OCEAN PARK SUBDIVISION
VIRGINIA BEACH, VIRGINIA

PROJECT NARRATIVE AND CALCULATIONS

JULY 3, 2025

PREPARED FOR:

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TIMMONS GROUP
YOUR VISION ACHIEVED THROUGH OURS.

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Project Description

This project proposes the development of 14 duplexes for a new residential subdivision on Marlin Bay Drive west of Winston Place. The property GPIN is 1489-47-6808-000 and zoned PD-H1.

The proposed development includes a public roadway with a cul-de-sac. Water, sanitary sewer, and stormwater will connect to existing facilities. During this development, the existing property lot lines will be modified to provide an extension of the Marlin Bay Drive public right of way.

Proposed land disturbance is approximately 3.13 acres.

Existing Site Conditions

The existing site conditions contain forested area, a public gravel trail, and neighboring roadways.

Adjacent and Offsite Areas

The site is bounded by Winston place to the east; R5 residential properties to the north; Marlin Bay to the west; and P1-preservation area to the south.

Soils

According to the "Web Soil Survey" provided by United States Department of Agriculture (USDA) the existing site has the following soil characteristics:

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
10	Corolla fine sand	A	1.7	56.3%
30	Psamments	A	1.4	43.7%
Totals for Area of Interest			**3.1**	**100.0%**

A geotechnical engineering report was prepared by ECS Mid Atlantic, LLC, dated November 23, 2022 with hand auger samples certified by a professional geologist with Fishburne Drilling Inc. dated November 10, 2022. Groundwater was encountered at depth 4 to 7 feet below existing grades at the time of drilling. Based on the stabilized groundwater depth recorded, an estimate of the seasonal high groundwater table is provided below:

	Estimated Groundwater Levels (ft, NAVD 88)			
	INF-01/B-01	**INF-02/B-02**	**INF-03/B-03**	**INF-04/B-04**
Approx. Elev. at Test Site	7.5	7.1	5.5	4.5
Certified SHGWT Depth	6	6	4	3
Estimated SHGWT Elevation	**1.5**	**1.1**	**1.5**	**1.5**

The USDA NRCS Web Soil Survey Maps can be found in Appendix A.

Critical Areas

The site is located in the AE el.7 flood zone.

Permitting

This project will require a Land Disturbance Permit and VSMP (Virginia Stormwater Management Program) Permit prior to the start of any land disturbing activities. The contractor is responsible for obtaining all necessary permits.

Erosion and Sediment Control

Unless otherwise indicated, all vegetative and structural erosion and sediment control practices shall be constructed and maintained in accordance to the minimum standards and specifications of the Virginia Stormwater Management Handbook (VSMH) v1.1. The minimum standards of the VSMH regulations shall be adhered to unless otherwise waived or approved by a variance. The erosion and sediment control measures as shown on the plan set are sufficient and meet the VSMH design criteria.

Structural Practices

1. Construction Entrance: (C-SCM-03)
   Temporary stone construction entrances will be installed at the entrances to the site along Salem Road where the access area intersects with existing paved roadways to avoid transporting mud and sediment onto existing paved roads.

2. Silt Fence: (C-PCM-04)
   Temporary silt fence sediment barriers will be installed around the perimeter of the site's disturbed areas to prevent sediment laden runoff from leaving the site.

3. Storm Drain Inlet Protection: (C-SCM-04)
   All new and existing downstream storm drain inlets shall be protected from sediment laden runoff during construction.

4. Temporary Diversion Dike: (C-ECM-04)
   Temporary diversion dikes will be used to divert storm runoff away from sensitive areas (wetlands) or from upstream areas into sediment basins or traps.

5. Temporary Diversion: (C-ECM-05)
   Temporary diversion swales and ditches will be installed as shown on the Phase I Erosion and Sediment Control Plans to convey runoff to a proposed sediment control measure.

6. Temporary Sediment Trap: (C-SCM-11)
   A temporary sediment trap will be formed by constructing an earthen embankment with a stone outlet. Sediment-laden water will be detained in the sediment trap long enough to allow the majority of the sediment to settle out.

7. Outlet Protection: (C-ECM-15)

Outlet protection will be installed at all pipe outlets and concentrated flow outlets to prevent scour and to minimize downstream erosion.

Vegetative Practices

8. Surface Roughening: (C-SSM-03)
   Surface roughening shall be implemented for all cut and fill slopes 4H:1V or greater prior to the placement of the next lift of fill, all cut and fill slopes 4H:1V or greater prior to seeding, and areas which have been graded and not stabilized immediately.

9. Temporary Seeding: (C-SSM-09)
   All denuded areas which will be left dormant for extended periods of time shall be seeded with fast germinating temporary vegetation immediately following grading activities. Selection of the seed mixture will depend on the time of year it is applied.

10. Permanent Seeding: (C-SSM-10)
    Permanent seeding will be established on all non-paved disturbed areas.

11. Mulching: (C-SSM-11)
    Mulch will be applied to all seeded areas to prevent erosion and foster the growth of vegetation.

12. Soil Stabilization Blankets and Matting: (C-SSM-05)
    Soil stabilization blankets and matting will be installed to aid in controlling erosion on critical areas of a steep slope.

13. Tree Preservation and Protection: (C-SSM-01)
    All trees that are to be saved will be protected with tree protection during construction.

14. Dust Control: (C-SCM-01)
    Areas subject to surface and air movement of dust shall be stabilized during construction to minimize dust release. Methods include but are not limited to vegetative cover, mulch, or irrigation.

Management Strategies

The following sequence of events and erosion control measures shall be incorporated into the construction schedule for this project and shall apply to all construction activities within the project limits.

1. Soil Stabilization:
   a. Permanent or temporary soil stabilization shall be applied to denuded areas within seven days after final grade is reached on any portion of the site.
   b. Temporary soil stabilization shall be applied within seven days to denuded areas that may not be at final grade but will remain dormant for longer than 30 days, but less than one year.
   c. Permanent stabilization shall be applied to areas that are to be left dormant for more than one year.

2. Soil Stockpile Stabilization: During construction, soil stockpiles and borrow areas shall be stabilized or protected with sediment trapping measures. Temporary protection and permanent stabilization shall be applied to all soil stockpiles on site and borrow areas or soil intentionally transferred off site.
3. Permanent Stabilization: Permanent vegetative cover shall be established on denuded areas not otherwise permanently stabilized. Permanent vegetation shall not be considered established until a ground cover is achieved that is:
    - Uniform
    - Mature enough to survive
    - Will inhibit erosion
4. Cut and Fill Slopes Design & Construction: Cut and fill slopes shall be designed and constructed in a manner that will minimize erosion. Slopes found to be eroding excessively within one year of permanent stabilization shall be provided with additional slope stabilizing measures until the problem is corrected.
5. Concentrated Runoff Down Slopes: Concentrated runoff shall not flow down cut or fill slopes unless contained within an adequate temporary or permanent channel, flume, or slope drain structure.
6. Slope Maintenance: Whenever water seeps from a slope face, adequate drainage or other protection shall be provided.
7. Storm Sewer Inlet Protection: All storm sewer inlets made operable during construction shall be protected so that sediment-laden water cannot enter the stormwater conveyance system without first being filtered/treated to remove sediment.
8. Stormwater Conveyance Protection: Before newly constructed stormwater conveyance channels or pipes are made operational, adequate outlet protection and any required temporary or permanent channel lining shall be installed in both the conveyance channel and the receiving channel.
9. Underground Utility Line Installation: Underground utility lines shall be installed in accordance with the following standards in addition to other applicable criteria:
    a. No more than 500 linear feet of trench may be opened at one time
    b. Excavated material shall be placed on the uphill side of trenches
    c. Effluent from dewatering operations shall be filtered or passed through an approved sediment trapping device, or both, and discharged in a manner that does not adversely affect flowing streams or off-site property
    d. Material used for backfilling trenches shall be properly compacted in order to minimize erosion and promote stabilization
    e. Restabilization shall be accomplished in accordance with these regulations
    f. Comply with applicable safety regulations
10. Vehicular Sediment Tracking: Where construction vehicle access routes intersect paved or public roads:
    a. Provisions shall be made to minimize the transport of sediment by vehicular tracking onto the paved surface
    b. Where sediment is transported onto a paved or public road surface, the road surface shall be cleaned thoroughly at the end of each day
    c. Sediment shall be removed from the roads by shoveling or sweeping and transported to a sediment control disposal area. Street washing shall be allowed only after sediment is removed in this manner

11. Removal of Temporary Measures: All temporary erosion and sediment control measures shall be removed within 30 days after final site stabilization or after the temporary measures are no longer needed, unless otherwise authorized by the program authority. Trapped sediment and the disturbed soil areas resulting from the disposition of temporary measures shall be permanently stabilized to prevent further erosion and sedimentation.

Maintenance

In general, all erosion and sediment control measures shall be checked after each rainfall or weekly, whichever is most frequent, and should be cleaned and repaired according to the following schedule.

1. Construction entrance shall be maintained in a condition which will prevent tracking or flow of mud onto paved surfaces and public rights-of-way. Maintain construction entrances in accordance with C-SCM-03 of the VSMH.
2. Silt fences shall be inspected after each rainfall and repaired immediately, as required. Maintain silt fence in accordance with C-PCM-04 of the VSMH.
3. The inlet protection will be checked regularly for sediment cleanout. Maintain inlet protection in accordance with C-SCM-04 of the VSMH.
4. Outlet protection shall be checked regularly and shall be cleaned and/or replaced if excessive sediment buildup is present.

5. Erosion and sediment control measures shall be checked regularly for undermining or deterioration and buildup or clogging with sediment. Corrective action shall be taken immediately.
6. Temporary sediment basin and temporary sediment traps shall be cleaned to remove sediment buildup when sediment accumulation reaches the elevation shown on the Erosion and Sediment Control Plans. Maintain temporary outfall to ensure proper sediment filtration and trash interception.
7. All seeded areas will be checked regularly to see that a good stand is maintained. Areas should be fertilized and reseeded as needed.
8. All temporary erosion and sediment measures shall be disposed of within thirty (30) days after final site stabilization is achieved and vegetation is established. Final site stabilization shall be approved by the City Inspector.

Virginia Department of Environmental Quality Minimum Standards

The design of this development shall conform to the minimum standards and specifications of the Virginia Stormwater Management Handbook (VSMP). Included in the Civil Site Plans is the Virginia Department of Environmental Quality (DEQ) checklist for compliance (MS-1 thru MS-19 Checklist). Information is provided in the Civil Site Plans as to how each applicable Minimum Standard is specifically satisfied.

Permanent Stabilization

After final grade is achieved the site shall be permanently stabilized. Seed shall be applied to all grass areas per the landscape plans included with the site plan. Other areas, to be shown in the full construction plan set, will be paved, contain buildings, sidewalks, etc. Some areas will be enhanced with trees, shrubs, mulch, etc.

Construction Sequence

Phase I Erosion Control Sequence

1. Submit and obtain all applicable permits. Contact applicable utility companies and coordinate utility relocation/removal.
2. Do not initiate any land disturbing activity until authorized to proceed by owner.
3. Coordinate mobilization and job site access with owner's representative and City of Virginia Beach Department of Public Works.
4. The contractor shall contact environmental stormwater management and environmental services so that a pre-construction conference can be scheduled.
5. Contractor is responsible for damage to existing pavement, unpaved right-of-way, and existing structures to remain due to truck traffic, and for keeping the roadway clean.
6.Install all erosion control measures as shown. Maintain E&SC measures throughout the project.
7. After perimeter erosion control measures are installed, with approval of the erosion control inspector, begin demolition and abandonment procedures as indicated on the plans.
8. Existing storm sewer system shall be maintained and remain operational until new storm sewer system is installed.
9. Always maintain positive drainage to existing storm sewer system and adjust measures if necessary to intercept sediment and prevent erosion.
10. The contractor shall inspect all erosion control measures periodically and after each rainfall event. Any necessary repairs or cleanup to maintain the effectiveness of the erosion control devices shall be made immediately in accordance with MS-5.
11. The contractor is responsible for the installation of any additional erosion control measures necessary to prevent erosion and sedimentation as determined by the inspector.

Phase II Erosion Control Sequence

1. Install underground utilities as depicted on the plans.
2. Rough grade the entire site and promptly stabilize areas to be vegetated as they are brought to final grade.
3. Install curb and stone base for parking lot and drive aisles.
4. Install concrete sidewalks and other impervious surfaces.
5. Fine grade roadways and commence asphalt paving at the direction of the owner.
6. Seed and permanently stabilize any remaining disturbed areas.
7. After completion of construction and flushing the stormwater conveyance system, remove all remaining erosion control measures. All temporary measures shall be removed within 30 days after final site stabilization or after the temporary measures are no longer needed, unless otherwise authorized by the VSMP authority.

Stormwater Management

Timmons Group is using the Virginia Beach Stormwater Management Model (PCSWM) to comprehensively address the issue of stormwater management on this project. An in depth report on the results in PCSWMM are included in the SWMM Narrative of this project submittal.

Existing Conditions

Portions of the site are located within flood plain zone AE (Elev. 7'). Additionally, the seasonal high ground water table is at Elev. 1.5', based upon the geotechnical engineering report.

The existing drainage for the development collects to an on-site low elevation, then overflows into five (5) subcatchment areas. The two (2) points of analysis adjacent to the property are:

- Point of analysis #1 (POA1) contains Western drainage. Stormwater is routed via storm pipes towards Mystic Cove Dr., then is discharged into Lynnhaven Bay.

- Point of analysis #2 (POA2) contains Western drainage. Stormwater is routed via storm pipes to a stormwater pump station located on Winston Place, then is discharged through a BMP into the Lynnhaven Bay.

Proposed Conditions

Proposed drainage was routed in split directions to POA1 & POA2. Preliminarily, it was assumed that all proposed drainage could be released into the pump station route; however, results found that upstream inlets were significantly impacted.

The proposed stormwater routing design is to release right-of-way drainage to the west (POA1) directly, and control on-site drainage to the east (POA2) pump station route. On-site drainage is to be controlled by outlet structures that are apart of four (4) stone-reservoir perforated pipe BMP systems between lots. The total volume provided with underground BMPs is approximately 7,500 CF.

100-Year Check Storm
The results of the 100-YR check storm show no increases in HGL greater than 0.05-ft, upstream or downstream of the site. Ponding is expected on-site during the check storm; however, it is contained within the limits of the site. Therefore, no adverse impacts to adjacent properties are created by this development.

Flood Protection
The flood protection requirements, in accordance with 9VAC25-875-600-C.3.c, is fulfilled by the containment of post-development HGLs from the project site to the mapped floodplain (Elev. 7.0') for both points of analysis (POA 1 & 2) during the 10-year, 24-hour storm. A table showing HGL and rim elevations from the project site and surrounding areas can be found in Appendix C.

Channel Protection
The channel protection requirements are fulfilled, in accordance with 9VAC25-875-600-B.1.b, by proposing stormwater velocities that will not cause erosion to the system. The analysis was performed using the PCSWMM model to both points of analysis, POA1 and POA2, at which the drainage area of

the project site is 1% or less than the total drainage area. The 1% point for our analysis for both POAs is Lynnhaven Bay, which meets the definition provided below, of a Major Water Body.

> *Major Water Body – A public bay, creek, lake, stream, river, ocean, or other large body of water the receives stormwater runoff and has a base flood elevation determined by the current FEMA Flood Insurance Study (FIS), the City Stormwater Master Plan, or other study available from the Public Works Stormwater Engineering Center.*

A map of the project site and the point of analysis as well as a table showing non-erosive velocities can be found in Appendix C.

Pump Station Analysis
Based on results in the 2-YR, 10-YR, and 100-YR storm events, no adverse impacts are seen to the downstream pumpstation (OP_PS2) from the addition of on-site drainage. Results show that the three (3) pumps (OP_PS2_P1, OP_PS2_P2, and OP_PS2_P3) have improved Utilization (%) and less Total Volume (MG) combined in all storm events.

Stormwater Quality

The Virginia Runoff Reduction Method (VRRM) Re-Development Compliance Spreadsheet was used to calculate the Total Phosphorus Load (TP) and runoff reduction required for the site. Approximately 3.13 acres will be disturbed for this development. The underground stone reservoir systems do not provide pollutant removal. The TP load reduction required for this project is 1.41 lb/yr.

It is anticipated that water quality guidelines (9VAC25-875-610, Code B-2) will be met via purchase of nutrient credits from the Nansemond Shoals Nutrient Reduction Implementation Plan (NRIP).

Refer to Appendix C for Stormwater Quality Calculations.

Utilities

Water

An existing 8” DI water main is provided east of the project site along Winston Place. The connection to the existing water main will be made with an 8’ x 8’ tee, from the connection, an 8” DI main will be extended to service the remaining portion of the development. The easternmost lots will connect to the existing main and the westernmost will be served by the newly proposed main extension. 5/8” water meters will be installed for the domestic service line and will connect to the duplexes via a 1” PVC. The proposed 8” watermain will terminate right before the cul de sac with a 2” blow off assembly. A new fire hydrant assembly Is proposed at the western region of the site.

The construction classification of the proposed building was assumed to be a two-family dwelling. Using the IFC Method of calculating Needed Fire Flow, it was determined that the required fire flow for the proposed buildings is 1,000 GPM.

A water model has been prepared to analyze the proposed water systems using fire hydrant capacity curves as provided by City of Virginia Beach staff. The average day demands are based on 225 gallons per house per day (gpd/house), taken from the City of Virginia Beach Department of Public Utilities

Design Standards Manual. The maximum day demand is calculated as 1.4 times the average day demand. Peak hour demands were based on the below equation from the Virginia Waterworks regulations (12VAC5-590-690): $Q=11.4N^{0.544}$, where Q equals total gallons per minute (gpm) and N equals total number of residential units. The calculated domestic demands are provided below:

Average Day Demand = 4.4 GPM
Max Day Demand = 6.1 GPM
Peak Hour Demand = 23.0 GPM

Each of the above model runs were run as a steady state model, which reports residual pressure in the "Pressure" column of the reporting tables.

Fire flow calculations within the model are run based on the Maximum Day with Manual Fire. The Maximum Day with Manual Fire scenario runs the maximum flow that can be used from each hydrant while still satisfying a 20-psi minimum pressure constraint. The fire flow report table for this scenario shows this flow as the Fire Flow (Available) column, as well as the maximum pipe velocity during that flowrate. The Pressure column shows the residual pressure without the fire flows compared to the Pressure (Calculated Residual) column shows the residual pressure when the fire flow is applied. The Maximum Day with Manual Fire runs the hydrant with the lowest allowable demand at 6.1 gpm max plus 1,000 gpm fire to show the demands throughout the system during a fire

Water related calculations along with water modeling results have been provided in Appendix D.

Sewer

There is an existing 8" DI sanitary sewer along Winston Place. A connection to the existing main will be made with a straddle manhole and a new proposed sanitary main will be extended westward along the new street. The easternmost lots will connect to the existing main and the westernmost will be served by the newly proposed main extension. All lots will have two separate 4" SDR 26 PVC sewer service laterals with 4" cleanouts.

The City of Virginia Beach standards give an average flow of 6.03 gpm and peak flow of 15.07 gpm.

Sanitary sewer calculations can be found in Appendix D.

Appendix A – Soil Maps and Geotechnical Report

Hydrologic Soil Group—City of Virginia Beach, Virginia
(50568 LOD)

Map Scale: 1:1,450 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 20 40 80 120

Feet: 0 50 100 200 300

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 18N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

A
A/D
B
B/D
C
C/D
D
Not rated or not available

Soil Rating Lines

A
A/D
B
B/D
C
C/D
D
Not rated or not available

Soil Rating Points

A
A/D
B
B/D
C
C/D
D
Not rated or not available

Water Features

Streams and Canals

Transportation

Rails
Interstate Highways
US Routes
Major Roads
Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:15,800.

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

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

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

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

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

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

Soil Survey Area: City of Virginia Beach, Virginia
Survey Area Data: Version 18, Aug 28, 2024

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

Date(s) aerial images were photographed: May 9, 2022—Aug 15, 2022

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

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
10	Corolla fine sand	A	1.7	56.3%
30	Psamments	A	1.4	43.7%
Totals for Area of Interest			**3.1**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

ECS MID-Atlantic, LLC

Geotechnical Engineering Report

Marlin Bay Drive Site Improvements

Marlin Bay Drive
Virginia Beach, VA

ECS Project Number 04:12065

November 23, 2022

November 23, 2022

Mr. Chris Aebel, P.E.
Timmons Group
2901 S Lynnhaven Road, Suite 200
Virginia Beach, VA 23452

ECS Project No. 04:12065

Reference: Report of Subsurface Exploration and Geotechnical Engineering Analysis
Marlin Bay Drive Site Improvements
Virginia Beach, Virginia

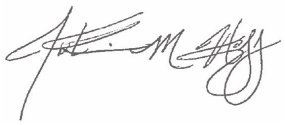
Dear Mr. Aebel,

ECS Mid-Atlantic LLC (ECS) has completed the subsurface exploration, laboratory testing, and geotechnical engineering analyses for the above referenced project. Our services were performed in general accordance with our proposal no. 04:18476-GP, dated October 6, 2022. This report presents our understanding of the geotechnical aspects of the project, the results of the field exploration and laboratory testing conducted, and our preliminary recommendations for design and construction.

It has been our pleasure to be of service to Timmons Group during the design phase of this project. We would appreciate the opportunity to remain involved during the continuation of the design phase, and we would like to provide our services during construction phase operations as well to verify the assumptions of subsurface conditions made for this report. Should you have any questions concerning the information contained in this report, or if we can be of further assistance to you, please contact us.

Respectfully submitted,

ECS Mid-Atlantic, LLC



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APPENDICES

EXECUTIVE SUMMARY

The following summarizes the main findings of the field exploration, particularly those that may have a cost impact on the planned development. Information gleaned from the executive summary should not be utilized in lieu of reading the entire report.

- The geotechnical exploration performed for the proposed development included four (4) soil test borings drilled to depths of 10 feet below the ground surface within the proposed roadways and BMP facilities. Additionally, two (2) bulk samples were collected within the proposed roadways for standard compaction and CBR testing and four (4) infiltration tests were performed at each bore location.

- The borings were conducted within a moderately wooded area and contained minimal amounts of topsoil as surface cover. The borings generally encountered Alluvial intermixed deposits of Poorly Graded Fine to Medium Sand with Silt (SP-SM) and Sand (SP) to the maximum explored depths of 10 feet below existing site grades. These coarse-grained soils were generally dense to very loose in relative density.

- In-situ infiltration testing was performed at each respective boring location in order to determine the appropriate infiltration rates and Hydrologic Soil Group for the project site. Based on the results of our borings, the soils across the project site fall under Class A.

- Based on the wooded nature of the site, deeper deposits of organics consisting of rootmat and forest litter should be considered as present throughout the area of development. This material, where encountered within the pavement subgrades should be removed and replaced with a well-compacted Structural Fill in accordance with this report.

1.0 INTRODUCTION

The purpose of this study is to provide geotechnical information for the site improvements for a new residential subdivision located along Marlin Bay Drive in the City of Virginia Beach, Virginia. Our evaluation was based on the plans dated December 11th, 2018 by MSA, P.C. Based on a review of the plans, Marlin Bay Drive will be extended to the east with a cul-de-sac at the end.

The recommendations developed for this report are based on project information supplied by Timmons Group and MSA, P.C. This report contains the results of our subsurface exploration, site characterization, engineering analyses, and recommendations for the design and construction of the proposed buildings and site features.

Our services were provided in accordance with our Proposal No. 04:18476-GP, dated October 14, 2022, as authorized by Timmons Group on October 14, 2022, which includes our Master Subconsultant Agreement between Timmons Group and ECS Mid-Atlantic, LLC.

This report contains the procedures and results of our preliminary subsurface exploration and laboratory testing programs, review of existing site conditions, engineering analyses, and recommendations for the design and construction of the project. The report includes the following items.

- A brief review and description of our field and laboratory test procedures and the results of testing conducted.
- A review of surface topographical features and site conditions.
- A review of area and site geologic conditions.
- A review of subsurface soil stratigraphy with pertinent available physical properties.
- Final copies of our soil test borings.
- Recommendations for pavements based on CBR results.
- Recommendations for site preparation and construction of compacted fills, including an evaluation of on-site soils for use as compacted fills.
- Evaluation of the site with respect to potential construction problems and recommendations dealing with earthwork and inspections during construction.
- Recommendations for BMP facilities based on the in-situ infiltration testing.
- Recommendations for additional testing for preparation of a final geotechnical engineering study.

The recommendations contained herein were developed from the data obtained in the soil test borings, which indicate subsurface conditions at the specific locations at the time of exploration. Soil and groundwater conditions may vary between the borings.

2.0 PROJECT INFORMATION

2.1 PROJECT LOCATION/CURRENT SITE USE/PAST SITE USE

The project site is located along Marlin Bay Drive in the City of Virginia Beach, Virginia. It is surrounded by Chesterfield Avenue to the north, the Pleasure House Point Natural Area to the east and south.

Figure 2.1.1 Site Location

The specific project site is currently overgrown and not occupied. The surrounding project site is currently indicated as the Pleasure House Point Natural Area with various hiking trails throughout. The area has high and low-lying areas at various places across the site. The provided plans concerning the existing site conditions and data from Google Earth indicate that elevations appear to vary from El. 7 to El. 12 feet across the site. These elevations should be considered approximate until surveying is conducted.

2.2 PROPOSED CONSTRUCTION

Based on the provided Site Plans, a new residential subdivision will be constructed on the property. We understand that the existing Marlin Bay Drive will be extended to the east, running parallel to the Pleasure House Point Natural Area. The end of the street will consist of a cul-de-sac. Gravel paths are anticipated to be constructed from the newly constructed roadway to tie into the neighboring property. Furthermore, stormwater management facilities are anticipated to accommodate the proposed construction.

3.0 FIELD EXPLORATION

The field exploration was planned with the objective of characterizing the project site in general geotechnical and geological terms and to evaluate subsequent field and laboratory data to assist in the determination of preliminary geotechnical recommendations.

3.1 SUBSURFACE CHARACTERIZATION

The subsurface conditions encountered were generally consistent with published geological mapping. The following sections provide generalized characterizations of the soil. Please refer to the boring logs in Appendix B.

Approximate Depth (ft)	Approximate Elevation (ft)	Stratum	Description	Ranges of SPT(2) N-values (bpf)
0 - 0.5	E.L 11 - E.L 10.5	N/A	Surface cover generally consisted of 3 to 6 inches of topsoil in various locations across the subject area.	N/A
0.5 - 10	E.L 10.5 - E.L 1.0	I	Underlying the surface cover, Stratum I soils generally consisted of Alluvial intermixed deposits of Poorly Graded Sand with Silt (SP-SM) and Poorly Graded Sand (SP). These coarse-grained materials were very loose to dense in relative density	4-33

Notes:

(1) Please note that the ground surface elevations were not surveyed by a licensed surveyor; these elevations are approximate based on Google-Earth© and published City GIS maps. Therefore, elevation ranges are approximate +/- several feet

(2) Standard Penetration Testing

A graphical presentation of the subsurface conditions is shown on the Subsurface Soil Profiles included in Appendix A.

3.2 GROUNDWATER OBSERVATIONS

Water levels in our borings were estimated based on visual/manual observation of the moisture content of recovered SPT samples and hand auger borings. The use of wet drilling methods (mud rotary) precludes direct measurement of water levels in the open boreholes and therefore, the hand auger borings more accurately portray actual groundwater conditions on the project site.

Groundwater depths at the time of drilling were approximately 4 to 7 feet below ground surface as noted on the boring logs in Appendix B depending on the elevation at which they were conducted. Furthermore, stabilized groundwater conditions were evaluated within the hand auger borings performed for the infiltration testing. Stabilized conditions appeared to be similar to the depths recorded at the time of drilling. The groundwater table was generally shallower from west to east.

Based on our experience with the geology in the vicinity of the site, the Seasonal High Water Table (SHWT) is generally encountered 1 foot above the stabilized groundwater readings. As such and based on the time of year in which our field exploration was conducted, an increase in

moisture content, and changes in the color of the soils, we estimate that the average SHWT to be on the order of approximately 6 to 3 feet below existing site grades (in the eastward direction) in the vicinity of the proposed stormwater management facility. At the time of this report, a topographic survey was not provided and therefore, the elevations indicated on our boring logs should be considered approximate. Below provides a summary of the conditions encountered on the project site:

Boring Location	Stabilized Groundwater Depths Below Grade (ft)	Seasonal High Water Table Estimated Depth Below Grade (ft)
INF-01/B-01	7.0	6.0
INF-02/B-02	6.75	6.0
INF-03/B-03	5.0	4.0
INF-04/B-04	4.0	3.0

A water table aquifer is distinguished from a perched groundwater table based on the water table aquifer's recharge ability, which may be limitless but can be lowered temporarily through adequate dewatering techniques such as deep wells and well points. Perched groundwater is often alleviated in excavations by pumping from sump pits and French drains. Variations in both groundwater types (perched and groundwater table aquifer) can occur as a result of changes in precipitation, evaporation, surface water runoff, construction activities, and other factors.

3.3 LABORATORY TESTING

The laboratory testing consisted of selected tests performed on samples obtained during our field exploration operations. Classification and index property tests were performed on representative soil samples. The index testing program included natural moisture content tests (ASTM D2216), percent passing the No. 200 sieve (ASTM D6913), and Atterberg Limits tests (ASTM D4318).

Each sample was visually classified on the basis of texture and plasticity in accordance with ASTM D2488 Standard Practice for Description and Identification of Soils (Visual-Manual Procedures) and including USCS classification symbols and ASTM D2487 Standard Practice for Classification for Engineering Purposes (Unified Soil Classification System (USCS)). After classification, the samples were grouped in the major zones noted on the boring logs in Appendix B. The group symbols for each soil type are indicated in parentheses along with the soil descriptions. The stratification lines between strata on the logs are approximate; in situ, the transitions may be gradual. Additionally, two (2) bulk soil samples were obtained within the proposed pavement areas for Standard Proctor tests and California Bearing Ratio (CBR) testing to aide in the pavement design.

4.0 DESIGN RECOMMENDATIONS

4.1 PAVEMENT SECTIONS

Subgrade Characteristics: Two (2) bulk soil samples were obtained within the proposed pavement areas for CBR testing. Based on the results of our soil test borings performed within the pavement footprints, it appears that the pavement subgrades will consist mainly of a Poorly Graded Sand (SP) subgrade. An ECS Geotechnical Engineer should be present during construction operations to determine the suitability of this material to remain in place. Any undercut material should be replaced with a well-compacted Fill material in accordance with the recommendations provided herein.

CBR testing was performed on bulk samples obtained at boring locations B-01 and B-03. Test results indicated an average CBR value of 30. Therefore, a design CBR value of 20 (taken as 2/3 of the CBR results) should be utilized in developing the pavement section. The pavement design was determined using the City of Virginia Beach Public Works Manual dated March 2022. As discussed in the manual, traffic rates were determined using VDOT's Pavement Design Guide for Subdivision and Secondary Roads. Due to the nature of the site, an assumed Average Daily Traffic (ADT) of 100 vehicles per day was used. Table V-1 of the design manual indicates a 0.1% growth rate for residential subdivisions with cul-de-sacs. Based on this information subgrades consist of suitable materials evaluated by ECS and passing a proofroll test (Section 6.1.2 Proofrolling). In addition to the pavement sections provided below, it is anticipated that gravel access paths will be constructed from the roadway to tie into the neighboring natural area.

Listed thicknesses are minimums. The Civil Engineer should review actual traffic patterns and loading to determine whether or not these sections are appropriate. We further assume that the civil designer will include ditches and swales along the edges of all pavements to promote drainage away from pavement edges and prevent water penetration into pavements and subgrade soils.

PROPOSED PAVEMENT SECTIONS				
MATERIAL	FLEXIBLE PAVEMENT		GRAVEL PATHS	RIGID PAVEMENT
	Heavy Duty	Light Duty		Heavy Duty
Portland Cement Concrete (f'_c = 4000 psi)	-	-	-	5.0 in
Asphaltic Concrete Surface Course (SM-9.5)	1.5 in	1.5 in	-	-
Asphaltic Concrete Surface Course (BM-25.0)	3.0 in	-	-	-
Graded Aggregate Base Course (VDOT #21A/21B)	6.0 in	6.0 in	4.0 in	6.0 in

In general, heavy-duty sections are areas that will be subjected to trucks, buses, or other similar vehicles including main drive lanes of the development. Light duty sections are appropriate for vehicular traffic and parking areas.

For the construction of new pavements, we recommend that any soft, unstable and/or unsuitable materials be removed from the pavement areas. The stripped surface should be proofrolled and carefully observed at the time of construction in order to aid in identifying any localized soft or unsuitable materials. This material, where encountered, should be closely evaluated during construction and should be removed from below the pavement as required or considered necessary by the Geotechnical Engineer. For construction during wet seasonal conditions, undercutting of loose, wet materials from below design subgrade elevations should be anticipated.

An important consideration with the design and construction of new pavements is surface and subsurface drainage. Where standing water develops, either on the pavement surface or within the base course layer, softening of the subgrade and other problems related to the deterioration of the pavement can be expected. Furthermore, good drainage should minimize the possibility of the subgrade materials becoming saturated over a long period of time. Based upon the results of the soil test borings, the groundwater table should not affect the performance of pavements. However, surface runoff which seeps into base materials could create localized deterioration of the soil's bearing capacity. Water that tends to collect within the base course layer may be minimized by installing weep holes in drainage structures and backfilling around these structures and storm sewer pipes with No. 57 Stone, construction of drainage swales and diversion ditches around the pavement perimeter, and proper backfilling and grading behind curbs to minimize water intrusion from behind the curbs.

4.2 INFILTRATION RECOMMENDATIONS

Our scope of our services included four (4) infiltration tests conducted at each boring location in order to determine stabilized groundwater depths, seasonal high water table estimates, and in-situ infiltration parameters at the time of testing. At the time of our exploration, the depth of the stormwater management facilities was unknown. As a result, the test depths were conducted approximately 1 foot above the seasonal high water table elevations as discussed in Section 3.2.

Infiltration testing was performed at directly adjacent to each boring location from B-01 to B-04 as indicated on the boring location plan in Appendix A. Infiltration testing was conducted using the Johnson Permeameter device, which is capable of measuring the coefficient of permeability, or saturated hydraulic conductivity, in the vadose zone (i.e., the unsaturated zone above the groundwater table). The permeameter establishes a constant head of water at a specified depth by use of a precision valve and float assembly. The rate of water flow into the borehole required to maintain the constant head is then determined at selected time intervals appropriate for the soil type being tested. The chart below summarizes infiltration test results:

Boring No.	Test Depth (ft)	Estimated Permeability[3] (in/hr)
B-01/INF-01	5.0	12.545
B-02/INF-02	4.75	6.816
B-03/INF-03	3.0	9.614
B-04/INF-04	2.0	5.411

A representative sample from the infiltration test location was tested for classification properties. The USDA textural classification and properties for the soil types tested are listed below with the following textural classifications observed:

Boring Number	Sample Number	Depth Interval (feet)	Percent Fines	Estimated USDA Texture Class	Estimated Hydrologic Soil Grouping	Published Infiltration Rate (in/hr)
B-01	S-5	4.5-5.0	1.1	Sand	A	8.4
B-02	S-5	4.25-4.75	1.8	Sand	A	8.4
B-03	S-3	2.5-3.0	2.1	Sand	A	8.4
B-04	S-2	1.5-2.0	6.0	Sand	A	8.4

Typically, soils with the Hydrologic Soil Group designations of A and B are considered suitable for infiltration purposes. Some soils designated as C type soils are considered suitable for infiltration practices but these soils would need to be evaluated on a case specific basis. Soils with group designations of D are generally not considered suitable. Based on the results of borings and in-situ infiltration testing, soils across the project site were relatively Class A soils. As a result, the soils are considered suitable for infiltration purposes across the project site.

Should infiltration be determined to be feasible for these facilities, the Geotechnical Engineer should be called on at the time of construction to verify the presence of suitable soils exposed at the bottom elevation of the facilities.

5.0 SITE CONSTRUCTION RECOMMENDATIONS

5.1 SUBGRADE PREPARATION

5.1.1 Demolition, Stripping, and Grubbing

Old foundations, pavements, or subsurface structures are not anticipated for the subject site, however, should be removed, where encountered, and replaced with well compacted Structural Fill. Subgrades disturbed by demolition and removal of existing site structures and utilities should be recompacted. Any resulting excavations should be thoroughly cleaned out of soft or wet materials and associated backfill, to the satisfaction of the Geotechnical Engineer, and grades restored by backfilling with well compacted Structural Fill.

The subgrade preparation should consist of stripping all vegetation, rootmat, topsoil, existing fill, and any soft or unsuitable materials from the 5-foot expanded building and pavement limits. Clearing for the wooded areas should be anticipated in the budget.

5.1.2 Proofrolling

Prior to fill placement or other construction on subgrades, the subgrades should be evaluated by an ECS field technician. The exposed subgrade should be thoroughly proofrolled with construction equipment having a minimum axle load of 10 tons [e.g. fully loaded tandem-axle dump truck]. Proofrolling should be traversed in two perpendicular directions with overlapping passes of the vehicle under the observation of an ECS technician. This procedure is intended to assist in identifying any localized yielding materials.

Where proofrolling identifies areas that are unstable or "pumping" subgrade those areas should be repaired prior to the placement of any subsequent Structural Fill or other construction materials. Methods of stabilization include undercutting, moisture conditioning, or chemical stabilization. The situation should be discussed with ECS to determine the appropriate procedure. Test pits may be excavated to explore the shallow subsurface materials to help in determining the cause of the observed unstable materials, and to assist in the evaluation of appropriate remedial actions to stabilize the subgrade.

5.2 EARTHWORK OPERATIONS

5.2.1 Structural Fill Materials

Prior to placement of Structural Fill, representative bulk samples (about 50 pounds) of on-site and/or off-site borrow should be submitted to ECS for laboratory testing, which will typically include Atterberg limits, natural moisture content, grain-size distribution, and moisture-density relationships (i.e., Proctors) for compaction. Import materials should be tested prior to being hauled to the site to determine if they meet project specifications. Alternatively, Proctor data from other accredited laboratories can be submitted if the test results are within the last 90 days.

Satisfactory Structural Fill Materials: Materials satisfactory for use as Structural Fill should consist of inorganic soils with the following engineering properties and compaction requirements.

STRUCTURAL FILL INDEX PROPERTIES	
Subject	**Property**
Building and Pavement Areas	LL < 25, PI<6
Max. Particle Size	1 inch
Fines Content	Max. 20 % < #200 sieve

STRUCTURAL FILL COMPACTION REQUIREMENTS	
Subject	**Requirement**
Compaction Standard	Standard Proctor, ASTM D698
Required Compaction	95% of Max. Dry Density
Moisture Content	-3 to +3 % points of the soil's optimum value
Loose Thickness	8 inches prior to compaction

On-Site Borrow Suitability: Natural deposits of soils that meet the definition of Satisfactory Structural Fill as mentioned above are present on the site. In the event the material will be reused for Structural Fill, representative soil samples should be submitted for further laboratory testing to determine their compaction characteristics in accordance with the recommendations described above.

6.0 CLOSING

ECS has prepared this report to guide the geotechnical-related design and construction aspects of the project. We performed these services in accordance with the standard of care expected of professionals in the industry performing similar services on projects of like size and complexity at this time in the region. No other representation, expressed or implied, and no warranty or guarantee is included or intended in this report.

The description of the proposed project is based on information provided to ECS by Timmons Group. If any of this information is inaccurate or changes, either because of our interpretation of the documents provided or site or design changes that may occur later, ECS should be contacted so we can review our recommendations and provide additional or alternate recommendations that reflect the proposed construction.

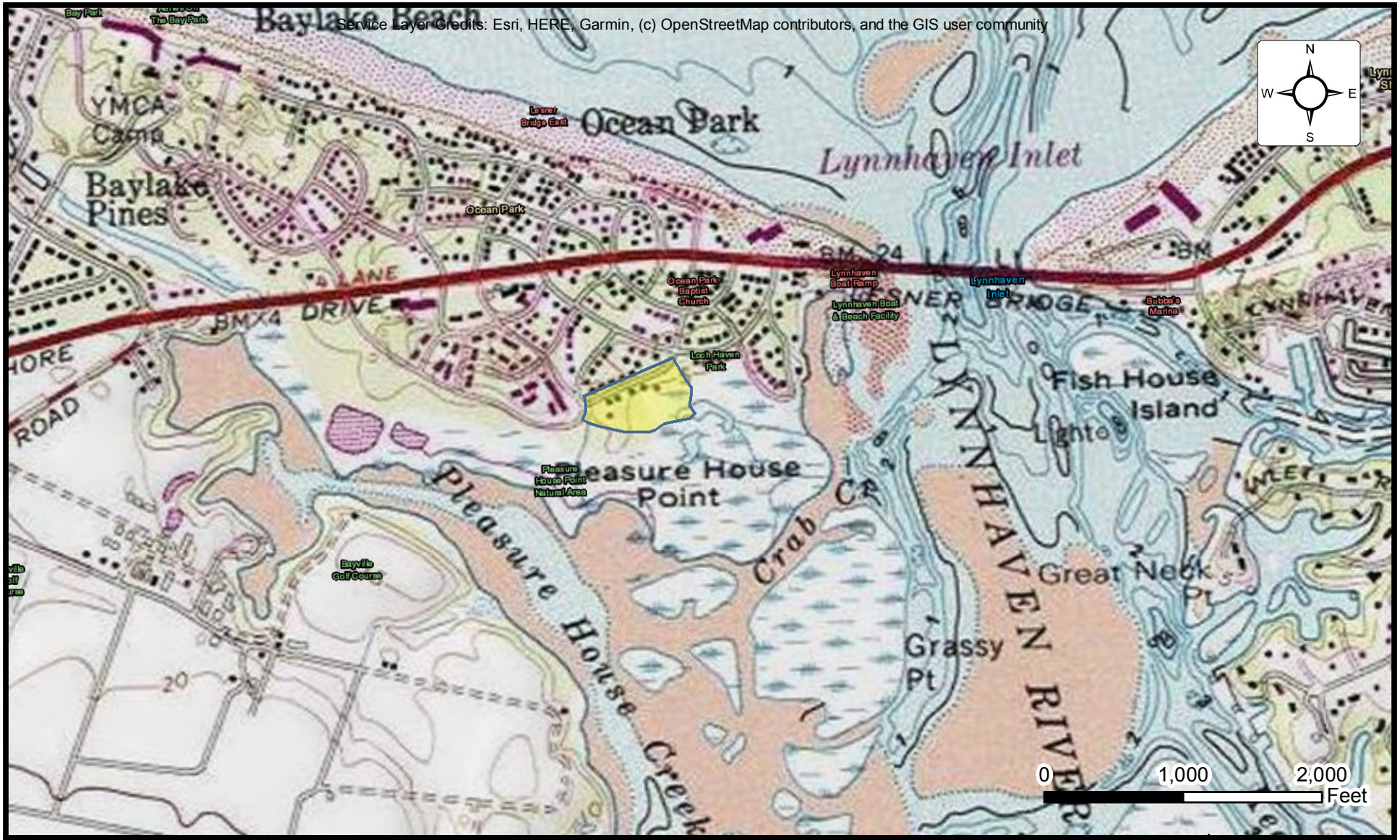
We recommend that ECS review the project plans and specifications so we can confirm that those plans/specifications are in accordance with the recommendations of this geotechnical report.

Field observations and quality assurance testing during earthwork and foundation installation are an extension of, and integral to, the geotechnical design. We recommend that ECS be retained to apply our expertise throughout the geotechnical phases of construction, and to provide consultation and recommendation should issues arise.

ECS is not responsible for the conclusions, opinions, or recommendations of others based on the data in this report.

APPENDIX A – Drawings

Site Location Diagram
Boring Location Diagram
Subsurface Profile



SITE LOCATION DIAGRAM
MARLIN BAY DRIVE SITE IMPROVEMENT

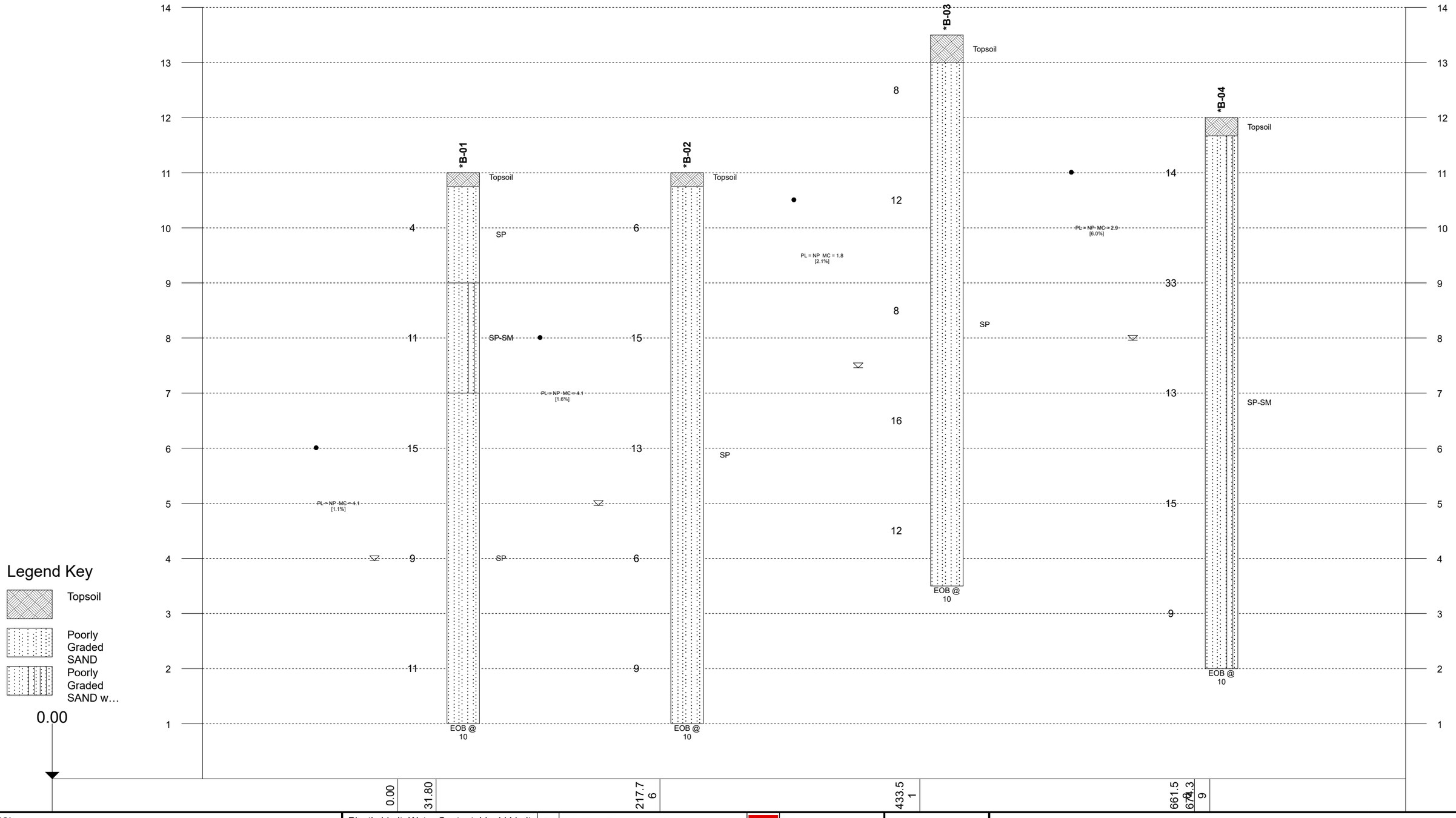
MARLIN BAY DRIVE, VIRGINIA BEACH, VIRGINIA
TIMMONS GROUP

ENGINEER	JBM4
SCALE	AS NOTED
PROJECT NO.	04:12065
FIGURE	1 OF 1
DATE	11/10/2022

BORING LOCATION DIAGRAM
MARLIN BAY DRIVE SITE IMPROVEMENT

MARLIN BAY DRIVE, VIRGINIA BEACH, VIRGINIA
TIMMONS GROUP

ENGINEER	JBM4
SCALE	AS NOTED
PROJECT NO.	04:12065
FIGURE	1 OF 1
DATE	11/10/2022



Notes:

1- EOB: END OF BORING AR: AUGER REFUSAL SR: SAMPLER REFUSAL.
2- THE NUMBER BELOW THE STRIPS IS THE DISTANCE ALONG THE BASELINE.
3- SEE INDIVIDUAL BORING LOG AND GEOTECHNICAL INFORMATION.
4- STANDARD PENETRATION TEST RESISTANCE (LEFT OF BORING) IN BLOWS PER FOOT (ASTM D1586).

Plastic Limit Water Content Liquid Limit
X———●———△
[FINES CONTENT%]
BOTTOM OF CASING
100 LOSS OF CIRCULATION

WL (First Encountered)		Fill	
WL (Completion)		Possible Fill	
WL (Estimated Seasonal High Water)		Probable Fill	
WL (Stabilized)		Rock	

ECS

GENERALIZED SUBSURFACE SOIL PROFILE Section line 1

Marlin Bay Drive Site Improvement
Timmons Group
Marlin Bay Drive, VIRGINIA BEACH, Virginia, 23454

Project No:	04:12065	Date:	11/10/2022

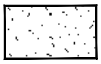
APPENDIX B – Field Operations

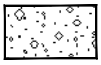
Reference Notes for Boring Logs
Subsurface Exploration Procedure: SPT
Boring Logs B-01 through B-04

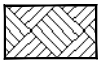
REFERENCE NOTES FOR BORING LOGS

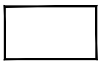
MATERIAL[1,2]

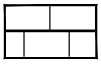

ASPHALT


CONCRETE


GRAVEL

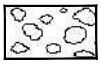

TOPSOIL

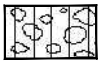

VOID


BRICK

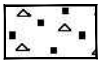

AGGREGATE BASE COURSE

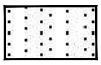

GW **WELL-GRADED GRAVEL**
gravel-sand mixtures, little or no fines

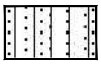

GP **POORLY-GRADED GRAVEL**
gravel-sand mixtures, little or no fines


GM **SILTY GRAVEL**
gravel-sand-silt mixtures

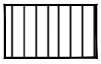

GC **CLAYEY GRAVEL**
gravel-sand-clay mixtures

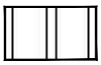

SW **WELL-GRADED SAND**
gravelly sand, little or no fines

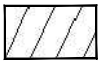

SP **POORLY-GRADED SAND**
gravelly sand, little or no fines


SM **SILTY SAND**
sand-silt mixtures

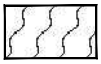

SC **CLAYEY SAND**
sand-clay mixtures

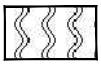

ML **SILT**
non-plastic to medium plasticity

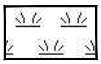

MH **ELASTIC SILT**
high plasticity


CL **LEAN CLAY**
low to medium plasticity


CH **FAT CLAY**
high plasticity


OL **ORGANIC SILT or CLAY**
non-plastic to low plasticity


OH **ORGANIC SILT or CLAY**
high plasticity


PT **PEAT**
highly organic soils

DRILLING SAMPLING SYMBOLS & ABBREVIATIONS

SS	Split Spoon Sampler	PM	Pressuremeter Test
ST	Shelby Tube Sampler	RD	Rock Bit Drilling
WS	Wash Sample	RC	Rock Core, NX, BX, AX
BS	Bulk Sample of Cuttings	REC	Rock Sample Recovery %
PA	Power Auger (no sample)	RQD	Rock Quality Designation %
HSA	Hollow Stem Auger		

PARTICLE SIZE IDENTIFICATION

DESIGNATION		PARTICLE SIZES
Boulders		12 inches (300 mm) or larger
Cobbles		3 inches to 12 inches (75 mm to 300 mm)
Gravel:	Coarse	¾ inch to 3 inches (19 mm to 75 mm)
	Fine	4.75 mm to 19 mm (No. 4 sieve to ¾ inch)
Sand:	Coarse	2.00 mm to 4.75 mm (No. 10 to No. 4 sieve)
	Medium	0.425 mm to 2.00 mm (No. 40 to No. 10 sieve)
	Fine	0.074 mm to 0.425 mm (No. 200 to No. 40 sieve)
Silt & Clay ("Fines")		<0.074 mm (smaller than a No. 200 sieve)

COHESIVE SILTS & CLAYS

UNCONFINED COMPRESSIVE STRENGTH, Q_P[4]	SPT[5] (BPF)	CONSISTENCY[7] (COHESIVE)
<0.25	<2	Very Soft
0.25 - <0.50	2 - 4	Soft
0.50 - <1.00	5 - 8	Firm
1.00 - <2.00	9 - 15	Stiff
2.00 - <4.00	16 - 30	Very Stiff
4.00 - 8.00	31 - 50	Hard
>8.00	>50	Very Hard

GRAVELS, SANDS & NON-COHESIVE SILTS

SPT[5]	DENSITY
<5	Very Loose
5 - 10	Loose
11 - 30	Medium Dense
31 - 50	Dense
>50	Very Dense

RELATIVE AMOUNT[7]	COARSE GRAINED (%)[8]	FINE GRAINED (%)[8]
Trace	≤5	≤5
With	10 - 20	10 - 25
Adjective *(ex: "Silty")*	25 - 45	30 - 45

WATER LEVELS[6]

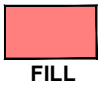

WL (First Encountered)


WL (Completion)


WL (Seasonal High Water)


WL (Stabilized)

FILL AND ROCK


FILL


POSSIBLE FILL


PROBABLE FILL


ROCK

[1]Classifications and symbols per ASTM D 2488-17 (Visual-Manual Procedure) unless noted otherwise.

[2]To be consistent with general practice, "POORLY GRADED" has been removed from GP, GP-GM, GP-GC, SP, SP-SM, SP-SC soil types on the boring logs.

[3]Non-ASTM designations are included in soil descriptions and symbols along with ASTM symbol [Ex: (SM-FILL)].

[4]Typically estimated via pocket penetrometer or Torvane shear test and expressed in tons per square foot (tsf).

[5]Standard Penetration Test (SPT) refers to the number of hammer blows (blow count) of a 140 lb. hammer falling 30 inches on a 2 inch OD split spoon sampler required to drive the sampler 12 inches (ASTM D 1586). "N-value" is another term for "blow count" and is expressed in blows per foot (bpf). SPT correlations per 7.4.2 Method B and need to be corrected if using an auto hammer.

[6]The water levels are those levels actually measured in the borehole at the times indicated by the symbol. The measurements are relatively reliable when augering, without adding fluids, in granular soils. In clay and cohesive silts, the determination of water levels may require several days for the water level to stabilize. In such cases, additional methods of measurement are generally employed.

[7]Minor deviation from ASTM D 2488-17 Note 14.

[8]Percentages are estimated to the nearest 5% per ASTM D 2488-17.

SUBSURFACE EXPLORATION PROCEDURE: STANDARD PENETRATION TESTING (SPT) ASTM D 1586 Split-Barrel Sampling

Standard Penetration Testing, or **SPT**, is the most frequently used subsurface exploration test performed worldwide. This test provides samples for identification purposes, as well as a measure of penetration resistance, or N-value. The N-Value, or blow counts, when corrected and correlated, can approximate engineering properties of soils used for geotechnical design and engineering purposes.

SPT Procedure:

- Involves driving a hollow tube (split-spoon) into the ground by dropping a 140-lb hammer a height of 30-inches at desired depth
- Recording the number of hammer blows required to drive split-spoon a distance of 12 inches (in 3 or 4 Increments of 6 inches each)

- Auger is advanced* and an additional SPT is performed
- One SPT test is typically performed for every two to five feet

- Obtain two-inch diameter soil sample

**Drilling Methods May Vary—* The predominant drilling methods used for SPT are open hole fluid rotary drilling and hollow-stem auger drilling.

CLIENT:	PROJECT NO.:	BORING NO.:	SHEET:
Timmons Group	**04:12065**	**B-01**	**1 of 1**
PROJECT NAME:	DRILLER/CONTRACTOR:		
Marlin Bay Drive Site Improvement	**Fishburne Drilling, Inc.**		
SITE LOCATION: **Marlin Bay Drive, VIRGINIA BEACH, Virginia, 23454**			LOSS OF CIRCULATION
NORTHING: **3497844.6**	EASTING: **12184163.7**	STATION:	SURFACE ELEVATION: **11.00**	BOTTOM OF CASING

DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
0	S-1	SS	24	16	Topsoil Thickness[3.00"] (SP) Alluvium, FINE SAND, light brown, moist, very loose		11	1-1-3-3 (4)
	S-2	SS	24	18	(SP-SM) FINE SAND WITH SILT, brown, moist, medium dense			4-5-6-8 (11)
5	S-3	SS	24	16	(SP) FINE TO MEDIUM SAND, light brown to light gray, moist to wet, medium dense to loose to medium dense		6	4-7-8-7 (15)
	S-4	SS	24	18		▽		6-5-4-6 (9)
	S-5	SS	24	18				4-5-6-6 (11)
10					**END OF BORING AT 10 FT**		1	
15							-4	
20							-9	
25							-14	
30							-19	

STANDARD PENETRATION BLOWS/FT: 20 40 60 80 100
ROCK QUALITY DESIGNATION & RECOVERY: RQD, REC
LIQUID LIMIT, PLASTIC LIMIT
CALIBRATED PENETROMETER TSF: 1 2 3 4 5
WATER CONTENT % [FINES CONTENT] %: 10 20 30 40 50
[1.1%]

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

▽ WL (First Encountered) **7.00**	BORING STARTED: **Nov 01 2022**	CAVE IN DEPTH:	
▼ WL (Completion)	BORING COMPLETED: **Nov 01 2022**	HAMMER TYPE: **Auto**	
▼ WL (Seasonal High Water)	EQUIPMENT: **Track**	LOGGED BY: **BND**	DRILLING METHOD: **Mud rotary**
▽ WL (Stabilized)			

GEOTECHNICAL BOREHOLE LOG

CLIENT:	PROJECT NO.:	BORING NO.:	SHEET:
Timmons Group	**04:12065**	**B-02**	**1 of 1**
PROJECT NAME:	DRILLER/CONTRACTOR:		
Marlin Bay Drive Site Improvement	**Fishburne Drilling, Inc.**		
SITE LOCATION: **Marlin Bay Drive, VIRGINIA BEACH, Virginia, 23454**			LOSS OF CIRCULATION
NORTHING: **3497809.6**	EASTING: **12184349.2**	STATION:	SURFACE ELEVATION: **11.00**
			BOTTOM OF CASING

DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
0	S-1	SS	24	20	Topsoil Thickness[3.00"] (SP) Alluvium, FINE SAND, tan to light gray, moist to wet, loose to medium dense to loose	▽	11	2-3-3-4 (6)
	S-2	SS	24	16				4-7-8-10 (15)
5	S-3	SS	24	18			6	5-6-7-5 (13)
	S-4	SS	24	16				4-3-3-3 (6)
	S-5	SS	24	24				2-4-5-7 (9)
10					**END OF BORING AT 10 FT**		1	
15							-4	
20							-9	
25							-14	
30							-19	

STANDARD PENETRATION BLOWS/FT (20 40 60 80 100)
ROCK QUALITY DESIGNATION & RECOVERY
RQD
REC

LIQUID LIMIT
PLASTIC LIMIT
CALIBRATED PENETROMETER TSF (1 2 3 4 5)
WATER CONTENT %
[FINES CONTENT] %
(10 20 30 40 50)

6 15 13 6 9

4.1 [1.6%]

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

▽ WL (First Encountered) **6.00**	BORING STARTED: **Nov 01 2022**		CAVE IN DEPTH:
▼ WL (Completion)	BORING COMPLETED: **Nov 01 2022**		HAMMER TYPE: **Auto**
▼ WL (Seasonal High Water)	EQUIPMENT: **Track**	LOGGED BY: **BND**	DRILLING METHOD: **Mud rotary**
▽ WL (Stabilized)			

GEOTECHNICAL BOREHOLE LOG

CLIENT:	PROJECT NO.:	BORING NO.:	SHEET:
Timmons Group	**04:12065**	**B-03**	**1 of 1**
PROJECT NAME:	DRILLER/CONTRACTOR:		
Marlin Bay Drive Site Improvement	**Fishburne Drilling, Inc.**		
SITE LOCATION:			LOSS OF CIRCULATION
Marlin Bay Drive, VIRGINIA BEACH, Virginia, 23454			
NORTHING:	EASTING:	STATION:	SURFACE ELEVATION:
3497811.4	**12184565.0**		**13.50**

BOTTOM OF CASING

DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
0	S-1	SS	24	16	Topsoil Thickness[6.00"] (SP) Alluvium, FINE TO MEDIUM SAND, brown to white to gray- brown, moist to wet, loose to medium dense to loose to medium dense	▽	13.5	3-4-4-5 (8)
	S-2	SS	24	20				5-6-6-7 (12)
5	S-3	SS	24	14			9	7-3-5-9 (8)
	S-4	SS	24	18				5-9-7-6 (16)
	S-5	SS	24	16			4	5-7-5-3 (12)
10					**END OF BORING AT 10 FT**			
15							-1	
20							-6	
25							-11	
30							-16	

STANDARD PENETRATION BLOWS/FT (20 40 60 80 100)
ROCK QUALITY DESIGNATION & RECOVERY
RQD
REC

LIQUID LIMIT
PLASTIC LIMIT
CALIBRATED PENETROMETER TSF (1 2 3 4 5)
WATER CONTENT %
[FINES CONTENT] %
(10 20 30 40 50)
[2.1%]

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

▽ WL (First Encountered) **6.00**	BORING STARTED: **Nov 01 2022**	CAVE IN DEPTH:	
▼ WL (Completion)	BORING COMPLETED: **Nov 01 2022**	HAMMER TYPE: **Auto**	
▼ WL (Seasonal High Water)	EQUIPMENT: **Track**	LOGGED BY: **BND**	DRILLING METHOD: **Mud rotary**
▽ WL (Stabilized)			

GEOTECHNICAL BOREHOLE LOG

CLIENT:	PROJECT NO.:	BORING NO.:	SHEET:
Timmons Group	**04:12065**	**B-04**	**1 of 1**
PROJECT NAME:	DRILLER/CONTRACTOR:		
Marlin Bay Drive Site Improvement	**Fishburne Drilling, Inc.**		
SITE LOCATION: **Marlin Bay Drive, VIRGINIA BEACH, Virginia, 23454**			LOSS OF CIRCULATION
NORTHING: **3497848.2**	EASTING: **12184793.6**	STATION:	SURFACE ELEVATION: **12.00**	BOTTOM OF CASING

DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
0	S-1	SS	24	16	Topsoil Thickness[4.00"] (SP-SM) Alluvium, FINE SAND WITH SILT, tan to light gray, moist to wet, medium dense to dense to medium dense to loose	▽	12	1-4-10-11 (14)
	S-2	SS	24	16				9-16-17-24 (33)
5	S-3	SS	24	12			7	6-9-4-2 (13)
	S-4	SS	24	24				5-8-7-6 (15)
	S-5	SS	24	18				4-5-4-3 (9)
10					**END OF BORING AT 10 FT**		2	
15							-3	
20							-8	
25							-13	
30							-18	

STANDARD PENETRATION BLOWS/FT (20 40 60 80 100)
ROCK QUALITY DESIGNATION & RECOVERY
RQD
REC
14
33
13
15
9

LIQUID LIMIT
PLASTIC LIMIT
CALIBRATED PENETROMETER TSF (1 2 3 4 5)
WATER CONTENT %
[FINES CONTENT] %
(10 20 30 40 50)
2.9
[6.0%]

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

▽ WL (First Encountered) **4.00**	BORING STARTED: **Nov 01 2022**	CAVE IN DEPTH:	
▼ WL (Completion)	BORING COMPLETED: **Nov 01 2022**	HAMMER TYPE: **Auto**	
▼ WL (Seasonal High Water)	EQUIPMENT: **Track**	LOGGED BY: **BND**	DRILLING METHOD: **Mud rotary**
▽ WL (Stabilized)			

GEOTECHNICAL BOREHOLE LOG

APPENDIX C – Laboratory Data

Laboratory Test Results Summary
Grain Size Analysis Test Results
Atterberg Limits Results
Standard Proctor Test Results
CBR Test Results

Laboratory Testing Summary

Sample Location	Sample Number	Depth (feet)	^MC (%)	Soil Type	Atterberg Limits			**Percent Passing No. 200 Sieve	Moisture - Density		CBR (%)		#Organic Content (%)
					LL	PL	PI		<Maximum Density (pcf)	<Optimum Moisture (%)	0.1 in.	0.2 in.	
B-01	Bulk	0-4	4.2	SP	NP	NP	NP	1.2	104.7	13.2	30.0	25.1	
B-01	S-3	4-6	4.1	SP	NP	NP	NP	1.1					
B-02	S-2	2-4	4.1	SP	NP	NP	NP	1.6					
B-03	Bulk	0-4	4.2	SP	NP	NP	NP	2.5	107.1	14.0	30.3	18.4	
B-03	S-2	2-4	1.8	SP	NP	NP	NP	2.1					
B-04	S-1	0-2	2.9	SP-SM	NP	NP	NP	6.0					

Notes: See test reports for test method, ^ASTM D2216-19, *ASTM D2488, **ASTM D1140-17, #ASTM D2974-20e1 < See test report for D4718 corrected values

Definitions: MC: Moisture Content, Soil Type: USCS (Unified Soil Classification System), LL: Liquid Limit, PL: Plastic Limit, PI: Plasticity Index, CBR: California Bearing Ratio, OC: Organic Content

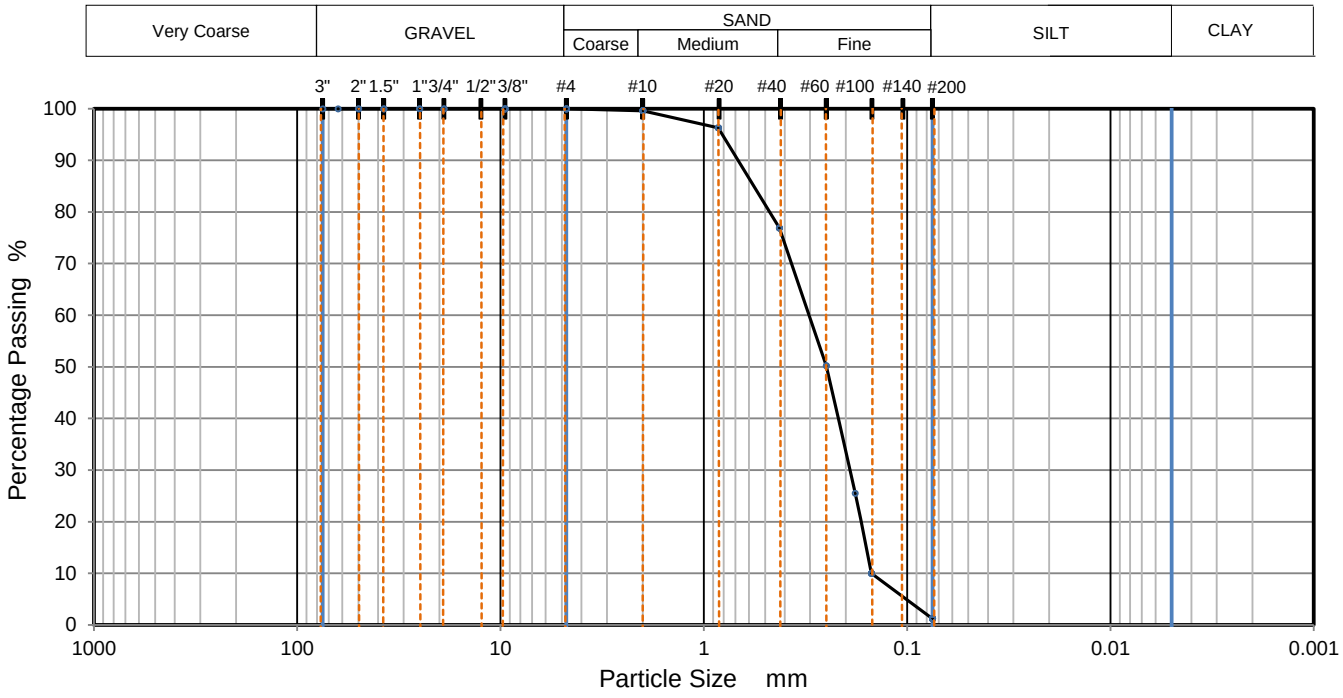
Project: Marlin Bay Drive Site Improvement
Client: Timmons Group

Project No.: 04:12065
Date Reported: 11/9/2022

Office / Lab	Address	Office Number / Fax
ECS Mid-Atlantic LLC - Chesapeake	804 Professional Place West Chesapeake, VA 23320	(757)366-5100 (757)366-5203

Tested by	Checked by	Approved by	Date Received
Technician	JMonnikendam	JMonnikendam	11/9/2022

PARTICLE SIZE DISTRIBUTION



TEST RESULTS (ASTM D6913M-17-METHOD A)

Sieving		Hydrometer Sedimentation	
Particle Size	% Passing	Particle Size mm	% Passing
3"	100		
2.5"	100		
2"	100		
1 1/2"	100		
1"	100		
3/4"	100		
3/8"	100		
#4	100		
#10	100		
#20	96		
#40	77		
#60	50		
#80	26		
#100	10		
#200	1		

Dry Mass of sample, g	137.4

Sample Proportions	% dry mass
Very coarse, >3" sieve	0
Gravel, 3" to # 4 sieve	0
Coarse Sand, #4 to #10 sieve	0
Medium Sand, #10 to #40	23
Fine Sand, #40 to #200	76
Fines <#200	1

USCS	SP	Liquid Limit	NP	D90	0.679	D50	0.249	D10	0.150
AASHTO	A-3	Plastic Limit	NP	D85	0.568	D30	0.191	Cu	2.025
USCS Group Name	Poorly graded sand	Plasticity Index	NP	D60	0.304	D15	0.159	Cc	0.801

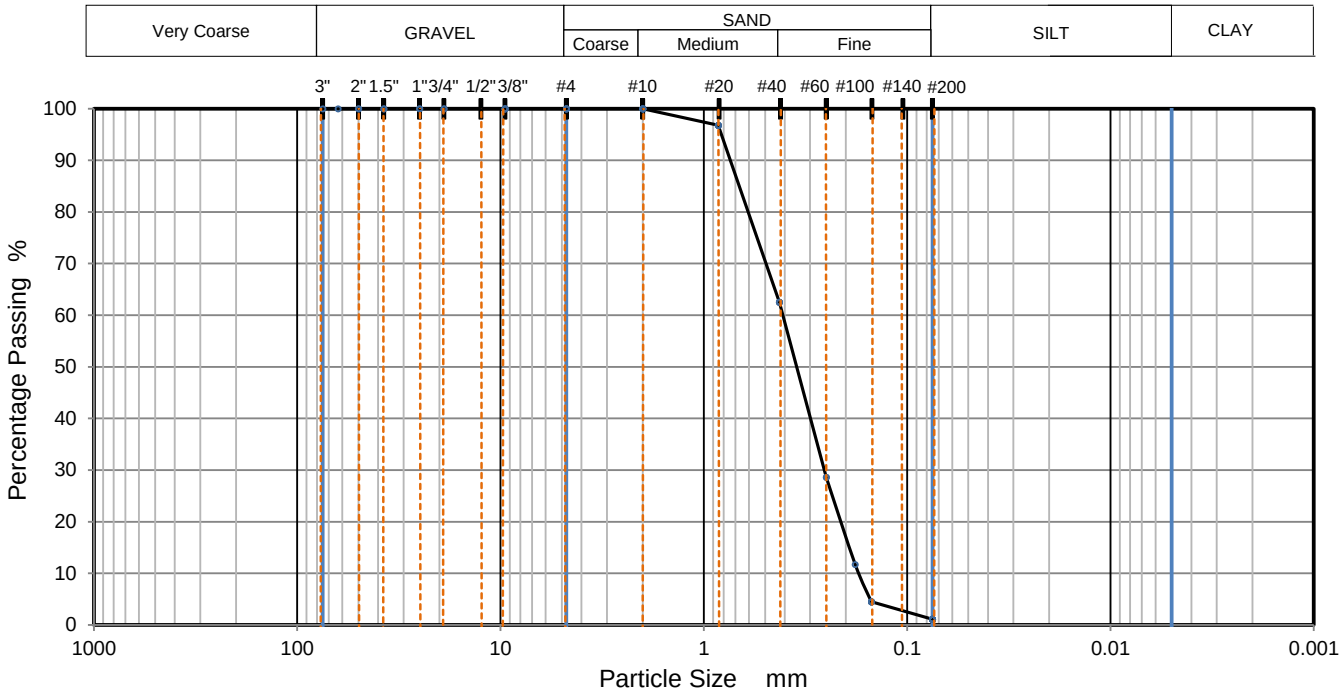
Project: Marlin Bay Drive Site Improvement
Client: Timmons Group
Sample Description: (SP) FINE TO MEDIUM SAND, light brown
Sample Source: B-01

Project No.: 04:12065
Depth (ft): 0 - 4
Sample No.: D3S-21
Date Reported: 11/9/2022

Office / Lab	Address	Office Number / Fax
ECS Mid-Atlantic LLC - Chesapeake	804 Professional Place West Chesapeake, VA 23320	(757)366-5100 (757)366-5203

Tested by	Checked by	Approved by	Date Received	Remarks
Technician	JMonnikendam	JMonnikendam	11/9/2022	

PARTICLE SIZE DISTRIBUTION



TEST RESULTS (ASTM D6913M-17-METHOD A)

Sieving		Hydrometer Sedimentation	
Particle Size	% Passing	Particle Size mm	% Passing
3"	100		
2.5"	100		
2"	100		
1 1/2"	100		
1"	100		
3/4"	100		
3/8"	100		
#4	100		
#10	100		
#20	97		
#40	63		
#60	29		
#80	12		
#100	5		
#200	1		

Dry Mass of sample, g	136.9

Sample Proportions	% dry mass
Very coarse, >3" sieve	0
Gravel, 3" to # 4 sieve	0
Coarse Sand, #4 to #10 sieve	0
Medium Sand, #10 to #40	38
Fine Sand, #40 to #200	61
Fines <#200	1

USCS	SP	Liquid Limit	NP	D90	0.741	D50	0.350	D10	0.172
AASHTO	A-3	Plastic Limit	NP	D85	0.670	D30	0.256	Cu	2.371
USCS Group Name	Poorly graded sand	Plasticity Index	NP	D60	0.409	D15	0.192	Cc	0.926

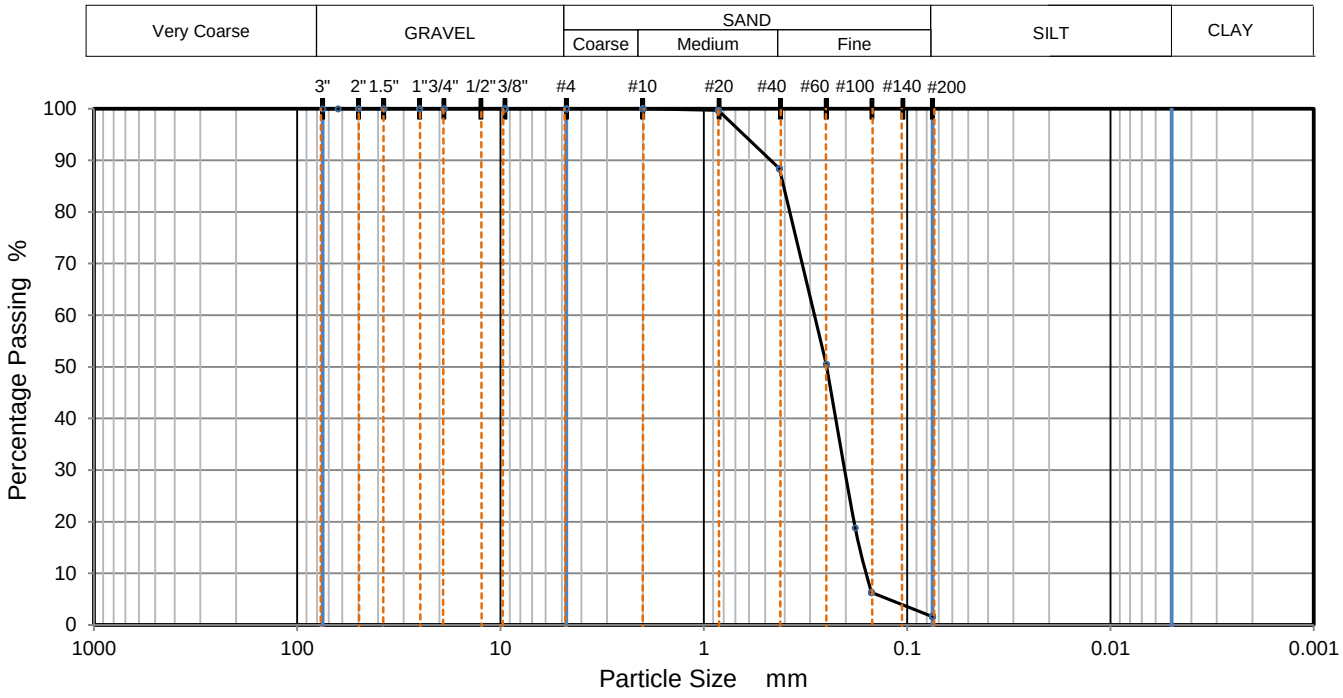
Project: Marlin Bay Drive Site Improvement
Client: Timmons Group
Sample Description: (SP) FINE TO MEDIUM SAND, light brown
Sample Source: B-01

Project No.: 04:12065
Depth (ft): 4 - 6
Sample No.: S-3
Date Reported: 11/9/2022

Office / Lab	Address	Office Number / Fax
ECS Mid-Atlantic LLC - Chesapeake	804 Professional Place West Chesapeake, VA 23320	(757)366-5100 (757)366-5203

Tested by	Checked by	Approved by	Date Received	Remarks
Technician	JMonnikendam	JMonnikendam	11/9/2022	

PARTICLE SIZE DISTRIBUTION



TEST RESULTS (ASTM D6913M-17-METHOD A)

Sieving		Hydrometer Sedimentation	
Particle Size	% Passing	Particle Size mm	% Passing
3"	100		
2.5"	100		
2"	100		
1 1/2"	100		
1"	100		
3/4"	100		
3/8"	100		
#4	100		
#10	100		
#20	100		
#40	88		
#60	51		
#80	19		
#100	6		
#200	2		

Dry Mass of sample, g	137.5

Sample Proportions	% dry mass
Very coarse, >3" sieve	0
Gravel, 3" to # 4 sieve	0
Coarse Sand, #4 to #10 sieve	0
Medium Sand, #10 to #40	12
Fine Sand, #40 to #200	87
Fines <#200	2

USCS	SP	Liquid Limit	NP	D90	0.469	D50	0.249	D10	0.158
AASHTO	A-3	Plastic Limit	NP	D85	0.405	D30	0.202	Cu	1.804
USCS Group Name	Poorly graded sand	Plasticity Index	NP	D60	0.286	D15	0.170	Cc	0.904

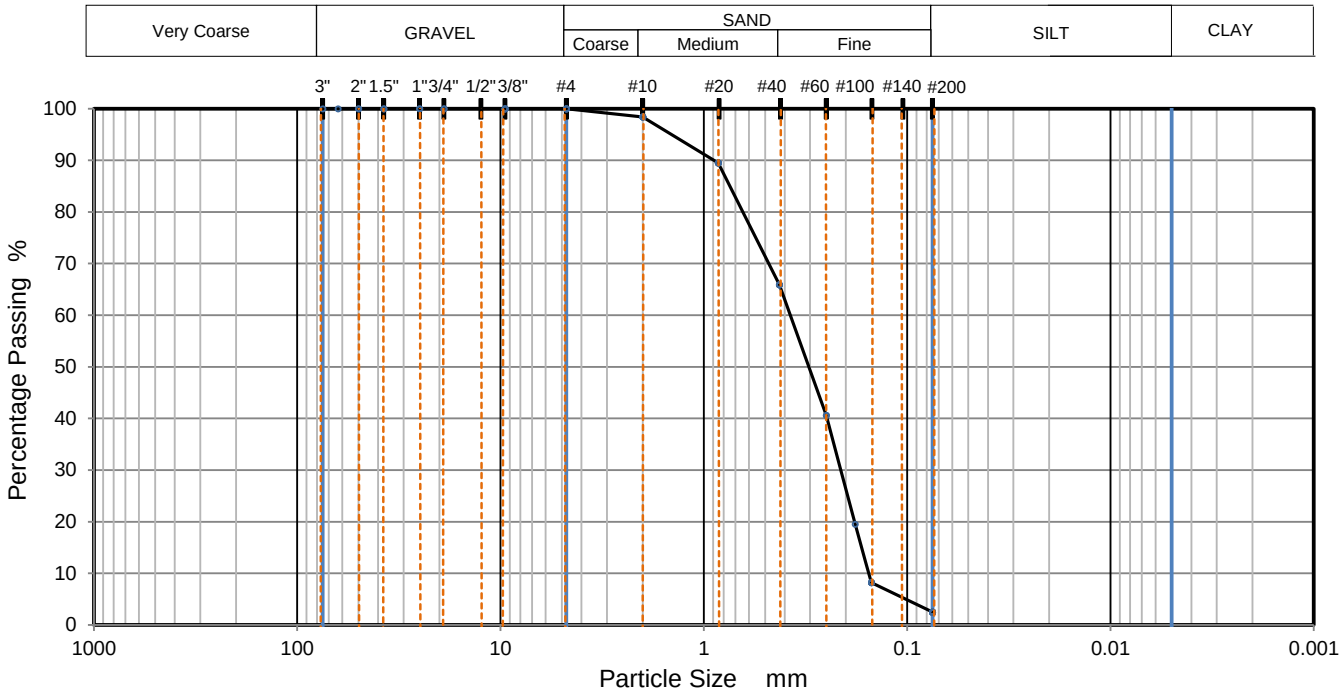
Project: Marlin Bay Drive Site Improvement
Client: Timmons Group
Sample Description: (SP) FINE SAND, tan
Sample Source: B-02

Project No.: 04:12065
Depth (ft): 2 - 4
Sample No.: S-2
Date Reported: 11/9/2022

Office / Lab	Address	Office Number / Fax
ECS Mid-Atlantic LLC - Chesapeake	804 Professional Place West Chesapeake, VA 23320	(757)366-5100 (757)366-5203

Tested by	Checked by	Approved by	Date Received	Remarks
Technician	JMonnikendam	JMonnikendam	11/9/2022	

PARTICLE SIZE DISTRIBUTION



TEST RESULTS (ASTM D6913M-17-METHOD A)

Sieving		Hydrometer Sedimentation	
Particle Size	% Passing	Particle Size mm	% Passing
3"	100		
2.5"	100		
2"	100		
1 1/2"	100		
1"	100		
3/4"	100		
3/8"	100		
#4	100		
#10	98		
#20	90		
#40	66		
#60	41		
#80	20		
#100	8		
#200	3		

Dry Mass of sample, g	133.6

Sample Proportions	% dry mass
Very coarse, >3" sieve	0
Gravel, 3" to # 4 sieve	0
Coarse Sand, #4 to #10 sieve	2
Medium Sand, #10 to #40	33
Fine Sand, #40 to #200	63
Fines <#200	3

USCS	SP	Liquid Limit	NP	D90	0.892	D50	0.305	D10	0.154
AASHTO	A-3	Plastic Limit	NP	D85	0.745	D30	0.212	Cu	2.432
USCS Group Name	Poorly graded sand	Plasticity Index	NP	D60	0.376	D15	0.167	Cc	0.775

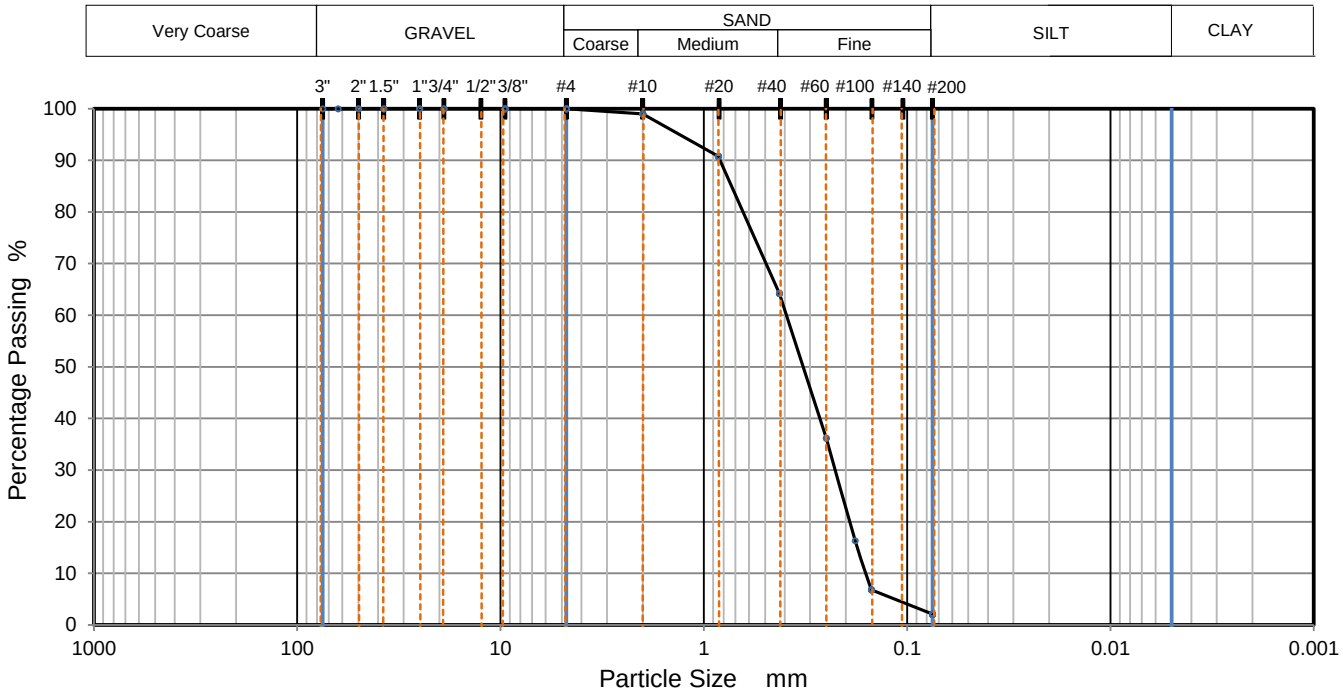
Project: Marlin Bay Drive Site Improvement
Client: Timmons Group
Sample Description: (SP) FINE TO MEDIUM SAND, light brown
Sample Source: B-03

Project No.: 04:12065
Depth (ft): 0 - 4
Sample No.: D3S-22
Date Reported: 11/9/2022

Office / Lab	Address	Office Number / Fax
ECS Mid-Atlantic LLC - Chesapeake	804 Professional Place West Chesapeake, VA 23320	(757)366-5100 (757)366-5203

Tested by	Checked by	Approved by	Date Received	Remarks
Technician	JMonnikendam	JMonnikendam	11/9/2022	

PARTICLE SIZE DISTRIBUTION



TEST RESULTS (ASTM D6913M-17-METHOD A)

Sieving		Hydrometer Sedimentation	
Particle Size	% Passing	Particle Size mm	% Passing
3"	100		
2.5"	100		
2"	100		
1 1/2"	100		
1"	100		
3/4"	100		
3/8"	100		
#4	100		
#10	99		
#20	91		
#40	64		
#60	36		
#80	16		
#100	7		
#200	2		

Dry Mass of sample, g	137.7

Sample Proportions	% dry mass
Very coarse, >3" sieve	0
Gravel, 3" to # 4 sieve	0
Coarse Sand, #4 to #10 sieve	1
Medium Sand, #10 to #40	35
Fine Sand, #40 to #200	62
Fines <#200	2

USCS	SP	Liquid Limit	NP	D90	0.833	D50	0.325	D10	0.160
AASHTO	A-3	Plastic Limit	NP	D85	0.731	D30	0.226	Cu	2.461
USCS Group Name	Poorly graded sand	Plasticity Index	NP	D60	0.393	D15	0.176	Cc	0.814

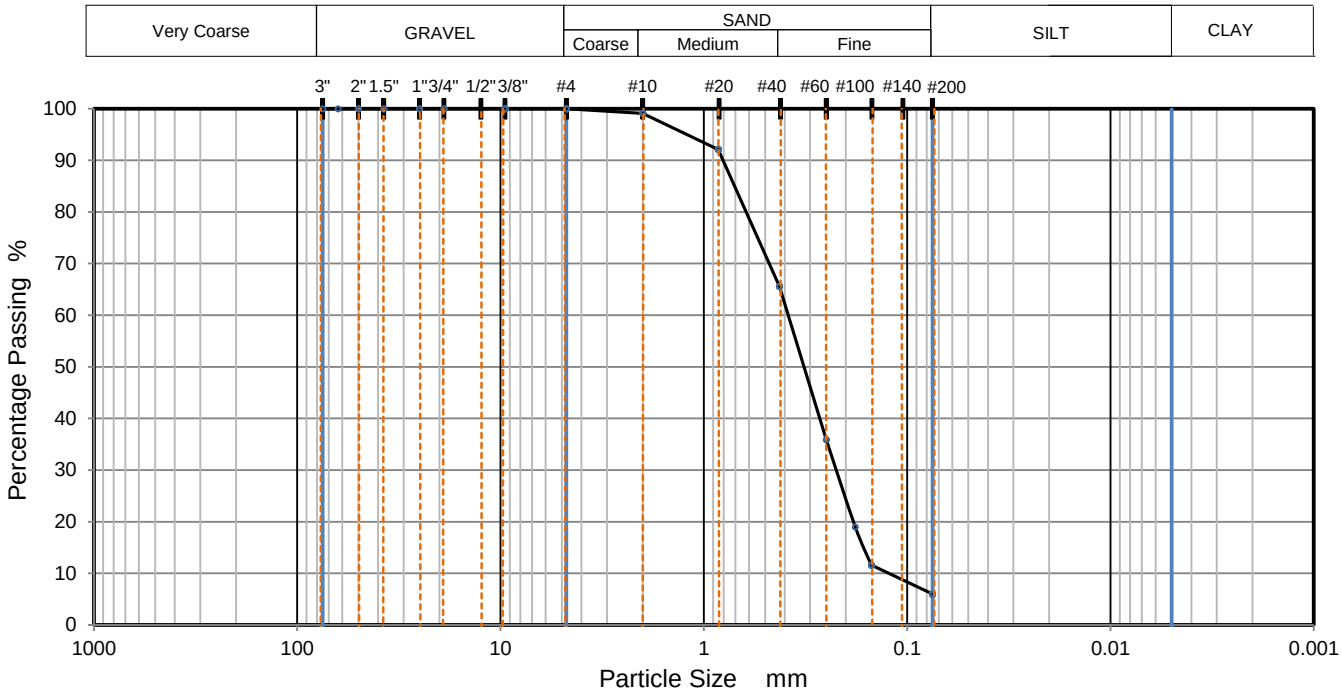
Project: Marlin Bay Drive Site Improvement
Client: Timmons Group
Sample Description: (SP) FINE TO MEDIUM SAND, brown
Sample Source: B-03

Project No.: 04:12065
Depth (ft): 2 - 4
Sample No.: S-2
Date Reported: 11/9/2022

Office / Lab	Address	Office Number / Fax
ECS Mid-Atlantic LLC - Chesapeake	804 Professional Place West Chesapeake, VA 23320	(757)366-5100 (757)366-5203

Tested by	Checked by	Approved by	Date Received	Remarks
Technician	JMonnikendam	JMonnikendam	11/9/2022	

PARTICLE SIZE DISTRIBUTION



TEST RESULTS (ASTM D6913M-17-METHOD A)

Sieving		Hydrometer Sedimentation	
Particle Size	% Passing	Particle Size mm	% Passing
3"	100		
2.5"	100		
2"	100		
1 1/2"	100		
1"	100		
3/4"	100		
3/8"	100		
#4	100		
#10	99		
#20	92		
#40	66		
#60	36		
#80	19		
#100	12		
#200	6		

Dry Mass of sample, g	127.5

Sample Proportions	% dry mass
Very coarse, >3" sieve	0
Gravel, 3" to # 4 sieve	0
Coarse Sand, #4 to #10 sieve	1
Medium Sand, #10 to #40	34
Fine Sand, #40 to #200	60
Fines <#200	6

USCS	SP-SM	Liquid Limit	NP	D90	0.805	D50	0.322	D10	0.123
AASHTO	A-3	Plastic Limit	NP	D85	0.706	D30	0.223	Cu	3.123
USCS Group Name	Poorly graded sand with silt	Plasticity Index	NP	D60	0.385	D15	0.163	Cc	1.050

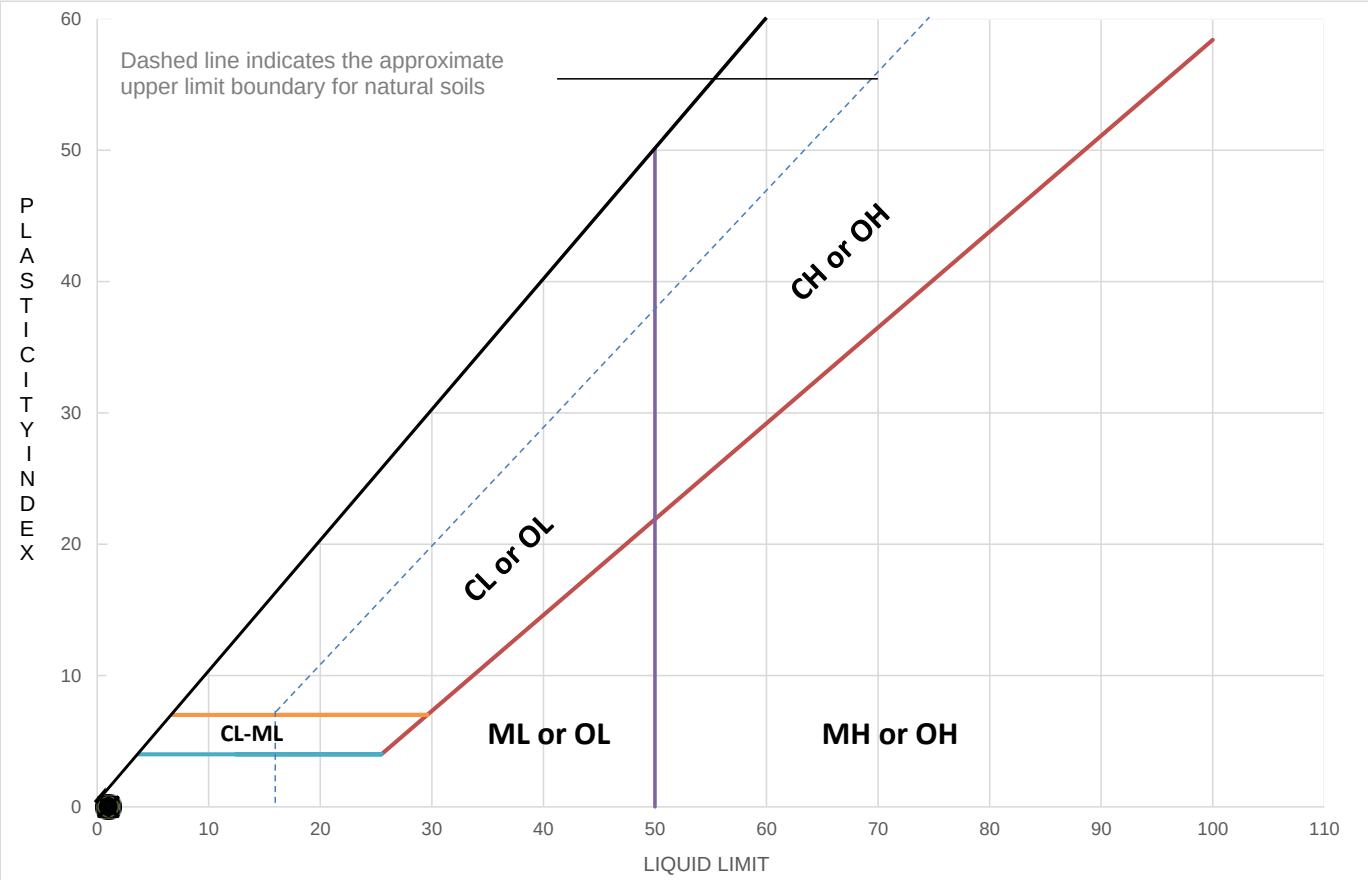
Project: Marlin Bay Drive Site Improvement
Client: Timmons Group
Sample Description: (SP-SM) FINE TO MEDIUM SAND WITH SILT, tan
Sample Source: B-04

Project No.: 04:12065
Depth (ft): 0 - 2
Sample No.: S-1
Date Reported: 11/9/2022

Office / Lab	Address	Office Number / Fax
ECS Mid-Atlantic LLC - Chesapeake	804 Professional Place West Chesapeake, VA 23320	(757)366-5100 (757)366-5203

Tested by	Checked by	Approved by	Date Received	Remarks
Technician	JMonnikendam	JMonnikendam	11/9/2022	

LIQUID AND PLASTIC LIMITS TEST REPORT



TEST RESULTS (ASTM D4318-10 (MULTIPOINT TEST))

	Sample Location	Sample Number	Sample Depth (ft)	LL	PL	PI	%<#40	%<#200	AASHTO	USCS	Material Description
■	B-01	D3S-21	0-4	NP	NP	NP	76.9	1.2	A-3	SP	(SP) FINE TO MEDIUM SAND, light brown
◆	B-01	S-3	4-6	NP	NP	NP	62.5	1.1	A-3	SP	(SP) FINE TO MEDIUM SAND, light brown
▲	B-02	S-2	2-4	NP	NP	NP	88.4	1.6	A-3	SP	(SP) FINE SAND, tan
●	B-03	D3S-22	0-4	NP	NP	NP	65.9	2.5	A-3	SP	(SP) FINE TO MEDIUM SAND, light brown
✳	B-03	S-2	2-4	NP	NP	NP	64.2	2.1	A-3	SP	(SP) FINE TO MEDIUM SAND, brown
⊗	B-04	S-1	0-2	NP	NP	NP	65.6	6.0	A-3	SP-SM	(SP-SM) FINE TO MEDIUM SAND WITH SILT, tan

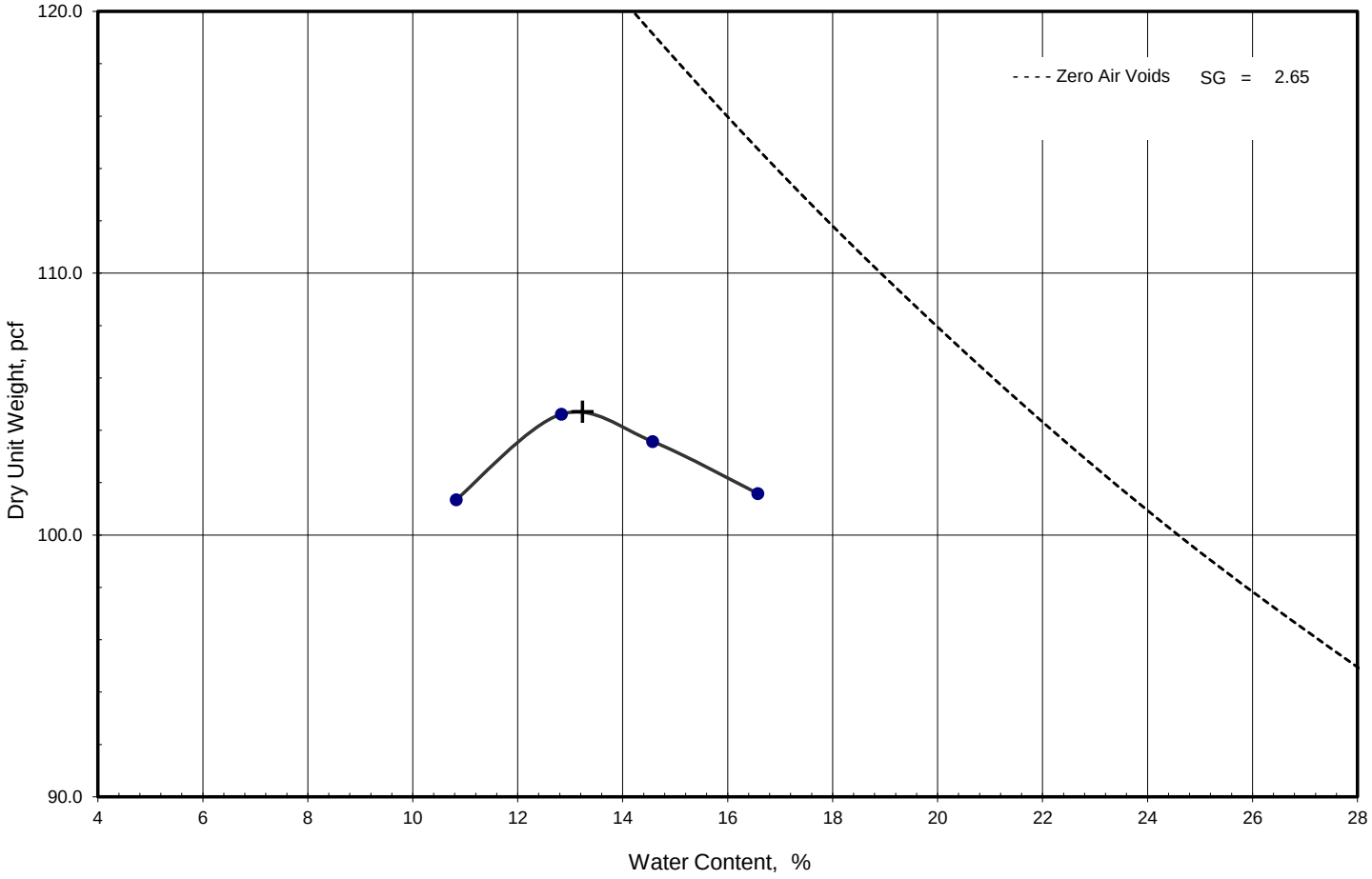
Project: Marlin Bay Drive Site Improvement
Client: Timmons Group

Project No.: 04:12065
Date Reported: 11/9/2022

Office / Lab	Address	Office Number / Fax
ECS Mid-Atlantic LLC - Chesapeake	804 Professional Place West Chesapeake, VA 23320	(757)366-5100 (757)366-5203

Tested by	Checked by	Approved by	Date Received
Technician	JMonnikendam	JMonnikendam	11/9/2022

Laboratory Compaction Characteristics of Soil
Using Standard Effort



Optimum Moisture Content		**13.2**	%
Maximum Dry Unit Weight		**104.7**	pcf
Cumulative material retained on:	3/4 in. sieve	0.0	%
	3/8 in. sieve	0.0	%
	#4 sieve	0.0	%

Preparation	ASTM dry preparation method	
Type of rammer	Manual - 5.5lbf (24.5N)	
Test Specfication / Method	VTM-1	
Specific gravity - D854 water pycnometer	2.65	Historical
Coarse Aggregate Specific Gravity -		

Soil Description	Nat. Moist. %	Liquid Limit	Plasticity Index	%< #200	USCS	AASHTO
(SP) FINE TO MEDIUM SAND, light brown	4.2	NP	NP	1.2	SP	A-3

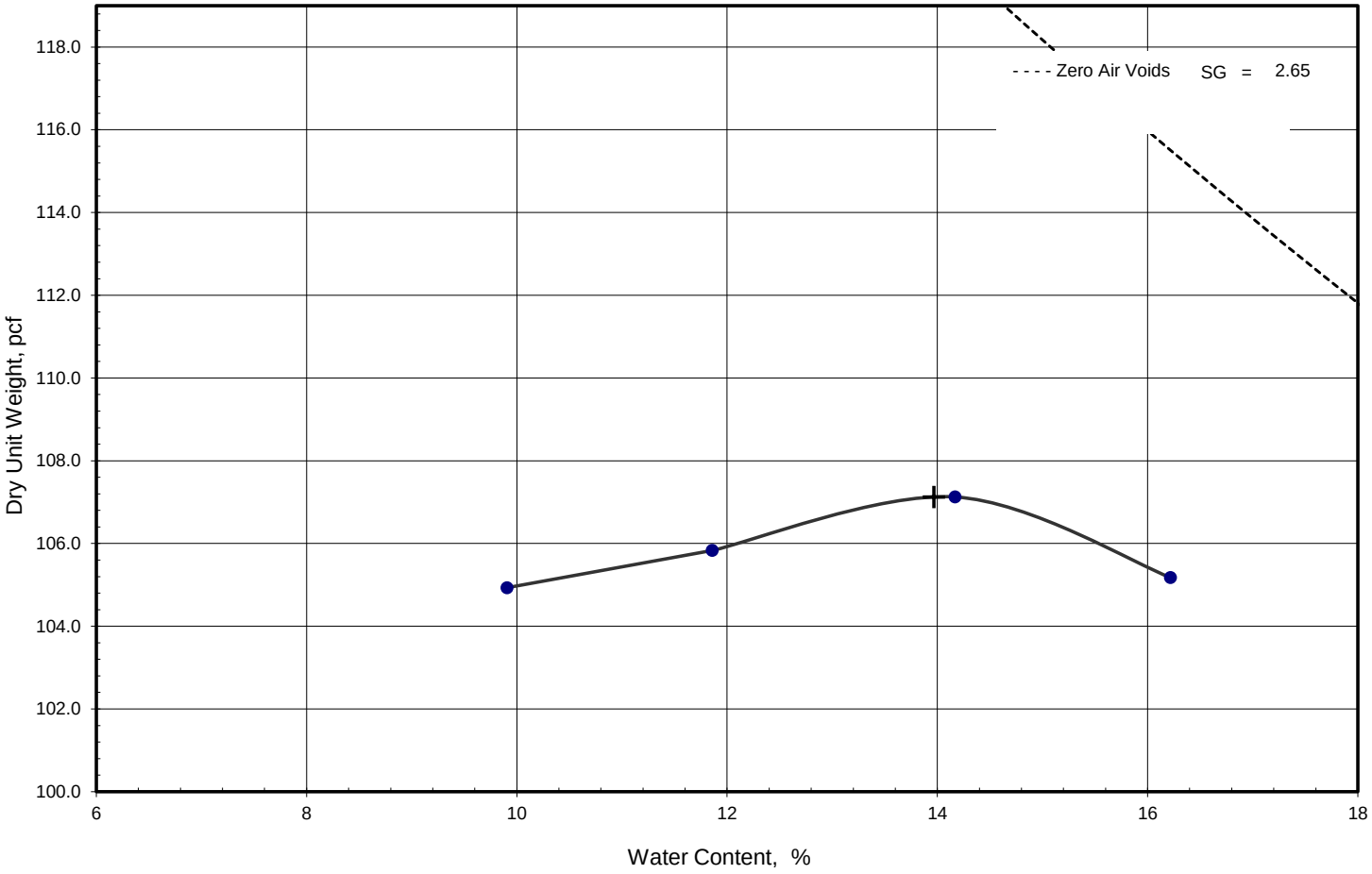
Project: Marlin Bay Drive Site Improvement
Client: Timmons Group
Sample / Source B-01
Test Reference/No.:

Project No.: 04:12065
Depth (ft.): 0 - 4
Sample No.: D3S-21
Date Reported:

Office / Lab	Address	Office Number / Fax
ECS Mid-Atlantic LLC - Chesapeake	804 Professional Place West Chesapeake, VA 23320	(757)366-5100 (757)366-5203

Tested by	Checked by	Approved by	Date Received	Remarks
Technician	JMonnikendam	JMonnikendam	11/9/2022	

Laboratory Compaction Characteristics of Soil
Using Standard Effort



Optimum Moisture Content		**14.0**	%
Maximum Dry Unit Weight		**107.1**	pcf
Cumulative material retained on:	3/4 in. sieve	0.0	%
	3/8 in. sieve	0.0	%
	#4 sieve	0.0	%

Preparation	ASTM dry preparation method	
Type of rammer	Manual - 5.5lbf (24.5N)	
Test Specfication / Method	VTM-1	
Specific gravity - D854 water pycnometer	2.65	Historical
Coarse Aggregate Specific Gravity -		

Soil Description	Nat. Moist. %	Liquid Limit	Plasticity Index	%< #200	USCS	AASHTO
(SP) FINE TO MEDIUM SAND, light brown	4.2	NP	NP	2.5	SP	A-3

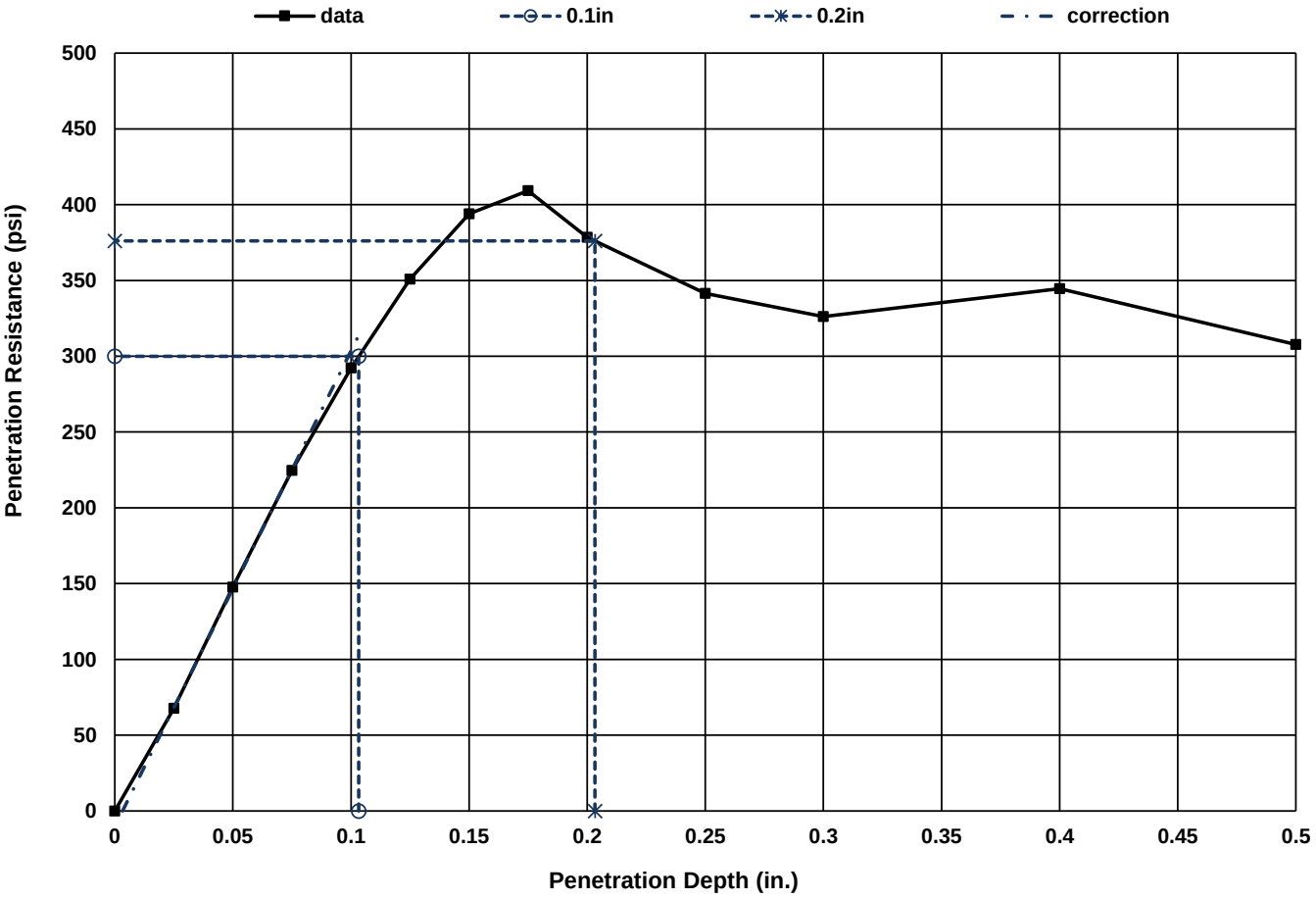
Project: Marlin Bay Drive Site Improvement
Client: Timmons Group
Sample / Source B-03
Test Reference/No.:

Project No.: 04:12065
Depth (ft.): 0 - 4
Sample No.: D3S-22
Date Reported:

Office / Lab	Address	Office Number / Fax
ECS Mid-Atlantic LLC - Chesapeake	804 Professional Place West Chesapeake, VA 23320	(757)366-5100 (757)366-5203

Tested by	Checked by	Approved by	Date Received	Remarks
Technician	JMonnikendam	JMonnikendam	11/9/2022	

California Bearing Ratios (CBR) of Laboratory-Compacted Soils



TEST RESULTS (VTM-8)

Molded			Soaked			CBR (%)		Linearity Correction (in.)	Surcharge (lbs.)		Swell (%)	
Density (pcf)	Percent of Max. Dens.	Moisture (%)	Density (pcf)	Percent of Max. Dens.	Moisture (%)	0.1 in.	0.2 in.					
107.1	102.3	13.3	107.3	102.5	13.0	30.0	25.1	0.00	10		0.04	
Material Description					AASHTO	USCS	MAX. Dens. (pcf)	Optimum Moisture (%)	LL	PI	% Fines	% Gravel
(SP) FINE TO MEDIUM SAND, light brown					A-3	SP	104.7	13.2	NP	NP	1.2	0.0

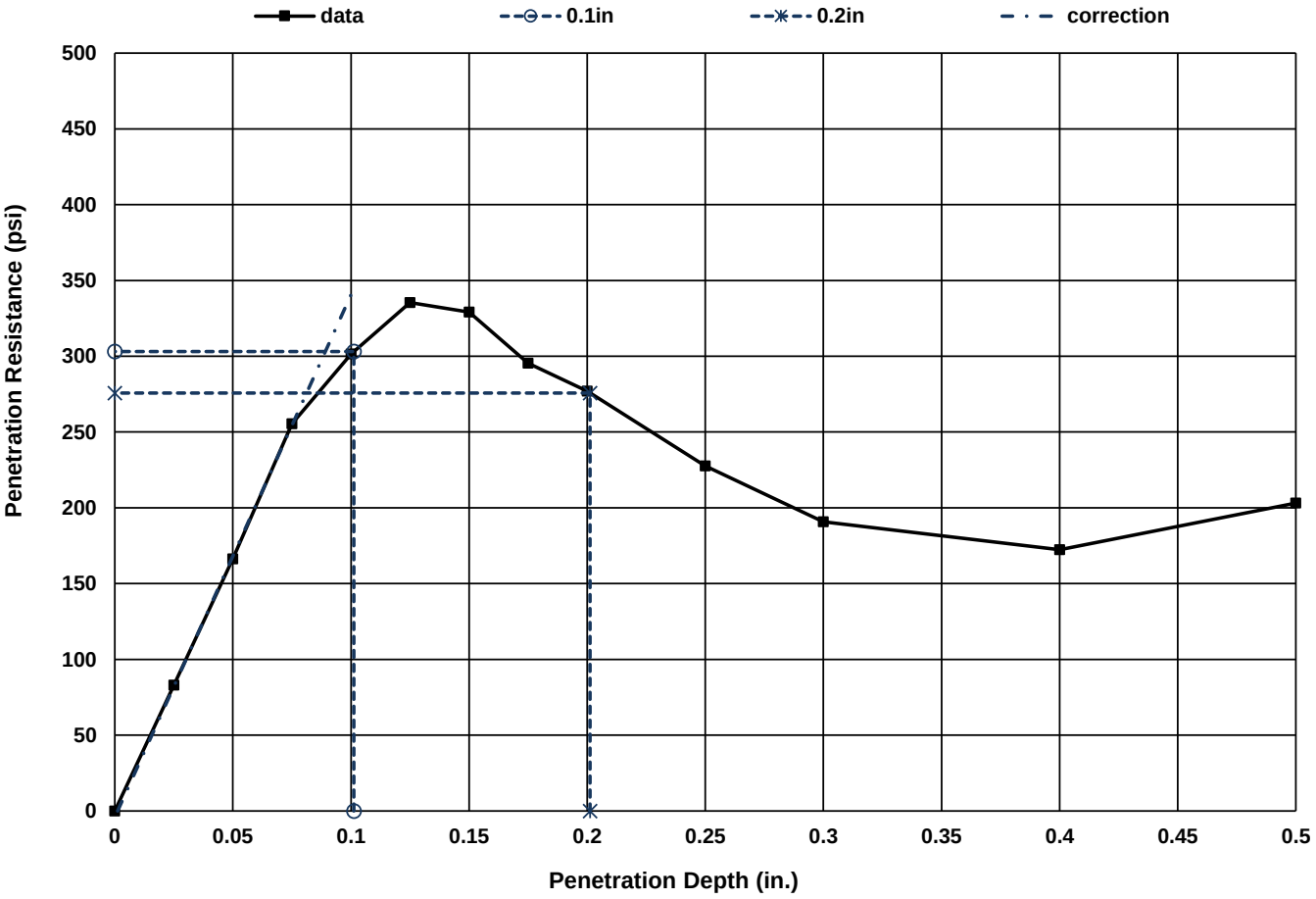
Project: Marlin Bay Drive Site Improvement
Client: Timmons Group
Sample / Source B-01
Test Reference/No.: 1

Project No.: 04:12065
Depth (ft.): 0 - 4
Sample No.: D3S-21
Date Reported: 11/22/2022

Office / Lab	Address	Office Number / Fax
ECS Mid-Atlantic LLC - Chesapeake	804 Professional Place West Chesapeake, VA 23320	(757)366-5100 (757)366-5203

Tested by	Checked by	Approved by	Date Received	Remarks
Technician	JMonnikendam	JMonnikendam	11/9/2022	

California Bearing Ratios (CBR) of Laboratory-Compacted Soils



TEST RESULTS (VTM-8)

Molded			Soaked			CBR (%)		Linearty Correction (in.)	Surcharge (lbs.)		Swell (%)	
Density (pcf)	Percent of Max. Dens.	Moisture (%)	Density (pcf)	Percent of Max. Dens.	Moisture (%)	0.1 in.	0.2 in.					
106.6	99.5	11.9	105.1	98.1	13.3	30.3	18.4	0.00	10		0.11	
Material Description					AASHTO	USCS	MAX. Dens. (pcf)	Optimum Moisture (%)	LL	PI	% Fines	% Gravel
(SP) FINE TO MEDIUM SAND, light brown					A-3	SP	107.1	14	NP	NP	2.5	0.0

Project: Marlin Bay Drive Site Improvement
Client: Timmons Group
Sample / Source B-03
Test Reference/No.: 1

Project No.: 04:12065
Depth (ft.): 0 - 4
Sample No.: D3S-22
Date Reported:

Office / Lab	Address	Office Number / Fax
ECS Mid-Atlantic LLC - Chesapeake	804 Professional Place West Chesapeake, VA 23320	(757)366-5100 (757)366-5203

Tested by	Checked by	Approved by	Date Received	Remarks
Technician	JMonnikendam	JMonnikendam	11/9/2022	

APPENDIX D – Infiltration Data

ECS MID-ATLANTIC, LLC

SATURATED HYDRAULIC CONDUCTIVITY WORKSHEET

Sheet No.: 1

Project Name.:	Marlin Bay Drive	**Parcel……..:**	INF-01	**Terminology and Solution**	
Boring No…...:	B-01	**Date……..:**	11/01/2022	Ksat :	Saturated hydraulic conductivity
Investigators.:	BND	**File Name……..:**		Q:	Steady-state rate of water flow into the soil
Boring Depth.:	5'	**WCU Base. Ht. h:**	15.0 **cm**	H:	Constant height of water in borehole
Boring Dia…..:	9.5 **cm**	**WCU Susp. Ht. S:**	15.0 **cm**	r:	Radius of cylindrical borehole
Boring Rad. (r):	4.76 **cm**	**Const. Wtr. Ht. H:**	30.0 **cm**	Ksat = Q[sinh-1(H/r) - $(r^2/H^2+1)^{.5}$ + r/H] / $(2piH^2)$ [Glover, R. E.	

VOLUME (ml)	Volume Out (ml) [a]	TIME (hr:min:sec a/p)	Elapsed Time (hr:min:sec)	Elapsed Time (min) [b]	Flow Rate Q (ml/min) [a/b]	Ksat Equivalent Values (cm/min)	(cm/sec)	(cm/day)	(in/hr)	(ft/day)
3000		3:42:38 PM								
2500	500	3:42:52 PM	0:00:14	0.23	2142.86	0.639	1.06E-02	920.0	15.092	30.18
2000	500	3:43:12 PM	0:00:20	0.33	1500.00	0.447	7.45E-03	644.0	10.565	21.13
1500	500	3:43:32 PM	0:00:20	0.33	1500.00	0.447	7.45E-03	644.0	10.565	21.13
1000	500	3:43:51 PM	0:00:19	0.32	1578.95	0.471	7.85E-03	677.9	11.121	22.24
500	500	3:44:08 PM	0:00:17	0.28	1764.71	0.526	8.77E-03	757.7	12.429	24.86
0	500	3:44:23 PM	0:00:15	0.25	2000.00	0.596	9.94E-03	858.7	14.086	28.17

Natural Moisture:	4.1%	**Init. Satur.Time:**	3:35:45 PM	**ESTIMATED FIELD Ksat……..:**		8.85E-03	12.545
Texture/Classif:	SP	**Consistency:**		**Bedrock Dpth:**	N/A	**Notes:**	Estimated Field Ksat is determined by averaging and/or rounding of test results for final three or four intervals.
Structure/Fabric:		**Water Tbl. Dpth:**	7'	**Imprm. Lyr.**	N/A		

ECS MID-ATLANTIC, LLC

SATURATED HYDRAULIC CONDUCTIVITY WORKSHEET

Sheet No.: 1

Project Name.:	Marlin Bay Drive	**Parcel…………..:**	INF-02
Boring No…...:	B-02	**Date……………..:**	11/01/2022
Investigators.:	BND	**File Name……...:**	
Boring Depth.:	4.75	**WCU Base. Ht. h:**	15.0 **cm**
Boring Dia…..:	9.5 **cm**	**WCU Susp. Ht. S:**	15.0 **cm**
Boring Rad. (r):	4.76 **cm**	**Const. Wtr. Ht. H:**	30.0 **cm**

Terminology and Solution

- Ksat : Saturated hydraulic conductivity
- Q: Steady-state rate of water flow into the soil
- H: Constant height of water in borehole
- r: Radius of cylindrical borehole
- Ksat = $Q[\sinh^{-1}(H/r) - (r^2/H^2+1)^{.5} + r/H] / (2\pi H^2)$ [Glover, R. E.

VOLUME (ml)	Volume Out (ml) [a]	TIME (hr:min:sec a/p)	Elapsed Time (hr:min:sec)	Elapsed Time (min) [b]	Flow Rate Q (ml/min) [a/b]	Ksat Equivalent Values (cm/min)	(cm/sec)	(cm/day)	(in/hr)	(ft/day)
3000		2:28:15 PM								
2500	500	2:28:45 PM	0:00:30	0.50	1000.00	0.298	4.97E-03	429.3	7.043	14.09
2000	500	2:29:11 PM	0:00:26	0.43	1153.85	0.344	5.73E-03	495.4	8.127	16.25
1500	500	2:29:39 PM	0:00:28	0.47	1071.43	0.319	5.32E-03	460.0	7.546	15.09
1000	500	2:30:10 PM	0:00:31	0.52	967.74	0.289	4.81E-03	415.5	6.816	13.63
500	500	2:30:41 PM	0:00:31	0.52	967.74	0.289	4.81E-03	415.5	6.816	13.63
0	500	2:31:12 PM	0:00:31	0.52	967.74	0.289	4.81E-03	415.5	6.816	13.63

Natural Moisture: 4.1%	**Init. Satur.Time:** 2:23:05 PM	**ESTIMATED FIELD Ksat……..:**	4.81E-03		6.816
Texture/Classif: SP	**Consistency:**	**Bedrock Dpth:** N/A	**Notes:** Estimated Field Ksat is determined by averaging and/or rounding of test results for final three or four intervals.		
Structure/Fabric:	**Water Tbl. Dpth:** 6.75'	**Imprm. Lyr.** N/A			

ECS MID-ATLANTIC, LLC

SATURATED HYDRAULIC CONDUCTIVITY WORKSHEET

Sheet No.: 1

Project Name.:	Marlin Bay Drive	**Parcel……..:**	INF-03	**Terminology and Solution**	
Boring No…...:	B-03	**Date……..:**	11/1/2022	Ksat :	Saturated hydraulic conductivity
Investigators.:	BND	**File Name……..:**		Q:	Steady-state rate of water flow into the soil
Boring Depth.:	3'	**WCU Base. Ht. h:**	15.0 **cm**	H:	Constant height of water in borehole
Boring Dia…..:	9.5 **cm**	**WCU Susp. Ht. S:**	15.0 **cm**	r:	Radius of cylindrical borehole
Boring Rad. (r):	4.76 **cm**	**Const. Wtr. Ht. H:**	30.0 **cm**	Ksat = Q[sinh-1(H/r) - $(r^2/H^2+1)^{.5}$ + r/H] / ($2piH^2$) [Glover, R. E.	

VOLUME (ml)	Volume Out (ml) [a]	TIME (hr:min:sec a/p)	Elapsed Time (hr:min:sec)	Elapsed Time (min) [b]	Flow Rate Q (ml/min) [a/b]	Ksat Equivalent Values (cm/min)	(cm/sec)	(cm/day)	(in/hr)	(ft/day)
3000		10:59:00 AM								
2500	500	10:59:25 AM	0:00:25	0.42	1200.00	0.358	5.96E-03	515.2	8.452	16.90
2000	500	10:59:58 AM	0:00:33	0.55	909.09	0.271	4.52E-03	390.3	6.403	12.81
1500	500	11:00:23 AM	0:00:25	0.42	1200.00	0.358	5.96E-03	515.2	8.452	16.90
1000	500	11:00:53 AM	0:00:30	0.50	1000.00	0.298	4.97E-03	429.3	7.043	14.09
500	500	11:01:14 AM	0:00:21	0.35	1428.57	0.426	7.10E-03	613.4	10.062	20.12
0	500	11:01:32 AM	0:00:18	0.30	1666.67	0.497	8.28E-03	715.6	11.738	23.48

Natural Moisture:	1.8%	**Init. Satur.Time:**	10:51:00 AM	**ESTIMATED FIELD Ksat……..:**		6.78E-03	9.614
Texture/Classif:	SP	**Consistency:**		**Bedrock Dpth:**	N/A	**Notes:**	Estimated Field Ksat is determined by averaging and/or rounding of test results for final three or four intervals.
Structure/Fabric:		**Water Tbl. Dpth:**	5.0'	**Imprm. Lyr.**	N/A		

ECS MID-ATLANTIC, LLC

SATURATED HYDRAULIC CONDUCTIVITY WORKSHEET

Sheet No.: 1

Project Name.:	Marlin Bay Drive	**Parcel.....:**	INF-04	**Terminology and Solution**	
Boring No.....:	B-04	**Date.....:**	11/1/2022	Ksat :	Saturated hydraulic conductivity
Investigators.:	BND	**File Name.....:**		Q:	Steady-state rate of water flow into the soil
Boring Depth.:	2'	**WCU Base. Ht. h:**	15.0 **cm**	H:	Constant height of water in borehole
Boring Dia.....:	9.5 **cm**	**WCU Susp. Ht. S:**	15.0 **cm**	r:	Radius of cylindrical borehole
Boring Rad. (r):	4.76 **cm**	**Const. Wtr. Ht. H:**	30.0 **cm**	Ksat =	$Q[\sinh^{-1}(H/r) - (r^2/H^2+1)^{.5} + r/H] / (2\pi iH^2)$ [Glover, R. E.

VOLUME (ml)	Volume Out (ml) [a]	TIME (hr:min:sec a/p)	Elapsed Time (hr:min:sec)	Elapsed Time (min) [b]	Flow Rate Q (ml/min) [a/b]	Ksat Equivalent Values (cm/min)	(cm/sec)	(cm/day)	(in/hr)	(ft/day)
3000		9:30:15 AM								
2500	500	9:30:59 AM	0:00:44	0.73	681.82	0.203	3.39E-03	292.7	4.802	9.60
2000	500	9:31:45 AM	0:00:46	0.77	652.17	0.194	3.24E-03	280.0	4.593	9.19
1500	500	9:32:30 AM	0:00:45	0.75	666.67	0.199	3.31E-03	286.2	4.695	9.39
1000	500	9:33:05 AM	0:00:35	0.58	857.14	0.256	4.26E-03	368.0	6.037	12.07
500	500	9:33:48 AM	0:00:43	0.72	697.67	0.208	3.47E-03	299.5	4.914	9.83
0	500	9:34:28 AM	0:00:40	0.67	750.00	0.224	3.73E-03	322.0	5.282	10.56

Natural Moisture:	2.9%	**Init. Satur.Time:**	9:24:10 AM	**ESTIMATED FIELD Ksat.....:**		3.82E-03	5.411
Texture/Classif:	SP-SM	**Consistency:**		**Bedrock Dpth:**	N/A	**Notes:**	Estimated Field Ksat is determined by averaging and/or rounding of test results for final three or four intervals.
Structure/Fabric:		**Water Tbl. Dpth:**	4.0'	**Imprm. Lyr.**	N/A		

Appendix B – Erosion and Sediment Control Calculations

TIMMONS GROUP
YOUR VISION ACHIEVED THROUGH OURS.

Project:	Ocean Park
Project No.:	50568
Date:	4/7/2025
Calculated By:	J. Kim

SEDIMENT TRAP DESIGN

Drainage Area to Sediment Trap	Wet Storage (67c.y./Ac.)			Dry Storage (67c.y./Ac.)		
(Acres)	(Cubic Yards)		(Cubic Feet)	(Cubic Yards)		(Cubic Feet)
2.75	184.25		4974.75	184.25		4974.75

Sediment Trap Volume:

Elevation	Depth	Area (sq. ft.)	Volume (cu. ft.)	Volume (cu. yd.)	Sum Volume (cu. ft.)	Sum Volume (cu. yd.)
-1.0	0	1848	0	0	0	0
0.0	1	2419	2133.5	79	2134	79
1.0	1	3047	2733	101	4867	180
2.0	1	3731	3389	126	8256	306
3.0	1	4471	4101	152	12357	458
3.0	0	4471	0	0	12357	458
3.0	0	4471	0	0	12357	458
3.0	0	4471	0	0	12357	458
3.0	0	4471	0	0	12357	458

Elevation of Wet Storage Volume = **1.03**

Elevation of Dry Storage Volume = **2.41**

Sediment Cleanout Elevation = **0.13**

Top Width of Embankment (H_O = **1.38** ft.) (H = **2.38** ft.) = **2.00** feet

Length of Aggregate Outlet Weir = 6 ft./acre & (Drainage Area) = **16.5** feet

TIMMONS GROUP
YOUR VISION ACHIEVED THROUGH OURS.

Channel Adequacy

Project:	Ocean Park
Date:	4/7/2025
Designed:	J.K
Channel:	DV 1

Channel Characteristics

Right Sideslope	=	**3.00**	:1	
Left Sideslope	=	**3.00**	:1	
Base Width	=	**0.00**	ft.	
Max. Depth	=	**2.00**	ft.	TC
Channel Slope	=	**1.03**	%	**5.00**
Mannings n	=	**0.05**		
Drainage Area	=	**1.92**	ac.	
Rational C	=	**0.60**		
2-year Intensity	=	*6.75*	*in/hr*	Q_2 = 7.78 cfs
10-year Intesity	=	*8.56*	*in/hr*	Q_{10} = 9.87 cfs
				(Q=CiA)

2-Year Storm Velocity Check

Depth of Flow	=	1.14	ft.	Velocity (V) = **2.00** fps
Area	=	3.89	sq. ft.	(Mannings Equation)
Wetted Perimeter	=	7.20	ft.	Flow (Q) = 7.77 cfs
Hydraulic Radius	=	0.54	ft.	(Q=VA)

Conclusion = **Adequate**

10-Year Storm Capacity Check

Depth of Flow	=	1.24	ft.	Velocity (V) = 2.12 fps
Area	=	4.64	sq. ft.	(Mannings Equation)
Wetted Perimeter	=	7.87	ft.	Flow (Q) = 9.85 cfs
Hydraulic Radius	=	0.59	ft.	(Q=VA)
Free Board	=	**0.76**	ft.	

TIMMONS GROUP
YOUR VISION ACHIEVED THROUGH OURS.

Channel Adequacy

Project:	Ocean Park
Date:	4/7/2025
Designed:	J.K
Channel:	DV 2

Channel Characteristics

Right Sideslope	=	3.00	:1		
Left Sideslope	=	3.00	:1		
Base Width	=	0.00	ft.		
Max. Depth	=	1.00	ft.	TC	
Channel Slope	=	0.70	%	5.00	
Mannings n	=	0.05			
Drainage Area	=	0.26	ac.		
Rational C	=	0.60			
2-year Intensity	=	*6.75*	*in/hr*	Q_2 =	1.05 cfs
10-year Intesity	=	*8.56*	*in/hr*	Q_{10} =	1.34 cfs
					(Q=CiA)

2-Year Storm Velocity Check

Depth of Flow	=	0.54	ft.	Velocity (V) =	**1.00** fps
Area	=	0.86	sq. ft.	(Mannings Equation)	
Wetted Perimeter	=	3.39	ft.	Flow (Q) =	0.86 cfs
Hydraulic Radius	=	0.25	ft.	(Q=VA)	

Conclusion = **Adequate**

10-Year Storm Capacity Check

Depth of Flow	=	0.59	ft.	Velocity (V) =	1.06 fps
Area	=	1.04	sq. ft.	(Mannings Equation)	
Wetted Perimeter	=	3.72	ft.	Flow (Q) =	1.10 cfs
Hydraulic Radius	=	0.28	ft.	(Q=VA)	
Free Board	=	**0.41**	ft.		

TIMMONS GROUP
YOUR VISION ACHIEVED THROUGH OURS.

Channel Adequacy

Project:	Ocean Park
Date:	4/7/2025
Designed:	J.K
Channel:	DV 3

Channel Characteristics

Right Sideslope	=	3.00	:1		
Left Sideslope	=	3.00	:1		
Base Width	=	0.00	ft.		
Max. Depth	=	1.00	ft.	TC	
Channel Slope	=	1.66	%	5.00	
Mannings n	=	0.05			
Drainage Area	=	0.19	ac.		
Rational C	=	0.60			
2-year Intensity	=	*6.75*	*in/hr*	Q_2 =	0.77 cfs
10-year Intesity	=	*8.56*	*in/hr*	Q_{10} =	0.98 cfs
					(Q=CiA)

2-Year Storm Velocity Check

Depth of Flow	=	0.48	ft.	Velocity (V) =	**1.42** fps
Area	=	0.69	sq. ft.	(Mannings Equation)	
Wetted Perimeter	=	3.02	ft.	Flow (Q) =	0.98 cfs
Hydraulic Radius	=	0.23	ft.	(Q=VA)	

Conclusion = **Adequate**

10-Year Storm Capacity Check

Depth of Flow	=	0.52	ft.	Velocity (V) =	1.51 fps
Area	=	0.82	sq. ft.	(Mannings Equation)	
Wetted Perimeter	=	3.30	ft.	Flow (Q) =	1.23 cfs
Hydraulic Radius	=	0.25	ft.	(Q=VA)	
Free Board	=	**0.48**	ft.		

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Channel Adequacy

Project:	Ocean Park
Date:	4/7/2025
Designed:	J.K
Channel:	DV 4

Channel Characteristics

Right Sideslope	=	3.00	:1	
Left Sideslope	=	3.00	:1	
Base Width	=	0.00	ft.	
Max. Depth	=	1.00	ft.	TC
Channel Slope	=	1.51	%	5.00
Mannings n	=	0.05		
Drainage Area	=	0.29	ac.	
Rational C	=	0.60		
2-year Intensity	=	*6.75*	*in/hr*	Q_2 = 1.18 cfs
10-year Intesity	=	*8.56*	*in/hr*	Q_{10} = 1.49 cfs

(Q=CiA)

2-Year Storm Velocity Check

Depth of Flow	=	0.56	ft.	Velocity (V) = **1.51** fps
Area	=	0.94	sq. ft.	(Mannings Equation)
Wetted Perimeter	=	3.54	ft.	Flow (Q) = 1.42 cfs
Hydraulic Radius	=	0.27	ft.	(Q=VA)

Conclusion = **Adequate**

10-Year Storm Capacity Check

Depth of Flow	=	0.61	ft.	Velocity (V) = 1.60 fps
Area	=	1.12	sq. ft.	(Mannings Equation)
Wetted Perimeter	=	3.87	ft.	Flow (Q) = 1.80 cfs
Hydraulic Radius	=	0.29	ft.	(Q=VA)
Free Board	=	**0.39**	ft.	

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Channel Adequacy

Project:	Ocean Park
Date:	4/7/2025
Designed:	J.K
Channel:	DV 5

Channel Characteristics

Right Sideslope	=	**3.00**	:1		
Left Sideslope	=	**3.00**	:1		
Base Width	=	**2.00**	ft.		
Max. Depth	=	**1.70**	ft.	TC	
Channel Slope	=	**0.50**	%	**5.00**	
Mannings n	=	**0.05**			
Drainage Area	=	**2.11**	ac.		
Rational C	=	**0.60**			
2-year Intensity	=	*6.75*	*in/hr*	Q_2 = 8.55	cfs
10-year Intesity	=	*8.56*	*in/hr*	Q_{10} = 10.84	cfs
				(Q=CiA)	

2-Year Storm Velocity Check

Depth of Flow	=	1.18	ft.	Velocity (V) = **1.64**	fps
Area	=	6.52	sq. ft.	(Mannings Equation)	
Wetted Perimeter	=	9.45	ft.	Flow (Q) = 10.70	cfs
Hydraulic Radius	=	0.69	ft.	(Q=VA)	

Conclusion = **Adequate**

10-Year Storm Capacity Check

Depth of Flow	=	1.29	ft.	Velocity (V) = 1.73	fps
Area	=	7.55	sq. ft.	(Mannings Equation)	
Wetted Perimeter	=	10.15	ft.	Flow (Q) = 13.04	cfs
Hydraulic Radius	=	0.74	ft.	(Q=VA)	
Free Board	=	**0.41**	ft.		

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DIVERSION CHANNEL ADEQUACY - Summary

Project:	Ocean Park
Date:	4/7/2025
Designed:	J.K

Channel Name	Channel Characteristics						Bare Soil Condition	
	Right Side Slope	*Left Side Slope*	*Bottom Width (ft)*	*Max. Depth (ft)*	*Channel Slope*	*Drainage Area (ac)*	*Q_2 (cfs)*	*Q_{10} (cfs)*
DV 1	3:1	3:1	0.00	2.00	1.03%	1.92	7.78	9.87
DV 2	3:1	3:1	0.00	1.00	0.70%	0.26	1.05	1.34
DV 3	3:1	3:1	0.00	1.00	1.66%	0.19	0.77	0.98
DV 4	3:1	3:1	0.00	1.00	1.51%	0.29	1.18	1.49
DV 5	3:1	3:1	2.00	1.70	0.50%	2.11	8.55	10.84

BARE SOIL CONDITION

Mannings n = 0.05, Runoff Coefficient = 0.6

Channel Name	2-Year Check						10-Year Check							
	Flow Depth (ft)	*Cross-Section Area (sq.ft.)*	*Wetted Perimeter (ft)*	*Hydraulic Radius (ft)*	*Velocity (fps)*	*Flowrate Check (cfs)*	*Flow Depth (ft)*	*Cross-Section Area (sq.ft.)*	*Wetted Perimeter (ft)*	*Hydraulic Radius (ft)*	*Velocity (fps)*	*Flowrate Check (cfs)*	Free Board (ft)	Free Board Check
DV 1	1.14	3.89	7.20	0.54	**2.00**	7.77	1.24	4.64	7.87	0.59	2.12	9.85	**0.76**	OK
DV 2	0.54	0.86	3.39	0.25	**1.00**	0.86	0.59	1.04	3.72	0.28	1.06	1.10	**0.41**	OK
DV 3	0.48	0.69	3.02	0.23	**1.42**	0.98	0.52	0.82	3.30	0.25	1.51	1.23	**0.48**	OK
DV 4	0.56	0.94	3.54	0.27	**1.51**	1.42	0.61	1.12	3.87	0.29	1.60	1.80	**0.39**	OK
DV 5	1.18	6.52	9.45	0.69	**1.64**	10.70	1.29	7.55	10.15	0.74	1.73	13.04	**0.41**	OK

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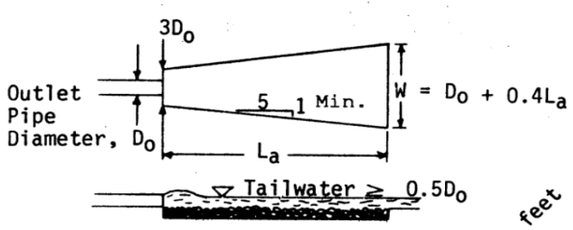
Outlet Protection

DVST1

Project: OCEAN PARK **Date:** 4/7/2025 **Designed:** JK

Pipe Diameter =	24 in	**Width at Outlet ($3D_0$) =**	6 ft	**Length (La) =**	9 ft
Discharge (Q) =	10.84 cfs	**Width at Outlet (W) =**	10 ft	**Riprap size (d_{50}) =**	0.5 ft

DESIGN OF OUTLET PROTECTION FROM A ROUND PIPE FLOWING FULL
MAXIMUM TAILWATER CONDITION ($T_w \geq 0.5$ DIAMETER)



Appendix C – Stormwater Management Calculations

`

DEQ Virginia Runoff Reduction Method Re-Development Compliance Spreadsheet - **Version 4.1**

CLEAR ALL (Ctrl+Shift+R)

data input cells
constant values
calculation cells
final results

Project Name: **Ocean Park Subdivision**
Date: **4/10/2025**
Linear Development Project? **No**

Site Information

Post-Development Project (Treatment Volume and Loads)

Enter Total Disturbed Area *(acres)* → 3.13

Maximum reduction required: **20%**
The site's net increase in impervious cover (acres) is: **2.1**
Post-Development TP Load Reduction for Site (lb/yr): **1.41**

Check:
BMP Design Specifications List: 2024 Stds & Specs
Linear project? No
Land cover areas entered correctly? ✓
Total disturbed area entered? ✓

Pre-ReDevelopment Land Cover (acres)

	A Soils	B Soils	C Soils	D Soils	Totals
Forest (acres) -- undisturbed, protected forest or reforested land	2.20				2.20
Mixed Open (acres) -- undisturbed/infrequently maintained grass or shrub land					0.00
Managed Turf (acres) -- disturbed, graded for yards or other turf to be mowed/managed	0.82				0.82
Impervious Cover (acres)	0.11				0.11
					3.13

Post-Development Land Cover (acres)

	A Soils	B Soils	C Soils	D Soils	Totals
Forest/Open Space (acres) -- undisturbed, protected forest or reforested land					0.00
Mixed Open (acres) -- undisturbed/infrequently maintained grass or shrub land					0.00
Managed Turf (acres) -- disturbed, graded for yards or other turf to be mowed/managed	0.92				0.92
Impervious Cover (acres)	2.21				2.21
Area Check	**OK.**	**OK.**	**OK.**	**OK.**	3.13

Post-Development Requirement for Site Area

TP Load Reduction Required (lb/yr)	1.41

Nitrogen Loads (Informational Purposes Only)

Pre-ReDevelopment TN Load (lb/yr)	7.33

Final Post-Development TN Load	32.23

LAND COVER SUMMARY -- PRE-REDEVELOPMENT

Land Cover Summary-Pre

Pre-ReDevelopment	Listed	Adjusted[1]
Forest Cover (acres)	2.20	0.10
Weighted Rv(forest)	0.02	0.02
Weighted Loading Rate(forest)	0.04	0.04
% Forest	70%	10%
Mixed Open Cover (acres)	0.00	0.00
Weighted Rv(mixed)	0.00	0.00
Weighted Loading Rate(mixed)	0.00	0.00
% Mixed Open	0%	0%
Managed Turf Cover (acres)	0.82	0.82
Weighted Rv(turf)	0.15	0.15
Weighted Loading Rate(turf)	0.51	0.51
% Managed Turf	26%	80%
Impervious Cover (acres)	0.11	0.11
Rv(impervious)	0.95	0.95
Weighted Loading Rate(impervious)	0.86	0.86
% Impervious	4%	11%
Total Site Area (acres)	**3.13**	**1.03**
Site Rv	**0.09**	**0.22**

Treatment Volume and Nutrient Load

Pre-ReDevelopment Treatment Volume (acre-ft)	0.0226	0.0191
Pre-ReDevelopment Treatment Volume (cubic feet)	986	833
Pre-ReDevelopment TP Load (lb/yr)	**0.60**	**0.52**
Pre-ReDevelopment TP Load per acre (lb/acre/yr)	0.19	0.50
Baseline TP Load (lb/yr) (0.26 lbs/acre/yr applied to pre-redevelopment area excluding pervious land proposed for new impervious cover)		*0.27*

[1] *Adjusted Land Cover Summary:*
Pre ReDevelopment land cover minus pervious land cover (forest, mixed open or managed turf) acreage proposed for new impervious cover.

Adjusted total acreage is consistent with Post-ReDevelopment acreage (minus acreage of new impervious cover).

Column I shows load reduction requirement for new impervious cover (based on new development load limit, 0.26 lbs/acre/year).

LAND COVER SUMMARY -- POST DEVELOPMENT

Land Cover Summary-Post (Final)

Post ReDev. & New Impervious	
Forest Cover (acres)	0.00
Weighted Rv(forest)	0.00
Wgt. Ld. Rate(forest)	0.00
% Forest	0%
Mixed Open Cover (acres)	0.00
Weighted Rv(mixed)	0.00
Wgt. Ld. Rate(mixed)	0.00
% Mixed Open	0%
Managed Turf Cover (acres)	0.92
Weighted Rv (turf)	0.15
Wgt. Ld. Rate(turf)	0.51
% Managed Turf	29%
Impervious Cover (acres)	2.21
Rv(impervious)	0.95
Wgt. Ld. Rate(imperv.)	0.86
% Impervious	71%
Final Site Area (acres)	**3.13**
Final Post Dev Site Rv	**0.71**

Land Cover Summary-Post

Post-ReDevelopment	
Forest Cover (acres)	0.00
Weighted Rv(forest)	0.00
Wgt. Ld. Rate(forest)	0.00
% Forest	0%
Mixed Open Cover (acres)	0.00
Weighted Rv(mixed)	0.00
Wgt. Ld. Rate(mixed)	0.00
% Mixed Open	0%
Managed Turf Cover (acres)	0.92
Weighted Rv (turf)	0.15
Wgt. Ld. Rate(turf)	0.51
% Managed Turf	89%
ReDev. Impervious Cover (acres)	0.11
Rv(impervious)	0.95
Wgt. Ld. Rate(imperv.)	0.86
% Impervious	11%
Total ReDev. Site Area (acres)	**1.03**
ReDev Site Rv	**0.24**

Land Cover Summary-Post

Post-Development New Impervious	
New Impervious Cover (acres)	2.10
Rv(impervious)	0.95

Treatment Volume and Nutrient Load

Final Post-Development Treatment Volume (acre-ft)	0.1865	Post-ReDevelopment Treatment Volume (acre-ft)	0.0202	Post-Development Treatment Volume (acre-ft)	0.1663
Final Post-Development Treatment Volume (cubic feet)	8,122	Post-ReDevelopment Treatment Volume (cubic feet)	880	Post-Development Treatment Volume (cubic feet)	7,242
Final Post-Development TP Load (lb/yr)	**2.36**	Post-ReDevelopment Load (TP) (lb/yr)*	**0.56**	Post-Development TP Load (lb/yr)	**1.80**
Final Post-Development TP Load per acre (lb/acre/yr)	0.76	Post-ReDevelopment TP Load per acre (lb/acre/yr)	0.55		
		Max. Reduction Required (Below Pre-ReDevelopment Load)	20%		
		TP Load Reduction Required for Redeveloped Area (lb/yr)	**0.15**	TP Load Reduction Required for New Impervious Area (lb/yr)	**1.26**

Site Results (Water Quality Compliance) VRRM 4.1, 2024

Area Checks	D.A. A	D.A. B	D.A. C	D.A. D	D.A. E	AREA CHECK
FOREST (ac)	0.00	0.00	0.00	0.00	0.00	OK.
MIXED OPEN (ac)	0.00	0.00	0.00	0.00	0.00	OK.
MIXED OPEN AREA TREATED(ac)	0.00	0.00	0.00	0.00	0.00	OK.
MANAGED TURF AREA (ac)	2.23	0.00	0.00	0.00	0.00	AREA EXCEEDED!
MANAGED TURF AREA TREATED (ac)	2.23	0.00	0.00	0.00	0.00	OK.
IMPERVIOUS COVER (ac)	2.39	0.00	0.00	0.00	0.00	AREA EXCEEDED!
IMPERVIOUS COVER TREATED (ac)	2.39	0.00	0.00	0.00	0.00	OK.
AREA CHECK	OK.	OK.	OK.	OK.	OK.	

Site Treatment Volume (ft^3)	8,122

Runoff Reduction Volume and TP By Drainage Area

	D.A. A	D.A. B	D.A. C	D.A. D	D.A. E	TOTAL
RUNOFF REDUCTION VOLUME ACHIEVED (ft^3)	0	0	0	0	0	0
TP LOAD AVAILABLE FOR REMOVAL (lb/yr)	3.71	0.00	0.00	0.00	0.00	3.71
TP LOAD REDUCTION ACHIEVED (lb/yr)	1.48	0.00	0.00	0.00	0.00	1.48
TP LOAD REMAINING (lb/yr)	2.23	0.00	0.00	0.00	0.00	2.23
NITROGEN LOAD REDUCTION ACHIEVED (lb/yr)	0.00	0.00	0.00	0.00	0.00	0.00

Total Phosphorus

FINAL POST-DEVELOPMENT TP LOAD (lb/yr)	2.36
TP LOAD REDUCTION REQUIRED (lb/yr)	x
TP LOAD REDUCTION ACHIEVED (lb/yr)	x
TP LOAD REMAINING (lb/yr):	x
REMAINING TP LOAD REDUCTION REQUIRED (lb/yr):	CHECK AREAS!

Total Nitrogen (For Information Purposes)

POST-DEVELOPMENT LOAD (lb/yr)	32.23
NITROGEN LOAD REDUCTION ACHIEVED (lb/yr)	0.00
REMAINING POST-DEVELOPMENT NITROGEN LOAD (lb/yr)	32.23

DEQ Virginia Runoff Reduction Method Re-Development Compliance Spreadsheet - Version 4.1

BMP Design Specifications List: **2024 Stds & Specs**

Site Summary

Project Title: Ocean Park Subdivision
Date: 45757

Total Disturbed Acreage:	3.13

Site Land Cover Summary

Pre-ReDevelopment Land Cover (acres)

	A soils	B Soils	C Soils	D Soils	Totals	% of Total
Forest (acres)	2.20	0.00	0.00	0.00	2.20	70
Mixed Open (acres)	0.00	0.00	0.00	0.00	0.00	0
Managed Turf (acres)	0.82	0.00	0.00	0.00	0.82	26
Impervious Cover (acres)	0.11	0.00	0.00	0.00	0.11	4
					3.13	100

Post-ReDevelopment Land Cover (acres)

	A soils	B Soils	C Soils	D Soils	Totals	% of Total
Forest (acres)	0.00	0.00	0.00	0.00	0.00	0
Mixed Open (acres)	0.00	0.00	0.00	0.00	0.00	0
Managed Turf (acres)	0.92	0.00	0.00	0.00	0.92	29
Impervious Cover (acres)	2.21	0.00	0.00	0.00	2.21	71
* Forest/Open Space areas must be protected in accordance with the Virginia Runoff Reduction Method					3.13	100

Site Tv and Land Cover Nutrient Loads

	Final Post-Development (Post-ReDevelopment & New Impervious)	Post-ReDevelopment	Post-Development (New Impervious)	Adjusted Pre-ReDevelopment
Site Rv	0.71	0.24	0.00	0.22
Treatment Volume (ft^3)	8,122	880	7,242	833
TP Load (lb/yr)	2.36	0.56	1.80	0.52

Pre-ReDevelopment TP Load per acre (lb/acre/yr)	Final Post-Development TP Load per acre (lb/acre/yr)	Post-ReDevelopment TP Load per acre (lb/acre/yr)
0.50	**0.76**	**0.55**

Total TP Load Reduction Required (lb/yr)	**1.41**	0.15	1.26

	Final Post-Development Load (Post-ReDevelopment & New Impervious)	Pre-ReDevelopment
TN Load (lb/yr)	32.23	7.33

AREA AND CURVE NUMBER COMPUTATIONS

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VRRM LAND COVER TABULATION

**Based project site limits of disturbance*

Project Name: Ocean Park Subdivision
Timmons Group Project No. 50568
Date: 2025-04-10
Calculated By: Kyle Brady

Pre-Development

Point of Analysis	Area	Area	Forest				Mixed Open Space				Managed Turf				Impervious Cover			
	(SF)	(AC)	HSG	SF	Acres	CN[1]	HSG	SF	Acres	CN[1]	HSG	SF	Acres	CN[1]	HSG	SF	Acres	CN[1]
EXISTING	136,446	3.13	A	95,979	2.20	30	A	0		34	A	35,854	0.82	39	A	4,613	0.11	98
			B	0		55	B	0		59	B	0		61	B	0		98
			C	0		70	C	0		72	C	0		74	C	0		98
			D	0		77	D	0		79	D	0		80	D	0		98

Post Development

Point of Analysis	Area	Area	Forest				Mixed Open Space				Managed Turf				Impervious Cover			
	(SF)	(AC)	HSG	SF	Acres	CN[1]	HSG	SF	Acres	CN[1]	HSG	SF	Acres	CN[1]	HSG	SF	Acres	CN[1]
Untreated	136,446	3.13	A	0		30	A	0		34	A	39,977	0.92	39	A	96,469	2.21	98
			B	0		55	B	0		59	B	0		61	B	0		98
			C	0		70	C	0		72	C			74	C			98
			D	0		77	D	0		79	D	0		80	D	0		98
TOTAL	136,446	3.13	A	0		30	A	0		34	A	0		39	A	0		98
			B	0		55	B	0		59	B	0		61	B	0		98
			C	0		70	C	0		72	C			74	C			98
			D	0		77	D	0		79	D	0		80	D	0		98

Date: February 11, 2025

To: Kevin Worsham, PE
Project Manager
TIMMONS GROUP

From: Amy Staley
Credit Sales Manager
Resource Environmental Solutions

Subject: James River Watershed – Nutrient Credit Availability

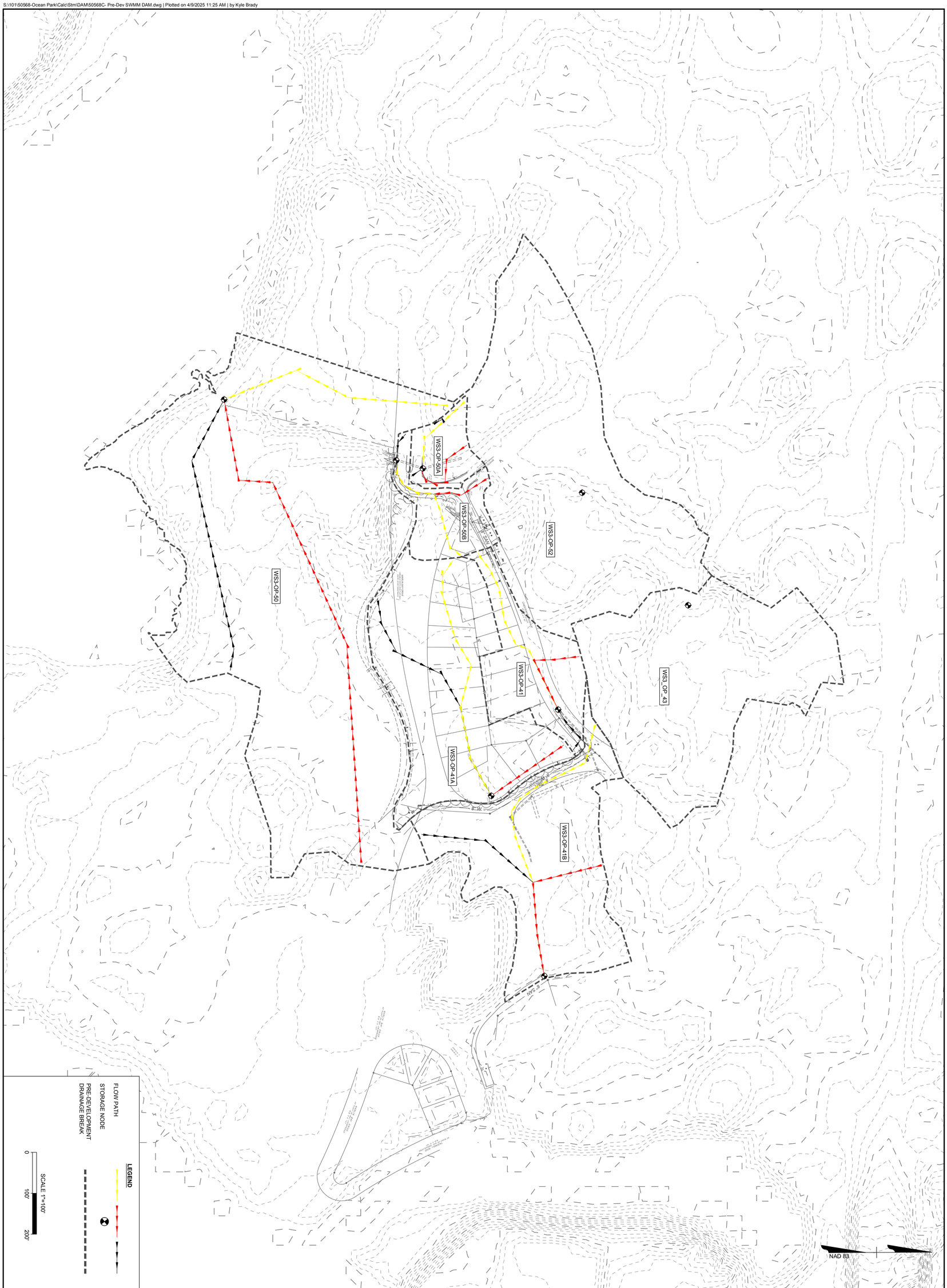
Project Reference: Ocean Park, 2.00 Credits Requested; HUC 02080108

This letter is to confirm the availability of 2.00 authorized nutrient credits ("Nutrient Credits") from one of Resource Environmental Solutions' ("RES") James nutrient Bank facilities for use by permit applicants within the James River watershed, including HUC 02080108, to compensate for nutrient loadings in excess of state or local regulations, as per Virginia Code § 62.1-44.15:35 and § 62.1-44.19:14 and Virginia Administrative Code 9 VAC 25-820-10 et seq. These Nutrient Credits are generated and managed under the terms of the Banking Instruments known as the Nansemond Shoals Nutrient Reduction Implementation Plan (NRIP).

Please feel free to contact me if you have any questions.

Sincerely,

Amy Staley
Credit Sales Manager
astaley@res.us | 919.209.1055



TIMMONS GROUP

YOUR VISION ACHIEVED THROUGH OURS.

THIS DRAWING PREPARED AT THE
VIRGINIA BEACH OFFICE
2901 South Lynnhaven Road, Suite 200 | Virginia Beach, VA 23452
TEL 757.213.6679 FAX 757.340.1415 www.timmons.com

COMMONWEALTH OF VIRGINIA
CHRISTOPHER T. ABBOTT
Lic. No. 002317
04/09/2025
PROFESSIONAL ENGINEER

OCEAN PARK SUBDIVISION

CITY OF VIRGINIA BEACH, VA

PRE DEVELOPMENT DRAINAGE AREA MAP

SHEET NO.	JOB NO.	SCALE	CHECKED BY	DESIGNED BY	DRAWN BY	DATE
PRE	50568	1" = 100'	CA	KW	KB	04/09/2025

DATE	REVISION DESCRIPTION

REVISED EXISTING

SUBCATCHMENT STORAGE SUMMARY
FOR VIRGINIA BEACH SWMM MODEL

TIMMONS GROUP
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Project Name: Ocean Park
Timmons Group Project No. 50568
Date: 3/13/2025
Calculated By: KRW

Subcatchment Area	**66,664 SF**	**1.53 AC**
Subcatchment Impervious	**52,742 SF**	**1.21 AC**
Impervious %	**79.1%**	
Storage Invert Elevation	**-5.0**	

Subcatchment: WS3_OP_41				**STORAGE NODE: 03020-022**	**Curve Name: WS3_OP_41@-5**
Elevation (NAVD88)	**Depth**	**Prop. Total Area**	**Incremental Storage**	**Total Storage**	**Notes**
FT	FT	SF	CF	CF	
-5.00	0.00	100	0	0	
3.50	8.50	100	850	850	
4.00	9.00	100	50	900	
4.50	9.50	4167	1067	1967	
5.00	10.00	16431	5150	7116	
5.50	10.50	23447	9970	17086	
6.00	11.00	34670	14529	31615	
6.50	11.50	41235	18976	50591	
7.00	12.00	49619	22714	73305	
7.50	12.50	54958	26144	99449	
8.00	13.00	60847	28951	128400	
8.50	13.50	66604	31863	160263	
9.00	14.00	66664	33317	193580	
19.00	24.00	66664	666640	860220	

SUBCATCHMENT STORAGE SUMMARY

FOR VIRGINIA BEACH SWMM MODEL

TIMMONS GROUP
YOUR VISION ACHIEVED THROUGH OURS.

Project Name: Ocean Park
Timmons Group Project No. 50568
Date: 2/17/2025
Calculated By: KRW

Subcatchment Area	**176,206 SF**	**4.05 AC**
Subcatchment Impervious	**13,126 SF**	**0.30 AC**
Impervious %	**7.4%**	
Storage Invert Elevation	**-5.0**	

Subcatchment: WS3_OP_41A				**STORAGE NODE: 03020-022A**	**Curve Name: WS3_OP_41A@-5**
Elevation (NAVD88)	**Depth**	**Prop. Total Area**	**Incremental Storage**	**Total Storage**	**Notes**
FT	FT	SF	CF	CF	
-5.00	0.00	100	0	0	
2.00	7.00	100	700	700	
2.50	7.50	201	75	775	
3.00	8.00	2552	688	1464	
3.50	8.50	13563	4029	5492	
4.00	9.00	28616	10545	16037	
4.50	9.50	57887	21626	37663	
5.00	10.00	80547	34609	72271	
5.50	10.50	104573	46280	118551	
6.00	11.00	127984	58139	176691	
6.50	11.50	143754	67935	244625	
7.00	12.00	156613	75092	319717	
7.50	12.50	168712	81331	401048	
8.00	13.00	173013	85431	486479	
8.50	13.50	175200	87053	573533	
9.00	14.00	176206	87852	661384	
19.00	24.00	176206	1762060	2423444	

SUBCATCHMENT STORAGE SUMMARY

FOR VIRGINIA BEACH SWMM MODEL

TIMMONS GROUP
YOUR VISION ACHIEVED THROUGH OURS.

Project Name: Ocean Park
Timmons Group Project No. 50568
Date: 3/13/2025
Calculated By: KRW

Subcatchment Area	**168,468 SF**	**3.87 AC**
Subcatchment Impervious	**38,690 SF**	**0.89 AC**
Impervious %	**23%**	
Storage Invert Elevation	**-5.0**	

Subcatchment: WS3_OP_41B				**STORAGE NODE: 03020-050**	**Curve Name: WS3_OP_41B@-5**
Elevation (NAVD88)	**Depth**	**Prop. Total Area**	**Incremental Storage**	**Total Storage**	**Notes**
FT	FT	SF	CF	CF	
-5.00	0.00	100	0	0	
2.50	7.50	100	750	750	
3.00	8.00	572	168	918	
3.50	8.50	31858	8108	9026	
4.00	9.00	78897	27689	36714	
4.50	9.50	108482	46845	83559	
5.00	10.00	121571	57513	141072	
5.50	10.50	130234	62951	204024	
6.00	11.00	141930	68041	272065	
6.50	11.50	156239	74542	346607	
7.00	12.00	162456	79674	426281	
7.50	12.50	165799	82064	508344	
8.00	13.00	167521	83330	591674	
8.50	13.50	168200	83930	675605	
9.00	14.00	168468	84167	759772	
19.00	24.00	168468	1684680	2444452	

SUBCATCHMENT STORAGE SUMMARY

FOR VIRGINIA BEACH SWMM MODEL

TIMMONS GROUP
YOUR VISION ACHIEVED THROUGH OURS.

Project Name: Ocean Park
Timmons Group Project No. 50568
Date: 3/13/2025
Calculated By: KRW

Subcatchment Area	**229,004 SF**	**5.26 AC**
Subcatchment Impervious	**120,253 SF**	**2.76 AC**
Impervious %	**52.5%**	
Storage Invert Elevation	**-10.0**	

Subcatchment: WS3_OP_43				**STORAGE NODE: 03020-046**	**Curve Name: WS3_OP_43@-10**
Elevation (NAVD88)	**Depth**	**Prop. Total Area**	**Incremental Storage**	**Total Storage**	**Notes**
FT	FT	SF	CF	CF	
-10.00	0.00	100	0	0	
1.50	11.50	100	1150	1150	
2.00	12.00	3504	901	2051	
2.50	12.50	14054	4390	6441	
3.00	13.00	49576	15908	22348	
3.50	13.50	89422	34750	57098	
4.00	14.00	110189	49903	107000	
4.50	14.50	124581	58693	165693	
5.00	15.00	141351	66483	232176	
5.50	15.50	156395	74437	306612	
6.00	16.00	171914	82077	388690	
6.50	16.50	189499	90353	479043	
7.00	17.00	208014	99378	578421	
7.50	17.50	216133	106037	684458	
8.00	18.00	223053	109797	794254	
8.50	18.50	228452	112876	907131	
9.00	19.00	229004	114364	1021495	
19.00	29.00	229004	2290040	3311535	

SUBCATCHMENT STORAGE SUMMARY

FOR VIRGINIA BEACH SWMM MODEL

TIMMONS GROUP
YOUR VISION ACHIEVED THROUGH OURS.

Project Name: Ocean Park
Timmons Group Project No. 50568
Date: 2/17/2025
Calculated By: KRW

Subcatchment Area	**613,714 SF**	**14.09 AC**
Subcatchment Impervious	**86,344 SF**	**1.98 AC**
Impervious %	**14.1%**	
Storage Invert Elevation	**-5.0**	

Subcatchment: WS3_OP_50				**STORAGE NODE: 03020-306**	**Curve Name: WS3_OP_50@-5**
Elevation (NAVD88)	**Depth**	**Prop. Total Area**	**Incremental Storage**	**Total Storage**	**Notes**
FT	FT	SF	CF	CF	
-5.00	0.00	100	0	0	
-0.50	4.50	100	450	450	
0.00	5.00	2287	597	1047	
0.50	5.50	16576	4716	5763	
1.00	6.00	32057	12158	17921	
1.50	6.50	46870	19732	37653	
2.00	7.00	79928	31700	69352	
2.50	7.50	124490	51105	120457	
3.00	8.00	184096	77147	197603	
3.50	8.50	238203	105575	303178	
4.00	9.00	289107	131828	435005	
4.50	9.50	380101	167302	602307	
5.00	10.00	460030	210033	812340	
5.50	10.50	504188	241055	1053395	
6.00	11.00	530314	258626	1312020	
6.50	11.50	551656	270493	1582513	
7.00	12.00	574384	281510	1864023	
7.50	12.50	593393	291944	2155967	
8.00	13.00	605008	299600	2455567	
8.50	13.50	610242	303813	2759380	
9.00	14.00	611388	305408	3064787	
9.50	14.50	611986	305844	3370631	
10.00	15.00	613196	306296	3676926	
10.50	15.50	613714	306728	3983654	
20.50	25.50	613714	6137140	10120794	

SUBCATCHMENT STORAGE SUMMARY

FOR VIRGINIA BEACH SWMM MODEL

TIMMONS GROUP
YOUR VISION ACHIEVED THROUGH OURS.

Project Name: Ocean Park
Timmons Group Project No. 50568
Date: 03/13/2025
Calculated By: KRW

Subcatchment Area	**25,565 SF**	**0.59 AC**
Subcatchment Impervious	**8,223 SF**	**0.19 AC**
Impervious %	**32.2%**	
Storage Invert Elevation	**-5.0**	

Subcatchment: WS3_OP_50A				**STORAGE NODE: 03020-626**	**Curve Name: WS3_OP_50A@-5**
Elevation (NAVD88)	**Depth**	**Prop. Total Area**	**Incremental Storage**	**Total Storage**	**Notes**
FT	FT	SF	CF	CF	
-5.00	0.00	100	0	0	
4.50	9.50	100	950	950	
5.00	10.00	121	55	1005	
5.50	10.50	1436	389	1395	
6.00	11.00	5796	1808	3203	
6.50	11.50	9698	3874	7076	
7.00	12.00	12069	5442	12518	
7.50	12.50	13904	6493	19011	
8.00	13.00	15564	7367	26378	
8.50	13.50	17909	8368	34746	
9.00	14.00	22605	10129	44875	
9.50	14.50	23959	11641	56516	
10.00	15.00	24848	12202	68718	
10.50	15.50	25544	12598	81316	
11.00	16.00	25565	12777	94093	
21.00	26.00	25565	255650	349743	

SUBCATCHMENT STORAGE SUMMARY

FOR VIRGINIA BEACH SWMM MODEL

TIMMONS GROUP
YOUR VISION ACHIEVED THROUGH OURS.

Project Name: Ocean Park
Timmons Group Project No. 50568
Date: 03/13/2025
Calculated By: KRW

Subcatchment Area	**39,783 SF**	**0.91 AC**
Subcatchment Impervious	**12,007 SF**	**0.28 AC**
Impervious %	**30.2%**	
Storage Invert Elevation	**-5.0**	

Subcatchment: WS3_OP_50B				**STORAGE NODE: 03020-624**	**Curve Name: WS3_OP_50B@-5**
Elevation (NAVD88)	**Depth**	**Prop. Total Area**	**Incremental Storage**	**Total Storage**	**Notes**
FT	FT	SF	CF	CF	
-5.00	0.00	100	0	0	
3.00	8.00	100	800	800	
3.50	8.50	100	50	850	
4.00	9.00	100	50	900	
4.50	9.50	248	87	987	
5.00	10.00	595	211	1198	
5.50	10.50	1848	611	1809	
6.00	11.00	11761	3402	5211	
6.50	11.50	18557	7580	12790	
7.00	12.00	22921	10370	23160	
7.50	12.50	28523	12861	36021	
8.00	13.00	32922	15361	51382	
8.50	13.50	37871	17698	69080	
9.00	14.00	39679	19388	88468	
9.50	14.50	39783	19866	108333	
19.50	24.50	39783	397830	506163	

SUBCATCHMENT STORAGE SUMMARY

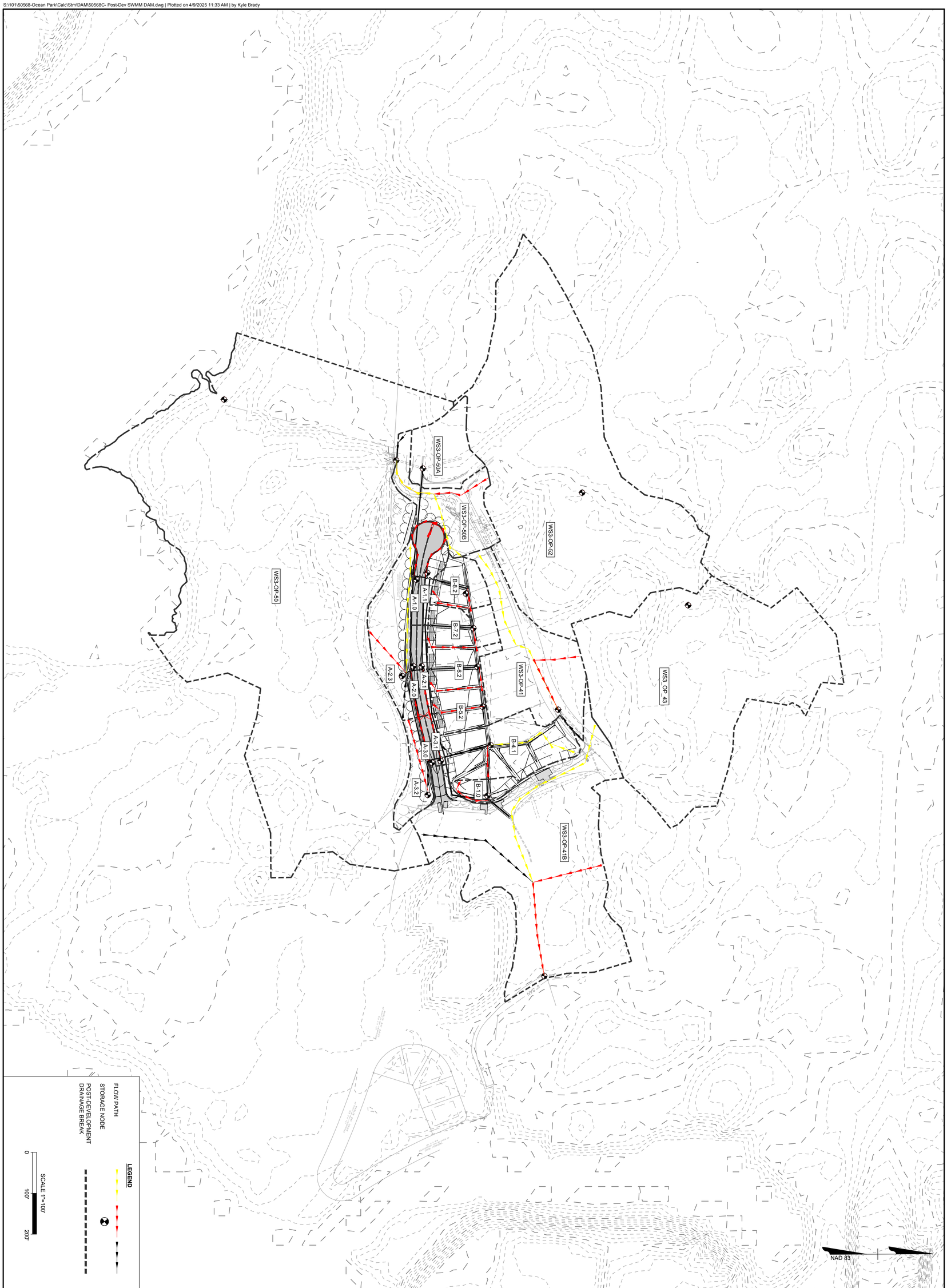
FOR VIRGINIA BEACH SWMM MODEL

TIMMONS GROUP
YOUR VISION ACHIEVED THROUGH OURS.

Project Name: Ocean Park
Timmons Group Project No. 50568
Date: 2/17/2025
Calculated By: KRW

Subcatchment Area	**294,930 SF**	**6.77 AC**
Subcatchment Impervious	**166,177 SF**	**3.81 AC**
Impervious %	**56.3%**	
Storage Invert Elevation	**-5.0**	

Subcatchment: WS3_OP_52				**STORAGE NODE: 03020-638**	**Curve Name: WS3_OP_52@-5**
Elevation (NAVD88)	**Depth**	**Prop. Total Area**	**Incremental Storage**	**Total Storage**	**Notes**
FT	FT	SF	CF	CF	
-5.00	0.00	100	0	0	
2.00	7.00	100	700	700	
2.50	7.50	1794	474	1174	
3.00	8.00	13205	3750	4923	
3.50	8.50	40450	13414	18337	
4.00	9.00	61100	25388	43725	
4.50	9.50	72724	33456	77181	
5.00	10.00	84157	39220	116401	
5.50	10.50	102825	46746	163146	
6.00	11.00	128287	57778	220924	
6.50	11.50	159576	71966	292890	
7.00	12.00	187568	86786	379676	
7.50	12.50	202419	97497	477173	
8.00	13.00	213488	103977	581150	
8.50	13.50	222578	109017	690166	
9.00	14.00	233183	113940	804106	
9.50	14.50	246155	119835	923941	
10.00	15.00	260689	126711	1050652	
10.50	15.50	277274	134491	1185143	
11.00	16.00	289218	141623	1326766	
11.50	16.50	291765	145246	1472011	
12.00	17.00	293679	146361	1618372	
12.50	17.50	294243	146981	1765353	
13.00	18.00	294651	147224	1912576	
13.50	18.50	294930	147395	2059972	
23.50	28.50	294930	2949300	5009272	



TIMMONS GROUP

YOUR VISION ACHIEVED THROUGH OURS.

THIS DRAWING PREPARED AT THE
VIRGINIA BEACH OFFICE
2901 South Lynnhaven Road, Suite 200 | Virginia Beach, VA 23452
TEL 757.213.6679 FAX 757.340.1415 www.timmons.com

COMMONWEALTH OF VIRGINIA
CHRISTOPHER T. ABBEL
Lic. No. 022317
04/09/2025
PROFESSIONAL ENGINEER

OCEAN PARK SUBDIVISION

CITY OF VIRGINIA BEACH, VA

POST DEVELOPMENT DRAINAGE AREA MAP

SHEET NO.	JOB NO.	SCALE	CHECKED BY	DESIGNED BY	DRAWN BY	DATE
POST	50568	1" = 100'	CA	KW	KB	04/09/2025

DATE	REVISION DESCRIPTION

SUBCATCHMENT STORAGE SUMMARY

FOR VIRGINIA BEACH SWMM MODEL

TIMMONS GROUP
YOUR VISION ACHIEVED THROUGH OURS.

Project Name: Ocean Park
Timmons Group Project No. 50568
Date: 3/6/2025
Calculated By: KRW

Subcatchment Area	**63,090 SF**	**1.45 AC**
Subcatchment Impervious	**52,756 SF**	**1.21 AC**
Impervious %	**83.6%**	
Storage Invert Elevation	**-5.0**	

Subcatchment: WS3_OP_41				**STORAGE NODE: 03020-022**	**Curve Name: WS3_OP_41@-5**
Elevation (NAVD88)	**Depth**	**Prop. Total Area**	**Incremental Storage**	**Total Storage**	**Notes**
FT	FT	SF	CF	CF	
-5.00	0.00	100	0	0	
3.50	8.50	100	850	850	
4.00	9.00	170	68	918	
4.50	9.50	5824	1499	2416	
5.00	10.00	18739	6141	8557	
5.50	10.50	25132	10968	19525	
6.00	11.00	35468	15150	34675	
6.50	11.50	40588	19014	53689	
7.00	12.00	46395	21746	75434	
7.50	12.50	51404	24450	99884	
8.00	13.00	57218	27156	127040	
8.50	13.50	63054	30068	157108	
9.00	14.00	63090	31536	188644	
19.00	24.00	63090	630900	819544	

SUBCATCHMENT STORAGE SUMMARY

FOR VIRGINIA BEACH SWMM MODEL

TIMMONS GROUP
YOUR VISION ACHIEVED THROUGH OURS.

Project Name: Ocean Park
Timmons Group Project No. 50568
Date: 3/6/2025
Calculated By: KRW

Subcatchment Area	**175,079 SF**	**4.02 AC**
Subcatchment Impervious	**44,028 SF**	**1.01 AC**
Impervious %	**25.1%**	
Storage Invert Elevation	**-5.0**	

Subcatchment: WS3_OP_41B				**STORAGE NODE: 03000-050**	**Curve Name: WS3_OP_41B@-5**
Elevation (NAVD88)	**Depth**	**Prop. Total Area**	**Incremental Storage**	**Total Storage**	**Notes**
FT	FT	SF	CF	CF	
-5.00	0.00	100	0	0	
2.50	7.50	100	750	750	
3.00	8.00	572	168	918	
3.50	8.50	31858	8108	9026	
4.00	9.00	78933	27698	36723	
4.50	9.50	109060	46998	83722	
5.00	10.00	123182	58061	141782	
5.50	10.50	132783	63991	205773	
6.00	11.00	145281	69516	275289	
6.50	11.50	160481	76441	351730	
7.00	12.00	168601	82271	434000	
7.50	12.50	172449	85263	519263	
8.00	13.00	174171	86655	605918	
8.50	13.50	174850	87255	693173	
9.00	14.00	175079	87482	780655	
19.00	24.00	175079	1750790	2531445	

SUBCATCHMENT STORAGE SUMMARY

FOR VIRGINIA BEACH SWMM MODEL

TIMMONS GROUP
YOUR VISION ACHIEVED THROUGH OURS.

Project Name: Ocean Park
Timmons Group Project No. 50568
Date: 3/6/2025
Calculated By: KRW

Subcatchment Area	**32,143 SF**	**0.74 AC**
Subcatchment Impervious	**12,108 SF**	**0.28 AC**
Impervious %	**37.7%**	
Storage Invert Elevation	**-5.0**	

Subcatchment: WS3_OP_50B				**STORAGE NODE: 03020-624**	**Curve Name: WS3_OP_50B@-5**
Elevation (NAVD88)	**Depth**	**Prop. Total Area**	**Incremental Storage**	**Total Storage**	**Notes**
FT	FT	SF	CF	CF	
-5.00	0.00	100	0	0	
3.00	8.00	100	800	800	
3.50	8.50	100	50	850	
4.00	9.00	100	50	900	
4.50	9.50	248	87	987	
5.00	10.00	595	211	1198	
5.50	10.50	1848	611	1809	
6.00	11.00	11766	3404	5212	
6.50	11.50	18533	7575	12787	
7.00	12.00	22530	10266	23053	
7.50	12.50	24414	11736	34789	
8.00	13.00	26998	12853	47642	
8.50	13.50	30511	14377	62019	
9.00	14.00	32031	15636	77654	
9.50	14.50	32143	16044	93698	
19.50	24.50	32143	321430	415128	

SUBCATCHMENT STORAGE SUMMARY

FOR VIRGINIA BEACH SWMM MODEL

TIMMONS GROUP
YOUR VISION ACHIEVED THROUGH OURS.

Project Name: Ocean Park
Timmons Group Project No. 50568
Date: 3/6/2025
Calculated By: KRW

Subcatchment Area	**5,449 SF**	**0.13 AC**
Subcatchment Impervious	**5,449 SF**	**0.13 AC**
Impervious %	**100.0%**	
Storage Invert Elevation	**-5.0**	

Subcatchment: A-1.0				**STORAGE NODE: A1.0**	**Curve Name: A1.0@-5**
Elevation (NAVD88)	**Depth**	**Prop. Total Area**	**Incremental Storage**	**Total Storage**	**Notes**
FT	FT	SF	CF	CF	
-5.00	0.00	100	0	0	
6.50	11.50	100	1150	1150	
7.00	12.00	631	183	1333	
7.50	12.50	4668	1325	2658	
8.00	13.00	5447	2529	5186	
8.50	13.50	5449	2724	7910	
18.5	23.50	5449	54490	62400	

PROPOSED

SUBCATCHMENT STORAGE SUMMARY

FOR VIRGINIA BEACH SWMM MODEL

TIMMONS GROUP
YOUR VISION ACHIEVED THROUGH OURS.

Project Name: Ocean Park
Timmons Group Project No. 50568
Date: 3/6/2025
Calculated By: KRW

Subcatchment Area	**9,924 SF**	**0.23 AC**
Subcatchment Impervious	**7,049 SF**	**0.16 AC**
Impervious %	**71.0%**	
Storage Invert Elevation	**-5.0**	

Subcatchment: A-1.1				**STORAGE NODE: A1.1**	**Curve Name: A1.1@-5**
Elevation (NAVD88)	**Depth**	**Prop. Total Area**	**Incremental Storage**	**Total Storage**	**Notes**
FT	FT	SF	CF	CF	
-5.00	0.00	100	0	0	
6.50	11.50	100	1150	1150	
7.00	12.00	609	177	1327	
7.50	12.50	6012	1655	2983	
8.00	13.00	9241	3813	6796	
8.50	13.50	9781	4756	11551	
9.00	14.00	9924	4926	16478	
19	24.00	9924	99240	115718	

SUBCATCHMENT STORAGE SUMMARY

FOR VIRGINIA BEACH SWMM MODEL

TIMMONS GROUP
YOUR VISION ACHIEVED THROUGH OURS.

Project Name: Ocean Park
Timmons Group Project No. 50568
Date: 3/6/2025
Calculated By: KRW

Subcatchment Area	**3,488 SF**	**0.08 AC**
Subcatchment Impervious	**3,488 SF**	**0.08 AC**
Impervious %	**100.0%**	
Storage Invert Elevation	**-5.0**	

Subcatchment: A-2.0				**STORAGE NODE: A2.0**	**Curve Name: A2.0@-5**
Elevation (NAVD88)	**Depth**	**Prop. Total Area**	**Incremental Storage**	**Total Storage**	**Notes**
FT	FT	SF	CF	CF	
-5.00	0.00	100	0	0	
6.50	11.50	100	1150	1150	
7.00	12.00	643	186	1336	
7.50	12.50	3480	1031	2367	
8.00	13.00	3488	1742	4109	
18.00	23.00	3488	34880	38989	

PROPOSED

SUBCATCHMENT STORAGE SUMMARY

FOR VIRGINIA BEACH SWMM MODEL

TIMMONS GROUP
YOUR VISION ACHIEVED THROUGH OURS.

Project Name: Ocean Park
Timmons Group Project No. 50568
Date: 3/6/2025
Calculated By: KRW

Subcatchment Area	**5,849 SF**	**0.13 AC**
Subcatchment Impervious	**4,317 SF**	**0.10 AC**
Impervious %	**73.8%**	
Storage Invert Elevation	**-5.0**	

Subcatchment: A-2.1				**STORAGE NODE: A2.1**	**Curve Name: A2.1@-5**
Elevation (NAVD88)	**Depth**	**Prop. Total Area**	**Incremental Storage**	**Total Storage**	**Notes**
FT	FT	SF	CF	CF	
-5.00	0.00	100	0	0	
6.50	11.50	100	1150	1150	
7.00	12.00	620	180	1330	
7.50	12.50	4893	1378	2708	
8.00	13.00	5849	2686	5394	
18.00	23.00	5849	58490	63884	

PROPOSED

SUBCATCHMENT STORAGE SUMMARY

FOR VIRGINIA BEACH SWMM MODEL

TIMMONS GROUP
YOUR VISION ACHIEVED THROUGH OURS.

Project Name: Ocean Park
Timmons Group Project No. 50568
Date: 3/6/2025
Calculated By: KRW

Subcatchment Area	**32,213 SF**	**0.74 AC**
Subcatchment Impervious	**2,358 SF**	**0.05 AC**
Impervious %	**7.3%**	
Storage Invert Elevation	**-5.0**	

Subcatchment: A-2.2				**STORAGE NODE: A2.2**	**Curve Name: A2.2@-5**
Elevation (NAVD88)	**Depth**	**Prop. Total Area**	**Incremental Storage**	**Total Storage**	**Notes**
FT	FT	SF	CF	CF	
-5.00	0.00	100	0	0	
5.00	10.00	334	2170	2170	
5.50	10.50	5026	1340	3510	
6.00	11.00	13466	4623	8133	
6.50	11.50	19972	8360	16493	
7.00	12.00	23995	10992	27484	
7.50	12.50	31429	13856	41340	
8.00	13.00	32213	15911	57251	
18.00	23.00	32213	322130	379381	

PROPOSED

SUBCATCHMENT STORAGE SUMMARY

FOR VIRGINIA BEACH SWMM MODEL

TIMMONS GROUP
YOUR VISION ACHIEVED THROUGH OURS.

Project Name: Ocean Park
Timmons Group Project No. 50568
Date: 3/6/2025
Calculated By: KRW

Subcatchment Area	**1,953 SF**	**0.04 AC**
Subcatchment Impervious	**1,953 SF**	**0.04 AC**
Impervious %	**100.0%**	
Storage Invert Elevation	**-5.0**	

Subcatchment: A-3.0				**STORAGE NODE: A3.0**	**Curve Name: A3.0@-5**
Elevation (NAVD88)	**Depth**	**Prop. Total Area**	**Incremental Storage**	**Total Storage**	**Notes**
FT	FT	SF	CF	CF	
-5.00	0.00	100	0	0	
6.50	11.50	100	1150	1150	
7.00	12.00	461	140	1290	
7.50	12.50	1948	602	1893	
8.00	13.00	1953	975	2868	
18.00	23.00	1953	19530	22398	

PROPOSED

SUBCATCHMENT STORAGE SUMMARY

FOR VIRGINIA BEACH SWMM MODEL

TIMMONS GROUP
YOUR VISION ACHIEVED THROUGH OURS.

Project Name: Ocean Park
Timmons Group Project No. 50568
Date: 3/6/2025
Calculated By: KRW

Subcatchment Area	**3,171 SF**	**0.07 AC**
Subcatchment Impervious	**2,342 SF**	**0.05 AC**
Impervious %	**73.9%**	
Storage Invert Elevation	**-5.0**	

Subcatchment: A-3.1				**STORAGE NODE: A3.1**	**Curve Name: A3.1@-5**
Elevation (NAVD88)	**Depth**	**Prop. Total Area**	**Incremental Storage**	**Total Storage**	**Notes**
FT	FT	SF	CF	CF	
-5.00	0.00	100	0	0	
6.50	11.50	100	1150	1150	
7.00	12.00	470	143	1293	
7.50	12.50	2791	815	2108	
8.00	13.00	3171	1491	3598	
18.00	23.00	3171	31710	35308	

PROPOSED

SUBCATCHMENT STORAGE SUMMARY

FOR VIRGINIA BEACH SWMM MODEL

TIMMONS GROUP
YOUR VISION ACHIEVED THROUGH OURS.

Project Name: Ocean Park
Timmons Group Project No. 50568
Date: 3/6/2025
Calculated By: KRW

Subcatchment Area	**13,986 SF**	**0.32 AC**
Subcatchment Impervious	**1,235 SF**	**0.03 AC**
Impervious %	**8.8%**	
Storage Invert Elevation	**-5.0**	

Subcatchment: A-3.2				**STORAGE NODE: A3.2**	**Curve Name: A3.2@-5**
Elevation (NAVD88)	**Depth**	**Prop. Total Area**	**Incremental Storage**	**Total Storage**	**Notes**
FT	FT	SF	CF	CF	
-5.00	0.00	100	0	0	
3.50	8.50	100	850	850	
4.00	9.00	406	127	977	
4.50	9.50	4986	1348	2325	
5.00	10.00	10257	3811	6135	
5.50	10.50	12936	5798	11934	
6.00	11.00	13287	6556	18489	
6.50	11.50	13521	6702	25191	
7.00	12.00	13738	6815	32006	
7.50	12.50	13981	6930	38936	
8.00	13.00	13986	6992	45928	
18.00	23.00	13986	139860	185788	

PROPOSED

SUBCATCHMENT STORAGE SUMMARY

FOR VIRGINIA BEACH SWMM MODEL

TIMMONS GROUP
YOUR VISION ACHIEVED THROUGH OURS.

Project Name: Ocean Park
Timmons Group Project No. 50568
Date: 3/6/2025
Calculated By: KRW

Subcatchment Area	**7,149 SF**	**0.16 AC**
Subcatchment Impervious	**5,362 SF**	**0.12 AC**
Impervious %	**75.0%**	
Storage Invert Elevation	**-5.0**	

Subcatchment: ST-B1.0				**STORAGE NODE: B1.0**	**Curve Name: B1.0@-5**
Elevation (NAVD88)	**Depth**	**Prop. Total Area**	**Incremental Storage**	**Total Storage**	**Notes**
FT	FT	SF	CF	CF	
-5.00	0.00	100	0	0	
3.00	8.00	100	800	800	
3.50	8.50	100	50	850	
4.00	9.00	341	110	960	
4.50	9.50	1064	351	1312	
5.00	10.00	1985	762	2074	
5.50	10.50	3668	1413	3487	
6.00	11.00	6891	2640	6127	
6.50	11.50	7149	3510	9637	
7.00	12.00	7149	3575	13211	
17.00	22.00	7149	71490	84701	

PROPOSED

SUBCATCHMENT STORAGE SUMMARY

FOR VIRGINIA BEACH SWMM MODEL

TIMMONS GROUP
YOUR VISION ACHIEVED THROUGH OURS.

Project Name: Ocean Park
Timmons Group Project No. 50568
Date: 3/6/2025
Calculated By: KRW

Subcatchment Area	**39,823 SF**	**0.91 AC**
Subcatchment Impervious	**26,157 SF**	**0.60 AC**
Impervious %	**65.7%**	
Storage Invert Elevation	**-5.0**	

Subcatchment: B-4.1				**STORAGE NODE: B4.1**	**Curve Name: B4.1@-5**
Elevation (NAVD88)	**Depth**	**Prop. Total Area**	**Incremental Storage**	**Total Storage**	**Notes**
FT	FT	SF	CF	CF	
-5.00	0.00	100	0	0	
2.00	7.00	100	700	700	
2.50	7.50	100	50	750	
3.00	8.00	319	105	855	
3.50	8.50	2675	749	1603	
4.00	9.00	4998	1918	3522	
4.50	9.50	7912	3228	6749	
5.00	10.00	10214	4532	11281	
5.50	10.50	16401	6654	17934	
6.00	11.00	25806	10552	28486	
6.50	11.50	33557	14841	43327	
7.00	12.00	38897	18114	61440	
7.50	12.50	39820	19679	81120	
8.00	13.00	39823	19911	101030	
18.00	23.00	39823	398230	499260	

SUBCATCHMENT STORAGE SUMMARY

FOR VIRGINIA BEACH SWMM MODEL

TIMMONS GROUP
YOUR VISION ACHIEVED THROUGH OURS.

Project Name: Ocean Park
Timmons Group Project No. 50568
Date: 3/6/2025
Calculated By: KRW

Subcatchment Area	**13,167 SF**	**0.30 AC**
Subcatchment Impervious	**9,875 SF**	**0.23 AC**
Impervious %	**75.0%**	
Storage Invert Elevation	**-5.0**	

Subcatchment: B-5.2				**STORAGE NODE: B5.2**	**Curve Name: B5.2@-5**
Elevation (NAVD88)	**Depth**	**Prop. Total Area**	**Incremental Storage**	**Total Storage**	**Notes**
FT	FT	SF	CF	CF	
-5.00	0.00	100	0	0	
3.50	8.50	100	850	850	
4.00	9.00	453	138	988	
4.50	9.50	785	310	1298	
5.00	10.00	1002	447	1745	
5.50	10.50	1808	703	2447	
6.00	11.00	5017	1706	4153	
6.50	11.50	8436	3363	7517	
7.00	12.00	11530	4992	12508	
7.50	12.50	12896	6107	18615	
8.00	13.00	13167	6516	25130	
18.00	23.00	13167	131670	156800	

SUBCATCHMENT STORAGE SUMMARY

FOR VIRGINIA BEACH SWMM MODEL

TIMMONS GROUP
YOUR VISION ACHIEVED THROUGH OURS.

Project Name: Ocean Park
Timmons Group Project No. 50568
Date: 3/6/2025
Calculated By: KRW

Subcatchment Area	**14,425 SF**	**0.33 AC**
Subcatchment Impervious	**10,379 SF**	**0.24 AC**
Impervious %	**71.9%**	
Storage Invert Elevation	**-5.0**	

Subcatchment: B-6.2				**STORAGE NODE: B6.2**	**Curve Name: B6.2@-5**
Elevation (NAVD88)	**Depth**	**Prop. Total Area**	**Incremental Storage**	**Total Storage**	**Notes**
FT	FT	SF	CF	CF	
-5.00	0.00	100	0	0	
4.00	9.00	100	900	900	
4.50	9.50	629	182	1082	
5.00	10.00	1373	501	1583	
5.50	10.50	2219	898	2481	
6.00	11.00	4213	1608	4089	
6.50	11.50	8796	3252	7341	
7.00	12.00	12868	5416	12757	
7.50	12.50	14394	6816	19573	
8.00	13.00	14425	7205	26777	
18.00	23.00	14425	144250	171027	

SUBCATCHMENT STORAGE SUMMARY

FOR VIRGINIA BEACH SWMM MODEL

TIMMONS GROUP
YOUR VISION ACHIEVED THROUGH OURS.

Project Name: Ocean Park
Timmons Group Project No. 50568
Date: 3/6/2025
Calculated By: KRW

Subcatchment Area	**16,049 SF**	**0.37 AC**
Subcatchment Impervious	**11,589 SF**	**0.27 AC**
Impervious %	**72.2%**	
Storage Invert Elevation	**-5.0**	

Subcatchment: B-7.2				**STORAGE NODE: B7.2**	**Curve Name: B7.2@-5**
Elevation (NAVD88)	**Depth**	**Prop. Total Area**	**Incremental Storage**	**Total Storage**	**Notes**
FT	FT	SF	CF	CF	
-5.00	0.00	100	0	0	
4.50	9.50	150	1188	1188	
5.00	10.00	553	176	1363	
5.50	10.50	2304	714	2078	
6.00	11.00	6255	2140	4217	
6.50	11.50	9552	3952	8169	
7.00	12.00	14041	5898	14067	
7.50	12.50	15610	7413	21480	
8.00	13.00	16049	7915	29395	
18.00	23.00	16049	160490	189885	

SUBCATCHMENT STORAGE SUMMARY

FOR VIRGINIA BEACH SWMM MODEL

TIMMONS GROUP
YOUR VISION ACHIEVED THROUGH OURS.

Project Name: Ocean Park
Timmons Group Project No. 50568
Date: 3/6/2025
Calculated By: KRW

Subcatchment Area	**14,339 SF**	**0.33 AC**
Subcatchment Impervious	**10,350 SF**	**0.24 AC**
Impervious %	**72.2%**	
Storage Invert Elevation	**-5.0**	

Subcatchment: B-8.2				**STORAGE NODE: B8.2**	**Curve Name: B8.2@-5**
Elevation (NAVD88)	**Depth**	**Prop. Total Area**	**Incremental Storage**	**Total Storage**	**Notes**
FT	FT	SF	CF	CF	
-5.00	0.00	100	0	0	
5.50	10.50	100	1050	1050	
6.00	11.00	703	201	1251	
6.50	11.50	2428	783	2034	
7.00	12.00	5511	1985	4018	
7.50	12.50	9903	3854	7872	
8.00	13.00	12502	5601	13473	
8.50	13.50	14088	6648	20121	
9	14.00	14339	7107	27227	
19	24.00	14339	143390	170617	

PROPOSED

SUBCATCHMENT STORAGE SUMMARY

FOR VIRGINIA BEACH SWMM MODEL

TIMMONS GROUP
YOUR VISION ACHIEVED THROUGH OURS.

Project Name: Ocean Park
Timmons Group Project No. 50568
Date: 4/7/2025
Calculated By: KRW

Storage Invert Elevation **0.0**

Subcatchment: B-5.2				STORAGE NODE: B-5.1	Curve Name: BMP1@0
Elevation (NAVD88)	**Depth**	**Prop. Total Area**	**Incremental Storage**	**Total Storage**	**Notes**
FT	FT	SF	CF	CF	
0	0.00	100	0	0	Bedding Stone
0.11	0.11	100	11	11	
0.12	0.12	740	4	15	Stone Below SHWT
1.49	1.49	740	1014	1029	
1.5	1.50	740	7	1036	Seasonal High Ground Water Table
1.6	1.60	813	78	1114	Perforated 24" Pipes (4) & Stone
1.7	1.70	841	83	1197	
1.8	1.80	860	85	1282	
1.9	1.90	874	87	1369	
2	2.00	885	88	1456	
2.1	2.10	894	89	1545	
2.2	2.20	900	90	1635	
2.3	2.30	905	90	1725	
2.4	2.40	907	91	1816	
2.5	2.50	908	91	1907	
2.6	2.60	907	91	1997	
2.7	2.70	905	91	2088	
2.8	2.80	900	90	2178	
2.81	2.81	563	7	2186	
3.3	3.30	549	272	2458	
3.31	3.31	100	3	2461	Above Ground Storage
16	16.00	100	1269	3730	

BMP Storage Provided = 1429 CF

PROPOSED

SUBCATCHMENT STORAGE SUMMARY

FOR VIRGINIA BEACH SWMM MODEL

TIMMONS GROUP
YOUR VISION ACHIEVED THROUGH OURS.

Project Name: Ocean Park
Timmons Group Project No. 50568
Date: 4/7/2025
Calculated By: KRW

Storage Invert Elevation **0.0**

Subcatchment: B-6.2				**STORAGE NODE: B-6.1**	**Curve Name: BMP2@0**
Elevation (NAVD88)	**Depth**	**Prop. Total Area**	**Incremental Storage**	**Total Storage**	**Notes**
FT	FT	SF	CF	CF	
0	0.00	100	0	0	Bedding Stone
0.66	0.66	100	66	66	
0.67	0.67	740	4	70	Stone Below SHWT
1.49	1.49	740	607	677	
1.5	1.50	740	7	684	Seasonal High Ground Water Table
1.6	1.60	813	78	762	Perforated 24" Pipes (4) & Stone
1.7	1.70	841	83	845	
1.8	1.80	860	85	930	
1.9	1.90	874	87	1017	
2	2.00	885	88	1104	
2.1	2.10	894	89	1193	
2.2	2.20	900	90	1283	
2.3	2.30	905	90	1373	
2.4	2.40	907	91	1464	
2.5	2.50	908	91	1555	
2.6	2.60	907	91	1645	
2.7	2.70	905	91	1736	
2.8	2.80	900	90	1826	
2.9	2.90	894	90	1916	
3	3.00	885	89	2005	
3.1	3.10	874	88	2093	
3.2	3.20	860	87	2180	
3.3	3.30	841	85	2265	
3.4	3.40	813	83	2347	

PROPOSED

SUBCATCHMENT STORAGE SUMMARY

FOR VIRGINIA BEACH SWMM MODEL

TIMMONS GROUP
YOUR VISION ACHIEVED THROUGH OURS.

Project Name: Ocean Park
Timmons Group Project No. 50568
Date: 4/7/2025
Calculated By: KRW

Storage Invert Elevation **0.0**

Subcatchment: B-6.2				**STORAGE NODE: B-6.1**	**Curve Name: BMP2@0**
Elevation (NAVD88)	**Depth**	**Prop. Total Area**	**Incremental Storage**	**Total Storage**	**Notes**
FT	FT	SF	CF	CF	
3.45	3.45	740	39	2386	Perforated 24" Pipes (4) & Stone
3.46	3.46	300	5	2391	
3.95	3.95	300	147	2538	
3.96	3.96	100	2	2540	Above Ground Storage
16	16.00	100	1204	3744	

BMP Storage Provided = 1861 CF

SUBCATCHMENT STORAGE SUMMARY

FOR VIRGINIA BEACH SWMM MODEL

TIMMONS GROUP
YOUR VISION ACHIEVED THROUGH OURS.

Project Name: Ocean Park
Timmons Group Project No. 50568
Date: 4/7/2025
Calculated By: KRW

Storage Invert Elevation **0.0**

Subcatchment: B-7.2				STORAGE NODE: B-7.1	Curve Name: BMP3@0
Elevation (NAVD88)	**Depth**	**Prop. Total Area**	**Incremental Storage**	**Total Storage**	**Notes**
FT	FT	SF	CF	CF	
0	0.00	100	0	0	Bedding Stone
0.66	0.66	100	66	66	
0.67	0.67	668	4	70	Stone Below SHWT
1.49	1.49	668	548	618	
1.5	1.50	668	7	624	Seasonal High Ground Water Table
1.6	1.60	741	70	695	Perforated 24" Pipes (4) & Stone
1.7	1.70	769	75	770	
1.8	1.80	788	78	848	
1.9	1.90	802	79	928	
2	2.00	813	81	1008	
2.1	2.10	822	82	1090	
2.2	2.20	828	83	1173	
2.3	2.30	833	83	1256	
2.4	2.40	835	83	1339	
2.5	2.50	836	84	1423	
2.6	2.60	835	84	1506	
2.7	2.70	833	83	1590	
2.8	2.80	828	83	1673	
2.9	2.90	822	83	1755	
3	3.00	813	82	1837	
3.1	3.10	802	81	1918	
3.2	3.20	788	80	1997	
3.3	3.30	769	78	2075	
3.4	3.40	741	76	2150	

SUBCATCHMENT STORAGE SUMMARY

FOR VIRGINIA BEACH SWMM MODEL

TIMMONS GROUP
YOUR VISION ACHIEVED THROUGH OURS.

Project Name: Ocean Park
Timmons Group Project No. 50568
Date: 4/7/2025
Calculated By: KRW

Storage Invert Elevation **0.0**

Subcatchment: B-7.2				STORAGE NODE: B-7.1	Curve Name: BMP3@0
Elevation (NAVD88)	**Depth**	**Prop. Total Area**	**Incremental Storage**	**Total Storage**	**Notes**
FT	FT	SF	CF	CF	
3.5	3.50	668	70	2221	Perforated 24" Pipes (4) & Stone
3.51	3.51	300	5	2226	
4	4.00	300	147	2373	
4.01	4.01	100	2	2375	Above Ground Storage
16	16.00	100	1199	3574	

SUBCATCHMENT STORAGE SUMMARY

FOR VIRGINIA BEACH SWMM MODEL

TIMMONS GROUP
YOUR VISION ACHIEVED THROUGH OURS.

Project Name: Ocean Park
Timmons Group Project No. 50568
Date: 4/7/2025
Calculated By: KRW

Storage Invert Elevation **0.0**

Subcatchment: B-8.2				STORAGE NODE: B-8.1	Curve Name: BMP4@0
Elevation (NAVD88)	**Depth**	**Prop. Total Area**	**Incremental Storage**	**Total Storage**	**Notes**
FT	FT	SF	CF	CF	
0	0.00	100	0	0	Bedding Stone
0.66	0.66	100	66	66	
0.67	0.67	600	4	70	Stone Below SHWT
1.49	1.49	600	492	562	
1.5	1.50	600	6	568	Seasonal High Ground Water Table
1.6	1.60	685	64	632	Perforated 24" Pipes (4) & Stone
1.7	1.70	717	70	702	
1.8	1.80	739	73	775	
1.9	1.90	756	75	849	
2	2.00	768	76	926	
2.1	2.10	778	77	1003	
2.2	2.20	785	78	1081	
2.3	2.30	790	79	1160	
2.4	2.40	793	79	1239	
2.5	2.50	794	79	1318	
2.6	2.60	793	79	1398	
2.7	2.70	790	79	1477	
2.8	2.80	785	79	1556	
2.9	2.90	778	78	1634	
3	3.00	768	77	1711	
3.1	3.10	756	76	1787	
3.2	3.20	739	75	1862	
3.3	3.30	717	73	1935	
3.4	3.40	685	70	2005	

SUBCATCHMENT STORAGE SUMMARY
FOR VIRGINIA BEACH SWMM MODEL

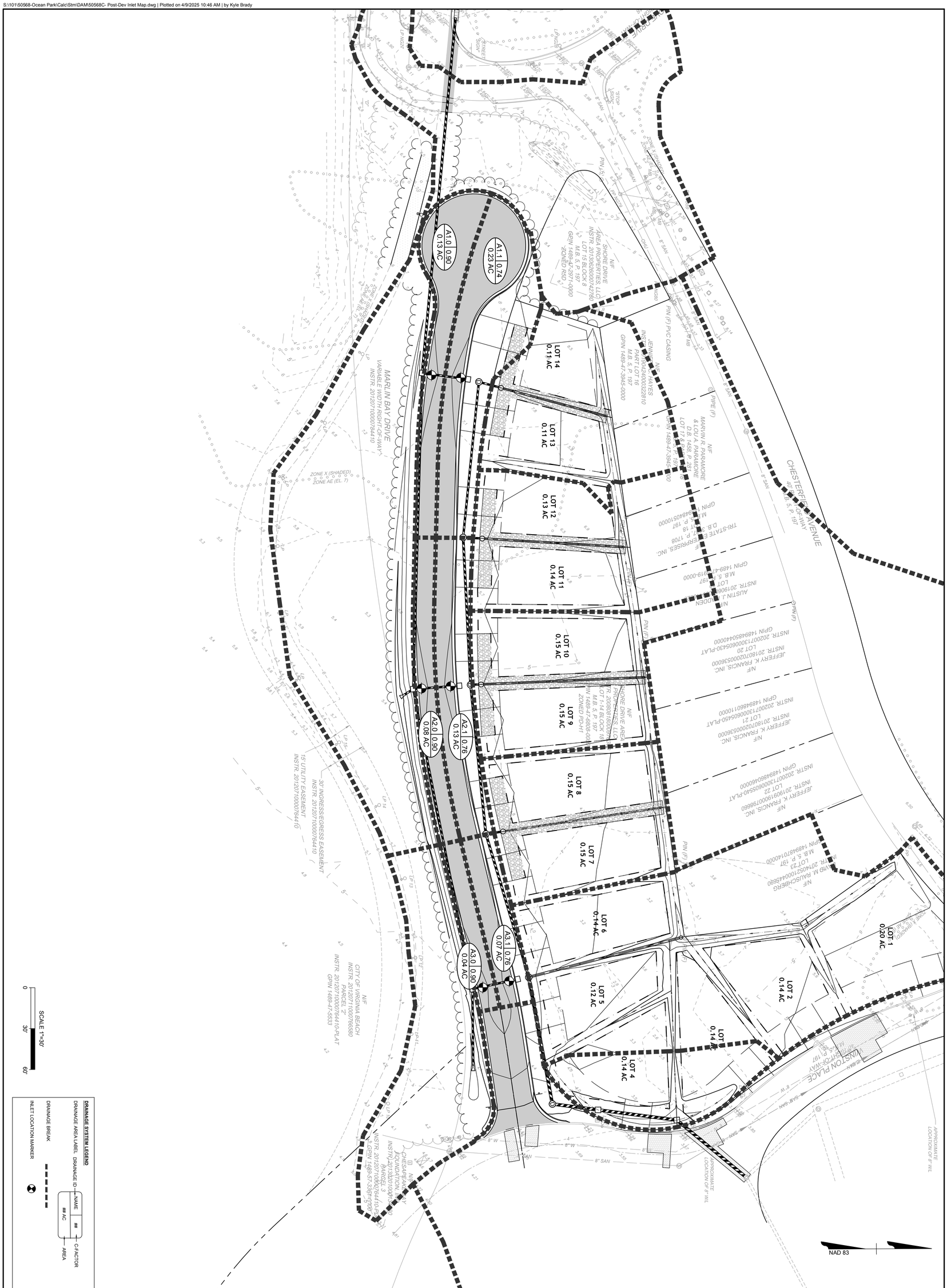
TIMMONS GROUP
YOUR VISION ACHIEVED THROUGH OURS.

Project Name: Ocean Park
Timmons Group Project No. 50568
Date: 4/7/2025
Calculated By: KRW

Storage Invert Elevation **0.0**

Subcatchment: B-8.2				STORAGE NODE: B-8.1	Curve Name: BMP4@0
Elevation (NAVD88)	**Depth**	**Prop. Total Area**	**Incremental Storage**	**Total Storage**	**Notes**
FT	FT	SF	CF	CF	
3.5	3.50	600	64	2069	Perforated 24" Pipes (4) & Stone
3.6	3.60	600	60	2129	
3.7	3.70	600	60	2189	
3.8	3.80	600	60	2249	
3.9	3.90	600	60	2309	
4	4.00	600	60	2369	
4.1	4.10	600	60	2429	
4.2	4.20	600	60	2489	
4.3	4.30	600	60	2549	
4.4	4.40	600	60	2609	
4.5	4.50	600	60	2669	
4.6	4.60	600	60	2729	
4.7	4.70	600	60	2789	
4.8	4.80	600	60	2849	
4.86	4.86	600	36	2885	
4.87	4.87	332	5	2890	
5.36	5.36	332	163	3052	
5.37	5.37	100	2	3055	Above Ground Storage
16	16.00	100	1063	4118	

S:\101\50568-Ocean Park\Calc\Stm\DAM\50568C- Post-Dev Inlet Map.dwg | Plotted on 4/9/2025 10:46 AM | by Kyle Brady



TIMMONS GROUP

YOUR VISION ACHIEVED THROUGH OURS.

THIS DRAWING PREPARED AT THE
VIRGINIA BEACH OFFICE
2901 South Lynnhaven Road, Suite 200 | Virginia Beach, VA 23452
TEL 757.213.6679 FAX 757.340.1415 www.timmons.com

COMMONWEALTH OF VIRGINIA
CHRISTOPHER T. ABERG
Lic. No. 032137
04/09/2025
PROFESSIONAL ENGINEER

OCEAN PARK SUBDIVISION

CITY OF VIRGINIA BEACH, VA

POST DEVELOPMENT INLET AREA MAP

SHEET NO.	JOB NO.	SCALE	CHECKED BY	DESIGNED BY	DRAWN BY	DATE
POST	50568	1" = 30'	CA	KW	KB	04/09/2025

DATE	REVISION DESCRIPTION

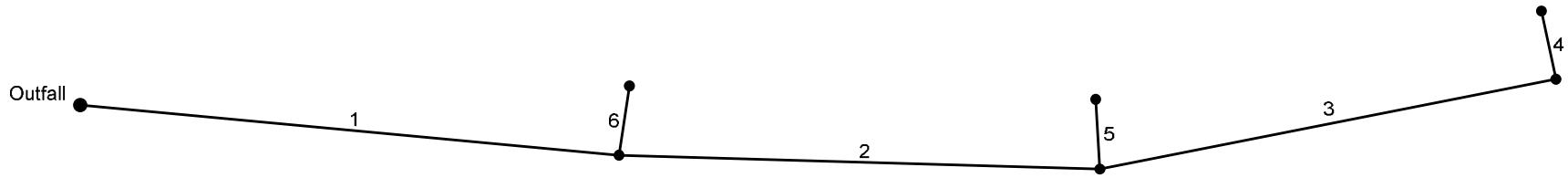
AREA AND C-FACTOR COMPUTATIONS

STORM SEWER SYSTEM

Project Name: Ocean Park Subdivision
Timmons Group Project No. 50568
Date: 04/08/2025
Calculated By: KB

Storm Structure ID	Total Area (SF)	Total Area (Acres)	Forest/Open Space (SF)	(Acres)	C[1]	Turf & Mulch Cover (SF)	(Acres)	C[1]	Impervious Cover (SF)	(Acres)	C[1]	Weighted C
A1.0	5,449	**0.13**	0	0.00	0.30	0	0.00	0.35	5,449	0.13	0.90	**0.90**
A1.1	9,924	**0.23**	0	0.00	0.30	2,875	0.07	0.35	7,049	0.16	0.90	**0.74**
A2.0	3,488	**0.08**	0	0.00	0.30	0	0.00	0.35	3,488	0.08	0.90	**0.90**
A2.1	5,849	**0.13**	0	0.00	0.30	1,532	0.04	0.35	4,317	0.10	0.90	**0.76**
A3.0	1,953	**0.04**	0	0.00	0.30	0	0.00	0.35	1,953	0.04	0.90	**0.90**
A3.1	3,171	**0.07**	0	0.00	0.30	829	0.02	0.35	2,342	0.05	0.90	**0.76**

Hydraflow Storm Sewers Extension for Autodesk® Civil 3D® Plan



Project File: 50568 - Inlet Spread Calculation.stm	Number of lines: 6	Date: 4/8/2025

Inlet Report

Line No	Inlet ID	Q = CIA (cfs)	Q carry (cfs)	Q capt (cfs)	Q Byp (cfs)	Junc Type	Curb Inlet		Grate Inlet			Gutter							Inlet			Byp Line No
							Ht (in)	L (ft)	Area (sqft)	L (ft)	W (ft)	So (ft/ft)	W (ft)	Sw (ft/ft)	Sx (ft/ft)	n	Depth (ft)	Spread (ft)	Depth (ft)	Spread (ft)	Depr (in)	
1	A1.0	0.47	0.00	0.47	0.00	Curb	4.0	2.50	0.00	0.00	0.00	Sag	2.00	0.083	0.021	0.013	0.23	4.93	0.39	4.93	2.0	Off
2	A2.0	0.29	0.00	0.29	0.00	Curb	4.0	2.50	0.00	0.00	0.00	Sag	2.00	0.083	0.021	0.013	0.20	3.57	0.37	3.57	2.0	Off
3	A3.0	0.14	0.00	0.14	0.00	Curb	4.0	2.50	0.00	0.00	0.00	Sag	2.00	0.083	0.021	0.013	0.17	2.25	0.34	2.25	2.0	Off
4	A3.1	0.21	0.00	0.21	0.00	Curb	4.0	2.50	0.00	0.00	0.00	Sag	2.00	0.083	0.021	0.013	0.19	2.91	0.35	2.91	2.0	Off
5	A2.1	0.40	0.00	0.40	0.00	Curb	4.0	2.50	0.00	0.00	0.00	Sag	2.00	0.083	0.021	0.013	0.22	4.40	0.38	4.40	2.0	Off
6	A1.1	0.68	0.00	0.68	0.00	Curb	4.0	2.50	0.00	0.00	0.00	Sag	2.00	0.083	0.021	0.013	0.26	6.33	0.42	6.33	2.0	Off

Project File: 50568 - Inlet Spread Calculation.stm | Number of lines: 6 | Run Date: 4/8/2025

NOTES: Inlet N-Values = 0.016; Intensity = 4.00 / (Inlet time + 0.10) ^ 0.00; Return period = 3 Yrs. ; * Indicates Known Q added. All curb inlets are throat.

CHANNEL PROTECTION COMPLIANCE
FOR VIRGINIA BEACH SWMM MODEL

TIMMONS GROUP
YOUR VISION ACHIEVED THROUGH OURS.

Project Name: Ocean Park Subdivision
Timmons Group Proj. No.: 50568
Date: 3/27/2025
Calculated By: KB

Point of Analysis #1
03020-304

This spreadsheet verifies that the conveyance system between the site and the limits of analysis does not experience erosive velocities. Velocities are considered non-erosive if they are less than 10 fps for manmade systems (concrete, corrugated metal, or polyethylene) or 2.5 fps for natural systems. The conduits and velocities listed below were obtained directly from the post development SWMM model for the 2-year, 24-hour storm.

Point of analysis #1 is routed through west property line pipe system to the model outfall.

CONDUIT VELOCITY ANALYSIS: 2-YEAR, 24-HOUR STORM					
Conduit ID	**Equiv. Pipe Dia.**	**Conduit Description**	**Max. Reported Velocity**	**Max. Permitted Velocity**	**Erosive?**
Name	(in)		(fps)	(fps)	
A3.2:A3.0	15	RCP	1.59	10.00	NO
A3.1:A3.0	15	RCP	0.31	10.00	NO
A3.0:A2.0	15	RCP	0.98	10.00	NO
A2.1:A2.0	15	RCP	0.52	10.00	NO
A2.0:A1.0	15	RCP	0.45	10.00	NO
A1.1:A1.0	15	RCP	0.84	10.00	NO
A1.0:03020-626	18	RCP	1.20	10.00	NO
03020-626:03020-624	36	RCP	0.52	10.00	NO
03020-624:03020-306	42	RCP	0.58	10.00	NO
03020-306:03020-304	30	HDPE	1.03	10.00	NO

CHANNEL PROTECTION COMPLIANCE
FOR VIRGINIA BEACH SWMM MODEL

TIMMONS GROUP
YOUR VISION ACHIEVED THROUGH OURS.

Project Name: Ocean Park Subdivision
Timmons Group Proj. No.: 50568
Date: 3/27/2025
Calculated By: KB

Point of Analysis #2
03020-000A
03020-000B

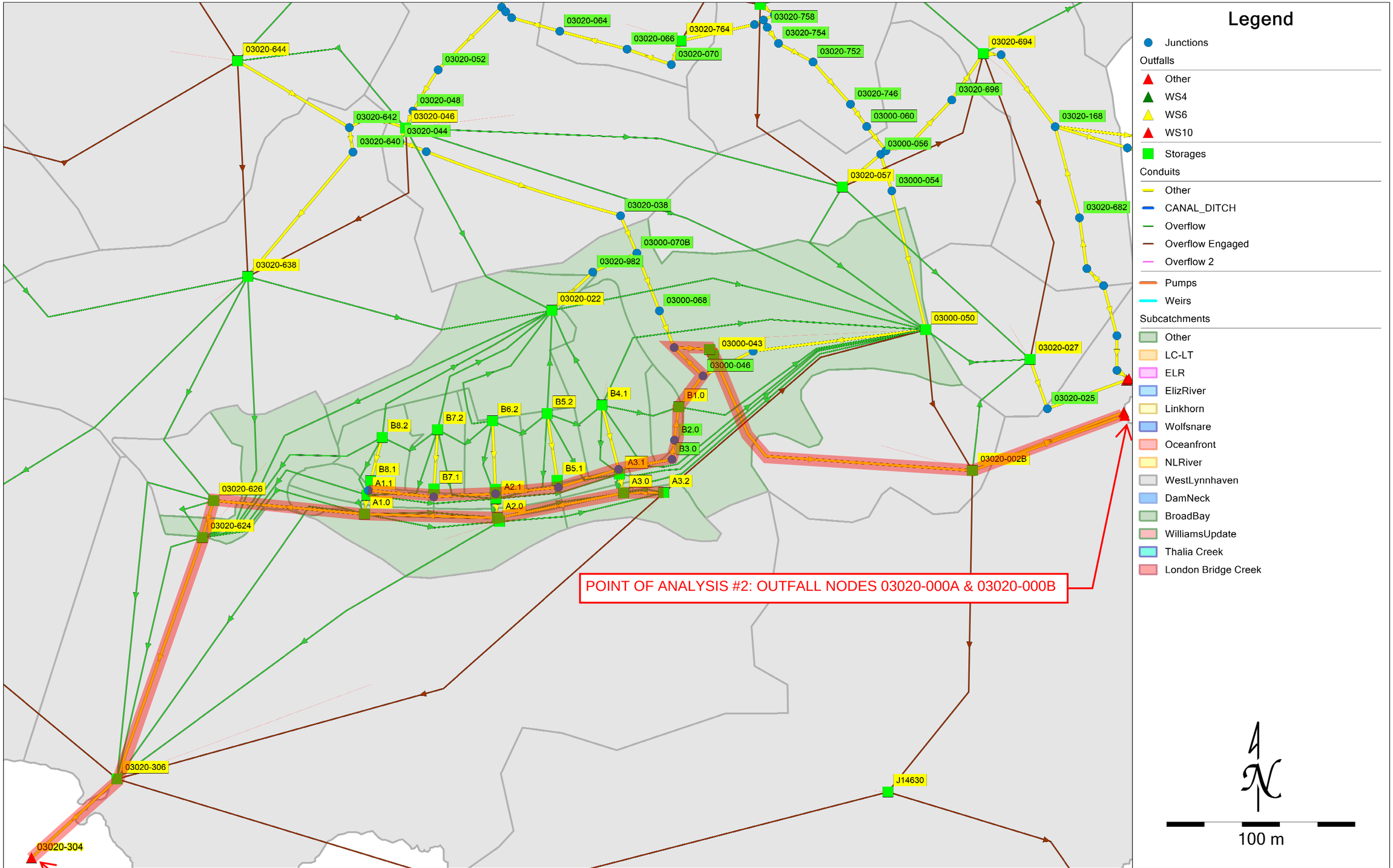
This spreadsheet verifies that the conveyance system between the site and the limits of analysis does not experience erosive velocities. Velocities are considered non-erosive if they are less than 10 fps for manmade systems (concrete, corrugated metal, or polyethylene) or 2.5 fps for natural systems. The conduits and velocities listed below were obtained directly from the post development SWMM model for the 2-year, 24-hour storm.

Point of analysis #2 is routed through eastern property line pipe system to the model outfall.

CONDUIT VELOCITY ANALYSIS: 2-YEAR, 24-HOUR STORM

Conduit ID	Equiv. Pipe Dia.	Conduit Description	Max. Reported Velocity	Max. Permitted Velocity	Erosive?
Name	(in)		(fps)	(fps)	
B8.0:B7.0	15	Pipe	2.04	10.00	NO
B7.0:B6.0	18	Pipe	1.99	10.00	NO
B6.0:B5.0	18	Pipe	1.59	10.00	NO
B5.0:B4.0	24	Pipe	1.61	10.00	NO
B4.0:B3.0	24	Pipe	2.62	10.00	NO
B3.0:B2.0	24	Pipe	2.47	10.00	NO
B2.0:B1.0	24	Pipe	2.34	10.00	NO
B1.0:03000-046	24	Pipe	3.16	10.00	NO
03000-046:03999-902	36	Pipe	6.42	10.00	NO
03999-902:Pump_Station	72	Pipe	6.78	10.00	NO
030000-046:03020-035	36	Pipe	6.76	10.00	NO
03020-035:03020-000A	54	Pipe	0.86	10.00	NO
03020-035:03020-000B	54	Pipe	0.86	10.00	NO

CHANNEL PROTECTION VIA NON-EROSIVE VELOCITIES PCSWMM PLAN VIEW



SWMM Flood Protection HGL Comparisons

Project Name: Ocean Park
Timmons Group Project No. 50568
Date: 03/27/2025
Calculated By: KB

Design Storm Analysis - 10 YR

POA-1

Post Development Model

Storage Nodes

Name	Rim Elev. (ft)	REAL HGL (ft)	Rim Elev. (ft) Actual	Flowline Elevation	Height above/below Flowline
03020-626	15.55	4.76	5.55	5.05	-0.79
03020-624	15.66	4.75	5.66	5.16	-0.91
03020-306	32.172	4.74	2.17	-	2.57
A1.0	17.17	5.02	7.17	6.67	-1.65
A1.1	17.17	5.07	7.17	6.67	-1.60
A2.0	17.19	5.05	7.19	6.69	-1.64
A2.1	17.19	5.06	7.19	6.69	-1.63
A3.0	17.18	4.88	7.18	6.68	-1.80
A3.1	17.18	4.88	7.18	6.68	-1.80

Notes

Storage Node 03020-306 is within the floodplain.

POA-2

Post Development Model

Junctions

Name	Rim Elev. (ft)	REAL HGL (ft)	Rim Elev. (ft) Actual	Height above/below Rim
03000-046	13.47	2.45	3.47	-1.02
03999-902	14.59	2.06	4.59	-2.53
B3.0	15.32	2.63	5.32	-2.69
B4.0	17.36	2.71	7.36	-4.65
B5.0	17.61	2.78	7.61	-4.83
B6.0	17.4	2.85	7.40	-4.55
B7.0	17.59	2.87	7.59	-4.72
B8.0	17.37	2.89	7.37	-4.48

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Storage Nodes

Name	Rim Elev. (ft)	REAL HGL (ft)	Rim Elev. (ft) Actual	Flowline Elevation	Height above/below Flowline
03000-043	13.8	6.60	3.80	-	2.80

Storage Node 03000-043 is within the floodplain.

SWMM HGL Comparisons

Project Name: Ocean Park
Timmons Group Project No. 50568
Date: 04/07/2025
Calculated By: KB

TIMMONS GROUP
YOUR VISION ACHIEVED THROUGH OURS.

Design Storm Analysis - 10 YR

10-Year Storm

Original Existing Model

Junctions

Name	Rim Elev. (ft)	REAL HGL (ft)	Rim Elev. (ft) Actual	Height above/below Rim
03000-046	13.76	15.31	3.76	11.55
03000-048	13.11	1.98	3.11	-1.13
03000-050	15.1	2.80	5.10	-2.30
03000-054	14.64	5.45	4.64	0.81
03000-056	14	6.43	4.00	2.43
03000-058	13.99	7.28	3.99	3.29
03000-060	13.87	8.09	3.87	4.22
03000-064	13.4	6.89	3.40	3.49
03000-068	34.224	1.61	4.22	-2.61
03000-070B	15.37	1.71	5.37	-3.66
03020-025	35.085	4.70	5.09	-0.39
03020-038	16.06	1.78	6.06	-4.28
03020-044	12.38	1.98	2.38	-0.40
03020-048	32.77	2.21	2.77	-0.56
03020-052	32.962	2.28	2.96	-0.68
03020-054	13.14	2.35	3.14	-0.79
03020-055	12.93	2.39	2.93	-0.54
03020-060	31.921	2.86	1.92	0.94
03020-064	32.283	3.01	2.28	0.73
03020-066	32.377	3.14	2.38	0.76
03020-070	33.003	3.32	3.00	0.32
03020-071	13.61	2.47	3.61	-1.14
03020-072	33.05	2.62	3.05	-0.43
03020-074	13.38	3.07	3.38	-0.31
03020-076	13.79	3.25	3.79	-0.54
03020-092	33.483	4.05	3.48	0.57
03020-092A	13.68	4.11	3.68	0.43
03020-092B	14.36	4.18	4.36	-0.18
03020-168	34.482	4.70	4.48	0.22
03020-262	16.36	4.96	6.36	-1.40
03020-640	31.525	3.09	1.53	1.57
03020-642	12.34	2.90	2.34	0.56
03020-660	32.305	2.59	2.31	0.29
03020-674	34.426	4.71	4.43	0.28
03020-676	34.76	4.74	4.76	-0.02
03020-678	34.549	4.73	4.55	0.18
03020-680	34.199	4.74	4.20	0.54
03020-682	33.662	4.74	3.66	1.08
03020-686	16.01	4.70	6.01	-1.31
03020-692	15.02	4.58	5.02	-0.44
03020-696	33.467	5.69	3.47	2.22
03020-712	14.57	4.60	4.57	0.03
03020-714	14.77	4.62	4.77	-0.15
03020-716	14.52	4.57	4.52	0.05
03020-720	15.14	4.56	5.14	-0.58
03020-746	13.84	8.66	3.84	4.82
03020-752	13.67	9.69	3.67	6.02
03020-754	33.194	10.05	3.19	6.86
03020-758	13.74	10.04	3.74	6.30
03020-760	13.59	9.48	3.59	5.89
03020-762	32.812	8.83	2.81	6.02
03020-768	33.133	7.51	3.13	4.38
03020-912	32.766	3.33	2.77	0.56
03020-930	33.48	3.28	3.48	-0.20
03020-934	33.422	3.60	3.42	0.18
03020-937	14.61	4.54	4.61	-0.07
03020-946	13.79	2.82	3.79	-0.97
03020-982	16.8	3.43	6.80	-3.37
03999-058	11.74	1.90	1.74	0.16
REFER TO STORAGE NODE TABLE FOR 03999-902				

10-Year Storm

Revised Existing Model

Junctions

Name	Rim Elev. (ft)	REAL HGL (ft)	Rim Elev. (ft) Actual	Height above/below Rim	Change from Existing Conditions
03000-046	13.47	2.5	3.47	-0.97	-12.81
03000-048	13.52	2.77	3.52	-0.75	0.79
REFER TO STORAGE NODE TABLE FOR 03000-050					
03000-054	14.64	4.72	4.64	0.08	1.92
03000-056	14	4.7	4.00	0.70	-1.73
03000-058	13.99	4.69	3.99	0.70	-2.59
03000-060	13.87	4.7	3.87	0.83	-3.39
03000-064	13.4	4.71	3.40	1.31	-2.18
03000-068	15.8	2.36	5.80	-3.44	0.75
03000-070B	15.91	2.45	5.91	-3.46	0.74
03020-025	35.085	4.71	5.09	-0.38	0.01
03020-038	16.06	2.52	6.06	-3.54	0.74
03020-044	12.38	2.73	2.38	0.35	0.75
03020-048	32.77	2.95	2.77	0.18	0.74
03020-052	32.962	3.01	2.96	0.05	0.73
03020-054	13.14	3.04	3.14	-0.10	0.69
03020-055	12.93	3.08	2.93	0.15	0.69
03020-060	31.921	3.09	1.92	1.17	0.23
03020-064	32.283	3.26	2.28	0.98	0.25
03020-066	32.377	3.39	2.38	1.01	0.25
03020-070	33.003	3.6	3.00	0.60	0.28
03020-071	13.61	3.13	3.61	-0.48	0.66
03020-072	33.05	3.21	3.05	0.16	0.59
03020-074	13.38	3.46	3.38	0.08	0.39
03020-076	13.79	3.57	3.79	-0.22	0.32
03020-092	33.483	4.37	3.48	0.89	0.32
03020-092A	13.68	4.45	3.68	0.77	0.34
03020-092B	14.36	4.56	4.36	0.20	0.38
03020-168	34.482	4.7	4.48	0.22	0.00
03020-262	16.36	4.96	6.36	-1.40	0.00
03020-640	31.525	2.95	1.53	1.43	-0.14
03020-642	12.34	2.96	2.34	0.62	0.06
03020-660	32.305	2.95	2.31	0.65	0.36
03020-674	34.426	4.7	4.43	0.27	-0.01
03020-676	34.76	4.73	4.76	-0.03	-0.01
03020-678	34.549	4.73	4.55	0.18	0.00
03020-680	34.199	4.74	4.20	0.54	0.00
03020-682	33.662	4.74	3.66	1.08	0.00
03020-686	16.01	4.7	6.01	-1.31	0.00
03020-692	15.02	4.73	5.02	-0.29	0.15
03020-696	33.467	4.7	3.47	1.23	-0.99
03020-712	14.57	4.67	4.57	0.10	0.07
03020-714	14.77	4.68	4.77	-0.09	0.06
03020-716	14.52	4.66	4.52	0.14	0.09
03020-720	15.14	4.67	5.14	-0.47	0.11
03020-746	13.84	4.71	3.84	0.87	-3.95
03020-752	13.67	4.69	3.67	1.02	-5.00
03020-754	33.194	4.68	3.19	1.49	-5.37
03020-758	13.74	4.69	3.74	0.95	-5.35
03020-760	13.59	4.69	3.59	1.10	-4.79
03020-762	32.812	4.67	2.81	1.86	-4.16
03020-768	33.133	4.67	3.13	1.54	-2.84
03020-912	32.766	3.56	2.77	0.79	0.23
03020-930	33.48	3.57	3.48	0.09	0.29
03020-934	33.422	3.93	3.42	0.51	0.33
03020-937	14.61	4.65	4.61	0.04	0.11
03020-946	13.79	3.31	3.79	-0.48	0.49
03020-982	16.94	3.27	6.94	-3.67	-0.16
03999-058	11.74	2.67	1.74	0.93	0.77
03999-902	14.59	2.21	4.59	-2.38	2.21

10-Year Storm

Post Development Model

Junctions

Name	Rim Elev. (ft)	REAL HGL (ft)	Rim Elev. (ft) Actual	Height above/below Rim	Change from Revised Existing Conditions
03000-046	13.47	2.45	3.47	-1.02	-0.05
03000-048	13.52	2.76	3.52	-0.76	-0.01
03000-054	14.64	4.72	4.64	0.08	0.00
03000-056	14	4.70	4.00	0.70	0.00
03000-058	13.99	4.70	3.99	0.71	0.01
03000-060	13.87	4.71	3.87	0.84	0.01
03000-064	13.4	4.70	3.40	1.30	-0.01
03000-068	15.8	2.19	5.80	-3.61	-0.17
03000-070B	15.91	2.25	5.91	-3.66	-0.20
03020-025	35.085	4.71	5.09	-0.38	0.00
03020-038	16.06	2.34	6.06	-3.72	-0.18
03020-044	12.38	2.58	2.38	0.20	-0.15
03020-048	32.77	2.84	2.77	0.07	-0.11
03020-052	32.962	2.89	2.96	-0.07	-0.12
03020-054	13.14	2.94	3.14	-0.20	-0.10
03020-055	12.93	2.99	2.93	0.06	-0.09
03020-060	31.921	3.0200	1.92	1.10	-0.070
03020-064	32.283	3.17	2.28	0.89	-0.09
03020-066	32.377	3.32	2.38	0.94	-0.07
03020-070	33.003	3.53	3.00	0.53	-0.07
03020-071	13.61	3.04	3.61	-0.57	-0.09
03020-072	33.05	3.14	3.05	0.09	-0.07
03020-074	13.38	3.42	3.38	0.04	-0.04
03020-076	13.79	3.54	3.79	-0.25	-0.03
03020-092	33.483	4.36	3.48	0.88	-0.01
03020-092A	13.68	4.43	3.68	0.75	-0.02
03020-092B	14.36	4.55	4.36	0.19	-0.01
03020-168	34.482	4.70	4.48	0.22	0.00
03020-262	16.36	4.96	6.36	-1.40	0.00
03020-640	31.525	2.86	1.53	1.34	-0.09
03020-642	12.34	2.86	2.34	0.52	-0.10
03020-660	32.305	2.86	2.31	0.56	-0.09
03020-674	34.426	4.70	4.43	0.27	0.00
03020-676	34.76	4.74	4.76	-0.02	0.01
03020-678	34.549	4.73	4.55	0.18	0.00
03020-680	34.199	4.74	4.20	0.54	0.00
03020-682	33.662	4.74	3.66	1.08	0.00
03020-686	16.01	4.70	6.01	-1.31	0.00
03020-692	15.02	4.72	5.02	-0.30	-0.01
03020-696	33.467	4.70	3.47	1.23	0.00
03020-712	14.57	4.68	4.57	0.11	0.01
03020-714	14.77	4.68	4.77	-0.09	0.00
03020-716	14.52	4.65	4.52	0.13	-0.01
03020-720	15.14	4.65	5.14	-0.49	-0.02
03020-746	13.84	4.70	3.84	0.86	-0.01
03020-752	13.67	4.69	3.67	1.02	0.00
03020-754	33.194	4.69	3.19	1.50	0.01
03020-758	13.74	4.69	3.74	0.95	0.00
03020-760	13.59	4.70	3.59	1.11	0.01
03020-762	32.812	4.66	2.81	1.85	-0.01
03020-768	33.133	4.66	3.13	1.53	-0.01
03020-912	32.766	3.53	2.77	0.76	-0.03
03020-930	33.48	3.55	3.48	0.07	-0.02
03020-934	33.422	3.91	3.42	0.49	-0.02
03020-937	14.61	4.65	4.61	0.04	0.00
03020-946	13.79	3.25	3.79	-0.54	-0.06
03020-982	16.94	2.30	6.94	-4.64	-0.97
03999-058	11.74	2.51	1.74	0.77	-0.16
03999-902	14.59	2.06	4.59	-2.53	-0.15
B2.0	14.27	2.61	4.27	-1.66	
B3.0	15.32	2.63	5.32	-2.69	
B4.0	17.36	2.71	7.36	-4.65	
B5.0	17.61	2.78	7.61	-4.83	
B6.0	17.4	2.85	7.40	-4.55	
B7.0	17.59	2.87	7.59	-4.72	
B8.0	17.37	2.89	7.37	-4.48	

SWMM HGL Comparisons

Project Name: Ocean Park
Timmons Group Project No. 50568
Date: 04/07/2025
Calculated By: KB

Design Storm Analysis - 10 YR

10-Year Storm

Original Existing Model

Storage Nodes

Name	Rim Elev. (ft)	REAL HGL (ft)	Rim Elev (ft) Actual	Height above/below Rim
03020-002B	30.32	4.74	0.32	4.42
03020-022	16.39	4.74	6.39	-1.65
03020-027	33.262	4.70	3.26	1.44
03020-046	32.05	2.15	2.05	0.10
03020-057	33.181	4.46	3.18	1.28
03020-086	38.264	5.35	8.26	-2.91
03020-094	33.266	5.15	3.27	1.88
03020-264	15.84	5.62	5.84	-0.22
03020-306	32.172	4.74	2.17	2.57
03020-310	32.354	4.74	2.35	2.39
03020-598	35.385	5.44	5.39	0.06
03020-638	32.617	3.93	2.62	1.31
03020-644	31.551	3.69	1.55	2.14
03020-694	33.882	4.57	3.88	0.69
03020-706	15.08	4.68	5.08	-0.40
03020-764	32.242	4.61	2.24	2.37
03020-774	32.248	4.55	2.25	2.30
03020-914	33.446	3.29	3.45	-0.16
03020-916	34.347	3.51	4.35	-0.84
03020-938	32.991	4.53	2.99	1.54
03020-942	35.248	4.80	5.25	-0.45
03040-070	32.62	3.52	2.62	0.90
03040-108	33.119	4.06	3.12	0.94
03999-902	13.6	1.48	3.60	-2.12
J14630	35	4.70	5.00	-0.30

10-Year Storm

Revised Existing Model

Storage Nodes

Name	Rim Elev. (ft)	REAL HGL (ft)	Rim Elev. (ft) Actual	Height above/below Rim	Change from Existing Conditions
03000-043	13.8	6.60	3.80	2.80	6.60
03000-050	15.1	4.73	5.10	-0.37	4.73
03020-002B	30.32	4.73	0.32	4.41	-0.01
03020-022	16.59	4.09	6.59	-2.50	-0.65
03020-022A	19	4.73	9.00	-4.27	4.73
03020-027	33.262	4.72	3.26	1.46	0.02
03020-046	32.05	2.92	2.05	0.87	0.77
03020-057	33.181	4.62	3.18	1.44	0.16
03020-086	38.264	5.35	8.26	-2.91	0.00
03020-094	33.266	5.20	3.27	1.93	0.05
03020-264	15.84	5.62	5.84	-0.22	0.00
03020-306	32.172	4.74	2.17	2.57	0.00
03020-310	32.354	4.74	2.35	2.39	0.00
03020-598	35.385	5.44	5.39	0.06	0.00
03020-624	15.66	4.74	5.66	-0.92	4.74
03020-626	15.55	4.75	5.55	-0.80	4.75
03020-638	32.617	2.94	2.62	0.32	-0.99
03020-644	31.551	2.94	1.55	1.39	-0.75
03020-694	33.882	4.71	3.88	0.83	0.14
03020-706	15.08	4.7	5.08	-0.38	0.02
03020-764	32.242	4.62	2.24	2.38	0.01
03020-774	32.248	4.62	2.25	2.37	0.07
03020-914	33.446	3.56	3.45	0.11	0.27
03020-916	34.347	3.55	4.35	-0.80	0.04
03020-938	32.991	4.62	2.99	1.63	0.09
03020-942	35.248	5.16	5.25	-0.09	0.36
03040-070	32.62	3.55	2.62	0.93	0.03
03040-108	33.119	4.06	3.12	0.94	0.00
J14630	35	4.7	5.00	-0.30	0.00
Pump_Station	13.8	2.05	3.80	-1.75	2.05

10-Year Storm

Post Development Model

Storage Nodes

Name	Rim Elev. (ft)	REAL HGL (ft)	Rim Elev. (ft) Actual	Height above/below Rim	Change from Revised Existing Conditions
03000-043	13.8	6.6	3.80	2.80	0.00
03000-050	15.1	4.74	5.10	-0.36	0.01
03020-002B	30.32	4.74	0.32	4.42	0.01
03020-022	16.59	2.32	6.59	-4.27	-1.77
03020-027	33.262	4.72	3.26	1.46	0.00
03020-046	32.05	2.81	2.05	0.76	-0.11
03020-057	33.181	4.61	3.18	1.43	-0.01
03020-086	38.264	5.35	8.26	-2.91	0.00
03020-094	33.266	5.19	3.27	1.92	-0.01
03020-264	15.84	5.62	5.84	-0.22	0.00
03020-306	32.172	4.74	2.17	2.57	0.00
03020-310	32.354	4.74	2.35	2.39	0.00
03020-598	35.385	5.44	5.39	0.06	0.00
03020-624	15.66	4.75	5.66	-0.91	0.01
03020-626	15.55	4.76	5.55	-0.79	0.01
03020-638	32.617	2.84	2.62	0.22	-0.10
03020-644	31.551	2.85	1.55	1.30	-0.09
03020-694	33.882	4.71	3.88	0.83	0.00
03020-706	15.08	4.7	5.08	-0.38	0.00
03020-764	32.242	4.61	2.24	2.37	-0.01
03020-774	32.248	4.61	2.25	2.36	-0.01
03020-914	33.446	3.53	3.45	0.08	-0.03
03020-916	34.347	3.54	4.35	-0.81	-0.01
03020-938	32.991	4.61	2.99	1.62	-0.01
03020-942	35.248	5.15	5.25	-0.10	-0.01
03040-070	32.62	3.54	2.62	0.92	-0.01
03040-108	33.119	4.06	3.12	0.94	0.00
J14630	35	4.7	5.00	-0.30	0.00
Pump_Station	13.8	1.9	3.80	-1.90	-0.15
A1.0	17.17	5.02	7.17	-2.15	
A1.1	17.17	5.07	7.17	-2.10	
A2.0	17.19	5.05	7.19	-2.14	
A2.1	17.19	5.06	7.19	-2.13	
A2.2	16	5.06	6.00	-0.94	
A3.0	17.18	4.88	7.18	-2.30	
A3.1	17.18	4.88	7.18	-2.30	
A3.2	15.1	4.74	5.10	-0.36	
B1.0	13.46	2.52	3.46	-0.94	
B4.1	12.4	2.77	2.40	0.37	
B5.1	17.27	2.79	7.27	-4.48	
B5.2	13.3	2.8	3.30	-0.50	
B6.1	17.08	2.85	7.08	-4.23	
B6.2	13.95	2.87	3.95	-1.08	
B7.1	17.25	2.88	7.25	-4.37	
B7.2	14.01	2.9	4.01	-1.11	
B8.1	17.31	2.9	7.31	-4.41	
B8.2	15.36	3.04	4.01	-0.97	

SWMM HGL Comparisons

Project Name: Ocean Park
Timmons Group Project No. 50568
Date: 04/07/2025
Calculated By: KB

TIMMONS GROUP
YOUR VISION ACHIEVED THROUGH OURS.

Check Storm Analysis - 100 YR

100-Year Storm

Original Existing Model

Junctions

Name	Rim Elev. (ft)	REAL HGL (ft)	Rim Elev. (ft) Actual	Height above/below Rim
03000-046	13.76	13.29	3.76	9.53
03000-048	13.11	2.45	3.11	-0.66
03000-050	15.1	3.25	5.10	-1.85
03000-054	14.64	4.04	4.64	-0.60
03000-056	14	4.41	4.00	0.41
03000-058	13.99	4.49	3.99	0.50
03000-060	13.87	4.49	3.87	0.62
03000-064	13.4	4.52	3.40	1.12
03000-068	34.224	2.13	4.22	-2.09
03000-070B	15.37	2.24	5.37	-3.13
03020-025	35.085	4.43	5.09	-0.66
03020-038	16.06	2.31	6.06	-3.75
03020-044	12.38	2.53	2.38	0.15
03020-048	32.77	2.78	2.77	0.01
03020-052	32.962	2.84	2.96	-0.12
03020-054	13.14	2.90	3.14	-0.24
03020-055	12.93	2.94	2.93	0.01
03020-060	31.921	3.34	1.92	1.42
03020-064	32.283	3.45	2.28	1.17
03020-066	32.377	3.58	2.38	1.20
03020-070	33.003	3.74	3.00	0.74
03020-071	13.61	3.05	3.61	-0.56
03020-072	33.05	3.19	3.05	0.14
03020-074	13.38	3.63	3.38	0.25
03020-076	13.79	3.83	3.79	0.04
03020-092	33.483	4.42	3.48	0.94
03020-092A	13.68	4.45	3.68	0.77
03020-092B	14.36	4.51	4.36	0.15
03020-168	34.482	4.30	4.48	-0.18
03020-262	16.36	4.72	6.36	-1.64
03020-640	31.525	3.84	1.53	2.32
03020-642	12.34	3.69	2.34	1.35
03020-660	32.305	3.37	2.31	1.07
03020-674	34.426	4.31	4.43	-0.12
03020-676	34.76	4.34	4.76	-0.42
03020-678	34.549	4.33	4.55	-0.22
03020-680	34.199	4.35	4.20	0.15
03020-682	33.662	4.35	3.66	0.69
03020-686	16.01	4.30	6.01	-1.71
03020-692	15.02	4.65	5.02	-0.37
03020-696	33.467	4.56	3.47	1.09
03020-712	14.57	4.83	4.57	0.26
03020-714	14.77	4.82	4.77	0.05
03020-716	14.52	4.90	4.52	0.38
03020-720	15.14	4.95	5.14	-0.19
03020-746	13.84	4.50	3.84	0.66
03020-752	13.67	4.51	3.67	0.84
03020-754	33.194	4.50	3.19	1.31
03020-758	13.74	4.49	3.74	0.75
03020-760	13.59	4.50	3.59	0.91
03020-762	32.812	4.50	2.81	1.69
03020-768	33.133	4.53	3.13	1.40
03020-912	32.766	3.99	2.77	1.22
03020-930	33.48	3.92	3.48	0.44
03020-934	33.422	4.09	3.42	0.67
03020-937	14.61	5.00	4.61	0.39
03020-946	13.79	3.38	3.79	-0.41
03020-982	16.8	3.57	6.80	-3.23
03999-058	11.74	2.46	1.74	0.72
REFER TO STORAGE NODE TABLE FOR 03999-902				

100-Year Storm

Revised Existing Model

Junctions

Name	Rim Elev. (ft)	REAL HGL (ft)	Rim Elev. (ft) Actual	Height above/below Rim	Change from Existing Conditions
03000-046	13.47	3.06	3.47	-0.41	-10.23
03000-048	13.52	3.27	3.52	-0.25	0.82
REFER TO STORAGE NODE TABLE FOR 03000-050					
03000-054	14.64	4.67	4.64	0.03	1.42
03000-056	14	4.69	4.00	0.69	0.28
03000-058	13.99	4.71	3.99	0.72	0.22
03000-060	13.87	4.7	3.87	0.83	0.21
03000-064	13.4	4.73	3.40	1.33	0.21
03000-068	15.8	3.06	5.80	-2.74	0.93
03000-070B	15.91	3.16	5.91	-2.75	0.92
03020-025	35.085	4.46	5.09	-0.63	0.03
03020-038	16.06	3.26	6.06	-2.80	0.95
03020-044	12.38	3.53	2.38	1.15	1.00
03020-048	32.77	3.82	2.77	1.05	1.04
03020-052	32.962	3.84	2.96	0.88	1.00
03020-054	13.14	3.85	3.14	0.71	0.95
03020-055	12.93	3.88	2.93	0.95	0.94
03020-060	31.921	3.88	1.92	1.96	0.54
03020-064	32.283	3.97	2.28	1.69	0.52
03020-066	32.377	4.03	2.38	1.65	0.45
03020-070	33.003	4.14	3.00	1.14	0.40
03020-071	13.61	3.88	3.61	0.27	0.83
03020-072	33.05	3.9	3.05	0.85	0.71
03020-074	13.38	3.97	3.38	0.59	0.34
03020-076	13.79	4.01	3.79	0.22	0.18
03020-092	33.483	4.56	3.48	1.08	0.14
03020-092A	13.68	4.62	3.68	0.94	0.17
03020-092B	14.36	4.66	4.36	0.30	0.15
03020-168	34.482	4.3	4.48	-0.18	0.00
03020-262	16.36	4.72	6.36	-1.64	0.00
03020-640	31.525	3.8	1.53	2.28	-0.04
03020-642	12.34	3.82	2.34	1.48	0.13
03020-660	32.305	3.82	2.31	1.52	0.45
03020-674	34.426	4.3	4.43	-0.13	-0.01
03020-676	34.76	4.34	4.76	-0.42	0.00
03020-678	34.549	4.33	4.55	-0.22	0.00
03020-680	34.199	4.34	4.20	0.14	-0.01
03020-682	33.662	4.35	3.66	0.69	0.00
03020-686	16.01	4.3	6.01	-1.71	0.00
03020-692	15.02	4.76	5.02	-0.26	0.11
03020-696	33.467	4.74	3.47	1.27	0.18
03020-712	14.57	4.62	4.57	0.05	-0.21
03020-714	14.77	4.63	4.77	-0.14	-0.19
03020-716	14.52	4.63	4.52	0.11	-0.27
03020-720	15.14	4.65	5.14	-0.49	-0.30
03020-746	13.84	4.7	3.84	0.86	0.20
03020-752	13.67	4.7	3.67	1.03	0.19
03020-754	33.194	4.72	3.19	1.53	0.22
03020-758	13.74	4.72	3.74	0.98	0.23
03020-760	13.59	4.7	3.59	1.11	0.20
03020-762	32.812	4.7	2.81	1.89	0.20
03020-768	33.133	4.7	3.13	1.57	0.17
03020-912	32.766	3.97	2.77	1.20	-0.02
03020-930	33.48	3.99	3.48	0.51	0.07
03020-934	33.422	4.26	3.42	0.84	0.17
03020-937	14.61	4.66	4.61	0.05	-0.34
03020-946	13.79	3.93	3.79	0.14	0.55
03020-982	16.94	3.66	6.94	-3.28	0.09
03999-058	11.74	3.45	1.74	1.71	0.99
03999-902	14.59	2.89	4.59	-1.70	2.89

100-Year Storm

Post Development Model

Junctions

Name	Rim Elev. (ft)	REAL HGL (ft)	Rim Elev. (ft) Actual	Height above/below Rim	Change from Revised Existing Conditions
03000-046	13.47	3.27	3.47	-0.20	0.21
03000-048	13.52	3.44	3.52	-0.08	0.17
03000-054	14.64	4.68	4.64	0.04	0.01
03000-056	14	4.69	4.00	0.69	0.00
03000-058	13.99	4.70	3.99	0.71	-0.01
03000-060	13.87	4.71	3.87	0.84	0.01
03000-064	13.4	4.72	3.40	1.32	-0.01
03000-068	15.8	3.10	5.80	-2.70	0.04
03000-070B	15.91	3.18	5.91	-2.73	0.02
03020-025	35.085	4.46	5.09	-0.63	0.00
03020-038	16.06	3.28	6.06	-2.78	0.02
03020-044	12.38	3.55	2.38	1.17	0.02
03020-048	32.77	3.85	2.77	1.08	0.03
03020-052	32.962	3.86	2.96	0.90	0.02
03020-054	13.14	3.88	3.14	0.74	0.03
03020-055	12.93	3.90	2.93	0.97	0.02
03020-060	31.921	3.9100	1.92	1.99	0.030
03020-064	32.283	3.98	2.28	1.70	0.01
03020-066	32.377	4.05	2.38	1.67	0.02
03020-070	33.003	4.17	3.00	1.17	0.03
03020-071	13.61	3.90	3.61	0.29	0.02
03020-072	33.05	3.92	3.05	0.87	0.02
03020-074	13.38	3.98	3.38	0.60	0.01
03020-076	13.79	4.04	3.79	0.25	0.03
03020-092	33.483	4.58	3.48	1.10	0.02
03020-092A	13.68	4.61	3.68	0.93	-0.01
03020-092B	14.36	4.66	4.36	0.30	0.00
03020-168	34.482	4.30	4.48	-0.18	0.00
03020-262	16.36	4.72	6.36	-1.64	0.00
03020-640	31.525	3.846	1.53	2.32	0.046
03020-642	12.34	3.84	2.34	1.50	0.02
03020-660	32.305	3.83	2.31	1.53	0.01
03020-674	34.426	4.30	4.43	-0.13	0.00
03020-676	34.76	4.34	4.76	-0.42	0.00
03020-678	34.549	4.33	4.55	-0.22	0.00
03020-680	34.199	4.35	4.20	0.15	0.01
03020-682	33.662	4.34	3.66	0.68	-0.01
03020-686	16.01	4.30	6.01	-1.71	0.00
03020-692	15.02	4.77	5.02	-0.25	0.01
03020-696	33.467	4.73	3.47	1.26	-0.01
03020-712	14.57	4.62	4.57	0.05	0.00
03020-714	14.77	4.64	4.77	-0.13	0.01
03020-716	14.52	4.64	4.52	0.12	0.01
03020-720	15.14	4.66	5.14	-0.48	0.01
03020-746	13.84	4.70	3.84	0.86	0.00
03020-752	13.67	4.71	3.67	1.04	0.01
03020-754	33.194	4.70	3.19	1.51	-0.02
03020-758	13.74	4.70	3.74	0.96	-0.02
03020-760	13.59	4.70	3.59	1.11	0.00
03020-762	32.812	4.69	2.81	1.88	-0.01
03020-768	33.133	4.70	3.13	1.57	0.00
03020-912	32.766	3.98	2.77	1.21	0.01
03020-930	33.48	3.99	3.48	0.51	0.00
03020-934	33.422	4.27	3.42	0.85	0.01
03020-937	14.61	4.67	4.61	0.06	0.01
03020-946	13.79	3.95	3.79	0.16	0.02
03020-982	16.94	3.54	6.94	-3.40	-0.12
03999-058	11.74	3.47	1.74	1.73	0.02
03999-902	14.59	2.94	4.59	-1.65	0.05
B2.0	14.27	3.67	4.27	-0.60	
B3.0	15.32	3.78	5.32	-1.54	
B4.0	17.36	4.02	7.36	-3.34	
B5.0	17.61	4.25	7.61	-3.36	
B6.0	17.4	4.44	7.40	-2.96	
B7.0	17.59	4.54	7.59	-3.05	
B8.0	17.37	4.67	7.37	-2.70	

SWMM HGL Comparisons

Project Name: Ocean Park
Timmons Group Project No. 50568
Date: 04/07/2025
Calculated By: KB

Check Storm Analysis - 100 YR

100-Year Storm

Original Existing Model

Storage Nodes

Name	Rim Elev. (ft)	REAL HGL (ft)	Rim Elev (ft) Actual	Height above/below Rim
03020-002B	30.32	4.59	0.32	4.27
03020-022	16.39	4.59	6.39	-1.80
03020-027	33.262	4.69	3.26	1.43
03020-046	32.05	2.73	2.05	0.68
03020-057	33.181	4.84	3.18	1.66
03020-086	38.264	5.66	8.26	-2.60
03020-094	33.266	5.42	3.27	2.15
03020-264	15.84	5.77	5.84	-0.07
03020-306	32.172	4.59	2.17	2.42
03020-310	32.354	4.59	2.35	2.24
03020-598	35.385	5.61	5.39	0.23
03020-638	32.617	4.01	2.62	1.39
03020-644	31.551	4.01	1.55	2.46
03020-694	33.882	4.65	3.88	0.77
03020-706	15.08	4.79	5.08	-0.29
03020-764	32.242	4.99	2.24	2.75
03020-774	32.248	5.02	2.25	2.77
03020-914	33.446	3.98	3.45	0.53
03020-916	34.347	4.03	4.35	-0.32
03020-938	32.991	5.11	2.99	2.12
03020-942	35.248	6.01	5.25	0.76
03040-070	32.62	4.03	2.62	1.41
03040-108	33.119	4.33	3.12	1.21
03999-902	13.6	2.00	3.60	-1.60
J14630	35	4.30	5.00	-0.70

100-Year Storm

Revised Existing Model

Storage Nodes

Name	Rim Elev. (ft)	REAL HGL (ft)	Rim Elev. (ft) Actual	Height above/below Rim	Change from Existing Conditions
03000-043	13.8	6.46	3.80	2.66	6.46
03000-050	15.1	4.59	5.10	-0.51	4.59
03020-002B	30.32	4.59	0.32	4.27	0.00
03020-022	16.59	4.33	6.59	-2.26	-0.26
03020-022A	19	4.59	9.00	-4.41	4.59
03020-027	33.262	4.77	3.26	1.51	0.08
03020-046	32.05	3.80	2.05	1.75	1.07
03020-057	33.181	4.67	3.18	1.49	-0.17
03020-086	38.264	5.66	8.26	-2.60	0.00
03020-094	33.266	5.43	3.27	2.16	0.01
03020-264	15.84	5.77	5.84	-0.07	0.00
03020-306	32.172	4.62	2.17	2.45	0.03
03020-310	32.354	4.62	2.35	2.27	0.03
03020-598	35.385	5.61	5.39	0.23	0.00
03020-624	15.66	4.63	5.66	-1.03	4.63
03020-626	15.55	4.63	5.55	-0.92	4.63
03020-638	32.617	3.8	2.62	1.18	-0.21
03020-644	31.551	3.8	1.55	2.25	-0.21
03020-694	33.882	4.76	3.88	0.88	0.11
03020-706	15.08	4.58	5.08	-0.50	-0.21
03020-764	32.242	4.67	2.24	2.43	-0.32
03020-774	32.248	4.67	2.25	2.42	-0.35
03020-914	33.446	3.94	3.45	0.49	-0.04
03020-916	34.347	4.04	4.35	-0.31	0.01
03020-938	32.991	4.67	2.99	1.68	-0.44
03020-942	35.248	6.08	5.25	0.83	0.07
03040-070	32.62	4.04	2.62	1.42	0.01
03040-108	33.119	4.33	3.12	1.21	0.00
J14630	35	4.3	5.00	-0.70	0.00
Pump_Station	13.8	2.72	3.80	-1.08	2.72

100-Year Storm

Post Development Model

Storage Nodes

Name	Rim Elev. (ft)	REAL HGL (ft)	Rim Elev. (ft) Actual	Height above/below Rim	Change from Revised Existing Conditions
03000-043	13.8	6.44	3.80	2.64	-0.02
03000-050	15.1	4.57	5.10	-0.53	-0.02
03020-002B	30.32	4.57	0.32	4.25	-0.02
03020-022	16.59	4.13	6.59	-2.46	-0.20
03020-027	33.262	4.78	3.26	1.52	0.01
03020-046	32.05	3.82	2.05	1.77	0.02
03020-057	33.181	4.68	3.18	1.50	0.01
03020-086	38.264	5.66	8.26	-2.60	0.00
03020-094	33.266	5.43	3.27	2.16	0.00
03020-264	15.84	5.77	5.84	-0.07	0.00
03020-306	32.172	4.64	2.17	2.47	0.02
03020-310	32.354	4.64	2.35	2.29	0.02
03020-598	35.385	5.61	5.39	0.23	0.00
03020-624	15.66	4.64	5.66	-1.02	0.01
03020-626	15.55	4.64	5.55	-0.91	0.01
03020-638	32.617	3.83	2.62	1.21	0.03
03020-644	31.551	3.83	1.55	2.28	0.03
03020-694	33.882	4.76	3.88	0.88	0.00
03020-706	15.08	4.59	5.08	-0.49	0.01
03020-764	32.242	4.68	2.24	2.44	0.01
03020-774	32.248	4.68	2.25	2.43	0.01
03020-914	33.446	3.95	3.45	0.50	0.01
03020-916	34.347	4.04	4.35	-0.31	0.00
03020-938	32.991	4.68	2.99	1.69	0.01
03020-942	35.248	6.08	5.25	0.83	0.00
03040-070	32.62	4.04	2.62	1.42	0.00
03040-108	33.119	4.33	3.12	1.21	0.00
J14630	35	4.3	5.00	-0.70	0.00
Pump_Station	13.8	2.79	3.80	-1.01	0.07
A1.0	17.17	5.24	7.17	-1.93	
A1.1	17.17	5.38	7.17	-1.79	
A2.0	17.19	5.26	7.19	-1.93	
A2.1	17.19	5.31	7.19	-1.88	
A2.2	16	5.27	6.00	-0.73	
A3.0	17.18	5	7.18	-2.18	
A3.1	17.18	5.01	7.18	-2.17	
A3.2	15.1	4.72	5.10	-0.38	
B1.0	13.46	3.46	3.46	0.00	
B4.1	12.4	4.26	2.40	1.86	
B5.1	17.27	4.24	7.27	-3.03	
B5.2	13.3	4.26	3.30	0.96	
B6.1	17.08	4.45	7.08	-2.63	
B6.2	13.95	4.48	3.95	0.53	
B7.1	17.25	4.57	7.25	-2.68	
B7.2	14.01	4.61	4.01	0.60	
B8.1	17.31	4.72	7.31	-2.59	
B8.2	15.36	4.8	4.01	0.79	

Pump Station Comparison Table

Updated 2025/04/07

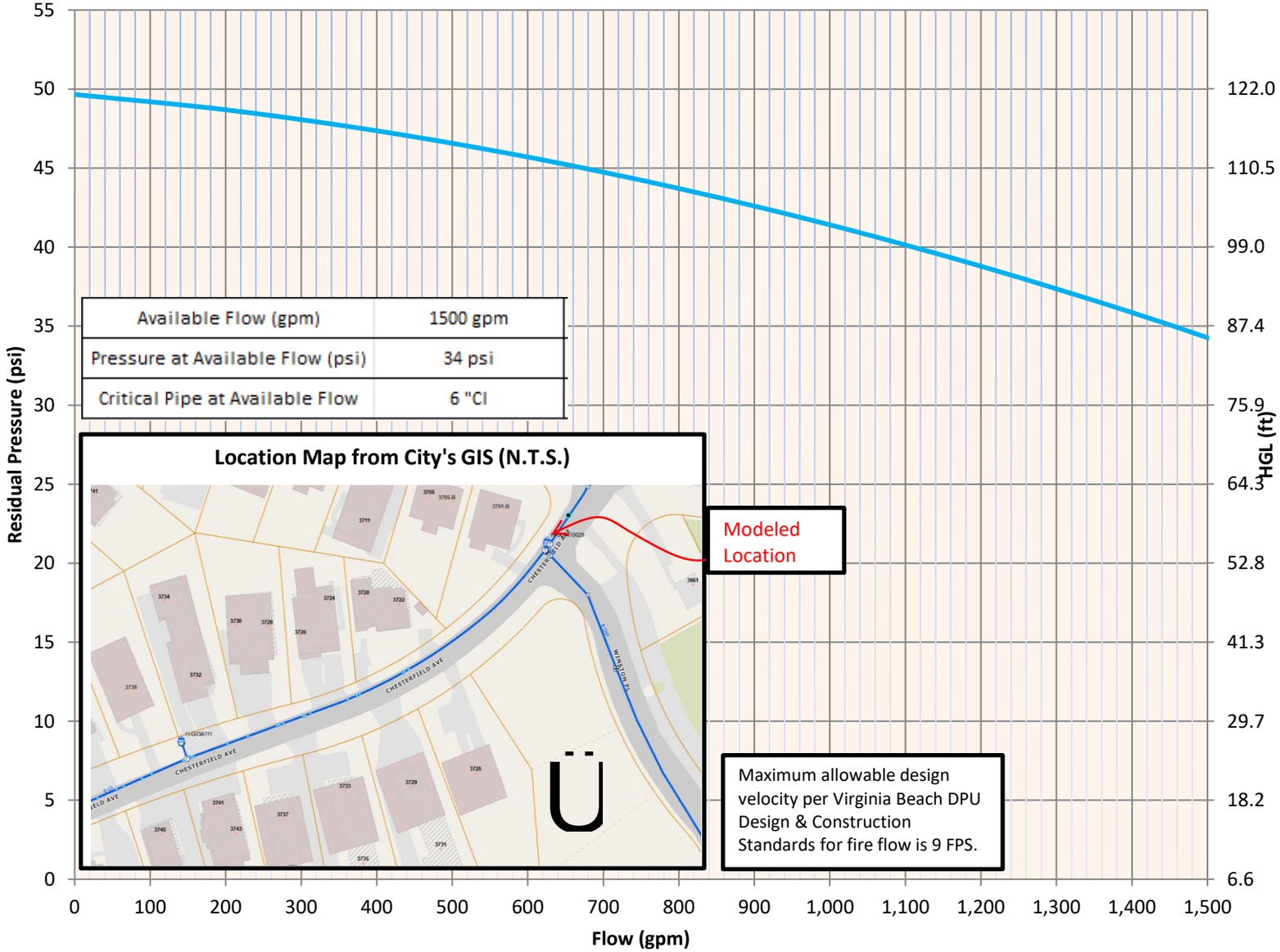
Pump Station (Utilization %)						
	Revised Existing			Post-Development		
Pump ID	2-YR %	10-YR %	100-YR %	2-YR %	10-YR %	100-YR %
OP_PS2_P1	89.44	89.46	88.66	88.92	88.97	88.70
OP_PS2_P2	86.04	86.25	80.00	82.08	82.35	80.04
OP_PS2_P3	80.71	81.17	57.89	68.44	69.25	57.80
Pump Average	**85.40**	**85.63**	**75.52**	**79.81**	**80.19**	**75.51**

Pump Station (Total Volume)						
	Revised Existing			Post-Development		
Pump ID	2-YR (MG)	10-YR (MG)	100-YR (MG)	2-YR (MG)	10-YR (MG)	100-YR (MG)
OP_PS2_P1	12.524	12.526	12.415	12.452	12.458	12.420
OP_PS2_P2	82.478	82.681	76.690	78.684	78.944	76.727
OP_PS2_P3	77.374	77.809	55.491	65.605	66.388	55.414
Pump Combined	**172.376**	**173.016**	**144.596**	**156.741**	**157.79**	**144.561**

Appendix D – Utility Calculations

City of Virginia Beach Water Distribution System

Modeled Capacity Curve at Peak Hour
(With Max. Day Demand)



Location:
Ints. Chesterfield Ave & Winston Pl

Pressure Zone:
Eastern

Pipe Diameter (in):
6

Node Type:
6" x 6" Tee

Node ID:
F-G03A10684

Node Elevation (ft):
6.63

H-L11D115

Parcel GPIN:
14894768080000

CITY OF VIRGINIA BEACH

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3/25/2025

City of Virginia Beach

VBgov.com

VIRGINIA BEACH FIRE
PREVENTION BUREAU
(757) 385-4228 OFFICE
(757) 385-5676 FAX

MUNICIPAL CENTER
BUILDING #21
2408 COURTHOUSE DRIVE
VIRGINIA BEACH, VA 23456

Fire Flow Worksheet

This needed fire-flow calculation worksheet is based on the Virginia Statewide Fire Prevention Code, Appendix B Fire-Flow Requirements for Buildings. For all inquiries, please consult with a fire plan examiner. Fill in the information as it applies to the proposed project.

Date	03/26/2025	DSC File #	
Project Name	Ocean Park Residential		
Certified Engineer	Kevin Worsham	Phone #	757-217-4876
Address or Parcel #	Marlin Bay Dr. VIRGINIA BEACH, VA 23455		

Fire Protection Water Demand Computations

Fire-Flow Calculation Area: The fire-flow calculation area shall be the total floor area of all floors within the exterior walls and under the horizontal projections of the roof of a building.
Area Separation: Portions of buildings which are separated by fire walls **without openings** (even if openings are fire-rated), constructed in accordance to the Virginia Construction Code, are allowed to be considered as separate fire-flow areas.
Construction Type IA & IB: The fire-flow calculation area of buildings constructed of Type IA and Type IB construction shall be the area of the three largest successive floors. **Exception:** Fire-flow calculation area for open parking garages shall be determined by the area of the largest floor.

Section I – Fire–Flow Demand for One- & Two-Family Dwellings, Group R-3, R-4, and Townhouses

Note: Per the technical code change in the 2015 Virginia Statewide Fire Prevention Code, §507.5.1, fire hydrant requirements do not apply to in-fill development of fewer than 5 detached single-family dwellings constructed in existing developments & for the reconstruction or rehabilitation of detached single-family dwellings.

Fire-Flow Calculation Area (square feet)	Minimum Fire-Flow (gallons per minute)		Flow Duration (hours)	
0 -3,600	No sprinklers: 1,000	Sprinklers: 500	No sprinklers: 1	Sprinklers: 1/2
3,601 and greater*	No sprinklers: value in Table B105.1 (2)	n/a	No sprinklers: duration in Table B105.1 (2)	n/a
	Sprinklers: ½ value in Table B105.1 (2)	n/a	Sprinklers: 1 hour	1 hour

Allowances for one- & two-family dwellings installed with an automatic fire sprinkler system per NFPA 13D:

1. <3,600 sf: minimum fire-flow & flow duration are permitted to be reduced by 50%.
2. *3,601 > sf: minimum fire-flow permitted to be 50% of the values in Table B105.1 (2) & flow duration is 1 hour.

Section II – Fire-Flow Demand for Other than One- & Two-Family Dwellings, Group R-3, R-4, & Townhouses. Includes Commercial and Multi-Family Developments - Use Table B105.1(2) Structural information must be provided from the Virginia Construction Code							
Occupancy classification		Construction type		Square footage		# of stories	
A. Fire-flow value from Table B105.1 (2)		gpm		Flow duration in hours			
The next two fields are for when the proposed building will be installed with a fire sprinkler system throughout.							
B. Reduction for sprinklers: Enter 25% of the value from field A. • NFPA 13 system: the reduced fire-flow cannot be less than 1,000 gpm. • NFPA 13R system: the reduced fire-flow cannot be less than 1500 gpm.						gpm	
C. Enter fire sprinkler system demand plus hose stream allowance, per NFPA 13.						gpm	
Note: The water supply shall be capable of providing the greater of either the needed fire-flow (NFF) or the fire sprinkler demand including the hose stream demand. Therefore, either value in **B** or **C** is the applicable fire protection water demand.							

Section III – Comparison of Fire Protection Water Demand vs Available Water Supply Data If the supply is greater than the demand, then meets criteria for approval. If the supply is less than the demand, then other alternatives may be approved by the Fire Marshal.	
Site fire protection water demand - enter the value from applicable Section I or Section II, either **A** (where no sprinklers are used), or the higher value of either **B** or **C.**	1000
Justification of available water supply– enter the value from the hydraulic analysis report.	1500

IFC APPENDIX B TABLE B105.1 (2)
MINIMUM FIRE-FLOW AND FLOW DURATION

FIRE-FLOW CALCULATION AREA (square feet)					FIRE-FLOW (gallons per minute)	FLOW DURATION (hours)
Type IA & IB	Type IIA & IIIA	Type IV & V-A	Type IIB & IIIB	Type V-B		
0-22,700	0-12,700	0-8,200	0-5,900	0-3,600	1,500	2
22,701-30,200	12,701-17,000	8,201-10,900	5,901-7,900	3,601-4,800	1,750	
30,201-38,700	17,001-21,800	10,901-12,900	7,901-9,800	4,801-6,200	2,000	
38,701,48,300	21,801-24,200	12,901-17,400	9,801-12,600	6,201-7,700	2,250	
48,301-59,000	24,201-33,200	17,401-21,300	12,601-15,400	7,701-9,400	2,500	
59,001-70,900	33,201-39,700	21,301-25,500	15,401-18,400	9,401-11,300	2,750	
70,901-83,700	39,701-47,100	25,501-30,100	18,401-21,800	11,301-13,400	3,000	3
83,701-97,700	47,101-54,900	30,101-35,200	21,801-25,900	13,401-15,600	3,250	
97,701-112,700	54,901-63,400	35,201-40,600	25,901-29,300	15,601-18,000	3,500	
112,701-128,700	63,401-72,400	40,601-46,400	29,301-33,500	18,001-20,600	3,750	
128,701-145,900	72,401-82,100	46,401-52,500	33,501-37,900	20,601-23,300	4,000	4
145,901-164,200	82,101-92,400	52,501-59,100	37,901-42,700	23,301-26,300	4,250	
164,201-183,400	92,401-103,100	59,101-66,000	42,701-47,700	26,301-29,300	4,500	
183,401-203,700	103,101-114,600	66,001-73,300	47,701-53,000	29,301-32,600	4,750	
203,701-225,200	114,601-126,700	73,301-81,100	53,001-58,600	32,601-36,000	5,000	
225,201-247,700	126,701-139,400	81,101-89,200	58,601-65,400	36,001-39,600	5,250	
247,701-271,200	139,401-152,600	89,201-97,700	65,401-70,600	39,601-43,400	5,500	
271,201-295,900	152,601-166,500	97,701-106,500	70,601-77,000	43,401-47,400	5,750	
295,901-Greater	166,501-Greater	106,501-115,800	77,001-83,700	47,401-51,500	6,000	
-	-	115,801-125,500	83,701-90,600	51,501-55,700	6,250	
-	-	125,501-135,500	90,601-97,900	55,701-60,200	6,500	
-	-	135,501-145,800	97,901-106,800	60,201-64,800	6,750	
-	-	145,801-156,700	106,801-113,200	64,801-69,600	7,000	
-	-	156,701-167,900	113,201-121,300	69,601-74,600	7,250	
-	-	167,901-179,400	121,301-129,600	74,601-79,800	7,500	
-	-	179,401-191,400	129,601-138,300	79,801-85,100	7,750	
-	-	191,401-Greater	138,301-Greater	85,101-Greater	8,000	

a. Types of construction are based on the Virginia Construction Code.
b. Fire-Flow measured at 20 psi residual pressure

Ocean Park Residential
Water Demands

Project # 50568

Date: 03-19-2025

AREA		Units	Units per Node	Flow of Demand Duration	Flow of Demand	Ave. Demand	Ave. Demand	Max Day Demand Factor	Max. Demand	Peak Hour	Fire Flow	Fire Flow with Max Day Demand
				(HOURS)	(GPD/UNIT)	(GPD)	(GPM)		(GPM)	(GPM)	(GPM)	GPM
Proposed Development												
14 Duplexes	-	Per Duplex	14	24.0	450.0	6300.0	4.4	1.4	6.1	23.0	1500.0	1506.1

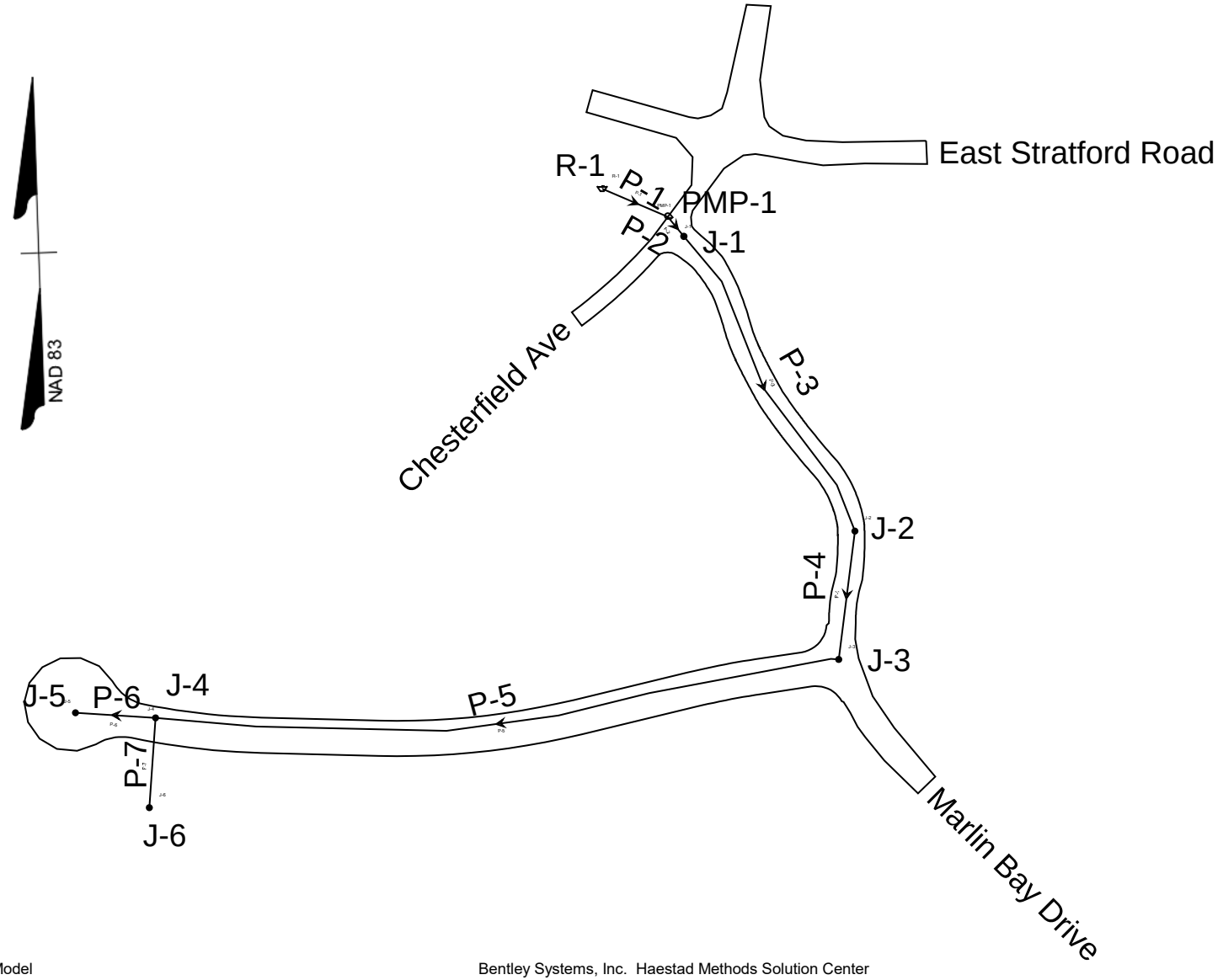
Assumptions & Calculations

(City of Virginia Beach 2024 Public Utilities Design Standards Manual)

8.3.B Domestic Demand

1. Average day demand for residential units shall be 225 gallons/unit/day.
2. Residential peak hour demand (Q) shall be calculated by Q=11.4N^0.544, where N is the number of dwelling units.
3. Peak hour demand for commercial sites shall be calculated by AWWA Manual, M22, "Sizing Water Service Lines and Meters.
4. Max day demand for commercial and residential uses shall be equal to 1.4 times the average day demand.

Ocean Park Water Model



Scenario: Average Day

Junction Table - Time: 0.00 hours

Label	Elevation (ft)	Demand (gpm)	Hydraulic Grade (ft)	Pressure Head (ft)	Pressure (psi)
J-1	0.00	0	116.35	116.35	50
J-2	0.00	0	116.35	116.35	50
J-3	0.00	0	116.35	116.35	50
J-4	0.00	0	116.34	116.34	50
J-5	0.00	4	116.34	116.34	50
J-6	0.00	0	116.34	116.34	50

Pipe Table - Time: 0.00 hours

Label	Length (ft)	Start Node	Stop Node	Diameter (in)	Hazen-Williams C	Flow (gpm)	Velocity (ft/s)	Minor Loss Coefficient (Unified)
P-1	1	R-1	PMP-1	72.0	150.0	4	0.00	0.000
P-2	23	PMP-1	J-1	6.0	120.0	4	0.05	0.350
P-3	280	J-1	J-2	8.0	120.0	4	0.03	1.310
P-4	108	J-2	J-3	8.0	120.0	4	0.03	0.740
P-5	594	J-3	J-4	8.0	120.0	4	0.03	1.720
P-6	13	J-4	J-5	8.0	120.0	4	0.03	0.350
P-7	25	J-4	J-6	6.0	120.0	0	0.00	1.280

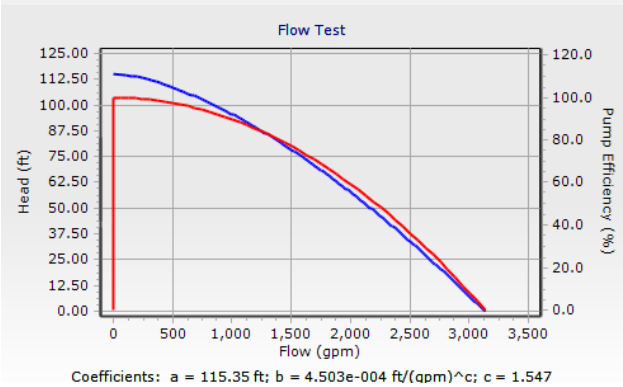
Reservoir Table - Time: 0.00 hours

Label	Elevation (ft)	Hydraulic Grade (ft)	Flow (In net) (gpm)	Flow (Out net) (gpm)
R-1	1.00	1.00	-4	4

Pump Table - Time: 0.00 hours

Label	Elevation (ft)	Pump Definition	Status (Initial)	Hydraulic Grade (Suction) (ft)	Hydraulic Grade (Discharge) (ft)	Flow (Total) (gpm)	Pump Head (ft)
PMP-1	0.00	Flow Test	On	1.00	116.35	4	115.35

	Flow (gpm)	Head (ft)
Shutoff:	0	115.35
Design:	1,500	78.44
Max. Operating:	2,252	46.14



Coefficients: a = 115.35 ft; b = 4.503e-004 ft/(gpm)^c; c = 1.547

Scenario: Maximum Day

Junction Table - Time: 0.00 hours

Label	Elevation (ft)	Demand (gpm)	Hydraulic Grade (ft)	Pressure Head (ft)	Pressure (psi)
J-1	0.00	0	116.34	116.34	50
J-2	0.00	0	116.34	116.34	50
J-3	0.00	0	116.34	116.34	50
J-4	0.00	0	116.34	116.34	50
J-5	0.00	6	116.34	116.34	50
J-6	0.00	0	116.34	116.34	50

Pipe Table - Time: 0.00 hours

Label	Length (ft)	Start Node	Stop Node	Diameter (in)	Hazen-Williams C	Flow (gpm)	Velocity (ft/s)	Minor Loss Coefficient (Unified)
P-1	1	R-1	PMP-1	72.0	150.0	6	0.00	0.000
P-2	23	PMP-1	J-1	6.0	120.0	6	0.07	0.350
P-3	280	J-1	J-2	8.0	120.0	6	0.04	1.310
P-4	108	J-2	J-3	8.0	120.0	6	0.04	0.740
P-5	594	J-3	J-4	8.0	120.0	6	0.04	1.720
P-6	13	J-4	J-5	8.0	120.0	6	0.04	0.350
P-7	25	J-4	J-6	6.0	120.0	0	0.00	1.280

Reservoir Table - Time: 0.00 hours

Label	Elevation (ft)	Hydraulic Grade (ft)	Flow (In net) (gpm)	Flow (Out net) (gpm)
R-1	1.00	1.00	-6	6

Pump Table - Time: 0.00 hours

Label	Elevation (ft)	Pump Definition	Status (Initial)	Hydraulic Grade (Suction) (ft)	Hydraulic Grade (Discharge) (ft)	Flow (Total) (gpm)	Pump Head (ft)
PMP-1	0.00	Flow Test	On	1.00	116.34	6	115.34

Scenario: Maximum Day w/ Fire

Junction Table - Time: 0.00 hours

Label	Elevation (ft)	Demand (gpm)	Hydraulic Grade (ft)	Pressure Head (ft)	Pressure (psi)
J-1	0.00	0	93.74	93.74	41
J-2	0.00	0	86.91	86.91	38
J-3	0.00	0	84.11	84.11	36
J-4	0.00	0	70.29	70.29	30
J-5	0.00	6	70.29	70.29	30
J-6	0.00	1,000	65.59	65.59	28

Pipe Table - Time: 0.00 hours

Label	Length (ft)	Start Node	Stop Node	Diameter (in)	Hazen-Williams C	Flow (gpm)	Velocity (ft/s)	Minor Loss Coefficient (Unified)
P-1	1	R-1	PMP-1	72.0	150.0	1,006	0.08	0.000
P-2	23	PMP-1	J-1	6.0	120.0	1,006	11.42	0.350
P-3	280	J-1	J-2	8.0	120.0	1,006	6.42	1.310
P-4	108	J-2	J-3	8.0	120.0	1,006	6.42	0.740
P-5	594	J-3	J-4	8.0	120.0	1,006	6.42	1.720
P-6	13	J-4	J-5	8.0	120.0	6	0.04	0.350
P-7	25	J-4	J-6	6.0	120.0	1,000	11.35	1.280

Reservoir Table - Time: 0.00 hours

Label	Elevation (ft)	Hydraulic Grade (ft)	Flow (In net) (gpm)	Flow (Out net) (gpm)
R-1	1.00	1.00	-1,006	1,006

Pump Table - Time: 0.00 hours

Label	Elevation (ft)	Pump Definition	Status (Initial)	Hydraulic Grade (Suction) (ft)	Hydraulic Grade (Discharge) (ft)	Flow (Total) (gpm)	Pump Head (ft)
PMP-1	0.00	Flow Test	On	1.00	96.45	1,006	95.45

Scenario: Peak Hour

Junction Table - Time: 0.00 hours

Label	Elevation (ft)	Demand (gpm)	Hydraulic Grade (ft)	Pressure Head (ft)	Pressure (psi)
J-1	0.00	0	116.29	116.29	50
J-2	0.00	0	116.28	116.28	50
J-3	0.00	0	116.28	116.28	50
J-4	0.00	0	116.27	116.27	50
J-5	0.00	23	116.27	116.27	50
J-6	0.00	0	116.27	116.27	50

Pipe Table - Time: 0.00 hours

Label	Length (ft)	Start Node	Stop Node	Diameter (in)	Hazen-Williams C	Flow (gpm)	Velocity (ft/s)	Minor Loss Coefficient (Unified)
P-1	1	R-1	PMP-1	72.0	150.0	23	0.00	0.000
P-2	23	PMP-1	J-1	6.0	120.0	23	0.26	0.350
P-3	280	J-1	J-2	8.0	120.0	23	0.15	1.310
P-4	108	J-2	J-3	8.0	120.0	23	0.15	0.740
P-5	594	J-3	J-4	8.0	120.0	23	0.15	1.720
P-6	13	J-4	J-5	8.0	120.0	23	0.15	0.350
P-7	25	J-4	J-6	6.0	120.0	0	0.00	1.280

Reservoir Table - Time: 0.00 hours

Label	Elevation (ft)	Hydraulic Grade (ft)	Flow (In net) (gpm)	Flow (Out net) (gpm)
R-1	1.00	1.00	-23	23

Pump Table - Time: 0.00 hours

Label	Elevation (ft)	Pump Definition	Status (Initial)	Hydraulic Grade (Suction) (ft)	Hydraulic Grade (Discharge) (ft)	Flow (Total) (gpm)	Pump Head (ft)
PMP-1	0.00	Flow Test	On	1.00	116.29	23	115.29

HRSD Small Communities Sanitary Sewer Flow Calculations Worksheet

Applicants with projects generating sanitary sewer flow must use this worksheet to calculate flows and submit to HRSD Development Services using the email link: developrequest@hrsd.com

Project Name: 50568 - Ocean Park

Pump Station Replacement - Upgrade - Modification projects

HRSD shall certify a pump station based on metered data if available. In absence of metered data, water consumption data shall be used instead. If there is a future flow component in the calculations for the catchment, please use the worksheet below.

	PS No:	N/A		
	PS Name:			
	Pump Station Catchment Basin			
	Avg. Dry Weather Flow		Wet Weather Flow	
	gpd	gpm	gpd	gpm
Enter				
Metered →		0.00		0.00
OR Water Consumption Flow →		0.00	0	0.00
Sub-totals:	0	0.00	0	0.00

Proposed Development

Please use the table below to calculate sanitary sewer flows for your project

Land Use	Contributing Unit Type	Flow (gpd/Unit)	Flow Duration (hours)	Peak Factor	Enter No. of Units	Avg. Flow (gpd)	Avg. Flow (gpm)	Peak Flow (gpd)	Peak Flow (gpm)
Residential									
Single Family Homes, Trailers, Apartments, Condos, Townhomes, Duplexes	Residential Dwelling	310	24	2.5	28	8,680	6.03	21,700	15.07
Medical Facilities									
Hospitals	Medical Bed	300	24	3		0	0.00	0	0.00
Nursing Homes & Assisted Living		160	24	3		0	0.00	0	0.00
Funeral Homes	Gross SF	0.25	12	3		0	0.00	0	0.00
Medical Office Building	Gross SF	0.25	12	3		0	0.00	0	0.00
Tourism Facilities									
Motels & Hotels	Room	130	24	3		0	0.00	0	0.00
Educational Facilities									
High School (w/ showers)	Student / Faculty	15	8	3		0	0.00	0	0.00
Elementary & Middle School		10	8	3		0	0.00	0	0.00
College/University Campus & Day Care		10	12	3		0	0.00	0	0.00
Boarding Schools		75	16	3		0	0.00	0	0.00
Recreational Facilities									
Picnic Areas, Parks & Amusement Parks	Person	5	12	3		0	0.00	0	0.00
Movie Theater	Seat	2.5	12	3		0	0.00	0	0.00
Religious Assembly		2.5	6	3		0	0.00	0	0.00
Campground / Cabins	Camping site	100	24	3		0	0.00	0	0.00
Dining /Eatery Facilities									
Restaurants	Seat	30	16	3		0	0.00	0	0.00
Service & Retail Facilities									
Shopping Mall & Retail Shops	Gross SF	0.2	12	3		0	0.00	0	0.00
Convenient Store		0.3	24	3		0	0.00	0	0.00
Office Building, Storage Units Office		0.1	12	3		0	0.00	0	0.00
Fitness Center		0.1	16	3		0	0.00	0	0.00
Service Stations		0.4	16	3		0	0.00	0	0.00
Laundromats	Machine	500	16	3		0	0.00	0	0.00
Industrial Facilities									
Heavy Industrial	Gross SF	0.35	16	3		0	0.00	0	0.00
Light Industrial		0.1	16	3		0	0.00	0	0.00
Warehouse		0.05	24	3		0	0.00	0	0.00
					Sub-Totals:	8,680	6.03	21,700	15.07

Future Growth Flow Calculations

Land use	Contributing Unit Type	Enter Flow (gpd/Unit)	Flow Duration (hrs)	Peak Factor	Enter No. of Units	Avg. Flow (gpd)	Avg. Flow (gpm)	Peak Flow (gpd)	Peak Flow (gpm)
Residential									
Single Family Homes, Trailers, Apartments, Condos, Townhomes, Duplexes	Residential Dwelling	310	24	2.5		0	0.00	0	0.00
Commercial									
Medical, Tourism, Educational, Recreational, Dining, Service & Retail Facilities	Acres	1,000.00	24	3		0	0.00	0	0.00
Industrial									
Heavy & Light Industrial, Manufacturing, Warehouses	Acres	1,000.00	24	3		0	0.00	0	0.00
					Sub-totals:	0	0	0	0

Grand Totals:	8,680	6.03	21,700	15.07

NOTE: Enter the number of units as indicated in the appropriate land use to calculate project design flows.

Under the Future Growth Flow Calculations section, you may edit the default values for the flow factor (gpd/Unit) based on best engineering practices.

Comments:

This project proposes the development of a new residential subdivision on Marlin Bay drive.

Applicant's Name: Kyle Brady
Phone No: (757) 905-5484
Email: kyle.brady@timmons.com

Ocean Park Subdivision
Proposed Flows

Flow Calculations - City of Virginia Beach

Discharge Facility		Flow gpd	Flow duration (hr)	Peak Factor	No. of Units	Average Flow (gpm)	Average Flow (gpd)	Peak Flow (gpd)	Peak Flow (gpm)
Dwelling	per dwelling	310	24	2.5	28	6.03	8,680	21,700	15.07

TOTAL DAILY FLOW (gpd)	**8,680**
TOTAL AVERAGE FLOW (gpm)	**6.03**
TOTAL PEAK FLOW (gpd)	**21,700**
TOTAL PEAK FLOW (gpm)	**15.07**

Ocean Park Subdivision
Proposed Flows

Flow Calculations - VDH

Discharge Facility		Flow gpd	Flow duration (hr)	Peak Factor	No. of Units	Average Flow (gpm)	Average Flow (gpd)	Peak Flow (gpd)	Peak Flow (gpm)
Dwellings	per dwelling	400	24	2.5	28	7.78	11,200	28,000	19.44

TOTAL DAILY FLOW (gpd)	**11,200**
TOTAL AVERAGE FLOW (gpm)	**7.78**
TOTAL PEAK FLOW (gpd)	**28,000**
TOTAL PEAK FLOW (gpm)	**19.44**

Appendix E – Pavement Design

PAVEMENT DESIGN

Vaswani Method

PROJECT: Ocean Park Subdivision
LOCATION: Virginia Beach, VA
PAVEMENT: Marlin Bay Drive

JOB # 50568
DESIGNED BY: KB
DATE: 04/09/25

No. of Units	ADT/Unit	Total
28	6	168

TRAFFIC ANALYSIS

1. Present ADT (Veh. Per Day) = 168
2. % of Trucks (HCV) = 5%
3. Equivalent ADT (Veh. Per Day) = 168
4. Design Period
   Years = 30
   % Growth = 0.1%
5. Growth Factor = 1.03
6. Design ADT (Veh. Per Day) = 173

SUBGRADE ANALYSIS

1. CBR Values = 30.0
2. Enter No. of Tests = 1
3. Average CBR = 30.00 *
4. Design CBR = 20.00
5. Soil Resiliency Factor = 2.00
6. Soil Support Value = 30.00

***Note:** Minimum CBR values of 9 is required for subgrade support. Since CBR values of 9 cannot be achieved for this project, unsuitable material shall be undercut and replaced with up to 18 inches of sand per the addendum to the geotechnical report from ETS, Inc. dated

PAVEMENT DESIGN

1. Thickness Index Required = 6.47 inches

2. Design

Material	Thickness Equivalency Value (a)	Thickness	Index	% Asphalt
SM-9.0A	1.67	1.5	2.5	0.14
IM-19.0 A	1.67		0.0	0.00
BM-25.0	1.67	3.0	5.0	0.29
Aggregate	0.60	6.0	3.6	
Select Material	0.50		0.0	
	TOTAL	10.5	11.1	0.43

3. Thickness Index Provided = 11.1 inches > or = Required Thickness Index of 6.5 inches
   > or = 30 % Asphalt : Total Ratio
   OK!