Project Name: Black Brook Stream Crossing Assessment
Subaward Number: SNEPWG21—12-SMF
Grant and Reporting Period: January 1, 2022 - June 30, 2024)
Subawardee Organization: Sheriff's Meadow Foundation
Project Leader: Kristen Geagan, geagan@sheriffsmeadow.org, 508-693-5207
Report Type: Final

Black Brook Stream Crossing Assessment
FINAL REPORT

SNEPWG21-12-SMF

08/01/2024

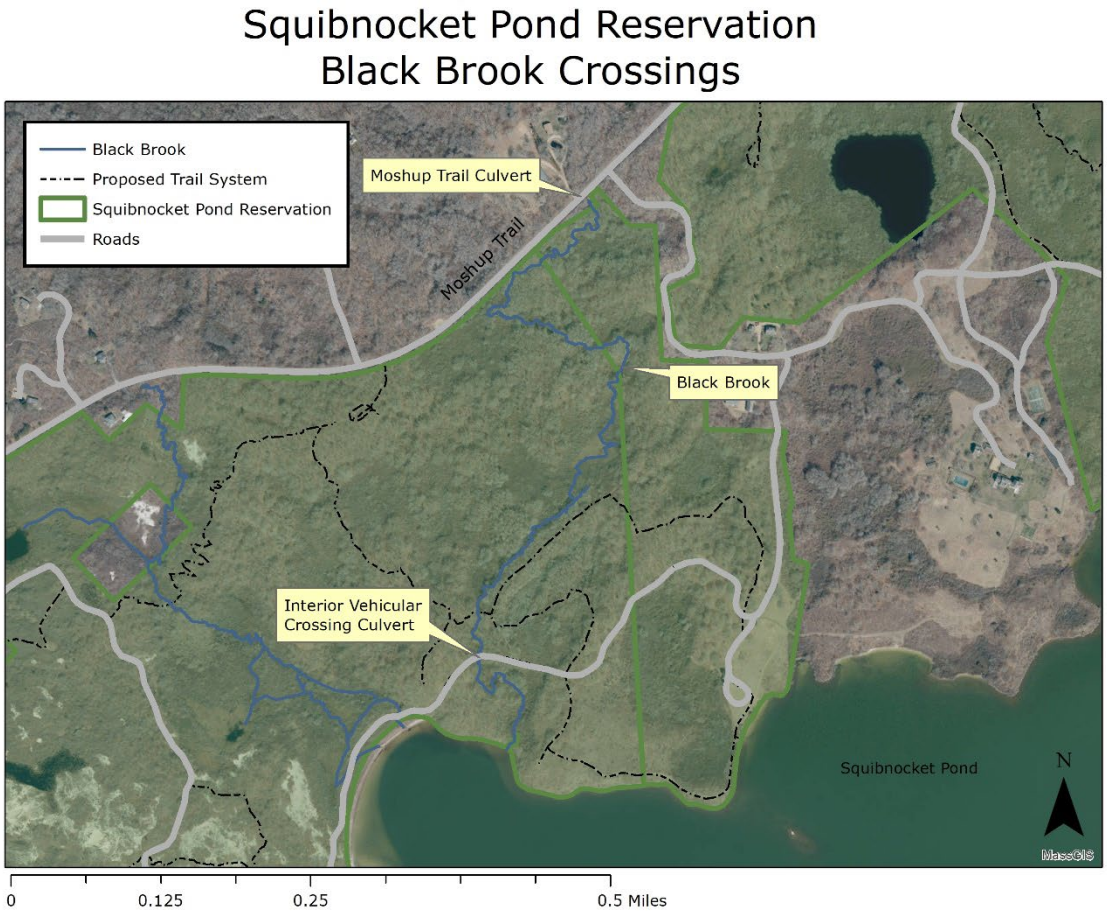
Executive Summary:

Roth Woodlands Stream Restoration and Culvert Replacement Project

The Sheriff's Meadow Foundation (SMF) project that was originally funded by Southeast New England Program (SNEP) Watershed Grant was the Roth Woodland Culvert Replacement Project. That project has been held up in court and at MA DEP by appeals from the abutters. We are working on negotiating an agreement with the abutters, but due to concerns about timing, we revised the scope of work and received approval by the SNEP to reallocate the funding to the Black Brook Stream Crossing Assessment. The only work completed for the Roth Woodlands project under the SNEP grant was the development of a Quality Assurance Project Plan (QAPP) covering all the data collected in the original scope of work.

Black Brook Stream Crossing Assessment

SMF contracted with Horsley Witten Group to assess three Black Brook stream crossings on the Squibnocket Pond Reservation property in Aquinnah, MA. The scope of the project focused on the section of Black Brook from Moshup Trail to where it empties into Squibnocket Pond. The first crossing is a Town owned culvert under Moshup trail, the second is an interior vehicular dirt road crossing, and the third was a proposed pedestrian suspension bridge. The latter two locations occur on Squibnocket Pond Reservation, a property owned jointly by Sheriff's Meadow Foundation (SMF) and the Martha's Vineyard Land Bank (MVLB). The intended outcome of the project was collection of existing conditions and site assessment of all three locations, alternative designs and permitting for the two SMF/MVLB owned structures and the development and approval of a Quality Assurance Project Plan (QAPP) covering all the data collected in the scope of work. As the project progressed the scope of work was revised to eliminate the pedestrian bridge crossing and include an alternatives analysis of the Town owned culvert. The Black Brook Stream Crossing Assessment is supported by Southeast New England Program (SNEP) Watershed Grants. SNEP Watershed Grants are funded by the U.S. Environmental Protection Agency (EPA)through a collaboration with Restore America's Estuaries (RAE). For more on SNEP Watershed Grants, see www.snepgrants.org. The results of this project provide increased resiliency from climate change impacts, and otherwise improve habitat and transportation conditions for SMF and its visitors, the Aquinnah Wampanoag tribal community (the Tribe), the Town of Aquinnah (the Town), and other stakeholders.



Moshup Trail Culvert

The Moshup Trail Culvert is a 73’ long, 3’ in diameter reinforced concrete pipe installed with a 3% slope. Horsley Witten Group (HW) conducted an assessment of the town owned culvert including the collection

of existing conditions data, a site survey (including a longitudinal profile, stream cross sections and bankfull width), streamflow measurements, water level monitoring, sediment sampling and resource area delineations. The baseline hydraulic and hydrological data collected was used to model and evaluate the potential flow restriction caused by the culvert.
The water level data showed that during high flow events the culvert creates a considerable flow restriction causing water to back up upstream of the structure. A scour pool has developed downstream of the culvert that had approximately 1' of accumulated sediment at the time of HW's site visit. Sediment samples collected showed that sediment in the Black Brook is essentially free of contaminants.

The Moshup Trail culvert is undersized, not embedded, does not have a natural bottom and does not meet the openness ratio. HW presented two alternative culvert replacements that meet Massachusetts Stream Crossing Standards and improve flow and passage for aquatic animals. To meet the openness ratio two culvert sizes were proposed, both of which would be embedded 2' to provide a natural stream bottom. One alternative is a 10'x8'box culvert (PR M1) and the other is a 16'x6' box culvert (PR M2).

Interior Vehicular Crossing

The interior bridge crossing consists of a 12.5' x 14' x 4' concrete box culvert. HW conducted an assessment of the interior vehicular crossing owned by Sheriff's Meadow Foundation and the Martha's Vineyard Land Bank over which the abutters have an access easement. Data collected included the collection of existing conditions data, a site survey (including a longitudinal profile, stream cross sections and bankfull width), streamflow measurements, water level monitoring, soil boring, sediment sampling and resource area delineations. The water level data collected was used to support hydraulic modeling and to develop alternatives and preliminary replacement design.

The culvert bottom is slightly sloped creating varied elevation and flow depth across the culvert. The culvert is perched and not embedded. Both ends of the culvert are slightly perched 6-9' above the stream bed in the immediate vicinity and 2' above the natural stream bottom. The field stone wingwalls have also partially collapsed into the stream further creating obstacles and supporting the accumulation of debris.

HW presented 3 alternatives to improve passage for aquatic animals. The first alternative proposed is to use the existing culvert but lower it to the natural stream bed. This alternative would have 1ft of

embedment which does not meet Standards but is an improvement over the existing conditions. The second alternative proposed is to replace the existing culvert with a 12x6 concrete box culvert which meets Massachusetts Stream Crossing Standards. The third alternative is to leave the existing box culvert and create a series of rock weirs downstream of the culvert spanning the hydraulic gap and creating fish passage.

Potential Pedestrian Suspension Bridge

HW began the initial data collection of the proposed bridge location including resource area delineation. The proposed location was reviewed by HW, Vineyard Land Surveying, SMF and MVLB. It was determined that the steepness of the slopes, sensitive habitat, and limited access to the site created significant obstacles. The initial location was withdrawn from the scope of work and replaced with an alternate location 400' upstream. This revised location requires a longer boardwalk over bordering vegetation but a much simpler boardwalk over Black Brook. SMF and MVLB will be completing the design and permitting for this boardwalk crossing in-house.

Hydrologic and Hydraulic Analysis

Using the data collected, HW developed a 2-D model of the stretch of the Black Brook from the Moshup Culvert to the opening into Squibnocket Pond. Parameters were determined by comparing the streamflow measurements recorded for the Black Brook with a reference stream gauge. Based on this comparison, the Black Brook is anticipated to run dry during periods of low precipitation. HW data collection occurred during a wetter time of year, and they suggest additional monitoring during late summer and fall to determine if the brook does run dry seasonally. The model was used to compare existing conditions to the proposed alternatives and a "pred-development model" that reflects natural flow without any impediment.

The two alternatives proposed for the Moshup Trail crossing lowered water surface elevation upstream of the culvert. Of the alternatives PR M2 performed better, lowering the upstream elevation to almost pre-development levels and keeping the downstream elevation constant.

All three of the alternatives proposed for Interior Road Crossing improve fish passage, but if the Black Brook does run dry seasonally as inferred by the refence stream gauge, fish passage would still be a

challenge during low flow periods. Natural stream hydraulic can only be improved by eliminating the perched conditions of the existing culvert. Of the two culvert alternatives proposed, both resulted in lower water surface elevation with minimal difference between the results. The alternative to reuse the existing culvert is significantly more cost effective.

Project Budget Report

The original project budget was $215,404 with $138,842 grant funded and $76,562 match. The budget was revised with the scope of work and project location change from Roth Woodlands to Black Brook in June 2023. The revised budget total was $183, 052 with $138,587 grant funded and $44,465 funded by match. The match was made up of SMF staff hours, volunteer hours by MVLB staff and cash contribution from SMF.

Summary Budget Table 2: Expenditures by Federal Cost Category

SNEPWG21-12-SMF

SNEPWG21-12-SMF
Budget Report June 15, 2024 - June 30, 2024

Budget Category	Total Budgeted Funds	Total Budgeted Match	Grant Funds Expended This Period	Grant Funds Expended Cumulative	Match Fund Expended This Period	Match Funds Expended Cumulative	Match Source (note cash or in-kind)
Personnel	$0.00		$0	$0	$34		in-kind
Fringe	$0.00		$0	$0	$13		in-kind
Travel	$0.00	$0.00	$0	$0	$0	$0	
Equipment	$0.00	$0.00	$0	$0	$0	$0	
Supplies	$0.00	$0.00	$0	$0	$0	$0	
Contracts	$138,587		$57,500.00	$129,969.43	$1,800		cash
Other	$0.00		$0	$0	$0		volunteer
Total Direct	$138,587		$0	$0	$0	$0	
Indirect	$0.00		$0	$0	$0	$0	
Total	**$138,587**	**$44,095**	**$57,500.00**	**$129,969.43**	**$1,846.72**	**$31,416.49**	

Summary Budget Tables 3: Expenditures by Project Task (Grant Funds Only)

Budget Category	Budgeted Grant Funds	Expended Progress Period 1	Expended Progress Period 2	Expended Progress Period 3	Expended Progress Period 4	Expended Progress Period 5	Actual Expended to Date
Task 1 - Contractual	$112,487	-	-	-	-	$115,242	115,242.25
Task 2 - QAAP Black Brook	$10,000	-	-	-	$8,140.00	-	8,140.00
Task 3 - QAAP Roth Woodlands	$7,200	-	$3,846.88	$2,740.50	-	-	6,587.38
Total	$129,687	-	3,846.88	2,740.50	8,140.00	-	129,969.63

Next Steps

SMF and MVLB will share this HW report with the Town of Aquinnah and Wampanoag Tribe of Gay Head (Aquinnah). Outcomes regarding the replacement of the Town owned culvert would be a Town decision requiring Town meeting and outside grant funding through programs such as the Culvert Replacement Municipal Grant Program administered by MA DER. The alternatives proposed for the Interior Road Crossing will be evaluated by the SMF and MVLB Boards. Factors to consider are cost and ecological benefits. The estimate for the first alternative which re-uses the existing culvert was $255,000 versus $383,000 to replace the existing culvert with a completely new one. Although it doesn't quite meet MA Stream Crossing Standards, the first option of re-using the existing culvert but embedding it appears to be the most cost-effective solution and provides the same hydrological connection as a complete replacement with a new structure. If this option is selected by SMF and MVLB boards, SMF and MVLB would pre-consult with the Aquinnah Conservation Commission and MA Department of Environmental Protection to ensure that the plan satisfied their concerns before pursuing funding. Once the alternative design choice is confirmed, fundraising will be necessary to pay for the cost of permitting and construction. Fundraising will include applying for grants, private donations and funds allocated directly from SMF and MVLB. If fundraising is successful, the projected timeline for project completion is 5 years.

Certification

The undersigned verifies that the descriptions of activities and expenditures in this final report are accurate to the best of my knowledge; and that the activities were conducted in agreement with the grant contract. I certify that the matching fund levels established in the grant contract and reported here have been met.

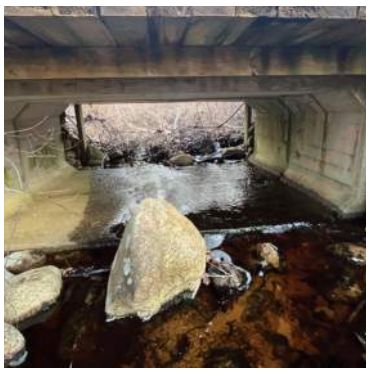
Grantee Signature: Kristen Geagan
Name: Kristen Geagan
Job Title: Director of Stewardship
Date: 07/31/2024
Organization: Sheriff's Meadow Foundation

BLACK BROOK STREAM CROSSING ASSESSMENT

Aquinnah, Massachusetts

June 2024






Prepared for:
Sheriff's Meadow Foundation
Vineyard Haven, MA

Horsley Witten Group

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Figures:

Attachments:

1. INTRODUCTION

The Horsley Witten Group, Inc. (HW) is pleased to submit to the Sheriff's Meadow Foundation (SMF) this Stream Crossings Alternatives Analysis Assessment and Design report. The report summarizes field data collection activities, assessment and preliminary design work for two stream crossing locations along Black Brook in Aquinnah, Massachusetts (the Project Area). The Project is funded by a grant from the Southeast New England Program (SNEP) with project support from the SMF and Martha's Vineyard Land Bank (MVLB) (the Project Partners). The Project is closely aligned with the 2021 Squibnocket Pond Reservation Management Plan prepared by the SMF and MVLB Commission, who collaborated to purchase the surrounding lands in 2020-2021.[1]

As the Project was funded through a SNEP grant (awarded in collaboration with Restore America's Estuaries (RAE)), a Quality Assurance Project Plan (QAPP) was submitted to the U.S. Environmental Protection Agency (EPA) for review on January 19, 2024, and approved on January 22, 2024. The QAPP established project scope, field activities, and quality assurance/control measures to ensure successful project execution and data collection.

The Black Brook culvert replacement sites are located on the 323-acre Squibnocket Pond Reservation land (Figures 1 and 2). The project area is generally the run of the brook from shortly upstream of Moshup Trail down to shortly upstream of where the brook discharges to Squibnocket Pond. The Moshup Trail stream crossing culvert is located at the northern extent of the project area. Black Brook's headwaters are comprised of a wetland complex located north of Moshup Trail and west of State Road, and the Brook flows approximately one mile north to south.

Image 1. Wooden Vehicle Crossing Looking West (March 19, 2024)

[1] December 20, 2021 Squibnocket Pond Reservation Management Plan, Aquinnah, Massachusetts

Horsley Witten Group
Sustainable Environmental Solutions

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Service Layer Credits: USGSTopo: USGS The National Map: National Boundaries Dataset, 3DEP Elevation Program, Geographic Names Information System, National Hydrography Dataset, National Land Cover Database, National Structures Dataset, and National Transportation Dataset; USGS Global

Date: 6/21/2024
Data Sources: Bureau of Geographic Information (MassGIS), ESRI

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Project Work Area

Stream Crossing Assessment
Black Brook, Aquinnah MA

Figure 1
USGS Locus

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Sustainable Environmental Solutions

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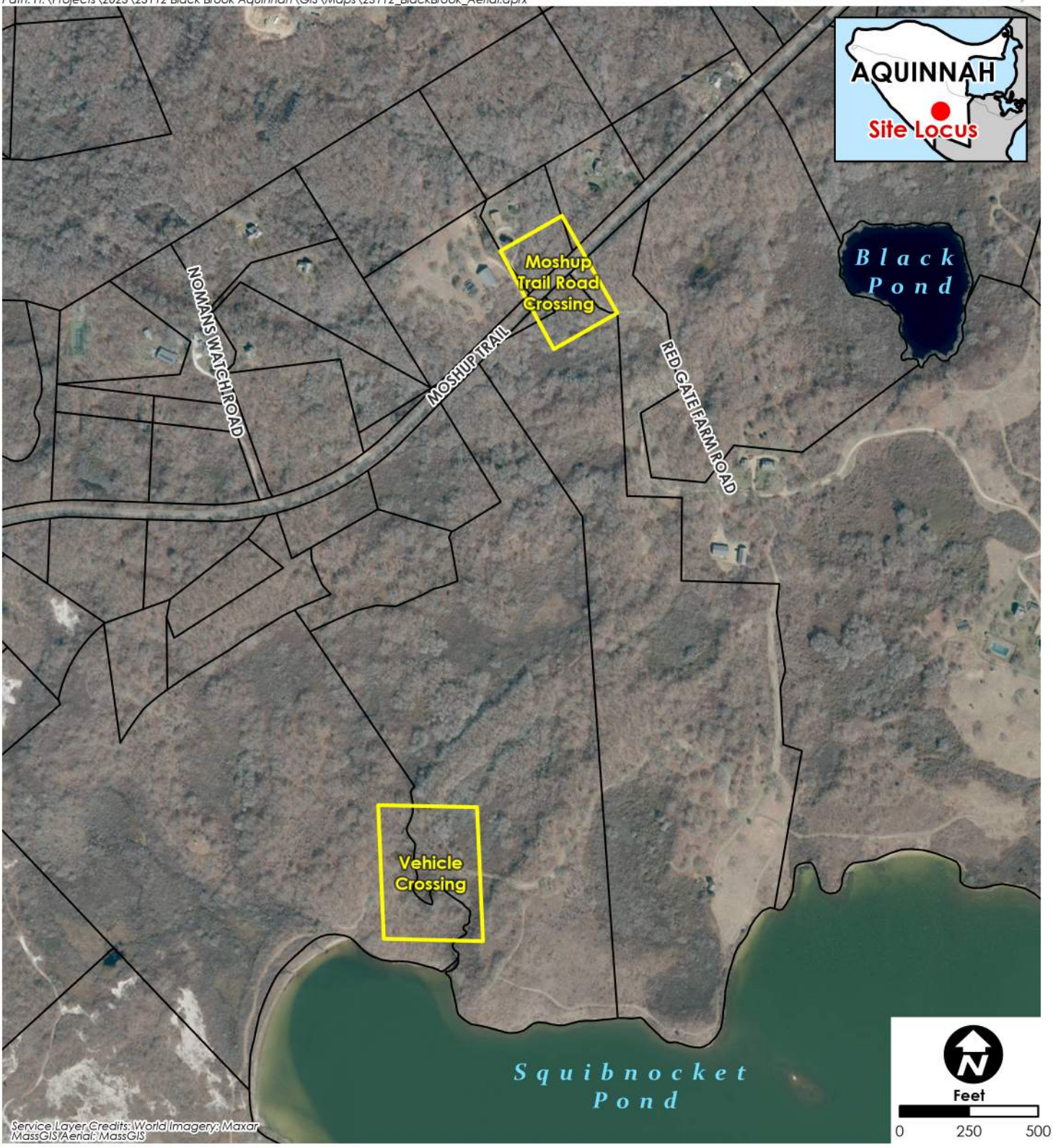

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Data Sources: Bureau of Geographic Information (MassGIS), ESRI

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Project Work Area
Parcels

Stream Crossing Assessment
Black Brook, Aquinnah MA

Figure 2
Aerial

Black Brook empties into Squibnocket Pond, a shallow coastal pond within the Towns of Aquinnah and Chilmark on the southern shore of Martha's Vineyard that is separated from the Atlantic Ocean by a thin barrier beach. The approximately 600-acre coastal pond provides unique habitat and supports a wide variety of species. The Pond is mostly fresh water but does receive periodic ocean water overwash of the barrier beach during some storms, as well as limited tidal exchange with Menemsha Pond, to the north, via a herring run that passes through a culvert located under State Road.[2]

In this report all left and right directional references are relative to the direction of river flow looking downstream; river left refers to the river's left (generally approximately east) bank and river right refers to the river's right (generally west) bank. All elevation data given in this report are relative to the NAVD88 vertical datum in units of feet.

Figure 3 identifies the areas of focus for the Project and key features discussed in this Report , including:

Moshup Trail Crossing (Figure 3):

Moshup Trail is a Town owned, paved road. This culvert has ownership interests with the Town, the Aquinnah Wampanoag tribal community (the Tribe), and SMF. The Moshup Trail stream crossing culvert is owned by the Town and thus did not receive all of the design considerations during this Project as did the second Project crossing owned by SMF. More advanced design of a Moshup Trail culvert replacement could potentially occur in future Project Phases if desired by the Town and SMF.

Image 2. Moshup Trail Crossing Upstream Culvert (March 19, 2024)

[2] Squibnocket Pond 2019, Martha's Vineyard Commission

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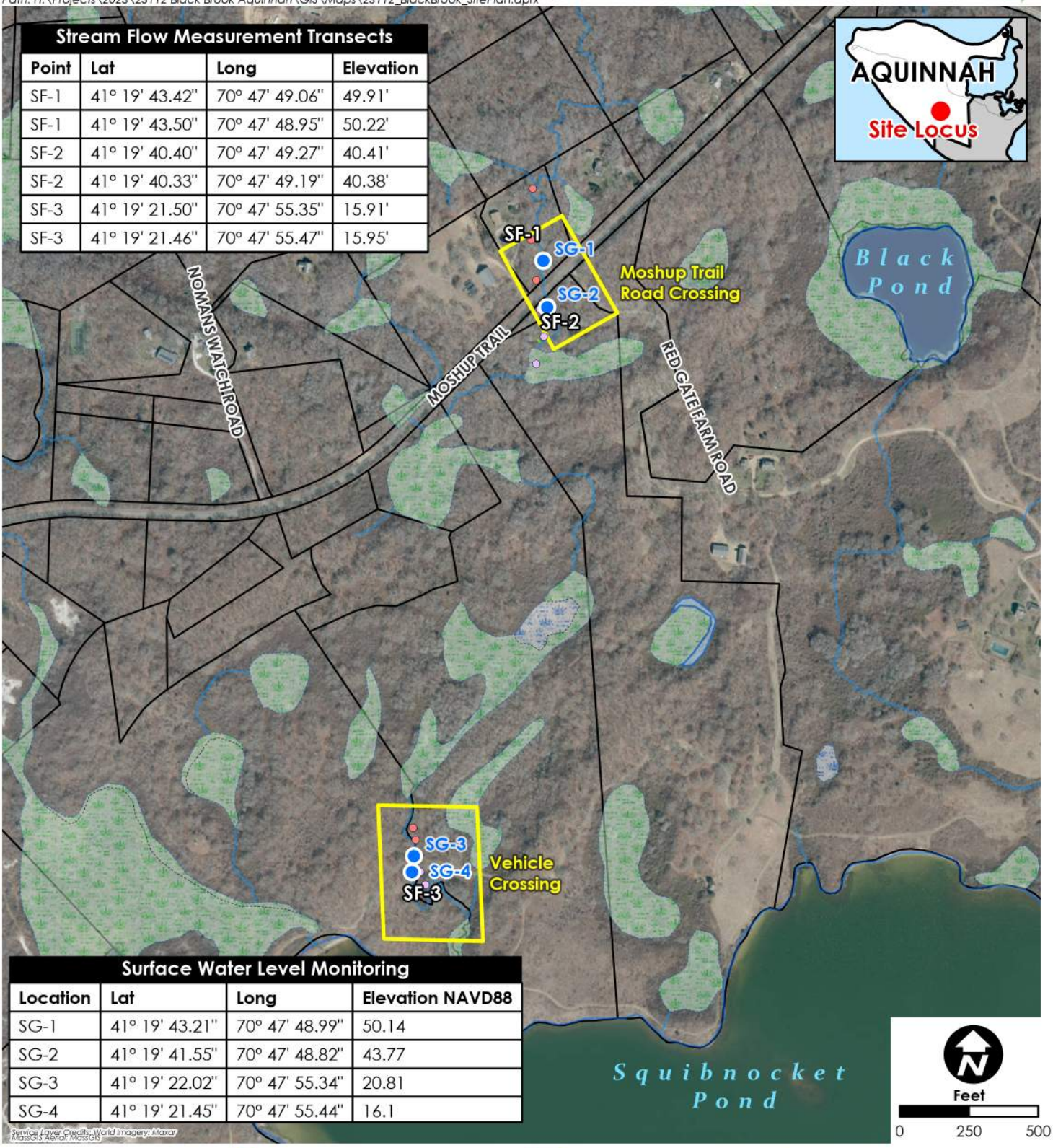

Stream Flow Measurement Transects

Point	Lat	Long	Elevation
SF-1	41° 19' 43.42"	70° 47' 49.06"	49.91'
SF-1	41° 19' 43.50"	70° 47' 48.95"	50.22'
SF-2	41° 19' 40.40"	70° 47' 49.27"	40.41'
SF-2	41° 19' 40.33"	70° 47' 49.19"	40.38'
SF-3	41° 19' 21.50"	70° 47' 55.35"	15.91'
SF-3	41° 19' 21.46"	70° 47' 55.47"	15.95'

Surface Water Level Monitoring

Location	Lat	Long	Elevation NAVD88
SG-1	41° 19' 43.21"	70° 47' 48.99"	50.14
SG-2	41° 19' 41.55"	70° 47' 48.82"	43.77
SG-3	41° 19' 22.02"	70° 47' 55.34"	20.81
SG-4	41° 19' 21.45"	70° 47' 55.44"	16.1

Service Layer Credits: World Imagery: Maxar
MassGIS Aerial: MassGIS

Date: 6/20/2024
Data Sources: Bureau of Geographic Information (MassGIS), ESRI

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- Surface Water Level Monitoring
- Stream Transects

Sediment Sample Locations
- Downstream
- Upstream

- Project Work Area
- Parcels

DEP Wetlands Linear Features
- Shoreline
- Hydrologic Connection

- Wetland Limit
- Closure Line

DEP Wetland Areas
- Marsh/Bog
- Wooded marsh
- Open Water

Stream Crossing Assessment
Black Brook, Aquinnah MA

Figure 3
Site Plan

The culvert crossing beneath the roadway consists of an approximately 73-foot long 3-foot diameter reinforced concrete pipe (RCP) with approximately 12-foot wide and 4-foot tall concrete headwall/wingwall ends. The culvert was observed to be in good physical condition, however, the stream morphology immediately downstream of the culvert outfall transitions to a scour pool before reverting to a more natural condition further downstream, indicating that velocity outflow form the culvert is likely excessive during higher flow conditions. Material removed from scour pool during high flow events was observed accumulated immediately downstream. The upstream and downstream inverts of the culvert pipe are vertically situated at elevations 42.53 feet and 40.33 feet, respectively. The downstream culvert outfall was almost entirely submerged by the water level in the scour pool at the time of HW's site visits, with backwatering extending partially up the culvert pipe and approximately one foot of accumulated sediment present in the culvert pipe outlet.

To support potential future restoration project effort at the Moshup Trail culvert, the Project included resource area delineation, and the collection of existing conditions and baseline hydrological data. The data were utilized to support modeling and allow for an evaluation of the extent of potential flow restriction posed by the culvert, as discussed in Sections 4 and 5.

Wooden Vehicle Crossing (Figure 3):

A wooden vehicle crossing over Black Brook is located approximately 1,700 feet downstream of Moshup Trail, on an SMF/MVLB-owned dirt road. The vehicle crossing construction features a 12.5-foot wide by 4-foot tall concrete box culvert set slightly above the stream bed grade, with a wooden timber deck and railing spanning the stream on top of the box culvert structure. At the time of HW's site visits, stream flow was limited to the left side of the box culvert, as depicted in Image 3. Boulders and rocks from the left bank of the crossing have fallen into Black Brook, capturing wooden/organic debris and further restricting flow.

Image 3. Wooden Vehicle Crossing Downstream Culvert (March 19, 2024)

At the wooden vehicle crossing location, the Project included resource area delineation and the collection of existing conditions and baseline hydrologic data to support hydraulic modeling and preliminary replacement design, with future permitting and final design to be completed in fullfilling the scope of the Project.

Potential Pedestrian Bridge:

A core component of SMF's management of the Squibnocket Pond Reservation is promoting outdoor recreational opportunities that align with responsible land stewardship principles. An existing pedestrian trail network allows visitors to observe the unique habitat and landscape characteristics of the Reservation, with future enhancements to the trail network planned.

During the initial stages of the Project, Project Partners identified a location approximately 300' downstream of the wooden vehicle crossing, and shortly upstream of Squibnocket Pond, as a desirable area for potential pedestrian bridge. During HW's initial visit to the proposed location, the steep topography of the stream banks at this location and surrounding vicinity were identified as significant hurdles to the design and construction of a pedestrian bridge. Subsequent discussion between HW and SMF eliminated this initial location from consideration, and it was decided to remove this potential pedestrian bridge crossing from HW's Scope of Work for the Project. SMF is independently pursuing an alternative crossing location, approximately 400 feet upstream of the wooden vehicle crossing, where a much simpler boardwalk structure can achieve the desired crossing objective. HW delineated wetlands resource areas at the alternative crossing location.

2. SCOPE OF WORK

The scope of data collection activities completed in support of the Project was finalized in the Project QAPP and field activities were initiated in March 2024. The project tasks were as follows:

- Existing Conditions Data Collection: HW began this task by compiling existing GIS data to inform more detailed field data collection activities. Figure 4 depicts Massachusetts Department of Environmental Protection (MassDEP) wetlands, Natural Heritage and Endangered Species Program (NHESP) estimated and priority habitats, and related environmental constraints. Figure 5 depicts Federal Emergency Management Association (FEMA) flood mapping. Figure 6 depicts MassGIS soils data.

Image 4. Black Brook north of Moshup Trail (March 20, 2024)

Field Data Collection:

Field survey work included the following activities, discussed in greater detail in Section 3.0:

- Streamflow measurements at each of the crossing locations on two separate occasions;
- Water level monitoring using continuous water level loggers at four locations along Black Brook;
- Resource area delineations in the immediate vicinity of the crossings, identification and documentation of key infrastructure and utilities in the immediate vicinity of the crossings;
- Site field survey utilizing Real Time Kinematic Global Positioning System (RTK GPS) and traditional Total Station equipment. Site field survey extended approximately 100 feet upstream and downstream of both the Moshup Trail and Wooden Vehicle crossings; and,
- Completion of a soil boring and sediment sampling from Black Brook to provide an understanding of subsurface geology and sediment quality characteristics.

- Crossings Alternatives Assessment: This task included hydrologic and hydraulic (H&H) modeling of Black Brook flow under existing and potential restored conditions at Moshup Trail and the wooden vehicle crossing with a variety of different hydrologic scenarios in order to evaluate potential stream crossing / culvert replacement options and associated hydraulic impacts. H&H modeling is discussed in greater detail in Sections 4 and 5.
- Design & Engineering: HW evaluated several options for culvert replacement at both the Moshup Trail and the wooden vehicle crossing locations based on the H&H modelling. Additional information relative to the culvert options is provided in Section 5, below. For the wooden vehicle crossing, the two preferred alternatives have been advanced to the 60% preliminary design level. An Opinion of Probable Cost (OPC) accompanying the 60% design is included as Attachment A. Because the Moshup trail crossing is not owned by SMF, design of a culvert replacement at this location is not part of HW's Scope of Work.

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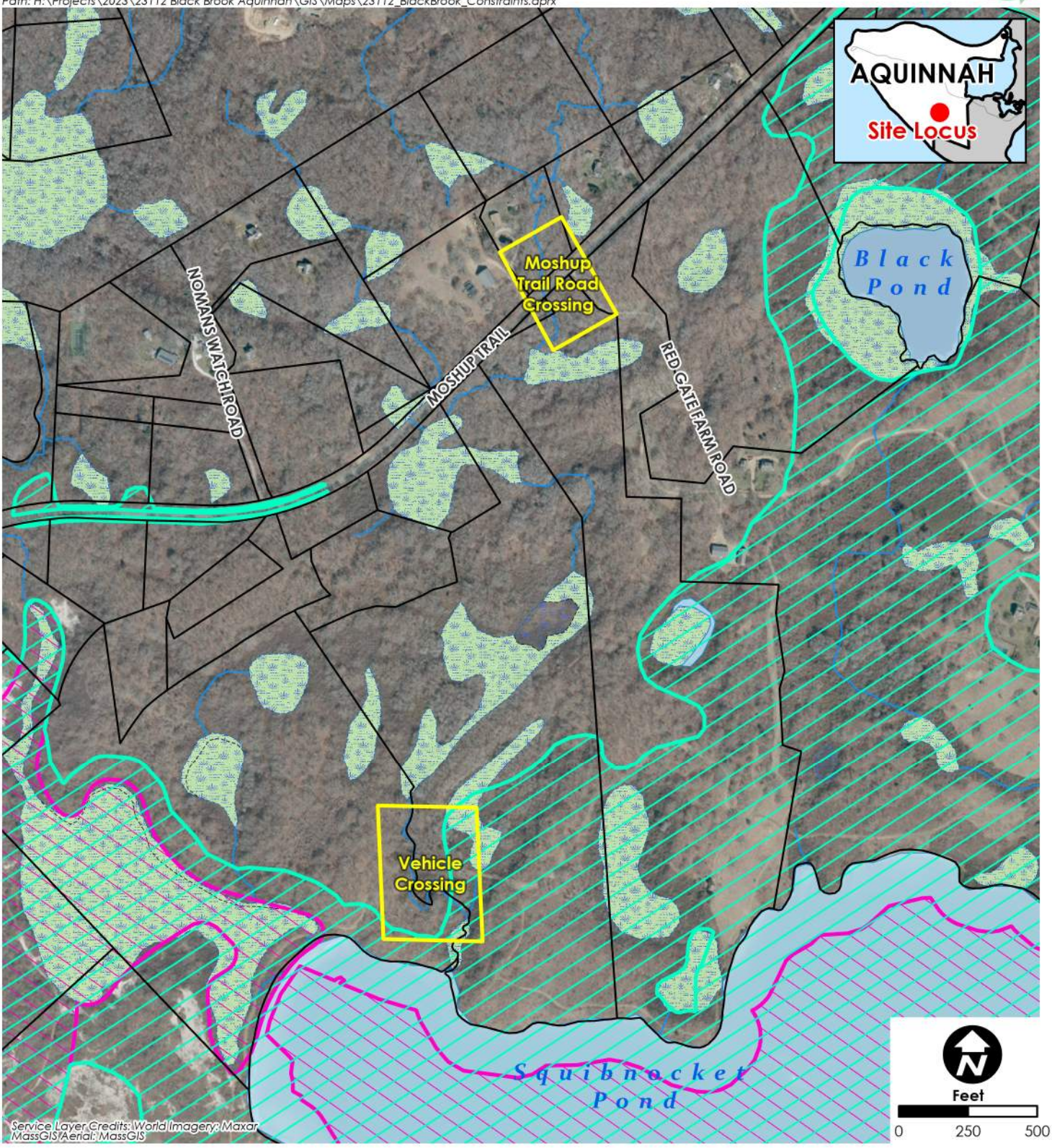

Date: 6/18/2024
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- Project Work Area
- Parcels
- NHESP Priority Habitats of Rare Species
- NHESP Estimated Habitats of Rare Wildlife
- DEP Wetlands (2005)
  - Shoreline
  - Hydrologic Connection
  - Wetland Limit
  - Closure Line
  - Marsh/Bog
  - Wooded marsh
  - Open Water

Stream Crossing Assessment
Black Brook, Aquinnah MA

Figure 4
MassDEP Constraints

Horsley Witten Group
Sustainable Environmental Solutions

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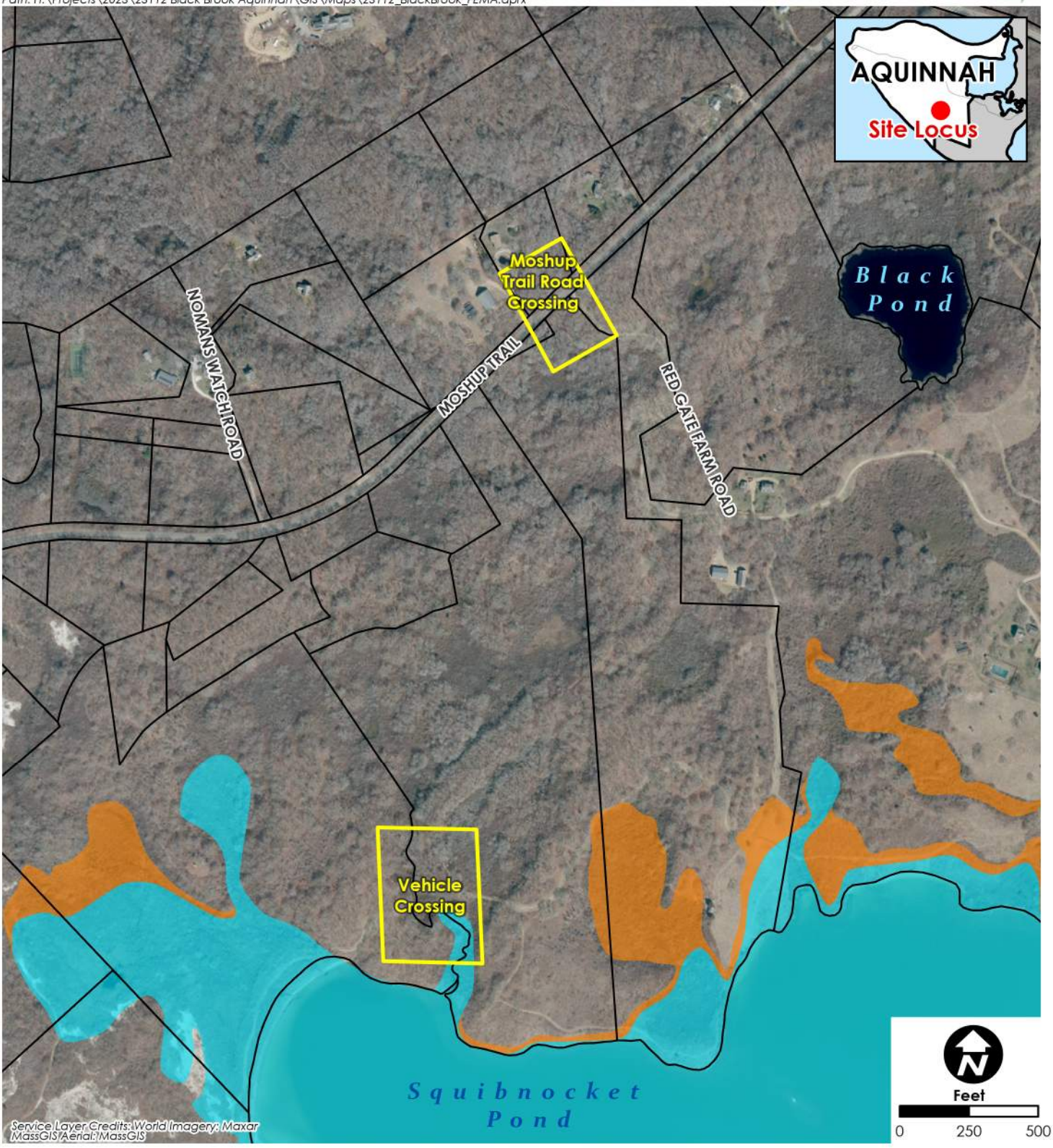

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Project Work Area
Parcels

Flood Hazard Zones
1% Annual Chance Flood Hazard
0.2% Annual Chance Flood Hazard

Stream Crossing Assessment
Black Brook, Aquinnah MA

Figure 5
FEMA Flood Zones

Horsley Witten Group
Sustainable Environmental Solutions

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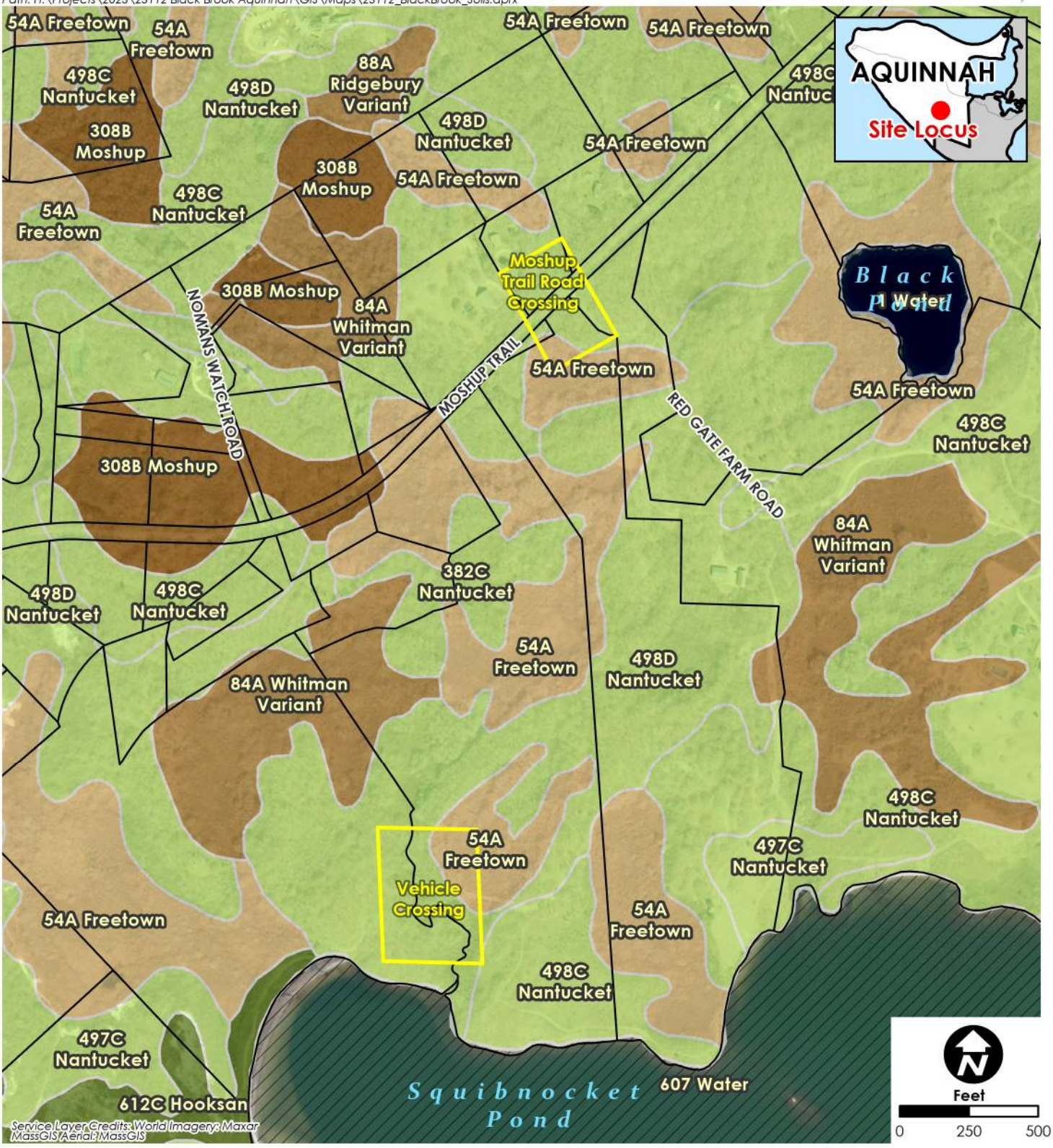

Date: 6/18/2024
Data Sources: Bureau of Geographic Information (MassGIS), ESRI

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Project Work Area
Parcels
Hydrologic Soil Group
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A
B
B/D
C/D
D

Stream Crossing Assessment
Black Brook, Aquinnah MA

Figure 6
Soils

3. FIELD DATA COLLECTION

Field data collection was conducted over several months in early 2024 (March through May). Data collection activities and data are summarized below.

3.1 Existing Conditions Survey

Two days of field work were conducted on March 19 and 20, 2024 to initiate collection of field data, including an existing conditions survey of the Project Area utilizing RTK. At the Moshup Trail and wooden vehicle crossing, culvert dimensions, invert elevations, and pertinent features (i.e. drainage structures or utilities) of the roadway and wooden crossing platform were surveyed. Topographic survey of the surrounding landscape was extended approximately 100 feet upstream and 100 feet downstream, of each crossing location. To support an evaluation of stream geomorphology, the bottom of the stream channel was surveyed to establish a longitudinal profile, and cross sections of the stream were surveyed to establish bankfull conditions and flood plain connectivity. The existing conditions survey, longitudinal profile, and stream cross sections are included as Sheets 2-5 in Attachment B.

Image 5. Typical Bankfull Width Segment Location

Bankfull width is typically measured both upstream and downstream of hydraulic restrictions within a watershed. HW staff measured natural bankfull widths at three locations in the Project Area, beginning approximately 100 feet upstream of Moshup Trail, and continuing further downstream. Bankfull width estimates are summarized in Table 1 and average 5.25 feet.

Table 1. Bankfull Width Measurements

Location	Bankfull Width (ft)	Latitude	Longitude
SF-1	3.5	41.3287	-70.7969
SF-2	4.25	41.3287	-70.7969
SF-3	8.0	41.3226	-70.7987
Average	5.25		

3.2 Surface Water Monitoring

Staff gages SG-1 through SG-4 were installed along Black Brook, upstream and downstream of the Moshup Trail and wooden vehicle crossings. Staff gage and surface water monitoring locations are depicted on Sheets 3 and 4 in Attachment B, and Images 6 and 7. At each staff gage location, a VanEssen™ TD-Diver water level datalogger was installed beneath the water surface and pre-programmed to collect pressure (water column) measurements at 15-minute intervals. An additional datalogger was installed in an upland location to collect barometric pressure data to compensate the water column measurement data for prevailing changes in atmospheric pressure. The elevation at the top of each staff gage was collected via RTK GPS, and a depth to water surface measurement was collected. The dataloggers were retrieved from the Project Site on May 15, 2024. The water column measurements were compensated utilizing the barometric pressure data, and elevation and depth to surface water measurements were used to convert the datalogger measurements into North Atlantic Vertical Datum 1988 (NAVD88).

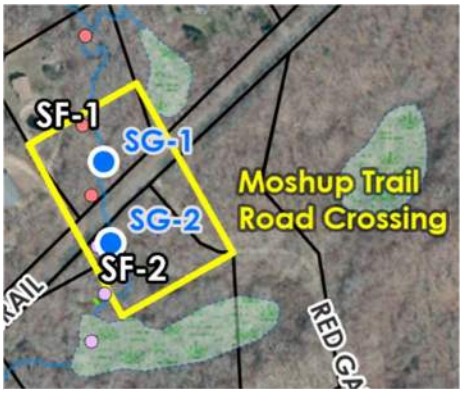


Image 6. Moshup Trail Locations

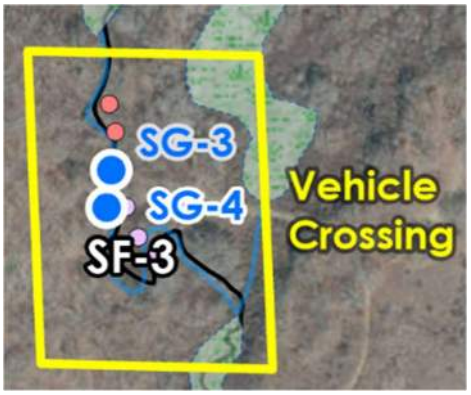


Image 7. Vehicle Crossing Locations

Overall water level data for both crossing locations is depicted on Figure 7 and Figure 8 depicts a zoomed in view of an approximately 10-day time period characterized by two large rainfall events. Precipitation data was obtained from National Oceanic and Atmospheric Administration (NOAA) weather stations in Chilmark and the Martha's Vineyard Airport. The surface water monitoring data show similar rapid responses to precipitation for all four monitoring locations, indicating that the brook is significantly responsive to rainfall. There is also close correlation from upstream to downstream monitoring locations for both crossings, indicating that significant flow restrictions are not posed by either culvert under most hydrologic conditions that occurred over the monitoring period.

Closer examination of the water level record for Moshup Trail shown on Figure 9 indicates that, at its peak, the water level upstream of the culvert rose 32% more (0.28 feet) than it did downstream of the culvert in response to 3.4-inch rainfall event on April 4th, indicating that the culvert does pose a significant enough flow restriction during higher flow events to back up water behind it.

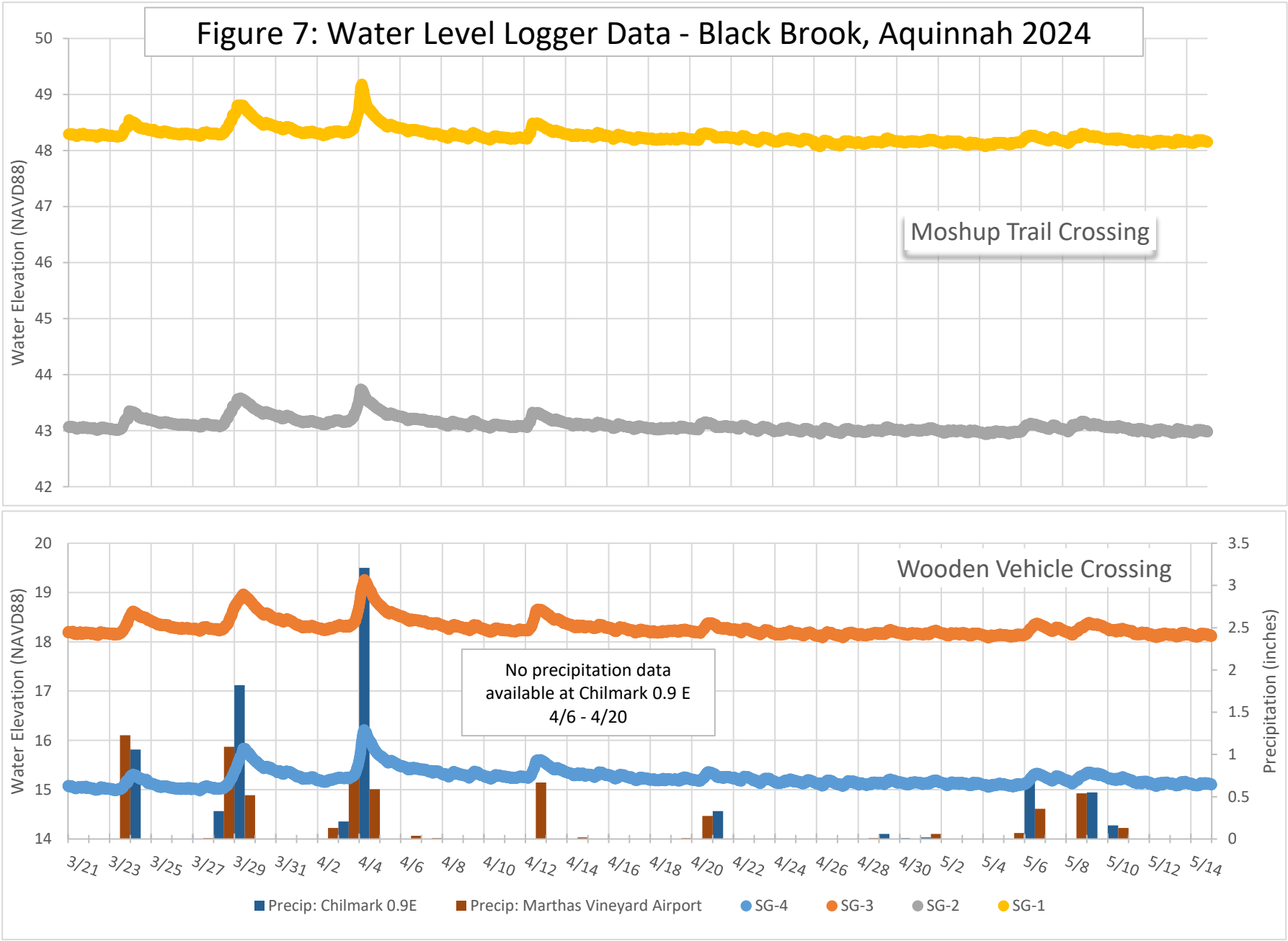


Figure 7: Water Level Logger Data - Black Brook, Aquinnah 2024
Water Elevation (NAVD88)
50
49
48
47
46
45
44
43
42
Moshup Trail Crossing
Wooden Vehicle Crossing
No precipitation data
available at Chilmark 0.9 E
4/6 - 4/20
Water Elevation (NAVD88)
20
19
18
17
16
15
14
Precipitation (inches)
3.5
3
2.5
2
1.5
1
0.5
0
3/21
3/23
3/25
3/27
3/29
3/31
4/2
4/4
4/6
4/8
4/10
4/12
4/14
4/16
4/18
4/20
4/22
4/24
4/26
4/28
4/30
5/2
5/4
5/6
5/8
5/10
5/12
5/14
Precip: Chilmark 0.9E
Precip: Marthas Vineyard Airport
SG-4
SG-3
SG-2
SG-1

Figure 8: Water Level Logger Data - Black Brook, Aquinnah 2024

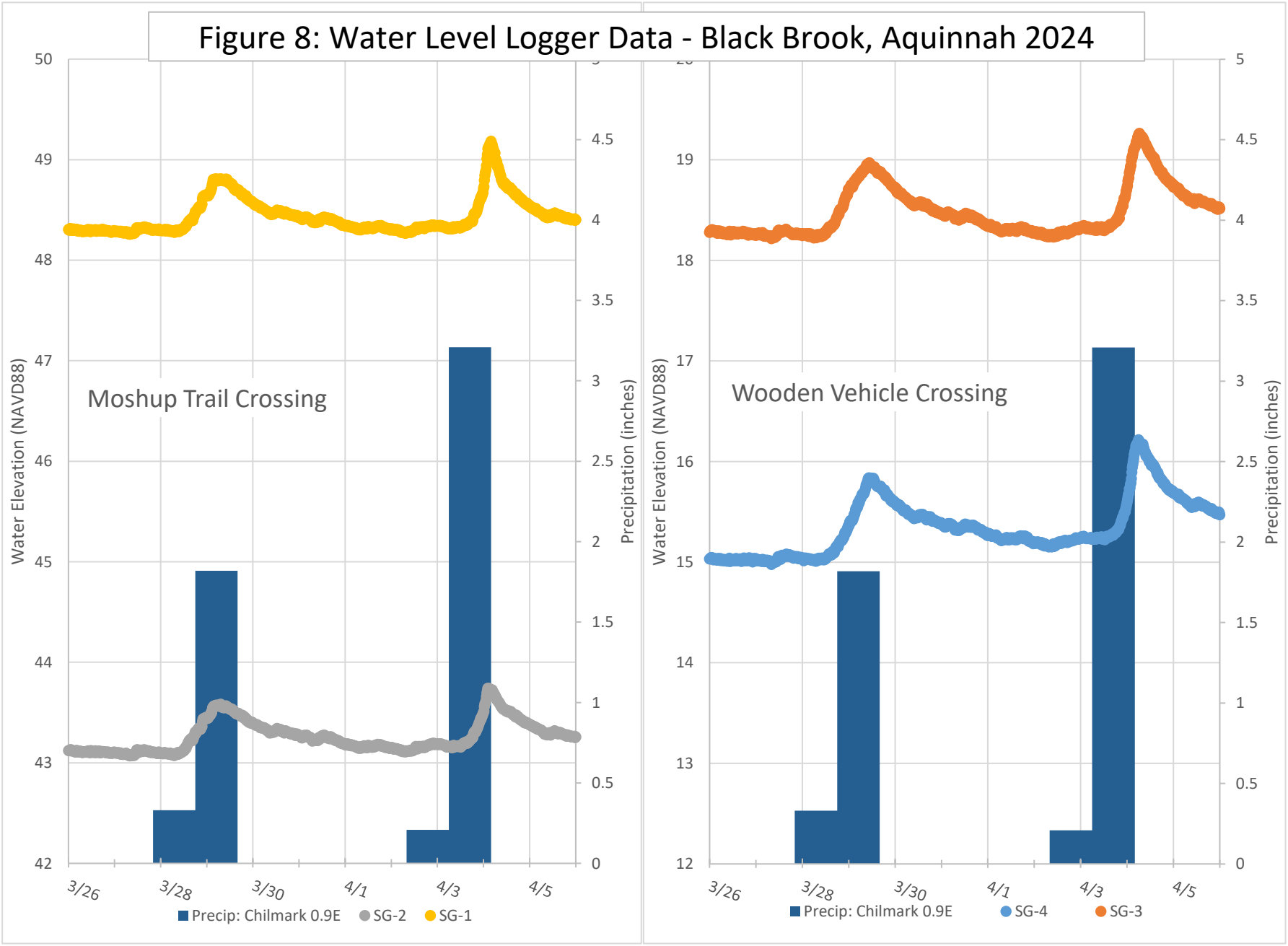
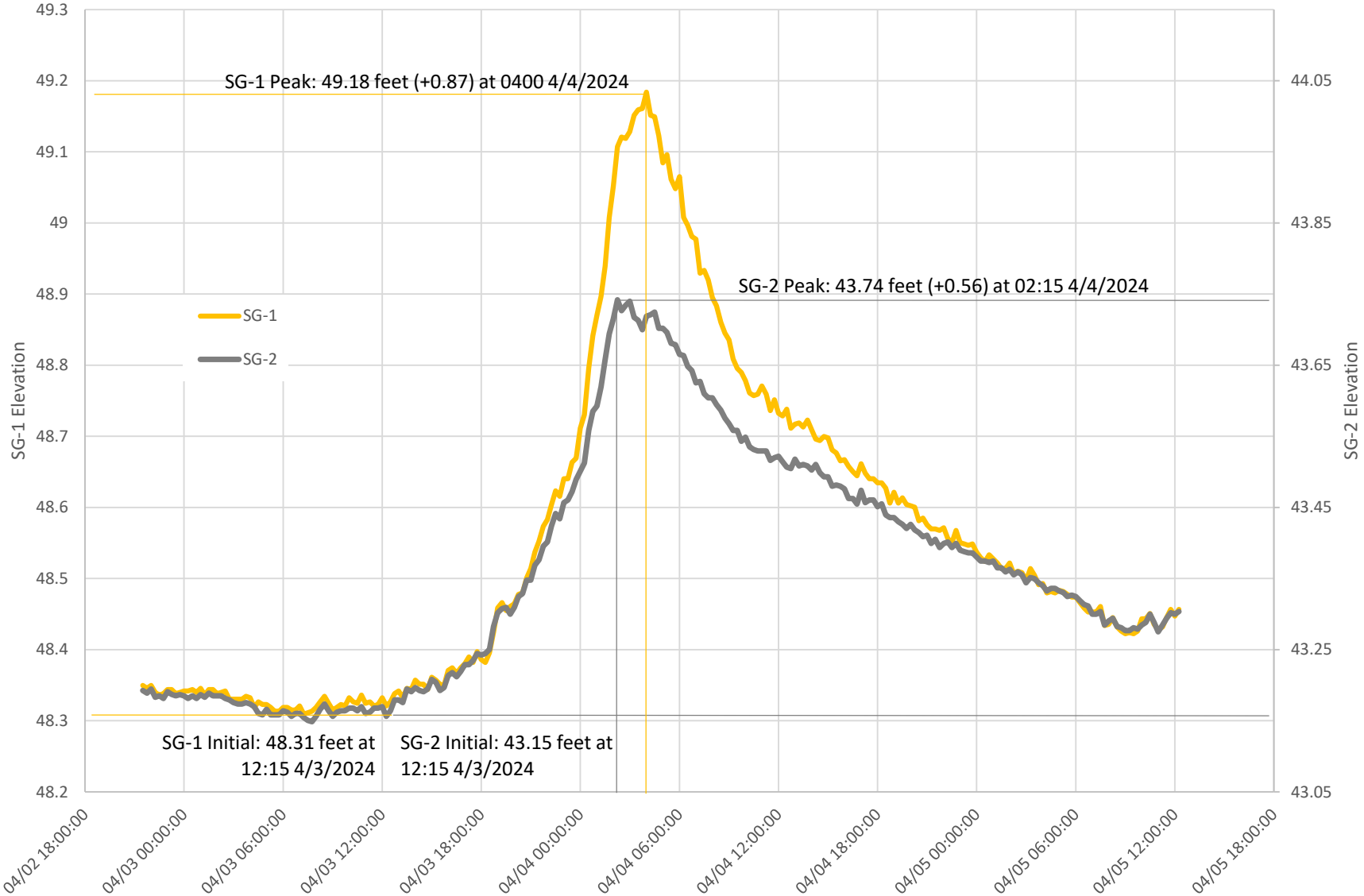


Figure 9: Water Level Response at SG-1 and SG-2
(3.4 inch Rain Event Overnight on April 3-4, 2024)



3.3 Stream Flow Measurements

Streamflow measurements were collected on March 19, 2024 at three locations (SF-1 through SF-3) along Black Brook (Figure 3). Streamflow discharge measurements were collected in accordance with the United States Geologic Survey (USGS) document *Measurement and Computation of Streamflow: Volume 1. Measurement of Stage and Discharge.* At each streamflow measurement location, stream surface water depth was recorded, and velocity (in feet per second) was measured utilizing a Marsh-McBirney Model 2000 Flo-Mate portable flowmeter mounted on a USGS Topset Wading Rod. On May 15, 2024, a second set of streamflow measurements was collected at the same locations utilizing the same approach. The stream depth and velocity measurements were compiled in an excel spreadsheet to calculate discharge in cubic feet per second (cfs), and are summarized in Table 2, below. Additional discussion of the hydrology of Black Brook, with a comparative evaluation to a nearby reference stream with historical flow data, is provided in Section 5.

Table 2. Stream Flow Measurements

Location	Date	Discharge (cfs)
SF-1	3/19/2024	0.429
	5/15/2024	0.098
SF-2	3/19/2024	0.420
	5/15/2024	0.229
SF-3	3/19/2024	0.526
	5/15/2024	0.200

3.4 Wooden Vehicle Crossing Soil Boring

Image 8. Wooden Vehicle Crossing Soil Boring

On May 15, 2024, a soil boring was completed in the center of the SMF/MVLB-owned dirt road on the western approach to the wooden vehicle crossing to evaluate subsurface geological conditions. The soil boring was completed by Geosearch of Sterling, Massachusetts, using 4.25" diameter hollow stem auger drilling equipment. Continuous soil samples were collected from the boring with 2 foot long 2-inch inner diameter stainless steel split spoons to a completion depth of 24 feet below ground surface (bgs). Split spoon samples were collected by driving with a hammer with blow counts recorded for each 6 inches of spoon advancement. Subsurface soil materials encountered ranged from very fine/fine to medium/coarse sand down to a depth of 15 feet bgs, with some clayey fine sand observed from 15 to 24 feet bgs. No organic material deposits were encountered. Groundwater was encountered in the soil boring at approximately 7 feet bgs, roughly equal to the observed level of Black Brook in relation to the soil boring location. The observed materials do not appear to pose a limiting factor for design and construction of an appropriately sized replacement structure at the wooden vehicle crossing location. A soil boring log is included as Attachment C.

3.5 Sediment Sampling

On May 15, 2024, four sediment samples were collected from Black Brook and submitted for laboratory analysis of key parameters, consistent with the MassDEP 401 Water Quality Certification (WQC) requirements established at 314 CMR 9.00**.**

A limited due diligence review was completed prior to sediment sampling and consisted of a review of MassDEP records of reported releases of oil and/or hazardous materials (OHM) on the Massachusetts Executive Office of Energy & Environmental Affairs data portal.[3] There were no reported OHM release sites in the vicinity of Black Brook or upstream of the Project Area that appeared to have the potential to result in impacts to sediment quality within the Brook. A review of historical maps and aerial photographs revealed only minor changes in land use over time with most of the watershed remaining as primarily open space and agricultural land, albeit with an increasing component of low-density residential development over time.[4]

Sediment samples were collected upstream and downstream of both the Moshup Trail and wooden vehicle crossings, in the vicinity of the previously installed staff gages (SG-1 through SG-4) and are depicted on Figure 3. Each laboratory sediment sample was comprised of three grab samples that were composited into one sample for laboratory analysis. At each grab sample location, a stainless steel auger was advanced into the shallow sediment in the channel, and visually observed for appearance/physical characteristics. Based upon the above-discussed due diligence review, and in consideration of the MassDEP 401 WQC, the sediment samples were submitted to ESS Laboratory of Cranston, RI, for the following analyses:

- Resource Conservation and Recovery Act (RCRA) 8 Metals (Arsenic, Cadmium, Chromium, Copper, Lead, Mercury, Nickel, and Zinc);
- Extractable Petroleum Hydrocarbons (EPH) and Polycyclic Aromatic Hydrocarbons (PAHs);
- PCBs with congeners;
- Total Organic Carbon
- Percent Water; and
- Grain Size Distribution.

Laboratory sediment quality results were entered into the standard Massachusetts Division of Ecological Restoration (DER) sediment quality spreadsheet for comparison to Massachusetts Contingency Plan (MCP) standards for human health as well as the key ecological Threshold Effects Concentrations (TEC) and Probable Effects Concentrations (PEC) for freshwater. The DER spreadsheet is included with ESS Laboratory analytical report 24E0926 in Attachment D. Key observations from the sediment sampling are as follows:

[3] https://eeaonline.eea.state.ma.us/portal#!/search/wastesite/results?TownName=AQUINNAH

[4] December 20, 2021 Squibnocket Pond Reservation Management Plan, Aquinnah, Massachusetts

- Chromium, lead, and zinc were present at all of the locations at relatively low concentrations and did not exceed any of the DER criteria.
- Arsenic was present at concentrations below the DER criteria in the upstream and downstream samples collected at the wooden vehicle crossing, but below laboratory detection limits at the Moshup Trail crossing.
- PAHs were below laboratory detection limits in three of the four sediment samples. In the sample collected downstream of the wooden vehicle crossing, fluoranthene, phenanthrene, and pyrene were present at relatively low concentrations and did not exceed any of the DER criteria.
- PCB congeners were below laboratory detection limits in all four sediment samples.
- EPH were below laboratory detection limits in all four sediment samples.
- Grain size analysis indicated relatively consistent grain size distribution across all four samples, with sediment consisting of brown poorly graded sand with gravel, with relatively low total organic content ranging from below laboratory detection limits (250) to 20,600 parts per million (ppm).

Sediment sampling activities indicate that sediment quality within Black Brook is relatively free of contaminants across the Project Area and is unlikely to pose any significant ecological risk or permitting challenges. Additional sediment sampling may be necessary to support future MassDEP permitting requirements in the event that proposed improvements to either of the stream crossings require significant sediment or resource area disturbance.

3.6 Resource Area Delineation

HW wetland biologists delineated wetland resource areas within the Project Area in March 2024. Throughout this section of the report, the area around Moshup Trail is referred to as Area 1, and the area where the stream crosses under the wooden vehicle crossing is referred to as Area 2. Wetland resource area delineations were performed along the upstream and downstream sections of these existing stream crossings. At Area 2 delineation was extended further upstream to include the area identified as a potential future pedestrian pathway location for SMF (outside of HW Scope of Work) as discussed in Section 1.0.

HW followed wetland resource area identification and on-site delineation procedure guidelines described in the Massachusetts *Wetlands Protection Act* (M.G.L. Ch. 131 § 40), its implementing Regulations (310 CMR 10.00), as well as the Town of Aquinnah Wetland Bylaw (Chapter XXIV). Delineation of Bordering Vegetated Wetland (BVW) resource areas was completed in accordance with the procedures and guidelines described in the MassDEP handbook, entitled *Massachusetts Handbook for Delineation of Bordering Vegetated Wetlands* (September 2022).

The Project Area supports freshwater wetland resource areas. Jurisdictional areas identified at or adjacent to the site include Inland Bank; Bordering Vegetated Wetland (BVW); Riverfront Area (RA); Land Under Water Bodies and Waterways (LUW), and the 100-foot and 200-foot Buffers to Bank and BVW.

Prior to conducting field delineations, HW reviewed existing source data, including USGS Geological Survey 7.5 minute topographic maps, MassDEP wetlands source data available through the Massachusetts Geographic Information System (MassGIS), United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) soils survey, U.S. Fish and Wildlife Service National Wetland Inventory (NWI) maps, and other source data to identify the presence of jurisdictional wetlands and waters of the United States within the site. This information was used to compile base maps to assist in the understanding of the hydrologic variables, soils conditions, and vegetation communities prior to commencing field visits.

A brief description of the regulatory definitions and the observed resources areas is provided below, refer to Sheets 3 and 4 of the Existing Conditions Plans included as Attachment B.

3.6.1 Bank (Inland)

Bank is defined at 310 CMR 10.54(2)(a) as "*the portion of land surface which normally abuts and confines a water body. It occurs between a water body and a vegetated bordering wetland and adjacent floodplain, or, in the absence of these, it occurs between a water body and an upland. A Bank may be partially or totally vegetated, or it may be comprised of exposed soil, gravel or stone. The upper boundary of a Bank is the first observable break in the slope or the mean annual flood level, whichever is lower. The lower boundary of a Bank is the mean annual low flow level*" [310 CMR 10.54(2)(c)].

The Aquinnah Wetlands applies the same Inland Bank definition found in 310 CMR, as stated above.

The Project Site supports Banks along both sides of the Black Brook channel for both Areas 1 and 2 of the Project Site. The upper boundaries of the Banks were determined by a combination of field indicators of bankfull conditions including changes in slope, changes in vegetation, stain lines, changes in bank material, and bank undercuts.

Area 1

The upper boundary of the Bank was located on both sides of Black Brook, north and south of the stream's crossing at Moshup Trail.

North of Moshup Trail, the stream has a well-defined channel with a tall, steep rising slopes on both the west (river right) and east (river left) sides of the stream, with the exception of a section on the east side, further north of Moshup Trail, where there is a shorter, steep-rising slope that then flattens out briefly adjacent to the stream before rising steeply to the east again.

South of Moshup Trail, the stream fans out into smaller braided channels, where the west side (river right) of the stream maintains a more distinct main channel and Bank, defined by a short, steep rising slope that then flattens out into floodplain BVW area between the steam and a slope that rises steeply toward Moshup Trail. The east side (river left) of the stream's braided

section has a flatter topography consisting of smaller, less-defined channels that transitions into a floodplain BVW adjacent to the steam, which is bounded by a steeper-rising slope further to the east.

Vegetation observed along the Banks on both sides of Moshup Trail include red maple (*Acer rubrum*), black gum (*Nyssa sylvatica*), sweet-pepperbush (*Clethra alnifolia*), maleberry (*Lyonia Ligustrina*), American witch-hazel (*Hamamelis virginiana*), highbush blueberry (*Vaccinium corymbosum*), skunk-cabbage (*Symplocarpus foetidus*), and various sedges (*Carex spp.*) and fern species. Vegetation observed within the uplands directly adjacent to the Banks include American beech (*Fagus grandifolia*), black oak (*Quercus velutina*), white oak (*Quercus alba*), American holly (*Ilex opaca*), sweet-pepperbush, American witch-hazel, round-leaf greenbrier (*Smilax rotundifolia*), and Japanese honeysuckle (*Lonicera japonica*).

HW delineated the landward boundary of the Banks with a series of consecutive blue flagging stations labeled as follows:

North of Moshup Trail

- BANK 100 to BANK 106 (river left/east side);
- BANK 107 to BANK 115 (river right/west side);

South of Moshup Trail

- BANK 200 to BANK 206 (river right/west side);
- BANK 207 to BANK 213 (river left/east side);

Area 2

The upper boundary of the Bank was located on both sides of Black Brook, north and south of the stream's crossing at the wooden vehicular structure. North of the vehicular crossing, the stream has a well-defined channel with tall, steep rising slopes on both the west (river right) and east (river left) sides of the stream. South of the vehicular crossing, the stream has a well-defined channel with tall, steep rising slopes on both the west (river right) and east (river left) sides of the stream.

Vegetation observed along the Banks on both sides of the vehicular crossing include red maple, gray willow (*Salix cinerea*), sweet-pepperbush, winterberry (*Ilex verticillata*), arrowwood viburnum (*Viburnum dentatum*), highbush blueberry, round-leaf greenbrier, grape (*Vitis sp.*), soft rush (*Juncus effusus*), sensitive fern (*Onoclea sensibilis*), skunk-cabbage and various grass and moss species. Vegetation observed within the uplands directly adjacent to the Banks include black oak, white oak, black cherry (*Prunus serotina*), autumn olive (*Elaeagnus umbellate*), sweet-pepperbush, American witch-hazel, highbush blueberry, arrowwood viburnum, and round-leaf greenbrier (*Smilax rotundifolia*).

HW delineated the landward boundary of the Banks with a series of consecutive blue flagging stations labeled as follows:

North of the Vehicle Crossing

- BANK 300 to BANK 305 (river right/west side), and
- BANK 306 to BANK 310 (river left/east side);

South of Vehicle Crossing

- BANK 400 to BANK 404 (river left/east side), and
- BANK 405 to BANK 409 (river right/west side);

3.6.2 Bordering Vegetated Wetland

Bordering Vegetated Wetland (BVW) is defined at 310 CMR 10.55(2)(a) as: "*freshwater wetlands that border on creeks, rivers, streams, ponds and lakes. The types of freshwater wetlands are wet meadows, marshes, swamps and bogs. Bordering Vegetated Wetlands are areas where the soils are saturated and/or inundated such that they support a predominance of wetland indicator plants. The boundary of Bordering Vegetated Wetland is defined at 310 CMR 10.55 (2)(c) as the line within which 50% or more of the vegetational community consists of wetland indicator plants and saturated or inundated conditions exist.*"

The Aquinnah Wetlands applies the same Bordering Vegetated Wetland definition found in 310 CMR, as stated above.

The Project Site supports forested swamp BVW areas adjacent to Black Brook at Area 1 (Moshup Trail) and there is shrub swamp BVW area located within 200 feet of Area 2. The boundaries of these wetlands were determined via a combination of observed field variables indicating hydric conditions, including vegetation, soils, and hydrology, as well as desktop analysis and use of MassGIS wetland data layers.

AREA 1

Area 1 supports forested swamp BVW wetlands adjacent to both sides of Black Brook on the south side of Moshup Trail. These wetlands occur within relatively flat, broad floodplain areas adjacent to the streams channel. These wetlands are confined by slopes rising north toward Moshup Trail (west side of Black Brook) and to the east toward Red Gate Farm Road (east side of Black Brook).

There are no BVW wetland areas located north of Moshup Trail, due to the steeper topography occurring adjacent to the stream channel in this location.

Commonly observed vegetation within the forested wetland areas south of Moshup Trail include red maple, black gum, sweet-pepperbush, highbush blueberry, American witch-hazel, round-leaf green-brier, grape, skunk-cabbage, sensitive fern, and various sedge, rush, and grass species. Common vegetation observed in upland areas adjacent to the forested wetlands include white oak, black oak, sassafras (*Sassafras albidum*), American witch-hazel, sweet-pepperbush, highbush blueberry, and round-leaf greenbrier.

HW delineated the landward boundary of the BVW areas with a series of consecutive pink flagging stations labeled BVW 100 to BVW 102 (west of Black Brook) and BVW 103 to BVW 105 (east of Black Brook).

AREA 2

BVW wetland areas do not occur within the immediate vicinity of Area 2; however, there is a shrub swamp BVW located within 200 feet of the proposed project activity to the northeast of Area 2. HW used MassGIS wetland data from MassMapper (2024) to show the approximate 100-foot and 200-foot buffer boundaries from this BVW wetland area on the proposed project plans (see Sheet 4 of the Existing Conditions Plans). Detailed assessment of these more distal wetlands was beyond HW's scope of effort for the Project activity being proposed for Area 2 of the current Project Site. It is HW's understanding that the Sheriff's Meadow Foundation (SMF) is considering a potential trail improvement project that would include a proposed pedestrian crossing of this BVW wetland, as well as another crossing at a section of Black Brook north of Area 2. SMF work on those proposed crossings will include more detailed assessment of the wetland boundaries at these locations. HW delineated the wetlands resources in these areas, but the flag locations were GPS-located by SMF. All work at these other potential crossing locations was beyond HW's Scope of Work for the project activity being proposed for Area 2 of the current Project Site.

3.6.3 Riverfront Area

Riverfront Area is defined at 310 CMR 10.58(2)(a)(3) as *"the area of land between a river's mean annual high-water line measured horizontally outward from the river and a parallel line located 200 feet away (…)"*

2. Mean Annual High-water Line of a river is the line that is apparent from visible markings or changes in the character of soils or vegetation due to the prolonged presence of water and that distinguishes between predominantly aquatic and predominantly terrestrial land. (…).

The Aquinnah Wetlands applies the same Riverfront Area definition found in 310 CMR, as stated above.

The mean annual high-water (MAHW) line of Black Brook at the Project Site coincides with the upper boundary of the delineated Banks along the edge of the channel and was determined by a combination of field indicators of bankfull conditions including changes in slope, changes in vegetation, stain lines, changes in bank material, and bank undercuts. The Riverfront Area extends outward from the MAHW line and overlaps with adjacent BVW and upland areas, including the buffer zones associated with Bank and/or BVW.

3.7 FEMA Designation

According to the Federal Emergency Management Agency (FEMA) National Flood Hazard Map (Community Panel No. 25007C0158J, effective July 20, 2016) the Project Area is located within an Area of Minimal Flood Hazard, Zone X (Image 9-10).

Image 9. Excerpt from the Federal Emergency Management Agency (FEMA) FIRMette for Moshup Trail crossing

Image 10. Excerpt from the Federal Emergency Management Agency (FEMA) FIRMette for the wooden vehicle crossing

3.8 State-Listed Rare Species Habitat

According to the most recent version of the *Massachusetts Natural Heritage Atlas* (15th Edition, August 1, 2021), the site is not located within areas mapped as *Estimated Habitat of Rare Wildlife, Priority Habitat of Rare Species*, *Certified Vernal Pools*, or *Potential Vernal Pools*, as designated by NHESP (Image 11).

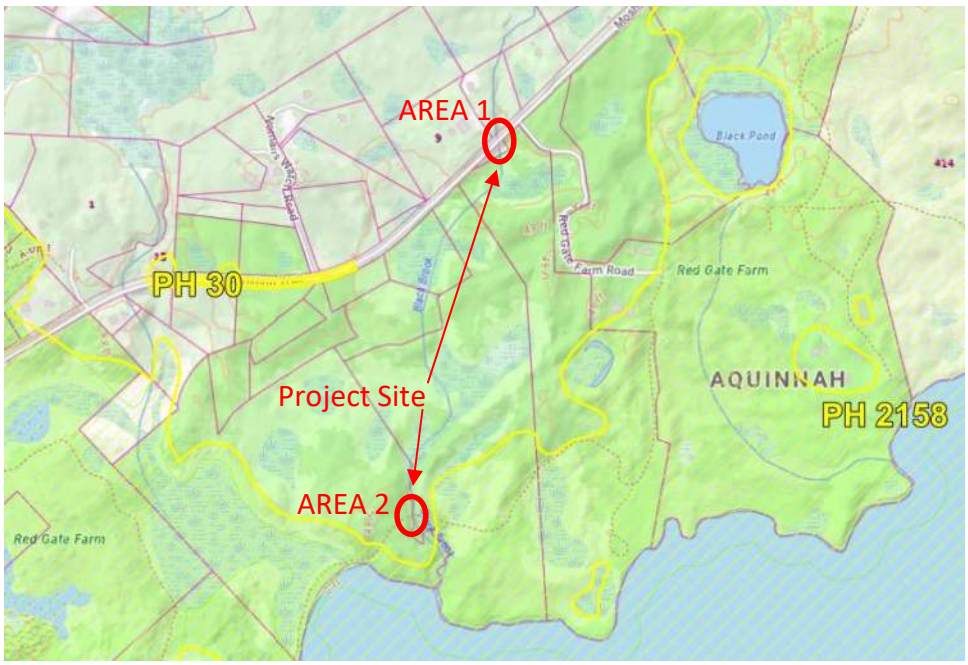


Image 11. Rare species habitat (Source: MassMapper 2024)

4. CULVERT ALTERNATIVES

The existing culvert under Moshup Trail is an approximately 73-foot long, 3-foot diameter RCP culvert with an upstream invert elevation of 42.53 feet and downstream invert elevation of 40.33 (3% slope). The culvert outfall was mostly submerged by the standing water level in the scour pool that has developed downstream of the culvert, and approximately 1 foot of accumulated sediment was present in the outfall at the time of HW's site reconnaissance.

The existing wooden vehicle crossing culvert consists of a 12.5-foot wide by 4-foot-tall concrete box culvert with an average upstream invert elevation of 18.04 feet, and a downstream average invert of 17.50 feet. The culvert bottom is sloped slightly to the left, resulting in varied bottom elevations and flow depth across the width of the culvert. During HW's site reconnaissance, flow was limited to the left two thirds of the culvert and reached a maximum depth of 2.5 inches. The upstream and downstream ends of the culvert are perched approximately 6-9 inches above the immediately adjacent stream channel bed, which may serve as an obstacle to flow during low flow conditions and for passage of aquatic species. The total vertical "perch" of the culvert is, however, closer to two feet when comparing the culvert bottom to the natural channel bottom approximately 10 feet downstream from the culvert. In addition, the field stone wingwalls are deteriorating and have partially collapsed into the brook channel, contributing to the accumulation of vegetative/organic debris.

Massachusetts Stream Crossing Standards (the Standards) developed by the River and Stream Continuity Partnership[5] provide information to evaluate existing crossings and inform future construction methods to enhance stream and habitat connectivity. To determine the optimal stream crossing size to promote aquatic organism passage, stream connectivity, and wildlife passage at the Moshup Trail and wooden vehicle crossing, the following guidelines were incorporated:

1. Spans that preserve the natural stream channel are strongly preferred.
2. If a culvert is used, then it should be embedded a minimum of 2 feet.
3. The stream crossing spans the channel width (a minimum of 1.2 times the bankfull width).
4. Natural bottom substrate exists within the structure.
5. The stream crossing is designed with appropriate bed forms and streambed characteristics so that water depths and velocities are comparable to those found in the natural channel at a variety of flows.
6. "Openness" of the crossing is greater than 0.82. Openness is defined as the ratio of a culvert or crossing's open area (height times width) to its length (the distance from the midpoints of the structure's entrance and exit).

[5] https://www.mass.gov/doc/massachusetts-stream-crossing-handbook/download

7. Banks should be present on each side of the stream matching the horizontal profile of the existing stream banks.

The channel length for the replacement culvert at Moshup Trail and the wooden vehicle crossings were assumed to be equivalent to the existing culvert lengths (73 feet and 14 feet, respectively), with increased height to accommodate embedment in approximately 2 feet of natural material in the bottom of the culvert. Using the measured values and the Standards, the minimum dimensions for each of the culvert replacements are calculated below. Model results for each alternative are discussed in Section 5.

4.1 Moshup Trail

The existing culvert at Moshup Trail fails the Standards in several ways. The 3-foot diameter culvert does not span the channel bankfull width (Standard 3), is not embedded (Standard 2), and does not have a natural bottom (Standard 4). The openness ratio of the existing culvert is 0.097 (7 ft2 / 73 ft = 0.097), which does not meet the minimum openness of 0.82 (Standard 6) There is approximately 7.5 feet of cover above the existing culvert, which allows for a larger culvert.

The longitudinal profile of Black Brook at Moshup Trail (see Attachment B, Sheet 5) indicates that while the culvert slope approximates the natural stream bed, the undersized culvert has created a scour pool and sediment mound just downstream of the culvert that creates perched conditions during lower water time periods. The scoured material creates a high point flow obstruction in the channel shortly downstream from the scour pool.

Standards compliant culvert width is equal to 1.2 X Bankfull Width. In this case that is 1.2 X 4.25 feet = 5.1 feet (minimum). Since culverts are typically available in prescribed widths, the smallest Standards compliant width for this location would be 6 feet. However, to meet the openness criteria for a culvert of this length, a wider and/ or taller structure is needed.

The following Standards-compliant culvert alternatives were evaluated and modeled in HEC-RAS to evaluate the changes in water surface elevation both upstream and downstream of Moshup Trail:

- Alternative PR M1 – Replace existing RCP culvert with a 10-foot wide by 8-foot-high concrete box culvert and embed that 2 feet into the channel bottom to provide a hydraulic height of 6 ft. A 6-foot-wide culvert would be an appropriate selection based solely on the minimum width (5.1 ft). However, the openness ratio requirement dictates that a 6-foot-wide culvert must be 10 feet tall (10 x 6 / 73 = 0.82, minimum ratio). To provide maximum flow area, a culvert with a 60 ft cross sectional area (6x10) was chosen. The invert of the culvert would be 2 feet below the existing culvert invert, to result in an effective invert equivalent to the existing RCP culvert. This matches the approximate elevation of the sediment layer directly upstream of the existing culvert

and the natural longitudinal profile of the stream bed. This alternative meets the Stream Crossing Standards.

  - Width = 10 ft
  - Hydraulic height = 6 ft (total height =8 feet)
  - Openness = Height x Width / Length = 6 ft x 10 ft / 73 ft = 0.82 (> 0.82)

- Alternative PR M2 – Replace existing RCP culvert with a 16-foot wide by 6-foot-high concrete box culvert and embed 2 feet into the channel bottom to provide a hydraulic height of 4 ft. The effective invert of the culvert is equal to Alternative M1, which meets the approximate elevation of the sediment layer directly upstream of the existing culvert and the natural longitudinal profile of the stream bed. This alternative meets the Stream Crossing Standards.
  - Width = 16 ft
  - Hydraulic height = 4 ft (total height = 6 feet)
  - Openness = Height x Width / Length = 4 ft x 16 ft / 73 ft = 0.88 (> 0.82)

4.2 Wooden Vehicle Crossing

The existing culvert at the vehicle crossing is perched above the existing and estimated natural bottom of the stream bed. It is also not embedded, which fails to meet Stream Crossing Standards 2 & 4. The culvert does span the bankfull channel width (meeting Standard 3) and meets the openness criteria (Standard 6).

Standards compliant culvert width is equal to 1.2 X Bankfull Width = 1.2 X 8.0 feet = 9.6 feet (minimum)

The following culvert alternatives were modeled in HEC-RAS to evaluate the changes in water surface elevation both upstream and downstream of the Wooden Vehicle Crossing:

- Alternative PR VC1 – Reuse existing box culvert and lower to natural stream bed. The culvert would have 1 foot embedment, which is less than required by the stream crossing standards, but an improvement on existing conditions. The effective invert of the culvert was lowered to 16.6 feet, which matches the approximate elevation of the natural longitudinal profile of the stream bed. This alternative does not meet the 2 feet of embedment required and therefore does not meet the Stream Crossing Standards, but this alternative would functionally meet the Standards.
  - Width = 12.5 ft
  - Hydraulic height = 3 ft (total height = 4 feet)
  - Openness = Height x Width / Length = 3 ft x 12.5 ft / 14 ft = 2.68 (> 0.82)

- Alternative PR VC2 – Replace existing box culvert with a 12-foot wide by 6-foot-high concrete box culvert and embed 2 feet into the channel bottom to maintain the existing open height of 4 ft. As with Alternative PR VC1, the effective invert of the culvert would be lowered to 16.6 ft, which matches the approximate elevation of the natural

longitudinal profile of the stream bed. This alternative meets the Stream Crossing Standards.

  - Width = 16 ft
  - Hydraulic height = 4 ft (total height =6 feet)
  - Openness = Height x Width / Length = 4 ft x 16 ft / 14 ft = 4.57 (> 0.82)

- Alternative PR VC3 – Leave existing box culvert as is and install a series of rock weirs downstream of the culvert to bridge the hydraulic drop from the culvert invert to the downstream streambed and thereby provide for adequate fish passage. The existing culvert is not embedded and remains perched, so therefore does not meet the Stream Crossing Standards. This option is presented in case the Project Partners choose not to replace the culvert for reasons of cost, logistics, permitting, or other issues.
  - Width = 12.5 ft
  - Hydraulic & total height = 4 ft
  - Openness = Height x Width / Length = 4 ft x 12.5 ft / 14 ft = 3.57 (> 0.82)

Each of these alternatives were modeled in HEC-RAS. Results are discussed in section 5.4 through 5.6.

5. HYDROLOGIC & HYDRAULIC ANALYSIS

HW's hydrologic and hydraulic (H&H) analysis of Black Brook consisted of modeling the subject stretch of the river to provide an understanding of stream behavior and how the Moshup Trail and wooden vehicle crossings affect water levels, flow velocities, fish passage, and sediment transport within the project area. Specifically, this analysis was used to determine the potential future impacts of replacing the 3-foot diameter culvert at Moshup Trail and replacing or improving the wooden vehicle crossing. Hydrology, in this context, refers to the conveyance of precipitation-derived water from the watershed into the brook under different storm events, while hydraulics refers to the flow characteristics of the river resulting from those hydrologic inputs under the same set of various storm conditions.

5.1 Hydrologic Assessment – Peak Streamflow and Exceedance Probability Determination

Key statistical parameters describing high flow events (2-, 5-, 10-, 25-, 50-, 100-, and 200-year flows) and exceedance probabilities of low (95% exceedance probability), average (50% exceedance probability), and high (5% exceedance probability) flows were determined by comparison of streamflow measurements recorded at Black Brook with a nearby United States Geological Survey (USGS) reference stream gage. Note that while flow data from the nearby Mill Brook collected in recent years by the Mill Brook Watershed Management Committee was evaluated for this purpose, the period of record is far too short for use for this Project purpose. The USGS reference stream gage chosen for use on this Project was identified from a set of nearby gaging stations with continuous records available on the USGS StreamStats web-map. No USGS gaging stations (continuous or otherwise) are available on the island of Martha's

Vineyard. Five stations were identified on Cape Cod and Southeastern Massachusetts within approximately 40 miles of the project location. These five stations are:

- Quashnet River at Waquoit Village, MA
- Paskamanset River near South Dartmouth, MA
- Adamsville Brook at Adamsville, Rhode Island
- Rattlesnake Brook near Assonet, MA, and
- Segreganset River near Dighton, MA

Several characteristics of the five nearby stream gaging stations were assessed to determine applicability of those stations for comparison against field data collected at Black Brook. These characteristics include the following:

- Period of record**:** Comparison of streamflow measurements at Black Brook requires contemporaneous measurements of stream discharge at the target reference gaging station.
- Drainage area size**:** Streamflow dynamics are driven by the drainage area upstream of the monitoring point. The drainage area of Black Brook at the SF-2 monitoring point was estimated to be 0.3 mi^2 by the StreamStats web-map delineation tool.
- Surficial Geology**:** Streamflow dynamics are further influenced by the surficial geology material, which effects the amount of baseflow contribution from groundwater and the amount of surficial runoff which rapidly contributes volume to stream discharge in response to storm events.

Evaluation of the five candidate reference stream gages against the characteristics listed above indicate that the Segreganset River near Dighton, MA (station 01109070) was the most appropriate reference stream gage for statistical analysis. The period of record at Segreganset includes the recent 2024 period of streamflow measurement at Black Brook. The drainage area at Segreganset is 10.7 square miles (mi^2). While this is 1.3 orders of magnitude larger than the drainage area at Black Brook SF-2, it is among the smallest drainage areas of reference gages assessed. Finally, the surficial geology in the Segreganset drainage area includes large portions of bedrock or till, with some sand and gravel in the immediate stream channel. The surficial geology of the Black Brook drainage area is identified as end moraine deposits, which are till and, from a hydrogeologic standpoint, are more similar to the Segreganset gage than the sand and gravel deposits which comprise the drainage areas of other candidate reference stream gages.

The reasons for exclusion of the other candidate reference stream gages are described below:

- Quashnet River**:** The Quashnet River gage period of record includes the Black Brook monitoring period, and the small drainage area of 2.6 mi^2 is the closest of any candidate to the drainage area of Black Brook. However, the surficial geology of the Quashnet River gage is entirely sand and gravel or large sand deposits. Streams in sandy geologic settings will have a higher baseflow and lower surface runoff response to rain events,

making this reference gage less desirable to represent conditions at Black Brook, as compared to the Segreganset River gage.

- Paskamanset River**:** The Paskamanset River gage period of record includes the Black Brook monitoring period, however the drainage area of the Paskamanset gage is 26.2 mi^2, an area much larger than that of the Segreganset gage. The Paskamanset drainage area surficial geology includes significant amounts of till and bedrock in the periphery, as well as sand and gravel, sand, and floodplain alluvium deposits in the immediate vicinity of the stream.
- Adamsville Brook**:** The period of record for the Adamsville Brook gage ends in 1987, making direct comparison with the flow measurements obtained at Black Brook impossible.
- Rattlesnake Brook**:** The period of record for the Rattlesnake Brook gage ends in 2009, making direct comparison with the flow measurements obtained at Black Brook impossible.

Annual peak flow volumes were available for the Segreganset River gage from 1967 through 2023. A Log-Pearson Type III distribution calculator was utilized to determine the high flow values for 2-, 5-, 10-, 25-, 50-, 100-, and 200-year recurrence interval events.

Daily mean flow values for the Segreganset River reference gage were utilized to calculate 95%, 50%, and 5% exceedance probability flows in Black Brook. The period of record for the Segreganset River gage includes 21,000 daily measurements from 1966 to present.

Flow statistics calculated for the Segreganset River reference gage were related to Black Brook based on a drainage area ratio approach. The respective drainage areas for each of these monitoring points were calculated based on the USGS StreamStats online drainage area delineation tool and the ratio each to the Segreganset River gage drainage area was calculated. This ratio was used to calculate an anticipated flow measurement at the time that streamflow was measured at Black Brook, based on the instantaneous Segreganset River discharge at the time. For each of the 4 measurements, the anticipated flows were approximately 1.6 times greater than the actual flows. Based on this relationship, flow statistics were translated by the function:

*[Black Brook Flow] = [Segreganset Gage Flow] * [Area Ratio] / 1.6*

Table 3, below, summarizes the comparative streamflow measurements described above.

Table 3. Comparative Streamflow Measurements

Monitoring Point	Drainage area (mi^2)*	Drainage Area Ratio	Measurement Time	Segreganset Gage Discharge (cfs)	Anticipated Discharge	Actual Discharge (cfs)	Adjustment Factor
SF-2	0.304	0.03915	3/19/2024 1225	24.5	0.703	0.420	1.67
			5/15/2024 1415	11.4	0.327	0.229	1.43
SF-3	0.415	0.02868	3/20/2024 0917	21.7	0.850	0.526	1.62
			5/15/2024 1229	11.4	0.327	0.200	1.63

*The drainage area of the Segreganset River gage is 10.6 mi^2.

Based on our comparative streamflow evaluation, Black Brook would be anticipated to run dry during periods of reduced precipitation, particularly during periods of lower groundwater elevations (Table 4). HW's water level monitoring and field data collection activities occurred during the late Winter and early Spring, typically wetter times of the calendar year, and flow was observed throughout the duration of the project. Additional monitoring during early Summer through late Fall would be necessary to document whether Black Brook runs dry, similar to Segreganset.

Table 4. Estimated Recurrence Flows Summary

Daily Flow Statistics			
Exceedance Probability	Segreganset Gage Discharge (cfs)	Black Brook SF-2 Discharge (cfs)	Black Brook SF-3 Discharge (cfs)
95%	0.090	0.00	0.00
50%	12.700	0.23	0.31
5%	77.750	1.39	1.90
Peak Flow Statistics			
Recurrence Interval	Segreganset Gage Discharge (cfs)	Black Brook SF-2 Discharge (cfs)	Black Brook SF-3 Discharge (cfs)
2-year	335	6.00	8.20
5-year	504	9.04	12.34
10-year	627	11.23	15.33
25-year	791	14.18	19.36
50-year	921	16.51	22.54
100-year	1057	18.95	25.86
200-year	1200	21.51	29.36

5.2 Existing Conditions Model

A two-dimensional (2-D) hydraulic model of Black Brook was developed for this study by HW using the United States Army Corps of Engineers (USACE) Hydraulic Engineering Center River Analysis System (HEC-RAS) program. HEC-RAS 2-D models utilize detailed data inputs such as 3-D bathymetry to produce detailed predictions of hydraulics. Unlike simpler 1-D models, 2-D models can predict lateral variation in water velocity and shear stress across the full extents of the modeled river's floodplain. 2-D models are useful tools for detailed evaluations of sediment transport, fish passage, and river morphology. In this Project, the 2-D model that was developed extends from upstream of Moshup Trail to downstream of the Vehicle Crossing.

Existing model geometry was developed using topography and bathymetry survey data gathered by HW in March 2024 combined with light detection and ranging (LiDAR) topographic data available from MassGIS to extend the model geometry beyond the surveyed area (Figures 10-12).

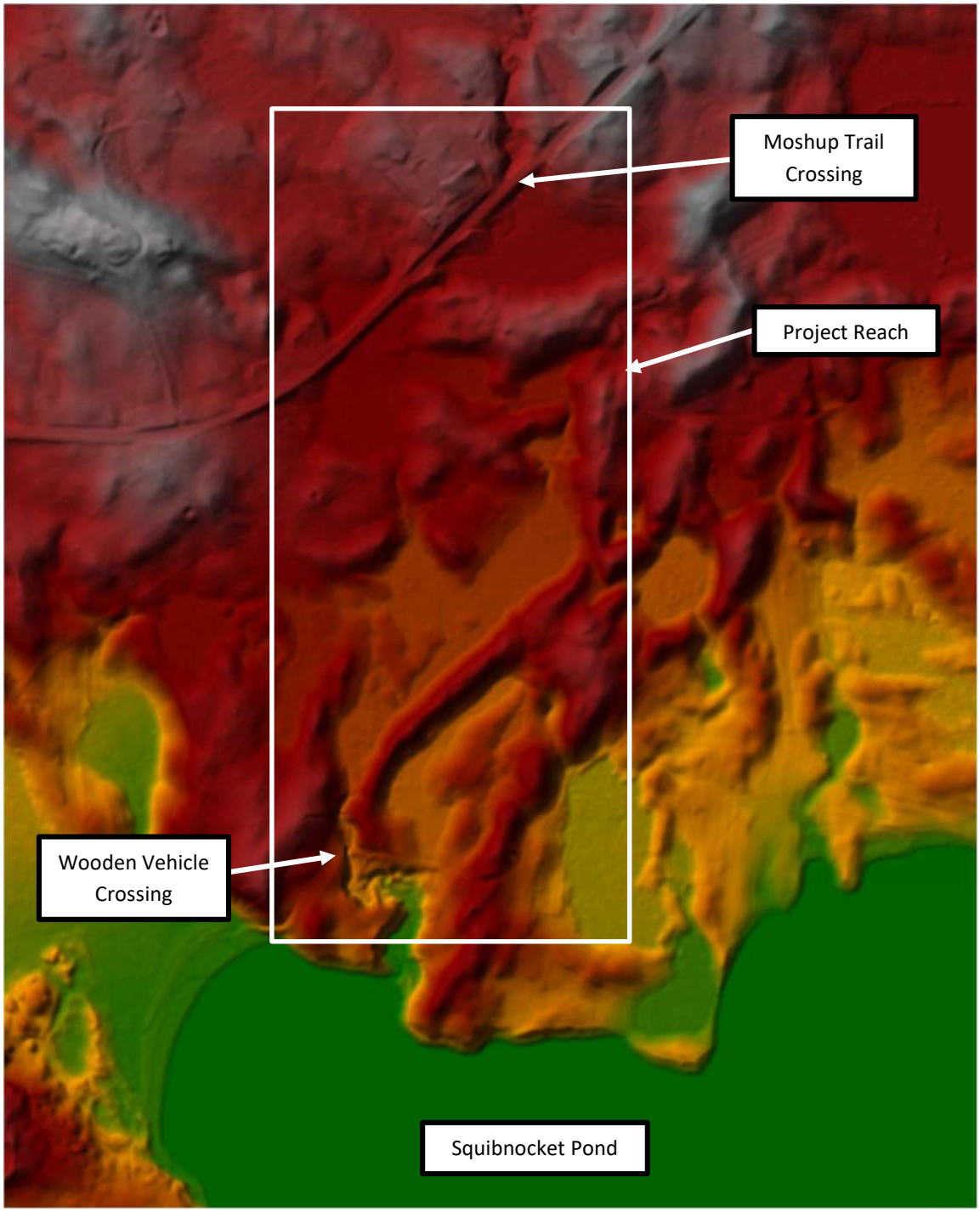


Figure 10. Extents of 2-D HEC-RAS Model Geometry

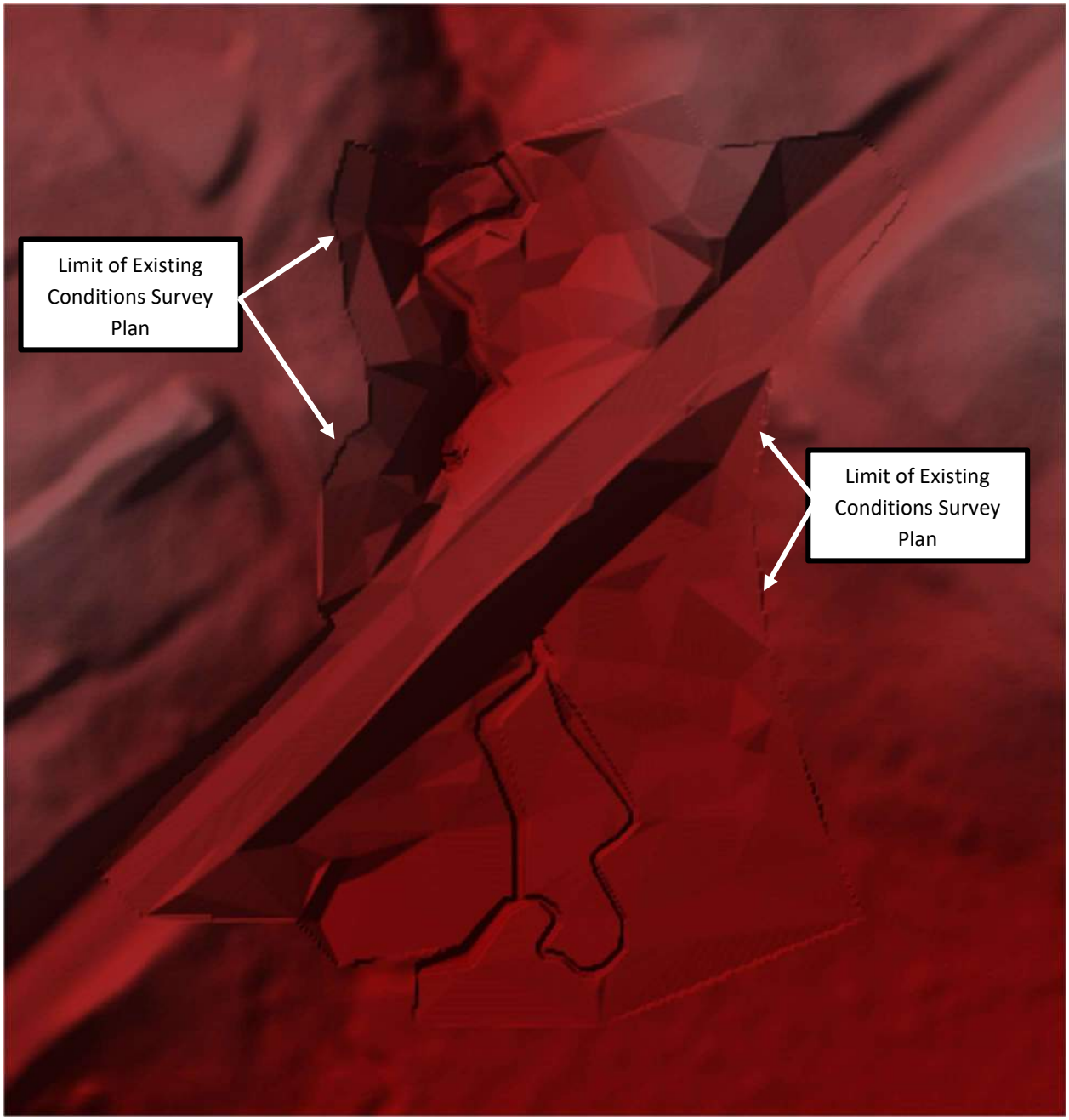


Figure 11. Existing Conditions Geometry at Moshup Trail

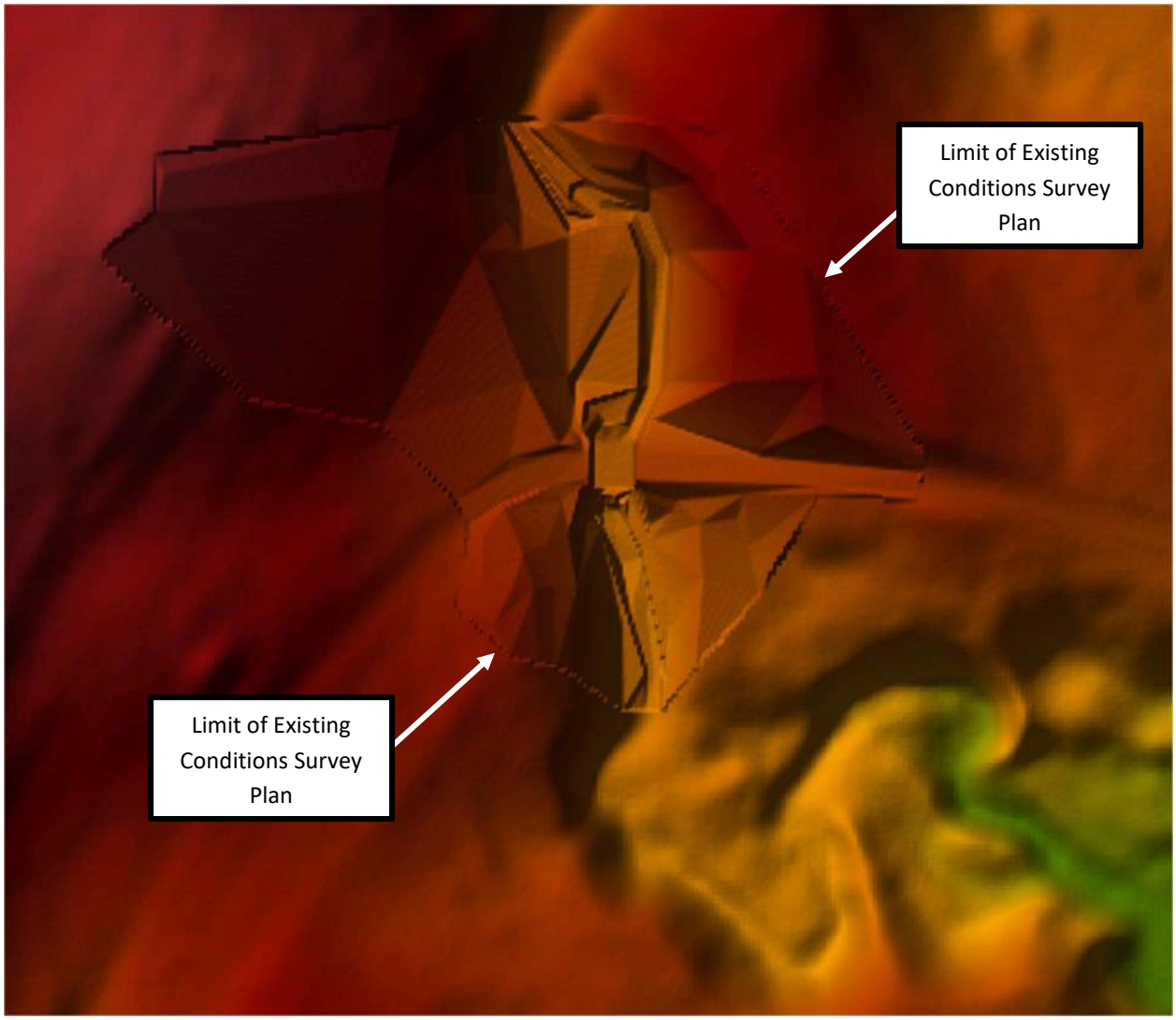


Figure 12. Existing Conditions Geometry at Vehicle Crossing

5.2.1 Boundary Conditions

Inflow into the H&H model was input as a 24-hour flow hydrograph with flow rates set at 6-minute intervals. Minimum flow rates were set as follows:

- Minimum flow rates and for the 2-year and 5% daily exceedance hydrographs were set to 0.5 cfs to approximate the observed flow and ensure model continuity.
- For the 100-year hydrograph, minimum flow rates were set based on the peak flow of the 5% flow, assuming that water levels are likely already high prior to a storm event that would precipitate the 100-year flow.

Downstream boundary conditions were set to a "normal depth" of 0.04 ft/ft which represents the energy grade slope at the downstream model boundary as determined by surveyed topography. Upstream energy grades were likewise set based on the energy grade slope of 0.03 ft/ft upstream of the Moshup Trail culvert.

5.2.2 Channel Roughness

Manning's roughness coefficients ("n") were applied to the Black Brook channel and floodplain according to guidance developed by Chow (1959)[6]. The roughness coefficient is a unitless measure of the roughness or friction factor of a surface. Larger n values represent higher friction and therefore slower water flow, and lower n values represent lower friction and faster flow. Main channel roughness was assigned a value of n = 0.05, corresponding to a main channel with lower stages, ineffective slopes and sections and more stones (type 1.f). The rest of the site was assigned a roughness value between n = 0.038 (water) and n = 0.15 (deciduous forest) based on land cover type, as provided by MassGIS.

5.3 Proposed Conditions Model

The existing conditions model was modified to reflect the various proposed alternatives at Moshup Trail and the vehicle crossing. Culvert sizes, inverts and model topography were adjusted to reflect each of the alternatives.

A modified existing conditions model was also developed with the Moshup Trail road berm and vehicle crossing completely removed to simulate fully natural hydraulic conditions as if human influence had never occurred. In the following sections, this is referred to as the "Pre-Development" model. This model was compared to both existing and proposed models.

5.3.1 Model Results: Water Surface at Moshup Trail

Water surface elevations for the various alternatives were modeled at the Moshup Trail culvert, as presented in Table 5 and Figure 13.

[6] Chow, V.T., 1959, Open-channel hydraulics; New York, McGraw-Hill Book Co., 680 p.

Table 5. Water Surface Elevations Immediately Upstream and Downstream of Moshup Trail Crossing Under the 100-Year Flow.

	Upstream of Moshup Trail	Downstream of Moshup Trail
Existing Elevation (feet)	46.1	43.8
Pre-Development Elevation (feet)	46.2	43.6
PR M1 Elevation (feet)	44.7	44.1
PR M2 Elevation (feet)	44.5	44.2

At Moshup Trail, both proposed culvert alternatives would lower the water surface elevation upstream of the crossing. PR M1 reduces the upstream water surface by 0.8 feet and PR M2 reduces the upstream water surface elevation by 1.8 feet and is only 0.2 ft above the Pre-Development scenario.

The downstream water surface elevation increases by 0.7 feet for PR M1, while the downstream water surface elevation remains constant between the existing, pre-development and PR M2 scenarios.

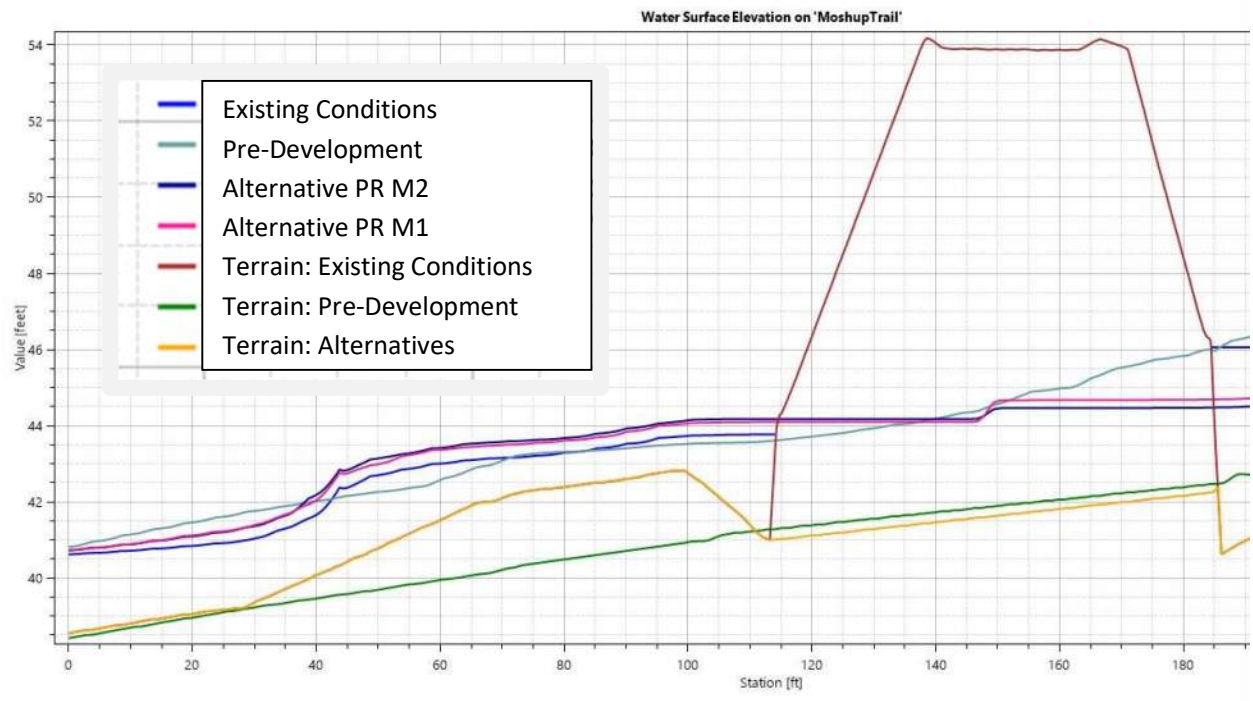


Figure 13. HEC-RAS results for Maximum Water Surface Elevation at Moshup Trail

5.3.2 Model Results: Water Surface and Velocities at Vehicle Crossing

Water surface elevations for the various alternatives was also modeled at the vehicle crossing. To provide a better comparison, all models of alternatives at the vehicle crossing reflect existing conditions upstream, as presented in Table 6 and Figure 14.

Table 6. Maximum Water Surface Elevations Immediately Upstream and Downstream of Vehicle Crossing Under the 100-Year Flow.

	Upstream of Vehicle Crossing (elevation, ft)	Downstream of Vehicle Crossing (elevation, ft)
Existing Conditions	18.6	17.8
Pre-Development	16.9	16.7
PR VC1: Lower existing box culvert	17.2	16.5
PR VC2: Lower and widen box culvert	17.1	16.5
PR VC3: Add rock pools to existing culvert	18.6	18.2

The two alternatives that include lowering the culvert will result in a lower water surface elevation at the crossing. There is a minimal difference between maximum elevation upstream for the reusing of the existing culvert alternative VC1 (12.5 ft wide) and the new culvert alternative VC2 (16 feet wide). PR VC3 fish passage improvement only maintains the water surface elevation directly upstream of the crossing and increases it by 0.4 ft directly below the culvert (approx. STA 75 on the table below). The increase is due to the rock pools created just downstream of the culvert.

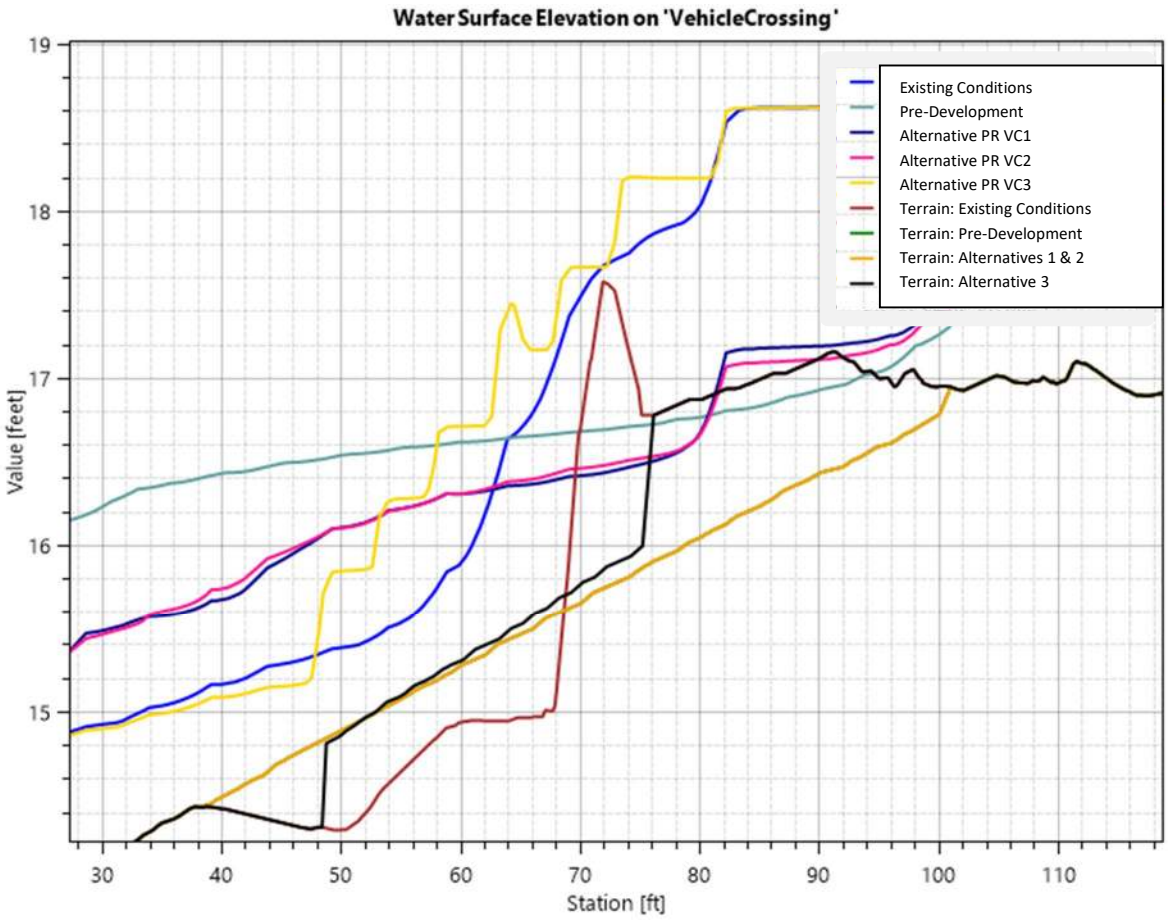


Figure 24. HEC-RAS results for Water Surface Elevation at Vehicle Crossing

Model results, and visual observation in the field, indicate that natural stream hydraulics cannot be restored without lowering the existing culvert to eliminate the perched conditions there. Fish passage can be improved by the option to retain the existing culvert and mitigate by building a rock weir riffle/pool fish passage to bridge that perched hydraulic gap. As shown on Table 6 and Figure 14, the option to fully replace the existing culvert does not produce significantly better hydraulic results than does reusing the existing culvert at a lower invert elevation.

There is not a significant quantity of fine sediment impounded behind the existing culvert and none of the potential alternatives are, therefore, likely to result in significant sediment mobilization. Natural sediment transport dynamics would be better restored with either of the culvert reuse/ replacement options than would be the case for the rock weir alternative.

5.3.3 Model Results: Fish Passage

The existing vehicle crossing culvert represents a barrier to the passage of aquatic and terrestrial organisms. All three alternatives discussed here represent significant improvements to fish passage to varying extents. However, as previously discussed in Section 5.1, correlation to the flow statistics from the USGS Segreganset River reference gauge indicates that Black Brook may run dry during drought periods and, therefore if true, would not support continuous fish passage during those dry periods. Additional data collection would be required to confirm the frequency and duration of these dry periods.

Table 7 depicts the modeled water depth and velocity conditions at the vehicle crossing, for the three alternatives. By increasing water depth and decreasing hydraulic jump, both conditions improve habitat connectivity. Modeled velocity during the 5% exceedance high flow hydrology is within acceptable fish passage criteria for all three options. As discussed above, water levels for all three alternatives during the 95% exceedance hydrology fall to near zero; thereby failing to meet fish passage criteria, assuming the hydrology established by correlation to the Segreganset River gage is accurate.

Table 7. Water Depth and Velocity by Alternative

	5% Exceedance Flow (1.9 cfs)		95% Exceedance Flow (0.0022 cfs)	
	Water Depth (feet)	**Velocity (feet/sec)**	**Water Depth (feet)**	**Velocity (feet/sec)**
Alternative PR M1: 10 ft wide X 6 ft tall box culvert				
Upstream of Culvert	2.41	0.16	0.00	0.00
Downstream of Culvert	2.02	0.02	0.00	0.00
Alternative PR M2: 16 ft wide X 4 ft tall box culvert				
Upstream of Culvert	2.21	0.02	0.00	0.00
Downstream of Culvert	1.92	0.03	0.00	0.00
Alternative PR VC1: existing box culvert set at streambed elevation				
Upstream of Culvert	0.25	0.48	0.00	0.00
Downstream of Culvert	0.29	0.82	0.00	0.00
Alternative PR VC2: 16 ft wide x 4 ft tall box culvert set at streambed elevation				
Upstream of Culvert	0.25	0.11	0.00	0.00
Downstream of Culvert	0.30	0.64	0.00	0.00
Alternative PR VC3: No change to existing culvert, add rock pools below				
Upstream of Culvert	1.04	0.10	0.00	0.00
Downstream of Culvert	1.42	0.11	0.00	0.00

6. PRELIMINARY DESIGN PLANS AND COST ESTIMATES

Within the scope of the Project, preliminary design plans for two alternatives for the wooden vehicle crossing were advanced to the 60% design level, and an accompanying estimate of permitting level construction costs based on those designs was compiled. Both the 60% design plans and cost estimate are included herein as Attachments A and B, respectively. The permitting design is presented as a 10-sheet plan set that includes existing conditions, sediment and erosion control, stream cross sections and longitudinal profile, construction access, materials staging locations, demolition plan, grading plan, and typical details.

7. DISCUSSION

HW's evaluation of Black Brook indicates that under existing conditions, the concrete box culvert at the wooden vehicle crossing is an impediment to the upstream movement of fish and other aquatic species. This is due to both the perched invert on the downstream edge of the culvert as well as the shallow water column distributed across the concrete box culvert bottom during low flow periods. As natural stream bed material is not present across the bottom of the culvert, the concrete surface is inconsistent with the natural stream channel upstream and downstream of the structure and not Standards compliant. To be consistent with the Standards, the bottom of the box culvert would need to be lowered by approximately 1 foot to allow for the placement of bedding material on top of the culvert bottom, which would in turn emulate the natural stream bed conditions and allow for a natural riverine channel to be established.

The volume of mobile sediment that has accumulated upstream of the structure is minimal. Downstream sediment transport is a natural riverine process. That natural process is altered by restrictions that capture and accumulate sediment migrating from upstream sources while thereby depriving downstream areas of the sediment supply needed to support a vibrant riverine ecology. While the volume of mobile sediment impounded by the box culvert is minimal, restoring sediment dynamics here would be beneficial, though not likely to a sufficient enough extent to constitute a reason for culvert replacement on its own.

Assuming the statistical correlation of hydrology for Black Brook to the USGS Segreganset River gage is accurate, low flow conditions are naturally low enough to challenge fish passage during drier time periods. However, fish passage should still be maximized within the natural flow constraints of the brook. Adequate fish passage can be obtained with the rock weir fish passage structure alternative but fish passage conditions would be better improved by either of the two alternatives that replace or lower the existing culvert. Between the two culvert work alternatives, there is not a significant difference in modeled hydraulics between the two. Therefore, the alternative that reuses the existing culvert at a lower elevation is the more cost effective. The rock weir alternative that does not touch the existing culvert is the least expensive of the three but also the least effective.

8. REFERENCES

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ATTACHMENT A

60% Design Opinion of Probable Cost

Horsley Witten Group
Sustainable Environmental Solutions
90 Route 6A • Unit 1 • Sandwich, MA 02563
508-833-6600 • horsleywitten.com

Project: Black Brook Wooden Vehicle Crossing - Reset Existing Culvert
Location: Aquinnah, MA

Submission: 60% Design
Date: 6/28/2024

Estimator: GH **Checked By:** NP

Division 2-GENERAL SITEWORK	Unit	Quantity	Unit Cost	Total Cost
ACCESS AND STAGING				
Site Mobilization / Demobilization	LS	1	$ 25,000.00	**$ 25,000.00**
Silt Sock Erosion Control	LF	200	$ 9.00	**$ 1,800.00**
Construction Fence	LF	250	$ 11.00	**$ 2,750.00**
Dewatering	LS	1	$ 20,000.00	**$ 20,000.00**
Clear & Grub Site	AC	0.01	$ 60,000.00	**$ 600.00**
Remove and Stockpile Boulder Material from Edges	EA	50	$ 250.00	**$ 12,500.00**
Remove and Stockpile Material Behind Boulders	CY	50	$ 65.00	**$ 3,250.00**
Subtotal Access and Staging			**$ 65,900.00**	
DEMOLITION				
Remove Wooden Vehicle Crossing Deck and Dispose Offsite	EA	1	$ 7,500.00	**$ 7,500.00**
Remove Existing Box Culvert Sections for Reuse	EA	2	$ 2,500.00	**$ 5,000.00**
Excavate and Stockpile Channel Material	CY	15	$ 65.00	**$ 975.00**
Subtotal Demolition			**$ 13,475.00**	
RESTORATION AND STABILIZATION				
Dense Graded Crushed Stone	CY	5	$ 90.00	**$ 450.00**
Triax Geogrid and Related Subbase	SF	250	$ 5.00	**$ 1,250.00**
Replace Wooden Vehicle Crossing Deck and Railing	EA	1	$ 15,000.00	**$ 15,000.00**
12x4x4 Box Culverts (2) Reset on 12" Dense Grade Material	EA	2	$ 3,500.00	**$ 7,000.00**
Place Stockpiled Native Channel Bottom Fill In Culvert Bottom	CY	15	$ 65.00	**$ 975.00**
Rounded River Stone	CY	20	$ 100.00	**$ 2,000.00**
Restore Boulder Edges	EA	50	$ 250.00	**$ 12,500.00**
Replace Stockpiled Material Behind Boulders	CY	50	$ 65.00	**$ 3,250.00**
Landscaping	LS	1	$ 10,000.00	**$ 10,000.00**
Subtotal Restoration and Stabilzation			**$ 52,425.00**	
TOTAL GENERAL SITE - DIV 2			**$ 131,800.00**	

ESTIMATED CONSTRUCTION COSTS		**$ 131,800.00**
General Conditions	12%	$ 15,900.00
ESTIMATED CONSTRUCTION COST (Including General Conditions)		**$ 147,700.00**
Construction Overhead and Profit	15%	$ 22,200.00
Contingency	35%	$ 51,700.00
TOTAL ESTIMATED CONSTRUCTION COSTS		**$ 221,600.00**
RANGE (-3% TO +15%)		
Low		**$ 215,000.00**
High		**$ 255,000.00**

Qualifications:
The following items are not included in the scope of work:

Street Opening Permits / Bonds For Off Site Work
Police /Traffic details
Temporary Water
Preparation of NPDES SWPPP
Soil Management Plan
Protect Existing Trees to Remain
Contaminated Soil
Sheeting / Earth Support

Quantities provided are based on permit-level plans "Black Brook Wooden Vehicle Crossing, Aquinnah, MA" June 2024, prepared by Horsley Witten Group.

Unit prices provided are based upon typical 2024 construction costs and data. Unit prices are subject to change due to adjustments to material and labor costs, site conditions and inflation.

Horsley Witten Group
Sustainable Environmental Solutions
90 Route 6A • Unit 1 • Sandwich, MA 02563
508-833-6600 • horsleywitten.com

Project: Black Brook Wooden Vehicle Crossing - Replace Existing Culvert
Location: Aquinnah, MA

Submission: 60% Design
Date: 6/28/2024

Estimator: GH **Checked By:** NP

Division 2-GENERAL SITEWORK	Unit	Quantity	Unit Cost	Total Cost
ACCESS AND STAGING				
Site Mobilization / Demobilization	LS	1	$ 35,000.00	**$ 35,000.00**
Silt Sock Erosion Control	LF	200	$ 9.00	**$ 1,800.00**
Construction Fence	LF	250	$ 11.00	**$ 2,750.00**
Dewatering	LS	1	$ 30,000.00	**$ 30,000.00**
Clear & Grub Site	AC	0.05	$ 60,000.00	**$ 3,000.00**
Remove and Stockpile Boulder Material from Edges	EA	50	$ 250.00	**$ 12,500.00**
Remove and Stockpile Material Behind Boulder Edges	CY	50	$ 65.00	**$ 3,250.00**
Subtotal Access and Staging			**$ 88,300.00**	
DEMOLITION				
Remove Wooden Vehicle Crossing Deck and Dispose Offsite	EA	1	$ 7,500.00	**$ 7,500.00**
Remove Existing Box Culvert Sections and Dispose Off-Site	EA	2	$ 3,500.00	**$ 7,000.00**
Excavate and Stockpile Channel Material	CY	30	$ 65.00	**$ 1,950.00**
Subtotal Demolition			**$ 16,450.00**	
RESTORATION AND STABILIZATION				
Dense Graded Crushed Stone	CY	15	$ 90.00	**$ 1,350.00**
Replace Wooden Vehicle Crossing Deck and Railing	EA	1	$ 15,000.00	**$ 15,000.00**
Triax Geogrid and Related Subbase	SF	400	$ 5.00	**$ 2,000.00**
12x6x6 Replacement Box Culverts	EA	2	$ 22,500.00	**$ 45,000.00**
Place Stockpiled Native Channel Bottom Fill In Culvert Bottom	CY	30	$ 65.00	**$ 1,950.00**
Rounded River Stone	CY	20	$ 100.00	**$ 2,000.00**
Restore Boulders	EA	50	$ 250.00	**$ 12,500.00**
Replace Stockpiled Material Behind Boulders	CY	50	$ 65.00	**$ 3,250.00**
Landscaping	LS	1	$ 10,000.00	**$ 10,000.00**
Subtotal Restoration and Stabilzation			**$ 93,050.00**	
TOTAL GENERAL SITE - DIV 2			**$ 197,800.00**	

ESTIMATED CONSTRUCTION COSTS		**$ 197,800.00**
General Conditions	12%	$ 23,800.00
ESTIMATED CONSTRUCTION COST (Including General Conditions)		**$ 221,600.00**
Construction Overhead and Profit	15%	$ 33,300.00
Contingency	35%	$ 77,600.00
TOTAL ESTIMATED CONSTRUCTION COSTS		**$ 332,500.00**
RANGE (-3% TO +15%)		
Low		**$ 323,000.00**
High		**$ 383,000.00**

Qualifications:
The following items are not included in the scope of work:

Street Opening Permits / Bonds For Off Site Work
Police /Traffic details
Temporary Water
Preparation of NPDES SWPPP
Soil Management Plan
Protect Existing Trees to Remain
Contaminated Soil
Sheeting / Earth Support

Quantities provided are based on permit-level plans "Black Brook Wooden Vehicle Crossing, Aquinnah, MA" June 2024, prepared by Horsley Witten Group.

Unit prices provided are based upon typical 2024 construction costs and data. Unit prices are subject to change due to adjustments to material and labor costs, site conditions and inflation.

Horsley Witten Group
Sustainable Environmental Solutions
90 Route 6A • Unit 1 • Sandwich, MA 02563
508-833-6600 • horsleywitten.com

Project: Black Brook Wooden Vehicle Crossing - Rock Weir & Pool
Location: Aquinnah, MA

Submission: 60% Design
Date: 6/28/2024

Estimator: GH **Checked By:** NP

Division 2-GENERAL SITEWORK	Unit	Quantity	Unit Cost	Total Cost
ACCESS AND STAGING				
Site Mobilization / Demobilization	LS	1	$ 10,000.00	**$ 10,000.00**
Temp. Entrance Mat For Truck Traffic & Sediment Control	CY	8	$ 130.00	**$ 1,040.00**
Silt Sock Erosion Control	LF	500	$ 9.00	**$ 4,500.00**
Construction Fence	LF	250	$ 11.00	**$ 2,750.00**
Dewatering	LS	1	$ 20,000.00	**$ 20,000.00**
Clear & Grub Site	AC	0.05	$ 60,000.00	**$ 3,000.00**
Subtotal Access and Staging			**$ 41,290.00**	
DEMOLITION				
Excavate and Stockpile Channel Material	CY	12	$ 65.00	**$ 780.00**
Subtotal Demolition			**$ 780.00**	
RESTORATION AND STABILIZATION				
Dense Graded Crushed Stone	CY	8	$ 90.00	**$ 720.00**
Geotextile Liner for Beneath Stone Weirs	SY	75	$ 130.00	**$ 9,750.00**
Rounded River Stone	CY	50	$ 200.00	**$ 10,000.00**
Place Stockpiled Native Channel Bottom Fill Following Weir Construction	CY	30	$ 65.00	**$ 1,950.00**
Landscaping	LS	1	$ 10,000.00	**$ 10,000.00**
Subtotal Restoration and Stabilzation			**$ 32,420.00**	
TOTAL GENERAL SITE - DIV 2			**$ 74,500.00**	

ESTIMATED CONSTRUCTION COSTS		**$ 74,500.00**
General Conditions	12%	$ 9,000.00
ESTIMATED CONSTRUCTION COST (Including General Conditions)		**$ 83,500.00**
Construction Overhead and Profit	15%	$ 12,600.00
Contingency	35%	$ 29,300.00
TOTAL ESTIMATED CONSTRUCTION COSTS		**$ 125,400.00**
RANGE (-3% TO +15%)		
Low		**$ 122,000.00**
High		**$ 145,000.00**

Qualifications:
The following items are not included in the scope of work:

Street Opening Permits / Bonds For Off Site Work
Police /Traffic details
Temporary Water
Preparation of NPDES SWPPP
Soil Management Plan
Protect Existing Trees to Remain
Contaminated Soil
Sheeting / Earth Support

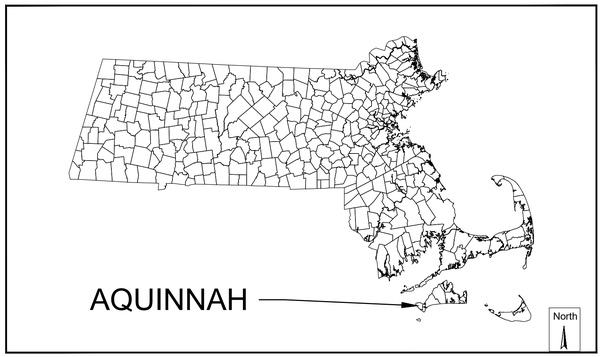
Quantities provided are based on permit-level plans "Black Brook Wooden Vehicle Crossing, Aquinnah, MA" June 2024, prepared by Horsley Witten Group.

Unit prices provided are based upon typical 2024 construction costs and data. Unit prices are subject to change due to adjustments to material and labor costs, site conditions and inflation.

ATTACHMENT B

Existing Conditions and Design Plans

STREAM CROSSING IMPROVEMENTS
BLACK BROOK
AQUINNAH, MASSACHUSETTS
JUNE 2024



MASSACHUSETTS
Graphic Scale
0 150000
SCALE IN FEET
1:150000

TOWN
Graphic Scale
0 12000
SCALE IN FEET
1:12000

VICINITY MAP
Graphic Scale
1-inch = 2000-feet

Sheet List Table	
Sheet Number	Sheet Title
1	COVER
2	EXISTING CONDITIONS - KEY SHEET
3	EXISTING CONDITIONS PLAN - MOSHUP TRAIL
4	EXISTING CONDITIONS PLAN - VEHICLE CROSSING
5	LONGITUDINAL PROFILES & CROSS SECTIONS
6	EROSION CONTROL PLAN
7	ROCK POOLS SITE PLAN
8	ROCK POOLS PROFILE
9	CULVERT REPLACEMENT SITE PLAN
10	CULVERT REPLACEMENT PROFILE

GENERAL NOTES:
1. THIS PLAN SET IS FOR PERMITTING ONLY AND NOT FOR CONSTRUCTION.

Plan Set:
STREAM CROSSING IMPROVEMENTS
BLACK BROOK
AQUINNAH, MASSACHUSETTS

Prepared For:
Sherrif's Meadow Foundation
57 David Avenue
Vineyard Haven, MA 02568
(508) 693-5207

Prepared By:
Horsley Witten Group, Inc.
Sustainable Environmental Solutions
www.horsleywitten.com

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112 Water Street, 6th Floor
Boston, MA 02109
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1 Turks Head Place, Suite 300
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Phone: (401) 272-1717
Fax: (401) 437-8368

113 R2 Water Street
Exeter, NH 03833
Phone: (603) 658-1660

Date Issued: JUNE 2024
Designed By: EWH
Drawn By: EWH
Checked By: NP

Registration: DRAFT NOT FOR CONSTRUCTION

Revisions

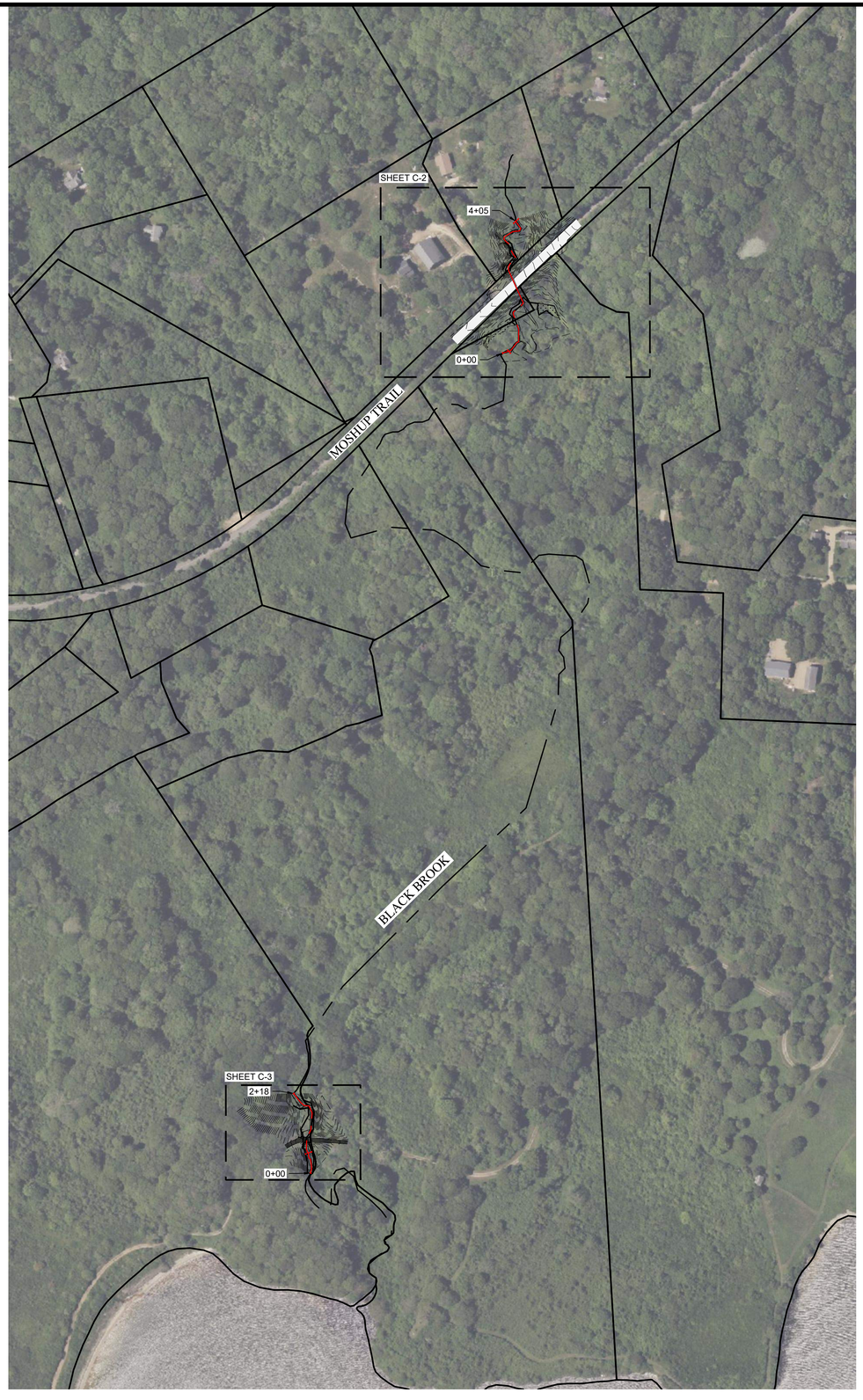
Rev.	Date	By	Appr.	Description
1				
2				
3				
4				
5				
6				
7				

Project Number: 23112
Sheet Number: 1 of 10
Drawing Number: C - 1

last modified: 07/01/24 printed: 07/01/24 by eh H:\Projects\2023\23112 Black Brook Aquinnah\Drawings\23112 CV.dwg

SURVEY NOTES

1. THE TOPOGRAPHY AND EXISTING SITE CONDITIONS DEPICTED HEREON ARE THE RESULT OF AN ON THE GROUND FIELD SURVEY CONDUCTED BY THE HORSLEY WITTEN GROUP, INC. MARCH 19 AND 20, 2024. TOPOGRAPHY HAS BEEN SUPPLEMENTED WITH LIDAR DATA IN AREAS BEYOND THE SURVEY EXTENTS.
2. HORIZONTAL DATUM IS MASS STATE PLANE COORDINATE SYSTEM. DATUM ESTABLISHED BY GNSS OBSERVATIONS.
3. THE ELEVATIONS DEPICTED HEREON WERE BASED ON THE NORTH AMERICAN VERTICAL DATUM (NAVD) OF 1988.
4. NO PROPERTY LINE SURVEY WAS CONDUCTED FOR THIS EXISTING CONDITIONS PLAN.
5. THE PROPERTY LINES AND RIGHTS OF WAYS DEPICTED ARE APPROXIMATE ONLY.
6. THIS PLAN DOES (DOES NOT) SHOW EXISTING EASEMENTS. HOWEVER, THIS DOES NOT CONSTITUTE A GUARANTEE THAT THIS PLAN IS A FULL LIST OF EASEMENTS EITHER RECORD OR UNWRITTEN.
7. THE ACCURACY OF MEASURED PIPE INVERTS AND PIPE SIZES IS SUBJECT TO FIELD CONDITIONS, THE ABILITY TO MAKE VISUAL OBSERVATIONS, DIRECT ACCESS TO THE VARIOUS ELEMENTS AND OTHER CONDITIONS.
8. THE LOCATION AND/OR ELEVATION OF EXISTING UTILITIES AND STRUCTURES AS SHOWN ON THESE PLANS ARE BASED ON RECORDS OF VARIOUS UTILITY COMPANIES, AND WHEREVER POSSIBLE, MEASUREMENTS TAKEN IN THE FIELD. THIS INFORMATION IS NOT TO BE RELIED UPON AS BEING EXACT OR COMPLETE. THE LOCATION OF ALL UNDERGROUND UTILITIES AND STRUCTURES SHALL BE VERIFIED IN THE FIELD PRIOR TO THE START OF ANY CONSTRUCTION. THE CONTRACTOR MUST CONTACT THE APPROPRIATE UTILITY COMPANY, ANY GOVERNING PERMITTING AUTHORITY IN THE TOWN OF AQUINNAH, AND "DIGSAFE" (1-888-344-7233) AT LEAST 72 HOURS PRIOR TO ANY EXCAVATION WORK IN PREVIOUSLY UNALTERED AREAS TO REQUEST EXACT FIELD LOCATION OF UTILITIES.
9. UTILITY PROVIDERS: ELECTRIC - EVERSOURCE TELEPHONE - VERIZON CABLE - COMCAST
10. THE PROPERTY IS LOCATED WITHIN F.I.R.M ZONE X AND VE EL. 13 AS SHOWN ON COMMUNITY PANEL NO. 25007C0158J DATED JULY 20, 2016.
11. THE WETLAND DELINEATION SHOWN HEREON WAS CONDUCTED BY THE HORSLEY WITTEN GROUP, INC. ON MARCH 19, 2024.
12. APPROXIMATE WETLAND LOCATIONS ARE USED TO SHOW WETLAND 100' AND 200' BUFFER ZONES AS NOTED ON SHEET C-3.
13. LIDAR DATA, PROPERTY LINES, AND SUPPLEMENTAL WETLAND LOCATIONS ARE TAKEN FROM THE BUREAU OF GEOGRAPHIC INFORMATION (MASSGIS), COMMONWEALTH OF MASSACHUSETTS, EXECUTIVE OFFICE OF TECHNOLOGY AND SECURITY SERVICES.



MASS STATE PLANE

LEGEND:

GENERAL		SYMBOLS	
	BERM		BOLLARD
44	CONTOUR - MINOR		CONTROL POINT
45	CONTOUR - MAJOR		EXISTING TREE
	CURB	UP1	UTILITY POLE
	EDGE OF PAVEMENT	WF	WETLAND FLAG
	PATHWAY		ROCK
	RIP RAP/STONES		STAFF GAUGE
	WALL - RETAINING		
	WALL - STONE		
OHW	OVERHEAD WIRE		
	PROPERTY LINE (GIS)		
ENVIRONMENTAL			
	WETLAND BOUNDARY		
	WETLAND 100' BUFFER ZONE		
	WETLAND 200' BUFFER ZONE		
	INLAND BANK		
	100' RIVERFRONT AREA		
	200' RIVERFRONT AREA		
	LONGITUDINAL PROFILE		
	EDGE OF WATER		
	FEMA FLOOD ZONE		

GRAPHIC SCALE

150 0 750 150 300 600

(in feet)

1 INCH = 150 FEET

Revisions

Rev.	Date	By	Appr.	Description

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Sustainable Environmental Solutions
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Checked By: DHW
Drawn By: JAP
Designed By: EVH
Date: JUNE 2024

Plan Set: STREAM CROSSING IMPROVEMENTS
BLACK BROOK
AQUINNAH, MASSACHUSETTS

Plan Title: EXISTING CONDITIONS - KEY SHEET

Prepared For:
Sherrif's Meadow Foundation
57 David Avenue
Vineyard Haven, MA 02568
Phone: (508) 693-5207
Fax: - -

Survey Provided By:
Horsley Witten Group, Inc.
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Phone: 508-833-6600
Fax: 508-833-3150
Dated: March 20, 2024

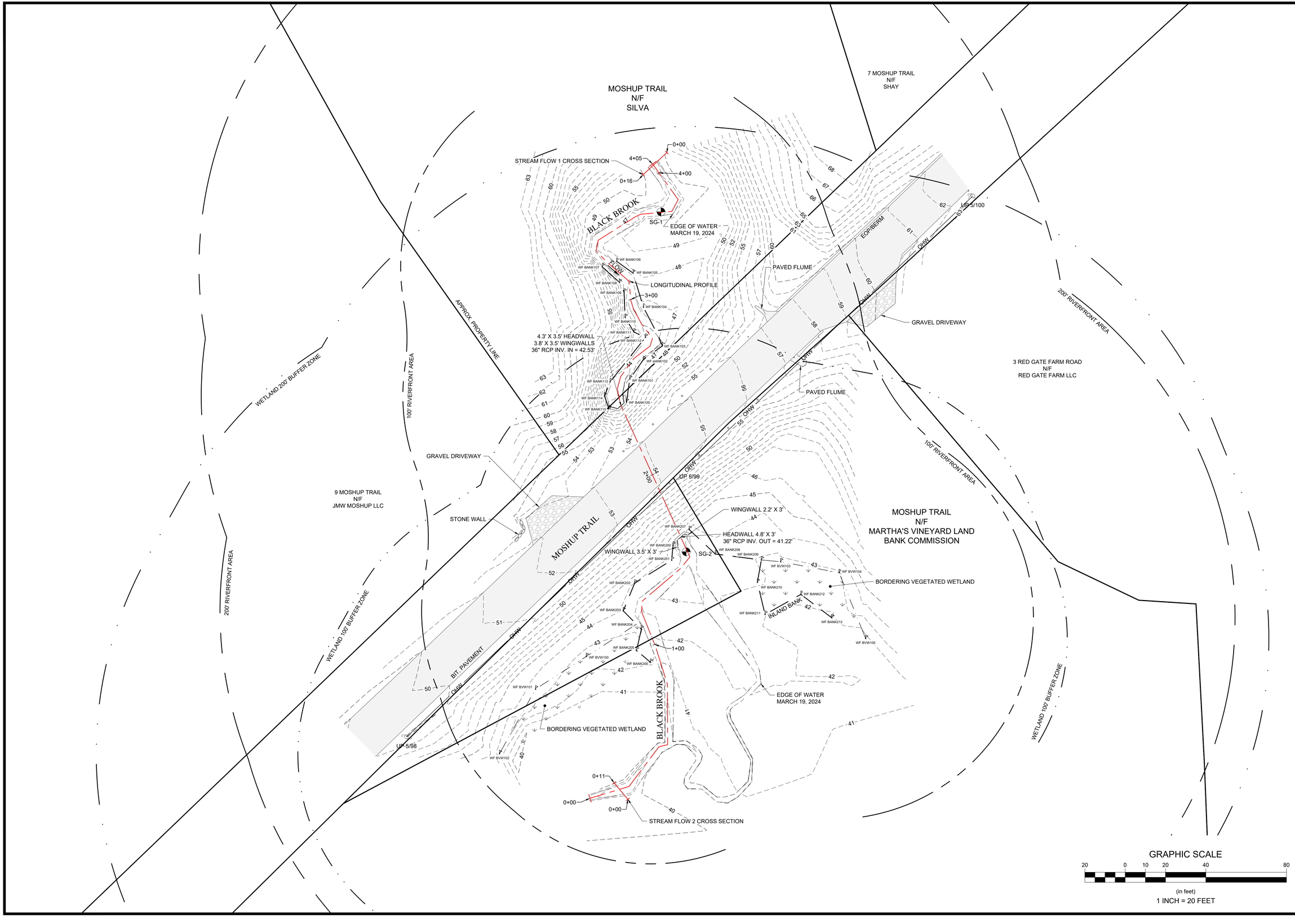
Registration:

DRAFT
NOT FOR CONSTRUCTION

Project Number: 23112

Sheet : 2 of 10

Sheet Number: C - 2



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Drawn By: JSP
Checked By: DHM
Date: JUNE 2024

Plan Set: STREAM CROSSING IMPROVEMENTS
BLACK BROOK
AQUINNAH, MASSACHUSETTS

Plan Title: EXISTING CONDITIONS PLAN - MOSHUP TRAIL

Prepared For:
Sherrif's Meadow Foundation
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Vineyard Haven, MA 02568
Phone: (508) 693-5207
Fax: - -

Survey Provided By:
Horsley Witten Group, Inc.
90 Route 6A
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Fax: 508-833-3150
Dated: March 20, 2024

Registration:

DRAFT
NOT FOR CONSTRUCTION

Project Number: 23112

Sheet : 3 of 10

Sheet Number: C - 3

NOTES

1. WETLAND 100' AND 200' BUFFER ZONES ARE BASED ON GIS DATA FROM MASSGIS AND ARE APPROXIMATE ONLY.

GRAPHIC SCALE

10 0 5 10 20 40

(in feet)

1 INCH = 10 FEET

Revisions

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Horsley Witten Group, Inc.
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Checked By: DWM | Drawn By: JJP | Designed By: EWH | Date: JUNE 2024

Plan Set: STREAM CROSSING IMPROVEMENTS
BLACK BROOK
AQUINNAH, MASSACHUSETTS

Plan Title: EXISTING CONDITIONS PLAN - VEHICLE CROSSING

Prepared For:
Sherrif's Meadow Foundation
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Vineyard Haven, MA 02568
Phone: (508) 693-3207
Fax: - -

Survey Provided By:
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DRAFT
NOT FOR CONSTRUCTION

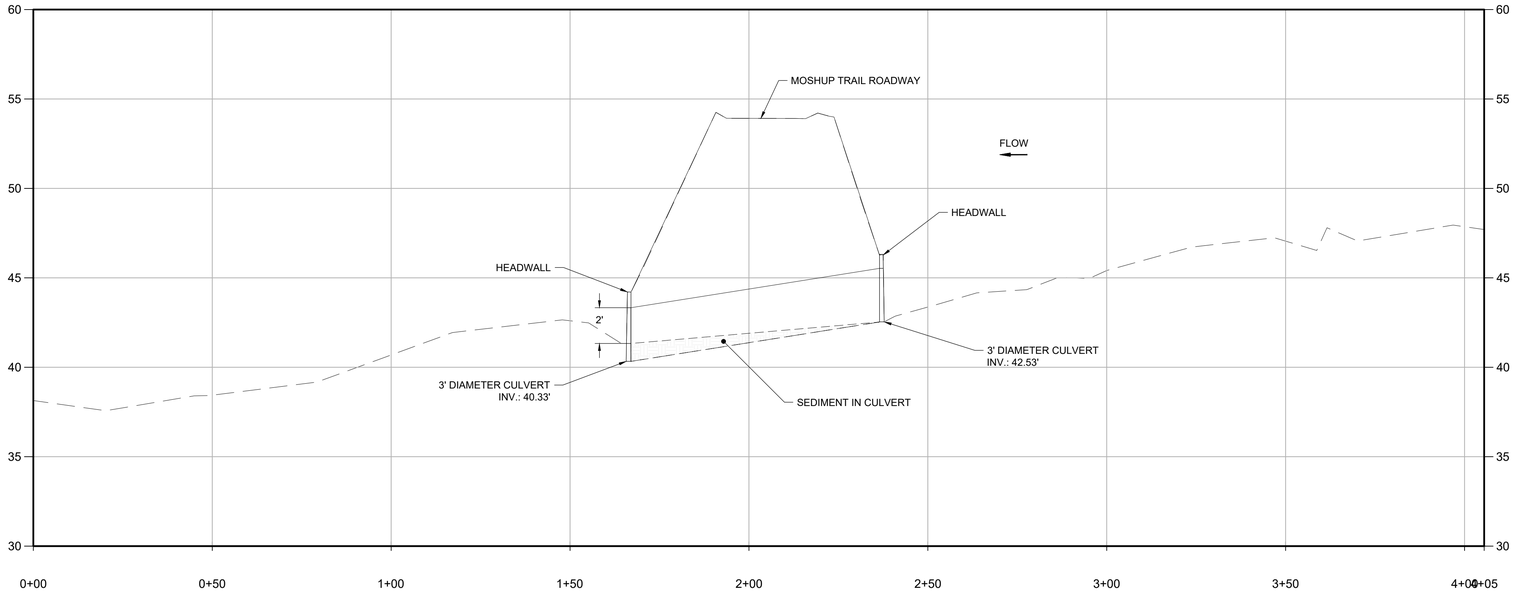
Project Number: 23112

Sheet : 4 of 10

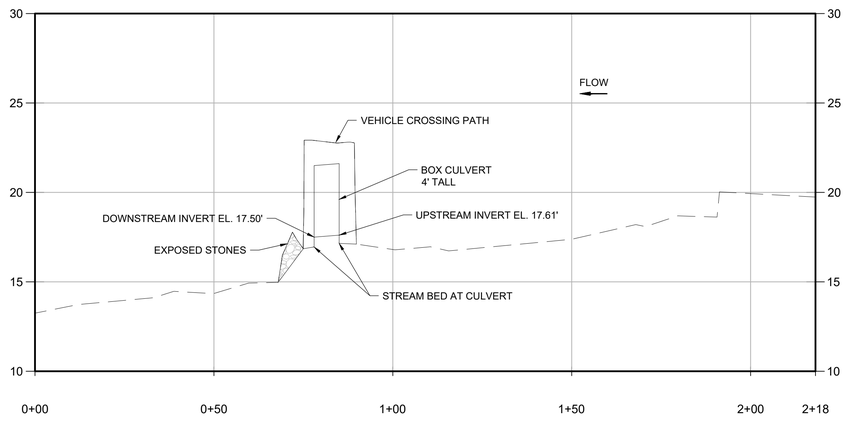
Sheet Number: C - 4

PROFILE/CROSS SECTIONLEGEND:

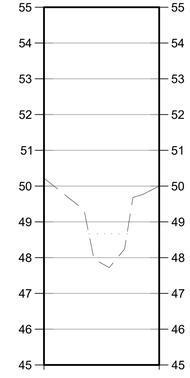
– – – – – –	STREAM BED
. . . . .	WATER ELEVATION



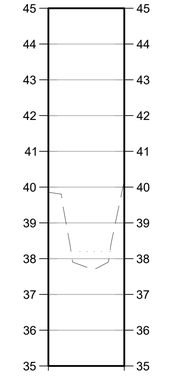
MOSHUP TRAIL LONGITUDINAL PROFILE
HORIZONTAL SCALE: 1" = 10'
VERTICAL SCALE: 1" = 2'



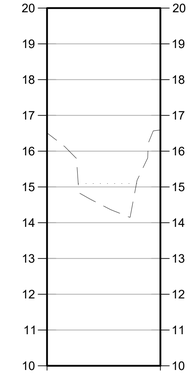
VEHICLE CROSSING LONGITUDINAL PROFILE
HORIZONTAL SCALE: 1" = 10'
VERTICAL SCALE: 1" = 2'



STREAM FLOW 1 CROSS SECTION
HORIZONTAL SCALE: 1" = 10'
VERTICAL SCALE: 1" = 2'



STREAM FLOW 2 CROSS SECTION
HORIZONTAL SCALE: 1" = 10'
VERTICAL SCALE: 1" = 2'



STREAM FLOW 3 CROSS SECTION
HORIZONTAL SCALE: 1" = 10'
VERTICAL SCALE: 1" = 2'

Revisions

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Checked By: DHM
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Plan Set:
STREAM CROSSING IMPROVEMENTS
BLACK BROOK
AQUINNAH, MASSACHUSETTS

Plan Title:
LONGITUDINAL PROFILES & CROSS SECTIONS

Prepared For:
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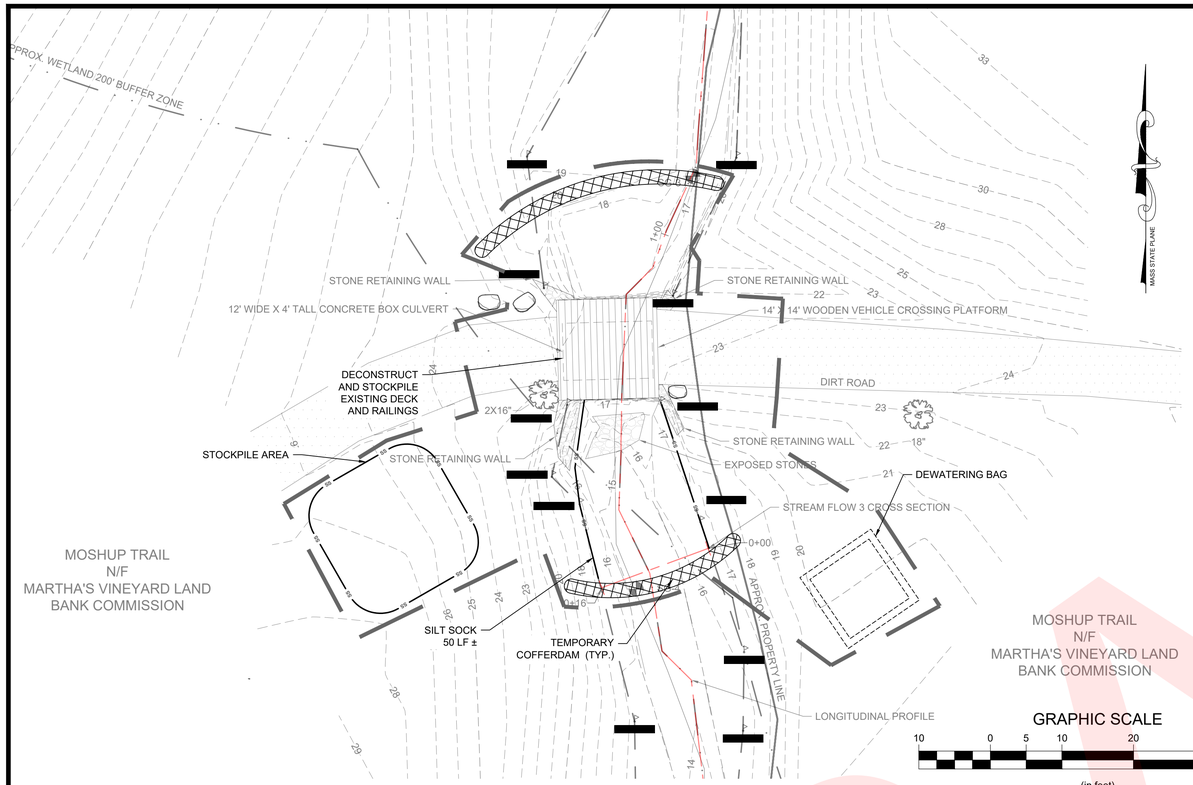
Project Number: 23112
Sheet : 5 of 10

Sheet Number:
C - 5



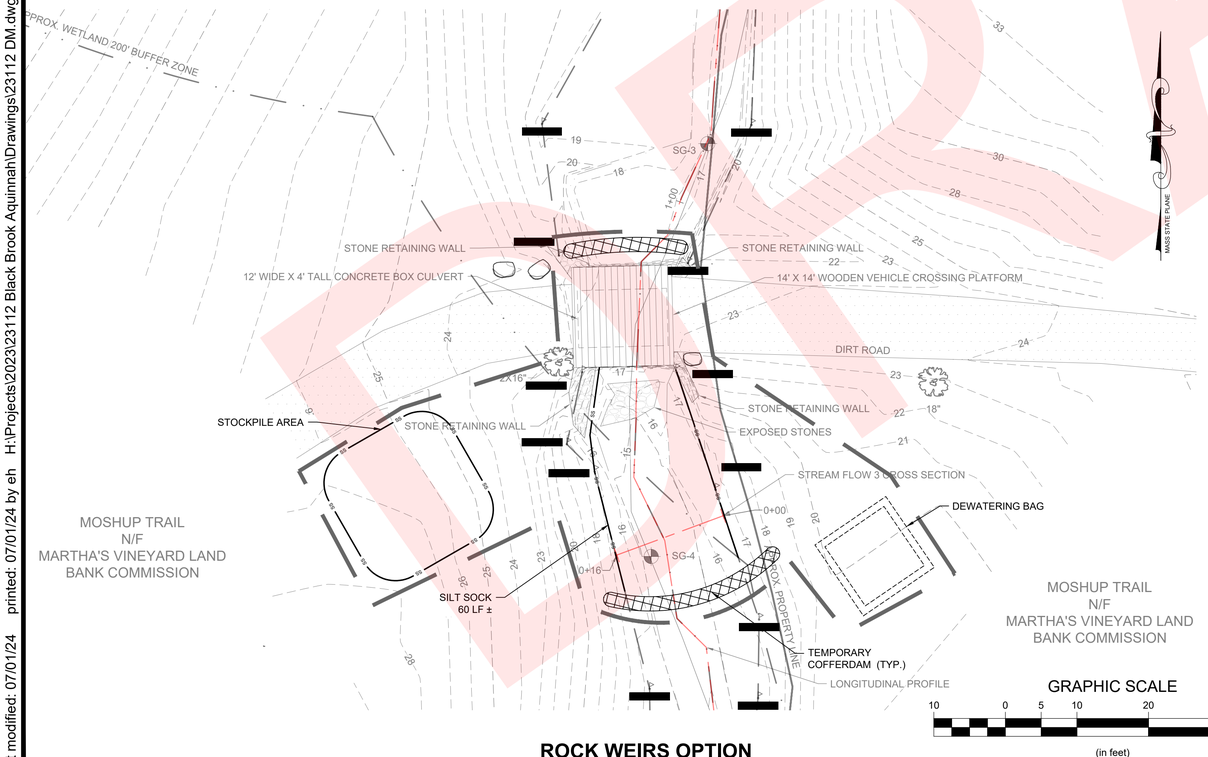
CULVERT REPLACEMENT OPTION

GRAPHIC SCALE

10 0 5 10 20 40

(in feet)

1 INCH = 10 FEET



ROCK WEIRS OPTION

GRAPHIC SCALE

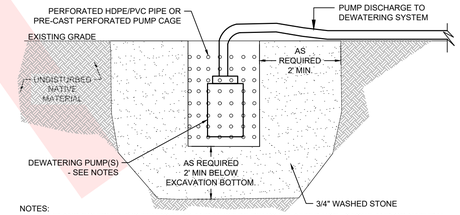
10 0 5 10 20 40

(in feet)

1 INCH = 10 FEET

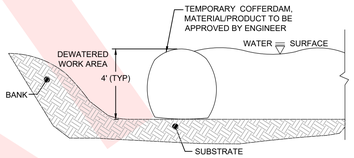
EROSION & SEDIMENT CONTROL NOTES:

1. DESIGNATE THE SITE CONSTRUCTION FOREMAN AS THE ON-SITE PERSONNEL RESPONSIBLE FOR THE DAILY INSPECTION AND MAINTENANCE OF ALL SEDIMENT AND EROSION CONTROLS AND IMPLEMENTATION OF ALL NECESSARY MEASURES TO CONTROL EROSION AND PREVENT SEDIMENT FROM LEAVING THE SITE.
2. INSTALL ALL EROSION AND SEDIMENT CONTROL (ESC) MEASURES AS INDICATED ON DRAWINGS IN CONSULTATION WITH THE CONSERVATION AGENT, AND ENGINEER BEFORE ANY CONSTRUCTION ACTIVITIES BEGIN. INSPECT, MAINTAIN REPAIR AND REPLACE EROSION CONTROL MEASURES, AS NECESSARY, DURING THE ENTIRE CONSTRUCTION PERIOD OF THE PROJECT. THE SITE PERIMETER EROSION CONTROLS ARE THE DESIGNATED LIMIT OF WORK. INFORM ALL PERSONNEL WORKING ON THE PROJECT SITE THAT NO CONSTRUCTION ACTIVITY IS TO OCCUR BEYOND THE LIMIT OF WORK AT ANY TIME THROUGHOUT THE CONSTRUCTION PERIOD.
3. MAINTAIN A MINIMUM SURPLUS OF 100 FEET OF EROSION CONTROL BARRIER (SILT FENCE, STRAWBALE, &/OR SILT SOCK) ONSITE AT ALL TIMES.
4. PROTECT THE ADJACENT RESOURCE AREA FROM SEDIMENTATION DURING PROJECT CONSTRUCTION UNTIL ACCEPTANCE BY THE OWNER & IN CONFORMANCE WITH THE ORDER OF CONDITIONS.
5. PROVIDE CONSTRUCTION EXITS AS INDICATED ON DRAWINGS TO SHED DIRT FROM CONSTRUCTION VEHICLE TIRES. CLEAN AND/OR REPLACE THE CRUSHED STONE PAD, AS NECESSARY, TO MAINTAIN ITS EFFECTIVENESS.
6. KEEP THE LIMIT OF CLEARING, GRADING AND DISTURBANCES TO A MINIMUM WITHIN THE PROPOSED AREA OF CONSTRUCTION. PHASE THE SITE WORK IN A MANNER TO MINIMIZE AREAS OF EXPOSED SOIL. IF TREES ARE TO BE CUT ON THE ENTIRE SITE, CLEAR AND GRUB ONLY THOSE AREAS WHICH ARE ACTIVELY UNDER CONSTRUCTION. PROPERLY INSTALL THE SEDIMENTATION CONTROLS PRIOR TO BEGINNING ANY LAND CLEARING ACTIVITY AND/OR OTHER CONSTRUCTION RELATED WORK.
7. MONITOR LOCAL WEATHER REPORTS DURING CONSTRUCTION AND PRIOR TO SCHEDULING EARTHMOVING OR OTHER CONSTRUCTION ACTIVITIES WHICH LEAVE LARGE DISTURBED AREAS UNSTABILIZED. IF INCLEMENT WEATHER IS PREDICTED, USE BEST PROFESSIONAL JUDGEMENT AND GOOD CONSTRUCTION PRACTICES WHEN SCHEDULING CONSTRUCTION ACTIVITIES AND ENSURE THE NECESSARY EROSION CONTROL DEVICES ARE INSTALLED AND FUNCTIONING PROPERLY TO MINIMIZE EROSION FROM ANY IMPENDING WEATHER EVENTS.
8. INSPECT EROSION AND SEDIMENT CONTROL DEVICES AND STABILIZED SLOPES ON A WEEKLY BASIS AND AFTER EACH RAINFALL EVENT OF .25 INCH OR GREATER. REPAIR IDENTIFIED PROBLEMS WITHIN 24 HOURS TO ENSURE EROSION AND SEDIMENT CONTROLS ARE IN GOOD WORKING ORDER. RESET OR REPLACE MATERIALS AS REQUIRED.
9. SURROUND THE PERIMETER OF SOIL STOCKPILES WITH SILT SOCK, SILT FENCE, STRAWBALES, OR A COMBINATION OF SILT FENCE WITH STRAWBALE, AS DETERMINED NECESSARY.
10. DISTURBED AREAS AND SLOPES MUST NOT BE LEFT UNATTENDED OR EXPOSED FOR EXCESSIVE PERIODS OF TIME SUCH AS THE INACTIVE WINTER SEASON. PROVIDE APPROPRIATE STABILIZATION PRACTICES ON ALL DISTURBED AREAS AS SOON AS POSSIBLE BUT NOT MORE THAN 7 DAYS AFTER THE CONSTRUCTION ACTIVITY IN THAT AREA HAS TEMPORARILY OR PERMANENTLY CEASED. REINFORCE TEMPORARY AREAS HAVING A SLOPE GREATER THAN 4:1 WITH EROSION BLANKETS OR APPROVED EQUAL UNTIL THE SITE IS PROPERLY STABILIZED. TEMPORARY SWALES MAY ALSO BE REQUIRED IF DETERMINED NECESSARY IN THE FIELD BY THE ENGINEER.
11. CONTAIN ALL SEDIMENT ONSITE. SWEEP ALL EXITS FROM THE SITE AS NECESSARY INCLUDING ANY SEDIMENT TRACKING. SWEEP PAVED AREAS AS NEEDED TO REMOVE SEDIMENT AND POTENTIAL POLLUTANTS ACCUMULATED DURING SITE CONSTRUCTION.
12. REGULARLY REMOVE ACCUMULATED SEDIMENT FROM ALL EROSION CONTROL MEASURES AND AFTER RAIN EVENTS TO MAINTAIN PROPER DRAINAGE. DISPOSE OF IN A PRE-APPROVED LOCATION.
13. PROVIDE ON SITE OR MAKE READILY AVAILABLE THE NECESSARY EQUIPMENT AND SITE PERSONNEL DURING CONSTRUCTION HOURS FOR THE DURATION OF THE PROJECT TO ENSURE ALL EROSION AND SEDIMENTATION CONTROL DEVICES ARE PROPERLY MAINTAINED AND REPAIRED IN A TIMELY AND RESPONSIBLE MANNER. IF SITE WORK IS SUSPENDED DURING THE WINTER MONTHS THE CONTRACTOR MUST CONTINUE TO PROVIDE PERSONNEL AND EQUIPMENT EITHER ON SITE OR READILY AVAILABLE TO PROPERLY MAINTAIN AND REPAIR ALL EROSION AND SEDIMENTATION CONTROL DEVICES IN A TIMELY AND RESPONSIBLE MANNER

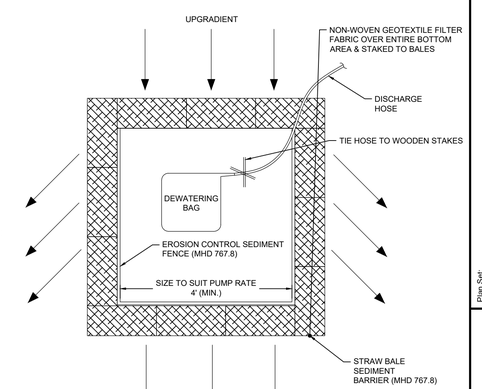


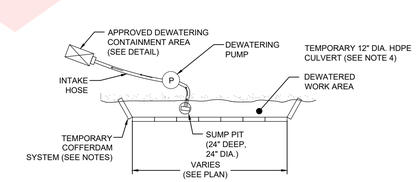
NOTES:
1. SUMP AND EQUIPMENT IS TEMPORARY AND MUST BE REMOVED AFTER USE. STONE AND/OR NATURAL MATERIAL CAN REMAIN.
2. LOCATE PUMP OUTSIDE OF THE MAIN EXCAVATION AREA TO MINIMIZE SEDIMENTATION.
3. SIZE PUMP TO SUFFICIENTLY DEWATER EXCAVATION. MULTIPLE PUMPS TO BE INSTALLED AS NECESSARY.
4. PUMP CHAMBER SIZE TO BE DETERMINED BASED ON PUMP DIMENSIONS.
5. FINAL DEPTH TO BE DETERMINED BY CONTRACTOR BASED ON EXISTING GRADE AND DEPTH OF WATER.

DEWATERING SUMP
NOT TO SCALE



TEMPORARY COFFERDAM INSTALLATION DETAIL





NOTE: DETAIL APPLICABLE FOR WORK ON EITHER SIDE OF MARSH. MIRROR DETAIL AS APPLICABLE.

DEWATERING PUMP PLAN

NOTES:
1. THE DEWATERING PLAN, INCLUDING THE TEMPORARY COFFERDAM SYSTEM TO BE USED, SHALL BE APPROVED BY THE ENGINEER. WATER-INFLATED BARRIERS BY AQUA-BARRIER OR OTHER APPROVED MANUFACTURERS ARE ACCEPTABLE ALTERNATIVES.
2. THE TEMPORARY COFFERDAM SYSTEM SHALL BE INSTALLED ACCORDING TO THE MANUFACTURER RECOMMENDATIONS, BEGINNING AT THE MOST UPSTREAM LOCATION.
3. ANY SANDBAGS USED IN THE DEWATERING PROCESS SHALL CONSIST OF MATERIALS WHICH ARE RESISTANT TO ULTRA-VIOLET RADIATION, TEAR AND PUNCTURE AND WOVEN TIGHTLY ENOUGH TO PREVENT LEAKAGE OF FILL MATERIAL (I.E. SAND, FINE GRAVEL).
4. SEE PLANS FOR LOCATION AND DIMENSIONS OF BYPASS CHANNEL.
5. ALL DEWATERING CONTAINMENT AREAS AND EROSION/SEDIMENT CONTROL DEVICES SHALL BE INSTALLED PRIOR TO ANY COFFERDAM INSTALLATION AND ACCORDING TO THE CONSTRUCTION PLANS AND DETAILS.
6. ALL EXCAVATED SEDIMENTS OR DEBRIS SHALL BE DISPOSED OF IN AN APPROVED STOCK PILE AREA AND PROTECTED WITH EROSION/SEDIMENT CONTROL BARRIERS.
7. EROSIONS/SEDIMENT CONTROL DEVICES ARE TO REMAIN IN PLACE UNTIL ALL DISTURBED AREAS ARE STABILIZED IN ACCORDANCE WITH THE SPECIFICATIONS.

TEMPORARY COFFERDAM INSTALLATION
(PORTA-DAM OR APPROVED EQUIVALENT)
NOT TO SCALE

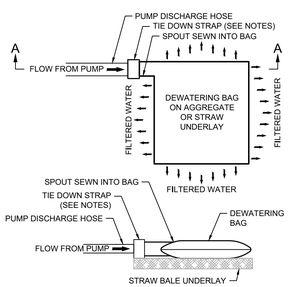
PLAN VIEW — SECTION

NOTES:
1. SILT SOCK MANUFACTURER TO BE SILT SOXX OR ENGINEER APPROVED EQUAL.
2. ALL MATERIAL TO MEET MANUFACTURER'S SPECIFICATIONS.
3. SEDIMENT SILT SOCK TO BE FILLED WITH LEAF COMPOST AND/OR WOODY MULCH PER MANUFACTURER'S REQUIREMENTS.
4. FOLLOWING CONSTRUCTION AND SITE STABILIZATION, COMPOST MATERIAL TO BE REMOVED OR DISPERSED ON SITE, AS APPROVED BY THE ENGINEER.

SEDIMENT SILT SOCK DETAIL
NOT TO SCALE

INSTALLATION NOTES:
1. PLACE LIFTING STRAPS (NOT INCLUDED) UNDER THE UNIT TO FACILITATE REMOVAL AFTER USAGE
2. UNFOLD DANDY DEWATERING BAG ON STABILIZED AREA OVER DENSE VEGETATION, STRAW, OR GRAVEL (IF AN INCREASED DRAINAGE SURFACE IS NEEDED)
3. INSERT DISCHARGE HOSE FROM PUMP INTO DANDY DEWATERING BAG A MINIMUM OF SIX INCHES AND TIGHTLY SECURE WITH ATTACHED TIE DOWN STRAP TO PREVENT WATER FROM FLOWING OUT OF THE UNIT WITHOUT BEING FILTERED
4. IF USING OPTIONAL ABSORBENTS, PLACE ABSORBENT BOOM INTO THE DANDY DEWATERING BAG

MAINTENANCE:
5. REPLACE THE UNIT WHEN 1/2 FULL OF SEDIMENT OR WHEN SEDIMENT HAS REDUCED THE FLOW RATE OF THE PUMP DISCHARGE TO AN IMPRACTICAL RATE
6. IF USING OPTIONAL OIL ABSORBENTS, REMOVE AND REPLACE ABSORBENT PILLOW WHEN NEAR SATURATION



SECTION A - A

DEWATERING BAG
NOT TO SCALE

Revisions

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Plan Set: STREAM CROSSING IMPROVEMENTS
BLACK BROOK
AQUINNAH, MASSACHUSETTS

Plan Title: EROSION CONTROL PLAN

Prepared For:
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Dated: March 20, 2024

Registration:

DRAFT NOT FOR CONSTRUCTION

Project Number: 23112 | Sheet: 6 of 10

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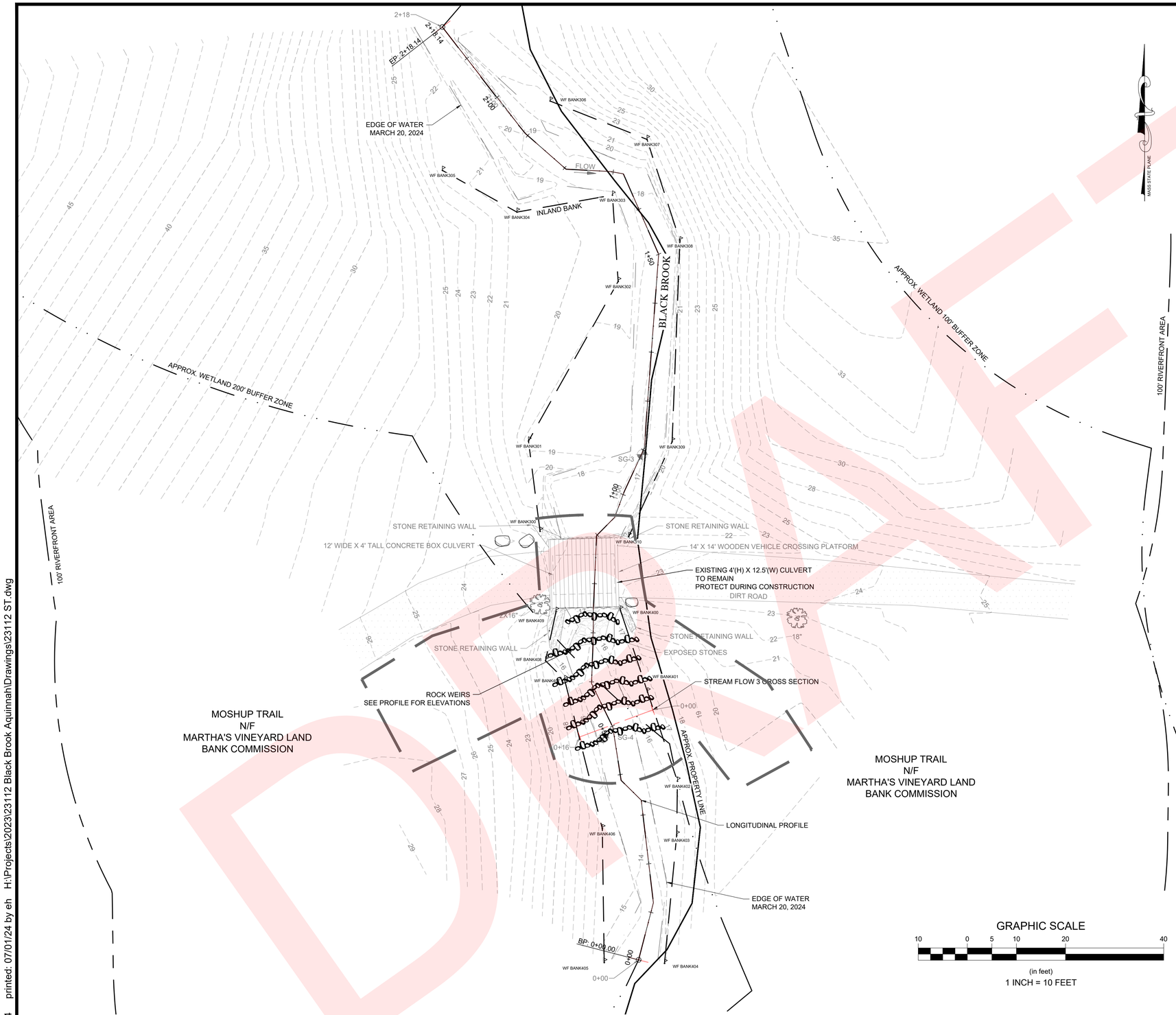

GRAPHIC SCALE

10 0 5 10 20 40

(in feet)

1 INCH = 10 FEET

GENERAL CONSTRUCTION NOTES:

1. ALL SITE WORK TO COMPLETE THIS PROJECT, AS INDICATED ON THE DRAWINGS, IN THE SPECIFICATIONS AND AS DESCRIBED BELOW IS THE SOLE RESPONSIBILITY OF THE CONTRACTOR.
2. IMMEDIATELY CONTACT AND COORDINATE WITH THE ENGINEER AND OWNER IF ANY DEVIATION OR ALTERATION OF THE WORK PROPOSED ON THESE DRAWINGS IS REQUIRED.
3. UTILIZE ALL PRECAUTIONS AND MEASURES TO ENSURE THE SAFETY OF THE PUBLIC, ALL PERSONNEL AND PROPERTY DURING CONSTRUCTION IN ACCORDANCE WITH OSHA STANDARDS, INCLUDING THE INSTALLATION OF TEMPORARY FENCING BARRICADES, SAFETY LIGHTING, CONES, POLICE DETAIL AND/OR FLAGMEN AS DETERMINED NECESSARY BY THE TOWN.
4. MAKE ALL NECESSARY CONSTRUCTION NOTIFICATIONS AND APPLY FOR AND OBTAIN ALL NECESSARY CONSTRUCTION PERMITS, PAY ALL FEES INCLUDING POLICE DETAILS AND POST ALL BONDS, IF NECESSARY, ASSOCIATED WITH THE SAME, AND COORDINATE WITH THE OWNER AND THE ENGINEER.
5. ALL EXISTING CONDITIONS SHOWN ARE APPROXIMATE AND ARE BASED ON THE BEST INFORMATION AVAILABLE. PRIOR TO THE START OF CONSTRUCTION VERIFY THAT THE PROPOSED IMPROVEMENTS SHOWN ON THE PLANS DO NOT CONFLICT WITH ANY KNOWN EXISTING OR OTHER PROPOSED IMPROVEMENTS. IF ANY CONFLICTS ARE DISCOVERED, NOTIFY THE OWNER AND THE ENGINEER PRIOR TO INSTALLING ANY PORTION OF THE SITE WORK WHICH WOULD BE AFFECTED.
6. IMPORT ONLY CLEAN MATERIAL. MATERIAL FROM AN EXISTING OR FORMER 21E SITE AS DEFINED BY THE MASSACHUSETTS CONTINGENCY PLAN 310 CMR 40.0000 WILL NOT BE ACCEPTED .
7. ESTABLISH AND MAINTAIN ALL CONTROL POINTS AND BENCHMARKS DURING CONSTRUCTION INCLUDING BENCHMARK LOCATIONS AND ELEVATIONS AT CRITICAL AREAS. COORDINATE WITH THE ENGINEER THE LOCATION OF ALL CONTROL POINTS AND BENCHMARKS.
8. SITE LAYOUT REQUIRED FOR CONSTRUCTION IS TO BE PROVIDED BY THE CONTRACTOR AND SHOULD BE PERFORMED BY A MASSACHUSETTS' REGISTERED PROFESSIONAL LAND SURVEYOR. THE CONTRACTOR IS RESPONSIBLE FOR COORDINATING WITH THE SURVEYOR FOR ALL SURVEY LAYOUT. IF THE CONTRACTOR CHOOSES TO USE GPS, THEY ASSUME THE LIABILITY FOR THE ACCURACY OF ALL HORIZONTAL AND VERTICAL LAYOUT.
9. MAINTAIN ALL GRADE STAKES SET BY THE SURVEYOR. GRADE STAKES ARE TO REMAIN UNTIL A FINAL INSPECTION OF THE ITEM HAS BEEN COMPLETED BY THE ENGINEER. RE-STAKING OF PREVIOUSLY SURVEYED SITE FEATURES IS THE RESPONSIBILITY (INCLUDING COST) OF THE CONTRACTOR.
10. UNLESS OTHERWISE INDICATED ON THE DRAWINGS AND/OR IN THE SPECIFICATIONS, ALL SITE CONSTRUCTION MATERIALS AND METHODOLOGIES ARE TO CONFORM TO THE MOST RECENT VERSION OF THE MASSACHUSETTS DEPARTMENT OF TRANSPORTATION STANDARD SPECIFICATIONS.
11. PROVIDE ALL CONSTRUCTION SERVICE IN ACCORDANCE WITH APPLICABLE LAWS AND REGULATIONS REGARDING NOISE, VIBRATION, DUST, SEDIMENTATION CONTAINMENT, AND TRENCH WORK.
12. COLLECT SOLID WASTES AND STORE IN A SECURED DUMPSTER. THE DUMPSTER MUST MEET ALL LOCAL AND STATE SOLID WASTE MANAGEMENT REGULATIONS.
13. RESTORE ALL SURFACES EQUAL TO THEIR ORIGINAL CONDITION AFTER CONSTRUCTION IS COMPLETE PER SPECIFICATIONS. LEAVE ALL AREAS NOT DISTURBED BY CONSTRUCTION IN THEIR NATURAL STATE. TAKE CARE TO PREVENT DAMAGE TO SHRUBS, TREES, OTHER LANDSCAPING AND/OR NATURAL FEATURES. WHEREAS THE PLANS DO NOT SHOW ALL LANDSCAPE FEATURES, EXISTING CONDITIONS MUST BE VERIFIED BY THE CONTRACTOR IN ADVANCE OF THE WORK.
14. PROVIDE A UNIT PRICE COST IN CUBIC YARD MEASURE FOR LEDGE AND/OR BOULDER REMOVAL. LEDGE AND/OR BOULDERS LESS THAN 1 CUBIC YARD IN SIZE BASED ON THE AVERAGE DIMENSIONS WILL NOT BE CONSIDERED PAYABLE ROCK. PROVIDE UNIT PRICES FOR BOTH ON AND OFF SITE DISPOSAL. IF ADDITIONAL FILL MATERIAL IS REQUIRED INCLUDE THE COST OF ALL FILL MATERIAL.
15. REGULARLY INSPECT THE PERIMETER OF THE PROPERTY TO CLEAN UP AND REMOVE LOOSE CONSTRUCTION DEBRIS BEFORE IT LEAVES THE SITE. PROMPTLY REMOVE ALL DEMOLITION DEBRIS FROM THE SITE TO AN APPROVED DUMP SITE.
16. ALL TRUCKS LEAVING THE SITE MUST BE COVERED.
17. DO NOT WASH ANY CONCRETE TRUCKS ONSITE. REMOVE BY HAND ANY CEMENT OR CONCRETE DEBRIS LEFT IN THE DISTURBED AREA.
18. BURIAL OF ANY STUMPS, SOLID DEBRIS, AND/OR STONES/BOULDERS ONSITE IS PROHIBITED. DO NOT USE ROAD SALT OR OTHER DE-ICING CHEMICALS ON THE ACCESS ROADWAY.
19. AT THE END OF CONSTRUCTION, REMOVE ALL CONSTRUCTION DEBRIS AND SURPLUS MATERIALS FROM THE SITE. PERFORM A THOROUGH INSPECTION OF THE WORK PERIMETER. COLLECT AND REMOVE ALL MATERIALS AND BLOWN OR WATER CARRIED DEBRIS FROM THE SITE.

BASIC CONSTRUCTION SEQUENCE:

THE FOLLOWING CONSTRUCTION SEQUENCE IS TO BE USED AS A GENERAL GUIDELINE. COORDINATE WITH THE OWNER AND ENGINEERS AND SUBMIT A PROPOSED CONSTRUCTION SEQUENCE FOR REVIEW AND APPROVAL PRIOR TO CONSTRUCTION.

1. SURVEY AND STAKE THE PROPOSED LIMIT OF DISTURBANCE AND LIMIT OF SEDIMENTATION BARRIERS.
2. PLACE SEDIMENTATION BARRIERS AS INDICATED ON DRAWINGS AND STAKED OUT IN THE FIELD. UNDER NO CIRCUMSTANCES IS THE LIMIT OF WORK TO EXTEND BEYOND THE SEDIMENTATION BARRIERS/LIMIT OF DISTURBANCE AS INDICATED ON DRAWINGS AS APPROVED BY THE LOCAL CONSERVATION COMMISSION AND DEPARTMENT OF ENVIRONMENTAL PROTECTION (DEP).
3. INSTALL TEMPORARY CONSTRUCTION ENTRANCES IN LOCATIONS INDICATED ON DRAWINGS. NO OTHER ENTRANCES ARE TO BE USED TO GAIN ACCESS TO THE SITE BY ANY CONSTRUCTION OR DELIVERY VEHICLES.
4. BEGIN SITE PREPARATION, CLEARING AND DEMOLITION AS REQUIRED. BEGIN CLEARING AND GRUBBING THE AREAS OF ROADWAYS AND STORMWATER MANAGEMENT AREAS. TOPSOIL IS TO BE STRIPPED FROM THE AREA OF THE PROPOSED ROADWAYS AND STORMWATER MANAGEMENT AREAS AND STOCKPILED IN APPROVED LOCATIONS. TOPSOIL STOCKPILES MUST BE PROTECTED BY A SEDIMENT BARRIER
5. SURVEY AND STAKE CENTERLINE OF THE WORK.
6. EXCAVATE AND ROUGH GRADE.
7. INSTALL CULVERT OR ROCK POOLS/WEIRS.
8. RESTORE DISTURBED AREAS.
9. FINISH PERMANENT STABILIZATION AND COMPLETE ALL REMAINING PLANTING AND SEEDING.
10. ENGINEER TO APPROVE THE REMOVAL OF ALL TEMPORARY SOIL EROSION AND SEDIMENTATION CONTROL MEASURES FOLLOWING VEGETATIVE ESTABLISHMENT OF ALL DISTURBED AREAS AND DETERMINE WHEN THE CONTRIBUTING AREA HAS REACHED A MINIMUM OF 80% STABILIZATION.

GENERAL GRADING AND DRAINAGE NOTES:

7. ALL CUT AND FILL SLOPES SHALL BE 3:1 OR FLATTER UNLESS OTHERWISE NOTED.
8. EXISTING GRADE CONTOUR INTERVALS SHOWN AT 1 FOOT.
9. PROPOSED GRADE CONTOUR INTERVALS SHOWN AT 1 FOOT.
10. ADJUST AND/OR CUT EXISTING PAVEMENT AS NECESSARY TO ASSURE A SMOOTH FIT AND CONTINUOUS GRADE.
11. PROPOSED ELEVATIONS ARE SHOWN TO FINISH GRADE UNLESS NOTED OTHERWISE.
12. ALL EARTHWORK AND SITE PREPARATION MUST BE DONE IN STRICT ACCORDANCE WITH THE RECOMMENDATIONS OF ANY SUBSURFACE INVESTIGATION OR GEOTECHNICAL REPORTS PREPARED FOR THIS SITE.

Revisions

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Plan Set: STREAM CROSSING IMPROVEMENTS
BLACK BROOK
AQUINNAH, MASSACHUSETTS

Plan Title: ROCK WEIRS SITE PLAN

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Vineyard Haven, MA 02568
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Survey Provided By:
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Dated: March 20, 2024

Registration:

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Project Number: 23112

Sheet : 7 of 10

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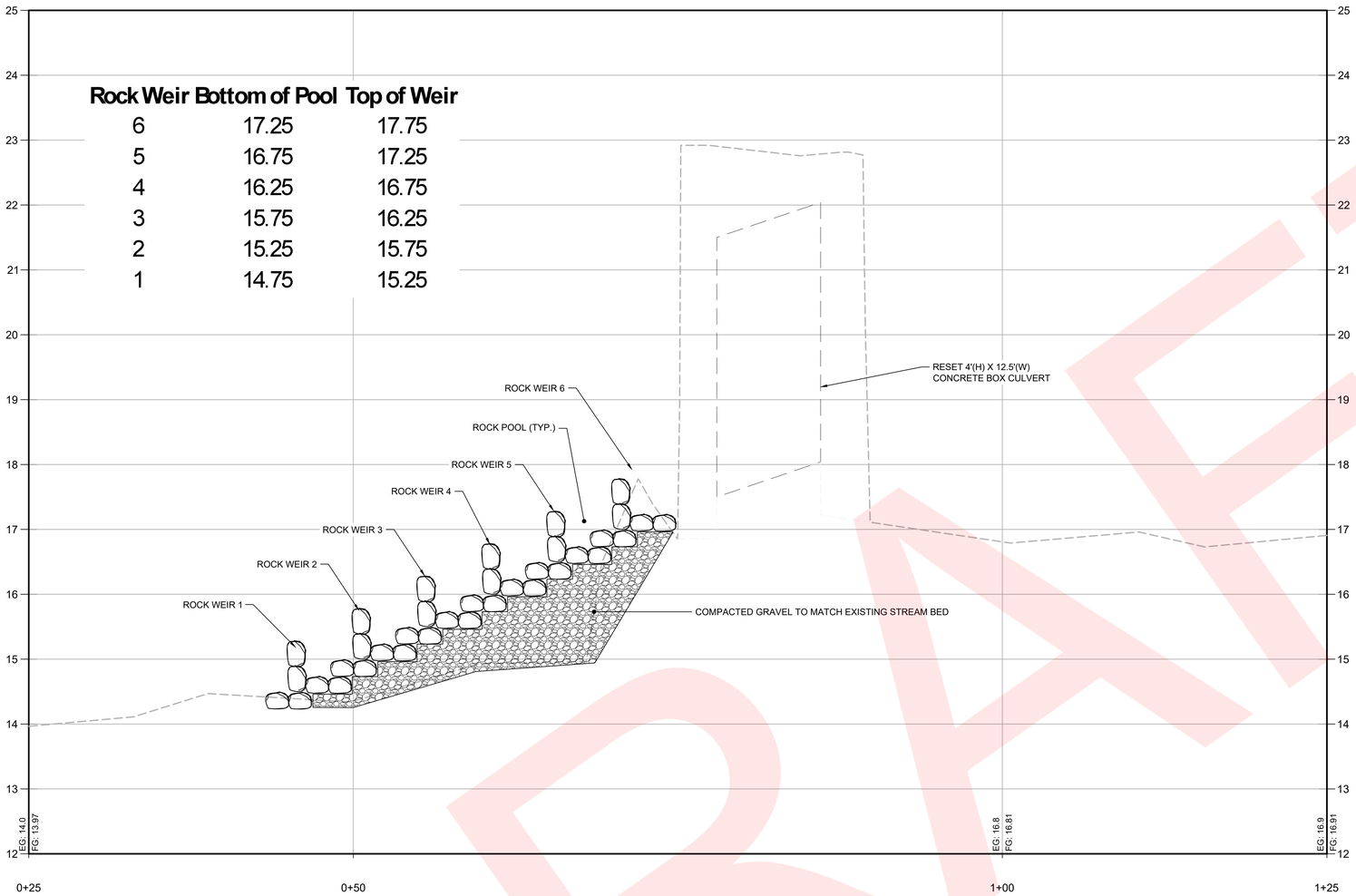
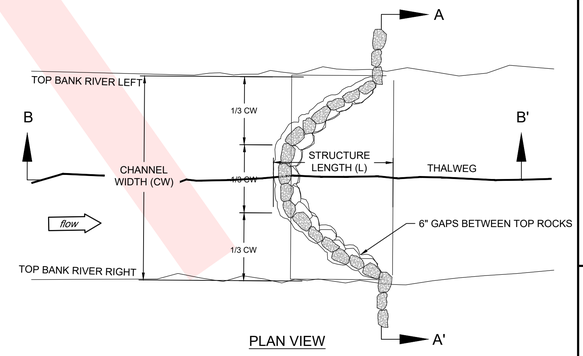
Rock Weir	Bottom of Pool	Top of Weir
6	17.25	17.75
5	16.75	17.25
4	16.25	16.75
3	15.75	16.25
2	15.25	15.75
1	14.75	15.25



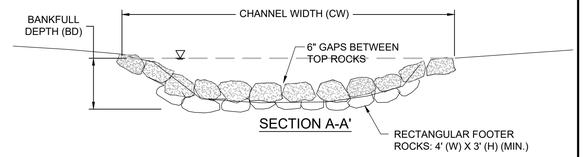
VEHICLE CROSSING ROCK WEIRS PROFILE

HORIZONTAL SCALE: 1" = 5'

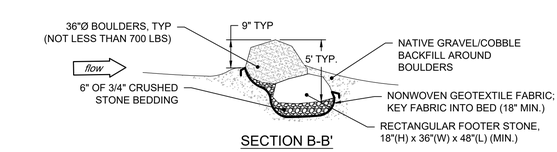
VERTICAL SCALE: 1" = 1'



PLAN VIEW



SECTION A-A'



SECTION B-B'

NOTES:
1. FEATURE DIRECTS FLOW TO CENTERLINE OF CHANNEL AND AWAY FROM STREAM BANKS.
2. CROSS-VANE CREST INVERT SET AT ORDINARY HIGH WATER ELEVATION.
3. GRAVEL/COBBLE MIX FOR BACKFILL MUST BE APPROVED BY ENGINEER.

ROCK WEIR
NOT TO SCALE

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Checked By: MP
Drawn By: EHH
Designed By: EHH
Date: JUNE 2024

Plan Set: STREAM CROSSING IMPROVEMENTS
BLACK BROOK
AQUINNAH, MASSACHUSETTS

Plan Title: ROCK WEIRS PROFILE

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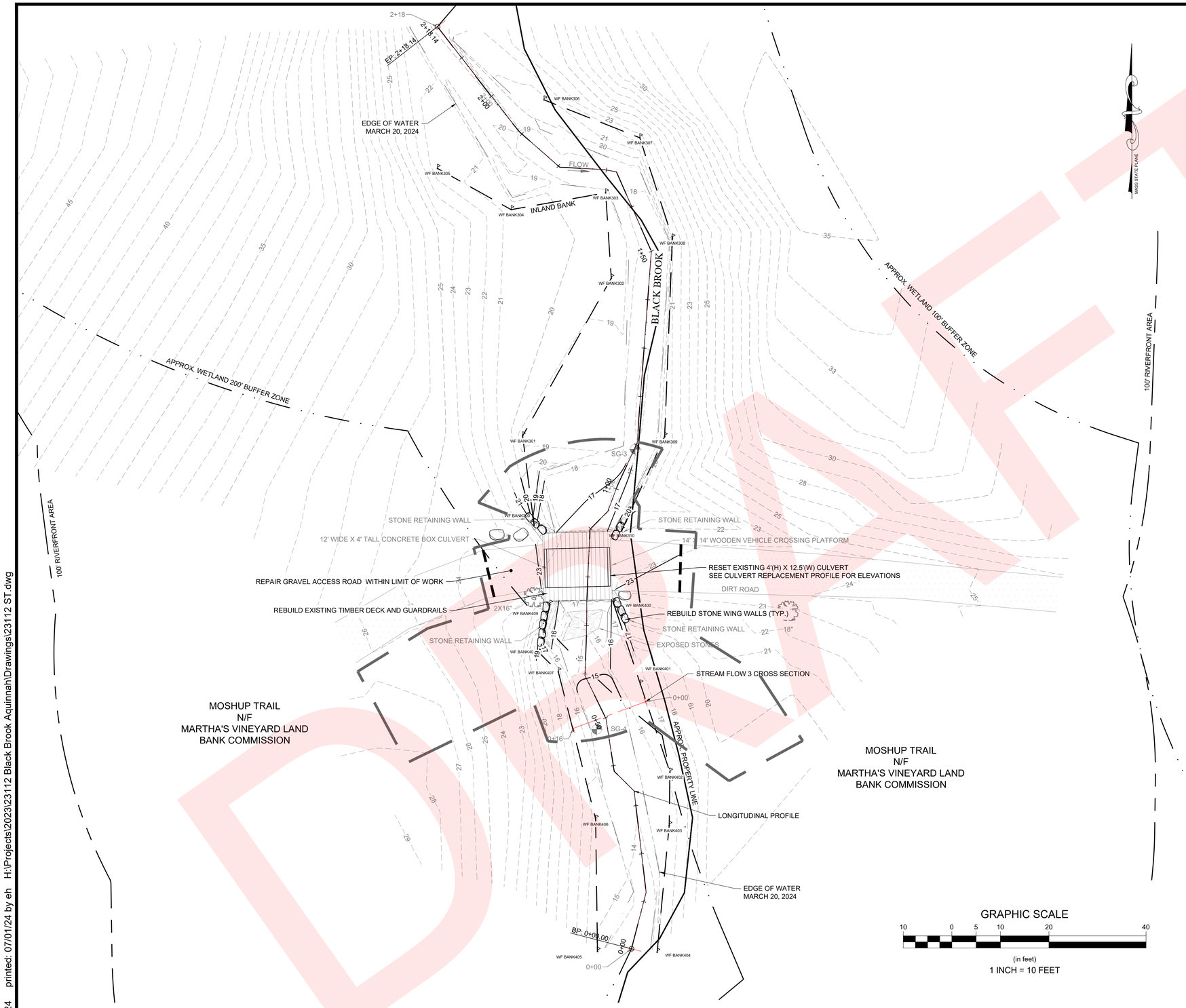
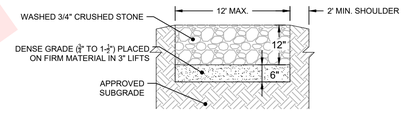
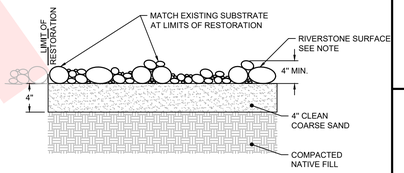




NOTES:
1. PLACE DENSE GRADE SUB-BASE IN MAXIMUM 3" LIFTS (COMPACTED TO 95%).
2. COMPACT SUBGRADE FILL TO 95% COMPACTION.
3. SEE PLANS FOR ROAD WIDTH AND LOCATION.

GRAVEL ACCESS ROAD
NOT TO SCALE

NOTE:
RIVERSTONE SURFACE TO BE MADE OF
THE FOLLOWING STONE SIZE RATIO:
50% : 1"
40% : 1" - 3"
10% : 3" - 6"



RESTORED CHANNEL BOTTOM DETAIL
NOT TO SCALE

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Drawn By: EYH
Designed By: EYH
Date: JUNE 2024

Plan Set: STREAM CROSSING IMPROVEMENTS
BLACK BROOK
AQUINNAH, MASSACHUSETTS

Plan Title: CULVERT REPLACEMENT SITE PLAN

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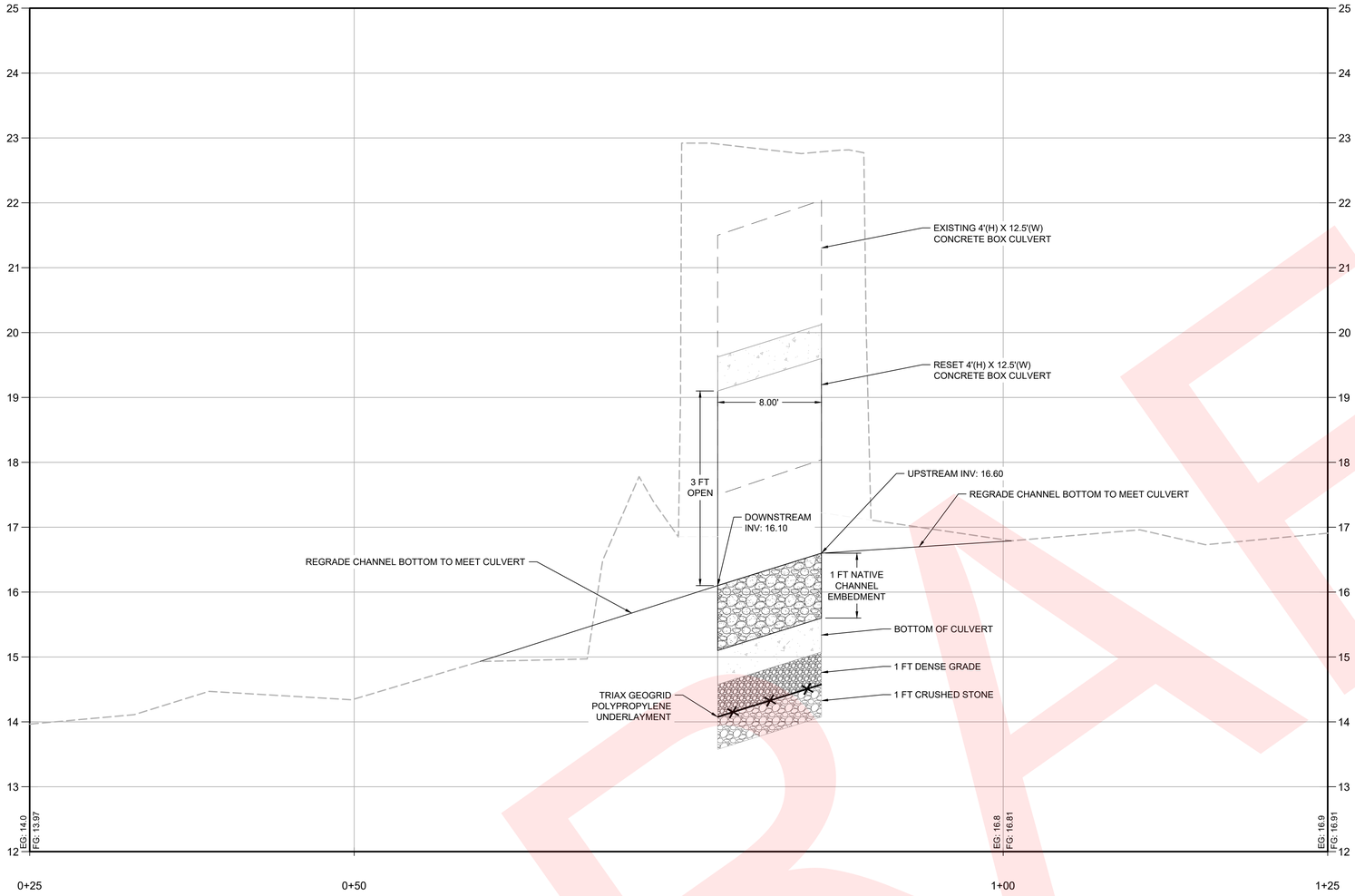

VEHICLE CROSSING CULVERT REPLACEMENT PROFILE

HORIZONTAL SCALE: 1" = 5'

VERTICAL SCALE: 1" = 1'

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ATTACHMENT C

Soil Boring Log

BORING LOG

SB-1

Horsley Witten Group
Sustainable Environmental Solutions

Project: Black Brook
Client: Sherrif's Meadow Foundation
Boring Contractor: Geosearch
Boring Equipment: Hollowstem Auger / ATV

Date: 5/15/2024
Completion Depth: 24'
Elevation: NA
Inspector: CG

Depth Feet	Description	Sample Interval	Penetra./ Recovery	Blow Count	USCS Code	USCS Color	USGS Angularity	Comments	Well Details	Depth Feet
0	Fine to medium coarse SAND		12"	7-8-5-8		Br				
	Fine to medium coarse SAND, trace woody debris		8"	4-5-7-10		Br				
5	Saturated fine to medium coarse SAND		2"	11-9-8-7		Br		▽		
	Fine to medium coarse SAND, trace silty sand		10"	6-6-6-8		Br		water table at 7'		
10	Very fine to fine SAND		14"	4-7-7-7		Br				
	Very fine to fine SAND and medium fine SAND		18"	9-11-15-15		Br				
15	Clayey fine Sand and medium fine to medium coarse Sand		14"	5-4-6-10		Br/Gr				
	Medium fine to medium coarse SAND		18"	7-7-9-12		Gr				
20	Clayey fine Sand and medium coarse Sand		14"	5-5-8-13		Br/Gr				
	Clayey fine Sand medium coarse to medium fine Sand		22"	15-11-10-12		Br/Gr				
								Boring end at 24'		

Proportions Used:

trace (tr)	0 - 10%
little (li)	10 - 20%
some (so)	20 - 35%
and	35 - 50%

Color

Blue (Bl)	Tan (T)
Red (R)	Gray (Gy)
Light (lt)	Brown (Br)
Dark (dk)	Yellow (Yl)

Angular

Round (rnd.)
Angular (ang.)

Abbreviations:

Misc.

Fragments (frag.)
Cement (cem.)
Well-Graded Sand (SW)
Poorly-Graded Sand (SP)
Well-Graded Gravel (GW)
Poorly-Graded Gravel (GP)
Below Land Surface (BLS)

Not Available (N/A)

Size

Fine = (f)	Fine to Coarse = (f-c)
Medium = (m)	Very = (v)
Coarse = (c)	More/Less = (+/-)
Dark = (dk)	

ATTACHMENT D

Sediment Quality Summary Spreadsheet and Laboratory Analytical Report

Black Brook, Aquinnah, MA **Sediment Quality Sampling**				**Ecological Thresholds (aquatic)**		**Human Exposure Thresholds (upland/floodplain)**							**Downstream Samples Results**		**Upstream Samples**	
Parameters	Units			Freshwater		*(for comparison)*	Direct Contact	Direct Contact	Direct Contact				5/15/2024	5/15/2024	5/15/2024	5/15/2024
		"Natural Soil" Background	"Urban Soil" Background	TEC/TEL	PEC/PEL	Method 1 Soil Standards S-1/GW-1	Method 2 (S-1)	Method 2 (S-2)	Method 2 (S-3)	Method 3 Ceiling Limits	TCLP	Max Concentrations for Toxicity	SED-MD (Moshup Trail Downstream)	SED-CD (path culvert downstream)	SED-MU (Moshup Trail Upstream)	SED-CU (path culvert upstream)
Metals (mg/kg)											mg/kg	mg/L				
Arsenic	mg/kg (ppm)	20	20	9.79	33.0	20	20	20	50	600	100.0	5.0	0.2	4.89	0.19	0.61
Cadmium	mg/kg (ppm)	2	3	0.99	4.98	80	80	80	80	800	20.0	1.0	0.05	0.045	0.05	0.05
Chromium (TOTAL)	mg/kg (ppm)	30	40	43.4	111	100	100	200	200	2,000	100.0	5.0	0.78	4.62	0.72	1.0
Copper	mg/kg (ppm)	40	200	31.6	149								0.5	9.02	1.85	1.13
Lead	mg/kg (ppm)	100	600	35.8	128	200	200	600	600	6,000	100.0	5.0	1.54	14.20	2.25	3.68
Mercury	mg/kg (ppm)	0.3	1.0	0.18	1.06	20	20	40	40	400	4.0	0.2	0.005	0.0045	0.0045	0.0045
Nickel	mg/kg (ppm)	20	30	22.7	48.6	700	700	1,000	1,000	10,000			0.5	5.27	1.22	0.49
Zinc	mg/kg (ppm)	100	300	121	459	1,000	1,000	3,000	5,000	10,000			2.31	13.9	3.61	4.34
PAHs (ug/kg)																
Acenaphthene	ug/kg (ppb)	500	2,000	6.71	88.9	4,000	1,000,000	3,000,000	5,000,000	10,000,000			4.5	5	5	6.5
Acenaphthylene	ug/kg (ppb)	500	1,000	5.87	128	2,000	1,000,000	3,000,000	5,000,000	10,000,000			4.5	5	5	6.5
Anthracene	ug/kg (ppb)	1,000	4,000	57.2	845	1,000,000	1,000,000	3,000,000	5,000,000	10,000,000			4.5	5	5	6.5
Benzo(a)anthracene	ug/kg (ppb)	2,000	9,000	108	1,050	20,000	20,000	300,000	2,000,000	10,000,000			4.5	5	5	6.5
Benzo(a)pyrene	ug/kg (ppb)	2,000	7,000	150	1,450	2,000	2,000	30,000	30,000	300,000			4.5	5	5	6.5
Benzo(b)fluoranthene	ug/kg (ppb)	2,000	8,000			20,000	20,000	300,000	2,000,000	10,000,000			4.5	5	5	6.5
Benzo(g,h,i)perylene	ug/kg (ppb)	1,000	3,000			1,000,000	1,000,000	3,000,000	5,000,000	10,000,000			4.5	5	5	6.5
Benzo(k)fluoranthene	ug/kg (ppb)	1,000	4,000			200,000	200,000	3,000,000	5,000,000	10,000,000			4.5	5	5	6.5
Chrysene	ug/kg (ppb)	2,000	7,000	166	1,290	200,000	200,000	3,000,000	5,000,000	10,000,000			4.5	5	5	6.5
Dibenzo(a,h)anthracene	ug/kg (ppb)	500	1,000	33.0	135	2,000	2,000	30,000	50,000	2,000,000			4.5	5	5	6.5
Fluoranthene	ug/kg (ppb)	4,000	10,000	423	2,230	1,000,000	1,000,000	3,000,000	5,000,000	10,000,000			4.5	14	5	6.5
Fluorene	ug/kg (ppb)	1,000	2,000	77.4	536	1,000,000	1,000,000	3,000,000	5,000,000	10,000,000			4.5	5	5	6.5
Indeno(1,2,3-cd)pyrene	ug/kg (ppb)	1,000	3,000			20,000	20,000	300,000	2,000,000	10,000,000			4.5	5	5	6.5
2-Methylnaphthalene	ug/kg (ppb)	500	1,000			700	300,000	500,000	500,000	5,000,000			4.5	5	5	6.5
Naphthalene	ug/kg (ppb)	500	1,000	176	561	4,000	500,000	1,000,000	3,000,000	10,000,000			4.5	5	5	6.5
Phenanthrene	ug/kg (ppb)	3,000	20,000	204	1,170	10,000	500,000	1,000,000	3,000,000	10,000,000			4.5	16	5	6.5
Pyrene	ug/kg (ppb)	4,000	20,000	195	1,520	1,000,000	500,000	1,000,000	3,000,000	10,000,000			4.5	11	5	6.5
Total PAHs	ug/kg (ppb)	26,500	103,000	1,610	22,800	5,183,400	8,026,700	22,791,000	49,160,000	124,600,000			ND	41	ND	ND
PCBs (mg/kg or ppm)																
Total PCBs (mg/kg)	mg/kg (ppm)			0.0598	0.676	1.00	1.00	4.00	4.00	100			ND	ND	ND	ND
PCB-8													0.00016	0.000165	0.00016	0.000205
PCB-18													0.00016	0.000165	0.00016	0.000205
PCB-28													0.00016	0.000165	0.00016	0.000205
PCB-44													0.00016	0.000165	0.00016	0.000205
PCB-52													0.00016	0.000165	0.00016	0.000205
PCB-66													0.00016	0.000165	0.00016	0.000205
PCB-101													0.00016	0.000165	0.00016	0.000205
PCB-105													0.00016	0.000165	0.00016	0.000205
PCB-118													0.00016	0.000165	0.00016	0.000205
PCB-128													0.00016	0.000165	0.00016	0.000205
PCB-138													0.00016	0.000165	0.00016	0.000205
PCB-153													0.00016	0.000165	0.00016	0.000205
PCB-170													0.00016	0.000165	0.00016	0.000205
PCB-180													0.00016	0.000165	0.00016	0.000205

PCB-187									0.00016	0.000165	0.00016	0.000205
PCB-195									0.00016	0.000165	0.00016	0.000205
PCB-206									0.00016	0.000165	0.00016	0.000205
DCB Decachlorobiphenyl									0.00016	0.000165	0.00016	0.000205
TPH and EPH (mg/kg or ppm)												
C9-C18 Aliphatic Hydrocarbons	mg/kg (ppm)			1,000	1,000	3,000	5,000	20,000	8.8	9	9.3	11.75
C19-C36 Aliphatic Hydrocarbons	mg/kg (ppm)			3,000	3,000	5,000	5,000	20,000	8.8	9	9.3	11.75
C11-C22 Aromatic Hydrocarbons	mg/kg (ppm)			1,000	1,000	3,000	5,000	10,000	8.8	9	9.3	11.75
Physical Characteristics												
Total Organic Carbon	mg/kg (ppm)								250	8150	808.0	20600
Percent Water (%)	%								16.0	18	17.0	35
Sieve No. 4 (% passing)	% passing								85.0	81.0	44.5	95.1
Sieve No. 10 (% passing)	% passing								71.1	65.2	30.5	84.1
Sieve No. 40 (% passing)	% passing								19.4	21.2	6.8	19.9
Sieve No. 60 (% passing)	% passing								4.0	5.3	2.0	5.3
Sieve No. 200 (% passing)	% passing								0.6	0.5	0.4	0.7

Notes:
Samples collected by Horsley Witten Group, Inc., and analyzed at ESS Laboratory, Cranston, Rhode Island
ppm - parts per million
ppb - parts per billion
Results in green font were below the laboratory detection limit, half of the laboratory detection limit shown.
Results in bold indicate an exceedance of an applicable criteria, with corresponding cell shading.

ESS Laboratory
DIVISION OF THE RISE GROUP
BAL Laboratory Analytical Balance

CERTIFICATE OF ANALYSIS

Neal Price
Horsley & Witten
90 Route 6A
Sandwich, MA 02563

RE: Black Brook (23112)
ESS Laboratory Work Order Number: 24E0926

This signed Certificate of Analysis is our approved release of your analytical results. These results are only representative of sample aliquots received at the laboratory. ESS Laboratory expects its clients to follow all regulatory sampling guidelines. Beginning with this page, the entire report has been paginated. This report should not be copied except in full without the approval of the laboratory. Samples will be disposed of thirty days after the final report has been delivered. If you have any questions or concerns, please feel free to call our Customer Service Department.

Laurel Stoddard
Laboratory Director

REVIEWED
By ESS Laboratory at 3:20 pm, Jun 03, 2024

Analytical Summary
The project as described above has been analyzed in accordance with the ESS Quality Assurance Plan. This plan utilizes the following methodologies: US EPA SW-846, US EPA Methods for Chemical Analysis of Water and Wastes per 40 CFR Part 136, APHA Standard Methods for the Examination of Water and Wastewater, American Society for Testing and Materials (ASTM), and other recognized methodologies. The analyses with these noted observations are in conformance to the Quality Assurance Plan. In chromatographic analysis, manual integration is frequently used instead of automated integration because it produces more accurate results.

The test results present in this report are in compliance with TNI and relative state standards, and/or client Quality Assurance Project Plans (QAPP). The laboratory has reviewed the following: Sample Preservations, Hold Times, Initial Calibrations, Continuing Calibrations, Method Blanks, Blank Spikes, Blank Spike Duplicates, Duplicates, Matrix Spikes, Matrix Spike Duplicates, Surrogates and Internal Standards. Any results which were found to be outside of the recommended ranges stated in our SOPs will be noted in the Project Narrative.

Subcontracted Analyses

CTS - Cranston, RI	Grain Size Analysis, Grain Size for - 401WQ

CERTIFICATE OF ANALYSIS

Client Name: Horsley & Witten
Client Project ID: Black Brook

ESS Laboratory Work Order: 24E0926

SAMPLE RECEIPT

The following samples were received on May 22, 2024 for the analyses specified on the enclosed Chain of Custody Record.

Samples 24E0926-01, -02, and -03 were decanted prior to preparation/analysis.

Samples 24E0926-01, -02, -03, and -04 for Metals were air dried prior to extraction and relogged in as Sample 24E0926-05, -06, -07, and -08. This was done to increase the dry weight of the sample extracted which decreases variabilty of results and lowers the detection limits for samples with high water content.

Lab Number	Sample Name	Matrix	Analysis
24E0926-01	SED-MD	Soil	2540G, 8082A Cong, EPH8270, EPH8270SIM, LK, MADEP-EPH, SUB
24E0926-02	SED-MU	Soil	2540G, 8082A Cong, EPH8270, EPH8270SIM, LK, MADEP-EPH, SUB
24E0926-03	SED-CU	Soil	2540G, 8082A Cong, EPH8270, EPH8270SIM, LK, MADEP-EPH, SUB
24E0926-04	SED-CD	Soil	2540G, 8082A Cong, EPH8270, EPH8270SIM, LK, MADEP-EPH, SUB
24E0926-05	SED-MD - Air Dried	Soil	6010D, 7471B
24E0926-06	SED-MU - Air Dried	Soil	6010D, 7471B
24E0926-07	SED-CU - Air Dried	Soil	6010D, 7471B
24E0926-08	SED-CD - Air Dried	Soil	6010D, 7471B

CERTIFICATE OF ANALYSIS

Client Name: Horsley & Witten
Client Project ID: Black Brook ESS Laboratory Work Order: 24E0926

PROJECT NARRATIVE

MADEP-EPH Extractable Petroleum Hydrocarbons
D4E0506-CCV2 **Continuing Calibration %Diff/Drift is below control limit (CD-).**
2-Bromonaphthalene (26% @ 25%)

Total Metals
DE42410-BSD1 **Blank Spike recovery is below lower control limit (B-).**
Chromium (73% @ 74-126%), Copper (74% @ 78-122%), Nickel (74% @ 75-125%), Zinc (69% @ 70-130%)

No other observations noted.

End of Project Narrative.

DATA USABILITY LINKS

To ensure you are viewing the most current version of the documents below, please clear your internet cookies for www.ESSLaboratory.com. Consult your IT Support personnel for information on how to clear your internet cookies.

Definitions of Quality Control Parameters

Semivolatile Organics Internal Standard Information

Semivolatile Organics Surrogate Information

Volatile Organics Internal Standard Information

Volatile Organics Surrogate Information

EPH and VPH Alkane Lists

CERTIFICATE OF ANALYSIS

Client Name: Horsley & Witten
Client Project ID: Black Brook

ESS Laboratory Work Order: 24E0926

CURRENT SW-846 METHODOLOGY VERSIONS

Analytical Methods

1010A - Flashpoint
6010D - ICP
6020B - ICP MS
7010 - Graphite Furnace
7196A - Hexavalent Chromium
7470A - Aqueous Mercury
7471B - Solid Mercury
8011 - EDB/DBCP/TCP
8015C - GRO/DRO
8081B - Pesticides
8082A - PCB
8100M - TPH
8151A - Herbicides
8260D - VOA
8270E - SVOA
8270E SIM - SVOA Low Level
9014 - Cyanide
9038 - Sulfate
9040C - Aqueous pH
9045D - Solid pH (Corrosivity)
9050A - Specific Conductance
9056A - Anions (IC)
9060A - TOC
9095B - Paint Filter
MADEP 19-2.1 - EPH
MADEP 18-2.1 - VPH

Prep Methods

3005A - Aqueous ICP Digestion
3020A - Aqueous Graphite Furnace / ICP MS Digestion
3050B - Solid ICP / Graphite Furnace / ICP MS Digestion
3060A - Solid Hexavalent Chromium Digestion
3510C - Separatory Funnel Extraction
3520C - Liquid / Liquid Extraction
3540C - Manual Soxhlet Extraction
3546 - Microwave Extraction
3580A - Waste Dilution
5030B - Aqueous Purge and Trap
5030C - Aqueous Purge and Trap
5035A - Solid Purge and Trap

SW846 Reactivity Methods 7.3.3.2 (Reactive Cyanide) and 7.3.4.1 (Reactive Sulfide) have been withdrawn by EPA. These methods are reported per client request and are not NELAP accredited.

CERTIFICATE OF ANALYSIS

Client Name: Horsley & Witten
Client Project ID: Black Brook
Client Sample ID: SED-MD
Date Sampled: 05/15/24 16:30
Percent Solids: 84
Initial Volume: 25.5g
Final Volume: 1ml
Extraction Method: 3546

ESS Laboratory Work Order: 24E0926
ESS Laboratory Sample ID: 24E0926-01
Sample Matrix: Soil
Units: mg/kg dry

Prepared: 5/22/24 20:15

MADEP-EPH Extractable Petroleum Hydrocarbons

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Sequence	Batch
C9-C18 Aliphatics1	ND (17.5)	---	MADEP-EPH	---	1	JDN	05/24/24 15:42	D4E0525	DE42254
C19-C36 Aliphatics1	ND (17.5)	---	MADEP-EPH	---	1	JDN	05/24/24 15:42	D4E0525	DE42254
C11-C22 Unadjusted Aromatics1	ND (17.5)	---	EPH8270	---	1	IBM	05/24/24 10:38	D4E0506	DE42254
C11-C22 Aromatics1,2	ND (17.7)	---	EPH8270	---		TJ	05/28/24 21:57	---	[CALC]
2-Methylnaphthalene	ND (0.009)	---	EPH8270SIM	---	1	TJ	05/28/24 21:57	D4E0587	DE42254
Acenaphthene	ND (0.009)	---	EPH8270SIM	---	1	TJ	05/28/24 21:57	D4E0587	DE42254
Naphthalene	ND (0.009)	---	EPH8270SIM	---	1	TJ	05/28/24 21:57	D4E0587	DE42254
Phenanthrene	ND (0.009)	---	EPH8270SIM	---	1	TJ	05/28/24 21:57	D4E0587	DE42254
Acenaphthylene	ND (0.009)	---	EPH8270SIM	---	1	TJ	05/28/24 21:57	D4E0587	DE42254
Anthracene	ND (0.009)	---	EPH8270SIM	---	1	TJ	05/28/24 21:57	D4E0587	DE42254
Benzo(a)anthracene	ND (0.009)	---	EPH8270SIM	---	1	TJ	05/28/24 21:57	D4E0587	DE42254
Benzo(a)pyrene	ND (0.009)	---	EPH8270SIM	---	1	TJ	05/28/24 21:57	D4E0587	DE42254
Benzo(b)fluoranthene	ND (0.009)	---	EPH8270SIM	---	1	TJ	05/28/24 21:57	D4E0587	DE42254
Benzo(g,h,i)perylene	ND (0.009)	---	EPH8270SIM	---	1	TJ	05/28/24 21:57	D4E0587	DE42254
Benzo(k)fluoranthene	ND (0.009)	---	EPH8270SIM	---	1	TJ	05/28/24 21:57	D4E0587	DE42254
Chrysene	ND (0.009)	---	EPH8270SIM	---	1	TJ	05/28/24 21:57	D4E0587	DE42254
Dibenzo(a,h)Anthracene	ND (0.009)	---	EPH8270SIM	---	1	TJ	05/28/24 21:57	D4E0587	DE42254
Fluoranthene	ND (0.009)	---	EPH8270SIM	---	1	TJ	05/28/24 21:57	D4E0587	DE42254
Fluorene	ND (0.009)	---	EPH8270SIM	---	1	TJ	05/28/24 21:57	D4E0587	DE42254
Indeno(1,2,3-cd)Pyrene	ND (0.009)	---	EPH8270SIM	---	1	TJ	05/28/24 21:57	D4E0587	DE42254
Pyrene	ND (0.009)	---	EPH8270SIM	---	1	TJ	05/28/24 21:57	D4E0587	DE42254

	%Recovery	Qualifier	Limits
Surrogate: 1-Chlorooctadecane	*71 %*		*40-140*
Surrogate: 2-Bromonaphthalene	*95 %*		*40-140*
Surrogate: 2-Fluorobiphenyl	*95 %*		*40-140*
Surrogate: O-Terphenyl	*91 %*		*40-140*

CERTIFICATE OF ANALYSIS

Client Name: Horsley & Witten
Client Project ID: Black Brook
Client Sample ID: SED-MD
Date Sampled: 05/15/24 16:30
Percent Solids: 84

ESS Laboratory Work Order: 24E0926
ESS Laboratory Sample ID: 24E0926-01
Sample Matrix: Soil

Classical Chemistry

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Percent Moisture	**16** (1)	---	2540G	---	1	CCP	05/22/24 19:00	%	DE42247
Total Organic Carbon (Average)	ND (500)	---	LK	---	1	CCP	05/28/24 11:56	mg/kg	[CALC]

CERTIFICATE OF ANALYSIS

Client Name: Horsley & Witten
Client Project ID: Black Brook
Client Sample ID: SED-MD
Date Sampled: 05/15/24 16:30

ESS Laboratory Work Order: 24E0926
ESS Laboratory Sample ID: 24E0926-01
Sample Matrix: Soil

Subcontracted Analysis

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Grain Size	**See Attached** (N/A)	---		---				%	

CERTIFICATE OF ANALYSIS

Client Name: Horsley & Witten
Client Project ID: Black Brook
Client Sample ID: SED-MD
Date Sampled: 05/15/24 16:30
Percent Solids: 84
Initial Volume: 30.4g
Final Volume: 2ml
Extraction Method: 3540C

ESS Laboratory Work Order: 24E0926
ESS Laboratory Sample ID: 24E0926-01
Sample Matrix: Soil
Units: mg/kg dry
Analyst: DMC
Prepared: 5/28/24 12:30

8082 Polychlorinated Biphenyls (PCB) / Congeners

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
BZ#8	ND (0.00032)	---	8082A Cong	---	1	05/29/24 16:23	D4E0570	DE42809
BZ#18	ND (0.00032)	---	8082A Cong	---	1	05/29/24 16:23	D4E0570	DE42809
BZ#28	ND (0.00032)	---	8082A Cong	---	1	05/29/24 16:23	D4E0570	DE42809
BZ#44	ND (0.00032)	---	8082A Cong	---	1	05/29/24 16:23	D4E0570	DE42809
BZ#52	ND (0.00032)	---	8082A Cong	---	1	05/29/24 16:23	D4E0570	DE42809
BZ#66	ND (0.00032)	---	8082A Cong	---	1	05/29/24 16:23	D4E0570	DE42809
BZ#101	ND (0.00032)	---	8082A Cong	---	1	05/29/24 16:23	D4E0570	DE42809
BZ#105	ND (0.00032)	---	8082A Cong	---	1	05/29/24 16:23	D4E0570	DE42809
BZ#118	ND (0.00032)	---	8082A Cong	---	1	05/29/24 16:23	D4E0570	DE42809
BZ#128	ND (0.00032)	---	8082A Cong	---	1	05/29/24 16:23	D4E0570	DE42809
BZ#138	ND (0.00032)	---	8082A Cong	---	1	05/29/24 16:23	D4E0570	DE42809
BZ#153	ND (0.00032)	---	8082A Cong	---	1	05/29/24 16:23	D4E0570	DE42809
BZ#170	ND (0.00032)	---	8082A Cong	---	1	05/29/24 16:23	D4E0570	DE42809
BZ#180	ND (0.00032)	---	8082A Cong	---	1	05/29/24 16:23	D4E0570	DE42809
BZ#187	ND (0.00032)	---	8082A Cong	---	1	05/29/24 16:23	D4E0570	DE42809
BZ#195	ND (0.00032)	---	8082A Cong	---	1	05/29/24 16:23	D4E0570	DE42809
BZ#206	ND (0.00032)	---	8082A Cong	---	1	05/29/24 16:23	D4E0570	DE42809
BZ#209	ND (0.00032)	---	8082A Cong	---	1	05/29/24 16:23	D4E0570	DE42809

	%Recovery	Qualifier	Limits
Surrogate: Tetrachloro-m-xylene [2C]	*69 %*		*30-150*

CERTIFICATE OF ANALYSIS

Client Name: Horsley & Witten
Client Project ID: Black Brook
Client Sample ID: SED-MU
Date Sampled: 05/15/24 16:15
Percent Solids: 83
Initial Volume: 24.3g
Final Volume: 1ml
Extraction Method: 3546

ESS Laboratory Work Order: 24E0926
ESS Laboratory Sample ID: 24E0926-02
Sample Matrix: Soil
Units: mg/kg dry

Prepared: 5/22/24 20:15

MADEP-EPH Extractable Petroleum Hydrocarbons

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Sequence	Batch
C9-C18 Aliphatics1	ND (18.6)	---	MADEP-EPH	---	1	JDN	05/24/24 17:26	D4E0525	DE42254
C19-C36 Aliphatics1	ND (18.6)	---	MADEP-EPH	---	1	JDN	05/24/24 17:26	D4E0525	DE42254
C11-C22 Unadjusted Aromatics1	ND (18.6)	---	EPH8270	---	1	IBM	05/24/24 12:25	D4E0506	DE42254
C11-C22 Aromatics1,2	ND (18.8)	---	EPH8270	---		TJ	05/28/24 23:00	---	[CALC]
2-Methylnaphthalene	ND (0.010)	---	EPH8270SIM	---	1	TJ	05/28/24 23:00	D4E0587	DE42254
Acenaphthene	ND (0.010)	---	EPH8270SIM	---	1	TJ	05/28/24 23:00	D4E0587	DE42254
Naphthalene	ND (0.010)	---	EPH8270SIM	---	1	TJ	05/28/24 23:00	D4E0587	DE42254
Phenanthrene	ND (0.010)	---	EPH8270SIM	---	1	TJ	05/28/24 23:00	D4E0587	DE42254
Acenaphthylene	ND (0.010)	---	EPH8270SIM	---	1	TJ	05/28/24 23:00	D4E0587	DE42254
Anthracene	ND (0.010)	---	EPH8270SIM	---	1	TJ	05/28/24 23:00	D4E0587	DE42254
Benzo(a)anthracene	ND (0.010)	---	EPH8270SIM	---	1	TJ	05/28/24 23:00	D4E0587	DE42254
Benzo(a)pyrene	ND (0.010)	---	EPH8270SIM	---	1	TJ	05/28/24 23:00	D4E0587	DE42254
Benzo(b)fluoranthene	ND (0.010)	---	EPH8270SIM	---	1	TJ	05/28/24 23:00	D4E0587	DE42254
Benzo(g,h,i)perylene	ND (0.010)	---	EPH8270SIM	---	1	TJ	05/28/24 23:00	D4E0587	DE42254
Benzo(k)fluoranthene	ND (0.010)	---	EPH8270SIM	---	1	TJ	05/28/24 23:00	D4E0587	DE42254
Chrysene	ND (0.010)	---	EPH8270SIM	---	1	TJ	05/28/24 23:00	D4E0587	DE42254
Dibenzo(a,h)Anthracene	ND (0.010)	---	EPH8270SIM	---	1	TJ	05/28/24 23:00	D4E0587	DE42254
Fluoranthene	ND (0.010)	---	EPH8270SIM	---	1	TJ	05/28/24 23:00	D4E0587	DE42254
Fluorene	ND (0.010)	---	EPH8270SIM	---	1	TJ	05/28/24 23:00	D4E0587	DE42254
Indeno(1,2,3-cd)Pyrene	ND (0.010)	---	EPH8270SIM	---	1	TJ	05/28/24 23:00	D4E0587	DE42254
Pyrene	ND (0.010)	---	EPH8270SIM	---	1	TJ	05/28/24 23:00	D4E0587	DE42254

	%Recovery	*Qualifier*	*Limits*
Surrogate: 1-Chlorooctadecane	*60 %*		*40-140*
Surrogate: 2-Bromonaphthalene	*96 %*		*40-140*
Surrogate: 2-Fluorobiphenyl	*96 %*		*40-140*
Surrogate: O-Terphenyl	*86 %*		*40-140*

CERTIFICATE OF ANALYSIS

Client Name: Horsley & Witten
Client Project ID: Black Brook
Client Sample ID: SED-MU
Date Sampled: 05/15/24 16:15
Percent Solids: 83

ESS Laboratory Work Order: 24E0926
ESS Laboratory Sample ID: 24E0926-02
Sample Matrix: Soil

Classical Chemistry

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Percent Moisture	**17** (1)	---	2540G	---	1	CCP	05/22/24 19:00	%	DE42247
Total Organic Carbon (Average)	**808** (500)	---	LK	---	1	CCP	05/28/24 13:02	mg/kg	[CALC]

CERTIFICATE OF ANALYSIS

Client Name: Horsley & Witten
Client Project ID: Black Brook
Client Sample ID: SED-MU
Date Sampled: 05/15/24 16:15

ESS Laboratory Work Order: 24E0926
ESS Laboratory Sample ID: 24E0926-02
Sample Matrix: Soil

Subcontracted Analysis

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Grain Size	**See Attached** (N/A)	---		---				%	

CERTIFICATE OF ANALYSIS

Client Name: Horsley & Witten
Client Project ID: Black Brook
Client Sample ID: SED-MU
Date Sampled: 05/15/24 16:15
Percent Solids: 83
Initial Volume: 30.4g
Final Volume: 2ml
Extraction Method: 3540C

ESS Laboratory Work Order: 24E0926
ESS Laboratory Sample ID: 24E0926-02
Sample Matrix: Soil
Units: mg/kg dry
Analyst: DMC
Prepared: 5/28/24 12:30

8082 Polychlorinated Biphenyls (PCB) / Congeners

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
BZ#8	ND (0.00032)	---	8082A Cong	---	1	05/29/24 16:53	D4E0570	DE42809
BZ#18	ND (0.00032)	---	8082A Cong	---	1	05/29/24 16:53	D4E0570	DE42809
BZ#28	ND (0.00032)	---	8082A Cong	---	1	05/29/24 16:53	D4E0570	DE42809
BZ#44	ND (0.00032)	---	8082A Cong	---	1	05/29/24 16:53	D4E0570	DE42809
BZ#52	ND (0.00032)	---	8082A Cong	---	1	05/29/24 16:53	D4E0570	DE42809
BZ#66	ND (0.00032)	---	8082A Cong	---	1	05/29/24 16:53	D4E0570	DE42809
BZ#101	ND (0.00032)	---	8082A Cong	---	1	05/29/24 16:53	D4E0570	DE42809
BZ#105	ND (0.00032)	---	8082A Cong	---	1	05/29/24 16:53	D4E0570	DE42809
BZ#118	ND (0.00032)	---	8082A Cong	---	1	05/29/24 16:53	D4E0570	DE42809
BZ#128	ND (0.00032)	---	8082A Cong	---	1	05/29/24 16:53	D4E0570	DE42809
BZ#138	ND (0.00032)	---	8082A Cong	---	1	05/29/24 16:53	D4E0570	DE42809
BZ#153 [2C]	ND (0.00032)	---	8082A Cong	---	1	05/29/24 16:53	D4E0570	DE42809
BZ#170	ND (0.00032)	---	8082A Cong	---	1	05/29/24 16:53	D4E0570	DE42809
BZ#180	ND (0.00032)	---	8082A Cong	---	1	05/29/24 16:53	D4E0570	DE42809
BZ#187	ND (0.00032)	---	8082A Cong	---	1	05/29/24 16:53	D4E0570	DE42809
BZ#195	ND (0.00032)	---	8082A Cong	---	1	05/29/24 16:53	D4E0570	DE42809
BZ#206	ND (0.00032)	---	8082A Cong	---	1	05/29/24 16:53	D4E0570	DE42809
BZ#209	ND (0.00032)	---	8082A Cong	---	1	05/29/24 16:53	D4E0570	DE42809

	%Recovery	Qualifier	Limits
Surrogate: Tetrachloro-m-xylene [2C]	*74 %*		*30-150*

CERTIFICATE OF ANALYSIS

Client Name: Horsley & Witten
Client Project ID: Black Brook
Client Sample ID: SED-CU
Date Sampled: 05/15/24 15:30
Percent Solids: 65
Initial Volume: 24.5g
Final Volume: 1ml
Extraction Method: 3546

ESS Laboratory Work Order: 24E0926
ESS Laboratory Sample ID: 24E0926-03
Sample Matrix: Soil
Units: mg/kg dry

Prepared: 5/22/24 20:15

MADEP-EPH Extractable Petroleum Hydrocarbons

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Sequence	Batch
C9-C18 Aliphatics1	ND (23.5)	---	MADEP-EPH	---	1	JDN	05/24/24 18:01	D4E0525	DE42254
C19-C36 Aliphatics1	ND (23.5)	---	MADEP-EPH	---	1	JDN	05/24/24 18:01	D4E0525	DE42254
C11-C22 Unadjusted Aromatics1	ND (23.5)	---	EPH8270	---	1	IBM	05/24/24 13:00	D4E0506	DE42254
C11-C22 Aromatics1,2	ND (23.8)	---	EPH8270	---		TJ	05/28/24 23:21	---	[CALC]
2-Methylnaphthalene	ND (0.013)	---	EPH8270SIM	---	1	TJ	05/28/24 23:21	D4E0587	DE42254
Acenaphthene	ND (0.013)	---	EPH8270SIM	---	1	TJ	05/28/24 23:21	D4E0587	DE42254
Naphthalene	ND (0.013)	---	EPH8270SIM	---	1	TJ	05/28/24 23:21	D4E0587	DE42254
Phenanthrene	ND (0.013)	---	EPH8270SIM	---	1	TJ	05/28/24 23:21	D4E0587	DE42254
Acenaphthylene	ND (0.013)	---	EPH8270SIM	---	1	TJ	05/28/24 23:21	D4E0587	DE42254
Anthracene	ND (0.013)	---	EPH8270SIM	---	1	TJ	05/28/24 23:21	D4E0587	DE42254
Benzo(a)anthracene	ND (0.013)	---	EPH8270SIM	---	1	TJ	05/28/24 23:21	D4E0587	DE42254
Benzo(a)pyrene	ND (0.013)	---	EPH8270SIM	---	1	TJ	05/28/24 23:21	D4E0587	DE42254
Benzo(b)fluoranthene	ND (0.013)	---	EPH8270SIM	---	1	TJ	05/28/24 23:21	D4E0587	DE42254
Benzo(g,h,i)perylene	ND (0.013)	---	EPH8270SIM	---	1	TJ	05/28/24 23:21	D4E0587	DE42254
Benzo(k)fluoranthene	ND (0.013)	---	EPH8270SIM	---	1	TJ	05/28/24 23:21	D4E0587	DE42254
Chrysene	ND (0.013)	---	EPH8270SIM	---	1	TJ	05/28/24 23:21	D4E0587	DE42254
Dibenzo(a,h)Anthracene	ND (0.013)	---	EPH8270SIM	---	1	TJ	05/28/24 23:21	D4E0587	DE42254
Fluoranthene	ND (0.013)	---	EPH8270SIM	---	1	TJ	05/28/24 23:21	D4E0587	DE42254
Fluorene	ND (0.013)	---	EPH8270SIM	---	1	TJ	05/28/24 23:21	D4E0587	DE42254
Indeno(1,2,3-cd)Pyrene	ND (0.013)	---	EPH8270SIM	---	1	TJ	05/28/24 23:21	D4E0587	DE42254
Pyrene	ND (0.013)	---	EPH8270SIM	---	1	TJ	05/28/24 23:21	D4E0587	DE42254

	%Recovery	Qualifier	Limits
Surrogate: 1-Chlorooctadecane	*81 %*		*40-140*
Surrogate: 2-Bromonaphthalene	*93 %*		*40-140*
Surrogate: 2-Fluorobiphenyl	*92 %*		*40-140*
Surrogate: O-Terphenyl	*78 %*		*40-140*

CERTIFICATE OF ANALYSIS

Client Name: Horsley & Witten
Client Project ID: Black Brook
Client Sample ID: SED-CU
Date Sampled: 05/15/24 15:30
Percent Solids: 65

ESS Laboratory Work Order: 24E0926
ESS Laboratory Sample ID: 24E0926-03
Sample Matrix: Soil

Classical Chemistry

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Percent Moisture	**35** (1)	---	2540G	---	1	CCP	05/22/24 19:00	%	DE42247
Total Organic Carbon (Average)	**20600** (500)	---	LK	---	1	CCP	05/28/24 13:52	mg/kg	[CALC]

CERTIFICATE OF ANALYSIS

Client Name: Horsley & Witten
Client Project ID: Black Brook
Client Sample ID: SED-CU
Date Sampled: 05/15/24 15:30

ESS Laboratory Work Order: 24E0926
ESS Laboratory Sample ID: 24E0926-03
Sample Matrix: Soil

Subcontracted Analysis

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Grain Size	**See Attached** (N/A)	---		---				%	

CERTIFICATE OF ANALYSIS

Client Name: Horsley & Witten
Client Project ID: Black Brook
Client Sample ID: SED-CU
Date Sampled: 05/15/24 15:30
Percent Solids: 65
Initial Volume: 30.1g
Final Volume: 2ml
Extraction Method: 3540C

ESS Laboratory Work Order: 24E0926
ESS Laboratory Sample ID: 24E0926-03
Sample Matrix: Soil
Units: mg/kg dry
Analyst: DMC
Prepared: 5/28/24 12:30

8082 Polychlorinated Biphenyls (PCB) / Congeners

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
BZ#8	ND (0.00041)	---	8082A Cong	---	1	05/29/24 17:24	D4E0570	DE42809
BZ#18	ND (0.00041)	---	8082A Cong	---	1	05/29/24 17:24	D4E0570	DE42809
BZ#28	ND (0.00041)	---	8082A Cong	---	1	05/29/24 17:24	D4E0570	DE42809
BZ#44	ND (0.00041)	---	8082A Cong	---	1	05/29/24 17:24	D4E0570	DE42809
BZ#52	ND (0.00041)	---	8082A Cong	---	1	05/29/24 17:24	D4E0570	DE42809
BZ#66	ND (0.00041)	---	8082A Cong	---	1	05/29/24 17:24	D4E0570	DE42809
BZ#101	ND (0.00041)	---	8082A Cong	---	1	05/29/24 17:24	D4E0570	DE42809
BZ#105	ND (0.00041)	---	8082A Cong	---	1	05/29/24 17:24	D4E0570	DE42809
BZ#118	ND (0.00041)	---	8082A Cong	---	1	05/29/24 17:24	D4E0570	DE42809
BZ#128	ND (0.00041)	---	8082A Cong	---	1	05/29/24 17:24	D4E0570	DE42809
BZ#138	ND (0.00041)	---	8082A Cong	---	1	05/29/24 17:24	D4E0570	DE42809
BZ#153	ND (0.00041)	---	8082A Cong	---	1	05/29/24 17:24	D4E0570	DE42809
BZ#170 [2C]	ND (0.00041)	---	8082A Cong	---	1	05/29/24 17:24	D4E0570	DE42809
BZ#180	ND (0.00041)	---	8082A Cong	---	1	05/29/24 17:24	D4E0570	DE42809
BZ#187 [2C]	ND (0.00041)	---	8082A Cong	---	1	05/29/24 17:24	D4E0570	DE42809
BZ#195	ND (0.00041)	---	8082A Cong	---	1	05/29/24 17:24	D4E0570	DE42809
BZ#206	ND (0.00041)	---	8082A Cong	---	1	05/29/24 17:24	D4E0570	DE42809
BZ#209	ND (0.00041)	---	8082A Cong	---	1	05/29/24 17:24	D4E0570	DE42809

	%Recovery	*Qualifier*	*Limits*
Surrogate: Tetrachloro-m-xylene [2C]	*65 %*		*30-150*

CERTIFICATE OF ANALYSIS

Client Name: Horsley & Witten
Client Project ID: Black Brook
Client Sample ID: SED-CD
Date Sampled: 05/15/24 15:15
Percent Solids: 82
Initial Volume: 24.7g
Final Volume: 1ml
Extraction Method: 3546

ESS Laboratory Work Order: 24E0926
ESS Laboratory Sample ID: 24E0926-04
Sample Matrix: Soil
Units: mg/kg dry

Prepared: 5/22/24 20:15

MADEP-EPH Extractable Petroleum Hydrocarbons

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Sequence	Batch
C9-C18 Aliphatics1	ND (18.6)	---	MADEP-EPH	---	1	JDN	05/24/24 18:35	D4E0525	DE42254
C19-C36 Aliphatics1	ND (18.6)	---	MADEP-EPH	---	1	JDN	05/24/24 18:35	D4E0525	DE42254
C11-C22 Unadjusted Aromatics1	ND (18.6)	---	EPH8270	---	1	IBM	05/24/24 13:36	D4E0506	DE42254
C11-C22 Aromatics1,2	ND (18.8)	---	EPH8270	---		TJ	05/28/24 23:41	---	[CALC]
2-Methylnaphthalene	ND (0.010)	---	EPH8270SIM	---	1	TJ	05/28/24 23:41	D4E0587	DE42254
Acenaphthene	ND (0.010)	---	EPH8270SIM	---	1	TJ	05/28/24 23:41	D4E0587	DE42254
Naphthalene	ND (0.010)	---	EPH8270SIM	---	1	TJ	05/28/24 23:41	D4E0587	DE42254
Phenanthrene	**0.016** (0.010)	---	EPH8270SIM	---	1	TJ	05/28/24 23:41	D4E0587	DE42254
Acenaphthylene	ND (0.010)	---	EPH8270SIM	---	1	TJ	05/28/24 23:41	D4E0587	DE42254
Anthracene	ND (0.010)	---	EPH8270SIM	---	1	TJ	05/28/24 23:41	D4E0587	DE42254
Benzo(a)anthracene	ND (0.010)	---	EPH8270SIM	---	1	TJ	05/28/24 23:41	D4E0587	DE42254
Benzo(a)pyrene	ND (0.010)	---	EPH8270SIM	---	1	TJ	05/28/24 23:41	D4E0587	DE42254
Benzo(b)fluoranthene	ND (0.010)	---	EPH8270SIM	---	1	TJ	05/28/24 23:41	D4E0587	DE42254
Benzo(g,h,i)perylene	ND (0.010)	---	EPH8270SIM	---	1	TJ	05/28/24 23:41	D4E0587	DE42254
Benzo(k)fluoranthene	ND (0.010)	---	EPH8270SIM	---	1	TJ	05/28/24 23:41	D4E0587	DE42254
Chrysene	ND (0.010)	---	EPH8270SIM	---	1	TJ	05/28/24 23:41	D4E0587	DE42254
Dibenzo(a,h)Anthracene	ND (0.010)	---	EPH8270SIM	---	1	TJ	05/28/24 23:41	D4E0587	DE42254
Fluoranthene	**0.014** (0.010)	---	EPH8270SIM	---	1	TJ	05/28/24 23:41	D4E0587	DE42254
Fluorene	ND (0.010)	---	EPH8270SIM	---	1	TJ	05/28/24 23:41	D4E0587	DE42254
Indeno(1,2,3-cd)Pyrene	ND (0.010)	---	EPH8270SIM	---	1	TJ	05/28/24 23:41	D4E0587	DE42254
Pyrene	**0.011** (0.010)	---	EPH8270SIM	---	1	TJ	05/28/24 23:41	D4E0587	DE42254

	%Recovery	*Qualifier*	*Limits*
Surrogate: 1-Chlorooctadecane	*75 %*		*40-140*
Surrogate: 2-Bromonaphthalene	*93 %*		*40-140*
Surrogate: 2-Fluorobiphenyl	*93 %*		*40-140*
Surrogate: O-Terphenyl	*88 %*		*40-140*

CERTIFICATE OF ANALYSIS

Client Name: Horsley & Witten
Client Project ID: Black Brook
Client Sample ID: SED-CD
Date Sampled: 05/15/24 15:15
Percent Solids: 82

ESS Laboratory Work Order: 24E0926
ESS Laboratory Sample ID: 24E0926-04
Sample Matrix: Soil

Classical Chemistry

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Percent Moisture	**18** (1)	---	2540G	---	1	CCP	05/22/24 19:00	%	DE42247
Total Organic Carbon (Average)	**8150** (500)	---	LK	---	1	CCP	05/28/24 14:08	mg/kg	[CALC]

CERTIFICATE OF ANALYSIS

Client Name: Horsley & Witten
Client Project ID: Black Brook
Client Sample ID: SED-CD
Date Sampled: 05/15/24 15:15

ESS Laboratory Work Order: 24E0926
ESS Laboratory Sample ID: 24E0926-04
Sample Matrix: Soil

Subcontracted Analysis

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Grain Size	**See Attached** (N/A)	---		---				%	

CERTIFICATE OF ANALYSIS

Client Name: Horsley & Witten
Client Project ID: Black Brook
Client Sample ID: SED-CD
Date Sampled: 05/15/24 15:15
Percent Solids: 82
Initial Volume: 30.2g
Final Volume: 2ml
Extraction Method: 3540C

ESS Laboratory Work Order: 24E0926
ESS Laboratory Sample ID: 24E0926-04
Sample Matrix: Soil
Units: mg/kg dry
Analyst: DMC
Prepared: 5/28/24 12:30

8082 Polychlorinated Biphenyls (PCB) / Congeners

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
BZ#8	ND (0.00033)	---	8082A Cong	---	1	05/29/24 17:54	D4E0570	DE42809
BZ#18	ND (0.00033)	---	8082A Cong	---	1	05/29/24 17:54	D4E0570	DE42809
BZ#28	ND (0.00033)	---	8082A Cong	---	1	05/29/24 17:54	D4E0570	DE42809
BZ#44	ND (0.00033)	---	8082A Cong	---	1	05/29/24 17:54	D4E0570	DE42809
BZ#52	ND (0.00033)	---	8082A Cong	---	1	05/29/24 17:54	D4E0570	DE42809
BZ#66	ND (0.00033)	---	8082A Cong	---	1	05/29/24 17:54	D4E0570	DE42809
BZ#101	ND (0.00033)	---	8082A Cong	---	1	05/29/24 17:54	D4E0570	DE42809
BZ#105	ND (0.00033)	---	8082A Cong	---	1	05/29/24 17:54	D4E0570	DE42809
BZ#118	ND (0.00033)	---	8082A Cong	---	1	05/29/24 17:54	D4E0570	DE42809
BZ#128	ND (0.00033)	---	8082A Cong	---	1	05/29/24 17:54	D4E0570	DE42809
BZ#138	ND (0.00033)	---	8082A Cong	---	1	05/29/24 17:54	D4E0570	DE42809
BZ#153	ND (0.00033)	---	8082A Cong	---	1	05/29/24 17:54	D4E0570	DE42809
BZ#170	ND (0.00033)	---	8082A Cong	---	1	05/29/24 17:54	D4E0570	DE42809
BZ#180	ND (0.00033)	---	8082A Cong	---	1	05/29/24 17:54	D4E0570	DE42809
BZ#187	ND (0.00033)	---	8082A Cong	---	1	05/29/24 17:54	D4E0570	DE42809
BZ#195	ND (0.00033)	---	8082A Cong	---	1	05/29/24 17:54	D4E0570	DE42809
BZ#206	ND (0.00033)	---	8082A Cong	---	1	05/29/24 17:54	D4E0570	DE42809
BZ#209	ND (0.00033)	---	8082A Cong	---	1	05/29/24 17:54	D4E0570	DE42809

	%Recovery	*Qualifier*	*Limits*
Surrogate: Tetrachloro-m-xylene [2C]	*76 %*		*30-150*

CERTIFICATE OF ANALYSIS

Client Name: Horsley & Witten
Client Project ID: Black Brook
Client Sample ID: SED-MD - Air Dried
Date Sampled: 05/15/24 16:30
Percent Solids: 100

ESS Laboratory Work Order: 24E0926
ESS Laboratory Sample ID: 24E0926-05
Sample Matrix: Soil
Units: mg/kg dry

Extraction Method: 3050B

Total Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	IV / FV	Batch
Arsenic	ND (0.40)	---	6010D	---	1	KJB	05/24/24 14:23	5 100	DE42410
Cadmium	ND (0.10)	---	6010D	---	1	KJB	05/24/24 14:23	5 100	DE42410
Chromium	**0.78** (0.40)	---	6010D	---	1	KJB	05/24/24 14:23	5 100	DE42410
Copper	ND (1.00)	---	6010D	---	1	KJB	05/24/24 14:23	5 100	DE42410
Lead	**1.54** (1.00)	---	6010D	---	1	KJB	05/24/24 14:23	5 100	DE42410
Mercury	ND (0.010)	---	7471B	---	1	AFV	05/28/24 16:30	2.07 40	DE42804
Nickel	ND (1.00)	---	6010D	---	1	KJB	05/24/24 14:23	5 100	DE42410
Zinc	**2.31** (1.00)	---	6010D	---	1	KJB	05/24/24 14:23	5 100	DE42410

CERTIFICATE OF ANALYSIS

Client Name: Horsley & Witten
Client Project ID: Black Brook
Client Sample ID: SED-MU - Air Dried
Date Sampled: 05/15/24 16:15
Percent Solids: 100

ESS Laboratory Work Order: 24E0926
ESS Laboratory Sample ID: 24E0926-06
Sample Matrix: Soil
Units: mg/kg dry

Extraction Method: 3050B

Total Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	IV / FV	Batch
Arsenic	ND (0.38)	---	6010D	---	1	KJB	05/28/24 19:46	5.2 100	DE42410
Cadmium	ND (0.10)	---	6010D	---	1	KJB	05/24/24 14:25	5.2 100	DE42410
Chromium	**0.72** (0.38)	---	6010D	---	1	KJB	05/24/24 14:25	5.2 100	DE42410
Copper	**1.85** (0.96)	---	6010D	---	1	KJB	05/24/24 14:25	5.2 100	DE42410
Lead	**2.25** (0.96)	---	6010D	---	1	KJB	05/24/24 14:25	5.2 100	DE42410
Mercury	ND (0.009)	---	7471B	---	1	AFV	05/28/24 16:33	2.11 40	DE42804
Nickel	**1.22** (0.96)	---	6010D	---	1	KJB	05/24/24 14:25	5.2 100	DE42410
Zinc	**3.61** (0.96)	---	6010D	---	1	KJB	05/24/24 14:25	5.2 100	DE42410

CERTIFICATE OF ANALYSIS

Client Name: Horsley & Witten
Client Project ID: Black Brook
Client Sample ID: SED-CU - Air Dried
Date Sampled: 05/15/24 15:30
Percent Solids: 100

ESS Laboratory Work Order: 24E0926
ESS Laboratory Sample ID: 24E0926-07
Sample Matrix: Soil
Units: mg/kg dry

Extraction Method: 3050B

Total Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	IV / FV	Batch
Arsenic	**0.61** (0.39)	---	6010D	---	1	KJB	05/24/24 14:27	5.1 100	DE42410
Cadmium	ND (0.10)	---	6010D	---	1	KJB	05/24/24 14:27	5.1 100	DE42410
Chromium	**1.00** (0.39)	---	6010D	---	1	KJB	05/24/24 14:27	5.1 100	DE42410
Copper	**1.13** (0.98)	---	6010D	---	1	KJB	05/24/24 14:27	5.1 100	DE42410
Lead	**3.68** (0.98)	---	6010D	---	1	KJB	05/24/24 14:27	5.1 100	DE42410
Mercury	ND (0.009)	---	7471B	---	1	AFV	05/28/24 16:35	2.15 40	DE42804
Nickel	ND (0.98)	---	6010D	---	1	KJB	05/24/24 14:27	5.1 100	DE42410
Zinc	**4.34** (0.98)	---	6010D	---	1	KJB	05/24/24 14:27	5.1 100	DE42410

CERTIFICATE OF ANALYSIS

Client Name: Horsley & Witten
Client Project ID: Black Brook
Client Sample ID: SED-CD - Air Dried
Date Sampled: 05/15/24 15:15
Percent Solids: 100

ESS Laboratory Work Order: 24E0926
ESS Laboratory Sample ID: 24E0926-08
Sample Matrix: Soil
Units: mg/kg dry

Extraction Method: 3050B

Total Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	IV / FV	Batch
Arsenic	**4.89** (0.38)	---	6010D	---	1	KJB	05/24/24 14:29	5.32 100	DE42410
Cadmium	ND (0.09)	---	6010D	---	1	KJB	05/24/24 14:29	5.32 100	DE42410
Chromium	**4.62** (0.38)	---	6010D	---	1	KJB	05/24/24 14:29	5.32 100	DE42410
Copper	**9.02** (0.94)	---	6010D	---	1	KJB	05/24/24 14:29	5.32 100	DE42410
Lead	**14.2** (0.94)	---	6010D	---	1	KJB	05/24/24 14:29	5.32 100	DE42410
Mercury	ND (0.009)	---	7471B	---	1	AFV	05/28/24 16:41	2.15 40	DE42804
Nickel	**5.27** (0.94)	---	6010D	---	1	KJB	05/24/24 14:29	5.32 100	DE42410
Zinc	**13.9** (0.94)	---	6010D	---	1	KJB	05/24/24 14:29	5.32 100	DE42410

CERTIFICATE OF ANALYSIS

Client Name: Horsley & Witten
Client Project ID: Black Brook

ESS Laboratory Work Order: 24E0926

Quality Control Data

Analyte	Result	MRL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qualifier
Total Metals										
Batch DE42410 - 3050B										
Blank										
Arsenic	ND	1.00	mg/kg wet							
Cadmium	ND	0.25	mg/kg wet							
Chromium	ND	1.00	mg/kg wet							
Copper	ND	2.50	mg/kg wet							
Lead	ND	2.50	mg/kg wet							
Nickel	ND	2.50	mg/kg wet							
Zinc	ND	2.50	mg/kg wet							
LCS										
Arsenic	57.7	3.33	mg/kg wet	75.60		76	73-127			
Cadmium	192	0.83	mg/kg wet	259.0		74	69-131			
Chromium	123	3.33	mg/kg wet	156.0		79	74-126			
Copper	166	8.33	mg/kg wet	210.0		79	78-122			
Lead	174	8.33	mg/kg wet	225.0		77	72-128			
Nickel	137	8.33	mg/kg wet	174.0		79	75-125			
Zinc	589	8.33	mg/kg wet	806.0		73	70-130			
LCS Dup										
Arsenic	56.9	3.08	mg/kg wet	75.60		75	73-127	1	30	
Cadmium	183	0.77	mg/kg wet	259.0		71	69-131	5	30	
Chromium	115	3.08	mg/kg wet	156.0		73	74-126	7	30	B-
Copper	156	7.69	mg/kg wet	210.0		74	78-122	6	30	B-
Lead	163	7.69	mg/kg wet	225.0		72	72-128	6	30	
Nickel	129	7.69	mg/kg wet	174.0		74	75-125	6	30	B-
Zinc	560	7.69	mg/kg wet	806.0		69	70-130	5	30	B-
Batch DE42804 - 245.1/7470A										
Blank										
Mercury	ND	0.032	mg/kg wet							
LCS										
Mercury	22.9	2.91	mg/kg wet	25.50		90	80-120			
LCS Dup										
Mercury	23.2	3.09	mg/kg wet	25.50		91	80-120	1	30	
MADEP-EPH Extractable Petroleum Hydrocarbons										
Batch DE42254 - 3546										
Blank										
C19-C36 Aliphatics1	ND	15.0	mg/kg wet							
C9-C18 Aliphatics1	ND	15.0	mg/kg wet							
Surrogate: 1-Chlorooctadecane	*1.79*		mg/kg wet	*2.000*		*89*	*40-140*			
Blank										
C11-C22 Unadjusted Aromatics1	ND	15.0	mg/kg wet							

CERTIFICATE OF ANALYSIS

Client Name: Horsley & Witten
Client Project ID: Black Brook

ESS Laboratory Work Order: 24E0926

Quality Control Data

Analyte	Result	MRL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qualifier
MADEP-EPH Extractable Petroleum Hydrocarbons										
Batch DE42254 - 3546										
Surrogate: 2-Bromonaphthalene	*1.92*		mg/kg wet	*2.000*		*96*	*40-140*			
Surrogate: 2-Fluorobiphenyl	*1.87*		mg/kg wet	*2.000*		*94*	*40-140*			
Surrogate: O-Terphenyl	*1.84*		mg/kg wet	*2.000*		*92*	*40-140*			
Blank										
2-Methylnaphthalene	ND	0.008	mg/kg wet							
Acenaphthene	ND	0.008	mg/kg wet							
Acenaphthylene	ND	0.008	mg/kg wet							
Anthracene	ND	0.008	mg/kg wet							
Benzo(a)anthracene	ND	0.008	mg/kg wet							
Benzo(a)pyrene	ND	0.008	mg/kg wet							
Benzo(b)fluoranthene	ND	0.008	mg/kg wet							
Benzo(g,h,i)perylene	ND	0.008	mg/kg wet							
Benzo(k)fluoranthene	ND	0.008	mg/kg wet							
Chrysene	ND	0.008	mg/kg wet							
Dibenzo(a,h)Anthracene	ND	0.008	mg/kg wet							
Fluoranthene	ND	0.008	mg/kg wet							
Fluorene	ND	0.008	mg/kg wet							
Indeno(1,2,3-cd)Pyrene	ND	0.008	mg/kg wet							
Naphthalene	0.009	0.008	mg/kg wet							
Phenanthrene	ND	0.008	mg/kg wet							
Pyrene	ND	0.008	mg/kg wet							
LCS										
C19-C36 Aliphatics1	17.6	15.0	mg/kg wet	16.00		110	40-140			
C9-C18 Aliphatics1	9.9	15.0	mg/kg wet	12.00		83	40-140			
Surrogate: 1-Chlorooctadecane	*1.70*		mg/kg wet	*2.000*		*85*	*40-140*			
LCS										
C11-C22 Unadjusted Aromatics1	28.3	15.0	mg/kg wet	34.00		83	40-140			
Surrogate: 2-Bromonaphthalene	*1.64*		mg/kg wet	*2.000*		*82*	*40-140*			
Surrogate: 2-Fluorobiphenyl	*1.87*		mg/kg wet	*2.000*		*93*	*40-140*			
Surrogate: O-Terphenyl	*1.79*		mg/kg wet	*2.000*		*89*	*40-140*			
LCS										
2-Methylnaphthalene Breakthrough	0.0		%				0-5			
Naphthalene Breakthrough	0.0		%				0-5			
LCS										
2-Methylnaphthalene	1.17	0.040	mg/kg wet	2.000		59	40-140			
Acenaphthene	1.50	0.040	mg/kg wet	2.000		75	40-140			
Acenaphthylene	1.50	0.040	mg/kg wet	2.000		75	40-140			
Anthracene	1.76	0.040	mg/kg wet	2.000		88	40-140			
Benzo(a)anthracene	1.38	0.040	mg/kg wet	2.000		69	40-140			
Benzo(a)pyrene	1.75	0.040	mg/kg wet	2.000		87	40-140			
Benzo(b)fluoranthene	1.42	0.040	mg/kg wet	2.000		71	40-140			

CERTIFICATE OF ANALYSIS

Client Name: Horsley & Witten
Client Project ID: Black Brook

ESS Laboratory Work Order: 24E0926

Quality Control Data

Analyte	Result	MRL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qualifier
MADEP-EPH Extractable Petroleum Hydrocarbons										
Batch DE42254 - 3546										
Benzo(g,h,i)perylene	1.56	0.040	mg/kg wet	2.000		78	40-140			
Benzo(k)fluoranthene	1.84	0.040	mg/kg wet	2.000		92	40-140			
Chrysene	1.89	0.040	mg/kg wet	2.000		94	40-140			
Dibenzo(a,h)Anthracene	1.56	0.040	mg/kg wet	2.000		78	40-140			
Fluoranthene	1.76	0.040	mg/kg wet	2.000		88	40-140			
Fluorene	1.35	0.040	mg/kg wet	2.000		68	40-140			
Indeno(1,2,3-cd)Pyrene	1.55	0.040	mg/kg wet	2.000		77	40-140			
Naphthalene	1.44	0.040	mg/kg wet	2.000		72	40-140			
Phenanthrene	1.37	0.040	mg/kg wet	2.000		69	40-140			
Pyrene	1.70	0.040	mg/kg wet	2.000		85	40-140			
LCS Dup										
C19-C36 Aliphatics1	18.1	15.0	mg/kg wet	16.00		113	40-140	3	25	
C9-C18 Aliphatics1	9.9	15.0	mg/kg wet	12.00		82	40-140	0.2	25	
Surrogate: 1-Chlorooctadecane	*1.66*		mg/kg wet	*2.000*		*83*	*40-140*			
LCS Dup										
C11-C22 Unadjusted Aromatics1	27.5	15.0	mg/kg wet	34.00		81	40-140	3	25	
Surrogate: 2-Bromonaphthalene	*1.57*		mg/kg wet	*2.000*		*78*	*40-140*			
Surrogate: 2-Fluorobiphenyl	*1.83*		mg/kg wet	*2.000*		*92*	*40-140*			
Surrogate: O-Terphenyl	*1.67*		mg/kg wet	*2.000*		*83*	*40-140*			
LCS Dup										
2-Methylnaphthalene Breakthrough	0.0		%				0-5		200	
Naphthalene Breakthrough	0.0		%				0-5		200	
LCS Dup										
2-Methylnaphthalene	1.17	0.040	mg/kg wet	2.000		59	40-140	0.2	30	
Acenaphthene	1.52	0.040	mg/kg wet	2.000		76	40-140	0.8	30	
Acenaphthylene	1.52	0.040	mg/kg wet	2.000		76	40-140	1	30	
Anthracene	1.83	0.040	mg/kg wet	2.000		92	40-140	4	30	
Benzo(a)anthracene	1.44	0.040	mg/kg wet	2.000		72	40-140	4	30	
Benzo(a)pyrene	1.82	0.040	mg/kg wet	2.000		91	40-140	4	30	
Benzo(b)fluoranthene	1.44	0.040	mg/kg wet	2.000		72	40-140	2	30	
Benzo(g,h,i)perylene	1.61	0.040	mg/kg wet	2.000		81	40-140	3	30	
Benzo(k)fluoranthene	1.94	0.040	mg/kg wet	2.000		97	40-140	5	30	
Chrysene	1.87	0.040	mg/kg wet	2.000		94	40-140	0.8	30	
Dibenzo(a,h)Anthracene	1.60	0.040	mg/kg wet	2.000		80	40-140	3	30	
Fluoranthene	1.84	0.040	mg/kg wet	2.000		92	40-140	5	30	
Fluorene	1.41	0.040	mg/kg wet	2.000		71	40-140	4	30	
Indeno(1,2,3-cd)Pyrene	1.58	0.040	mg/kg wet	2.000		79	40-140	2	30	
Naphthalene	1.42	0.040	mg/kg wet	2.000		71	40-140	0.9	30	
Phenanthrene	1.45	0.040	mg/kg wet	2.000		73	40-140	6	30	
Pyrene	1.73	0.040	mg/kg wet	2.000		87	40-140	2	30	
Classical Chemistry										

CERTIFICATE OF ANALYSIS

Client Name: Horsley & Witten
Client Project ID: Black Brook

ESS Laboratory Work Order: 24E0926

Quality Control Data

Analyte	Result	MRL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qualifier
Classical Chemistry										
Batch DE42246 - General Preparation										
Blank										
Total Organic Carbon (1)	ND	500	mg/kg							
Total Organic Carbon (2)	ND	500	mg/kg							
LCS										
Total Organic Carbon (1)	9450	500	mg/kg	10010		94	80-120			
Total Organic Carbon (2)	9370	500	mg/kg	10010		94	80-120			
LCS Dup										
Total Organic Carbon (1)	9670	500	mg/kg	10010		97	80-120	2	25	
Total Organic Carbon (2)	9270	500	mg/kg	10010		93	80-120	1	25	
8082 Polychlorinated Biphenyls (PCB) / Congeners										
Batch DE42809 - 3540C										
Blank										
BZ#101	ND	0.00027	mg/kg wet							
BZ#101 [2C]	ND	0.00027	mg/kg wet							
BZ#105	ND	0.00027	mg/kg wet							
BZ#105 [2C]	ND	0.00027	mg/kg wet							
BZ#118	ND	0.00027	mg/kg wet							
BZ#118 [2C]	ND	0.00027	mg/kg wet							
BZ#128	ND	0.00027	mg/kg wet							
BZ#128 [2C]	ND	0.00027	mg/kg wet							
BZ#138	ND	0.00027	mg/kg wet							
BZ#138 [2C]	ND	0.00027	mg/kg wet							
BZ#153	ND	0.00027	mg/kg wet							
BZ#153 [2C]	ND	0.00027	mg/kg wet							
BZ#170	ND	0.00027	mg/kg wet							
BZ#170 [2C]	ND	0.00027	mg/kg wet							
BZ#18	ND	0.00027	mg/kg wet							
BZ#18 [2C]	ND	0.00027	mg/kg wet							
BZ#180	ND	0.00027	mg/kg wet							
BZ#180 [2C]	ND	0.00027	mg/kg wet							
BZ#187	ND	0.00027	mg/kg wet							
BZ#187 [2C]	ND	0.00027	mg/kg wet							
BZ#195	ND	0.00027	mg/kg wet							
BZ#195 [2C]	ND	0.00027	mg/kg wet							
BZ#206	ND	0.00027	mg/kg wet							
BZ#206 [2C]	ND	0.00027	mg/kg wet							
BZ#209	ND	0.00027	mg/kg wet							
BZ#209 [2C]	ND	0.00027	mg/kg wet							
BZ#28	ND	0.00027	mg/kg wet							
BZ#28 [2C]	ND	0.00027	mg/kg wet							
BZ#44	ND	0.00027	mg/kg wet							
BZ#44 [2C]	ND	0.00027	mg/kg wet							

CERTIFICATE OF ANALYSIS

Client Name: Horsley & Witten
Client Project ID: Black Brook

ESS Laboratory Work Order: 24E0926

Quality Control Data

Analyte	Result	MRL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qualifier
8082 Polychlorinated Biphenyls (PCB) / Congeners										
Batch DE42809 - 3540C										
BZ#52	ND	0.00027	mg/kg wet							
BZ#52 [2C]	ND	0.00027	mg/kg wet							
BZ#66	ND	0.00027	mg/kg wet							
BZ#66 [2C]	ND	0.00027	mg/kg wet							
BZ#8	ND	0.00027	mg/kg wet							
BZ#8 [2C]	ND	0.00027	mg/kg wet							
Surrogate: Tetrachloro-m-xylene	*0.00242*		mg/kg wet	*0.003333*		*73*	*30-150*			
Surrogate: Tetrachloro-m-xylene [2C]	*0.00250*		mg/kg wet	*0.003333*		*75*	*30-150*			
LCS										
BZ#101	0.00292	0.00027	mg/kg wet	0.003333		88	40-140			
BZ#101 [2C]	0.00296	0.00027	mg/kg wet	0.003333		89	40-140			
BZ#105	0.00302	0.00027	mg/kg wet	0.003333		91	40-140			
BZ#105 [2C]	0.00310	0.00027	mg/kg wet	0.003333		93	40-140			
BZ#118	0.00278	0.00027	mg/kg wet	0.003333		83	40-140			
BZ#118 [2C]	0.00301	0.00027	mg/kg wet	0.003333		90	40-140			
BZ#128	0.00276	0.00027	mg/kg wet	0.003333		83	40-140			
BZ#128 [2C]	0.00313	0.00027	mg/kg wet	0.003333		94	40-140			
BZ#138	0.00293	0.00027	mg/kg wet	0.003333		88	40-140			
BZ#138 [2C]	0.00310	0.00027	mg/kg wet	0.003333		93	40-140			
BZ#153	0.00287	0.00027	mg/kg wet	0.003333		86	40-140			
BZ#153 [2C]	0.00303	0.00027	mg/kg wet	0.003333		91	40-140			
BZ#170	0.00292	0.00027	mg/kg wet	0.003333		88	40-140			
BZ#170 [2C]	0.00313	0.00027	mg/kg wet	0.003333		94	40-140			
BZ#18	0.00281	0.00027	mg/kg wet	0.003333		84	40-140			
BZ#18 [2C]	0.00269	0.00027	mg/kg wet	0.003333		81	40-140			
BZ#180	0.00290	0.00027	mg/kg wet	0.003333		87	40-140			
BZ#180 [2C]	0.00316	0.00027	mg/kg wet	0.003333		95	40-140			
BZ#187	0.00282	0.00027	mg/kg wet	0.003333		85	40-140			
BZ#187 [2C]	0.00296	0.00027	mg/kg wet	0.003333		89	40-140			
BZ#195	0.00294	0.00027	mg/kg wet	0.003333		88	40-140			
BZ#195 [2C]	0.00304	0.00027	mg/kg wet	0.003333		91	40-140			
BZ#206	0.00286	0.00027	mg/kg wet	0.003333		86	40-140			
BZ#206 [2C]	0.00298	0.00027	mg/kg wet	0.003333		89	40-140			
BZ#209	0.00271	0.00027	mg/kg wet	0.003333		81	40-140			
BZ#209 [2C]	0.00292	0.00027	mg/kg wet	0.003333		88	40-140			
BZ#28	0.00288	0.00027	mg/kg wet	0.003333		86	40-140			
BZ#28 [2C]	0.00318	0.00027	mg/kg wet	0.003333		95	40-140			
BZ#44	0.00284	0.00027	mg/kg wet	0.003333		85	40-140			
BZ#44 [2C]	0.00289	0.00027	mg/kg wet	0.003333		87	40-140			
BZ#52	0.00271	0.00027	mg/kg wet	0.003333		81	40-140			
BZ#52 [2C]	0.00281	0.00027	mg/kg wet	0.003333		84	40-140			
BZ#66	0.00290	0.00027	mg/kg wet	0.003333		87	40-140			
BZ#66 [2C]	0.00299	0.00027	mg/kg wet	0.003333		90	40-140			

CERTIFICATE OF ANALYSIS

Client Name: Horsley & Witten
Client Project ID: Black Brook

ESS Laboratory Work Order: 24E0926

Quality Control Data

Analyte	Result	MRL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qualifier
8082 Polychlorinated Biphenyls (PCB) / Congeners										
Batch DE42809 - 3540C										
BZ#8	0.00239	0.00027	mg/kg wet	0.003333		72	40-140			
BZ#8 [2C]	0.00325	0.00027	mg/kg wet	0.003333		97	40-140			
Surrogate: Tetrachloro-m-xylene	*0.00291*		mg/kg wet	*0.003333*		*87*	*30-150*			
Surrogate: Tetrachloro-m-xylene [2C]	*0.00305*		mg/kg wet	*0.003333*		*91*	*30-150*			
LCS Dup										
BZ#101	0.00249	0.00027	mg/kg wet	0.003333		75	40-140	16	30	
BZ#101 [2C]	0.00258	0.00027	mg/kg wet	0.003333		77	40-140	14	30	
BZ#105	0.00263	0.00027	mg/kg wet	0.003333		79	40-140	14	30	
BZ#105 [2C]	0.00267	0.00027	mg/kg wet	0.003333		80	40-140	15	30	
BZ#118	0.00240	0.00027	mg/kg wet	0.003333		72	40-140	15	30	
BZ#118 [2C]	0.00258	0.00027	mg/kg wet	0.003333		77	40-140	16	30	
BZ#128	0.00242	0.00027	mg/kg wet	0.003333		73	40-140	13	30	
BZ#128 [2C]	0.00267	0.00027	mg/kg wet	0.003333		80	40-140	16	30	
BZ#138	0.00250	0.00027	mg/kg wet	0.003333		75	40-140	16	30	
BZ#138 [2C]	0.00263	0.00027	mg/kg wet	0.003333		79	40-140	17	30	
BZ#153	0.00249	0.00027	mg/kg wet	0.003333		75	40-140	14	30	
BZ#153 [2C]	0.00260	0.00027	mg/kg wet	0.003333		78	40-140	15	30	
BZ#170	0.00246	0.00027	mg/kg wet	0.003333		74	40-140	17	30	
BZ#170 [2C]	0.00262	0.00027	mg/kg wet	0.003333		79	40-140	17	30	
BZ#18	0.00250	0.00027	mg/kg wet	0.003333		75	40-140	12	30	
BZ#18 [2C]	0.00240	0.00027	mg/kg wet	0.003333		72	40-140	12	30	
BZ#180	0.00243	0.00027	mg/kg wet	0.003333		73	40-140	18	30	
BZ#180 [2C]	0.00263	0.00027	mg/kg wet	0.003333		79	40-140	18	30	
BZ#187	0.00242	0.00027	mg/kg wet	0.003333		73	40-140	15	30	
BZ#187 [2C]	0.00252	0.00027	mg/kg wet	0.003333		76	40-140	16	30	
BZ#195	0.00244	0.00027	mg/kg wet	0.003333		73	40-140	18	30	
BZ#195 [2C]	0.00255	0.00027	mg/kg wet	0.003333		76	40-140	18	30	
BZ#206	0.00239	0.00027	mg/kg wet	0.003333		72	40-140	18	30	
BZ#206 [2C]	0.00247	0.00027	mg/kg wet	0.003333		74	40-140	18	30	
BZ#209	0.00226	0.00027	mg/kg wet	0.003333		68	40-140	18	30	
BZ#209 [2C]	0.00243	0.00027	mg/kg wet	0.003333		73	40-140	18	30	
BZ#28	0.00256	0.00027	mg/kg wet	0.003333		77	40-140	12	30	
BZ#28 [2C]	0.00281	0.00027	mg/kg wet	0.003333		84	40-140	12	30	
BZ#44	0.00246	0.00027	mg/kg wet	0.003333		74	40-140	15	30	
BZ#44 [2C]	0.00255	0.00027	mg/kg wet	0.003333		76	40-140	13	30	
BZ#52	0.00239	0.00027	mg/kg wet	0.003333		72	40-140	12	30	
BZ#52 [2C]	0.00248	0.00027	mg/kg wet	0.003333		74	40-140	12	30	
BZ#66	0.00249	0.00027	mg/kg wet	0.003333		75	40-140	15	30	
BZ#66 [2C]	0.00259	0.00027	mg/kg wet	0.003333		78	40-140	14	30	
BZ#8	0.00224	0.00027	mg/kg wet	0.003333		67	40-140	7	30	
BZ#8 [2C]	0.00290	0.00027	mg/kg wet	0.003333		87	40-140	11	30	
Surrogate: Tetrachloro-m-xylene	*0.00250*		mg/kg wet	*0.003333*		*75*	*30-150*			

CERTIFICATE OF ANALYSIS

Client Name: Horsley & Witten
Client Project ID: Black Brook

ESS Laboratory Work Order: 24E0926

Quality Control Data

Analyte	Result	MRL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qualifier
8082 Polychlorinated Biphenyls (PCB) / Congeners										
Batch DE42809 - 3540C										
Surrogate: Tetrachloro-m-xylene [2C]	*0.00262*		mg/kg wet	*0.003333*		*79*	*30-150*			

CERTIFICATE OF ANALYSIS

Client Name: Horsley & Witten
Client Project ID: Black Brook ESS Laboratory Work Order: 24E0926

Notes and Definitions

Z-08	See Attached
U	Analyte included in the analysis, but not detected
D	Diluted.
CD-	Continuing Calibration %Diff/Drift is below control limit (CD-).
B-	Blank Spike recovery is below lower control limit (B-).
ND	Analyte NOT DETECTED at or above the MRL (LOQ), LOD for DoD Reports, MDL for J-Flagged Analytes
dry	Sample results reported on a dry weight basis
RPD	Relative Percent Difference
MDL	Method Detection Limit
MRL	Method Reporting Limit
LOD	Limit of Detection
LOQ	Limit of Quantitation
DL	Detection Limit
I/V	Initial Volume
F/V	Final Volume
§	Subcontracted analysis; see attached report
1	Range result excludes concentrations of surrogates and/or internal standards eluting in that range.
2	Range result excludes concentrations of target analytes eluting in that range.
3	Range result excludes the concentration of the C9-C10 aromatic range.
Avg	Results reported as a mathematical average.
NR	No Recovery
[CALC]	Calculated Analyte
SUB	Subcontracted analysis; see attached report
RL	Reporting Limit
EDL	Estimated Detection Limit
MF	Membrane Filtration
MPN	Most Probable Number
TNTC	Too numerous to Count
CFU	Colony Forming Units

CERTIFICATE OF ANALYSIS

Client Name: Horsley & Witten
Client Project ID: Black Brook

ESS Laboratory Work Order: 24E0926

ESS LABORATORY CERTIFICATIONS AND ACCREDITATIONS

ENVIRONMENTAL

Rhode Island Potable and Non Potable Water: LAI00179
http://www.health.ri.gov/find/labs/analytical/ESS.pdf

Connecticut Potable and Non Potable Water, Solid and Hazardous Waste: PH-0750
http://www.ct.gov/dph/lib/dph/environmental_health/environmental_laboratories/pdf/OutofStateCommercialLaboratories.pdf

Maine Potable and Non Potable Water, and Solid and Hazardous Waste: RI00002
http://www.maine.gov/dhhs/mecdc/environmental-health/dwp/partners/labCert.shtml

Massachusetts Potable and Non Potable Water: M-RI002
http://public.dep.state.ma.us/Labcert/Labcert.aspx

New Hampshire (NELAP accredited) Potable and Non Potable Water, Solid and Hazardous Waste: 2424
http://des.nh.gov/organization/divisions/water/dwgb/nhelap/index.htm

New York (NELAP accredited) Non Potable Water, Solid and Hazardous Waste: 11313
http://www.wadsworth.org/labcert/elap/comm.html

New Jersey (NELAP accredited) Non Potable Water, Solid and Hazardous Waste: RI006
http://datamine2.state.nj.us/DEP_OPRA/OpraMain/pi_main?mode=pi_by_site&sort_order=PI_NAMEA&Select+a+Site:=58715

Pennsylvania: 68-01752
http://www.dep.pa.gov/Business/OtherPrograms/Labs/Pages/Laboratory-Accreditation-Program.aspx

Thielsch
DIVISION OF THE RISE GROUP

195 Frances Avenue
Cranston RI, 02910
Phone: (401)-467-6454
Fax: (401)-467-2398
cts.thielsch.com
Let's Build a Solid Foundation

Client Information:	
Horsley Witten Group	
Sandwich, MA	
Project Manager:	Neal Price
Assigned By:	ESS Laboratory
Collected By:	Client

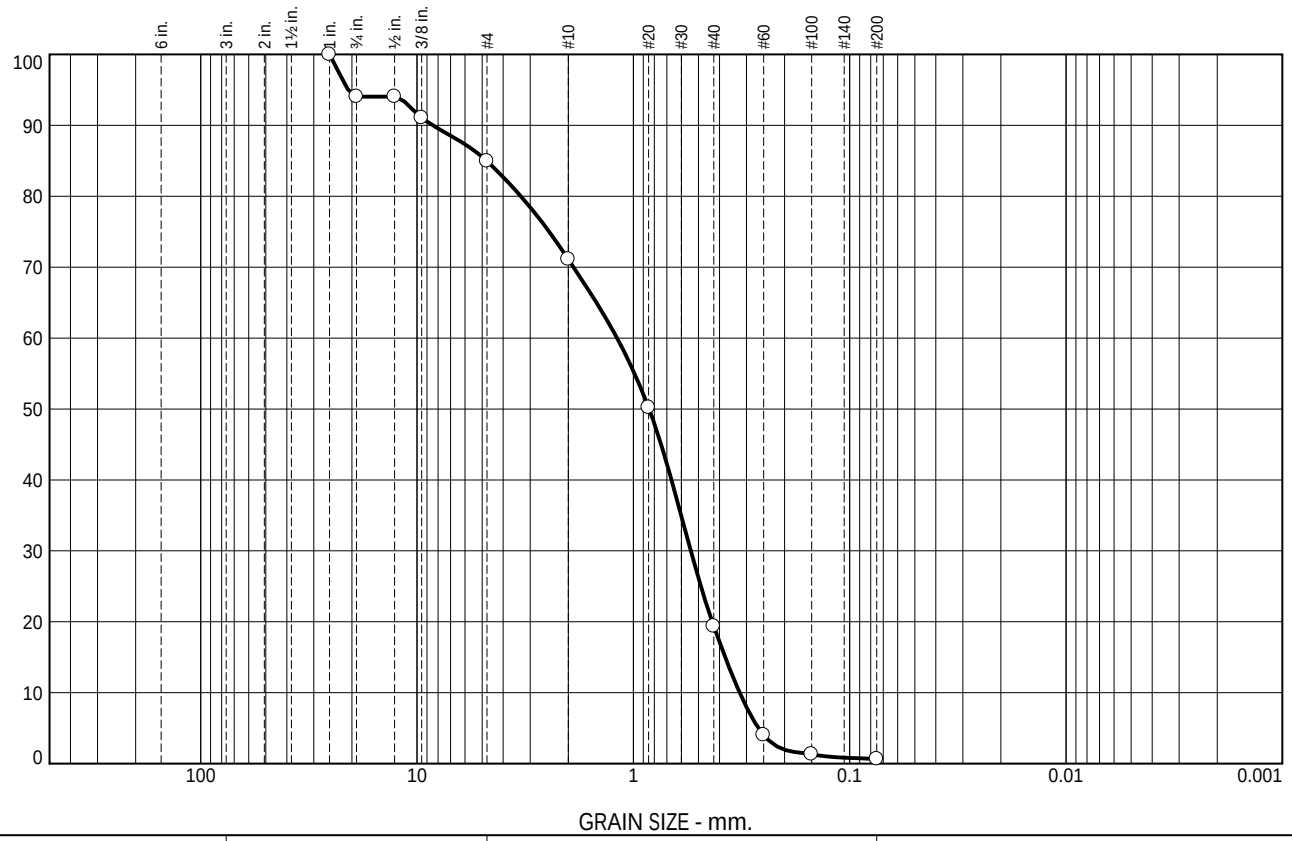
Project Information:	
Black Brook	
Aquinnah, MA	
Project Number:	24E0926
Summary Page:	1 of 1
Report Date:	05.31.24

LABORATORY TESTING DATA SHEET, Report No.: 7424-E-221

Material Source	Sample ID	Depth (ft)	Laboratory No.	Identification Tests									Proctor / CBR / Permeability Tests								Laboratory Log and Soil Description
				As Rcvd Moisture Content %	LL %	PL %	OD LL	Gravel %	Sand %	Fines %	Org. %	pH	g_d MAX (pcf) W_{opt} (%)	g_d MAX (pcf) W_{opt} (%) (Corr.)	Dry unit wt. (pcf)	Test Moisture Content %	Target Test Setup as % of Proctor	CBR @ 0.1"	CBR @ 0.2"	Permeability cm/sec	
				D2216	D4318			D6913			D2974	D4792	D1557								
Composite	SED-MD	-	24E0926-01					15.0	84.4	0.6											Brown poorly graded sand with gravel
Composite	SED-MU	-	24E0926-02					55.5	44.1	0.4											Brown poorly graded gravel with sand
Composite	SED-CU	-	24E0926-03					4.9	94.4	0.7											Brown poorly graded sand
Composite	SED-CD	-	24E0926-04					19.0	80.5	0.5											Brown poorly graded sand with gravel

Date Received: **05.24.24** Reviewed By: Date Reviewed: **05.31.24**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	6.0	9.0	13.9	51.7	18.8	0.6	

SIEVE SIZE OR DIAMETER	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1"	100.0		
3/4"	94.0		
1/2"	94.0		
3/8"	91.1		
#4	85.0		
#10	71.1		
#20	50.2		
#40	19.4		
#60	4.0		
#100	1.3		
#200	0.6		

* (no specification provided)

Soil Description

Brown poorly graded sand with gravel

Atterberg Limits

PL= NP LL= NV PI= NP

Coefficients

D_{90}= 8.4471 D_{85}= 4.7690 D_{60}= 1.1898
D_{50}= 0.8451 D_{30}= 0.5427 D_{15}= 0.3763
D_{10}= 0.3227 C_u= 3.69 C_c= 0.77

Classification

USCS= SP AASHTO= A-1-b

Remarks

Source of Sample: Comp
Sample Number: SED-MD

Date: 05.30.24

Thielsch Engineering Inc.

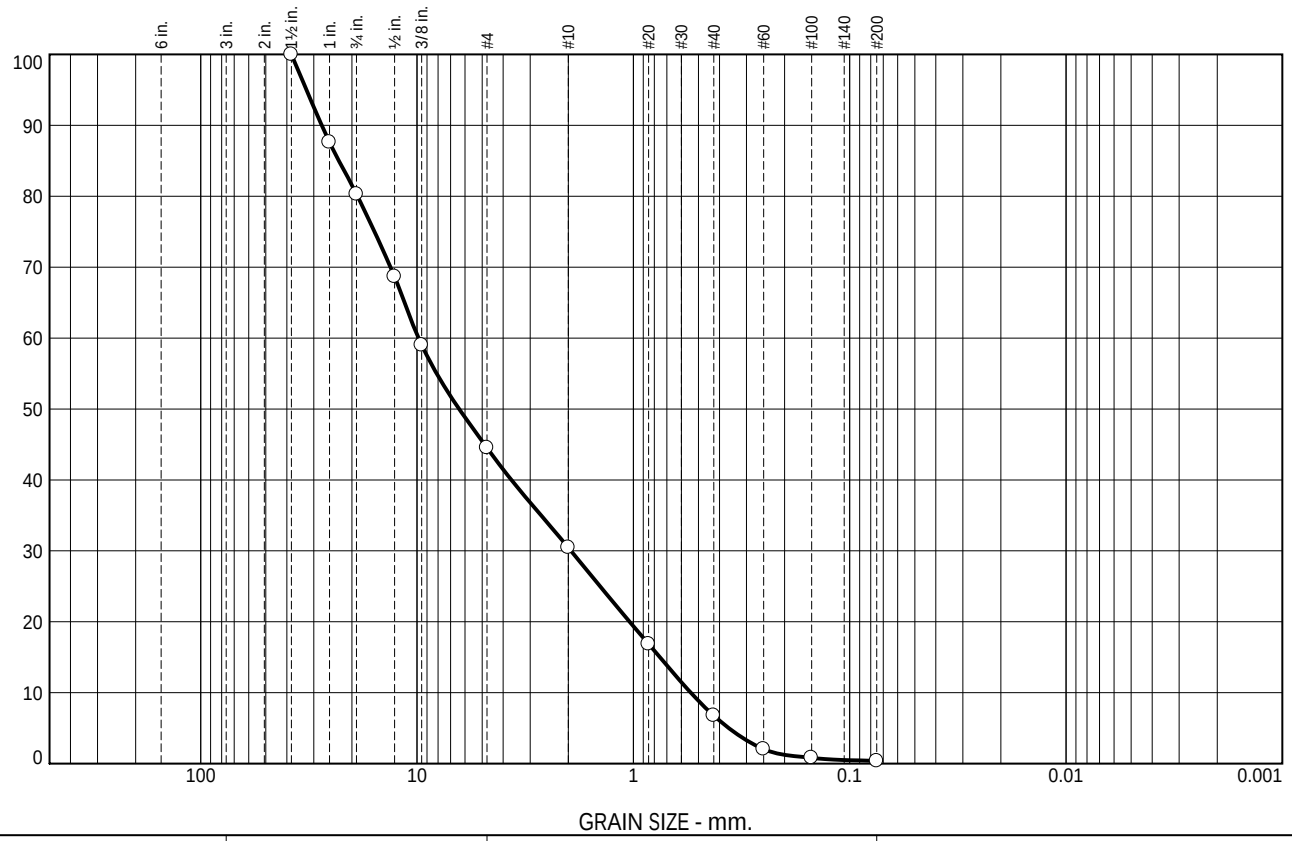
Cranston, RI

Client: ESS Laboratory
Project: Black Brook
Aquinnah, MA
Project No: 23112

Fig. 24E0926-01

Tested By: MCS Checked By: Rebecca Roth

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	19.7	35.8	14.0	23.7	6.4	0.4	

SIEVE SIZE OR DIAMETER	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1 1/2"	100.0		
1"	87.6		
3/4"	80.3		
1/2"	68.7		
3/8"	59.0		
#4	44.5		
#10	30.5		
#20	16.9		
#40	6.8		
#60	2.0		
#100	0.8		
#200	0.4		

* (no specification provided)

Soil Description

Brown poorly graded gravel with sand

Atterberg Limits

PL= NP LL= NV PI= NP

Coefficients

D_{90}= 27.5763 D_{85}= 22.9798 D_{60}= 9.8603
D_{50}= 6.3852 D_{30}= 1.9434 D_{15}= 0.7535
D_{10}= 0.5429 C_u= 18.16 C_c= 0.71

Classification

USCS= GP AASHTO= A-1-a

Remarks

Source of Sample: Comp
Sample Number: SED-MU

Date: 05.31.24

Thielsch Engineering Inc.

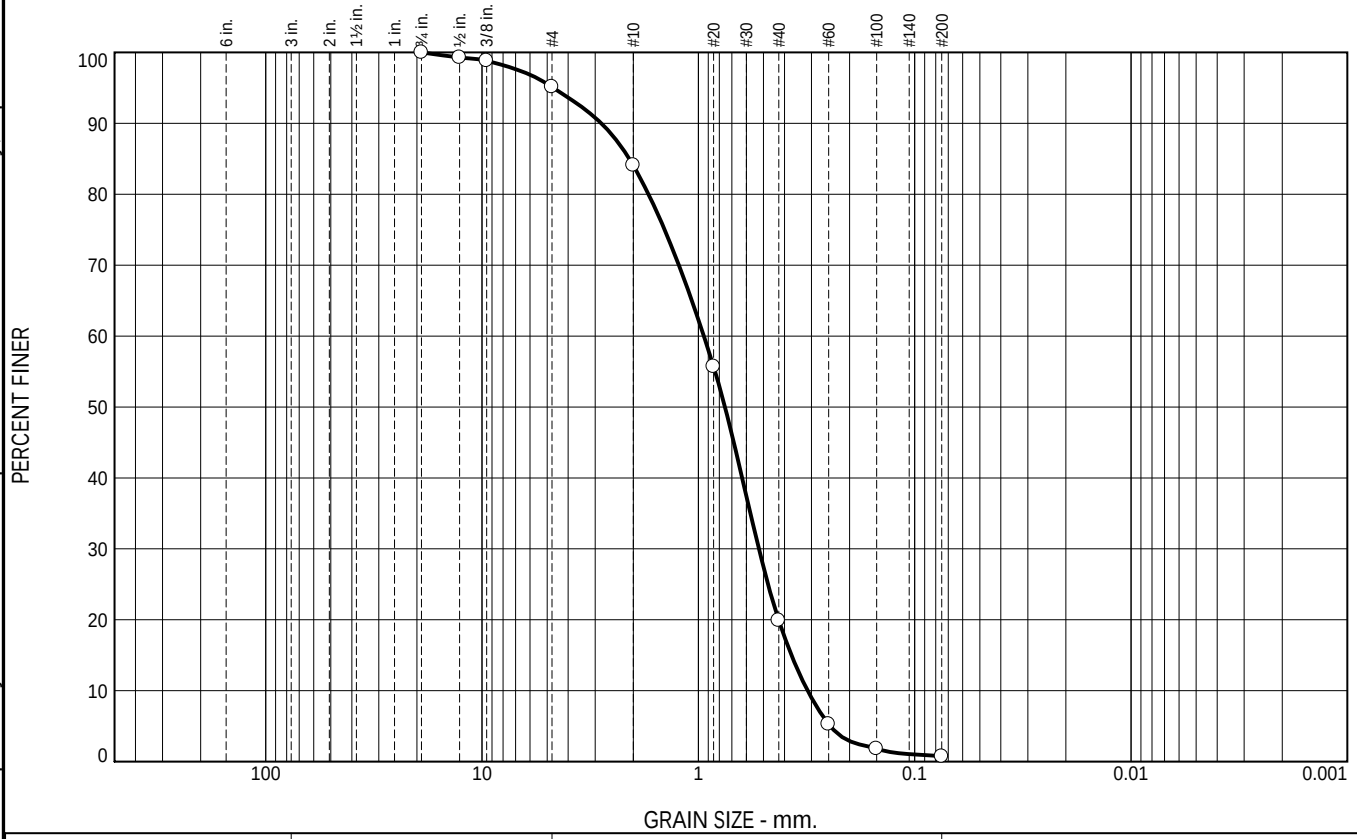
Cranston, RI

Client: ESS Laboratory
Project: Black Brook
Aquinnah, MA
Project No: 23112

Fig. 24E0926-02

Tested By: MCS Checked By: Rebecca Roth

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	4.9	11.0	64.2	19.2	0.7	

SIEVE SIZE OR DIAMETER	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4"	100.0		
1/2"	99.3		
3/8"	98.8		
#4	95.1		
#10	84.1		
#20	55.7		
#40	19.9		
#60	5.3		
#100	1.8		
#200	0.7		

* (no specification provided)

Soil Description

Brown poorly graded sand

Atterberg Limits

PL= NP LL= NV PI= NP

Coefficients

D_{90}= 2.8091 D_{85}= 2.0851 D_{60}= 0.9433
D_{50}= 0.7533 D_{30}= 0.5252 D_{15}= 0.3713
D_{10}= 0.3127 C_u= 3.02 C_c= 0.94

Classification

USCS= SP AASHTO= A-1-b

Remarks

Source of Sample: Comp
Sample Number: SED-CU

Date: 05.31.24

Thielsch Engineering Inc.

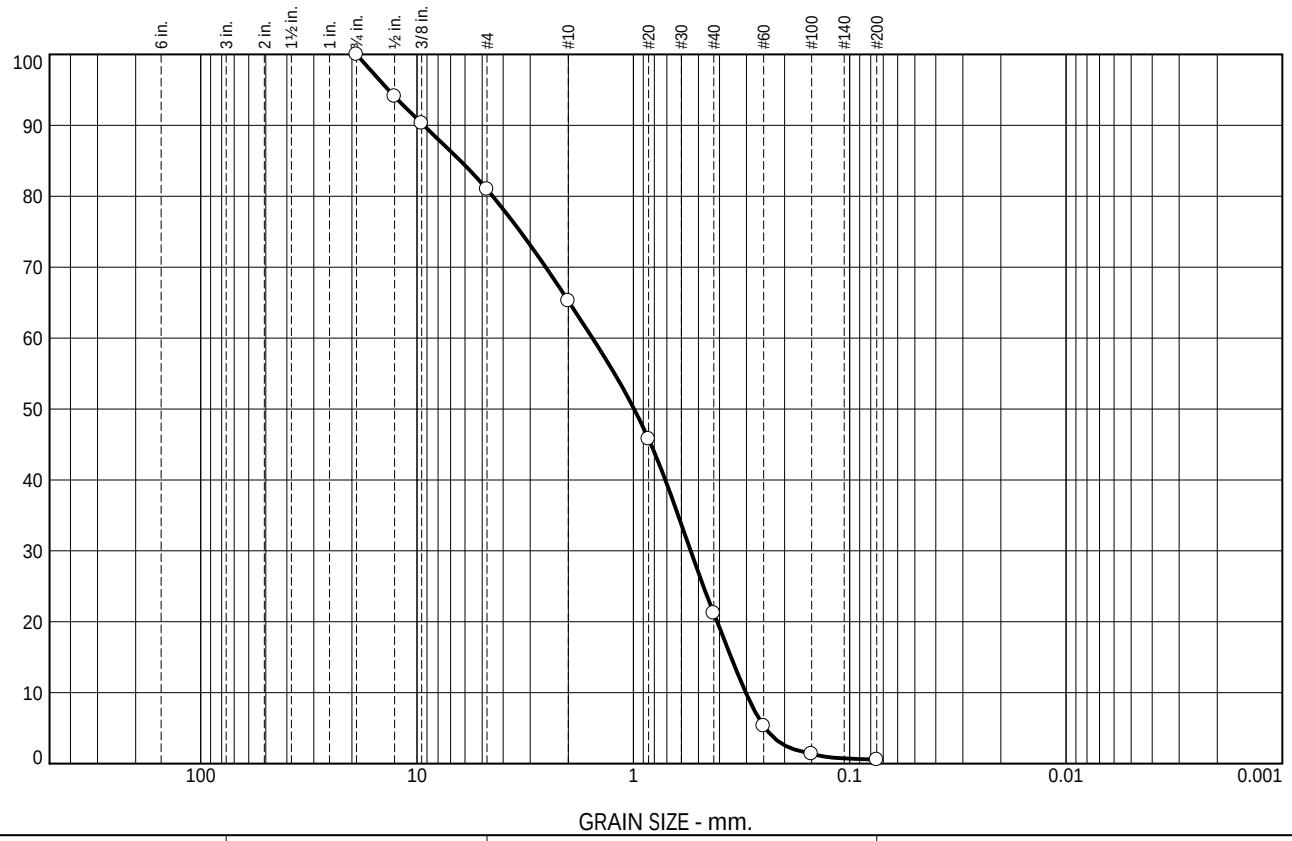
Cranston, RI

Client: ESS Laboratory
Project: Black Brook
Aquinnah, MA
Project No: 23112

Fig. 24E0926-03

Tested By: MCS Checked By: Rebecca Roth

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	19.0	15.8	44.0	20.7	0.5	

SIEVE SIZE OR DIAMETER	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4"	100.0		
1/2"	94.1		
3/8"	90.3		
#4	81.0		
#10	65.2		
#20	45.8		
#40	21.2		
#60	5.3		
#100	1.4		
#200	0.5		

* (no specification provided)

Soil Description

Brown poorly graded sand with gravel

Atterberg Limits

PL= NP LL= NV PI= NP

Coefficients

D_{90}= 9.3160 D_{85}= 6.2962 D_{60}= 1.5451
D_{50}= 0.9924 D_{30}= 0.5436 D_{15}= 0.3535
D_{10}= 0.3022 C_u= 5.11 C_c= 0.63

Classification

USCS= SP AASHTO= A-1-b

Remarks

Source of Sample: Comp
Sample Number: SED-CD

Date: 05.31.24

Thielsch Engineering Inc.

Cranston, RI

Client: ESS Laboratory
Project: Black Brook
Aquinnah, MA
Project No: 23112

Fig. 24E0926-04

Tested By: MCS Checked By: Rebecca Roth

ESS Laboratory Sample and Cooler Receipt Checklist

Client: Horsley Witten Group - TJM

Shipped/Delivered Via: ESS Courier

ESS Project ID: 24E0926
Date Received: 5/22/2024
Project Due Date: 5/30/2024
Days for Project: 5 Day

1. Air bill manifest present? No
   Air No.: NA
2. Were custody seals present? No
3. Is radiation count <100 CPM? Yes
4. Is a Cooler Present? Yes
   Temp: 2.4 Iced with: Ice
5. Was COC signed and dated by client? Yes
6. Does COC match bottles? Yes
7. Is COC complete and correct? Yes
8. Were samples received intact? Yes
9. **Were labs informed about short holds & rushes?** Yes / No / NA
10. Were any analyses received outside of hold time? Yes / No

11. Any Subcontracting needed? Yes / No
    ESS Sample IDs: **1--4**
    Analysis: **Grain size**
    TAT: **5 day**
12. Were VOAs received? Yes / No
    a. Air bubbles in aqueous VOAs? Yes / No
    b. Does methanol cover soil completely? Yes / No / NA
13. Are the samples properly preserved? Yes / No
    a. If metals preserved upon receipt: Date: ____ Time: ____ By/Acid Lot#: ____
    b. If dissolved metals are requested, are they: Yes / No Field Filtered Yes / No To Be Lab Filtered
    c. Low Level VOA vials frozen: Date: 5/22/24 Time: 1903 By: MM

Sample Receiving Notes:

14. Was there a need to contact Project Manager? Yes / No
    a. Was there a need to contact the client? Yes / No
    Who was contacted? ____ Date: ____ Time: ____ By: ____

Resolution:

Sample Number	Container ID	Proper Container	Air Bubbles Present	Sufficient Volume	Container Type	Preservative	Record pH (Cyanide and 608 Pesticides)
1	552845	Yes	N/A	Yes	Driller Jar	NP	
1	552849	Yes	N/A	Yes	8 oz jar	NP	
1	552850	Yes	N/A	Yes	8 oz jar	NP	
2	552846	Yes	N/A	Yes	Driller Jar	NP	
2	552851	Yes	N/A	Yes	8 oz jar	NP	
2	552852	Yes	N/A	Yes	8 oz jar	NP	
3	552847	Yes	N/A	Yes	Driller Jar	NP	
3	552853	Yes	N/A	Yes	8 oz jar	NP	
3	552854	Yes	N/A	Yes	8 oz jar	NP	
4	552848	Yes	N/A	Yes	Driller Jar	NP	
4	552855	Yes	N/A	Yes	8 oz jar	NP	
4	552856	Yes	N/A	Yes	8 oz jar	NP	

2nd Review
Were all containers scanned into storage/lab? Initials TO
Are barcode labels on correct containers? Yes / No
Are all Flashpoint stickers attached/container ID # circled? Yes / No / NA
Are all Hex Chrome stickers attached? Yes / No / NA
Are all QC stickers attached? Yes / No / NA
Are VOA stickers attached if bubbles noted? Yes / No / NA

ESS Laboratory Sample and Cooler Receipt Checklist

Client:	Horsley Witten Group - TJM	ESS Project ID:	24E0926
		Date Received:	5/22/2024
Completed By:	[signature]	Date & Time:	5/22/24 1840
Reviewed By:	[signature]	Date & Time:	5/22/24 1903

CHAIN OF CUSTODY

ESS Lab # 745D920 | Page 1 of 1

185 Frances Avenue
Cranston, RI 02921
Phone: 401-461-7181
[redacted]
www.esslaboratory.com

Turn Time: ☒ >5 ☐ 5 ☐ 4 ☐ 3 ☐ 2 ☐ 1 ☐ Same Day
Regulatory State: MA Criteria: 401 WQC
Is this project for any of the following?: ☐ CT RCP ☐ MA MCP ☐ RGP ☐ Permit ☒ 401 WQ

ELECTRONIC DELIVERABLES (Final Reports are PDF)
☐ Limit Checker ☐ State Forms ☐ EQuIS
☒ Excel ☐ Hard Copy ☐ Enviro Data
☐ CLP-Like Package ☐ Other (Specify) →

CLIENT INFORMATION

Client: Horsley Witten Group
Address: 90 Route 6A Sandwich, MA
Phone: 508-833-6600
Email Distribution List: cgran@horsleywitten.com
apnce@horsleywitten.com

PROJECT INFORMATION

Project Name: Black Brook
Project Location: Aquinnah, MA
Project Number: 23112
Project Manager: Neal Price
Bill to:
PO#:
Quote#:

Client acknowledges that sampling is compliant with all EPA / State regulatory programs

REQUESTED ANALYSES

ESS Lab ID	Collection Date	Collection Time	Sample Type	Sample Matrix	Sample ID	401 WQC Metals	(As, Cd, Cr, Cu, Pb, Hg, Ni, Zn)	PAHs	PCBs	EDH	TOC	% water	Grain Size	Total Number of Bottles
1	5/15/24	16:30	comp	sed	SED-MD	X		X	X	X	X	X	X	
2	↓	16:15	comp	sed	SED-MU	X		X	X	X	X	X	X	
3	↓	15:30	comp	sed	SED-CU	X		X	X	X	X	X	X	
4	↓	15:15	comp	sed	SED-CD	X		X	X	X	X	X	X	

Container Type: AC-Air Cassette AG-Amber Glass B-BOD Bottle C-Cubitainer J-Jar O-Other P-Poly S-Sterile V-Vial
Container Volume: 1-100 mL 2-2.5 gal 3-250 mL 4-300 mL 5-500 mL 6-1L 7-VOA 8-2 oz 9-4 oz 10-8 oz 11-Other*
Preservation Code: 1-Non Preserved 2-HCl 3-H2SO4 4-HNO3 5-NaOH 6-Methanol 7-Na2S2O3 8-ZnAce, NaOH 9-NH4Cl 10-DI H2O 11-Other*

Sampled by: Caroline Gran

Chain needs to be filled out neatly and completely for on time delivery.

Laboratory Use Only
Cooler Temperature (°C): 2.4
ONIce

Comments: * Please specify "Other" preservative and containers types in this space
*please meet 401 WQC reporting limits

All samples submitted are subject to ESS Laboratory's payment terms and conditions.

Dissolved Filtration
☐ Lab Filter

Relinquished by (Signature)	Date	Time	Received by (Signature)	Relinquished by (Signature)	Date	Time	Received by (Signature)
Caroline Gran	5/20/24	1048	[signature]	5/22/24 1048 [signature]	5/22/24	1831	[signature]