to determine stormwater management requirements.
2. The project location is not within a designated MS4 area.
3. Maintenance and safety improvement projects whereby the sites are not connected and disturbs less than one acre at each individual site. This includes projects such as repaving, shoulder building, fiber optic line installation, sign addition, and sound barrier installation.
4. Projects that have their environmental documents approved or ROW plans submitted for approval on or before June 30th, 2012.
5. Road projects that disturb less than 1 acre or for site development projects that add less than 5,000 $ft^2$ of impervious area.

For this project, no project level exclusion criteria are met.

**Outfall Level Exclusions**

1. Cases where the project would require an existing roadway alignment change solely to allow for BMPs. This exclusion applies only to existing roadway alignment changes that would create a safety concern. A written explanation of the safety concern(s) must be included with the post-construction stormwater report for all uses of this exclusion.
2. Instances where the installation of post-construction BMPs would require the re-alignment and/or piping of a stream.
3. When a project would impact existing vegetated stream buffers or wetlands solely for the purposes of installing BMPs. See state requirements for additional information on stream buffers.
4. Where stormwater discharges from the project site are designed to exit the ROW as sheet flow (non-point source discharges). Sheet flow should be designed in a manner to ensure that the flow will not cause instability, erosion, or flooding. The designer should determine if this is possible by visiting the site prior to design, and providing a written explanation with supporting evidence for this drainage area.
5. As stated in section 4.2.5.1(a) of the GDOT MS4 permit, "Stormwater runoff that must be treated does not apply to flows that originate outside of GDOT's right-of-way or diverted flows from undisturbed areas." If feasible, direct all offsite stormwater around the project site to the cross drain or stream such that it does not combine with stormwater from the project's impervious surfaces or conveyance systems. This redirection allows the BMPs to only treat or detain the stormwater that originates from GDOT's site, and stormwater that originates off-site to pass through the right of way unimpeded.

6. As stated in section 4.2.5.1(a) of the GDOT MS4 permit, for outfalls along linear roadway projects whereby the net impervious surface area within that outfall's drainage area has been reduced or remains the same as pre-developed conditions, post-construction stormwater requirements will not apply. Special consideration from the Department may be given to those projects with a minimal increase in impervious area. In such cases, the designer will be required to provide supporting calculations showing that the increase in stormwater runoff and/or volume required to be treated for water quality is negligible with respect to the drainage area in question.

**Feasibility Evaluation**

GDOT's MS4 permit requires treatment of stormwater runoff from GDOT property and ROW to the maximum extent practicable. Therefore, the requirements and minimum standards previously described should be met to the maximum extent practicable. In some situations, site constraints and other factors may make this infeasible. The following criteria are used to define the situations where implementing post-construction BMPs is considered infeasible and should be applied to each discharge point or drainage area individually:

1. The BMP costs equal or exceed 10% of the total project costs. Project costs should include:
    a. ROW acquisition
    b. roadway construction (not including Intelligent Transportation Systems (ITS) or toll related expenses)
    c. utility relocation

    BMP costs should only be compared to the portion of the project within the BMP's associated drainage area and should include:
    a. additional ROW requirements
    b. BMP construction and all other related design elements
2. Implementation of BMPs will cause 90 days or greater of delays to the project.
3. Implementation of BMPs will cause loss of habitat for endangered or threatened species.
4. Implementation of BMPs will cause significant damage to a cultural or community resource such as an historical site, archeological site, cemetery, a park, wildlife refuge, nature trail, or school facilities.
5. Implementation of BMPs would result in the displacement of a residence or business.
6. Implementation of BMPs would result in violation of state or federal law or regulation.
7. Site limitations including: shallow bedrock, contaminated soils, high groundwater, utilities, or underground facilities if avoidance or relocation is infeasible (cost of the relocation equals or exceeds the cost of the BMP).
8. Soil infiltration capacity is limited, where the soil hydraulic conductivity (K) is less than $10^{-4}$ cm/second.
9. Site is too small to infiltrate a significant volume.
10. Site does not allow for gravity flow to the appropriate BMP.

**Best Management Practices**

In addition to the above criteria, an appropriate BMP must be available for construction. Current GDOT policy allows the following eleven BMPs for post-construction stormwater management. The minimum total suspended solids (TSS) removal level for this project is 80%.

| | Treatment Parameters | | | | |
|---|---|---|---|---|---|
| BMP | $WQ_V$ | TSS Removal | $CP_V$ | $Q_{P25}$ | $Q_f$ |
| Filter Strip | Yes | 60% | No | No | No |
| Grass Channel | Yes | 50% | No | No | No |
| Enhanced Swale | Yes | 80% | In Some Situations | No | No |
| Infiltration Trench | Yes | 80% | In Some Situations | No | No |
| Sand Filter | Yes | 80% | In Some Situations | No | No |
| Dry Detention Basin | Yes | 65% | Yes | Yes | Yes |
| Wet Detention Pond | Yes | 80% | Yes | Yes | Yes |
| Stormwater Wetland | Yes | 85% | Yes | Yes | Yes |
| Bioslope | Yes | 95% | No | No | No |
| Bioretention Area | Yes | 85% | In Some Situations | No | No |
| Open Graded Friction Course | Yes | 50% | No | No | No |

TSS = Total Suspended Solids

As shown in the table above, certain BMPs do not provide all treatment required and would have to be used in a “treatment train.” If used in a treatment train, the TSS removal for the treatment train would be calculated by using 100% of the TSS removal of the first BMP in the treatment train and remaining TSS times the TSS removal rate of the second BMP in the treatment train. For example, if the open graded friction course (OGFC) and a dry detention pond were used together the total TSS removal based on the table above would be 50% (for the OGFC) + (50% remaining TSS)* 65% (for the dry detention pond) which would result in a total TSS removal of 82.5% which would exceed the required 80%.

In accordance with GDOT guidelines, applicable BMPs with the least amount of impact were evaluated first. The least amount of impact is defined as the lowest cost BMP with the lowest long term maintenance cost that will provide the required treatment for the drainage area. If determined inappropriate or infeasible, the next BMP with the least amount of impact will be considered until an appropriate BMP is selected or all of the BMPs are eliminated.

## Design Calculations

### Time of Concentration

For each MS4 drainage area, time of concentration was determined using the SCS method outlined in the TR-55 and the time of concentration for each MS4 drainage basin was calculated using the NRCS watershed lag method outlined in chapter 15 of the National Engineering Handbook Part 650.

As outlined in the TR-55, time of concentration is broken up into sheet flow, shallow concentrated flow, and open channel flow. Per the GDOT Drainage Manual and Georgia Stormwater Management Manual, sheet flow occurs for a maximum flow length of 100 feet before becoming shallow concentrated flow. Open channels flow begins where channels are visible on aerial imagery or where channels are assumed to begin using topography.

The travel time for each segment is to be calculated individually and summed to determine the time of concentration for each MS4 drainage area. A minimum time of concentration of 10 minutes was used. As outlined in chapter 3 of the TR-55, sheet flow is calculated using Equation 1-1.

$$T_t = \frac{0.007(nL)^{0.8}}{(P_2)^{0.5} s^{0.4}} \qquad \text{(Equation 1-1)}$$

Where: $T_t$ = Travel time (hr)
$n$ = Manning's roughness coefficient
$L$ = Flow length (ft)
$P_2$ = 2-year 24 hr rainfall (in)
$s$ = Slope (ft/ft)

Shallow concentrated flow was calculated by first determining the flow velocity using Equation 1-2 and Equation 1-3 for paved and unpaved surfaces respectively. The flow velocity was then used to determine the time of concentration using equation 1-4.

$$V = 20.3282(s)^{0.5} \qquad \text{(Equation 1-2)}$$

Where: $V$ = Velocity (ft/s)
$s$ = Slope (ft/ft)

$$V = 16.1345(s)^{0.5} \qquad \text{(Equation 1-3)}$$

Where: $V$ = Velocity (ft/s)
$s$ = Slope (ft/ft)

$$T_t = \frac{L}{3600V} \qquad \text{(Equation 1-4)}$$

Where: $T_t$ =Travel time (hr)
$L$ = Flow Length (ft)
$V$ = Velocity (ft/s)

Travel time for open channel flow was evaluated using Manning's equation (Equation 1-5) and Equation 1-4.

$$V = \frac{1.49(R)^{2/3}(s)^{0.5}}{n}$$ (Equation 1-5)

Where: $V$ = Velocity (ft/s)
$n$ = Manning's roughness coefficient for open channel flow
$R$ = Hydraulic radius (ft) = $A/P_w$
$P_w$ = Wetted perimeter (ft)
$A$ = Cross sectional flow area (ft2)
$s$ = Slope (ft/ft)

The time of concentration for each downstream analysis basin was determined using the NRCS watershed lag method (Equation 1-6) outlined in the National Engineering Handbook.

$$T_c = \frac{L^{0.5}(S+1)^{0.7}}{1140Y^{0.5}}$$ (Equation 1-6)

Where: $T_c$ = Time of concentration (hr)
$L$ = Flow Length (ft)
$S$ = Maximum potential retention, shown below (in)
$Y$ = Average watershed land slope (%)

$$S = \frac{1000}{CN} - 10$$ (Equation 1-7)

Where: $S$ = Maximum potential retention (in)
$CN$ = Curve Number

**Water Quality Volume (WQv)**

GDOT is not required to provide water quality (retrofit) for their existing infrastructure assets. For all new projects, improvements to existing infrastructure or additions, water quality treatment must be provided for the new portion of the project. In most cases, this implies a reduction in the overall water quality volume that would otherwise be required to be treated.

Once it has been determined that an outfall basin requires water quality treatment, the designer must follow the calculation process described below.

$$WQ_v = \frac{1.2R_vA}{12}$$ (Equation 1-8)

Where: $WQ_v$ = Water Quality Volume (acre-feet)
$R_v$ = Volumetric runoff coefficient, shown below (dimensionless)

$$R_v = 0.05 + 0.009(\frac{I}{A})$$ (Equation 1-9)

Where: $I$ = Percent impervious area (express as a whole number, not a decimal percentage, i.e. 80% = 80)

$A$ = Drainage area of the post-condition basin (acres)

FOR NEW CONSTRUCTION PROJECTS:

A sample calculation follows for a 1.5-acre drainage area that is 80% impervious in its proposed condition:

$$R_v = 0.05 + 0.009(80) = 0.77$$
$$WQ_v = \frac{1.2(0.77)(1.5)}{12}$$
$$WQ_v = 0.116\ ac-ft\ (5{,}053\ ft^3)$$

FOR PROJECTS WITH ADDITIONAL PROPOSED IMPERVIOUS AREAS:

A sample calculation follows for a 1.5-acre drainage area that is 60% in its existing condition and 80% impervious in its proposed condition (Note: Any use of the variable "A" will always refer to the post-basin size):

$$R_{v(Post)} = 0.05 + 0.009(80) = 0.77$$
$$R_{v(Pre)} = 0.05 + 0.009(60) = 0.59$$
$$R_{v(Pre)} - R_{v(Pre)} = 0.77 - 0.59 = 0.18$$
$$WQ_v = \frac{1.2(0.18)(1.5)}{12}$$
$$WQ_v = 0.027\ ac-ft\ (1{,}176\ ft^3)$$

**Channel Protection Volume (CPv)**

Urbanization and development increase runoff which in turn can cause channel erosion and loss of aquatic habitat. In order to protect stream channels and aquatic resources, 24-hour extended detention should be provided for the 1-year, 24-hour storm (CPv). Appropriate energy dissipation and velocity control measures are required at all outlets. CPv control is not required where proposed condition discharges are less than 2.0 ft3/s.

In order to determine CPv, the unit peak discharge was first calculated by following the procedures outlined in the TR-55. The unit peak discharge was then used to determine ratio of outflow to inflow using equation 1-10.

$$q_0/q_i = 12.03{q_u}^{-0.9406}$$ (Equation 1-10)

Where: $q_0/q_i$ = Ratio of Outflow to Inflow

$q_u$ = Unit peak discharge (csm/in)

Using the $q_o/q_i$ ratio calculated from equation 1-10, the required storage volume to runoff volume ratio ($V_s/V_r$) was calculated using equation 1-11.

$$\frac{V_s}{V_r} = 0.682 - 1.43\left(\frac{q_0}{q_i}\right) + 1.64\left(\frac{q_0}{q_i}\right)^2 - 1.804\left(\frac{q_0}{q_i}\right)^3 \quad \text{(Equation 1-11)}$$

Where: $q_0/q_i$ = Ratio of Outflow to Inflow
$V_s$ = Required storage volume (acre-feet)
$V_r$ = Runoff volume (acre-feet)

Using the $V_s/V_r$ ratio value calculated above, use equation 1-12 to calculate the required storage volume ($V_s$)

$$V_s = \frac{(V_S/V_r) \times (Q) \times (A)}{12} \quad \text{(Equation 1-12)}$$

Where: $V_s$ = Required storage volume – CPv (acre-feet)
$Q$ = Post-construction direct runoff (in – 1-year, 24-hour storm for CPv)
$A$ = Total drainage area (acres)

The channel protection volume peak flow was determined using equation 1-13 as outlined in the TR-55.

$$Q_p = q_u A Q F_p \quad \text{(Equation 1-13)}$$

Where: $Q_p$ = Peak discharge (ft3/s)
$q_u$ = Unit peak discharge (ft3/s/mi2/in)
$A$ = Drainage area (mi2)
$F_p$ = Pond and swamp adjustment factor ($F_p = 1$)

**Overbank Protection ($Q_{P25}$) and Extreme Flood Protection ($Q_f$)**

The peak discharge for the 25-year, 24-hour and 100-year, 24-hour rainfall events were determined using Hydraflow hydrographs.

Drainage Area 1 is located to the west along SR-21 from station 102+00 to Sta 118+50. This drainage area discharges into an existing ditch that flow out of the right of way and into Little Hearst Branch.

**Physical Parameters of Drainage Area 1**

| **Drainage Area 1 (Pre)** | **Area (Acres)** | **CN** |
|---|---|---|
| Open space - Good condition (grass cover > 75%) (Soil Type D) | 4.46 | 80 |
| Impervious areas | 2.93 | 98 |
| Woods - grass combination - Good condition (Soil Type D) | 0.11 | 79 |
| Woods - Good condition (Soil Type D) | 2.91 | 77 |
| **Total** | **10.41** | **84** |

| **Drainage Area 1 (Post)** | **Area (acres)** | **CN** |
|---|---|---|
| Open space - Good condition (grass cover > 75%) (Soil Type D) | 4.30 | 80 |
| Impervious areas | 3.09 | 98 |
| Woods - grass combination - Good condition (Soil Type D) | 0.11 | 79 |
| Woods - Good condition (Soil Type D) | 2.91 | 77 |
| **Total** | **10.41** | **84** |

| | **1-Year (cfs)** | **25-Year (cfs)** | **100-Year (cfs)** |
|---|---|---|---|
| Pre-Development | 15.29 | 43.86 | 62.97 |
| Post-Development | 15.29 | 43.86 | 62.97 |
| Change (Post - Pre) | 0.00 | 0.00 | 0.00 |
| Percent Change | 0.00% | 0.00% | 0.00% |

Drainage Area 1 was broken into four sub-basins for analysis based on flow patterns and optimal locations for water treatment and detention. Sub-basins 1C and 1D contain no additional impervious area.

**Downstream Analysis**

A downstream analysis was performed for Drainage Area 1 that included the outfall for Drainage Area 2. At this point both Drainage Area's discharge directly into Little Hearst Branch. At this point, the drainage basin for Little Hearse Branch is 11.87 square miles. Per GDOT policy, drainage areas with an upstream basin size that exceeds 5 square miles will not require a downstream analysis and will not be required to detain the 25-year storm.

Drainage Area 1A is located along SR-21 between station 102+00 and station 111+75. This drainage area discharges into an existing ditch that flows outside of the right of way and into Little Hearse Branch.

**Physical Parameters of Drainage Area 1A**

| **Drainage Area 1A (Pre)** | **Area (Acres)** | **CN** |
|---|---|---|
| Open space - Good condition (grass cover > 75%) (Soil Type D) | 1.17 | 80 |
| Impervious areas | 0.87 | 98 |
| Woods - Good condition (Soil Type D) | 2.25 | 77 |
| **Total** | **4.29** | **82** |

| **Drainage Area 1A (Post)** | **Area (acres)** | **CN** |
|---|---|---|
| Open space - Good condition (grass cover > 75%) (Soil Type D) | 1.02 | 80 |
| Impervious areas | 1.02 | 98 |
| Woods - Good condition (Soil Type D) | 2.25 | 77 |
| **Total** | **4.29** | **83** |

**Water Quality and Channel Protection**

| | |
|---|---|
| Total Drainage Area (Acres) | 4.29 |
| Pre-Developed Impervious Area (Acres) | 0.87 |
| Post-Developed Impervious Area (Acres) | 1.02 |
| Pre-Developed Impervious (%) | 20.20 |
| Post-Developed Impervious (%) | 23.78 |
| $R_V$ for $WQ_V$ | 0.032 |

| | Cubic Feet |
|---|---|
| Required $WQ_V$ | 602 |
| Required $CP_V$* | 0 |

*The downstream basin exceeds 5 square miles. No channel protection is required.

**Peak Flow Summary**

| | **1-Year (cfs)** | **25-Year (cfs)** | **100-Year (cfs)** |
|---|---|---|---|
| Pre-Development | 7.68 | 22.92 | 33.22 |
| Post-Development | 8.00 | 23.39 | 33.74 |
| Change (Post - Pre) | 0.32 | 0.47 | 0.52 |
| Percent Change | 4.17% | 2.05% | 1.57% |

Any attempt to construct a BMP in Drainage Area 1A will result in additional wetland impacts. Therefore, Outfall Level Exclusion #3 will be used to eliminate the MS4 BMPs from this basin.

**Outfall Level Exclusion #3**

When a project would impact existing vegetated stream buffers or wetlands solely for the purposes of installing BMPs. See state requirements for additional information on stream buffers.

Drainage Area 1B is located in the median of SR-21 from station 105+50 to station 111+50. This drainage area discharges into an existing drop inlet that passes under the southbound lanes and into an existing ditch that discharges into Little Hearse Branch.

**Physical Parameters of Drainage Area 1B**

| **Drainage Area 1B (Pre)** | **Area (Acres)** | **CN** |
|---|---|---|
| Open space - Good condition (grass cover > 75%) (Soil Type D) | 0.22 | 80 |
| Impervious areas | 0.52 | 98 |
| **Total** | **0.74** | **93** |

| **Drainage Area 1B (Post)** | **Area (acres)** | **CN** |
|---|---|---|
| Open space - Good condition (grass cover > 75%) (Soil Type D) | 0.21 | 80 |
| Impervious areas | 0.53 | 98 |
| **Total** | **0.74** | **93** |

**Water Quality and Channel Protection**

| | |
|---|---|
| Total Drainage Area (Acres) | 0.74 |
| Pre-Developed Impervious Area (Acres) | 0.52 |
| Post-Developed Impervious Area (Acres) | 0.53 |
| Pre-Developed Impervious (%) | 70.27 |
| Post-Developed Impervious (%) | 71.62 |
| $R_V$ for $WQ_V$ | 0.012 |

| | Cubic Feet |
|---|---|
| Required $WQ_V$ | 39 |
| Required $CP_V$* | 0 |

*The downstream basin exceeds 5 square miles. No channel protection is required.

**Peak flow Summary**

| | **1-Year (cfs)** | **25-Year (cfs)** | **100-Year (cfs)** |
|---|---|---|---|
| Pre-Development | 2.00 | 4.84 | 6.69 |
| Post-Development | 2.00 | 4.84 | 6.69 |
| Change (Post - Pre) | 0.00 | 0.00 | 0.00 |
| Percent Change | 0.00% | 0.00% | 0.00% |

There is a minimal increase in impervious area in comparison to basin size for this drainage area. Therefore, Outfall Level Exclusion #6 will be used to eliminate the MS4 BMP for this basin.

**Outfall Level Exclusion #6**

As stated in section 4.2.5.1(a) of the GDOT MS4 permit, for outfalls along linear roadway projects whereby the net impervious surface area within that outfall's drainage area has been reduced or remains the same as pre-developed conditions, post-construction stormwater requirements will not apply. Special consideration from the Department may be given to those projects with a minimal increase in impervious area. In such cases, the designer will be required to provide supporting calculations showing that the increase in stormwater runoff and/or volume required to be treated for water quality is negligible with respect to the drainage area in question.

Drainage Area 1C is located along SR-21 between station 111+50 and station 118+50. This drainage area discharges into an existing cross drain that passes under Rice Mill Rd and into an existing ditch that flows into Little Hearse Branch.

**Physical Parameters of Drainage Area 1C**

| **Drainage Area 1C (Pre)** | **Area (Acres)** | **CN** |
|---|---|---|
| Open space - Good condition (grass cover > 75%) (Soil Type D) | 2.32 | 80 |
| Impervious areas | 0.83 | 98 |
| Woods - grass combination - Good condition (Soil Type D) | 0.11 | 79 |
| Woods - Good condition (Soil Type D) | 0.66 | 77 |
| **Total** | **3.92** | **83** |

| **Drainage Area 1C (Post)** | **Area (acres)** | **CN** |
|---|---|---|
| Open space - Good condition (grass cover > 75%) (Soil Type D) | 2.32 | 80 |
| Impervious areas | 0.83 | 98 |
| Woods - grass combination - Good condition (Soil Type D) | 0.11 | 79 |
| Woods - Good condition (Soil Type D) | 0.66 | 77 |
| **Total** | **3.92** | **83** |

There is no increase in impervious area in Drainage Area 35C. Therefore, Outfall Level Exclusion #6 will be used to eliminate the MS4 BMP for this basin.

**Outfall Level Exclusion #6**

As stated in section 4.2.5.1(a) of the GDOT MS4 permit, for outfalls along linear roadway projects whereby the net impervious surface area within that outfall's drainage area has been reduced or remains the same as pre-developed conditions, post-construction stormwater requirements will not apply.

Drainage Area 1D is located in the median of SR-21 between stations 111+50 to station 118+50. This drainage area discharges into an existing drop inlet that passes under the southbound lanes and into an existing ditch that discharges into Little Hearse Branch.

**Physical Parameters of Drainage Area 1D**

| **Drainage Area 1D (Pre)** | **Area (Acres)** | **CN** |
|---|---|---|
| Open space - Good condition (grass cover > 75%) (Soil Type D) | 0.75 | 80 |
| Impervious areas | 0.71 | 98 |
| **Total** | **1.46** | **89** |

| **Drainage Area 1D (Post)** | **Area (acres)** | **CN** |
|---|---|---|
| Open space - Good condition (grass cover > 75%) (Soil Type D) | 0.75 | 80 |
| Impervious areas | 0.71 | 98 |
| **Total** | **1.46** | **89** |

There is no increase in impervious area in Drainage Area 1D. Therefore, Outfall Level Exclusion #6 will be used to eliminate the MS4 BMP for this basin.

**Outfall Level Exclusion #6**

As stated in section 4.2.5.1(a) of the GDOT MS4 permit, for outfalls along linear roadway projects whereby the net impervious surface area within that outfall's drainage area has been reduced or remains the same as pre-developed conditions, post-construction stormwater requirements will not apply.

Drainage Area 2 is located along SR 21 from station 100+00 to station 118+50. This drainage area discharges into an existing ditch that flows into Little Hearse Branch.

**Physical Parameters of Drainage Area 2**

| **Drainage Area 2 (Pre)** | **Area (Acres)** | **CN** |
|---|---|---|
| Open space - Good condition (grass cover > 75%) (Soil Type D) | 6.17 | 80 |
| Impervious areas | 1.82 | 98 |
| Woods - Good condition (Soil Type D) | 5.20 | 77 |
| **Total** | **13.19** | **81** |

| **Drainage Area 2 (Post)** | **Area (acres)** | **CN** |
|---|---|---|
| Open space - Good condition (grass cover > 75%) (Soil Type D) | 6.05 | 80 |
| Impervious areas | 1.95 | 98 |
| Woods - Good condition (Soil Type D) | 5.19 | 77 |
| **Total** | **13.19** | **81** |

| | **1-Year (cfs)** | **25-Year (cfs)** | **100-Year (cfs)** |
|---|---|---|---|
| Pre-Development | 15.42 | 46.93 | 68.35 |
| Post-Development | 15.42 | 46.93 | 68.35 |
| Change (Post - Pre) | 0.00 | 0.00 | 0.00 |
| Percent Change | 0.00% | 0.00% | 0.00% |

Drainage Area 2 was broken into two sub-basins for analysis based on flow patterns and optimal locations for water treatment and detention. Sub-basin 2B contains no additional impervious area.

Drainage Area 2A is located along SR-21 between station 100+00 and station 111+50. This drainage area discharges into an existing ditch that flows outside of the right of way and into Little Hearse Branch.

**Physical Parameters of Drainage Area 2A**

| **Drainage Area 2A (Pre)** | **Area (Acres)** | **CN** |
|---|---|---|
| Open space - Good condition (grass cover > 75%) (Soil Type D) | 5.03 | 80 |
| Impervious areas | 0.96 | 98 |
| Woods - Good condition (Soil Type D) | 2.01 | 77 |
| **Total** | **8.00** | **81** |

| **Drainage Area 2A (Post)** | **Area (acres)** | **CN** |
|---|---|---|
| Open space - Good condition (grass cover > 75%) (Soil Type D) | 4.91 | 80 |
| Impervious areas | 1.09 | 98 |
| Woods - Good condition (Soil Type D) | 2.00 | 77 |
| **Total** | **8.00** | **82** |

**Water Quality and Channel Protection**

| | |
|---|---|
| Total Drainage Area (Acres) | 8.00 |
| Pre-Developed Impervious Area (Acres) | 0.96 |
| Post-Developed Impervious Area (Acres) | 1.09 |
| Pre-Developed Impervious (%) | 12.00 |
| Post-Developed Impervious (%) | 13.63 |
| $R_V$ for $WQ_V$ | 0.015 |

| | Cubic Feet |
|---|---|
| Required $WQ_V$ | 510 |
| Required $CP_V$* | 0 |

*The downstream basin exceeds 5 square miles. No channel protection is required.

**Peak Flow Summary**

| | **1-Year (cfs)** | **25-Year (cfs)** | **100-Year (cfs)** |
|---|---|---|---|
| Pre-Development | 9.35 | 28.46 | 41.45 |
| Post-Development | 9.74 | 29.05 | 42.11 |
| Change (Post - Pre) | 0.39 | 0.59 | 0.66 |
| Percent Change | 4.17% | 2.07% | 1.59% |

For Drainage Area 2A, there is a negligible peak flow increase of 0.66 cfs for the 100 year storm and the existing drainage system has enough capacity to handle the small increase in flow rates. Therefore, Outfall Level Exclusion #6 will be used to eliminate the MS4 BMP for this basin.

**Outfall Level Exclusion #6**

As stated in section 4.2.5.1(a) of the GDOT MS4 permit, for outfalls along linear roadway projects whereby the net impervious surface area within that outfall's drainage area has been reduced or remains the same as pre-developed conditions, post-construction stormwater requirements will not apply. Special consideration from the Department may be given to those projects with a minimal increase in impervious area. In such cases, the designer will be required to provide supporting calculations showing that the increase in stormwater runoff and/or volume required to be treated for water quality is negligible with respect to the drainage area in question.

Drainage Area 2B is located in the median of SR-21 between stations 111+50 to station 118+50. This drainage area discharges into an existing cross drain that passes under Market BLVD and into an existing ditch that flows to Little Hearse Branch.

**Physical Parameters of Drainage Area 2B**

| **Drainage Area 2B (Pre)** | **Area (Acres)** | **CN** |
|---|---|---|
| Open space - Good condition (grass cover > 75%) (Soil Type D) | 1.14 | 80 |
| Impervious areas | 0.86 | 98 |
| Woods - Good condition (Soil Type D) | 3.19 | 77 |
| **Total** | **5.19** | **81** |

| **Drainage Area 2B (Post)** | **Area (acres)** | **CN** |
|---|---|---|
| Open space - Good condition (grass cover > 75%) (Soil Type D) | 1.14 | 80 |
| Impervious areas | 0.86 | 98 |
| Woods - Good condition (Soil Type D) | 3.19 | 77 |
| **Total** | **5.19** | **81** |

There is no increase in impervious area in Drainage Area 2B. Therefore, Outfall Level Exclusion #6 will be used to eliminate the MS4 BMP for this basin.

**Outfall Level Exclusion #6**

As stated in section 4.2.5.1(a) of the GDOT MS4 permit, for outfalls along linear roadway projects whereby the net impervious surface area within that outfall's drainage area has been reduced or remains the same as pre-developed conditions, post-construction stormwater requirements will not apply.

| | |
|---|---|
| Project Name: | GEC-TO_8_WO_1_Ped_Bridge |
| Project Number: | 13549 |
| Calculated By: | CCS |
| Date: | 3/7/2016 |
| Drainage Area: | 1 |

Denotes Input Cell

***Drainage Area Information***

| | | |
|---|---|---|
| County | Chatham | |
| Drainage Area Pre ($A_{Pre}$) | 10.41 | ac |
| Drainage Area Post ($A_{Post}$) | 10.41 | ac |
| SCS Curve Number Pre ($CN_{Pre}$) | 84 | |
| SCS Curve Number Post ($CN_{Post}$) | 84 | |
| Time of Concentration ($T_C$) | 24.0 | min |

***Water Quality Volume Calculation***

$$R_V = 0.05 + 0.009(I) \qquad WQ_V = \frac{1.2 R_V A}{12}$$

| | | | |
|---|---|---|---|
| Percent Impervious Pre ($I_{Pre}$) | 28.15 | % | |
| Percent Impervious Post ($I_{Post}$) | 29.68 | % | |
| Runoff Coefficient Pre ($R_{V\ Pre}$) | 0.303 | | |
| Runoff Coefficient Post ($R_{V\ Post}$) | 0.317 | | |
| Runoff Coefficient Design ($R_V$) | 0.014 | | *(Equals Rv Post-Rv Pre)* |
| Water Quality Volume ($WQ_V$) | 0.014 | ac-ft | |
| Water Quality Volume ($WQ_V$) | 627 | cf | |

***Required Volume Storage Summary***

| | $CP_V$/1-Year (cf) | 25-Year (cf) | 100-Year (cf) |
|---|---|---|---|
| Post-Development | 0 | 0 | 0 |

Channel Protection Volume ($CP_V$) Control Required? No *(No change in peak flow)*

***Peak Flow Summary***

| | 1-Year (cfs) | 25-Year (cfs) | 100-Year (cfs) |
|---|---|---|---|
| Pre-Development | 15.29 | 43.86 | 62.97 |
| Post-Development | 15.29 | 43.86 | 62.97 |
| Change (Post - Pre) | 0.00 | 0.00 | 0.00 |
| Percent Change | 0.00% | 0.00% | 0.00% |

Project Name: GEC-TO_8_WO_1_Ped_Bridge
Project Number: 13549
Calculated By: CCS
Date: 3/7/2016
Drainage Area: 1

***Time of Concentration ($T_C$) Calculation***

Denotes Input Cell

| Flow Type | Length (ft) | Slope (ft/ft) | Surface | Manning's n | Area (sf) | WP (ft) | Velocity (ft/s) | Time (hr) |
|---|---|---|---|---|---|---|---|---|
| Sheet | 100.0 | 0.02 | Grass-Range, Short | 0.150 | ----- | ----- | ----- | 0.141 |
| Shallow Concentrated | 853.2 | 0.0034 | Unpaved | ----- | ----- | ----- | 0.94 | 0.252 |
| Shallow Concentrated | | | | ----- | ----- | ----- | ----- | ----- |
| Channel | 763.6 | 0.0041 | ----- | 0.150 | 763.60 | 2.00 | 33.54 | 0.006 |
| Channel | | | ----- | | | | ----- | ----- |
| **Total** | **1716.8** | | | | | | | **0.399** |

| | |
|---|---|
| Project Name: | GEC-TO_8_WO_1_Ped_Bridge |
| Project Number: | 13549 |
| Calculated By: | CCS |
| Date: | 3/7/2016 |
| Drainage Area: | 1A |

Denotes Input Cell

***Drainage Area Information***

| | | |
|---|---|---|
| County | Chatham | |
| Drainage Area Pre ($A_{Pre}$) | 4.29 | ac |
| Drainage Area Post ($A_{Post}$) | 4.29 | ac |
| SCS Curve Number Pre ($CN_{Pre}$) | 82 | |
| SCS Curve Number Post ($CN_{Post}$) | 83 | |
| Time of Concentration ($T_C$) | 10.0 | min |

***Water Quality Volume Calculation***

$$R_V = 0.05 + 0.009(I) \qquad WQ_V = \frac{1.2 R_V A}{12}$$

| | | | |
|---|---|---|---|
| Percent Impervious Pre ($I_{Pre}$) | 20.20 | % | |
| Percent Impervious Post ($I_{Post}$) | 23.78 | % | |
| Runoff Coefficient Pre ($R_{V\ Pre}$) | 0.232 | | |
| Runoff Coefficient Post ($R_{V\ Post}$) | 0.264 | | |
| Runoff Coefficient Design ($R_V$) | 0.032 | | *(Equals Rv Post-Rv Pre)* |
| Water Quality Volume ($WQ_V$) | 0.014 | ac-ft | |
| Water Quality Volume ($WQ_V$) | 602 | cf | |

***Required Volume Storage Summary***

| | $CP_V$/1-Year (cf) | 25-Year (cf) | 100-Year (cf) |
|---|---|---|---|
| Post-Development | 0 | 0 | 0 |

Channel Protection Volume ($CP_V$) Control Required? Yes *(1-year peak flow greater than 2 cfs)*

***Peak Flow Summary***

| | 1-Year (cfs) | 25-Year (cfs) | 100-Year (cfs) |
|---|---|---|---|
| Pre-Development | 7.68 | 22.92 | 33.22 |
| Post-Development | 8.00 | 23.39 | 33.74 |
| Change (Post - Pre) | 0.32 | 0.47 | 0.52 |
| Percent Change | 4.17% | 2.05% | 1.57% |

Project Name: GEC-TO_8_WO_1_Ped_Bridge
Project Number: 13549
Calculated By: CCS
Date: 3/7/2016
Drainage Area: 1A

***Time of Concentration ($T_C$) Calculation***

Denotes Input Cell

| Flow Type | Length (ft) | Slope (ft/ft) | Surface | Manning's n | Area (sf) | WP (ft) | Velocity (ft/s) | Time (hr) |
|---|---|---|---|---|---|---|---|---|
| Sheet | 100.0 | 0.0058 | Smooth Surface | 0.011 | ----- | ----- | ----- | 0.029 |
| Shallow Concentrated | 91.0 | 0.012 | Paved | ----- | ----- | ----- | 2.23 | 0.011 |
| Shallow Concentrated | 629.0 | 0.0106 | Unpaved | ----- | ----- | ----- | 1.66 | 0.105 |
| Channel | 211.0 | 0.007 | ----- | 0.240 | 211.00 | 2.00 | 11.62 | 0.005 |
| Channel | | | ----- | | | | ----- | ----- |
| **Total** | **1031.0** | | | | | | | **0.150** |

| | |
|---|---|
| Project Name: | GEC-TO_8_WO_1_Ped_Bridge |
| Project Number: | 13549 |
| Calculated By: | CCS |
| Date: | 3/7/2016 |
| Drainage Area: | 1B |

Denotes Input Cell

***Drainage Area Information***

| | | |
|---|---|---|
| County | Chatham | |
| Drainage Area Pre ($A_{Pre}$) | 0.74 | ac |
| Drainage Area Post ($A_{Post}$) | 0.74 | ac |
| SCS Curve Number Pre ($CN_{Pre}$) | 93 | |
| SCS Curve Number Post ($CN_{Post}$) | 93 | |
| Time of Concentration ($T_C$) | 10.0 | min |

***Water Quality Volume Calculation***

$$R_V = 0.05 + 0.009(I) \qquad WQ_V = \frac{1.2 R_V A}{12}$$

| | | | |
|---|---|---|---|
| Percent Impervious Pre ($I_{Pre}$) | 70.27 | % | |
| Percent Impervious Post ($I_{Post}$) | 71.62 | % | |
| Runoff Coefficient Pre ($R_{V\ Pre}$) | 0.682 | | |
| Runoff Coefficient Post ($R_{V\ Post}$) | 0.695 | | |
| Runoff Coefficient Design ($R_V$) | 0.012 | | *(Equals Rv Post-Rv Pre)* |
| Water Quality Volume ($WQ_V$) | 0.001 | ac-ft | |
| Water Quality Volume ($WQ_V$) | 39 | cf | |

***Required Volume Storage Summary***

| | $CP_V$/1-Year (cf) | 25-Year (cf) | 100-Year (cf) |
|---|---|---|---|
| Post-Development | 0 | 0 | 0 |

Channel Protection Volume ($CP_V$) Control Required? No *(No change in peak flow)*

***Peak Flow Summary***

| | 1-Year (cfs) | 25-Year (cfs) | 100-Year (cfs) |
|---|---|---|---|
| Pre-Development | 2.00 | 4.84 | 6.69 |
| Post-Development | 2.00 | 4.84 | 6.69 |
| Change (Post - Pre) | 0.00 | 0.00 | 0.00 |
| Percent Change | 0.00% | 0.00% | 0.00% |

Project Name: GEC-TO_8_WO_1_Ped_Bridge
Project Number: 13549
Calculated By: CCS
Date: 3/7/2016
Drainage Area: 1B

***Time of Concentration ($T_C$) Calculation***

Denotes Input Cell

| Flow Type | Length (ft) | Slope (ft/ft) | Surface | Manning's n | Area (sf) | WP (ft) | Velocity (ft/s) | Time (hr) |
|---|---|---|---|---|---|---|---|---|
| Sheet | 100.0 | 0.0033 | Smooth Surface | 0.011 | ----- | ----- | ----- | 0.036 |
| Shallow Concentrated | 74.7 | 0.0085 | Paved | ----- | ----- | ----- | 1.87 | 0.011 |
| Shallow Concentrated | 428.6 | 0.0108 | Unpaved | ----- | ----- | ----- | 1.68 | 0.071 |
| Channel | | | ----- | | | | ----- | ----- |
| Channel | | | ----- | | | | ----- | ----- |
| **Total** | **603.3** | | | | | | | **0.118** |

Project Name: GEC-TO_8_WO_1_Ped_Bridge
Project Number: 13549
Calculated By: CCS
Date: 3/7/2016
Drainage Area: 1C

Denotes Input Cell

***Drainage Area Information***

| | | |
|---|---|---|
| County | Chatham | |
| Drainage Area Pre ($A_{Pre}$) | 3.92 | ac |
| Drainage Area Post ($A_{Post}$) | 3.92 | ac |
| SCS Curve Number Pre ($CN_{Pre}$) | 83 | |
| SCS Curve Number Post ($CN_{Post}$) | 83 | |
| Time of Concentration ($T_C$) | 23.6 | min |

***Water Quality Volume Calculation***

$$R_V = 0.05 + 0.009(I) \qquad WQ_V = \frac{1.2 R_V A}{12}$$

| | | | |
|---|---|---|---|
| Percent Impervious Pre ($I_{Pre}$) | 21.17 | % | |
| Percent Impervious Post ($I_{Post}$) | 21.17 | % | |
| Runoff Coefficient Pre ($R_{V\ Pre}$) | 0.241 | | |
| Runoff Coefficient Post ($R_{V\ Post}$) | 0.241 | | |
| Runoff Coefficient Design ($R_V$) | 0.000 | | *(Equals Rv Post-Rv Pre)* |
| Water Quality Volume ($WQ_V$) | 0.000 | ac-ft | |
| Water Quality Volume ($WQ_V$) | 0 | cf | |

***Required Volume Storage Summary***

| | $CP_V$/1-Year (cf) | 25-Year (cf) | 100-Year (cf) |
|---|---|---|---|
| Post-Development | 0 | 0 | 0 |

Channel Protection Volume ($CP_V$) Control Required? No *(No change in impervious)*

***Peak Flow Summary***

| | 1-Year (cfs) | 25-Year (cfs) | 100-Year (cfs) |
|---|---|---|---|
| Pre-Development | 5.57 | 16.29 | 23.50 |
| Post-Development | 5.57 | 16.29 | 23.50 |
| Change (Post - Pre) | 0.00 | 0.00 | 0.00 |
| Percent Change | 0.00% | 0.00% | 0.00% |

Project Name: GEC-TO_8_WO_1_Ped_Bridge
Project Number: 13549
Calculated By: CCS
Date: 3/7/2016
Drainage Area: 1C

***Time of Concentration ($T_C$) Calculation***

Denotes Input Cell

| Flow Type | Length (ft) | Slope (ft/ft) | Surface | Manning's n | Area (sf) | WP (ft) | Velocity (ft/s) | Time (hr) |
|---|---|---|---|---|---|---|---|---|
| Sheet | 100.0 | 0.02 | Grass-Range, Short | 0.150 | ----- | ----- | ----- | 0.141 |
| Shallow Concentrated | 853.2 | 0.0034 | Unpaved | ----- | ----- | ----- | 0.94 | 0.252 |
| Shallow Concentrated | | | | ----- | ----- | ----- | ----- | ----- |
| Channel | | | ----- | | | | ----- | ----- |
| Channel | | | ----- | | | | ----- | ----- |
| **Total** | **953.2** | | | | | | | **0.393** |

| | |
|---|---|
| Project Name: | GEC-TO_8_WO_1_Ped_Bridge |
| Project Number: | 13549 |
| Calculated By: | CCS |
| Date: | 3/7/2016 |
| Drainage Area: | 1D |

Denotes Input Cell

***Drainage Area Information***

| | | |
|---|---|---|
| County | Chatham | |
| Drainage Area Pre ($A_{Pre}$) | 1.46 | ac |
| Drainage Area Post ($A_{Post}$) | 1.46 | ac |
| SCS Curve Number Pre ($CN_{Pre}$) | 89 | |
| SCS Curve Number Post ($CN_{Post}$) | 89 | |
| Time of Concentration ($T_C$) | 26.7 | min |

***Water Quality Volume Calculation***

$$R_V = 0.05 + 0.009(I) \qquad WQ_V = \frac{1.2 R_V A}{12}$$

| | | | |
|---|---|---|---|
| Percent Impervious Pre ($I_{Pre}$) | 48.63 | % | |
| Percent Impervious Post ($I_{Post}$) | 48.63 | % | |
| Runoff Coefficient Pre ($R_{V\ Pre}$) | 0.488 | | |
| Runoff Coefficient Post ($R_{V\ Post}$) | 0.488 | | |
| Runoff Coefficient Design ($R_V$) | 0.000 | | *(Equals Rv Post-Rv Pre)* |
| Water Quality Volume ($WQ_V$) | 0.000 | ac-ft | |
| Water Quality Volume ($WQ_V$) | 0 | cf | |

***Required Volume Storage Summary***

| | $CP_V$/1-Year (cf) | 25-Year (cf) | 100-Year (cf) |
|---|---|---|---|
| Post-Development | 0 | 0 | 0 |

Channel Protection Volume ($CP_V$) Control Required? No *(No change in impervious)*

***Peak Flow Summary***

| | 1-Year (cfs) | 25-Year (cfs) | 100-Year (cfs) |
|---|---|---|---|
| Pre-Development | 2.48 | 6.48 | 9.09 |
| Post-Development | 2.48 | 6.48 | 9.09 |
| Change (Post - Pre) | 0.00 | 0.00 | 0.00 |
| Percent Change | 0.00% | 0.00% | 0.00% |

Project Name: GEC-TO_8_WO_1_Ped_Bridge
Project Number: 13549
Calculated By: CCS
Date: 3/7/2016
Drainage Area: 1D

***Time of Concentration ($T_C$) Calculation***

Denotes Input Cell

| Flow Type | Length (ft) | Slope (ft/ft) | Surface | Manning's n | Area (sf) | WP (ft) | Velocity (ft/s) | Time (hr) |
|---|---|---|---|---|---|---|---|---|
| Sheet | 100.0 | 0.0075 | Grass-Range, Short | 0.150 | ----- | ----- | ----- | 0.209 |
| Shallow Concentrated | 801.0 | 0.0034 | Unpaved | ----- | ----- | ----- | 0.94 | 0.237 |
| Shallow Concentrated | | | | ----- | ----- | ----- | ----- | ----- |
| Channel | | | ----- | | | | ----- | ----- |
| Channel | | | ----- | | | | ----- | ----- |
| **Total** | **901.0** | | | | | | | **0.446** |

| | |
|---|---|
| Project Name: | GEC-TO_8_WO_1_Ped_Bridge |
| Project Number: | 13549 |
| Calculated By: | CCS |
| Date: | 3/7/2016 |
| Drainage Area: | 2 |

Denotes Input Cell

***Drainage Area Information***

| | | |
|---|---|---|
| County | Chatham | |
| Drainage Area Pre ($A_{Pre}$) | 13.19 | ac |
| Drainage Area Post ($A_{Post}$) | 13.19 | ac |
| SCS Curve Number Pre ($CN_{Pre}$) | 81 | |
| SCS Curve Number Post ($CN_{Post}$) | 81 | |
| Time of Concentration ($T_C$) | 31.4 | min |

***Water Quality Volume Calculation***

$$R_V = 0.05 + 0.009(I) \qquad WQ_V = \frac{1.2 R_V A}{12}$$

| | | | |
|---|---|---|---|
| Percent Impervious Pre ($I_{Pre}$) | 13.80 | % | |
| Percent Impervious Post ($I_{Post}$) | 14.78 | % | |
| Runoff Coefficient Pre ($R_{V\ Pre}$) | 0.174 | | |
| Runoff Coefficient Post ($R_{V\ Post}$) | 0.183 | | |
| Runoff Coefficient Design ($R_V$) | 0.009 | | *(Equals Rv Post-Rv Pre)* |
| Water Quality Volume ($WQ_V$) | 0.012 | ac-ft | |
| Water Quality Volume ($WQ_V$) | 510 | cf | |

***Required Volume Storage Summary***

| | $CP_V$/1-Year (cf) | 25-Year (cf) | 100-Year (cf) |
|---|---|---|---|
| Post-Development | 0 | 0 | 0 |

Channel Protection Volume ($CP_V$) Control Required? No *(No change in peak flow)*

***Peak Flow Summary***

| | 1-Year (cfs) | 25-Year (cfs) | 100-Year (cfs) |
|---|---|---|---|
| Pre-Development | 15.42 | 46.93 | 68.35 |
| Post-Development | 15.42 | 46.93 | 68.35 |
| Change (Post - Pre) | 0.00 | 0.00 | 0.00 |
| Percent Change | 0.00% | 0.00% | 0.00% |

ARCADIS

Project Name: GEC-TO_8_WO_1_Ped_Bridge
Project Number: 13549
Calculated By: CCS
Date: 3/7/2016
Drainage Area: 2

***Time of Concentration ($T_C$) Calculation***

Denotes Input Cell

| Flow Type | Length (ft) | Slope (ft/ft) | Surface | Manning's n | Area (sf) | WP (ft) | Velocity (ft/s) | Time (hr) |
|---|---|---|---|---|---|---|---|---|
| Sheet | 100.0 | 0.005 | Grass-Range, Short | 0.150 | ----- | ----- | ----- | 0.246 |
| Shallow Concentrated | 1336.6 | 0.0069 | Unpaved | ----- | ----- | ----- | 1.34 | 0.277 |
| Shallow Concentrated | | | | ----- | ----- | ----- | ----- | ----- |
| Channel | | | ----- | 0.150 | 944.20 | 2.00 | ----- | ----- |
| Channel | | | ----- | | | | ----- | ----- |
| **Total** | **1436.6** | | | | | | | **0.523** |

4.28

| | |
|---|---|
| Project Name: | GEC-TO_8_WO_1_Ped_Bridge |
| Project Number: | 13549 |
| Calculated By: | CCS |
| Date: | 3/7/2016 |
| Drainage Area: | 2A |

Denotes Input Cell

***Drainage Area Information***

| | | |
|---|---|---|
| County | Chatham | |
| Drainage Area Pre ($A_{Pre}$) | 8.00 | ac |
| Drainage Area Post ($A_{Post}$) | 8.00 | ac |
| SCS Curve Number Pre ($CN_{Pre}$) | 81 | |
| SCS Curve Number Post ($CN_{Post}$) | 82 | |
| Time of Concentration ($T_C$) | 31.4 | min |

***Water Quality Volume Calculation***

$$R_V = 0.05 + 0.009(I) \qquad WQ_V = \frac{1.2 R_V A}{12}$$

| | | | |
|---|---|---|---|
| Percent Impervious Pre ($I_{Pre}$) | 12.00 | % | |
| Percent Impervious Post ($I_{Post}$) | 13.63 | % | |
| Runoff Coefficient Pre ($R_{V\ Pre}$) | 0.158 | | |
| Runoff Coefficient Post ($R_{V\ Post}$) | 0.173 | | |
| Runoff Coefficient Design ($R_V$) | 0.015 | | *(Equals Rv Post-Rv Pre)* |
| Water Quality Volume ($WQ_V$) | 0.012 | ac-ft | |
| Water Quality Volume ($WQ_V$) | 510 | cf | |

***Required Volume Storage Summary***

| | $CP_V$/1-Year (cf) | 25-Year (cf) | 100-Year (cf) |
|---|---|---|---|
| Post-Development | 34990 | 16587 | 23423 |

Channel Protection Volume ($CP_V$) Control Required? Yes *(1-year peak flow greater than 2 cfs)*

***Peak Flow Summary***

| | 1-Year (cfs) | 25-Year (cfs) | 100-Year (cfs) |
|---|---|---|---|
| Pre-Development | 9.35 | 28.46 | 41.45 |
| Post-Development | 9.74 | 29.05 | 42.11 |
| Change (Post - Pre) | 0.39 | 0.59 | 0.66 |
| Percent Change | 4.17% | 2.07% | 1.59% |

Project Name: GEC-TO_8_WO_1_Ped_Bridge
Project Number: 13549
Calculated By: CCS
Date: 3/7/2016
Drainage Area: 2A

***Time of Concentration ($T_C$) Calculation***

Denotes Input Cell

| Flow Type | Length (ft) | Slope (ft/ft) | Surface | Manning's n | Area (sf) | WP (ft) | Velocity (ft/s) | Time (hr) |
|---|---|---|---|---|---|---|---|---|
| Sheet | 100.0 | 0.005 | Grass-Range, Short | 0.150 | ----- | ----- | ----- | 0.246 |
| Shallow Concentrated | 1336.6 | 0.0069 | Unpaved | ----- | ----- | ----- | 1.34 | 0.277 |
| Shallow Concentrated | | | | ----- | ----- | ----- | ----- | ----- |
| Channel | | | ----- | | | | ----- | ----- |
| Channel | | | ----- | | | | ----- | ----- |
| **Total** | **1436.6** | | | | | | | **0.523** |

| | |
|---|---|
| Project Name: | GEC-TO_8_WO_1_Ped_Bridge |
| Project Number: | 13549 |
| Calculated By: | CCS |
| Date: | 3/7/2016 |
| Drainage Area: | 2B |

Denotes Input Cell

***Drainage Area Information***

| | | |
|---|---|---|
| County | Chatham | |
| Drainage Area Pre ($A_{Pre}$) | 5.19 | ac |
| Drainage Area Post ($A_{Post}$) | 5.19 | ac |
| SCS Curve Number Pre ($CN_{Pre}$) | 81 | |
| SCS Curve Number Post ($CN_{Post}$) | 81 | |
| Time of Concentration ($T_C$) | 21.5 | min |

***Water Quality Volume Calculation***

$$R_V = 0.05 + 0.009(I) \qquad WQ_V = \frac{1.2 R_V A}{12}$$

| | | | |
|---|---|---|---|
| Percent Impervious Pre ($I_{Pre}$) | 16.57 | % | |
| Percent Impervious Post ($I_{Post}$) | 16.57 | % | |
| Runoff Coefficient Pre ($R_{V\ Pre}$) | 0.199 | | |
| Runoff Coefficient Post ($R_{V\ Post}$) | 0.199 | | |
| Runoff Coefficient Design ($R_V$) | 0.000 | | *(Equals Rv Post-Rv Pre)* |
| Water Quality Volume ($WQ_V$) | 0.000 | ac-ft | |
| Water Quality Volume ($WQ_V$) | 0 | cf | |

***Required Volume Storage Summary***

| | $CP_V$/1-Year (cf) | 25-Year (cf) | 100-Year (cf) |
|---|---|---|---|
| Post-Development | 0 | 0 | 0 |

Channel Protection Volume ($CP_V$) Control Required? No *(No change in impervious)*

***Peak Flow Summary***

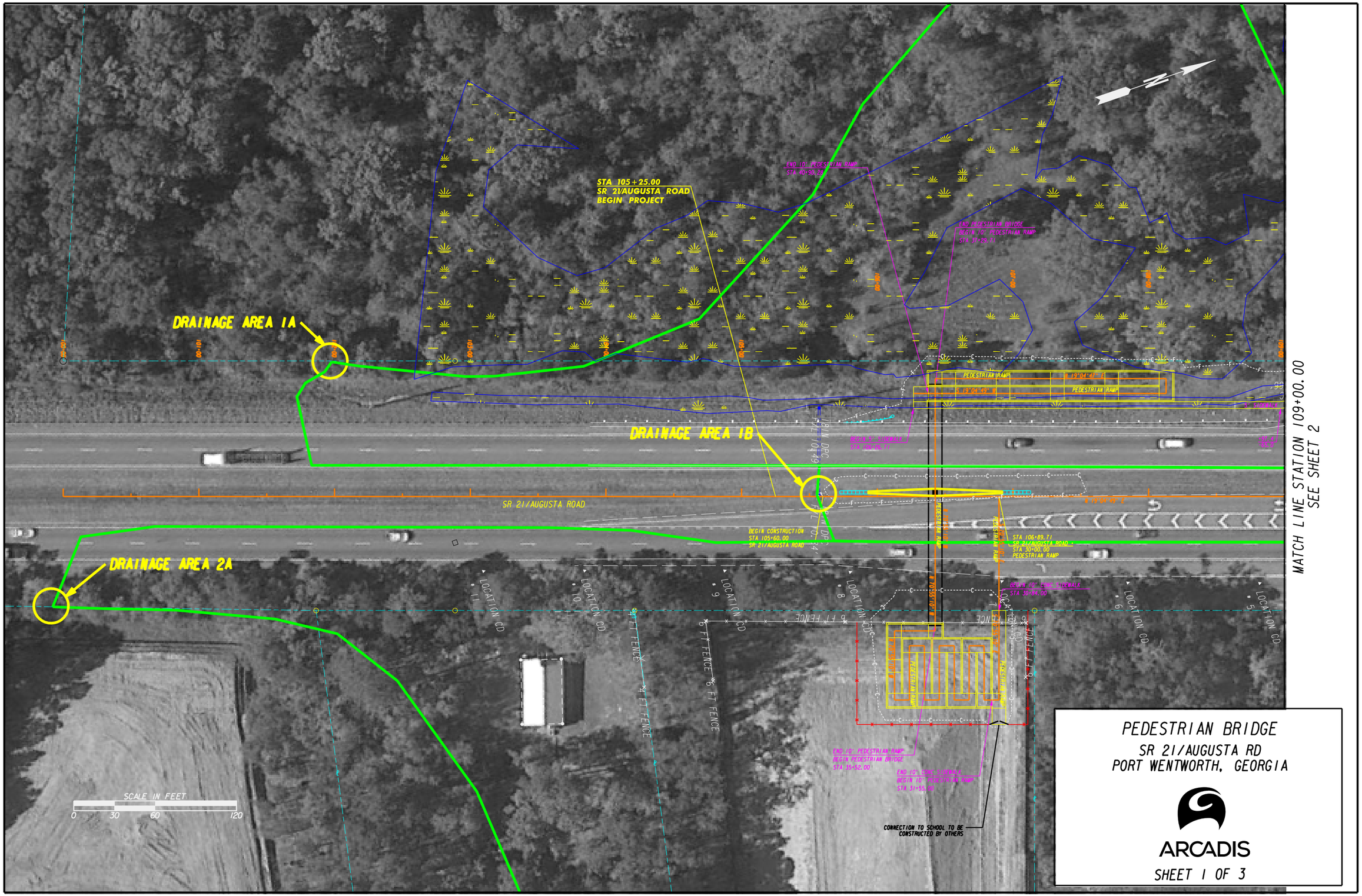
| | 1-Year (cfs) | 25-Year (cfs) | 100-Year (cfs) |
|---|---|---|---|
| Pre-Development | 7.04 | 21.44 | 31.23 |
| Post-Development | 7.04 | 21.44 | 31.23 |
| Change (Post - Pre) | 0.00 | 0.00 | 0.00 |
| Percent Change | 0.00% | 0.00% | 0.00% |

Project Name: GEC-TO_8_WO_1_Ped_Bridge
Project Number: 13549
Calculated By: CCS
Date: 3/7/2016
Drainage Area: 2B

***Time of Concentration ($T_C$) Calculation***

Denotes Input Cell

| Flow Type | Length (ft) | Slope (ft/ft) | Surface | Manning's n | Area (sf) | WP (ft) | Velocity (ft/s) | Time (hr) |
|---|---|---|---|---|---|---|---|---|
| Sheet | 100.0 | 0.0175 | Grass-Range, Short | 0.150 | ----- | ----- | ----- | 0.149 |
| Shallow Concentrated | 833.1 | 0.0047 | Unpaved | ----- | ----- | ----- | 1.11 | 0.209 |
| Shallow Concentrated | | | | ----- | ----- | ----- | ----- | ----- |
| Channel | | | ----- | | | | ----- | ----- |
| Channel | | | ----- | | | | ----- | ----- |
| **Total** | **933.1** | | | | | | | **0.358** |




MATCH LINE STATION 109+00.00
SEE SHEET 2

# PEDESTRIAN BRIDGE

SR 21/AUGUSTA RD
PORT WENTWORTH, GEORGIA

ARCADIS

SHEET 1 OF 3

MATCH LINE STATION 109+00.00
SEE SHEET 1

MATCH LINE STATION 118+00
SEE SHEET 3

DRAINAGE AREA 1C

DRAINAGE AREA 1D

DRAINAGE AREA 2B

1A

1B

1C

1D

2A

2B

SR 21/AUGUSTA ROAD

RICE MILL ROAD

MARKET BLVD

LIMIT OF CONSTRUCTION STA 14+50.00 MARKET BLVD/ RICE MILL RD

STA 110+57.56 SR 21/AUGUSTA ROAD STA 13+00.50 MARKET BLVD/ RICE MILL RD

END 5' SIDEWALK STA 14+60.00

END CONSTRUCTION STA 112+00.00 SR 21/AUGUSTA ROAD

STA 112+00.00 SR 21/AUGUSTA ROAD END PROJECT

36IN DPC E/E 14.15'

36IN DPC E/E 14.80'

36IN DPC E/E 12.53'

36IN DPC E/E 12.28'

36IN DPC E/E 11.10'

36IN DPC E/E 12.71'

36IN DPC E/E 13.15'

LOCATION CD D902

SCALE IN FEET

0 30 60 120

# PEDESTRIAN BRIDGE

SR 21/AUGUSTA RD
PORT WENTWORTH, GEORGIA

ARCADIS

SHEET 2 OF 3

MATCH LINE STATION 118+00.00
SEE SHEET 1

1C

1D

2B

599

596

MP 17 MILE
(HIGHWAY)

SCALE IN FEET
0 30 60 120

# PEDESTRIAN BRIDGE

SR 21/AUGUSTA RD
PORT WENTWORTH, GEORGIA

ARCADIS

SHEET 3 OF 3

**NOAA Atlas 14, Volume 9, Version 2**
**Location name: Port Wentworth, Georgia, US***
**Latitude: 32.2207°, Longitude: -81.1971°**
**Elevation: 21 ft***
* source: Google Maps

**POINT PRECIPITATION FREQUENCY ESTIMATES**

Sanja Perica, Deborah Martin, Sandra Pavlovic, Ishani Roy, Michael St. Laurent, Carl Trypaluk, Dale Unruh, Michael Yekta, Geoffery Bonnin

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

## PF tabular

**PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]**

| Duration | Average recurrence interval (years) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 5 | 10 | 25 | 50 | 100 | 200 | 500 | 1000 |
| 5-min | 0.541 (0.462–0.641) | 0.612 (0.522–0.726) | 0.728 (0.618–0.865) | 0.823 (0.694–0.983) | 0.955 (0.771–1.17) | 1.06 (0.829–1.32) | 1.16 (0.870–1.48) | 1.26 (0.899–1.65) | 1.39 (0.949–1.88) | 1.50 (0.987–2.06) |
| 10-min | 0.793 (0.677–0.939) | 0.896 (0.764–1.06) | 1.07 (0.905–1.27) | 1.21 (1.02–1.44) | 1.40 (1.13–1.72) | 1.55 (1.21–1.93) | 1.69 (1.27–2.16) | 1.84 (1.32–2.42) | 2.04 (1.39–2.76) | 2.19 (1.45–3.01) |
| 15-min | 0.967 (0.826–1.15) | 1.09 (0.932–1.30) | 1.30 (1.10–1.54) | 1.47 (1.24–1.76) | 1.71 (1.38–2.09) | 1.89 (1.48–2.35) | 2.07 (1.55–2.64) | 2.25 (1.61–2.95) | 2.49 (1.70–3.36) | 2.67 (1.76–3.67) |
| 30-min | 1.37 (1.17–1.62) | 1.56 (1.33–1.85) | 1.87 (1.59–2.22) | 2.12 (1.79–2.53) | 2.47 (1.99–3.03) | 2.73 (2.15–3.40) | 2.99 (2.25–3.82) | 3.26 (2.33–4.27) | 3.60 (2.45–4.86) | 3.86 (2.55–5.31) |
| 60-min | 1.77 (1.51–2.09) | 2.01 (1.71–2.38) | 2.41 (2.05–2.87) | 2.76 (2.32–3.29) | 3.24 (2.63–4.00) | 3.63 (2.85–4.54) | 4.02 (3.03–5.15) | 4.43 (3.17–5.83) | 4.98 (3.39–6.74) | 5.40 (3.57–7.43) |
| 2-hr | 2.16 (1.86–2.54) | 2.46 (2.11–2.89) | 2.96 (2.53–3.49) | 3.39 (2.88–4.02) | 4.02 (3.28–4.94) | 4.52 (3.58–5.63) | 5.04 (3.83–6.44) | 5.59 (4.03–7.34) | 6.35 (4.36–8.56) | 6.95 (4.62–9.49) |
| 3-hr | 2.39 (2.06–2.80) | 2.71 (2.33–3.18) | 3.28 (2.81–3.85) | 3.78 (3.22–4.46) | 4.53 (3.72–5.57) | 5.14 (4.10–6.40) | 5.79 (4.42–7.39) | 6.49 (4.70–8.50) | 7.47 (5.16–10.0) | 8.25 (5.50–11.2) |
| 6-hr | 2.78 (2.41–3.23) | 3.18 (2.75–3.70) | 3.90 (3.36–4.55) | 4.55 (3.90–5.34) | 5.55 (4.59–6.81) | 6.38 (5.12–7.92) | 7.28 (5.59–9.25) | 8.25 (6.02–10.8) | 9.63 (6.70–12.9) | 10.7 (7.21–14.5) |
| 12-hr | 3.19 (2.78–3.69) | 3.71 (3.23–4.28) | 4.63 (4.02–5.37) | 5.48 (4.71–6.38) | 6.75 (5.63–8.25) | 7.83 (6.32–9.66) | 8.99 (6.95–11.4) | 10.2 (7.52–13.3) | 12.0 (8.42–16.0) | 13.5 (9.10–18.1) |
| 24-hr | 3.68 (3.22–4.22) | 4.28 (3.75–4.91) | 5.37 (4.69–6.18) | 6.38 (5.52–7.37) | 7.90 (6.63–9.60) | 9.20 (7.47–11.3) | 10.6 (8.24–13.3) | 12.1 (8.95–15.6) | 14.3 (10.1–18.9) | 16.0 (10.9–21.4) |
| 2-day | 4.27 (3.77–4.87) | 4.91 (4.33–5.60) | 6.09 (5.34–6.96) | 7.19 (6.26–8.26) | 8.88 (7.52–10.7) | 10.3 (8.46–12.6) | 11.9 (9.34–14.9) | 13.6 (10.2–17.5) | 16.1 (11.4–21.2) | 18.1 (12.4–24.0) |
| 3-day | 4.66 (4.13–5.29) | 5.36 (4.74–6.08) | 6.63 (5.84–7.55) | 7.80 (6.82–8.92) | 9.60 (8.14–11.5) | 11.1 (9.14–13.5) | 12.8 (10.1–15.9) | 14.6 (10.9–18.6) | 17.2 (12.3–22.5) | 19.3 (13.3–25.4) |
| 4-day | 5.00 (4.44–5.65) | 5.74 (5.09–6.50) | 7.08 (6.25–8.03) | 8.30 (7.28–9.46) | 10.2 (8.63–12.1) | 11.7 (9.66–14.2) | 13.4 (10.6–16.6) | 15.3 (11.4–19.4) | 17.9 (12.8–23.4) | 20.0 (13.8–26.3) |
| 7-day | 5.91 (5.27–6.65) | 6.72 (5.98–7.56) | 8.15 (7.23–9.20) | 9.44 (8.32–10.7) | 11.4 (9.70–13.5) | 13.0 (10.7–15.6) | 14.7 (11.7–18.1) | 16.6 (12.5–20.9) | 19.2 (13.8–24.9) | 21.4 (14.8–27.9) |
| 10-day | 6.73 (6.02–7.54) | 7.59 (6.79–8.52) | 9.11 (8.10–10.2) | 10.5 (9.24–11.8) | 12.5 (10.6–14.7) | 14.1 (11.7–16.8) | 15.9 (12.6–19.4) | 17.8 (13.4–22.3) | 20.4 (14.7–26.3) | 22.5 (15.7–29.4) |
| 20-day | 9.08 (8.17–10.1) | 10.2 (9.13–11.3) | 12.0 (10.7–13.4) | 13.6 (12.1–15.2) | 15.8 (13.6–18.4) | 17.7 (14.7–20.8) | 19.6 (15.6–23.6) | 21.6 (16.4–26.8) | 24.3 (17.6–31.1) | 26.5 (18.6–34.3) |
| 30-day | 11.1 (10.0–12.3) | 12.4 (11.2–13.7) | 14.5 (13.0–16.1) | 16.3 (14.6–18.2) | 18.9 (16.2–21.7) | 20.9 (17.4–24.4) | 22.9 (18.3–27.4) | 25.0 (19.0–30.8) | 27.8 (20.2–35.3) | 30.0 (21.1–38.6) |
| 45-day | 13.6 (12.4–15.0) | 15.2 (13.8–16.8) | 17.8 (16.1–19.7) | 19.9 (17.9–22.2) | 22.8 (19.6–26.1) | 25.0 (20.9–29.0) | 27.2 (21.8–32.3) | 29.3 (22.4–35.9) | 32.2 (23.4–40.5) | 34.3 (24.2–44.0) |
| 60-day | 15.9 (14.4–17.5) | 17.8 (16.1–19.5) | 20.7 (18.8–22.9) | 23.1 (20.8–25.6) | 26.3 (22.6–29.8) | 28.6 (24.0–33.0) | 30.9 (24.8–36.5) | 33.1 (25.3–40.3) | 35.9 (26.1–44.9) | 37.8 (26.8–48.4) |

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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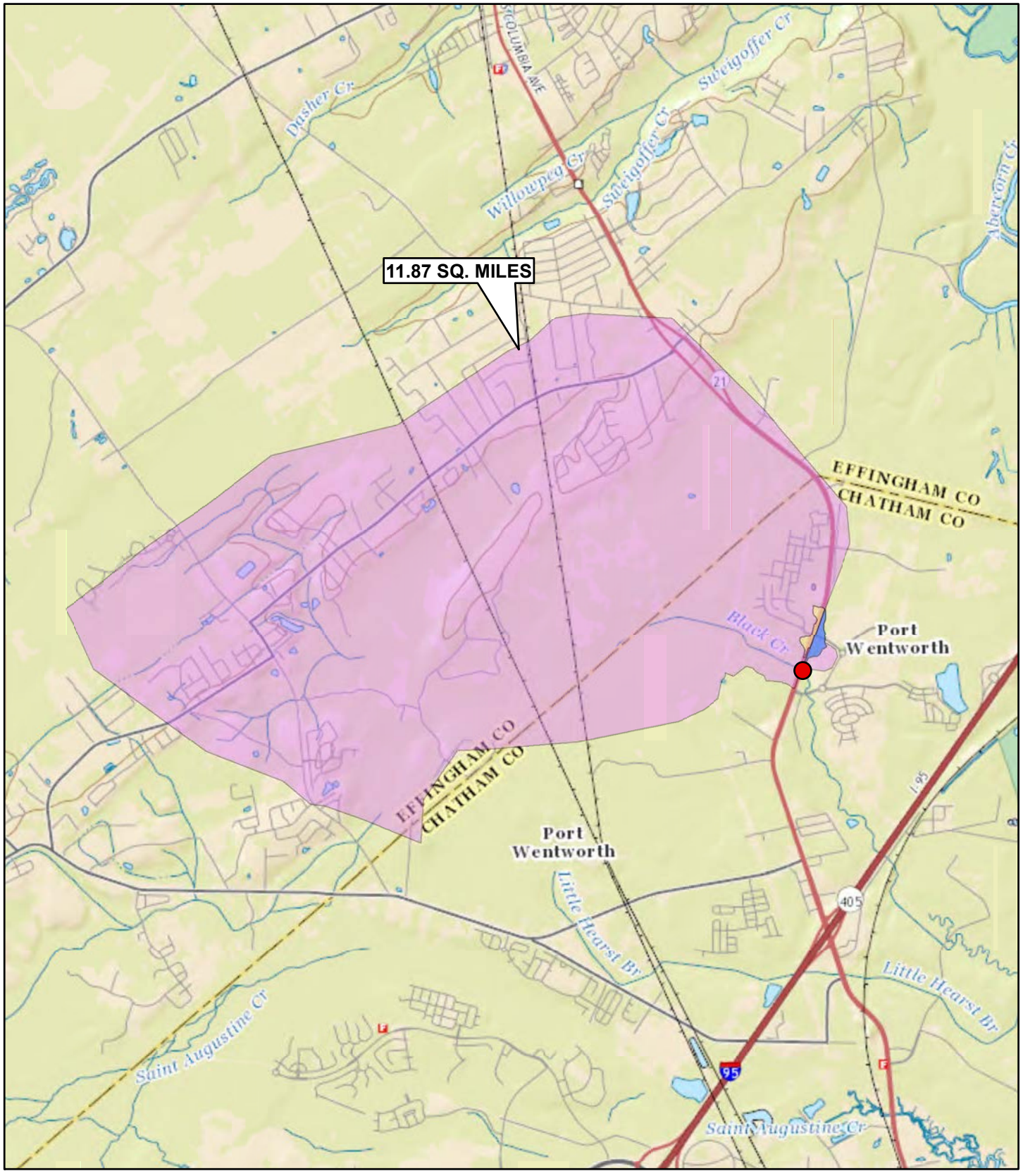
## PF graphical




**Georgia DOT**

**DOWNSTREAM ANALYSIS BASIN**
**PI: 0013549**
**CHATHAM COUNTY**

ARCADIS

FIGURE 1

United States Department of Agriculture

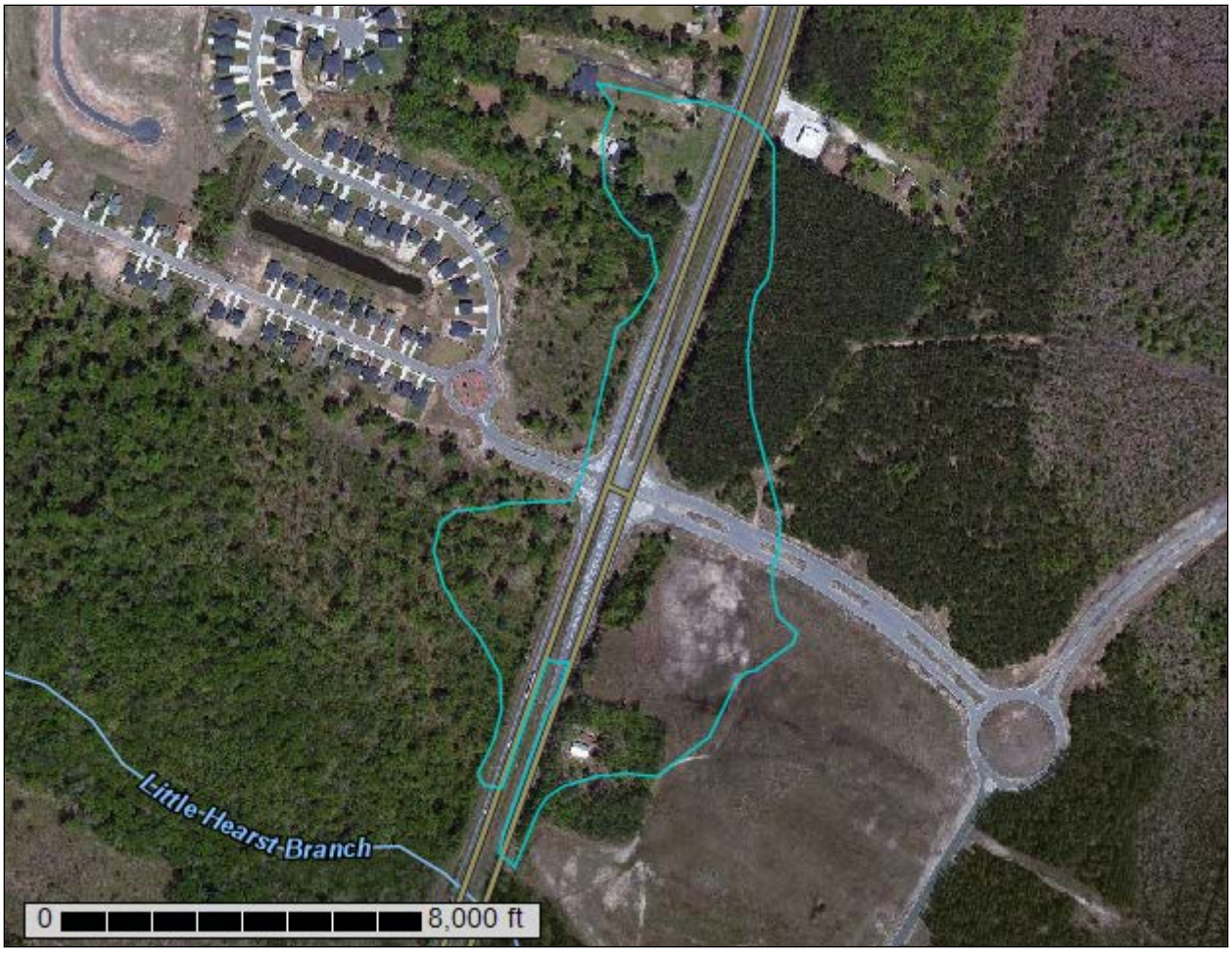
NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

# Custom Soil Resource Report for Bryan and Chatham Counties, Georgia

## GEC_TO_8_WO_1_Ped-Bridge




March 8, 2016

# Custom Soil Resource Report
## Soil Map


Map Scale: 1:3,820 if printed on A portrait (8.5" x 11") sheet.

N

Meters
0 50 100 200 300

Feet
0 150 300 600 900

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 17N WGS84

## MAP LEGEND

**Area of Interest (AOI)**
- Area of Interest (AOI)

**Soils**
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

**Special Point Features**
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

**Water Features**
- Streams and Canals

**Transportation**
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

**Background**
- Aerial Photography

## MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Bryan and Chatham Counties, Georgia
Survey Area Data: Version 9, Sep 17, 2014

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Mar 1, 2010—Apr 18, 2011

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

# Bryan and Chatham Counties, Georgia

## Oj—Ocilla complex

### Map Unit Setting

*National map unit symbol:* 46gt
*Elevation:* 10 to 450 feet
*Mean annual precipitation:* 44 to 52 inches
*Mean annual air temperature:* 64 to 70 degrees F
*Frost-free period:* 230 to 290 days
*Farmland classification:* Farmland of statewide importance

### Map Unit Composition

*Ocilla and similar soils:* 95 percent
*Minor components:* 5 percent
*Estimates are based on observations, descriptions, and transects of the mapunit.*

### Description of Ocilla

#### Setting

*Landform:* Interfluves
*Down-slope shape:* Convex
*Across-slope shape:* Linear
*Parent material:* Marine deposits

#### Typical profile

*H1 - 0 to 28 inches:* loamy fine sand
*H2 - 28 to 59 inches:* sandy clay loam
*H3 - 59 to 67 inches:* sandy clay loam

#### Properties and qualities

*Slope:* 0 to 2 percent
*Depth to restrictive feature:* More than 80 inches
*Natural drainage class:* Somewhat poorly drained
*Capacity of the most limiting layer to transmit water (Ksat):* Moderately high to high (0.20 to 1.98 in/hr)
*Depth to water table:* About 12 to 30 inches
*Frequency of flooding:* None
*Frequency of ponding:* None
*Available water storage in profile:* Low (about 5.5 inches)

#### Interpretive groups

*Land capability classification (irrigated):* None specified
*Land capability classification (nonirrigated):* 3w
*Hydrologic Soil Group:* B/D
*Ecological site:* Loamy Rise, Moderately Wet (R153AY001GA)

### Minor Components

#### Ellabelle

*Percent of map unit:* 3 percent
*Landform:* Drainageways, depressions
*Down-slope shape:* Linear, concave
*Across-slope shape:* Concave

**Pelham**

*Percent of map unit:* 2 percent
*Landform:* Depressions, flats
*Landform position (three-dimensional):* Dip
*Down-slope shape:* Concave, linear
*Across-slope shape:* Concave, linear

## Ok—Ogeechee loamy fine sand

**Map Unit Setting**

*National map unit symbol:* 46gw
*Elevation:* 10 to 50 feet
*Mean annual precipitation:* 44 to 52 inches
*Mean annual air temperature:* 64 to 70 degrees F
*Frost-free period:* 230 to 290 days
*Farmland classification:* Not prime farmland

**Map Unit Composition**

*Ogeechee and similar soils:* 100 percent
*Estimates are based on observations, descriptions, and transects of the mapunit.*

**Description of Ogeechee**

**Setting**

*Landform:* Depressions, drainageways, flats
*Down-slope shape:* Concave, linear
*Across-slope shape:* Concave, linear
*Parent material:* Marine deposits

**Typical profile**

*H1 - 0 to 8 inches:* loamy fine sand
*H2 - 8 to 23 inches:* sandy clay loam
*H3 - 23 to 42 inches:* sandy clay
*H4 - 42 to 60 inches:* sandy clay loam

**Properties and qualities**

*Slope:* 0 to 2 percent
*Depth to restrictive feature:* More than 80 inches
*Natural drainage class:* Poorly drained
*Capacity of the most limiting layer to transmit water (Ksat):* Moderately high to high (0.57 to 1.98 in/hr)
*Depth to water table:* About 0 to 12 inches
*Frequency of flooding:* Frequent
*Frequency of ponding:* None
*Available water storage in profile:* Moderate (about 6.4 inches)

**Interpretive groups**

*Land capability classification (irrigated):* None specified
*Land capability classification (nonirrigated):* 4w
*Hydrologic Soil Group:* B/D

## Pn—Pooler fine sandy loam

### Map Unit Setting

*National map unit symbol:* 46h1
*Elevation:* 20 to 100 feet
*Mean annual precipitation:* 44 to 52 inches
*Mean annual air temperature:* 64 to 70 degrees F
*Frost-free period:* 230 to 290 days
*Farmland classification:* Not prime farmland

### Map Unit Composition

*Pooler and similar soils:* 100 percent
*Estimates are based on observations, descriptions, and transects of the mapunit.*

### Description of Pooler

#### Setting

*Landform:* Depressions, flats
*Down-slope shape:* Concave, linear
*Across-slope shape:* Concave, linear
*Parent material:* Marine deposits

#### Typical profile

*H1 - 0 to 6 inches:* fine sandy loam
*H2 - 6 to 12 inches:* sandy clay loam
*H3 - 12 to 52 inches:* clay
*H4 - 52 to 72 inches:* sandy clay loam

#### Properties and qualities

*Slope:* 0 to 2 percent
*Depth to restrictive feature:* More than 80 inches
*Natural drainage class:* Poorly drained
*Capacity of the most limiting layer to transmit water (Ksat):* Moderately low to moderately high (0.06 to 0.20 in/hr)
*Depth to water table:* About 0 to 12 inches
*Frequency of flooding:* None
*Frequency of ponding:* None
*Available water storage in profile:* Moderate (about 8.7 inches)

#### Interpretive groups

*Land capability classification (irrigated):* None specified
*Land capability classification (nonirrigated):* 6w
*Hydrologic Soil Group:* C/D

# Custom Soil Resource Report
## Map—Hydrologic Soil Group


Map Scale: 1:3,820 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 50 100 200 300

Feet: 0 150 300 600 900

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 17N WGS84

## MAP LEGEND

**Area of Interest (AOI)**

Area of Interest (AOI)

**Soils**

**Soil Rating Polygons**

A

A/D

B

B/D

C

C/D

D

Not rated or not available

**Soil Rating Lines**

A

A/D

B

B/D

C

C/D

D

Not rated or not available

**Soil Rating Points**

A

A/D

B

B/D

C

C/D

D

Not rated or not available

**Water Features**

Streams and Canals

**Transportation**

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

**Background**

Aerial Photography

## MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Bryan and Chatham Counties, Georgia
Survey Area Data: Version 9, Sep 17, 2014

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Mar 1, 2010—Apr 18, 2011

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

## Table—Hydrologic Soil Group

| Hydrologic Soil Group— Summary by Map Unit — Bryan and Chatham Counties, Georgia (GA613) | | | | |
|---|---|---|---|---|
| **Map unit symbol** | **Map unit name** | **Rating** | **Acres in AOI** | **Percent of AOI** |
| Oj | Ocilla complex | B/D | 7.0 | 29.6% |
| Ok | Ogeechee loamy fine sand | B/D | 4.0 | 17.0% |
| Pn | Pooler fine sandy loam | C/D | 12.6 | 53.3% |
| **Totals for Area of Interest** | | | **23.6** | **100.0%** |

## Rating Options—Hydrologic Soil Group

*Aggregation Method:* Dominant Condition

*Component Percent Cutoff: None Specified*

*Tie-break Rule:* Higher

END 10' PEDESTRIAN RAMP
STA 40+90.28

END PEDESTRIAN BRIDGE
BEGIN 10' PEDESTRIAN RAMP
STA 37+29.71

END TP 2 CONC C & G
STA 109+35.79

END 5' SIDEWALK
STA 14+50.00

LIMIT OF CONSTRUCTION
STA 14+50.00
MARKET BLVD/
RICE MILL RD

STA 110+57.56
SR 21/AUGUSTA HWY
STA 13+00.50
MARKET BLVD/
RICE MILL RD

+00.0
- 46.0

BEGIN 5' SIDEWALK
BEGIN TP 2 CONC C & G
STA 106+26.71

N CONSTRUCTION
104+98.88
1/AUGUSTA HWY

STA 106+89.71
SR 21/AUGUSTA HWY -
STA 30+00.00
PEDESTRIAN RAMP

END CONSTRUCTION
STA 110+29.36
SR 21/AUGUSTA HWY

END 5' SIDEWALK
STA 106+99.87

STA 112+00.00
SR 21/AUGUSTA HWY
END PROJECT

BEGIN 5' SIDEWALK
STA 105+17.93

END 10' PEDESTRIAN RAMP
BEGIN PEDESTRIAN BRIDGE
STA 35+52.00

END 10' CONC SIDEWALK
BEGIN 10' PEDESTRIAN RAMP
STA 31+55.00

SCALE IN FEET
0 30 60 120

# PEDESTRIAN BRIDGE

SR 21/AUGUSTA RD
PORT WENTWORTH, GEORGIA

ARCADIS

# Attachment D
# Milestone Plan Submittal Checklist

**Preliminary Field Plan Review (PFPR) Milestone**

Yes / No

☒ ☐ Has the preliminary hydrology study (submitted in concept) been altered?

- ☒ A detailed study has been provided including the design of detention and water quality structures
- ☒ The detail design includes all of the following:
  - ☒ Percent impervious
  - ☒ Drainage area
  - ☒ Runoff (C) or (CN) values
  - ☒ Average slope of site
  - ☒ Soil conditions
  - ☒ Stage/Storage/Discharge Table
  - ☒ Outlet structure details
  - ☒ (For infiltration) Hydraulic Conductivity "K"
  - ☒ Grading necessary for any BMPs
  - ☒ Time of concentration

Yes / No

☒ ☐ The Post-Construction BMP Summary Tables have been completed.

☒ ☐ The Low Impact Development (LID) / Green Infrastructure (GI) Checklist been completed.

☒ ☐ The Infeasibility & Outfall Level Exclusion Report has been completed. (Note – this is required if the two above items have not been completed.)

**Final Field Plan Review (FFPR), Final Plans, and Use-on-Construction Milestone**

Yes / No

☐ ☐ Has the detailed hydrology study (submitted in PFPR) been altered?

- ☐ There have been changes that warrant a revision to the previous study
- ☐ There have been changes that warrant a revision to the post-construction BMP details