# Stormwater Assessment Study
## Marvin Loop Trail

AMT Project Number 15-0072.003

Prepared for:

Village of Marvin
10006 Marvin School Road
Marvin, NC 28173

Prepared by:

A. Morton Thomas and Associates, Inc.
10735 David Taylor Dr, Suite 310
Charlotte, NC 28262

June 2024

Table of Contents

## I. INTRODUCTION

The Marvin Loop Trail under review consists of a 1.5-mile asphalt trail that begins at Marvin Elementary School and ends at the intersection of Joe Kerr Road and Wheat Field Drive. This trail has flooding and standing water issues in two primary areas, one being next to the Marvin Elementary School's athletic field (Site 1) and the other area being between Autumn Blossom Lane and Groves Edge Lane along the south side of Joe Kerr Road (Site 2).

The following items have been conveyed to A. Morton Thomas (AMT) as specific stormwater issues/concerns:

- The amount of uncontrolled stormwater runoff flowing onto and around the trail causes flooding within the walking trail.
- Water ponds throughout the trail for several days after storm events.
- Concerns that the drainage design of the trail or nearby systems failed to incorporate the collective stormwater runoff causing the ponding issues along the trail.

AMT has been tasked by the Village of Marvin to evaluate the issues/concerns and present recommendations to help alleviate the situation. The purpose of this study is to summarize the current conditions and provide remediation options for the Village to implement.

## II. SITE ENVIRONMENTAL RESOURCES DESCRIPTION

### Topography

The assessment and recommendations provided in this study were based on available Union County and NCDOT GIS information (contours and impervious surfaces) and supplemented by aerial photos and USGS mapping as topographic survey was not completed for this study. The site conditions were field verified.

### Watershed:

Runoff from both sites flow towards the north through a series of ditches, culverts and ponds and into an unnamed tributary ultimately draining into Sixmile Creek along the Union County and Mecklenburg County line.

### Soils:

Soil information for the project was obtained from the Union County Soil Survey developed by the Soil Conservation Service (SCS). The predominant soil types within the project limits are designated as hydrologic soil types "C" and "D". These soil types have low infiltration rates and are typically fine texture or clay soils. The Soil Map is included in Appendix A.

### Floodplain, Waters of the US & Wetlands:

There are no floodplains, Waters of the US, or wetlands within the project limits.


Figure 1: Vicinity Map
*Source: Google Maps - Not to scale*

## III. IDENTIFICATION AND ASSESSMENT OF ISSUES

Prior to visiting the site, AMT completed a desktop analysis to evaluate the surrounding land use and delineate the area draining to each site. Base mapping was generated and used during the field investigation. The site visit was scheduled after periods of rainfall to better understand the drainage issues on site. Based on Weather Underground.com records, the area received 1.75 inches of rain on May 15th, 1.38 inches on May 16th and 0.20 inches on May 18th. AMT visited both sites on May 20,

2024 to verify the GIS information, land use, and existing drainage patterns. Notes and photos taken during the field investigation are included in Appendix E and F, respectively.

A hydrologic analysis for each site was completed using the methods outlined in the Village of Marvin Engineering Standards and Procedures Manual and Charlotte-Mecklenburg Storm Water Design Manual. The rational method was utilized which incorporates land use (runoff coefficients), flow path length, and rainfall intensities to determine the peak discharge for the 2-, 10-, and 25-year storm events. Rainfall intensities were taken from Table 2-2 of the Charlotte-Mecklenburg Storm Water Design Manual with the Cf factor of 1.1 applied for the 25-year storm event. Based on the manuals, roadside ditches should be designed to convey the 10-year storm event with 6 inches of freeboard while culverts should be designed to convey the 25-year storm event. Refer to Appendix C for the hydrology computations.

**Site 1:**

Site 1 is located just north of the Marvin Elementary School where the trail enters into a wooded area. Based on Google Earth photos, it appears this section of the trail was constructed in 2008. Along the school property, a roadside ditch conveys runoff from the trail and roadway to the north. The ditch becomes less defined at the outfall of a culvert located under Marvin School Road that appears to flow to the west, towards the trail.

The culvert conveys approximately 4.60 acres of woods, residential homes, and a portion of roadway from the east side of Marvin School Road. During the site investigation, the culvert did not appear to be actively in use with vegetation and cobwebs lining the inflow and outlet. Any flow from the culvert appears to flow into the wooded area between the trail and the roadway. A roadside ditch begins near the edge of the woods but is very flat with an ill-defined backslope allowing for any runoff to flow into the woods.

As the trail enters the woods , there is a pond area to the left which does not appear to have a defined inflow or outflow points. It is not clear what the intent of this area was, it may have been constructed when the berm for the school was installed, however based on the depth, it does not appear the ponded water would impact the trail. The berm does not have any impact on the drainage to the trail.

The asphalt of the trail is built up a few inches preventing runoff from the west from flowing over the trail and towards the road. Based on the build up of sediment and debris and moisture of the soil on the left side of the trail, it appears that water may pond and overtop the trail in larger storm events. On the east side of the trail, there appears to be a small ditch/flow path in the woods. This area is fairly flat so sediment and debris and wet soils were noted. The flow path appears to flow to the north towards the road and roadside ditch however a build up of leaves and other woody debris has accumulated along the wood line and is preventing runoff from leaving the woods in the ditch. Since this area is flat, the runoff that would be conveyed in the small ditch may be backing up and causing flooding conditions on the trail and adjacent areas.

Once the trail exits the wooded area heading north, a more defined roadside swale exists. However, the slope of the ditch is very flat and may not have adequate capacity to convey the flow from the wooded area. There is a culvert in the roadside ditch to allow for vehicular or maintenance equipment to access the trail. The ends of the culvert have been damaged and the culvert has a large

accumulation of sand and silt which reduces the capacity and functionality of the pipe. The grass swale downstream of the culvert is in good condition and due to a steeper slope, appears to have adequate capacity to convey the ditch flow. The area draining to the culvert is 8.71 acres of woods, residential area, grass, and impervious area (trail and road).


Figure 2: Site 1 – Existing Conditions
*Source: Google Maps - Not to scale*

**Site 2**:
Site 2 is located west of the intersection of Joe Kerr Road and Autumn Blossom Lane as the trail gets closer to Joe Kerr Road in the woods. Based on Google Earth photos, it appears this section of the trail was constructed between 2009 and 2010.

Similar to Site 1, the asphalt of the trail is built up a few inches preventing runoff from the south, particularly the properties along Hickory Bark Court, from flowing over the trail and towards the road. Based on the buildup of sediment, debris, and moisture of the soil on the left side of the trail, it appears that water may pond and overtop the trail in larger storm events. Runoff from Joe Kerr Road and two inlets along Autumn Blossom Lane outfall into a small riprap area approximately 100 feet west of Autumn Blossom Lane. The outfall pipe from the two inlets was mostly buried with sediment and riprap. Runoff downstream of the riprap appeared to flow into the woods between the trail and the road with no defined swale or roadside ditch. The area draining to the riprap area is approximately 4.29 acres of woods, residential area, and impervious (trail and roadway). As the trail gets closer to Joe Kerr Road and along the edge of the tree line, a small roadside ditch forms. However, this ditch does not have positive flow since standing water was observed. There is a gap in ditch between the riprap and the defined ditch section.

At the low point in the trail, twin RCP culverts convey runoff under the trail, into the ditch and towards a RCP and CMP culvert under Joe Kerr Road. The twin RCP culverts are partially filled with sediment. The headwall and endwall on either side of the trail are in good condition. The RCP culvert under Joe Kerr has disconnected at the first joint, is partially blocked with debris and has accumulated sediment in the invert,. The CMP culvert appears in ok condition with some accumulation of sediment and rocks. The outfall of the RCP culvert was mostly buried while there is erosion and a scour hole at the CMP outfall. The culvert outfalls in a ditch which ultimately flows into a RCP pipe that outfalls into a pond in the adjacent neighborhood. The area draining to the upstream end of the culverts under Joe Kerr Road is 9.68 acres of woods, residential area and impervious (trail and roadway).


Figure 3: Site 2 – Existing Conditions
*Source: Google Maps - Not to scale*

## IV. IMPROVEMENT RECOMMENDATIONS & PRELIMINARY COST ESTIMATE

**Site 1:**

In order to provide positive flow from the wooded area (area of concern), the following actions are recommended:

Option 1:
Remove the debris accumulation in the confluence between the ditch from the woods and the roadside ditch. This will enable the wooded area to properly drain into the existing ditch downstream of the woods and prevent a backup of water. This work can be done by hand and should be a regularly scheduled maintenance item.

Preliminary cost: The approximate cost for this option is $140-160 and includes 2 hours of labor at $60-80/hr.

Option 2:
This option should be implemented in conjunction with Option 1. Create a more defined ditch along the road from where the ditch along the school property combines with the outfall of the culvert under Marvin School Road to the culvert under the access road. There is little to no backslope on the existing ditch in this area causing the flow to dissipate into the woods. A more defined ditch section would keep runoff along the road, out of the woods and off the trail. Based on the ditch sizing requirements in the Charlotte-Mecklenburg Storm Water Design Manual, roadside ditches should be sized to convey the 10-year storm event, with a maximum of 3:1 slope from the road and 2:1 back slope with a 6-inch freeboard requirement. With the 10-yr storm event peak discharge of 14.72 cfs, a 2 ft flat bottom ditch that is 18 inches deep would meet the requirements.

Approximately 500 linear feet of berm would be required (blue line in Figure 4) between the road culvert and the end of the woods. The existing ditch would be excavated to widen the bottom and fill placed on the backslope to create a berm. The existing ditch north of the woods to the access road culvert (red line in Figure 4) is more defined and should require additional excavation to establish the recommended ditch section. This section is approximately 250 linear feet. A minimum longitudinal slope of 0.5% is recommended to provide positive flow. Based on the calculated velocities of less than 5 cfs, a grass lined ditch is recommended.

Cleaning and repair of the culvert under the access road is recommended. Based on preliminary sizing computations, the culvert is not adequately sized to convey the 10-year storm peak discharge of 17.13 cfs.

Preliminary cost: The approximate cost for this option is $41,300 and includes the following:

| Quantity | Item | Unit Cost | Total |
|---|---|---|---|
| 180 cy | Excavation | $100/cy | $18,000 |
| 140 cy | Fill | $85/cy | $11,900 |
| 25 lf | Pipe Cleaning | $60/lf | $1,500 |
| 660 sy | 4” Topsoil | $12/sy | $7,920 |
| 660 sy | Seed | $3/sy | $1,980 |

If the onsite excavated material is suitable for construction of the berm, the fill quantity can be reduced or eliminated for a cost savings. Substituting sod instead of seed would be an increase of approximate $7,920 to the estimate noted above. Pipe repair or replacement would be an additional cost.

Option 3:
Install a trench drain or underdrain pipes under the trail at the low point in the woods to convey runoff coming from the west, under the trail. This will prevent runoff from ponding due to the built up trail and overtopping the trail during larger storm events. This would also help with ponding water during smaller events. These drains would need to be maintained regularly to prevent clogging due to the amount of debris and sediment that was observed.

Preliminary cost: The approximate cost for this option ranges from $750 for 30 lf of 6-inch PVC underdrain at $25/lf to $3,000 for 30 lf of trench drain at $80-100/lf. Minor grading upstream or downstream of the drain would be an additional cost.


Figure 4: Site 1 – Remediation Option 2
*Source: Google Maps - Not to scale*

**Site 2:**

In order to provide positive flow from the wooded area (area of concern), the following actions are recommended:

Option 1:

Create a more defined ditch along the road from the storm drain outfall west of Autumn Blossom Lane to the culverts under Joe Kerr Road to prevent runoff from flowing into the woods and trail. There is little to no ditch from the outfall and riprap for approximately 250 linear feet and ponded water was observed immediately downstream of the riprap. The remaining 300 linear feet of existing ditch to the culverts also had ponded water which indicates a lack of ditch slope. Based on the ditch

sizing requirements in the Charlotte-Mecklenburg Storm Water Design Manual, roadside ditches should be sized to convey the 10-year storm event, with a maximum of 3:1 slope from the road and 2:1 back slope with a 6-inch freeboard requirement. With the 10-yr storm event peak discharge of 20.10 cfs, a 2 ft flat bottom ditch that is 18 inches deep would meet the requirements.

Approximately 250 linear feet of new ditch would be required (red line in Figure 5) starting from the riprap outfall. The existing ditch along the woods to the culverts (blue line in Figure 5) is more defined and would require additional excavation to establish the recommended ditch section. This section is approximately 300 linear feet. A minimum longitudinal slope of 0.5% is recommended to provide positive flow. Based on the calculated velocities of less than 6 cfs, a grass lined ditch is recommended.

Preliminary cost: The approximate cost for this option is $19,850 and includes the following:

| Quantity | Item | Unit Cost | Total |
|---|---|---|---|
| 125 cy | Excavation | $100/cy | $12,500 |
| 490 sy | 4" Topsoil | $12/sy | $5,880 |
| 490 sy | Seed | $3/sy | $1,470 |

Substituting sod instead of seed would be an increase of approximate $5,880 to the estimate noted above.


Figure 5: Site 2 – Remediation Option 2
*Source: Google Maps - Not to scale*

Option 2:
This option should be implemented in conjunction with Option 1. Clean and repair of the culverts under the trail and Joe Kerr Road is recommended to improve functionality and capacity of the pipes. With the increased efficiency and conveyance capacity of the upgraded ditches, the culverts under Joe Kerr Road could result in a back up of flow and flooding on the trail and the road. Based on preliminary sizing computations, the CMP culvert alone is not adequately sized to convey the 25-year storm peak discharge of 25.86 cfs however with the combined capacity of a clean and fully functioning RCP culvert, the 25-yr event may be safely conveyed under the roadway.

Preliminary cost: The approximate cost for this option is $9,000 and includes 150 lf of pipe cleaning at $60/lf. Pipe repair or replacement would be an additional cost.

Option 3:
Install a trench drain or underdrain pipes under the trail at the low point in the woods to convey runoff coming from the south, under the trail. This will prevent runoff from ponding due to the built up trail and overtopping the trail during larger storm events. This would also help with ponding water during smaller events. These drains would need to be maintained regularly to prevent clogging due to the amount of debris and sediment that was observed.

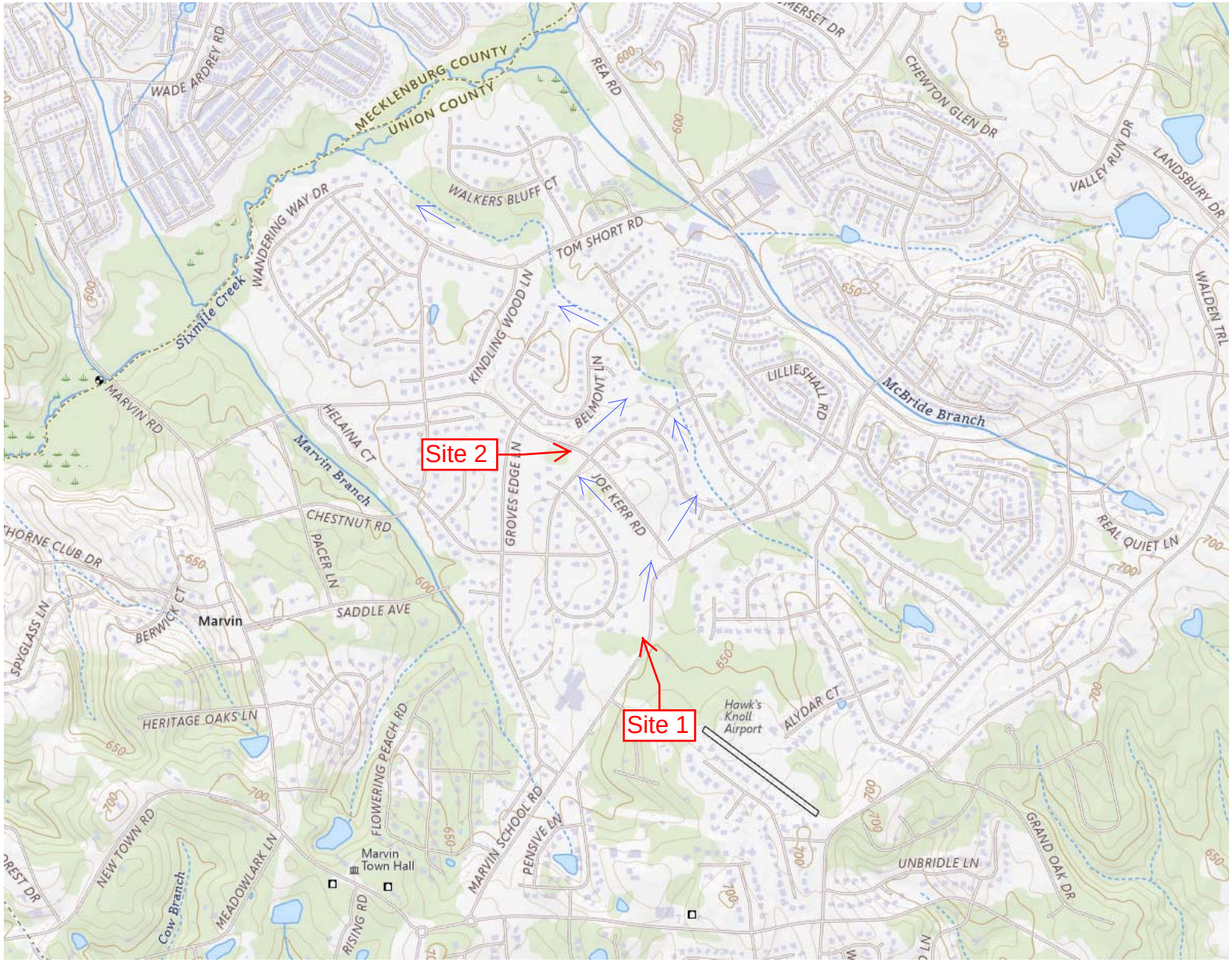
Preliminary cost: The approximate cost for this option ranges from $750 for 30 lf of 6-inch PVC underdrain at $25/lf to $3,000 for 30 lf of trench drain at $80-100/lf. Minor grading upstream or downstream of the drain would be an additional cost.

## V. CONCLUSION

Based on the field visit and available information, it is recommended to establish more defined roadway ditch sections to provide positive flow away from the wooded areas that the trail passes through and limit the amount of runoff reaching these areas. Regular cleaning and repair of the culverts within these areas will aid in the removal of excess ponding water.

# APPENDIX A

Environmental Resources Mapping


MECKLENBURG COUNTY
UNION COUNTY
WADE AUDREY RD
WANDERING WAY DR
Sixmile Creek
WALKERS BLUFF CT
TOM SHORT RD
REA RD
CHEWTON GLEN DR
VALLEY RUN DR
LANDSBURY DR
WALDEN TRL
KINDLING WOOD LN
BELMONT LN
LILLIESHALL RD
McBride Branch
MARVIN RD
HELAINA CT
Marvin Branch
Site 2
GROVES EDGE LN
JOE KERR RD
REAL QUIET LN
CHESTNUT RD
PACER LN
SADDLE AVE
Marvin
BERWICK CT
SPYGLASS LN
HERITAGE OAKS LN
Site 1
Hawk's Knoll Airport
ALYDAR CT
FLOWERING PEACH RD
NEW TOWN RD
MEADOWLARK LN
Cow Branch
Marvin Town Hall
RISING RD
MARVIN SCHOOL RD
PENSIVE LN
UNBRIDLE LN
GRAND OAK DR

Flow Arrows

Hydrologic Soil Group—Union County, North Carolina

**Marvin Loop - Sites 1 and 2**


Map Scale: 1:11,100 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 150 300 600 900

Feet: 0 500 1000 2000 3000

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

## MAP LEGEND

**Area of Interest (AOI)**

Area of Interest (AOI)

**Soils**

**Soil Rating Polygons**

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

**Soil Rating Lines**

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

**Soil Rating Points**

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

**Water Features**

Streams and Canals

**Transportation**

Rails
Interstate Highways
US Routes
Major Roads
Local Roads

**Background**

Aerial Photography

## MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

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

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

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

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
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: Union County, North Carolina
Survey Area Data: Version 24, Sep 13, 2023

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

Date(s) aerial images were photographed: Mar 13, 2022—May 9, 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 |
|---|---|---|---|---|
| ChA | Chewacla silt loam, 0 to 2 percent slopes, frequently flooded | B/D | 19.5 | 3.2% |
| HeB | Helena fine sandy loam, 2 to 8 percent slopes | D | 5.2 | 0.9% |
| IrA | Iredell loam, 0 to 3 percent slopes | C/D | 413.9 | 67.7% |
| LdB2 | Lloyd clay loam, 2 to 8 percent slopes, moderately eroded | B | 58.0 | 9.5% |
| MeB2 | Mecklenburg sandy clay loam, 2 to 8 percent slopes, moderately eroded | C | 84.8 | 13.9% |
| TaB | Tarrus gravelly silt loam, 2 to 8 percent slopes | B | 19.3 | 3.2% |
| WyB | Wynott gravelly loam, 2 to 8 percent slopes | D | 10.8 | 1.8% |
| **Totals for Area of Interest** | | | **611.6** | **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

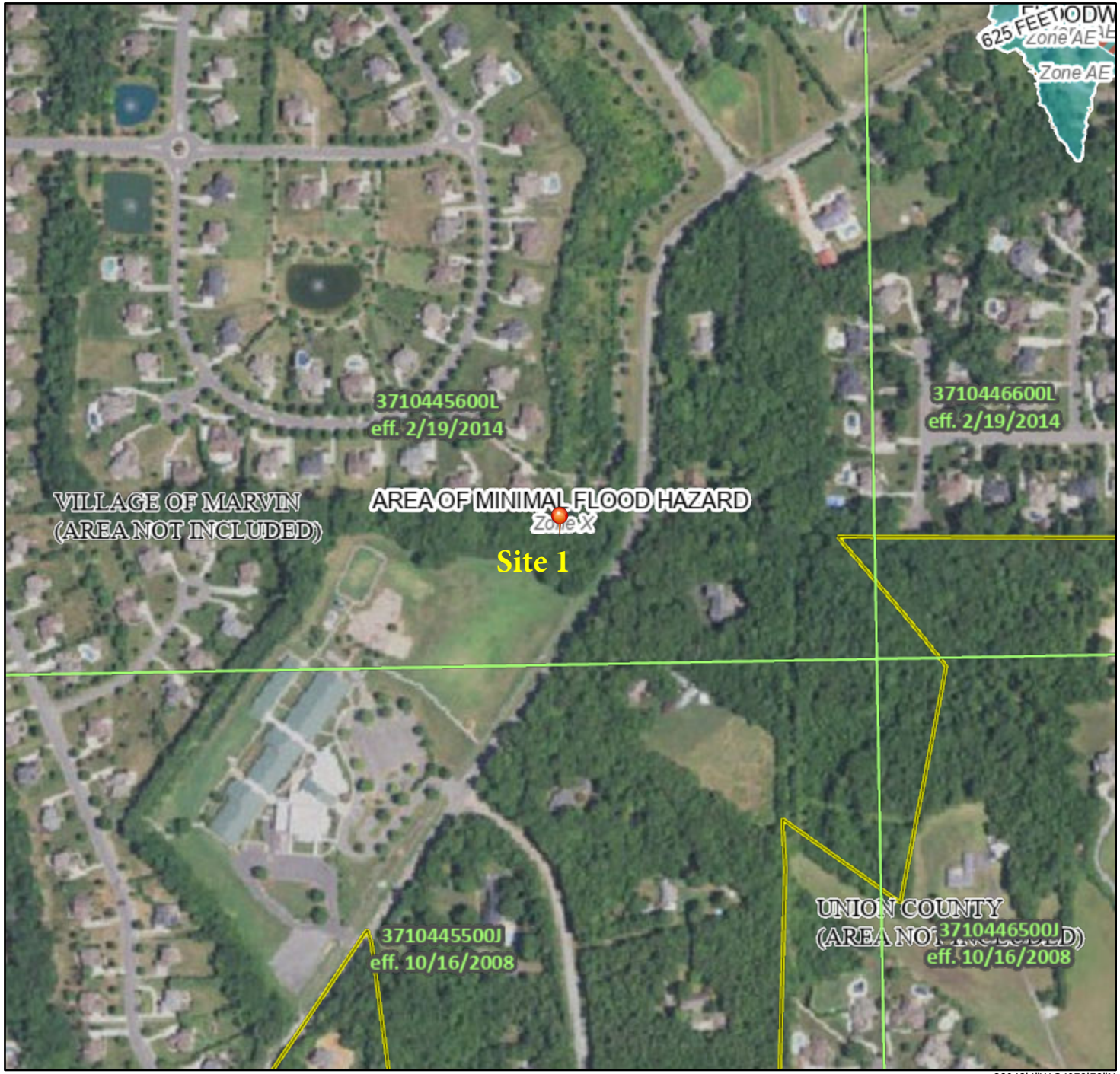
*Component Percent Cutoff: None Specified*

*Tie-break Rule:* Higher

# National Flood Hazard Layer FIRMette

FEMA

80°48'41"W 35°0'20"N




80°48'4"W 34°59'50"N

0 250 500 1,000 1,500 2,000 Feet

1:6,000

*Basemap Imagery Source: USGS National Map 2023*

## Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

**SPECIAL FLOOD HAZARD AREAS**
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

**OTHER AREAS OF FLOOD HAZARD**
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

**OTHER AREAS**
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

**GENERAL STRUCTURES**
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

**OTHER FEATURES**
- 20.2 Cross Sections with 1% Annual Chance
- 17.5 Water Surface Elevation
- Coastal Transect
- Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

**MAP PANELS**
- Digital Data Available
- No Digital Data Available
- Unmapped

N

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

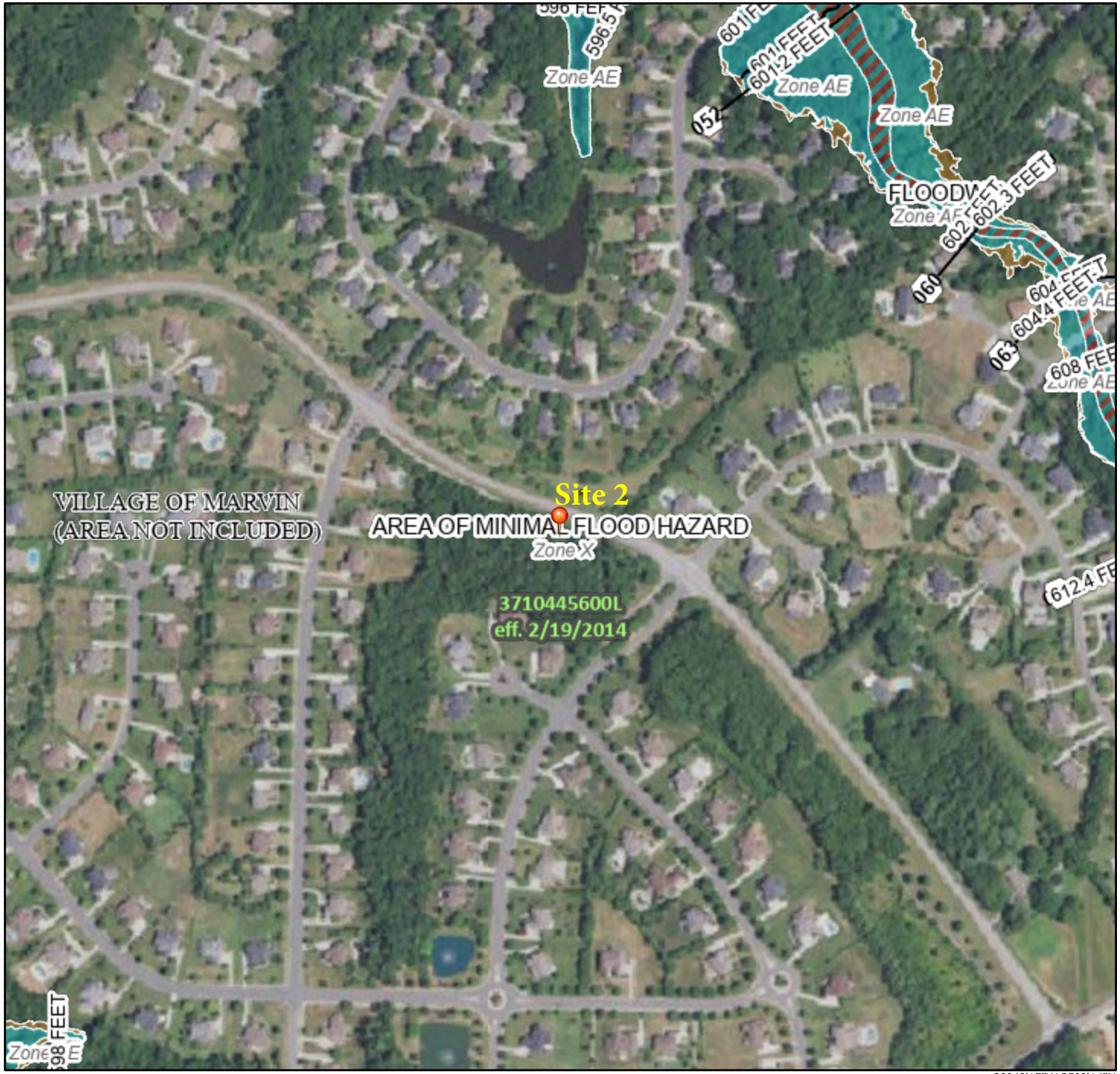
The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 6/18/2024 at 2:01 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

# National Flood Hazard Layer FIRMette

FEMA

80°48'52"W 35°0'43"N




80°48'15"W 35°0'14"N

0 250 500 1,000 1,500 2,000 Feet

1:6,000

*Basemap Imagery Source: USGS National Map 2023*

## Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

**SPECIAL FLOOD HAZARD AREAS**
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

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- 513 Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

**MAP PANELS**
- Digital Data Available
- No Digital Data Available
- Unmapped

N

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# APPENDIX B

Drainage Area Maps


A. MORTON THOMAS AND ASSOCIATES, INC.
CONSULTING ENGINEERS
10735 DAVID TAYLOR DRIVE, SUITE 310
CHARLOTTE, NC 28262
PHONE (704) 595-9975
EMAIL: AMT1@AMTENGINEERING.COM

CONSULTANTS

# VILLAGE OF MARVIN SWM ASSESSMENT

MARVIN, NORTH CAROLINA

Village of Marvin
Enriched by Nature

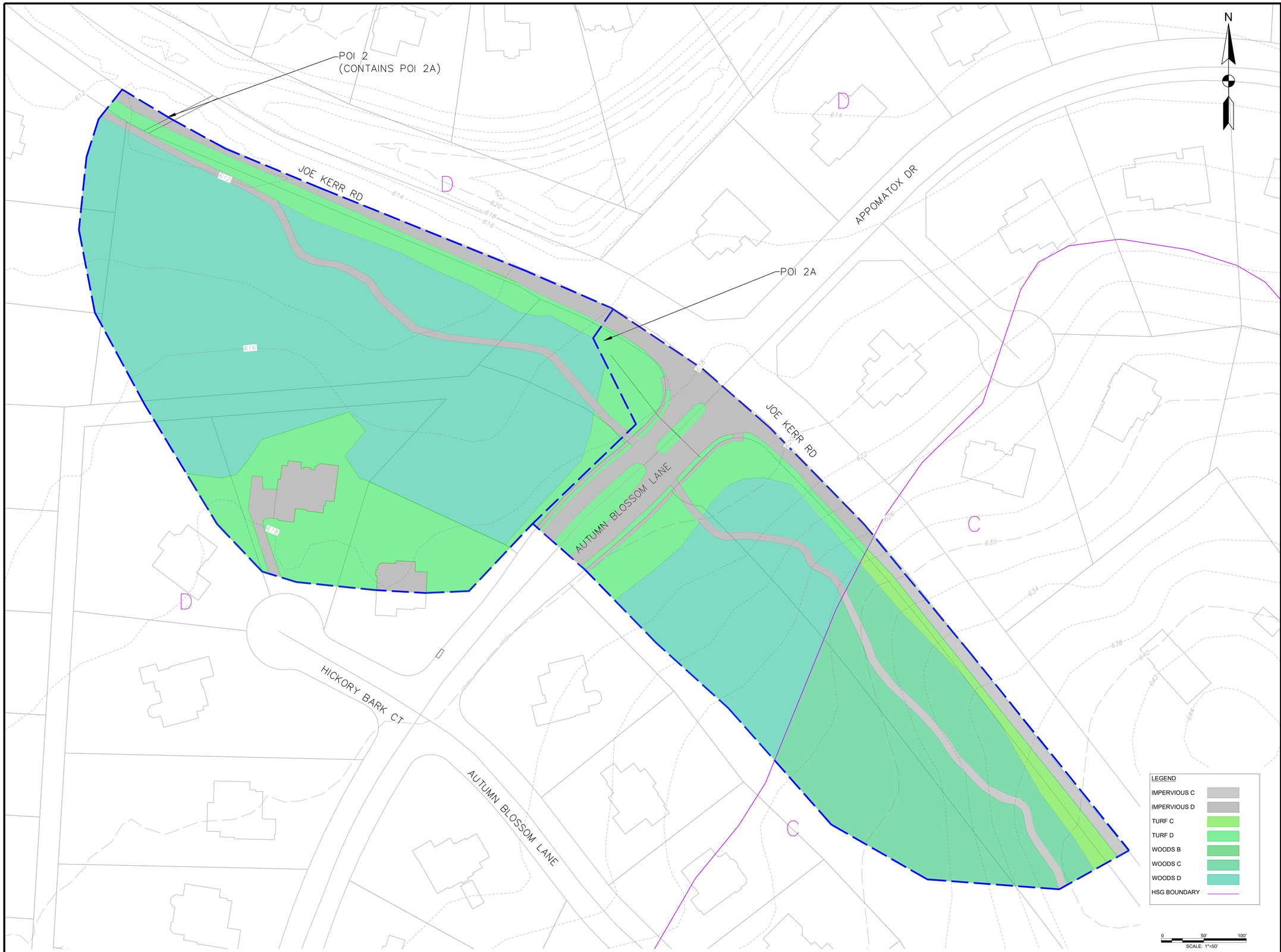
## MARVIN LOOP TRAIL STORMWATER ASSESSMENT

SITE 1

| MARK | DATE | DESCRIPTION |
|---|---|---|

| | |
|---|---|
| PROJECT NO: | 15-0072.003 |
| SCALE: | 1" = 60' |
| DESIGNED BY: | HH |
| DRAWN BY: | HH |
| CHECKED BY: | KS |

SHEET TITLE




A. MORTON THOMAS AND ASSOCIATES, INC.
CONSULTING ENGINEERS
10735 DAVID TAYLOR DRIVE, SUITE 310
CHARLOTTE, NC 28262
PHONE (704) 595-9975
EMAIL: AMT1@AMTENGINEERING.COM

CONSULTANTS

# VILLAGE OF MARVIN SWM ASSESSMENT

MARVIN, NORTH CAROLINA

Village of Marvin
Enriched by Nature

## MARVIN LOOP TRAIL STORMWATER ASSESSMENT

SITE 2

| MARK | DATE | DESCRIPTION |
|---|---|---|

| | |
|---|---|
| PROJECT NO: | 15-0072.003 |
| SCALE: | 1" = 50' |
| DESIGNED BY: | HH |
| DRAWN BY: | HH |
| CHECKED BY: | KS |

SHEET TITLE

SHEET 2 OF 2

# APPENDIX C

Hydrology/Hydraulic Computations

A. Morton Thomas

10735 David Taylor Dr, Suite 310
Charlotte, NC 28262

## RATIONAL METHOD

Village of Marvin
Marvin Loop

JOB NO. 15-0072.003 DESIGNED BY HH DATE: 6/17/2024

CHECKED BY: KS DATE: 6/20/2024

**DITCH LOCATION**

INLET #
STUDY POINT # POI 1-A

STATION=
DESCRIPTION= Culvert under Marvin School Road

**FLOW CALCULATION**

| | | AREA 1 | AREA 2 | AREA 3 | |
|---|---|---|---|---|---|
| LAND USE | | Streets | Grass, flat slope | Woods | |
| AREA (sq ft) | | 15936 | 16944 | 167325 | |
| AREA (ac) | | 0.37 | 0.39 | 3.84 | |
| RUNOFF COEFF. (C) | | 0.95 | 0.30 | 0.25 | |
| TOTAL AREA = | **4.60** | acres | | | |
| WEIGHTED C = | 0.31 | | 0.31 | 0.34 | (includes the Cf factor of 1.1) |
| TIME OF CONCENTRATION (Tc)= | 10 | min | | | |
| DESIGN STORM= | 2 | year | 10 year | 25 | year |
| RAINFALL INTENSITY (I)= | 3.99 | in/hr | 5.84 in/hr | 6.83 | in/hr |
| **RUNOFF (Q=ciA) =** | **5.68** | **CFS** | **8.32 CFS** | **10.70** | **CFS** |

A. Morton Thomas

10735 David Taylor Dr, Suite 310
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**DITCH LOCATION**

INLET #
STUDY POINT # POI 1-B

STATION=
DESCRIPTION= Low Point in Woods

**FLOW CALCULATION**

| | | AREA 1 | AREA 2 | AREA 3 | |
|---|---|---|---|---|---|
| LAND USE | | Streets | Grass, flat slope | Woods | |
| AREA (sq ft) | | 35853 | 32634 | 263809 | |
| AREA (ac) | | 0.82 | 0.75 | 6.06 | |
| RUNOFF COEFF. (C) | | 0.95 | 0.30 | 0.25 | |
| TOTAL AREA = | **7.63** | acres | | | |
| WEIGHTED C = | 0.33 | | 0.33 | 0.36 | (includes the Cf factor of 1.1) |
| TIME OF CONCENTRATION (Tc)= | 10 | min | | | |
| DESIGN STORM= | 2 | year | 10 year | 25 | year |
| RAINFALL INTENSITY (I)= | 3.99 | in/hr | 5.84 in/hr | 6.83 | in/hr |
| **RUNOFF (Q=ciA) =** | **10.06** | **CFS** | **14.72 CFS** | **18.94** | **CFS** |

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**DITCH LOCATION**

INLET #
STUDY POINT # POI 1

STATION=
DESCRIPTION= Culvert in ditch along Marvin School Road

**FLOW CALCULATION**

| | | AREA 1 | AREA 2 | AREA 3 | |
|---|---|---|---|---|---|
| LAND USE | | Streets | Grass, flat slope | Woods | |
| AREA (sq ft) | | 43884 | 44940 | 290538 | |
| AREA (ac) | | 1.01 | 1.03 | 6.67 | |
| RUNOFF COEFF. (C) | | 0.95 | 0.30 | 0.25 | |
| TOTAL AREA = | **8.71** | acres | | | |
| WEIGHTED C = | 0.34 | | 0.34 | 0.37 | (includes the Cf factor of 1.1) |
| TIME OF CONCENTRATION (Tc)= | 10 | min | | | |
| DESIGN STORM= | 2 | year | 10 year | 25 year | |
| RAINFALL INTENSITY (I)= | 3.99 | in/hr | 5.84 in/hr | 6.83 in/hr | |
| **RUNOFF (Q=ciA) =** | **11.71** | **CFS** | **17.13 CFS** | **22.04 CFS** | |

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**DITCH LOCATION**

INLET #
STUDY POINT # POI 2-A

STATION=
DESCRIPTION= Storm drain outfall SW corner of Joe Kerr & Autumn Ln

**FLOW CALCULATION**

| | | AREA 1 | AREA 2 | AREA 3 | |
|---|---|---|---|---|---|
| LAND USE | | Streets | Grass, flat slope | Woods | |
| AREA (sq ft) | | 35016 | 35122 | 116732 | |
| AREA (ac) | | 0.80 | 0.81 | 2.68 | |
| RUNOFF COEFF. (C) | | 0.95 | 0.30 | 0.25 | |
| TOTAL AREA = | **4.29** | acres | | | |
| WEIGHTED C = | 0.39 | | 0.39 | 0.43 | (includes the Cf factor of 1.1) |
| TIME OF CONCENTRATION (Tc)= | 10 | min | | | |
| DESIGN STORM= | 2 | year | 10 year | 25 | year |
| RAINFALL INTENSITY (I)= | 3.99 | in/hr | 5.84 in/hr | 6.83 | in/hr |
| **RUNOFF (Q=ciA) =** | **6.69** | **CFS** | **9.78 CFS** | **12.59** | **CFS** |

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**DITCH LOCATION**

INLET #
STUDY POINT # POI 2

STATION=
DESCRIPTION= Culverts under Joe Kerr Road

**FLOW CALCULATION**

| | | AREA 1 | AREA 2 | AREA 3 | |
|---|---|---|---|---|---|
| LAND USE | | Streets | Grass, flat slope | Woods | |
| AREA (sq ft) | | 57274 | 88245 | 276118 | |
| AREA (ac) | | 1.31 | 2.03 | 6.34 | |
| RUNOFF COEFF. (C) | | 0.95 | 0.30 | 0.25 | |
| TOTAL AREA = | **9.68** | acres | | | |
| WEIGHTED C = | 0.36 | | 0.36 | 0.39 | (includes the Cf factor of 1.1) |
| TIME OF CONCENTRATION (Tc)= | 10 | min | | | |
| DESIGN STORM= | 2 | year | 10 year | 25 | year |
| RAINFALL INTENSITY (I)= | 3.99 | in/hr | 5.84 in/hr | 6.83 | in/hr |
| **RUNOFF (Q=ciA) =** | **13.73** | **CFS** | **20.10 CFS** | **25.86** | **CFS** |

# Hydraulic Analysis Report

## Project Data

Project Title: Marvin Loop

Designer: KS

Project Date: Friday, June 21, 2024

Project Units:  U.S. Customary Units

Notes:

## Channel Analysis: POI 1A to POI 1B (Culvert under Marvin School Rd to end of woods)

Notes:

### Input Parameters

Channel Type:  Trapezoidal

Side Slope 1 (Z1): 3.0000 ft/ft

Side Slope 2 (Z2): 2.0000 ft/ft

Channel Width 2.00 ft

Longitudinal Slope: 0.0050 ft/ft

Manning's n:  0.0150

Flow 14.7200 cfs

### Result Parameters

Depth 0.8130 ft

Area of Flow 3.2785 ft^2

Wetted Perimeter 6.3890 ft

Hydraulic Radius 0.5132 ft

Average Velocity 4.4898 ft/s

Top Width 6.0651 ft

Froude Number:  1.0762

Critical Depth 0.8446 ft

Critical Velocity 4.2389 ft/s

Critical Slope: 0.0043 ft/ft

Critical Top Width 6.22 ft

Calculated Max Shear Stress 0.2537 lb/ft^2

Calculated Avg Shear Stress 0.1601 lb/ft^2

## Channel Analysis: POI 1B to POI 1 (end of woods to culvert under Access Road)

Notes:

### Input Parameters

Channel Type:  Trapezoidal

Side Slope 1 (Z1): 3.0000 ft/ft

Side Slope 2 (Z2): 2.0000 ft/ft

Channel Width 2.00 ft

Longitudinal Slope: 0.0050 ft/ft

Manning's n:  0.0150

Flow 17.1300 cfs

### Result Parameters

Depth 0.8751 ft

Area of Flow 3.6647 ft^2

Wetted Perimeter 6.7241 ft

Hydraulic Radius 0.5450 ft

Average Velocity 4.6743 ft/s

Top Width 6.3755 ft

Froude Number:  1.0865

Critical Depth 0.9132 ft

Critical Velocity 4.3794 ft/s

Critical Slope: 0.0042 ft/ft

Critical Top Width 6.57 ft

Calculated Max Shear Stress 0.2730 lb/ft^2

Calculated Avg Shear Stress 0.1700 lb/ft^2

## Channel Analysis: POI 2A to POI 2 (Riprap outfall to culverts under Joe Kerr Road)

Notes:

### Input Parameters

Channel Type: Trapezoidal

Side Slope 1 (Z1): 3.0000 ft/ft

Side Slope 2 (Z2): 2.0000 ft/ft

Channel Width 2.00 ft

Longitudinal Slope: 0.0060 ft/ft

Manning's n: 0.0150

Flow 20.1000 cfs

### Result Parameters

Depth 0.9047 ft

Area of Flow 3.8556 ft^2

Wetted Perimeter 6.8839 ft

Hydraulic Radius 0.5601 ft

Average Velocity 5.2132 ft/s

Top Width 6.5235 ft

Froude Number: 1.1950

Critical Depth 0.9907 ft

Critical Velocity 4.5318 ft/s

Critical Slope: 0.0041 ft/ft

Critical Top Width 6.95 ft

Calculated Max Shear Stress 0.3387 lb/ft^2

Calculated Avg Shear Stress 0.2097 lb/ft^2

# APPENDIX D

Site Photos

Photo 1: Marvin Elementary School – looking north.

Photo 2: Loop trail entering the woods at the elementary school property line. Outfall of culvert under Marvin School Road near the tree line

Photo 3: Outfall of culvert under Marvin School Road

Photo 4: Close up of culvert outfall

Photo 5: Upstream end of culvert on east side of Marvin School Road

Photo 6: Trail just inside the wood line, heading north.

Photo 7: Deep ponded area of water on the west side of the trail. School fence is in the background.


Photo 8: northbound trail

Photo 9: Northbound trail with areas of sediment build up and wet soil.

Photo 10: Northbound trail with areas of sediment build up and wet soil.

Photo 11: Shallow swale in the woods between the trail and Marvin School Road (note red car on the road in the background)

Photo 12: Shallow swale in the woods running parallel to the road and trail.

Photo 13: Accumulation of debris and sediment at the end of the shallow swale preventing positive flow into roadside ditch.

Photo 14: Connecting trail to Arborvitae Court. Note discoloration on the trail where water ponds.

Photo 15: Northbound trail. Note discoloration on the trail where water ponds.

Photo 16: RCP culvert under the access road, looking north.

Photo 17: Roadside ditch downstream of the culvert and access road

Photo 18: Outlet of the RCP under the access road

Photo 19: Looking south from the access road at the existing ditch.

Photo 20: Existing ditch at wood line, looking south.

Photo 21: Existing ditch along the wood line, looking south.

Photo 22: Existing ditch along wood line, note debris accumulation along the brush indicating runoff flowing into the woods. Culvert under the road is near the utility pole in the background.


Photo 1: Inlet on Autumn Blossom Lane that flows west.

Photo 2: Inlet on Autumn Blossom Lane that flows west.


Photo 3: Entrance to Autumn Blossom Lane off Joe Kerr Road

Photo 4: End of curb and riprap for storm drain outfall along Joe Kerr Road, looking west.

Photo 5: Riprap at outfall of storm drain system (inlets along Autumn Blossom Lane) Outfall pipe is partially buried.

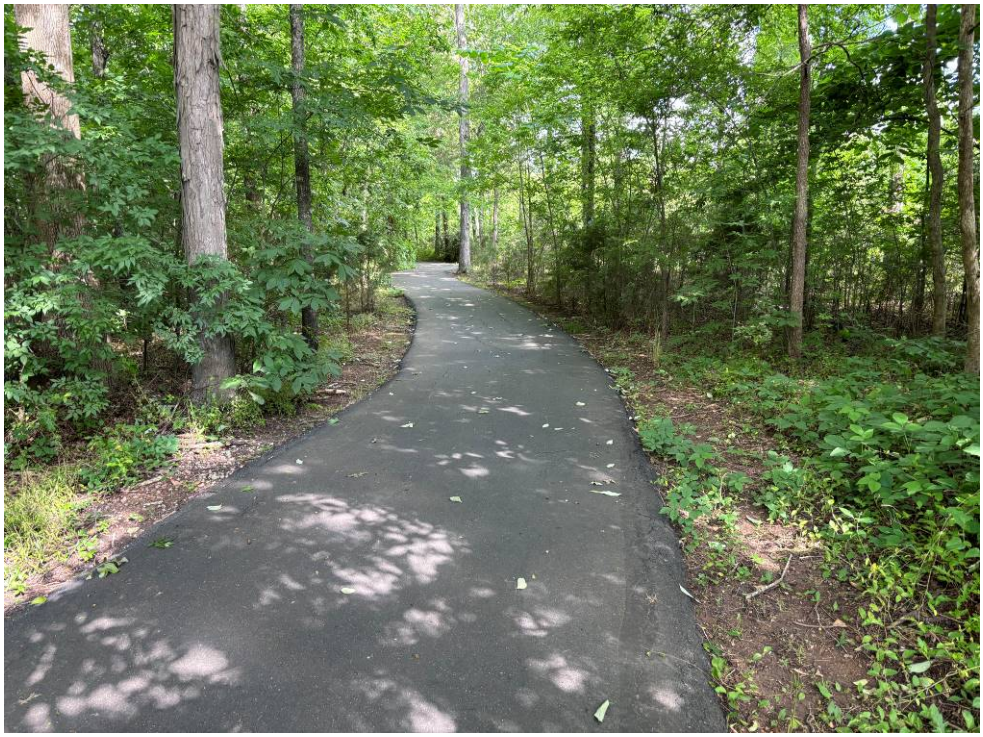


Photo 6: Trail entrance off Autumn Blossom Lane.

Photo 7: Trail heading west. Sediment and wet soils on either side of trail.

Photo 8: Trail heading west. Sediment and wet soils on either side of trail

Photo 9: Trail heading west. Sediment and wet soils between the trail and road.

Photo 10: Trail heading west. Sediment and wet soils between the trail and road.

Photo 11: Shallow wet roadside ditch west of the woods.

Photo 12: Looking back east towards the trail and the beginning of the shallow wet ditch.

Photo 13: Confluence of the roadside ditches, culverts under the trail and road culverts.

Photo 14: Upstream end of the culverts under Joe Kerr Road. Note the RCP on the left is broken and clogged.

Photo 15: Headwall and RCP culverts under the trail.

Photo 16: CMP pipe from adjacent residential area to the culverts under Joe Kerr Road. Pipe is almost completely buried.

Photo 17: Downstream end of the RCP culvert under the trail.

Photo 18: Headwall and upstream end of the culverts under the trail

Photo 19: Upstream end of the CMP under Joe Kerr Road

Photo 20: Upstream end of the RCP culvert under Joe Kerr Road.

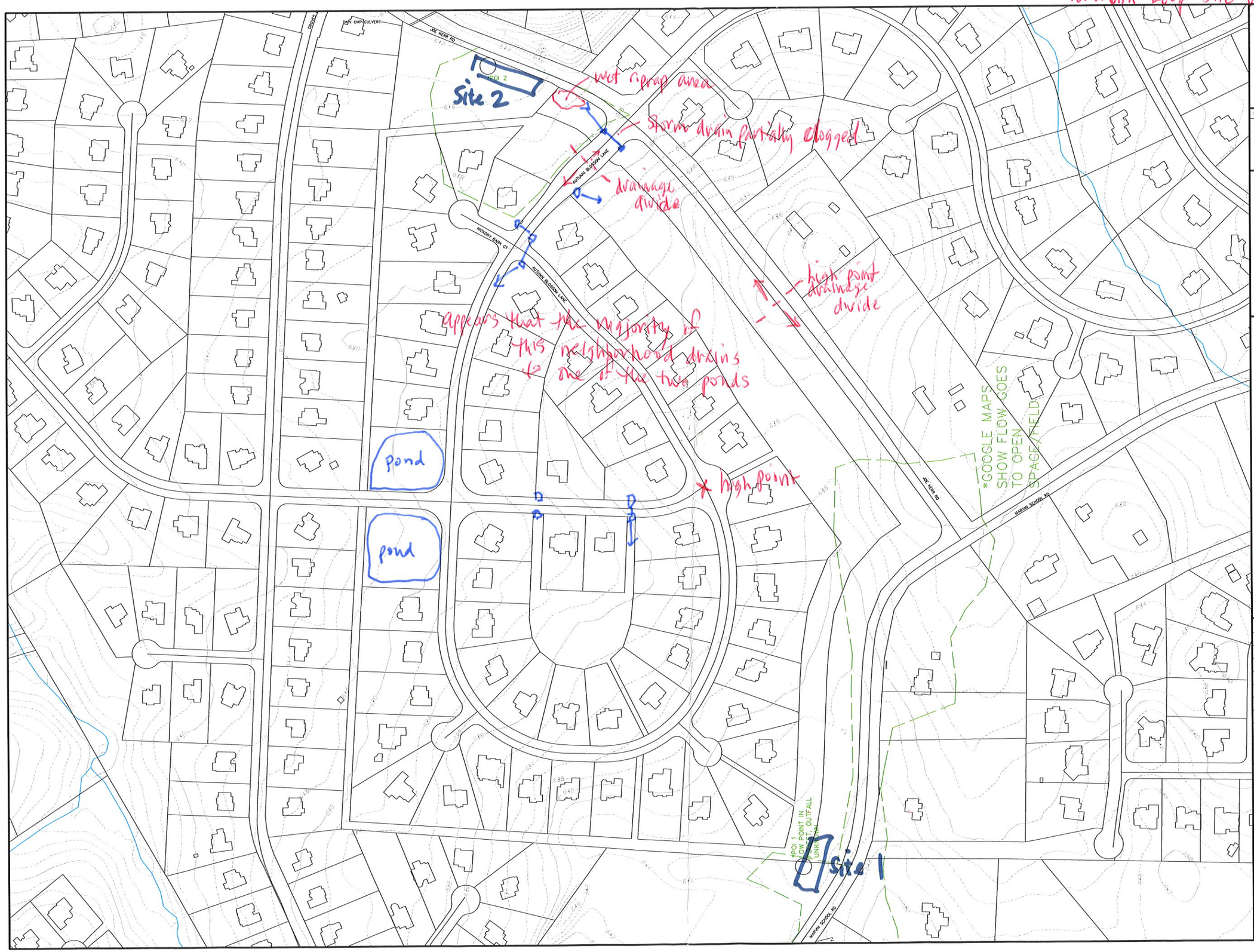
Photo 21: Downstream end of the CMP culvert under Joe Kerr Road. Outfall of the RCP culvert is in the background.

Photo 22: Outfall of the RCP under Joe Kerr Road. Outfall of the CMP culvert is in the background.

# APPENDIX E

Field Notes

Marvin Loop Site Visit - 5/20/24 KCS





A. MORTON THOMAS AND ASSOCIATES, INC.
CONSULTING ENGINEERS
700 KING FARM BOULEVARD, SUITE 300
ROCKVILLE, MD 20850
PHONE (301) 881-2545 | FAX (301) 881-0814
EMAIL: AMT1@AMTENGINEERING.COM


CONSULTANTS

# VILLAGE OF MARVIN SWM ASSESSMENT

MARVIN, NORTH CAROLINA

| MARK | DATE | DESCRIPTION |
|---|---|---|

| | |
|---|---|
| PROJECT NO: | ##-#####.### |
| SCALE: | |
| DESIGNED BY: | |
| DRAWN BY: | |
| CHECKED BY: | |
| SHEET TITLE | |

Marvin Loop Site Visit - 5/20/24 KCB

A. MORTON THOMAS AND ASSOCIATES, INC.
CONSULTING ENGINEERS
700 KING FARM BOULEVARD, SUITE 300
ROCKVILLE, MD 20850
PHONE (301) 881-2545 | FAX (301) 881-0814
EMAIL: AMT1@AMTENGINEERING.COM

CONSULTANTS

VILLAGE OF MARVIN
SWM ASSESSMENT
MARVIN, NORTH CAROLINA

| MARK | DATE | DESCRIPTION |
|---|---|---|

| | |
|---|---|
| PROJECT NO: | ##-#####.### |
| SCALE: | |
| DESIGNED BY: | |
| DRAWN BY: | |
| CHECKED BY: | |
| SHEET TITLE | |

SHEET 2 OF 3

Site 1

deep pool - no inflow or outflow

*POINT LOW POINT IN FOREST, OUTFALL UNKNOWN

shallow ditch in woods between path + road - outflow is blocked w/ leaves - debris - doesn't drain

ditches are clean

culvert in ditch is broken

DRIVEWAY CULVERT

Culvert does not appear to be used - lots of cobwebs assumed flow direction towards the school

Shallow ditch with minimal back slope - flows into woods

*GOOGLE MAPS SHOW FLOW GOES TO OPEN SPACE/FIELD

ROBINWOOD LANE

MARVIN SCHOOL RD

DOE FERN RD

Marvin Loop Site Visit - 5/20/24 KCS

CANTERFIELD DRIVE

GROVES EDGE LANE

JOE KERR RD

AUTUMN BLOSSOM LANE

HICKORY BARK CT

TWIN CMP CULVERT

headwall in ditch

inlets appear backwatered from pond but very deep

outflow is buried inflow blocked + disconnected RCP culvert

RCP Culvert

CMP - erosion at outfall some debris in pipe

high pt at the light pole

twin RCP pipes - ½ clogged with sediment Convey flow under path

existing ditch does not drain

low point

Site 2

no ditch on this area - runoff flows back towards path

wet riprap area

pipe is buried with pipe needles and riprap

riprap low point no pipe found - possible flow from inlet on Autumn Blossom?

riprap

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EMAIL: AMT1@AMTENGINEERING.COM

CONSULTANTS

VILLAGE OF MARVIN
SWM ASSESSMENT
MARVIN, NORTH CAROLINA

| MARK | DATE | DESCRIPTION |
|---|---|---|

PROJECT NO: ##-#####.###
SCALE:
DESIGNED BY:
DRAWN BY:
CHECKED BY:
SHEET TITLE

SHEET 3 OF 3