Harness Creek Gully Repair
P584605

30% Schematic Design Report

Anne Arundel County, Maryland

KCI Technologies, Inc.
May 2022
KCI Project Number 171804667.16

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1.0 INTRODUCTION

1.1 Background

The Anne Arundel County Department of Public Works investigated the Harness Creek area within Quiet Waters Park with the goal of constructing a boardwalk down to the water, storage bins, small vessel rack, and an aluminum pier for water access to the creek. A schematic design was prepared, and it was determined that the project would not move forward.

As part of this investigation, it was determined that drainage from the roadway and the upper trail, passing through a corrugated metal pipe (CMP) culvert and into the wooded area adjacent to the proposed boardwalk, was causing erosion and a gully was forming. This gully extends from the CMP culvert downstream about 450 feet before the slope flattens just upstream of the tidal interface. The gully depth ranges up to about five feet, and several large trees have fallen along the limits of the gully. The location of the Harness Creek Gully Repair is shown in Figure 1 below.

Modification opportunities for stabilization of the channel and water quality treatment were identified. As part of this effort survey and natural resource data were reviewed and collected, hydrologic computations were developed to assess existing conditions, and a field inspection was performed.

The following sections of this report include detailed descriptions of existing conditions and the schematic design developed for the gully repair. Design computations were conducted per County SPSC and Maryland Department of the Environment (MDE) stormwater facility design standards.

Figure 1.0- Harness Creek Gully Repair Project Location Map

1.2 Project Objectives

This Schematic Design Report was developed to address key project objectives as outlined below:

Complete hydrologic/hydraulic analyses of the existing system(s) to determine a design approach that restores the eroded channel to stable conditions.
Develop a design to provide maximum water quality benefits in the facility.
Document credit towards Anne Arundel County's National Pollutant Discharge Elimination System (NPDES) municipal separate storm sewer system (MS4) permit watershed restoration requirement and assisting in meeting Anne Arundel County's waste load allocation towards the Chesapeake Bay Total Maximum Daily Load (TMDL).

Detailed analyses of the watershed and site area were performed and design requirements were identified based on the results of the study. This Schematic Design Report documents each of the studies performed and documents the proposed restoration.

2.0 EXISTING SITE CONDITIONS

2.1 Project Site Description

Harness Creek is located in Quiet Waters Park in Annapolis, MD. A site conditions map showing existing conditions and the storm drain systems is provided in Appendix B. An eroded channel conveys storm flow from the adjacent trail, open green space, roadway, and wooded area of the park into Harness Creek through a 24" CMP pipe. The channel begins at the edge of Quiet Waters Park Rd at the outfall of a 24-inch reinforced concrete pipe (RCP), passes beneath a walking trail (24-CMP), and approximately 450ft east to Harness Creek. The main channel has an approximate 4-foot head cut and 3-foot-high banks.

Drainage to the channel originates from wooded and recreational fields. Roadway and parking areas also contribute drainage. Additionally, a section of the adjacent walking trail drains to the channel through sheet flow. The existing culverts and storm drains are in fair condition but currently clogged with debris.

2.2 Federal Emergency Management Agency Regulated Floodplain

The project site is included on one Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM), Panel Identification Number 24003C0242F (Appendix A) (FEMA, October 2012). The proposed facility is not located within a special flood hazard area. It is not anticipated that the proposed project will increase flood elevations in downstream areas since the goal of the project is to detain stormwater.

2.3 Natural Resource Inventory

KCI visited the site in March 2022 to perform an update of the wetland delineation that was performed originally as part of the boardwalk project. The field reconnaissance was performed for the entire study area to verify the presence or absence of wetland areas. KCI reviewed the wetland datasheets prepared previously and verified these using the *Corps of Engineers Wetland Delineation Manual.* See Appendix B for details on the wetland delineation.

Wetlands were identified near the downstream limits of the project. The channel was identified as ephemeral.

2.4 Hydrologic Investigation

Hydrologic Parameters

Drainage Area - The drainage area of Harness Creek was delineated using the County's GIS topography (1:2400) and field verified. The area was evaluated for existing drainage conditions. Future land use changes for the drainage area were assessed using zoning GIS data provided by the County. The land use data indicated the area is projected to remain zoned as designated Parks and Open Space.

Hydrologic Soil Groups - The hydrologic soils within the drainage area were identified from the online NRCS Soil Data Mart, (Natural Resources Conservation Service, United States Department of Agriculture, January 2016). The soils within the drainage area to Harness Creek Gully Repair are primarily hydrologic soil groups (HSG) B and C soils with some A and D soils. Soils are illustrated on the drainage area maps in Appendix C.

Runoff Curve Number - The overall existing land use within the Harness Creek Gully Repair watershed are primarily parks and open space. 1.45 acres of impervious surface within the park used for parking and walking trails.

The land use information along with the drainage area were used to create NRCS Technical Release 55 (TR-55) models (Natural Resources Conservation Service, United States Department of Agriculture, June 1986) for existing and ultimate conditions. The TR-55 model uses hydrologic soil groups which characterize the runoff potential of the soil, and land use data to determine a Runoff Curve Number (RCN), which represents the runoff potential of an area. The RCN used for the existing conditions model is based on current land use. A model representing ultimate conditions was also created based on future changes in land use predicted by zoning classifications as discussed above. To approximate the RCN in the model, industrial land use was used for the institutional since industrial has the most similar impervious cover percentage to the actual impervious coverage. The subsequent curve numbers represent an impervious coverage slightly higher than the actual conditions, resulting in a conservative model. TR-55 reports are included in Appendix C and results are shown in Table 1.

Times of Concentration - The time of concentration (Tc) is the time required for runoff to travel from the most hydrologically remote point to the bottom of the drainage area. The Tc path was delineated for the drainage area using the County's aerial topography (1:2400 feet). The Tc is given in Table 1 and calculations are provided in Appendix C.

Table 1: Drainage Area Hydrologic Data

	DA (acres)	Existing RCN	Ultimate RCN	Tc (hours)
Harness Creek Gully Repair	12.92	75	75	0.22

Hydrologic Method

The NRCS Technical Release 20 (TR-20) method was used to estimate peak discharges reaching the Harness channel for existing and proposed conditions (NRCS-USDA, 2015). NOAA Atlas 14 rainfall depths with the Type C rainfall distribution over a 24-hour duration were used to estimate peak discharges for existing and ultimate conditions (Natural Resources Conversation Service, United States Department of Agriculture, 1992). This method uses a synthetic hydrograph based on a dimensionless unit hydrograph and rainfall depths for accepted storm events. The TR-20 inputs include the: drainage area, runoff curve number, time of concentration, and rainfall depth. Table 2 lists the design rainfall events simulated.

Table 2: Modeled Rainfall Events

	Storm Event			
	1-yr	2-yr	10-yr	100-yr
Duration (hr)	24	24	24	24
Rainfall (in)	2.66	3.22	5.01	8.64

Hydrologic Results

The peak discharges were estimated for 1-, 2-, 10-, and 100-year storm events for existing watershed conditions. The 100-year storm event was modeled using ultimate watershed conditions however there are no projected changes to land use within the drainage area. Table 3 lists the hydrologic results. The TR-20 model is included in Appendix C.

Table 3: Existing Discharges (cfs)

Location	Storm Event			
	1-yr	2-yr	10-yr	100-yr
Harness Creek Gully Repair Existing	9.3	14.3	32.7	74.1

3.0 PROPOSED SCHEMATIC DESIGN

3.1 Design Objectives

The design approach focused on restoring the stability of the incised channel and providing water quality benefits for the watershed while attempting to increase stormwater attenuation and reduce flow velocities throughout the project limits. To accomplish these goals, the design proposes modifying the stormwater management pond by installing a Step Pool Storm Conveyance (SPSC) System from the 24" CMP inflow pipe to the outfall at harness creek. The pools contained within the SPSC will attenuate storm flows, and the underlying sand/woodchip filter will provide water quality treatment.

3.2 Design Approach

The proposed SPSC along the channel consists of 12 riffle weirs, one short cascade (two-foot vertical drop), and 14 pools between the upstream 24" CMP inflow and the project outfall into Harness Creek. The riffle weirs and cascades will be constructed of cobbles and boulders with berms connecting the weirs to the stream banks, constructed of fill material. The weir structures are designed to safely convey the 100-year storm runoff of 74.1 cfs (Table 4) as it transitions down 14 feet over a length of approximately 450 feet. All proposed grading surrounding pools and weir structures is at a 3:1 slope. All structures follow the NRCS-MD 378 small pond restriction and have embankments of less than four feet.

Table 4: Riffle 100-Year Storm Event Design Values

Weir Top Width (ft)	Weir Length (ft)	Weir Depth (ft)	Cobble Mean Diameter (d50) (in.)	100-YR Q (cfs)	Full-Flow Capacity Q (cfs)	Full-Flow Velocity (fps)	Maximum Allowable Velocity (fps)
16	8	.92	9	74.1	74.2	7.6	7.7

Restoration Credit and Nutrient Reduction Analysis

The proposed Harness Creek Gully restoration is dry step pool storm conveyance system (SPSC) within an incised ephermal channel at the outfall of corrugated metal pipe. SPSCs, or dry Regenerative Storm Conveyances (RSC), are eligible for credit and nutrient reductions for Protocol 4 (Dry Channel RSC as an Upland Stormwater Retrofit) and Protocol 5 (Outfall and Gully Stabilization (OGS) Practices), based on *Recommendations for Crediting Outfall and Gully Stabilization Projects in the Chesapeake Bay Watershed* (Urban Stormwater Workgroup, 2019).

Protocol 4

Protocol 4 computes an annual nutrient and sediment reduction rate for the contributing drainage area to a qualifying dry channel RSC project. The modifications provide 7,758 cubic feet of water quality treatment, treating 109.56% of the target volume for treatment of the upstream drainage area. This water quality volume is based on volume stored within the SPSC pools. Table 6 below shows summary of treatment needed for the upstream drainage area versus proposed water quality treatment.

Table 6: Summary of Required vs. Proposed Water Quality Treatment

	WQv (ac-ft)	Equivalent Rainfall Depth Treated (inches)	Impervious Area Treated (acres)
Required	0.16	1.00	
Proposed	0.18	1.10	1.45

Protocol 5

Protocol 5 is an adaptation of the prevented sediment protocol that is applied to highly incised channels in the headwater transition zone that experience severe vertical erosion problems. Protocol 5 was calculated by determining the difference between existing conditions and interpolating an estimated equilibrium channel geometry using bulk density, grain size distribution, cross sectional data from channel the existing channel, and an estimate equilibrium bank slope. Table 7 below shows summary of the equivalent impervious treatment acres restored (EIA_f), length restored, and impervious acres credit per linear foot restored.

Table 7: Summary of Protocol 5 Impervious Acres Treatment and Length Restored

Impervious Treatment Acres Restored (ac)	Length Restored (LF)	Impervious Acres credit per Linear Foot Restored (ac/LF)
22.53	457	0.05

A summary of the reduced annual pollutant loads per acre per year for the two protocols for the proposed retrofit at Harness Creek Gully can be found in Table 8 below.

Table 8: Proposed Annual Pollutant Load Reductions

	TN (lbs)	TP (lbs)	TSS (tons)
Protocol 4	6.88	1.49	3,094
Protocol 5 (over 30 years)	182.23	83.92	159,849
Total	189.11	85.41	162,943

The treatment provided using Protocol 4, as an equivalent impervious area treated, is approximately 1.45 acres. The prevented sediment associated with the stabilization of the gully, as calculated using Protocol 5, generates an equivalent impervious area treated of approximately 22.53 acres. Combined, this produced a credit for the project of 23.98 acres of treatment impervious area. All computations for the schematic design of the modifications to Harness Creek can be found in Appendix D.

4.0 ADDITIONAL DESIGN CONSIDERATIONS

4.1 Natural Resource Impacts

The proposed SPSC system will impact several large trees along the tributary corridor. These trees, along with several others, will be removed. Wetlands present in the tidal zone will be temporarily impacted.

4.2 Existing Utilities

No utilities were identified within the proposed project limits.

4.3 Pedestrian and Park-Use Impacts

During construction, the project as proposed will include use of an existing parking area adjacent to the project. A walking trail will be used to access the stabilized construction entrance from the parking area. Staging will be provided in the parking lot. This will have an impact on park users, with parking reduction and rerouting of pedestrians around the project entrance.

4.4 Stormwater BMP Data Tracking Table

In accordance with the County, the Stormwater BMP Data Tracking Table for Harness Creek Gully Repair is included in Appendix E.

4.5 Anticipated Construction Cost

Appendix F contains a preliminary construction cost estimate developed for the schematic design. The proposed Harness Creek SPSC system cost, including a 30% contingency is approximately $294,000. The cost estimate will be refined during subsequent design phases.

5.0 SUMMARY

In order to meet the County's stormwater management goals and provide stabilization for an eroded gully to Harness Creek in Quiet Waters Park located in Annapolis, MD, the design proposes to install a dry SPSC system within the existing channel. The location of the existing corrugated metal inflow pipe is proposed to remain the same. The proposed conveyance system promotes stormwater retention and water quality treatment. Tables 8 and 9 below summarize the benefits of the proposed SPSC system.

Table 9: Proposed Annual Pollutant Load Reductions and Impervious Area (IA) Credit

	TN (lbs)	TP (lbs)	TSS (tons)	IA Credit
Protocol 4	6.88	1.49	3,094	1.45
Protocol 5 (over 30 years)	182.23	83.92	159,849	22.53
Total	189.11	85.41	162,943	23.98

Table 10: Harness Creek SPSC Construction Summary

	Cost	Impervious Acres Treated	Cost per Impervious Acre Treated
Proposed SPSC	$293,886	23.98	$12,255

6.0 REFERENCES

Anne Arundel County. Online GIS Data. Anne Arundel County, Annapolis, Maryland.

Anne Arundel County. *"Stormwater Management Practices and Procedures Manual"*. 2012. Anne Arundel County, Annapolis, Maryland.

Anne Arundel County. *"Regenerative Step Pool Storm Conveyance (SPSC) – Design Guidelines"*. 2021. Anne Arundel County, Annapolis, Maryland.

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Maryland Department of the Environment. "*Maryland Stormwater Design Manual Volume I & II"*. 2009. Baltimore, MD.

Maryland Department of the Environment. *"Accounting for Stormwater Wasteload Allocations and Impervious Acres Treated"*. June 2020. Baltimore, Maryland.

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Natural Resources Conversation Service, United States Department of Agriculture. Web Soil Survey. Accessed March 2022.

Urban Stormwater Work Group (Stream Restoration Group 2). 2019. *"Recommendations for Crediting Outfall and Gully Stabilization Projects in the Chesapeake Bay Watershed"*. Chesapeake Bay Foundation.

Urban Stormwater Work Group (Stream Restoration Group 2). 2019. *"Recommendations for Crediting Outfall and Gully Stabilization Projects in the Chesapeake Bay Watershed"*. Chesapeake Bay Foundation.

Appendix A – FEMA Flood Insurance Rate Map

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD 88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations tables in the Flood Insurance Study report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations tables should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) zone 18N. The **horizontal datum** was NAD 83, GRS 80 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of information shown on this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at **(301) 713-3242**, or visit its website at http://www.ngs.noaa.gov.

Base map information was provided by the Anne Arundel County GIS Department. The digital ortho imagery was compiled by Axis Geospatial at a scale of 1:100 with a 6 inch ground pixel resolution, and published by the Maryland Department of Information Technology in 2011.

This map reflects more detailed and up-to-date **stream channel configurations** than those shown on the previous FIRM for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRM may have been adjusted to confirm to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables in the Flood Insurance Study Report (which contains authoritative hydraulic data) may reflect stream channel distances that differ from what is shown on this map.

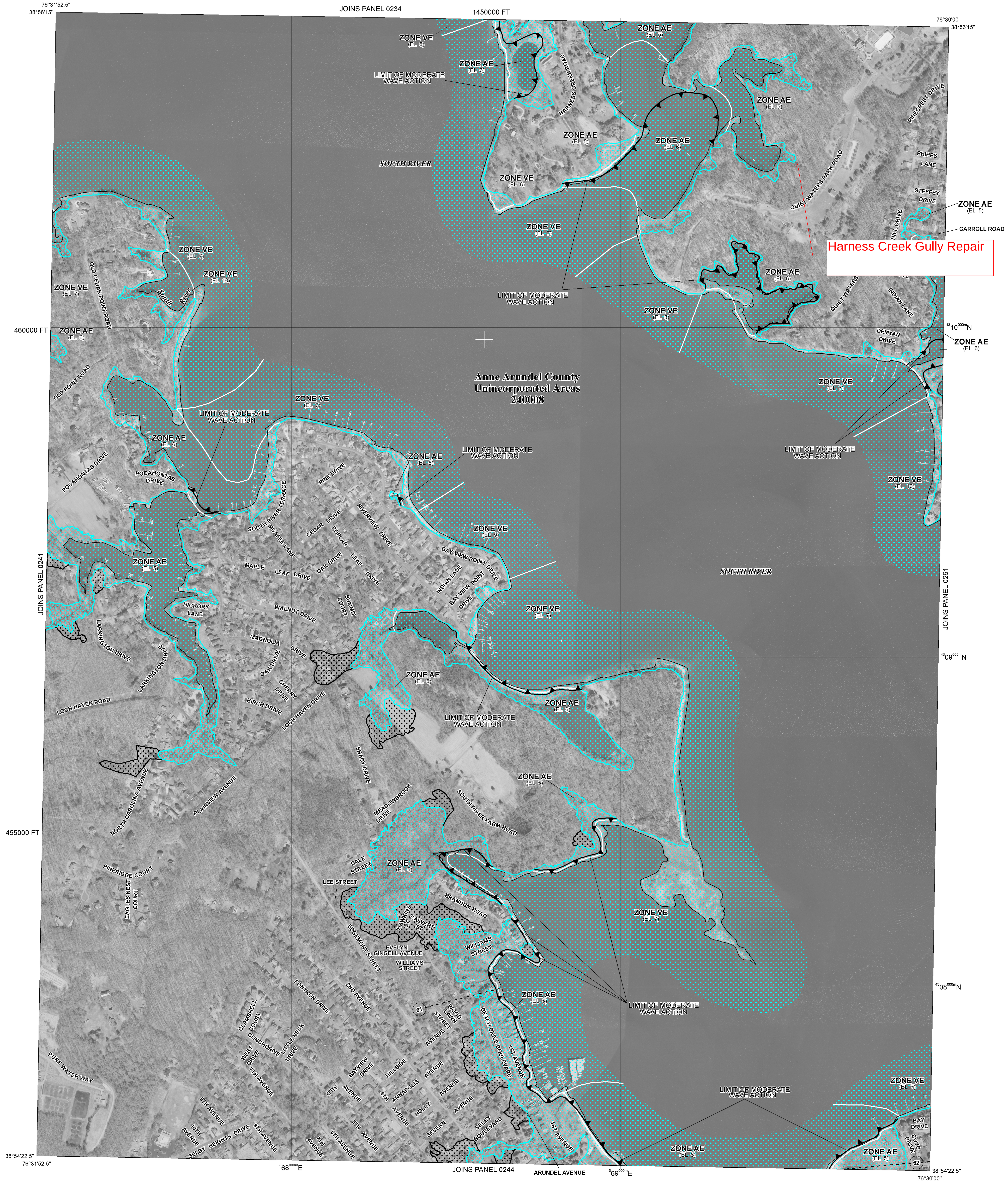
Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

The AE Zone category has been divided by a **Limit of Moderate Wave Action (LiMWA).** The LiMWA represents the approximate landward limit of the 1.5-foot breaking wave. The effects of wave hazards between the VE Zone and the LiMWA (or between the shoreline and the LiMWA for areas where VE Zones are not identified) will be similar to, but less severe than those in the VE Zone.

Contact the **FEMA Map Information eXchange** at 1-877-336-2627 for information on available products associated with this FIRM. Available products may include previously issued Letters of Map Change, a Flood Insurance Study report, and/or digital versions of this map. The FEMA Map Information eXchange may also be reached by Fax at 1-800-358-9620 and their website at http://www.msc.fema.gov/.

If you have **questions about this map** or questions concerning the National Flood Insurance Program in general, please call **1-877-FEMA MAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov/business/nfip.



LEGEND

SPECIAL FLOOD HAZARD AREAS SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A	No Base Flood Elevations determined.
ZONE AE	Base Flood Elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR	Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99	Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V	Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE	Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X	Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X	Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D	Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

1% annual chance floodplain boundary

0.2% annual chance floodplain boundary

Floodway boundary

Zone D boundary

CBRS and OPA boundary

Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.

Limit of Moderate Wave Action

~~ 513 ~~~	Base Flood Elevation line and value; elevation in feet*
(EL 987)	Base Flood Elevation value where uniform within zone; elevation in feet*

* Referenced to the North American Vertical Datum of 1988

(A)——(A)	Cross section line
(23)- - - - -(23)	Transect line
87°07'45", 32°22'30"	Geographic coordinates referenced to the North American Datum of 1983 (NAD 83), Western Hemisphere
2476000mN	1000-meter Universal Transverse Mercator grid values, zone 18N
600000 FT	5000-foot grid values: Maryland State Plane coordinate system (FIPSZONE 1900), Lambert Conformal Conic projection
DX5510 ×	Bench mark (see explanation in Notes to Users section of this FIRM panel)
● M1.5	River Mile

MAP REPOSITORY
Refer to listing of Map Repositories on Map Index

EFFECTIVE DATE OF COUNTYWIDE
FLOOD INSURANCE RATE MAP
October 16, 2012

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL
February 18, 2015 - To incorporate new detailed coastal flood hazard analysis and to reflect updated topographic information.

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your Insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 500'

250 0 500 1000 FEET

150 0 150 300 METERS

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0242F

FIRM
FLOOD INSURANCE RATE MAP

ANNE ARUNDEL COUNTY, MARYLAND
AND INCORPORATED AREAS

PANEL 242 OF 385

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
ANNE ARUNDEL COUNTY	240008	0242	F

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
24003C0242F

MAP REVISED
FEBRUARY 18, 2015

Federal Emergency Management Agency

Appendix B – Natural Resources Inventory

April 11, 2022

Ms. Melissa Harlinski
Anne Arundel County Department of Public Works
2662 Riva Road
Annapolis, MD 21401

RE: Harness Creek
Quiet Waters Park
Annapolis, MD

SUB: Summary of Findings Report

Dear Ms. Harlinski:

The Anne Arundel County Department of Public Works is proposing a regenerative step pool stormwater conveyance within Quiet Waters Park, at the headwaters of Harness Creek. As part of this effort, KCI Technologies, Inc. (KCI) reviewed and confirmed a previous wetland delineation performed by others. Resources throughout the study area were verified using criteria established in the *Corps of Engineers Wetlands Delineation Manual* (Environmental Laboratory, 1987), the *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Atlantic and Gulf Coastal Plain (Version 2.0)* (Environmental Laboratory, 2010), and subsequent guidance documents. Additionally, KCI confirmed a tree survey performed by others.

The project area consists of forested parkland adjacent to tidal waters. A nontidal wetland borders the tidal waters at the western edge of the study area. An ephemeral channel flows west through the study area, loses definition to become overflow, and flow eventually enters the nontidal and tidal wetlands.

Wetland Methodology

A field reconnaissance was performed for the entire study area to verify the presence or absence of wetland areas during March 2022. KCI reviewed wetland datasheets previously prepared by others and compared the data to conditions onsite. Wetlands were verified using the criteria outlined in the *Corps of Engineers Wetlands Delineation Manual* (Environmental Laboratory, 1987) and the *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Atlantic and Gulf Coastal Plain Region (Version 2.0)* (Environmental Laboratory, 2010). An

Existing Conditions Map prepared by KCI is included in Appendix A to this report. Wetland datasheets are included in Appendix B.

Findings

The field investigation performed during March 2022 located one nontidal wetland system and one tidal wetland system. An ephemeral channel was also identified within the study area.

Wetlands

Wetland DP-1 is a palustrine, forested, broad-leaved deciduous, seasonally flooded/saturated (PFO1E) wetland dominated by black gum (*Nyssa sylvatica*), sweet gum (*Liquidambar styraciflua*), American elm (*Ulmus americana*), American sycamore (*Platanus occidentalis*), blackhaw viburnum (*Viburnum prunifolium*), jewelweed (*Impatiens capensis*), Japanese stiltgrass (*Microstegium vimineum*), and Jack in the Pulpit (*Arisaema triphyllum*). Groundwater contributes hydrology to the wetland and hydric soils were identified.

The tidal fringe wetland along Harness Creek is dominated by eastern baccharis (*Baccharis halimfolia*), cattail (*Typha latifolia*), and sea-side club rush (*Schoenoplectus robustus*). The wetland is tidally influenced.

Waterways

An ephemeral channel originates within a forested area, approximately 400 feet east of Harness Creek. The channel conveys overland flow east, loses definition, and this flow eventually enters the wetland along the edge of Harness Creek.

Tree Survey

KCI walked the study area to verify a tree survey performed by others. KCI verified species, size, and condition of more than 200 trees located in the study area. Species ranged from sweet gum to tulip poplar (*Liriodendron tulipifera*), American sycamore, red maple (*Acer rubrum*), box elder (*Acer negundo*), and sassafras (*Sassafras albidum*). A number of trees were noted to be dead. An existing conditions plan prepared by others illustrating the trees and KCI's updated tree survey data are included as Appendix C to this report.

If you should have any questions regarding the information outlined above, or if you require additional information concerning this memorandum, please do not hesitate to contact me.

Very truly yours,
KCI TECHNOLOGIES, INC.

Jennifer Bird
Senior Project Manager
Natural Resources Practice

Direct Dial Phone: 410.316.7959
Email: jennifer.bird@kci.com

Enclosures: Appendix A: Existing Conditions Map, prepared by KCI
Appendix B: Wetland Datasheets
Appendix C: Tree Survey Map and Inventory

APPENDIX A

Existing Conditions Map

SOILS CHART

SYMBOL	SOIL	HSG
AsB	ANNAPOLIS FINE SANDY LOAM	C
AsC	ANNAPOLIS FINE SANDY LOAM	C
AsE	ANNAPOLIS FINE SANDY LOAM	C
CRD	COLLINGTON & ANNAPOLIS SOILS	B
CRD	COLLINGTON & ANNAPOLIS SOILS	B
CSE	COLLINGTON, WIST, & WESTPHALIA SOILS	A
DnB	DONLONTON FINE SANDY LOAM	D
W	WATER	N/A

KCI TECHNOLOGIES INC.
ENGINEERS AND PLANNERS
936 RIDGEBROOK ROAD
SPARKS, MARYLAND
21152
(410) 316-7800

"PROFESSIONAL CERTIFICATION. I HEREBY CERTIFY THAT THESE DOCUMENTS WERE PREPARED OR APPROVED BY ME, AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MARYLAND, LICENSE NO. 31201, EXPIRATION DATE: 2/1/2023."

SIGNATURE DATE

ANNE ARUNDEL COUNTY
DEPARTMENT OF PUBLIC WORKS

REVISIONS		
NO.	DATE	BY

APPROVED DATE — CHIEF ENGINEER
APPROVED DATE — WPRP ADMINISTRATOR
APPROVED DATE — PROJECT MANAGER
APPROVED DATE — CHIEF RIGHT-OF-WAY

SCALE: 1"= 20'
DRAWN BY: KL
CHECKED BY: JT
SHEET NO. 1 OF 1
PROJECT NO.: P584600
CONTRACT NO.: P584605

EXISTING CONDITIONS PLAN

HARNESS CREEK
GULLY REPAIR
APRIL 2022
2ND ELECTION DISTRICT, TAX MAP 56, PARCEL 88, GRID 17, ZONING OS, ZIP CODE 21403

APPENDIX B

Wetland Datasheets

WETLAND DETERMINATION DATA FORM – Atlantic and Gulf Coastal Plain Region

Project/Site: Harness Creek PadRow Facility City/County: Annapolis/Anne Arundel Sampling Date: 5/29/2020

Applicant/Owner: Anne Arundel County State: MD Sampling Point: DP_1-1_Wet

Investigator(s): Jason Traband, Cody Matteson Section, Township, Range: Quiet Waters Park

Landform (hillslope, terrace, etc.): Floodplain Local relief (concave, convex, none): Concave Slope (%): <1%

Subregion (LRR or MLRA): LRR S; MLRA 149A Lat: 38.933723 Long: -76.505462 Datum: NAD 83

Soil Map Unit Name: Collington, Wist, and Westphalia, 15-25% (CSE) NWI classification: N/A

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ✔ No ___ (If no, explain in Remarks.)

Are Vegetation ___, Soil ___, or Hydrology ___ significantly disturbed? Are "Normal Circumstances" present? Yes ✔ No ___

Are Vegetation ___, Soil ___, or Hydrology ___ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ✔	No ___
Hydric Soil Present?	Yes ✔	No ___
Wetland Hydrology Present?	Yes ✔	No ___

Is the Sampled Area within a Wetland? **Yes** ✔ **No** ___

Remarks:

The sample plot satisfies the three mandatory wetland criteria; therefore, this area is classified as a palustrine, forested, broad-leaved deciduous, seasonally flooded/saturated (PFO1E) wetland. The sample plot is located on at the border of the southern ephemeral channel and the wetland.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ☐ Surface Water (A1)
- ☑ High Water Table (A2)
- ☑ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☑ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☑ Water-Stained Leaves (B9)
- ☐ Aquatic Fauna (B13)
- ☐ Marl Deposits (B15) **(LRR U)**
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres along Living Roots (C3)
- ☑ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Thin Muck Surface (C7)
- ☐ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ☐ Surface Soil Cracks (B6)
- ☑ Sparsely Vegetated Concave Surface (B8)
- ☑ Drainage Patterns (B10)
- ☐ Moss Trim Lines (B16)
- ☐ Dry-Season Water Table (C2)
- ☐ Crayfish Burrows (C8)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☑ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-Neutral Test (D5)
- ☐ Sphagnum moss (D8) **(LRR T, U)**

Field Observations:

Surface Water Present?	Yes ___	No ✔	Depth (inches): ___
Water Table Present?	Yes ✔	No ___	Depth (inches): 6"
Saturation Present? (includes capillary fringe)	Yes ✔	No ___	Depth (inches): surface

Wetland Hydrology Present? Yes ✔ **No** ___

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

The sample plot satisfies the wetland hydrology criterion.

VEGETATION (Four Strata) – Use scientific names of plants.

Sampling Point: DP_1-1_Wet

Tree Stratum (Plot size: 30ft radius)

	Absolute % Cover	Dominant Species?	Indicator Status
1. Nyssa sylvatica (Black Gum)	25	Yes	FAC
2. Liquidambar styraciflua (Sweet Gum)	25	Yes	FAC
3. Ulmus americana (American Elm)	15	Yes	FAC
4.			
5.			
6.			
7.			
8.			
	65	= Total Cover	

50% of total cover: 32.5 20% of total cover: 13

Sapling/Shrub Stratum (Plot size: 30ft radius)

	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
	0	= Total Cover	

50% of total cover: 0 20% of total cover: 0

Herb Stratum (Plot size: 30ft radius)

	Absolute % Cover	Dominant Species?	Indicator Status
1. Microstegium vimineum (Japanese Stiltgrass)	25	Yes	FAC
2. Arisaema triphyllum (Jack in the pulpit)	15	Yes	FACW
3. Nyssa sylvatica (Black Gum)	5	No	FAC
4. Impatiens capensis (Jewelweed)	5	No	FACW
5. Carex glaucodea (Blue Sedge)	5	No	FACW
6. Hibiscus laevis (Rose Mallow)	5	No	OBL
7. Juncus effusus (Soft Rush)	3	No	OBL
8. Galium aparine (Stickywilly)	1	No	FACU
9.			
10.			
11.			
12.			
	64	= Total Cover	

50% of total cover: 35 20% of total cover: 12.8

Woody Vine Stratum (Plot size: 30ft radius)

	Absolute % Cover	Dominant Species?	Indicator Status
1. Parthenocissus quinquefolia (Virginia Creeper)	5	Yes	FACU
2.			
3.			
4.			
5.			
	5	= Total Cover	

50% of total cover: 2.5 20% of total cover: 1

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 5 (A)

Total Number of Dominant Species Across All Strata: 6 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 84% (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species	8	x 1 = 8
FACW species	25	x 2 = 50
FAC species	95	x 3 = 285
FACU species	6	x 4 = 24
UPL species	0	x 5 = 0
Column Totals:	134 (A)	367 (B)

Prevalence Index = B/A = 2.73

Hydrophytic Vegetation Indicators:

- ☐ 1 - Rapid Test for Hydrophytic Vegetation
- ☑ 2 - Dominance Test is >50%
- ☑ 3 - Prevalence Index is ≤3.0[1]
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Four Vegetation Strata:

Tree – Woody plants, excluding vines, 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/Shrub – Woody plants, excluding vines, less than 3 in. DBH and greater than 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vine – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? Yes ✔ No ☐

Remarks: (If observed, list morphological adaptations below).

The sample plot satisfies the hydrophytic vegetation criterion.

SOIL

Sampling Point: DP_1-1_Wet

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox %	Type[1]	Loc[2]	Texture	Remarks
0-4	5Y 3/2	70	7.5YR 3/4	10	C	M	ms	
			10YR 4/6	20	C	M		
4-9	Gley 1 4/10GY	95	2.5YR 3/4	5	C	M	sicl	
9-16	2.5Y 4/3	44	2.5YR 4/6	2	C	M	cl	
	10YR 5/6	44	Gley 1 4/10GY	10	D	M		

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Stratified Layers (A5)
- ☐ Organic Bodies (A6) **(LRR P, T, U)**
- ☐ 5 cm Mucky Mineral (A7) **(LRR P, T, U)**
- ☐ Muck Presence (A8) **(LRR U)**
- ☐ 1 cm Muck (A9) **(LRR P, T)**
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Coast Prairie Redox (A16) **(MLRA 150A)**
- ☐ Sandy Mucky Mineral (S1) **(LRR O, S)**
- ☐ Sandy Gleyed Matrix (S4)
- ☑ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Dark Surface (S7) **(LRR P, S, T, U)**
- ☐ Polyvalue Below Surface (S8) **(LRR S, T, U)**
- ☐ Thin Dark Surface (S9) **(LRR S, T, U)**
- ☐ Loamy Mucky Mineral (F1) **(LRR O)**
- ☑ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)
- ☐ Marl (F10) **(LRR U)**
- ☐ Depleted Ochric (F11) **(MLRA 151)**
- ☐ Iron-Manganese Masses (F12) **(LRR O, P, T)**
- ☐ Umbric Surface (F13) **(LRR P, T, U)**
- ☐ Delta Ochric (F17) **(MLRA 151)**
- ☐ Reduced Vertic (F18) **(MLRA 150A, 150B)**
- ☐ Piedmont Floodplain Soils (F19) **(MLRA 149A)**
- ☐ Anomalous Bright Loamy Soils (F20) **(MLRA 149A, 153C, 153D)**

Indicators for Problematic Hydric Soils[3]:

- ☐ 1 cm Muck (A9) **(LRR O)**
- ☐ 2 cm Muck (A10) **(LRR S)**
- ☐ Reduced Vertic (F18) **(outside MLRA 150A,B)**
- ☐ Piedmont Floodplain Soils (F19) **(LRR P, S, T)**
- ☐ Anomalous Bright Loamy Soils (F20) **(MLRA 153B)**
- ☐ Red Parent Material (TF2)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: N/A

Depth (inches): ______

Hydric Soil Present? Yes ✔ No ______

Remarks:

The sample plot satisfies the hydric soils criterion.

WETLAND DETERMINATION DATA FORM – Atlantic and Gulf Coastal Plain Region

Project/Site: Harness Creek PadRow Facility City/County: Annapolis/Anne Arundel Sampling Date: 5/29/2020

Applicant/Owner: Anne Arundel County State: MD Sampling Point: DP_1-2_Wet

Investigator(s): Jason Traband, Cody Matteson Section, Township, Range: Quiet Waters Park

Landform (hillslope, terrace, etc.): Floodplain Local relief (concave, convex, none): Concave Slope (%): <1%

Subregion (LRR or MLRA): LRR S; MLRA 149A Lat: 38.933562 Long: -76.505693 Datum: NAD 83

Soil Map Unit Name: Donlonton fine sandy loam, 2-5% slopes (DnB) NWI classification: N/A

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ✔ No ___ (If no, explain in Remarks.)

Are Vegetation ___, Soil ___, or Hydrology ___ significantly disturbed? Are "Normal Circumstances" present? Yes ✔ No ___

Are Vegetation ___, Soil ___, or Hydrology ___ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ✔ No ___	**Is the Sampled Area within a Wetland?**	**Yes** ✔ **No** ___
Hydric Soil Present?	Yes ✔ No ___		
Wetland Hydrology Present?	Yes ✔ No ___		

Remarks:

The sample plot satisfies the three mandatory wetland criteria; therefore, this area is classified as a palustrine, forested, broad-leaved deciduous, seasonally flooded/saturated (PFO1E) wetland. The sample plot is located within the designated wetland marsh area. The wetland is traversed by a hiking trail within the area.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- [ ] Surface Water (A1)
- [x] High Water Table (A2)
- [x] Saturation (A3)
- [x] Water Marks (B1)
- [ ] Sediment Deposits (B2)
- [ ] Drift Deposits (B3)
- [ ] Algal Mat or Crust (B4)
- [ ] Iron Deposits (B5)
- [ ] Inundation Visible on Aerial Imagery (B7)
- [ ] Water-Stained Leaves (B9)
- [ ] Aquatic Fauna (B13)
- [ ] Marl Deposits (B15) **(LRR U)**
- [ ] Hydrogen Sulfide Odor (C1)
- [ ] Oxidized Rhizospheres along Living Roots (C3)
- [x] Presence of Reduced Iron (C4)
- [ ] Recent Iron Reduction in Tilled Soils (C6)
- [ ] Thin Muck Surface (C7)
- [ ] Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- [ ] Surface Soil Cracks (B6)
- [x] Sparsely Vegetated Concave Surface (B8)
- [x] Drainage Patterns (B10)
- [ ] Moss Trim Lines (B16)
- [ ] Dry-Season Water Table (C2)
- [ ] Crayfish Burrows (C8)
- [ ] Saturation Visible on Aerial Imagery (C9)
- [x] Geomorphic Position (D2)
- [ ] Shallow Aquitard (D3)
- [ ] FAC-Neutral Test (D5)
- [ ] Sphagnum moss (D8) **(LRR T, U)**

Field Observations:

Surface Water Present? Yes ___ No ✔ Depth (inches): ___

Water Table Present? Yes ✔ No ___ Depth (inches): 10"

Saturation Present? (includes capillary fringe) Yes ✔ No ___ Depth (inches): surface

Wetland Hydrology Present? Yes ✔ **No** ___

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

The sample plot satisfies the wetland hydrology criterion.

VEGETATION (Four Strata) – Use scientific names of plants. Sampling Point: DP_1-2_Wet

Tree Stratum (Plot size: 30ft radius)	Absolute % Cover	Dominant Species?	Indicator Status
1. Platanus occidentalis (American Sycamore)	30	Yes	FACW
2.			
3.			
4.			
5.			
6.			
7.			
8.			
	30	= Total Cover	
50% of total cover: 15	20% of total cover: 6		

Sapling/Shrub Stratum (Plot size: 30ft radius)	Absolute % Cover	Dominant Species?	Indicator Status
1. Viburnum prunifolium (Black Haw)	10	Yes	FACU
2.			
3.			
4.			
5.			
6.			
7.			
8.			
	10	= Total Cover	
50% of total cover: 5	20% of total cover: 2		

Herb Stratum (Plot size: 30ft radius)	Absolute % Cover	Dominant Species?	Indicator Status
1. Arisaema triphyllum (Jack in the pulpit)	5	Yes	FACW
2. Impatiens capensis (Jewelweed)	5	Yes	FACW
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	10	= Total Cover	
50% of total cover: 5	20% of total cover: 5		

Woody Vine Stratum (Plot size: 30ft radius)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
	0	= Total Cover	
50% of total cover: 0	20% of total cover: 0		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 3 (A)

Total Number of Dominant Species Across All Strata: 4 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 75% (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	0	x 1 =	0
FACW species	40	x 2 =	80
FAC species	0	x 3 =	0
FACU species	10	x 4 =	40
UPL species	0	x 5 =	0
Column Totals:	50 (A)		120 (B)

Prevalence Index = B/A = 2.4

Hydrophytic Vegetation Indicators:

- ☐ 1 - Rapid Test for Hydrophytic Vegetation
- ☑ 2 - Dominance Test is >50%
- ☑ 3 - Prevalence Index is ≤3.0[1]
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Four Vegetation Strata:

Tree – Woody plants, excluding vines, 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/Shrub – Woody plants, excluding vines, less than 3 in. DBH and greater than 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vine – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? Yes ✔ No ☐

Remarks: (If observed, list morphological adaptations below).

The sample plot satisfies the hydrophytic vegetation criterion.

SOIL

Sampling Point: DP_1-2_Wet

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox %	Type[1]	Loc[2]	Texture	Remarks
0-11	5Y 3/1	90	10YR 3/6	10	C	M	ms	
11-18	5Y 4/2	60	10YR 5/6	40	C	M	sicl	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Stratified Layers (A5)
- ☐ Organic Bodies (A6) **(LRR P, T, U)**
- ☐ 5 cm Mucky Mineral (A7) **(LRR P, T, U)**
- ☐ Muck Presence (A8) **(LRR U)**
- ☐ 1 cm Muck (A9) **(LRR P, T)**
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Coast Prairie Redox (A16) **(MLRA 150A)**
- ☐ Sandy Mucky Mineral (S1) **(LRR O, S)**
- ☐ Sandy Gleyed Matrix (S4)
- ☑ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Dark Surface (S7) **(LRR P, S, T, U)**
- ☐ Polyvalue Below Surface (S8) **(LRR S, T, U)**
- ☐ Thin Dark Surface (S9) **(LRR S, T, U)**
- ☐ Loamy Mucky Mineral (F1) **(LRR O)**
- ☐ Loamy Gleyed Matrix (F2)
- ☑ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)
- ☐ Marl (F10) **(LRR U)**
- ☐ Depleted Ochric (F11) **(MLRA 151)**
- ☐ Iron-Manganese Masses (F12) **(LRR O, P, T)**
- ☐ Umbric Surface (F13) **(LRR P, T, U)**
- ☐ Delta Ochric (F17) **(MLRA 151)**
- ☐ Reduced Vertic (F18) **(MLRA 150A, 150B)**
- ☐ Piedmont Floodplain Soils (F19) **(MLRA 149A)**
- ☐ Anomalous Bright Loamy Soils (F20) **(MLRA 149A, 153C, 153D)**

Indicators for Problematic Hydric Soils[3]:

- ☐ 1 cm Muck (A9) **(LRR O)**
- ☐ 2 cm Muck (A10) **(LRR S)**
- ☐ Reduced Vertic (F18) **(outside MLRA 150A,B)**
- ☐ Piedmont Floodplain Soils (F19) **(LRR P, S, T)**
- ☐ Anomalous Bright Loamy Soils (F20) **(MLRA 153B)**
- ☐ Red Parent Material (TF2)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: N/A

Depth (inches): ______

Hydric Soil Present? Yes ✔ No ____

Remarks:

The sample plot satisfies the hydric soil criterion.

WETLAND DETERMINATION DATA FORM – Atlantic and Gulf Coastal Plain Region

Project/Site: Harness Creek PadRow Facility City/County: Annapolis/Anne Arundel Sampling Date: 5/29/2020

Applicant/Owner: Anne Arundel County State: MD Sampling Point: DP_2-1_Up

Investigator(s): Jason Traband, Cody Matteson Section, Township, Range: Quiet Waters Park

Landform (hillslope, terrace, etc.): Floodplain Local relief (concave, convex, none): Concave Slope (%): 2%

Subregion (LRR or MLRA): LRR S;MLRA 149A Lat: 38.933590 Long: -76.505346 Datum: NAD 83

Soil Map Unit Name: Collington, Wist, and Westphalia, 15-25% slopes (CSE) NWI classification: N/A

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ✔ No ___ (If no, explain in Remarks.)

Are Vegetation ___, Soil ___, or Hydrology ___ significantly disturbed? Are "Normal Circumstances" present? Yes ✔ No ___

Are Vegetation ___, Soil ___, or Hydrology ___ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ✔ No ___	**Is the Sampled Area within a Wetland?** **Yes** ___ **No** ✔
Hydric Soil Present?	Yes ___ No ✔	
Wetland Hydrology Present?	Yes ___ No ✔	

Remarks:

The sample plot satisfies only one of the three mandatory wetland criteria; therefore, this area is classified as upland. There is a lot of downed woody debris present within the upland sample plot due to wind storms that have taken out trees.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Water-Stained Leaves (B9)
- ☐ Aquatic Fauna (B13)
- ☐ Marl Deposits (B15) **(LRR U)**
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Thin Muck Surface (C7)
- ☐ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ☐ Surface Soil Cracks (B6)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Drainage Patterns (B10)
- ☐ Moss Trim Lines (B16)
- ☐ Dry-Season Water Table (C2)
- ☐ Crayfish Burrows (C8)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-Neutral Test (D5)
- ☐ Sphagnum moss (D8) **(LRR T, U)**

Field Observations:

Surface Water Present? Yes ___ No ✔ Depth (inches): ___

Water Table Present? Yes ___ No ✔ Depth (inches): ___

Saturation Present? (includes capillary fringe) Yes ___ No ✔ Depth (inches): ___

Wetland Hydrology Present? Yes ___ **No** ✔

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

The sample plot does not satisfy the wetland hydrology criterion.

VEGETATION (Four Strata) – Use scientific names of plants.

Sampling Point: DP_1-2_Up

Tree Stratum (Plot size: 30ft radius)	Absolute % Cover	Dominant Species?	Indicator Status
1. Platanus Occidentalis (American Sycamore)	30	Yes	FACW
2. Liquidambar styraciflua (Sweet Gum)	15	Yes	FAC
3. Liriodendron tulipifera (Tulip Poplar)	15	Yes	FACW
4. Acer rubrum (Red Maple)	10	No	FAC
5.			
6.			
7.			
8.			
	70 = Total Cover		
50% of total cover: 35	20% of total cover: 14		

Sapling/Shrub Stratum (Plot size: 30ft radius)	Absolute % Cover	Dominant Species?	Indicator Status
1. Baccharis halimifolia (Eatern Baccharis)	30	Yes	FAC
2. Lindera benzoin (Spicebush)	20	Yes	FACW
3.			
4.			
5.			
6.			
7.			
8.			
	50 = Total Cover		
50% of total cover: 25	20% of total cover: 10		

Herb Stratum (Plot size: 30ft radius)	Absolute % Cover	Dominant Species?	Indicator Status
1. Berberis thunbergii	35	Yes	UPL
2. Impatiens capensis (Jewelweed)	15	No	FACW
3. Hibiscus laevis (Rose Mallow)	10	No	OBL
4. Carex glaucodea (Blue Sedge)	5	No	FACW
5. Arisaema triphyllum (Jack in the pulpit)	5	No	FACW
6. Liquidambar styraciflua (Sweet Gum)	5	No	FAC
7. Lonicera japonica (japanes Honeysuckle)	5	No	FACU
8. Rubus phoenicolasius (Wineberry)	5	No	FACU
9.			
10.			
11.			
12.			
	85 = Total Cover		
50% of total cover: 42.5	20% of total cover: 17		

Woody Vine Stratum (Plot size: 30ft radius)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
	0 = Total Cover		
50% of total cover: 0	20% of total cover: 0		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 5 (A)

Total Number of Dominant Species Across All Strata: 6 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 83% (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	10	x 1 =	10
FACW species	90	x 2 =	180
FAC species	60	x 3 =	180
FACU species	10	x 4 =	40
UPL species	35	x 5 =	175
Column Totals:	205 (A)		585 (B)

Prevalence Index = B/A = 2.85

Hydrophytic Vegetation Indicators:

- ☐ 1 - Rapid Test for Hydrophytic Vegetation
- ☑ 2 - Dominance Test is >50%
- ☑ 3 - Prevalence Index is ≤3.0[1]
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Four Vegetation Strata:

Tree – Woody plants, excluding vines, 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/Shrub – Woody plants, excluding vines, less than 3 in. DBH and greater than 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vine – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? Yes ✔ No ☐

Remarks: (If observed, list morphological adaptations below).

The sample plot satisfies the hydrophytic vegetation criterion.

SOIL

Sampling Point: DP_2-1_Up

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox %	Type[1]	Loc[2]	Texture	Remarks
0-8	5Y 3/2	100					sicl	
8-15	2.5Y 4/4	100					sicl	
15-18	2.5Y 4/3	80	5YR 4/2	20	D	M	sicl	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Stratified Layers (A5)
- ☐ Organic Bodies (A6) **(LRR P, T, U)**
- ☐ 5 cm Mucky Mineral (A7) **(LRR P, T, U)**
- ☐ Muck Presence (A8) **(LRR U)**
- ☐ 1 cm Muck (A9) **(LRR P, T)**
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Coast Prairie Redox (A16) **(MLRA 150A)**
- ☐ Sandy Mucky Mineral (S1) **(LRR O, S)**
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Dark Surface (S7) **(LRR P, S, T, U)**
- ☐ Polyvalue Below Surface (S8) **(LRR S, T, U)**
- ☐ Thin Dark Surface (S9) **(LRR S, T, U)**
- ☐ Loamy Mucky Mineral (F1) **(LRR O)**
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)
- ☐ Marl (F10) **(LRR U)**
- ☐ Depleted Ochric (F11) **(MLRA 151)**
- ☐ Iron-Manganese Masses (F12) **(LRR O, P, T)**
- ☐ Umbric Surface (F13) **(LRR P, T, U)**
- ☐ Delta Ochric (F17) **(MLRA 151)**
- ☐ Reduced Vertic (F18) **(MLRA 150A, 150B)**
- ☐ Piedmont Floodplain Soils (F19) **(MLRA 149A)**
- ☐ Anomalous Bright Loamy Soils (F20) **(MLRA 149A, 153C, 153D)**

Indicators for Problematic Hydric Soils[3]:

- ☐ 1 cm Muck (A9) **(LRR O)**
- ☐ 2 cm Muck (A10) **(LRR S)**
- ☐ Reduced Vertic (F18) **(outside MLRA 150A,B)**
- ☐ Piedmont Floodplain Soils (F19) **(LRR P, S, T)**
- ☐ Anomalous Bright Loamy Soils (F20) **(MLRA 153B)**
- ☐ Red Parent Material (TF2)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: N/A

Depth (inches): ______

Hydric Soil Present? Yes ______ No ✔

Remarks:

The sample plot does not satisfy the hydric soil criterion.

APPENDIX C

Tree Survey
Map and Inventory

EXISTING TREE SURVEY

TREE NUMBER	COMMON NAME	DBH 1	DBH 2
TR 1	SWEET GUM	12.5	–
TR 2	SWEET GUM	13.1	–
TR 3	TULIP POPLAR	12.5	–
TR 4	SWEET GUM	14.0	–
TR 5	TULIP POPLAR	20.8	–
TR 6	TULIP POPLAR	27.0	–
TR 7	RED MAPLE	25.7	–
TR 8	RED MAPLE	27.4	–
TR 9	SWEET GUM	12.7	–
TR 10	BOX ELDER	13.2	–
TR 11	TULIP POPLAR	25.5	–
TR 12	TULIP POPLAR	15.2	–
TR 13	TULIP POPLAR	19.8	–
TR 14	TULIP POPLAR	13.1	–
TR 15	TULIP POPLAR	21.8	–
TR 16	SWEET GUM	16.3	–
TR 17	TULIP POPLAR	19.0	–
TR 18	TULIP POPLAR	12.9	–
TR 19	TULIP POPLAR	27.8	–
TR 20	TULIP POPLAR	13.4	–
TR 21	TULIP POPLAR	18.7	–
TR 22	TULIP POPLAR	17.5	–
TR 23	SWEET GUM	11.9	–
TR 24	TULIP POPLAR	12.7	–
TR 25	TULIP POPLAR	10.6	18.2
TR 26	TULIP POPLAR	19.2	–
TR 27*	TULIP POPLAR	18.6	–
TR 28	TULIP POPLAR	18.8	–

*DENOTES TREE TO BE REMOVED

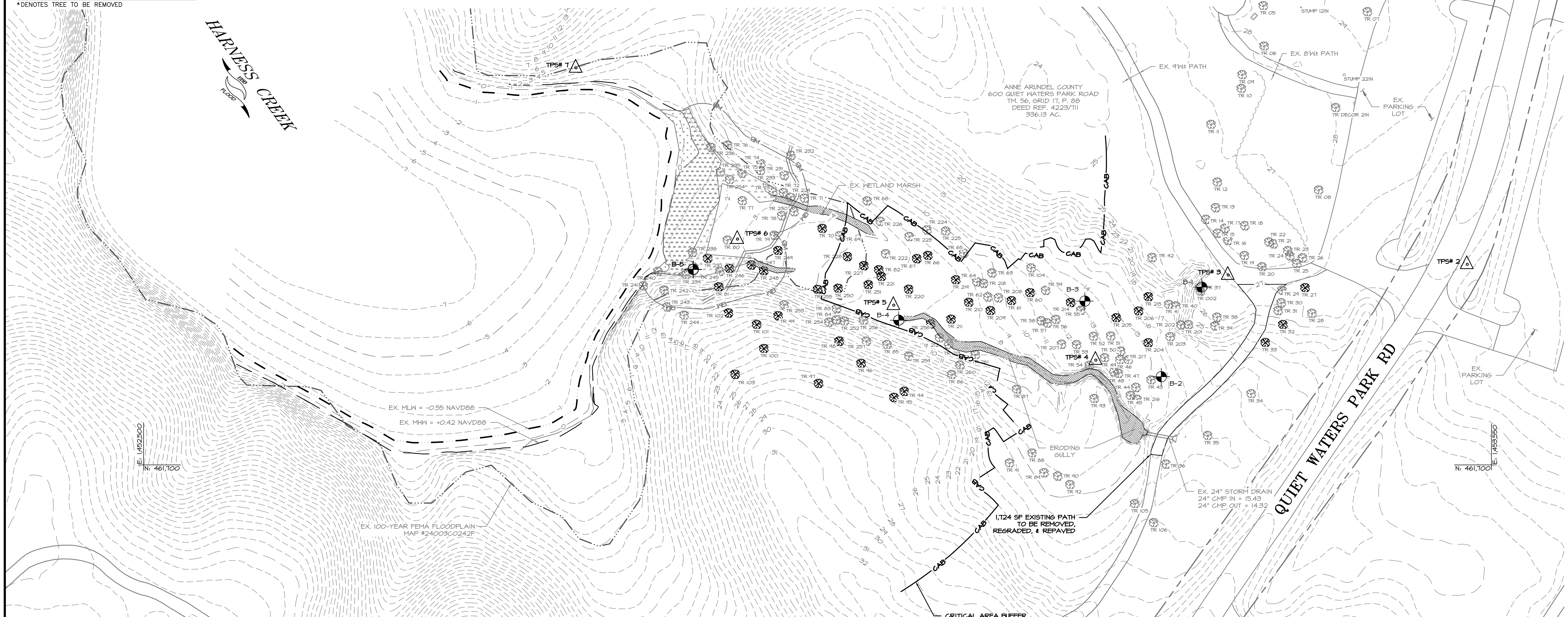
TREE NUMBER	COMMON NAME	DBH 1	DBH 2
TR 29	TULIP POPLAR	24.9	–
TR 30	TULIP POPLAR	14.7	–
TR 31	SWEET GUM	14.6	–
TR 32*	SWEET GUM	13.5	–
TR 33*	TULIP POPLAR	16.6	–
TR 34	SWEET GUM	12.4	–
TR 35	TULIP POPLAR	14.0	–
TR 36	TULIP POPLAR	25.1	–
TR 37	AMERICAN SYCAMORE	26.4	–
TR 38	DEAD	12.0	–
TR 39	SASSAFRAS	16.1	–
TR 40	TULIP POPLAR	16.4	–
TR 41	TULIP POPLAR	39.4	–
TR 42	TULIP POPLAR	44.9	–
TR 43	SWEET GUM	17.2	–
TR 44	TULIP POPLAR	19.8	–
TR 45	TULIP POPLAR	24.2	–
TR 46	TULIP POPLAR	31.6	–
TR 47	TULIP POPLAR	28.9	–
TR 48	SWEET GUM	18.4	–
TR 49	SWEET GUM	21.4	–
TR 50	SWEET GUM	12.9	–
TR 51	TULIP POPLAR	27.8	–
TR 52	SWEET GUM	15.1	–
TR 53	AMERICAN SYCAMORE	19.0	–
TR 54	SWEET GUM	13.5	–
TR 55	TULIP POPLAR	34.7	–
TR 56	SWEET GUM	29.0	–

TREE NUMBER	COMMON NAME	DBH 1	DBH 2
TR 57	NORTHERN RED OAK	14.2	–
TR 58	NORTHERN RED OAK	32.1	–
TR 59	TULIP POPLAR	40.2	–
TR 60*	SWEET GUM	21.4	–
TR 61*	SWEET GUM	26.5	–
TR 62	AMERICAN SYCAMORE	32.9	–
TR 63	SWEET GUM	19.7	–
TR 64	SWEET GUM	17.3	–
TR 65	SWEET GUM	31.9	–
TR 66*	SWEET GUM	12.8	–
TR 67*	TULIP POPLAR	38.1	–
TR 68	DEAD	37.8	–
TR 69	SWEET GUM	19.9	–
TR 70*	AMERICAN SYCAMORE	33.6	–
TR 71	SWEET GUM	23.2	–
TR 72	SWEET GUM	13.5	–
TR 73	SWEET GUM	22.2	–
TR 74	TULIP POPLAR	29.1	–
TR 75	AMERICAN SYCAMORE	16.7	–
TR 76	TULIP POPLAR	34.7	–
TR 77	RED MAPLE	21.4	–
TR 78	AMERICAN SYCAMORE	29.0	–
TR 79	SWEET GUM	18.9	–
TR 80	BOX ELDER	12.4	–
TR 81*	DEAD	40.4	–
TR 82*	TULIP POPLAR	18.5	–
TR 83	TULIP POPLAR	17.3	–
TR 84	CHESTNUT OAK	22.3	–

TREE NUMBER	COMMON NAME	DBH 1	DBH 2
TR 85	RED MAPLE	11.8	–
TR 86	WHITE OAK	29.1	–
TR 87	TULIP POPLAR	19.5	–
TR 88	AMERICAN SYCAMORE	33.7	13.2
TR 89	SWEET GUM	13.7	–
TR 90	SWEET GUM	16.1	–
TR 91	TULIP POPLAR	36.6	–
TR 92	DEAD	12.6	–
TR 93	AMERICAN SYCAMORE	27.1	–
TR 94*	DEAD	36.0	–
TR 95*	DEAD	36.9	–
TR 96*	DEAD	18.5	18.5
TR 97*	DEAD	18.9	–
TR 98*	DEAD	23.9	27.8
TR 99*	DEAD	29.3	–
TR 100*	DEAD	24.8	–
TR 101*	DEAD	23.5	–
TR 102*	DEAD	17	26.5
TR 103*	DEAD	17.8	19.9
TR 104	SWEET GUM	22.8	–
TR 105	TULIP POPLAR	22.8	–
TR 106	TULIP POPLAR	24.7	–
TR 200	BLACK CHERRY	6.0	–
TR 201	BLACK CHERRY	6.1	–
TR 202	TULIP POPLAR	7.9	–
TR 203	BLACK TUPELO	9.7	–
TR 204*	SWEET GUM	6.5	–
TR 205*	SWEET GUM	6.2	–

TREE NUMBER	COMMON NAME	DBH 1	DBH 2
TR 206*	SWEET GUM	8.0	–
TR 207	SWEET GUM	5.9	–
TR 208	AMERICAN HOLLY	8.4	–
TR 209*	TULIP POPLAR	8.5	–
TR 210*	AMERICAN HOLLY	10.6	–
TR 211*	AMERICAN ELM	5.9	–
TR 212	RED MAPLE	9.2	–
TR 213	RED MAPLE	10.9	–
TR 214*	BLACK TUPELO	11.0	–
TR 215*	SWEET GUM	9.9	–
TR 216	BLACKHAW	6.0	–
TR 217	SWEET GUM	11.0	–
TR 218	SWEET GUM	10.9	–
TR 219*	BOX ELDER	7.1	–
TR 220*	AMERICAN HOLLY	6.8	–
TR 221*	SWEET GUM	11.4	–
TR 222	AMERICAN ELM	6.6	–
TR 223	RED MAPLE	8.1	–
TR 224	SWEET GUM	9.7	–
TR 225	SWEET GUM	8.5	–
TR 226	RED MAPLE	11.0	–
TR 227*	AMERICAN ELM	6.4	–
TR 228*	DEAD	9.0	–
TR 229	SWEET GUM	10.3	–
TR 230	BOX ELDER	5.9	–
TR 231	SWEET GUM	7.3	–
TR 232	SWEET GUM	9.3	–
TR 233	TULIP POPLAR	8.8	–

TREE NUMBER	COMMON NAME	DBH 1	DBH 2
TR 234	SWEET GUM	9.1	–
TR 235	SWEET GUM	7.7	–
TR 236	BLACKHAW	6.0	–
TR 237*	RED MAPLE	6.1	–
TR 238	RED MAPLE	16.0	–
TR 239	BLACK TUPELO	10.6	–
TR 240	BLACK TUPELO	10.7	–
TR 241	CHESTNUT OAK	6.2	–
TR 242	RED MAPLE	10.5	–
TR 243	CHESTNUT OAK	10.4	–
TR 244	BLACK OAK	30.9	–
TR 245	BLACK TUPELO	9.7	–
TR 246*	SWEET GUM	8.0	–
TR 247*	BLACK TUPELO	8.1	–
TR 248*	AMERICAN HOLLY	7.0	–
TR 249*	RED MAPLE	8.9	4.9
TR 250*	BLACKHAW	5.8	4.0
TR 251*	AMERICAN ELM	7.6	–
TR 252	RED MAPLE	7.6	–
TR 253	BLACK TUPELO	7.1	–
TR 254	RED MAPLE	9.2	–
TR 255*	BLACKHAW	6.0	–
TR 256	RED MAPLE	7.7	–
TR 257	RED MAPLE	6.8	–
TR 258*	RED MAPLE	6.8	–
TR 259	RED MAPLE	7.1	–
TR 260	RED MAPLE	9.2	–
TR 261	RED MAPLE	6.0	–



SOIL BORING LOG

BORING #1

DEPTH/ELEV.	EL.
0.0'	26.1 GROUND SURFACE
1.0'/25.1	DARK BROWN SILTY SAND WITH ORGANICS (SM)
4.0'/22.1	BROWN CLAYEY SAND (SC)
7.5'/18.6	BROWN POORLY-GRADED SAND WITH SILT (SP-SM)
10.0'/16.1	BROWN SILTY SAND (SM)

BOTTOM EL. 16.1
SCALE: NOT TO SCALE
SAMPLE DATE: 06/2020

SOIL BORING LOG

BORING #2

DEPTH/ELEV.	EL.
0.0'	16.1 GROUND SURFACE
1.0'/15.1	DARK BROWN SILTY SAND WITH ORGANICS (SM)
3.0'/13.1	BROWN POORLY-GRADED SAND WITH SILT (SP-SM)
5.5'/10.6	BROWN SILTY SAND (SM)
8.5'/7.6	BROWN POORLY-GRADED SAND WITH SILT (SP-SM)

BOTTOM EL. 7.6
SCALE: NOT TO SCALE
SAMPLE DATE: 06/2020

SOIL BORING LOG

BORING #3

DEPTH/ELEV.	EL.
0.0'	13.8 GROUND SURFACE
1.0'/12.8	DARK BROWN SILTY SAND WITH ORGANICS (SM)
6.0'/7.8	BROWN/ORANGE CLAYEY SAND (SP-SC)
9.0'/4.8	BROWN SANDY LEAN CLAY (CL)

BOTTOM EL. 4.8
SCALE: NOT TO SCALE
SAMPLE DATE: 06/2020

SOIL BORING LOG

BORING #4

DEPTH/ELEV.	EL.
0.0'	7.3 GROUND SURFACE
0.5'/6.8	BROWN POORLY-GRADED SAND (SP)
▽ 3.5'/3.3	BROWN/RED CLAYEY SAND (SC)
6.0'/1.3	TAN/ORANGE SAND WITH CLAY (SP-SC)
8.0'/-0.7	ORANGE/GRAY CLAYEY SAND (SC)
9.0'/-1.7	ORANGE/BROWN SAND WITH CLAY (SP-SC)
10.0'/-2.7	BROWN/RED CLAYEY SAND (SC)

BOTTOM EL. -2.7
SCALE: NOT TO SCALE
SAMPLE DATE: 06/2020

SOIL BORING LOG

BORING #5

DEPTH/ELEV.	EL.
0.0'	2.4 GROUND SURFACE
▽ 3.0'/-1.4	BROWN SILTY SAND (SM)
6.0'/-4.4	GRAY SILTY, CLAYEY, SAND (SC-SM)
8.5'/-6.1	DARK GRAY SILTY, CLAYEY SAND WITH ORGANICS (SC-SM)

BOTTOM EL. -6.1
SCALE: NOT TO SCALE
SAMPLE DATE: 06/2020

SOIL CLASSIFICATION

SOIL SAMPLE NUMBER	TESTING DEPTH (FT)	PERCENT PASSING NO. 4 SIEVE	PERCENT PASSING NO. 40 SIEVE	PERCENT PASSING NO. 200 SIEVE	USCS CLASSIFCATION
B-1	7.5'-10'	100.0	97.8	4.4	BROWN SILTY SAND (SM)
B-2	3.5'-5.5'	100.0	91.9	17.7	BROWN SILTY SAND (SM)
B-3	1.0'-6.0'	99.0	92.2	19.2	BROWN/ORANGE CLAYEY SAND (SC)
B-4	3.5'-6'	99.7	90.5	14.8	TAN/ORANGE SAND WITH CLAY (SP-SC)
B-5	0'-3'	100.0	91.0	18.6	BROWN SILTY SAND (SM)

NOTES:
1. SOIL BORINGS ARE NOT TO SCALE.
2. BORING LAYERS IDENTIFIED IN THE SOIL CLASSIFICATION TABLE HAVE BEEN VISUALLY CLASSIFIED AND VERIFIED WITH A GRADATION ANALYSIS. ALL OTHER BORING LOGS ARE BASED ON VISUAL FIELD CLASSIFICATION ONLY.
3. SOIL BORINGS WERE OBTAINED FOR DESIGN PURPOSES ONLY. BORING DATA IS PROVIDED FOR THE CONTRACTOR'S CONVENIENCE AND IS APPLICABLE ONLY AT THE SPECIFIC POINTS WHERE THE BORINGS WERE PERFORMED. NO WARRANTY IS IMPLIED FOR THE CONTINUITY OF SUBSURFACE CONDITIONS.

0 20 40 80
1 INCH = 40 FEET

30% SCHEMATIC DESIGN

BayLand Consultants & Designers, Inc.
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BAYLAND JOB NO. 5_18201

ANNE ARUNDEL COUNTY
DEPARTMENT OF PUBLIC WORKS

REVISED DATE	BY	APPROVED	DATE	APPROVED	DATE	SCALE:	1" = 40'
		CHIEF ENGINEER		PROJECT MANAGER		DESIGNED BY:	MB
		APPROVED	DATE	APPROVED	DATE	DRAWN BY:	MW
						CHECKED BY:	MB
		ENGINEER ADMINISTRATOR		CHIEF, RIGHT OF WAY		SHEET NO.	2 OF 4

HARNESS CREEK
PADDLING & ROWING FACILITY
EXISTING CONDITIONS &
DEMOLITION PLAN

Z:\5_18201_HARNESS_CREEK_PADROW_FACILITY\CAD Files\Sheet Files\5_18201_EX02

TREE NUMBER	DBH, IN (SINGLE STEM)	COMMON NAME	CONDITION	Field Verified	REASON WHY NOT VERIFIED
TR 1	12.5	Sweet Gum	GOOD	YES	OUTSIDE OF WORK AREA
TR 2	13.1	Sweet Gum	FAIR	YES	OUTSIDE OF WORK AREA
TR 3	12.5	Tulip Poplar	GOOD	YES	OUTSIDE OF WORK AREA
TR 4	14.0	Sweet Gum	GOOD	YES	OUTSIDE OF WORK AREA
TR 5	20.8	Tulip Poplar	GOOD	YES	OUTSIDE OF WORK AREA
TR 6	27.0	Tulip Poplar	GOOD	YES	OUTSIDE OF WORK AREA
TR 7	25.7	Red Maple	GOOD	YES	OUTSIDE OF WORK AREA
TR 8	27.4	Red Maple	GOOD	YES	
TR 9	12.7	Sweet Gum	FAIR	YES	
TR 10	13.2	Box Elder	FAIR	YES	
TR 11	25.5	Tulip Poplar	GOOD	YES	
TR 12	15.2	Tulip Poplar	GOOD	YES	
TR 13	19.8	Tulip Poplar	GOOD	YES	
TR 14	13.1	Tulip Poplar	GOOD	YES	
TR 15	21.8	Tulip Poplar	GOOD	YES	
TR 16	16.3	Sweet Gum	FAIR	YES	
TR 17	19.0	Tulip Poplar	FAIR	YES	
TR 18	12.9	Tulip Poplar	GOOD	YES	
TR 19	27.8	Tulip Poplar	FAIR	YES	
TR 20	13.4	Tulip Poplar	FAIR	YES	
TR 21	18.7	Tulip Poplar	GOOD	YES	
TR 22	17.5	Tulip Poplar	GOOD	YES	
TR 23	11.9	Sweet Gum	FAIR	YES	
TR 24	12.7	Tulip Poplar	GOOD	YES	
TR 25	NA	Tulip Poplar	GOOD	YES	
TR 26	19.2	Tulip Poplar	GOOD	YES	
TR 27	18.6	Tulip Poplar	GOOD	YES	
TR 28	18.8	Tulip Poplar	FAIR	YES	
TR 29	24.9	Tulip Poplar	GOOD	YES	
TR 30	14.7	Tulip Poplar	FAIR	YES	
TR 31	14.6	Sweet Gum	FAIR	YES	
TR 32	13.5	Sweet Gum	FAIR	YES	
TR 33	16.6	Tulip Poplar	FAIR	YES	
TR 34	12.4	Sweet Gum	FAIR	YES	
TR 35	14.0	Tulip Poplar	GOOD	YES	
TR 36	25.1	Tulip Poplar	GOOD	YES	
TR 37	26.4	American Sycamore	GOOD	YES	

TR 38	12.0	DEAD	DEAD		
TR 39	16.1	Sassafras	FAIR	YES	
TR 40	16.4	Tulip Poplar	GOOD	YES	
TR 41	39.4	Tulip Poplar	FAIR	YES	
TR 42	44.9	Tulip Poplar	GOOD	YES	
TR 43	17.2	Sweet Gum	FAIR	YES	
TR 44	19.8	Tulip Poplar	POOR	YES	
TR 45	24.2	Tulip Poplar	FAIR	YES	
TR 46	31.6	Tulip Poplar	FAIR	YES	
TR 47	28.9	Tulip Poplar	FAIR	YES	
TR 48	18.4	Sweet Gum	GOOD	YES	
TR 49	21.4	Sweet Gum	GOOD	YES	
TR 50	12.9	Sweet Gum	GOOD	YES	
TR 51	27.8	Tulip Poplar	GOOD	YES	
TR 52	15.1	Sweet Gum	GOOD	YES	
TR 53	19.0	American Sycamore	POOR	YES	
TR 54	13.5	Sweet Gum	FAIR	YES	
TR 55	34.7	Tulip Poplar	GOOD	YES	
TR 56	29.0	Sweet Gum	FAIR	YES	
TR 57	14.2	Northern Red Oak	GOOD	YES	
TR 58	32.1	Northern Red Oak	POOR	YES	
TR 59	40.2	Tulip Poplar	FAIR	YES	
TR 60	21.4	Sweet Gum	GOOD	YES	
TR 61	26.5	Sweet Gum	GOOD	YES	
TR 62	32.9	American Sycamore	POOR	YES	
TR 63	19.7	Sweet Gum	GOOD	YES	
TR 64	17.3	Sweet Gum	GOOD	YES	
TR 65	31.9	Sweet Gum	GOOD	YES	
TR 66	12.8	Sweet Gum	GOOD	YES	
TR 67	38.1	Tulip Poplar	FAIR	YES	
TR 68	37.8	DEAD	DEAD		
TR 69	19.9	Sweet Gum	GOOD	YES	
TR 70	33.6	American Sycamore	POOR	YES	
TR 71	23.2	Sweet Gum	FAIR	YES	
TR 72	13.5	Sweet Gum	FAIR	YES	
TR 73	22.2	Sweet Gum	GOOD	YES	
TR 74	29.1	Tulip Poplar	FAIR	NO	OUTSIDE OF WORK AREA
TR 75	16.7	American Sycamore	POOR	NO	OUTSIDE OF WORK AREA
TR 76	34.7	Tulip Poplar	GOOD	NO	OUTSIDE OF WORK AREA
TR 77	21.4	Red Maple	GOOD	YES	
TR 78	29.0	American Sycamore	POOR	YES	

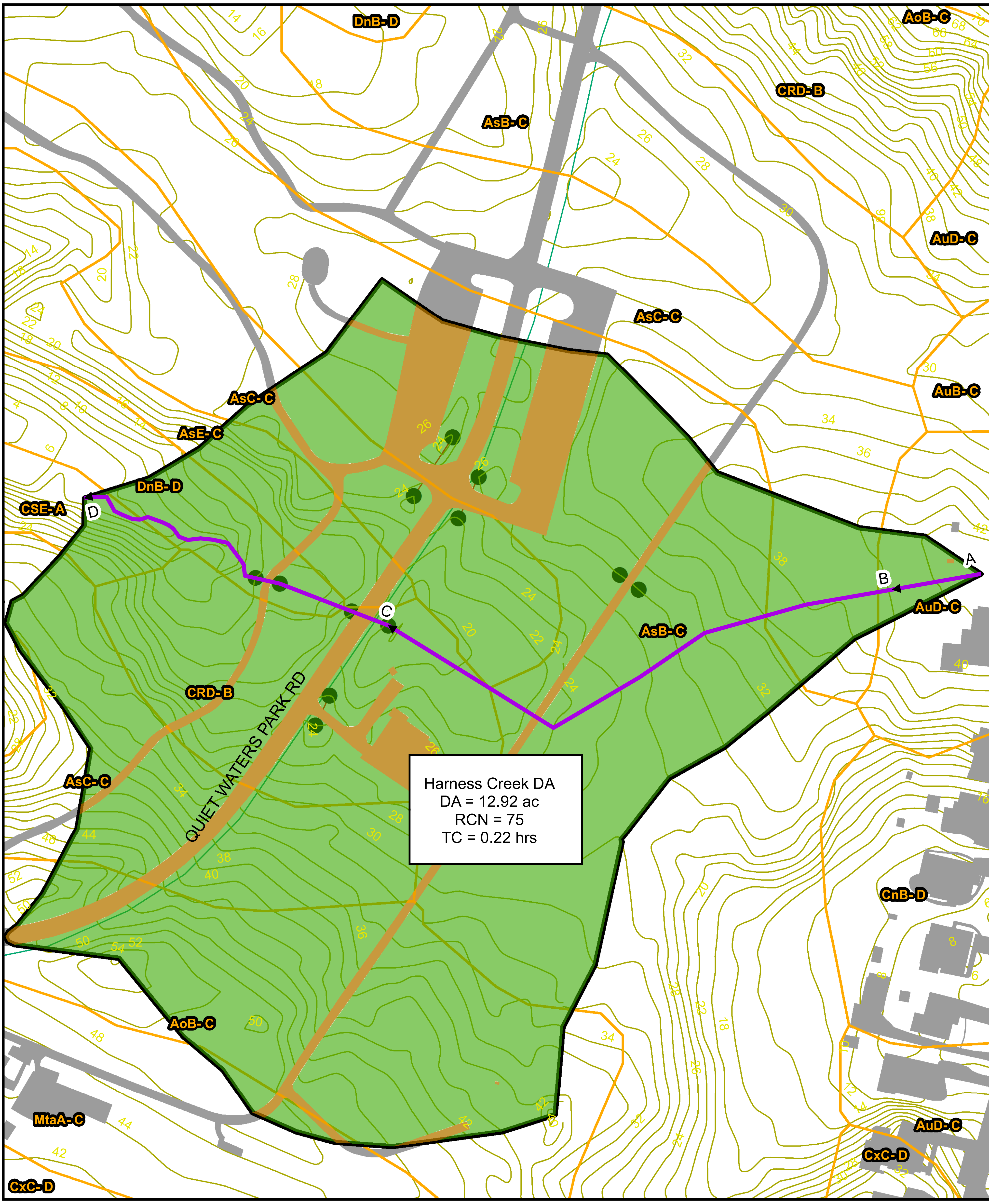
TR 79	18.9	Sweet Gum	GOOD	YES	
TR 80	12.4	Box Elder	FAIR	YES	
TR 81	40.4	DEAD	DEAD		
TR 82	18.5	Tulip Poplar	POOR	YES	
TR 83	17.3	Tulip Poplar	GOOD	YES	
TR 84	22.3	Chestnut Oak	FAIR	YES	
TR 85	11.8	Red Maple	GOOD	NO	OUTSIDE OF WORK AREA
TR 86	29.1	White Oak	GOOD	NO	OUTSIDE OF WORK AREA
TR 87	19.5	Tulip Poplar	GOOD	NO	OUTSIDE OF WORK AREA
TR 88	NA	American Sycamore	POOR	NO	OUTSIDE OF WORK AREA
TR 89	13.7	Sweet Gum	GOOD	NO	OUTSIDE OF WORK AREA
TR 90	16.1	Sweet Gum	GOOD	NO	OUTSIDE OF WORK AREA
TR 91	36.6	Tulip Poplar	FAIR	NO	OUTSIDE OF WORK AREA
TR 92	12.6	DEAD	DEAD		
TR 93	27.1	American Sycamore	POOR	YES	
TR 94	36.0	--- ---	DEAD		
TR 95	36.9	--- ---	DEAD		
TR 96	NA	--- ---	DEAD		
TR 97	18.9	--- ---	DEAD		
TR 98	NA	--- ---	DEAD		
TR 99	29.3	--- ---	DEAD		
TR 100	24.8	--- ---	DEAD		
TR 101	23.5	--- ---	DEAD		
TR 102	NA	--- ---	DEAD		
TR 103	NA	--- ---	DEAD		
TR 104	22.8	Sweet Gum	GOOD	YES	
TR 105	22.8	Tulip Poplar	FAIR	NO	OUTSIDE OF WORK AREA
TR 106	24.7	Tulip Poplar	FAIR	NO	OUTSIDE OF WORK AREA
TR 107	55.0	Tulip Poplar	FAIR	ADDED	
TR 200	6.0	Black Cherry	FAIR	YES	
TR 201	6.1	Black Cherry	GOOD	YES	
TR 202	7.9	Tulip Poplar	GOOD	YES	
TR 203	9.7	Black Tupelo	GOOD	YES	
TR 204	6.5	Sweet Gum	GOOD	YES	
TR 205	6.2	Sweet Gum	GOOD	YES	
TR 206	8.0	Sweet Gum	GOOD	YES	
TR 207	5.9	Sweet Gum	GOOD	YES	
TR 208	8.4	American Holly	GOOD	YES	
TR 209	8.5	Tulip Poplar	GOOD	YES	
TR 210	10.6	American Holly	GOOD	YES	
TR 211	5.9	American Elm	GOOD	YES	

TR 212	9.2	Red Maple	GOOD	YES	
TR 213	10.9	Red Maple	GOOD	YES	
TR 214	11.0	Black Tupelo	FAIR	YES	
TR 215	9.9	Sweet Gum	GOOD	YES	
TR 216	6.0	Blackhaw	GOOD	YES	
TR 217	11.0	Sweet Gum	FAIR	YES	
TR 218	10.9	Sweet Gum	GOOD	YES	
TR 219	7.1	Box Elder	GOOD	YES	
TR 220	6.8	American Holly	GOOD	YES	
TR 221	11.4	Sweet Gum	GOOD	YES	
TR 222	6.6	American Elm	GOOD	YES	
TR 223	8.1	Red Maple	GOOD	YES	
TR 224	9.7	Sweet Gum	GOOD	YES	
TR 225	8.5	Sweet Gum	GOOD	YES	
TR 226	11.0	Red Maple	POOR	YES	
TR 227	6.4	American Elm	POOR	YES	
TR 228	9.0	--- ---	DEAD		
TR 229	10.3	Sweet Gum	GOOD	YES	
TR 230	5.9	Box Elder	FAIR	YES	
TR 231	7.3	Sweet Gum	FAIR	NO	OUTSIDE OF WORK AREA
TR 232	9.3	Sweet Gum	GOOD	NO	OUTSIDE OF WORK AREA
TR 233	8.8	Tulip Poplar	GOOD	NO	OUTSIDE OF WORK AREA
TR 234	9.1	Sweet Gum	GOOD	NO	OUTSIDE OF WORK AREA
TR 235	7.7	Sweet Gum	GOOD	NO	OUTSIDE OF WORK AREA
TR 236	6.0	Blackhaw	FAIR	NO	OUTSIDE OF WORK AREA
TR 237	6.1	Red Maple	FAIR	YES	
TR 238	16.0	Red Maple	POOR	YES	
TR 239	10.6	Black Tupelo	GOOD	YES	
TR 240	10.7	Black Tupelo	GOOD	YES	
TR 241	6.2	Chestnut Oak	GOOD	YES	
TR 242	10.5	Red Maple	GOOD	NO	OUTSIDE OF WORK AREA
TR 243	10.4	Chestnut Oak	GOOD	NO	OUTSIDE OF WORK AREA
TR 244	30.9	Black Oak	GOOD	NO	OUTSIDE OF WORK AREA
TR 245	9.7	Black Tupelo	GOOD	YES	
TR 246	8.0	Sweet Gum	GOOD	YES	
TR 247	8.1	Black Tupelo	GOOD	YES	
TR 248	7.0	American Holly	GOOD	YES	
TR 249	NA	Red Maple	GOOD	YES	
TR 250	NA	Blackhaw	GOOD	YES	
TR 251	7.6	American Elm	GOOD	YES	
TR 252	7.6	Red Maple	GOOD	NO	OUTSIDE OF WORK AREA

TR 253	7.1	Black Tupelo	GOOD	NO	OUTSIDE OF WORK AREA
TR 254	9.2	Red Maple	GOOD	NO	OUTSIDE OF WORK AREA
TR 255	6.0	Blackhaw	GOOD	YES	
TR 256	7.7	Red Maple	FAIR	YES	
TR 257	6.8	Red Maple	GOOD	NO	OUTSIDE OF WORK AREA
TR 258	6.8	Red Maple	GOOD	YES	
TR 259	7.1	Red Maple	GOOD	NO	OUTSIDE OF WORK AREA
TR 260	9.2	Red Maple	GOOD	NO	OUTSIDE OF WORK AREA
TR 261	6.0	Red Maple	GOOD	YES	
TR 262	8	Black Gum	GOOD	ADDED	
TR 263	6.0	American Holly	GOOD	ADDED	
TR 264	13.0	Sweet Gum	GOOD	ADDED	

Appendix C – Existing Hydrologic Analysis

C-1 Existing Conditions Drainage Area Map



Harness Creek Gully Repair Existing Landuse Conditions Drainage Map
Quiet Waters Park
Contract No. 10499
KCI Project No: 171804667

N

1 in = 0.02 miles

Legend

TCPath

LandUse

Impervious Area

Open Space

Drainage Area

Soil Type and Hydrologic Group

ImperviousArea

2ftContours

Streams

Stormdrain Structures

Stormdrain Pipe

C-2 Existing Conditions TR-55 Analysis

KCI Technologies, Inc.

936 Ridgebrook Road, Sparks MD. 21152

TR-55 DESIGN COMPUTATIONS

By:	WBD	Project Name:	Harness Creek	Project Number:	171804667.16
Date:	4/1/2022	County:	Anne Arundel		
Check:	YH	Drainage Area:	12.92 acres	Existing:	X
Date:	4/1/2022			Proposed:	
Sheet	1 of 1				

WEIGHTED RUNOFF CURVE NUMBER

Soil Group	Land Use or Zoning* No.	Description	% Imperv.	RCN Table 2-2	RCN Figure 2-3	RCN Figure 2-4	Area (Acre)	RCN x Area
A	3	Open Space (good) - grass >75%		39			0.18	6.93
B	3	Open Space (good) - grass >75%		61			1.61	98.20
B	4	Imperv. - paved parking lots,roofs,drives	100	98			0.29	28.39
C	3	Open Space (good) - grass >75%		74			9.27	686.20
C	4	Imperv. - paved parking lots,roofs,drives	100	98			1.15	112.56
D	3	Open Space (good) - grass >75%		80			0.40	32.28
D	4	Imperv. - paved parking lots,roofs,drives	100	98			0.01	1.39
			Total Square Miles:		0.02018	Total Acres:	12.92	965.95
			Weighted RCN=		74.78	, Use	75	

*Industrial land use category used for Institutional land use.

TIME OF CONCENTRATION

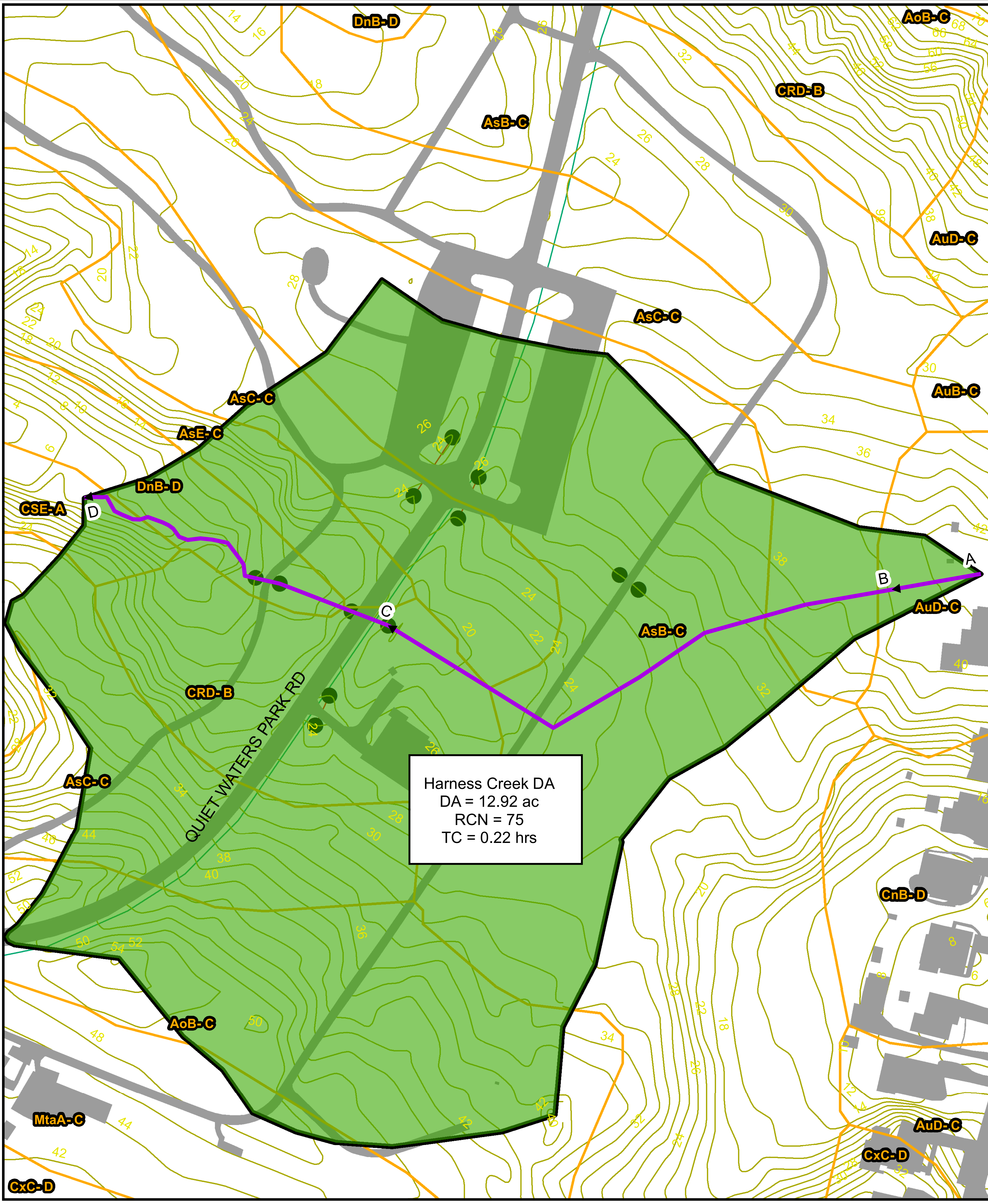
ID		Type of Flow	L(ft.)	n	A	WP	Slope (Percent)	Vel. (fps)	Time (Hours)
		Sheet Flow							
A-B	5	Grass - short	100	0.150			3.2		0.137
		Shallow Conc. Flow							
B-C		paved X unpaved	625				3.2	2.88	0.060
		paved unpaved							
		paved unpaved							
		paved unpaved							
		paved unpaved							
		Channel or Storm Drain Flow							
C-D	1	Channel Flow, d (ft) = 0.75	384	0.040	4.50	9.18	3.2	4.17	0.026
								Total	0.22

WATER QUALITY VOLUME

P (in.)	Impervious Area to Treat** (ac.)	% Impervious	Rv	WQ_v (ac.-ft.)	WQ_v (cf.)
1.0	1.45	11.2%	0.151	0.163	7081

** Impervious Area to Treat was estimated using the County's GIS Impervious layer.

C-3 Ultimate Conditions Drainage Area Map



Harness Creek Gully Repair Ultimate Landuse Conditions Drainage Map
Quiet Waters Park
Contract No. 10499
KCI Project No: 171804667

N

1 in = 0.02 miles

Legend

TCPath

2040 Planned Zoning

Parks and Open Space

Drainage Area

Soil Type and Hydrologic Group

ImperviousArea

2ftContours

Streams

Stormdrain Structures

Stormdrain Pipe

C-4 Harness Creek Existing Conditions TR-20: SPSC Routing

```
WinTR-20 Printed Page File      Beginning of Input Data List
M:\2018\171804667.16\Engr\Existing\HarnessCreek_TR20.inp
```

```
WinTR-20: Version 3.20                  0         0         1.        0
Profile Output Table - TR20 Table
Harness Creek Existing Conditions

SUB-AREA:
          DA0       0                   0.020     75.       .22


STREAM REACH:
          0         OUTLET    1.0                 389.


STORM ANALYSIS:
          1_yr_sm                       2.66      TYPE NO_C 2         3.22
          2_yr_sm                       3.22      TYPE NO_C 2
          10_yr_sm                      5.01      TYPE NO_C 2
          100_yr_sm                     8.64      TYPE NO_C 2




STREAM CROSS SECTION:
          1.0       8.60
                    8.50      0.00      0.00      0.00       0.031
                    8.77      10.00     4.30      31.16      0.031
                    8.85      20.00     7.20      40.40      0.031
                    8.91      30.00     9.70      47.01      0.031
                    8.96      40.00     11.90     50.91      0.031
                    9.00      50.00     13.90     54.05      0.031
                    9.03      60.00     15.90     56.87      0.031
                    9.06      70.00     17.70     58.96      0.031
                    9.09      80.00     19.40     60.72      0.031
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GLOBAL OUTPUT:

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WinTR-20 Printed Page File   End of Input Data List

Profile Output Table - TR20 Table
Harness Creek Existing Conditions

Name of printed page file:
M:\2018\171804667.16\Engr\Existing\HarnessCreek_TR20.out

STORM 1_yr_sm

Area or Reach Identifier	Drainage Area (sq mi)	Rain Gage ID or Location	Runoff Amount (in)	Peak Flow Elevation (ft)	Peak Flow Time (hr)	Peak Flow Rate (cfs)	Peak Flow Rate (csm)
DA0	0.020		0.420		12.20	9.3	462.70

Line Start Time (hr)	Flow Values @ time increment of 0.250 hr (cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
11.750	0.0	2.8	8.4	3.8	2.2	1.7	1.3
13.500	1.1	0.0					

Area or Reach Identifier	Drainage Area (sq mi)	Rain Gage ID or Location	Runoff Amount (in)	Peak Flow Elevation (ft)	Peak Flow Time (hr)	Peak Flow Rate (cfs)	Peak Flow Rate (csm)
0	0.020	Upstream	0.420	8.75	12.20	9.3	462.70

Line Start Time (hr)	Flow Values @ time increment of 0.250 hr (cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
11.750	0.0	2.8	8.4	3.8	2.2	1.7	1.3
13.500	1.1	0.0					

Area or Reach Identifier	Drainage Area (sq mi)	Rain Gage ID or Location	Runoff Amount (in)	Peak Flow Elevation (ft)	Peak Flow Time (hr)	Peak Flow Rate (cfs)	Peak Flow Rate (csm)
0	0.020	Downstream	0.412	8.75	12.23	9.2	461.79

Line Start Time (hr)	Flow Values @ time increment of 0.250 hr (cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
11.750	0.0	2.2	9.1	4.1	2.4	1.8	1.4
13.500	1.1	0.0					

Area or Reach Identifier	Drainage Area (sq mi)	Rain Gage ID or Location	Runoff Amount (in)	Peak Flow Elevation (ft)	Peak Flow Time (hr)	Peak Flow Rate (cfs)	Peak Flow Rate (csm)
OUTLET	0.020		0.412		12.23	9.2	461.79

Profile Output Table - TR20 Table
Harness Creek Existing Conditions

Line Start Time (hr)	Flow Values @ time increment of 0.250 hr (cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
11.750	0.0	2.2	9.1	4.1	2.4	1.8	1.4
13.500	1.1	0.0					

STORM 2_yr_sm

Area or Reach Identifier	Drainage Area (sq mi)	Rain Gage ID or Location	Runoff Amount (in)	Peak Flow Elevation (ft)	Peak Flow Time (hr)	Peak Flow Rate (cfs)	Peak Flow Rate (csm)
DA0	0.020		0.732		12.18	14.3	714.86

Line Start Time (hr)	Flow Values @ time increment of 0.250 hr (cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
11.500	0.0	1.5	4.9	12.7	5.5	3.2	2.4
13.250	1.9	1.5	1.3	1.2	1.1	0.0	

Area or Reach Identifier	Drainage Area (sq mi)	Rain Gage ID or Location	Runoff Amount (in)	Peak Flow Elevation (ft)	Peak Flow Time (hr)	Peak Flow Rate (cfs)	Peak Flow Rate (csm)

0	0.020	Upstream	0.732	8.80	12.18	14.3	714.86

Line Start Time (hr)	------------ Flow Values @ time increment of 0.250 hr ------------ (cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
11.500	0.0	1.5	4.9	12.7	5.5	3.2	2.4
13.250	1.9	1.5	1.3	1.2	1.1	0.0	

Area or Reach Identifier	Drainage Area (sq mi)	Rain Gage ID or Location	Runoff Amount (in)	------------ Peak Flow ------------ Elevation (ft)	Time (hr)	Rate (cfs)	Rate (csm)
0	0.020	Downstream	0.724	8.80	12.23	14.3	714.36

Line Start Time (hr)	------------ Flow Values @ time increment of 0.250 hr ------------ (cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
11.750	0.4	4.0	13.9	5.9	3.4	2.5	1.9
13.500	1.6	1.3	1.2	1.1	0.0		

Area or Reach Identifier	Drainage Area (sq mi)	Rain Gage ID or Location	Runoff Amount (in)	------------ Peak Flow ------------ Elevation (ft)	Time (hr)	Rate (cfs)	Rate (csm)
OUTLET	0.020		0.724		12.23	14.3	714.36

Profile Output Table - TR20 Table
Harness Creek Existing Conditions

Line Start Time (hr)	------------ Flow Values @ time increment of 0.250 hr ------------ (cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
11.750	0.4	4.0	13.9	5.9	3.4	2.5	1.9
13.500	1.6	1.3	1.2	1.1	0.0		

STORM 10_yr_sm

Area or Reach Identifier	Drainage Area (sq mi)	Rain Gage ID or Location	Runoff Amount (in)	------------ Peak Flow ------------ Elevation (ft)	Time (hr)	Rate (cfs)	Rate (csm)
DA0	0.020		2.026		12.18	32.7	1634.51

Line Start Time (hr)	Flow Values @ time increment of 0.250 hr (cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
10.750	0.0	1.1	1.6	2.5	4.9	13.2	28.3
12.500	11.5	6.5	4.9	3.8	3.0	2.5	2.3
14.250	2.1	1.9	1.7	1.6	1.4	1.3	1.3
16.000	1.3	1.2	1.2	1.1	1.1	1.0	0.0

Area or Reach Identifier	Drainage Area (sq mi)	Rain Gage ID or Location	Runoff Amount (in)	Peak Flow Elevation (ft)	Time (hr)	Rate (cfs)	Rate (csm)
0	0.020	Upstream	2.026	8.92	12.18	32.7	1634.51

Line Start Time (hr)	Flow Values @ time increment of 0.250 hr (cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
10.750	0.0	1.1	1.6	2.5	4.9	13.2	28.3
12.500	11.5	6.5	4.9	3.8	3.0	2.5	2.3
14.250	2.1	1.9	1.7	1.6	1.4	1.3	1.3
16.000	1.3	1.2	1.2	1.1	1.1	1.0	0.0

Area or Reach Identifier	Drainage Area (sq mi)	Rain Gage ID or Location	Runoff Amount (in)	Peak Flow Elevation (ft)	Time (hr)	Rate (cfs)	Rate (csm)
0	0.020	Downstream	2.017	8.92	12.21	32.7	1634.51

Line Start Time (hr)	Flow Values @ time increment of 0.250 hr (cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
10.750	0.0	1.0	1.6	2.4	4.6	11.4	30.8
12.500	12.3	6.8	5.0	3.8	3.1	2.5	2.3
14.250	2.1	1.9	1.8	1.6	1.4	1.4	1.3
16.000	1.3	1.2	1.2	1.1	1.1	1.0	0.0

Profile Output Table - TR20 Table
Harness Creek Existing Conditions

Area or Reach Identifier	Drainage Area (sq mi)	Rain Gage ID or Location	Runoff Amount (in)	Peak Flow Elevation (ft)	Time (hr)	Rate (cfs)	Rate (csm)

OUTLET	0.020		2.017		12.21	32.7	1634.51

Line Start Time (hr)	------------ Flow Values @ time increment of 0.250 hr ------------ (cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
10.750	0.0	1.0	1.6	2.4	4.6	11.4	30.8
12.500	12.3	6.8	5.0	3.8	3.1	2.5	2.3
14.250	2.1	1.9	1.8	1.6	1.4	1.4	1.3
16.000	1.3	1.2	1.2	1.1	1.1	1.0	0.0

STORM 100_yr_sm

Area or Reach Identifier	Drainage Area (sq mi)	Rain Gage ID or Location	Runoff Amount (in)	------------ Peak Flow ------------ Elevation (ft)	Time (hr)	Rate (cfs)	Rate (csm)
DA0	0.020		5.516		12.18	74.1	3706.13

Line Start Time (hr)	------------ Flow Values @ time increment of 0.250 hr ------------ (cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
9.250	0.0	1.2	1.4	1.7	2.0	2.3	2.9
11.000	3.9	5.4	7.5	13.6	32.9	62.8	24.4
12.750	13.4	10.0	7.7	6.2	5.0	4.6	4.2
14.500	3.8	3.5	3.1	2.8	2.7	2.6	2.5
16.250	2.4	2.3	2.2	2.1	2.0	1.9	1.8
18.000	1.7	1.6	1.6	1.6	1.5	1.5	1.5
19.750	1.5	1.4	1.4	1.4	1.4	1.3	1.3
21.500	1.3	1.3	1.3	1.2	1.2	1.2	1.2
23.250	1.1	1.1	1.1	1.1	0.0		

Area or Reach Identifier	Drainage Area (sq mi)	Rain Gage ID or Location	Runoff Amount (in)	------------ Peak Flow ------------ Elevation (ft)	Time (hr)	Rate (cfs)	Rate (csm)
0	0.020	Upstream	5.516	9.07	12.18	74.1	3706.13

Line Start Time (hr)	------------ Flow Values @ time increment of 0.250 hr ------------ (cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
9.250	0.0	1.2	1.4	1.7	2.0	2.3	2.9
11.000	3.9	5.4	7.5	13.6	32.9	62.8	24.4
12.750	13.4	10.0	7.7	6.2	5.0	4.6	4.2
14.500	3.8	3.5	3.1	2.8	2.7	2.6	2.5
16.250	2.4	2.3	2.2	2.1	2.0	1.9	1.8
18.000	1.7	1.6	1.6	1.6	1.5	1.5	1.5

19.750	1.5	1.4	1.4	1.4	1.4	1.3	1.3
21.500	1.3	1.3	1.3	1.2	1.2	1.2	1.2

Profile Output Table - TR20 Table
Harness Creek Existing Conditions

Line Start Time (hr)	Flow Values @ time increment of 0.250 hr (cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
23.250	1.1	1.1	1.1	1.1	0.0		

Area or Reach Identifier	Drainage Area (sq mi)	Rain Gage ID or Location	Runoff Amount (in)	Peak Flow Elevation (ft)	Time (hr)	Rate (cfs)	Rate (csm)
0	0.020	Downstream	5.507	9.07	12.21	73.9	3696.16

Line Start Time (hr)	Flow Values @ time increment of 0.250 hr (cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
9.500	0.5	1.4	1.7	1.9	2.3	2.8	3.8
11.250	5.3	7.3	13.1	29.7	67.5	25.7	13.9
13.000	10.2	7.8	6.3	5.1	4.6	4.2	3.9
14.750	3.5	3.1	2.8	2.7	2.6	2.5	2.4
16.500	2.3	2.2	2.1	2.0	1.9	1.8	1.7
18.250	1.6	1.6	1.6	1.5	1.5	1.5	1.5
20.000	1.5	1.4	1.4	1.4	1.4	1.3	1.3
21.750	1.3	1.3	1.2	1.2	1.2	1.2	1.1
23.500	1.1	1.1	1.1	0.0			

Area or Reach Identifier	Drainage Area (sq mi)	Rain Gage ID or Location	Runoff Amount (in)	Peak Flow Elevation (ft)	Time (hr)	Rate (cfs)	Rate (csm)
OUTLET	0.020		5.507		12.21	73.9	3696.16

Line Start Time (hr)	Flow Values @ time increment of 0.250 hr (cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
9.500	0.5	1.4	1.7	1.9	2.3	2.8	3.8
11.250	5.3	7.3	13.1	29.7	67.5	25.7	13.9
13.000	10.2	7.8	6.3	5.1	4.6	4.2	3.9
14.750	3.5	3.1	2.8	2.7	2.6	2.5	2.4
16.500	2.3	2.2	2.1	2.0	1.9	1.8	1.7
18.250	1.6	1.6	1.6	1.5	1.5	1.5	1.5

20.000	1.5	1.4	1.4	1.4	1.4	1.3	1.3
21.750	1.3	1.3	1.2	1.2	1.2	1.2	1.1
23.500	1.1	1.1	1.1	0.0			

Profile Output Table - TR20 Table
Harness Creek Existing Conditions

Area or Reach Identifier	Drainage Area (sq mi)	----------- Peak Flow by Storm ----------- 1_yr_sm (cfs)	2_yr_sm (cfs)	10_yr_sm (cfs)	100_yr_sm (cfs)	(cfs)
DA0	0.020	9.3	14.3	32.7	74.1	
0	0.020	9.3	14.3	32.7	74.1	
DOWNSTREAM		9.2	14.3	32.7	73.9	
OUTLET	0.020	9.2	14.3	32.7	73.9	

Appendix D – Design Computations

KCI Technologies, Inc.

Project Name:	Harness Creek	Originator:	WBD
County:	Anne Arundel	Date:	4/5/2022
Project Number:	171804667.16	Reviewed By:	BE
		Date:	4/6/2022

SPSC Riffle Sizing Spreadsheet
(Based on Anne Arundel County SPSC Guidelines, 2021)

Designer must select/input
Calculated value/Designer shall not change
Default values provided. Advanced designer may change to customize to site specific design

Riffle Grade Control Sizing			
	Q_{100}	Q_{10}	Q_2
Design Flow (cfs)	74.1	32.7	14.3
Width (ft)	16.0	16.0	16.0
L, Length (ft)	8.0	8.0	8.0
H, Height (ft)	1.0	1.0	1.0
Design Depth of flow (ft)	0.92	0.9	0.9
D50 (in)	9	9	9
P_D, Parabolic Depth (ft)	0.92	0.92	0.92
Degree of incision (W/P_D)	17.4	17.4	17.4
Manning's n Value	0.050	0.1	0.1
Slope (ft/ft)	0.1	0.1	0.1
Rock Unit Weight (lbs/cf)	165.0	165.0	165.0
Top Width at Depth	16.0	16.0	16.0
Flow area (sf)	9.8	9.8	9.8
Hydraulic Radius	0.61	0.61	0.61
Froude	1.4	1.1	1.1
Isbash Maximum Velocity (ft/s)	7.7	7.7	7.7
Depth ("A") at TW/4 offset from centerline	0.7	0.7	0.7
Calculated Flow at Design Depth (cfs)	74.2	59.9	59.9
Calculated Velocity (ft/s)	7.6	6.1	6.1
Does the proposed section provide adequate conveyance?	YES	YES	YES
Is the proposed velocity less than the maximum allowable velocity?	YES	YES	YES

Maximum allowable riffle stone size for a given Q100	
Q100, cfs ≤	Max D50, inches
15	6
125	9
500	12
1500	18
2000	24

KCI Technologies, Inc.

Project Name:	Harness Creek	Originator:	WBD
County:	Anne Arundel	Date:	4/8/2022
Project Number:	171804667.16	Reviewed By:	BE
		Date:	4/8/2022

SPSC Cascade Sizing Spreadsheet
(Based on Anne Arundel County SPSC Guidelines, 2021)

Designer must select/input
Calculated value/Designer shall not change
Default values provided. Advanced designer may change to customize to site specific design

Cascade Sizing			
	Q_{100}	Q_{10}	Q_2
Design Flow (cfs)	74.1	32.7	14.3
Width (ft)	16.0	16.0	16.0
L, Length (ft)	8.0	8.0	8.0
H, Height (ft)	2.0	2.0	2.0
Design Depth of flow (ft)	0.92	0.9	0.9
D50 (in)	30	30	30
P_D, Parabolic Depth (ft)	0.92	0.92	0.92
Degree of incision (W/P_D)	17.4	17.4	17.4
Manning's n Value	0.050	0.050	0.050
Slope (ft/ft)	0.3	0.3	0.3
Rock Unit Weight (lbs/cf)	165.0	165.0	165.0
Top Width at Depth	16.0	16.0	16.0
Flow area (sf)	9.8	9.8	9.8
Hydraulic Radius	0.61	0.61	0.61
Froude	2.0	2.0	2.0
Isbash Maximum Velocity (ft/s)	14.0	14.0	14.0
Depth ("A") at TW/4 offset from centerline	0.7	0.7	0.7
Calculated Flow at Design Depth (cfs)	104.9	104.9	104.9
Calculated Velocity (ft/s)	10.7	10.7	10.7
Does the proposed section provide adequate conveyance?	YES	YES	YES
Is the proposed velocity less than the maximum allowable velocity?	YES	YES	YES
Does the proposed cascade have a slope of <= 0.5 ft/ft?	YES		

Scour Depth - pools downstream of cascades	
Q_{100}, cfs	74.1
H, Height of upstream grade control structure, ft	2.0
TW, Top width of the upstream grade control structure, ft	16.0
y, depth of Q_{100} in downstream/receiving structure	0.92
K, coefficient	1.32
p_d, Calculated scour depth, ft	2.6
Minimum footer boulder depth below pool bottom, ft	2.0

Project #: 71804667.16
Project Name: Harness Creek Gully Repair

BY: WBD 4/18/2022
CHECK: BLE 4/18/2022

Proposed Pool Storage for Runoff Volume Reduction

Volume Stored in Pools

Structure	Pool Bottom Elevation (ft)	U/S Pool Bottom Area (ft^2)	U/S Pool Top Area (ft^2)	Volume (ft^3)
RW1	-1	168.9	561.4	730
RW2	0	141.9	510.2	652
RW3	1	205.5	623.9	829
RW4	2	168.5	559.6	728
RW5	3	114.2	469.9	584
RW6	4	248.5	697.2	946
RW7	5	290.0	774.6	1065
RW8	6	47.0	333.1	380
RW9	7	46.0	325.6	372
RW10	7	21.3	379.8	401
C1	10	119.8	470.6	590
RW11	11	0.4	192.5	193
RW12	12	61.2	225.8	287

Total Volume Stored in Pools = 7,758 ft^3

Project:	Harness Creek Gully Repair	BY:	WBD	4/19/2022
		CHECKED:	BLE	4/19/2022

Upland Structural BMP Impervious Acre Credits & Pollutant Load Reductions

Reference: *Accounting for Stormwater Wasteload Allocations and Impervious Acres Treated: Guidance for National Pollutant Discharge Elimination System Stormwater Permits.* June, 2020. Maryland Department of the Environment.

Impervious Credit Acres:

Total Drainage Area to BMP =	12.92	ac		
Total Untreated Impervious Area to BMP =	1.45	ac		
Pervious Area to BMP =	11.47	ac		
WQv Target (1 in. Rainfall Depth Treated) =	7,081	cf	0.16	ac-ft
WQv Provided =	7,758	cf	0.18	ac-ft
% of Target =	109.56	%		
Max. WQv Provided =	7,758	cf		
Rainfall Depth Treated (P_E) (Max. 3 in.) =	1.10	in.		
WQ_T Credit =	1.02	in.		
Impervious Area Treated =	**1.48**	**ac**		

Annual Nutrient Load Reduction (lbs/yr):

$$Load\ Reduction\ (lbs/yr) = [Urban\ Unit\ Load\ (lbs/acre/yr)] \times [Impervious\ Surface\ in\ BMP\ Drainage\ Area\ (acres)] \times [BMP\ Efficiency/100] \times [Phase\ 6\ Modeling\ Segment\ Delivery\ Factor]$$

Urban Unit Load (lbs/ac/yr):

Load Source	Acres in BMP Drainage Area	Statewide EOS Urban Unit Load TN	TP	TSS
Aggregate Impervious		20.09	2.55	8,474
Impervious Road	1.45	35.79	6.95	17,328
Mixed Open	3.81	8.15	1.59	1,414
Septic		16.66	0.00	0
Tree Canopy over Impervious		32.75	6.19	16,115
Turf		13.35	2.12	1,414
Tree Canopy over Turf		10.18	1.62	1,332
True Forest	7.66	2.28	0.32	719
Total Urban		12.89	1.46	3,306
Total:	12.92	7.77	1.44	2,788

	TN	TP	TSS		
BMP Efficiency =	61.0	71.4	76.5	(Table 3)	BMP Type = RR
Urban Unit Load (lbs/ac/yr) =	7.77	1.44	2,788	(Table 4)	
Edge of Tide Loading Factor =	1	1	1	(MDE EOT Factor Map)	
Load (lb/yr) =	11.27	2.09	4,043		
Load Reduction (lb/yr) =	**6.88**	**1.49**	**3,094**		
Load Post-Retrofit (lb/yr) =	4.39	0.60	949		

Table 2. Stormwater BMPs for Upland Applications

Runoff Reduction (RR) Practices		Stormwater Treatment (ST) Practices	
Manual Reference	**Practice**	**Manual Reference**	**Practice**
Infiltration		**Ponds**	
M-3	Landscape Infiltration	P-1	Micro-Pool Extended Detention (ED)
M-4	Infiltration Berm	P-2	Wet Pond
M-5	Dry Well	P-3	Wet ED Pond
Filtering Systems		P-4	Multiple Pond
F-6	Bioretention[1]	P-5	Pocket Pond
M-2	Submerged Gravel Wetland	**Wetlands[2]**	
M-6	Micro-Bioretention[1]	W-1	Shallow Wetland
M-7	Rain Garden	W-2	ED Shallow Wetland
M-9	Enhanced Filter	W-3	Pond/Wetland System
Open Channel Systems		W-4	Pocket Wetland
O-1	Dry Swale	**Infiltration[2]**	
M-8	Grass Swale	I-1	Infiltration Trench
M-8	Bio-Swale	I-2	Infiltration Basin
M-8	Wet Swale	**Filtering Systems**	
Alternative Surfaces		F-1	Surface Sand Filter
A-1	Green Roof	F-2	Underground Filter
A-2	Permeable Pavement	F-3	Perimeter Filter

Table 3. TN, TP, and TSS Removal Efficiencies for Upland BMPs

Rainfall Depth Treated (inches)	TN Removal Efficiency (%)		TSS Removal Efficiency (%)		TP Removal Efficiency (%)	
	RR	ST	RR	ST	RR	ST
0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.20	23.3	13.6	29.1	27.2	27.2	21.4
0.40	39.2	22.8	48.9	45.7	45.7	35.9
0.60	49.3	28.8	61.7	57.5	57.5	45.2
0.80	55.7	32.5	69.7	65.1	65.1	51.1
1.00	59.7	35.0	74.9	69.9	69.9	54.9
1.20	62.5	36.5	78.3	73.0	73.0	57.4
1.40	64.4	37.6	80.7	75.2	75.2	59.1
1.60	65.6	38.4	82.3	76.7	76.7	60.3
1.80	66.4	38.8	83.3	77.6	77.6	61.0
2.00	66.8	39.1	83.9	78.2	78.2	61.4
2.20	67.1	39.2	84.2	78.4	78.4	61.7
2.40	67.5	39.3	84.6	78.6	78.6	61.9
2.60[1]	67.9	39.4	85.0	78.8	78.8	62.1
2.80[1]	68.3	39.5	85.4	79.0	79.0	62.3
3.00[1]	68.6	39.6	85.8	79.2	79.2	62.5

Note:
[1] Values exceed the adjustor curves and are extrapolated from the CBP formulas.

Table 4. Statewide Edge-of-Stream Urban Unit Load Summary

Load Source[1]	Statewide EOS Urban Unit Load (lbs/acre/yr)		
	TN	TP	TSS
Aggregate Impervious	20.09	2.55	8,474
Impervious Road	35.79	6.95	17,328
Mixed Open	8.15	1.59	1,414
Septic	16.66	0.00	0.00
Tree Canopy over Impervious	32.75	6.19	16,115
Turf	13.35	2.12	1,414
Tree Canopy over Turf	10.18	1.62	1,332
True Forest	2.28	0.32	719
Total Urban	12.89	1.46	3,306

Note

[1] For more information on Load Sources in the Phase 6 Model, see Appendix B.

Protocol 5 Credit Computations

Project Name: Harness Creek **By:** **BLE**
Project Number: 171804667.16 **Check:**

Base Level Controls

Upstream Control Point = Outfall
Upstream Control Point Elevation = 14.41 ft
If upstream limits of erosion if outfall is not present, use L_{max}.

$$L_{max} = 153A_d^{0.6}$$

L_{max} = 710 ft
Downstream Control Point = Confluence with Harness Creek
Downstream Control Point Elevation = 0 ft
Total Length = 457 ft
Existing Channel Slope = 0.0315 ft/ft

Note: If existing slope is within 5% of the equilibrium slope calculated for existing conditions, this portion of the channel is considered stable base level control.

	XS 1	XS 2	XS 3	Average	
Bottom Width =	6.8	6.0	4.2	5.7	ft

Equilibrium Bed Slope

Cohesive Beds:

Simon and Thomas:

$$S = 0.0028A^{-0.33}$$

where
S = Equilibrium Slope (ft/ft);
A = Drainage Area (km^2)

Drainage Area (A) = 12.92 ac = 0.052 km^2
S = 0.0074 ft/ft

Beds Coarser than Sand:

Pebble Count:

	(mm)	(ft)
D16		0.000
D35		0.000
D50	1	0.003
D84		0.000
D90		0.000
D95		0.000

Mean Grain Size (D_m) = 1 mm
n = 0.045 (Estimated from field)
Channel Forming Discharge = 10.5 cfs (Usually Bankfull Q or $Q_{1.5}$)
Average Channel Width = 5.7 ft
Channel Forming Discharge per Unit Width (q) = 1.85 ft^2/s

Beds of Sand and Fine Gravel (0.1 - 5 mm) (No Bed-Material Sediment Supplied from Upstream):

Pemberton and Lara:

$$S_{eq} = \left(\frac{\tau_c}{\gamma_w y}\right)$$

where
S_{eq} = Equilibrium Slope (ft/ft);
τ_c = Critical Shear Stress (lb/ft^2);
γ_w = Specific Weight of Water (lb/ft^3);
y = Mean Flow Depth (ft)

Critical Shear Stress = 0.062 lb/ft^2 (From Figure TS14B-9)

Specific Weight of Water = 62.4 lb/ft^3

Storm Event	**Q (cfs)**[1]	**Flow Depth (ft)**[2]				**S_{eq} (ft/ft)**
		XS 1	**XS 2**	**XS 3**	**Average**	
Bankfull	-	0.59	0.52	0.63	0.58	0.0017
1.25-Year	10.5	0.59	0.52	0.63	0.58	0.0017
2-Year	14.3	0.72	0.62	0.75	0.70	0.0014
10-Year	32.7	1.18	1.01	1.2	1.13	0.0008
100-Year	74.1	1.9	1.59	1.87	1.79	0.0005

[1]Q determined from TR-20 or StreamStats.

[2]Flow depth determined from Manning's equation.

Selected Equilibrium Slope:	**S_{eq} =**	**0.0017**	**ft/ft**

Equilibrium Bank Slope

- **No Seepage Condition:** Equilibrium bank slopes are in the range of 1.4:1 to 2.1:1 for banks comprised of sand and 1.9:1 for silt.
- **Seepage Flowing Generally Parallel to Slope Condition:** Stable bank slopes are in the range of 2.6:1 to 4.1:1 for banks comprised of sand and 3.9:1 for silt.
- **Seepage Generally Flowing along Horizontal Flow Paths Condition:** Stable bank slopes are in the range of 2.9:1 to 4.4 :1 for banks comprised of sand and 4.2:1 for silt.

Equilibrium Bank Slope = 1.76 :1 (H:V) = 0.57 %

Note: The default value of 1.76 is used unless there is information to justify using a different value (different bank material).

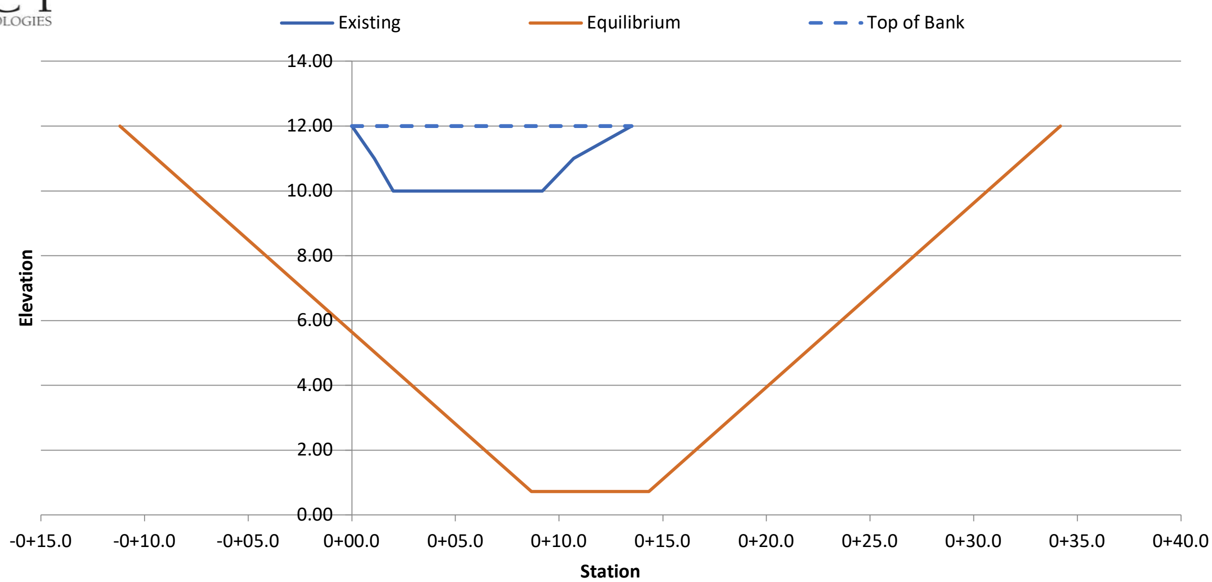
References

MDOT SHA. 2018. Alternative Headwater Channel and Outfall Crediting Protocol.

Urban Stormwater Work Group (Stream Restoration Group 2). 2019. Recommendations for Crediting Outfall and Gully Stabilization Projects in the Chesapeake Bay Watershed. Chesapeake Bay Foundation.

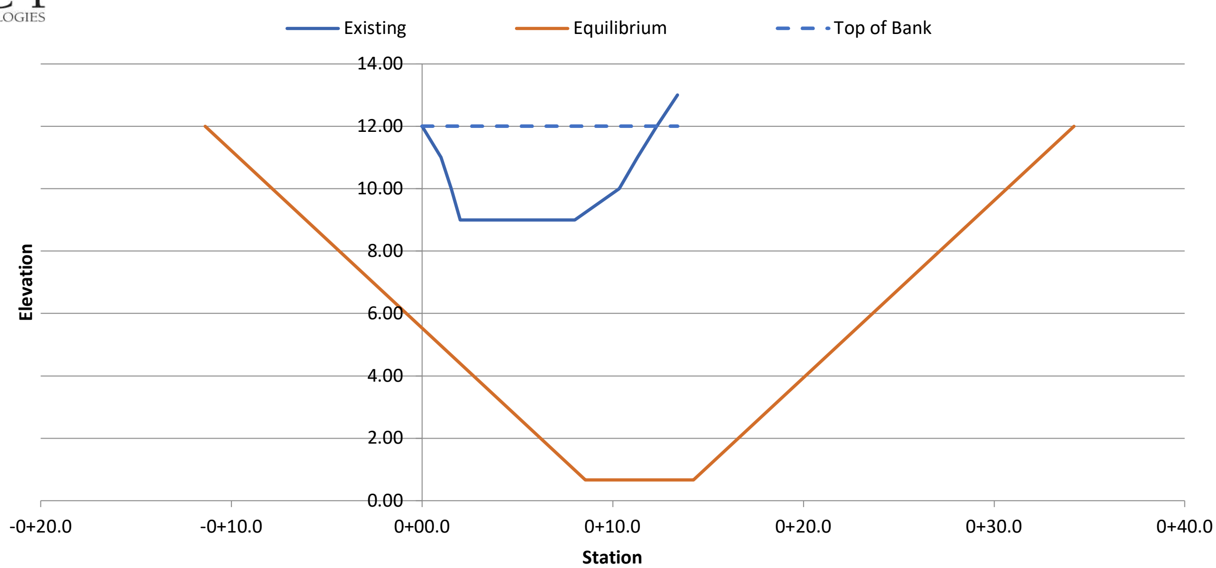
USDA. 2007. Technical Supplement 14B Scour Calculations.

Cross Section 1



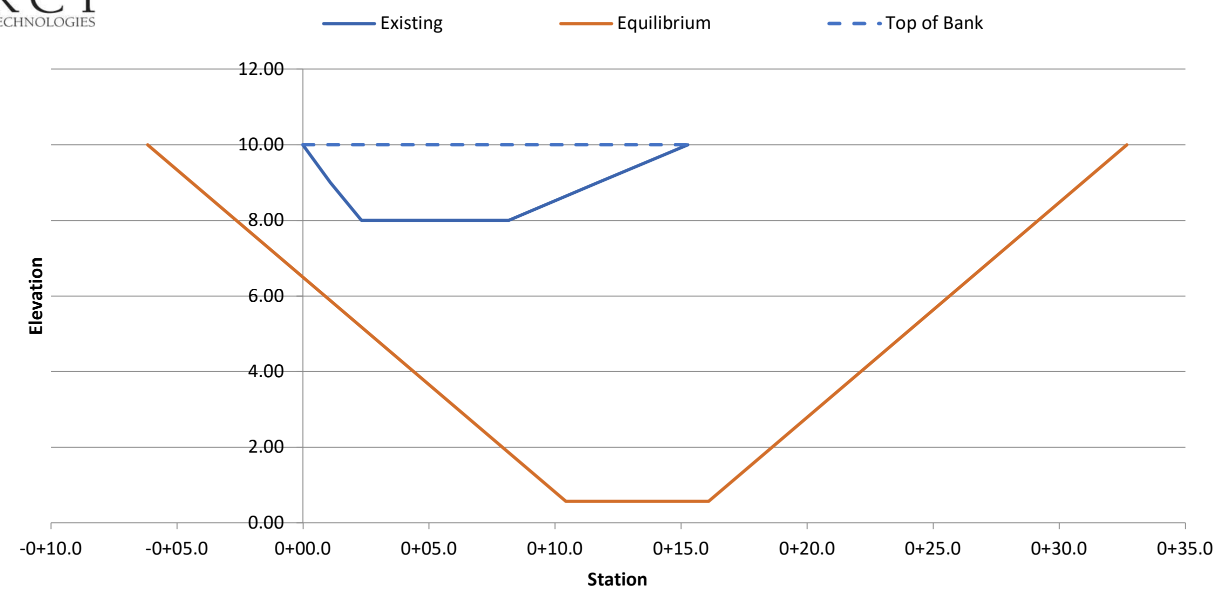
BKFL/TOB ELEV= 12	WIDTH (FT)	MEAN DEPTH (FT)	CROSS SECTION AREA (SQ FT)	WIDTH-DEPTH RATIO	DISCHARGE (cfs)
EXISTING	13.5	1.5	20.0	9.1	89.2
EQUILIBRIUM	45.4	6.3	287.7	7.2	181.2

Cross Section 2



BKFL/TOB ELEV= 12	WIDTH (FT)	MEAN DEPTH (FT)	CROSS SECTION AREA (SQ FT)	WIDTH-DEPTH RATIO	DISCHARGE (cfs)
EXISTING	12.3	2.3	28.3	5.4	152.5
EQUILIBRIUM	45.6	6.4	290.4	7.2	230.0

Cross Section 3



BKFL/TOB ELEV= 10	WIDTH (FT)	MEAN DEPTH (FT)	CROSS SECTION AREA (SQ FT)	WIDTH-DEPTH RATIO	DISCHARGE (cfs)
EXISTING	15.3	1.4	21.2	11.0	60.7
EQUILIBRIUM	38.8	5.4	209.8	7.2	153.1

Protocol 5 Credit Computations

Project Name: Harness Creek **By:** BLE
Project Number: 171804667.16 **Check:**

Nutrient and Sediment Load & Impervious Acre Credit

Average Bulk Density =	93	lb/ft^3 =	0.047	$tons/ft^3$
Sample TN Concentration =	2.28	lb/ton of sediment		
Sample TP Concentration =	1.05	lb/ton of sediment		

Note: For planning purposes, default values of 93 lb/ft^3 for bulk density and concentrations of 2.28 lb TN/ton of sediment and 1.05 lb TP/ton of sediment may be used.

Potential Sediment:

	XS 1	XS 2	XS 3	
Cross Section Starting STA =	0	37	77	
Cross Section Ending STA =	37	77	457	
Cross Section Applicable Length =	37	40	380	ft
Existing Channel Cross Sectional Area =	19.96	28.26	21.17	ft^2
Equilibrium Channel Cross Sectional Area =	287.73	290.40	209.81	ft^2
Volume of Potential Sediment =	9,907	10,486	71,686	ft^3

Total Volume of Sediment =	92,079	ft^3			
Total Weight of Sediment =	**8,563,332**	**lb**	**=**	**4,282**	**tons**

Pollutants:

Removal Efficiency = 56% (50% from Urban Stormwater Work Group, 56% from MDOT SHA)

	TN	**TP**	**TSS**	
Load =	9,762.20	4,495.75	8,563,332	lbs
Load Reduction =	5,466.83	2,517.62	4,795,466	lbs
Load Reduction Over 30 Years =	**182.23**	**83.92**	**159,849**	**lbs/yr**

Impervious Surface Treatment:

Equation 5. EIA$_f$ Calculation for Alternative BMPs

$$EIA_f = \frac{\left(\frac{TN\ Load\ Red.}{I-F_{TN}}\right)+\left(\frac{TP\ Load\ Red.}{I-F_{TP}}\right)+\left(\frac{TSS\ Load\ Red.}{I-F_{TSS}}\right)}{3}$$

Where:

EIA_f = Equivalent impervious acre conversion factor
TN Load Red. = BMP load reduction for TN (lbs/unit/yr)
TP Load Red. = BMP load reduction for TP (lbs/unit/yr)
TSS Load Red. = BMP load reduction for TSS (lbs/unit/yr)
$I - F_{TN}$ = Aggregate impervious unit load minus true forest unit load for TN (lbs/acre/yr)
$I - F_{TP}$ = Aggregate impervious unit load minus true forest unit load for TP (lbs/acre/yr)
$I - F_{TSS}$ = Aggregate impervious unit load minus true forest unit load for TSS (lbs/acre/yr)

Table 5. True Forest and Aggregate Impervious Pollutant Unit Load Deltas

	TN	TP	TSS	
Aggregate Impervious Unit Load =	20.39	2.55	8,793	lbs/ac/yr
True Forest Unit Load =	2.31	0.32	747	lbs/ac/yr
Delta =	18.08	2.23	8,046	lbs/ac/yr

EIA$_f$ = 22.53 ac

Length of Channel Requiring Restoration = 457 LF

Acres of Impervious Credit per Linear Foot Restored = 0.05 ac/LF

References

MDE. 2020. Accounting for Stormwater Wasteload Allocations and Impervious Acres Treated. Guidance for National Pollutant Discharge Elimination System Stormwater Permits.

Urban Stormwater Work Group (Stream Restoration Group 2). 2019. Recommendations for Crediting Outfall and Gully Stabilization Projects in the Chesapeake Bay Watershed. Chesapeake Bay Foundation.

Appendix E – Stormwater BMP Data Tracking Table

ANNE ARUNDEL COUNTY
MARYLAND
Department of Public Works

Heritage Complex
2662 Riva Road
Annapolis, MD 21401

Christopher J. Phipps, P.E.
Director

STORMWATER BMP DATA FORM

Project Name (List any previous/aka names)	Harness Creek Gully Repair
Contract #	10499
Storm_ID (See Note 5)	
County Project Manager	Melissa Harlinski, PE
Consultant Firm	KCI Technologies, Inc.
Consultant Project Manager	James Tomlinson, PE
BMP Address	600 Quiet Waters Park Rd Annapolis MD, 21403
BMP Location North Easting Coordinates	N 461725; E 1453280
Proposed/Retrofit BMP Type (See note 3)	SPSC
Original/Existing BMP Type (if applicable) (See note 3)	N/A
Proposed/Retrofit BMP Class (See note 4)	RR
BMP Drainage Area (Acres)	12.92
Existing Impervious Area (Acres) to the BMP	1.45
Treated Impervious Area (Acres) to the BMP	2.18
P_e (provided) (inches)	1.10
Required WQv (ac-ft.)	0.16
Actual WQv (ac-ft.) achieved with Retrofit	0.18
% of the Required WQv captured	109.56%
Retrofit BMP Proposed Date – SD Finalized	N/A
Retrofit BMP Completion Date – CD Finalized	N/A
Length of Shoreline Restored (linear feet)	N/A
Approved % Removal Efficiency for TN	61.0 (Protocol 4), 56.0 (Protocol 5)
Approved % Removal Efficiency for TP	71.4 (Protocol 4), 56.0 (Protocol 5)
Approved % Removal Efficiency for TSS	76.5 (Protocol 4), 56.0 (Protocol 5)
Number of pounds of TN removed	189.11
Number of pounds of TP removed	85.41
Number of tons of TSS removed	162,943
Load Reduction Credit (See note 2)	23.98

Telephone #410-222-7092 Mailstop #7400 FAX #410-222-4374
Website: www.aacounty.org/dpw
Recycled Paper

Notes:

1. This form is to be completed and included at the 30% Schematic, Construction design submittal, and as-built stages.
2. Use approved EPA CBP Expert Panel Removal Rate methodology. Cite the date and title of the Expert Panel Report used and attaches reference calculations.
3. Use MDE BMP Code from the attached
4. Use MDE BMP Classification (E, S, or A) from the attached
5. Provide the Storm_Id, if available (For ex. BMP retrofits); If not, use a ID number provided by the County PM. Make sure this ID number is also used on the project plans and reports.
6. Provide all associated GIS files for the project per attached "CIP Project GIS Layers Description and Upload Instructions."

Name of professional completing the form Winnie Boa-Durgammah Date 04/19/2022

Source: Accounting for Stormwater Wasteload Allocations and Impervious Acres Treated Guidance for National Pollution Discharge Elimination System Stormwater Permits August, 2014

Appendix F – Preliminary Cost Estimate

P584605

Harness Creek Gully Repair

30% Schematic Design Construction Cost Estimate

ITEM	QTY	UNITS	UNIT COST	TOTAL
Mobilization	1	LS	$25,000.00	$25,000
Clearing and Grubbing	0.64	AC	$500.00	$320
Remove Large Trees	18	EA	$1,500.00	$27,000
Maintenance of Traffic	1	LS	$2,700.00	$2,700
Orange Safety Fence	1150	LF	$2.66	$3,059
Channel or Stream Change Excavation	479	CY	$16.00	$7,664
Offsite Disposal of Excess and Unsuitable Materials	234	CY	$10.00	$2,344
Maintenance of Stream Flow	1	LS	$12,000.00	$12,000
Stablized Construction Entrance	1	EA	$750.00	$750
Erosion and Sediment Control Practices	1	LS	$5,000.00	$5,000
Cobble	137	CY	$535.00	$73,295
Boulders	46	CY	$250.00	$11,500
Sand/Woodchip Mix	94	CY	$123.00	$11,562
Geotextile Class SE	18	SY	$10.63	$191
1" Wood Chips with 3" Compost	138	CY	$70.00	$9,660
Natural Fiber Matting	69	SY	$10.00	$690
Temporary Stabilization	3092	SY	$2.50	$7,730
Landscaping	0.64	AC	$40,000.00	$25,600
			Direct Construction Subtotal	$226,066
			Contingency (30%)	$67,820
			Construction Subtotal	$293,886