Combining the potential for archaeological sites for each of the alternatives, Alt-1, Alt-2 and Alt-3 all have a higher potential for the presence of archaeological sites based upon standard settlement models than the chosen alternative.

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APPENDIX 2: VIEWSHED ANALYSIS

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Draper Aden Associates
Engineering • Surveying • Environmental Services

Memorandum

To:	Browning and Associates
From:	Lynn Klappich, Program Manager
Date:	February 12, 2020
Project Name:	Green Ridge Recycling and Disposal Facility – Cumberland County, VA
Project Number:	18020117-030102
Subject:	Viewshed analysis – Modified analysis – Appendix 2 – Phase I report
cc:	Mike Futrell

On February 10, 2020, Draper Aden Associates GIS personnel completed a revised viewshed analysis for the above referenced facility. The revision was required as the initial analysis had assumed two disposal units and a consistent height above existing ground as a design was not available. At this time a conceptual design has been completed for the western fill area and this design was utilized in the modified analysis.

Below is a description of our methodology and findings for the viewshed analysis.

Methodology – A viewshed analysis was performed for the area surrounding the proposed Green Ridge landfill to determine if the completed landfill would be visible from archaeological sites and standing structures that are either on the National Register of Historic Places (NRHP) or eligible for inclusion on the NRHP.

Lidar data from 2016 for all areas within 5 miles of the proposed landfill property were acquired from the Virginia Geographic Information Network (VGIN) lidar download FTP site. The data set is formally referred to as the "USGS Chesapeake Bay VA QL2 LiDAR Project". We acquired the raw point cloud in LAS format. The same data set can also be downloaded from the USGS website: https://viewer.nationalmap.gov/basic/

The viewshed analysis is a common tool in GIS analysis of topography. Historically the challenges have been data resolution and approaches to taking forest cover into account. A 'bare earth' model, or a digital elevation model (DEM) was often all that was available. If a land use or forest cover layer existed for a study site the model could be augmented by adding elevation to the forested areas in order to approximate the tree canopy. With the availability of lidar it is possible to accurately model features

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sitting upon the earth surface. This is typically referred to as a digital surface model (DSM) and represents the upper surfaces such as tree canopy and building roofs. Using this surface makes viewshed analysis much more representative of reality.

Our first step was to convert the lidar point cloud into a DSM raster layer. We chose a grid or cell size of 10-feet as a reasonable generalization of tree canopy and more than sufficient for bare ground representation. Using ArcGIS lidar tools, 'LAS Dataset to Raster', we calculated the DSM using a MAXIMUM cell assignment type. Basically, this assigned the DSM cell elevation as the highest point falling in the cell.

The current proposed finished landfill includes one waste management area and has a distinct peak at an elevation of 690 MSL. For a conservative measure we set a viewpoint above the peak at an elevation of 695 MSL. We then used the ArcGIS Viewshed Tool Set, 'Viewshed' to generate the standard visible/not-visible derivative layer based upon the DSM. This layer is typically shown as green/red, though often made partially transparent for evaluation of individual locations, so often it will be shown as a lime/pink overlay.

The majority of visible features are tree canopy, especially beyond the first mile. The forest cover effectively blocks a sight line to other features. Each of the sites were then manually reviewed with aerial imagery and terrain models to determine if the viewshed analysis made sense and corresponded with the aerial imagery. This provided a secondary and different review of whether the mound of the proposed Green Ridge landfill would be visible or not. Again, the review showed that the line of sight to the proposed landfill is typically blocked by trees that are in relative near proximity to the sites.

The resulting viewshed analysis is shown in Figure 2. Areas shaded in pink will not have a direct line of sight to the finished waste management area. Based on this analysis, the landfill will be potentially visible from only one resource currently listed or eligible for inclusion on the National Register of Historic Places (DHR ID 024-5082 - Pine Grove School) depending on viewer position and status of the tree line across the road.

Attachment 1 – Figure 1 - Viewshed Analysis

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ATTACHMENT 1

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Assumed finished elevation at 690’ (above MSL)

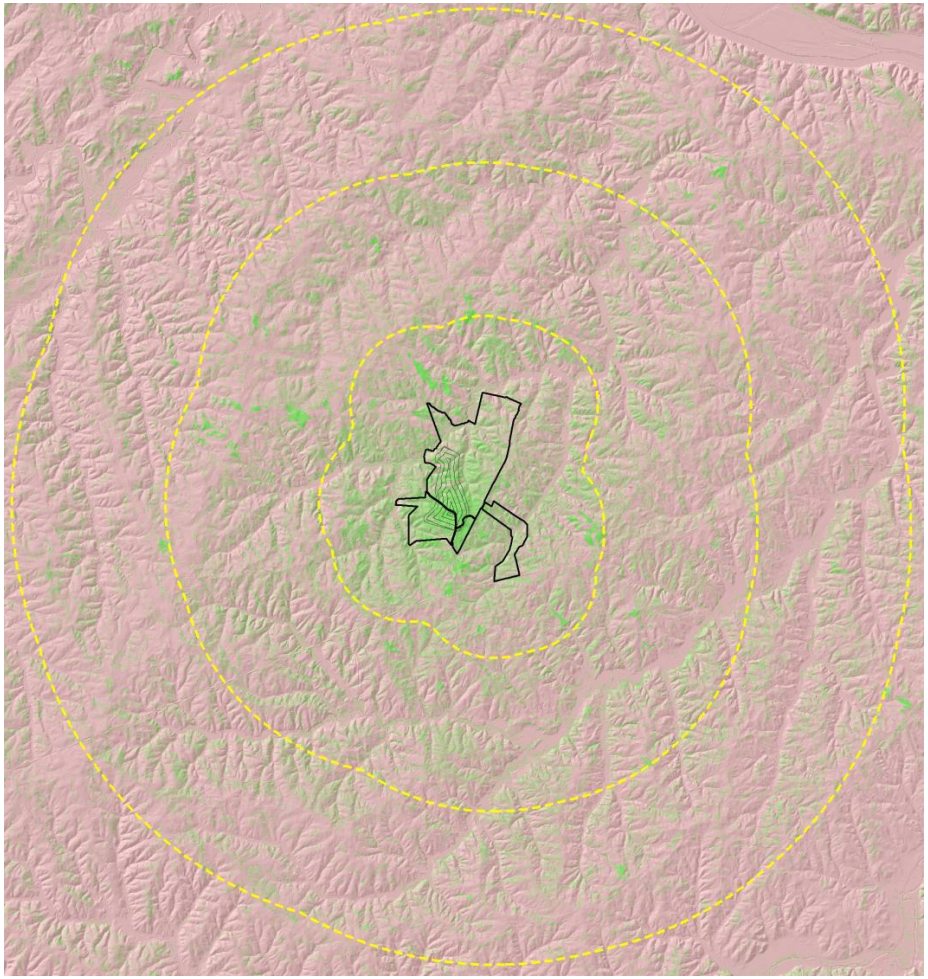

Figure 1 – Viewshed Analysis – Green Ridge Landfill – Buffers at 1, 3, and 5 miles (Areas in Pink are not visible from the finished landfill)

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APPENDIX 3: ARTIFACT INVENTORY

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Area 3

44CM0136

STP 114, Fill 1

Glass

1 white milk glass canning jar lid liner fragment

STP 115, Fill 1

Miscellaneous

4 brick fragments (61g)

STP 118, Fill 1

Ceramics

2 stoneware sherds, white, undecorated, refined, flatware

Glass

1 clear unidentified fragment

4 windowpane fragments, lime soda (1864-present)

2 windowpane fragments, lime soda (1864-present)

3 light aqua bottle/jar fragments

Metal

2 cut nail(s), machine headed (1805-present)

1 cut nail(s) fragment, machine headed (1805-present)

Miscellaneous

1 brick fragment (18g) (discarded in lab)

STP 119, Fill 1

Glass

1 windowpane fragment, lime soda (1864-present)

Metal

1 button flat, round, copper alloy button, 18mm in diameter, missing shank, embossed lettering on back LONDON

1 unidentified nail(s) fragment

Miscellaneous

5 brick fragments (52g) (discarded in lab)

STP 122, Fill 1

Glass

1 windowpane fragment, lime soda (1864-present)

1 windowpane fragment, lime soda (1864-present)

1 olive green bottle/jar fragment

1 dark olive green bottle/jar fragment

Metal

3 unidentified nail(s) fragments

STP 123, Fill 1

Glass

1 windowpane fragment, lime soda (1864-present)

5 windowpane fragments, lime soda burned (1864-present)

1 clear unidentified fragment thin

1 clear bottle/jar fragment, automatic bottle machine (ABM) possible rim or lip (1912-present)

7 windowpane fragments, lime soda (1864-present)

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2 windowpane fragments, lime soda one burned/deformed (1864-present)

Metal

2 fragments thin, corroded

1 cut nail(s) fragment (1805-present)

1 chain link corroded, possible spring snap link

STP 124, Ap

Ceramics

1 stoneware sherd, brown, undecorated, utilitarian

Glass

1 windowpane fragment, lime soda (1864-present)

1 clear bottle/jar fragment, automatic bottle machine (ABM) (1912-present)

Metal

1 unidentified nail(s) fragment

1 wire nail(s), roofing (1901-present)

3 wire nail(s) (1890s-present)

STP 125, Fill 1

Metal

1 wire nail(s) fragment (1890s-present)

STP 128, Apb

Glass

1 windowpane fragment, lime soda (1864-present)

STP 132, Apb

Glass

1 cobalt unidentified fragment

STP 133, Fill 1

Glass

1 pale green bottle/jar fragment

2 clear bottle/jar fragments, automatic bottle machine (ABM) (1912-present)

Metal

4 fragments

4 unidentified nail(s) fragments

3 wire nail(s) (1890s-present)

STP 134, Fill 1

Ceramics

1 unidentified earthenware sherd, no glaze, flatware spalled

Glass

1 windowpane fragment, lime soda (1864-present)

STP 137, Fill 1

Glass

1 clear cylindrical bottle/jar fragment, automatic bottle machine (ABM) (1912-present)

STP 145, Ap

Ceramics

1 pearlware sherd, undecorated, refined (1779-1830)

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STP 161, Fill 1

Miscellaneous

3 brick fragments (95g) (discarded in lab)

STP 162, Ap

Ceramics

1 pearlware sherd, unidentified, rim, refined, flatware white with blue along rim edge (1779-1830)

Metal

1 wrought nail(s), hand headed

STP 163, Fill 1

Glass

1 windowpane fragment, lime soda (1864-present)

STP 165, Fill 1

Ceramics

2 pearlware sherds, embossed, base, refined, flatware one with embossed annular pattern (1779-1830)

STP 133N, Fill 1

Glass

3 windowpane fragments, lime soda (1864-present)

1 windowpane fragment, lime soda (1864-present)

1 windowpane fragment, lime soda (1864-present)

3 clear cylindrical bottle/jar fragments, automatic bottle machine (ABM) (1912-present)

9 Ball blue canning jar jar fragments, cylindrical, automatic bottle machine (1909-ca. 1939)

Metal

4 wire nail(s) fragments (1890s-present)

2 wire nail(s) (1890s-present)

3 fragments heavily corroded

Miscellaneous

2 bone fragments (20g)

STP 133W, Fill 1

Metal

1 wire nail(s) fragment (1890s-present)

1 wire nail(s) (1890s-present)

STP 137W, Fill 1

Miscellaneous

5 bone fragments

Area 1

44CM0137

STP 22, Ap

Glass

2 clear cylindrical bottle/jar fragments , automatic bottle machine (ABM) (1912-present)

STP 48, Ap

Glass

1 clear bottle/jar fragment, automatic bottle machine (ABM) (1912-present)

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STP 52, Ap

Ceramics

1 hard paste porcelain sherd, white, undecorated, refined, flatware

Glass

2 clear bottle/jar fragments, automatic bottle machine (ABM) one square base (1912-present)

1 clear bottle/jar fragment, automatic bottle machine (ABM) stippling on one side (1912-present)

1 clear bottle/jar fragment, automatic bottle machine (ABM) approx 6 x4cm, embossed lettering and numbering on base: "I58"; "S"; "T" in a keystone maker's mark (Knox Bottle Co. of Mississippi. Palestine, Texas plant) (1940-1952)

Miscellaneous

2 coal fragments (4g)

STP 53, Ap

Glass

1 dark bluish-green unidentified fragment decorative embossed pattern

STP 60, Ap

Glass

2 clear bottle/jar fragments

STP 64, Ap

Glass

2 Ball blue canning jar bottle/jar fragments, automatic bottle machine (ABM) one embossed, "E" above "S O" (1909-ca. 1939)

STP 89, Ap

Glass

1 windowpane fragment, lime soda (1864-present)

1 clear bottle/jar fragment, automatic bottle machine (ABM) (1912-present)

STP 91, Ap

Glass

1 clear bottle/jar fragment

1 windowpane fragment, lime soda (1864-present)

1 clear bottle/jar fragment, automatic bottle machine (ABM) (1912-present)

STP 48E, Ap

Glass

1 clear cylindrical bottle/jar fragment, automatic bottle machine (ABM) (1912-present)

STP 48W, Ap

Glass

1 amber bottle/jar fragment, automatic bottle machine (ABM) embossed lettering "TE" (1912-present)

1 white milk glass canning jar lid liner fragment

1 clear bottle/jar fragment, automatic bottle machine (ABM) (1912-present)

STP 60E, Ap

Glass

1 windowpane fragment, lime soda (1864-present)

STP 60N, Ap

Ceramics

1 whiteware sherd, white, undecorated, rim, refined (1820-present)

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1 whiteware sherd, white, undecorated, base, refined, flatware portion of makers mark (1820-present)

Glass

1 clear bottle/jar fragment, automatic bottle machine (ABM) (1912-present)

STP 60W, Ap

Glass

1 white milk glass canning jar lid liner fragment

STP 64E, Ap

Glass

1 clear bottle/jar fragment, automatic bottle machine (ABM) (1912-present)

Metal

1 unidentified nail(s) heavily corroded

STP 64S, Ap

Ceramics

1 whiteware sherd, white, undecorated, refined, holloware (1820-present)

Glass

1 clear bottle fragment, automatic bottle machine (ABM) square, flat, base, embossed "4" in circle (1912-present)

Metal

2 fragments

1 unidentified nail(s) fragment

STP 91E, Ap

Ceramics

1 pearlware sherd, white, undecorated, rim, refined (1779-1830)

Area 1

44CM0138

MD 01, Fill 1

Metal

1 wire nail(s) (1890s-present)

MD 02, Fill 1

Metal

1 wire nail(s) fragment (1890s-present)

MD 03, Fill 1

Metal

1 eye bolt

MD 04, Fill 1

Metal

1 fragment angled rim, 1.5 cm thick

MD 05, Ap

Metal

1 wire nail(s) (1890s-present)

MD 06, Ap

Ceramics

1 pearlware sherd, undecorated, base, refined, flatware (1779-1830)

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Metal

1 tubular, tapered, threaded end

MD 07, Ap

Metal

1 wire nail(s) (1890s-present)

Miscellaneous

1 bone fragment (60g)

MD 08, Ap

Metal

1 enamelware pot lid fragment blue and white, hole in center

MD 09, Ap

Metal

1 strap hinge fragment

MD 10, Fill 1

Metal

1 boot spur with heel band, neck, and rowel

MD 11, Fill 1

Metal

1 wire nail(s) (1890s-present)

MD 12, Fill 1

Glass

5 clear unidentified fragments burned

Metal

4 cut nail(s), T-head (1805-present)

2 cut nail(s), machine headed (1805-present)

6 wire nail(s) (1890s-present)

1 wire nail(s), roofing (1901-present)

Miscellaneous

1 shoe sole fragment child's shoe heel

MD 13, Fill 1

Glass

1 clear unidentified fragment burned and fused

1 windowpane fragment, lime soda (1864-present)

Metal

1 fragment thin

6 wire nail(s) (1890s-present)

1 wire fragment

2 wire nail(s) fragments (1890s-present)

MD 14, Fill 1

Glass

1 clear bottle/jar fragment, automatic bottle machine (ABM) (1912-present)

Metal

12 wire nail(s) (1890s-present)

1 wire nail(s) fragment (1890s-present)

1 cut nail(s), machine headed (1805-present)

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1 safety pin fragment

MD 15, Fill 1

Glass

1 clear unidentified fragment burned

2 windowpane fragments, lime soda (1864-present)

Metal

1 wire nail(s) fragment (1890s-present)

5 wire nail(s) (1890s-present)

1 staple

MD 16, Fill 1

Metal

1 wire nail(s) fragment (1890s-present)

5 wire nail(s) (1890s-present)

1 wire nail(s), roofing (1901-present)

Miscellaneous

1 bone fragment flat, thin

MD 17, Fill 1

Metal

1 staple fragment

MD 18, Fill 1

Glass

1 clear cylindrical bottle/jar fragment, automatic bottle machine (ABM) (1912-present)

Metal

4 barbed wire fragments corroded

MD 19, Fill 1

Metal

1 wire nail(s) (1890s-present)

MD 20, Fill 1

Metal

1 wire nail(s) (1890s-present)

MD 21, Fill 1

Metal

3 barbed wire fragments corroded

MD 22, Fill 1

Metal

1 wire nail(s) (1890s-present)

MD 23, Fill 1

Glass

2 very pale aqua unidentified fragments burned and fused

2 orange unidentified fragments burned

1 red unidentified fragments burned and fused

1 windowpane fragment, lime soda (1864-present)

Metal

3 wire nail(s) fragments (1890s-present)

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Miscellaneous

2 unknown material, burned with nail holes, fused with window glass and charcoal

MD 24, Fill 1

Glass

4 clear unidentified fragments burned and fused

1 clear cylindrical bottle/jar base fragment, automatic bottle machine (ABM) (1912-present)

Metal

1 steamer trunk corner guard fragment

1 wire nail(s) fragment (1890s-present)

1 steamer trunk corner guard with attached fasteners

MD 25, Fill 1

Glass

1 amber bottle fragment, duraglas base, burned, stippled, embossed "4" (post-1940)

2 clear unidentified fragments burned

1 clear cylindrical bottle/jar fragment, automatic bottle machine (ABM) (1912-present)

Metal

3 wire nail(s) (1890s-present)

2 wire nail(s) fragments (1890s-present)

MD 26, Fill 1

Glass

1 clear unidentified fragment burned

1 clear bottle/jar fragment, automatic bottle machine (ABM) (1912-present)

1 clear canister annular, embossed lines along rim, embossed "J"

Metal

1 wire nail(s) (1890s-present)

1 wire nail(s) fragment (1890s-present)

MD 27, Fill 1

Metal

2 fragments thin

1 steamer trunk corner guard decorated, two attached nail fragments

2 wire nail(s) (1890s-present)

MD 28, Fill 1

Metal

1 hinge door or cabinet hinge

MD 29, Fill 1

Glass

4 windowpane fragments, lime soda (1864-present)

MD 30, Fill 1

Metal

1 fragment 21x6x0.6 cm, curved, raised rim

MD 31, Fill 1

Glass

1 clear jar fragment, cylindrical, automatic bottle machine (ABM) ball/mason jar threaded rim, intact metal lid and milk glass lid liner; embossed lettering on lid, "Presto" (1912-present)

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MD 32, Fill 1

Metal

3 wire nail(s) (1890s-present)

MD 34, Fill 1

Metal

1 fragment

MD 35, Fill 1

Metal

2 unidentified nail(s) fragments

3 wire nail(s) fragments (1890s-present)

MD 36, Fill 1

Metal

1 wire nail(s) fragment (1890s-present)

2 wire nail(s) (1890s-present)

MD 37, Fill 1

Ceramics

1 whiteware sherd, undecorated, refined, flatware (1820-present)

Metal

1 cut nail(s), machine headed (1805-present)

MD 38, Fill 1

Glass

1 white milk glass tableware fragment rim ; scalloped and linear, molded pattern on exterior surface, smooth interior.

1 white milk glass tableware fragment rim ; molded shell pattern on exterior surface, floral pattern on interior.

Metal

2 wire nail(s) (1890s-present)

1 disk 3.5 cm in diameter with three linear holes

MD 39, Fill 1

Ceramics

1 whiteware sherd, undecorated, refined (1820-present)

Metal

1 thin, folded

2 fragments thin

MD 40, Fill 1

Metal

1 fragment thin, flat, square or rectangular, two intact edges; raised rim, slightly raised ridge 2 cm from rim.

MD 41, Fill 1

Ceramics

1 hard paste porcelain sherd, white, refined, flatware gold and green annular pattern

Metal

1 spoon fragment spoon, nearly intact bowl and attached neck

MD 42, Fill 1

Metal

1 door lock case

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SC 01, Ap

Glass

1 clear bottle/jar fragment burned
4 windowpane fragments, lime soda (1864-present)
4 clear unidentified fragments burned

Area 6

44CM0139

STP 35, Fill 1

Glass

1 windowpane fragment, lime soda (1864-present)
1 windowpane fragment, lime soda (1864-present)
1 windowpane fragment, lime soda thin (1864-present)

Metal

14 thin

Miscellaneous

83 brick 80+ brick fragments and 3 whole bricks (discarded in field)

STP 36, Fill 1

Miscellaneous

25 brick fragments observed but not collected

STP 40, Fill 1

Miscellaneous

25 brick fragments observed but not collected

STP 35N, Fill 1

Miscellaneous

25 brick fragments (not collected)

STP 40N, Fill 1

Glass

1 windowpane fragment, lime soda (1864-present)

Metal

1 triangular; wire ring; pull tab (possible)

Area 2

44CM0141

STP 262, Ap

Metal

1 spike corroded, length: 22 cm.
1 wire nail(s) fragment (1890s-present)
1 thin strap, u-bolts and eye bolt with iron ring attached
1 wire nail(s) (1890s-present)

STP 267, Ap

Glass

1 clear bottle/jar fragment, automatic bottle machine (ABM) (1912-present)

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STP 290, Ap

Glass

1 clear bottle/jar fragment, automatic bottle machine (ABM) rectangular 4.5x3x8.5 cm., 2.5cm diameter mouth, embossed lettering/numbering on base "2.5 FL. OZ.", "S" within a circle maker's mark (1914-1930)

STP 293, Ap

Glass

3 clear bottle fragments, contact mold one rectangular (1810-1880)

Metal

11 fragments 3 possible rim fragments

STP 294, Ap

Metal

1 fragment thin

1 wire nail(s) fragment (1890s-present)

1 wire nail(s) (1890s-present)

STP 297, Ap

Metal

1 wire nail(s) (1890s-present)

STP 304, Ap

Glass

7 unidentified fragments

STP 308, Ap

Miscellaneous

4 concrete fragments (discarded in field)

STP 309, Ap

Metal

3 unidentified nail(s) fragments

STP 313, Ap

Glass

6 clear cylindrical bottle/jar fragments, automatic bottle machine (ABM) 2 threaded rim fragments (1912-present)

Metal

3 unidentified nail(s) fragments

1 wagon endgate/box rod length: 54 cm.

STP 267N, Ap

Metal

4 unidentified nail(s) fragments

STP 293N, Ap

Glass

1 clear bottle/jar fragment

STP 294E, Ap

Glass

3 clear bottle/jar fragments, automatic bottle machine (ABM) (1912-present)

1 white milk glass canning jar lid liner jar fragment

24 windowpane fragments, lime soda (1864-present)

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STP 294S, Ap

Ceramics

1 pearlware sherd, white, undecorated, base, refined, flatware (1779-1830)

STP 297E, Ap

Glass

1 clear cylindrical bottle/jar fragment, automatic bottle machine (ABM) (1912-present)

Metal

3 handle fragments

1 wire nail(s) with bent tip (1890s-present)

1 threaded cap with four prongs

Area 3

44CM0144

MD 1, Ap

Metal

1 oval ring, length: 8 cm; chain link (possible)

MD 2, Ap

Metal

1 fragment square, 6x5x1 cm .

MD 3, Ap

Metal

1 hoop diameter: 9 cm, width: 5 cm, with raised element 2 cm wide and high along width of hoop

MD 4, Ap

Metal

1 wire nail(s) fragment (1890s-present)

MD 5, Ap

Metal

1 fragment curved, 7.5x4.5x0.6 cm.

MD 6, Ap

Metal

1 strap hinge fragment

MD 7, Ap

Metal

1 plowshare

MD 8, Ap

Metal

1 horseshoe fragment

MD 9, Ap

Metal

1 fragment flat, thickness: 0.05 cm

MD 10, Ap

Metal

1 cultivator shank bent, 16.5x4.5 cm, single hole in center.

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MD 11, Ap

Metal

1 fragment flat, with raised rim, 0.5 cm in thickness

MD 12, Ap

Metal

1 bar, corroded, 15x3x.5 cm

MD 13, Ap

Metal

1 strap hinge fragment

MD 14, Ap

Metal

1 wire nail(s) fragment (1890s-present)

MD 15, Ap

Metal

1 strap hinge fragment nut and bolt attached

MD 16, Ap

Metal

1 horseshoe fragment

MD 18, Ap

Metal

1 horseshoe

MD 19, Ap

Metal

1 plowshare

MD 20, Ap

Metal

1 fragment flat, curved; hoe (possible)

MD 21, Ap

Glass

1 dark amber cylindrical bottle/jar fragment 0.6 cm thick

1 amber bottle/jar fragment, automatic bottle machine (ABM) embossed lettering "...DE MARK R..." (1912-present)

Metal

1 fragment length: 9 cm, diameter: 1.5 cm

1 unidentified nail(s) fragment heavily corroded

MD 22, Ap

Ceramics

1 stoneware sherd, white, salt glazed, utilitarian, holloware large jug mouth and body; mouth diameter 3 cm.

Glass

1 clear bottle fragment, automatic bottle machine (ABM) rectangular, narrow neck; includes portion of mouth, neck and body; whiskey or medicine bottle. (1912-present)

Miscellaneous

1 brick fragment (122g) (discarded in lab)

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MD 23, Ap

Metal

1 wire nail(s) fragment (1890s-present)

1 bent, corroded

MD 24, Ap

Metal

1 wire nail(s) (1890s-present)

MD 25, Ap

Metal

1 horseshoe

MD 26, Ap

Metal

1 unidentified nail(s) fragment

MD 27, Ap

Metal

1 strap 79x1.5x0.3 cm with holes for fasteners. Weight: 237.7 g.

MD 28, Ap

Metal

1 horseshoe

MD 29, Ap

Metal

1 fragment thin

1 cylindrical, length: 4 cm

1 unidentified nail(s) fragment heavily corroded

MD 30, Ap

Metal

1 wire fragment length: 38 cm.

MD 31, Ap

Metal

1 wire nail(s) (1890s-present)

1 wire nail(s) fragment (1890s-present)

MD 32, Ap

Metal

3 wire nail(s) (1890s-present)

MD 33, Ap

Metal

1 wire nail(s) (1890s-present)

MD 34, Ap

Metal

1 fragment 13x2x1 cm

MD 35, Ap

Metal

1 fragment

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MD 36, Ap

Metal

1 unidentified nail(s) fragment

MD 38, Ap

Metal

1 wire nail(s) fragment (1890s-present)

3 wire nail(s) (1890s-present)

MD 39, Ap

Metal

1 strap fragment 11x3 cm, hole 3 cm from end, strap hinge (possible)

MD 40, Ap

Metal

1 fragment 22x5 cm, stepped edge and raised ridge along length

MD 41, Ap

Metal

1 wire nail(s) fragment (1890s-present)

MD 42, Ap

Metal

1 fragment

MD 43, Ap

Metal

1 bolt fragment corroded, remnant of attached nut

1 fragment thin, thickness: 0.4 cm, raised ridge along one edge

MD 44, Ap

Metal

1 unidentified nail(s) fragment

MD 45, Ap

Metal

1 wire nail(s) fragment (1890s-present)

MD 46, Ap

Metal

1 fragment thin, 1.4x3.5 cm, rounded on one end; kitchen utensil handle (possible)

MD 47, Ap

Metal

1 horseshoe fragment

MD 48, Ap

Metal

1 fragment curved, length: 20 cm, thickness: 1-2 cm

MD 49, Ap

Metal

1 fragment concave, thickness: 0.5 cm; embossed "S" on surface

MD 50, Ap

Metal

1 wire-like link, corroded

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MD 51, Ap

Metal

1 fragment flat with raised edges, 9.5x7x0.4 cm.

MD 52, Ap

Metal

1 fragment square 6 x 6 x 0.4 cm , raised rim (.06 cm) along one edge

MD 53, Ap

Metal

1 scissors fragment scissor handle

MD 54, Ap

Metal

1 fragment L-shaped, length: 11cm, thickness: 1-2 cm; weight: 123.3g

MD 55, Ap

Metal

1 horseshoe fragment

MD 56, Ap

Metal

1 fragment length: 8 cm

MD 57, Ap

Metal

1 fragment

MD 58, Ap

Metal

1 wire nail(s) (1890s-present)

MD 59, Ap

Metal

2 strap fragments

MD 60, Ap

Metal

1 fragment 4.4x1.7x1.2 cm, slightly tapered along length

MD 61, Ap

Glass

2 clear cylindrical bottle/jar fragments, automatic bottle machine (ABM) (1912-present)

Miscellaneous

1 brick fragments (93g) (discarded in field)

MD 62, Ap

Metal

1 cultivator shank 16.5x4.5 cm, single hole in center

MD 63, Ap

Metal

1 wire nail(s) (1890s-present)

MD 64, Ap

Metal

1 fragments thin, width: 2.5 cm, evenly spaced, slotted holes

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MD 65, Ap

Metal

1 wire nail(s) 10.5cm (1890s-present)

MD 66, Ap

Metal

1 wire nail(s) (1890s-present)

MD 67, Ap

Metal

1 wire nail(s) (1890s-present)

MD 68, Ap

Metal

1 plowshare fragment

MD 69, Ap

Metal

1 fragment curved, 4.5x1.5x1.5 cm

MD 70, Ap

Glass

1 windowpane fragment, lime soda (1864-present)

1 clear bottle/jar base, diameter: 2.5 cm

Metal

1 wire nail(s) (1890s-present)

MD 71, Ap

Metal

1 door/gate latch one side of bolt latch receiver with 3 slotted head screws attached

MD 72, Ap

Glass

1 windowpane fragment, lime soda (1864-present)

Metal

1 wire nail(s) (1890s-present)

MD 73, Ap

Metal

1 fragment 17x4.5 cm, curved along width; pipe (possible)

MD 74, Ap

Metal

1 cultivator shank 16.5x4.5 cm, single hole in center.

MD 75, Ap

Metal

1 flatiron missing handle

MD 76, Ap

Metal

1 wrought nail(s) fragment

MD 77, Ap

Metal

1 wire nail(s) fragment (1890s-present)

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MD 78, Ap

Metal

1 wire nail(s) (1890s-present)

MD 79, Ap

Metal

1 ax head single blade

MD 80, Ap

Metal

1 spike length: 25 cm, 2 cm, square shank

MD 81, Ap

Metal

1 fragment thin, flat, with curved notch on one edge

MD 82, Ap

Metal

1 wire nail(s) (1890s-present)

MD 83, Ap

Metal

1 fragment heavily corroded, triangular, length: 17.5 cm

MD 84, Ap

Metal

1 fragment triangular, 0.7 cm thick-161.4 g.

MD 85, Ap

Metal

1 wire nail(s) (1890s-present)

MD 86, Ap

Metal

1 wire nail(s) 13 cm in length (1890s-present)

1 wire nail(s) (1890s-present)

MD 87, Ap

Metal

1 wire nail(s) (1890s-present)

MD 88, Ap

Metal

1 fragment flat, 0.4 cm thick, raised ridge along one edge

MD 89, Ap

Metal

1 spike length: 14 cm, 1.3 cm square shank

MD 90, Ap

Metal

1 cut nail(s), machine headed (1805-present)

MD 91, Ap

Metal

1 wire nail(s) fragment (1890s-present)

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MD 92, Ap

Metal

1 ring, diameter: 4 cm

MD 93, Ap

Metal

1 fragment thin, folded, slightly rounded-4.6 g.

MD 94, Ap

Metal

1 wire nail(s) (1890s-present)

MD 95, Ap

Metal

1 wire fragment corroded

1 wire nail(s) (1890s-present)

MD 96, Ap

Metal

1 wire nail(s) (1890s-present)

MD 97, Ap

Metal

1 wire nail(s) (1890s-present)

MD 98, Ap

Metal

1 boot spur rowel

MD 99, Ap

Metal

1 wire nail(s) (1890s-present)

MD 100, Ap

Metal

1 wire nail(s) (1890s-present)

MD 101, Ap

Metal

1 cut nail(s), machine headed 5 cm in length (1805-present)

MD 102, Ap

Glass

1 windowpane fragment, lime soda (1864-present)

Metal

1 unidentified nail(s) fragment

MD 103, Ap

Metal

1 unidentified nail(s) fragment

MD 104, Ap

Metal

1 strap hinge fragment

MD 105, Ap

Metal

4 fragments

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MD 106, Ap

Metal

1 wire nail(s) (1890s-present)

MD 107, Ap

Metal

1 wire nail(s) (1890s-present)

MD 108, Ap

Metal

3 wire nail(s) (1890s-present)

MD 109, Ap

Metal

1 wire nail(s) (1890s-present)

1 hoop, diameter: 14 cm, width: 2 cm, thickness: 0.4 cm

MD 110, Ap

Metal

1 wire nail(s) fragment (1890s-present)

1 fragment square, 9x7.5x0.4 cm.

2 wire nail(s) (1890s-present)

MD 111, Ap

Metal

1 wire nail(s) (1890s-present)

MD 112, Ap

Metal

1 wire nail(s) fragment (1890s-present)

MD 113, Ap

Glass

1 windowpane fragment, lime soda (1864-present)

Metal

1 horseshoe modified, tapered to a point on the ends

1 hoop hoop, diameter: 22 cm, width: 3 cm; wagon wheel hub hardware (possible)

1 D shaped ring, diameter: 3 cm

1 pliers missing one half

MD 114, Ap

Metal

1 fragment L-shaped, 19x3x0.5 cm

MD 115, Ap

Metal

1 broken, cast iron wheel, 6 spokes with square hub, missing 1 spoke and portion of rim, bent spike through the center of he hub, 35 cm in diameter, rim and spokes approximately 2 cm in width

MD 116, Ap

Metal

1 strap hinge

MD 117, Ap

Metal

2 wire nail(s) (1890s-present)

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1 wing nut

MD 118, Ap

Metal

1 pintle hinge

MD 119, Ap

Metal

1 wire nail(s) fragment (1890s-present)

MD 120, Ap

Metal

1 wire nail(s) (1890s-present)

1 strap hinge fragment

1 tag fragment plate, embossed "HASSLER" within an oval logo. Additional lettering includes "SHOCK ABSORBER, MANUFACTURED, ROBERT H. HASSL", "INDIANAPOLIS"; from shock absorbers for Model T Fords.

MD 121, Ap

Metal

1 wire nail(s) (1890s-present)

MD 122, Ap

Metal

1 wire nail(s) fragment (1890s-present)

2 wire nail(s) (1890s-present)

MD 123, Ap

Metal

1 horseshoe

MD 124, Ap

Metal

1 wire nail(s) (1890s-present)

MD 125, Ap

Metal

1 wire nail(s) (1890s-present)

MD 127, Ap

Metal

1 fragment 14.5x2x0.2 cm. Oval shaped hole at one end with short bolt and nut attached. Two additional bolts fastening a second 5 cm long fragment of equal width and thickness atop first.

1 stirrup fragment

MD 128, Ap

Ceramics

2 stoneware sherds, white, salt glazed, base, utilitarian, holloware large crock/jug base, one with dark blue glaze along edge

Metal

1 wire nail(s) (1890s-present)

MD 130, Ap

Metal

1 (457g) bent bar, 16mm in diameter

1 plate with flared edge

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MD 131, Ap

Metal

1 strap hinge fragment

1 wire nail(s) (1890s-present)

MD 132, Ap

Metal

1 fragment flat, square, 5.5x5.5x0.4 cm, 4 cm opening at one end.

MD 133, Ap

Metal

1 wire nail(s) (1890s-present)

MD 134, Ap

Metal

1 hook with squared end and hole for fastener

MD 135, Ap

Metal

1 hoop diameter: 14 cm, width: 7cm, with rounded notch; possible wagon wheel hub hardware

MD 136, Ap

Metal

1 wire nail(s) (1890s-present)

MD 137, Ap

Metal

1 fragment cast iron pipe (possible)

MD 138, Ap

Metal

1 ax head single blade

MD 139, Ap

Metal

1 wire nail(s) (1890s-present)

STP 358, Ap

Glass

1 pale purple bottle/jar fragment, clear manganese (1880-1915)

STP 370, Fill 1

Ceramics

1 whiteware sherd, white, unidentified, refined, holloware light green decoration (1820-present)

Glass

1 windowpane fragment, lime soda (1864-present)

STP 600, Fill 1

Ceramics

1 pearlware sherd, green, undecorated, refined (1779-1830)

Metal

1 45 cm, attached bolts and iron rings

1 wire nail(s) fragment (1890s-present)

1 strap fragment 20 cm x 2 cm x 0.5 cm, attached iron bolt and nut

2 wire nail(s) (1890s-present)

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STP 370N, Fill 1

Glass

1 pale aqua bottle/jar fragment

Metal

1 wire nail(s) (1890s-present)

STP 370W, Ap

Glass

1 Ball blue cylindrical bottle/jar fragment, automatic bottle machine (ABM) (1909-ca. 1939)

STP 600N, Fill 1

Metal

1 wire nail(s) (1890s-present)

2 steamer trunk corner guard fragments

1 ring, 4.5 cm diameter

STP 600S, Fill 1

Ceramics

1 creamware sherds, white, undecorated, rim, refined 1 rim sherd, spalled, feather edged (possible) (1762-1820)

Metal

1 unidentified nail(s) fragment

1 shotgun shell base remnants of paper within base; imprinted lettering on bottom of base "FEDERAL MONARK No 12"

1 wire nail(s) (1890s-present)

STP 600W, Fill 1

Glass

1 windowpane fragment, lime soda (1864-present)

Area 6

44CM0145

F 4, Fill 1

Ceramics

16 pearlware sherds, green, feather edge, rim/base, refined, flatware, scalloped rim (refit), impressed anchor makers mark, possible Davenport (ca. 1793-1810) (1779-1830)

1 stoneware sherd, base, holloware gray body, brown exterior glaze, red interior

2 unidentified earthenware sherds

Glass

2 olive green blackglass wine bottle fragments patinated

Metal

1 wrought nail(s) fragment

MD 1, Ap

Glass

1 clear other oval, flat, glass bead approximately 1.3x1x0.4 cm, crenulated pattern around outer rim

Metal

1 cut nail(s) fragment possible horseshoe nail (1805-present)

MD 2, Ap

Metal

1 cut nail(s) possible horseshoe nail (1805-present)

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MD 3, Ap

Metal

1 cut nail(s) fragment possible horseshoe nail (1805-present)

MD 4, Ap

Metal

1 cut nail(s) possible horseshoe nail (1805-present)

MD 5, Ap

Metal

1 cut nail(s) possible horseshoe nail (1805-present)

MD 6, Ap

Metal

1 cut nail(s) fragment (1805-present)

MD 7, Ap

Metal

1 horseshoe

MD 8, Ap

Metal

1 fragment approximately 5.5x5.0.5 cm.

MD 9, Ap

Metal

1 cut nail(s) possible horseshoe nail (1805-present)

MD 10, Ap

Metal

1 cut nail(s) possible horseshoe nail (1805-present)

MD 11, Ap

Metal

1 cut nail(s) possible horseshoe nail (1805-present)

MD 12, Ap

Metal

1 fragment approximately 2x1.5x1 cm, wedge shaped

MD 13, Ap

Metal

1 wrought nail(s) length: 7 cm, square head 2.5x2.5 cm .

MD 14, Ap

Metal

1 fragment 6.5x3x1.5 cm.

MD 15, Ap

Metal

1 cut nail(s) fragment possible horseshoe nail (1805-present)

SC SC-1, Ap

Ceramics

3 pearlware sherds, white, undecorated, refined (1779-1830)

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Area 1

Loc 01

STP 81, Ap

Metal

1 chain, link approx 1.4m in length, possibly modern

Area 3

Loc 02

STP 232, Ap

Lithics

1 quartz flake

Area 3

Loc 03

STP 314, Ap

Lithics

1 quartzite hammerstone chipped

1 quartz flake

Area 3

Loc 04

STP 402, Ap

Lithics

1 quartz point Stanley fragment, Middle Archaic

Area 3

Loc 05

STP 560, Ap

Lithics

1 quartzite scraper, no cortex

Area 3

Loc 06

STP T4-18, Ap

Glass

1 windowpane fragment , lime soda (1864-present)

Area 3

Loc 07

STP 357, Ap

Ceramics

1 whiteware sherd, white, undecorated, refined, flatware (1820-present)

Area 3

Loc 08

STP 371, Ap

Metal

1 unidentified nail(s) fragment

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Area 4

Loc 09

STP 127, Ap

Lithics

1 quartz point Clarksville, Late Woodland

Area 4

Loc 10

STP 130, Ap

Ceramics

1 refined white earthenware sherd, undecorated, undecorated

Area 4

Loc 11

STP 208, Ap

Ceramics

1 refined white earthenware sherd, undecorated, undecorated

Area 4

Loc 12

STP 21, Ap

Lithics

2 quartz point Rossville, Early Woodland (mend)

Area 5

Loc 13

STP 167, Ap

Metal

1 cut nail(s) fragment, machine headed (1805-present)

Area 5

Loc 14

STP 97, Ap

Glass

1 clear bottle/jar fragment, automatic bottle machine (ABM) (1912-present)

Area 6

Loc 15

STP 23, Ap

Metal

1 wire nail(s) (1890s-present)

Area 6

Loc 16

STP 49, Ap

Miscellaneous

1 brick fragment (8g)

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Area 7

Loc 17

STP 201, Ap

Lithics

1 quartz flake fragment fragment

Area 7

Loc 18

STP 215, Ap

Lithics

1 quartz flake fragment fragment

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VII. THREATENED AND ENDANGERED SPECIES REPORT

The following report contains two sections. The first was prepared by Koontz Bryant Johnson Williams and contains information obtained from the U.S. Fish and Wildlife Service. The aim of this section was to identify the potential for the presence of any threatened and endangered species within the project area and from there to pursue further investigation. This report will show that KBJW identified a total of four potential species with the potential for onsite presence. These included James Spinymussel (*Pleurobema collina*), Green Floater (*Lasmigona subviridis*), Atlantic Pigtoe (*Fusconaia masoni*) and the Northern Long-Eared Bat (*Myotis septentrionalis*).

The second portion was prepared by Daguna Consulting, LLC and contains their findings on the presence of any threatened and endangered mussel species within the project area. Field work was conducted in May of 2019.

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Threatened and Endangered Species Summary

Project: Green Ridge Landfill
Cumberland County, Virginia
May 24, 2019

Updated: December 9, 2019

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Section I: Introduction

The Green Ridge Landfill Project site lies off of Pinegrove Road and Anderson Highway (Rt. 60) in Cumberland County, Virginia. The site encompasses a total of 1,177.63 acres and contains both forested and unforested areas along with a wetland system that was delineated in March and April of 2018. The wetland system contains two named creeks. The first, Muddy Creek, lies on the northwestern portion of the associated project parcels. The second feature, Maple Swamp Creek, is a perennial stream that flows through the southeastern portion of the project area. This system encompasses a drainage basin that is approximately 8.31 square miles. For a list of the parcels that are associated with this project please see Table 1.0.

Table 1.0: Parcels Associated with the Green Ridge Landfill Project	
44-A-36	44-A-19-A
44-A-13	44-A-19
44-A-14	45-2-2-A
44-A-22	45-2-2-B
45-A-7	44-A-21
37-A-69	44-A-37
44-A-20	44-A-22-A
45-A-1	45-1-40
38-A-7	45-1-41

In order to assist with obtaining a Solid Waste Permit from the Virginia Department of Environmental Quality (VDEQ), the client, CWV, LLC., has decided to conduct a threatened and endangered species assessment for the project site. The following narrative is a summary of all research that has been performed in relation to the project.

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Section II: Threatened and Endangered Species - Animals

U.S. Fish and Wildlife Services (USFWS) – Endangered Species Project Review

The USFWS Endangered Species Project Review process was followed to evaluate the potential for the occurrence of threatened and endangered species populations within the project boundaries.

Step One: The Action Area was defined for the project site. According to the USFWS, the action area includes "all areas to be affected directly or indirectly by the action and not merely the immediate area involved in the action (50 CFR 402.02)."

Step Two - Four: An Official Species List (OSL) was produced via the USFWS "Information for Planning and Consultation (iPac)" website. This report was produced on August 14, 2018 and shows a summary of all threatened and endangered species that are potentially present along with a summary of any critical habitat within the designated project area. According to the OSL, there is "a total of 1 threatened, endangered, or candidate species" within the project area. This is the Northern Long-eared Bat (*Myotis septentrionalis*) which has a threatened status underneath the Endangered Species Act (ESA). No critical habitats were identified in the OSL. A species conclusion table was compiled with the results of the project review. This table can be found in the appendix. Please see Table 1.1 for a summary of the species predicted on the OSL.

Table 1.1: Summary of Potential T & E Species via the Official Species List (OSL)

Group	Common Name	Scientific Name	ESA Status
Mammal	Northern Long-eared Bat	*Myotis septentrionalis*	Threatened

In terms of suitable habitat, the OSL report states that "no critical habitat has been designated for this species." In addition to the OSL, a search was done on the preferred habitat of the Northern Long-eared
Bat (NLEB). According to the Virginia Department of Game and Inland Fisheries (VDGIF) information page on the NLEB, the species "inhabits forested regions and will forage mainly on hillsides and ridge forests rather than riparian and floodplain forests." A large portion of the site consists of low-lying forested areas that are adjacent to wetlands, streams and creeks and there are no cave or rock outcroppings on site that might harbor NLEB hibernacula. The VDGIF maintains the "NLEB Winter Habitat and Roost Trees" interactive map which shows that there are no known hibernacula located east of Interstate 81 and therefore there is no known NLEB habitat located within Cumberland County or the project area. In summary, it is unlikely that any populations of NLEB will be put a risk through this project.

Step Five: It should be noted that the site does not lie within any of the counties that contain federally designated critical habitat.

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Step Six: The Center for Conservation Biology maintains the VA Eagle Nest Locator through the CCB Mapping Portal. According to this application, there are no known Bald Eagle nests or roosts located within the project area. The project will have no effect on this species. Please see the appendix for a copy of the VA Eagle Nest Locator generated map (Appendix B).

Step Seven: Please see the attached Species Conclusion Table (Appendix D) for all results of the Project Review.

Environmental Conservation Online System (ECOS) - USFWS

In addition to the research done through the Endangered Species Project Review and iPAC, the Environmental Conservation Online System (ECOS) was utilized to perform a county specific search for any potential threatened or endangered species. The search returned a list with a total of four potential species and includes three species of mussel, the James spinymussel (*Pleurobema collina*), the Green floater (*Lasmigona subviridis*) and the Atlantic pigtoe (*Fusconaia masoni*). The fourth and final species on the list was the Northern Long-eared Bat. Please see Table 1.2 for a summary of all potential threatened and endangered species within Cumberland County, Virginia.

Table 1.2: Summary of Potential T & E Species for Cumberland County, Virgnia

Group	Common Name	Scientific Name	ESA Status
Clams	James spinymussel	*Pleurobema collina*	Endangered
Clams	Green floater	*Lasmigona subviridis*	Under Review
Clams	Atlantic pigtoe	*Fusconaia masoni*	Proposed Threatened
Mammals	Northern Long-eared Bat	*Myotis septentrionalis*	Threatened

Having already determined that the potential for NLEB habitat on site is negligible, the three remaining mussel species take priority. As previously mentioned, the 1,177.63-acre site contains an extensive wetland system that primarily consists of two named creek systems, Muddy Creek and Maple Swamp Creek. Maple Swamp Creek flows into Muddy Creek to the northeast of the property and from there Muddy Creek flows directly into the James River, roughly 10-15 miles to the north. Due to the high prevalence of stream and creek habitats, the client has contracted Daguna Consulting, LLC to perform an onsite survey for any presence of these mussel species. This survey was conducted during the week of May 13th through the 17th of 2019. Please see Appendix F for their complete report.

For a complete list of all threatened and endangered animal species found within the state of Virginia, please see Appendix E.

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Section III: Threatened and Endangered Species - Plants

U.S. Fish and Wildlife Services (USFWS) – Endangered Species Project Review

The USFWS Endangered Species Project Review process was followed to evaluate the potential for the occurrence of threatened and endangered plant species populations within the project boundaries. The Official Species List produced during Step Two did not report the presence of any endangered or threatened plant species within the project boundary. For more information regarding the Endangered Species Project Review process, please reference Section II.

Environmental Conservation Online System (ECOS) – USFWS

The ECOS system was also utilized to perform a county specific search for any endangered or threatened plant species. The system did not return a list for plant species and therefore, it is indicated that there are no reported endangered or threatened plant species within Cumberland County. For a list of all threatened and endangered plant species found within Virginia, please reference Appendix E.

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RESOURCES

"Endangered Species: Project Reviews in Virginia." *Virginia Field Office*, U.S. Fish and Wildlife, 3 Apr. 2019, https://www.fws.gov/northeast/virginiafield/endangered/projectreviews_step1.html

"IPAC: Information for Planning and Consultation." *IPaC: Home*, U.S. Fish and Wildlife Service, https://ecos.fws.gov/ipac/.

Leon, Sarah. "Find Endangered Species." Official Web Page of the U.S. Fish and Wildlife Service, U.S. Fish and Wildlife Service, https://www.fws.gov/endangered/?s8fid=112762573903&countyName=Cumberland+County.

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Appendices

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Appendix A

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United States Department of the Interior

FISH AND WILDLIFE SERVICE
Virginia Ecological Services Field Office
6669 Short Lane
Gloucester, VA 23061-4410
Phone: (804) 693-6694 Fax: (804) 693-9032
http://www.fws.gov/northeast/virginiafield/

In Reply Refer To: May 06, 2019
Consultation Code: 05E2VA00-2018-SLI-4952
Event Code: 05E2VA00-2019-E-08954
Project Name: Cumberland County Wetland Delineation - Landfill

Subject: Updated list of threatened and endangered species that may occur in your proposed project location, and/or may be affected by your proposed project

To Whom It May Concern:

The enclosed species list identifies threatened, endangered, proposed and candidate species, as well as proposed and final designated critical habitat, that may occur within the boundary of your proposed project and/or may be affected by your proposed project. The species list fulfills the requirements of the U.S. Fish and Wildlife Service (Service) under section 7(c) of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 *et seq.*). Any activity proposed on National Wildlife Refuge lands must undergo a 'Compatibility Determination' conducted by the Refuge. Please contact the individual Refuges to discuss any questions or concerns.

New information based on updated surveys, changes in the abundance and distribution of species, changed habitat conditions, or other factors could change this list. Please feel free to contact us if you need more current information or assistance regarding the potential impacts to federally proposed, listed, and candidate species and federally designated and proposed critical habitat. Please note that under 50 CFR 402.12(e) of the regulations implementing section 7 of the Act, the accuracy of this species list should be verified after 90 days. This verification can be completed formally or informally as desired. The Service recommends that verification be completed by visiting the ECOS-IPaC website at regular intervals during project planning and implementation for updates to species lists and information. An updated list may be requested through the ECOS-IPaC system by completing the same process used to receive the enclosed list.

The purpose of the Act is to provide a means whereby threatened and endangered species and the ecosystems upon which they depend may be conserved. Under sections 7(a)(1) and 7(a)(2) of the Act and its implementing regulations (50 CFR 402 *et seq.*), Federal agencies are required to utilize their authorities to carry out programs for the conservation of threatened and endangered

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species and to determine whether projects may affect threatened and endangered species and/or designated critical habitat.

A Biological Assessment is required for construction projects (or other undertakings having similar physical impacts) that are major Federal actions significantly affecting the quality of the human environment as defined in the National Environmental Policy Act (42 U.S.C. 4332(2)(c)). For projects other than major construction activities, the Service suggests that a biological evaluation similar to a Biological Assessment be prepared to determine whether the project may affect listed or proposed species and/or designated or proposed critical habitat. Recommended contents of a Biological Assessment are described at 50 CFR 402.12.

If a Federal agency determines, based on the Biological Assessment or biological evaluation, that listed species and/or designated critical habitat may be affected by the proposed project, the agency is required to consult with the Service pursuant to 50 CFR 402. In addition, the Service recommends that candidate species, proposed species and proposed critical habitat be addressed within the consultation. More information on the regulations and procedures for section 7 consultation, including the role of permit or license applicants, can be found in the "Endangered Species Consultation Handbook" at:

http://www.fws.gov/endangered/esa-library/pdf/TOC-GLOS.PDF

Please be aware that bald and golden eagles are protected under the Bald and Golden Eagle Protection Act (16 U.S.C. 668 *et seq.*), and projects affecting these species may require development of an eagle conservation plan (http://www.fws.gov/windenergy/eagle_guidance.html). Additionally, wind energy projects should follow the wind energy guidelines (http://www.fws.gov/windenergy/) for minimizing impacts to migratory birds and bats.

Guidance for minimizing impacts to migratory birds for projects including communications towers (e.g., cellular, digital television, radio, and emergency broadcast) can be found at: http://www.fws.gov/migratorybirds/CurrentBirdIssues/Hazards/towers/towers.htm; http://www.towerkill.com; and http://www.fws.gov/migratorybirds/CurrentBirdIssues/Hazards/towers/comtow.html.

We appreciate your concern for threatened and endangered species. The Service encourages Federal agencies to include conservation of threatened and endangered species into their project planning to further the purposes of the Act. Please include the Consultation Tracking Number in the header of this letter with any request for consultation or correspondence about your project that you submit to our office.

Attachment(s):

- Official Species List
- USFWS National Wildlife Refuges and Fish Hatcheries

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Official Species List

This list is provided pursuant to Section 7 of the Endangered Species Act, and fulfills the requirement for Federal agencies to "request of the Secretary of the Interior information whether any species which is listed or proposed to be listed may be present in the area of a proposed action".

This species list is provided by:

Virginia Ecological Services Field Office
6669 Short Lane
Gloucester, VA 23061-4410
(804) 693-6694

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Project Summary

Consultation Code: 05E2VA00-2018-SLI-4952

Event Code: 05E2VA00-2019-E-08954

Project Name: Cumberland County Wetland Delineation - Landfill

Project Type: DEVELOPMENT

Project Description: Cumberland County Potential Landfill - Wetland delineation

Project Location:
Approximate location of the project can be viewed in Google Maps: https://www.google.com/maps/place/37.563559517272864N78.12966063086748W

Counties: Cumberland, VA

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Endangered Species Act Species

There is a total of 1 threatened, endangered, or candidate species on this species list.

Species on this list should be considered in an effects analysis for your project and could include species that exist in another geographic area. For example, certain fish may appear on the species list because a project could affect downstream species.

IPaC does not display listed species or critical habitats under the sole jurisdiction of NOAA Fisheries[1], as USFWS does not have the authority to speak on behalf of NOAA and the Department of Commerce.

See the "Critical habitats" section below for those critical habitats that lie wholly or partially within your project area under this office's jurisdiction. Please contact the designated FWS office if you have questions.

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1. NOAA Fisheries, also known as the National Marine Fisheries Service (NMFS), is an office of the National Oceanic and Atmospheric Administration within the Department of Commerce.

Mammals

NAME	STATUS
Northern Long-eared Bat *Myotis septentrionalis* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/9045	Threatened

Critical habitats

THERE ARE NO CRITICAL HABITATS WITHIN YOUR PROJECT AREA UNDER THIS OFFICE'S JURISDICTION.

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USFWS National Wildlife Refuge Lands And Fish Hatcheries

Any activity proposed on lands managed by the National Wildlife Refuge system must undergo a 'Compatibility Determination' conducted by the Refuge. Please contact the individual Refuges to discuss any questions or concerns.

THERE ARE NO REFUGE LANDS OR FISH HATCHERIES WITHIN YOUR PROJECT AREA.

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Appendix B

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Appendix B

CCB Mapping Portal

Layers: VA Eagle Nest Locator

Map Center [longitude, latitude]: [-78.10601234436035, 37.56318759963322]

Map Link:
https://ccbbirds.org/maps/#layer=VA+Eagle+Nest+Locator&zoom=14&lat=37.56318759963322&lng=-78.10601234436035&legend=legend_tab_7c321b7e-e523-11e4-aaa0-0e0c41326911&base=Street+Map+%28OSM%29

Report Generated On: 04/12/2019

The Center for Conservation Biology (CCB) provides certain data online as a free service to the public and the regulatory sector. CCB encourages the use of its data sets in wildlife conservation and management applications. These data are protected by intellectual property laws. All users are reminded to view the Data Use Agreement to ensure compliance with our data use policies. For additional data access questions, view our Data Distribution Policy, or contact our Data Manager, Marie Pitts, at mlpitts@wm.edu or 757-221-7503.

Report generated by The Center for Conservation Biology Mapping Portal.

To learn more about CCB visit ccbbirds.org or contact us at info@ccbbirds.org

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Appendix C

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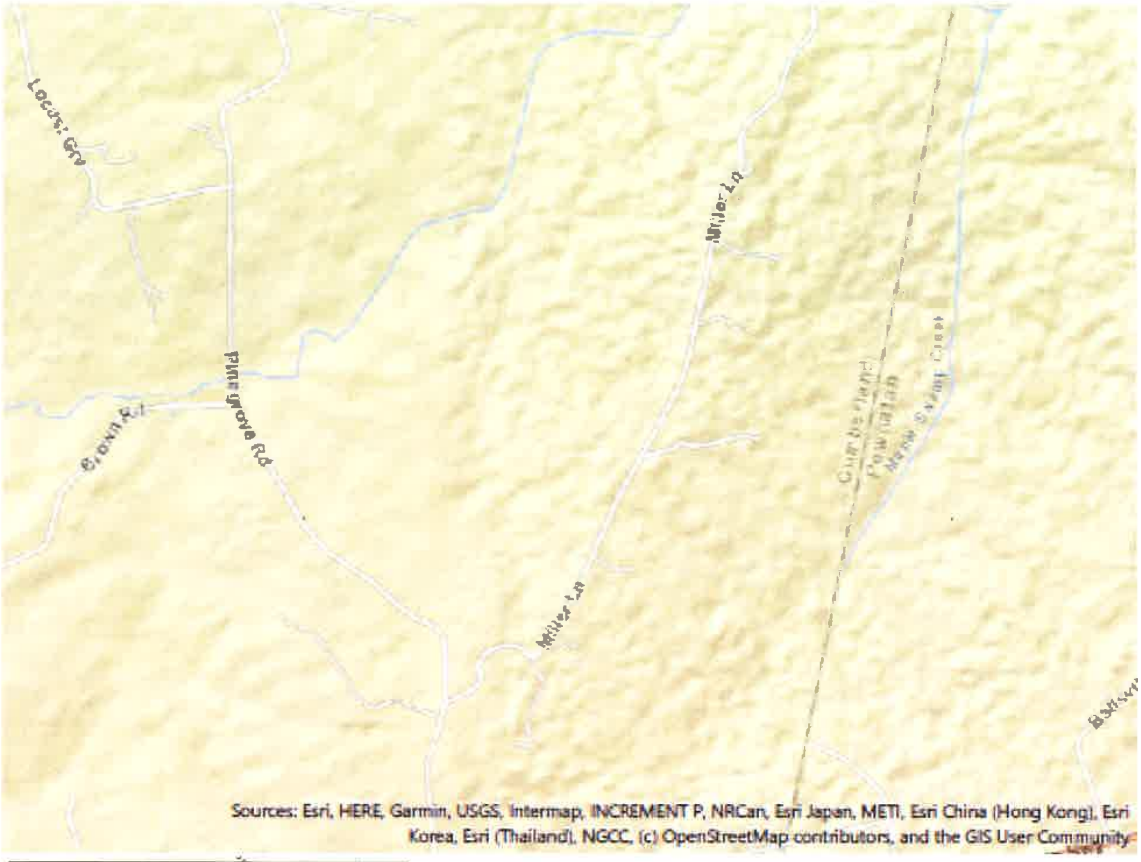
Appendix C: NLEB Hibernaculum and Roost Tree Map

Obtained from: https://dgif-virginia.maps.arcgis.com/apps/webappviewer/index.html?id=32ea4ee4935942c092e41ddcd19e5ec5

May 6, 2019



Legend

NLEB Known Occupied Maternity Roost (Summer Habitat)

NLEB Hibernaculum 5.5 Mile Buffer

NLEB Hibernaculum Half Mile Buffer

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Appendix D

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Appendix D: Species Conclusions Table

Project Name: Green Ridge Landfill – Cumberland County, Virginia

Date: May 6, 2019

Species / Resource Name	Conclusion	ESA Section 7	Notes / Documentation
Bald Eagle (*Haliaeetus leucocephalus*)	No suitable habitat present	Not likely to adversely affect	-Please see Threatened and Endangered Species Summary -No active nests are present on the CCB Mapping Portal
Northern Long Eared Bat (*Myotis septentrionalis*)	No suitable habitat present	No effect	-Please see Steps Two – Four in the Threatened and Endangered Species Summary
Critical habitat	No critical habitat present	N/A	-Project does not occur in any of the designated counties

*Please note that this table includes only the species produced on the Official Species List generated by the Information, Planning and Consultation System (iPac), which is maintained by the U.S. Fish and Wildlife Service.

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Appendix E

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Listed species -- 74 listings

Animals -- 57 listings

Status	Species/Listing Name
E	Bat, gray Wherever found (*Myotis grisescens*)
E	Bat, Indiana Wherever found (*Myotis sodalis*)
T	Bat, Northern long-eared Wherever found (*Myotis septentrionalis*)
E	Bat, Virginia big-eared Wherever found (*Corynorhinus (=Plecotus) townsendii virginianus*)
E	Bean, Cumberland (pearlymussel) Wherever found; Except where listed as Experimental Populations (*Villosa trabalis*)
E	Bean, purple Wherever found (*Villosa perpurpurea*)
E	Bean, rayed Wherever found (*Villosa fabalis*)
E	Blossom, green (pearlymussel) Wherever found (*Epioblasma torulosa gubernaculum*)
E	Bumble bee, Rusty patched Wherever found (*Bombus affinis*)
E	Butterfly, Mitchell's satyr Wherever found (*Neonympha mitchellii mitchellii*)
T	Chub, slender Wherever found (*Erimystax cahni*)
T	Chub, spotfin Wherever found, except where listed as an experimental population (*Erimonax monachus*)
E	Combshell, Cumberlandian Wherever found; Except where listed as Experimental Populations (*Epioblasma brevidens*)
T	Crayfish, Big Sandy Wherever found (*Cambarus callainus*)
T	Dace, blackside Wherever found (*Phoxinus cumberlandensis*)
E	Darter, candy Wherever found (*Etheostoma osburni*)
E	Darter, duskytail Wherever found (*Etheostoma percnurum*)
E	Fanshell Wherever found (*Cyprogenia stegaria*)

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Status	Species/Listing Name
E	Isopod, Lee County cave Wherever found (*Lirceus usdagalun*)
T	Isopod, Madison Cave Wherever found (*Antrolana lira*)
E	Kidneyshell, fluted Wherever found (*Ptychobranchus subtentum*)
T	Knot, red Wherever found (*Calidris canutus rufa*)
T	Lance, yellow Wherever found (*Elliptio lanceolata*)
E	Logperch, Roanoke Wherever found (*Percina rex*)
T	Madtom, yellowfin Wherever found, except where listed as an experimental population (*Noturus flavipinnis*)
E	Monkeyface, Appalachian (pearlymussel) Wherever found (*Quadrula sparsa*)
E	Monkeyface, Cumberland (pearlymussel) Wherever found; Except where listed as Experimental Populations (*Quadrula intermedia*)
E	Mucket, pink (pearlymussel) Wherever found (*Lampsilis abrupta*)
E	Mussel, oyster Wherever found; Except where listed as Experimental Populations (*Epioblasma capsaeformis*)
E	Mussel, sheepnose Wherever found (*Plethobasus cyphyus*)
E	Mussel, snuffbox Wherever found (*Epioblasma triquetra*)
E	Pearlymussel, birdwing Wherever found; Except where listed as Experimental Populations (*Lemiox rimosus*)
E	Pearlymussel, cracking Wherever found; Except where listed as Experimental Populations (*Hemistena lata*)
E	Pearlymussel, dromedary Wherever found; Except where listed as Experimental Populations (*Dromus dromas*)
E	Pearlymussel, littlewing Wherever found (*Pegias fabula*)
E	Pearlymussel, slabside Wherever found (*Pleuronaia dolabelloides*)
E	Pigtoe, finerayed Wherever found; Except where listed as Experimental Populations (*Fusconaia cuneolus*)
E	Pigtoe, rough Wherever found (*Pleurobema plenum*)

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Status	Species/Listing Name
E	Pigtoe, shiny Wherever found; Except where listed as Experimental Populations (*Fusconaia cor*)
T	Plover, piping [Atlantic Coast and Northern Great Plains populations] - Wherever found, except those areas where listed as endangered. (*Charadrius melodus*)
E	Rabbitsfoot, rough Wherever found (*Quadrula cylindrica strigillata*)
E	Riffleshell, tan Wherever found (*Epioblasma florentina walkeri (=E. walkeri)*)
E	Salamander, Shenandoah Wherever found (*Plethodon shenandoah*)
T	Sea turtle, green North Atlantic DPS (*Chelonia mydas*)
E	Sea turtle, hawksbill Wherever found (*Eretmochelys imbricata*)
E	Sea turtle, Kemp's ridley Wherever found (*Lepidochelys kempii*)
E	Sea turtle, leatherback Wherever found (*Dermochelys coriacea*)
T	Sea turtle, loggerhead Northwest Atlantic Ocean DPS (*Caretta caretta*)
E	Snail, Virginia fringed mountain Wherever found (*Polygyriscus virginianus*)
E	Spectaclecase (mussel) Wherever found (*Cumberlandia monodonta*)
E	Spider, spruce-fir moss Wherever found (*Microhexura montivaga*)
E	Spinymussel, James Wherever found (*Pleurobema collina*)
E	Squirrel, Carolina northern flying Wherever found (*Glaucomys sabrinus coloratus*)
E	Tern, roseate Northeast U.S. nesting population (*Sterna dougallii dougallii*)
T	Tiger beetle, Northeastern beach Wherever found (*Cicindela dorsalis dorsalis*)
E	Wedgemussel, dwarf Wherever found (*Alasmidonta heterodon*)
E	Woodpecker, red-cockaded Wherever found (*Picoides borealis*)

Plants -- 17 listings

Status	Species/Listing Name
T	Amaranth, seabeach (*Amaranthus pumilus*)

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Status	Species/Listing Name
T	Birch, Virginia round-leaf (*Betula uber*)
E	Bittercress, small-anthered (*Cardamine micranthera*)
E	Bluet, Roan Mountain (*Hedyotis purpurea var. montana*)
E	Bulrush, Northeastern (*Scirpus ancistrochaetus*)
E	Coneflower, smooth (*Echinacea laevigata*)
E	Harperella (*Ptilimnium nodosum*)
T	Joint-vetch, Sensitive (*Aeschynomene virginica*)
E	Lichen, rock gnome (*Gymnoderma lineare*)
E	Mallow, Peter's Mountain (*Iliamna corei*)
T	Orchid, eastern prairie fringed (*Platanthera leucophaea*)
T	Pink, swamp (*Helonias bullata*)
T	Pogonia, small whorled (*Isotria medeoloides*)
E	rock cress, Shale barren (*Arabis serotina*)
T	Sneezeweed, Virginia (*Helenium virginicum*)
T	Spiraea, Virginia (*Spiraea virginiana*)
E	Sumac, Michaux's (*Rhus michauxii*)

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Appendix F

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REVISED FINAL REPORT

Surveys for Protected Freshwater Mussels at the Proposed Green Ridge Recycling and Disposal Facility in Cumberland County, VA

by

Brett J. K. Ostby and B. B. Beaty
Daguna Consulting, LLC
7509 Pin Oak Circle
Bristol, VA 24202

for

Koontz, Bryant, Johnson, Williams Group
11901 Old Stage Road
Chester, VA

May 29th, 2019
Revised August 15th, 2019
Final Revision December 5th, 2019

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INTRODUCTION

The proposed Green Ridge Recycling and Disposal Facility is planned for rural Cumberland County, Virginia. Preliminary review of the property indicated that streams potentially containing freshwater mussels may be present. Therefore, the project developer requested a survey for the imperiled freshwater mussels to better understand any potential impact. Nearby perennial streams include Muddy Creek and Maple Swamp Creek. These perennial streams border and, in some places, flow through the Green Ridge property (Figure 1). Many unnamed tributaries to these streams drain the property.

The James River Basin is inhabited by the federally endangered James Spinymussel (*Pleurobema collina*), the state-threatened Green Floater (*Lasmigona subviridis*), and the state-threatened Atlantic Pigtoe (*Fusconaia masoni*). The state-listed Green Floater is known from the James River upstream and downstream of the Muddy Creek confluence (The Catena Group 2010, Chazal et al. 2012). Relic shell material of the Atlantic Pigtoe was recently detected in the Powhatan County reach of the James River by Chazal et al. (2012). The James Spinymussel is known from nearby Rock Island Creek (~ 40 km to the northwest, Chazal et al. 2012). Ostby (2007) detected a significant population of a common mussel species (Eastern Elliptio, *Elliptio complanata*) in a small unnamed stream in Powhatan County (~20 km to the east). That small unnamed stream was comparable to the perennial streams on the Green Ridge site. Chazal et al. (2012) conducted 2 surveys of Davis Creek, a tributary to Muddy Creek entering downstream of the Green Ridge site. They identified suitable habitat but detected no native mussels in those surveys.

On May 25 and 26, 2019, biologists Brett Ostby and Braven Beaty of Daguna Consulting, LLC visited the Green Ridge property to assess potential mussel habitat in streams and conduct surveys for freshwater mussels where necessary. Surveys were conducted to meet the requirements of "Abbreviated Surveys" as defined in "Freshwater Mussel Guidelines for Virginia (USFWS and VDGIF 2013)". Most efforts focused on Muddy Creek and Maple Swamp Creek.

METHODS

Stream Assessment

We either visited streams by hiking through the site or assessed streams as they entered either Muddy Creek or Maple Swamp Creek. Assessments determined whether sufficient flow and suitable substrate were present to support freshwater mussels. We also assessed overall stream conditions. In some streams with sufficient flow, we searched for mussels.

Stream Surveys

The perennial streams (Muddy Creek and Maple Swamp Creek) were surveyed for mussels to qualitatively assess species composition, abundance, and the possible presence of protected species. In accordance with the published Virginia freshwater mussel survey guidelines, we searched reaches of stream extending from 400 downstream to 100 m upstream of proposed impacts. Because most habitats were shallow (<0.5 m), we used viewscopes and unaided visual

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inspection. In some areas tactile searches were employed. All stream reaches were surveyed unless the habitat was deemed "unsuitable" for mussels based on the site visit. The "unsuitability" of any stream reach(es) as habitat for mussels was fully documented. We searched stream banks and exposed shoals for mussel shells to obtain a complete list of species at the site. Surveys were conducted when water level and clarity were suitable to locate shells and live individuals with ease. Sufficient effort was expended to visually inspect a sufficient amount of suitable habitat so that we could state with reasonable confidence that endangered and/or threatened species did or did not occur in the reach sampled. Representative specimens of each species detected were photographed. Geographical Information System (GIS) programs were used to georeference survey boundaries, location of protected species, and location of other pertinent features.

RESULTS

Weather and Stream Conditions

Skies were clear on both May 25th and May 26th. Air temperature reached a high of 29 ºC (85 ºF) on May 25th and 32 ºC (90 ºF) on May 26th. Flows were assumed to be near median in Muddy Creek and Maple Swamp Creek based on information from nearby gages, including USGS 02036500 on Fine Creek at Fine Creek Mills, VA and USGS 02039500 on the Appomattox River at Farmville, VA. Little to no rain had fallen in the area over the preceding week. Water clarity in Muddy Creek was limited due to tannins and turbidity from an unknown source. In general, the streambed was clearly visibly in laminar flows less than 0.4 m depth. Water temperature in Muddy Creek was 22 ºC (76 ºF) when surveyed on May 25th. Maple Swamp Creek had no evidence of tannins and was considerably clearer, with all streambed habitats visible from the water surface in laminar flow. Water in Maple Swamp Creek was 18ºC (64 ºF) during the May 26th survey.

Muddy Creek Habitat and Species Observations

We surveyed Muddy Creek from the abandoned Miller Lane bridge (37.584320, -78.106711) to upstream of the Pine Grove culvert crossing (37.567270, -78.138347), with the exception of a 100 m reach directly downstream of the Pine Grove crossing (Figure 2). The total surveyed reach was approximately 3,800 m. Muddy Creek flowed through a corridor of mature bottomland forests, with extensive marshes in the 1000 m reach upstream of the abandoned bridge (Figure 3). Its average bankfull width was 7 m with wetted width usually 5-6 m. Bankfull height was 1 to 1.5 m throughout, with sand banks forming a natural dike between the channel and marsh areas. In forested areas, banks were steep but stable and usually vegetated (Figure 4).

Instream habitat in Muddy Creek was 95% run habitat with a sand streambed (see Figure3). The sand streambed ranged from firm to soft. All instream habitat structure in the lower 3,400 m of the surveyed reach was formed by large woody debris. Approximately 5% of the habitat was pool. Exposed bedrock, boulders, cobble and gravel were only observed starting 300 m downstream of the Pine Grove crossing. From 400 m downstream to 200 m upstream of the Pine Grove crossing, a few riffles were noted (Figure 5). Overall the streambed was 99% sand, with

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some patches being unstable and soft. Maximum water depth was 1.25 m with most habitats less than 0.4 m deep.

In a 9 person-hour effort, we detected 12 live Eastern Ellipito (*E. complanata*), 5 live Northern Lance (*E. fisheriana*) and 1 live Eastern Floater (*Pyganodon cataracta*) in the main channel of Muddy Creek. Figures 6-8 are photographs of example specimens. We detected live mussels only from the start point to approximately 1000 m upstream. We observed recent shell material on exposed banks nearer the Pine Grove crossing, but no live specimens were detected in the vicinity. Non-native Asian Clams (*Corbicula fluminea*) were present throughout the stream but not common. There was little habitat for aquatic insects except near the Pine Grove crossing where we observed a few mayfly larvae under cobbles. We also observed some water scorpions (*Ranatra*) in large woody debris closer to the survey start point. We observed cyprinids, mostly dace, and centrarchids. Several centrarchid nests were noted near the survey start point. Three frog species were abundant in Muddy Creek and its associated wetlands including Green Frogs, Cricket Frogs and Leopard Frogs. Tadpole of American Toads and calls of Grey Treefrogs were also noted.

We noted several tributaries entering Muddy Creek (marked as Trib 1-3 and 5-6 in Figure 2 and geo-referenced as Trib 1-6 in Table 1) but none appeared suitable for freshwater mussels, being either too small or unstable (Figures 9-14, see Table 1 for locations). We extensively searched a tributary flowing from the south which eventually dissipated into a marsh but found no evidence of mussels (Trib 1, see Figures 9 and 10). The largest tributary flowing through the Green Ridge property into Muddy Creek from the northwest had a significantly incised channel clogged by sand with little flow (Trib 3, 37.5744, -78.12536, see Figure 12). Upstream of the Pine Grove Road crossing, we assessed and surveyed an unnamed tributary draining from the south. This stream showed evidence of recent catastrophic disturbance, with a newly incised channel cut into clay banks (Figure 14). There was also a copious amount of gravel, likely originating from Brown Road, in the stream bed (see Figure 5). Further survey of this stream was not warranted. Other tributaries flowing off the Green Ridge site into the surveyed reach of Muddy Creek as marked on the topographic map by dotted blue lines (see Figure 2) were not detected during the survey of Muddy Creek because they were likely dry on May 25th.

Maple Swamp Creek Habitat and Species Observations

At the survey start point (37.55975, 78.10566), Maple Swamp Creek flowed along a marsh on its left ascending side and a mature forest on the other (Figure 15 and 16). This reach had low banks (<0.5 m). It was exclusively run habitat with a sand stream bed. Some patches of sand were extremely soft. Large woody debris was common. Bankfull width was 3-4 m and mostly wetted. Water depth was usually less than 0.3 m.

Moving from downstream to upstream the character of Maple Swamp Creek gradually changed. Further upstream, this stream flowed through a mature forested corridor with higher banks. Upstream of the unnamed tributary labeled Trib 7, riffles and larger streambed particles became more common. For approximately the upstream 600 m of the surveyed reach, bankfull height was usually 1 to 1.5 m, reaching a maximum of 2 m. For the upstream 600 m of the surveyed

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reach habitat was 75% run, 10% riffle and 5% pool (Figure 17). While most of the streambed remained sand (75%), boulder, cobble and gravel were more common. Some habitats had an exposed bedrock streambed.

In a 5 person-hour effort, we surveyed an approximately 1,800 m reach, detecting no evidence of native mussels. No Asian Clams (*C. fluminea*) were detected either. Fish were more common in Maple Swamp Creek than in Muddy Creek, with dace, central stone rollers, and darters observed. Aquatic insects were more frequently encountered in Maple Swamp Creek than in Muddy Creek, including mayfly larvae, whirligig beetles, caddis fly larvae and water pennies. Several frog species were abundant in Maple Swamp Creek and its associated wetlands including Green Frogs, Cricket Frogs and Leopard Frogs. Calls of Grey Treefrogs were also noted.

Two apparently perennial tributaries (Trib 7 and 8 on Figure 15) were assessed. No evidence of mussels was detected though suitable habitat and habitat complexity were noted near Maple Swamp Creek in both cases (Figures 18 and 19).

CONCLUSION

Muddy Creek supports a low-density mussel assemblage comprised of three common species. We found no evidence to suggest additional species inhabited the surveyed reach. None of the Muddy Creek tributaries draining the Green Ridge property appeared to provide suitable habitat for native mussels. We found no evidence to suggest Maple Swamp Creek or its tributaries were inhabited by native mussels. Disturbances to any stream flowing off the Green Ridge property might impact native mussels living downstream in Muddy Creek. Maple Swamp Creek is also a tributary to Muddy Creek.

Adequate habitat area was searched to detect extremely low-density populations of protected species. Using a sampling equation from Smith (2006), we calculated post hoc detection probabilities based on total area searched and assumed detection of an individual mussel when present (or search efficacy, Table 2). We surveyed at least 19,000 m^2 of habitat in Muddy Creek and 5,400 m^2 in Maple Swamp Creek. Generally, detection of an individual mussel is 0.2 on a scale from 0 to 1, where “0” means an individual was present but not detected and “1” means an individual was detected. An individual detection rate of 0.1 was more appropriate for Muddy Creek due to tannins and turbidity, whereas 0.2 was appropriate for Maple Swamp Creek. We had an extremely high probability (>0.99) to detect mussels present at 0.01 m^{-2} in both Maple Swamp Creek and Muddy Creek.

Densities in Muddy Creek were so low that it would require large areas be surveyed to detect existing populations, so it should be no surprise that Department of Conservation and Recreation, Division of Natural Heritage surveys conducted by Chazal et al (2012) failed to detect mussels in the Muddy Creek drainage.

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Smith, D. R. 2006. Survey design for detecting rare freshwater mussels. Journal of the North American Benthological Society 25(3): 701-711.

The Catena Group. 2010. Freshwater Mussel Survey Report for Proposed Water Intake, James River, Powhatan Co, VA. Report for Malcom Pirnie, Inc. Newport News, VA. 15 pp.

U. S. Fish and Wildlife Service and Virginia Department of Game and Inland Fisheries. 2013. Freshwater Mussel Guidelines for Virginia. Gloucester, VA. 9 pp.

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Table 1. Latitude and longitude markers (WGS84) for mussel surveys and assessments.

Label	Lattitude	Longitude	Figure
Assessment Trib 1 upstream	37.57729	-78.11288	
Assessment Trib 1 and photo	37.57812	-78.11368	9
Assessment Trib 1 downstream and photo	37.58120	-78.11529	10
Muddy Creek survey start	37.58423	-78.10672	
Assessment Trib 2 and photo	37.57520	-78.12201	11
Assessment Trib 3 and photo	37.57440	-78.12536	12
Larger substrate and exposed bed upstream	37.57089	-78.12895	
Assessement Trib 4 and first riffle	37.57006	-78.12954	
Shells on exposed bar	37.56992	-78.13188	
Assessment Trib 5 and photo	37.56804	-78.13322	13
Road gravel noted in streambed	37.56740	-78.13779	5
Upstream Assessement Trib 6 and photo	37.56806	-78.13294	14
Muddy Creek survey end	37.56729	78.13835	
Upstream Assessement Trib 7	37.55895	-78.11561	
Assessment Trib 7 and photo	37.55569	-78.11260	17
Maple Swamp Creek survey start	37.55971	-78.10574	15
Assessement Trib 8 and photo	37.55217	-78.11458	18
Upstream Assessement Trib 8	37.55216	-78.11551	
Maple Swamp Creek survey end	37.54780	-78.11513	

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Table 2. Probability of detecting a species (p) using Smith (2006) equation, $p = 1 - e^{-\beta\alpha\mu}$, given search efficacy (β), actual area covered in a survey (α), and a theoretical density (μ). We also present a theoretical population size for a survey reach for a given density (0.01 or 0.005 individuals per meter square). For example, if we were only able to detect 1 in 10 *L. subviridis* present in Muddy Creek and there were only 94 in the entire surveyed reach, we had a 0.9913 probably to detect at least a single individual.

	p	**β**	**α**	**μ**	
Stream	Probability of populuation detection	Probability of Individual Detection	Area Visually Searched	Poulation Density	Population Size in Survey Reach
Muddy Creek	0.9999	0.05	19000	0.01	190
	1.0000	0.1	19000	0.01	190
	0.9913	0.05	19000	0.005	95
	0.9999	0.1	19000	0.005	95
Maple Swamp Creek	1.0000	0.2	5400	0.01	54
	0.9955	0.1	5400	0.01	54
	0.9328	0.05	5400	0.01	54
	0.9955	0.2	5400	0.005	27
	0.9328	0.1	5400	0.005	27
	0.7408	0.05	5400	0.005	27

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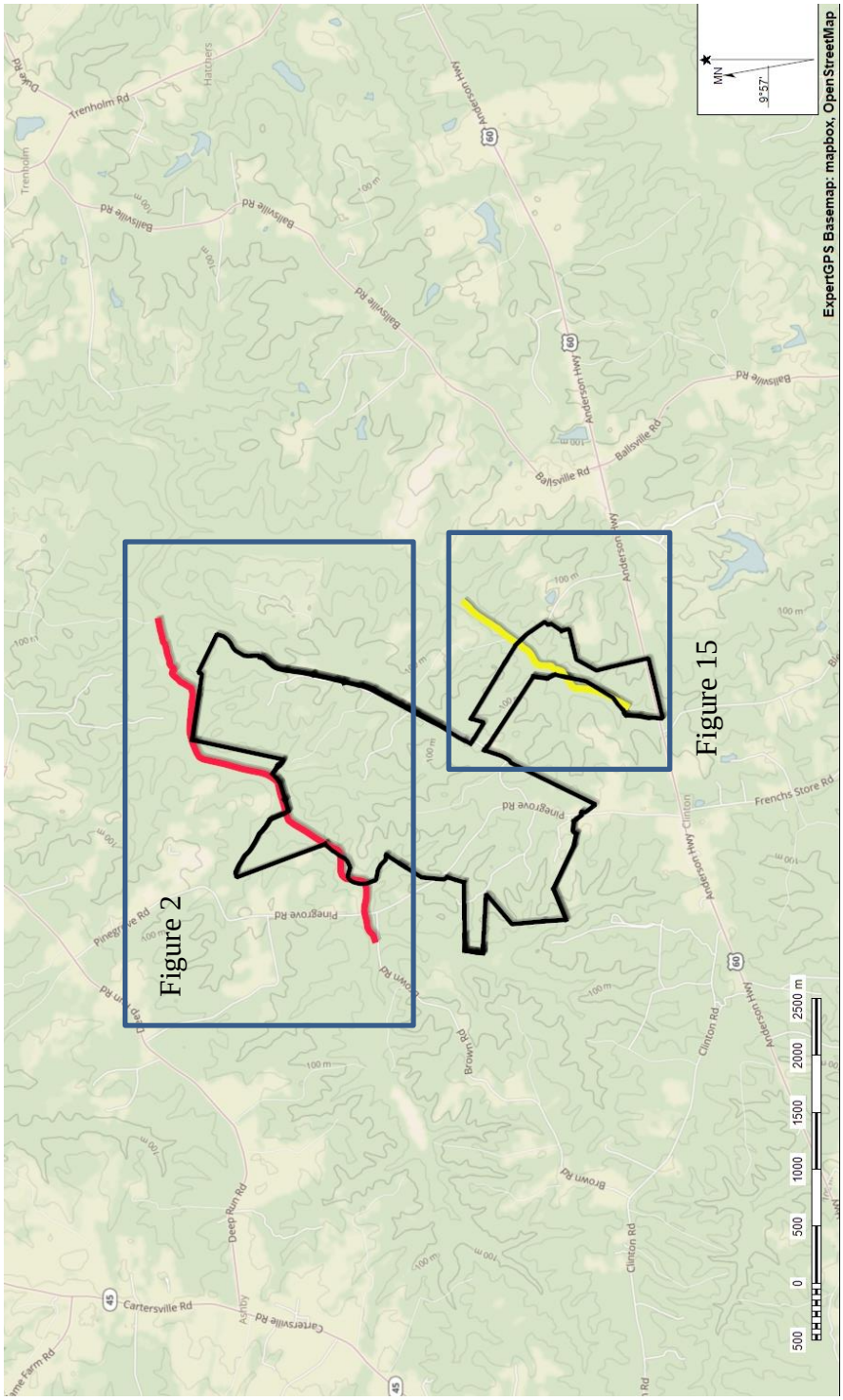

Figure 1. Area road map illustrating the reaches of Muddy Creek (red) and Maple Swamp Creek (yellow) that were surveyed for freshwater mussels. Property boundaries are marked in black.

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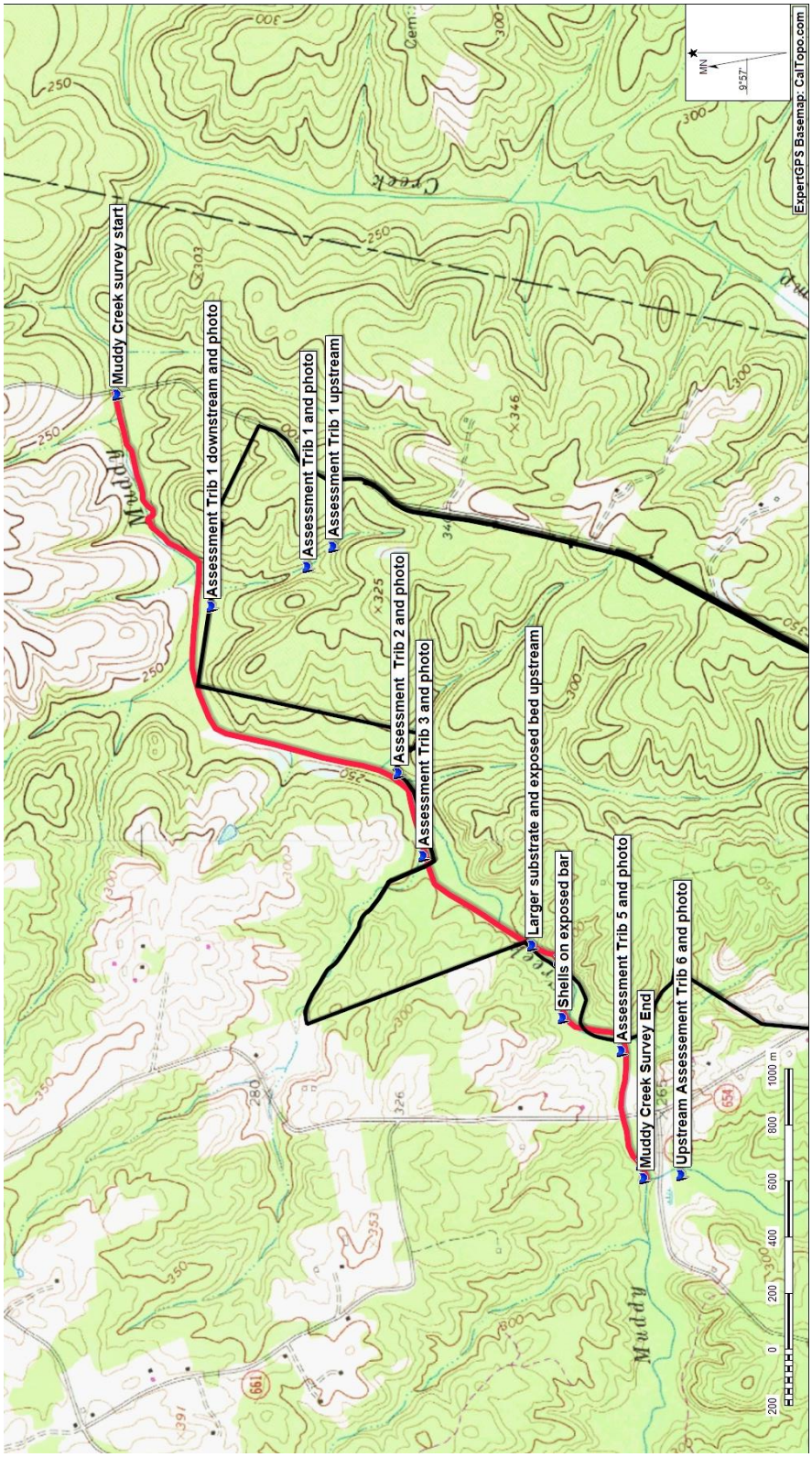

Figure 2. Topographic map illustrating survey reach of Muddy Creek (red) and its tributaries that were assessed. Property boundaries are marked in black. Tributary 4 was not marked here due to label overlap. All assessment are geo-referenced in Table 1.

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Figure 3. Marsh bordering Muddy Creek near the survey start point. The most extensive marsh was present along the right ascending side.

Figure 4. Typical run habitat in Muddy Creek flowing through the forested corridor.

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Figure 5. Muddy Creek upstream of Pine Grove crossing with gravel bar. Bar material appears to have originated from a gravel road and did not resemble stream bed material observed elsewhere in Muddy Creek or its tributaries.

Figure 6. The Eastern Elliptio (*E. complanata*) was the most frequently encountered species. Most were greater than 90 mm, with ages approximately 10 years or greater.

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Figure 7. Northern Lance (*E. fisheriana*) were found in clay banks. Shell material of specimens as young as 3 years old were detected just downstream of the Pine Grove stream crossing on exposed bars.

Figure 8. We observed only a single specimen of Eastern Floater (*P. cataracta*) in Muddy Creek. It was 4 years old.

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Figure 9. Stream feeding Muddy Creek from the south (Trib 1) was deeply incised in some locations. It was likely too small to support native mussels but did harbor dace.

Figure 10. Forested marsh near the Muddy Creek channel where the unnamed tributary channel (Trib 1) pictured in Figure 9 dissipated.

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Figure 11. A beaver dam blocked this small tributary draining the Green Ridge site from the south (37.57520, -78.12201). This stream was too small to support freshwater mussels, so no further survey was warranted.

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Figure 12. Unnamed tributary feeding Muddy Creek from the northwest had little flow and contributed large amounts of sand to the stream (37.5744, -78.12536). This stream drains the Green Ridge site and was not surveyed. Flow was only a few mm deep and filled less than half the channel, suggesting it may be ephemeral.

Figure 13. We followed this unnamed tributary as we exited Muddy Creek and made several checks (37.56804, -78.13322). Like other feeding tributaries it was too small to support mussels.

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Figure 14. A recently incised channel within an older channel upstream of the new Brown Road crossing. This stream recently suffered a catastrophic event forming a new and deeper channel.

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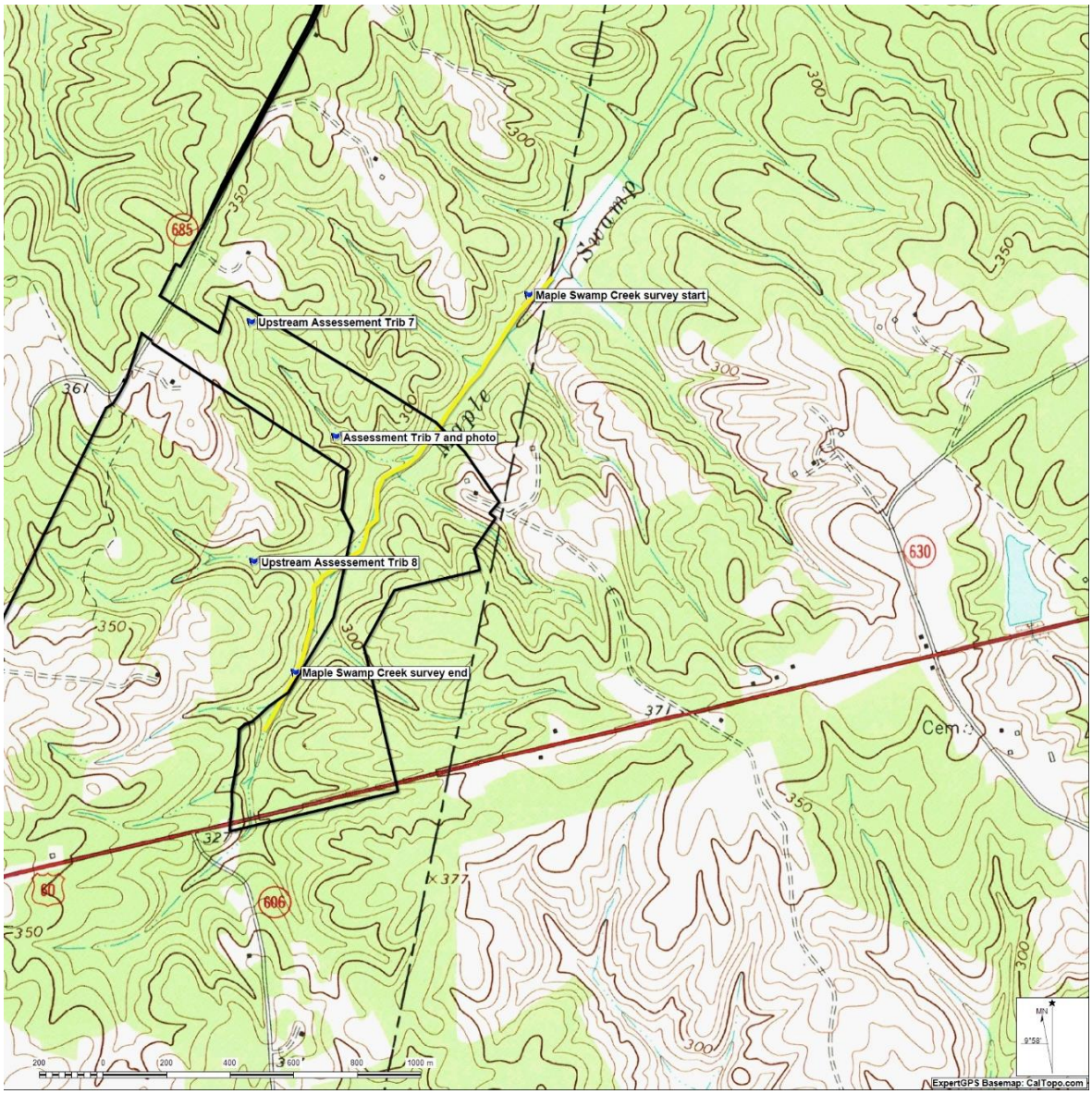

Figure 15. Topographic map illustrating survey reach of Maple Swamp Creek (yellow) and its tributaries that were assessed. Property boundaries are marked in black.

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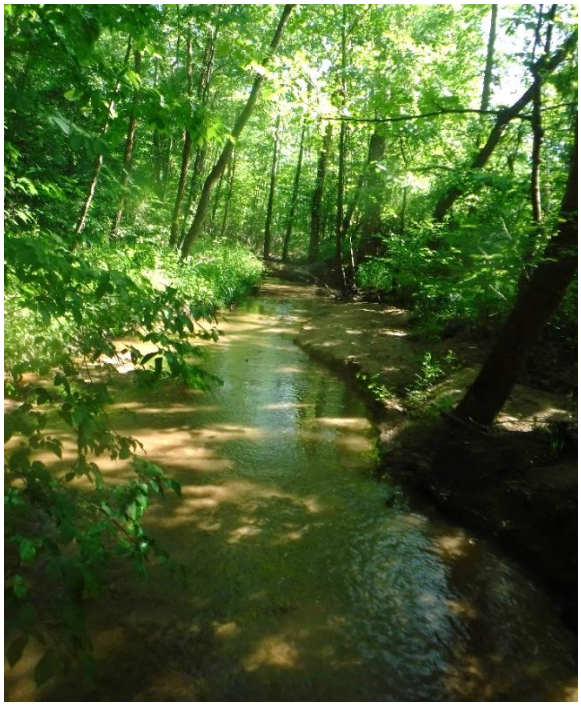

Figure 16. Run habitat with a sand streambed in Maple Swamp Creek near survey start.

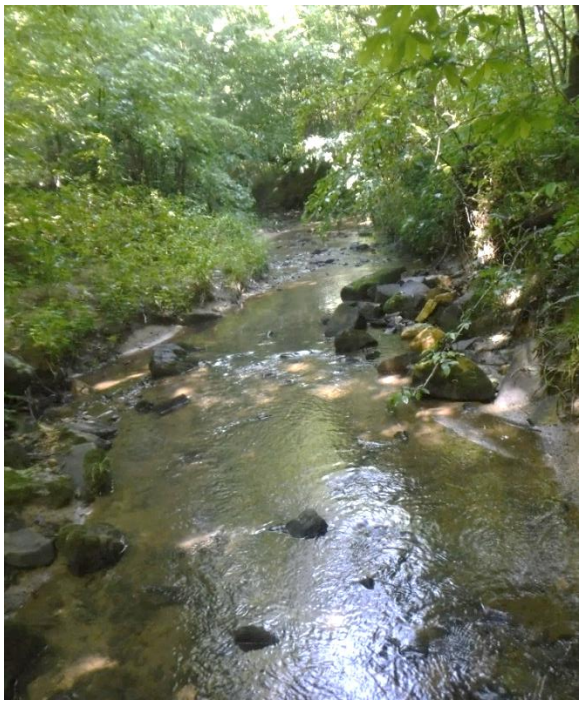

Figure 17. More complex meandering instream habitat farther upstream in Maple Swamp Creek. Boulders and cobble in the streambed here were absent downstream. We observed more fish, including darters in this habitat.

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Figure 18. While hiking in from Miller Road, we searched approximately 200 m of a tributary feeding Maple Swamp Creek, finding suitable habitat but failing to detect any evidence of mussels (37.55569, -78.11260).

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Figure 19. We searched an approximately 200 m reach of a small tributary feeding Maple Swamp Creek from its mouth upstream finding no evidence of mussels (37.5521, -78.11458).

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7509 Pin Oak Circle Bristol, VA 24202 Contact: 276-608-6508 or 540-230-1042
DagunaConsulting@gmail.com

Survey Record #1

Site #: DAGUNA05252019.1

Stream: Muddy Creek

County: Cumberland

Description: Surveyed 3,800 m reach of main channel and assessed several feeding tributaries

Drainage: James

USGS Quadrangle Map: Whiteville/Trenholm

Projection: WGS 84

Survey Start: 37.58423, -78.10672

Survey End: 37.56729, -78.13835

Survey Date: 5/25/2019 and 5/26/2019

Survey Effort: 9 person-hours

Personnel: B. J. K. Ostby, B. B. Beaty

Mollusks Observed:

12 Live *Elliptio complanta*
5 Live *E. fisheriana*
1 Live *Pyganodon cataracta*
Live *Corbicula fluminea* (uncommon)

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7509 Pin Oak Circle Bristol, VA 24202
Contact: 276-608-6508 or 540-230-1042
DagunaConsulting@gmail.com

Survey Record #2

Site #: DAGUNA05262019.1

Stream: Maple Swamp Creek

County: Cumberland

Description: Surveyed 1,800 m of main channel and assessed 2 feeding tributaries

Drainage: James

USGS Quadrangle Map: Trenholm

Projection: WGS 84

Survey Start: 37.55971, -78.10574

Survey End: 37.547796, -78.11513

Survey Date: 5/26/2019

Survey Effort: 5 person-hours

Personnel: B. J. K. Ostby, B. B. Beaty

Mollusks Observed:

None

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VIII. WETLAND AND STREAM IMPACT REPORT

The wetland and stream impact report will begin with a summary of all impacts, both primary and secondary, that are associated with the proposed construction of the Green Ridge Facility. Following this summary, a complete report of all stream scoring conducted across the property is included. The goal of the stream scoring process was to determine an accurate compensation requirement for the construction of the project. This compensation requirement was utilized in the design of the Impact Mitigation Report that is included in Section IX. A complete set of impact maps are included at the end of Section VIII.

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VIII. Wetland and Stream Impact Report

Section 8.1 Primary and Secondary Impacts – The following is a brief summary and description of all associated stream impacts for the proposed construction of the Green Ridge Recycling and Disposal Facility, LLC.

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VIII. Wetland and Stream Impact Report

Section 8.1 Primary and Secondary Impacts - The Green Ridge Facility is approximately 1,178+ acres in size. Of this acreage, 238 acres will be dedicated to lined-landfill (disposal unit boundary). The waste management unit boundary, which includes items such as leachate and gas management, maintenance and office facilities, and fueling facilities, will be a total of 438.1 acres. The impacts associated with this project include both primary and secondary impacts that stem from landfill impacts, roadway realignment impacts on Pinegrove Road and entryway impacts coming off of Route 60. These impacts will affect both perennial and intermittent tributaries within the wetland system. In regards to the calculation of impact areas, a width of five (5) feet was used to determine the area for all perennial impacts while all intermittent impacts were calculated using a width of three (3) feet. A summary of all impacts is included in *Table 1.3: Summary of Wetland and Water Impacts for the Proposed Green Ridge Facility*. Overall, there will be a total of 43,803 ft^2 (1.006 acres) of impact associated with the Green Ridge Facility. The following is a summary description of all project impacts.

A. Primary Impacts

This project will require a total of twenty-one (21) varying impacts across the site and of these twenty-one impacts, nineteen (19) will be considered primary. All nineteen primary impacts will be considered permanent.

Table 1.1: Primary v. Secondary Impacts		
Impact Type	**Impact Area (Acres)**	**Percentage of Total Impact**
Primary (19)	0.957	95%
Secondary (2)	0.049	5%
Total Impacts (21)	**1.006**	**100%**

Table 1.2: Composition of Impact Causes		
Impact Cause	**Impact Area (Acres)**	**Percentage of Total Impact**
Landfill Impacts (14)	0.889	88%
Roadway Realignment (3)	0.057	6%
Entryway Construction (4)	0.059	6%
Total Impacts (21)	**1.006**	**100%**

Impacts 1.1-9.1 (Table 1.1) will result from filling within the 238-acre disposal area and will comprise approximately 0.957 acres of the total 1.006 acres of impact (roughly 88% of total impact area). Impacts EW.1-EW.4 will result from the construction of the entryway road off of Route 60. Entryway impacts will constitute an estimated 0.059 acres of impact (6% of total impact area). Lastly, Impact RR.3, which results from the realignment of Pinegrove Road around the proposed landfill area. RR.3 is roughly 0.008 acres (<1% of total impacts). Please note that the Roadway Realignment in Table 1.2 include both primary and secondary roadway impacts. A break-down of impact composition can be found in *Table 1.1 Primary v. Secondary Impacts* and *Table 1.2: Composition of Impact Causes*.

B. Secondary Impacts

A total of two (2) secondary impacts will be associated with the proposed facility. The first, Impact RR.1, is approximately 850 ft^2 (0.02 acres) while the second, Impact RR.2, is an estimated 1,275 ft^2 (0.029 acres). This makes for a total of 2,125 ft^2 (0.049 acres) of

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secondary impacts. Both secondary impacts are associated with the placement of the proposed stormwater basins and will be considered permanent. Of the seven (7) total stormwater basins, only two have been identified in areas with the potential to cause secondary impacts. The basins associated with RR.1 and RR.2 have the potential to discharge water to the existing channels at velocity rates and volumes above current levels during high intensity rainfall events. Therefore, while not a certainty, the possibility for erosional impacts, change in channel morphology, and change in stream flow regime are possible. Therefore, these locations have been considered secondary impacts and have been added to the overall impact table accordingly.

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Table 1.3: Summary of Wetland and Water Impacts for the Proposed Green Ridge Facility												
Impact #	**Impact Type**	**Impact Description**	**Lat./Long.**	**Cowardin Class**	**Stream Length (ft.)**	**Stream Width (ft.)**	**Waters impact area (square feet)**	**Waters impact area (acreage)**	**Approximate contributing drainage area (square miles)**	**DEQ Class of Resources**	**Volume of fill below mean Ordinary High Water Mark**	**Dune/beach impact area (square feet)**
1.1	P	F, PE, PR, V	37.5657, -78.1231 (Central point of project site)	R3	700	5	3,500	0.080	0.18	Class III	N/A	N/A
1.2	P	F, PE, PR, V		R3	184	5	920	0.021				
1.3	P	F, PE, IN, V		R4	952	3	2,856	0.066				
2.1	P	F, PE, PR, V		R3	2,323	5	11,615	0.267	0.11			
2.2	P	F, PE, IN, V		R4	542	3	1,626	0.037				
3.1	P	F, PE, PR, V		R3	433	5	2,165	0.050	0.04			
3.2	P	F, PE, IN, V		R4	1,382	3	4,146	0.095				
4.1	P	F, PE, PR, V		R3	820	5	4,100	0.094	0.04			
5.1	P	F, PE, PR, V		R3	300	5	1,500	0.034	0.05			
5.2	P	F, PE, IN, V		R4	814	3	2,442	0.056				
6.1	P	F, PE, IN, V		R4	239	3	717	0.016	0.02			
7.1	P	F, PE, IN, V		R4	408	3	1,224	0.028	0.02			
8.1	P	F, PE, IN, V		R4	131	3	393	0.009	0.02			
9.1	P	F, PE, IN, V		R4	513	3	1,539	0.035	0.04			
RR.1	S	F, PE, PR, V		R3	170	5	850	0.020	0.08			
RR.2	S	F, PE, PR, V		R3	255	5	1,275	0.029	0.05			
RR.3	P	F, PE, IN, V		R4	122	3	366	0.008	0.04			
EW.1	P	F, PE, IN, V		R4	117	3	351	0.008	0.44			
EW.2	P	F, PE, PR, V		R3	181	5	905	0.021	0.88			
EW.3	P	F, PE, PR, V		R3	109	5	545	0.013	1.96			
EW.4	P	F, PE, IN, V		R4	256	3	768	0.018	0.03			
				Total:	**10951**	**N/A**	**43803**	**1.006**	N/A			

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KEY			
Impact Type		**Impact Description**	
F	Fill	P	Primary
EX	Excavation	S	Secondary
S	Structure		
T	Tidal		
NT	Non-tidal		
TE	Temporary		
PE	Permanent		
PR	Perennial		
IN	Intermittent		
SB	Subaqueous bottom		
DB	Dune/beach		
IS	Hydrolog. Isolated		
V	Vegetated		
NV	Non-vegetated		
MC	Mechanized clearing of PFO		

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VIII. Wetland and Stream Impact Report

Section 8.2 – United Stream Methodology: Stream Scoring Report

Between the months of October 2019 and January 2020, a stream scoring investigation was conducted at the project site to determine the compensatory requirements for all impacted stream reaches. The *Unified Stream Methodology, for use in Virginia,* published in January 2007 by the U.S. Army Corps of Engineers (USACOE) in collaboration with Virginia Department of Environment Quality (VDEQ), outlines the Unified Stream Methodology process that was utilized to evaluate and score each stream reach with the Green Ridge Facility impact area.

An in-field assessment was completed for each of the thirteen (13) stream reaches with proposed impacts. This assessment allowed for the calculation of a Reach Condition Index (RCI). The RCI in combination with the Stream Impact Factor allows for the determination of the compensation requirement needed to mitigate project impacts. In the case of the Green Ridge Facility, a stream impact factor of "Severe" (1.0) was used for all impacted stream reaches within the project area due the nature of impacts which involve high levels of fill placement within stream reaches. Upon completion of all stream reach assessments, the *Stream Assessment Summary Form (Form 2),* was used to summarize all impacts. This table, which is included in the following report, will show a total of 10,951 linear feet of stream impact associated with the proposed Green Ridge Facility. With RCI values ranging from 0.75 to 1.32, it was determined that a total compensation requirement of 10,613 credits is required for the proposed Green Ridge Facility.

Enclosed is a summary of all stream reaches scored, including scoresheets and example photos along with a description of the compensation requirements found upon completion of the analysis. This data was provided to RES to use in the design of their mitigation plan, which will be addressed in Section IX.

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Stream Assessment Form (Form 1)

Unified Stream Methodology for use in Virginia

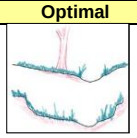
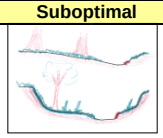
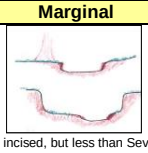
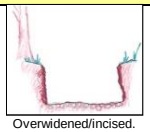
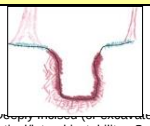
For use in wadeable channels classified as intermittent or perennial

Project #	Project Name	Locality	Cowardin Class.	HUC	Date	SAR #	Impact/SAR length	Impact Factor
2017-890	Cumberland - Green Ridge Landfill		R3/R4	02080205	10/2/19	1.1	700	1

Name(s) of Evaluator(s)	Stream Name and Information
Hannah Miller	Reach 1 - Section 1.1 (GPS name - RCH1 - START)

1. Channel Condition: Assess the cross-section of the stream and prevailing condition (erosion, aggradation)

Conditional Category

	Optimal	Suboptimal	Marginal	Poor	Severe	
Channel Condition	 Very little incision or active erosion; 80-100% stable banks. Vegetative surface protection or natural rock, prominent (80-100%). AND/OR Stable point bars/bankfull benches are present. Access to their original floodplain or fully developed wide bankfull benches. Mid-channel bars, and transverse bars few. Transient sediment deposition covers less than 10% of bottom.	 Slightly incised, few areas of active erosion or unprotected banks. Majority of banks are stable (60-80%). Vegetative protection or natural rock prominent (60-80%) AND/OR Depositional features contribute to stability. The bankfull and low flow channels are well defined. Stream likely has access to bankfull benches, or newly developed floodplains along portions of the reach. Transient sediment covers 10-40% of the stream bottom.	 Often incised, but less than Severe or Poor. Banks more stable than Severe or Poor due to lower bank slopes. Erosion may be present on 40-60% of both banks. Vegetative protection on 40-60% of banks. Streambanks may bevertical or undercut. AND/OR 40-60% of stream is covered by sediment. Sediment may be temporary/transient, contribute instability. Deposition that contribute to stability, may be forming/present. AND/OR V-shaped channels have vegetative protection on > 40% of the banks and depositional features which	 Overwidened/incised. Vertically/laterally unstable. Likely to widen further. Majority of both banks are near vertical. Erosion present on 60-80% of banks. Vegetative protection present on 20-40% of banks, and is insufficient to prevent erosion. AND/OR 60-80% of the stream is covered by sediment. Sediment is temporary/transient in nature, and contributing to instability. AND/OR V-shaped channels have vegetative protection is present on > 40% of the banks and stable sediment deposition is absent.	 Deeply incised (or excavated), vertical/lateral instability. Severe incision, flow contained within the banks. Streambed below average rooting depth, majority of banks vertical/undercut. Vegetative protection present on less than 20% of banks, is not preventing erosion. Obvious bank sloughing present. Erosion/raw banks on 80-100%. AND/OR Aggrading channel. Greater than 80% of stream bed is covered by deposition, contributing to instability. Multiple thread channels and/or subterranean flow.	CI
Score	3	2.4	2	1.6	1	2.0
NOTES>>						

2. RIPARIAN BUFFERS: Assess both bank's 100 foot riparian areas along the entire SAR. (rough measurements of length & width may be acceptable)

Conditional Category

NOTES>> Easement located within portion of riparion buffer.

	Optimal	Suboptimal		Marginal		Poor	
Riparian Buffers	Tree stratum (dbh > 3 inches) present, with > 60% tree canopy cover and a non-maintained understory. Wetlands located within the riparian areas.	**High Suboptimal:** Riparian areas with tree stratum (dbh > 3 inches) present, with 30% to 60% tree canopy cover and containing both herbaceous and shrub layers or a non-maintained understory.	**Low Suboptimal:** Riparian areas with tree stratum (dbh > 3 inches) present, with > 30% tree canopy cover and a maintained understory. Recent cutover (dense vegetation).	**High Marginal:** Non-maintained, dense herbaceous vegetation with either a shrub layer or a tree layer (dbh > 3 inches) present, with <30% tree canopy cover.	**Low Marginal:** Non-maintained, dense herbaceous vegetation, riparian areas lacking shrub and tree stratum, hay production, ponds, open water. If present, tree stratum (dbh >3 inches) present, with <30% tree canopy cover with maintained understory.	**High Poor:** Lawns, mowed, and maintained areas, nurseries; no-till cropland; actively grazed pasture, sparsely vegetated non-maintained area, recently seeded and stabilized, or other comparable condition.	**Low Poor:** Impervious surfaces, mine spoil lands, denuded surfaces, row crops, active feed lots, trails, or other comparable conditions.
		High	Low	High	Low	High	Low
Condition Scores	1.5	1.2	1.1	0.85	0.75	0.6	0.5

1. Delineate riparian areas along each stream bank into Condition Categories and Condition Scores using the descriptors.
2. Determine square footage for each by measuring or estimating length and width. Calculators are provided for you below.
3. Enter the % Riparian Area and Score for each riparian category in the blocks below.

Ensure the sums of % Riparian Blocks equal 100

Right Bank	% Riparian Area>	100%						100%			
	Score >	1.2									
									E		
Left Bank	% Riparian Area>	75%	25%					100%	Rt Bank CI >	1.20	CI
	Score >	1.2	1.1						Lt Bank CI >	1.18	1.19

3. INSTREAM HABITAT: Varied substrate sizes, water velocity and depths; woody and leafy debris; stable substrate; low embededness; shade; undercut banks; root mats; SAV; riffle poole complexes, stable features.

NOTES>>

Conditional Category

	Optimal	Suboptimal	Marginal	Poor	
Instream Habitat/ Available Cover	Habitat elements are typically present in greater than 50% of the reach.	Stable habitat elements are typically present in 30-50% of the reach and are adequate for maintenance of populations.	Stable habitat elements are typically present in 10-30% of the reach and are adequate for maintenance of populations.	Habitat elements listed above are lacking or are unstable. Habitat elements are typically present in less than 10% of the reach.	CI
Score	1.5	1.2	0.9	0.5	1.20

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Stream Impact Assessment Form Page 2

Project #	Applicant	Locality	Cowardin Class.	HUC	Date	Data Point	SAR length	Impact Factor
2017-890			R3/R4	02080205	10/2/19			

4. CHANNEL ALTERATION: Stream crossings, riprap, concrete, gabions, or concrete blocks, straightening of channel, channelization, embankments, spoil piles, constrictions, livestock

NOTES>>

	Conditional Category						
	Negligible	**Minor**		**Moderate**		**Severe**	
Channel Alteration	Channelization, dredging, alteration, or hardening absent. Stream has an unaltered pattern or has naturalized.	Less than 20% of the stream reach is disrupted by any of the channel alterations listed in the parameter guidelines.	20-40% of the stream reach is disrupted by any of the channel alterations listed in the parameter guidelines.	40 - 60% of reach is disrupted by any of the channel alterations listed in the parameter guidelines. If stream has been channelized, normal stable stream meander pattern has not recovered.	60 - 80% of reach is disrupted by any of the channel alterations listed in the parameter guidelines. If stream has been channelized, normal stable stream meander pattern has not recovered.	Greater than 80% of reach is disrupted by any of the channel alterations listed in the parameter guidelines AND/OR 80% of banks shored with gabion, riprap, or cement.	
SCORE	**1.5**	**1.3**	**1.1**	**0.9**	**0.7**	**0.5**	**1.50**

REACH CONDITION INDEX and STREAM CONDITION UNITS FOR THIS REACH

NOTE: **The CIs and RCI should be rounded to 2 decimal places. The CR should be rounded to a whole number.**

THE REACH CONDITION INDEX (RCI) >>	**1.18**
RCI= (Sum of all CI's)/5	
COMPENSATION REQUIREMENT (CR) >>	**826**
CR = RCI X LF X IF	

INSERT PHOTOS:

Example of Reach 1.1

DESCRIBE PROPOSED IMPACT:

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Stream Assessment Form (Form 1)

Unified Stream Methodology for use in Virginia

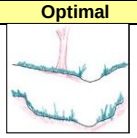
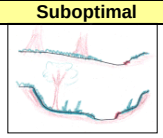
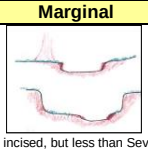
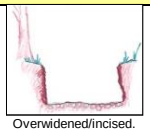
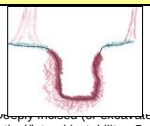
For use in wadeable channels classified as intermittent or perennial

Project #	Project Name	Locality	Cowardin Class.	HUC	Date	SAR #	Impact/SAR length	Impact Factor
2017-890	Cumberland - Green Ridge Landfill		R3/R4	02080205	10/2/19	1.2	184	1

Name(s) of Evaluator(s)	Stream Name and Information
Hannah Miller	Reach 1 - Section 1.2 (GPS name - RCH2 - START)

1. Channel Condition: Assess the cross-section of the stream and prevailing condition (erosion, aggradation)

Conditional Category

	Optimal	Suboptimal	Marginal	Poor	Severe	
Channel Condition	 Very little incision or active erosion; 80-100% stable banks. Vegetative surface protection or natural rock, prominent (80-100%). AND/OR Stable point bars/bankfull benches are present. Access to their original floodplain or fully developed wide bankfull benches. Mid-channel bars, and transverse bars few. Transient sediment deposition covers less than 10% of bottom.	 Slightly incised, few areas of active erosion or unprotected banks. Majority of banks are stable (60-80%). Vegetative protection or natural rock prominent (60-80%) AND/OR Depositional features contribute to stability. The bankfull and low flow channels are well defined. Stream likely has access to bankfull benches, or newly developed floodplains along portions of the reach. Transient sediment covers 10-40% of the stream bottom.	 Often incised, but less than Severe or Poor. Banks more stable than Severe or Poor due to lower bank slopes. Erosion may be present on 40-60% of both banks. Vegetative protection on 40-60% of banks. Streambanks may bevertical or undercut. AND/OR 40-60% of stream is covered by sediment. Sediment may be temporary/transient, contribute instability. Deposition that contribute to stability, may be forming/present. AND/OR V-shaped channels have vegetative protection on > 40% of the banks and depositional features which	 Overwidened/incised. Vertically/laterally unstable. Likely to widen further. Majority of both banks are near vertical. Erosion present on 60-80% of banks. Vegetative protection present on 20-40% of banks, and is insufficient to prevent erosion. AND/OR 60-80% of the stream is covered by sediment. Sediment is temporary/transient in nature, and contributing to instability. AND/OR V-shaped channels have vegetative protection is present on > 40% of the banks and stable sediment deposition is absent.	 Deeply incised (or aggraded), vertical/lateral instability. Severe incision, flow contained within the banks. Streambed below average rooting depth, majority of banks vertical/undercut. Vegetative protection present on less than 20% of banks, is not preventing erosion. Obvious bank sloughing present. Erosion/raw banks on 80-100%. AND/OR Aggrading channel. Greater than 80% of stream bed is covered by deposition, contributing to instability. Multiple thread channels and/or subterranean flow.	CI
Score	3	2.4	2	1.6	1	1.6

NOTES>>

2. RIPARIAN BUFFERS: Assess both bank's 100 foot riparian areas along the entire SAR. (rough measurements of length & width may be acceptable)

Conditional Category

NOTES>>

	Optimal	Suboptimal		Marginal		Poor	
Riparian Buffers	Tree stratum (dbh > 3 inches) present, with > 60% tree canopy cover and a non-maintained understory. Wetlands located within the riparian areas.	**High Suboptimal:** Riparian areas with tree stratum (dbh > 3 inches) present, with 30% to 60% tree canopy cover and containing both herbaceous and shrub layers or a non-maintained understory.	**Low Suboptimal:** Riparian areas with tree stratum (dbh > 3 inches) present, with > 30% tree canopy cover and a maintained understory. Recent cutover (dense vegetation).	**High Marginal:** Non-maintained, dense herbaceous vegetation with either a shrub layer or a tree layer (dbh > 3 inches) present, with <30% tree canopy cover.	**Low Marginal:** Non-maintained, dense herbaceous vegetation, riparian areas lacking shrub and tree stratum, hay production, ponds, open water. If present, tree stratum (dbh >3 inches) present, with <30% tree canopy cover with maintained understory.	**High Poor:** Lawns, mowed, and maintained areas, nurseries; no-till cropland; actively grazed pasture, sparsely vegetated non-maintained area, recently seeded and stabilized, or other comparable condition.	**Low Poor:** Impervious surfaces, mine spoil lands, denuded surfaces, row crops, active feed lots, trails, or other comparable conditions.
		High	Low	High	Low	High	Low
Condition Scores	1.5	1.2	1.1	0.85	0.75	0.6	0.5

1. Delineate riparian areas along each stream bank into Condition Categories and Condition Scores using the descriptors.
2. Determine square footage for each by measuring or estimating length and width. Calculators are provided for you below.
3. Enter the % Riparian Area and Score for each riparian category in the blocks below.

Ensure the sums of % Riparian Blocks equal 100

Right Bank	% Riparian Area>	100%						100%			
	Score >	1.2									
									E		
Left Bank	% Riparian Area>	100%						100%	Rt Bank CI >	1.20	CI
	Score >	1.2							Lt Bank CI >	1.20	1.20

3. INSTREAM HABITAT: Varied substrate sizes, water velocity and depths; woody and leafy debris; stable substrate; low embededness; shade; undercut banks; root mats; SAV; riffle poole complexes, stable features.

NOTES>>

Conditional Category

	Optimal	Suboptimal	Marginal	Poor	
Instream Habitat/ Available Cover	Habitat elements are typically present in greater than 50% of the reach.	Stable habitat elements are typically present in 30-50% of the reach and are adequate for maintenance of populations.	Stable habitat elements are typically present in 10-30% of the reach and are adequate for maintenance of populations.	Habitat elements listed above are lacking or are unstable. Habitat elements are typically present in less than 10% of the reach.	CI
Score	1.5	1.2	0.9	0.5	0.90

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Stream Impact Assessment Form Page 2

Project #	Applicant	Locality	Cowardin Class.	HUC	Date	Data Point	SAR length	Impact Factor
2017-890			R3/R4	02080205	10/2/19			

4. CHANNEL ALTERATION: Stream crossings, riprap, concrete, gabions, or concrete blocks, straightening of channel, channelization, embankments, spoil piles, constrictions, livestock

NOTES>>

	Conditional Category						
	Negligible	**Minor**		**Moderate**		**Severe**	
Channel Alteration	Channelization, dredging, alteration, or hardening absent. Stream has an unaltered pattern or has naturalized.	Less than 20% of the stream reach is disrupted by any of the channel alterations listed in the parameter guidelines.	20-40% of the stream reach is disrupted by any of the channel alterations listed in the parameter guidelines.	40 - 60% of reach is disrupted by any of the channel alterations listed in the parameter guidelines. If stream has been channelized, normal stable stream meander pattern has not recovered.	60 - 80% of reach is disrupted by any of the channel alterations listed in the parameter guidelines. If stream has been channelized, normal stable stream meander pattern has not recovered.	Greater than 80% of reach is disrupted by any of the channel alterations listed in the parameter guidelines AND/OR 80% of banks shored with gabion, riprap, or cement.	
SCORE	**1.5**	**1.3**	**1.1**	**0.9**	**0.7**	**0.5**	**1.50**

REACH CONDITION INDEX and STREAM CONDITION UNITS FOR THIS REACH

NOTE: **The CIs and RCI should be rounded to 2 decimal places. The CR should be rounded to a whole number.**

THE REACH CONDITION INDEX (RCI) >>	**1.04**
RCI= (Sum of all CI's)/5	
COMPENSATION REQUIREMENT (CR) >>	**191**
CR = RCI X LF X IF	

INSERT PHOTOS:

Example of Reach 1.2

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Ephemeral Stream Assessment Form (Form 1a)

Unified Stream Methodology for use in Virginia

For use in ephemeral streams

Project #	Project Name	Locality	Cowardin Class.	HUC	Date	SAR #	Impact/SAR length	Impact Factor
2017-890	Cumberland - Green Ridge Landfill		R4	02080205	10/2/2019	1.3	952	1

Name(s) of Evaluator(s)	Stream Name and Information
Hannah Miller	Reach 1 - Section 1.3 (GPS name - RCH3 - START)

2. RIPARIAN BUFFERS: Assess both bank's 100 foot riparian areas along the entire SAR. (rough measurements of length & width may be acceptable)

	Conditional Category							NOTES>>
	Optimal	Suboptimal		Marginal		Poor		
Riparian Buffers	Tree stratum (dbh > 3 inches) present, with > 60% tree canopy cover and an non-maintained understory. Wetlands areas.	**High Suboptimal:** Riparian areas with tree stratum (dbh > 3 inches) present, with 30% to 60% tree canopy cover and containing both herbaceous and shrub layers or a non-maintained understory.	**Low Suboptimal:** Riparian areas with tree stratum (dbh > 3 inches) present, with >30% tree canopy cover and a maintained understory. Recent cutover (dense vegetation).	**High Marginal:** Non-maintained, dense herbaceous vegetation with either a shrub layer or a tree layer (dbh > 3 inches) present, with <30% tree canopy cover.	**Low Marginal:** Non-maintained, dense herbaceous vegetation, riparian areas lacking shrub and tree stratum, hay production, ponds, open water. If present, tree stratum (dbh >3 inches) present, with <30% tree canopy cover with maintained understory.	**High Poor:** Lawns, mowed, and maintained areas, nurseries; no-till cropland; actively grazed pasture, sparsely vegetated non-maintained area, recently seeded and stabilized, or other comparable condition.	**Low Poor:** Impervious surfaces, mine spoil lands, denuded surfaces, row crops, active feed lots, trails, or other comparable conditions.	
		High	Low	High	Low	High	Low	
Condition Scores	1.5	1.2	1.1	0.85	0.75	0.6	0.5	

1. Delineate riparian areas along each stream bank into Condition Categories and Condition Scores using the descriptors.
2. Determine square footage for each by measuring or estimating length and width. Calculators are provided for you below.
3. Enter the % Riparian Area and Score for each riparian category in the blocks below.

Ensure the sums of % Riparian Blocks equal 100

Right Bank	% Riparian Area>	100%						100%			
	Score >	1.5									
									CI= (Sum % RA * Scores*0.01)/2		
Left Bank	% Riparian Area>	100%						100%	Rt Bank CI >	1.50	CI
	Score >	1.5							Lt Bank CI >	1.50	1.50

REACH CONDITION INDEX and STREAM CONDITION UNITS FOR THIS REACH

NOTE: **The CIs and RCI should be rounded to 2 decimal places. The CR should be rounded to a whole number.**

THE REACH CONDITION INDEX (RCI) >>	**0.75**
RCI= (Riparian CI)/2	
COMPENSATION REQUIREMENT (CR) >>	**714**
CR = RCI X LF X IF	

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Stream Assessment Form (Form 1)

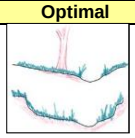
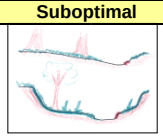
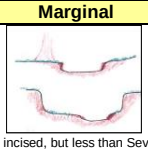
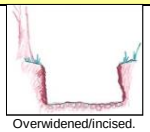
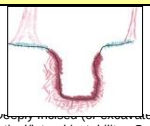
Unified Stream Methodology for use in Virginia

For use in wadeable channels classified as intermittent or perennial

Project #	Project Name	Locality	Cowardin Class.	HUC	Date	SAR #	Impact/SAR length	Impact Factor
2017-890	Cumberland - Green Ridge Landfill		R3	02080205	1/30/2020	EW1	290	1

Name(s) of Evaluator(s)	Stream Name and Information
Hannah Miller	Reach 10 - EW1 (Includes impacts EW.2 and EW.3)

1. Channel Condition: Assess the cross-section of the stream and prevailing condition (erosion, aggradation)

	Conditional Category					
	Optimal	Suboptimal	Marginal	Poor	Severe	
Channel Condition	 Very little incision or active erosion; 80-100% stable banks. Vegetative surface protection or natural rock, prominent (80-100%). AND/OR Stable point bars/bankfull benches are present. Access to their original floodplain or fully developed wide bankfull benches. Mid-channel bars, and transverse bars few. Transient sediment deposition covers less than 10% of bottom.	 Slightly incised, few areas of active erosion or unprotected banks. Majority of banks are stable (60-80%). Vegetative protection or natural rock prominent (60-80%) AND/OR Depositional features contribute to stability. The bankfull and low flow channels are well defined. Stream likely has access to bankfull benches, or newly developed floodplains along portions of the reach. Transient sediment covers 10-40% of the stream bottom.	 Often incised, but less than Severe or Poor. Banks more stable than Severe or Poor due to lower bank slopes. Erosion may be present on 40-60% of both banks. Vegetative protection on 40-60% of banks. Streambanks may bevertical or undercut. AND/OR 40-60% of stream is covered by sediment. Sediment may be temporary/transient, contribute instability. Deposition that contribute to stability, may be forming/present. AND/OR V-shaped channels have vegetative protection on > 40% of the banks and depositional features which	 Overwidened/incised. Vertically/laterally unstable. Likely to widen further. Majority of both banks are near vertical. Erosion present on 60-80% of banks. Vegetative protection present on 20-40% of banks, and is insufficient to prevent erosion. AND/OR 60-80% of the stream is covered by sediment. Sediment is temporary/transient in nature, and contributing to instability. AND/OR V-shaped channels have vegetative protection is present on > 40% of the banks and stable sediment deposition is absent.	 Deeply incised (or excavated), vertical/lateral instability. Severe incision, flow contained within the banks. Streambed below average rooting depth, majority of banks vertical/undercut. Vegetative protection present on less than 20% of banks, is not preventing erosion. Obvious bank sloughing present. Erosion/raw banks on 80-100%. AND/OR Aggrading channel. Greater than 80% of stream bed is covered by deposition, contributing to instability. Multiple thread channels and/or subterranean flow.	CI
Score	3	2.4	2	1.6	1	2.0
NOTES>>						

2. RIPARIAN BUFFERS: Assess both bank's 100 foot riparian areas along the entire SAR. (rough measurements of length & width may be acceptable)

	Conditional Category							NOTES>>
	Optimal	Suboptimal		Marginal		Poor		
Riparian Buffers	Tree stratum (dbh > 3 inches) present, with > 60% tree canopy cover and a non-maintained understory. Wetlands located within the riparian areas.	**High Suboptimal:** Riparian areas with tree stratum (dbh > 3 inches) present, with 30% to 60% tree canopy cover and containing both herbaceous and shrub layers or a non-maintained understory.	**Low Suboptimal:** Riparian areas with tree stratum (dbh > 3 inches) present, with > 30% tree canopy cover and a maintained understory. Recent cutover (dense vegetation).	**High Marginal:** Non-maintained, dense herbaceous vegetation with either a shrub layer or a tree layer (dbh > 3 inches) present, with <30% tree canopy cover.	**Low Marginal:** Non-maintained, dense herbaceous vegetation, riparian areas lacking shrub and tree stratum, hay production, ponds, open water. If present, tree stratum (dbh >3 inches) present, with <30% tree canopy cover with maintained understory.	**High Poor:** Lawns, mowed, and maintained areas, nurseries; no-till cropland; actively grazed pasture, sparsely vegetated non-maintained area, recently seeded and stabilized, or other comparable condition.	**Low Poor:** Impervious surfaces, mine spoil lands, denuded surfaces, row crops, active feed lots, trails, or other comparable conditions.	
		High	Low	High	Low	High	Low	
Condition Scores	1.5	1.2	1.1	0.85	0.75	0.6	0.5	

1. Delineate riparian areas along each stream bank into Condition Categories and Condition Scores using the descriptors.
2. Determine square footage for each by measuring or estimating length and width. Calculators are provided for you below.
3. Enter the % Riparian Area and Score for each riparian category in the blocks below.

Ensure the sums of % Riparian Blocks equal 100

Right Bank	% Riparian Area>	100%						100%			
	Score >	1.5									
									E		
Left Bank	% Riparian Area>	100%						100%	Rt Bank CI >	1.50	CI
	Score >	1.5							Lt Bank CI >	1.50	1.50

3. INSTREAM HABITAT: Varied substrate sizes, water velocity and depths; woody and leafy debris; stable substrate; low embededness; shade; undercut banks; root mats; SAV; riffle poole complexes, stable features.

NOTES>>

	Conditional Category				
	Optimal	Suboptimal	Marginal	Poor	
Instream Habitat/ Available Cover	Habitat elements are typically present in greater than 50% of the reach.	Stable habitat elements are typically present in 30-50% of the reach and are adequate for maintenance of populations.	Stable habitat elements are typically present in 10-30% of the reach and are adequate for maintenance of populations.	Habitat elements listed above are lacking or are unstable. Habitat elements are typically present in less than 10% of the reach.	CI
Score	1.5	1.2	0.9	0.5	1.20

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Stream Impact Assessment Form Page 2

Project #	Applicant	Locality	Cowardin Class.	HUC	Date	Data Point	SAR length	Impact Factor
2017-890			R3/R4	02080205	1/30/2020		290	1

4. CHANNEL ALTERATION: Stream crossings, riprap, concrete, gabions, or concrete blocks, straightening of channel, channelization, embankments, spoil piles, constrictions, livestock

NOTES>>

	Conditional Category						
	Negligible	Minor		Moderate		Severe	
Channel Alteration	Channelization, dredging, alteration, or hardening absent. Stream has an unaltered pattern or has naturalized.	Less than 20% of the stream reach is disrupted by any of the channel alterations listed in the parameter guidelines.	20-40% of the stream reach is disrupted by any of the channel alterations listed in the parameter guidelines.	40 - 60% of reach is disrupted by any of the channel alterations listed in the parameter guidelines. If stream has been channelized, normal stable stream meander pattern has not recovered.	60 - 80% of reach is disrupted by any of the channel alterations listed in the parameter guidelines. If stream has been channelized, normal stable stream meander pattern has not recovered.	Greater than 80% of reach is disrupted by any of the channel alterations listed in the parameter guidelines AND/OR 80% of banks shored with gabion, riprap, or cement.	
SCORE	**1.5**	**1.3**	**1.1**	**0.9**	**0.7**	**0.5**	**1.50**

REACH CONDITION INDEX and STREAM CONDITION UNITS FOR THIS REACH

NOTE: **The CIs and RCI should be rounded to 2 decimal places. The CR should be rounded to a whole number.**

THE REACH CONDITION INDEX (RCI) >>	**1.24**
RCI= (Sum of all CI's)/5	
COMPENSATION REQUIREMENT (CR) >>	**360**
CR = RCI X LF X IF	

INSERT PHOTOS:

Examples of Reach 10 - Near impact EW.3

Example of Reach 10 - near Impact EW.2

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Ephemeral Stream Assessment Form (Form 1a)

Unified Stream Methodology for use in Virginia

For use in ephemeral streams

Project #	Project Name	Locality	Cowardin Class.	HUC	Date	SAR #	Impact/SAR length	Impact Factor
2017-890	Cumberland - Green Ridge Landfill		R4	02080205	1/30/2020	11	373	1

Name(s) of Evaluator(s)	Stream Name and Information
Hannah Miller	Reach 11 - Section EW2 (includes impacts EW.1 and EW.4)

2. RIPARIAN BUFFERS: Assess both bank's 100 foot riparian areas along the entire SAR. (rough measurements of length & width may be acceptable)

	Conditional Category							NOTES>>
	Optimal	Suboptimal		Marginal		Poor		
Riparian Buffers	Tree stratum (dbh > 3 inches) present, with > 60% tree canopy cover and an non-maintained understory. Wetlands areas.	**High Suboptimal:** Riparian areas with tree stratum (dbh > 3 inches) present, with 30% to 60% tree canopy cover and containing both herbaceous and shrub layers or a non-maintained understory.	**Low Suboptimal:** Riparian areas with tree stratum (dbh > 3 inches) present, with >30% tree canopy cover and a maintained understory. Recent cutover (dense vegetation).	**High Marginal:** Non-maintained, dense herbaceous vegetation with either a shrub layer or a tree layer (dbh > 3 inches) present, with <30% tree canopy cover.	**Low Marginal:** Non-maintained, dense herbaceous vegetation, riparian areas lacking shrub and tree stratum, hay production, ponds, open water. If present, tree stratum (dbh >3 inches) present, with <30% tree canopy cover with maintained understory.	**High Poor:** Lawns, mowed, and maintained areas, nurseries; no-till cropland; actively grazed pasture, sparsely vegetated non-maintained area, recently seeded and stabilized, or other comparable condition.	**Low Poor:** Impervious surfaces, mine spoil lands, denuded surfaces, row crops, active feed lots, trails, or other comparable conditions.	
		High	Low	High	Low	High	Low	
Condition Scores	1.5	1.2	1.1	0.85	0.75	0.6	0.5	

1. Delineate riparian areas along each stream bank into Condition Categories and Condition Scores using the descriptors.
2. Determine square footage for each by measuring or estimating length and width. Calculators are provided for you below.
3. Enter the % Riparian Area and Score for each riparian category in the blocks below.

Ensure the sums of % Riparian Blocks equal 100

Right Bank	% Riparian Area>	100%						100%			
	Score >	1.5									
									CI= (Sum % RA * Scores*0.01)/2		
Left Bank	% Riparian Area>	100%						100%	Rt Bank CI >	1.50	CI
	Score >	1.5							Lt Bank CI >	1.50	1.50

REACH CONDITION INDEX and STREAM CONDITION UNITS FOR THIS REACH

NOTE: **The CIs and RCI should be rounded to 2 decimal places. The CR should be rounded to a whole number.**

THE REACH CONDITION INDEX (RCI) >>	**0.75**
RCI= (Riparian CI)/2	
COMPENSATION REQUIREMENT (CR) >>	**280**
CR = RCI X LF X IF	

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DESCRIBE PROPOSED IMPACT:

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Stream Assessment Form (Form 1)

Unified Stream Methodology for use in Virginia

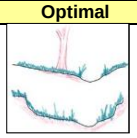
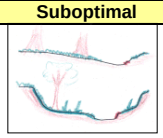
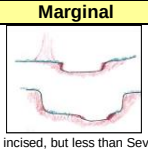
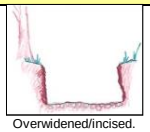
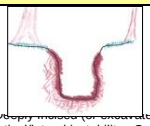
For use in wadeable channels classified as intermittent or perennial

Project #	Project Name	Locality	Cowardin Class.	HUC	Date	SAR #	Impact/SAR length	Impact Factor
2017-890	Cumberland - Green Ridge Landfill		R3	02080205	1/30/2020	12	425	1

Name(s) of Evaluator(s)	Stream Name and Information
Hannah Miller	Reach 12 - Section RR1 (includes impacts RR.1 and RR.2)

1. Channel Condition: Assess the cross-section of the stream and prevailing condition (erosion, aggradation)

Conditional Category

	Optimal	Suboptimal	Marginal	Poor	Severe	
Channel Condition	 Very little incision or active erosion; 80-100% stable banks. Vegetative surface protection or natural rock, prominent (80-100%). AND/OR Stable point bars/bankfull benches are present. Access to their original floodplain or fully developed wide bankfull benches. Mid-channel bars, and transverse bars few. Transient sediment deposition covers less than 10% of bottom.	 Slightly incised, few areas of active erosion or unprotected banks. Majority of banks are stable (60-80%). Vegetative protection or natural rock prominent (60-80%) AND/OR Depositional features contribute to stability. The bankfull and low flow channels are well defined. Stream likely has access to bankfull benches, or newly developed floodplains along portions of the reach. Transient sediment covers 10-40% of the stream bottom.	 Often incised, but less than Severe or Poor. Banks more stable than Severe or Poor due to lower bank slopes. Erosion may be present on 40-60% of both banks. Vegetative protection on 40-60% of banks. Streambanks may bevertical or undercut. AND/OR 40-60% of stream is covered by sediment. Sediment may be temporary/transient, contribute instability. Deposition that contribute to stability, may be forming/present. AND/OR V-shaped channels have vegetative protection on > 40% of the banks and depositional features which	 Overwidened/incised. Vertically/laterally unstable. Likely to widen further. Majority of both banks are near vertical. Erosion present on 60-80% of banks. Vegetative protection present on 20-40% of banks, and is insufficient to prevent erosion. AND/OR 60-80% of the stream is covered by sediment. Sediment is temporary/transient in nature, and contributing to instability. AND/OR V-shaped channels have vegetative protection is present on > 40% of the banks and stable sediment deposition is absent.	 Deeply incised (or excavated), vertical/lateral instability. Severe incision, flow contained within the banks. Streambed below average rooting depth, majority of banks vertical/undercut. Vegetative protection present on less than 20% of banks, is not preventing erosion. Obvious bank sloughing present. Erosion/raw banks on 80-100%. AND/OR Aggrading channel. Greater than 80% of stream bed is covered by deposition, contributing to instability. Multiple thread channels and/or subterranean flow.	CI
Score	3	2.4	2	1.6	1	2.4
NOTES>>						

2. RIPARIAN BUFFERS: Assess both bank's 100 foot riparian areas along the entire SAR. (rough measurements of length & width may be acceptable)

Conditional Category

	Optimal	Suboptimal		Marginal		Poor		NOTES>>
Riparian Buffers	Tree stratum (dbh > 3 inches) present, with > 60% tree canopy cover and a non-maintained understory. Wetlands located within the riparian areas.	**High Suboptimal:** Riparian areas with tree stratum (dbh > 3 inches) present, with 30% to 60% tree canopy cover and containing both herbaceous and shrub layers or a non-maintained understory.	**Low Suboptimal:** Riparian areas with tree stratum (dbh > 3 inches) present, with > 30% tree canopy cover and a maintained understory. Recent cutover (dense vegetation).	**High Marginal:** Non-maintained, dense herbaceous vegetation with either a shrub layer or a tree layer (dbh > 3 inches) present, with <30% tree canopy cover.	**Low Marginal:** Non-maintained, dense herbaceous vegetation, riparian areas lacking shrub and tree stratum, hay production, ponds, open water. If present, tree stratum (dbh >3 inches) present, with <30% tree canopy cover with maintained understory.	**High Poor:** Lawns, mowed, and maintained areas, nurseries; no-till cropland; actively grazed pasture, sparsely vegetated non-maintained area, recently seeded and stabilized, or other comparable condition.	**Low Poor:** Impervious surfaces, mine spoil lands, denuded surfaces, row crops, active feed lots, trails, or other comparable conditions.	
		High	Low	High	Low	High	Low	
Condition Scores	1.5	1.2	1.1	0.85	0.75	0.6	0.5	

1. Delineate riparian areas along each stream bank into Condition Categories and Condition Scores using the descriptors.
2. Determine square footage for each by measuring or estimating length and width. Calculators are provided for you below.
3. Enter the % Riparian Area and Score for each riparian category in the blocks below.

Ensure the sums of % Riparian Blocks equal 100

Right Bank	% Riparian Area>	100%						100%			
	Score >	1.5									
									E		
Left Bank	% Riparian Area>	100%						100%	Rt Bank CI >	1.50	CI
	Score >	1.5							Lt Bank CI >	1.50	1.50

3. INSTREAM HABITAT: Varied substrate sizes, water velocity and depths; woody and leafy debris; stable substrate; low embededness; shade; undercut banks; root mats; SAV; riffle poole complexes, stable features.

NOTES>>

Conditional Category

	Optimal	Suboptimal	Marginal	Poor	
Instream Habitat/ Available Cover	Habitat elements are typically present in greater than 50% of the reach.	Stable habitat elements are typically present in 30-50% of the reach and are adequate for maintenance of populations.	Stable habitat elements are typically present in 10-30% of the reach and are adequate for maintenance of populations.	Habitat elements listed above are lacking or are unstable. Habitat elements are typically present in less than 10% of the reach.	CI
Score	1.5	1.2	0.9	0.5	1.20

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Stream Impact Assessment Form Page 2

Project #	Applicant	Locality	Cowardin Class.	HUC	Date	Data Point	SAR length	Impact Factor
2017-890			R3/R4	02080205	10/24/19			

4. CHANNEL ALTERATION: Stream crossings, riprap, concrete, gabions, or concrete blocks, straightening of channel, channelization, embankments, spoil piles, constrictions, livestock

NOTES>>

	Conditional Category						
	Negligible	**Minor**		**Moderate**		**Severe**	
Channel Alteration	Channelization, dredging, alteration, or hardening absent. Stream has an unaltered pattern or has naturalized.	Less than 20% of the stream reach is disrupted by any of the channel alterations listed in the parameter guidelines.	20-40% of the stream reach is disrupted by any of the channel alterations listed in the parameter guidelines.	40 - 60% of reach is disrupted by any of the channel alterations listed in the parameter guidelines. If stream has been channelized, normal stable stream meander pattern has not recovered.	60 - 80% of reach is disrupted by any of the channel alterations listed in the parameter guidelines. If stream has been channelized, normal stable stream meander pattern has not recovered.	Greater than 80% of reach is disrupted by any of the channel alterations listed in the parameter guidelines AND/OR 80% of banks shored with gabion, riprap, or cement.	
SCORE	**1.5**	**1.3**	**1.1**	**0.9**	**0.7**	**0.5**	**1.50**

REACH CONDITION INDEX and STREAM CONDITION UNITS FOR THIS REACH

NOTE: **The CIs and RCI should be rounded to 2 decimal places. The CR should be rounded to a whole number.**

THE REACH CONDITION INDEX (RCI) >>	**1.32**
RCI= (Sum of all CI's)/5	
COMPENSATION REQUIREMENT (CR) >>	**561**
CR = RCI X LF X IF	

INSERT PHOTOS:

Example of Reach 12 (close to RR.2)

DESCRIBE PROPOSED IMPACT:

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Ephemeral Stream Assessment Form (Form 1a)

Unified Stream Methodology for use in Virginia

For use in ephemeral streams

Project #	Project Name	Locality	Cowardin Class.	HUC	Date	SAR #	Impact/SAR length	Impact Factor
2017-890	Cumberland - Green Ridge Landfill		R4	02080205	1/30/2020	13	122	1

Name(s) of Evaluator(s)	Stream Name and Information
Hannah Miller	Reach 13 - Section RR2 (includes impacts RR.3)

2. RIPARIAN BUFFERS: Assess both bank's 100 foot riparian areas along the entire SAR. (rough measurements of length & width may be acceptable)

	Conditional Category							NOTES>>
	Optimal	Suboptimal		Marginal		Poor		
Riparian Buffers	Tree stratum (dbh > 3 inches) present, with > 60% tree canopy cover and an non-maintained understory. Wetlands areas.	**High Suboptimal:** Riparian areas with tree stratum (dbh > 3 inches) present, with 30% to 60% tree canopy cover and containing both herbaceous and shrub layers or a non-maintained understory.	**Low Suboptimal:** Riparian areas with tree stratum (dbh > 3 inches) present, with >30% tree canopy cover and a maintained understory. Recent cutover (dense vegetation).	**High Marginal:** Non-maintained, dense herbaceous vegetation with either a shrub layer or a tree layer (dbh > 3 inches) present, with <30% tree canopy cover.	**Low Marginal:** Non-maintained, dense herbaceous vegetation, riparian areas lacking shrub and tree stratum, hay production, ponds, open water. If present, tree stratum (dbh >3 inches) present, with <30% tree canopy cover with maintained understory.	**High Poor:** Lawns, mowed, and maintained areas, nurseries; no-till cropland; actively grazed pasture, sparsely vegetated non-maintained area, recently seeded and stabilized, or other comparable condition.	**Low Poor:** Impervious surfaces, mine spoil lands, denuded surfaces, row crops, active feed lots, trails, or other comparable conditions.	
		High	Low	High	Low	High	Low	
Condition Scores	1.5	1.2	1.1	0.85	0.75	0.6	0.5	

1. Delineate riparian areas along each stream bank into Condition Categories and Condition Scores using the descriptors.
2. Determine square footage for each by measuring or estimating length and width. Calculators are provided for you below.
3. Enter the % Riparian Area and Score for each riparian category in the blocks below.

Ensure the sums of % Riparian Blocks equal 100

Right Bank	% Riparian Area>	100%						100%			
	Score >	1.5									
									CI= (Sum % RA * Scores*0.01)/2		
Left Bank	% Riparian Area>	100%						100%	Rt Bank CI >	1.50	CI
	Score >	1.5							Lt Bank CI >	1.50	1.50

REACH CONDITION INDEX and STREAM CONDITION UNITS FOR THIS REACH

NOTE: **The CIs and RCI should be rounded to 2 decimal places. The CR should be rounded to a whole number.**

THE REACH CONDITION INDEX (RCI) >>	**0.75**
RCI= (Riparian CI)/2	
COMPENSATION REQUIREMENT (CR) >>	**92**
CR = RCI X LF X IF	

INSERT PHOTOS:

Example of Reach 13

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