APPLE BRANCH ENGINEERING STUDY
DANVILLE, VIRGINIA

Tropical Storm Michael october 10, 2018

FINAL REPORT AUGUST 5, 2022

PREPARED FOR:
The City of Danville Public Works Department
Engineering Division
427 Patton Street
Danville, VA 24541

COMMONWEALTH OF VIRGINIA
Becky Lynne Ward
BECKY LYNNE WARD
Lic. No. 033155
8-5-2022
PROFESSIONAL ENGINEER

PREPARED BY:
Timmons Group
NC License No. C-1652
5410 Trinity Road, Suite 102
Raleigh, North Carolina 27607
984.255.2354
919.859.5663 fax
Becky.ward@timmons.com
Calculations By: Abrham Asfaw
Checked By: Becky Ward, PE

TIMMONS GROUP
YOUR VISION ACHIEVED THROUGH OURS.

Executive Summary

A hydrologic and hydraulic engineering study was conducted on the Apple Branch watershed to investigate flooding conditions at properties located on Riverside Drive within the watershed. The engineering study was partially funded by the Commonwealth of Virginia Department of Emergency Management Pre-Disaster Mitigation Grant Program. Currently, 5 buildings are impacted during the 10-year storm event, 9 during the 25-year event, and 18 during the 100-year event on Audubon Drive, Arnett Boulevard and Riverside Drive.

Project goals included:

- Evaluation of existing conditions of the watershed
- Development of solutions to eliminate or reduce structural flooding to existing structures and roadways
- Estimating budgetary costs to construct mitigation options.

The objectives of the study included:

- Development of hydrologic and hydraulic models to represent the existing and proposed conditions of the watershed
- Preparation of conceptual plan alternatives for protection of adjacent structures and existing roadways at Audubon Drive and Riverside Drive
- Preparation of conceptual plan alternatives for pipe system improvements at Arnett Boulevard and Riverside Drive
- Estimations of budgetary costs for conceptual plan alternatives.

The Apple Branch watershed covers an area of approximately 2.1 square miles above Riverside Drive. The primary area of interest for the study was from Apollo Drive downstream to the confluence with the Dan River to address flooding concerns. A secondary drainage system located on Arnett Boulevard at Riverside was identified during the study as a contributing factor to the existing flooding along Riverside Drive in the area of interest and therefore the system was added to the study.

An existing condition hydrologic analysis was performed to estimate runoff generated from the watershed using HEC-HMS for various storm events. Historical storms that produced structural flooding, including Tropical Storm Michael (October 11, 2018) and a high intensity short duration storm on May 18, 2018, were used in the hydrological analysis to validate model results. Storm data used in the study was obtained from the Danville Regional Airport as well as from NEXRAD Level III radar data. The 100-year peak discharge predicted by the models at the culvert on Apple Branch at Riverside Drive is approximately 2,900 cubic feet per second (cfs).

The current extent of flooding and identification of floodplain capacity issues were characterized through the creation of one-dimensional (1D) and two-dimensional (2D) HEC-RAS, as well as PC-SWMM, models. The analysis included open channels and closed piped systems.

The existing condition analyses identified channel and floodplain capacity issues on Apple Branch just upstream of Riverside Drive. Flooding on Audubon Drive from Apple Branch was shown to occur as frequently as the 10-year storm event. The existing culverts under Riverside Drive provide a restriction of channel flows resulting in increased upstream water surface elevations and associated flooding. The existing pipe system on Arnett Boulevard exacerbates

the flooding on Riverside Drive during the 25-year storm event as the capacity of that system is exceeded. If improvements are not completed on Arnett Boulevard concurrently or in conjunction with the improvements on Apple Branch, flooding will still occur on Riverside Drive; however, the depth and extent of flooding will be primarily limited to the roadway.

Opportunities were developed to mitigate flood waters impacting structures along Riverside Drive for various storm return periods. Considerations for both maintaining the existing box culverts under Riverside Drive temporarily and a future bridge replacement were included in the study. With the existing box culverts the proposed improvements mitigate structural flooding for all currently impacted structures however, proposed floodwalls on Apple Branch will be exceeded during a 25-year storm event. Street flooding will still occur on Audubon and Riverside Drives. A future bridge replacement for the existing culvert increases the proposed improvement benefits by containing the 100-year storm event within the proposed floodwalls on Apple Branch, and alleviating street flooding from this source. Conceptual designs for improvements considered:

- Installation of two detention basins and flood walls adjacent to Apollo Drive and Audubon Drive
- Floodplain grading to create storage on vacant lots upstream of the Apple Branch culverts under Riverside Drive
- Partial and full removal of existing buildings at Audubon Drive and Riverside Drive
- Pipe system improvements to increase capacity on Audubon Drive, Arnett Boulevard and Riverside Drive.

Budgetary cost estimates were completed that included construction costs, easement/property acquisition, and design costs. For improvements to mitigate flooding on Apple Branch, including upstream floodplain storage and total building removal, the total cost was estimated at $7.85 million. The Arnett Boulevard storm drainage improvement options ranged from $1.7 to $2.6 million. To complete the improvements for both Apple Branch and Arnett Boulevard, the cost ranges from $9.3 to $10.4 million.

Table of Contents

Tables

Figures

Appendices

Appendix A – Field Data Collection

Watershed and Drainage System Data

- *Project Location Map*
- *Photo Location Exhibit*
- *Stream Reach Data*
- *Existing Stream Crossing Data*
- *Street and Pipe System Data*
- *Field Recorded Flood Data*
- *Sub Surface Utility Investigation Test Hole Reports*

Morphological Data

- *Morphological Survey Location Map*
- *Downstream Survey Longitudinal Profile*
- *Downstream Cross Sections*
- *Upstream Survey Longitudinal Profile Reference Reach*
- *Upstream Cross Sections*

Appendix B – Hydrology

- *Land Use Map*
- *Watershed Connectivity Map*
- *Soil Map*
- *NRCS Curve Number - Apple Branch*
- *NRCS Curve Number - Arnett Boulevard*
- *Overland Flow Tc & T-Lag*
- *Dan River DS Boundary Condition- Tropical Storm Michael*
- *Pattern Curve - Tropical Storm Michael Storm*
- *Pattern Curve – May 18, 2018 Storm*
- *Precipitation Frequency Data*
- *StreamStats Output Data 10-14-2021*
- *HEC-HMS Hydrology Summary- Tropical Storm Michael*
- *100-year Storm HMS Hydrology Summary*
- *25-year Storm HMS Hydrology Summary*

Appendix C –Hydraulics

Apple Branch Stream

- *Floodplain Boundary Work Map Partial Building Removal*
- *Floodplain Boundary Work Map Full Building Removal*
- *Existing and Proposed Water surface Profile Partial Building Removal*
- *Existing and Proposed Water surface Profile Full Building Removal*

Pipe Systems

- *PCSWMM Report – Audubon Drive Existing Conditions*
- *PCSWMM Report – Audubon Drive Proposed Conditions*
- *PCSWMM Report – Arnett Boulevard Existing Conditions*
- *PCSWMM Report – Arnett Boulevard Proposed Conditions Option 1& 2*
- *PCSWMM Report – Arnett Boulevard Proposed Conditions Option 3*
- *Profile A -Arnett Boulevard Existing Hydraulic Grade Line*
- *Profile B - Audubon Drive Proposed Hydraulic Grade Line*
- *Profile C - Arnett Boulevard Proposed Hydraulic Grade Line Option 1 and 2*
- *Profile D - Arnett Boulevard Proposed Hydraulic Grade Line Option 3*

Appendix D – Conceptual Exhibits- Proposed Improvements

- *Exhibit A - Floodplain Storage with Partial Building Removal Concept*
- *Exhibit B - Floodplain Storage with Full Building Removal Concept*
- *Exhibit C - Audubon Pipe System Improvements and Upstream Detention Concept*
- *Exhibit D - Arnett Boulevard Pipe System Improvements Concept - Option-1*
- *Exhibit E - Arnett Boulevard Pipe System Improvements Concept - Option-2*
- *Exhibit F - Arnett Boulevard Pipe System Improvements Concept - Option-3*

Appendix E –Budgetary Cost Estimates

- *Apple Branch - Floodplain Storage with Partial Building Removal*
- *Apple Branch - Floodplain Storage with Total Building Removal*
- *Apple Branch - Arnett Boulevard Storm Drain Improvement Concept-1*
- *Apple Branch - Arnett Boulevard Storm Drain Improvement Concept-2*
- *Apple Branch - Arnett Boulevard Storm Drain Improvement Concept-3*

Appendix F - Apple Branch Study- Analysis Overview

- *Power Point Presentation (PDF Copy)*

1 Background

Apple Branch is located on the north side of the Dan River, adjacent to the intersection of Audubon Drive and Riverside Drive. The 2.8 square mile watershed is nearly built out and consists of 58% residential, 10% commercial/institutional and 16% undeveloped land uses. The watershed is bounded by Central Boulevard, Business 29, to the west, Arnett Boulevard to the east, Wendell Scott Drive to the north, and the Dan River to the south. The topography in the watershed consists of steep slopes in the range of 3 to 5 percent that flattens out to 0.7% percent at the edge of the Dan River floodplain. Both sides of Riverside Drive within the Dan River floodplain is developed with commercial businesses.

Apple Branch is a Federal Emergency Management Agency (FEMA) regulated stream located on Flood Insurance Rate Map (FIRM) panel 51143C0632E, dated September 29, 2010 and is designated as an AE zone with a regulated floodway and floodplain. The hydrology of the watershed and hydraulic models for Apple Branch and the Dan River are currently being revised by AECOM.

Flooding on Audubon and Riverside Drive occurred during Tropical Storm Michael that passed through Danville on October 12, 2018. A total of 18 structures had reported flooding during that event. The reported flooding occurred on and adjacent to Riverside Drive from Arnett Boulevard to the east for a distance of approximately 750 feet west of Audubon Drive. Two high intensity, short duration seasonal storms, occurring on May 18, 2018 and September 23, 2018, also produced flooding in this area.

Apple Branch is the main source of flooding on Riverside Drive and surrounding vicinity. During flooding events, stormwater is reported to exceed the channel banks and overtop Audubon Drive just below Apollo Drive. The existing double barrel box culvert under Riverside Drive, along with a partial building construction over the channel, provide restrictions to stormwater flows. Undersized storm drainage systems are also contributing to flooding issues. The existing stormwater infrastructure on Arnett Boulevard, Audubon Drive and Riverside Drive do not have sufficient capacity to convey stormwater runoff to the Dan River.

The City of Danville was awarded a FEMA Grant in October 2020 to take a comprehensive look at the Apple Branch watershed, quantify flooding issues along Riverside Drive and develop potential solutions through this study.

2 Approach

This Study includes the analysis of both the stream conveyance capacity of Apple Branch and the existing storm drainage infrastructure located on Audubon Drive, Riverside Drive and Arnett Boulevard to understand the flooding nature, source, and extent in the area. For this project, flooding issues within the watershed to be addressed were limited to the areas within the floodplain of the Dan River adjacent to Riverside Drive. A hydrologic and hydraulic analysis of these existing storm drainage systems was completed using the rainfall-runoff HEC-HMS model and 2-D HEC-RAS conveyance model to characterize the flooding extent from Apple Branch. A PCSWMM stormwater management model was used for the pipe hydraulic and hydrologic modeling. PCSWMM has the capability to model the piped drainage system as well as overland flow that occurs when the infrastructure exceeds its capacity.

3 Data Collection

The identification of available source data and data gathering was performed through a combination of desktop and field methods. The review of topographic maps, satellite images and reference sources were completed. Field data collection was accomplished through supplemental surveys by the City of Danville, site visits to verify watershed characteristics, a morphologic survey of Apple Branch, and high-water investigations with affected property owners on Riverside Drive.

3.1 Desktop Data

Available digital data was collected for hydro climatological information, GIS and mapping data, topographic survey data and past historical flood information. Data sources included the City of Danville, National Oceanic and Atmospheric Administration (NOAA), National Center for Environmental Information (NCEI), the United States Geological Survey (USGS) National Water Information System, and the Federal Emergency Management Agency (FEMA) publications. Previous studies in the area, including sidewalk and roadway improvements within the study area, were reviewed. Potential storage areas were identified for future study.

Historic storm data was researched and collected for use in this study. Three storms, identified by the City of Danville with known flooding impacts, were researched for available rainfall data. The effort to locate historic rainfall data within the vicinity of Apple branch watershed provided limited information. Four rainfall stations within 3.5 miles of the watershed, operated by the National Oceanic & Atmospheric Administration (NOAA), were investigated. The only available rainfall data located for the known flooding events was obtained from the Danville Regional Airport station for the Tropical Storm Michael and May 2018 storms. The Danville Regional Airport station is 3.5 miles from the Apple Branch Watershed.

Figure A Nearby Rainfall Stations

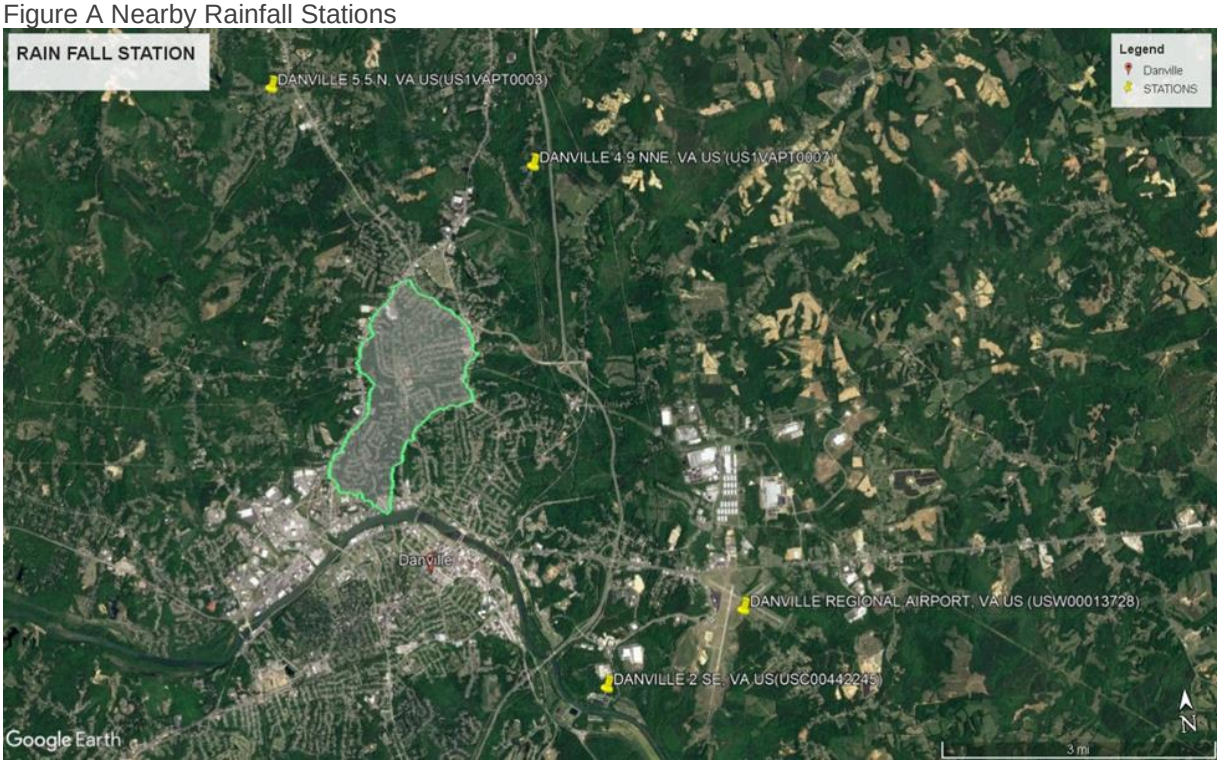


Table 1 Rainfall Station & Data Availability

Station Name	Station ID	May 18, 2018	September 23, 2018	October 11, 2018
DANVILLE 2 SE, VA US	USC00442245	N/A	N/A	N/A
DANVILLE 4.9 NNE, VA US	US1VAPT0007	N/A	N/A	N/A
DANVILLE 5.5 N, VA US	US1VAPT0003	N/A	N/A	N/A
DANVILLE REGIONAL AIRPORT, VA US	USW00013728	Yes	N/A	Yes

The NCEI measures and reports rainfall amounts on 15-minute time intervals. Review of the daily rainfall data shows the study area received nearly 6 inches of rainfall within 6 hours while some references suggest the total precipitation surpassed 6-inches. According to the National Weather Service Tropical Cyclone Michael summary report, a widespread 3 - 8 inches of rain was observed across much of Virginia.

The NCEI annual weather reported that on May 2018, the Danville Airport ASOS station measured 3.96 inches of rain for the 24-hour period ending at midnight on May 18, 2018. As a result, several roads in the City of Danville were closed due to flooding, including all lanes of Riverside Drive and Arnett Boulevard. This event was identified as having the 2nd highest daily rainfall in May ever, based on records dated back to 1916. The NCEI hourly record rainfall data is included in Appendix B. Although it was confirmed from various reference materials and

recorded events that a flood occurred on October 11, 2018, a source for precipitation depth records for the storm event were not found.

Due to the spatial variability of storm events, rainfall recorded at the Danville Regional Airport Station most likely does not accurately represent the storm distribution over the Apple Branch Watershed for the historic events considered in this analysis. NEXRAD Level III radar precipitation data was obtained from the National Centers for Environmental Information (NCEI). The Roanoke Radar site was selected for data acquisition for this study. A RAP (Radar Acquisition and Processing) model was created to process the NEXRAD Level III data within PCSWMM. The radar data files are large and are not included with the data files for this study but are available upon request.

3.2 Watershed Data Collection and Property Owner Meetings

A meeting was held with property owners along Riverside Drive to obtain information on high water elevations that occurred during Tropical Storm Michael to validate the models created for the study. The meeting was conducted with one City and one TG staff member on July 29, 2021. Information collected included approximate elevations of high-water marks as identified by the property owners. These elevations were measured from finished floor elevations and referenced to surveyed finished floor elevations collected by City of Danville surveyors. Pictures taken by the owners during the flood event were also obtained. A meeting summary is included in Appendix A, Field Recorded Field Data, describing the estimated water surface elevations and notes obtained during the meeting.

Data was collected to quantify land use parameters, stream reach information, existing bridge and culvert crossing structure sizes and numbers, and existing stormwater curb inlets, yard inlets, and manholes. Main channel and overbank Manning roughness coefficients were determined, and photographs were taken at locations where data was collected. The data collected are summarized in Appendix A: Photo Location Exhibit; Stream Reach Data, Existing Stream Crossing Data; and Street and Pipe System Data.

3.3 Morphological Data

Morphological Data was collected on Apple Branch at two locations: below the gabion basket wall adjacent to Audubon Drive and approximately 150 feet upstream of the gabion wall. The data collected upstream of the gabion wall was used as a reference reach for the channel and data was collected in a very stable stream segment. The data collected downstream of the gabions within the floodplain of the Dan River was collected within an area where potential storage was planned. The intent of this evaluation was to determine the bankfull height of a typical channel so that grading of the floodplain in this area could occur. Proposed grading for stormwater storage improvements would be designed to an elevation no lower than the bankfull elevation of the stream.

Downstream Morphology

Apple Branch below the gabion baskets has a stream slope of 0.008 ft/ft with a gravel substrate. The roughness coefficient for the channel was approximated to be 0.038. The contributing drainage area to this area on Apple Branch is approximately 2 square miles. Morphological data was collected at two riffles and two pools in the surveyed reach.

Table 2 Downstream Morphological Data (Project Area)

Cross Section	Slope (ft/ft)	Wbkf (ft)	Abkf (sqft)	dbkf (ft)	dmax bkf (ft)
Riffle 1	0.008	27.1	39.0	1.44	2.59
Pool 2	0.008	24.7	49.6	2.0	3.17
Pool 3	0.008	31.6	42.7	1.35	3.26
Riffle 4	0.008	30.6	45.9	1.49	2.93

Where:

Wbkf = Width of bankfull - Width of the surface of the water at the point where water just begins to overflow into the active floodplain. Generally, the 1-2 year storm event

Abkf = Area of bankfull - Cross sectional area of channel at the bankfull water surface elevation

dbkf = depth of bankfull - Average vertical distance between channel bed and the estimated water surface elevation at bankfull event

dmax dkf = max depth of bankfull - the difference in elevation between the bankfull stage and the deepest part of the cross section.

Average maximum channel depth at bankfull for this reach is 2.7 feet with a range of 2.6 feet to 2.93 feet. Based on this information, a floodplain bench below the existing gabion baskets wall will need to be constructed to accommodate a bankfull channel with a bank height of approximately 3 feet.

Upstream Morphology

Apple Branch upstream of the gabion baskets is in steeper terrain that is more representative of the overall conditions in the watershed. The stream slope in this reach is approximately 0.012 ft/ft and has a cobble boulder substrate. The roughness coefficient for this section of the channel was approximated as 0.055. The contributing drainage area to this area on Apple Branch is approximately 1.9 square miles. Morphological data was collected at three riffles and two pools within this reach.

Table 3 Upstream Morphological Data (Reference Reach)

Cross Section	Slope (ft/ft)	Wbkf (ft)	Abkf (sqft)	dbkf (ft)	dmax bkf (ft)
Pool 1	0.012	19.9	27.2	1.37	1.99
Riffle 2	0.012	22.6	33.1	1.46	1.97

Riffle 3	0.012	21.4	29.8	1.4	2.06
Pool 4	0.012	19.3	25.9	1.33	1.9
Riffle 5	0.012	19.6	26.8	1.39	1.94

The upstream channel morphological data was utilized to verify bankfull flows and channel parameters used in the lower reach. Summaries of collected morphological data is provided in Appendix A, including a location map, longitudinal profiles, and cross sections.

3.4 Survey and Mapping Information

The City of Danville provided stormwater database access for use in this study. City of Danville LiDAR topographic data was provided by the City in April 2021 and the data was utilized for the hydrologic and hydraulic models. The topography data obtained was based on the Virginia NAD83 horizontal datum in feet and the NAVD (88) vertical datum.

Additional survey data was collected by City of Danville surveyors in March 2022 in the Apple Branch floodplain, extending from the culvert under Riverside Drive up to Apollo Drive. Drawings for future improvements planned on Riverside Drive, along with the supporting AutoCAD files, were provided by the City. The survey data was combined with the LiDAR data to create a digital elevation terrain model for the 2D HEC-RAS hydraulic modeling with a one square foot resolution. Culverts that could potentially provide existing detention were surveyed by the City of Danville. Drone aerial imagery was collected by Winstead Wilkinson Architecture, PLLC on Riverside Drive on September 19, 2021. The imagery was used as a reference to check the accuracy of GIS data. Stormwater system components outside of the surveyed areas and data not provided on construction plans were based on the City of Danville GIS database. Subsurface Utility Investigation was performed by KCI Associates of North Carolina in June of 2022. This data was collected for future use to further quantify potential conflicts and relocations based on the conceptual stormwater conveyance system locations included herein. The location maps of the test holes, reference elevation summary table and investigation reports are included in Appendix A.

4 Existing Conditions Hydrologic Analysis Summary

A hydrologic analysis was performed to predict runoff generated from the Apple Branch watershed. Three types of storm data were utilized in the analysis, statistical data and two types of data from historic events.

- Storm event recorded data – Historic event hourly precipitation storm depths from Danville Regional Airport Station
- Storm event doppler data – Historic event NEXRAD level III radar data from National Center for Environmental Information (NCEI)
- Statistical data - Frequency storm event depth duration data from NOAA

4.1 Rainfall Data Analysis

The three types of rainfall data utilized in the modeling are as follows:

- Station data with actual historic storm events - used to calibrate the model.
- Doppler data for Tropical Storm Michael - used to calibrate the model.
- Statistical data
  - Used to assign historic storms into a frequency storm event category
  - Used for 2-D HEC-RAS modeling to evaluate flooding impacts under various storm event return periods to quantify hazard levels
  - Used as the basis of the existing and proposed conditions extent and frequency of flooding.

4.1.1 NCEI Hourly Precipitation

Station data was received that included recorded storm depths collected at 15-minute intervals and reported in hourly intervals. The data was used to create a storm pattern curve based on percent of hourly precipitation data. This storm pattern curve was used as the rainfall input in the HEC-HMS model.

4.1.2 NEXRAD Level III Radar Data Processing

The PCSWMM model was utilized to import NEXRAD data and process it for use in the HEC-HMS model. A RAP model is an internal program in the SWMM model that was utilized for this conversion. The RAP model was initially used to ground truth the radar data with the Danville Regional Airport station data and to establish an adjustment factor. This factor is applied to the radar data at the project location and area-weighted hyetographs for each sub-catchment was developed and used in the HEC-HMS model.

4.1.3 NOAA Frequency Storm

Metrological inputs based on statistical data of precipitation depths for frequency storms of the 2-, 25-, 50-, 100- and 500-year storm events were downloaded from the NOAA Atlas Precipitation Frequency Data Server as input data into the HEC-HMS model. The 24-hour duration precipitation depth values were obtained in inches. These values were used in the meteorology model parameter for each subbasin in the HEC-HMS model. Based on a Type II rainfall distribution and depth data, the model creates a cumulative distribution curve to represent specified return period storm events. The NOAA Atlas 14-point precipitation frequency estimates are provided in Appendix B.

4.2 Hydrologic Modeling

A multi-frequency hydrologic analysis was prepared for the Apple Branch Watershed. A unit hydrograph-based hydrologic analysis was prepared using the US Army Corps of Engineer's Hydrologic Modeling System, HEC-HMS Version 4.8. AutoCAD Civil 3D was used to define subbasin hydrologic parameters including drainage areas, times of concentration (TC), and basin average slopes. Aerial imagery, along with GIS data, was used in determining land use for the watershed.

The Apple Branch watershed HEC-HMS model was developed with seventeen (17) subbasins. Subbasins were generally delineated based on uniformity of subbasin size, topography, and land surface characteristics. Watershed Points of Interest (POI) were established at key analysis points throughout the watershed including stormwater junctions, inflow points and

major road crossings. Field visits were conducted to verify the watershed parameters. A Land Use Map and Watershed Connectivity Map are included in Appendix B.

Peak storm events were developed for 24-hour duration storms with a 50%,10%, 4%, 2%, 1% and 0.2% probability of occurrence in any given year. The Tropical Storm Michael event and the high intensity short duration storm event on May 18, 2018 were also evaluated in the hydrologic model simulations.

4.2.1 Time of Concentration

Subbasin times of concentrations (TC's) were calculated for each subbasin utilizing the TR-55 method. A subbasin lag time equivalent to 60% of the time of concentration was used for the unit hydrograph transformation for each hydrograph. Additionally, times of concentration for each basin was estimated using the NRCS Lag Time Method. This method approximates the basin average slope of each sub-watershed to generate lag times. Subbasin time of concentration and lag time (T-Lag) values are summarized in Appendix B.

4.2.2 Soil Infiltration

Soil infiltration parameters were estimated for each subbasin for incorporation into the HEC-HMS model. The Virginia Drainage Design Manual requires use of the Soil Conservation Services (SCS) Curve Number (CN) Method for soil infiltration parameters. Weighted CN values for each sub-basin were estimated based on land cover type(s) and hydrologic soil group(s) as identified by soil surveys obtained from the United States Department of Agriculture's Natural Resources Conservation Service Web Soil Survey. NRCS curve numbers and a soil report for the watershed are included in Appendix B.

4.2.3 Channel Reaches

A total of thirteen (13) channel reaches were created along the main Apple Branch stream in the HEC-HMS model. The Muskingum-Cunge eight-point routing method was used for all reaches. Each reach in the model was provided a channel length, slope and cross-sectional area estimated from a combination of LiDAR data and field measurements. Manning roughness coefficients were established for the overbank floodplain and channel for each reach. Stream reach data is included in Appendix A.

4.2.4 HMS Peak Flow Results

To determine peak flows, 25-year and 100-year frequency simulation HEC-HMS models were created. The results of the simulation runs were compared with results made by other methods for consistency. The methods used for comparison included the Virginia Regional Regression Equations and the hydrological analysis provided by AECOM for the current FEMA mapping re-studies of Apple Branch. Initial HEC-HMS model results were approximately 50% greater than the other methods. The HEC-HMS model was studied further and adjustments were made to improve model components and/or methods used. The refinements to the model resulted in a reduction in predicted peak discharges. A comparison of peak discharges for the various methods of Apple Branch at the confluence with the Dan River are shown in Table 4 below. Values are in cubic feet per second.

Table 4 Peak Discharge Method Comparison

Return Period	FEMA Effective (CFS)	HEC-HMS (CFS)	AECOM Regression (CFS)	VA Regression StreamStats (CFS)	Location
25-year	N/A	2083	1827	1720	Confluence with Dan River
100-year	2475	2942	3047	2880	Confluence with Dan River

For further validations of the peak discharges produced by the refined HEC-HMS model, the Tropical Storm Michael flood event was simulated. The resulting peak discharges were entered into the hydraulic model, as described in Section 5.1.2, to compare predicted peak water elevations with property owner high water marks observed during the Tropical Storm.

Table 5 shows the refined HEC-HMS model predicted peak discharges used in this study at POI locations for the 25-year, 100-year, and Tropical Storm Michael events.

Table 5 HEC-HMS Peak Discharges

Point of Interest	Peak Discharges (CFS)				Location
	Drainage Area (sq. mi.)	25-year (cfs)	100-year (cfs)	Tropical Storm Michael (cfs)	
POI-14	0.20	341	452	235	Northmont Blvd
POI-13	0.35	573	755	414	Parkland Dr
POI-12	0.76	1004	1345	839	U/S Guilford ST
POI-11	0.92	1142	1548	969	D/S Guilford ST
POI-10	1.06	1303	1780	1116	Colonial CT
POI-9	1.30	1526	2106	1313	U/S Wendell Scott Dr
POI-8	1.46	1628	2268	1426	U/S Starmont Dr
POI-7	1.49	1646	2297	1450	D/S Starmont Dr
POI-6	1.66	1766	2481	1583	D/S of Ginger Drive
POI-5	1.79	1887	2656	1700	Wood View Dr
POI-4	1.86	1948	2735	1755	Beginning of Gabion
POI-3	2.00	2072	2921	1902	End of Gabion
POI-2	2.03	2080	2928	1923	At Riverside Drive Culvert
POI-1	2.04	2084	2942	1934	Outlet to Danville River

5 Existing Conditions Hydraulic Analysis

The nature of flooding is complex due to lateral flows. A two-dimensional hydraulic analysis was used to model the flooding extents. The model has the capability to model both 1D and 2D flow conditions. The hydraulic analysis for Apple Branch was completed using HEC-RAS 2D Version 6.0 and the PCSWMM model was utilized for the pipe system analysis.

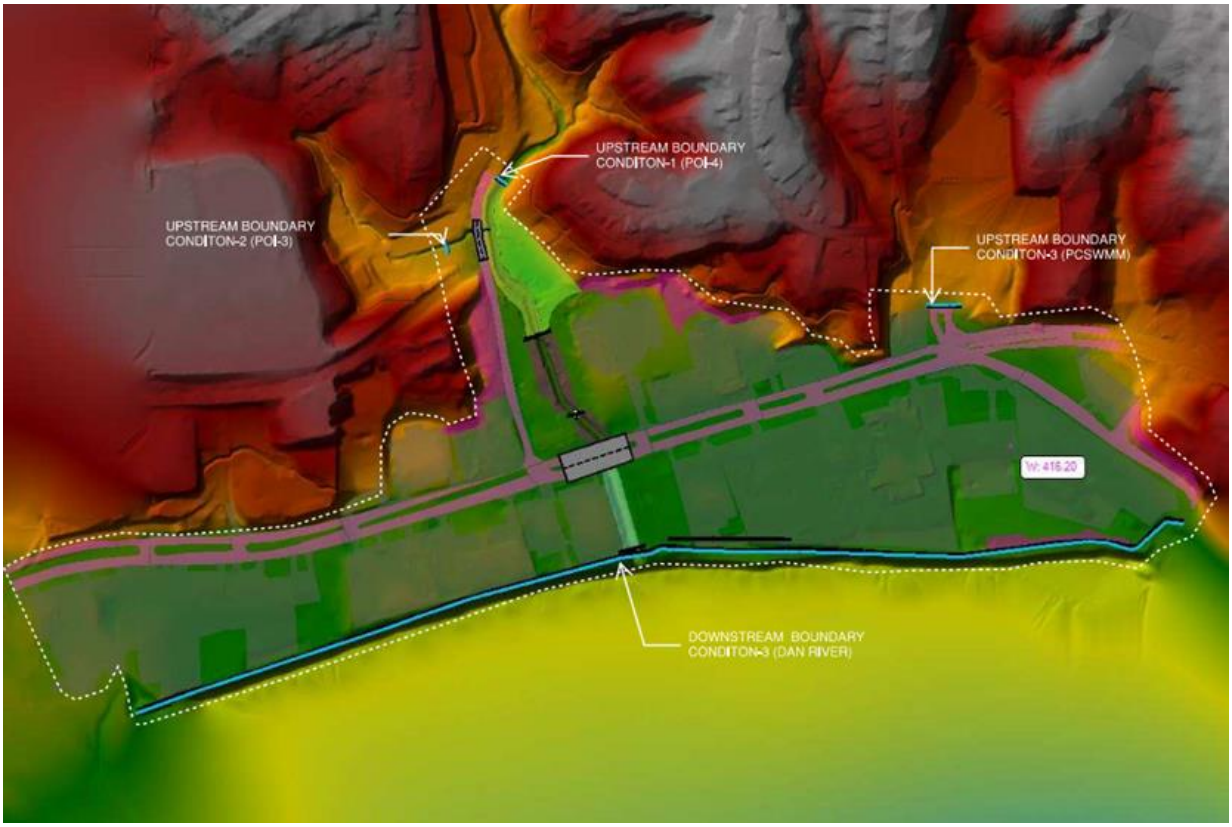
5.1 Apple Branch

5.1.1 HEC-RAS 2D Model

A HEC-RAS 2D model was created for the hydraulic analysis for both frequency and historic storm events. An existing conditions geometry file was created, and the following activities were performed for model setup.

- A Digital Elevation Model (DEM) covering the study area was created by combining LiDAR contours and topographic survey data into a 1 square foot grid. The surface was created in Civil 3D and converted to a DEM using ArcGIS.
- The existing conditions DEM prepared above was imported into HEC-RAS using the RAS Mapper tool.
- Computational meshes were created with a 20’ x 20’ cell spacing for the entire study area, with smaller mesh sizes used for more detail around structures and break lines.
- Break lines were created to define existing bridges, culverts, stream centerlines, stream banks and adjacent buildings.
- Culvert information provided to the model included: type, upstream and downstream inverts, dimensions, lengths and deck widths, and roughness coefficients .
- Boundary condition lines were created to define inflows at the head of the study area and downstream at the limits of the Dan River. Three locations were defined as upstream boundary conditions and inflow hydrographs were provided at each location in the model as shown on Figure B and as follows:
    - At the head of Apple Branch just north of the existing gabion retaining wall at POI-4. This hydrograph captures stormwater flows for the entire upstream watershed.
    - Runoff coming from the drainage area DA-4, North of Apollo Avenue and West of Summit Road, joins Apple Branch through a 48’’ RCP under Audubon Drive. This location is identified as POI-3 in the hydrological analysis and the hydrograph from sub-watershed DA-4 was provided as the boundary condition.
    - The third location is located at the eastern edge of the model domain at the Riverside Drive bridge. This boundary condition represents the runoff coming from watershed areas north of Arnett Boulevard that floods the road due to undersized storm drains. This runoff eventually flows downslope to the intersection with Riverside drive.
- The downstream boundary condition was defined at the junction with the Dan River.
- Overland Manning roughness coefficients were defined for the model based on land uses from Google Earth satellite images. The land uses were classified into parking lots, forest, grassed waterways, lawns, asphalt pavements and buildings. The coverage was digitized in the model based on the satellite imagery to define the relative values.

Figure B Apple Branch 2D Model Limits and Boundary Condition Locations



5.1.2 Tropical Storm Michael Model Calibration

Calibration of the model was performed with a known storm event and associated high water marks. The Tropical Storm Michael event flow files were imported into the HEC-HMS model. Flow hydrograph boundary conditions for contributing inflows were imported into the model at the locations provided in Table 6. The upstream boundary condition hydrographs were generated from the existing conditions HEC-HMS analysis for POI-4 and DA-4. The upstream boundary condition hydrograph for Arnett Boulevard was generated from the existing conditions PC SWMM model simulation.

Table 6 Tropical Storm Michael Upstream Boundary Conditions

Location	Boundary Condition Type	Peak Flow (cfs)	Notes
POI-4	Flow Hydrograph	1755	At the head of study area-Apple branch
DA- 4	Flow Hydrograph	210	At the junction with Sub watershed DA-4
Arnett Boulevard	Flow Hydrograph	160	Excess runoff from Arnett Boulevard

The downstream boundary condition was provided at the junction with the Dan River. The gauge reading from Danville River for the Tropical Storm Michael event was retrieved from the

USGS at the USGS 02075045 Dan River at STP Near Danville, VA Station. The data was obtained as a stage-time series at 5-minute intervals. This data was converted into a gauge elevation and provided to the model for the duration of the simulation as a stage hydrograph for the boundary condition.

The Tropical Storm Michael model was run for an 8-hour duration to replicate the timing of the event. The resulting peak water surface elevations (WSEL) were calculated by the model and compared to the high-water elevations obtained during field data collection The table below shows the comparison of the observed and simulated WSEL and the structure locations are shown in Figure B.

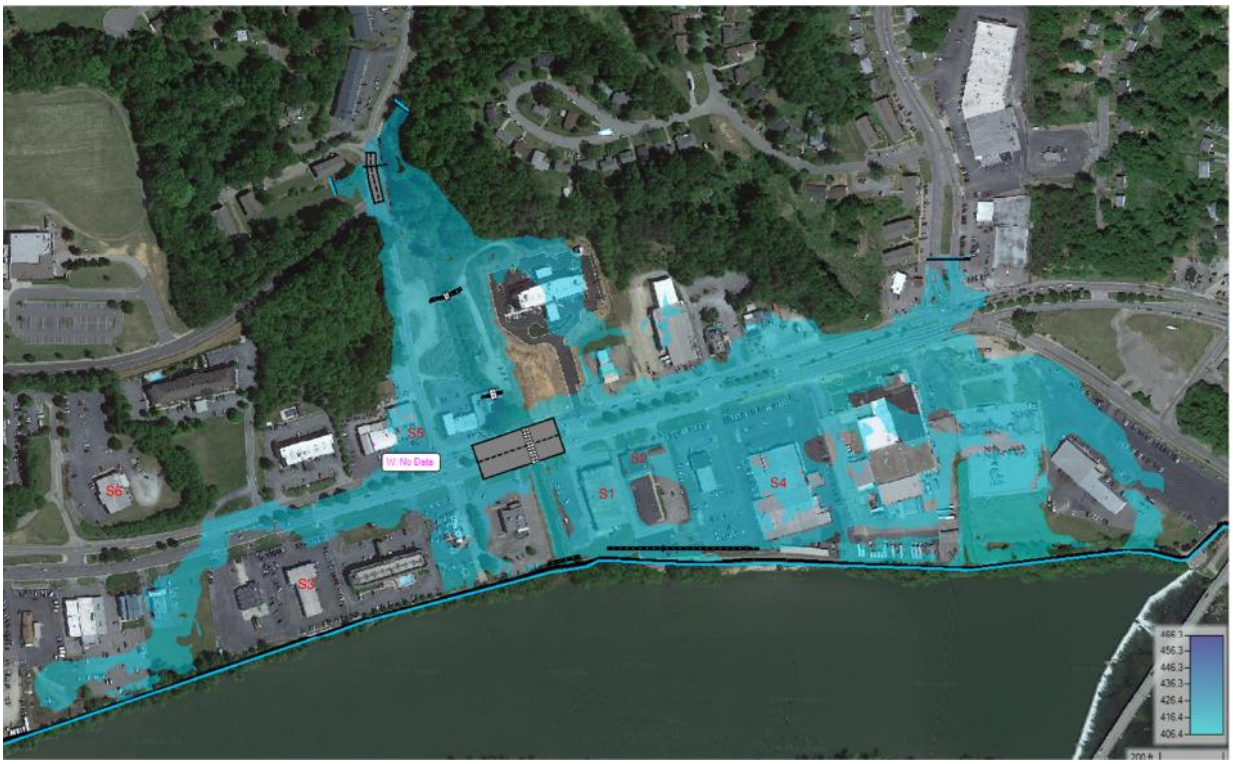
Table 7 Water Surface Elevation Comparison Observed and Simulated Tropical Storm Michael Event

Property Address	Property ID	Business Name	Observed High Water WSEL (ft)	FFE (ft)	HEC-RAS Predicted WSEL (ft)
1095 Riverside	S1	NAPA	417.8	416.32	417.40
1081 Riverside	S2	Sellers Insurance	417.8	417.26	417.32
1063 Riverside	S4	Robert Woodall Chevrolet Buick GMC	418.6	416.74	417.20
2104 Riverside	S5	Triangle Cycles North	421.3	419.99	420.20
2202 Riverside	S6	Waldo Smith Locksmith	420.3	418.99	419.90

The accuracy of the above comparison is uncertain. Most high-water marks were approximated from pictures or owner-recalled locations during the field data collection phase. Only one location, 1095 Riverside Drive (NAPA), had a permanent line on a structure showing the location of the high water during the Tropical Storm. The finished floor elevations for the structures were established by the City of Danville surveyors and the observed high-water marks were determined from measurements to reported flood elevations from the finished floor elevations. The model surface terrain was created from the best available data, primarily GIS information with supplemental survey data in available areas. Obstructions within the floodplain were not accounted for in the model such as cars parked at the dealership. Differences in observed and predicted water surface elevations varied from 0.4 to 0.6 feet.

The extent of flooding predicted by the HEC-RAS 2D model for the Tropical Storm Michael event is shown in Figure B. During the 2D simulation, flooding begins with the overtopping of the banks of Apple Branch near Summit Drive. Stormwater enters Audubon Drive and flows towards Riverside Drive. As the storm event continues, Apple Branch overtops its bank and overtops Riverside Drive. The floodwaters expand east and west along Riverside and onto adjacent properties, primarily on the south side of the road. Arnett Boulevard contributes runoff to Riverside when the existing system on Arnett exceeds its capacity. The Tropical Storm simulation appeared to model the flooding extents accurately to the recollection of City staff that had observed the event and were presented the results of the modeling effort. As such, the Tropical Storm 2D Tropical Storm simulation model was considered a good representation of the actual event. The results of this simulation are depicted on Figure C.

Figure C Tropical Storm Michael Flood 2D Modeling Peak Flood Extents



5.1.3 Frequency Storm Analysis

The Tropical Storm Michael HEC-RAS 2D model was copied and the following changes made to perform frequency storm simulations.

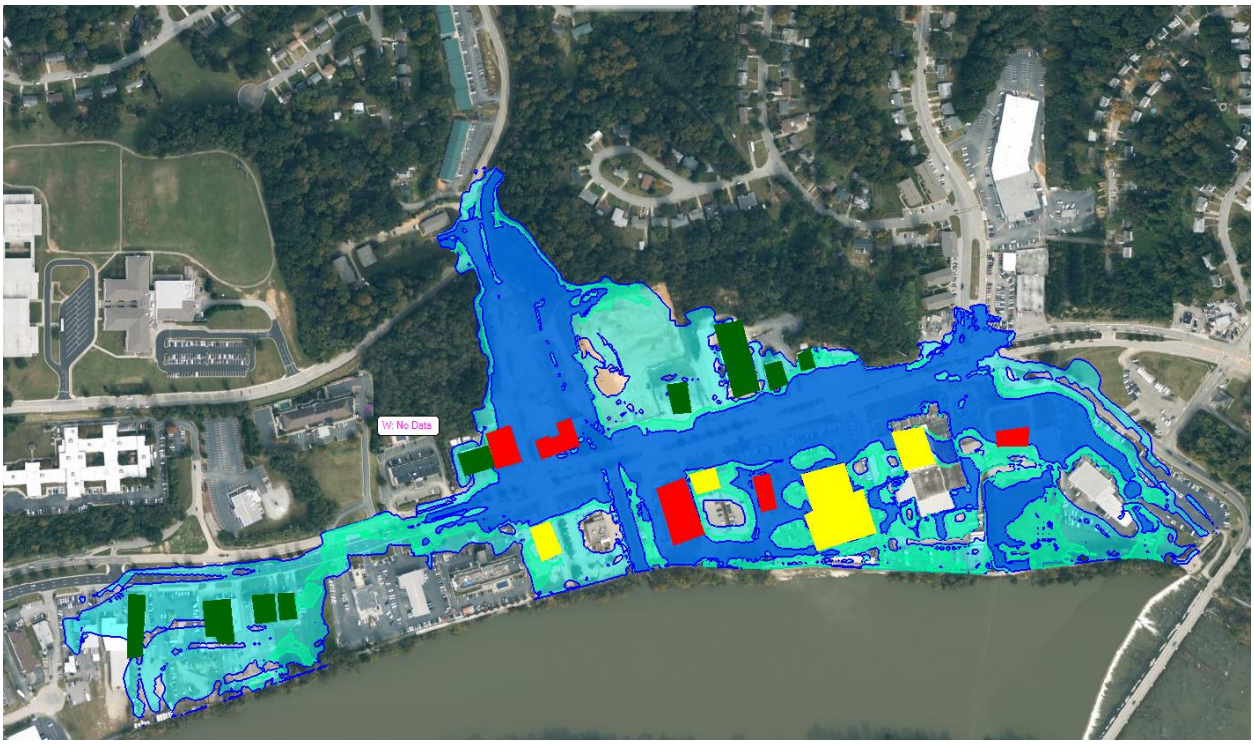
- Upstream boundary condition flow hydrographs at POI-3 and POI-4 were updated with 10-year, 25-year and 100-year flow hydrographs.
- The boundary condition at Arnett Boulevard was updated to reflect the 25-year storm overflow from the PCSWMM analysis for all simulations.
- The terrain model (DEM) was modified to reflect the existing condition. Manning roughness values were updated to reflect land use changes since the time of the Tropical Storm Michael event.
- The downstream boundary condition at the junction with the Dan River was changed to normal depth.

The model was run for the 10-, 25-year and 100-year storm events and the flood inundation limits for each event were determined. Table8 provides a summary of the structures impacted for the various storm events simulations and Figure C shows the inundation map for all storms.

Table 8 Storm Event Impacted Existing Structures

Flood Event	Map Key Building Impacted	Total Buildings Impacted	Impacted Streets
10-year	Red	5	Audubon and Riverside
25-year	Red +Yellow	9	Audubon, Arnett and Riverside
100-year	Red+ Yellow+ Dark Green	18	Audubon, Arnett, and Riverside

Figure D - Structure Impact Map



5.2 Storm System Analysis

A storm drainage analysis was performed to assess the capacity of existing adjacent systems and their contributions to flooding on Riverside Drive. PCSWMM was used for the pipe system hydrologic and hydraulic analysis on Arnett Boulevard. The existing storm system capacity for Audubon Drive was evaluated The City of Danville's GIS database was used to identify the location and approximate invert elevations of the existing storm system for most of the storm drainage structures and pipes in the evaluation area. Survey data was used where available.

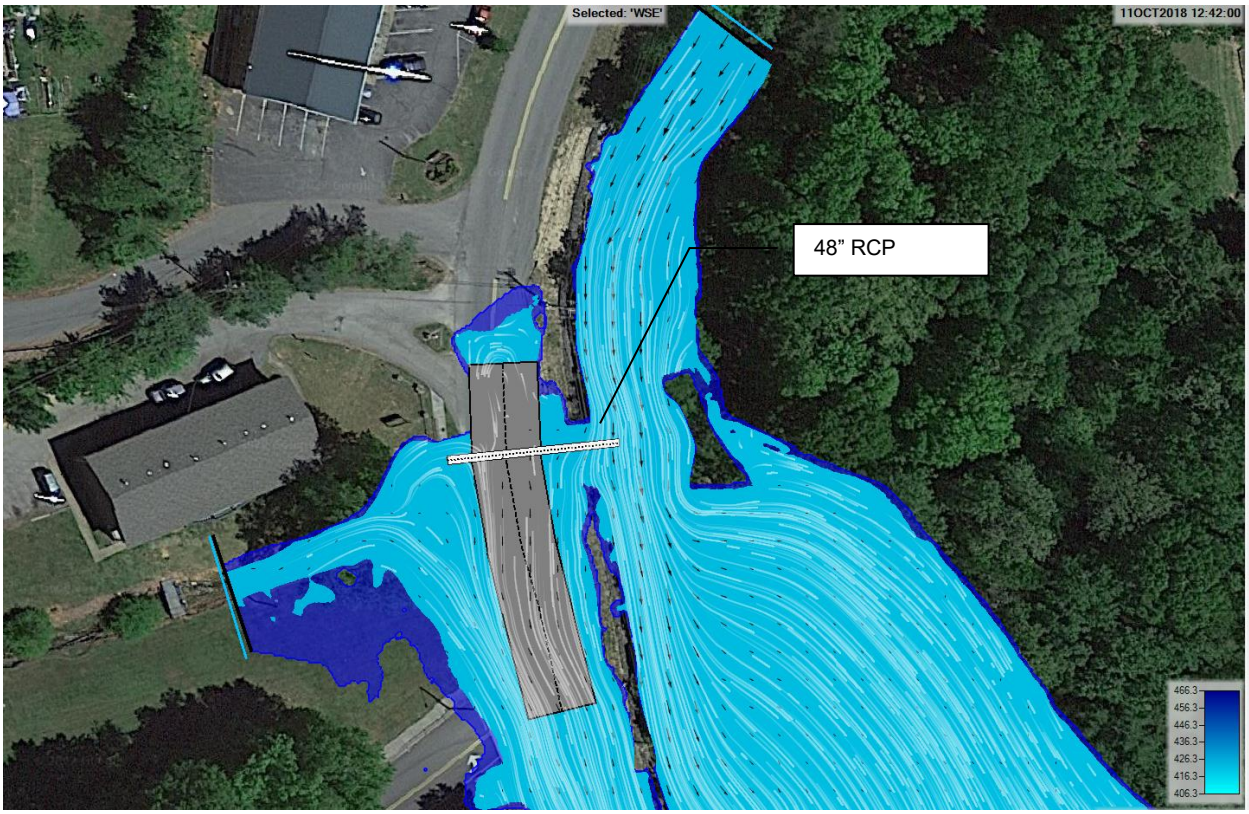
5.2.1 Audubon Drive

Audubon Drive from Apollo Drive to Riverside Drive was included in the analysis. A 48-inch RCP pipe conveys water from a tributary on the west side of Audubon Drive to Apple Branch. Two sets of catch basins are located on Audubon Drive below Apollo Drive. The catch basins at each location collects water from the north and southbound lanes and conveys it through a 15-inch pipe to Apple Branch. The tail water from Apple Branch on the outlet pipes quickly rises

and thus the capacity of the culverts is reduced to little or none. The low area in Audubon Drive near the intersection with Riverside Drive experiences frequent flooding. The 48-inch pipe under Audubon also experiences high tail water conditions, significantly reducing the conveyance capacity. When the water rises in Apple Branch to an elevation of 419 feet, flow reverses, causing water from Apple Branch to flow west through the pipe. The area at the inlet of the 48-inch pipe is quickly inundated and water overtops Apollo Drive and continues south along Audubon Drive to Riverside Drive.

Figure E, produced from the HEC-RAS 2D analysis, shows the flooding extent and flow directions occurring during a 25-year storm event at the existing 48-inch pipe on Audubon Drive. The dark blue areas in the figure show the maximum flooding extent while the light blue areas are the flood extent during a point in time to show the flow direction arrows.

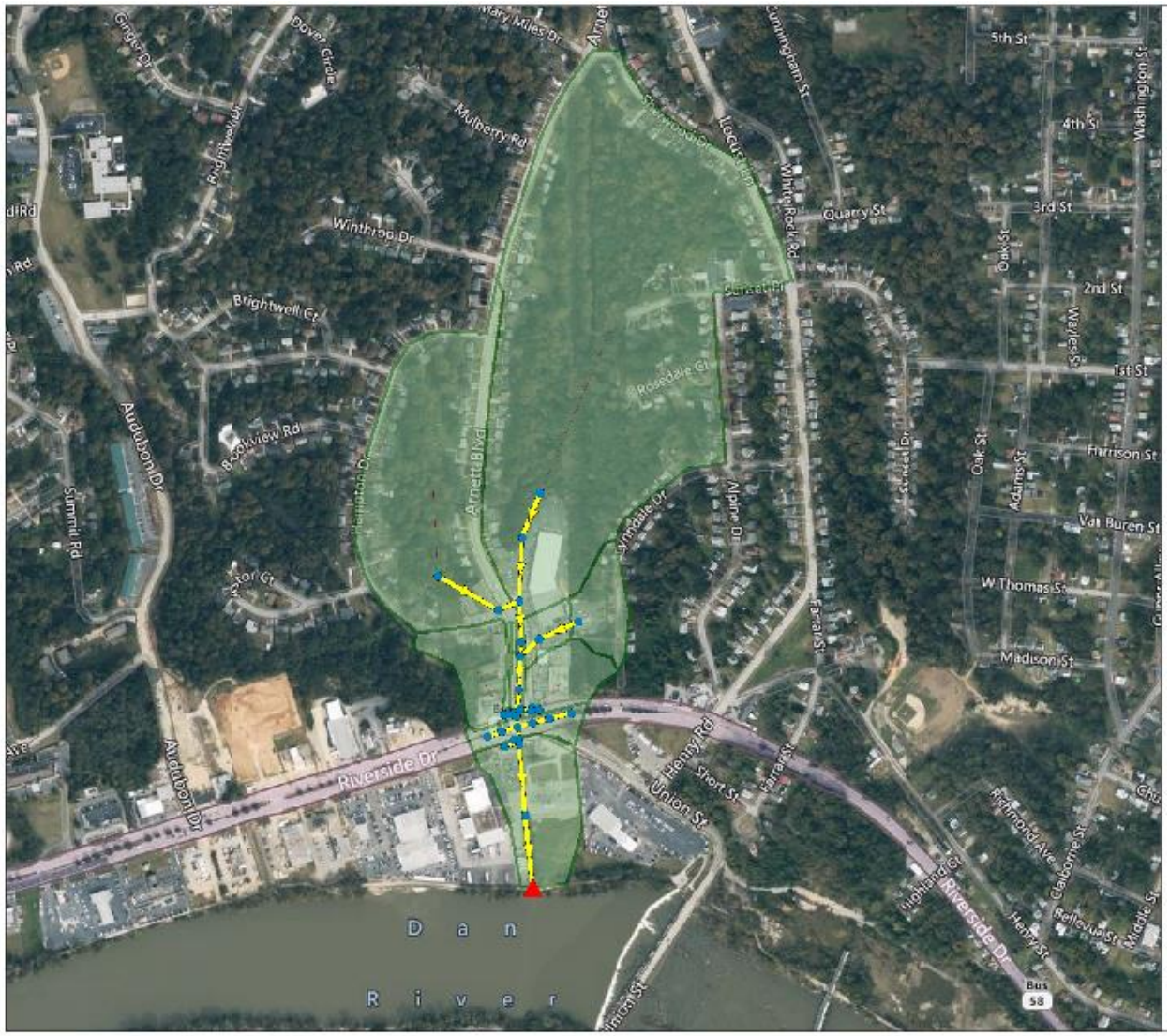
Figure E 25-Year Storm Flood Extent and Flow Patterns for Audubon and Apollo Drives



5.2.2 Arnett Boulevard and Riverside Drive

The existing storm pipe hydraulics on Arnett Boulevard was analyzed separately using PCSWMM. The storm network data and sub watersheds data were developed for the PCSWMM model. Figure F shows the 90-acre watershed, sub-basin delineations and pipe network.

Figure F Arnett Boulevard Existing Pipe System and Sub-basins



Danville GIS data was used for defining the locations of the existing storm drainage system. Junctions were created to represent manholes, curb inlets, yard inlets, storage nodes, and outfalls. Storm pipes and culverts were represented using the conduit feature in the model. Sub-basins were delineated based on LiDAR contours and composite curve numbers were calculated for each sub-basin based on existing land use and soil types. Storm pipe network parameters for the existing system were obtained from the GIS database. The database provided measured-down distances and as such, pipe and structure invert elevations were approximated using contour elevations at each structure. Detailed curve number calculations and the site soil map, along with the hydrologic calculations and drainage area map, are included in Appendix B.

The existing culvert under Riverside Drive is blocked by electric cables and debris as noted in the CCTV camera recordings provided by the City of Danville. This culvert in the PCSWMM model was assumed to be 30% blocked, therefore the pipe size of the culvert in the model was

represented by a conduit 60% of the existing size. The CCTV camera video is included with the electronic files provided with this document.

A frequency storm event with a 24-hour duration was used in the model based on NOAA Atlas 14 PFDS rainfall depths. The model was run using a 5-second time step interval. The existing conditions hydraulic profile for the 25-year storm event for the Arnett Boulevard existing pipe system is included in Appendix C.

The existing pipe system capacity is limited to a 10-year storm event based on the modeling results. Overtopping of the system occurs on Arnett Boulevard, resulting in stormwater conveyance to the sag in Riverside Drive that is located just east of Apple Branch. The stormwater flows from the Arnett Boulevard system significantly contribute to the flooding that is occurring from Apple Branch at this location.

6 Proposed Improvements

Opportunities for improvements to Apple Branch and the existing pipe infrastructure on Audubon, Arnett, and Riverside were investigated. Increasing pipe system capacities, providing detention, and improving the Riverside Drive box culvert were considered in the conceptual designs. The HEC-RAS 2D models and PCSWMM models developed for the existing conditions were modified to evaluate the proposed conceptual improvements.

6.1 Apple Branch Proposed Improvements

The improvements on Apple Branch include both detention within the floodplain of Apple Branch just upstream of Riverside Drive as well as two additional detention areas just north of Apollo Drive. The proposed detention area along Apple Branch provides needed storage, reduces peak discharges passing through the culvert restrictions at Riverside, contains flows and prevents the overtopping of Riverside and Audubon Drives. The proposed detention upstream of Apollo Drive provides needed storage to contain stormwater from the tributary to the west (DA-4) to reduce the stormwater overtopping of Apollo and the associated stormwater flows down Audubon Drive. The detention area on Apple Branch was created by excavating the existing floodplain on an adjacent parcel, along with partial or full removal of the buildings located on the northeast corner of Riverside Drive and Apollo Drive. Additionally, the construction of a flood wall will need to be installed to provide the required detention volume to effectively contain flooding from storm events. The detention above Apollo Drive was created by the excavation of two basins on the property located at the northeast corner of Apollo and Audubon Drives. The analysis was completed to evaluate the proposed improvements with the existing box culverts at Riverside Drive as well as a future 30-foot span replacement bridge.

Pipe system improvements are also required to fully reduce and/or capture floodwaters. Backflow prevention valves are proposed on the existing 48-inch pipe on Audubon Drive as well as the curb inlet pipe system north of the sag inlets on Audubon. The curb inlets at the sag of Audubon Drive are proposed to be replaced with a new system that disconnects this area from the existing discharge location upstream of the Riverside Drive existing box culverts. The pipe system will be improved to a 36-inch system that would be conveyed through Riverside Drive and outlet at the channel at the downstream side of the existing box culverts.

6.1.1 Floodplain Storage with Partial Building Removal

This option considers adding floodplain storage on Apple Branch, installation of a flood wall, and partial removal of the existing building at 2016 Riverside Drive. Detention areas adjacent to Apollo Drive and pipe system improvements on Audubon Drive are also proposed. For the analysis on Apple Branch, the peak flow from the west tributary conveyed by the 48-inch pipe was not included to represent the proposed backflow valve at that location. The following modifications were made to the existing conditions HEC-RAS 2D model.

- Partial building removal, excavation of the floodplain and reconfiguration of a driveway and parking area was evaluated at 2012 Riverside Drive. The partial building removal includes only the building extension that extends over the existing channel.
- Stream relocation was required to accommodate the new access drive at 2012 Riverside Drive.
- The building and existing parking lot was preserved at 2016 Riverside Drive.
- The floodplain was excavated to a bankfull elevation on the currently vacant property owned by JEB Realty LLC.
- Excavation of the floodplain and the establishment of a berm at 1089 Riverside Drive.
- The existing bridge to 1098 Riverside Drive was removed.
- A berm was established on the Astor Court property owned by Arnett E W Heirs that will require a drainage easement.
- A flood wall was designed on three sides of the excavated detention area extending from the existing gabion wall on the west floodplain terrace to the proposed berm on the eastern floodplain terrace.
- The proposed grading for floodplain storage and stream relocation was designed in Civil 3D and exported to HEC-RAS as a digital elevation model file.
- All other proposed improvements were included in the HEC-RAS geometry file.
- The model was run for the 25- and 100-year storm events.
- Models were created for both the existing dual box culverts and a future 30-foot bridge.

Based on the model results, the flood wall around the proposed detention basin requires two heights. A proposed permanent wall height was established based on the back-water surface elevation created when considering the future 30-foot bridge opening. A 2.5-foot temporary wall height extension is proposed to be constructed on top of the permanent wall height to improve the detention capacity while the existing culvert remains in place. Figure F shows a section view of the proposed partial building removal improvements and flood wall. Figure G shows the flood inundation area for the 25-year storm with the proposed improvements and existing box culverts remaining.

Figure G Proposed Stream Relocation and Flood Wall Section

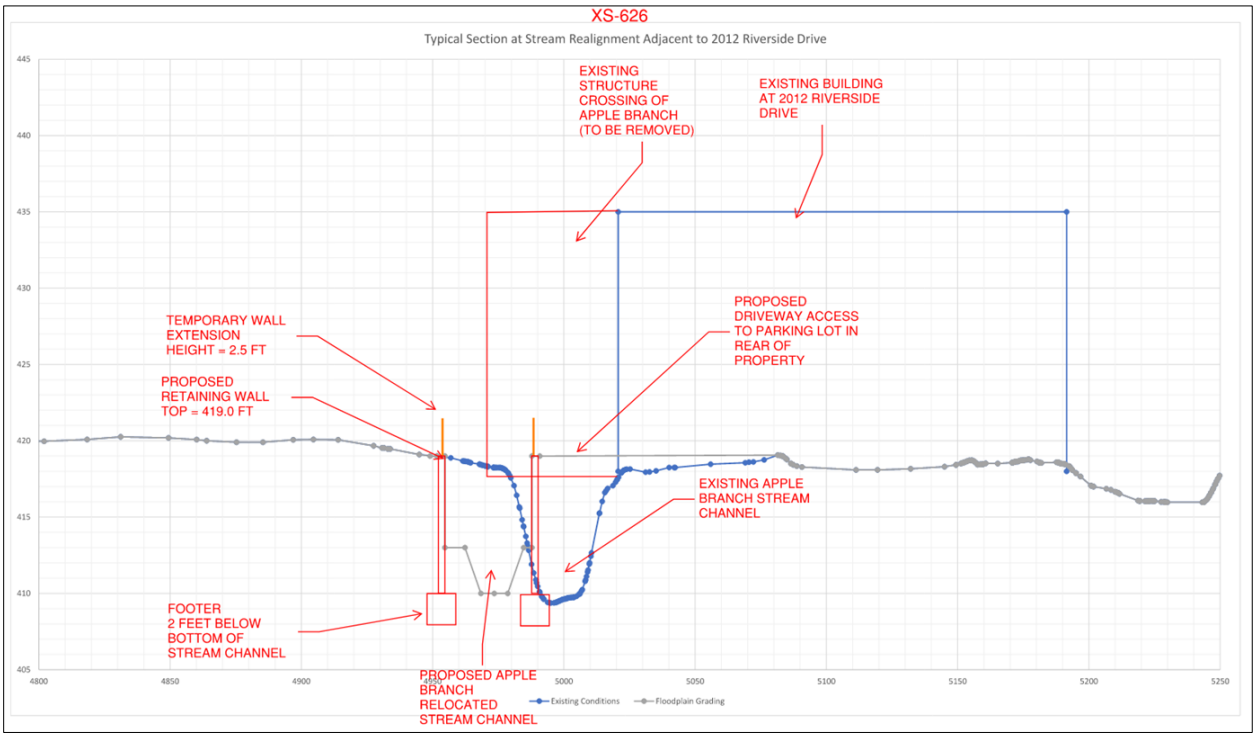


Figure H Partial Building Removal, 25-year Storm Event Proposed Inundation

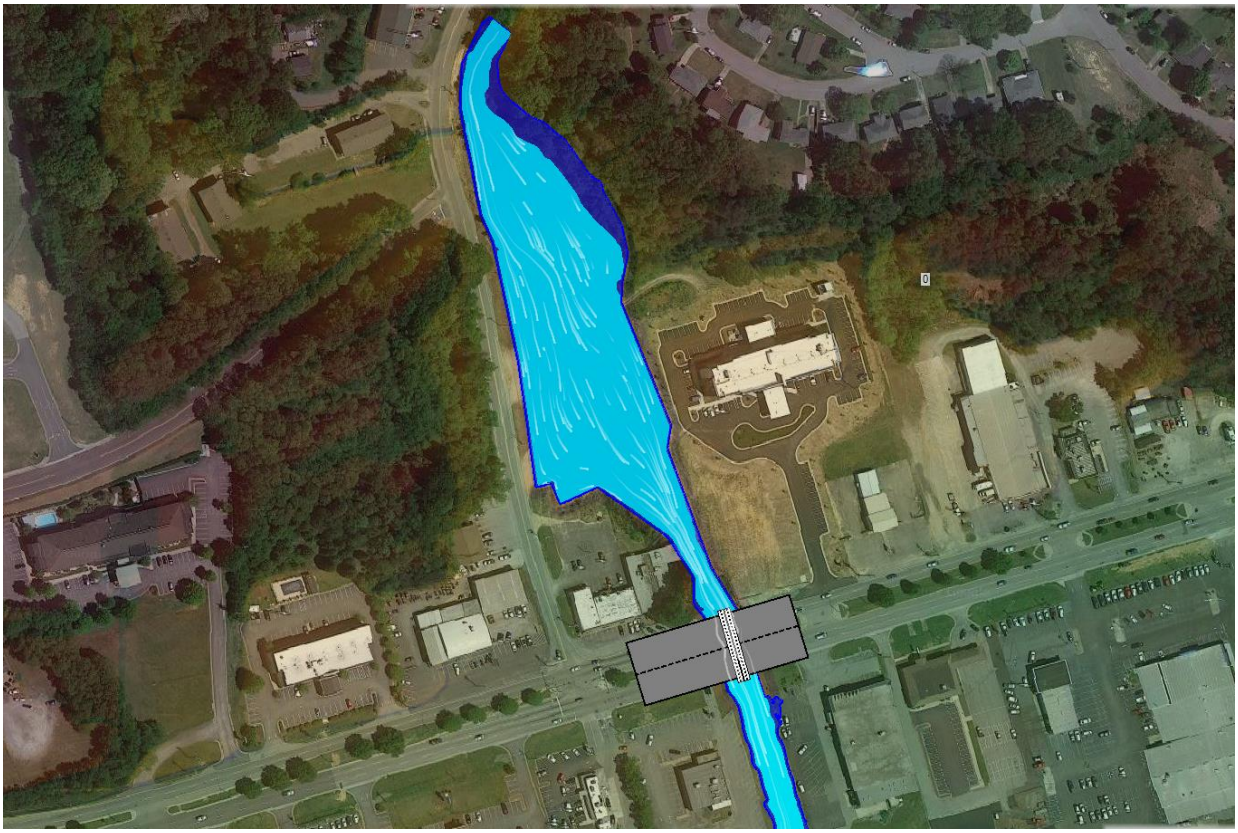


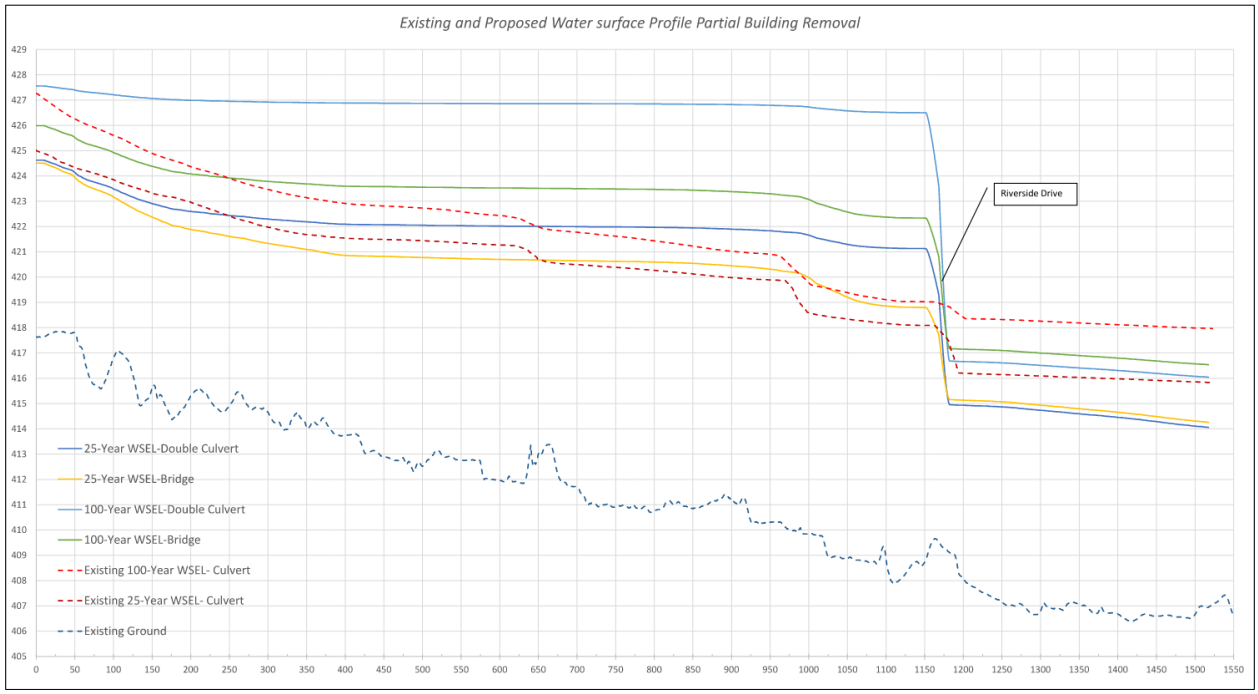
Table 9 summarizes the predicted upstream water surface elevations and proposed wall heights for the existing Riverside Drive box culvert and for future bridge considerations.

Table 9 Partial Building Removal Water Surface Elevations at Riverside Drive

Storm Event	Peak Discharge (cfs)	Culvert Water Surface Elevation (ft)	Bridge Water Surface Elevation (ft)	Permanent wall height (ft)	Temporary wall height (ft)
25-Year	2083	421	419.5	12	2.5
100-year	2942	427	422.5	12	2.5

Until the box culverts are replaced by the bridge, the detention benefits and flood wall provide for protection through a 25-year event. After the culverts are replaced with the 30-foot bridge, the temporary wall extension can be removed, and the 100-year flood will be contained to the detention area within the wall. With the proposed detention and partial building removal option, the water surface elevations upstream of Riverside Drive will decrease with the installation of the future bridge. However, due to the restriction that remains with the existing buildings, the new base flood 100-year water surface elevations exceed the Effective FEMA base flood elevations by 2 feet. This backwater will extend for a distance of approximately 900 feet upstream as shown in Figure H.

Figure I Partial Building Removal Backwater Profile



The Floodplain Storage with Partial Building Removal Concept is included in Appendix D.

6.1.2 Floodplain Storage with Full Building Removal

This option includes all the same improvements as the partial building removal option plus the complete removal of the existing buildings located at 2012 and 2016 Riverside Drive. With the removal of the existing buildings, additional flood storage capacity is obtained. The model was run for the 25- and 100-year storm events. The simulation shows the flooding will not exceed the proposed floodwall for the 25-year storm event as shown in the inundation map below.

Figure J Proposed Storage and Flood Wall Section

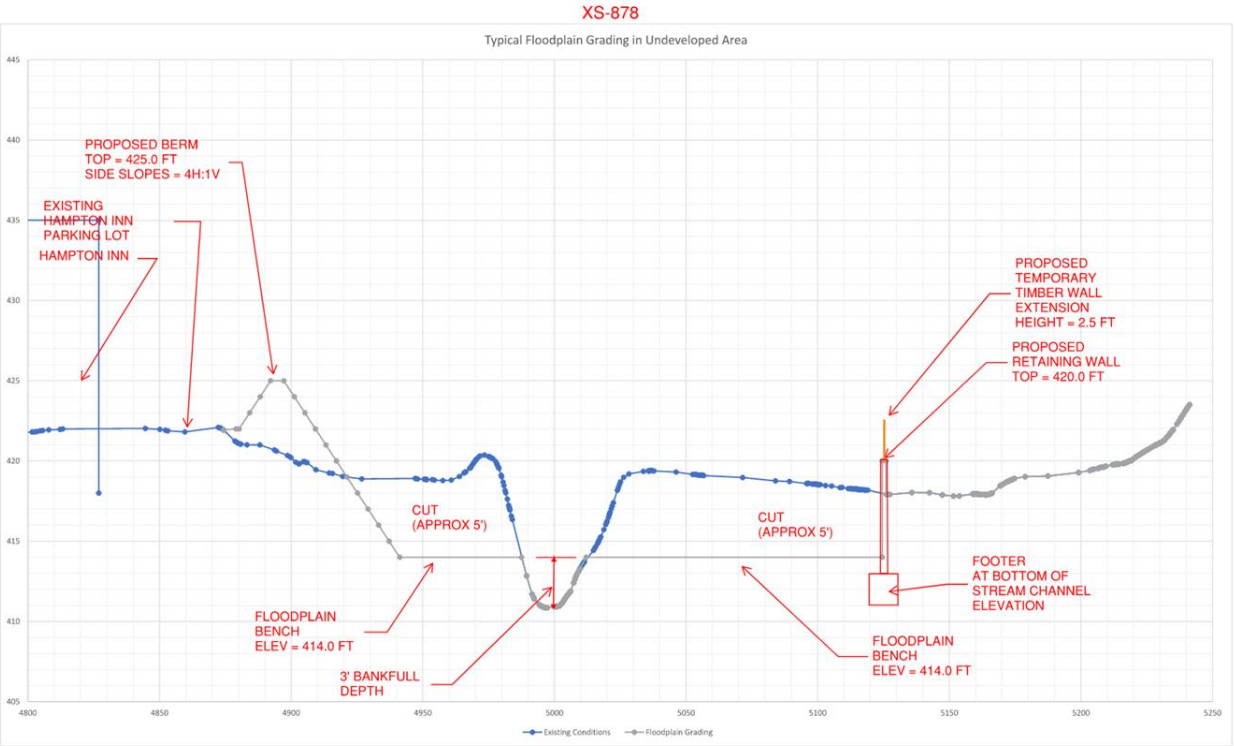
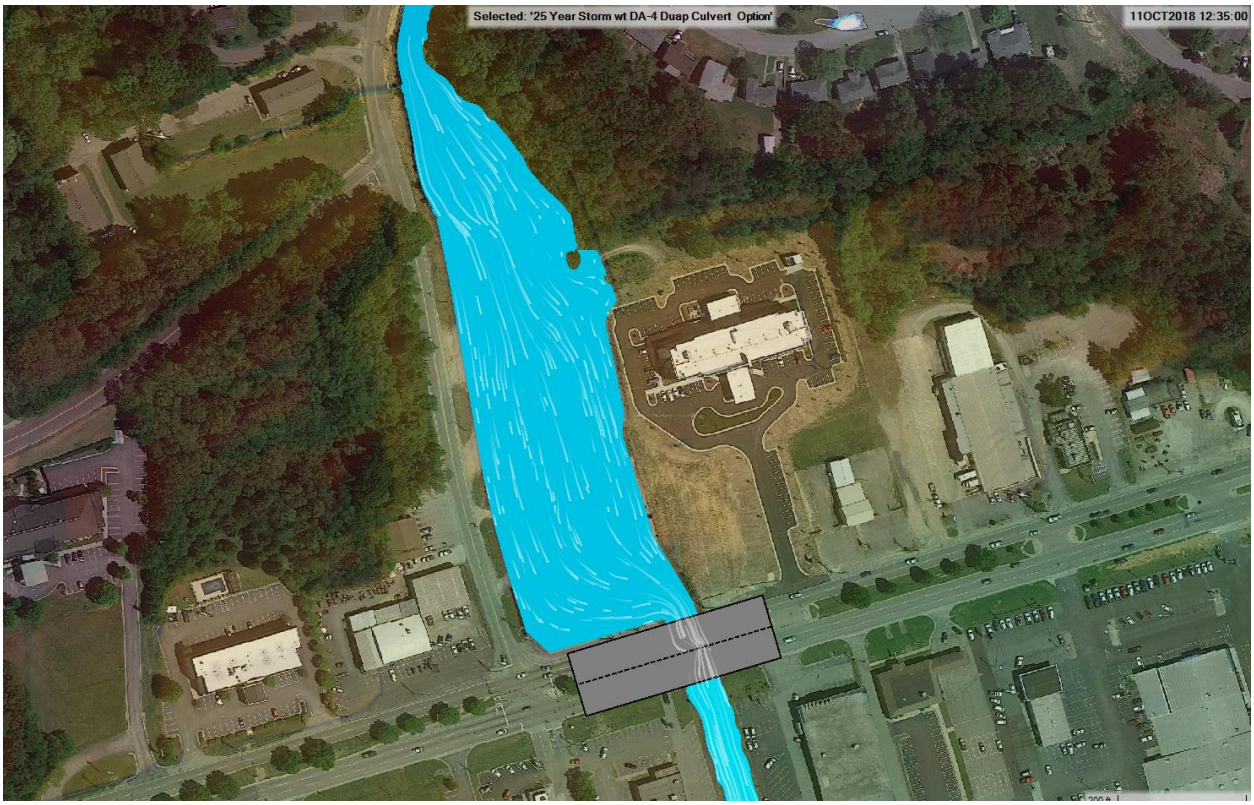


Figure K - Full Building Removal 25-year Storm Proposed Inundation



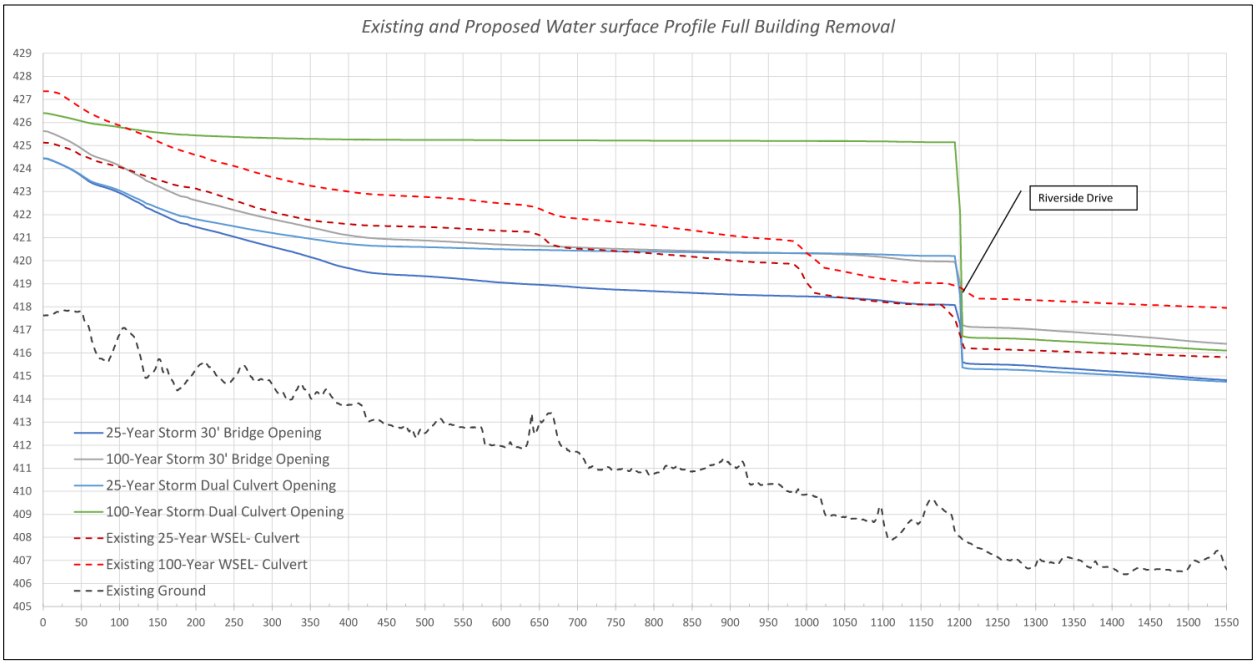
Advantages for the full building removal option include reduced backwater elevations and reductions in the required flood wall heights as the wall progresses upstream. A summary of upstream water surface elevations with full building removal is included in Table 5. The Floodplain Storage with Full Building Removal Concept plan is included in Appendix D.

Table 10 Full Building Removal Water Surface Elevations at Riverside Drive

Storm Event	Peak Discharge (cfs)	Culvert Water Surface Elevation (ft)	Bridge Water Surface Elevation (ft)	Permanent wall height (ft)	Temporary wall height (ft)
25-Year	2083	421	418	12	2.5
100-year	2942	425	421	12	2.5

Until the box culverts are replaced, this option provides similar detention benefits as the partial building removal with flood protection through a 25- year event with the existing culverts and 100-year containment after a future bridge is constructed. The benefits, however, increase significantly with the full building removal in returning the proposed 100-year base flood heights to elevations one foot above the Effective base flood for a distance of only 200 feet upstream as shown in Figure J. The proposed increases in base flood elevations would be contained to the proposed detention area.

Figure L Full Building Removal Backwater Profile



The Floodplain Storage with Partial Building Removal Concept is included in Appendix D.

6.2 Audubon Drive Proposed Improvement

Audubon Drive improvements include pipe system improvements, installation of back flow prevention and upstream detention. Upstream storage improvements were considered to evaluate the potential reduction of overtopping stormwater from the tributary to the west entering Audubon Drive. The reduction in peak overtopping flows were also considered in the proposed pipe system improvements.

6.2.1 Audubon Pipe System Improvements and Upstream Detention

Upstream Detention

Two areas were considered for floodplain storage improvements. Area A is located north of Apollo Drive just upstream of an existing building where flood issues have been reported. An existing 48-inch driveway culvert is located under an access driveway to the building just below this location. The second storage area, Area B, is located north of Apollo Drive at the intersection with Audubon Drive. The two basins were placed in existing open areas and designed to provide the maximum storage capacity available based on site conditions.

A PCSWMM model was developed to model the detention basins. A total storage volume of approximately 106,376 cubic feet were obtained between the two basins. The existing 48-inch culvert between the two proposed pond locations was found to be too restrictive and a secondary 48'' RCP is recommended at this location. The stage-storage and discharge rating curve for proposed ponds A and B are included in Appendix C. With the two proposed detention areas, the peak outflow from DA-4 was reduced by 74% for the 25-year storm event and 44% for the 100-year storm event.

Table 11 Detention Peak Flow Reduction

Storm Event	Existing Conditions Peak Discharge Overflow (cfs)	With Proposed Storage Improvements Peak Discharge Overflow (cfs)	% Reduction	Proposed Curb Inlet Capacity (cfs)	Remark
25-year	98	26	74	30	No flooding
100-year	160	70	44	30	Flooding anticipated

Pipe System Improvements

A PCSWMM analysis was performed to evaluate improvements to the existing storm pipe system along Audubon Drive. Improvements to the system were initially investigated without considering peak flow reductions; however, the sizes required to convey the flows required large box culverts. The proposed detention areas as described above on Apollo Drive significantly reduce the peak discharges. As such, the proposed pipe system improvements on Audubon Drive were designed considering only the reduced peak discharges with detention in place.

The proposed improvements include pipe system upgrades only to the stormwater collection system in the sag of Audubon Drive. A new pipe system in the sag will be installed to include 36-inch and 42-inch pipes. The existing 15-inch RCP under 2016 Riverside Drive will be abandoned and removed or grouted. The new system will be installed to cross Riverside Drive and convey stormwater to an outlet area downstream of the existing box culverts on Apple Branch as described in Table 12. The proposed pipe system has the capacity to accommodate the 25-year peak discharge from the proposed detention basins.

Table 12 Proposed Storm System at Audubon Drive

Pipe Location	Proposed Size (inch)	25-year Peak Discharge (cfs)	Pipe Length (ft)
CI-1– JB-1	36	24	10
JB-1 – JB-2	36	24	72
JB-2 – JB-3	42	30	206
JB-3 – JB-4	42	30	130
JB-4 – HW	42	30	42

Audubon Pipe System Improvements and Upstream Detention Concept is included in Appendix D. The proposed pipe system hydraulic grade line, Profile A: Existing Conditions Arnett Boulevard, is included in Appendix C.

6.3 Arnett Boulevard Proposed Improvement Options

Arnett Boulevard improvement options included providing additional storm pipes parallel to the existing drainage trunk line. From the existing condition analysis, the existing storm system is undersized to convey the runoff generated from the contributing watershed. Three options were

proposed for Arnett Boulevard storm drain improvement and each of them are discussed below. PCSWMM model was used for the analysis for all options.

6.3.1 Arnett Boulevard Pipe System Improvements Concept - Options 1 and 2

Pipe system improvements for Options 1 and 2 include the installation of a 42-inch pipe system on the west side of Arnett Boulevard. This system will divert approximately 25 acres of drainage area into the new system. The existing 60-inch system will gain capacity with the diversion of flow to the proposed system. The proposed system will extend west on Riverside Drive to connect with an existing outfall to the Dan River and will be upgraded with a combination of 24-inch through 48-inch pipes. Benefits of this option include a reduction in construction costs by avoiding sanitary sewer line conflicts; however, the ability to provide additional inlets for runoff interception on Riverside Drive is reduced. This option has the capacity to handle the 25-year storm event.

A second option was considered moving the proposed system to the north side of Riverside Drive. The benefit of this option is the ability to install additional curb inlet on Riverside Drive; however, the relocation of the existing sanitary sewer trunk line would be required, increasing construction costs.

A summary of the PCSWMM model used for the analysis is provided in Appendix C. Table 13 provides a summary of the 25-year storm from the PCSWMM simulation.

Table 13 Proposed Storm System Arnett Boulevard Options 1&2

Pipe Location	Pipe Diameter (inch)	Peak Discharge 25-yr (cfs)	Pipe Length (ft)
JB-16 – CI-15	30	83	16
JB-2 – CI-14	36	99	64
CI-14– CI-12	36	129	125
CI-12– CI-11	42	129	120
CI-11– JB-10	42	131	36
JB-10– JB-9	48	131	92
JB-9– JB-8	48	131	70
JB-8– JB-6	48	131	208
JB-6– JB-4	48	179	70
JB-4– JB-3	48	179	112
JB-3– JB-2	48	179	238
JB-2– FES-1	48	179	218

The hydraulic grade line plot, Profile B: Proposed Conditions Arnett Boulevard Option 1 &2 for the 25-year storm event, and PCSWMM hydraulic model report are included in Appendix C. Arnett Boulevard Pipe System Improvements Concepts Options 1 and 2 are included in Appendix D.

6.3.2 Arnett Boulevard Pipe System Improvements Concept - Option 3

For this option, the drainage area from the eastern watershed area (approximately 60 acres) was diverted to a proposed system located on the eastern side of Arnett Boulevard. The proposed system will follow the existing alignment and outfall to the same channel as the existing 60-inch pipe. The system improvements include 48-inch to 54-inch pipes. In addition to the new trunk line, additional inlets are proposed on Arnett Boulevard along with existing system upgrades on Riverside Drive. Advantages of this system are shorter pipe lengths. No additional inlets are provided on Riverside Drive and the traffic control required at the intersections of Arnett Boulevard, Riverside Drive and the Union Street Bridge will increase construction costs and affect traffic flow.

Table 14 Proposed Improvements for Arnett Boulevard - Option 3

Pipe	Proposed Size (inch)	25-year Peak Discharge (cfs)	Pipe Length (ft)
CI-12 – JB-10	48	166	160
JB-10 – JB-6	48	178	168
JB-6 – CI-5	48	178	76
CI-5 – JB-4	48	178	72
JB-4 – CI-3	48	186	48
CI-3 – YI-2T	48	191	38
YI-2T- HW-1	48	191	336

The hydraulic grade line plot, Profile C: Proposed Conditions Arnett Boulevard Option 3 for the 25-year storm event, and PCSWMM hydraulic model report are included in Appendix C. Arnett Boulevard Pipe System Improvements Concepts Options 3 is included in Appendix D.

6.4 FEMA Floodplain Analysis

A floodplain analysis was completed to assess the impact of the proposed improvements on the Effective Apple Branch FEMA regulated floodplain and floodway. A technical data request was made to FEMA Region III for the Effective models for Apple Branch. The model data was received as a paper HEC-2 model input. After examination of the data and discussions with the City, Timmons Group was informed of a re-study of Apple Branch being completed for FEMA by AECOM. The preliminary models were obtained from AECOM and used as the best available data for this study.

6.4.1 Existing Conditions Model

The preliminary model was copied and renamed Existing Conditions model. The preliminary model cross sections within the project area were determined to be at acceptable locations to capture the proposed improvement changes and therefore, no additional cross sections were added to the model. The cross-section data in the model were updated with surveyed topographic information as appropriate.

6.4.2 Post-Project Condition Model

The Existing Conditions model was copied and renamed Post Project Conditions model. Cross sections within the project area were updated to reflect the proposed floodplain grading and flood wall. The HEC-RAS one-dimensional model does not have the ability to accurately evaluate the storage that was created upstream of the existing box culverts so increased water surface elevations were observed in the model output.

6.4.3 Future One-Dimensional Modeling

One-dimensional modeling can be adjusted for storage effects utilizing a combination of both HEC-HMS and HEC-RAS models. The process was not performed for this study as two-dimensional modeling quantified the flooding extents and depths for this report. Additionally, the floodway limits upstream of the existing culverts at Riverside Drive would need to be set at the locations of the berm and floodwalls defining the detention area. One-dimensional modeling, however, will be important as the project moves into permitting through FEMA for proposed improvements and revisions to effective floodplain boundaries are imminent.

The process includes modification to the HEC-HMS program to model the selected storage improvements and culvert/bridge crossing at Riverside Drive. The tail water elevations established in the 1D HEC-RAS model will be utilized as the tail water conditions for the HEC-HMS reservoir. The peak discharges for each storm event are run through the culvert in the HEC-RAS model. An iterative process is completed with adjustments to both models until the maximum water surface elevations upstream of the Riverside Drive culvert/bridge converge to within 0.1 feet.

7 Analysis Summary, Budgetary Estimates and Recommendations

7.1 Analysis Summary

The Apple Branch Watershed Apple Branch is the primary cause of flooding currently occurring on Riverside Drive. Flooding events have 10% of occurrence in any given year with five structures having documented flood water impacts along Riverside Drive at this frequency. Overall, in this area, a total of 18 structures are impacted by flooding. Issues contributing to flooding include:

- Existing box culverts on Apple Branch at Riverside Drive create a restriction to peak flows generated by the 2.1 square mile watershed.
- Existing stormwater system on Audubon Drive has infrequent collection points with submerged outlets at Apple Branch that provide little to no conveyance capacity.
- Lack of stormwater system capacity on Arnett Boulevard that services a 90-acre watershed, causing bypass flow to Riverside Drive and adjacent properties.

Limited opportunities exist in the Apple Branch watershed to slow down or detain flood waters. The area just upstream of Riverside Drive provides the best area to accomplish detention goals and to provide a reduction in peak discharges passing through the structure on Riverside Drive. Additional conveyance capacity is needed at Riverside Drive that can be achieved through a replacement bridge structure to reduce backwater/peak flood elevations. Back flow prevention on the existing 48-inch culvert as well as other stormwater systems on Audubon Drive

discharging to Apple Branch will contain stormwater flow to Apple Branch. Detention upstream of the existing 48-inch culvert provides a needed reduction in overtopping flows to Audubon Drive. Although overtopping at Apollo and Audubon cannot be prevented for all storm events from the western tributary, detention provides significant reductions in peak flows anticipated on Audubon Drive and at the sag in the road. Disconnecting the pipe system at the sag from its current outlet to Apple Branch upstream of Riverside Drive, increasing the size of the pipe system and changing the system outlet to downstream of culverts improves the conveyance ability of this system to move stormwater out of Audubon Drive, limiting overflow to Riverside Drive.

Increasing the stormwater system conveyance capacity on Arnett Boulevard will additionally reduce stormwater contributions to flooding on Riverside Drive originating from this 90-acre watershed. Installing supplemental infrastructure capacity through a new system will also reduce peak flows on the existing system, increasing its capacity. Diversion from either the eastern or western contributing sub-watershed areas at the top of the existing collection system on Arnett Boulevard to proposed system options, equally provide adequate conveyance capacity to eliminate bypass flows to Riverside Drive.

7.2 Budgetary Improvement Estimates

Budgetary estimates were prepared for each proposed improvement option. These budgets are preliminary based on the conceptual plans prepared in this study. Although the estimates provided are intended to be conservative, refinements during the design phase could impact the provided estimates as design are further developed. Costs are estimated to range from $9.3 to $10.4 million for design, easement/property acquisition, and construction implementation of conceptual improvements. Concept summary estimates are included in Table 11. Detailed cost estimate information is included in Appendix E.

Table 15 Proposed Budgetary Estimate Summary

Proposed Improvements	Construction Budget	Easement and Property Acquisition	Design Budget	Total Estimate
Apple Branch				
Floodplain Storage (Partial Building Removal) and Audubon Pipe System Improvements with Upstream Detention	$6,547,450	$376,000	$675,000	$7,600,000
Floodplain Storage (Total Building Removal) and Audubon Pipe System Improvements with Upstream Detention	$6,123,675	$1,226,000	$500,000	$7,850,000
Arnett Boulevard Storm Drainage Improvements				

Option - 1	$1,619,688	$161,000	$200,000	$1,990,000
Option - 2	$2,142,188	$161,000	$250,000	$2,600,000
Option - 3	$1,451,563	$10,000	$200,000	$1,700,000

7.3 Recommendations

To effectively reduce street and structural flooding on Riverside Drive all of the following improvements are recommended to be completed:

- Apple Branch floodplain storage creation, floodwall construction, bridge installation and full building removal
- Audubon Drive pipe system improvements with upstream detention
- Arnett Boulevard storm drainage improvements.

The flooding issues on Riverside Drive will only be partially resolved if not all recommended improvements are implemented. The most significant reduction will occur through creation of floodplain storage upstream of Riverside Drive with floodwall installation and replacement bridge construction on Riverside Drive. Full building removal is recommended to return base flood elevations close to effective elevations upstream of Riverside Drive however, partial building removal is also a good option if full building removal cannot be accomplished.

Due to the significant overall project budget and property easement/acquisition constraints, the recommended improvements could be broken into phased projects that would include pipe system improvements and channel capacity/storage improvements. The pipe system improvements if implemented first would improve the overall capacity of the system during frequent storm events and provide some relief during a large event until the substantial improvements along the Apple Branch Channel could be made.

- Phase 1- Audubon Drive pipe system upgrades and implementation of proposed detention basins at Audubon and Apollo Drives.
- Phase 2- Pipe system improvements on Arnett and Riverside Drive.

The Channel capacity and storage improvements resolve the current flooding issues however these improvements have the largest capital investments and property owner easements/acquisition requirements. Providing a larger bridge opening on Apple Branch at Riverside Drive will improve the current box culvert restriction. The bridge abutments should be designed with considerations of future upstream flood wall installation.

- Phase 3- Bridge installation on Riverside Drive
- Phase 4- Property acquisition, grading to improve storage and construction of the flood wall on Apple Branch just upstream of Riverside Drive.

8 Computer models

The following list of computer models have been included on a CD included with the report:

Hydrological HEC-HMS models

The HEC-HMS project files were created using HEC-HMS 4.9**.** The name of the file is Apple Branch Existing Condition. HEC-HMS model run requires three components: a basin model, a meteorologic model, and a control specification. Each storm event is a separate model run. Below is a list of components that is associated with each model run:

Existing Models**:**
These models were analyzed using frequency storms.
Simulation Run: Tropical Storm Michael
Basin Model: Danville Apple Branch
Meteorologic Model: Tropical Storm Michael
Control Specifications: Tropical Storm Michael

Simulation Run: 10yr
Basin Model: Danville Apple Branch
Meteorologic Model: 10yr
Control Specifications: 10yr

Simulation Run: 25yr
Basin Model: Danville Apple Branch
Meteorologic Model: 25yr
Control Specifications: 25yr

Simulation Run: 50yr
Basin Model: Danville Apple Branch
Meteorologic Model: 50yr
Control Specifications: 50yr

Simulation Run: 100yr
Basin Model: Danville Apple Branch
Meteorologic Model: 100yr
Control Specifications: 100yr

Simulation Run: May-18 Storm
Basin Model: Danville Apple Branch
Meteorologic Model: May-18 Storm
Control Specifications: May-18 Storm

Hydraulic HEC-RAS models

Existing Conditions**:**
The existing conditions model includes Tropical Storm Michael, May 18- Storm flows as well as the 10-, 25- and 100-year storm events.

Project: Apple Branch	Apple Branch.prj
Plan: Tropical Storm Michael	Apple Branch. p03
Geometry: Tropical Storm Michael	Apple Branch. g01
Unsteady Flow: Tropical Storm Michael	Apple Branch. u01

Project: Apple Branch	Apple Branch.prj
Plan: Existing 10Year	Apple Branch. p06
Geometry: Existing	Apple Branch. g01
Unsteady Flow: 10year Storm	Apple Branch. u05
Project: Apple Branch	Apple Branch.prj
Plan: Existing 25 Year	Apple Branch.p10
Geometry: Existing	Apple Branch.g02
Unsteady Flow: 25 year	Apple Branch.u08

Project: Apple Branch	Apple Branch.prj
Plan: Existing 100 Year	Apple Branch .p05
Geometry: Existing	Apple Branch .g01
Unsteady Flow: 100 year Storm	Apple Branch .u04

Project: Apple Branch	Apple Branch.prj
Plan: Existing May18-Storm	Apple Branch .p02
Geometry: Existing	Apple Branch .g01
Unsteady Flow: May18-Storm	Apple Branch .u02

Proposed Conditions:

The following proposed conditions models were established with improvements for the Apple Branch Floodplain storage and Floodwall. Proposed conditions models were run for 25- and 100-year storm events.

Project: Apple Branch	Apple Branch.prj
Plan: Proposed 25-Storm	Apple Branch. p03
Geometry: Culvert	Apple Branch. go6
Unsteady Flow: 25-year Storm	Apple Branch. u10

Project: Apple Branch	Apple Branch.prj
Plan: Proposed 25-Storm	Apple Branch. p05
Geometry: Bridge	Apple Branch. go5
Unsteady Flow: 25-year Storm	Apple Branch. u10

Project: Apple Branch	Apple Branch.prj
Plan: Proposed 100-Storm	Apple Branch. p08
Geometry: Culvert	Apple Branch. g06
Unsteady Flow: 100-year Storm	Apple Branch. u12

Project: Apple Branch	Apple Branch.prj
Plan: Proposed 100-Storm	Apple Branch. p10
Geometry: Bridge	Apple Branch. g05
Unsteady Flow: 100-year Storm	Apple Branch. u12

PCSWMM Models

Arnett Boulevard Existing Conditions - 25 and 100 Year Storm
Arnett Boulevard Proposed Conditions Option 1& 2 -25- and 100-Year Storm
Arnett Boulevard Proposed Conditions Option 3 -25- and 100-Year Storm
Audubon Drive Proposed Conditions -25- and 100-Year Storm

9 References

Malcom, H. Rooney P.E/, Elements of Urban Stormwater Design, North Carolina State University, 1989.

Natural Resource Conservation Service (NRCS). 1977. Soil Survey of Wake County, North Carolina. US Department of Agriculture. Soil Conservation Service.

City of Danville, Virginia GIS Information.

Rosgen, D.L. 1996. Applied River Morphology, Wildland Hydrology, Pagosa Springs Colorado.

Urban Hydrology for Small Watersheds, Soil Conservation Services, June 1986, Technical Release 55

US Army Corps of Engineers, HEC-HMS Hydrologic Modeling System 4.9.

US Army Corps of Engineers, HEC-RAS Step Backwater Program 6.2.

US Geological Survey, Water-supply Paper 1898-B. Determination of the Manning Coefficient From measured Bed Roughness in Natural Channels, 1970.

US Geological Survey, Water-supply Paper 2339. Guide for Selecting Manning's Roughness Coefficients for Natural channels and Floodplains

Wolman, M.G., 1954. A Method of Sampling Course River-Bed Material, Transactions of American Geophysical Union 35:951-956.

NOAA's National Weather Service: Hydrometeorological Design Studies Center - Precipitation Frequency Data Server. Available URL: http://dipper.nws.noaa.gov/hdsc/pfds/

United States Department of Agriculture, Natural Resources Conservation Service. Custom Soil Resource Report January 2022.

National Oceanic and Atmospheric Administration, May 2018, Volume 60 Number 5 storm data and unusual weather phenomena with latest reports and corrections

Woodward, D. E., Hawkins, R. H., Jiang, R., Hjelmfelt, Jr., A. T., Van Mullem, J. A., & Quan, Q. D. (2003). Runoff Curve Number Method: Examination of the initial abstraction ratio. World Water & Environmental Resources Congress 2003. .

United States Department of Commerce, N. O. A. A. (2005, November 7). NOAA Atlas 14 Point Precipitation Frequency Estimates: NC. PF Map

National oceanic and atmospheric administration, May 2018, Volume 60 number 5 storm data and unusual weather phenomena with late reports and corrections

Guide for Selecting Manning's Roughness Coefficients for Natural Channels and Flood Plains, United States Geological Survey Water-supply Paper 2339

APPENDIX A
FIELD DATA COLLECTION

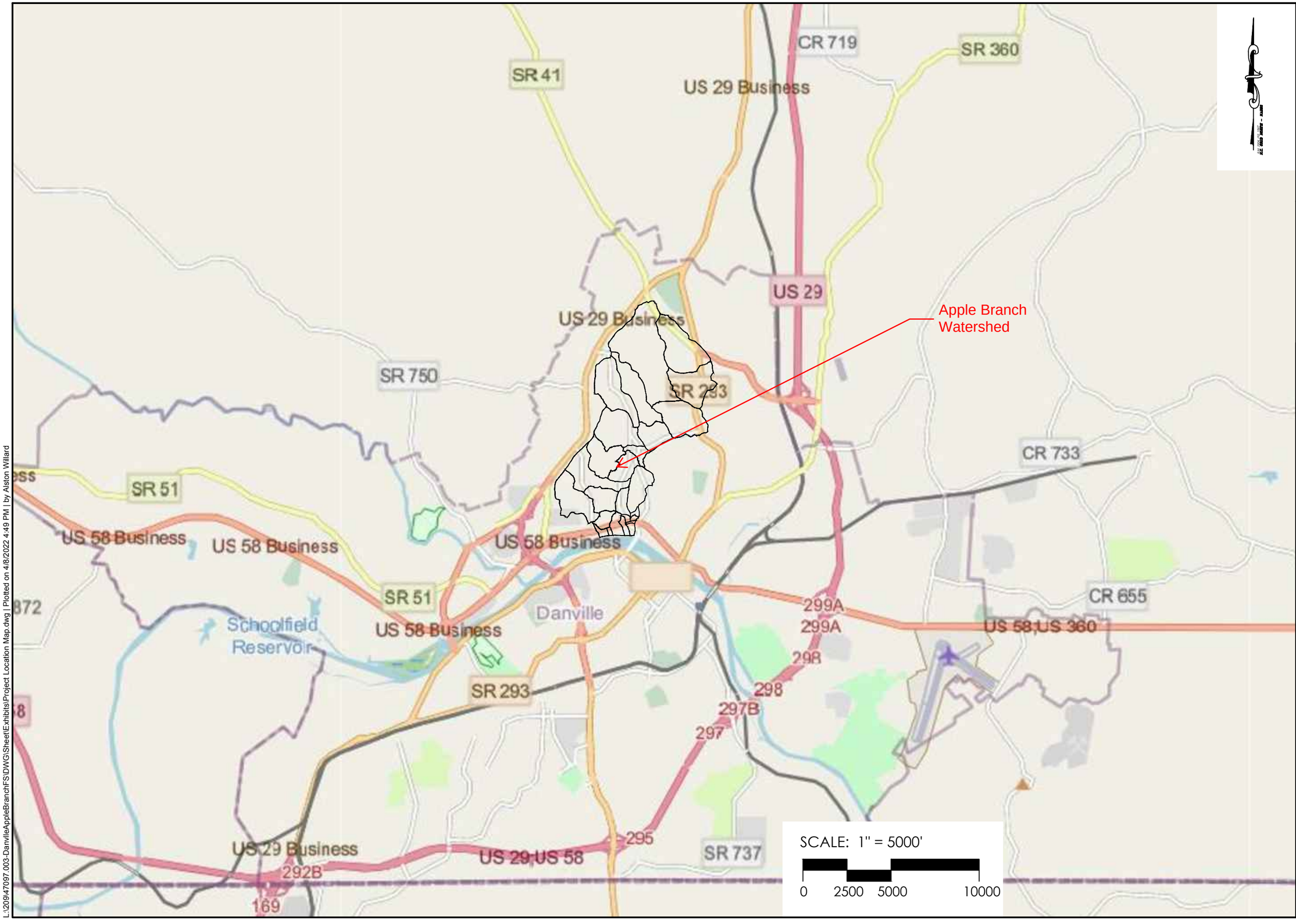
WATERSHED AND DRAINAGE SYSTEM DATA

- *Project Location Map*
- *Photo Location Exhibit*
- *Stream Reach Data*
- *Existing Stream Crossing Data*
- *Field Recorded Flood Data*
- *Sub Surface Utility Investigation Test Hole Reports*

MORPHOLOGICAL DATA

- *Morphological Survey Location Map*
- *Downstream Survey Longitudinal Profile*
- *Downstream Cross Sections*
- *Upstream Survey Longitudinal Profile Reference Reach*
- *Upstream Cross Sections*

Watershed and Drainage System Data



THIS DRAWING PREPARED AT THE
RALEIGH OFFICE
5410 Trinity Road, Suite 102 | Raleigh, NC 27607
TEL 919.866.4951 FAX 919.833.8124 www.timmons.com
North Carolina License No. C-1652

YOUR VISION ACHIEVED THROUGH OURS.

REVISION DESCRIPTION	DATE

DATE: 4-8-2022
DRAWN BY: A. WILLARD
DESIGNED BY: A. ASFAW
CHECKED BY: B. WARD
SCALE: 1"=5000'

TIMMONS GROUP
NORTH CAROLINA LICENSE NO. C-1652

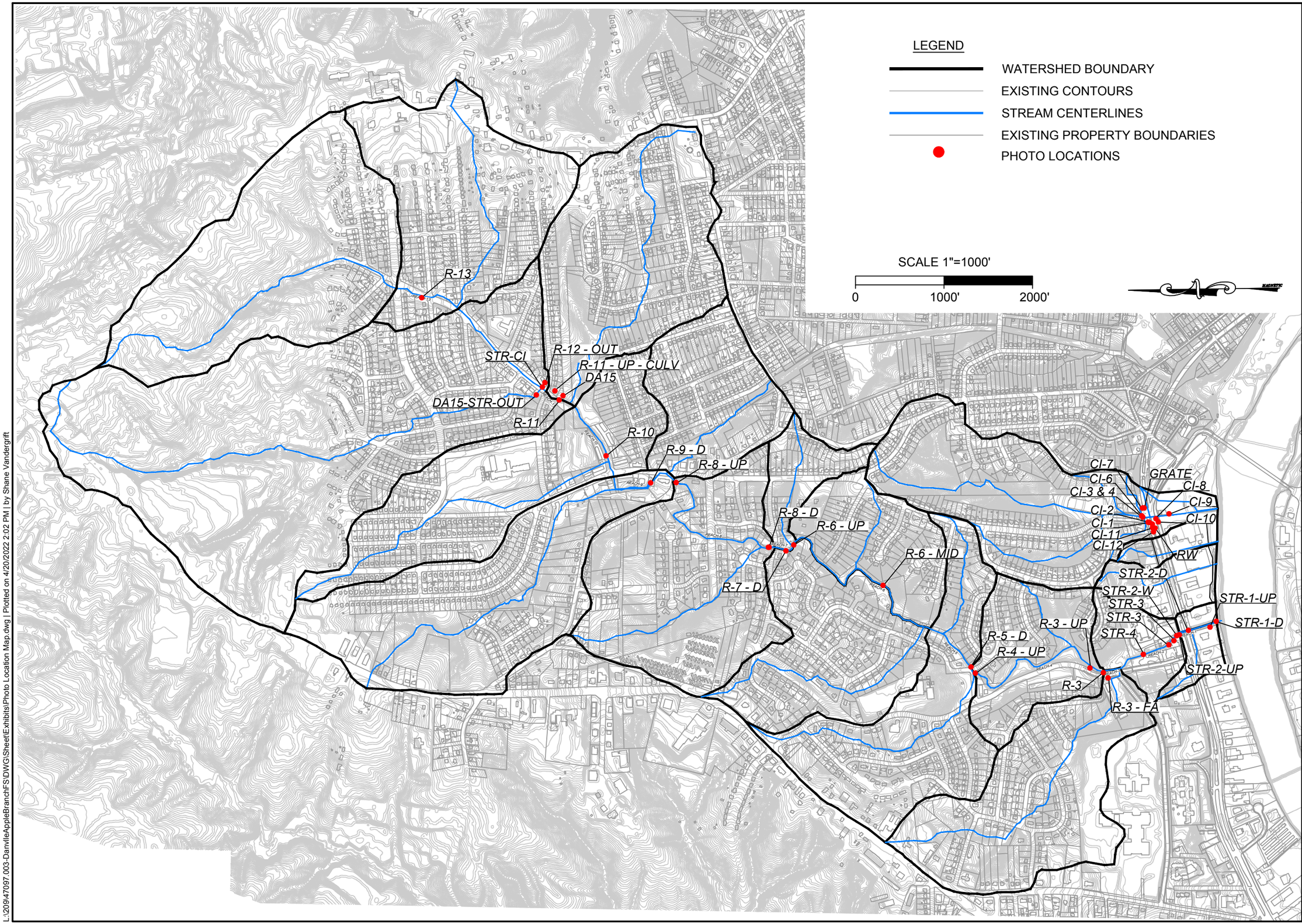
APPLEBRANCH WATERSHED STUDY

CITY OF DANVILLE - VIRGINIA

PROJECT LOCATION MAP

JOB NO. 47997
SHEET NO. 1

L:\209\47097.003-DanvilleAppleBranchFS\DWG\SheetExhibits\Project Location Map.dwg | Plotted on 4/8/2022 4:49 PM | by Alston Willard



THIS DRAWING PREPARED AT THE
RALEIGH OFFICE
5410 Trinity Road, Suite 102 | Raleigh, NC 27607
TEL 919.866.4951 FAX 919.833.8124 www.timmons.com
North Carolina License No. C-1652

YOUR VISION ACHIEVED THROUGH OURS.

REVISION DESCRIPTION

DATE

DATE 8-27-2021

DRAWN BY A. WILLARD

DESIGNED BY A. ASFAW

CHECKED BY B. WARD

SCALE 1"=1000'

TIMMONS GROUP

NORTH CAROLINA LICENSE NO. C-1652

APPLE BRANCH WATERSHED STUDY

CITY OF DANVILLE - VIRGINIA

PHOTO LOCATION MAP

JOB NO. 47097.003

SHEET NO. 1

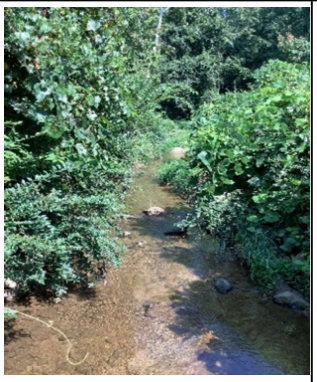
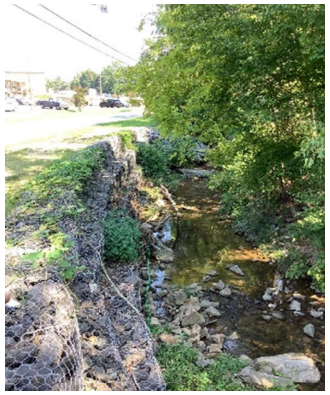
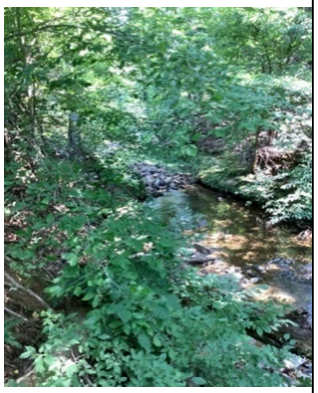
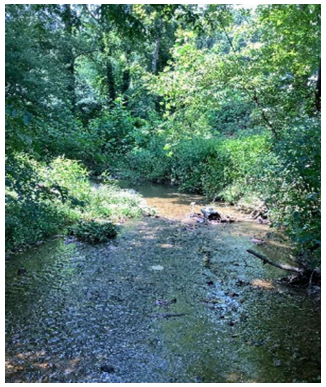
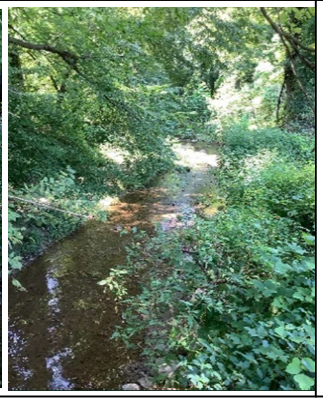
L:\209\47097.003-Danville\AppleBranchFS\DWG\SheetExhibits\Photo Location Map.dwg | Plotted on 4/20/2022 2:02 PM | by Shane Vandergrift

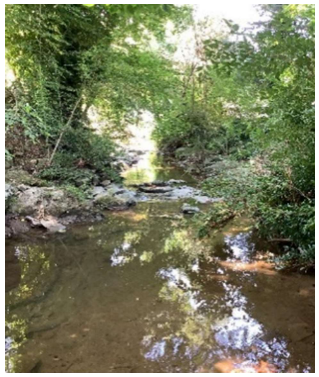
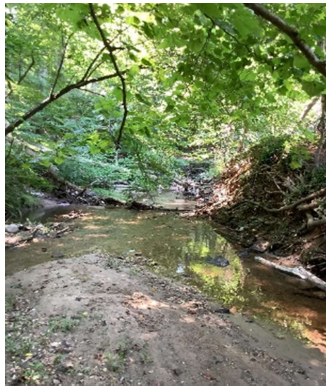
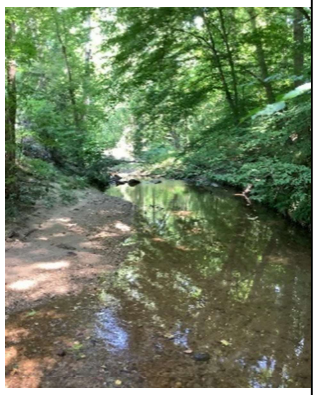
HYDROLOGY - TIME OF CONCENTRATION - FIELD DATA COLLECTION

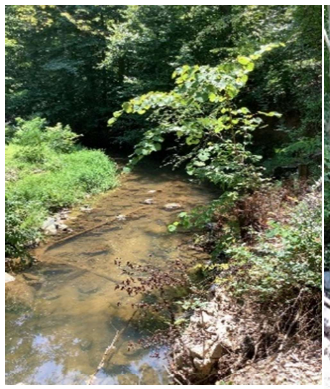
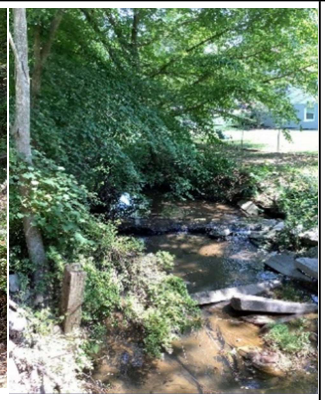
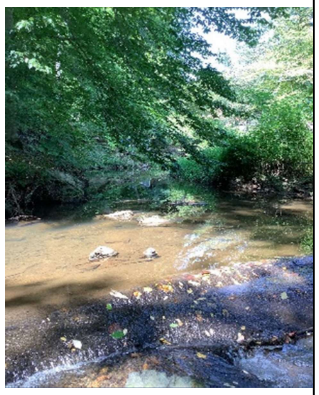
Project Name:	Apple Branch
Project Number:	47097.003
Location:	Apple Branch -City of Danville, Virginia
Date:	10/19/2021
Prepared By:	Alston Willard, EI
Checked By:	Abrham Asfaw, EI
Existing or Proposed:	Existing
Hydrologic Element:	Reach

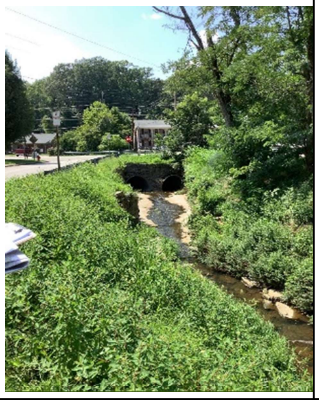
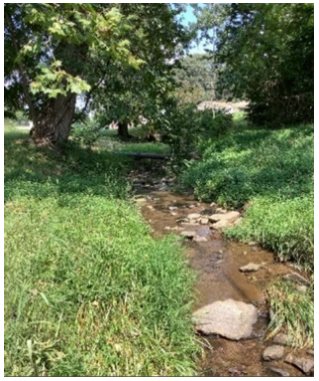
TIMMONS GROUP
YOUR VISION ACHIEVED THROUGH OURS.

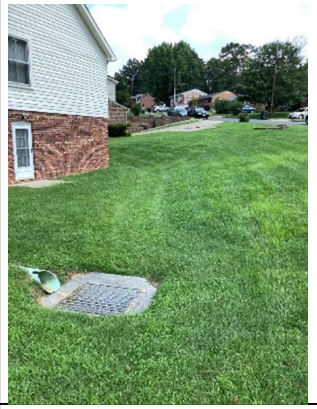
Reach ID	Remark	Picture taken on Augest 24, 2021	Bottom Width ,ft	Depth,ft	Side slope	Chnnel Slope ,ft/ft	Main Channel, n	Flood plain, n
Reach-1	Looking downstream the picture was taken from the Existing Double barrel Culvert . The stream has a defined straight reach with rock riprap banks		20	7	1.5	0.012	0.039	0.029
Reach-2 - Downstream of Existing Building and Footbridge	Looking downstream the picture taken from the Existing building side. The stream has a defined meandering reach with rock at the bottom and vegitated banks		18	8.5	2	0.005	0.071	0.1068

Reach ID	Remark	Picture taken on Augest 24, 2021	Bottom Width ,ft	Depth,ft	Side slope	Chnnel Slope ,ft/ft	Main Channel, n	Flood plain, n
Reach-2 - Upstream of Existing Brdige	Looking upstream the picture taken from Existing Bridge. The stream has a defined straight reach wth vegitated banks	 	14	10	2	0.050	0.057	0.069
Reach 3	Looking upstream, Left side is Gabion Wall (3x3 gabion) and right vegitated bank	 	15	10	2:1 left bank and Gabion wall right bank	0.012	0.048	0.053
Reach 4	Bush on either side of bank, rock bottom, trees on either side of upstream direction and a wide channel	 	18	5	2	0.012	0.043	0.058

Reach ID	Remark	Picture taken on Augest 24, 2021	Bottom Width ,ft	Depth,ft	Side slope	Chnnel Slope ,ft/ft	Main Channel, n	Flood plain, n
Reach 5	Vegatated side bank	 	12 ft	5	2	0.007	0.060	0.07
Reach 6 - Middle	Vegetated banks and sand bottom	 	25 ft	8 ft	2	0.009	0.042	0.0638
Reach 6 - upstream	rock bottom and vegetated banks	 	25 ft	4.5 ft	4	0.009	0.061	0.077

Reach ID	Remark	Picture taken on Augest 24, 2021	Bottom Width ,ft	Depth,ft	Side slope	Chnnel Slope ,ft/ft	Main Channel, n	Flood plain, n
Reach 7	Vegetated banks	 	20	4	2	0.00480631	0.055	0.064
Reach 8 at culvert	Vegetated banks	 	20	4	2	0.00480631	0.055	0.07
Reach 8 - upstream	rock bottom and vegetated banks	 	20	7	2	0.007	0.050	0.075

Reach ID	Remark	Picture taken on Augest 24, 2021	Bottom Width ,ft	Depth,ft	Side slope	Chnnel Slope ,ft/ft	Main Channel, n	Flood plain, n
Reach 9 - after culvert (most of reach)	Some of reach goes under an existing building	 	12 ft	7 ft	2	0.013	0.039	0.034
Reach 10		 	12	7	0.25	0.005	0.027	0.027
Reach 11	Grassed bank	 	6 ft	4.5 ft	3 to 1	0.013	0.047	0.052

Reach ID	Remark	Picture taken on Augest 24, 2021	Bottom Width ,ft	Depth,ft	Side slope	Chnnel Slope ,ft/ft	Main Channel, n	Flood plain, n
DA-15 outlet	vegetated bank near a house	 						0.004
Reach 12	Swale and Storm system are underground. A 5 ft culvert feeds to a floodprone area	 	4	3	4	0.015	0.035	0
Reach 13	Reach-13 is a combination of storm pipe and swale	 	4	3	4	0.015	0.035	0

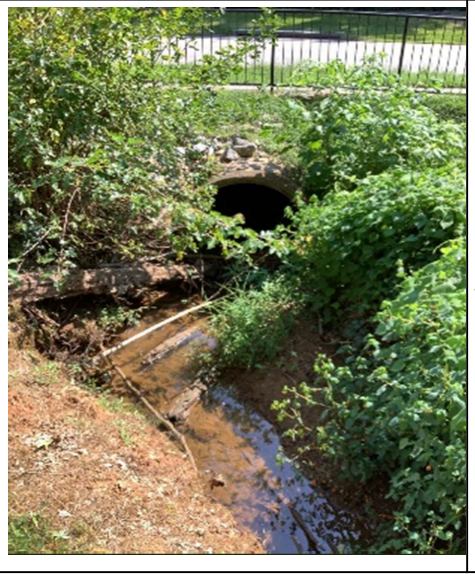
STRUCTURE - FIELD DATA COLLECTION

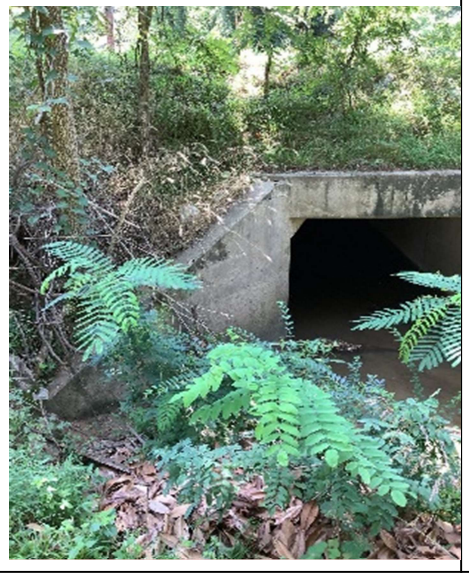
Project Name:	Apple Branch -City of Danville, Virginia
Project Number:	47097.003
Location:	City of Danville, Virginia
Date:	8/25/2021
Prepared By:	Alston Willard, EI
Checked By:	Abrham Asfaw , EI
Existing or Proposed:	Existing
Hydrologic Element:	Bridges and Culverts

TIMMONS GROUP
YOUR VISION ACHIEVED THROUGH OURS.

Strcuture Name and Type	Structure Location	Structure Picture	Span ,ft	Rise,ft	Remark
STR-1 U/S and STR-1 D/S	Trail bridge located at junction of Apple Branch and Dan River	 		13	less than 1% obstruction, 6 inch from low to high chord
STR-2 U/S and STR-2 D/S	Riverside Drive Box Culvert on Apple Branch	 	10 ft	5.7 ft	Double barrel box culvert, 12 inch RCP and 15 inch RCP drianing at downstream side of culvert, 1' middle wall vegetated banks, wooden/paved banks

Strcuture Name and Type	Structure Location	Structure Picture	Span ,ft	Rise,ft	Remark
STR-2 W	Upstream of Riverside Drive box culvert	 			12 ft from wooden Apple branch bank to paved walkway on the floodplain
STR-3	Exisitng Building suspended over Apple Branch	 	18 ft	8.5 ft	The building is skewed
STR-3	Steel foot bridge at the back of the builidng	 	18 ft	8.5 ft	Steel foot bridge behind building (3.5 width), no wing wall, low chord 1-ft lower than the building low chord

Strcuture Name and Type	Structure Location	Structure Picture	Span ,ft	Rise,ft	Remark
STR-4	Steel Slab bridge with concrete abutement walls	 	14 ft	8 ft	Vegetated banks, 26 ft length of bridge
Reach- 3FA	DA-4 to Reach 3 outlet under Audoubon Drive	 	48-inch RCP		Drains DA-4, 48 inch RCP culvert,

Strcuture Name and Type	Structure Location	Structure Picture	Span ,ft	Rise,ft	Remark
Reach 5 D and Reach 4 U	Existing Box Culvert connecring Reach 4 and Reach 5	 	745	5 ft	Skewed (8 ft perpendicular and 10 ft at skew)
Reach 7 DS and Reach 6 US	Box Culvert Connecting Reach 7 and Reach 6	 	10 ft x 2	6.5 ft	1.5 thick top slab Box Culvert

Strcuture Name and Type	Structure Location	Structure Picture	Span ,ft	Rise,ft	Remark
Reach 10 DS and Reach 9 US	Culvert Connecting Concrete Lined Reach 10 and Reach 9	 	22 ft	4.5 ft	60 inch CMP arch culverts, some depth covered, under buildings
DA-15 STR OUT		 			DA 15 outlet Arch CMP culvert

Strcuture Name and Type	Structure Location	Structure Picture	Span ,ft	Rise,ft	Remark
Reach 11 DS Structure	Reach 11 Outlet structure downstream side				4 barrels, 2 not useable, overgrown and not maintained
Reach 11 US Structure (culvert)	Reach 11 upstream side culvert				15 inch RCP on right bank

Strcuture Name and Type	Structure Location	Structure Picture	Span ,ft	Rise,ft	Remark
Reach 12 - DS	Reach 12 Yard inlet	 			No-defined natrual stream at Reach 12 outlet

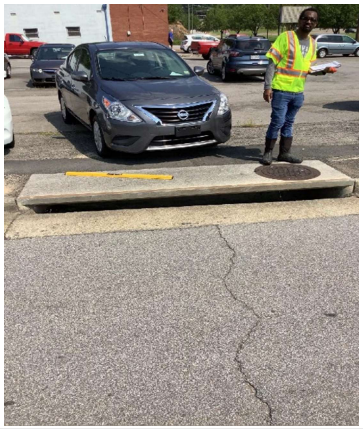
STRUCTURE - FIELD DATA COLLECTION

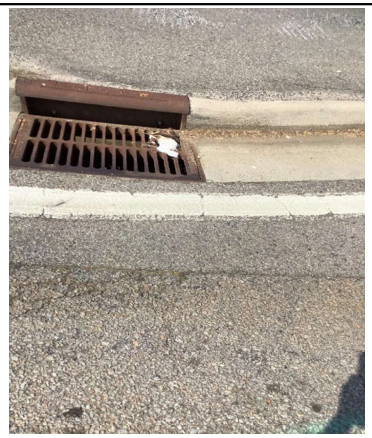
Project Name: Apple Branch
Project Number: 47097.003
Location: City of Danville, Virginia
Date: 8/25/2021
Prepared By: Alston Willard, EI
Checked By: Abrham Asfaw , EI
Existing or Proposed: Existing
Hydrologic Element:

TIMMONS GROUP
YOUR VISION ACHIEVED THROUGH OURS.

Strcuture Name and Type	Structure Location	Schematic Diagram and Remark	Length	Road slope	Gutter slope	Manning N
CI-1	Arnett Boulevard		2.5 ft	2.30%	26%	
CI-2	Arnett Boulevard		4 ft	2.3%	2.3%	

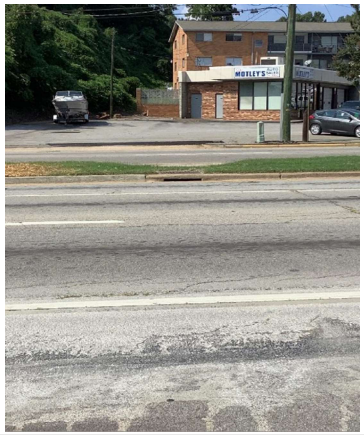
Strcuture Name and Type	Structure Location	Schematic Diagram and Remark	Length	Road slope	Gutter slope	Manning N
CI-3	Arnett Boulevard		7 ft	2.1%	2.1%	
CI-4	Arnett Boulevard		7 ft	2.5%	2.5%	

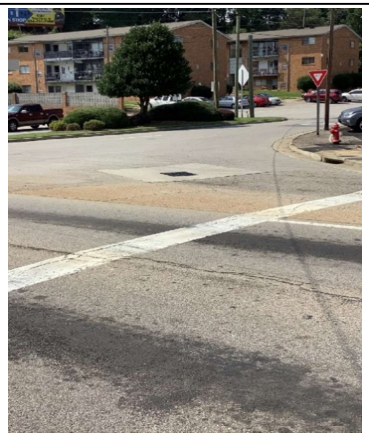
Strcuture Name and Type	Structure Location	Schematic Diagram and Remark	Length	Road slope	Gutter slope	Manning N
CI-5	Arnett Boulevard		11 ft	6.2%	2.0%	
CI-6	Arnett Boulevard		5 ft	5.9%	2.0%	

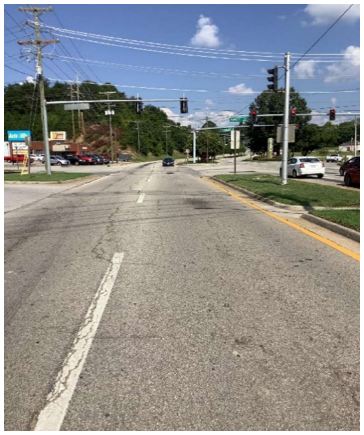
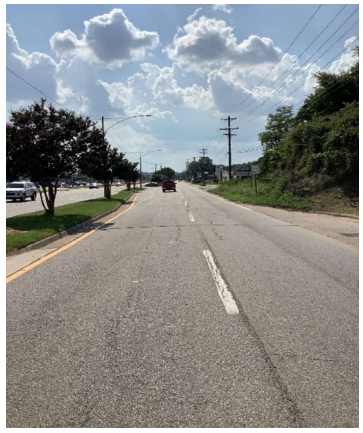
Strcuture Name and Type	Structure Location	Schematic Diagram and Remark	Length	Road slope	Gutter slope	Manning N
CI-7	Arnett Boulevard		3 ft	12.5%	4.0%	
CI-8	Arnett Boulevard		7 ft	13.7%		

Strcuture Name and Type	Structure Location	Schematic Diagram and Remark	Length	Road slope	Gutter slope	Manning N
CI-9	Near transmission line area, not in street with pipe near		3.5 ft			
CI-10	Yard Inlet (2.5 ft x 2.5 ft)					

Strcuture Name and Type	Structure Location	Schematic Diagram and Remark	Length	Road slope	Gutter slope	Manning N
CI-11	Riverside Drive		3.5	26.0%		
CI-11 back	Grate inlet at back of curb inlet - clogged with grass clippings					

Strcuture Name and Type	Structure Location	Schematic Diagram and Remark	Length	Road slope	Gutter slope	Manning N
CI-12	Riverside Drive		3.5 ft	28.8%		
CI-12 back	Riverside Drive					

Strcuture Name and Type	Structure Location	Schematic Diagram and Remark	Length	Road slope	Gutter slope	Manning N
Grate in median	Riverside Drive					
Grate in street	Riverside Drive					

Strcuture Name and Type	Structure Location	Schematic Diagram and Remark	Length	Road slope	Gutter slope	Manning N
Roadway cross section - toward intersection	Riverside Drive					
Roadway cross section - away from intersection	Riverside Drive					

FIELD DATA COLLECTION-FLOODING INFORMATION

Project Name:	Apple Branch
Project Number:	47097.003
Location:	City of Danville, Virginia
Date:	8/1/2021
Prepared by:	Chris Rogers, EI
Checked by:	Becky Ward, PE
Existing or Proposed:	EXISTING
Catchment:	Appel Branch

TIMMONS GROUP
YOUR VISION ACHIEVED THROUGH OURS.

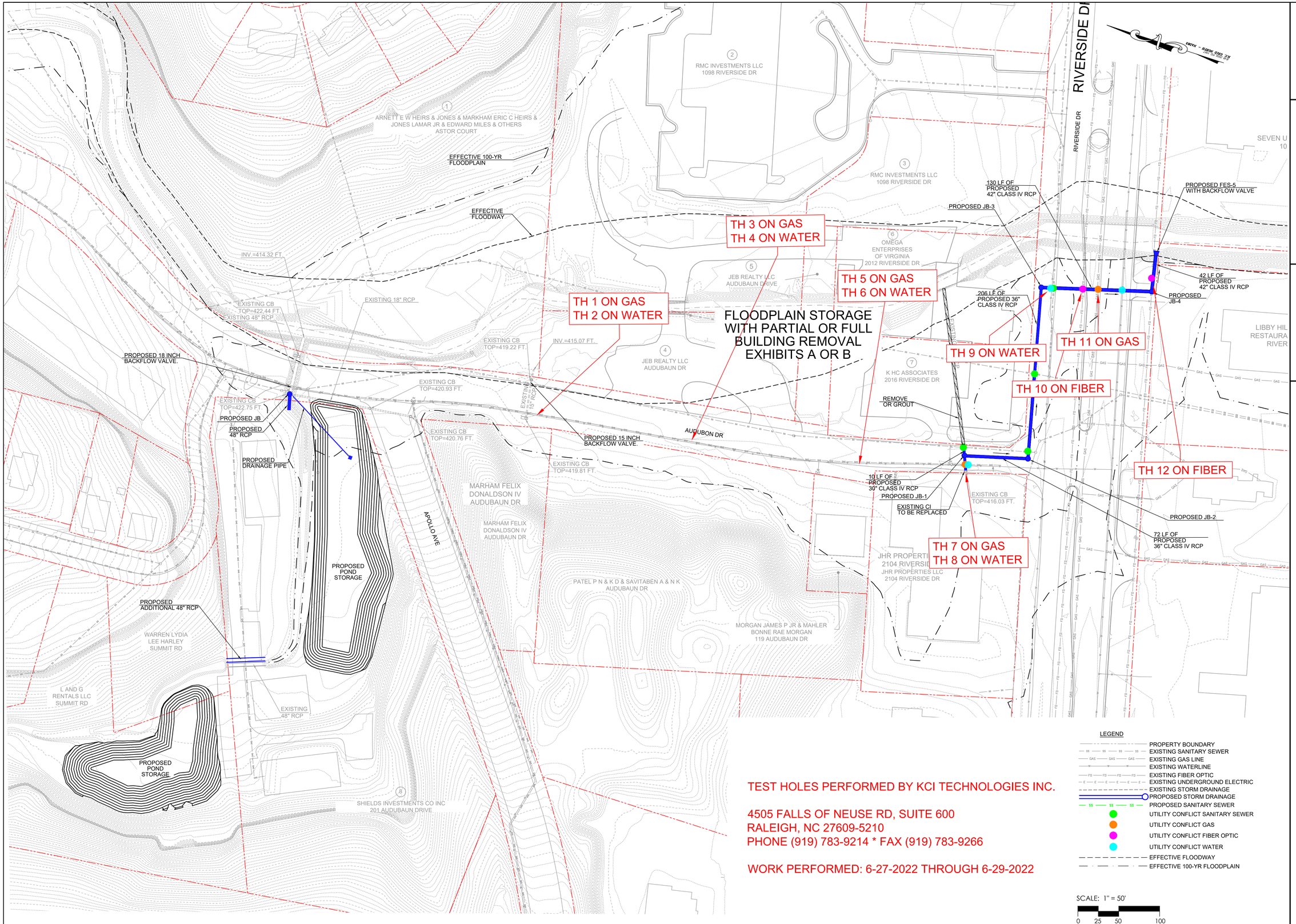
Property Address	Business Name	Did flooding come from Dan River or Apple Branch for the three storms?	Does any flooding from the Dan River affect the site at all?	Observed Elevations							Notes
				FFE	FFE - Ground (inches)	Elevation (FFE - Ground)	FFE - May 11 2018 (inches)	FFE - Sep 28 2018 (inches)	FFE - Oct 11 2018 (inches)	Elevation (FFE - Oct 11 2018)	
1095 Riverside	NAPA	Apple Branch	None Reported	416.32	0	416.32	N/A	N/A	18	417.82	This location provided a wealth of information and visible markings from the October 2018 storm. Wayne Porch will send photos to Chris Franks
1081 Riverside	Sellers Insurance	Apple Branch	None Reported	417.26	0	417.26	N/A	N/A	7	417.84	The FFE is at the adjacent ground elevation which is also the top of curb elevation.
2143 Riverside	Robert Woodall Hyundai	Apple Branch	None Reported	420.9	0	420.9	N/A	N/A	0.5	420.94	FFE at Curb Elevation. Flooding was reportedly approximately a half inch
1063 Riverside	Robert Woodall Call Center	Apple Branch	None Reported	416.74	14	415.57	N/A	N/A	22	418.57	
1063 Riverside	Robert Woodall Automart	Apple Branch	None Reported	417.24							This building is the call center between Sellers Insurance and the dealership
2104 Riverside	Triangle Cycles North	Apple Branch	None Reported	419.99	0		N/A	N/A	16	421.32	This business was impacts as flows backed up on Audubon Drive. Floodwaters "stacked up" at the rear of the structure and was allowed to flow through and out the front door to Riverside Drive. FFE varied throughout the site. FFE was at adjacent ground level at the two sites measured. Additionally, photos from the owner show the water surface at a measureable location on the fence between the building and Audubon Drive. The photo also shows the high water running along the structure at 2022 Riverside Drive.
1042 Riverside	Riverside Coin			418.14							Not visited
1098 Riverside	Hampton Inn	None Reported	None Reported	423.55							The Hampton Inn was under construction at the time of the October 2018 storm. As a result of the storm, the finished grade was raised.
1050 Riverside	La Nostra Cucina			417.86							Not visited
1066 Riverside	Mama's Attic Thrift Store			419.41							Not visited
1098 Riverside	B W of Danville										Not visited
109 Audubon	Kwik Shop			420.36							Not visited
2121 Riverside	Holiday Inn Express			421.3							Not visited

FIELD DATA COLLECTION-FLOODING INFORMATION

Project Name:	Apple Branch
Project Number:	47097.003
Location:	City of Danville, Virginia
Date:	8/1/2021
Prepared by:	Chris Rogers, EI
Checked by:	Becky Ward, PE
Existing or Proposed:	EXISTING
Catchment:	Appel Branch

TIMMONS GROUP
YOUR VISION ACHIEVED THROUGH OURS.

Property Address	Business Name	Did flooding come from Dan River or Apple Branch for the three storms?	Does any flooding from the Dan River affect the site at all?	Observed Elevations							Notes
				FFE	FFE - Ground (inches)	Elevation (FFE - Ground)	FFE - May 11 2018 (inches)	FFE - Sep 28 2018 (inches)	FFE - Oct 11 2018 (inches)	Elevation (FFE - Oct 11 2018)	
2101 Riverside	Biscuitville			419.3							Photos show that this building was impacted, however there were no visible markings and there was noone present that was around during the storm.
2015 Riverside	Unknown	None Reported	None Reported	419.86							This business is vacant. Based on conversations with NAPA, the building was not impacted by flooding.
1001 Riverside	Pepsi	None Reported	None Reported	418.73							The floodwaters did not enter the building
1002 Riverside	Mike Motley's Auto Sales										Not visited
1038 Riverside	Unknown										Vacant Lot
1044 Riverside	Riverside Produce and Plants										Vacant Lot
1080 Riverside	Leonard Aluminum Utility			418.35							Vacant Business
2012 Riverside	Missouri Payday Loan			419.13							Attached to structure containing 2020 Riverside
2012 Riverside	USA Checks Cashed			419.07							Attached to structure containing 2020 Riverside
2016 Riverside	Peace of Mind Therapies			419.13							Same structure as 2020 Riverside
2022 Riverside	SHHH LLC			419.05							Same structure as 2020 Riverside
2202 Riverside	Waldo Smith Locksmith			419.04							Same structure as 2020 Riverside
2020	Tx Computers	Apple Branch	None Reported	418.99	9	418.24	N/A	N/A	16	420.32	FFE is at the sidewalk/TOC elevation. Based on photo evidence, the floodwaters were approximately 16" above the FFE.



TEST HOLES PERFORMED BY KCI TECHNOLOGIES INC.

4505 FALLS OF NEUSE RD, SUITE 600
RALEIGH, NC 27609-5210
PHONE (919) 783-9214 * FAX (919) 783-9266

WORK PERFORMED: 6-27-2022 THROUGH 6-29-2022

LEGEND

- PROPERTY BOUNDARY
- EXISTING SANITARY SEWER
- EXISTING GAS LINE
- EXISTING WATERLINE
- EXISTING FIBER OPTIC
- EXISTING UNDERGROUND ELECTRIC
- EXISTING STORM DRAINAGE
- PROPOSED STORM DRAINAGE
- PROPOSED SANITARY SEWER
- UTILITY CONFLICT SANITARY SEWER
- UTILITY CONFLICT GAS
- UTILITY CONFLICT FIBER OPTIC
- UTILITY CONFLICT WATER
- EFFECTIVE FLOODWAY
- EFFECTIVE 100-YR FLOODPLAIN

SCALE: 1" = 50'

0 25 50 100

THIS DRAWING PREPARED AT THE
RALEIGH OFFICE
5410 Trinity Road, Suite 102 Raleigh, NC 27607
TEL 919.866.4951 FAX 919.833.8124 www.timmons.com
North Carolina License No. C-1652

YOUR VISION ACHIEVED THROUGH OURS.

REVISION DESCRIPTION	DATE

DATE: 3-16-2022
DRAWN BY: S. Vandergrift
DESIGNED BY: C. Rogers
CHECKED BY: C. Rogers
SCALE: 1" = 50'

TIMMONS GROUP

APPLE BRANCH ENGINEERING STUDY

CITY OF DANVILLE - VIRGINIA

SUBSURFACE UTILITY LOCATION MAP RIVERSIDE DR. & AUDUBON DR.

JOB NO. 47097

SHEET NO. MAP 1

MATCHLINE

PROPOSED JB-14
PROPOSED 30" RCP
20 LF
PROPOSED CI-13
PROPOSED 30" RCP
104 LF
EXISTING 30" RCP TO BE ABANDONED
110 LF
TH 17 ON WATER
HAMPTON DR
EXISTING 4" PE GAS LINE
PROPOSED CI-12
EXISTING 54" RCP TO BE ABANDONED
102 LF
PROPOSED CI
TH 16 ON GAS
PROPOS
160 LF
PROPOSED 30" RCP
52 LF
PROPOSED JB-11
PROPOSED DI-9
TH 24 ON GAS
EXISTING STMH
EXISTING SSMH
EXISTING 15" RCP
ARNETT BLVD
TH 20 ON FIBER
PROPOSED 18" RCP
92 LF
TH 25 ON FIBER
PROPOSED JB-10
PROPOSED CI-8
EXISTING 15" RCP
(TO BE ABANDONED)
EXISTING SSMH
TOP=415.13 FT.
DEPTH=2.63 FT.
PROPOSED 48" RCP
168 LF
PROPOSED 18 " RCP
60 LF
PROPOSED 18 " RCP
88 LF
PROPOSED DI-16
PROPOSED DI-15
(TO REPLACE EXISTING DI
PROPOSED JB-6
PROPOSED 24" RCP
40 LF
EXISTING JB-7 TO BE REPLACED
PROPOSED 48" RCP
76 LF
PROPOSED DI-17
EXISTING CI
EXISTING RCP TO BE ABANDONED
EXISTING SSMH
TOP=417.12 FT.
DEPTH=2.6 FT.
TH 23 ON GAS
EXISTING
4" ST GAS LINE
EXISTING
8" SS TCP
TH 15 ON FIBER
SED BACK FLOW VALVE
PROPOSED CI-5
EXISTING 16" WATERMAIN
EXISTING 8" SS TCP
PROPOSED 48" RCP
72 LF
PROPOSED JB-4
PROPOSED 48" RCP
48 LF
EXISTING 8" ST GAS LINE
PROPOSED JB-18
EXISTING STMH
WITH CONC.
TH 22 ON GAS
RIVERSIDE DR
PROPOSED 54" RCP
38 LF
EXISTING 12" WATERMAIN
EXISTING
8" ST GAS MAIN
EXISTING FIBER OPTIC
EXISTING 15" RCP
PROPOSED 30" RCP
PROPOSED JB-19
EXISTING 8" SS TCP
PROPOSED CI-3
BRICK ARCH
5 FT. SPAN
3.8 FT RISE
POSSIBLY BURIED
EXISTING SSMH
TOP=415.90'
DEPTH=6.34 FT.
EXISTING CI
EXISTING
1" ST GAS
SERVICE
EXISTING 1" PE
GAS SERVICE
EXISTING 12" SS TCP
TH 21 ON GAS
EXISTING 8" SS TCP
EXISTING 1" PE
GAS SERVICE
TH 18 ON WATER
TH 19 ON FIBER
CULVERT
SPAN
T. RISE
UNDERGROUND
ELECTRIC
UNION STREET N.
EXISTING SSMH
TOP=415.68'
DEPTH=5.68 FT.
EXISTING YI
PROPOSED YI -2 T
TH 14 ON FIBER
PROPOSED 48" RCP PARALLEL TO EXISTING
TO BE PLACED ON A CONCRETE FILL TO
SPRING LINE OR PIPE 336 LF
PROPOSED HW-T
EXISTING SWALE TO BE IMPROVED

EXISTING STORAGE AREA TO
BE PRESERVED AS PERMANENT
DRAINAGE EASEMENT
ARNETT DR
MATCHLINE
EXISTING 48" RCP
EXISTING 30" RCP
EXISTING 30" RCP TO BE ABANDONED
110 LF
TH 17 ON WATER

POND STORAGE AREA
SCALE: 1" = 60'
0 30 60 120

TEST HOLES PERFORMED BY KCI TECHNOLOGIES INC.

4505 FALLS OF NEUSE RD, SUITE 600
RALEIGH, NC 27609-5210
PHONE (919) 783-9214 * FAX (919) 783-9266

WORK PERFORMED: 6-27-2022 THROUGH 6-29-2022

LEGEND
- PROPERTY BOUNDARY
- EXISTING SANITARY SEWER
- EXISTING GAS LINE
- EXISTING WATERLINE
- EXISTING FIBER OPTIC
- EXISTING UNDERGROUND ELECTRIC
- EXISTING STORM DRAINAGE
- PROPOSED STORM DRAINAGE
- UTILITY CONFLICT SANITARY SEWER
- UTILITY CONFLICT GAS
- UTILITY CONFLICT FIBER OPTIC
- UTILITY CONFLICT WATER
- EFFECTIVE FLOODWAY
- EFFECTIVE 100-YR FLOODPLAIN

SCALE: 1" = 60'
0 30 60 120

THIS DRAWING PREPARED AT THE
RALEIGH OFFICE
5410 Trinity Road, Suite 102 Raleigh, NC 27607
TEL 919.866.4951 FAX 919.833.8124 www.timmons.com
North Carolina License No. C-1652

YOUR VISION ACHIEVED THROUGH OURS.

TIMMONS GROUP

APPLE BRANCH ENGINEERING STUDY

CITY OF DANVILLE- VIRGINIA

SUBSURFACE UTILITY LOCATION MAP RIVERSIDE DR. & ARNETT BLVD.

REVISION DESCRIPTION	DATE

DATE 12-17-21
DRAWN BY S.VANDERGRIFT
DESIGNED BY A.ASFAW
CHECKED BY B.WARD
SCALE

JOB NO. 47097
SHEET NO. MAP 2

Test Hole Number	Test Hole Location		Elevation Survey Marker	Depth from Survey Marker	Size and Type of Utility
	Easting	Northing			
TH-1	3378313.35	11217330.64	419.159	-3.77	4" STEEL GAS MAIN
TH-2	3378313.02	11217329.85	419.139	-3.96	12" CAST IRON WATER MAIN
TH-3	3378142.49	11217360.21	418.237	-2.62	4" STEEL GAS MAIN
TH-4	3378142.46	11217359.19	418.860	-3.41	12" CAST IRON WATER MAIN
TH-5	3377912.25	11217413.50	416.841	-3.56	4" STEEL GAS MAIN
TH-6	3377912.30	11217412.35	416.816	-4.24	12" CAST IRON WATER MAIN
TH-7	3377791.49	11217455.78	416.211	-4.35	4" STEEL GAS MAIN
TH-8	3377791.01	11217454.77	416.179	-4.94	4" STEEL GAS MAIN
TH-9	3377777.95	11217696.76	416.950	-8.19	8" CAST IRON WATER MAIN
TH-10	3377729.56	11217709.66	416.903	-5.21	2 X 1½" HDPE CONDUITS
TH-11	3377718.65	11217712.02	417.408	-3.41	8" WRAPPED STEEL GAS MAIN
TH-12	3377675.33	11217725.25	417.010	-4.94	42" CONCRETE DUCTBANK
TH-13				-3.22	2" PLASTIC GAS
TH-14	3377937.82	11218691.87	414.470	-1.49	46" CONCRETE DUCTBANK
TH-15	3378163.02	11218992.78	417.410	-2.74	42" CONCRETE DUCTBANK
TH-16	3378634.13	11219009.15	437.720	-2.26	4" PLASTIC GAS
TH-17	3378645.65	11219006.54	438.860	-3.37	8" PVC WATER MAIN
TH-18	3378055.10	11219082.30	415.800	-3.13	10" CAST IRON WATER MAIN
TH-19	3378061.86	11219080.68	415.780	-3.67	36" Concrete Ductbank
TH-20	3378006.64	11218672.93	415.070	-3.05	2 X 1½" HDPE CONDUITS
TH-21	3378000.68	11218674.23	415.360	-3.1	8" WRAPPED STEEL GAS MAIN
TH-22	3378175.45	11219083.37	417.580	-3.11	8" WRAPPED STEEL GAS MAIN
TH-23	3378207.86	11219077.77	418.450	-1.86	4" PLASTIC GAS MAIN
TH-24	3378527.31	11219092.31	428.890	-4.55	4" PLASTIC GAS MAIN
TH-25	3378307.86	11219063.73	420.880	-3.66	24" CONCRETE DUCTBANK

Elevations for Test Hole Survey Markers provided by City of Danville Surveyors July 25, 2022
VA South
Horizontal Datum: NAD83
Vertical Datum: NAVD88

No Survey data available for TH-13

KCI ASSOCIATES OF NC
Engineers * Planners * Scientists * Construction Managers
4505 Falls of Neuse Rd, Suite 600
Raleigh, NC 27609-5210
Phone (919) 783-9214 * Fax (919) 783-9266

Client: **TIMMONS GROUP**

CLIENT JOB #: . KCI JOB #: .

TEST HOLE #: 1 DATE: **06.27.22**

AREA LOCATION: **AUDUBON DR**

JURISDICTION: **DANVILLE, VA**

UTILITY REQUESTED: **GAS**

TEST HOLE DUG AT PROPOSED: **STORM INSTALLATION**

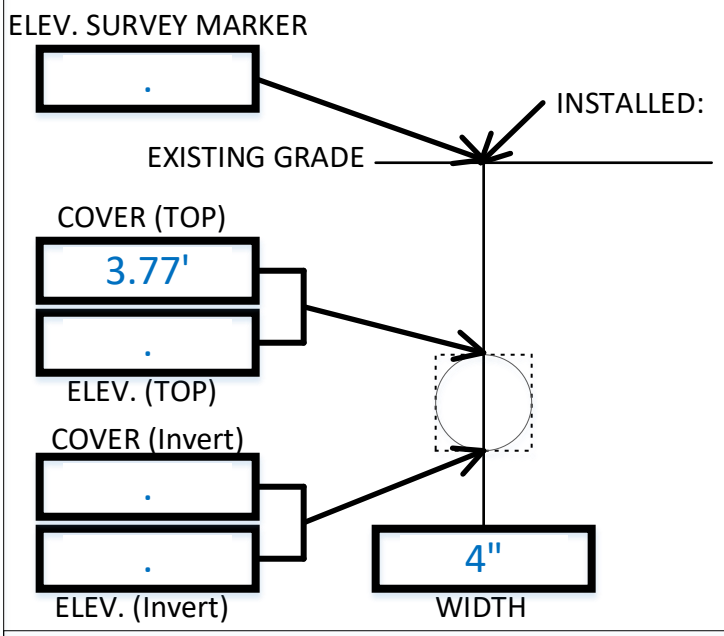
OUTSIDE DIAMETER & TYPE OF UTILITY FOUND

4" STEEL GAS MAIN

PAVING THICKNESS / CONDITION: **3" SOFT ASPHALT**

SOIL CONDITIONS: **SANDY SOIL**

UTILITY CONDITION: **GOOD**



SURVEY MARKER LOCATED BY: .

TEST PIT SURVEY INFORMATION

NORTHING: .

EASTING: .

BASELINE: .

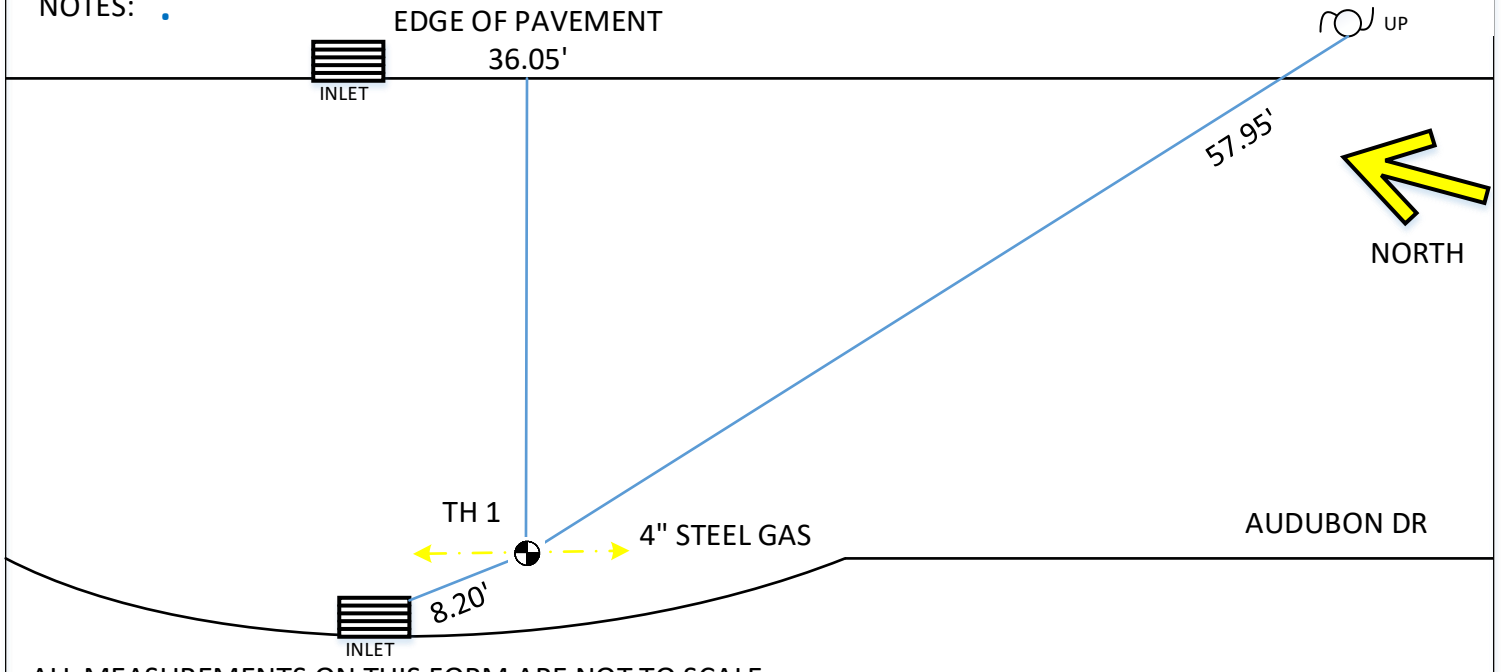
STATION: .

OFFSET: .

HORIZONTAL & VERTICAL CONTROL PROVIDED BY:

.

NOTES: .



ALL MEASUREMENTS ON THIS FORM ARE NOT TO SCALE

KCI ASSOCIATES OF NC
Engineers * Planners * Scientists * Construction Managers
4505 Falls of Neuse Rd, Suite 600
Raleigh, NC 27609-5210
Phone (919) 783-9214 * Fax (919) 783-9266

Client: **TIMMONS GROUP**

CLIENT JOB #: . KCI JOB #: .

TEST HOLE #: 2 DATE: **06.27.22**

AREA LOCATION: **AUDUBON DR**

JURISDICTION: **DANVILLE, VA**

UTILITY REQUESTED: **WATER**

TEST HOLE DUG AT PROPOSED: **STORM INSTALLATION**

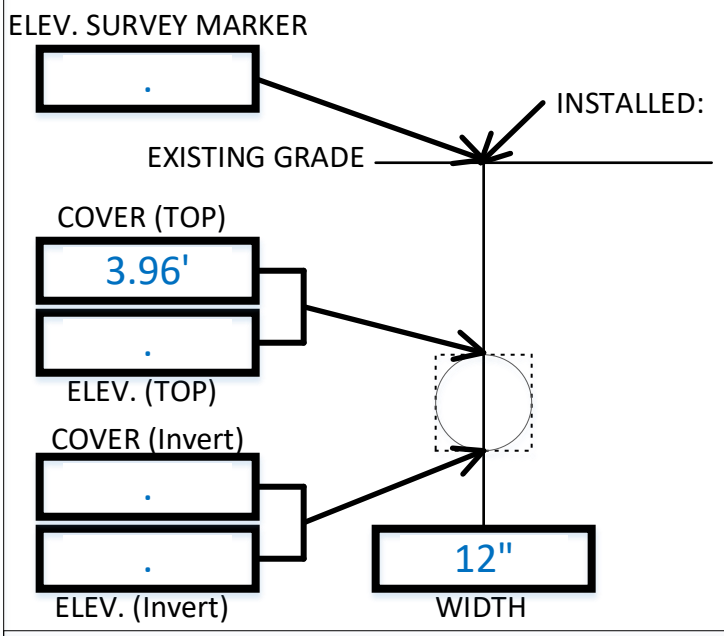
OUTSIDE DIAMETER & TYPE OF UTILITY FOUND

12" CAST IRON WATER MAIN

PAVING THICKNESS / CONDITION: **3" SOFT ASPHALT**

SOIL CONDITIONS: **SANDY SOIL**

UTILITY CONDITION: **GOOD**



SURVEY MARKER LOCATED BY: .

TEST PIT SURVEY INFORMATION

NORTHING: .

EASTING: .

BASELINE: .

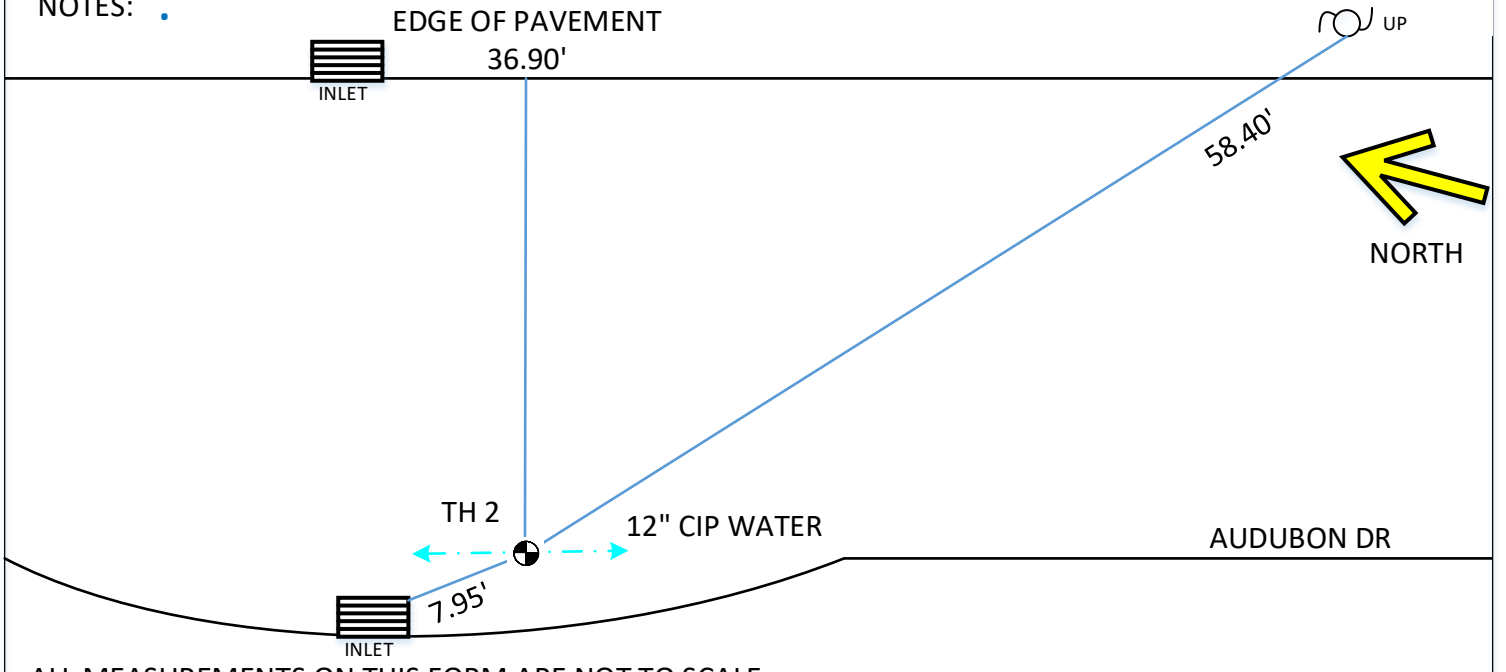
STATION: .

OFFSET: .

HORIZONTAL & VERTICAL CONTROL PROVIDED BY:

.

NOTES: .



ALL MEASUREMENTS ON THIS FORM ARE NOT TO SCALE

KCI ASSOCIATES OF NC
Engineers * Planners * Scientists * Construction Managers
4505 Falls of Neuse Rd, Suite 600
Raleigh, NC 27609-5210
Phone (919) 783-9214 * Fax (919) 783-9266

Client: **TIMMONS GROUP**

CLIENT JOB #: . KCI JOB #: .

TEST HOLE #: 3 DATE: **06.27.22**

AREA LOCATION: **AUDUBON DR**

JURISDICTION: **DANVILLE, VA**

UTILITY REQUESTED: **GAS**

TEST HOLE DUG AT PROPOSED: **STORM INSTALLATION**

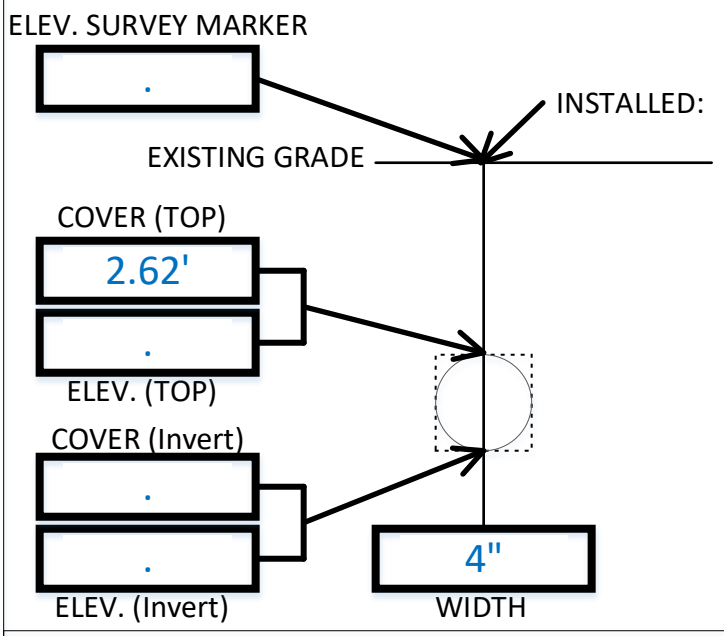
OUTSIDE DIAMETER & TYPE OF UTILITY FOUND

4" STEEL GAS MAIN

PAVING THICKNESS / CONDITION: **N/A**

SOIL CONDITIONS: **SANDY SOIL**

UTILITY CONDITION: **GOOD**



SURVEY MARKER LOCATED BY: .

TEST PIT SURVEY INFORMATION

NORTHING: .

EASTING: .

BASELINE: .

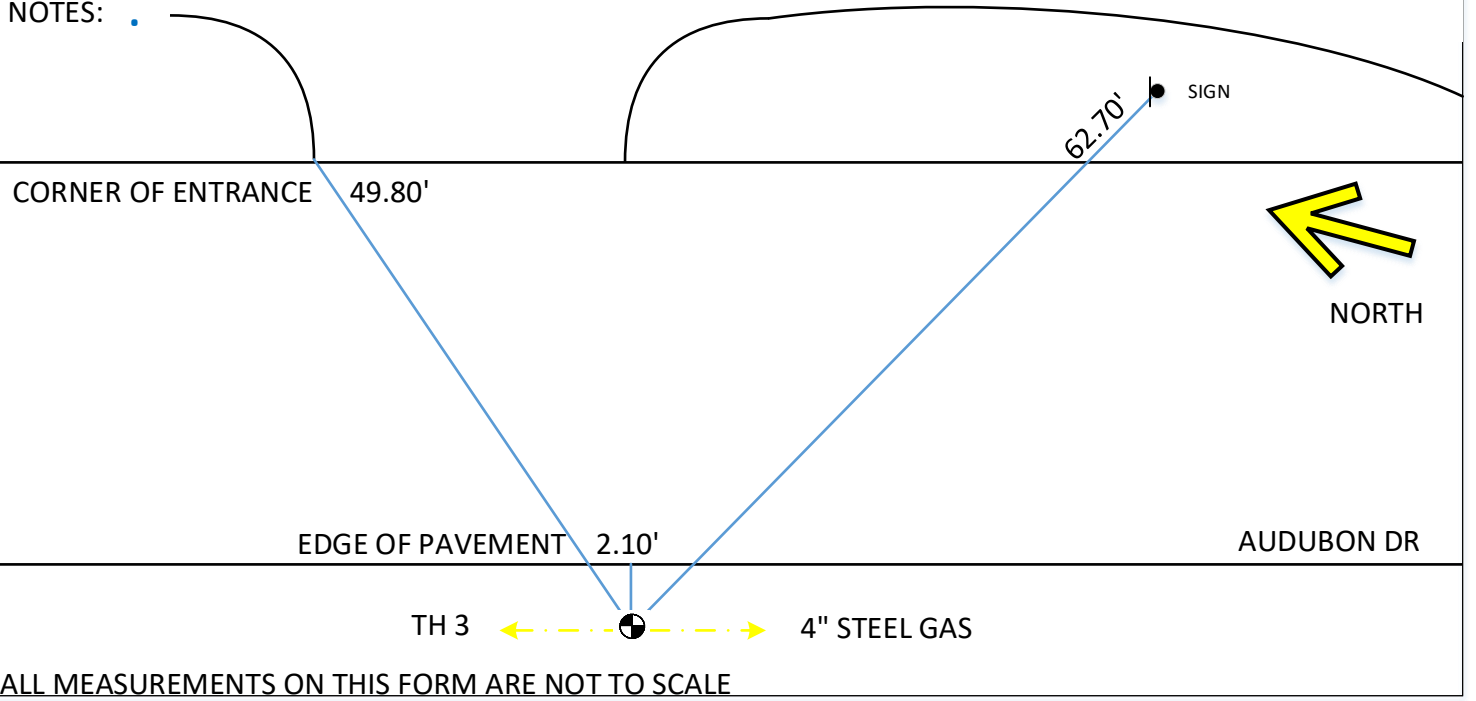
STATION: .

OFFSET: .

HORIZONTAL & VERTICAL CONTROL PROVIDED BY:

.

NOTES: .



ALL MEASUREMENTS ON THIS FORM ARE NOT TO SCALE

KCI ASSOCIATES OF NC
Engineers * Planners * Scientists * Construction Managers
4505 Falls of Neuse Rd, Suite 600
Raleigh, NC 27609-5210
Phone (919) 783-9214 * Fax (919) 783-9266

Client: **TIMMONS GROUP**

CLIENT JOB #: . KCI JOB #: .

TEST HOLE #: 4 DATE: 06.27.22

AREA LOCATION: **AUDUBON DR**

JURISDICTION: **DANVILLE, VA**

UTILITY REQUESTED: **WATER**

TEST HOLE DUG AT PROPOSED: **STORM INSTALLATION**

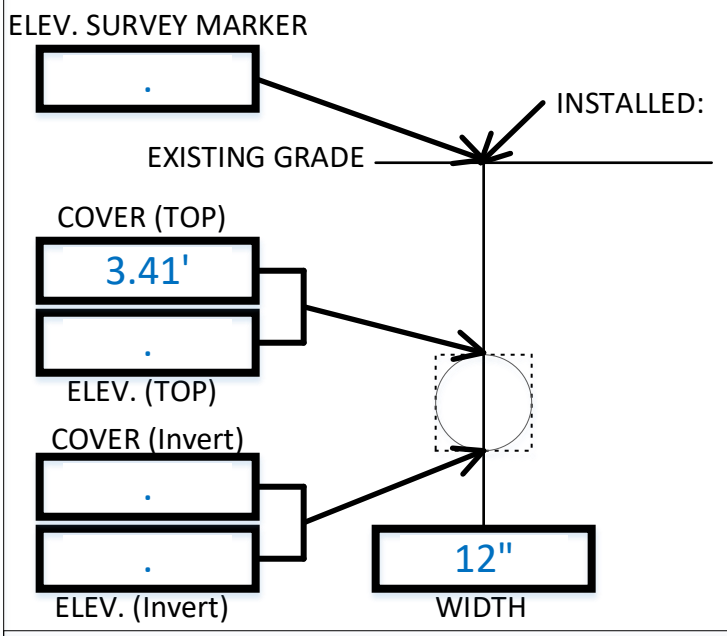
OUTSIDE DIAMETER & TYPE OF UTILITY FOUND

12" CAST IRON WATER MAIN

PAVING THICKNESS / CONDITION: **N/A**

SOIL CONDITIONS: **SANDY SOIL**

UTILITY CONDITION: **GOOD**



SURVEY MARKER LOCATED BY: .

TEST PIT SURVEY INFORMATION

NORTHING: .

EASTING: .

BASELINE: .

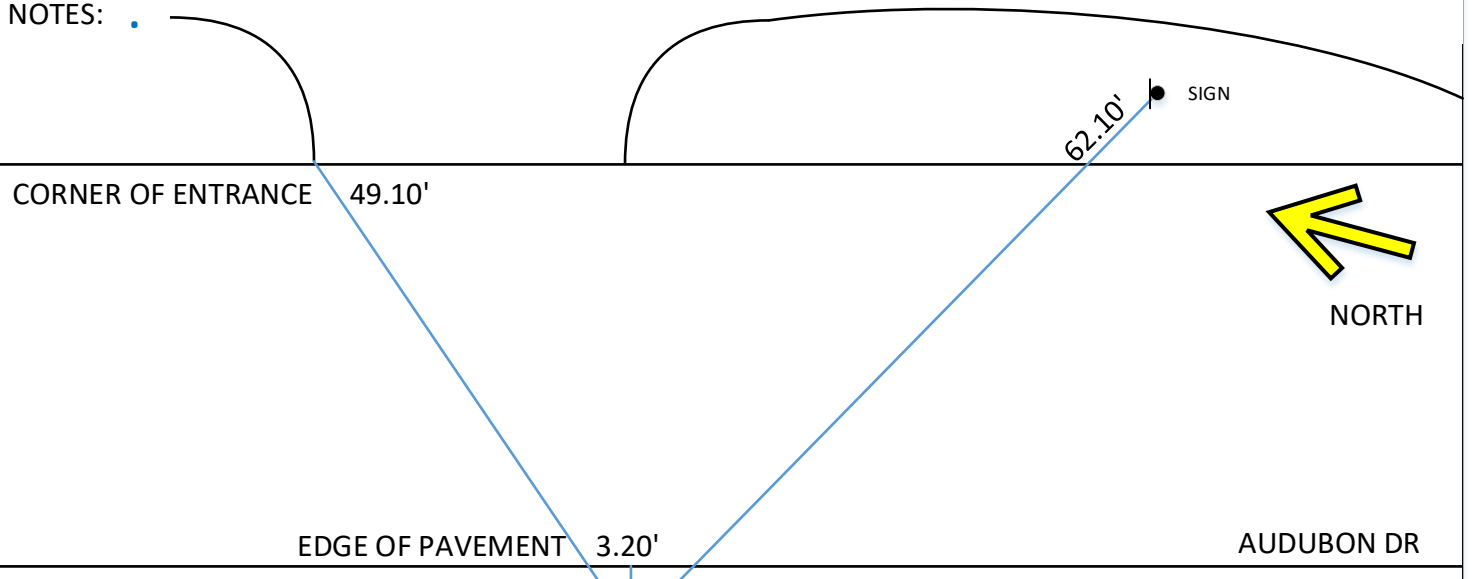
STATION: .

OFFSET: .

HORIZONTAL & VERTICAL CONTROL PROVIDED BY:

.

NOTES: .



ALL MEASUREMENTS ON THIS FORM ARE NOT TO SCALE

KCI ASSOCIATES OF NC
Engineers * Planners * Scientists * Construction Managers
4505 Falls of Neuse Rd, Suite 600
Raleigh, NC 27609-5210
Phone (919) 783-9214 * Fax (919) 783-9266

Client: **TIMMONS GROUP**

CLIENT JOB #: . KCI JOB #: .

TEST HOLE #: 5 DATE: 06.27.22

AREA LOCATION: AUDUBON DR

JURISDICTION: DANVILLE, VA

UTILITY REQUESTED: GAS

TEST HOLE DUG AT PROPOSED: STORM INSTALLATION

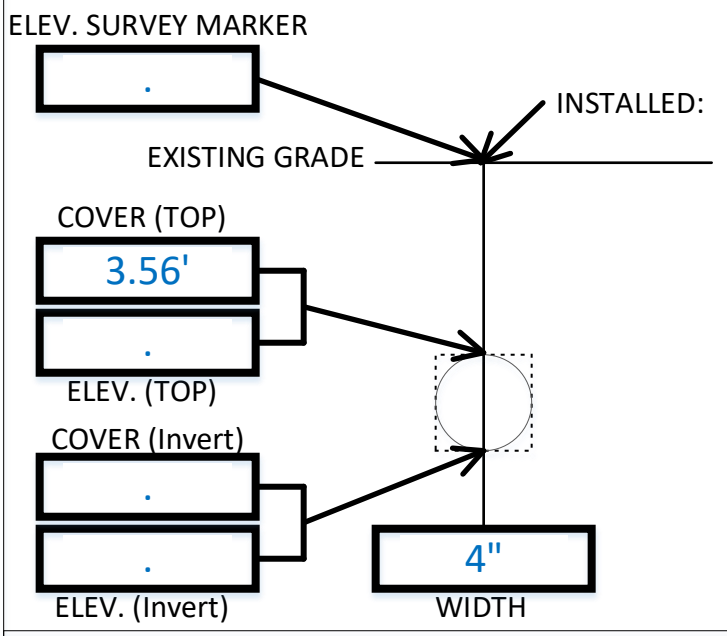
OUTSIDE DIAMETER & TYPE OF UTILITY FOUND

4" STEEL GAS MAIN

PAVING THICKNESS / CONDITION: 4" SOFT ASPHALT

SOIL CONDITIONS: SANDY SOIL

UTILITY CONDITION: GOOD



SURVEY MARKER LOCATED BY: .

TEST PIT SURVEY INFORMATION

NORTHING: .

EASTING: .

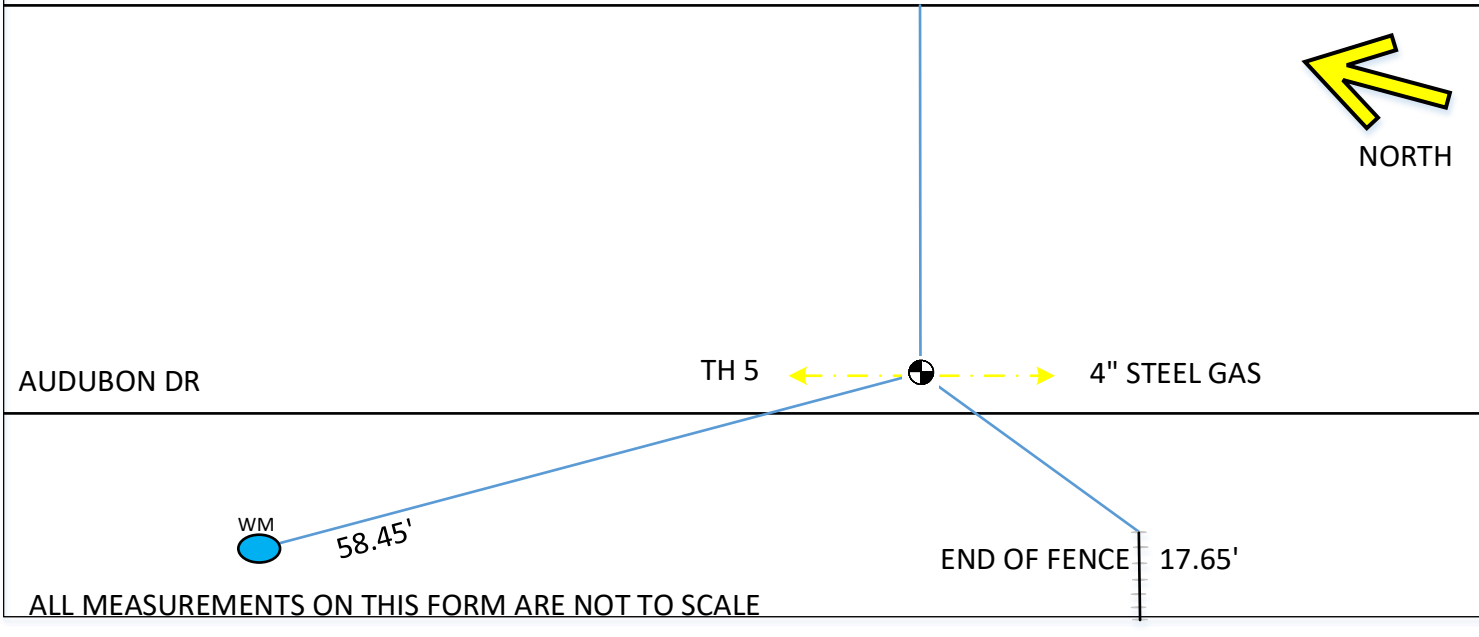
BASELINE: .

STATION: .

OFFSET: .

HORIZONTAL & VERTICAL CONTROL PROVIDED BY: .

NOTES: .



ALL MEASUREMENTS ON THIS FORM ARE NOT TO SCALE

KCI ASSOCIATES OF NC
Engineers * Planners * Scientists * Construction Managers
4505 Falls of Neuse Rd, Suite 600
Raleigh, NC 27609-5210
Phone (919) 783-9214 * Fax (919) 783-9266

Client: **TIMMONS GROUP**

CLIENT JOB #: . KCI JOB #: .

TEST HOLE #: 6 DATE: **06.27.22**

AREA LOCATION: **AUDUBON DR**

JURISDICTION: **DANVILLE, VA**

UTILITY REQUESTED: **WATER**

TEST HOLE DUG AT PROPOSED: **STORM INSTALLATION**

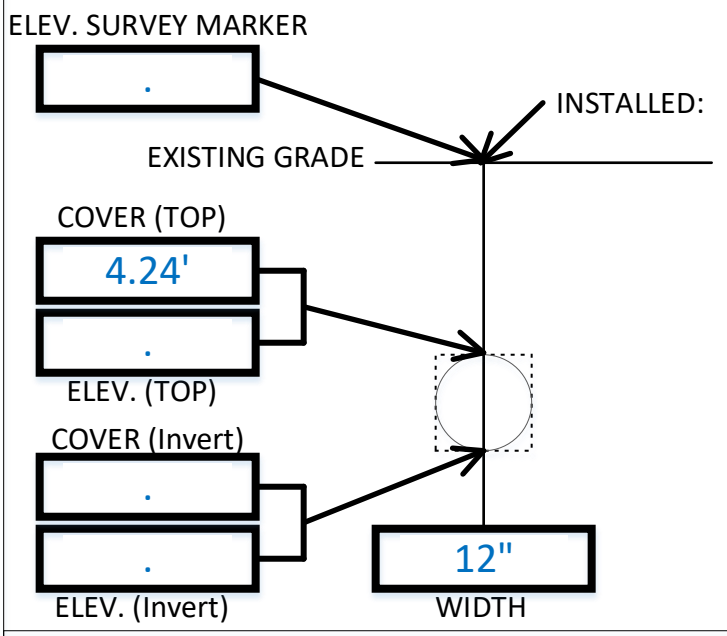
OUTSIDE DIAMETER & TYPE OF UTILITY FOUND

12" CAST IRON WATER MAIN

PAVING THICKNESS / CONDITION: **4" SOFT ASPHALT**

SOIL CONDITIONS: **SANDY SOIL**

UTILITY CONDITION: **GOOD**



SURVEY MARKER LOCATED BY: .

TEST PIT SURVEY INFORMATION

NORTHING: .

EASTING: .

BASELINE: .

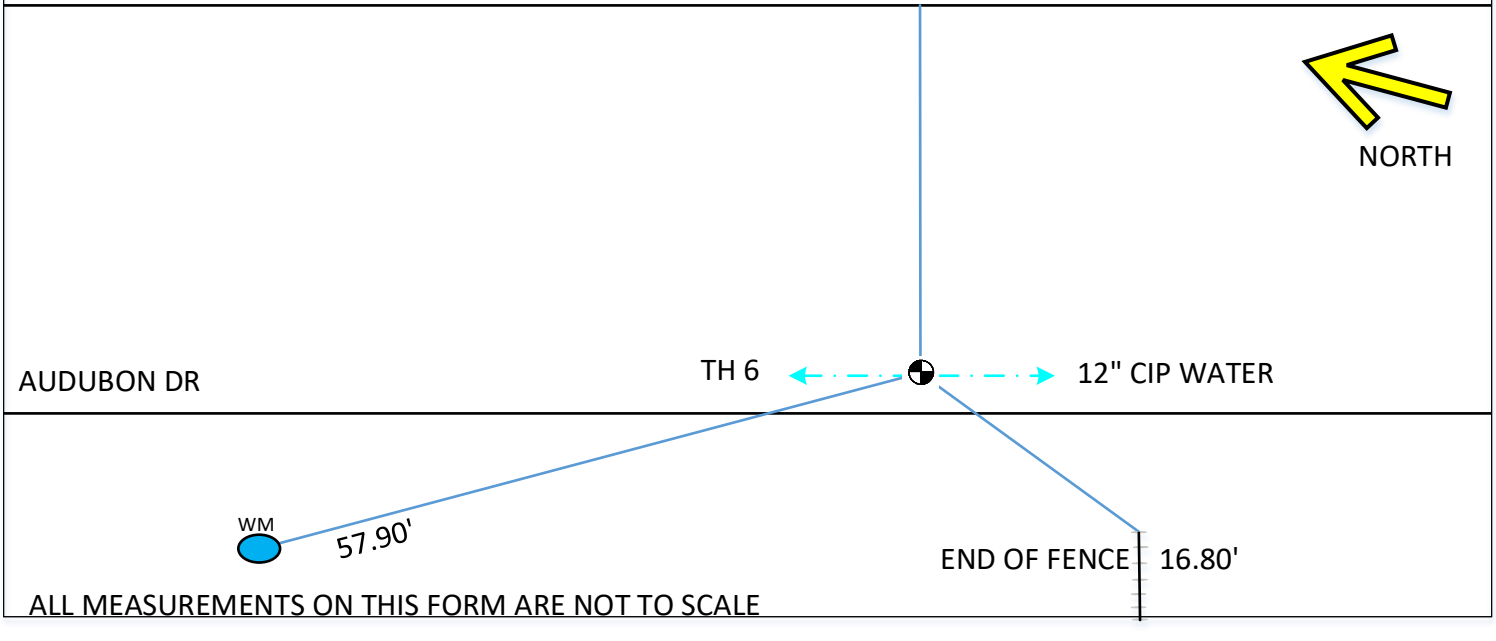
STATION: .

OFFSET: .

HORIZONTAL & VERTICAL CONTROL PROVIDED BY:

.

NOTES: .



ALL MEASUREMENTS ON THIS FORM ARE NOT TO SCALE

KCI ASSOCIATES OF NC
Engineers * Planners * Scientists * Construction Managers
4505 Falls of Neuse Rd, Suite 600
Raleigh, NC 27609-5210
Phone (919) 783-9214 * Fax (919) 783-9266

Client: **TIMMONS GROUP**

CLIENT JOB #: . KCI JOB #: .

TEST HOLE #: 7 DATE: 06.29.22

AREA LOCATION: **AUDUBON DR**

JURISDICTION: **DANVILLE, VA**

UTILITY REQUESTED: **GAS**

TEST HOLE DUG AT PROPOSED: **STORM INSTALLATION**

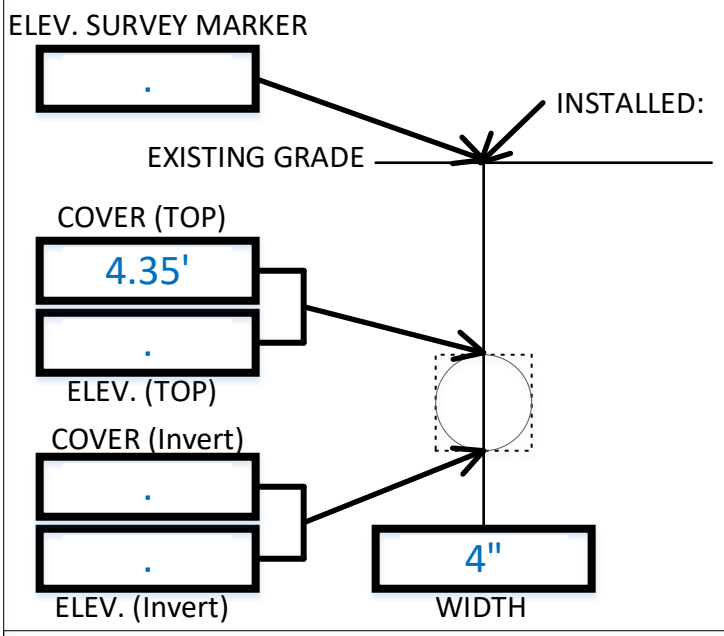
OUTSIDE DIAMETER & TYPE OF UTILITY FOUND

4" STEEL GAS MAIN

PAVING THICKNESS / CONDITION: **4" SOFT ASPHALT**

SOIL CONDITIONS: **SANDY SOIL**

UTILITY CONDITION: **GOOD**



SURVEY MARKER LOCATED BY: .

TEST PIT SURVEY INFORMATION

NORTHING: .

EASTING: .

BASELINE: .

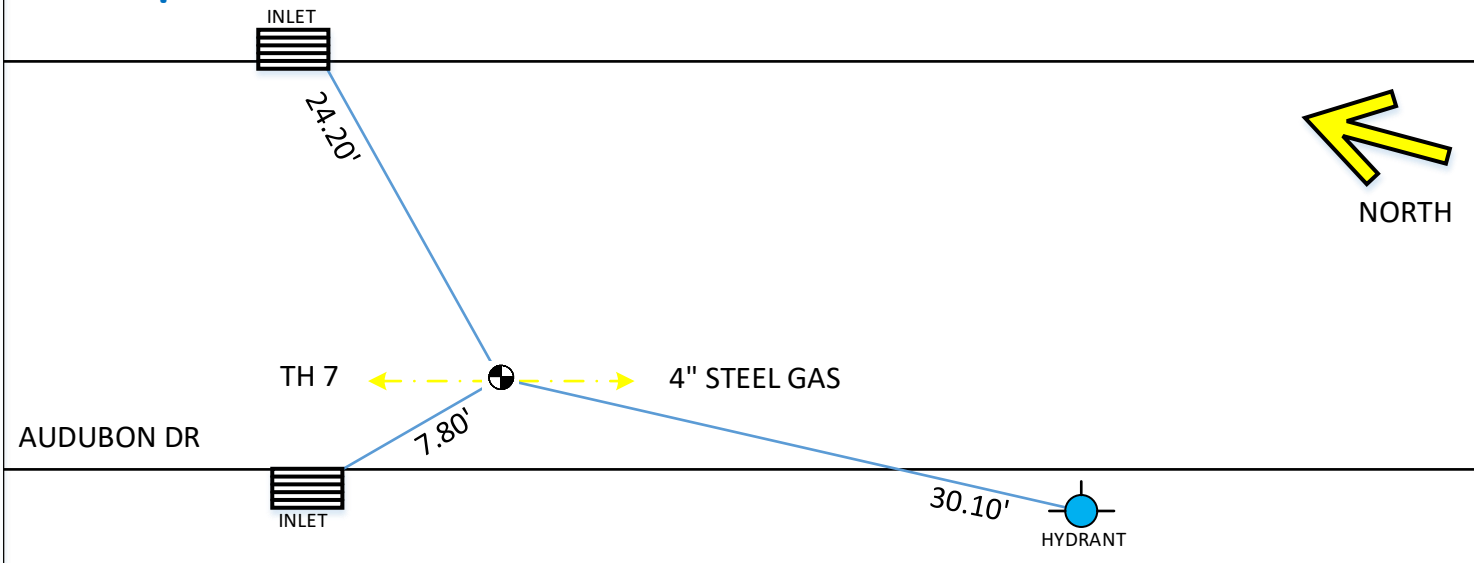
STATION: .

OFFSET: .

HORIZONTAL & VERTICAL CONTROL PROVIDED BY:

.

NOTES: .



ALL MEASUREMENTS ON THIS FORM ARE NOT TO SCALE

KCI ASSOCIATES OF NC
Engineers * Planners * Scientists * Construction Managers
4505 Falls of Neuse Rd, Suite 600
Raleigh, NC 27609-5210
Phone (919) 783-9214 * Fax (919) 783-9266

Client: **TIMMONS GROUP**

CLIENT JOB #: . KCI JOB #: .

TEST HOLE #: 8 DATE: 06.29.22

AREA LOCATION: **AUDUBON DR**

JURISDICTION: **DANVILLE, VA**

UTILITY REQUESTED: **WATER**

TEST HOLE DUG AT PROPOSED: **STORM INSTALLATION**

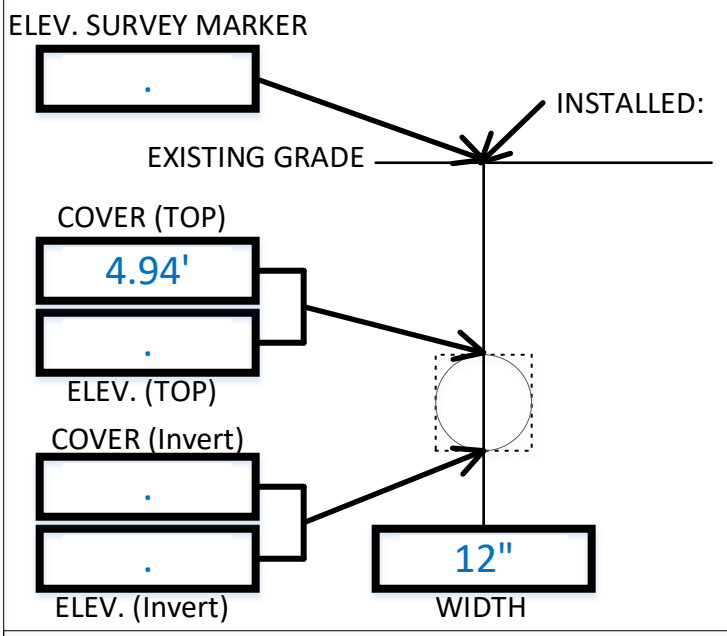
OUTSIDE DIAMETER & TYPE OF UTILITY FOUND

12" CAST IRON WATER MAIN

PAVING THICKNESS / CONDITION: **4" SOFT ASPHALT**

SOIL CONDITIONS: **SANDY SOIL**

UTILITY CONDITION: **GOOD**



SURVEY MARKER LOCATED BY: .

TEST PIT SURVEY INFORMATION

NORTHING: .

EASTING: .

BASELINE: .

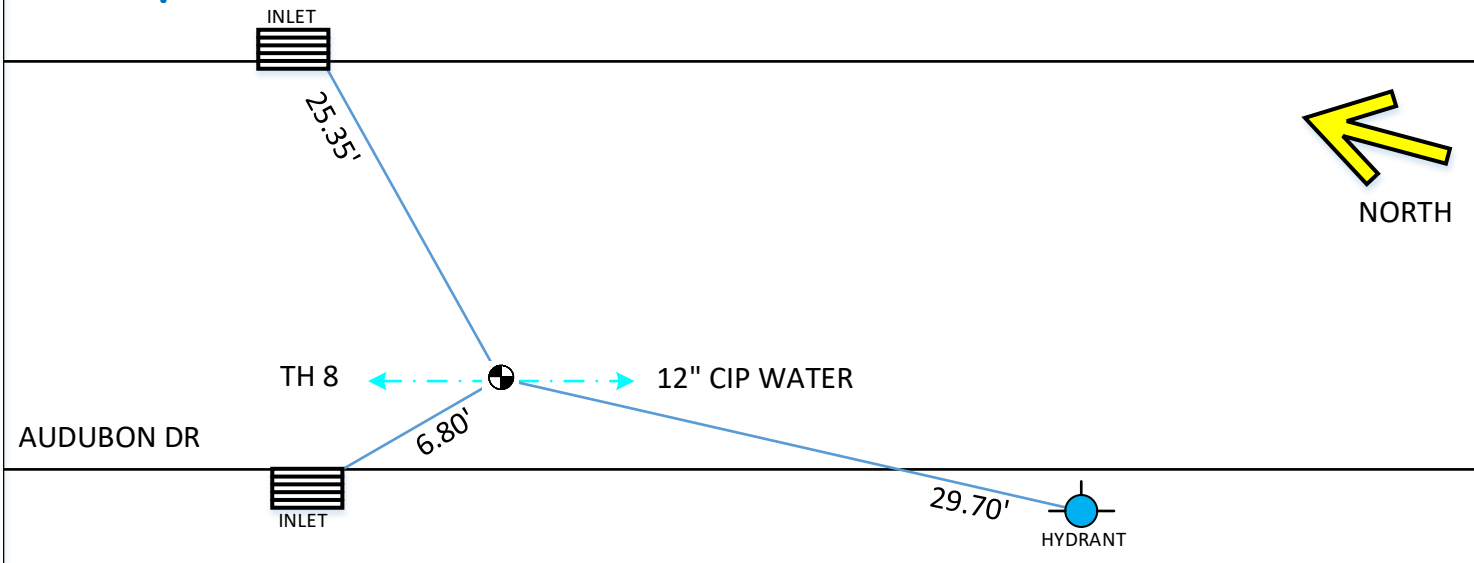
STATION: .

OFFSET: .

HORIZONTAL & VERTICAL CONTROL PROVIDED BY:

.

NOTES: .



ALL MEASUREMENTS ON THIS FORM ARE NOT TO SCALE

KCI ASSOCIATES OF NC
Engineers * Planners * Scientists * Construction Managers
4505 Falls of Neuse Rd, Suite 600
Raleigh, NC 27609-5210
Phone (919) 783-9214 * Fax (919) 783-9266

Client: **TIMMONS GROUP**

CLIENT JOB #: . KCI JOB #: .

TEST HOLE #: 9 DATE: 06.28.22

AREA LOCATION: RIVERSIDE DR

JURISDICTION: DANVILLE, VA

UTILITY REQUESTED: WATER

TEST HOLE DUG AT PROPOSED: STORM INSTALLATION

OUTSIDE DIAMETER & TYPE OF UTILITY FOUND

8" CAST IRON WATER MAIN

PAVING THICKNESS / CONDITION: 6" SOFT ASPHALT

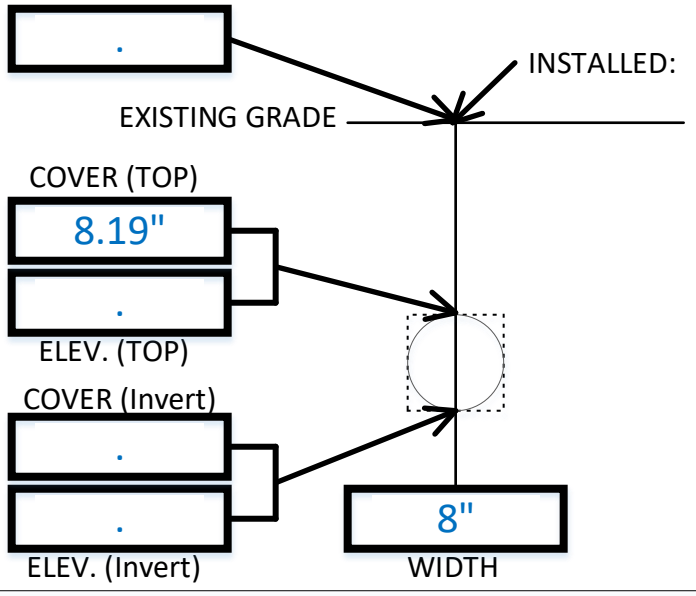
SOIL CONDITIONS: SANDY SOIL

UTILITY CONDITION: GOOD

ELEV. SURVEY MARKER

.

INSTALLED: PK AT EXISITING GRADE OF: ASPHALT



SURVEY MARKER LOCATED BY: .

TEST PIT SURVEY INFORMATION

NORTHING: .

EASTING: .

BASELINE: .

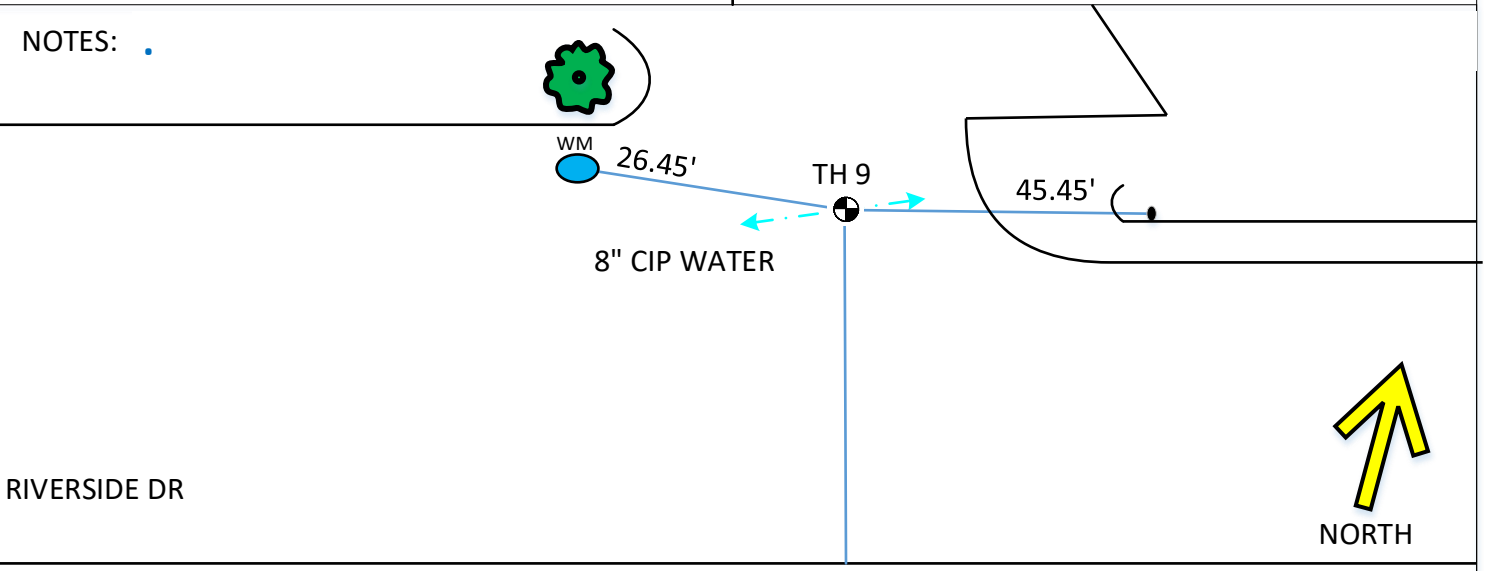
STATION: .

OFFSET: .

HORIZONTAL & VERTICAL CONTROL PROVIDED BY:

.

NOTES: .



ALL MEASUREMENTS ON THIS FORM ARE NOT TO SCALE

KCI ASSOCIATES OF NC
Engineers * Planners * Scientists * Construction Managers
4505 Falls of Neuse Rd, Suite 600
Raleigh, NC 27609-5210
Phone (919) 783-9214 * Fax (919) 783-9266

Client: **TIMMONS GROUP**

CLIENT JOB #: . KCI JOB #: .

TEST HOLE #: 10 DATE: **06.28.22**

AREA LOCATION: **RIVERSIDE DR**

JURISDICTION: **DANVILLE, VA**

UTILITY REQUESTED: **FIBER**

TEST HOLE DUG AT PROPOSED: **STORM INSTALLATION**

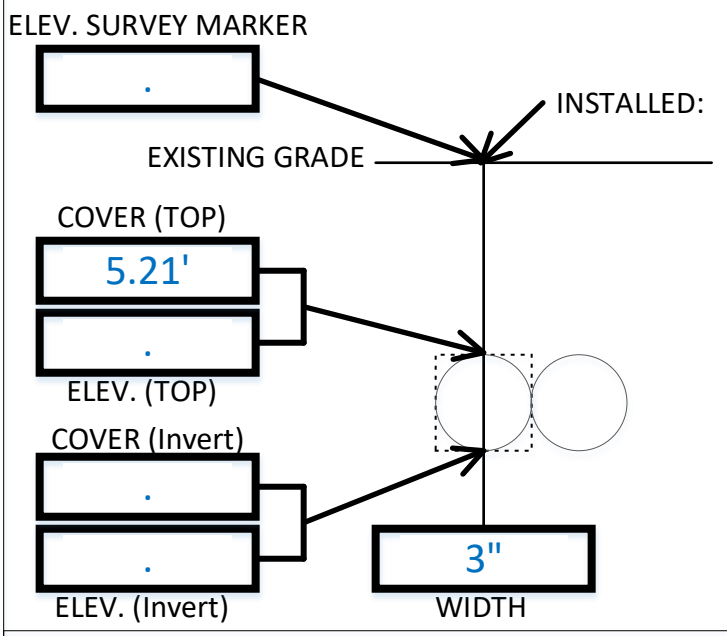
OUTSIDE DIAMETER & TYPE OF UTILITY FOUND

2 X 1½" HDPE CONDUITS

PAVING THICKNESS / CONDITION: **N/A**

SOIL CONDITIONS: **SANDY SOIL**

UTILITY CONDITION: **GOOD**



SURVEY MARKER LOCATED BY: .

TEST PIT SURVEY INFORMATION

NORTHING: .

EASTING: .

BASELINE: .

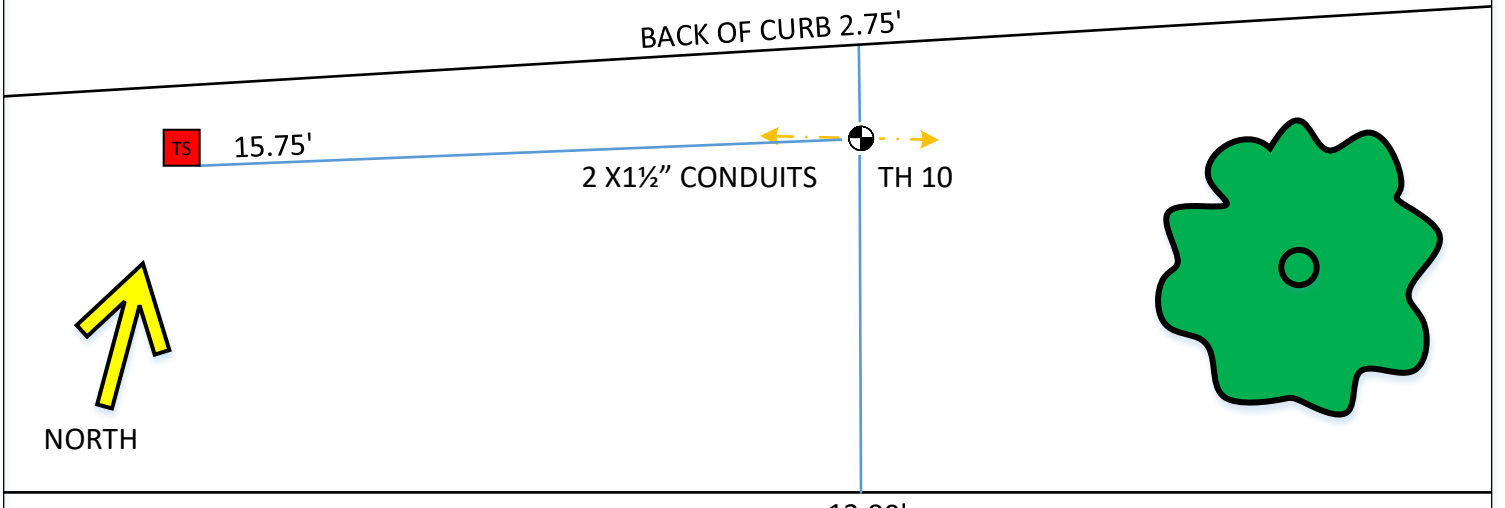
STATION: .

OFFSET: .

HORIZONTAL & VERTICAL CONTROL PROVIDED BY:

.

NOTES: .



ALL MEASUREMENTS ON THIS FORM ARE NOT TO SCALE

KCI ASSOCIATES OF NC
Engineers * Planners * Scientists * Construction Managers
4505 Falls of Neuse Rd, Suite 600
Raleigh, NC 27609-5210
Phone (919) 783-9214 * Fax (919) 783-9266

Client: **TIMMONS GROUP**

CLIENT JOB #: . KCI JOB #: .

TEST HOLE #: 11 DATE: 06.28.22

AREA LOCATION: **RIVERSIDE DR**

JURISDICTION: **DANVILLE, VA**

UTILITY REQUESTED: **GAS**

TEST HOLE DUG AT PROPOSED: **STORM INSTALLATION**

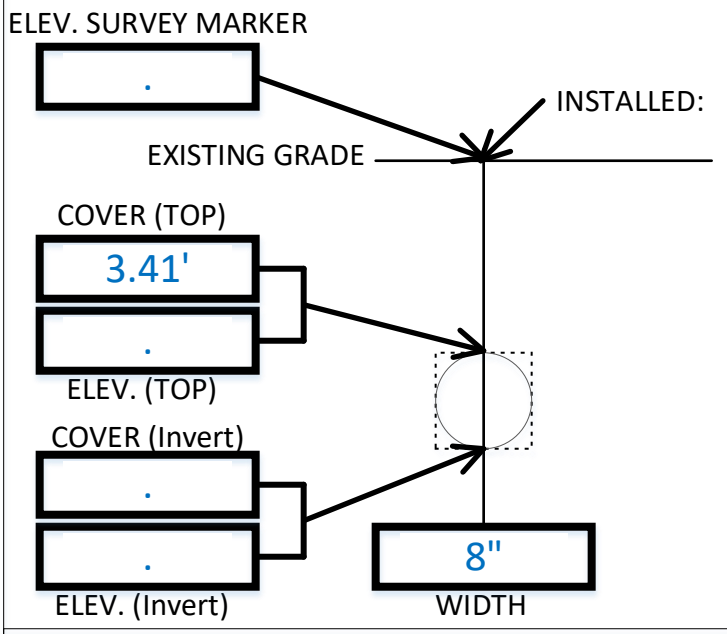
OUTSIDE DIAMETER & TYPE OF UTILITY FOUND

8" WRAPPED STEEL GAS MAIN

PAVING THICKNESS / CONDITION: **N/A**

SOIL CONDITIONS: **SANDY SOIL**

UTILITY CONDITION: **GOOD**



SURVEY MARKER LOCATED BY: .

TEST PIT SURVEY INFORMATION

NORTHING: .

EASTING: .

BASELINE: .

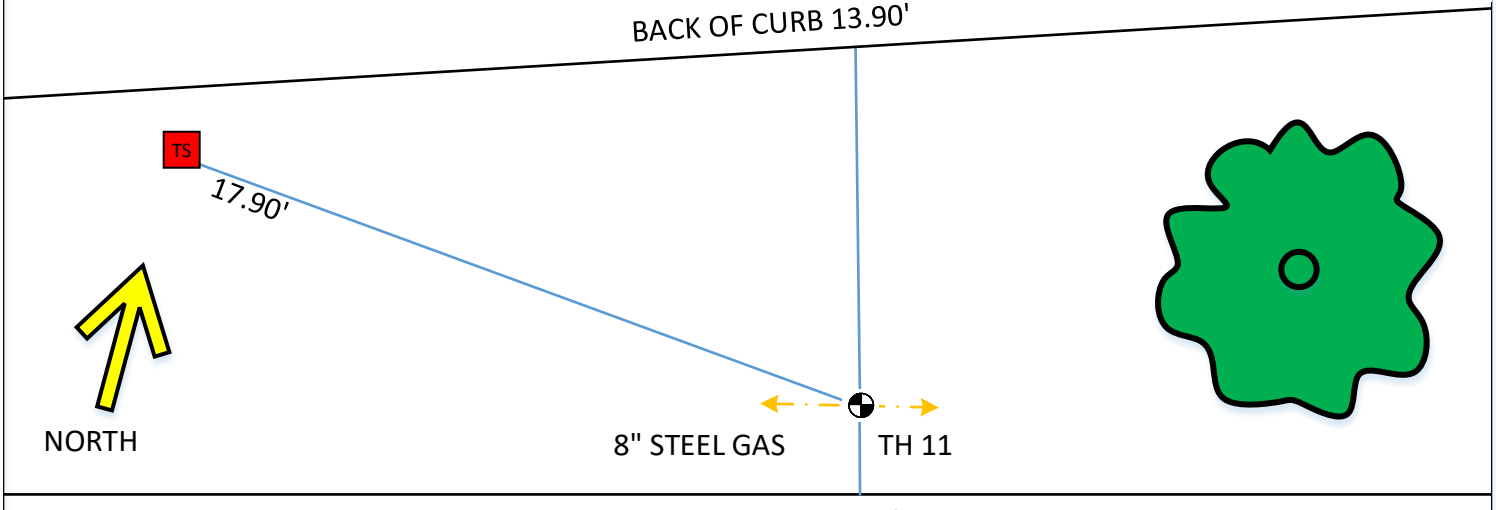
STATION: .

OFFSET: .

HORIZONTAL & VERTICAL CONTROL PROVIDED BY:

.

NOTES: .



ALL MEASUREMENTS ON THIS FORM ARE NOT TO SCALE

KCI ASSOCIATES OF NC
Engineers * Planners * Scientists * Construction Managers
4505 Falls of Neuse Rd, Suite 600
Raleigh, NC 27609-5210
Phone (919) 783-9214 * Fax (919) 783-9266

Client: **TIMMONS GROUP**

CLIENT JOB #: . KCI JOB #: .

TEST HOLE #: 12 DATE: 06.28.22

AREA LOCATION: **RIVERSIDE DR**

JURISDICTION: **DANVILLE, VA**

UTILITY REQUESTED: **FIBER**

TEST HOLE DUG AT PROPOSED: **STORM INSTALLATION**

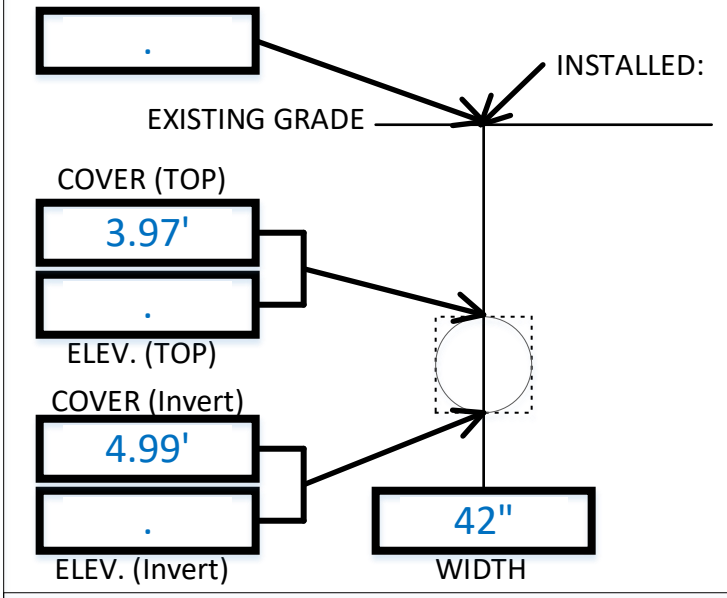
OUTSIDE DIAMETER & TYPE OF UTILITY FOUND

42" CONCRETE DUCTBANK

PAVING THICKNESS / CONDITION: **8" GOOD CONCRETE**

SOIL CONDITIONS: **SANDY SOIL**

UTILITY CONDITION: **GOOD**



AT EXISITING GRADE OF: **CONCRETE**

SURVEY MARKER LOCATED BY: .

TEST PIT SURVEY INFORMATION

NORTHING: .

EASTING: .

BASELINE: .

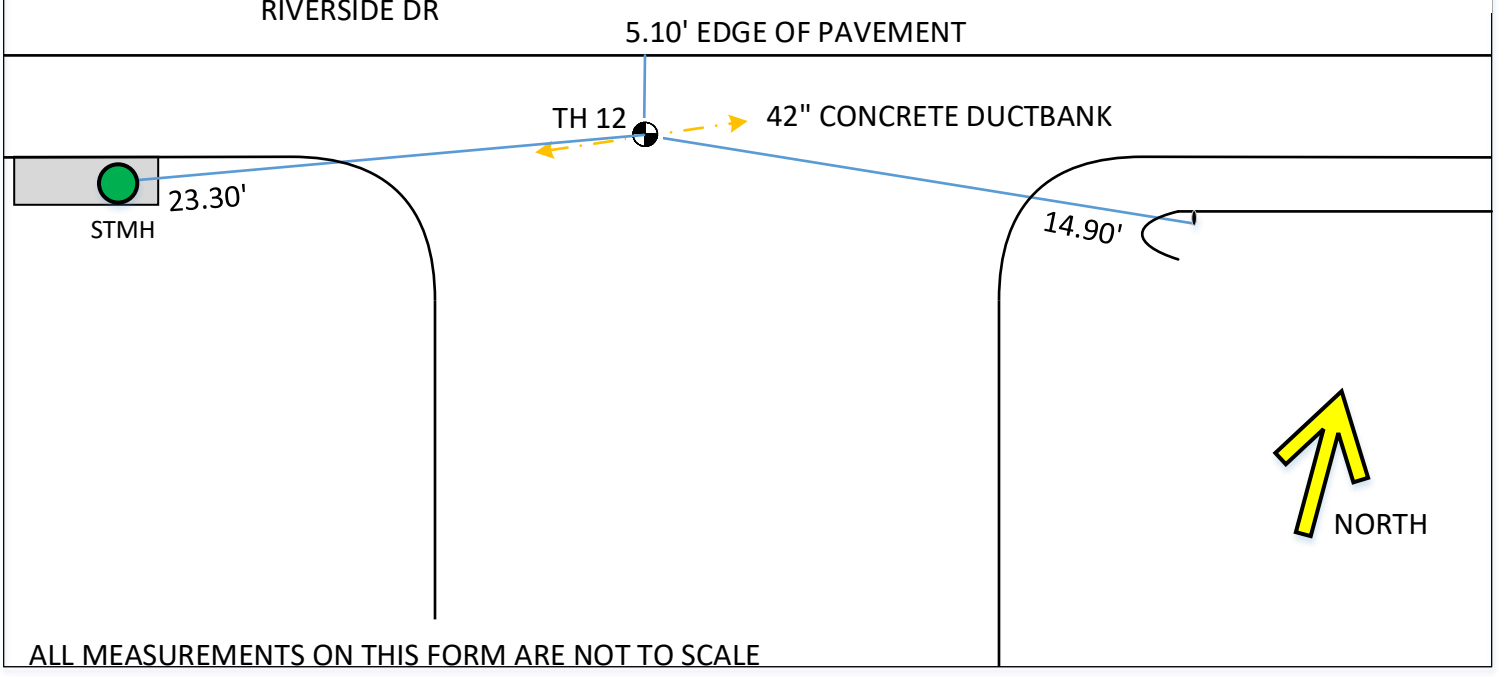
STATION: .

OFFSET: .

HORIZONTAL & VERTICAL CONTROL PROVIDED BY:

.

NOTES: .



ALL MEASUREMENTS ON THIS FORM ARE NOT TO SCALE

KCI ASSOCIATES OF NC
Engineers * Planners * Scientists * Construction Managers
4505 Falls of Neuse Rd, Suite 600
Raleigh, NC 27609-5210
Phone (919) 783-9214 * Fax (919) 783-9266

Client: **TIMMONS GROUP**

CLIENT JOB #: . KCI JOB #: .

TEST HOLE #: 13 DATE: 06.29.22

AREA LOCATION: **AUDUBON DR**

JURISDICTION: **DANVILLE, VA**

UTILITY REQUESTED: **GAS**

TEST HOLE DUG AT PROPOSED: **STORM INSTALLATION**

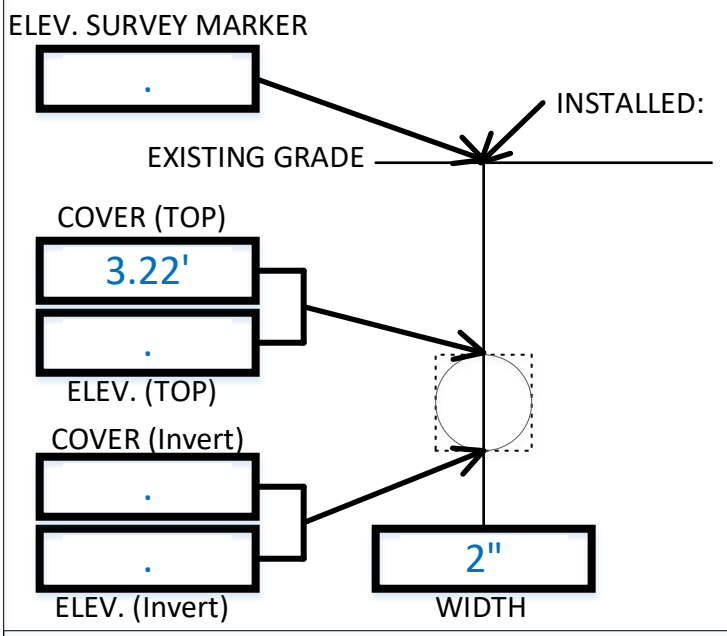
OUTSIDE DIAMETER & TYPE OF UTILITY FOUND

2" PLASTIC GAS

PAVING THICKNESS / CONDITION: **N/A**

SOIL CONDITIONS: **SANDY SOIL**

UTILITY CONDITION: **GOOD**



SURVEY MARKER LOCATED BY: .

TEST PIT SURVEY INFORMATION

NORTHING: .

EASTING: .

BASELINE: .

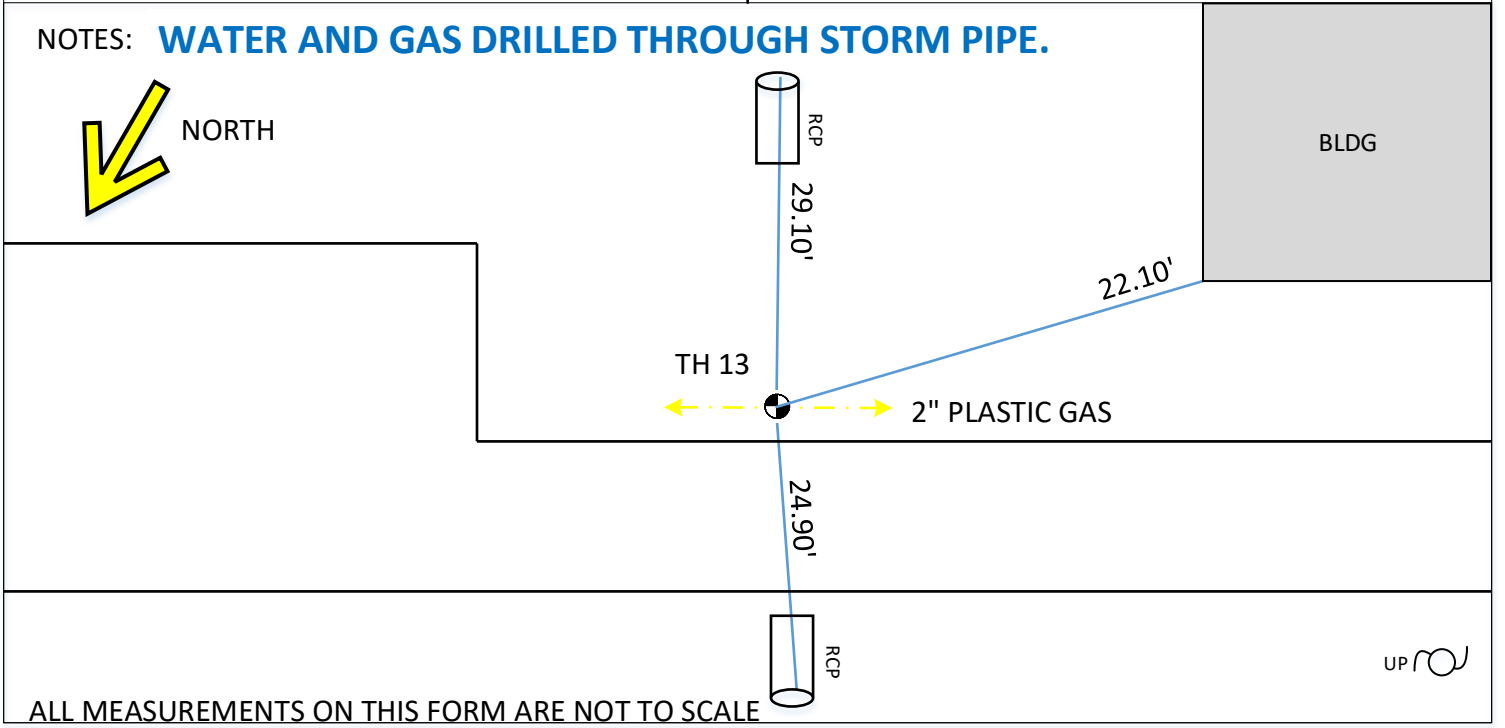
STATION: .

OFFSET: .

HORIZONTAL & VERTICAL CONTROL PROVIDED BY:

.

NOTES: **WATER AND GAS DRILLED THROUGH STORM PIPE.**



ALL MEASUREMENTS ON THIS FORM ARE NOT TO SCALE

KCI ASSOCIATES OF NC
Engineers * Planners * Scientists * Construction Managers
4505 Falls of Neuse Rd, Suite 600
Raleigh, NC 27609-5210
Phone (919) 783-9214 * Fax (919) 783-9266

Client: **TIMMONS GROUP**

CLIENT JOB #: . KCI JOB #: .

TEST HOLE #: 14 DATE: 06.29.22

AREA LOCATION: RIVERSIDE DR

JURISDICTION: DANVILLE, VA

UTILITY REQUESTED: FIBER

TEST HOLE DUG AT PROPOSED: STORM INSTALLATION

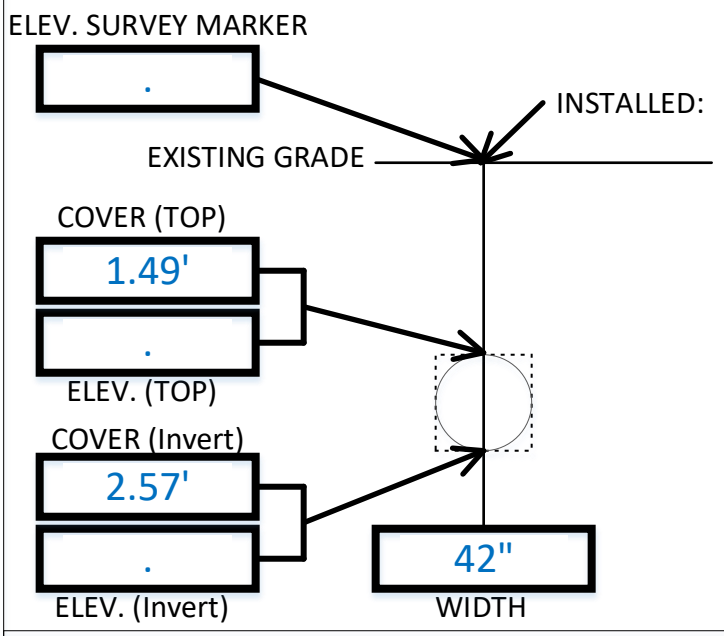
OUTSIDE DIAMETER & TYPE OF UTILITY FOUND

46" CONCRETE DUCTBANK

PAVING THICKNESS / CONDITION: N/A

SOIL CONDITIONS: SANDY SOIL

UTILITY CONDITION: GOOD



SURVEY MARKER LOCATED BY: .

TEST PIT SURVEY INFORMATION

NORTHING: .

EASTING: .

BASELINE: .

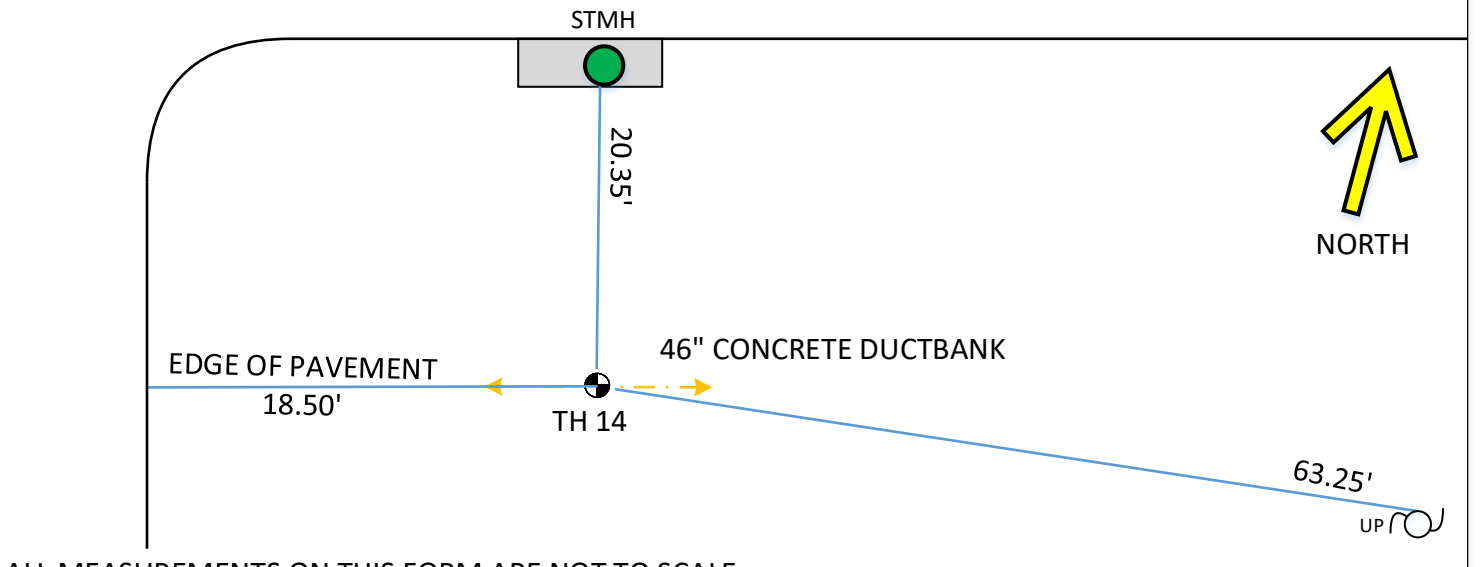
STATION: .

OFFSET: .

HORIZONTAL & VERTICAL CONTROL PROVIDED BY:

.

NOTES: .



ALL MEASUREMENTS ON THIS FORM ARE NOT TO SCALE

KCI ASSOCIATES OF NC
Engineers * Planners * Scientists * Construction Managers
4505 Falls of Neuse Rd, Suite 600
Raleigh, NC 27609-5210
Phone (919) 783-9214 * Fax (919) 783-9266

Client: **TIMMONS GROUP**

CLIENT JOB #: . KCI JOB #: .

TEST HOLE #: 15 DATE: **06.30.22**

AREA LOCATION: **ARNETT BLVD AND RIVERSIDE DR**

JURISDICTION: **DANVILLE, VA**

UTILITY REQUESTED: **FIBER**

TEST HOLE DUG AT PROPOSED: **STORM INSTALLATION**

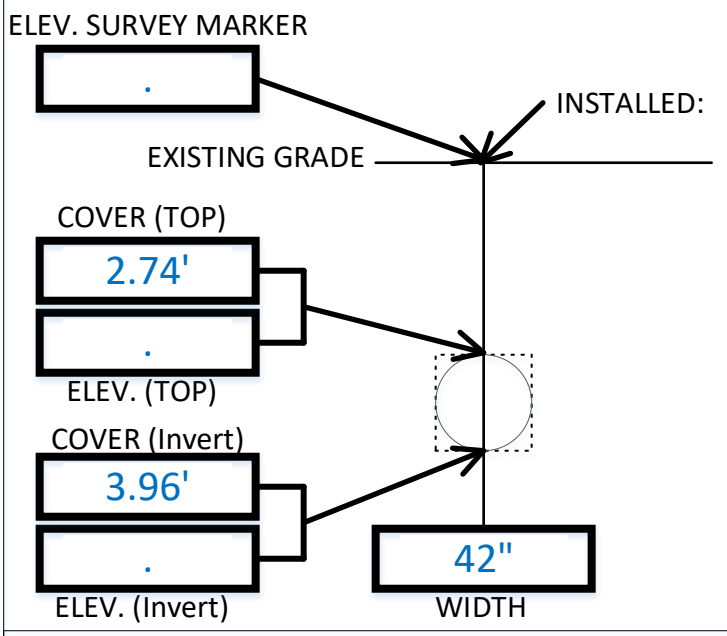
OUTSIDE DIAMETER & TYPE OF UTILITY FOUND

42" CONCRETE DUCTBANK

PAVING THICKNESS / CONDITION: **N/A**

SOIL CONDITIONS: **SANDY SOIL**

UTILITY CONDITION: **GOOD**



SURVEY MARKER LOCATED BY: .

TEST PIT SURVEY INFORMATION

NORTHING: .

EASTING: .

BASELINE: .

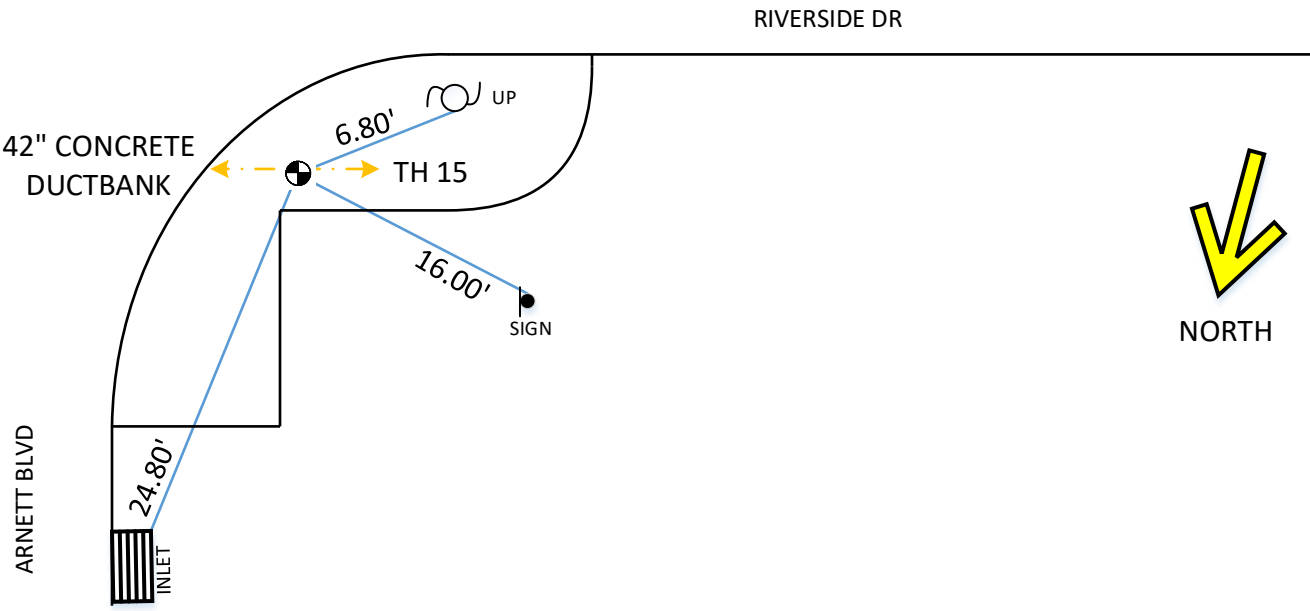
STATION: .

OFFSET: .

HORIZONTAL & VERTICAL CONTROL PROVIDED BY:

.

NOTES: .



ALL MEASUREMENTS ON THIS FORM ARE NOT TO SCALE

KCI ASSOCIATES OF NC
Engineers * Planners * Scientists * Construction Managers
4505 Falls of Neuse Rd, Suite 600
Raleigh, NC 27609-5210
Phone (919) 783-9214 * Fax (919) 783-9266

Client: **TIMMONS GROUP**

CLIENT JOB #: . KCI JOB #: .

TEST HOLE #: 16 DATE: **06.29.22**

AREA LOCATION: **ARNETT BLVD AND HAMPTON DR**

JURISDICTION: **DANVILLE, VA**

UTILITY REQUESTED: **GAS**

TEST HOLE DUG AT PROPOSED: **STORM INSTALLATION**

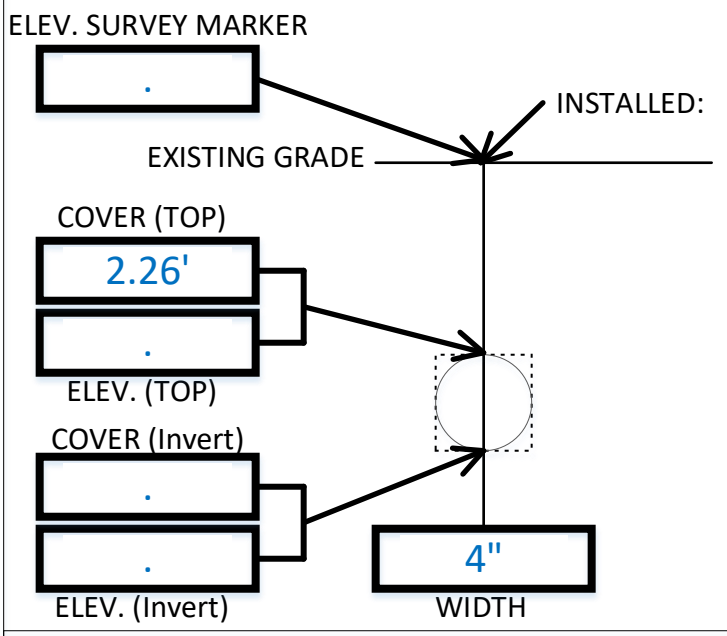
OUTSIDE DIAMETER & TYPE OF UTILITY FOUND

4" PLASTIC GAS

PAVING THICKNESS / CONDITION: **6" SOFT ASPHALT**

SOIL CONDITIONS: **SANDY SOIL**

UTILITY CONDITION: **GOOD**



SURVEY MARKER LOCATED BY: .

TEST PIT SURVEY INFORMATION

NORTHING: .

EASTING: .

BASELINE: .

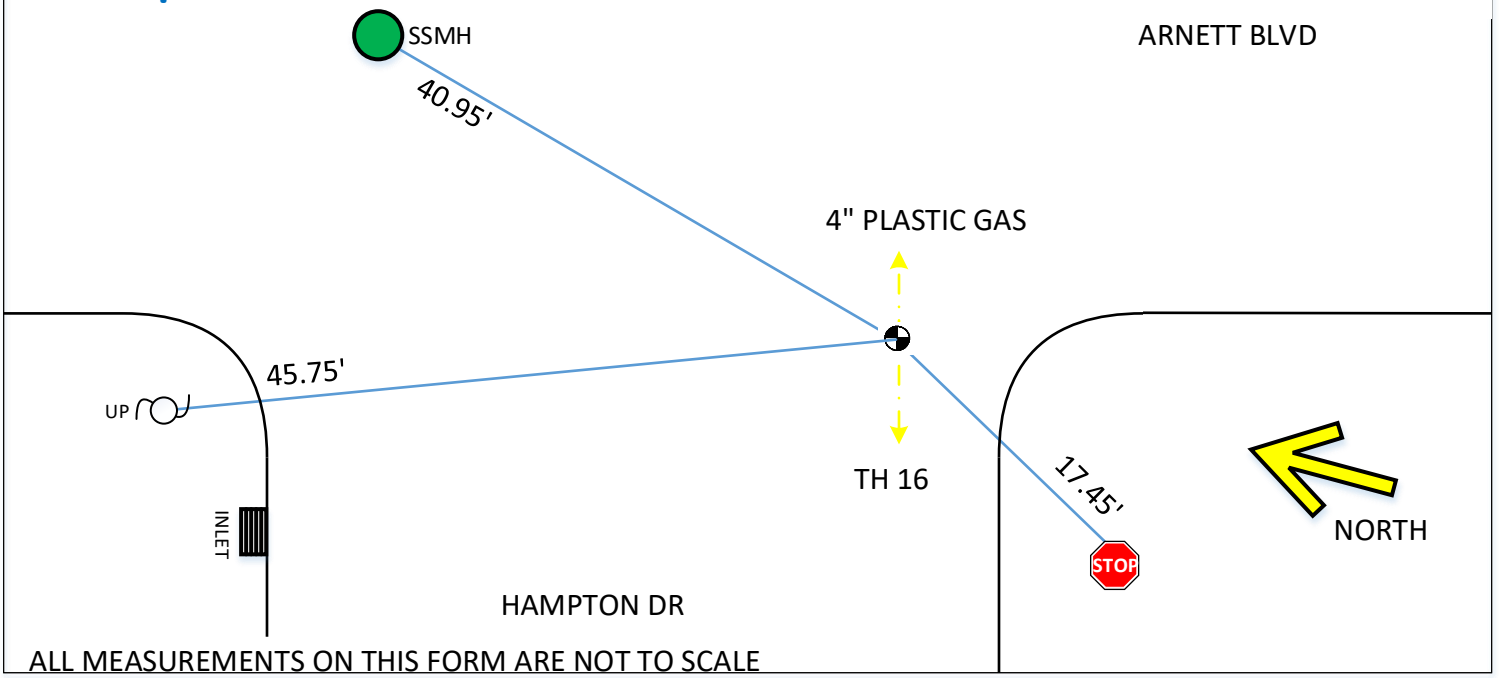
STATION: .

OFFSET: .

HORIZONTAL & VERTICAL CONTROL PROVIDED BY:

.

NOTES: .



ALL MEASUREMENTS ON THIS FORM ARE NOT TO SCALE

KCI ASSOCIATES OF NC
Engineers * Planners * Scientists * Construction Managers
4505 Falls of Neuse Rd, Suite 600
Raleigh, NC 27609-5210
Phone (919) 783-9214 * Fax (919) 783-9266

Client: **TIMMONS GROUP**

CLIENT JOB #: . KCI JOB #: .

TEST HOLE #: 17 DATE: 06.29.22

AREA LOCATION: ARNETT BLVD AND HAMPTON DR

JURISDICTION: DANVILLE, VA

UTILITY REQUESTED: WATER

TEST HOLE DUG AT PROPOSED: STORM INSTALLATION

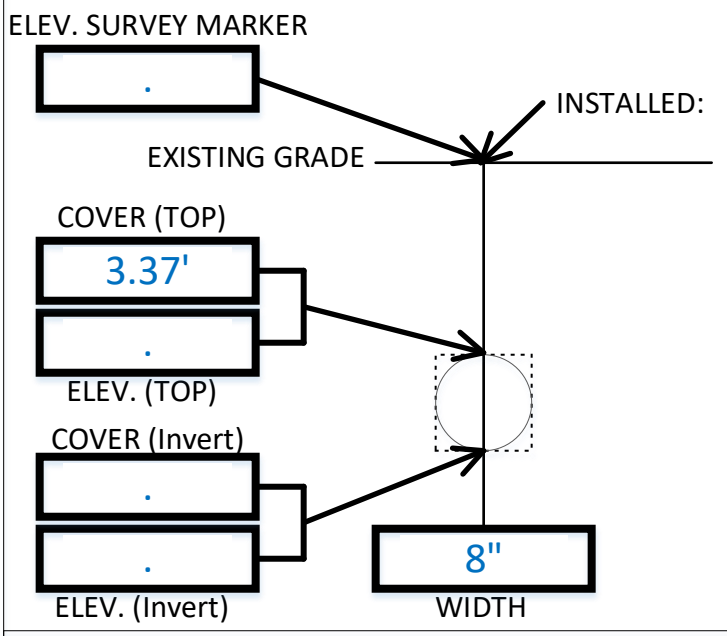
OUTSIDE DIAMETER & TYPE OF UTILITY FOUND

8" PVC WATER MAIN

PAVING THICKNESS / CONDITION: 6" SOFT ASPHALT

SOIL CONDITIONS: SANDY SOIL

UTILITY CONDITION: GOOD



SURVEY MARKER LOCATED BY: .

TEST PIT SURVEY INFORMATION

NORTHING: .

EASTING: .

BASELINE: .

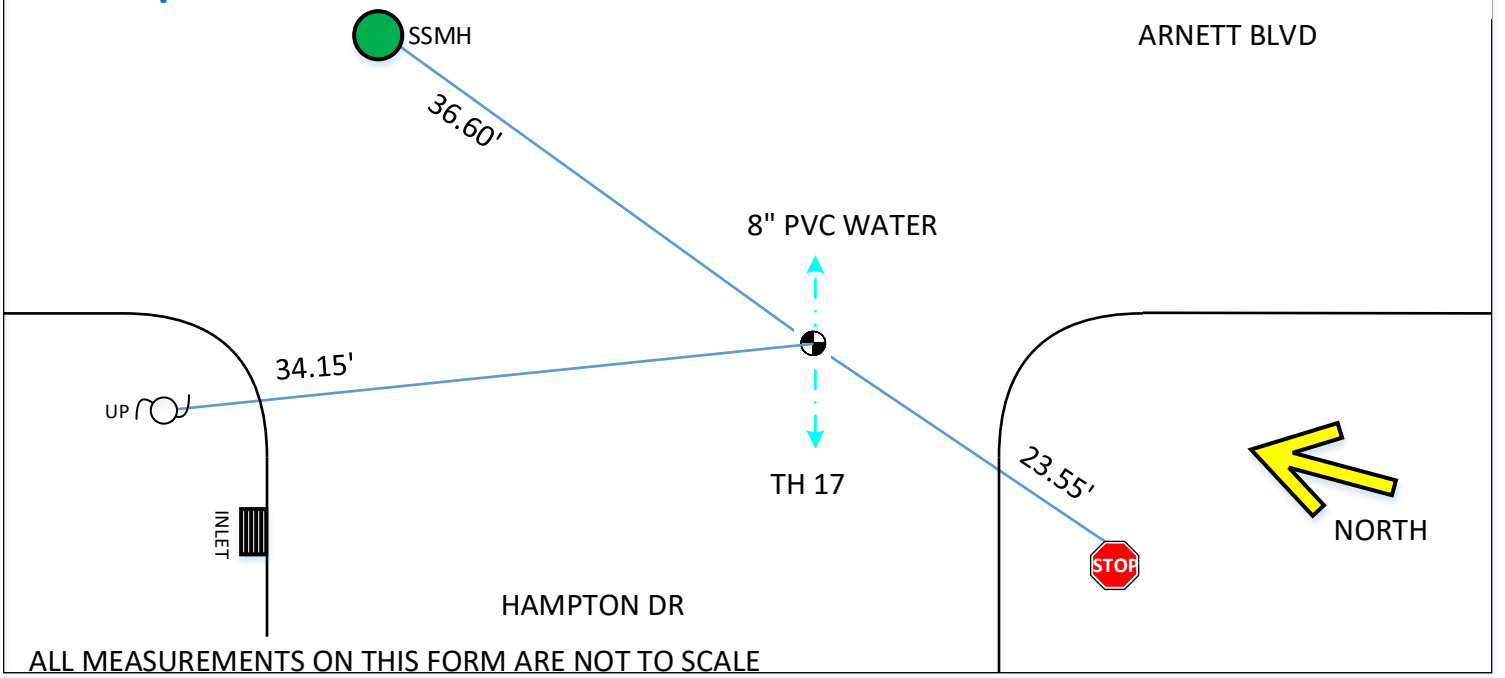
STATION: .

OFFSET: .

HORIZONTAL & VERTICAL CONTROL PROVIDED BY:

.

NOTES: .



ALL MEASUREMENTS ON THIS FORM ARE NOT TO SCALE

KCI ASSOCIATES OF NC
Engineers * Planners * Scientists * Construction Managers
4505 Falls of Neuse Rd, Suite 600
Raleigh, NC 27609-5210
Phone (919) 783-9214 * Fax (919) 783-9266

Client: **TIMMONS GROUP**

CLIENT JOB #: . KCI JOB #: .

TEST HOLE #: 18 DATE: 06.30.22

AREA LOCATION: ARNETT BLVD AND RIVERSIDE DR

JURISDICTION: DANVILLE, VA

UTILITY REQUESTED: WATER

TEST HOLE DUG AT PROPOSED: STORM INSTALLATION

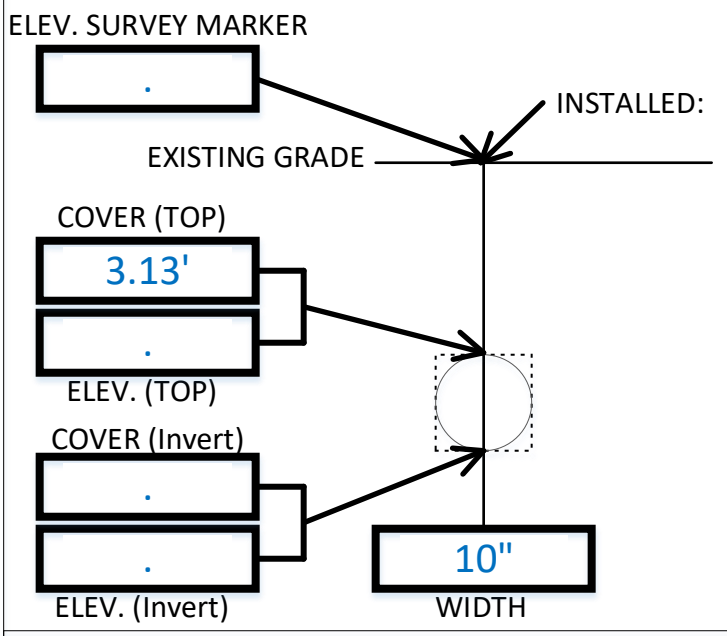
OUTSIDE DIAMETER & TYPE OF UTILITY FOUND

10" CAST IRON WATER MAIN

PAVING THICKNESS / CONDITION: N/A

SOIL CONDITIONS: SANDY SOIL

UTILITY CONDITION: GOOD



SURVEY MARKER LOCATED BY: .

TEST PIT SURVEY INFORMATION

NORTHING: .

EASTING: .

BASELINE: .

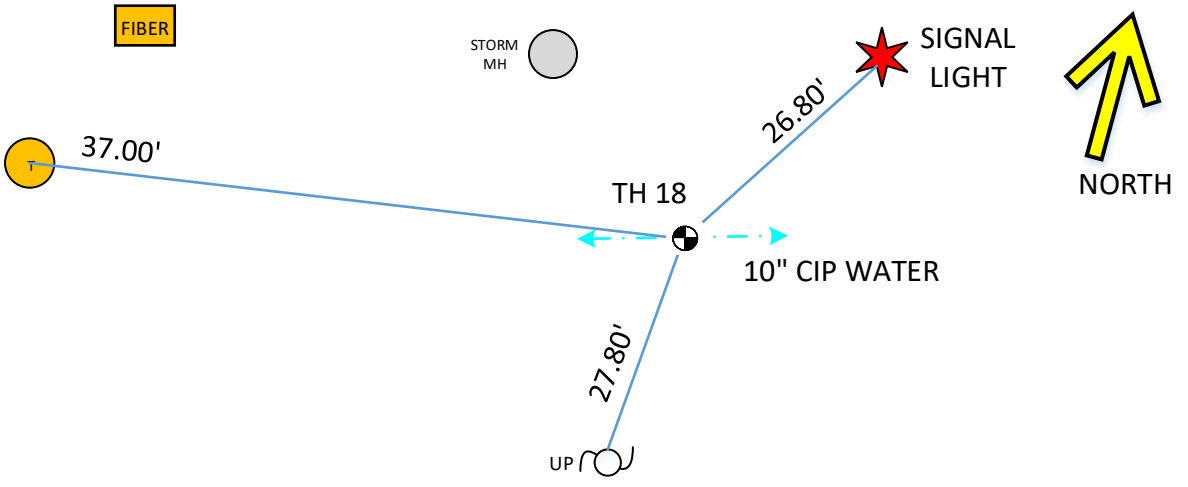
STATION: .

OFFSET: .

HORIZONTAL & VERTICAL CONTROL PROVIDED BY: .

NOTES: .

RIVERSIDE DR



ALL MEASUREMENTS ON THIS FORM ARE NOT TO SCALE

KCI ASSOCIATES OF NC
Engineers * Planners * Scientists * Construction Managers
4505 Falls of Neuse Rd, Suite 600
Raleigh, NC 27609-5210
Phone (919) 783-9214 * Fax (919) 783-9266

Client: **TIMMONS GROUP**

CLIENT JOB #: . KCI JOB #: .

TEST HOLE #: 19 DATE: 06.30.22

AREA LOCATION: ARNETT BLVD AND RIVERSIDE DR

JURISDICTION: DANVILLE, VA

UTILITY REQUESTED: FIBER

TEST HOLE DUG AT PROPOSED: STORM INSTALLATION

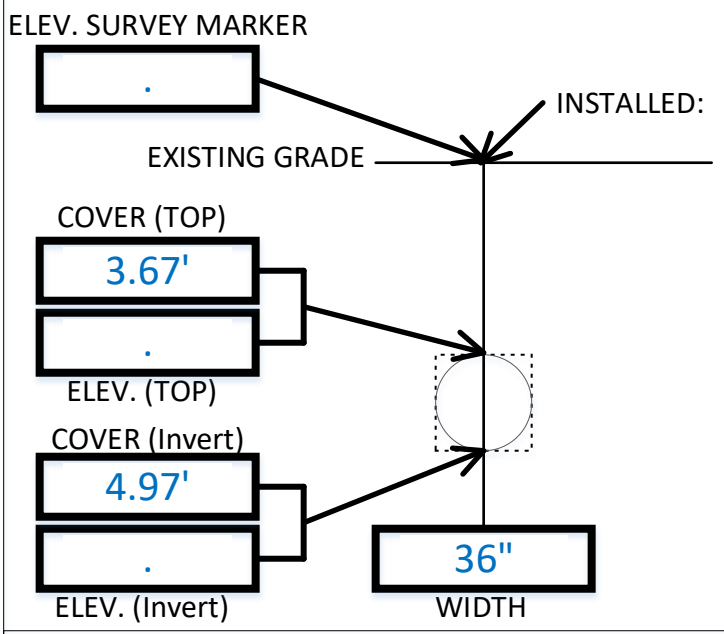
OUTSIDE DIAMETER & TYPE OF UTILITY FOUND

36" CONCRETE DUCTBANK

PAVING THICKNESS / CONDITION: N/A

SOIL CONDITIONS: SANDY SOIL

UTILITY CONDITION: GOOD



SURVEY MARKER LOCATED BY: .

TEST PIT SURVEY INFORMATION

NORTHING: .

EASTING: .

BASELINE: .

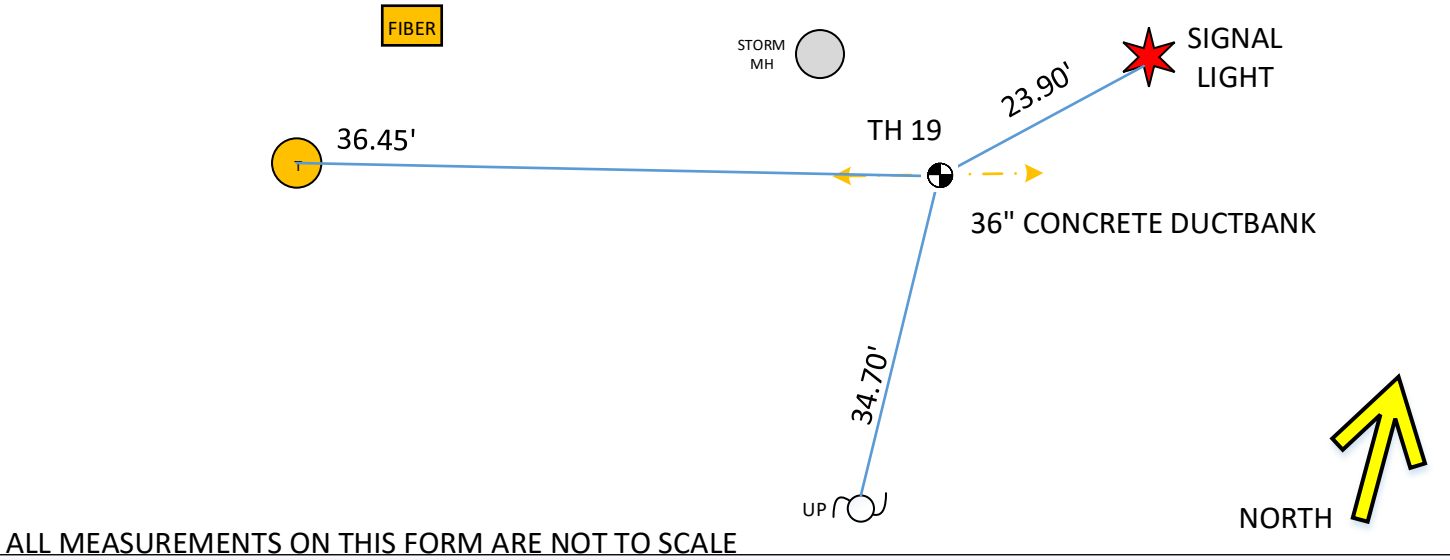
STATION: .

OFFSET: .

HORIZONTAL & VERTICAL CONTROL PROVIDED BY: .

NOTES: .

RIVERSIDE DR



ALL MEASUREMENTS ON THIS FORM ARE NOT TO SCALE

KCI ASSOCIATES OF NC
Engineers * Planners * Scientists * Construction Managers
4505 Falls of Neuse Rd, Suite 600
Raleigh, NC 27609-5210
Phone (919) 783-9214 * Fax (919) 783-9266

Client: **TIMMONS GROUP**

CLIENT JOB #: . KCI JOB #: .

TEST HOLE #: 20 DATE: **06.30.22**

AREA LOCATION: **ARNETT BLVD AND RIVERSIDE DR**

JURISDICTION: **DANVILLE, VA**

UTILITY REQUESTED: **FIBER**

TEST HOLE DUG AT PROPOSED: **STORM INSTALLATION**

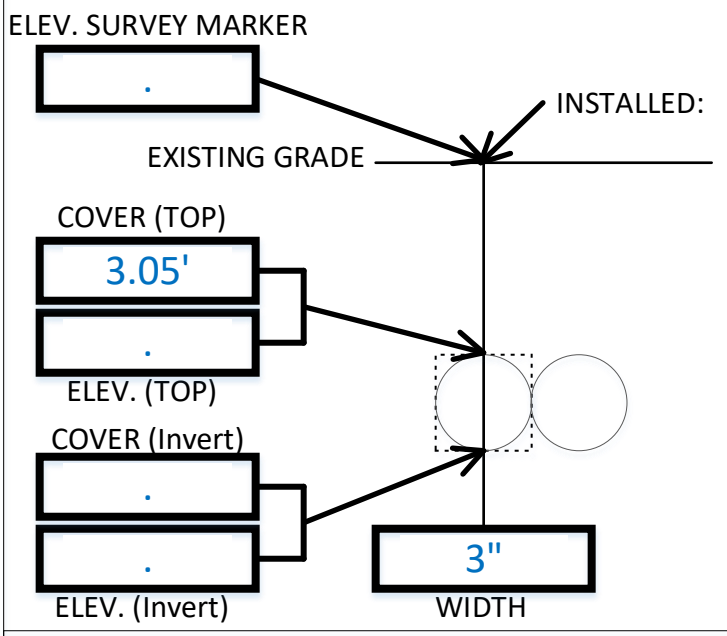
OUTSIDE DIAMETER & TYPE OF UTILITY FOUND

2 X 1½" HDPE CONDUITS

PAVING THICKNESS / CONDITION: **N/A**

SOIL CONDITIONS: **SANDY SOIL**

UTILITY CONDITION: **GOOD**



SURVEY MARKER LOCATED BY: .

TEST PIT SURVEY INFORMATION

NORTHING: .

EASTING: .

BASELINE: .

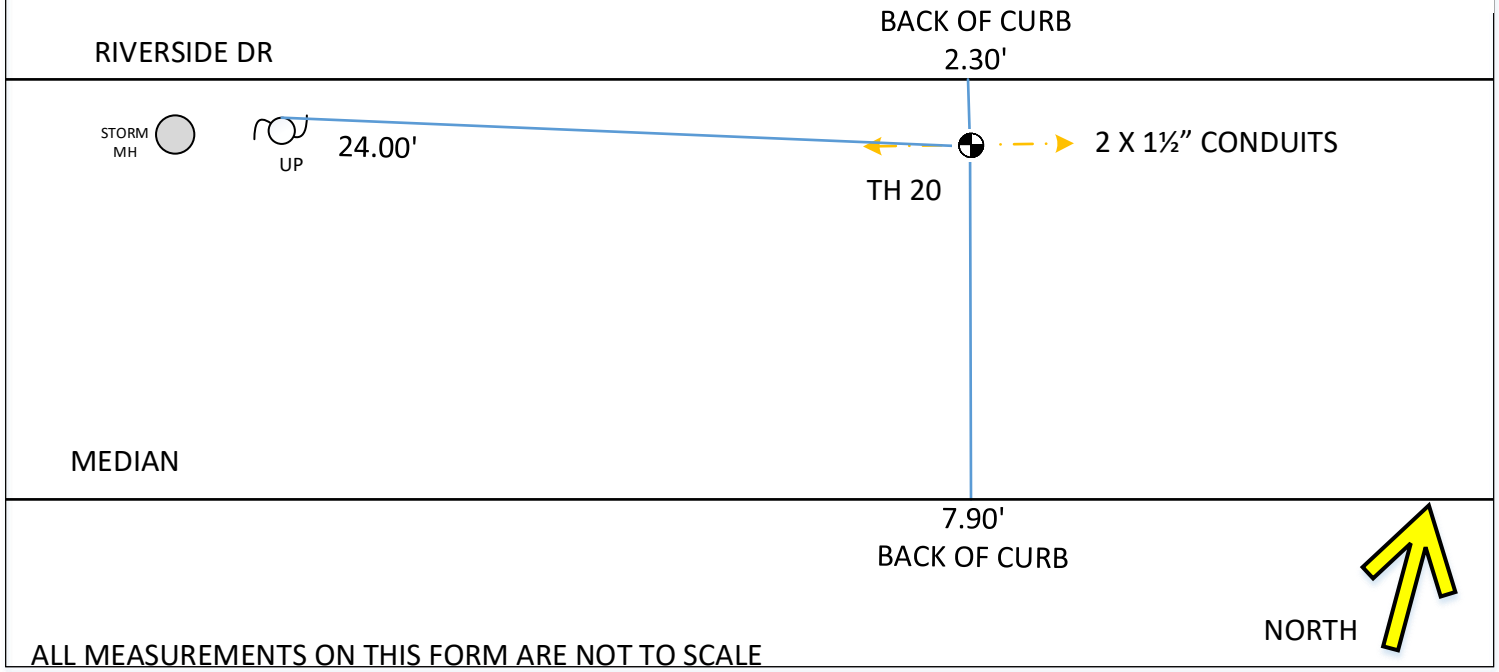
STATION: .

OFFSET: .

HORIZONTAL & VERTICAL CONTROL PROVIDED BY:

.

NOTES: .



ALL MEASUREMENTS ON THIS FORM ARE NOT TO SCALE

KCI ASSOCIATES OF NC
Engineers * Planners * Scientists * Construction Managers
4505 Falls of Neuse Rd, Suite 600
Raleigh, NC 27609-5210
Phone (919) 783-9214 * Fax (919) 783-9266

Client: **TIMMONS GROUP**

CLIENT JOB #: . KCI JOB #: .

TEST HOLE #: 21 DATE: **06.30.22**

AREA LOCATION: **ARNETT BLVD AND RIVERSIDE DR**

JURISDICTION: **DANVILLE, VA**

UTILITY REQUESTED: **GAS**

TEST HOLE DUG AT PROPOSED: **STORM INSTALLATION**

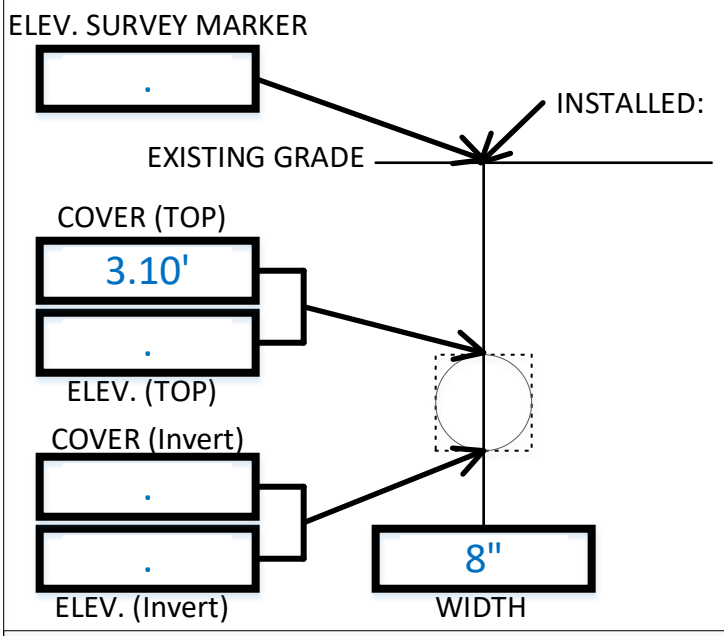
OUTSIDE DIAMETER & TYPE OF UTILITY FOUND

8" WRAPPED STEEL GAS MAIN

PAVING THICKNESS / CONDITION: **N/A**

SOIL CONDITIONS: **SANDY SOIL**

UTILITY CONDITION: **GOOD**



SURVEY MARKER LOCATED BY: .

TEST PIT SURVEY INFORMATION

NORTHING: .

EASTING: .

BASELINE: .

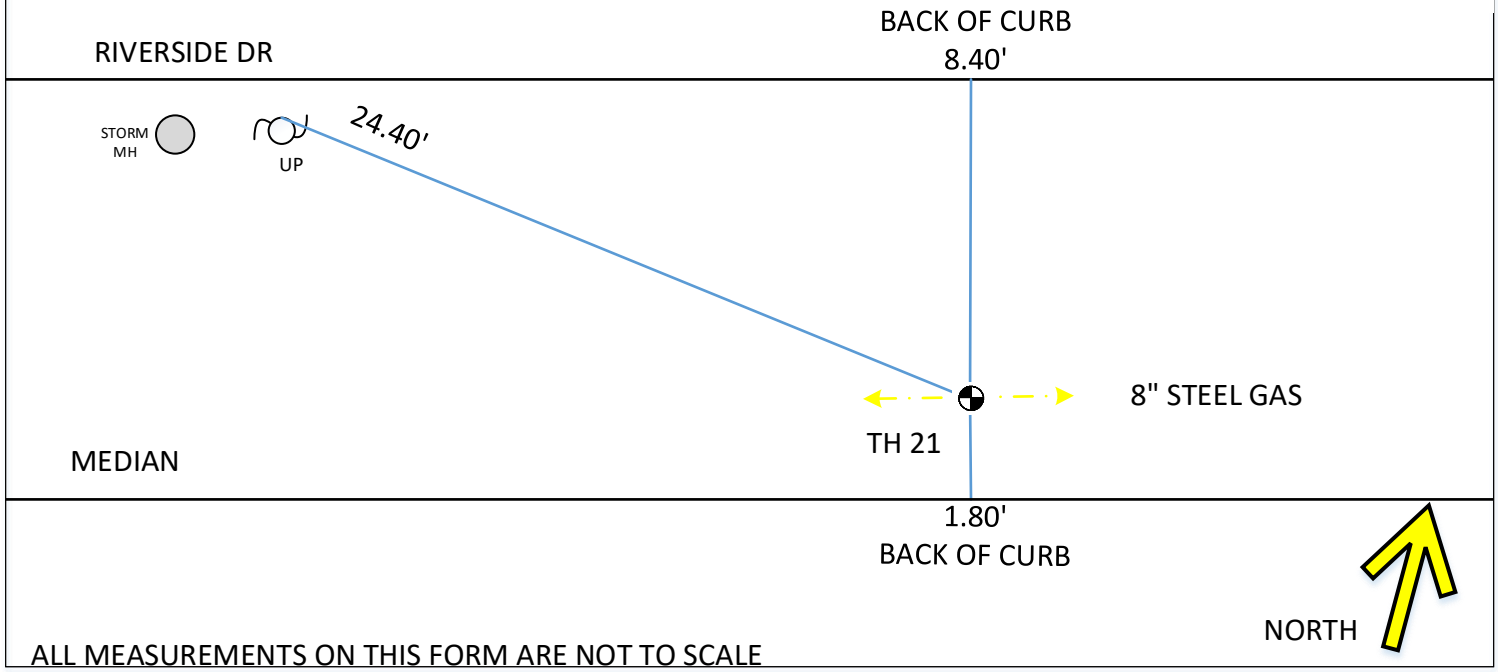
STATION: .

OFFSET: .

HORIZONTAL & VERTICAL CONTROL PROVIDED BY:

.

NOTES: .



ALL MEASUREMENTS ON THIS FORM ARE NOT TO SCALE

KCI ASSOCIATES OF NC
Engineers * Planners * Scientists * Construction Managers
4505 Falls of Neuse Rd, Suite 600
Raleigh, NC 27609-5210
Phone (919) 783-9214 * Fax (919) 783-9266

Client: **TIMMONS GROUP**

CLIENT JOB #: . KCI JOB #: .

TEST HOLE #: 22 DATE: 06.30.22

AREA LOCATION: ARNETT BLVD AND RIVERSIDE DR

JURISDICTION: DANVILLE, VA

UTILITY REQUESTED: GAS

TEST HOLE DUG AT PROPOSED: STORM INSTALLATION

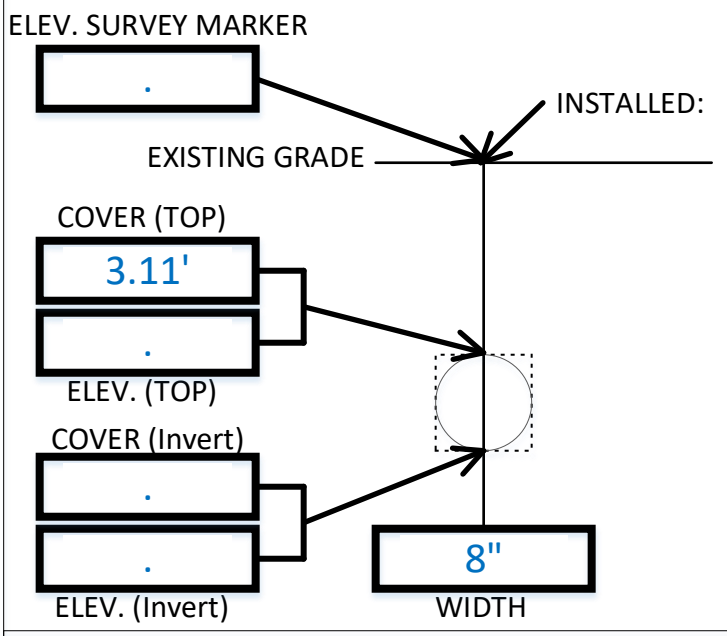
OUTSIDE DIAMETER & TYPE OF UTILITY FOUND

8" WRAPPED STEEL GAS MAIN

PAVING THICKNESS / CONDITION: 4" GOOD ASPHALT

SOIL CONDITIONS: SANDY SOIL

UTILITY CONDITION: GOOD



SURVEY MARKER LOCATED BY: .

TEST PIT SURVEY INFORMATION

NORTHING: .

EASTING: .

BASELINE: .

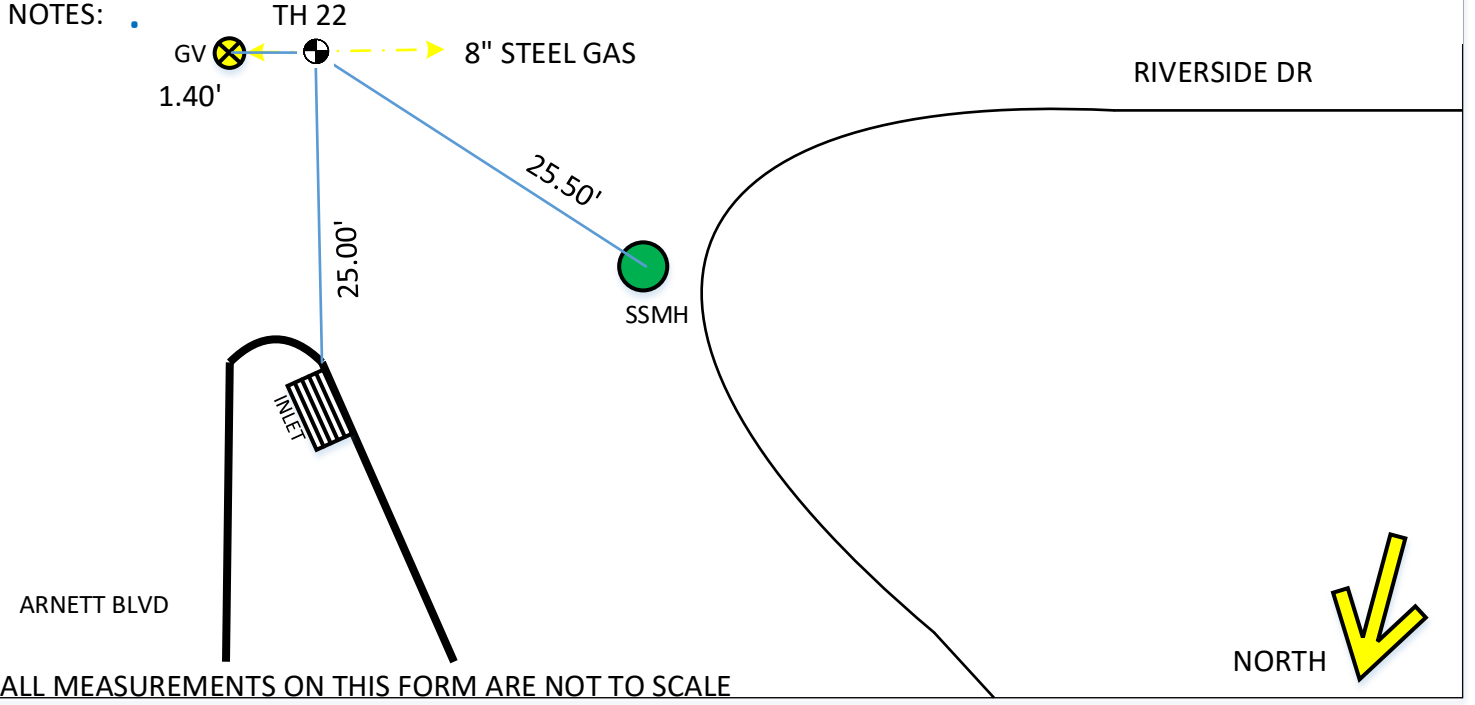
STATION: .

OFFSET: .

HORIZONTAL & VERTICAL CONTROL PROVIDED BY:

.

NOTES: .



ALL MEASUREMENTS ON THIS FORM ARE NOT TO SCALE

KCI ASSOCIATES OF NC
Engineers * Planners * Scientists * Construction Managers
4505 Falls of Neuse Rd, Suite 600
Raleigh, NC 27609-5210
Phone (919) 783-9214 * Fax (919) 783-9266

Client: **TIMMONS GROUP**

CLIENT JOB #: . KCI JOB #: .

TEST HOLE #: 23 DATE: **06.30.22**

AREA LOCATION: **ARNETT BLVD AND RIVERSIDE DR**

JURISDICTION: **DANVILLE, VA**

UTILITY REQUESTED: **GAS**

TEST HOLE DUG AT PROPOSED: **STORM INSTALLATION**

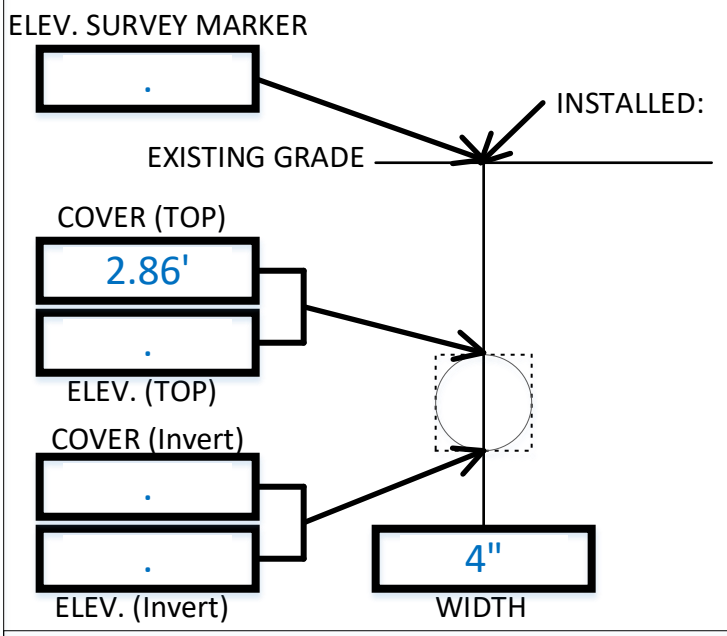
OUTSIDE DIAMETER & TYPE OF UTILITY FOUND

4" PLASTIC GAS MAIN

PAVING THICKNESS / CONDITION: **N/A**

SOIL CONDITIONS: **SANDY SOIL**

UTILITY CONDITION: **GOOD**



SURVEY MARKER LOCATED BY: .

TEST PIT SURVEY INFORMATION

NORTHING: .

EASTING: .

BASELINE: .

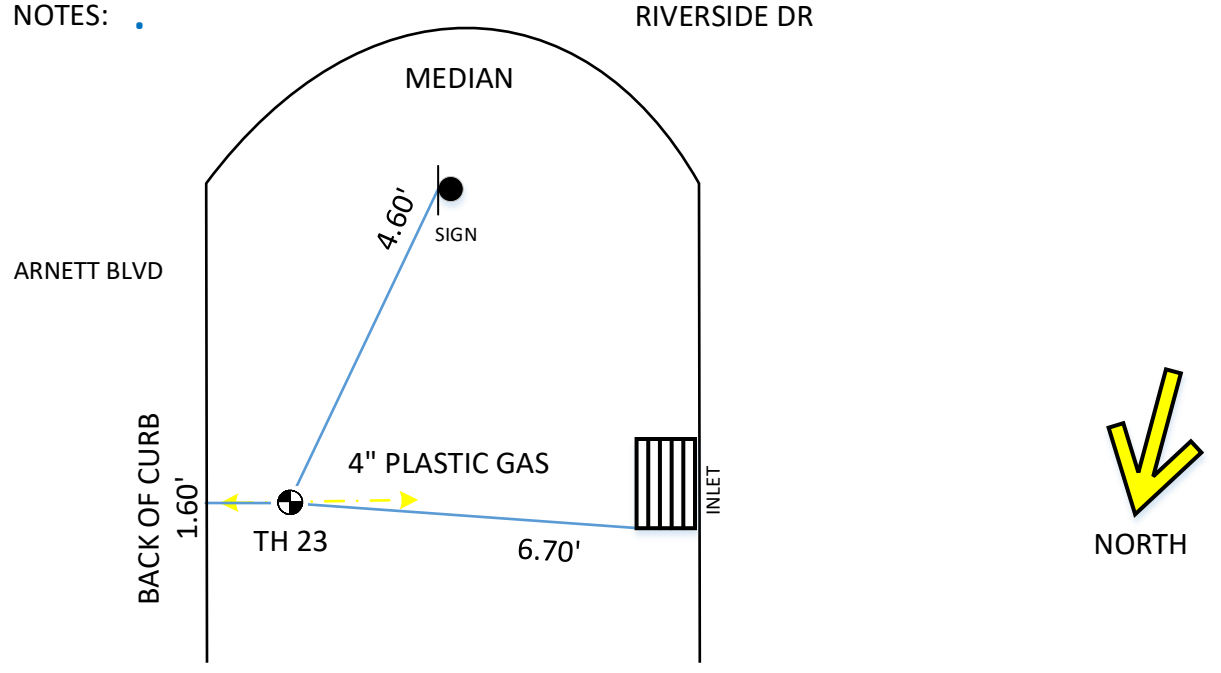
STATION: .

OFFSET: .

HORIZONTAL & VERTICAL CONTROL PROVIDED BY:

.

NOTES: .



ALL MEASUREMENTS ON THIS FORM ARE NOT TO SCALE

KCI ASSOCIATES OF NC
Engineers * Planners * Scientists * Construction Managers
4505 Falls of Neuse Rd, Suite 600
Raleigh, NC 27609-5210
Phone (919) 783-9214 * Fax (919) 783-9266

Client: **TIMMONS GROUP**

CLIENT JOB #: . KCI JOB #: .

TEST HOLE #: 24 DATE: 06.30.22

AREA LOCATION: **ARNETT BLVD**

JURISDICTION: **DANVILLE, VA**

UTILITY REQUESTED: **GAS**

TEST HOLE DUG AT PROPOSED: **STORM INSTALLATION**

OUTSIDE DIAMETER & TYPE OF UTILITY FOUND

4" PLASTIC GAS MAIN

PAVING THICKNESS / CONDITION: **4" GOOD ASPHALT**

SOIL CONDITIONS: **SANDY SOIL**

UTILITY CONDITION: **GOOD**

ELEV. SURVEY MARKER

.

INSTALLED: **PK** AT EXISITING GRADE OF: **ASPHALT**

EXISTING GRADE

COVER (TOP)

4.55'

.

ELEV. (TOP)

COVER (Invert)

.

.

ELEV. (Invert)

4"

WIDTH

SURVEY MARKER LOCATED BY: .

TEST PIT SURVEY INFORMATION

NORTHING: .

EASTING: .

BASELINE: .

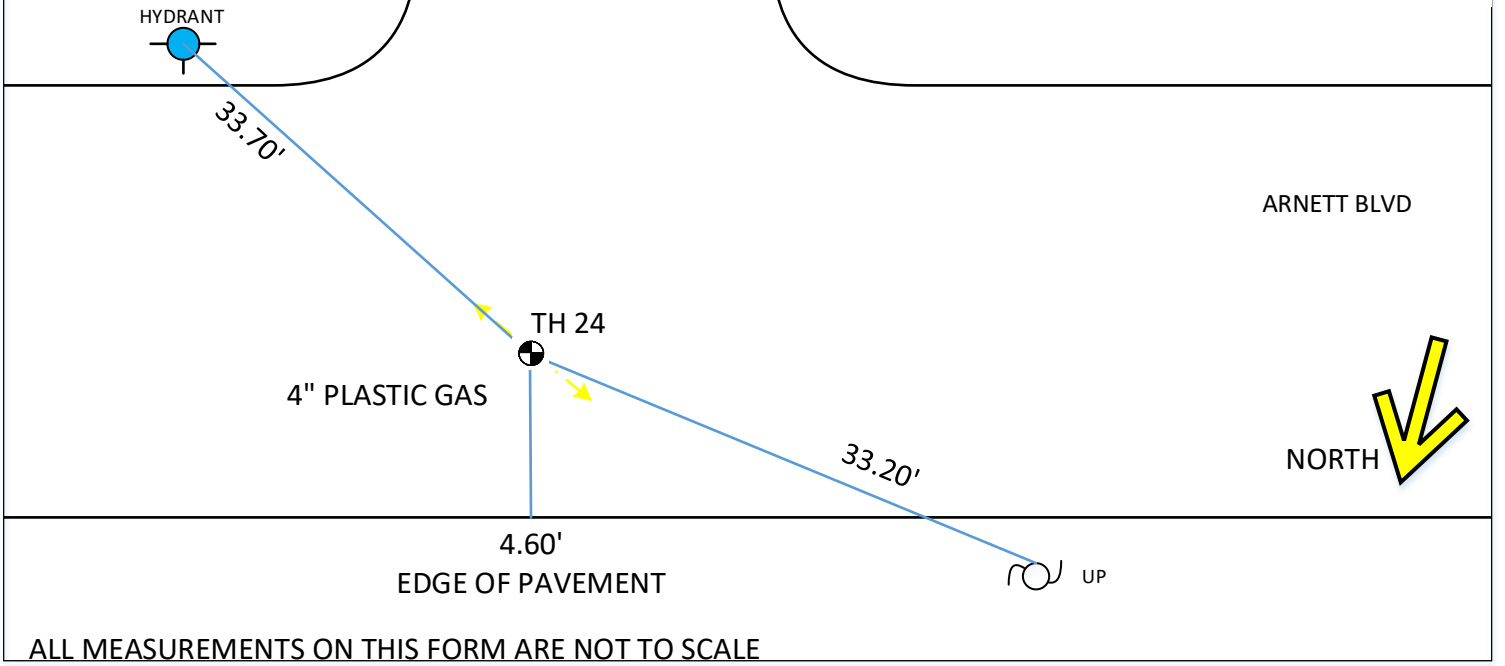
STATION: .

OFFSET: .

HORIZONTAL & VERTICAL CONTROL PROVIDED BY:

.

NOTES: .



ALL MEASUREMENTS ON THIS FORM ARE NOT TO SCALE

KCI ASSOCIATES OF NC
Engineers * Planners * Scientists * Construction Managers
4505 Falls of Neuse Rd, Suite 600
Raleigh, NC 27609-5210
Phone (919) 783-9214 * Fax (919) 783-9266

Client: **TIMMONS GROUP**

CLIENT JOB #: . KCI JOB #: .

TEST HOLE #: 25 DATE: 06.30.22

AREA LOCATION: **ARNETT BLVD**

JURISDICTION: **DANVILLE, VA**

UTILITY REQUESTED: **FIBER**

TEST HOLE DUG AT PROPOSED: **STORM INSTALLATION**

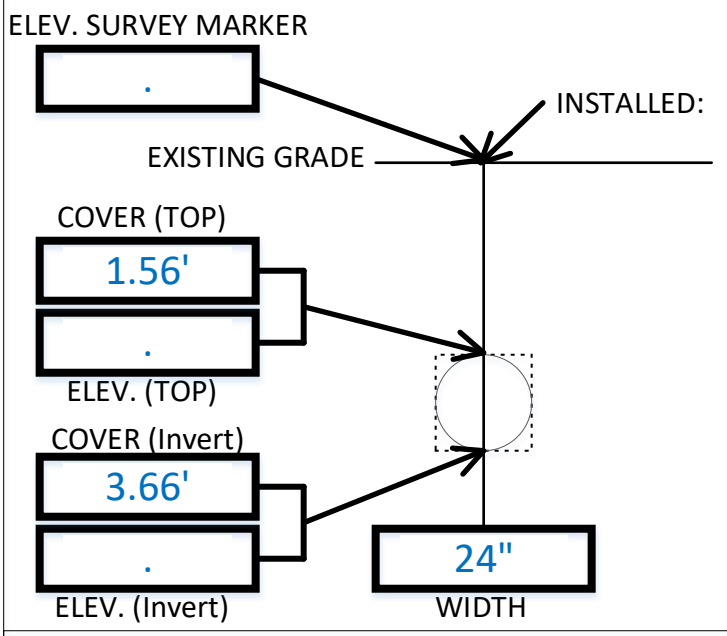
OUTSIDE DIAMETER & TYPE OF UTILITY FOUND

24" CONCRETE DUCTBANK

PAVING THICKNESS / CONDITION: **10" GOOD ASPHALT**

SOIL CONDITIONS: **SANDY SOIL**

UTILITY CONDITION: **GOOD**



SURVEY MARKER LOCATED BY: .

TEST PIT SURVEY INFORMATION

NORTHING: .

EASTING: .

BASELINE: .

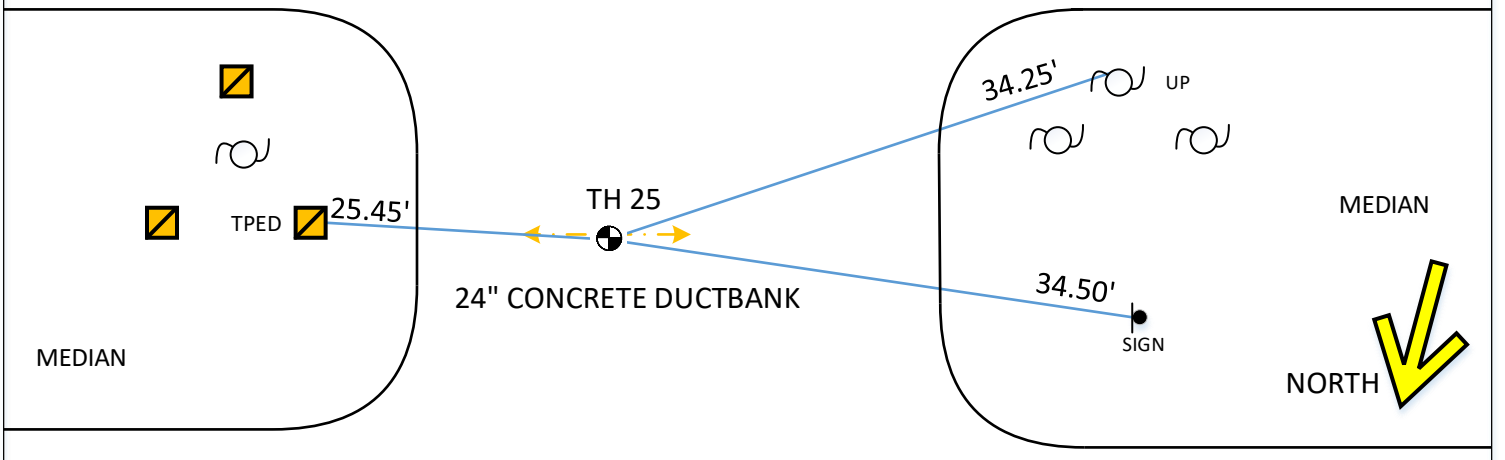
STATION: .

OFFSET: .

HORIZONTAL & VERTICAL CONTROL PROVIDED BY:

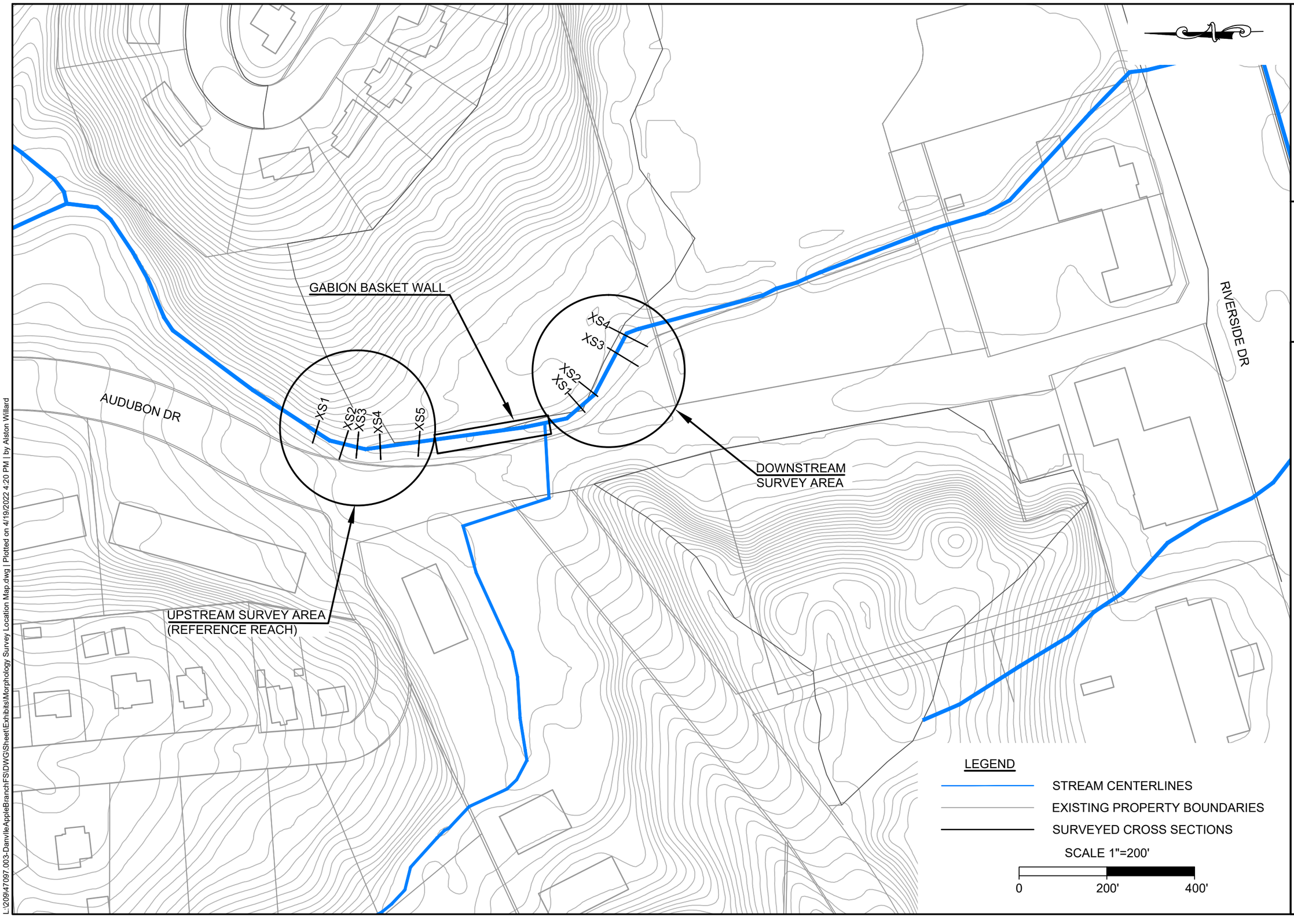
.

NOTES: .



ALL MEASUREMENTS ON THIS FORM ARE NOT TO SCALE

Morphological Data



THIS DRAWING PREPARED AT THE
RALEIGH OFFICE
5410 Trinity Road, Suite 102 | Raleigh, NC 27607
TEL 919.866.4951 FAX 919.833.8124 www.timmons.com
North Carolina License No. C-1652

YOUR VISION ACHIEVED THROUGH OURS.

REVISION DESCRIPTION

DATE

DATE 4/19/2022

DRAWN BY A. WILLARD

DESIGNED BY A. ASFAW

CHECKED BY B. WARD

SCALE 1"=200'

TIMMONS GROUP

NORTH CAROLINA LICENSE NO. C-1652

APPLEBRANCH WATERSHED STUDY

CITY OF DANVILLE - VIRGINIA

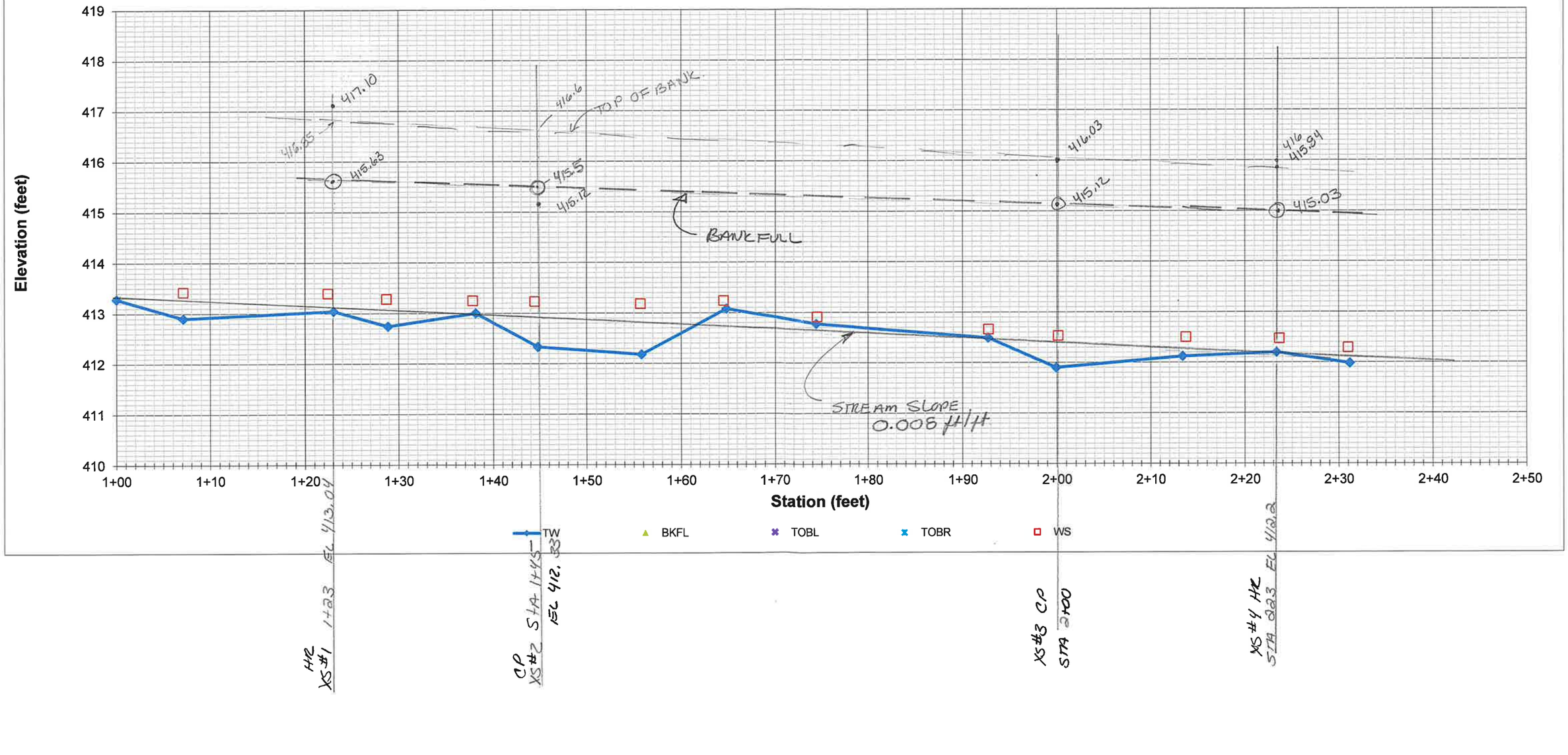
MORPHOLOGICAL SURVEY LOCATION MAP

JOB NO. 47097.003

SHEET NO. 1

L:\209\47097.003-DanvilleAppleBranchFS\DWG\Sheet\Exhibits\Morphology Survey Location Map.dwg | Plotted on 4/19/2022 4:20 PM | by Alston Willard

Apple Branch - Project Survey Area (DOWNSTREAM)
Longitudinal Profile
Main Channel: Station 1+00 - 2+50



Project:	Applebranch Survey Data	**Location:**	Cross Section 1 - 2:1 scale
Station:	1+23	**Benchmark description:**	Riffle
Date:	8/20/2021		USGS Grid Coordinates: North / East; Plan Sheet Ref. No.
Photo Reference Location:			
Permanent Benchmark Elevation:		**Permanent Benchmark Location:**	

Blue cells are instructions and notes. Please read them.
Gray cells are outputs and should be left alone.
Yellow cells are for data input and manipulation
Cells that turn red indicate and error.

Cross Section taken from left to right looking downstream.

If you need additional sheets for more cross sections, just create a copy of the sheet by right clicking on the tab at the bottom of this sheet.

Station	BS	HI	FS	Elevation	"TW", "Bankfull right" and "bankfull left" MUST be entered verbatim in this column for the sheet to work. "TOBL", "TOBR", "TOE L" and TOE R" are recommended.	Bankfull Cross Section: Left End Station	Right End Station	Station	Elevation	Elevation from bankfull	Incremental Avg. Height (ft)	Incremental Distance (ft)	Incremental Area (ft^2)	2 X Bankfull: Station	Distance Between Points
	Back-Sight	Height of Instrument	Fore-Sight	Height											
Feet	Feet	Feet	Feet	Feet											
Purple rows are for additional data. Start station 0+00 at the first yellow row.					Additional data needed if elevation is less than bankfull or 2 x bankfull.	Delete values in these columns where the ground elevation falls lower than bankfull outside the bounds of the stated/calculated bankfull station.									
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
419.60				418.22		-	-	0	0	0	0	0	0	419.6	0
481.94				417.39		-	-	0	0	0	0	0	0	0	0
483.48				415.63	TOBL, bankfull left	-	-	483.48	415.63	0	0	0	0	0	0
489.54				415.18		483.48	-	489.54	415.18	0.45	0.225	6.06	1.3635	0	6.076685
491.96				414.78		-	-	491.96	414.78	0.85	0.65	2.42	1.573	0	2.452835
494.39				413.32	TOEL	-	-	494.39	413.32	2.31	1.58	2.43	3.8394	0	2.834872
498.12				413.17		-	-	498.12	413.17	2.46	2.385	3.73	8.89605	0	3.733015
500.00				413.04	TW	-	-	500	413.04	2.59	2.525	1.88	4.747	0	1.884489
504.64				413.39	TOER	-	-	504.64	413.39	2.24	2.415	4.64	11.2056	0	4.653182
505.50				414.20		-	-	505.5	414.2	1.43	1.835	0.86	1.5781	0	1.181397
506.60				414.45	TOBR	-	-	506.6	414.45	1.18	1.305	1.1	1.4355	0	1.128051
510.33				414.53	Bankfull right	-	-	510.33	414.53	1.1	1.14	3.73	4.2522	0	3.730858
510.92				417.10		-	510.58253	510.58253	415.63	0	0.55	0.252529	0.138891	0	1.128615
512.02				417.00		-	-	0	0	0	0	0	0	0	0
512.82				418.00		-	-	0	0	0	0	0	0	0	0
513.62				419.00		-	-	0	0	0	0	0	0	512.996	0
514.42				420.00		-	-	0	0	0	0	0	0	0	0
515.22				421.00		-	-	0	0	0	0	0	0	0	0
516.02				422.00		-	-	0	0	0	0	0	0	0	0
522.52				422.00		-	-	0	0	0	0	0	0	0	0
526.82				421.00		-	-	0	0	0	0	0	0	0	0
535.02				420.00		-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
					Pull down orange if more rows needed.	-	-	0	0	0	0	0	0	0	0

These numbers are taken from the raw data table. There is no need to change these cells

TW		Bankfull Left		Bankfull Right		TOB Left		TOB Right	
Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation
500	413.04	483.48	415.63	510.33	414.53	483.48	415.63	506.6	414.45

You can change the yellow cells below. This is where you can adjust the stations or elevations of the parameters below. The units are +/- feet of offset. The cells can be left blank if you do not wish to make changes.

TW		Bankfull Left		Bankfull Right		TOB Left		TOB Right	
Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation
0	0	0	0	0	1.1	0	0	0	0

These are parameters that are used for morphology calculations, after any adjustments below. There is no need to change these cells.

TW		Bankfull Left		Bankfull Right		TOB Left		TOB Right	
Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation
500	413.04	483.48	415.63	510.33	415.63	483.48	415.63	506.6	414.45

Bankfull	
Station	Elevation
483.48	415.63
510.5825	415.63
2xBankfull	
Station	Elevation
419.60	418.22
513.00	418.22

Error, data needed if red

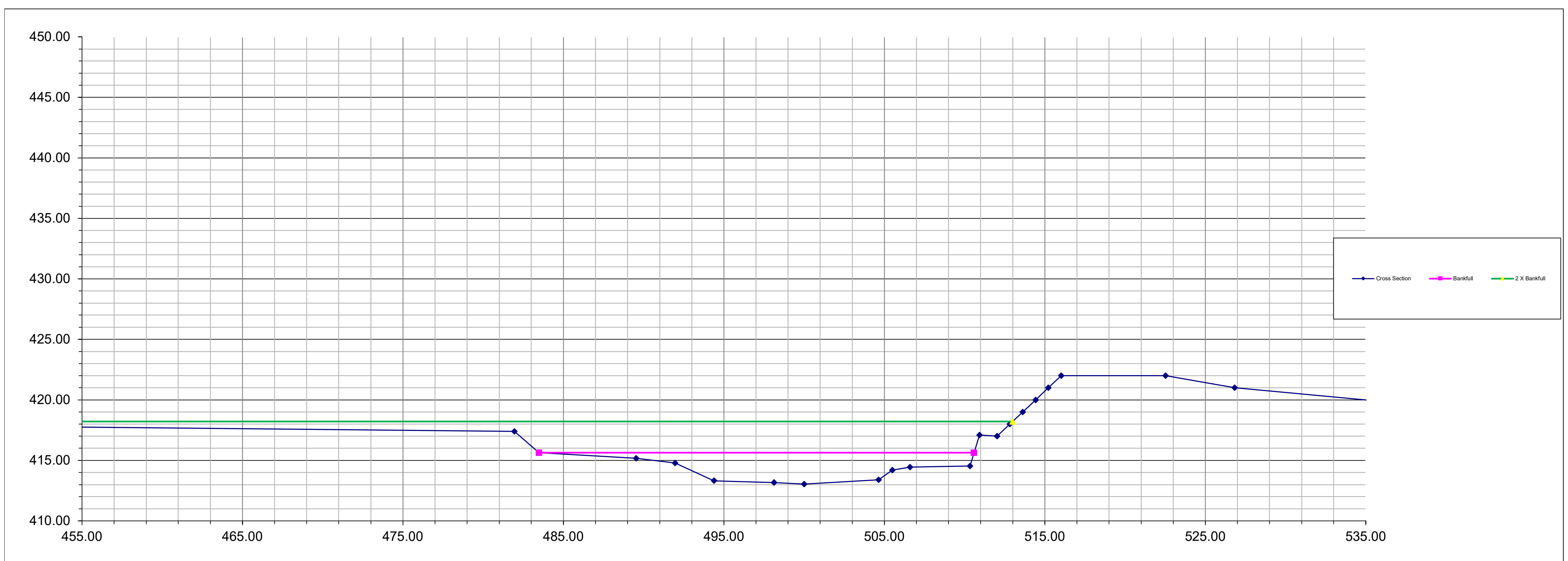
Average Bankfull Elevation (ft)	**415.63**
Bankfull Width (ft)	**27.10253**
Bankfull Area (ft^2)	**39.02924**
Bankfull Wetted Perimeter (ft)	**28.804**
Bankfull Hydraulic Radius (ft)	**1.354994**
Low Bank Height (ft)	**1.41**
Average PIN Elevation (ft)	**0**

LPIN and RPIN	
Sta	Elev
0	0
0	0

PIN Area
0

Stream Morphology	
Wbkf =	27.103
Abkf =	39.029
dbkf =	1.440
W/D =	18.820
dmbkf =	2.590
Wfpa =	93.396
ER =	3.446
LBH =	1.410
LBH/dmax	0.544
D50 =	
Qbkf =	
DA =	
Slope =	
Sinuosity=	

If red, cross section does not reach bankfull elevation, add data.



Project: Applebranch - Survey Data
Station: 1+45
Date: 8/20/2021
Photo Reference Location:
Permanent Benchmark Elevation:

Location: Cross Section 2 -2:1 scale
Benchmark description: Pool

USGS Grid Coordinates North	East	Plan Sheet Ref. No.

Permanent Benchmark Location:

Blue cells are instructions and notes. Please read them.
Gray cells are outputs and should be left alone.
Yellow cells are for data input and manipulation
Cells that turn red indicate and error.

Cross Section taken from left to right looking downstream.

If you need additional sheets for more cross sections, just create a copy of the sheet by right clicking on the tab at the bottom of this sheet.

	Back-Sight	Height of Instrument	Fore-Sight	Height	**"TW", "Bankfull right" and "bankfull left" MUST be entered verbatim in this column for the sheet to work. "TOBL", "TOBR", "TOE L" and TOE R" are recommended.**	Bankfull Cross Section								2 X Bankfull	
Station	**BS**	**HI**	**FS**	**Elevation**		Left End Station	Right End Station	Station	Elevation	Elevation from bankfull	Incremental Avg. Height (ft)	Incremental Distance (ft)	Incremental Area (ft^2)	Station	Distance Between Points
Feet	Feet	Feet	Feet	Feet											
Purple rows are for additional data. Start station 0+00 at the first yellow row.					**Additional data needed if elevation is less than bankfull or 2 x bankfull.**	**Delete values in these columns where the ground elevation falls lower than bankfull outside the bounds of the stated/calculated bankfull station.**									
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
405.6				418		-	-	0	0	0	0	0	0	0	0
440.3				418		-	-	0	0	0	0	0	0	0	0
479.3				418.77		-	-	0	0	0	0	0	0	474.2351	0
486.3				416.05	bankfull left	-	-	0	0	0	0	0	0	479.5574	0
490.1				414.23		487.44835	-	487.44835	415.5	0	0	0	0	0	0
492.1				412.81	TOEL	-	-	492.1	412.81	2.69	1.345	4.651648	6.256467	0	5.373447
500				412.33	TW	-	-	500	412.33	3.17	2.93	7.9	23.147	0	7.914569
504				412.62	TOER	-	-	504	412.62	2.88	3.025	4	12.1	0	4.010499
506.4				414.62		-	-	506.4	414.62	0.88	1.88	2.4	4.512	0	3.1241
511.2				415	Bankfull right	-	-	511.2	415	0.5	0.69	4.8	3.312	0	4.815018
513.1				416		-	512.15	512.15	415.5	0	0.25	0.95	0.2375	0	1.073546
514.8				417		-	-	0	0	0	0	0	0	0	0
516.4				418		-	-	0	0	0	0	0	0	0	0
518				419		-	-	0	0	0	0	0	0	517.472	0
519.6				420		-	-	0	0	0	0	0	0	0	0
521.2				421		-	-	0	0	0	0	0	0	0	0
522.7				422		-	-	0	0	0	0	0	0	0	0
526.3				422		-	-	0	0	0	0	0	0	0	0
538.2				421		-	-	0	0	0	0	0	0	0	0
545.5				420.5		-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
					Pull down orange if more rows needed.	-	-	0	0	0	0	0	0	0	0

These numbers are taken from the raw data table. There is no need to change these cells

TW		Bankfull				TOB			
		Left		Right		Left		Right	
Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation
500	412.33	486.3	416.05	511.2	415	0	0	0	0

You can change the yellow cells below. This is where you can adjust the stations or elevations of the parameters below. The units are +/- feet of offset. The cells can be left blank if you do not wish to make changes.

TW		Bankfull				TOB			
		Left		Right		Left		Right	
Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation
0	0	0	-0.55	0	0.5	0	0	0	0

These are parameters that are used for morphology calculations, after any adjustments below. There is no need to change these cells.

TW		Bankfull				TOB			
		Left		Right		Left		Right	
Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation
500	412.33	486.3	415.5	511.2	415.5	0	0	0	0

Bankfull	
Station	Elevation
487.4484	415.5
512.15	415.5
2xBankfull	
Station	Elevation
474.24	418.67
517.47	418.67

Error, data needed if red

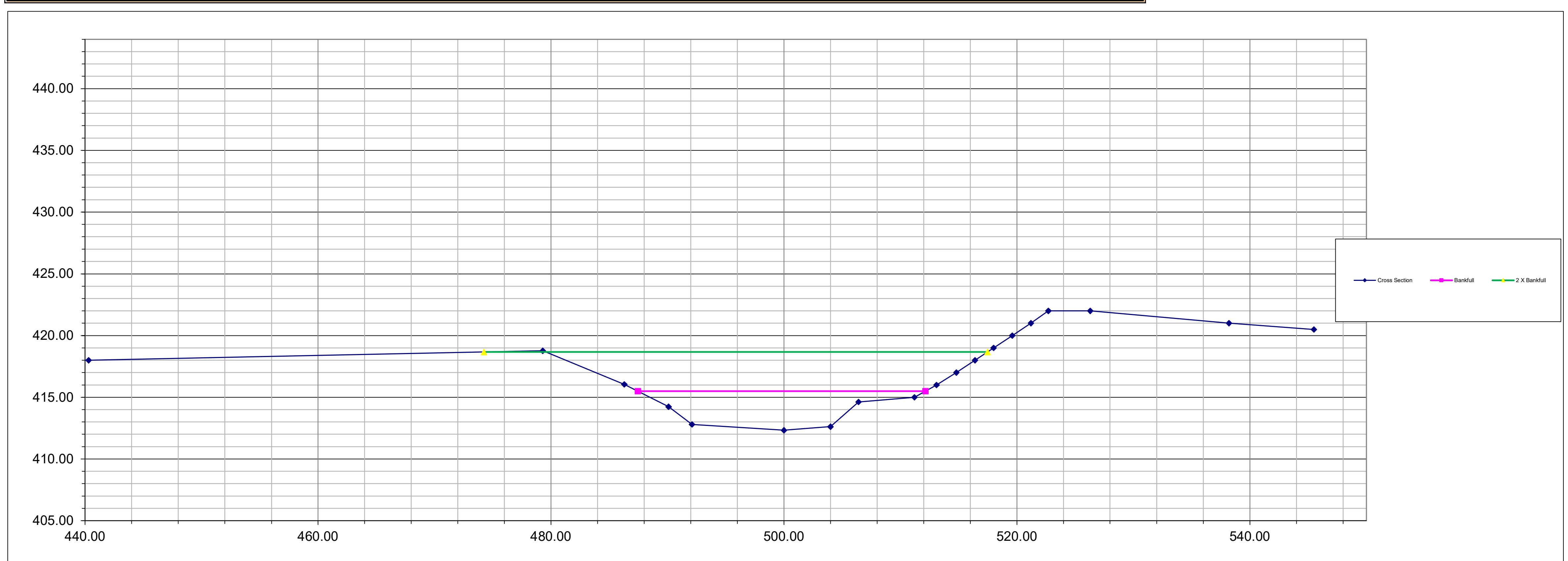
Average Bankfull Elevation (ft)	**415.5**
Bankfull Width (ft)	**24.70165**
Bankfull Area (ft^2)	**49.56497**
Bankfull Wetted Perimeter (ft)	**26.31118**
Bankfull Hydraulic Radius (ft)	**1.883799**
Low Bank Height (ft)	**-412.33**
Average PIN Elevation (ft)	**0**

LPIN and RPIN	
Sta	Elev
0	0
0	0

PIN Area
0

Stream Morphology	
Wbkf =	24.702
Abkf =	49.565
dbkf =	2.007
W/D =	12.311
dmbkf =	3.170
Wfpa =	43.237
ER =	1.750
LBH =	-412.330
LBH/dmax	-130.073
D50 =	
Qbkf =	
DA =	
Slope =	
Sinuosity=	

If red, cross section does not reach bankfull elevation, add data.



Project:	Applebranch - Survey Data	**Location:**	Cross Section 3 - 2:1 scale
Station:	2+00	**Benchmark description:**	Pool
Date:	8/20/2021		
Photo Reference Location:			

USGS Grid Coordinates North	East	Plan Sheet Ref. No.

Permanent Benchmark Elevation: | **Permanent Benchmark Location:**

Blue cells are instructions and notes. Please read them.

Gray cells are outputs and should be left alone.

Yellow cells are for data input and manipulation

Cells that turn red indicate and error.

Cross Section taken from left to right looking downstream.

If you need additional sheets for more cross sections, just create a copy of the sheet by right clicking on the tab at the bottom of this sheet.

Station (Feet)	Back-Sight BS (Feet)	Height of Instrument HI (Feet)	Fore-Sight FS (Feet)	Height Elevation (Feet)	"TW", "Bankfull right" and "bankfull left" MUST be entered verbatim in this column for the sheet to work. "TOBL", "TOBR", "TOE L" and TOE R" are recommended.	Bankfull Cross Section: Left End Station	Right End Station	Station	Elevation	Elevation from bankfull	Incremental Avg. Height (ft)	Incremental Distance (ft)	Incremental Area (ft^2)	2 X Bankfull Station	Distance Between Points
Purple rows are for additional data. Start station 0+00 at the first yellow row.					**Additional data needed if elevation is less than bankfull or 2 x bankfull.**	**Delete values in these columns where the ground elevation falls lower than bankfull outside the bounds of the stated/calculated bankfull station.**									
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
438.08				417.50		-	-	0	0	0	0	0	0	0	0
451.08				417.00		-	-	0	0	0	0	0	0	0	0
481.28				416.00		-	-	0	0	0	0	0	0	0	0
485.28				415.00		484.8	-	0	0	0	0	0	0	0	0
487.68				416.03		-	-	0	0	0	0	0	0	0	0
491.18				415.19		-	-	0	0	0	0	0	0	0	0
494.78				414.21	bankfull left	491.43714	-	491.43714	415.12	0	0	0	0	0	0
495.98				414.06	TOBL	-	-	495.98	414.06	1.06	0.53	4.542857	2.407714	0	4.664885
497.28				412.34	TOEL	-	-	497.28	412.34	2.78	1.92	1.3	2.496	0	2.156015
500.00				411.86	TW	-	-	500	411.86	3.26	3.02	2.72	8.2144	0	2.762028
500.08				411.90		-	-	500.08	411.9	3.22	3.24	0.08	0.2592	0	0.089443
503.19				412.55	TOER	-	-	503.19	412.55	2.57	2.895	3.11	9.00345	0	3.1772
506.66				414.02	TOBR	-	-	506.66	414.02	1.1	1.835	3.47	6.36745	0	3.768528
511.22				413.98		-	-	511.22	413.98	1.14	1.12	4.56	5.1072	0	4.560175
517.61				414.23		-	-	517.61	414.23	0.89	1.015	6.39	6.48585	0	6.394889
523.12				415.12	Bankfulll right	-	523.12	523.12	415.12	0	0.445	5.51	2.45195	0	5.581416
528.45				417.81		-	-	0	0	0	0	0	0	0	0
535.25				418.00		-	-	0	0	0	0	0	0	0	0
551.65				419.00		-	-	0	0	0	0	0	0	541.482	0
571.25				420.00		-	-	0	0	0	0	0	0	0	0
579.55				421.00		-	-	0	0	0	0	0	0	0	0
582.45				421.00		-	-	0	0	0	0	0	0	0	0
583.65				421.00		-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
					Pull down orange if more rows needed.	-	-	0	0	0	0	0	0	0	0

These numbers are taken from the raw data table. There is no need to change these cells

TW		Bankfull Left		Bankfull Right		TOB Left		TOB Right	
Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation
500	411.86	494.78	414.21	0	0	495.98	414.06	506.66	414.02

You can change the yellow cells below. This is where you can adjust the stations or elevations of the parameters below. The units are +/- feet of offset. The cells can be left blank if you do not wish to make changes.

TW		Bankfull Left		Bankfull Right		TOB Left		TOB Right	
Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation
0	0	0	0.91	0	0	0	0	0	0

These are parameters that are used for morphology calculations, after any adjustments below. There is no need to change these cells.

TW		Bankfull Left		Bankfull Right		TOB Left		TOB Right	
Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation
500	411.86	494.78	415.12	0	0	495.98	414.06	506.66	414.02

Bankfull	
Station	Elevation
491.4371	415.12
523.12	415.12
2xBankfull	
Station	Elevation
541.48	418.38
541.48	418.38

Error, data needed if red

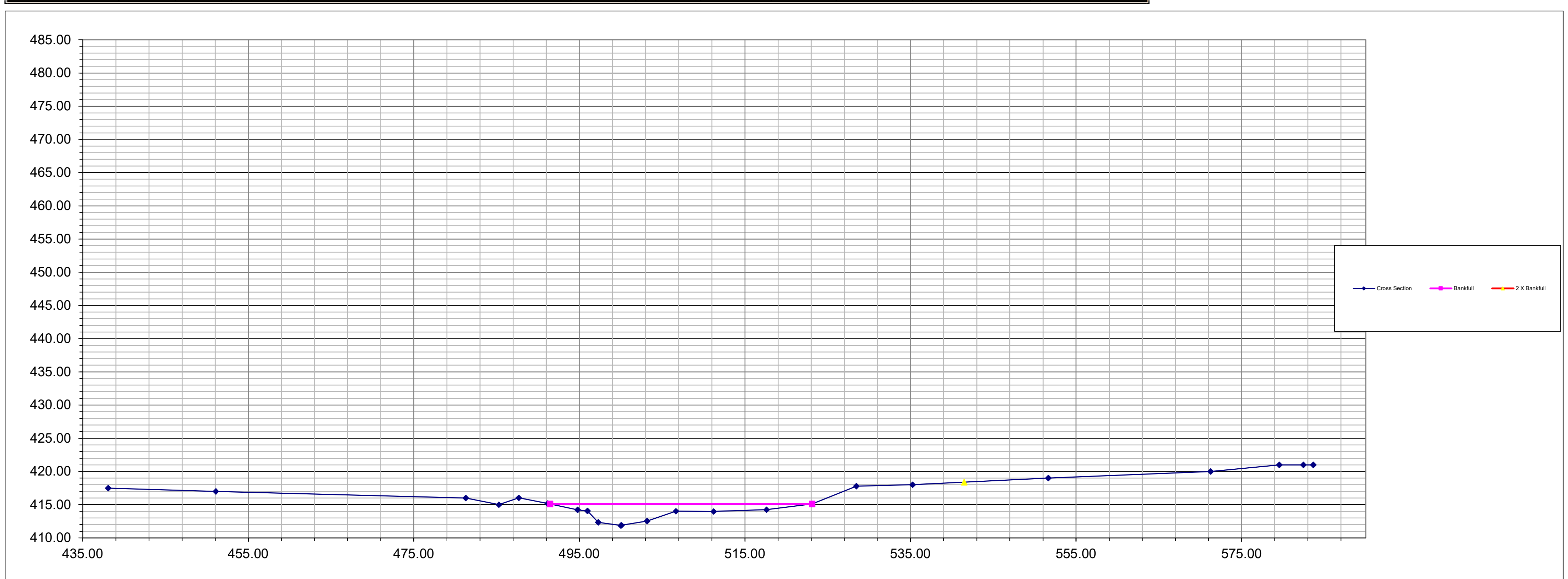
Average Bankfull Elevation (ft)	**415.12**
Bankfull Width (ft)	**31.68286**
Bankfull Area (ft^2)	**42.79321**
Bankfull Wetted Perimeter (ft)	**33.15458**
Bankfull Hydraulic Radius (ft)	**1.290718**
Low Bank Height (ft)	**2.16**
Average PIN Elevation (ft)	**0**

LPIN and RPIN	
Sta	Elev
0	0
0	0

PIN Area
0

Stream Morphology	
Wbkf =	31.683
Abkf =	42.793
dbkf =	1.351
W/D =	23.457
dmbkf =	3.260
Wfpa =	0.000
ER =	0.000
LBH =	2.160
LBH/dmax	0.663
D50 =	
Qbkf =	
DA =	
Slope =	
Sinuosity=	

If red, cross section does not reach bankfull elevation, add data.



Project:	Applebranch - Survey Data	**Location:**	Cross Section 4 - 2:1 scale
Station:	2+23	**Benchmark description:**	Riffle
Date:	8/20/2021		USGS Grid Coordinates / Plan Sheet
Photo Reference Location:			North / East / Ref. No.
Permanent Benchmark Elevation:		**Permanent Benchmark Location:**	

Blue cells are instructions and notes. Please read them.
Gray cells are outputs and should be left alone.
Yellow cells are for data input and manipulation
Cells that turn red indicate and error.

Cross Section taken from left to right looking downstream.

If you need additional sheets for more cross sections, just create a copy of the sheet by right clicking on the tab at the bottom of this sheet.

Station	Back-Sight BS	Height of Instrument HI	Fore-Sight FS	Height Elevation	"TW", "Bankfull right" and "bankfull left" MUST be entered verbatim in this column for the sheet to work. "TOBL", "TOBR", "TOE L" and TOE R" are recommended.	Bankfull Cross Section: Left End Station	Right End Station	Station	Elevation	Elevation from bankfull	Incremental Avg. Height (ft)	Incremental Distance (ft)	Incremental Area (ft^2)	2 X Bankfull: Station	Distance Between Points
Feet	Feet	Feet	Feet	Feet											
Purple rows are for additional data. Start station 0+00 at the first yellow row.					**Additional data needed if elevation is less than bankfull or 2 x bankfull.**	**Delete values in these columns where the ground elevation falls lower than bankfull outside the bounds of the stated/calculated bankfull station.**									
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
432.09				418.07		-	-	0	0	0	0	0	0	0	0
455.89				417		-	-	0	0	0	0	0	0	436.761	0
465.09				416		-	-	0	0	0	0	0	0	0	0
474.89				417.09		-	-	0	0	0	0	0	0	0	0
485.03				415.03	Bankfull left	-	-	0	0	0	0	0	0	0	0
489.83				415.19		-	-	0	0	0	0	0	0	0	0
492.93				413.97		490.23656	-	490.23656	415.03	0	0	0	0	0	0
493.28				412.93		-	-	493.28	412.93	2.1	1.05	3.043443	3.195615	0	3.69764
496.09				412.76	TOBL	-	-	496.09	412.76	2.27	2.185	2.81	6.13985	0	2.815138
497				412.45	TOEL	-	-	497	412.45	2.58	2.425	0.91	2.20675	0	0.961353
499.78				412.23		-	-	499.78	412.23	2.8	2.69	2.78	7.4782	0	2.788691
500				412.2	TW	-	-	500	412.2	2.83	2.815	0.22	0.6193	0	0.222036
502.5				412.46	TOER	-	-	502.5	412.46	2.57	2.7	2.5	6.75	0	2.513484
505.45				413.62	TOBR	-	-	505.45	413.62	1.41	1.99	2.95	5.8705	0	3.169874
508.32				413.87		-	-	508.32	413.87	1.16	1.285	2.87	3.68795	0	2.880868
516.43				414.22	Bankfull right	-	-	516.43	414.22	0.81	0.985	8.11	7.98835	0	8.117549
519.66				414.74		-	-	519.66	414.74	0.29	0.55	3.23	1.7765	0	3.27159
524.28				415.84		-	520.878	520.878	415.03	0	0.145	1.218	0.17661	0	1.252048
533.18				417		-	-	0	0	0	0	0	0	0	0
542.78				418		-	-	0	0	0	0	0	0	541.436	0
555.58				419		-	-	0	0	0	0	0	0	0	0
586.78				420		-	-	0	0	0	0	0	0	0	0
592.48				421		-	-	0	0	0	0	0	0	0	0
595.88				421		-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
					Pull down orange if more rows needed.	-	-	0	0	0	0	0	0	0	0

These numbers are taken from the raw data table. There is no need to change these cells

TW		Bankfull				TOB			
		Left		Right		Left		Right	
Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation
500	412.2	485.03	415.03	516.43	414.22	496.09	412.76	505.45	413.62

You can change the yellow cells below. This is where you can adjust the stations or elevations of the parameters below. The units are +/- feet of offset. The cells can be left blank if you do not wish to make changes.

TW		Bankfull				TOB			
		Left		Right		Left		Right	
Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation
0	0	0		0	0.81	0	0	0	0

These are parameters that are used for morphology calculations, after any adjustments below. There is no need to change these cells.

TW		Bankfull				TOB			
		Left		Right		Left		Right	
Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation
500	412.2	485.03	415.03	516.43	415.03	496.09	412.76	505.45	413.62

Bankfull	
Station	Elevation
490.2366	415.03
520.878	415.03
2xBankfull	
Station	Elevation
436.76	417.86
541.44	417.86

Error, data needed if red

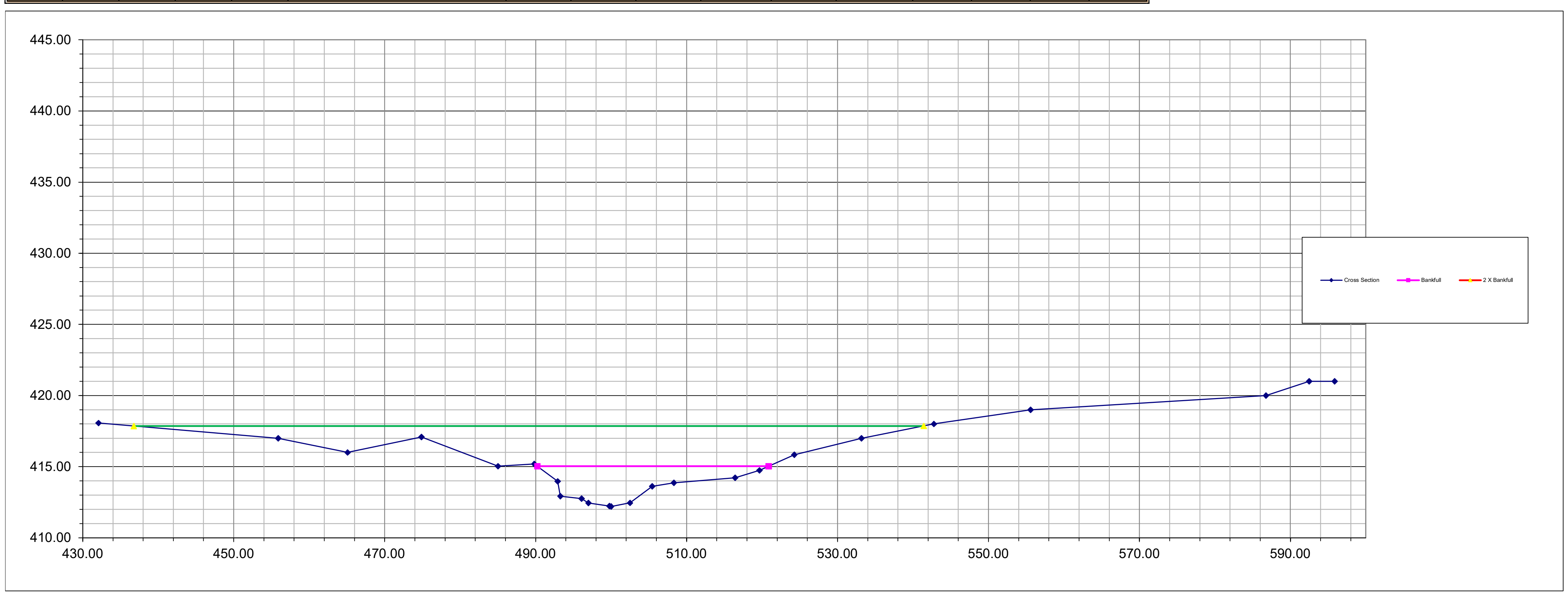
Average Bankfull Elevation (ft)	**415.03**
Bankfull Width (ft)	**30.64144**
Bankfull Area (ft^2)	**45.88962**
Bankfull Wetted Perimeter (ft)	**31.69027**
Bankfull Hydraulic Radius (ft)	**1.448067**
Low Bank Height (ft)	**0.56**
Average PIN Elevation (ft)	**0**

LPIN and RPIN	
Sta	Elev
0	0
0	0

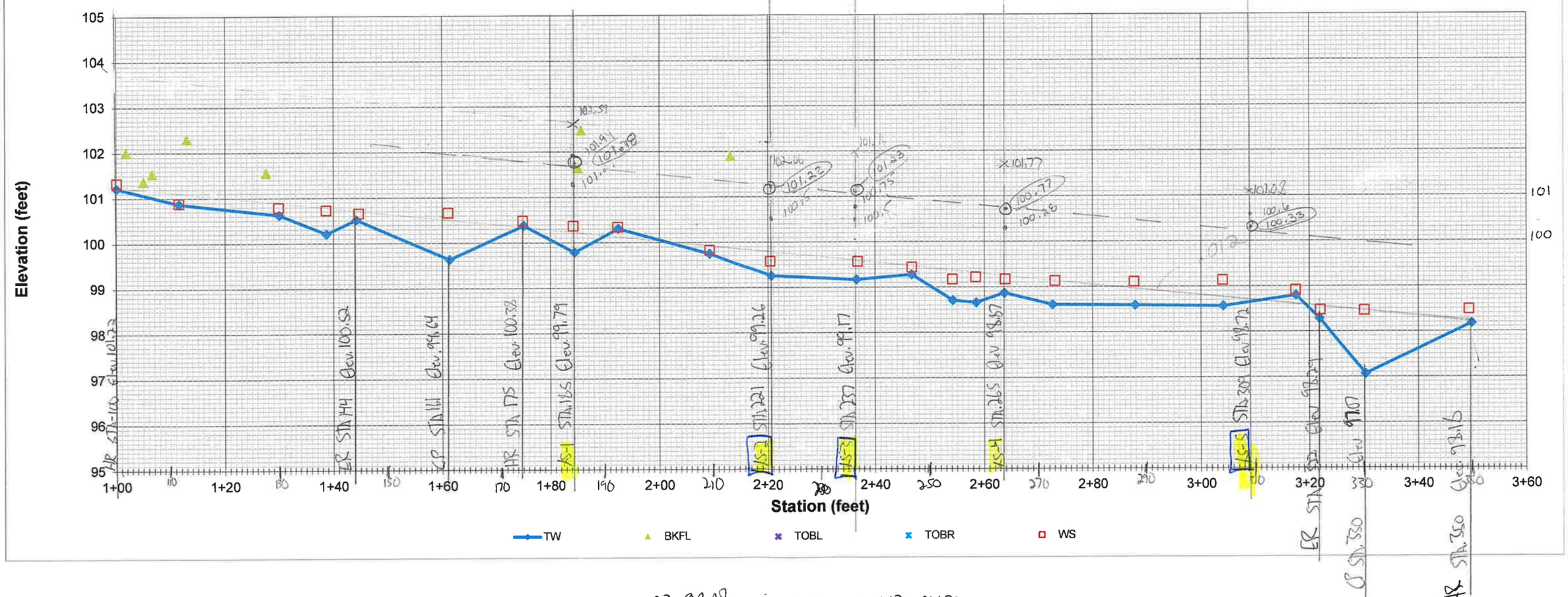
PIN Area
0

Stream Morphology	
Wbkf =	30.641
Abkf =	45.890
dbkf =	1.498
W/D =	20.460
dmbkf =	2.830
Wfpa =	104.675
ER =	3.416
LBH =	0.560
LBH/dmax	0.198
D50 =	
Qbkf =	
DA =	
Slope =	
Sinuosity=	

If red, cross section does not reach bankfull elevation, add data.



Apple Branch - Reference Reach
Longitudinal Profile
Main Channel: Station 1+00 - 3+60



$$\frac{101.22 - 98.18}{350 - 100} = \frac{3.04}{250} = 0.012 \text{ ft/ft}$$

Project:	Applebranch - Reference Reach	**Location:**	Cross Section 1
Station:	1+85	**Benchmark description:**	
Date:	8/20/2021		
Photo Reference Location:			

	USGS Grid Coordinates North	USGS Grid Coordinates East	Plan Sheet Ref. No.
Permanent Benchmark Elevation:			
Permanent Benchmark Location:			

Blue cells are instructions and notes. Please read them.
Gray cells are outputs and should be left alone.
Yellow cells are for data input and manipulation
Cells that turn red indicate and error.

Cross Section taken from left to right looking downstream.

If you need additional sheets for more cross sections, just create a copy of the sheet by right clicking on the tab at the bottom of this sheet.

Station	BS (Back-Sight)	HI (Height of Instrument)	FS (Fore-Sight)	Elevation (Height)	"TW", "Bankfull right" and "bankfull left" MUST be entered verbatim in this column for the sheet to work. "TOBL", "TOBR", "TOE L" and TOE R" are recommended.	Bankfull Cross Section: Left End Station	Right End Station	Station	Elevation	Elevation from bankfull	Incremental Avg. Height (ft)	Incremental Distance (ft)	Incremental Area (ft^2)	2 X Bankfull: Station	Distance Between Points
Feet	Feet	Feet	Feet	Feet											
Purple rows are for additional data. Start station 0+00 at the first yellow row.					**Additional data needed if elevation is less than bankfull or 2 x bankfull.**	**Delete values in these columns where the ground elevation falls lower than bankfull outside the bounds of the stated/calculated bankfull station.**									
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
90.83				105.87		-	-	0	0	0	0	0	0	0	0
91.17				102.48	bankfull left	-	-	0	0	0	0	0	0	91.04062	0
93.54				101.94	TOBL	-	-	0	0	0	0	0	0	0	0
95.53				101.24		93.994857	-	93.994857	101.78	0	0	0	0	0	0
96.61				100.53	TOEL	-	-	96.61	100.53	1.25	0.625	2.615143	1.634464	0	2.898529
98.24				100.14		-	-	98.24	100.14	1.64	1.445	1.63	2.35535	0	1.676007
100.00				99.79	TW	-	-	100	99.79	1.99	1.815	1.76	3.1944	0	1.794464
101.35				100.28		-	-	101.35	100.28	1.5	1.745	1.35	2.35575	0	1.436175
104.71				100.33		-	-	104.71	100.33	1.45	1.475	3.36	4.956	0	3.360372
107.17				100.36		-	-	107.17	100.36	1.42	1.435	2.46	3.5301	0	2.460183
109.63				100.17		-	-	109.63	100.17	1.61	1.515	2.46	3.7269	0	2.467326
112.60				100.32	TOER	-	-	112.6	100.32	1.46	1.535	2.97	4.55895	0	2.973785
113.87				101.78		-	113.87	113.87	101.78	0	0.73	1.27	0.9271	0	1.935071
114.75				102.70	TOBR, Bankfull right	-	-	0	0	0	0	0	0	0	0
117.39				103.44		-	-	0	0	0	0	0	0	0	0
124.35				105.39		-	-	0	0	0	0	0	0	118.5678	0
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
					Pull down orange if more rows needed.	-	-	0	0	0	0	0	0	0	0

These numbers are taken from the raw data table. There is no need to change these cells

TW		Bankfull				TOB			
		Left		Right		Left		Right	
Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation
100	99.79	91.17	102.48	114.75	102.7	93.54	101.94	114.75	102.7

You can change the yellow cells below. This is where you can adjust the stations or elevations of the parameters below. The units are +/- feet of offset. The cells can be left blank if you do not wish to make changes.

TW		Bankfull				TOB			
		Left		Right		Left		Right	
Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation
0	0	0	-0.7	0	-0.92	0	0	0	0

These are parameters that are used for morphology calculations, after any adjustments below. There is no need to change these cells.

TW		Bankfull				TOB			
		Left		Right		Left		Right	
Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation
100	99.79	91.17	101.78	114.75	101.78	93.54	101.94	114.75	102.7

Bankfull	
Station	Elevation
93.99486	101.78
113.87	101.78
2xBankfull	
Station	Elevation
91.04	103.77
118.57	103.77

Error, data needed if red

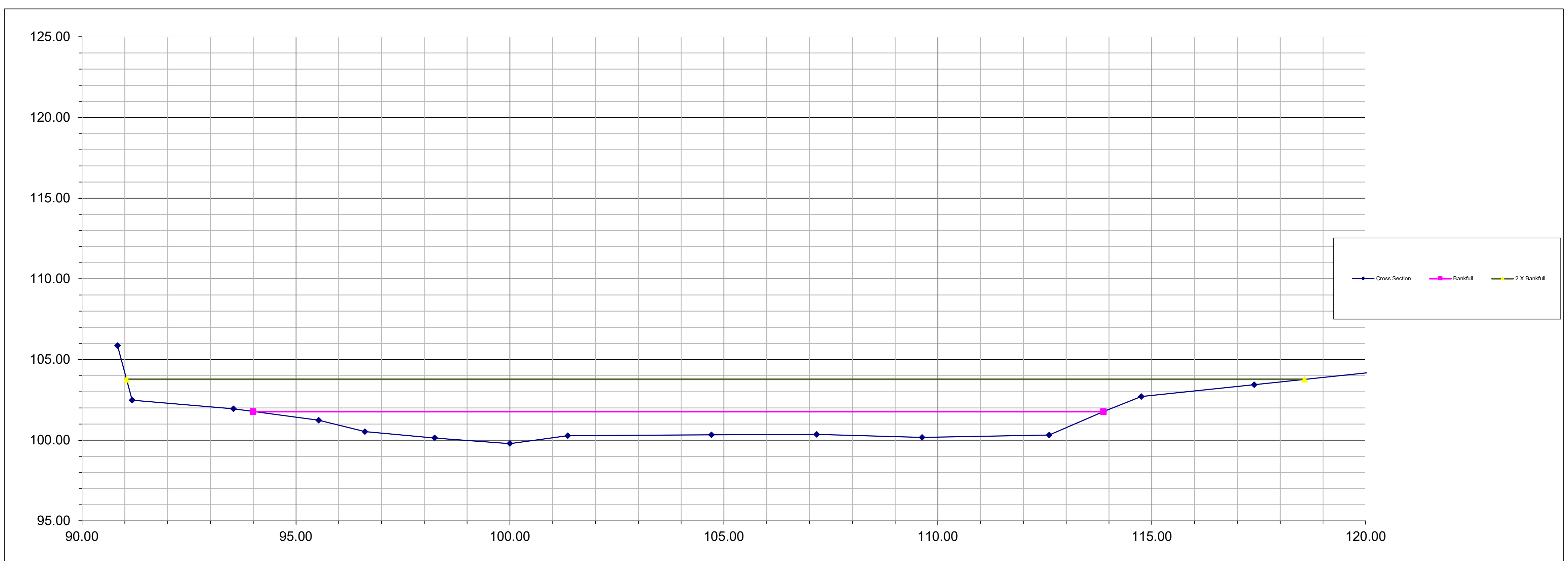
Average Bankfull Elevation (ft)	**101.78**
Bankfull Width (ft)	**19.87514**
Bankfull Area (ft^2)	**27.23901**
Bankfull Wetted Perimeter (ft)	**21.00191**
Bankfull Hydraulic Radius (ft)	**1.296978**
Low Bank Height (ft)	**2.15**
Average PIN Elevation (ft)	**0**

LPIN and RPIN	
Sta	Elev
0	0
0	0

PIN Area
0

Stream Morphology	
Wbkf =	19.875
Abkf =	27.239
dbkf =	1.371
W/D =	14.502
dmbkf =	1.990
Wfpa =	27.527
ER =	1.385
LBH =	2.150
LBH/dmax	1.080
D50 =	
Qbkf =	
DA =	
Slope =	
Sinuosity=	

If red, cross section does not reach bankfull elevation, add data.



Project:	Applebranch - Reference Reach	**Location:**	Cross Section 2
Station:	2+21	**Benchmark description:**	
Date:	8/20/2021		USGS Grid Coordinates: North / East; Plan Sheet Ref. No.
Photo Reference Location:			
Permanent Benchmark Elevation:		**Permanent Benchmark Location:**	

Blue cells are instructions and notes. Please read them.

Gray cells are outputs and should be left alone.

Yellow cells are for data input and manipulation

Cells that turn red indicate and error.

Cross Section taken from left to right looking downstream.

If you need additional sheets for more cross sections, just create a copy of the sheet by right clicking on the tab at the bottom of this sheet.

Station (Feet)	Back-Sight BS (Feet)	Height of Instrument HI (Feet)	Fore-Sight FS (Feet)	Height Elevation (Feet)	"TW", "Bankfull right" and "bankfull left" MUST be entered verbatim in this column for the sheet to work. "TOBL", "TOBR", "TOE L" and TOE R" are recommended.	Bankfull Cross Section: Left End Station	Right End Station	Station	Elevation	Elevation from bankfull	Incremental Avg. Height (ft)	Incremental Distance (ft)	Incremental Area (ft^2)	2 X Bankfull: Station	Distance Between Points
Purple rows are for additional data. Start station 0+00 at the first yellow row.					Additional data needed if elevation is less than bankfull or 2 x bankfull.	Delete values in these columns where the ground elevation falls lower than bankfull outside the bounds of the stated/calculated bankfull station.									
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
80.00				104.85		-	-	0	0	0	0	0	0	0	0
81.92				103.83		-	-	0	0	0	0	0	0	0	0
83.34				102.13	bankfull left	-	-	0	0	0	0	0	0	82.44624	0
85.02				101.22		85.001538	-	85.001538	101.23	0	0	0	0	0	0
85.74				100.48		-	-	85.74	100.48	0.75	0.375	0.738462	0.276923	0	1.052533
88.59				99.98		-	-	88.59	99.98	1.25	1	2.85	2.85	0	2.893527
90.07				99.66	TOEL	-	-	90.07	99.66	1.57	1.41	1.48	2.0868	0	1.514199
94.74				99.72		-	-	94.74	99.72	1.51	1.54	4.67	7.1918	0	4.670385
100.00				99.26	TW	-	-	100	99.26	1.97	1.74	5.26	9.1524	0	5.280076
105.34				99.54	TOER	-	-	105.34	99.54	1.69	1.83	5.34	9.7722	0	5.347336
107.13				100.98		-	-	107.13	100.98	0.25	0.97	1.79	1.7363	0	2.297325
109.01				101.98	TOBR, Bankfull right	-	107.6	107.6	101.23	0	0.125	0.47	0.05875	0	0.532353
112.12				102.64		-	-	0	0	0	0	0	0	0	0
113.51				103.77		-	-	0	0	0	0	0	0	112.8088	0
115.85				105.49		-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
					Pull down orange if more rows needed.	-	-	0	0	0	0	0	0	0	0

These numbers are taken from the raw data table. There is no need to change these cells

TW		Bankfull Left		Bankfull Right		TOB Left		TOB Right	
Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation
100	99.26	83.34	102.13	109.01	101.98	0	0	109.01	101.98

You can change the yellow cells below. This is where you can adjust the stations or elevations of the parameters below. The units are +/- feet of offset. The cells can be left blank if you do not wish to make changes.

TW		Bankfull Left		Bankfull Right		TOB Left		TOB Right	
Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation
0	0	0	-0.9	0	-0.75	0	0	0	0

These are parameters that are used for morphology calculations, after any adjustments below. There is no need to change these cells.

TW		Bankfull Left		Bankfull Right		TOB Left		TOB Right	
Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation
100	99.26	83.34	101.23	109.01	101.23	0	0	109.01	101.98

Bankfull	
Station	Elevation
85.00154	101.23
107.6	101.23
2xBankfull	
Station	Elevation
82.45	103.2
112.81	103.2

Error, data needed if red

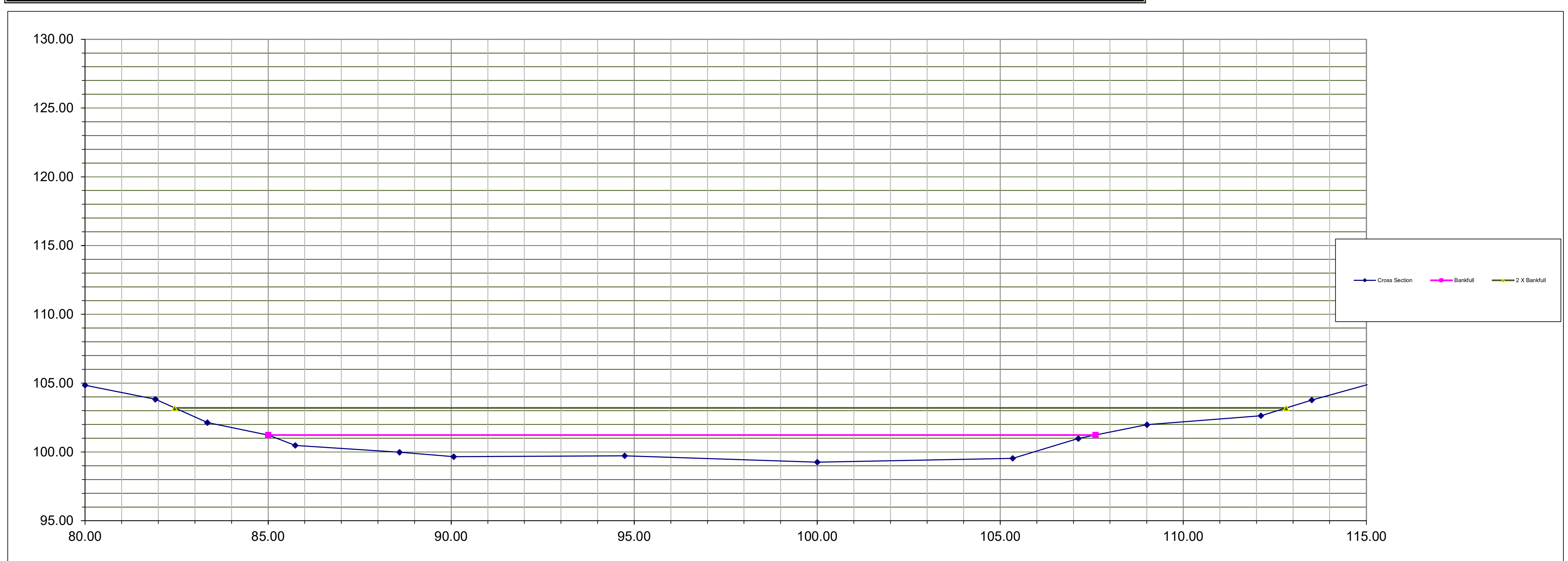
Average Bankfull Elevation (ft)	101.23
Bankfull Width (ft)	22.59846
Bankfull Area (ft^2)	33.12517
Bankfull Wetted Perimeter (ft)	23.58773
Bankfull Hydraulic Radius (ft)	1.404339
Low Bank Height (ft)	-99.26
Average PIN Elevation (ft)	0

LPIN and RPIN	
Sta	Elev
0	0
0	0

PIN Area
0

Stream Morphology	
Wbkf =	22.598
Abkf =	33.125
dbkf =	1.466
W/D =	15.417
dmbkf =	1.970
Wfpa =	30.363
ER =	1.344
LBH =	-99.260
LBH/dmax	-50.386
D50 =	
Qbkf =	
DA =	
Slope =	
Sinuosity=	

If red, cross section does not reach bankfull elevation, add data.



Project:	Applebranch - Reference Reach	**Location:**	Cross Section 3
Station:	2+37	**Benchmark description:**	
Date:	8/20/2021		
Photo Reference Location:			

Permanent Benchmark Elevation:		**Permanent Benchmark Location:**	USGS Grid Coordinates North	East	Plan Sheet Ref. No.

Blue cells are instructions and notes. Please read them.
Gray cells are outputs and should be left alone.
Yellow cells are for data input and manipulation
Cells that turn red indicate and error.

Cross Section taken from left to right looking downstream.

If you need additional sheets for more cross sections, just create a copy of the sheet by right clicking on the tab at the bottom of this sheet.

Station	Back-Sight BS	Height of Instrument HI	Fore-Sight FS	Height Elevation	"TW", "Bankfull right" and "bankfull left" MUST be entered verbatim in this column for the sheet to work. "TOBL", "TOBR", "TOE L" and TOE R" are recommended.	Bankfull Cross Section: Left End Station	Right End Station	Station	Elevation	Elevation from bankfull	Incremental Avg. Height (ft)	Incremental Distance (ft)	Incremental Area (ft^2)	2 X Bankfull: Station	Distance Between Points
Feet	Feet	Feet	Feet	Feet											
Purple rows are for additional data. Start station 0+00 at the first yellow row.					Additional data needed if elevation is less than bankfull or 2 x bankfull.	Delete values in these columns where the ground elevation falls lower than bankfull outside the bounds of the stated/calculated bankfull station.									
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
87.56				104.780		-	-	0	0	0	0	0	0	0	0
88.08				103.740		-	-	0	0	0	0	0	0	0	0
89.12				101.640	bankfull left	-	-	0	0	0	0	0	0	88.30286	0
91.61				100.960		90.621324	-	90.621324	101.23	0	0	0	0	0	0
93.05				100.750	TOBL	-	-	93.05	100.75	0.48	0.24	2.428676	0.582882	0	2.475655
93.95				100.230		-	-	93.95	100.23	1	0.74	0.9	0.666	0	1.039423
96.36				99.480	TOEL	-	-	96.36	99.48	1.75	1.375	2.41	3.31375	0	2.524005
100.00				99.170	TW	-	-	100	99.17	2.06	1.905	3.64	6.9342	0	3.653177
105.11				99.260		-	-	105.11	99.26	1.97	2.015	5.11	10.29665	0	5.110793
107.67				99.740	TOER	-	-	107.67	99.74	1.49	1.73	2.56	4.4288	0	2.604611
108.71				100.240		-	-	108.71	100.24	0.99	1.24	1.04	1.2896	0	1.15395
111.10				100.520		-	-	111.1	100.52	0.71	0.85	2.39	2.0315	0	2.406346
112.00				101.240		-	111.9875	111.9875	101.23	0	0.355	0.8875	0.315063	0	1.136555
114.31				101.970	bankfull right	-	-	0	0	0	0	0	0	0	0
115.77				102.410		-	-	0	0	0	0	0	0	0	0
117.66				105.310		-	-	0	0	0	0	0	0	116.3435	0
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
					Pull down orange if more rows needed.	-	-	0	0	0	0	0	0	0	0

These numbers are taken from the raw data table. There is no need to change these cells

TW		Bankfull				TOB			
		Left		Right		Left		Right	
Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation
100	99.17	89.12	101.64	114.31	101.97	93.05	100.75	0	0

You can change the yellow cells below. This is where you can adjust the stations or elevations of the parameters below. The units are +/- feet of offset. The cells can be left blank if you do not wish to make changes.

TW		Bankfull				TOB			
		Left		Right		Left		Right	
Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation
0	0		-0.41	0	-0.74	0	0	0	0

These are parameters that are used for morphology calculations, after any adjustments below. There is no need to change these cells.

TW		Bankfull				TOB			
		Left		Right		Left		Right	
Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation
100	99.17	89.12	101.23	114.31	101.23	93.05	100.75	0	0

Bankfull	
Station	Elevation
90.62132	101.23
111.9875	101.23
2xBankfull	
Station	Elevation
88.30	103.29
116.34	103.29

Error, data needed if red

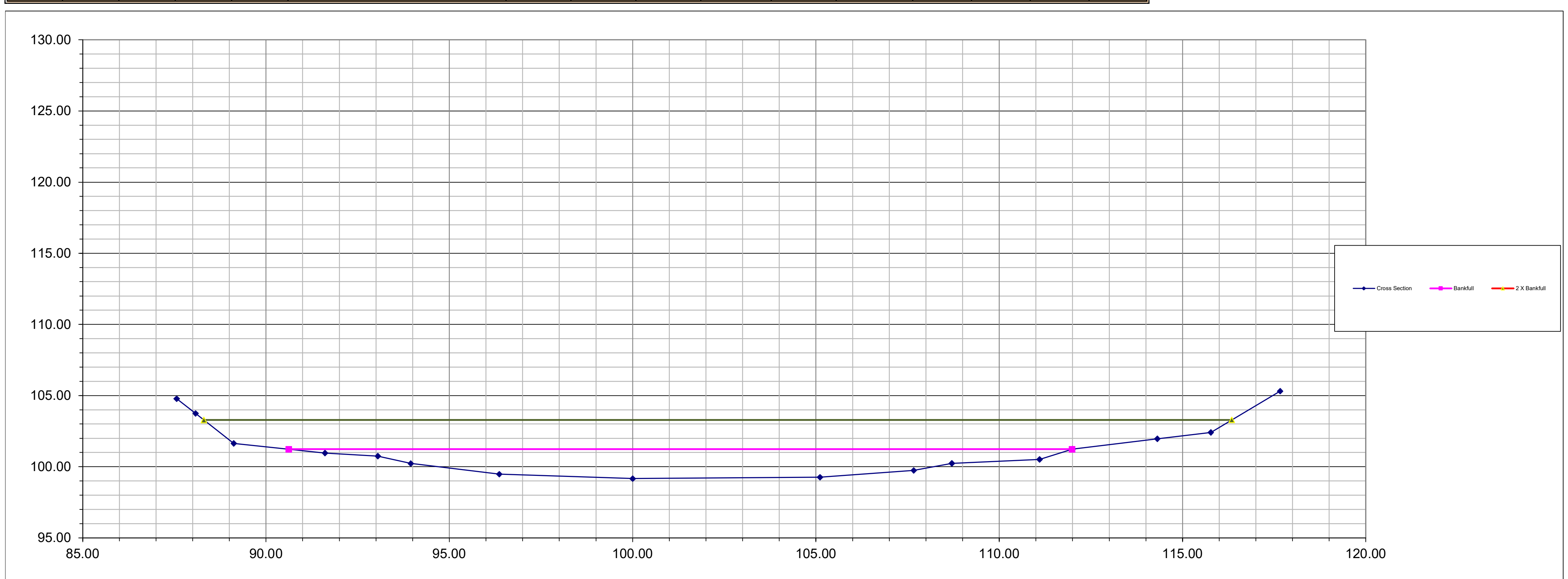
Average Bankfull Elevation (ft)	**101.23**
Bankfull Width (ft)	**21.36618**
Bankfull Area (ft^2)	**29.85844**
Bankfull Wetted Perimeter (ft)	**22.10451**
Bankfull Hydraulic Radius (ft)	**1.350785**
Low Bank Height (ft)	**-99.17**
Average PIN Elevation (ft)	**0**

LPIN and RPIN	
Sta	Elev
0	0
0	0

PIN Area
0

Stream Morphology	
Wbkf =	21.366
Abkf =	29.858
dbkf =	1.397
W/D =	15.289
dmbkf =	2.060
Wfpa =	28.041
ER =	1.312
LBH =	-99.170
LBH/dmax	-48.141
D50 =	
Qbkf =	
DA =	
Slope =	
Sinuosity=	

If red, cross section does not reach bankfull elevation, add data.



Project:	Applebranch - Reference Reach	**Location:**	Cross Section 4
Station:	2+65	**Benchmark description:**	
Date:	8/20/2021		
Photo Reference Location:			

	USGS Grid Coordinates North	USGS Grid Coordinates East	Plan Sheet Ref. No.
Permanent Benchmark Elevation:			
Permanent Benchmark Location:			

Blue cells are instructions and notes. Please read them.
Gray cells are outputs and should be left alone.
Yellow cells are for data input and manipulation
Cells that turn red indicate and error.

Cross Section taken from left to right looking downstream.

If you need additional sheets for more cross sections, just create a copy of the sheet by right clicking on the tab at the bottom of this sheet.

"TW", "Bankfull right" and "bankfull left" MUST be entered verbatim in this column for the sheet to work. "TOBL", "TOBR", "TOE L" and TOE R" are recommended.

Purple rows are for additional data. Start station 0+00 at the first yellow row.

Additional data needed if elevation is less than bankfull or 2 x bankfull.

Delete values in these columns where the ground elevation falls lower than bankfull outside the bounds of the stated/calculated bankfull station.

Station (Feet)	Back-Sight BS (Feet)	Height of Instrument HI (Feet)	Fore-Sight FS (Feet)	Height Elevation (Feet)	Notes	Bankfull Cross Section: Left End Station	Right End Station	Station	Elevation	Elevation from bankfull	Incremental Avg. Height (ft)	Incremental Distance (ft)	Incremental Area (ft^2)	2 X Bankfull Station	Distance Between Points
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
86.31				104.820		-	-	0	0	0	0	0	0	0	0
87.64				101.000	bankfull left	-	-	0	0	0	0	0	0	87.05856	0
89.42				100.770		-	-	89.42	100.77	0	0	0	0	0	0
91.68				99.480		89.42	-	91.68	99.48	1.29	0.645	2.26	1.4577	0	2.602249
94.88				99.140	TOEL	-	-	94.88	99.14	1.63	1.46	3.2	4.672	0	3.218012
100.00				98.870	TW	-	-	100	98.87	1.9	1.765	5.12	9.0368	0	5.127114
103.43				99.220	TOER	-	-	103.43	99.22	1.55	1.725	3.43	5.91675	0	3.447811
106.23				99.870		-	-	106.23	99.87	0.9	1.225	2.8	3.43	0	2.874456
107.97				100.280		-	-	107.97	100.28	0.49	0.695	1.74	1.2093	0	1.787652
109.65				101.120		-	108.95	108.95	100.77	0	0.245	0.98	0.2401	0	1.095673
111.85				101.700	Bankfull right	-	-	0	0	0	0	0	0	0	0
114.22				102.540		-	-	0	0	0	0	0	0	0	0
115.27				104.280		-	-	0	0	0	0	0	0	114.2984	0
116.32				106.020		-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
					Pull down orange if more rows needed.	-	-	0	0	0	0	0	0	0	0

These numbers are taken from the raw data table. There is no need to change these cells

TW		Bankfull				TOB			
		Left		Right		Left		Right	
Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation
100	98.87	87.64	101	111.85	101.7	0	0	0	0

You can change the yellow cells below. This is where you can adjust the stations or elevations of the parameters below. The units are +/- feet of offset. The cells can be left blank if you do not wish to make changes.

TW		Bankfull				TOB			
		Left		Right		Left		Right	
Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation
0	0	0	-0.23	0	-0.93	0	0	0	0

These are parameters that are used for morphology calculations, after any adjustments below. There is no need to change these cells.

TW		Bankfull				TOB			
		Left		Right		Left		Right	
Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation
100	98.87	87.64	100.77	111.85	100.77	0	0	0	0

Bankfull	
Station	Elevation
89.42	100.77
108.95	100.77
2xBankfull	
Station	Elevation
87.06	102.67
114.30	102.67

Error, data needed if red

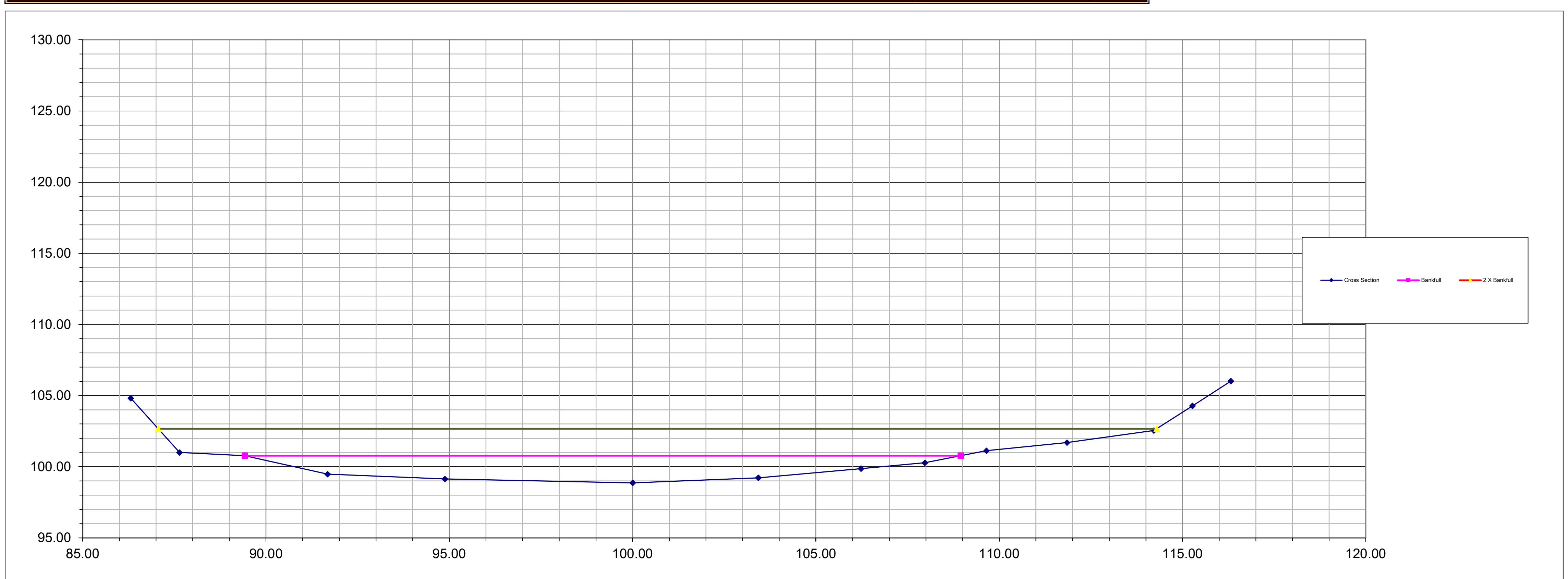
Average Bankfull Elevation (ft)	**100.77**
Bankfull Width (ft)	**19.53**
Bankfull Area (ft^2)	**25.96265**
Bankfull Wetted Perimeter (ft)	**20.15297**
Bankfull Hydraulic Radius (ft)	**1.288279**
Low Bank Height (ft)	**-98.87**
Average PIN Elevation (ft)	**0**

LPIN and RPIN	
Sta	Elev
0	0
0	0

PIN Area
0

Stream Morphology	
Wbkf =	19.530
Abkf =	25.963
dbkf =	1.329
W/D =	14.691
dmbkf =	1.900
Wfpa =	27.240
ER =	1.395
LBH =	-98.870
LBH/dmax	-52.037
D50 =	
Qbkf =	
DA =	
Slope =	
Sinuosity=	

If red, cross section does not reach bankfull elevation, add data.



Project:	Applebranch - Reference Reach	**Location:**	Cross Section 5
Station:	3+09	**Benchmark description:**	
Date:	8/20/2021		USGS Grid Coordinates (North, East); Plan Sheet Ref. No.
Photo Reference Location:			
Permanent Benchmark Elevation:		**Permanent Benchmark Location:**	

Blue cells are instructions and notes. Please read them.
Gray cells are outputs and should be left alone.
Yellow cells are for data input and manipulation
Cells that turn red indicate and error.

Cross Section taken from left to right looking downstream.

If you need additional sheets for more cross sections, just create a copy of the sheet by right clicking on the tab at the bottom of this sheet.

Station (Feet)	Back-Sight BS (Feet)	Height of Instrument HI (Feet)	Fore-Sight FS (Feet)	Height Elevation (Feet)	"TW", "Bankfull right" and "bankfull left" MUST be entered verbatim in this column for the sheet to work. "TOBL", "TOBR", "TOE L" and TOE R" are recommended.	Bankfull Cross Section: Left End Station	Right End Station	Station	Elevation	Elevation from bankfull	Incremental Avg. Height (ft)	Incremental Distance (ft)	Incremental Area (ft^2)	2 X Bankfull: Station	Distance Between Points
Purple rows are for additional data. Start station 0+00 at the first yellow row.					**Additional data needed if elevation is less than bankfull or 2 x bankfull.**	**Delete values in these columns where the ground elevation falls lower than bankfull outside the bounds of the stated/calculated bankfull station.**									
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
82.30				103.920		-	-	0	0	0	0	0	0	0	0
84.05				102.970		-	-	0	0	0	0	0	0	0	0
85.80				102.020		-	-	0	0	0	0	0	0	84.75	0
86.22				101.150		-	-	0	0	0	0	0	0	0	0
88.65				100.620	TOBL, Bankfull left	88.627075	-	88.627075	100.625	0	0	0	0	0	0
91.78				99.240	TOEL	-	-	91.78	99.24	1.385	0.6925	3.152925	2.1834	0	3.443713
96.53				99.040		-	-	96.53	99.04	1.585	1.485	4.75	7.05375	0	4.754209
100.00				98.720	TW	-	-	100	98.72	1.905	1.745	3.47	6.05515	0	3.484724
104.76				98.690	TOER	-	-	104.76	98.69	1.935	1.92	4.76	9.1392	0	4.760095
106.70				100.330	bankfull right	-	-	106.7	100.33	0.295	1.115	1.94	2.1631	0	2.540315
111.59				101.560		-	107.8728	107.8728	100.625	0	0.1475	1.172805	0.172989	0	1.209337
112.82				103.300		-	-	0	0	0	0	0	0	112.3181	0
114.05				105.040		-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
						-	-	0	0	0	0	0	0	0	0
					Pull down orange if more rows needed.	-	-	0	0	0	0	0	0	0	0

These numbers are taken from the raw data table. There is no need to change these cells

TW		Bankfull				TOB			
		Left		Right		Left		Right	
Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation
100	98.72	88.65	100.62	106.7	100.33	88.65	100.62	0	0

You can change the yellow cells below. This is where you can adjust the stations or elevations of the parameters below. The units are +/- feet of offset. The cells can be left blank if you do not wish to make changes.

TW		Bankfull				TOB			
		Left		Right		Left		Right	
Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation
0	0	0	0	0	0.3	0	0	0	0

These are parameters that are used for morphology calculations, after any adjustments below. There is no need to change these cells.

TW		Bankfull				TOB			
		Left		Right		Left		Right	
Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation
100	98.72	88.65	100.62	106.7	100.63	88.65	100.62	0	0

Bankfull	
Station	Elevation
88.62708	100.625
107.8728	100.625
2xBankfull	
Station	Elevation
84.75	102.59
112.32	102.59

Error, data needed if red

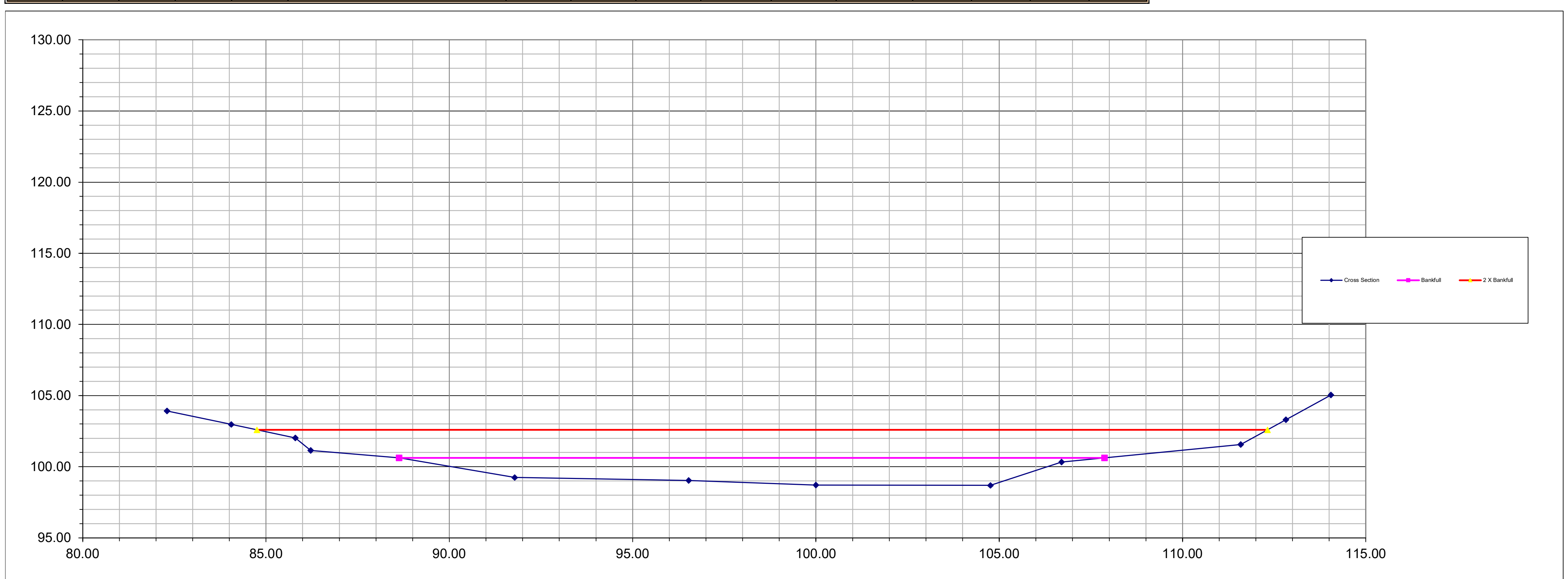
Average Bankfull Elevation (ft)	**100.625**
Bankfull Width (ft)	**19.24573**
Bankfull Area (ft^2)	**26.76759**
Bankfull Wetted Perimeter (ft)	**20.19239**
Bankfull Hydraulic Radius (ft)	**1.325627**
Low Bank Height (ft)	**-98.72**
Average PIN Elevation (ft)	**0**

LPIN and RPIN	
Sta	Elev
0	0
0	0

PIN Area
0

Stream Morphology	
Wbkf =	19.246
Abkf =	26.768
dbkf =	1.391
W/D =	13.838
dmbkf =	1.935
Wfpa =	27.568
ER =	1.432
LBH =	-98.720
LBH/dmax	-51.018
D50 =	
Qbkf =	
DA =	
Slope =	
Sinuosity=	

If red, cross section does not reach bankfull elevation, add data.



APPENDIX B
HYDROLOGY

Land Use Map
Watershed Connectivity Map
Soil Map
NRCS Curve Number - Apple Branch
NRCS Curve Number - Arnett Boulevard
Overland Flow Tc & T-Lag
Dan River DS Boundary Condition - Tropical Storm Michael
Pattern Curve - Tropical Storm Michael Storm
Pattern Curve - May 18, 2018 Storm
Precipitation Frequency Data
StreamStats Output Data 10-14-2021
HEC-HMS Hydrology Summary - Tropical Storm Michael
100-year Storm HMS Hydrology Summary
25-year Storm HMS Hydrology Summary

LAND USE LEGEND

- LAND USE - FOREST
- LAND USE - PASTURE
- LAND USE - COMMERCIAL
- LAND USE - RESIDENTIAL 1
- LAND USE - RESIDENTIAL 0.5
- LAND USE - RESIDENTIAL 0.33
- LAND USE - RESIDENTIAL 0.25
- LAND USE - RESIDENTIAL 0.125
- LAND USE - ROOF AND PAVEMENT
- NEWLY GRADED
- AUDUBON DRIVE DRAINAGE AREA
- ARNETT BLVD DRAINAGE AREA

DA-16
DA-17
DA-14
DA-18
ARNETT DRIVE
DRAINAGE AREA
DA-11
DA-15
DA-9
DA-18D
DA-18C
DA-18E
DA-18B
DA-18G
DA-18A
DA-13
DA-7
ARNETT BLVD
DA-18F
DA-1a
DAN RIVER
DA-1
DA-10
DA-12
DA-5
DA-3
DA-2
DA-8
AUDUBON DR
CENTRAL BLVD
RIVERSIDE DR
DA-6
DA-4
APOLLO AVE
CENTRAL BLVD

SCALE 1"=500'
0 500' 1000'

THIS DRAWING PREPARED AT THE
RALEIGH OFFICE
5410 Trinity Road, Suite 102 Raleigh, NC 27607
TEL 919.866.4951 FAX 919.833.8124 www.timmons.com
North Carolina License No. C-1652

YOUR VISION ACHIEVED THROUGH OURS.

TIMMONS GROUP

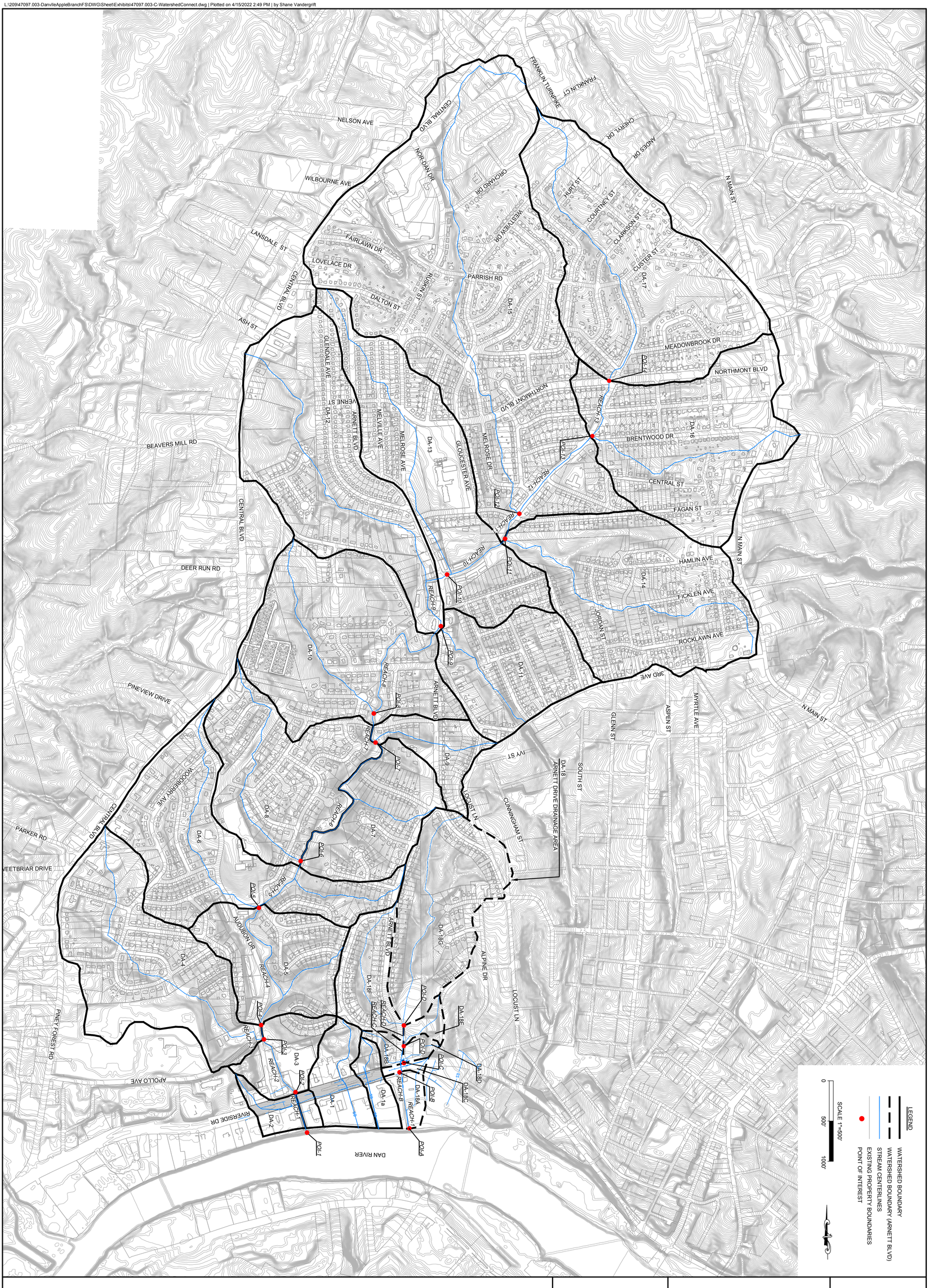
APPLEBRANCH WATERSHED STUDY

CITY OF DANVILLE - VIRGINIA

LAND USE MAP

REVISION DESCRIPTION	DATE

DATE	4-18-2022
DRAWN BY	A. WILLARD
DESIGNED BY	A. ASFAW
CHECKED BY	B. WARD
SCALE	1"=500'
JOB NO.	47997
SHEET NO.	1



TIMMONS GROUP

YOUR VISION ACHIEVED THROUGH OURS.

THIS DRAWING PREPARED AT THE
RALEIGH OFFICE
5410 Trinity Road, Suite 102 | Raleigh, NC 27607
TEL 919.866.4951 FAX 919.833.8124 www.timmons.com
North Carolina License No. C-1652

SHEET NO.	JOB NO.
1	47997

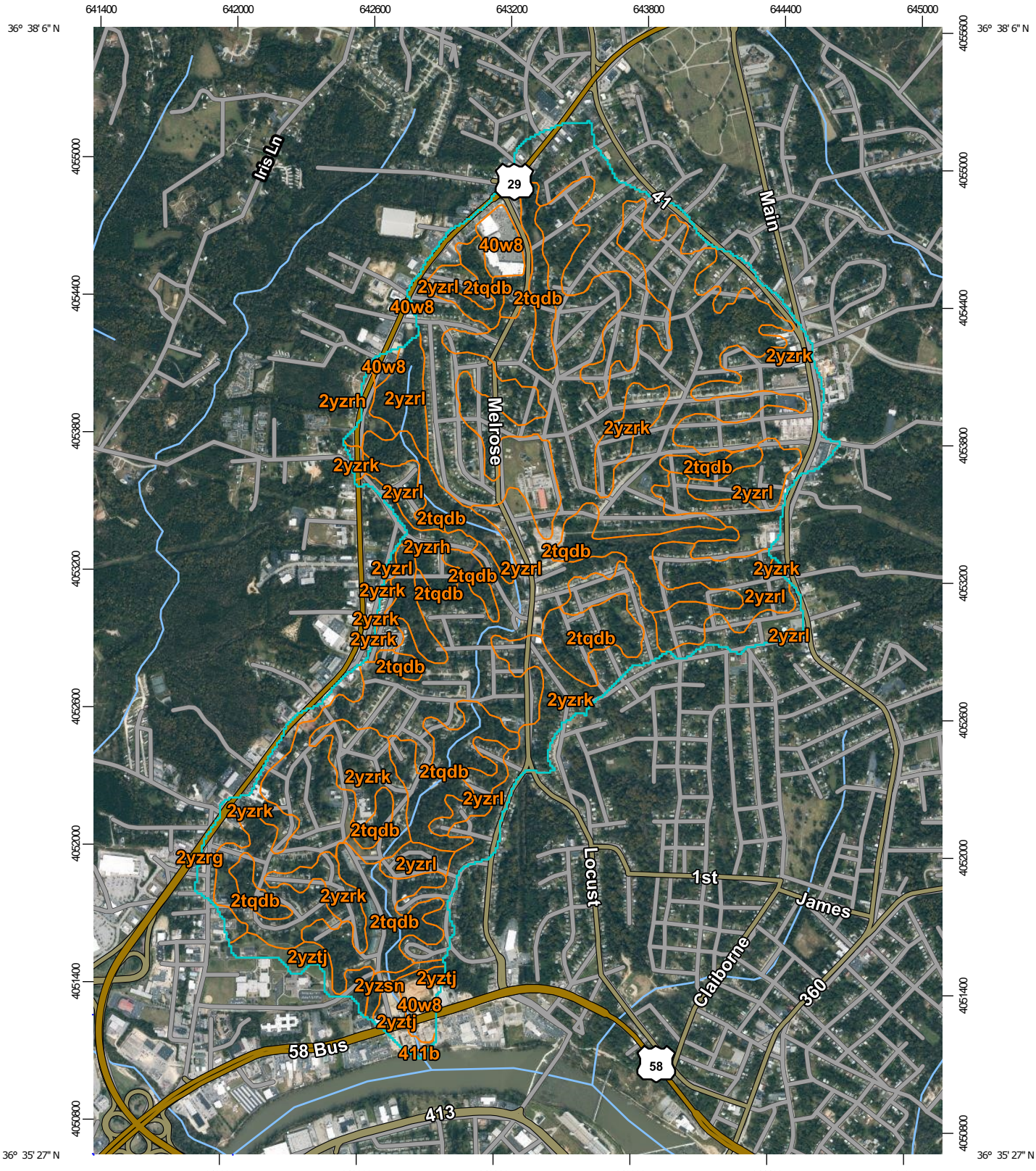
APPLEBRANCH WATERSHED STUDY

CITY OF DANVILLE - VIRGINIA

WATERSHED CONNECTIVITY MAP

SCALE	CHECKED BY	DESIGNED BY	DRAWN BY	DATE
1"=500'	B. WARD	A. ASFAW	A. WILLARD	4-8-2022

DATE	REVISION DESCRIPTION



Map Scale: 1:24,000 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 350 700 1400 2100

Feet: 0 1000 2000 4000 6000

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 Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

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.

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: Pittsylvania County and the City of Danville, Virginia
Survey Area Data: Version 13, Jun 5, 2020

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

Date(s) aerial images were photographed: Oct 24, 2018—Oct 30, 2018

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.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
2tqdb	Fairview fine sandy loam, 15 to 25 percent slopes	232.7	17.9%
2yzrg	Clifford sandy loam, 7 to 15 percent slopes	0.0	0.0%
2yzrh	Clifford sandy clay loam, 2 to 7 percent slopes, severely eroded	22.2	1.7%
2yzrk	Clifford-Urban land complex, 2 to 7 percent slopes	444.5	34.2%
2yzrl	Clifford-Urban land complex, 7 to 20 percent slopes	540.2	41.6%
2yzsn	Fairview fine sandy loam, 25 to 45 percent slopes	4.8	0.4%
2yztj	Udorthents, loamy, 0 to 15 percent slopes	30.6	2.4%
40w8	Urban land	24.3	1.9%
411b	Water	0.5	0.0%
Totals for Area of Interest		**1,299.8**	**100.0%**

HYDROLOGY - NRCS CURVE NUMBER

Project Name:	Applebranch
Project Number:	47097.003
Location:	City of Danville, Virginia
Date:	4/18/2022
Prepared by:	Alston Willard, EIT
Checked by:	Abrham Asfaw, PE
Existing or Proposed:	EXISTING
Catchment:	EX-DA-1a

TIMMONS GROUP
YOUR VISION ACHIEVED THROUGH OURS.

I. SUBBASIN SOIL CHARACTERISTICS

	AREA	
	ac	**%**
HSG 'A'	0.00	0%
HSG 'B'	0.00	0%
HSG 'C'	0.00	0%
HSG 'D'	7.76	100%

	7.76	**ac**
TOTAL AREA	**338203**	**sq ft**
	0.012131	**sq mi**

II. SUBBASIN LAND COVER CONDITIONS

COVER DESCRIPTION	AREA				
	TOTAL (AC)	**HSG 'A' (SQ.FT.)**	**HSG 'B' (SQ.FT.)**	**HSG 'C' (SQ.FT.)**	**HSG 'D' (SQ.FT.)**
Open Space (lawns, parks, golf courses, etc.)					
Poor Condition (<50% grass cover)	0.00	0	0	0	0
Fair Condition (50% to 75% grass cover)	0.00	0	0	0	0
Good Condition (>75% grass cover)	0.00	0	0	0	0
Impervious Areas					
Paved parking lots, roofs, driveways, etc.	0.00	0	0	0	0
Streets and roads:					
Paved; curbs and storm sewers	1.06	0	0	0	46065
Paved; open ditches	0.00	0	0	0	0
Gravel	0.00	0	0	0	0
Dirt	0.00	0	0	0	0
Urban Districs					
Commerical and business	4.77	0	0	0	207873
Industrial	0.00	0	0	0	0
Residential districts by average lot size:					
1/8 acre or less (town houses)	0.00	0	0	0	0
1/4 acre	0.00	0	0	0	0
1/3 acre	0.00	0	0	0	0
1/2 acre	0.00	0	0	0	0
1 acre	0.00	0	0	0	0
2 acre	0.00	0	0	0	0
Developing Urban Areas					
Newly graded areas	0.00	0	0	0	0
Pasture (<50% ground cover or heavily grazed)	0.00	0	0	0	0
Pasture (50% to 75% ground cover or not heavily grazed)	0.00	0	0	0	0
Pasture (>75% ground cover or lightly grazed)	0.00	0	0	0	0
Meadow - continuous grass, protected from grazing and generally mowed for hay	0.00	0	0	0	0
Brush (<50% ground cover)	0.00	0	0	0	0
Brush (50% to 75% ground cover)	0.00	0	0	0	0
Brush (>75% ground cover)	0.00	0	0	0	0

	Woods (Forest litter, small trees, and brush destroyed by heavy grazing or regular burning)	0.00	0	0	0	0
	Woods (Woods are grazed but not burned, and some forest litter covers the soil)	1.93	0	0	0	84265
	Woods (Woods are protected from grazing, and litter and brush adequately cover the soil)	0.00	0	0	0	0
	TOTAL (AC)	7.76	0.00	0.00	0.00	7.76

III. SCS CURVE NUMBER CALCULATION

COVER DESCRIPTION (Source: NCDEQ Stormwater MDC)	SCS CN			
	HSG 'A'	HSG 'B'	HSG 'C'	HSG 'D'
Open Space (lawns, parks, golf courses, etc.)				
Poor Condition (<50% grass cover)	68	79	86	89
Fair Condition (50% to 75% grass cover)	49	69	79	84
Good Condition (>75% grass cover)	39	61	74	80
Impervious Areas				
Paved parking lots, roofs, driveways, etc.	98	98	98	98
Streets and roads:				
Paved; curbs and storm sewers	98	98	98	98
Paved; open ditches	83	89	98	98
Gravel	76	85	89	91
Dirt	72	82	85	88
Urban Districts				
Commerical and business	89	92	94	95
Industrial	81	88	91	93
Residential districts by average lot size:				
1/8 acre or less (town houses)	77	85	90	92
1/4 acre	61	75	83	87
1/3 acre	57	72	81	86
1/2 acre	54	70	80	85
1 acre	51	68	79	84
2 acre	46	65	77	82
Developing Urban Areas				
Newly graded areas	77	86	91	94
Pasture (<50% ground cover or heavily grazed)	68	79	86	89
Pasture (50% to 75% ground cover or not heavily grazed)	49	69	79	84
Pasture (>75% ground cover or lightly grazed)	39	61	74	80
Meadow - continuous grass, protected from grazing and generally mowed for hay	30	58	71	78
Brush (<50% ground cover)	48	67	77	83
Brush (50% to 75% ground cover)	35	56	70	77
Brush (>75% ground cover)	30	48	65	73
Woods (Forest litter, small trees, and brush destroyed by heavy grazing or regular burning)	45	66	77	83
Woods (Woods are grazed but not burned, and some forest litter covers the soil)	36	60	73	79
Woods (Woods are protected from grazing, and litter and brush adequately cover the soil)	30	55	70	77
	0	**0**	**0**	**710**
COMPOSITE SCS CN	**91**			
% Impervious	**593310%**			

HYDROLOGY - NRCS CURVE NUMBER

Project Name:	Applebranch
Project Number:	47097.003
Location:	City of Danville, Virginia
Date:	10/15/2021
Prepared by:	Alston Willard, EIT
Checked by:	Abrham Asfaw, PE
Existing or Proposed:	EXISTING
Catchment:	EX-DA-2

TIMMONS GROUP
YOUR VISION ACHIEVED THROUGH OURS.

I. SUBBASIN SOIL CHARACTERISTICS

	AREA	
	ac	%
HSG 'A'	0.00	0%
HSG 'B'	0.00	0%
HSG 'C'	0.00	0%
HSG 'D'	6.78	100%

	6.78	**ac**
TOTAL AREA	**295244**	**sq ft**
	0.010590	**sq mi**

II. SUBBASIN LAND COVER CONDITIONS

COVER DESCRIPTION	AREA				
	TOTAL (AC)	HSG 'A' (SQ.FT.)	HSG 'B' (SQ.FT.)	HSG 'C' (SQ.FT.)	HSG 'D' (SQ.FT.)
Open Space (lawns, parks, golf courses, etc.)					
Poor Condition (<50% grass cover)	0.00	0	0	0	0
Fair Condition (50% to 75% grass cover)	0.00	0	0	0	0
Good Condition (>75% grass cover)	0.00	0	0	0	0
Impervious Areas					
Paved parking lots, roofs, driveways, etc.	1.77	0	0	0	77000
Streets and roads:					
Paved; curbs and storm sewers	0.00	0	0	0	0
Paved; open ditches	0.00	0	0	0	0
Gravel	0.00	0	0	0	0
Dirt	0.00	0	0	0	0
Urban Districs					
Commerical and business	4.44	0	0	0	193244
Industrial	0.00	0	0	0	0
Residential districts by average lot size:					
Apartment complex	0.00	0	0	0	0
1/4 acre	0.00	0	0	0	0
1/3 acre	0.00	0	0	0	0
1/2 acre	0.00	0	0	0	0
1 acre	0.00	0	0	0	0
2 acre	0.00	0	0	0	0
Developing Urban Areas					
Newly graded areas	0.00	0	0	0	0
Pasture (<50% ground cover or heavily grazed)	0.00	0	0	0	0
Pasture (50% to 75% ground cover or not heavily grazed)	0.00	0	0	0	0
Pasture (>75% ground cover or lightly grazed)	0.00	0	0	0	0
Meadow - continuous grass, protected from grazing and generally mowed for hay	0.00	0	0	0	0
Brush (<50% ground cover)	0.00	0	0	0	0
Brush (50% to 75% ground cover)	0.00	0	0	0	0
Brush (>75% ground cover)	0.00	0	0	0	0

	Woods (Forest litter, small trees, and brush destroyed by heavy grazing or regular burning)	0.00	0	0	0	0
	Woods (Woods are grazed but not burned, and some forest litter covers the soil)	0.57	0	0	0	25000
	Woods (Woods are protected from grazing, and litter and brush adequately cover the soil)	0.00	0	0	0	0
	TOTAL (AC)	6.78	0.00	0.00	0.00	6.78

III. SCS CURVE NUMBER CALCULATION

COVER DESCRIPTION (Source: NCDEQ Stormwater MDC)	SCS CN			
	HSG 'A'	HSG 'B'	HSG 'C'	HSG 'D'
Open Space (lawns, parks, golf courses, etc.)				
Poor Condition (<50% grass cover)	68	79	86	89
Fair Condition (50% to 75% grass cover)	49	69	79	84
Good Condition (>75% grass cover)	39	61	74	80
Impervious Areas				
Paved parking lots, roofs, driveways, etc.	98	98	98	98
Streets and roads:				
Paved; curbs and storm sewers	93	93	93	98
Paved; open ditches	83	89	98	98
Gravel	76	85	89	91
Dirt	72	82	85	88
Urban Districts				
Commerical and business	89	92	94	95
Industrial	81	88	91	93
Residential districts by average lot size:				
Apartment complex	77	85	90	92
1/4 acre	61	75	83	87
1/3 acre	57	72	81	86
1/2 acre	54	70	80	85
1 acre	51	68	79	84
2 acre	46	65	77	82
Developing Urban Areas				
Newly graded areas	77	86	91	94
Pasture (<50% ground cover or heavily grazed)	68	79	86	89
Pasture (50% to 75% ground cover or not heavily grazed)	49	69	79	84
Pasture (>75% ground cover or lightly grazed)	39	61	74	80
Meadow - continuous grass, protected from grazing and generally mowed for hay	30	58	71	78
Brush (<50% ground cover)	48	67	77	83
Brush (50% to 75% ground cover)	35	56	70	77
Brush (>75% ground cover)	30	48	65	73
Woods (Forest litter, small trees, and brush destroyed by heavy grazing or regular burning)	45	66	77	83
Woods (Woods are grazed but not burned, and some forest litter covers the soil)	36	60	73	79
Woods (Woods are protected from grazing, and litter and brush adequately cover the soil)	30	55	70	77
	0	**0**	**0**	**640**
COMPOSITE SCS CN	**94**			
% Impervious	**1136050%**			

HYDROLOGY - NRCS CURVE NUMBER

Project Name:	Applebranch
Project Number:	47097.003
Location:	City of Danville, Virginia
Date:	10/15/2021
Prepared by:	Alston Willard, EIT
Checked by:	Abrham Asfaw, PE
Existing or Proposed:	EXISTING
Catchment:	EX-DA-2a

TIMMONS GROUP
YOUR VISION ACHIEVED THROUGH OURS.

I. SUBBASIN SOIL CHARACTERISTICS

	AREA	
	ac	%
HSG 'A'	0.00	0%
HSG 'B'	0.00	0%
HSG 'C'	0.00	0%
HSG 'D'	2.33	100%

	2.33	**ac**
TOTAL AREA	**101557**	**sq ft**
	0.003643	**sq mi**

II. SUBBASIN LAND COVER CONDITIONS

COVER DESCRIPTION	AREA				
	TOTAL (AC)	HSG 'A' (SQ.FT.)	HSG 'B' (SQ.FT.)	HSG 'C' (SQ.FT.)	HSG 'D' (SQ.FT.)
Open Space (lawns, parks, golf courses, etc.)					
Poor Condition (<50% grass cover)	0.00	0	0	0	0
Fair Condition (50% to 75% grass cover)	0.00	0	0	0	0
Good Condition (>75% grass cover)	0.00	0	0	0	0
Impervious Areas					
Paved parking lots, roofs, driveways, etc.	0.63	0	0	0	27630
Streets and roads:					
Paved; curbs and storm sewers	0.00	0	0	0	0
Paved; open ditches	0.00	0	0	0	0
Gravel	0.00	0	0	0	0
Dirt	0.00	0	0	0	0
Urban Districs					
Commerical and business	1.70	0	0	0	73927
Industrial	0.00	0	0	0	0
Residential districts by average lot size:					
Apartment complex	0.00	0	0	0	0
1/4 acre	0.00	0	0	0	0
1/3 acre	0.00	0	0	0	0
1/2 acre	0.00	0	0	0	0
1 acre	0.00	0	0	0	0
2 acre	0.00	0	0	0	0
Developing Urban Areas					
Newly graded areas	0.00	0	0	0	0
Pasture (<50% ground cover or heavily grazed)	0.00	0	0	0	0
Pasture (50% to 75% ground cover or not heavily grazed)	0.00	0	0	0	0
Pasture (>75% ground cover or lightly grazed)	0.00	0	0	0	0
Meadow - continuous grass, protected from grazing and generally mowed for hay	0.00	0	0	0	0
Brush (<50% ground cover)	0.00	0	0	0	0
Brush (50% to 75% ground cover)	0.00	0	0	0	0
Brush (>75% ground cover)	0.00	0	0	0	0

	Woods (Forest litter, small trees, and brush destroyed by heavy grazing or regular burning)	0.00	0	0	0	0
	Woods (Woods are grazed but not burned, and some forest litter covers the soil)	0.00	0	0	0	0
	Woods (Woods are protected from grazing, and litter and brush adequately cover the soil)	0.00	0	0	0	0
	TOTAL (AC)	2.33	0.00	0.00	0.00	2.33

III. SCS CURVE NUMBER CALCULATION

COVER DESCRIPTION (Source: NCDEQ Stormwater MDC)	SCS CN			
	HSG 'A'	HSG 'B'	HSG 'C'	HSG 'D'
Open Space (lawns, parks, golf courses, etc.)				
Poor Condition (<50% grass cover)	68	79	86	89
Fair Condition (50% to 75% grass cover)	49	69	79	84
Good Condition (>75% grass cover)	39	61	74	80
Impervious Areas				
Paved parking lots, roofs, driveways, etc.	98	98	98	98
Streets and roads:				
Paved; curbs and storm sewers	93	93	93	98
Paved; open ditches	83	89	98	98
Gravel	76	85	89	91
Dirt	72	82	85	88
Urban Districts				
Commerical and business	89	92	94	95
Industrial	81	88	91	93
Residential districts by average lot size:				
Apartment complex	77	85	90	92
1/4 acre	61	75	83	87
1/3 acre	57	72	81	86
1/2 acre	54	70	80	85
1 acre	51	68	79	84
2 acre	46	65	77	82
Developing Urban Areas				
Newly graded areas	77	86	91	94
Pasture (<50% ground cover or heavily grazed)	68	79	86	89
Pasture (50% to 75% ground cover or not heavily grazed)	49	69	79	84
Pasture (>75% ground cover or lightly grazed)	39	61	74	80
Meadow - continuous grass, protected from grazing and generally mowed for hay	30	58	71	78
Brush (<50% ground cover)	48	67	77	83
Brush (50% to 75% ground cover)	35	56	70	77
Brush (>75% ground cover)	30	48	65	73
Woods (Forest litter, small trees, and brush destroyed by heavy grazing or regular burning)	45	66	77	83
Woods (Woods are grazed but not burned, and some forest litter covers the soil)	36	60	73	79
Woods (Woods are protected from grazing, and litter and brush adequately cover the soil)	30	55	70	77
	0	**0**	**0**	**223**
COMPOSITE SCS CN	**96**			
% Impervious	**1185111%**			

HYDROLOGY - NRCS CURVE NUMBER

Project Name:	Applebranch
Project Number:	47097.003
Location:	City of Danville, Virginia
Date:	10/15/2021
Prepared by:	Alston Willard, EIT
Checked by:	Abrham Asfaw, PE
Existing or Proposed:	EXISTING
Catchment:	EX-DA-3

TIMMONS GROUP
YOUR VISION ACHIEVED THROUGH OURS.

I. SUBBASIN SOIL CHARACTERISTICS

	AREA	
	ac	**%**
HSG 'A'	0.00	0%
HSG 'B'	9.10	49%
HSG 'C'	0.00	0%
HSG 'D'	9.58	51%

	18.68	**ac**
TOTAL AREA	**813797**	**sq ft**
	0.029191	**sq mi**

II. SUBBASIN LAND COVER CONDITIONS

COVER DESCRIPTION	AREA				
	TOTAL (AC)	**HSG 'A' (SQ.FT.)**	**HSG 'B' (SQ.FT.)**	**HSG 'C' (SQ.FT.)**	**HSG 'D' (SQ.FT.)**
Open Space (lawns, parks, golf courses, etc.)					
Poor Condition (<50% grass cover)	0.00	0	0	0	0
Fair Condition (50% to 75% grass cover)	0.00	0	0	0	0
Good Condition (>75% grass cover)	0.00	0	0	0	0
Impervious Areas					
Paved parking lots, roofs, driveways, etc.	0.00	0	0	0	0
Streets and roads:					
Paved; curbs and storm sewers	0.72	0	31352	0	0
Paved; open ditches	1.10	0	35937	0	11979
Gravel	0.00	0	0	0	0
Dirt	0.00	0	0	0	0
Urban Districs					
Commerical and business	2.04	0	0	0	88893
Industrial	0.00	0	0	0	0
Residential districts by average lot size:					
1/8 acre, townhouse	0.00	0	0	0	0
1/4 acre	2.56	0	111554	0	0
1/3 acre	0.00	0	0	0	0
1/2 acre	0.00	0	0	0	0
1 acre	0.00	0	0	0	0
2 acre	0.00	0	0	0	0
Developing Urban Areas					
Newly graded areas	5.60	0	0	0	244126
Pasture (<50% ground cover or heavily grazed)	0.00	0	0	0	0
Pasture (50% to 75% ground cover or not heavily grazed)	0.00	0	0	0	0
Pasture (>75% ground cover or lightly grazed)	0.00	0	0	0	0
Meadow - continuous grass, protected from grazing and generally mowed for hay	0.00	0	0	0	0
Brush (<50% ground cover)	0.00	0	0	0	0
Brush (50% to 75% ground cover)	0.00	0	0	0	0
Brush (>75% ground cover)	0.00	0	0	0	0

	Woods (Forest litter, small trees, and brush destroyed by heavy grazing or regular burning)	0.00	0	0	0	0
	Woods (Woods are grazed but not burned, and some forest litter covers the soil)	6.66	0	217467	0	72489
	Woods (Woods are protected from grazing, and litter and brush adequately cover the soil)	0.00	0	0	0	0
	TOTAL (AC)	18.68	0.00	9.10	0.00	9.58

III. SCS CURVE NUMBER CALCULATION

COVER DESCRIPTION (Source: NCDEQ Stormwater MDC)	SCS CN			
	HSG 'A'	HSG 'B'	HSG 'C'	HSG 'D'
Open Space (lawns, parks, golf courses, etc.)				
Poor Condition (<50% grass cover)	68	79	86	89
Fair Condition (50% to 75% grass cover)	49	69	79	84
Good Condition (>75% grass cover)	39	61	74	80
Impervious Areas				
Paved parking lots, roofs, driveways, etc.	98	98	98	98
Streets and roads:				
Paved; curbs and storm sewers	93	93	93	98
Paved; open ditches	83	89	98	98
Gravel	76	85	89	91
Dirt	72	82	85	88
Urban Districts				
Commerical and business	89	92	94	95
Industrial	81	88	91	93
Residential districts by average lot size:				
1/8 acre, townhouse	77	85	90	92
1/4 acre	61	75	83	87
1/3 acre	57	72	81	86
1/2 acre	54	70	80	85
1 acre	51	68	79	84
2 acre	46	65	77	82
Developing Urban Areas				
Newly graded areas	77	86	91	94
Pasture (<50% ground cover or heavily grazed)	68	79	86	89
Pasture (50% to 75% ground cover or not heavily grazed)	49	69	79	84
Pasture (>75% ground cover or lightly grazed)	39	61	74	80
Meadow - continuous grass, protected from grazing and generally mowed for hay	30	58	71	78
Brush (<50% ground cover)	48	67	77	83
Brush (50% to 75% ground cover)	35	56	70	77
Brush (>75% ground cover)	30	48	65	73
Woods (Forest litter, small trees, and brush destroyed by heavy grazing or regular burning)	45	66	77	83
Woods (Woods are grazed but not burned, and some forest litter covers the soil)	36	60	73	79
Woods (Woods are protected from grazing, and litter and brush adequately cover the soil)	30	55	70	77
	0	**632**	**0**	**879**
COMPOSITE SCS CN	**81**			
% Impervious	**424297%**			

HYDROLOGY - NRCS CURVE NUMBER

Project Name:	Applebranch
Project Number:	47097.003
Location:	City of Danville, Virginia
Date:	10/15/2021
Prepared by:	Alston Willard, EIT
Checked by:	Abrham Asfaw, PE
Existing or Proposed:	EXISTING
Catchment:	EX-DA-4

TIMMONS GROUP
YOUR VISION ACHIEVED THROUGH OURS.

I. SUBBASIN SOIL CHARACTERISTICS

	AREA	
	ac	**%**
HSG 'A'	0.00	0%
HSG 'B'	0.00	0%
HSG 'C'	0.00	0%
HSG 'D'	86.73	100%

	86.73	**ac**
TOTAL AREA	**3777778**	**sq ft**
	0.135509	**sq mi**

II. SUBBASIN LAND COVER CONDITIONS

COVER DESCRIPTION	AREA				
	TOTAL (AC)	**HSG 'A' (SQ.FT.)**	**HSG 'B' (SQ.FT.)**	**HSG 'C' (SQ.FT.)**	**HSG 'D' (SQ.FT.)**
Open Space (lawns, parks, golf courses, etc.)					
Poor Condition (<50% grass cover)	0.00	0	0	0	0
Fair Condition (50% to 75% grass cover)	12.80	0	0	0	557611
Good Condition (>75% grass cover)	0.00	0	0	0	0
Impervious Areas					
Paved parking lots, roofs, driveways, etc.	2.32	0	0	0	100897
Streets and roads:					
Paved; curbs and storm sewers	13.01	0	0	0	566615
Paved; open ditches	0.00	0	0	0	0
Gravel	0.00	0	0	0	0
Dirt	0.00	0	0	0	0
Urban Districs					
Commerical and business	8.27	0	0	0	360165
Industrial	0.00	0	0	0	0
Residential districts by average lot size:					
1/8 acre, townhouse	2.93	0	0	0	127695
1/4 acre	8.81	0	0	0	383672
1/3 acre	12.14	0	0	0	528912
1/2 acre	9.48	0	0	0	412767
1 acre	3.87	0	0	0	168543
2 acre	0.00	0	0	0	0
Developing Urban Areas					
Newly graded areas	0.00	0	0	0	0
Pasture (<50% ground cover or heavily grazed)	0.00	0	0	0	0
Pasture (50% to 75% ground cover or not heavily grazed)	0.00	0	0	0	0
Pasture (>75% ground cover or lightly grazed)	0.00	0	0	0	0
Meadow - continuous grass, protected from grazing and generally mowed for hay	0.00	0	0	0	0
Brush (<50% ground cover)	0.00	0	0	0	0
Brush (50% to 75% ground cover)	0.00	0	0	0	0
Brush (>75% ground cover)	0.00	0	0	0	0

	Woods (Forest litter, small trees, and brush destroyed by heavy grazing or regular burning)	0.00	0	0	0	0
	Woods (Woods are grazed but not burned, and some forest litter covers the soil)	13.11	0	0	0	570901
	Woods (Woods are protected from grazing, and litter and brush adequately cover the soil)	0.00	0	0	0	0
	TOTAL (AC)	86.73	0.00	0.00	0.00	86.73

III. SCS CURVE NUMBER CALCULATION

COVER DESCRIPTION (Source: NCDEQ Stormwater MDC)	SCS CN			
	HSG 'A'	HSG 'B'	HSG 'C'	HSG 'D'
Open Space (lawns, parks, golf courses, etc.)				
Poor Condition (<50% grass cover)	68	79	86	89
Fair Condition (50% to 75% grass cover)	49	69	79	84
Good Condition (>75% grass cover)	39	61	74	80
Impervious Areas				
Paved parking lots, roofs, driveways, etc.	98	98	98	98
Streets and roads:				
Paved; curbs and storm sewers	93	93	93	98
Paved; open ditches	83	89	98	98
Gravel	76	85	89	91
Dirt	72	82	85	88
Urban Districts				
Commerical and business	89	92	94	98
Industrial	81	88	91	93
Residential districts by average lot size:				
1/8 acre, townhouse	77	85	90	92
1/4 acre	61	75	83	87
1/3 acre	57	72	81	86
1/2 acre	54	70	80	85
1 acre	51	68	79	84
2 acre	46	65	77	82
Developing Urban Areas				
Newly graded areas	77	86	91	94
Pasture (<50% ground cover or heavily grazed)	68	79	86	89
Pasture (50% to 75% ground cover or not heavily grazed)	49	69	79	84
Pasture (>75% ground cover or lightly grazed)	39	61	74	80
Meadow - continuous grass, protected from grazing and generally mowed for hay	30	58	71	78
Brush (<50% ground cover)	48	67	77	83
Brush (50% to 75% ground cover)	35	56	70	77
Brush (>75% ground cover)	30	48	65	73
Woods (Forest litter, small trees, and brush destroyed by heavy grazing or regular burning)	45	66	77	83
Woods (Woods are grazed but not burned, and some forest litter covers the soil)	36	60	73	79
Woods (Woods are protected from grazing, and litter and brush adequately cover the soil)	30	55	70	77
	0	**0**	**0**	**7633**
COMPOSITE SCS CN	**88**			
% Impervious	**18%**			

HYDROLOGY - NRCS CURVE NUMBER

Project Name:	Applebranch
Project Number:	47097.003
Location:	City of Danville, Virginia
Date:	10/15/2021
Prepared by:	Alston Willard, EIT
Checked by:	Abrham Asfaw, PE
Existing or Proposed:	EXISTING
Catchment:	EX-DA-5

TIMMONS GROUP
YOUR VISION ACHIEVED THROUGH OURS.

I. SUBBASIN SOIL CHARACTERISTICS

	AREA	
	ac	**%**
HSG 'A'	0.00	0%
HSG 'B'	45.48	100%
HSG 'C'	0.00	0%
HSG 'D'	0.00	0%

	45.48	**ac**
TOTAL AREA	**1981133**	**sq ft**
	0.071063	**sq mi**

II. SUBBASIN LAND COVER CONDITIONS

COVER DESCRIPTION	AREA				
	TOTAL (AC)	**HSG 'A' (SQ.FT.)**	**HSG 'B' (SQ.FT.)**	**HSG 'C' (SQ.FT.)**	**HSG 'D' (SQ.FT.)**
Open Space (lawns, parks, golf courses, etc.)					
Poor Condition (<50% grass cover)	0.00	0	0	0	0
Fair Condition (50% to 75% grass cover)	0.00	0	0	0	0
Good Condition (>75% grass cover)	0.00	0	0	0	0
Impervious Areas					
Paved parking lots, roofs, driveways, etc.	0.00	0	0	0	0
Streets and roads:					
Paved; curbs and storm sewers	7.44	0	323943	0	
Paved; open ditches	0.00	0	0	0	0
Gravel	0.00	0	0	0	0
Dirt	0.00	0	0	0	0
Urban Districs					
Commerical and business	5.16	0	224923	0	
Industrial	0.00	0	0	0	0
Residential districts by average lot size:					
1/8 acre, townhouse	0.63	0	27625	0	0
1/4 acre	13.07	0	569321	0	0
1/3 acre	3.89	0	169325	0	0
1/2 acre	2.30	0	100333	0	0
1 acre	2.36	0	102755	0	0
2 acre	0.00	0	0	0	0
Developing Urban Areas					
Newly graded areas	0.00	0	0	0	0
Pasture (<50% ground cover or heavily grazed)	0.00	0	0	0	0
Pasture (50% to 75% ground cover or not heavily grazed)	0.00	0	0	0	0
Pasture (>75% ground cover or lightly grazed)	0.00	0	0	0	0
Meadow - continuous grass, protected from grazing and generally mowed for hay	0.00	0	0	0	0
Brush (<50% ground cover)	0.00	0	0	0	0
Brush (50% to 75% ground cover)	0.00	0	0	0	0
Brush (>75% ground cover)	0.00	0	0	0	0

	Woods (Forest litter, small trees, and brush destroyed by heavy grazing or regular burning)	0.00	0	0	0	0
	Woods (Woods are grazed but not burned, and some forest litter covers the soil)	10.63	0	462908	0	0
	Woods (Woods are protected from grazing, and litter and brush adequately cover the soil)	0.00	0	0	0	0
	TOTAL (AC)	45.48	0.00	45.48	0.00	0.00

III. SCS CURVE NUMBER CALCULATION

COVER DESCRIPTION (Source: NCDEQ Stormwater MDC)	SCS CN			
	HSG 'A'	HSG 'B'	HSG 'C'	HSG 'D'
Open Space (lawns, parks, golf courses, etc.)				
Poor Condition (<50% grass cover)	68	79	86	89
Fair Condition (50% to 75% grass cover)	49	69	79	84
Good Condition (>75% grass cover)	39	61	74	80
Impervious Areas				
Paved parking lots, roofs, driveways, etc.	98	98	98	98
Streets and roads:				
Paved; curbs and storm sewers	93	93	93	98
Paved; open ditches	83	89	98	98
Gravel	76	85	89	91
Dirt	72	82	85	88
Urban Districts				
Commerical and business	89	97	94	95
Industrial	81	88	91	93
Residential districts by average lot size:				
1/8 acre, townhouse	77	85	90	92
1/4 acre	61	75	83	87
1/3 acre	57	72	81	86
1/2 acre	54	70	80	85
1 acre	51	68	79	84
2 acre	46	65	77	82
Developing Urban Areas				
Newly graded areas	77	86	91	94
Pasture (<50% ground cover or heavily grazed)	68	79	86	89
Pasture (50% to 75% ground cover or not heavily grazed)	49	69	79	84
Pasture (>75% ground cover or lightly grazed)	39	61	74	80
Meadow - continuous grass, protected from grazing and generally mowed for hay	30	58	71	78
Brush (<50% ground cover)	48	67	77	83
Brush (50% to 75% ground cover)	35	56	70	77
Brush (>75% ground cover)	30	48	65	73
Woods (Forest litter, small trees, and brush destroyed by heavy grazing or regular burning)	45	66	77	83
Woods (Woods are grazed but not burned, and some forest litter covers the soil)	36	60	73	79
Woods (Woods are protected from grazing, and litter and brush adequately cover the soil)	30	55	70	77
	0	**3466**	**0**	**0**
COMPOSITE SCS CN	**76**			
% Impervious	**16%**			

HYDROLOGY - NRCS CURVE NUMBER

Project Name:	Applebranch
Project Number:	47097.003
Location:	City of Danville, Virginia
Date:	10/15/2021
Prepared by:	Alston Willard, EIT
Checked by:	Abrham Asfaw, PE
Existing or Proposed:	EXISTING
Catchment:	EX-DA-6

TIMMONS GROUP
YOUR VISION ACHIEVED THROUGH OURS.

I. SUBBASIN SOIL CHARACTERISTICS

	AREA	
	ac	**%**
HSG 'A'	0.00	0%
HSG 'B'	82.38	100%
HSG 'C'	0.00	0%
HSG 'D'	0.00	0%

	82.38	**ac**
TOTAL AREA	**3588410**	**sq ft**
	0.128716	**sq mi**

II. SUBBASIN LAND COVER CONDITIONS

COVER DESCRIPTION	AREA				
	TOTAL (AC)	**HSG 'A' (SQ.FT.)**	**HSG 'B' (SQ.FT.)**	**HSG 'C' (SQ.FT.)**	**HSG 'D' (SQ.FT.)**
Open Space (lawns, parks, golf courses, etc.)					
Poor Condition (<50% grass cover)	0.00	0	0	0	0
Fair Condition (50% to 75% grass cover)	6.64	0	289368	0	0
Good Condition (>75% grass cover)	0.00	0	0	0	0
Impervious Areas					
Paved parking lots, roofs, driveways, etc.	0.00	0	0	0	0
Streets and roads:					
Paved; curbs and storm sewers	20.15	0	877708	0	0
Paved; open ditches	0.00	0	0	0	0
Gravel	0.00	0	0	0	0
Dirt	0.00	0	0	0	0
Urban Districs					
Commerical and business	8.61	0	374943	0	0
Industrial	0.00	0	0	0	0
Residential districts by average lot size:					
1/8 acre, townhouse	2.79	0	121352	0	0
1/4 acre	12.05	0	524929	0	0
1/3 acre	15.74	0	685558	0	0
1/2 acre	7.47	0	325484	0	0
1 acre	0.47	0	20260	0	0
2 acre	0.00	0	0	0	0
Developing Urban Areas					
Newly graded areas	1.35	0	58841	0	0
Pasture (<50% ground cover or heavily grazed)	0.00	0	0	0	0
Pasture (50% to 75% ground cover or not heavily grazed)	0.00	0	0	0	0
Pasture (>75% ground cover or lightly grazed)	0.00	0	0	0	0
Meadow - continuous grass, protected from grazing and generally mowed for hay	0.00	0	0	0	0
Brush (<50% ground cover)	0.00	0	0	0	0
Brush (50% to 75% ground cover)	0.00	0	0	0	0
Brush (>75% ground cover)	0.00	0	0	0	0

	Woods (Forest litter, small trees, and brush destroyed by heavy grazing or regular burning)	0.00	0	0	0	0
	Woods (Woods are grazed but not burned, and some forest litter covers the soil)	7.12	0	309967	0	0
	Woods (Woods are protected from grazing, and litter and brush adequately cover the soil)	0.00	0	0	0	0
	TOTAL (AC)	82.38	0.00	82.38	0.00	0.00

III. SCS CURVE NUMBER CALCULATION

COVER DESCRIPTION (Source: NCDEQ Stormwater MDC)	SCS CN			
	HSG 'A'	HSG 'B'	HSG 'C'	HSG 'D'
Open Space (lawns, parks, golf courses, etc.)				
Poor Condition (<50% grass cover)	68	79	86	89
Fair Condition (50% to 75% grass cover)	49	69	79	84
Good Condition (>75% grass cover)	39	61	74	80
Impervious Areas				
Paved parking lots, roofs, driveways, etc.	98	98	98	98
Streets and roads:				
Paved; curbs and storm sewers	93	93	93	98
Paved; open ditches	83	89	98	98
Gravel	76	85	89	91
Dirt	72	82	85	88
Urban Districts				
Commerical and business	89	97	94	95
Industrial	81	88	91	93
Residential districts by average lot size:				
1/8 acre, townhouse	77	85	90	92
1/4 acre	61	75	83	87
1/3 acre	57	72	81	86
1/2 acre	54	70	80	85
1 acre	51	68	79	84
2 acre	46	65	77	82
Developing Urban Areas				
Newly graded areas	77	86	91	94
Pasture (<50% ground cover or heavily grazed)	68	79	86	89
Pasture (50% to 75% ground cover or not heavily grazed)	49	69	79	84
Pasture (>75% ground cover or lightly grazed)	39	61	74	80
Meadow - continuous grass, protected from grazing and generally mowed for hay	30	58	71	78
Brush (<50% ground cover)	48	67	77	83
Brush (50% to 75% ground cover)	35	56	70	77
Brush (>75% ground cover)	30	48	65	73
Woods (Forest litter, small trees, and brush destroyed by heavy grazing or regular burning)	45	66	77	83
Woods (Woods are grazed but not burned, and some forest litter covers the soil)	36	60	73	79
Woods (Woods are protected from grazing, and litter and brush adequately cover the soil)	30	55	70	77
	0	**6539**	**0**	**0**
COMPOSITE SCS CN	**79**			
% Impervious	**24%**			

HYDROLOGY - NRCS CURVE NUMBER

Project Name:	Applebranch
Project Number:	47097.003
Location:	City of Danville, Virginia
Date:	
Prepared by:	Alston Willard, EIT
Checked by:	
Existing or Proposed:	EXISTING
Catchment:	EX-DA-7

TIMMONS GROUP
YOUR VISION ACHIEVED THROUGH OURS.

I. SUBBASIN SOIL CHARACTERISTICS

	AREA	
	ac	**%**
HSG 'A'	0.00	0%
HSG 'B'	41.18	100%
HSG 'C'	0.00	0%
HSG 'D'	0.00	0%

	41.18	**ac**
TOTAL AREA	**1793738.2**	**sq ft**
	0.064342	**sq mi**

II. SUBBASIN LAND COVER CONDITIONS

COVER DESCRIPTION	AREA				
	TOTAL (AC)	**HSG 'A' (SQ.FT.)**	**HSG 'B' (SQ.FT.)**	**HSG 'C' (SQ.FT.)**	**HSG 'D' (SQ.FT.)**
Open Space (lawns, parks, golf courses, etc.)					
Poor Condition (<50% grass cover)	0.00	0	0	0	0
Fair Condition (50% to 75% grass cover)	1.71	0	74556	0	0
Good Condition (>75% grass cover)	0.00	0	0	0	0
Impervious Areas					
Paved parking lots, roofs, driveways, etc.	0.00	0	0	0	0
Streets and roads:					
Paved; curbs and storm sewers	5.02	0	218720	0	0
Paved; open ditches	0.00	0	0	0	0
Gravel	0.00	0	0	0	0
Dirt	0.00	0	0	0	0
Urban Districs					
Commerical and business	1.57	0	68342	0	0
Industrial	0.00	0	0	0	0
Residential districts by average lot size:					
1/8 acre, townhouse	0.30	0	13017	0	0
1/4 acre	2.08	0	90810	0	0
1/3 acre	13.02	0	567316	0	0
1/2 acre	0.92	0	40036	0	0
1 acre	0.00	0	0	0	0
2 acre	0.00	0	0	0	0
Developing Urban Areas					
Newly graded areas	0.00	0	0	0	0
Pasture (<50% ground cover or heavily grazed)	0.00	0	0	0	0
Pasture (50% to 75% ground cover or not heavily grazed)	0.00	0	0	0	0
Pasture (>75% ground cover or lightly grazed)	0.00	0	0	0	0
Meadow - continuous grass, protected from grazing and generally mowed for hay	0.00	0	0	0	0
Brush (<50% ground cover)	0.00	0	0	0	0
Brush (50% to 75% ground cover)	0.00	0	0	0	0
Brush (>75% ground cover)	0.00	0	0	0	0

	Woods (Forest litter, small trees, and brush destroyed by heavy grazing or regular burning)	0.00	0	0	0	0
	Woods (Woods are grazed but not burned, and some forest litter covers the soil)	16.55	0	720941	0	0
	Woods (Woods are protected from grazing, and litter and brush adequately cover the soil)	0.00	0	0	0	0
	TOTAL (AC)	41.18	0.00	41.18	0.00	0.00

III. SCS CURVE NUMBER CALCULATION

COVER DESCRIPTION (Source: NCDEQ Stormwater MDC)	SCS CN			
	HSG 'A'	HSG 'B'	HSG 'C'	HSG 'D'
Open Space (lawns, parks, golf courses, etc.)				
Poor Condition (<50% grass cover)	68	79	86	89
Fair Condition (50% to 75% grass cover)	49	69	79	84
Good Condition (>75% grass cover)	39	61	74	80
Impervious Areas				
Paved parking lots, roofs, driveways, etc.	98	98	98	98
Streets and roads:				
Paved; curbs and storm sewers	93	93	93	98
Paved; open ditches	83	89	98	98
Gravel	76	85	89	91
Dirt	72	82	85	88
Urban Districts				
Commerical and business	89	97	94	95
Industrial	81	88	91	93
Residential districts by average lot size:				
1/8 acre, townhouse	77	85	90	92
1/4 acre	61	75	83	87
1/3 acre	57	72	81	86
1/2 acre	54	70	80	85
1 acre	51	68	79	84
2 acre	46	65	77	82
Developing Urban Areas				
Newly graded areas	77	86	91	94
Pasture (<50% ground cover or heavily grazed)	68	79	86	89
Pasture (50% to 75% ground cover or not heavily grazed)	49	69	79	84
Pasture (>75% ground cover or lightly grazed)	39	61	74	80
Meadow - continuous grass, protected from grazing and generally mowed for hay	30	58	71	78
Brush (<50% ground cover)	48	67	77	83
Brush (50% to 75% ground cover)	35	56	70	77
Brush (>75% ground cover)	30	48	65	73
Woods (Forest litter, small trees, and brush destroyed by heavy grazing or regular burning)	45	66	77	83
Woods (Woods are grazed but not burned, and some forest litter covers the soil)	36	60	73	79
Woods (Woods are protected from grazing, and litter and brush adequately cover the soil)	30	55	70	77
	0	**2914**	**0**	**0**
COMPOSITE SCS CN	**71**			
% Impervious	**12%**			

HYDROLOGY - NRCS CURVE NUMBER

Project Name:	Applebranch
Project Number:	47097.003
Location:	City of Danville, Virginia
Date:	10/15/2021
Prepared by:	Alston Willard, EIT
Checked by:	Abrham Asfaw, PE
Existing or Proposed:	EXISTING
Catchment:	EX-DA-8

TIMMONS GROUP
YOUR VISION ACHIEVED THROUGH OURS.

I. SUBBASIN SOIL CHARACTERISTICS

	AREA	
	ac	**%**
HSG 'A'	0.00	0%
HSG 'B'	69.89	100%
HSG 'C'	0.00	0%
HSG 'D'	0.00	0%

	69.89	**ac**
TOTAL AREA	**3,044,508.00**	**sq ft**
	0.109207	**sq mi**

II. SUBBASIN LAND COVER CONDITIONS

COVER DESCRIPTION	AREA				
	TOTAL (AC)	**HSG 'A' (SQ.FT.)**	**HSG 'B' (SQ.FT.)**	**HSG 'C' (SQ.FT.)**	**HSG 'D' (SQ.FT.)**
Open Space (lawns, parks, golf courses, etc.)					
Poor Condition (<50% grass cover)	0.00	0	0	0	0
Fair Condition (50% to 75% grass cover)	4.08	0	177684	0	0
Good Condition (>75% grass cover)	0.00	0	0	0	0
Impervious Areas					
Paved parking lots, roofs, driveways, etc.	2.43	0	106062	0	0
Streets and roads:					
Paved; curbs and storm sewers	13.16	0	573297	0	0
Paved; open ditches	0.00	0	0	0	0
Gravel	0.00	0	0	0	0
Dirt	0.00	0	0	0	0
Urban Districs					
Commerical and business	3.84	0	167316	0	0
Industrial	0.00	0	0	0	0
Residential districts by average lot size:					
1/8 acre, townhouse	0.00	0	0	0	0
1/4 acre	9.34	0	406891	0	0
1/3 acre	25.51	0	1111118	0	0
1/2 acre	9.56	0	416264	0	0
1 acre	1.12	0	48886	0	0
2 acre	0.00	0	0	0	0
Developing Urban Areas					
Newly graded areas	0.00	0	0	0	0
Pasture (<50% ground cover or heavily grazed)	0.00	0	0	0	0
Pasture (50% to 75% ground cover or not heavily grazed)	0.00	0	0	0	0
Pasture (>75% ground cover or lightly grazed)	0.00	0	0	0	0
Meadow - continuous grass, protected from grazing and generally mowed for hay	0.00	0	0	0	0
Brush (<50% ground cover)	0.00	0	0	0	0
Brush (50% to 75% ground cover)	0.00	0	0	0	0
Brush (>75% ground cover)	0.00	0	0	0	0
Woods (Forest litter, small trees, and brush destroyed by heavy grazing or regular burning)	0.00	0	0	0	0

	Woods (Woods are grazed but not burned, and some forest litter covers the soil)	0.85	0	36990	0	0
	Woods (Woods are protected from grazing, and litter and brush adequately cover the soil)	0.00	0	0	0	0
	TOTAL (AC)	69.89	0.00	69.89	0.00	0.00

III. SCS CURVE NUMBER CALCULATION

COVER DESCRIPTION (Source: NCDEQ Stormwater MDC)	SCS CN			
	HSG 'A'	HSG 'B'	HSG 'C'	HSG 'D'
Open Space (lawns, parks, golf courses, etc.)				
Poor Condition (<50% grass cover)	68	79	86	89
Fair Condition (50% to 75% grass cover)	49	69	79	84
Good Condition (>75% grass cover)	39	61	74	80
Impervious Areas				
Paved parking lots, roofs, driveways, etc.	98	98	98	98
Streets and roads:				
Paved; curbs and storm sewers	93	93	93	98
Paved; open ditches	83	89	98	98
Gravel	76	85	89	91
Dirt	72	82	85	88
Urban Districs				
Commerical and business	89	97	94	95
Industrial	81	88	91	93
Residential districts by average lot size:				
1/8 acre, townhouse	77	85	90	92
1/4 acre	61	75	83	87
1/3 acre	57	72	81	86
1/2 acre	54	70	80	85
1 acre	51	68	79	84
2 acre	46	65	77	82
Developing Urban Areas				
Newly graded areas	77	86	91	94
Pasture (<50% ground cover or heavily grazed)	68	79	86	89
Pasture (50% to 75% ground cover or not heavily grazed)	49	69	79	84
Pasture (>75% ground cover or lightly grazed)	39	61	74	80
Meadow - continuous grass, protected from grazing and generally mowed for hay	30	58	71	78
Brush (<50% ground cover)	48	67	77	83
Brush (50% to 75% ground cover)	35	56	70	77
Brush (>75% ground cover)	30	48	65	73
Woods (Forest litter, small trees, and brush destroyed by heavy grazing or regular burning)	45	66	77	83
Woods (Woods are grazed but not burned, and some forest litter covers the soil)	36	60	73	79
Woods (Woods are protected from grazing, and litter and brush adequately cover the soil)	30	55	70	77
	0	**5450**	**0**	**0**
COMPOSITE SCS CN	**78**			
% Impervious	**22%**			

HYDROLOGY - NRCS CURVE NUMBER

Project Name:	Applebranch
Project Number:	47097.003
Location:	City of Danville, Virginia
Date:	10/15/2021
Prepared by:	Alston Willard, EIT
Checked by:	Abrham Asfaw, PE
Existing or Proposed:	EXISTING
Catchment:	EX-DA-9

TIMMONS GROUP
YOUR VISION ACHIEVED THROUGH OURS.

I. SUBBASIN SOIL CHARACTERISTICS

	AREA	
	ac	**%**
HSG 'A'	0.00	0%
HSG 'B'	18.43	100%
HSG 'C'	0.00	0%
HSG 'D'	0.00	0%

	18.43	**ac**
TOTAL AREA	**802968**	**sq ft**
	0.028803	**sq mi**

II. SUBBASIN LAND COVER CONDITIONS

COVER DESCRIPTION	AREA				
	TOTAL (AC)	**HSG 'A' (SQ.FT.)**	**HSG 'B' (SQ.FT.)**	**HSG 'C' (SQ.FT.)**	**HSG 'D' (SQ.FT.)**
Open Space (lawns, parks, golf courses, etc.)					
Poor Condition (<50% grass cover)	0.00	0	0	0	0
Fair Condition (50% to 75% grass cover)	0.84	0	36438	0	0
Good Condition (>75% grass cover)	0.00	0	0	0	0
Impervious Areas					
Paved parking lots, roofs, driveways, etc.	0.00	0	0	0	0
Streets and roads:					
Paved; curbs and storm sewers	2.77	0	120661	0	0
Paved; open ditches	0.00	0	0	0	0
Gravel	0.00	0	0	0	0
Dirt	0.00	0	0	0	0
Urban Districs					
Commerical and business	1.69	0	73623	0	0
Industrial	0.00	0	0	0	0
Residential districts by average lot size:					
1/8 acre, townhouse	0.00	0	0	0	0
1/4 acre	7.42	0	323351	0	0
1/3 acre	4.27	0	185997	0	0
1/2 acre	0.50	0	21914	0	0
1 acre	0.00	0	0	0	0
2 acre	0.00	0	0	0	0
Developing Urban Areas					
Newly graded areas	0.00	0	0	0	0
Pasture (<50% ground cover or heavily grazed)	0.00	0	0	0	0
Pasture (50% to 75% ground cover or not heavily grazed)	0.00	0	0	0	0
Pasture (>75% ground cover or lightly grazed)	0.00	0	0	0	0
Meadow - continuous grass, protected from grazing and generally mowed for hay	0.00	0	0	0	0
Brush (<50% ground cover)	0.00	0	0	0	0
Brush (50% to 75% ground cover)	0.00	0	0	0	0
Brush (>75% ground cover)	0.00	0	0	0	0

	Woods (Forest litter, small trees, and brush destroyed by heavy grazing or regular burning)	0.00	0	0	0	0
	Woods (Woods are grazed but not burned, and some forest litter covers the soil)	0.94	0	40984	0	0
	Woods (Woods are protected from grazing, and litter and brush adequately cover the soil)	0.00	0	0	0	0
	TOTAL (AC)	18.43	0.00	18.43	0.00	0.00

III. SCS CURVE NUMBER CALCULATION

COVER DESCRIPTION (Source: NCDEQ Stormwater MDC)	SCS CN			
	HSG 'A'	HSG 'B'	HSG 'C'	HSG 'D'
Open Space (lawns, parks, golf courses, etc.)				
Poor Condition (<50% grass cover)	68	79	86	89
Fair Condition (50% to 75% grass cover)	49	69	79	84
Good Condition (>75% grass cover)	39	61	74	80
Impervious Areas				
Paved parking lots, roofs, driveways, etc.	98	98	98	98
Streets and roads:				
Paved; curbs and storm sewers	93	93	93	98
Paved; open ditches	83	89	98	98
Gravel	76	85	89	91
Dirt	72	82	85	88
Urban Districts				
Commerical and business	89	97	94	95
Industrial	81	88	91	93
Residential districts by average lot size:				
1/8 acre, townhouse	77	85	90	92
1/4 acre	61	75	83	87
1/3 acre	57	72	81	86
1/2 acre	54	70	80	85
1 acre	51	68	79	84
2 acre	46	65	77	82
Developing Urban Areas				
Newly graded areas	77	86	91	94
Pasture (<50% ground cover or heavily grazed)	68	79	86	89
Pasture (50% to 75% ground cover or not heavily grazed)	49	69	79	84
Pasture (>75% ground cover or lightly grazed)	39	61	74	80
Meadow - continuous grass, protected from grazing and generally mowed for hay	30	58	71	78
Brush (<50% ground cover)	48	67	77	83
Brush (50% to 75% ground cover)	35	56	70	77
Brush (>75% ground cover)	30	48	65	73
Woods (Forest litter, small trees, and brush destroyed by heavy grazing or regular burning)	45	66	77	83
Woods (Woods are grazed but not burned, and some forest litter covers the soil)	36	60	73	79
Woods (Woods are protected from grazing, and litter and brush adequately cover the soil)	30	55	70	77
	0	**1435**	**0**	**0**
COMPOSITE SCS CN	**78**			
% Impervious	**15%**			

HYDROLOGY - NRCS CURVE NUMBER

Project Name:	Applebranch
Project Number:	47097.003
Location:	City of Danville, Virginia
Date:	10/15/2021
Prepared by:	Alston Willard, EIT
Checked by:	Abrham Asfaw, PE
Existing or Proposed:	EXISTING
Catchment:	EX-DA-10

TIMMONS GROUP
YOUR VISION ACHIEVED THROUGH OURS.

I. SUBBASIN SOIL CHARACTERISTICS

	AREA	
	ac	%
HSG 'A'	0.00	0%
HSG 'B'	92.70	93%
HSG 'C'	0.00	0%
HSG 'D'	7.39	7%

	100.09	**ac**
TOTAL AREA	**4359789**	**sq ft**
	0.156386	**sq mi**

II. SUBBASIN LAND COVER CONDITIONS

COVER DESCRIPTION	AREA				
	TOTAL (AC)	HSG 'A' (SQ.FT.)	HSG 'B' (SQ.FT.)	HSG 'C' (SQ.FT.)	HSG 'D' (SQ.FT.)
Open Space (lawns, parks, golf courses, etc.)					
Poor Condition (<50% grass cover)	0.00	0	0	0	0
Fair Condition (50% to 75% grass cover)	1.13	0	24604	0	24604
Good Condition (>75% grass cover)	0.00	0	0	0	0
Impervious Areas					
Paved parking lots, roofs, driveways, etc.	2.42	0	40099	0	65343
Streets and roads:					
Paved; curbs and storm sewers	10.53	0	458672	0	0
Paved; open ditches	0.00	0	0	0	0
Gravel	0.00	0	0	0	0
Dirt	0.00	0	0	0	0
Urban Districs					
Commerical and business	0.39	0	0	0	16938
Industrial	0.00	0	0	0	0
Residential districts by average lot size:					
1/8 acre, townhouse	7.68	0	190468	0	144111
1/4 acre	17.84	0	776981	0	0
1/3 acre	13.12	0	571323	0	0
1/2 acre	7.34	0	319624	0	0
1 acre	5.55	0	241545	0	0
2 acre	0.00	0	0	0	0
Developing Urban Areas					
Newly graded areas	0.00	0	0	0	0
Pasture (<50% ground cover or heavily grazed)	0.00	0	0	0	0
Pasture (50% to 75% ground cover or not heavily grazed)	0.00	0	0	0	0
Pasture (>75% ground cover or lightly grazed)	0.00	0	0	0	0
Meadow - continuous grass, protected from grazing and generally mowed for hay	0.00	0	0	0	0
Brush (<50% ground cover)	0.00	0	0	0	0
Brush (50% to 75% ground cover)	0.00	0	0	0	0
Brush (>75% ground cover)	0.00	0	0	0	0

	Woods (Forest litter, small trees, and brush destroyed by heavy grazing or regular burning)	0.00	0	0	0	0
	Woods (Woods are grazed but not burned, and some forest litter covers the soil)	34.10	0	1414740	0	70737
	Woods (Woods are protected from grazing, and litter and brush adequately cover the soil)	0.00	0	0	0	0
	TOTAL (AC)	100.09	0.00	92.70	0.00	7.39

III. SCS CURVE NUMBER CALCULATION

COVER DESCRIPTION (Source: NCDEQ Stormwater MDC)	SCS CN			
	HSG 'A'	HSG 'B'	HSG 'C'	HSG 'D'
Open Space (lawns, parks, golf courses, etc.)				
Poor Condition (<50% grass cover)	68	79	86	89
Fair Condition (50% to 75% grass cover)	49	69	79	84
Good Condition (>75% grass cover)	39	61	74	80
Impervious Areas				
Paved parking lots, roofs, driveways, etc.	98	98	98	98
Streets and roads:				
Paved; curbs and storm sewers	93	93	93	98
Paved; open ditches	83	89	98	98
Gravel	76	85	89	91
Dirt	72	82	85	88
Urban Districts				
Commerical and business	89	92	94	95
Industrial	81	88	91	93
Residential districts by average lot size:				
1/8 acre, townhouse	77	85	90	92
1/4 acre	61	75	83	87
1/3 acre	57	72	81	86
1/2 acre	54	70	80	85
1 acre	51	68	79	84
2 acre	46	65	77	82
Developing Urban Areas				
Newly graded areas	77	86	91	94
Pasture (<50% ground cover or heavily grazed)	68	79	86	89
Pasture (50% to 75% ground cover or not heavily grazed)	49	69	79	84
Pasture (>75% ground cover or lightly grazed)	39	61	74	80
Meadow - continuous grass, protected from grazing and generally mowed for hay	30	58	71	78
Brush (<50% ground cover)	48	67	77	83
Brush (50% to 75% ground cover)	35	56	70	77
Brush (>75% ground cover)	30	48	65	73
Woods (Forest litter, small trees, and brush destroyed by heavy grazing or regular burning)	45	66	77	83
Woods (Woods are grazed but not burned, and some forest litter covers the soil)	36	60	73	79
Woods (Woods are protected from grazing, and litter and brush adequately cover the soil)	30	55	70	77
	0	**6602**	**0**	**664**
COMPOSITE SCS CN	**73**			
% Impervious	**13%**			

HYDROLOGY - NRCS CURVE NUMBER

Project Name:	Applebranch
Project Number:	47097.003
Location:	City of Danville, Virginia
Date:	10/15/2021
Prepared by:	Alston Willard, EIT
Checked by:	Abrham Asfaw, PE
Existing or Proposed:	EXISTING
Catchment:	EX-DA-11

TIMMONS GROUP
YOUR VISION ACHIEVED THROUGH OURS.

I. SUBBASIN SOIL CHARACTERISTICS

	AREA	
	ac	**%**
HSG 'A'	0.00	0%
HSG 'B'	50.05	100%
HSG 'C'	0.00	0%
HSG 'D'	0.00	0%

	50.05	**ac**
TOTAL AREA	**2180042**	**sq ft**
	0.078198	**sq mi**

II. SUBBASIN LAND COVER CONDITIONS

COVER DESCRIPTION	AREA				
	TOTAL (AC)	**HSG 'A' (SQ.FT.)**	**HSG 'B' (SQ.FT.)**	**HSG 'C' (SQ.FT.)**	**HSG 'D' (SQ.FT.)**
Open Space (lawns, parks, golf courses, etc.)					
Poor Condition (<50% grass cover)	0.00	0	0	0	0
Fair Condition (50% to 75% grass cover)	0.12	0	5431	0	0
Good Condition (>75% grass cover)	0.00	0	0	0	0
Impervious Areas					
Paved parking lots, roofs, driveways, etc.	0.00	0	0	0	0
Streets and roads:					
Paved; curbs and storm sewers	8.50	0	370250	0	0
Paved; open ditches	0.00	0	0	0	0
Gravel	0.00	0	0	0	0
Dirt	0.00	0	0	0	0
Urban Districs					
Commerical and business	2.17	0	94317	0	0
Industrial	0.00	0	0	0	0
Residential districts by average lot size:					
1/8 acre, townhouse	7.65	0	333156	0	0
1/4 acre	14.23	0	619907	0	0
1/3 acre	5.98	0	260526	0	0
1/2 acre	4.18	0	181917	0	0
1 acre	1.24	0	54139	0	0
2 acre	0.00	0	0	0	0
Developing Urban Areas					
Newly graded areas	0.00	0	0	0	0
Pasture (<50% ground cover or heavily grazed)	0.00	0	0	0	0
Pasture (50% to 75% ground cover or not heavily grazed)	0.00	0	0	0	0
Pasture (>75% ground cover or lightly grazed)	0.00	0	0	0	0
Meadow - continuous grass, protected from grazing and generally mowed for hay	0.00	0	0	0	0
Brush (<50% ground cover)	0.00	0	0	0	0
Brush (50% to 75% ground cover)	0.00	0	0	0	0
Brush (>75% ground cover)	0.00	0	0	0	0

	Woods (Forest litter, small trees, and brush destroyed by heavy grazing or regular burning)	0.00	0	0	0	0
	Woods (Woods are grazed but not burned, and some forest litter covers the soil)	5.98	0	260399	0	0
	Woods (Woods are protected from grazing, and litter and brush adequately cover the soil)	0.00	0	0	0	0
	TOTAL (AC)	50.05	0.00	50.05	0.00	0.00

III. SCS CURVE NUMBER CALCULATION

COVER DESCRIPTION (Source: NCDEQ Stormwater MDC)	SCS CN			
	HSG 'A'	HSG 'B'	HSG 'C'	HSG 'D'
Open Space (lawns, parks, golf courses, etc.)				
Poor Condition (<50% grass cover)	68	79	86	89
Fair Condition (50% to 75% grass cover)	49	69	79	84
Good Condition (>75% grass cover)	39	61	74	80
Impervious Areas				
Paved parking lots, roofs, driveways, etc.	98	98	98	98
Streets and roads:				
Paved; curbs and storm sewers	93	93	93	98
Paved; open ditches	83	89	98	98
Gravel	76	85	89	91
Dirt	72	82	85	88
Urban Districts				
Commerical and business	89	97	94	95
Industrial	81	88	91	93
Residential districts by average lot size:				
1/8 acre, townhouse	77	85	90	92
1/4 acre	61	75	83	87
1/3 acre	57	72	81	86
1/2 acre	54	70	80	85
1 acre	51	68	79	84
2 acre	46	65	77	82
Developing Urban Areas				
Newly graded areas	77	86	91	94
Pasture (<50% ground cover or heavily grazed)	68	79	86	89
Pasture (50% to 75% ground cover or not heavily grazed)	49	69	79	84
Pasture (>75% ground cover or lightly grazed)	39	61	74	80
Meadow - continuous grass, protected from grazing and generally mowed for hay	30	58	71	78
Brush (<50% ground cover)	48	67	77	83
Brush (50% to 75% ground cover)	35	56	70	77
Brush (>75% ground cover)	30	48	65	73
Woods (Forest litter, small trees, and brush destroyed by heavy grazing or regular burning)	45	66	77	83
Woods (Woods are grazed but not burned, and some forest litter covers the soil)	36	60	73	79
Woods (Woods are protected from grazing, and litter and brush adequately cover the soil)	30	55	70	77
	0	**3893**	**0**	**0**
COMPOSITE SCS CN	**78**			
% Impervious	**17%**			

HYDROLOGY - NRCS CURVE NUMBER

Project Name:	Applebranch
Project Number:	47097.003
Location:	City of Danville, Virginia
Date:	10/15/2021
Prepared by:	Alston Willard, EIT
Checked by:	Abrham Asfaw, PE
Existing or Proposed:	EXISTING
Catchment:	EX-DA-10

TIMMONS GROUP
YOUR VISION ACHIEVED THROUGH OURS.

I. SUBBASIN SOIL CHARACTERISTICS

	AREA	
	ac	**%**
HSG 'A'	0.00	0%
HSG 'B'	103.54	98%
HSG 'C'	0.00	0%
HSG 'D'	2.34	2%

	105.88	**ac**
TOTAL AREA	**4612091**	**sq ft**
	0.165436	**sq mi**

II. SUBBASIN LAND COVER CONDITIONS

COVER DESCRIPTION	AREA				
	TOTAL (AC)	**HSG 'A' (SQ.FT.)**	**HSG 'B' (SQ.FT.)**	**HSG 'C' (SQ.FT.)**	**HSG 'D' (SQ.FT.)**
Open Space (lawns, parks, golf courses, etc.)					
Poor Condition (<50% grass cover)	0.00	0	0	0	0
Fair Condition (50% to 75% grass cover)	1.19	0	52037	0	0
Good Condition (>75% grass cover)	0.00	0	0	0	0
Impervious Areas					
Paved parking lots, roofs, driveways, etc.	0.00	0	0	0	0
Streets and roads:					
Paved; curbs and storm sewers	9.10	0	396252	0	0
Paved; open ditches	0.00	0	0	0	0
Gravel	0.00	0	0	0	0
Dirt	0.00	0	0	0	0
Urban Districs					
Commerical and business	13.19	0	472837	0	101815
Industrial	0.00	0	0	0	0
Residential districts by average lot size:					
1/8 acre, townhouse	4.04	0	176116	0	0
1/4 acre	27.48	0	1197075	0	0
1/3 acre	4.07	0	177374	0	0
1/2 acre	5.69	0	247749	0	0
1 acre	6.56	0	285597	0	0
2 acre	0.00	0	0	0	0
Developing Urban Areas					
Newly graded areas	0.00	0	0	0	0
Pasture (<50% ground cover or heavily grazed)	0.00	0	0	0	0
Pasture (50% to 75% ground cover or not heavily grazed)	0.00	0	0	0	0
Pasture (>75% ground cover or lightly grazed)	0.00	0	0	0	0
Meadow - continuous grass, protected from grazing and generally mowed for hay	0.00	0	0	0	0
Brush (<50% ground cover)	0.00	0	0	0	0
Brush (50% to 75% ground cover)	0.00	0	0	0	0
Brush (>75% ground cover)	0.00	0	0	0	0

	Woods (Forest litter, small trees, and brush destroyed by heavy grazing or regular burning)	0.00	0	0	0	0
	Woods (Woods are grazed but not burned, and some forest litter covers the soil)	34.56	0	1505239	0	0
	Woods (Woods are protected from grazing, and litter and brush adequately cover the soil)	0.00	0	0	0	0
	TOTAL (AC)	105.88	0.00	103.54	0.00	2.34

III. SCS CURVE NUMBER CALCULATION

COVER DESCRIPTION (Source: NCDEQ Stormwater MDC)	SCS CN			
	HSG 'A'	HSG 'B'	HSG 'C'	HSG 'D'
Open Space (lawns, parks, golf courses, etc.)				
Poor Condition (<50% grass cover)	68	79	86	89
Fair Condition (50% to 75% grass cover)	49	69	79	84
Good Condition (>75% grass cover)	39	61	74	80
Impervious Areas				
Paved parking lots, roofs, driveways, etc.	98	98	98	98
Streets and roads:				
Paved; curbs and storm sewers	93	93	93	98
Paved; open ditches	83	89	98	98
Gravel	76	85	89	91
Dirt	72	82	85	88
Urban Districts				
Commerical and business	89	97	94	95
Industrial	81	88	91	93
Residential districts by average lot size:				
1/8 acre, townhouse	77	85	90	92
1/4 acre	61	75	83	87
1/3 acre	57	72	81	86
1/2 acre	54	70	80	85
1 acre	51	68	79	84
2 acre	46	65	77	82
Developing Urban Areas				
Newly graded areas	77	86	91	94
Pasture (<50% ground cover or heavily grazed)	68	79	86	89
Pasture (50% to 75% ground cover or not heavily grazed)	49	69	79	84
Pasture (>75% ground cover or lightly grazed)	39	61	74	80
Meadow - continuous grass, protected from grazing and generally mowed for hay	30	58	71	78
Brush (<50% ground cover)	48	67	77	83
Brush (50% to 75% ground cover)	35	56	70	77
Brush (>75% ground cover)	30	48	65	73
Woods (Forest litter, small trees, and brush destroyed by heavy grazing or regular burning)	45	66	77	83
Woods (Woods are grazed but not burned, and some forest litter covers the soil)	36	60	73	79
Woods (Woods are protected from grazing, and litter and brush adequately cover the soil)	30	55	70	77
	0	**7597**	**0**	**222**
COMPOSITE SCS CN	**74**			
% Impervious	**374250%**			

HYDROLOGY - NRCS CURVE NUMBER

Project Name:	Applebranch
Project Number:	47097.003
Location:	City of Danville, Virginia
Date:	10/15/2021
Prepared by:	Alston Willard, EIT
Checked by:	Abrham Asfaw, PE
Existing or Proposed:	EXISTING
Catchment:	EX-DA-13

TIMMONS GROUP
YOUR VISION ACHIEVED THROUGH OURS.

I. SUBBASIN SOIL CHARACTERISTICS

	AREA	
	ac	%
HSG 'A'	0.00	0%
HSG 'B'	90.16	100%
HSG 'C'	0.00	0%
HSG 'D'	0.00	0%

	90.16	**ac**
TOTAL AREA	**3927273**	**sq ft**
	0.140872	**sq mi**

II. SUBBASIN LAND COVER CONDITIONS

COVER DESCRIPTION	AREA				
	TOTAL (AC)	HSG 'A' (SQ.FT.)	HSG 'B' (SQ.FT.)	HSG 'C' (SQ.FT.)	HSG 'D' (SQ.FT.)
Open Space (lawns, parks, golf courses, etc.)					
Poor Condition (<50% grass cover)	0.00	0	0	0	0
Fair Condition (50% to 75% grass cover)	12.02	0	523601	0	0
Good Condition (>75% grass cover)	0.00	0	0	0	0
Impervious Areas					
Paved parking lots, roofs, driveways, etc.	5.28	0	229913	0	0
Streets and roads:					
Paved; curbs and storm sewers	17.43	0	759155	0	0
Paved; open ditches	0.00	0	0	0	0
Gravel	0.00	0	0	0	0
Dirt	0.00	0	0	0	0
Urban Districs					
Commerical and business	1.86	0	81150	0	0
Industrial	1.20	0	52423	0	0
Residential districts by average lot size:					
1/8 acre, townhouse	25.35	0	1104163	0	0
1/4 acre	14.25	0	620876	0	0
1/3 acre	3.80	0	165552	0	0
1/2 acre	0.00	0	0	0	0
1 acre	0.00	0	0	0	0
2 acre	0.00	0	0	0	0
Developing Urban Areas					
Newly graded areas	5.00	0	217722	0	0
Pasture (<50% ground cover or heavily grazed)	0.00	0	0	0	0
Pasture (50% to 75% ground cover or not heavily grazed)	0.00	0	0	0	0
Pasture (>75% ground cover or lightly grazed)	0.00	0	0	0	0
Meadow - continuous grass, protected from grazing and generally mowed for hay	0.00	0	0	0	0
Brush (<50% ground cover)	0.00	0	0	0	0
Brush (50% to 75% ground cover)	0.00	0	0	0	0
Brush (>75% ground cover)	0.00	0	0	0	0

	Woods (Forest litter, small trees, and brush destroyed by heavy grazing or regular burning)	0.00	0	0	0	0
	Woods (Woods are grazed but not burned, and some forest litter covers the soil)	3.97	0	172718	0	0
	Woods (Woods are protected from grazing, and litter and brush adequately cover the soil)	0.00	0	0	0	0
	TOTAL (AC)	90.16	0.00	90.16	0.00	0.00

III. SCS CURVE NUMBER CALCULATION

COVER DESCRIPTION (Source: NCDEQ Stormwater MDC)	SCS CN			
	HSG 'A'	HSG 'B'	HSG 'C'	HSG 'D'
Open Space (lawns, parks, golf courses, etc.)				
Poor Condition (<50% grass cover)	68	79	86	89
Fair Condition (50% to 75% grass cover)	49	69	79	84
Good Condition (>75% grass cover)	39	61	74	80
Impervious Areas				
Paved parking lots, roofs, driveways, etc.	98	98	98	98
Streets and roads:				
Paved; curbs and storm sewers	93	93	93	98
Paved; open ditches	83	89	98	98
Gravel	76	85	89	91
Dirt	72	82	85	88
Urban Districts				
Commerical and business	89	97	94	95
Industrial	81	97	91	93
Residential districts by average lot size:				
1/8 acre, townhouse	77	85	90	92
1/4 acre	61	75	83	87
1/3 acre	57	72	81	86
1/2 acre	54	70	80	85
1 acre	51	68	79	84
2 acre	46	65	77	82
Developing Urban Areas				
Newly graded areas	77	86	91	94
Pasture (<50% ground cover or heavily grazed)	68	79	86	89
Pasture (50% to 75% ground cover or not heavily grazed)	49	69	79	84
Pasture (>75% ground cover or lightly grazed)	39	61	74	80
Meadow - continuous grass, protected from grazing and generally mowed for hay	30	58	71	78
Brush (<50% ground cover)	48	67	77	83
Brush (50% to 75% ground cover)	35	56	70	77
Brush (>75% ground cover)	30	48	65	73
Woods (Forest litter, small trees, and brush destroyed by heavy grazing or regular burning)	45	66	77	83
Woods (Woods are grazed but not burned, and some forest litter covers the soil)	36	60	73	79
Woods (Woods are protected from grazing, and litter and brush adequately cover the soil)	30	55	70	77
	0	**7430**	**0**	**0**
COMPOSITE SCS CN	**82**			
% Impervious	**25%**			

HYDROLOGY - NRCS CURVE NUMBER

Project Name:	Applebranch
Project Number:	47097.003
Location:	City of Danville, Virginia
Date:	10/15/2021
Prepared by:	Alston Willard, EIT
Checked by:	Abrham Asfaw, PE
Existing or Proposed:	EXISTING
Catchment:	EX-DA-14

TIMMONS GROUP
YOUR VISION ACHIEVED THROUGH OURS.

I. SUBBASIN SOIL CHARACTERISTICS

	AREA	
	ac	**%**
HSG 'A'	0.00	0%
HSG 'B'	102.41	100%
HSG 'C'	0.00	0%
HSG 'D'	0.00	0%

	102.41	**ac**
TOTAL AREA	**4460929**	**sq ft**
	0.160014	**sq mi**

II. SUBBASIN LAND COVER CONDITIONS

COVER DESCRIPTION	AREA				
	TOTAL (AC)	**HSG 'A' (SQ.FT.)**	**HSG 'B' (SQ.FT.)**	**HSG 'C' (SQ.FT.)**	**HSG 'D' (SQ.FT.)**
Open Space (lawns, parks, golf courses, etc.)					
Poor Condition (<50% grass cover)	0.00	0	0	0	0
Fair Condition (50% to 75% grass cover)	4.45	0	193814	0	0
Good Condition (>75% grass cover)	0.00	0	0	0	0
Impervious Areas					
Paved parking lots, roofs, driveways, etc.	1.03	0	44986	0	0
Streets and roads:					
Paved; curbs and storm sewers	15.10	0	657819	0	0
Paved; open ditches	0.00	0	0	0	0
Gravel	0.00	0	0	0	0
Dirt	0.00	0	0	0	0
Urban Districs					
Commerical and business	1.04	0	45271	0	0
Industrial	0.00	0	0	0	0
Residential districts by average lot size:					
1/8 acre, townhouse	15.00	0	653396	0	0
1/4 acre	25.88	0	1127214	0	0
1/3 acre	11.92	0	519384	0	0
1/2 acre	0.80	0	34734	0	0
1 acre	0.81	0	35105	0	0
2 acre	0.00	0	0	0	0
Developing Urban Areas					
Newly graded areas	0.00	0	0	0	0
Pasture (<50% ground cover or heavily grazed)	0.00	0	0	0	0
Pasture (50% to 75% ground cover or not heavily grazed)	0.00	0	0	0	0
Pasture (>75% ground cover or lightly grazed)	0.00	0	0	0	0
Meadow - continuous grass, protected from grazing and generally mowed for hay	0.00	0	0	0	0
Brush (<50% ground cover)	0.00	0	0	0	0
Brush (50% to 75% ground cover)	0.00	0	0	0	0
Brush (>75% ground cover)	0.00	0	0	0	0

	Woods (Forest litter, small trees, and brush destroyed by heavy grazing or regular burning)	0.00	0	0	0	0
	Woods (Woods are grazed but not burned, and some forest litter covers the soil)	26.38	0	1149206	0	0
	Woods (Woods are protected from grazing, and litter and brush adequately cover the soil)	0.00	0	0	0	0
	TOTAL (AC)	102.41	0.00	102.41	0.00	0.00

III. SCS CURVE NUMBER CALCULATION

COVER DESCRIPTION (Source: NCDEQ Stormwater MDC)	SCS CN			
	HSG 'A'	HSG 'B'	HSG 'C'	HSG 'D'
Open Space (lawns, parks, golf courses, etc.)				
Poor Condition (<50% grass cover)	68	79	86	89
Fair Condition (50% to 75% grass cover)	49	69	79	84
Good Condition (>75% grass cover)	39	61	74	80
Impervious Areas				
Paved parking lots, roofs, driveways, etc.	98	98	98	98
Streets and roads:				
Paved; curbs and storm sewers	93	93	93	98
Paved; open ditches	83	89	98	98
Gravel	76	85	89	91
Dirt	72	82	85	88
Urban Districts				
Commerical and business	89	97	94	95
Industrial	81	88	91	93
Residential districts by average lot size:				
1/8 acre, townhouse	77	85	90	92
1/4 acre	61	75	83	87
1/3 acre	57	72	81	86
1/2 acre	54	70	80	85
1 acre	51	68	79	84
2 acre	46	65	77	82
Developing Urban Areas				
Newly graded areas	77	86	91	94
Pasture (<50% ground cover or heavily grazed)	68	79	86	89
Pasture (50% to 75% ground cover or not heavily grazed)	49	69	79	84
Pasture (>75% ground cover or lightly grazed)	39	61	74	80
Meadow - continuous grass, protected from grazing and generally mowed for hay	30	58	71	78
Brush (<50% ground cover)	48	67	77	83
Brush (50% to 75% ground cover)	35	56	70	77
Brush (>75% ground cover)	30	48	65	73
Woods (Forest litter, small trees, and brush destroyed by heavy grazing or regular burning)	45	66	77	83
Woods (Woods are grazed but not burned, and some forest litter covers the soil)	36	60	73	79
Woods (Woods are protected from grazing, and litter and brush adequately cover the soil)	30	55	70	77
	0	**7681**	**0**	**0**
COMPOSITE SCS CN	**75**			
% Impervious	**16%**			

HYDROLOGY - NRCS CURVE NUMBER

Project Name:	Applebranch
Project Number:	47097.003
Location:	City of Danville, Virginia
Date:	10/15/2021
Prepared by:	Alston Willard, EIT
Checked by:	Abrham Asfaw, PE
Existing or Proposed:	EXISTING
Catchment:	EX-DA-15

TIMMONS GROUP
YOUR VISION ACHIEVED THROUGH OURS.

I. SUBBASIN SOIL CHARACTERISTICS

	AREA	
	ac	**%**
HSG 'A'	0.00	0%
HSG 'B'	247.66	95%
HSG 'C'	0.00	0%
HSG 'D'	12.86	5%

	260.52	**ac**
TOTAL AREA	**11348413**	**sq ft**
	0.407068	**sq mi**

II. SUBBASIN LAND COVER CONDITIONS

COVER DESCRIPTION	AREA				
	TOTAL (AC)	**HSG 'A' (SQ.FT.)**	**HSG 'B' (SQ.FT.)**	**HSG 'C' (SQ.FT.)**	**HSG 'D' (SQ.FT.)**
Open Space (lawns, parks, golf courses, etc.)					
Poor Condition (<50% grass cover)	0.00	0	0	0	0
Fair Condition (50% to 75% grass cover)	2.27	0	98940	0	0
Good Condition (>75% grass cover)	0.00	0	0	0	0
Impervious Areas					
Paved parking lots, roofs, driveways, etc.	15.35	0	108655	0	560148
Streets and roads:					
Paved; curbs and storm sewers	46.73	0	2035431	0	0
Paved; open ditches	0.00	0	0	0	0
Gravel	0.00	0	0	0	0
Dirt	0.00	0	0	0	0
Urban Districs					
Commerical and business	17.57	0	765211	0	0
Industrial	3.45	0	150203	0	0
Residential districts by average lot size:					
1/8 acre, townhouse	73.21	0	3188933	0	0
1/4 acre	73.21	0	3188933	0	0
1/3 acre	16.33	0	711328	0	0
1/2 acre	5.45	0	237394	0	0
1 acre	0.00	0	0	0	0
2 acre	0.00	0	0	0	0
Developing Urban Areas					
Newly graded areas	0.00	0	0	0	0
Pasture (<50% ground cover or heavily grazed)	0.00	0	0	0	0
Pasture (50% to 75% ground cover or not heavily grazed)	0.00	0	0	0	0
Pasture (>75% ground cover or lightly grazed)	0.00	0	0	0	0
Meadow - continuous grass, protected from grazing and generally mowed for hay	0.00	0	0	0	0
Brush (<50% ground cover)	0.00	0	0	0	0
Brush (50% to 75% ground cover)	0.00	0	0	0	0
Brush (>75% ground cover)	0.00	0	0	0	0

	Woods (Forest litter, small trees, and brush destroyed by heavy grazing or regular burning)	0.00	0	0	0	0
	Woods (Woods are grazed but not burned, and some forest litter covers the soil)	6.96	0	303237	0	0
	Woods (Woods are protected from grazing, and litter and brush adequately cover the soil)	0.00	0	0	0	0
	TOTAL (AC)	260.52	0.00	247.66	0.00	12.86

III. SCS CURVE NUMBER CALCULATION

COVER DESCRIPTION (Source: NCDEQ Stormwater MDC)	SCS CN			
	HSG 'A'	HSG 'B'	HSG 'C'	HSG 'D'
Open Space (lawns, parks, golf courses, etc.)				
Poor Condition (<50% grass cover)	68	79	86	89
Fair Condition (50% to 75% grass cover)	49	69	79	84
Good Condition (>75% grass cover)	39	61	74	80
Impervious Areas				
Paved parking lots, roofs, driveways, etc.	98	98	98	98
Streets and roads:				
Paved; curbs and storm sewers	93	93	93	98
Paved; open ditches	83	89	98	98
Gravel	76	85	89	91
Dirt	72	82	85	88
Urban Districts				
Commerical and business	89	97	94	95
Industrial	81	97	91	93
Residential districts by average lot size:				
1/8 acre, townhouse	77	85	90	92
1/4 acre	61	75	83	87
1/3 acre	57	72	81	86
1/2 acre	54	70	80	85
1 acre	51	68	79	84
2 acre	46	65	77	82
Developing Urban Areas				
Newly graded areas	77	86	91	94
Pasture (<50% ground cover or heavily grazed)	68	79	86	89
Pasture (50% to 75% ground cover or not heavily grazed)	49	69	79	84
Pasture (>75% ground cover or lightly grazed)	39	61	74	80
Meadow - continuous grass, protected from grazing and generally mowed for hay	30	58	71	78
Brush (<50% ground cover)	48	67	77	83
Brush (50% to 75% ground cover)	35	56	70	77
Brush (>75% ground cover)	30	48	65	73
Woods (Forest litter, small trees, and brush destroyed by heavy grazing or regular burning)	45	66	77	83
Woods (Woods are grazed but not burned, and some forest litter covers the soil)	36	60	73	79
Woods (Woods are protected from grazing, and litter and brush adequately cover the soil)	30	55	70	77
	0	**20473**	**0**	**1260**
COMPOSITE SCS CN	**83**			
% Impervious	**24%**			

HYDROLOGY - NRCS CURVE NUMBER

Project Name:	Applebranch
Project Number:	47097.003
Location:	City of Danville, Virginia
Date:	10/15/2021
Prepared by:	Alston Willard, EIT
Checked by:	Abrham Asfaw, PE
Existing or Proposed:	EXISTING
Catchment:	EX-DA-16

TIMMONS GROUP
YOUR VISION ACHIEVED THROUGH OURS.

I. SUBBASIN SOIL CHARACTERISTICS

	AREA	
	ac	%
HSG 'A'	15.48	16%
HSG 'B'	80.04	84%
HSG 'C'	0.00	0%
HSG 'D'	0.00	0%

	95.52	**ac**
TOTAL AREA	**4160745**	**sq ft**
	0.149246	**sq mi**

II. SUBBASIN LAND COVER CONDITIONS

COVER DESCRIPTION	AREA				
	TOTAL (AC)	HSG 'A' (SQ.FT.)	HSG 'B' (SQ.FT.)	HSG 'C' (SQ.FT.)	HSG 'D' (SQ.FT.)
Open Space (lawns, parks, golf courses, etc.)					
Poor Condition (<50% grass cover)	0.00	0	0	0	0
Fair Condition (50% to 75% grass cover)	0.08	0	3341	0	0
Good Condition (>75% grass cover)	0.00	0	0	0	0
Impervious Areas					
Paved parking lots, roofs, driveways, etc.	0.00	0	0	0	0
Streets and roads:					
Paved; curbs and storm sewers	15.48	674311	0	0	0
Paved; open ditches	0.00	0	0	0	0
Gravel	0.00	0	0	0	0
Dirt	0.00	0	0	0	0
Urban Districts					
Commerical and business	27.88	0	1214605	0	0
Industrial	0.00	0	0	0	0
Residential districts by average lot size:					
1/8 acre, townhouse	0.88	0	38184	0	0
1/4 acre	38.74	0	1687405	0	0
1/3 acre	8.64	0	376489	0	0
1/2 acre	1.25	0	54408	0	0
1 acre	0.00	0	0	0	0
2 acre	0.00	0	0	0	0
Developing Urban Areas					
Newly graded areas	0.00	0	0	0	0
Pasture (<50% ground cover or heavily grazed)	0.00	0	0	0	0
Pasture (50% to 75% ground cover or not heavily grazed)	0.00	0	0	0	0
Pasture (>75% ground cover or lightly grazed)	0.00	0	0	0	0
Meadow - continuous grass, protected from grazing and generally mowed for hay	0.00	0	0	0	0
Brush (<50% ground cover)	0.00	0	0	0	0
Brush (50% to 75% ground cover)	0.00	0	0	0	0
Brush (>75% ground cover)	0.00	0	0	0	0

	Woods (Forest litter, small trees, and brush destroyed by heavy grazing or regular burning)	0.00	0	0	0	0
	Woods (Woods are grazed but not burned, and some forest litter covers the soil)	2.57	0	112002	0	0
	Woods (Woods are protected from grazing, and litter and brush adequately cover the soil)	0.00	0	0	0	0
	TOTAL (AC)	95.52	15.48	80.04	0.00	0.00

III. SCS CURVE NUMBER CALCULATION

COVER DESCRIPTION (Source: NCDEQ Stormwater MDC)	SCS CN			
	HSG 'A'	HSG 'B'	HSG 'C'	HSG 'D'
Open Space (lawns, parks, golf courses, etc.)				
Poor Condition (<50% grass cover)	68	79	86	89
Fair Condition (50% to 75% grass cover)	49	69	79	84
Good Condition (>75% grass cover)	39	61	74	80
Impervious Areas				
Paved parking lots, roofs, driveways, etc.	98	98	98	98
Streets and roads:				
Paved; curbs and storm sewers	93	93	93	98
Paved; open ditches	83	89	98	98
Gravel	76	85	89	91
Dirt	72	82	85	88
Urban Districts				
Commerical and business	89	97	94	95
Industrial	81	88	91	93
Residential districts by average lot size:				
1/8 acre, townhouse	77	85	90	92
1/4 acre	61	75	83	87
1/3 acre	57	72	81	86
1/2 acre	54	70	80	85
1 acre	51	68	79	84
2 acre	46	65	77	82
Developing Urban Areas				
Newly graded areas	77	86	91	94
Pasture (<50% ground cover or heavily grazed)	68	79	86	89
Pasture (50% to 75% ground cover or not heavily grazed)	49	69	79	84
Pasture (>75% ground cover or lightly grazed)	39	61	74	80
Meadow - continuous grass, protected from grazing and generally mowed for hay	30	58	71	78
Brush (<50% ground cover)	48	67	77	83
Brush (50% to 75% ground cover)	35	56	70	77
Brush (>75% ground cover)	30	48	65	73
Woods (Forest litter, small trees, and brush destroyed by heavy grazing or regular burning)	45	66	77	83
Woods (Woods are grazed but not burned, and some forest litter covers the soil)	36	60	73	79
Woods (Woods are protected from grazing, and litter and brush adequately cover the soil)	30	55	70	77
	1440	**6554**	**0**	**0**
COMPOSITE SCS CN	**84**			
% Impervious	**705955%**			

HYDROLOGY - NRCS CURVE NUMBER

Project Name:	Applebranch
Project Number:	47097.003
Location:	City of Danville, Virginia
Date:	10/15/2021
Prepared by:	Alston Willard, EIT
Checked by:	Abrham Asfaw, PE
Existing or Proposed:	EXISTING
Catchment:	EX-DA-17

TIMMONS GROUP
YOUR VISION ACHIEVED THROUGH OURS.

I. SUBBASIN SOIL CHARACTERISTICS

	AREA	
	ac	**%**
HSG 'A'	0.00	0%
HSG 'B'	128.31	100%
HSG 'C'	0.00	0%
HSG 'D'	0.00	0%

	128.31	**ac**
TOTAL AREA	**5589139**	**sq ft**
	0.200483	**sq mi**

II. SUBBASIN LAND COVER CONDITIONS

COVER DESCRIPTION	AREA				
	TOTAL (AC)	**HSG 'A' (SQ.FT.)**	**HSG 'B' (SQ.FT.)**	**HSG 'C' (SQ.FT.)**	**HSG 'D' (SQ.FT.)**
Open Space (lawns, parks, golf courses, etc.)					
Poor Condition (<50% grass cover)	0.00	0	0	0	0
Fair Condition (50% to 75% grass cover)	0.00	0	0	0	0
Good Condition (>75% grass cover)	0.00	0	0	0	0
Impervious Areas					
Paved parking lots, roofs, driveways, etc.	0.00	0	0	0	0
Streets and roads:					
Paved; curbs and storm sewers	26.87	0	1170673	0	0
Paved; open ditches	0.00	0	0	0	0
Gravel	0.00	0	0	0	0
Dirt	0.00	0	0	0	0
Urban Districs					
Commerical and business	5.25	0	228502	0	0
Industrial	2.73	0	118729	0	0
Residential districts by average lot size:					
1/8 acre, townhouse	41.51	0	1808002	0	0
1/4 acre	41.51	0	1808002	0	0
1/3 acre	2.39	0	103973	0	0
1/2 acre	0.00	0	0	0	0
1 acre	0.00	0	0	0	0
2 acre	0.00	0	0	0	0
Developing Urban Areas					
Newly graded areas	0.00	0	0	0	0
Pasture (<50% ground cover or heavily grazed)	0.00	0	0	0	0
Pasture (50% to 75% ground cover or not heavily grazed)	0.00	0	0	0	0
Pasture (>75% ground cover or lightly grazed)	0.00	0	0	0	0
Meadow - continuous grass, protected from grazing and generally mowed for hay	0.00	0	0	0	0
Brush (<50% ground cover)	0.00	0	0	0	0
Brush (50% to 75% ground cover)	0.00	0	0	0	0
Brush (>75% ground cover)	0.00	0	0	0	0

	Woods (Forest litter, small trees, and brush destroyed by heavy grazing or regular burning)	0.00	0	0	0	0
	Woods (Woods are grazed but not burned, and some forest litter covers the soil)	8.06	0	351258	0	0
	Woods (Woods are protected from grazing, and litter and brush adequately cover the soil)	0.00	0	0	0	0
	TOTAL (AC)	128.31	0.00	128.31	0.00	0.00

III. SCS CURVE NUMBER CALCULATION

COVER DESCRIPTION (Source: NCDEQ Stormwater MDC)	SCS CN			
	HSG 'A'	HSG 'B'	HSG 'C'	HSG 'D'
Open Space (lawns, parks, golf courses, etc.)				
Poor Condition (<50% grass cover)	68	79	86	89
Fair Condition (50% to 75% grass cover)	49	69	79	84
Good Condition (>75% grass cover)	39	61	74	80
Impervious Areas				
Paved parking lots, roofs, driveways, etc.	98	98	98	98
Streets and roads:				
Paved; curbs and storm sewers	93	93	93	98
Paved; open ditches	83	89	98	98
Gravel	76	85	89	91
Dirt	72	82	85	88
Urban Districts				
Commerical and business	89	92	94	95
Industrial	81	88	91	93
Residential districts by average lot size:				
1/8 acre, townhouse	77	85	90	92
1/4 acre	61	75	83	87
1/3 acre	57	72	81	86
1/2 acre	54	70	80	85
1 acre	51	68	79	84
2 acre	46	65	77	82
Developing Urban Areas				
Newly graded areas	77	86	91	94
Pasture (<50% ground cover or heavily grazed)	68	79	86	89
Pasture (50% to 75% ground cover or not heavily grazed)	49	69	79	84
Pasture (>75% ground cover or lightly grazed)	39	61	74	80
Meadow - continuous grass, protected from grazing and generally mowed for hay	30	58	71	78
Brush (<50% ground cover)	48	67	77	83
Brush (50% to 75% ground cover)	35	56	70	77
Brush (>75% ground cover)	30	48	65	73
Woods (Forest litter, small trees, and brush destroyed by heavy grazing or regular burning)	45	66	77	83
Woods (Woods are grazed but not burned, and some forest litter covers the soil)	36	60	73	79
Woods (Woods are protected from grazing, and litter and brush adequately cover the soil)	30	55	70	77
	0	**10518**	**0**	**0**
COMPOSITE SCS CN	**82**			
% Impervious	**912386%**			

HYDROLOGY - NRCS CURVE NUMBER

Project Name:	Applebranch
Project Number:	47097.003
Location:	City of Danville, Virginia
Date:	4/18/2022
Prepared by:	Alston Willard, EIT
Checked by:	Abrham Asfaw, PE
Existing or Proposed:	EXISTING
Catchment:	EX-DA-18a

TIMMONS GROUP
YOUR VISION ACHIEVED THROUGH OURS.

I. SUBBASIN SOIL CHARACTERISTICS

	AREA	
	ac	%
HSG 'A'	0.00	0%
HSG 'B'	5.67	100%
HSG 'C'	0.00	0%
HSG 'D'	0.00	0%

	5.67	**ac**
TOTAL AREA	**247079.13**	**sq ft**
	0.008863	**sq mi**

II. SUBBASIN LAND COVER CONDITIONS

COVER DESCRIPTION	AREA				
	TOTAL (AC)	HSG 'A' (SQ.FT.)	HSG 'B' (SQ.FT.)	HSG 'C' (SQ.FT.)	HSG 'D' (SQ.FT.)
Open Space (lawns, parks, golf courses, etc.)					
Poor Condition (<50% grass cover)	1.80	0	78582	0	0
Fair Condition (50% to 75% grass cover)	0.00	0	0	0	0
Good Condition (>75% grass cover)	0.00	0	0	0	0
Impervious Areas					
Paved parking lots, roofs, driveways, etc.	0.35	0	15039	0	0
Streets and roads:					
Paved; curbs and storm sewers	3.52	0	153458	0	0
Paved; open ditches	0.00	0	0	0	0
Gravel	0.00	0	0	0	0
Dirt	0.00	0	0	0	0
Urban Districs					
Commerical and business	0.00	0	0	0	0
Industrial	0.00	0	0	0	0
Residential districts by average lot size:					
1/8 acre, townhouse	0.00	0	0	0	0
1/4 acre	0.00	0	0	0	0
1/3 acre	0.00	0	0	0	0
1/2 acre	0.00	0	0	0	0
1 acre	0.00	0	0	0	0
2 acre	0.00	0	0	0	0
Developing Urban Areas					
Newly graded areas	0.00	0	0	0	0
Pasture (<50% ground cover or heavily grazed)	0.00	0	0	0	0
Pasture (50% to 75% ground cover or not heavily grazed)	0.00	0	0	0	0
Pasture (>75% ground cover or lightly grazed)	0.00	0	0	0	0
Meadow - continuous grass, protected from grazing and generally mowed for hay	0.00	0	0	0	0
Brush (<50% ground cover)	0.00	0	0	0	0
Brush (50% to 75% ground cover)	0.00	0	0	0	0
Brush (>75% ground cover)	0.00	0	0	0	0

	Woods (Forest litter, small trees, and brush destroyed by heavy grazing or regular burning)	0.00	0	0	0	0
	Woods (Woods are grazed but not burned, and some forest litter covers the soil)	0.00	0	0	0	0
	Woods (Woods are protected from grazing, and litter and brush adequately cover the soil)	0.00	0	0	0	0
	TOTAL (AC)	5.67	0.00	5.67	0.00	0.00

III. SCS CURVE NUMBER CALCULATION

COVER DESCRIPTION (Source: NCDEQ Stormwater MDC)	SCS CN			
	HSG 'A'	HSG 'B'	HSG 'C'	HSG 'D'
Open Space (lawns, parks, golf courses, etc.)				
Poor Condition (<50% grass cover)	68	79	86	89
Fair Condition (50% to 75% grass cover)	49	69	79	84
Good Condition (>75% grass cover)	39	61	74	80
Impervious Areas				
Paved parking lots, roofs, driveways, etc.	98	98	98	98
Streets and roads:				
Paved; curbs and storm sewers	93	93	93	98
Paved; open ditches	83	89	98	98
Gravel	76	85	89	91
Dirt	72	82	85	88
Urban Districts				
Commerical and business	89	92	94	95
Industrial	81	88	91	93
Residential districts by average lot size:				
1/8 acre, townhouse	77	85	90	92
1/4 acre	61	75	83	87
1/3 acre	57	72	81	86
1/2 acre	54	70	80	85
1 acre	51	68	79	84
2 acre	46	65	77	82
Developing Urban Areas				
Newly graded areas	77	86	91	94
Pasture (<50% ground cover or heavily grazed)	68	79	86	89
Pasture (50% to 75% ground cover or not heavily grazed)	49	69	79	84
Pasture (>75% ground cover or lightly grazed)	39	61	74	80
Meadow - continuous grass, protected from grazing and generally mowed for hay	30	58	71	78
Brush (<50% ground cover)	48	67	77	83
Brush (50% to 75% ground cover)	35	56	70	77
Brush (>75% ground cover)	30	48	65	73
Woods (Forest litter, small trees, and brush destroyed by heavy grazing or regular burning)	45	66	77	83
Woods (Woods are grazed but not burned, and some forest litter covers the soil)	36	60	73	79
Woods (Woods are protected from grazing, and litter and brush adequately cover the soil)	30	55	70	77
	0	**504**	**0**	**0**
COMPOSITE SCS CN	**89**			
% Impervious	**2970607%**			

HYDROLOGY - NRCS CURVE NUMBER

Project Name:	Applebranch
Project Number:	47097.003
Location:	City of Danville, Virginia
Date:	
Prepared by:	Alston Willard, EIT
Checked by:	
Existing or Proposed:	EXISTING
Catchment:	EX-DA-18

TIMMONS GROUP
YOUR VISION ACHIEVED THROUGH OURS.

I. SUBBASIN SOIL CHARACTERISTICS

	AREA	
	ac	%
HSG 'A'	0.00	0%
HSG 'B'	1.51	100%
HSG 'C'	0.00	0%
HSG 'D'	0.00	0%

	1.51	**ac**
TOTAL AREA	**65723.49**	**sq ft**
	0.002358	**sq mi**

II. SUBBASIN LAND COVER CONDITIONS

COVER DESCRIPTION	AREA				
	TOTAL (AC)	HSG 'A' (SQ.FT.)	HSG 'B' (SQ.FT.)	HSG 'C' (SQ.FT.)	HSG 'D' (SQ.FT.)
Open Space (lawns, parks, golf courses, etc.)					
Poor Condition (<50% grass cover)	0.00	0	0	0	0
Fair Condition (50% to 75% grass cover)	0.00	0	0	0	0
Good Condition (>75% grass cover)	0.00	0	0	0	0
Impervious Areas					
Paved parking lots, roofs, driveways, etc.	1.51	0	65723	0	0
Streets and roads:					
Paved; curbs and storm sewers	0.00	0	0	0	0
Paved; open ditches	0.00	0	0	0	0
Gravel	0.00	0	0	0	0
Dirt	0.00	0	0	0	0
Urban Districts					
Commerical and business	0.00	0	0	0	0
Industrial	0.00	0	0	0	0
Residential districts by average lot size:					
1/8 acre, townhouse	0.00	0	0	0	0
1/4 acre	0.00	0	0	0	0
1/3 acre	0.00	0	0	0	0
1/2 acre	0.00	0	0	0	0
1 acre	0.00	0	0	0	0
2 acre	0.00	0	0	0	0
Developing Urban Areas					
Newly graded areas	0.00	0	0	0	0
Pasture (<50% ground cover or heavily grazed)	0.00	0	0	0	0
Pasture (50% to 75% ground cover or not heavily grazed)	0.00	0	0	0	0
Pasture (>75% ground cover or lightly grazed)	0.00	0	0	0	0
Meadow - continuous grass, protected from grazing and generally mowed for hay	0.00	0	0	0	0
Brush (<50% ground cover)	0.00	0	0	0	0
Brush (50% to 75% ground cover)	0.00	0	0	0	0
Brush (>75% ground cover)	0.00	0	0	0	0

	Woods (Forest litter, small trees, and brush destroyed by heavy grazing or regular burning)	0.00	0	0	0	0
	Woods (Woods are grazed but not burned, and some forest litter covers the soil)	0.00	0	0	0	0
	Woods (Woods are protected from grazing, and litter and brush adequately cover the soil)	0.00	0	0	0	0
	TOTAL (AC)	1.51	0.00	1.51	0.00	0.00

III. SCS CURVE NUMBER CALCULATION

COVER DESCRIPTION (Source: NCDEQ Stormwater MDC)	SCS CN			
	HSG 'A'	HSG 'B'	HSG 'C'	HSG 'D'
Open Space (lawns, parks, golf courses, etc.)				
Poor Condition (<50% grass cover)	68	79	86	89
Fair Condition (50% to 75% grass cover)	49	69	79	84
Good Condition (>75% grass cover)	39	61	74	80
Impervious Areas				
Paved parking lots, roofs, driveways, etc.	98	98	98	98
Streets and roads:				
Paved; curbs and storm sewers	93	93	93	98
Paved; open ditches	83	89	98	98
Gravel	76	85	89	91
Dirt	72	82	85	88
Urban Districts				
Commerical and business	89	92	94	95
Industrial	81	88	91	93
Residential districts by average lot size:				
1/8 acre, townhouse	77	85	90	92
1/4 acre	61	75	83	87
1/3 acre	57	72	81	86
1/2 acre	54	70	80	85
1 acre	51	68	79	84
2 acre	46	65	77	82
Developing Urban Areas				
Newly graded areas	77	86	91	94
Pasture (<50% ground cover or heavily grazed)	68	79	86	89
Pasture (50% to 75% ground cover or not heavily grazed)	49	69	79	84
Pasture (>75% ground cover or lightly grazed)	39	61	74	80
Meadow - continuous grass, protected from grazing and generally mowed for hay	30	58	71	78
Brush (<50% ground cover)	48	67	77	83
Brush (50% to 75% ground cover)	35	56	70	77
Brush (>75% ground cover)	30	48	65	73
Woods (Forest litter, small trees, and brush destroyed by heavy grazing or regular burning)	45	66	77	83
Woods (Woods are grazed but not burned, and some forest litter covers the soil)	36	60	73	79
Woods (Woods are protected from grazing, and litter and brush adequately cover the soil)	30	55	70	77
	0	**148**	**0**	**0**
COMPOSITE SCS CN	**98**			
% Impervious	**4356000%**			

HYDROLOGY - NRCS CURVE NUMBER

Project Name:	Applebranch
Project Number:	47097.003
Location:	City of Danville, Virginia
Date:	
Prepared by:	Alston Willard, EIT
Checked by:	
Existing or Proposed:	EXISTING
Catchment:	EX-DA-18

TIMMONS GROUP
YOUR VISION ACHIEVED THROUGH OURS.

I. SUBBASIN SOIL CHARACTERISTICS

	AREA	
	ac	%
HSG 'A'	0.00	0%
HSG 'B'	3.18	100%
HSG 'C'	0.00	0%
HSG 'D'	0.00	0%

	3.18	**ac**
TOTAL AREA	**138648.28**	**sq ft**
	0.004973	**sq mi**

II. SUBBASIN LAND COVER CONDITIONS

COVER DESCRIPTION	AREA				
	TOTAL (AC)	HSG 'A' (SQ.FT.)	HSG 'B' (SQ.FT.)	HSG 'C' (SQ.FT.)	HSG 'D' (SQ.FT.)
Open Space (lawns, parks, golf courses, etc.)					
Poor Condition (<50% grass cover)	0.00	0	0	0	0
Fair Condition (50% to 75% grass cover)	1.30	0	56590	0	0
Good Condition (>75% grass cover)	0.00	0	0	0	0
Impervious Areas					
Paved parking lots, roofs, driveways, etc.	0.88	0	38543	0	0
Streets and roads:					
Paved; curbs and storm sewers	0.39	0	17200	0	0
Paved; open ditches	0.00	0	0	0	0
Gravel	0.00	0	0	0	0
Dirt	0.00	0	0	0	0
Urban Districts					
Commerical and business	0.00	0	0	0	0
Industrial	0.00	0	0	0	0
Residential districts by average lot size:					
1/8 acre, townhouse	0.00	0	0	0	0
1/4 acre	0.00	0	0	0	0
1/3 acre	0.00	0	0	0	0
1/2 acre	0.00	0	0	0	0
1 acre	0.00	0	0	0	0
2 acre	0.00	0	0	0	0
Developing Urban Areas					
Newly graded areas	0.00	0	0	0	0
Pasture (<50% ground cover or heavily grazed)	0.00	0	0	0	0
Pasture (50% to 75% ground cover or not heavily grazed)	0.00	0	0	0	0
Pasture (>75% ground cover or lightly grazed)	0.00	0	0	0	0
Meadow - continuous grass, protected from grazing and generally mowed for hay	0.00	0	0	0	0
Brush (<50% ground cover)	0.00	0	0	0	0
Brush (50% to 75% ground cover)	0.00	0	0	0	0
Brush (>75% ground cover)	0.00	0	0	0	0

	Woods (Forest litter, small trees, and brush destroyed by heavy grazing or regular burning)	0.00	0	0	0	0
	Woods (Woods are grazed but not burned, and some forest litter covers the soil)	0.60	0	26316	0	0
	Woods (Woods are protected from grazing, and litter and brush adequately cover the soil)	0.00	0	0	0	0
	TOTAL (AC)	3.18	0.00	3.18	0.00	0.00

III. SCS CURVE NUMBER CALCULATION

COVER DESCRIPTION (Source: NCDEQ Stormwater MDC)	SCS CN			
	HSG 'A'	HSG 'B'	HSG 'C'	HSG 'D'
Open Space (lawns, parks, golf courses, etc.)				
Poor Condition (<50% grass cover)	68	79	86	89
Fair Condition (50% to 75% grass cover)	49	69	79	84
Good Condition (>75% grass cover)	39	61	74	80
Impervious Areas				
Paved parking lots, roofs, driveways, etc.	98	98	98	98
Streets and roads:				
Paved; curbs and storm sewers	93	93	93	98
Paved; open ditches	83	89	98	98
Gravel	76	85	89	91
Dirt	72	82	85	88
Urban Districts				
Commerical and business	89	92	94	95
Industrial	81	88	91	93
Residential districts by average lot size:				
1/8 acre, townhouse	77	85	90	92
1/4 acre	61	75	83	87
1/3 acre	57	72	81	86
1/2 acre	54	70	80	85
1 acre	51	68	79	84
2 acre	46	65	77	82
Developing Urban Areas				
Newly graded areas	77	86	91	94
Pasture (<50% ground cover or heavily grazed)	68	79	86	89
Pasture (50% to 75% ground cover or not heavily grazed)	49	69	79	84
Pasture (>75% ground cover or lightly grazed)	39	61	74	80
Meadow - continuous grass, protected from grazing and generally mowed for hay	30	58	71	78
Brush (<50% ground cover)	48	67	77	83
Brush (50% to 75% ground cover)	35	56	70	77
Brush (>75% ground cover)	30	48	65	73
Woods (Forest litter, small trees, and brush destroyed by heavy grazing or regular burning)	45	66	77	83
Woods (Woods are grazed but not burned, and some forest litter covers the soil)	36	60	73	79
Woods (Woods are protected from grazing, and litter and brush adequately cover the soil)	30	55	70	77
	0	**249**	**0**	**0**
COMPOSITE SCS CN	**78**			
% Impervious	**1751305%**			

HYDROLOGY - NRCS CURVE NUMBER

Project Name:	Applebranch
Project Number:	47097.003
Location:	City of Danville, Virginia
Date:	
Prepared by:	Alston Willard, EIT
Checked by:	
Existing or Proposed:	EXISTING
Catchment:	EX-DA-18

TIMMONS GROUP
YOUR VISION ACHIEVED THROUGH OURS.

I. SUBBASIN SOIL CHARACTERISTICS

	AREA	
	ac	%
HSG 'A'	0.00	0%
HSG 'B'	2.39	100%
HSG 'C'	0.00	0%
HSG 'D'	0.00	0%

	2.39	**ac**
TOTAL AREA	**104182.95**	**sq ft**
	0.003737	**sq mi**

II. SUBBASIN LAND COVER CONDITIONS

COVER DESCRIPTION	AREA				
	TOTAL (AC)	HSG 'A' (SQ.FT.)	HSG 'B' (SQ.FT.)	HSG 'C' (SQ.FT.)	HSG 'D' (SQ.FT.)
Open Space (lawns, parks, golf courses, etc.)					
Poor Condition (<50% grass cover)	0.00	0	0	0	0
Fair Condition (50% to 75% grass cover)	0.00	0	0	0	0
Good Condition (>75% grass cover)	0.00	0	0	0	0
Impervious Areas					
Paved parking lots, roofs, driveways, etc.	0.25	0	10882	0	0
Streets and roads:					
Paved; curbs and storm sewers	1.13	0	49066	0	0
Paved; open ditches	0.00	0	0	0	0
Gravel	0.00	0	0	0	0
Dirt	0.00	0	0	0	0
Urban Districts					
Commerical and business	0.00	0	0	0	0
Industrial	0.00	0	0	0	0
Residential districts by average lot size:					
1/8 acre, townhouse	0.00	0	0	0	0
1/4 acre	0.00	0	0	0	0
1/3 acre	0.68	0	29524	0	0
1/2 acre	0.00	0	0	0	0
1 acre	0.00	0	0	0	0
2 acre	0.00	0	0	0	0
Developing Urban Areas					
Newly graded areas	0.00	0	0	0	0
Pasture (<50% ground cover or heavily grazed)	0.00	0	0	0	0
Pasture (50% to 75% ground cover or not heavily grazed)	0.00	0	0	0	0
Pasture (>75% ground cover or lightly grazed)	0.00	0	0	0	0
Meadow - continuous grass, protected from grazing and generally mowed for hay	0.00	0	0	0	0
Brush (<50% ground cover)	0.00	0	0	0	0
Brush (50% to 75% ground cover)	0.00	0	0	0	0
Brush (>75% ground cover)	0.00	0	0	0	0

	Woods (Forest litter, small trees, and brush destroyed by heavy grazing or regular burning)	0.00	0	0	0	0
	Woods (Woods are grazed but not burned, and some forest litter covers the soil)	0.34	0	14711	0	0
	Woods (Woods are protected from grazing, and litter and brush adequately cover the soil)	0.00	0	0	0	0
	TOTAL (AC)	2.39	0.00	2.39	0.00	0.00

III. SCS CURVE NUMBER CALCULATION

COVER DESCRIPTION (Source: NCDEQ Stormwater MDC)	SCS CN			
	HSG 'A'	HSG 'B'	HSG 'C'	HSG 'D'
Open Space (lawns, parks, golf courses, etc.)				
Poor Condition (<50% grass cover)	68	79	86	89
Fair Condition (50% to 75% grass cover)	49	69	79	84
Good Condition (>75% grass cover)	39	61	74	80
Impervious Areas				
Paved parking lots, roofs, driveways, etc.	98	98	98	98
Streets and roads:				
Paved; curbs and storm sewers	93	93	93	98
Paved; open ditches	83	89	98	98
Gravel	76	85	89	91
Dirt	72	82	85	88
Urban Districts				
Commerical and business	89	92	94	95
Industrial	81	88	91	93
Residential districts by average lot size:				
1/8 acre, townhouse	77	85	90	92
1/4 acre	61	75	83	87
1/3 acre	57	72	81	86
1/2 acre	54	70	80	85
1 acre	51	68	79	84
2 acre	46	65	77	82
Developing Urban Areas				
Newly graded areas	77	86	91	94
Pasture (<50% ground cover or heavily grazed)	68	79	86	89
Pasture (50% to 75% ground cover or not heavily grazed)	49	69	79	84
Pasture (>75% ground cover or lightly grazed)	39	61	74	80
Meadow - continuous grass, protected from grazing and generally mowed for hay	30	58	71	78
Brush (<50% ground cover)	48	67	77	83
Brush (50% to 75% ground cover)	35	56	70	77
Brush (>75% ground cover)	30	48	65	73
Woods (Forest litter, small trees, and brush destroyed by heavy grazing or regular burning)	45	66	77	83
Woods (Woods are grazed but not burned, and some forest litter covers the soil)	36	60	73	79
Woods (Woods are protected from grazing, and litter and brush adequately cover the soil)	30	55	70	77
	0	**198**	**0**	**0**
COMPOSITE SCS CN	**83**			
% Impervious	**2506465%**			

HYDROLOGY - NRCS CURVE NUMBER

Project Name:	Applebranch
Project Number:	47097.003
Location:	City of Danville, Virginia
Date:	
Prepared by:	Alston Willard, EIT
Checked by:	
Existing or Proposed:	EXISTING
Catchment:	EX-DA-18

TIMMONS GROUP
YOUR VISION ACHIEVED THROUGH OURS.

I. SUBBASIN SOIL CHARACTERISTICS

	AREA	
	ac	**%**
HSG 'A'	0.00	0%
HSG 'B'	3.68	100%
HSG 'C'	0.00	0%
HSG 'D'	0.00	0%

	3.68	**ac**
TOTAL AREA	**160355.78**	**sq ft**
	0.005752	**sq mi**

II. SUBBASIN LAND COVER CONDITIONS

COVER DESCRIPTION	AREA				
	TOTAL (AC)	**HSG 'A' (SQ.FT.)**	**HSG 'B' (SQ.FT.)**	**HSG 'C' (SQ.FT.)**	**HSG 'D' (SQ.FT.)**
Open Space (lawns, parks, golf courses, etc.)					
Poor Condition (<50% grass cover)	0.00	0	0	0	0
Fair Condition (50% to 75% grass cover)	0.00	0	0	0	0
Good Condition (>75% grass cover)	0.00	0	0	0	0
Impervious Areas					
Paved parking lots, roofs, driveways, etc.	0.09	0	3750	0	0
Streets and roads:					
Paved; curbs and storm sewers	1.59	0	69378	0	0
Paved; open ditches	0.00	0	0	0	0
Gravel	0.00	0	0	0	0
Dirt	0.00	0	0	0	0
Urban Districts					
Commerical and business	0.00	0	0	0	0
Industrial	0.00	0	0	0	0
Residential districts by average lot size:					
1/8 acre, townhouse	0.00	0	0	0	0
1/4 acre	0.00	0	0	0	0
1/3 acre	2.00	0	87228	0	0
1/2 acre	0.00	0	0	0	0
1 acre	0.00	0	0	0	0
2 acre	0.00	0	0	0	0
Developing Urban Areas					
Newly graded areas	0.00	0	0	0	0
Pasture (<50% ground cover or heavily grazed)	0.00	0	0	0	0
Pasture (50% to 75% ground cover or not heavily grazed)	0.00	0	0	0	0
Pasture (>75% ground cover or lightly grazed)	0.00	0	0	0	0
Meadow - continuous grass, protected from grazing and generally mowed for hay	0.00	0	0	0	0
Brush (<50% ground cover)	0.00	0	0	0	0
Brush (50% to 75% ground cover)	0.00	0	0	0	0
Brush (>75% ground cover)	0.00	0	0	0	0

	Woods (Forest litter, small trees, and brush destroyed by heavy grazing or regular burning)	0.00	0	0	0	0
	Woods (Woods are grazed but not burned, and some forest litter covers the soil)	0.00	0	0	0	0
	Woods (Woods are protected from grazing, and litter and brush adequately cover the soil)	0.00	0	0	0	0
	TOTAL (AC)	3.68	0.00	3.68	0.00	0.00

III. SCS CURVE NUMBER CALCULATION

COVER DESCRIPTION (Source: NCDEQ Stormwater MDC)	SCS CN			
	HSG 'A'	HSG 'B'	HSG 'C'	HSG 'D'
Open Space (lawns, parks, golf courses, etc.)				
Poor Condition (<50% grass cover)	68	79	86	89
Fair Condition (50% to 75% grass cover)	49	69	79	84
Good Condition (>75% grass cover)	39	61	74	80
Impervious Areas				
Paved parking lots, roofs, driveways, etc.	98	98	98	98
Streets and roads:				
Paved; curbs and storm sewers	93	93	93	98
Paved; open ditches	83	89	98	98
Gravel	76	85	89	91
Dirt	72	82	85	88
Urban Districts				
Commerical and business	89	92	94	95
Industrial	81	88	91	93
Residential districts by average lot size:				
1/8 acre, townhouse	77	85	90	92
1/4 acre	61	75	83	87
1/3 acre	57	72	81	86
1/2 acre	54	70	80	85
1 acre	51	68	79	84
2 acre	46	65	77	82
Developing Urban Areas				
Newly graded areas	77	86	91	94
Pasture (<50% ground cover or heavily grazed)	68	79	86	89
Pasture (50% to 75% ground cover or not heavily grazed)	49	69	79	84
Pasture (>75% ground cover or lightly grazed)	39	61	74	80
Meadow - continuous grass, protected from grazing and generally mowed for hay	30	58	71	78
Brush (<50% ground cover)	48	67	77	83
Brush (50% to 75% ground cover)	35	56	70	77
Brush (>75% ground cover)	30	48	65	73
Woods (Forest litter, small trees, and brush destroyed by heavy grazing or regular burning)	45	66	77	83
Woods (Woods are grazed but not burned, and some forest litter covers the soil)	36	60	73	79
Woods (Woods are protected from grazing, and litter and brush adequately cover the soil)	30	55	70	77
	0	**301**	**0**	**0**
COMPOSITE SCS CN	**82**			
% Impervious	**1986494%**			

HYDROLOGY - NRCS CURVE NUMBER

Project Name:	Applebranch
Project Number:	47097.003
Location:	City of Danville, Virginia
Date:	
Prepared by:	Alston Willard, EIT
Checked by:	
Existing or Proposed:	EXISTING
Catchment:	EX-DA-18

TIMMONS GROUP
YOUR VISION ACHIEVED THROUGH OURS.

I. SUBBASIN SOIL CHARACTERISTICS

	AREA	
	ac	%
HSG 'A'	0.00	0%
HSG 'B'	21.55	100%
HSG 'C'	0.00	0%
HSG 'D'	0.00	0%

	21.55	**ac**
TOTAL AREA	**938752.53**	**sq ft**
	0.033673	**sq mi**

II. SUBBASIN LAND COVER CONDITIONS

COVER DESCRIPTION	AREA				
	TOTAL (AC)	HSG 'A' (SQ.FT.)	HSG 'B' (SQ.FT.)	HSG 'C' (SQ.FT.)	HSG 'D' (SQ.FT.)
Open Space (lawns, parks, golf courses, etc.)					
Poor Condition (<50% grass cover)	0.00	0	0	0	0
Fair Condition (50% to 75% grass cover)	0.00	0	0	0	0
Good Condition (>75% grass cover)	0.00	0	0	0	0
Impervious Areas					
Paved parking lots, roofs, driveways, etc.	9.00	0	391913	0	0
Streets and roads:					
Paved; curbs and storm sewers	0.00	0	0	0	0
Paved; open ditches	0.00	0	0	0	0
Gravel	0.00	0	0	0	0
Dirt	0.00	0	0	0	0
Urban Districs					
Commerical and business	0.00	0	0	0	0
Industrial	0.00	0	0	0	0
Residential districts by average lot size:					
1/8 acre, townhouse	0.00	0	0	0	0
1/4 acre	7.79	0	339516	0	0
1/3 acre	1.58	0	69027	0	0
1/2 acre	0.00	0	0	0	0
1 acre	0.00	0	0	0	0
2 acre	0.00	0	0	0	0
Developing Urban Areas					
Newly graded areas	0.00	0	0	0	0
Pasture (<50% ground cover or heavily grazed)	0.00	0	0	0	0
Pasture (50% to 75% ground cover or not heavily grazed)	0.00	0	0	0	0
Pasture (>75% ground cover or lightly grazed)	0.00	0	0	0	0
Meadow - continuous grass, protected from grazing and generally mowed for hay	0.00	0	0	0	0
Brush (<50% ground cover)	0.00	0	0	0	0
Brush (50% to 75% ground cover)	0.00	0	0	0	0
Brush (>75% ground cover)	0.00	0	0	0	0

Woods (Forest litter, small trees, and brush destroyed by heavy grazing or regular burning)	3.17	0	138296	0	0
Woods (Woods are grazed but not burned, and some forest litter covers the soil)	0.00	0	0	0	0
Woods (Woods are protected from grazing, and litter and brush adequately cover the soil)	0.00	0	0	0	0
TOTAL (AC)	21.55	0.00	21.55	0.00	0.00

III. SCS CURVE NUMBER CALCULATION

COVER DESCRIPTION (Source: NCDEQ Stormwater MDC)	SCS CN			
	HSG 'A'	HSG 'B'	HSG 'C'	HSG 'D'
Open Space (lawns, parks, golf courses, etc.)				
Poor Condition (<50% grass cover)	68	79	86	89
Fair Condition (50% to 75% grass cover)	49	69	79	84
Good Condition (>75% grass cover)	39	61	74	80
Impervious Areas				
Paved parking lots, roofs, driveways, etc.	98	98	98	98
Streets and roads:				
Paved; curbs and storm sewers	93	93	93	98
Paved; open ditches	83	89	98	98
Gravel	76	85	89	91
Dirt	72	82	85	88
Urban Districts				
Commerical and business	89	92	94	95
Industrial	81	88	91	93
Residential districts by average lot size:				
1/8 acre, townhouse	77	85	90	92
1/4 acre	61	75	83	87
1/3 acre	57	72	81	86
1/2 acre	54	70	80	85
1 acre	51	68	79	84
2 acre	46	65	77	82
Developing Urban Areas				
Newly graded areas	77	86	91	94
Pasture (<50% ground cover or heavily grazed)	68	79	86	89
Pasture (50% to 75% ground cover or not heavily grazed)	49	69	79	84
Pasture (>75% ground cover or lightly grazed)	39	61	74	80
Meadow - continuous grass, protected from grazing and generally mowed for hay	30	58	71	78
Brush (<50% ground cover)	48	67	77	83
Brush (50% to 75% ground cover)	35	56	70	77
Brush (>75% ground cover)	30	48	65	73
Woods (Forest litter, small trees, and brush destroyed by heavy grazing or regular burning)	45	66	77	83
Woods (Woods are grazed but not burned, and some forest litter covers the soil)	36	60	73	79
Woods (Woods are protected from grazing, and litter and brush adequately cover the soil)	30	55	70	77
	0	**1790**	**0**	**0**
COMPOSITE SCS CN	**83**			
% Impervious	**1818555%**			

HYDROLOGY - NRCS CURVE NUMBER

Project Name:	Applebranch
Project Number:	47097.003
Location:	City of Danville, Virginia
Date:	
Prepared by:	Alston Willard, EIT
Checked by:	
Existing or Proposed:	EXISTING
Catchment:	EX-DA-18

TIMMONS GROUP
YOUR VISION ACHIEVED THROUGH OURS.

I. SUBBASIN SOIL CHARACTERISTICS

	AREA	
	ac	%
HSG 'A'	0.00	0%
HSG 'B'	55.82	100%
HSG 'C'	0.00	0%
HSG 'D'	0.00	0%

	55.82	**ac**
TOTAL AREA	**2431693.1**	**sq ft**
	0.087225	**sq mi**

II. SUBBASIN LAND COVER CONDITIONS

COVER DESCRIPTION	AREA				
	TOTAL (AC)	HSG 'A' (SQ.FT.)	HSG 'B' (SQ.FT.)	HSG 'C' (SQ.FT.)	HSG 'D' (SQ.FT.)
Open Space (lawns, parks, golf courses, etc.)					
Poor Condition (<50% grass cover)	0.00	0	0	0	0
Fair Condition (50% to 75% grass cover)	0.00	0	0	0	0
Good Condition (>75% grass cover)	0.00	0	0	0	0
Impervious Areas					
Paved parking lots, roofs, driveways, etc.	15.52	0	676149	0	0
Streets and roads:					
Paved; curbs and storm sewers	4.96	0	215962	0	0
Paved; open ditches	0.00	0	0	0	0
Gravel	0.00	0	0	0	0
Dirt	0.00	0	0	0	0
Urban Districs					
Commerical and business	0.00	0	0	0	0
Industrial	0.00	0	0	0	0
Residential districts by average lot size:					
1/8 acre, townhouse	0.00	0	0	0	0
1/4 acre	0.00	0	0	0	0
1/3 acre	17.24	0	751115	0	0
1/2 acre	0.00	0	0	0	0
1 acre	0.00	0	0	0	0
2 acre	0.00	0	0	0	0
Developing Urban Areas					
Newly graded areas	0.00	0	0	0	0
Pasture (<50% ground cover or heavily grazed)	0.00	0	0	0	0
Pasture (50% to 75% ground cover or not heavily grazed)	0.00	0	0	0	0
Pasture (>75% ground cover or lightly grazed)	0.00	0	0	0	0
Meadow - continuous grass, protected from grazing and generally mowed for hay	0.00	0	0	0	0
Brush (<50% ground cover)	0.00	0	0	0	0
Brush (50% to 75% ground cover)	0.00	0	0	0	0
Brush (>75% ground cover)	0.00	0	0	0	0

	Woods (Forest litter, small trees, and brush destroyed by heavy grazing or regular burning)	0.00	0	0	0	0
	Woods (Woods are grazed but not burned, and some forest litter covers the soil)	18.10	0	788467	0	0
	Woods (Woods are protected from grazing, and litter and brush adequately cover the soil)	0.00	0	0	0	0
	TOTAL (AC)	55.82	0.00	55.82	0.00	0.00

III. SCS CURVE NUMBER CALCULATION

COVER DESCRIPTION (Source: NCDEQ Stormwater MDC)	SCS CN			
	HSG 'A'	HSG 'B'	HSG 'C'	HSG 'D'
Open Space (lawns, parks, golf courses, etc.)				
Poor Condition (<50% grass cover)	68	79	86	89
Fair Condition (50% to 75% grass cover)	49	69	79	84
Good Condition (>75% grass cover)	39	61	74	80
Impervious Areas				
Paved parking lots, roofs, driveways, etc.	98	98	98	98
Streets and roads:				
Paved; curbs and storm sewers	93	93	93	98
Paved; open ditches	83	89	98	98
Gravel	76	85	89	91
Dirt	72	82	85	88
Urban Districts				
Commerical and business	89	92	94	95
Industrial	81	88	91	93
Residential districts by average lot size:				
1/8 acre, townhouse	77	85	90	92
1/4 acre	61	75	83	87
1/3 acre	57	72	81	86
1/2 acre	54	70	80	85
1 acre	51	68	79	84
2 acre	46	65	77	82
Developing Urban Areas				
Newly graded areas	77	86	91	94
Pasture (<50% ground cover or heavily grazed)	68	79	86	89
Pasture (50% to 75% ground cover or not heavily grazed)	49	69	79	84
Pasture (>75% ground cover or lightly grazed)	39	61	74	80
Meadow - continuous grass, protected from grazing and generally mowed for hay	30	58	71	78
Brush (<50% ground cover)	48	67	77	83
Brush (50% to 75% ground cover)	35	56	70	77
Brush (>75% ground cover)	30	48	65	73
Woods (Forest litter, small trees, and brush destroyed by heavy grazing or regular burning)	45	66	77	83
Woods (Woods are grazed but not burned, and some forest litter covers the soil)	36	60	73	79
Woods (Woods are protected from grazing, and litter and brush adequately cover the soil)	30	55	70	77
	0	**4310**	**0**	**0**
COMPOSITE SCS CN	77			
% Impervious	**1598078%**			

HYDROLOGY - TIME OF CONCENTRATION - SEGMENTAL APPROACH (TR-55)

Project Name:	Applebranch
Project Number:	47097.003
Location:	City of Danville, Virginia
Date:	8/26/2021
Prepared By:	A. Willard, EIT
Checked By:	Abrham Asfaw, EI
Existing or Proposed:	Existing
Hydrologic Element:	DA-2

TIMMONS GROUP
YOUR VISION ACHIEVED THROUGH OURS.

SHEET FLOW

Travel Time (min) = $\frac{0.42\,(nL)^{0.8}}{(P_2)^{0.5}s^{0.4}}$

	A	B	C	
Manning's roughness coefficient, n =	0.08	0.08	0.08	
flow length L, ft =	50	0	0	
2-year, 24-hour rainfall $P_{2,}$ in =	3.34	3.34	3.34	
segment start elev., ft (NAVD88) =	417.0	416.0	426.0	
segment end elev., ft (NAVD88) =	416.0	426.0	426.0	
land slope s, % =	2.00%	#DIV/0!	#DIV/0!	
Segment Time =	*3.33 min*	*0.00 min*	*0.00 min*	**3.33 min** <-Sheet Flow Time

SHALLOW CONCENTRATED FLOW

Travel Time (min) = $\frac{L}{60V}$ V = 0.0203 √s paved; V = 0.0161 √s unpaved

	A	B	C	
segment start elev., ft (NAVD88) =	416.0	409.0	418.0	
segment end elev., ft (NAVD88) =	409.0	418.0	418.0	
land slope s, % =	2.06%	#DIV/0!	#DIV/0!	
segment is	unpaved	unpaved	unpaved	
flow length L, ft =	340	0	0	
average velocity V, ft/s =	2.32	#DIV/0!	#DIV/0!	
Segment Time =	*2.45 min*	*0.00 min*	*0.00 min*	**2.45 min** <-Shallow Conc Time

CHANNEL FLOW

Travel Time (min) = $\frac{L}{60V}$ V = $\frac{1.49\,r^{2/3}\sqrt{s}}{n}$ r = $\frac{a}{P_w}$

	A	B	C	
Bottom Width (assume trapezoidal channel w/1' flow depth), ft =	4	4	4	
side slopes (assume full flow), ft =	2	2	2	
cross sectional flow area A, ft^2	6.00	6.00	6.00	
wetted perimeter $P_{w,\,ft}$ =	6.28	6.28	6.28	
hydraulic radius Rh, ft =	0.95	0.95	0.95	
segment start elev., ft (NAVD88) =	409.0	408.0	416.0	
segment end elev., ft (NAVD88) =	408.0	416.0	416.0	
s =	1.02%	#DIV/0!	#DIV/0!	
Manning's roughness coefficient, n =	0.05	0.05	0.05	
flow length L, ft =	98	0	0	
average velocity V, ft/s =	2.92	#DIV/0!	#DIV/0!	
Segment Time =	*0.56 min*	*0.00 min*	*0.00 min*	**0.56 min** <-Channel Time

TOTAL TIME

TIME TO TRAVEL (min) =	**6**
TIME OF CONCENTRATION (MINIMUM TIME = 5 min) =	**6**
*Assume: Lag Time = 0.6*Time to Travel* **LAG TIME (min) =**	**4**

HYDROLOGY - TIME OF CONCENTRATION - SEGMENTAL APPROACH (TR-55)

Project Name:	Applebranch
Project Number:	47097.003
Location:	City of Danville, Virginia
Date:	8/26/2021
Prepared By:	A. Willard, EIT
Checked By:	Abrham Asfaw, EI
Existing or Proposed:	Existing
Hydrologic Element:	DA-3

TIMMONS GROUP
YOUR VISION ACHIEVED THROUGH OURS.

SHEET FLOW

Travel Time (min) = $\frac{0.42\,(nL)^{0.8}}{(P_2)^{0.5}s^{0.4}}$

	A	B	C
Manning's roughness coefficient, n =	0.08	0.08	0.08
flow length L, ft =	158.24	0	0
2-year, 24-hour rainfall $P_{2,}$ in =	3.34	3.34	3.34
segment start elev., ft (NAVD88) =	498.0	496.0	496.0
segment end elev., ft (NAVD88) =	496.0	496.0	496.0
land slope s, % =	1.26%	#DIV/0!	#DIV/0!
Segment Time =	*10.06 min*	*0.00 min*	*0.00 min*

10.06 min <-Sheet Flow Time

SHALLOW CONCENTRATED FLOW

Travel Time (min) = $\frac{L}{60V}$

V = 0.0203 √s paved
V = 0.0161 √s unpaved

	A	B	C
segment start elev., ft (NAVD88) =	496.0	476.0	420.0
segment end elev., ft (NAVD88) =	476.0	420.0	420.0
land slope s, % =	9.79%	32.30%	#DIV/0!
segment is	unpaved	unpaved	unpaved
flow length L, ft =	204.36	173.35	0
average velocity V, ft/s =	5.05	9.17	#DIV/0!
Segment Time =	*0.67 min*	*0.32 min*	*0.00 min*

0.99 min <-Shallow Conc Time

CHANNEL FLOW

Travel Time (min) = $\frac{L}{60V}$ $\quad V = \frac{1.49\,r^{2/3}\sqrt{s}}{n}$ $\quad r = \frac{a}{P_w}$

	A	B	C
Bottom Width (assume trapezoidal channel w/1' flow depth), ft =	4	4	4
side slopes (assume full flow), ft =	2	2	2
cross sectional flow area A, ft^2	6.00	6.00	6.00
wetted perimeter $P_{w,\,ft}$ =	6.28	6.28	6.28
hydraulic radius Rh, ft =	0.95	0.95	0.95
segment start elev., ft (NAVD88) =	420.0	412.0	412.0
segment end elev., ft (NAVD88) =	412.0	412.0	412.0
s =	1.27%	#DIV/0!	#DIV/0!
Manning's roughness coefficient, n =	0.05	0.05	0.05
flow length L, ft =	629.54	0	0
average velocity V, ft/s =	3.26	#DIV/0!	#DIV/0!
Segment Time =	*3.22 min*	*0.00 min*	*0.00 min*

3.22 min <-Channel Time

TOTAL TIME

TIME TO TRAVEL (min) =	**14**
TIME OF CONCENTRATION (MINIMUM TIME = 5 min) =	**14**
*Assume: Lag Time = 0.6*Time to Travel* **LAG TIME (min) =**	**9**

HYDROLOGY - TIME OF CONCENTRATION - SEGMENTAL APPROACH (TR-55)

Project Name:	Applebranch
Project Number:	47097.003
Location:	City of Danville, Virginia
Date:	8/26/2021
Prepared By:	A. Willard, EIT
Checked By:	Abrham Asfaw, EI
Existing or Proposed:	Existing
Hydrologic Element:	DA-4

TIMMONS GROUP
YOUR VISION ACHIEVED THROUGH OURS.

SHEET FLOW

Travel Time (min) = $\frac{0.42\,(nL)^{0.8}}{(P_2)^{0.5}s^{0.4}}$

	A	B	C	
Manning's roughness coefficient, n =	0.08	0.08	0.08	
flow length L, ft =	75	0	0	
2-year, 24-hour rainfall $P_{2,}$ in =	3.34	3.34	3.34	
segment start elev., ft (NAVD88) =	576.0	575.0	566.0	
segment end elev., ft (NAVD88) =	575.0	566.0	566.0	
land slope s, % =	1.33%	#DIV/0!	#DIV/0!	
Segment Time =	*5.42 min*	*0.00 min*	*0.00 min*	**5.42 min** <-Sheet Flow Time

SHALLOW CONCENTRATED FLOW

Travel Time (min) = $\frac{L}{60V}$ V = 0.0203 √s paved; V = 0.0161 √s unpaved

	A	B	C	
segment start elev., ft (NAVD88) =	566.0	514.0	470.0	
segment end elev., ft (NAVD88) =	514.0	470.0	436.0	
land slope s, % =	5.66%	3.09%	5.54%	
segment is	unpaved	unpaved	unpaved	
flow length L, ft =	919	1422	613.82	
average velocity V, ft/s =	3.84	2.84	3.80	
Segment Time =	*3.99 min*	*8.35 min*	*2.69 min*	**15.04 min** <-Shallow Conc Time

CHANNEL FLOW

Travel Time (min) = $\frac{L}{60V}$ V = $\frac{1.49\,r^{2/3}\sqrt{s}}{n}$ r = $\frac{a}{P_w}$

	A	B	C	
Bottom Width (assume trapezoidal channel w/1' flow depth), ft =	4	4	4	
side slopes (assume full flow), ft =	4	4	4	
cross sectional flow area A, ft^2	8.00	8.00	8.00	
wetted perimeter $P_{w,\,ft}$ =	12.57	12.57	12.57	
hydraulic radius Rh, ft =	0.64	0.64	0.64	
segment start elev., ft (NAVD88) =	514.0	428.0	416.0	
segment end elev., ft (NAVD88) =	428.0	416.0	416.0	
s =	36.54%	1.68%	#DIV/0!	
Manning's roughness coefficient, n =	0.06	0.05	0.05	
flow length L, ft =	235.37	715.79	0	
average velocity V, ft/s =	11.11	2.86	#DIV/0!	
Segment Time =	*0.35 min*	*4.18 min*	*0.00 min*	**4.53 min** <-Channel Time

TOTAL TIME

TIME TO TRAVEL (min) =	**25**
TIME OF CONCENTRATION (MINIMUM TIME = 5 min) =	**25**
*Assume: Lag Time = 0.6*Time to Travel* **LAG TIME (min) =**	**15**

HYDROLOGY - TIME OF CONCENTRATION - SEGMENTAL APPROACH (TR-55)

Project Name:	Applebranch
Project Number:	47097.003
Location:	City of Danville, Virginia
Date:	8/26/2021
Prepared By:	A. Willard, EIT
Checked By:	Abrham Asfaw, EI
Existing or Proposed:	Existing
Hydrologic Element:	DA-4

TIMMONS GROUP
YOUR VISION ACHIEVED THROUGH OURS.

SHEET FLOW

Travel Time (min) = $\frac{0.42\,(nL)^{0.8}}{(P_2)^{0.5}s^{0.4}}$

	A	B	C	
Manning's roughness coefficient, n =	0.08	0.08	0.08	
flow length L, ft =	75	0	0	
2-year, 24-hour rainfall $P_{2,}$ in =	3.34	3.34	3.34	
segment start elev., ft (NAVD88) =	576.0	575.0	566.0	
segment end elev., ft (NAVD88) =	575.0	566.0	566.0	
land slope s, % =	1.33%	#DIV/0!	#DIV/0!	
Segment Time =	*5.42 min*	*0.00 min*	*0.00 min*	**5.42 min** <-Sheet Flow Time

SHALLOW CONCENTRATED FLOW

Travel Time (min) = $\frac{L}{60V}$ V = 0.0203 √s paved; V = 0.0161 √s unpaved

	A	B	C	
segment start elev., ft (NAVD88) =	566.0	514.0	470.0	
segment end elev., ft (NAVD88) =	514.0	470.0	436.0	
land slope s, % =	5.66%	3.09%	5.54%	
segment is	unpaved	unpaved	unpaved	
flow length L, ft =	919	1422	613.82	
average velocity V, ft/s =	3.84	2.84	3.80	
Segment Time =	*3.99 min*	*8.35 min*	*2.69 min*	**15.04 min** <-Shallow Conc Time

CHANNEL FLOW

Travel Time (min) = $\frac{L}{60V}$ V = $\frac{1.49\,r^{2/3}\sqrt{s}}{n}$ r = $\frac{a}{P_w}$

	A	B	C	
Bottom Width (assume trapezoidal channel w/1' flow depth), ft =	4	4	4	
side slopes (assume full flow), ft =	4	4	4	
cross sectional flow area A, ft^2	8.00	8.00	8.00	
wetted perimeter $P_{w,\,ft}$ =	12.57	12.57	12.57	
hydraulic radius Rh, ft =	0.64	0.64	0.64	
segment start elev., ft (NAVD88) =	514.0	428.0	416.0	
segment end elev., ft (NAVD88) =	428.0	416.0	416.0	
s =	36.54%	1.68%	#DIV/0!	
Manning's roughness coefficient, n =	0.06	0.05	0.05	
flow length L, ft =	235.37	715.79	0	
average velocity V, ft/s =	11.11	2.86	#DIV/0!	
Segment Time =	*0.35 min*	*4.18 min*	*0.00 min*	**4.53 min** <-Channel Time

TOTAL TIME

TIME TO TRAVEL (min) =	**25**
TIME OF CONCENTRATION (MINIMUM TIME = 5 min) =	**25**
*Assume: Lag Time = 0.6*Time to Travel* **LAG TIME (min) =**	**15**

HYDROLOGY - TIME OF CONCENTRATION - SEGMENTAL APPROACH (TR-55)

Project Name:	Applebranch
Project Number:	47097.003
Location:	City of Danville, Virginia
Date:	8/26/2021
Prepared By:	A. Willard, EIT
Checked By:	Abrham Asfaw, EI
Existing or Proposed:	Existing
Hydrologic Element:	DA-5

TIMMONS GROUP
YOUR VISION ACHIEVED THROUGH OURS.

SHEET FLOW

Travel Time (min) = $\frac{0.42\,(nL)^{0.8}}{(P_2)^{0.5}s^{0.4}}$

	A	B	C
Manning's roughness coefficient, n =	0.08	0.08	0.08
flow length L, ft =	264	0	0
2-year, 24-hour rainfall $P_{2,}$ in =	3.34	3.34	3.34
segment start elev., ft (NAVD88) =	524.0	500.0	500.0
segment end elev., ft (NAVD88) =	500.0	500.0	500.0
land slope s, % =	9.09%	#DIV/0!	#DIV/0!
Segment Time =	*6.88 min*	*0.00 min*	*0.00 min*

6.88 min <-Sheet Flow Time

SHALLOW CONCENTRATED FLOW

Travel Time (min) = $\frac{L}{60V}$ V = 0.0203 √s paved
V = 0.0161 √s unpaved

	A	B	C
segment start elev., ft (NAVD88) =	500.0	424.0	624.0
segment end elev., ft (NAVD88) =	424.0	624.0	624.0
land slope s, % =	10.04%	#DIV/0!	#DIV/0!
segment is	unpaved	unpaved	unpaved
flow length L, ft =	757.04	0	0
average velocity V, ft/s =	5.11	#DIV/0!	#DIV/0!
Segment Time =	*2.47 min*	*0.00 min*	*0.00 min*

2.47 min <-Shallow Conc Time

CHANNEL FLOW

Travel Time (min) = $\frac{L}{60V}$ V = $\frac{1.49\,r^{2/3}\sqrt{s}}{n}$ r = $\frac{a}{P_w}$

	A	B	C
Bottom Width (assume trapezoidal channel w/1' flow depth), ft =	7	4	4
side slopes (assume full flow), ft =	2	2	2
cross sectional flow area A, ft^2	18.00	6.00	6.00
wetted perimeter $P_{w,\,ft}$ =	6.28	6.28	6.28
hydraulic radius Rh, ft =	2.86	0.95	0.95
segment start elev., ft (NAVD88) =	424.0	418.0	530.0
segment end elev., ft (NAVD88) =	418.0	530.0	530.0
s =	1.22%	#DIV/0!	#DIV/0!
Manning's roughness coefficient, n =	0.05	0.05	0.05
flow length L, ft =	489.92	0	0
average velocity V, ft/s =	6.65	#DIV/0!	#DIV/0!
Segment Time =	*1.23 min*	*0.00 min*	*0.00 min*

1.23 min <-Channel Time

TOTAL TIME

TIME TO TRAVEL (min) =	**11**
TIME OF CONCENTRATION (MINIMUM TIME = 5 min) =	**11**
*Assume: Lag Time = 0.6*Time to Travel* **LAG TIME (min) =**	**6**

HYDROLOGY - TIME OF CONCENTRATION - SEGMENTAL APPROACH (TR-55)

Project Name:	Applebranch
Project Number:	47097.003
Location:	City of Danville, Virginia
Date:	8/26/2021
Prepared By:	A. Willard, EIT
Checked By:	Abrham Asfaw, EI
Existing or Proposed:	Existing
Hydrologic Element:	DA-6

TIMMONS GROUP
YOUR VISION ACHIEVED THROUGH OURS.

SHEET FLOW

Travel Time (min) = $\frac{0.42\,(nL)^{0.8}}{(P_2)^{0.5}s^{0.4}}$

	A	B	C
Manning's roughness coefficient, n =	0.08	0.08	0.08
flow length L, ft =	288.7	0	0
2-year, 24-hour rainfall $P_{2,}$ in =	3.34	3.34	3.34
segment start elev., ft (NAVD88) =	590.0	584.0	584.0
segment end elev., ft (NAVD88) =	584.0	584.0	584.0
land slope s, % =	2.08%	#DIV/0!	#DIV/0!
Segment Time =	*13.34 min*	*0.00 min*	*0.00 min*

13.34 min <-Sheet Flow Time

SHALLOW CONCENTRATED FLOW

Travel Time (min) = $\frac{L}{60V}$

V = 0.0203 √s paved
V = 0.0161 √s unpaved

	A	B	C
segment start elev., ft (NAVD88) =	584.0	552.0	486.0
segment end elev., ft (NAVD88) =	552.0	486.0	474.0
land slope s, % =	5.06%	7.13%	2.24%
segment is	unpaved	unpaved	unpaved
flow length L, ft =	633	926	535.35
average velocity V, ft/s =	3.63	4.31	2.42
Segment Time =	*2.91 min*	*3.58 min*	*3.69 min*

10.18 min <-Shallow Conc Time

CHANNEL FLOW

Travel Time (min) = $\frac{L}{60V}$ $\quad V = \frac{1.49\,r^{2/3}\sqrt{s}}{n}$ $\quad r = \frac{a}{P_w}$

	A	B	C
Bottom Width (assume trapezoidal channel w/1' flow depth), ft =	8	8	8
side slopes (assume full flow), ft =	5	5	5
cross sectional flow area A, ft^2	13.00	13.00	13.00
wetted perimeter $P_{w,\,ft}$ =	15.71	15.71	15.71
hydraulic radius Rh, ft =	0.83	0.83	0.83
segment start elev., ft (NAVD88) =	474.0	444.0	444.0
segment end elev., ft (NAVD88) =	444.0	444.0	444.0
s =	3.50%	#DIV/0!	#DIV/0!
Manning's roughness coefficient, n =	0.05	0.05	0.05
flow length L, ft =	856	0	0
average velocity V, ft/s =	4.92	#DIV/0!	#DIV/0!
Segment Time =	*2.90 min*	*0.00 min*	*0.00 min*

2.90 min <-Channel Time

TOTAL TIME

TIME TO TRAVEL (min) =	**26**
TIME OF CONCENTRATION (MINIMUM TIME = 5 min) =	**26**
*Assume: Lag Time = 0.6*Time to Travel* **LAG TIME (min) =**	**16**

HYDROLOGY - TIME OF CONCENTRATION - SEGMENTAL APPROACH (TR-55)

Project Name:	Applebranch
Project Number:	47097.003
Location:	City of Danville, Virginia
Date:	8/26/2021
Prepared By:	A. Willard, EIT
Checked By:	Abrham Asfaw, EI
Existing or Proposed:	Existing
Hydrologic Element:	DA-7

TIMMONS GROUP
YOUR VISION ACHIEVED THROUGH OURS.

SHEET FLOW

Travel Time (min) = $\frac{0.42\,(nL)^{0.8}}{(P_2)^{0.5}s^{0.4}}$

	A	B	C	
Manning's roughness coefficient, n =	0.08	0.08	0.08	
flow length L, ft =	157	96	0	
2-year, 24-hour rainfall $P_{2,}$ in =	3.34	3.34	3.34	
segment start elev., ft (NAVD88) =	577.0	572.0	568.0	
segment end elev., ft (NAVD88) =	572.0	568.0	568.0	
land slope s, % =	3.18%	4.17%	#DIV/0!	
Segment Time =	*6.91 min*	*4.19 min*	*0.00 min*	**11.09 min** <-Sheet Flow Time

SHALLOW CONCENTRATED FLOW

Travel Time (min) = $\frac{L}{60V}$ V = 0.0203 √s paved; V = 0.0161 √s unpaved

	A	B	C	
segment start elev., ft (NAVD88) =	568.0	550.0	456.0	
segment end elev., ft (NAVD88) =	550.0	456.0	456.0	
land slope s, % =	11.25%	12.18%	#DIV/0!	
segment is	unpaved	unpaved	unpaved	
flow length L, ft =	160	772	0	
average velocity V, ft/s =	5.41	5.63	#DIV/0!	
Segment Time =	*0.49 min*	*2.29 min*	*0.00 min*	**2.78 min** <-Shallow Conc Time

CHANNEL FLOW

Travel Time (min) = $\frac{L}{60V}$ V = $\frac{1.49\,r^{2/3}\sqrt{s}}{n}$ r = $\frac{a}{P_w}$

	A	B	C	
Bottom Width (assume trapezoidal channel w/1' flow depth), ft =	18	18	18	
side slopes (assume full flow), ft =	2	2	2	
cross sectional flow area A, ft^2	20.00	20.00	20.00	
wetted perimeter $P_{w,\,ft}$ =	6.28	6.28	6.28	
hydraulic radius Rh, ft =	3.18	3.18	3.18	
segment start elev., ft (NAVD88) =	456.0	446.0	446.0	
segment end elev., ft (NAVD88) =	446.0	446.0	446.0	
s =	0.83%	#DIV/0!	#DIV/0!	
Manning's roughness coefficient, n =	0.05	0.05	0.05	
flow length L, ft =	1202	0	0	
average velocity V, ft/s =	5.88	#DIV/0!	#DIV/0!	
Segment Time =	*3.41 min*	*0.00 min*	*0.00 min*	**3.41 min** <-Channel Time

TOTAL TIME

TIME TO TRAVEL (min) =	**17**
TIME OF CONCENTRATION (MINIMUM TIME = 5 min) =	**17**
*Assume: Lag Time = 0.6*Time to Travel* **LAG TIME (min) =**	**10**

HYDROLOGY - TIME OF CONCENTRATION - SEGMENTAL APPROACH (TR-55)

Project Name:	Applebranch
Project Number:	47097.003
Location:	City of Danville, Virginia
Date:	8/26/2021
Prepared By:	A. Willard, EIT
Checked By:	Abrham Asfaw, EI
Existing or Proposed:	Existing
Hydrologic Element:	DA-8

TIMMONS GROUP
YOUR VISION ACHIEVED THROUGH OURS.

SHEET FLOW

Travel Time (min) = $\frac{0.42\,(nL)^{0.8}}{(P_2)^{0.5}s^{0.4}}$

	A	B	C	
Manning's roughness coefficient, n =	0.08	0.08	0.08	
flow length L, ft =	301.22	0	0	
2-year, 24-hour rainfall $P_{2,}$ in =	3.34	3.34	3.34	
segment start elev., ft (NAVD88) =	600.0	598.0	598.0	
segment end elev., ft (NAVD88) =	598.0	598.0	598.0	
land slope s, % =	0.66%	#DIV/0!	#DIV/0!	
Segment Time =	*21.78 min*	*0.00 min*	*0.00 min*	**21.78 min** <-Sheet Flow Time

SHALLOW CONCENTRATED FLOW

Travel Time (min) = $\frac{L}{60V}$ V = 0.0203 √s paved
V = 0.0161 √s unpaved

	A	B	C	
segment start elev., ft (NAVD88) =	598.0	572.0	530.0	
segment end elev., ft (NAVD88) =	572.0	530.0	504.0	
land slope s, % =	12.26%	8.51%	5.09%	
segment is	unpaved	unpaved	unpaved	
flow length L, ft =	212	493.52	510.47	
average velocity V, ft/s =	5.65	4.71	3.64	
Segment Time =	*0.63 min*	*1.75 min*	*2.34 min*	**4.71 min** <-Shallow Conc Time

CHANNEL FLOW

Travel Time (min) = $\frac{L}{60V}$ V = $\frac{1.49\,r^{2/3}\sqrt{s}}{n}$ r = $\frac{a}{P_w}$

	A	B	C	
Bottom Width (assume trapezoidal channel w/1' flow depth), ft =	4	6	8	
side slopes (assume full flow), ft =	2	2	2	
cross sectional flow area A, ft^2	6.00	8.00	10.00	
wetted perimeter $P_{w,\,ft}$ =	6.28	6.28	6.28	
hydraulic radius Rh, ft =	0.95	1.27	1.59	
segment start elev., ft (NAVD88) =	504.0	492.0	472.0	
segment end elev., ft (NAVD88) =	492.0	472.0	446.0	
s =	2.73%	3.87%	4.04%	
Manning's roughness coefficient, n =	0.05	0.05	0.05	
flow length L, ft =	439	517	643	
average velocity V, ft/s =	4.78	6.89	8.17	
Segment Time =	*1.53 min*	*1.25 min*	*1.31 min*	**4.09 min** <-Channel Time

TOTAL TIME

TIME TO TRAVEL (min) =	**31**
TIME OF CONCENTRATION (MINIMUM TIME = 5 min) =	**31**
*Assume: Lag Time = 0.6*Time to Travel* **LAG TIME (min) =**	**18**

HYDROLOGY - TIME OF CONCENTRATION - SEGMENTAL APPROACH (TR-55)

Project Name:	Applebranch
Project Number:	47097.003
Location:	City of Danville, Virginia
Date:	8/26/2021
Prepared By:	A. Willard, EIT
Checked By:	Abrham Asfaw, EI
Existing or Proposed:	Existing
Hydrologic Element:	DA-9

TIMMONS GROUP
YOUR VISION ACHIEVED THROUGH OURS.

SHEET FLOW

Travel Time (min) = $\frac{0.42\,(nL)^{0.8}}{(P_2)^{0.5}s^{0.4}}$

	A	B	C
Manning's roughness coefficient, n =	0.08	0.08	0.08
flow length L, ft =	271	0	0
2-year, 24-hour rainfall $P_{2,}$ in =	3.34	3.34	3.34
segment start elev., ft (NAVD88) =	590.0	580.0	580.0
segment end elev., ft (NAVD88) =	580.0	580.0	580.0
land slope s, % =	3.69%	#DIV/0!	#DIV/0!
Segment Time =	*10.08 min*	*0.00 min*	*0.00 min*

10.08 min <-Sheet Flow Time

SHALLOW CONCENTRATED FLOW

Travel Time (min) = $\frac{L}{60V}$ V = 0.0203 √s paved
V = 0.0161 √s unpaved

	A	B	C
segment start elev., ft (NAVD88) =	580.0	542.0	542.0
segment end elev., ft (NAVD88) =	542.0	542.0	542.0
land slope s, % =	13.89%	#DIV/0!	#DIV/0!
segment is	unpaved	unpaved	unpaved
flow length L, ft =	273.58	0	0
average velocity V, ft/s =	6.01	#DIV/0!	#DIV/0!
Segment Time =	*0.76 min*	*0.00 min*	*0.00 min*

0.76 min <-Shallow Conc Time

CHANNEL FLOW

Travel Time (min) = $\frac{L}{60V}$ V = $\frac{1.49\,r^{2/3}\sqrt{s}}{n}$ r = $\frac{a}{P_w}$

	A	B	C
Bottom Width (assume trapezoidal channel w/1' flow depth), ft =	6	6	6
side slopes (assume full flow), ft =	2	2	2
cross sectional flow area A, ft^2	7.50	7.50	7.50
wetted perimeter $P_{w,\,ft}$ =	4.71	4.71	4.71
hydraulic radius Rh, ft =	1.59	1.59	1.59
segment start elev., ft (NAVD88) =	542.0	446.0	446.0
segment end elev., ft (NAVD88) =	446.0	446.0	446.0
s =	8.85%	#DIV/0!	#DIV/0!
Manning's roughness coefficient, n =	0.05	0.05	0.05
flow length L, ft =	1085	0	0
average velocity V, ft/s =	12.08	#DIV/0!	#DIV/0!
Segment Time =	*1.50 min*	*0.00 min*	*0.00 min*

1.50 min <-Channel Time

TOTAL TIME

TIME TO TRAVEL (min) =	**12**
TIME OF CONCENTRATION (MINIMUM TIME = 5 min) =	**12**
*Assume: Lag Time = 0.6*Time to Travel* **LAG TIME (min) =**	**7**

HYDROLOGY - TIME OF CONCENTRATION - SEGMENTAL APPROACH (TR-55)

Project Name:	Applebranch
Project Number:	47097.003
Location:	City of Danville, Virginia
Date:	8/26/2021
Prepared By:	A. Willard, EIT
Checked By:	Abrham Asfaw, EI
Existing or Proposed:	Existing
Hydrologic Element:	DA-10

TIMMONS GROUP
YOUR VISION ACHIEVED THROUGH OURS.

SHEET FLOW

Travel Time (min) = $\frac{0.42\,(nL)^{0.8}}{(P_2)^{0.5}s^{0.4}}$

	A	B	C	
Manning's roughness coefficient, n =	0.08	0.08	0.08	
flow length L, ft =	237	0	0	
2-year, 24-hour rainfall $P_{2,}$ in =	3.34	3.34	3.34	
segment start elev., ft (NAVD88) =	600.0	586.0	586.0	
segment end elev., ft (NAVD88) =	586.0	586.0	586.0	
land slope s, % =	5.91%	#DIV/0!	#DIV/0!	
Segment Time =	*7.50 min*	*0.00 min*	*0.00 min*	**7.50 min** <-Sheet Flow Time

SHALLOW CONCENTRATED FLOW

Travel Time (min) = $\frac{L}{60V}$ V = 0.0203 √s paved; V = 0.0161 √s unpaved

	A	B	C	
segment start elev., ft (NAVD88) =	586.0	558.0	534.0	
segment end elev., ft (NAVD88) =	558.0	534.0	522.0	
land slope s, % =	7.53%	8.08%	4.82%	
segment is	unpaved	unpaved	unpaved	
flow length L, ft =	372	297	249	
average velocity V, ft/s =	4.43	4.59	3.54	
Segment Time =	*1.40 min*	*1.08 min*	*1.17 min*	**3.65 min** <-Shallow Conc Time

CHANNEL FLOW

Travel Time (min) = $\frac{L}{60V}$ V = $\frac{1.49\,r^{2/3}\sqrt{s}}{n}$ r = $\frac{a}{P_w}$

	A	B	C	
Bottom Width (assume trapezoidal channel w/1' flow depth), ft =	4	6	8	
side slopes (assume full flow), ft =	2	2	2	
cross sectional flow area A, ft^2	6.00	8.00	10.00	
wetted perimeter $P_{w,\,ft}$ =	6.28	6.28	6.28	
hydraulic radius Rh, ft =	0.95	1.27	1.59	
segment start elev., ft (NAVD88) =	522.0	512.0	488.0	
segment end elev., ft (NAVD88) =	512.0	488.0	468.0	
s =	2.79%	4.25%	3.78%	
Manning's roughness coefficient, n =	0.05	0.05	0.05	
flow length L, ft =	358	565	529	
average velocity V, ft/s =	4.83	7.22	7.90	
Segment Time =	*1.24 min*	*1.31 min*	*1.12 min*	**3.66 min** <-Channel Time

TOTAL TIME

TIME TO TRAVEL (min) =	**15**
TIME OF CONCENTRATION (MINIMUM TIME = 5 min) =	**15**
*Assume: Lag Time = 0.6*Time to Travel* **LAG TIME (min) =**	**9**

HYDROLOGY - TIME OF CONCENTRATION - SEGMENTAL APPROACH (TR-55)

Project Name:	Applebranch
Project Number:	47097.003
Location:	City of Danville, Virginia
Date:	8/26/2021
Prepared By:	A. Willard, EIT
Checked By:	Abrham Asfaw, EI
Existing or Proposed:	Existing
Hydrologic Element:	DA-11

TIMMONS GROUP
YOUR VISION ACHIEVED THROUGH OURS.

SHEET FLOW

Travel Time (min) = $\frac{0.42\,(nL)^{0.8}}{(P_2)^{0.5}s^{0.4}}$

	A	B	C
Manning's roughness coefficient, n =	0.08	0.08	0.08
flow length L, ft =	268.21	0	0
2-year, 24-hour rainfall $P_{2,}$ in =	3.34	3.34	3.34
segment start elev., ft (NAVD88) =	594.0	588.0	588.0
segment end elev., ft (NAVD88) =	588.0	588.0	588.0
land slope s, % =	2.24%	#DIV/0!	#DIV/0!
Segment Time =	*12.21 min*	*0.00 min*	*0.00 min*

12.21 min <-Sheet Flow Time

SHALLOW CONCENTRATED FLOW

Travel Time (min) = $\frac{L}{60V}$ V = 0.0203 √s paved
V = 0.0161 √s unpaved

	A	B	C
segment start elev., ft (NAVD88) =	588.0	574.0	546.0
segment end elev., ft (NAVD88) =	574.0	546.0	522.0
land slope s, % =	6.70%	9.59%	5.65%
segment is	unpaved	unpaved	unpaved
flow length L, ft =	209	292	425
average velocity V, ft/s =	4.18	5.00	3.83
Segment Time =	*0.83 min*	*0.97 min*	*1.85 min*

3.66 min <-Shallow Conc Time

CHANNEL FLOW

Travel Time (min) = $\frac{L}{60V}$ V = $\frac{1.49\,r^{2/3}\sqrt{s}}{n}$ r = $\frac{a}{P_w}$

	A	B	C
Bottom Width (assume trapezoidal channel w/1' flow depth), ft =	4	6	8
side slopes (assume full flow), ft =	2	2	2
cross sectional flow area A, ft^2	6.00	8.00	10.00
wetted perimeter $P_{w,\,ft}$ =	6.28	6.28	6.28
hydraulic radius Rh, ft =	0.95	1.27	1.59
segment start elev., ft (NAVD88) =	522.0	522.0	522.0
segment end elev., ft (NAVD88) =	506.0	498.0	496.0
s =	3.26%	8.08%	7.07%
Manning's roughness coefficient, n =	0.05	0.05	0.05
flow length L, ft =	491.35	297	368
average velocity V, ft/s =	5.21	9.95	10.80
Segment Time =	*1.57 min*	*0.50 min*	*0.57 min*

2.64 min <-Channel Time

TOTAL TIME

TIME TO TRAVEL (min) =	**19**
TIME OF CONCENTRATION (MINIMUM TIME = 5 min) =	**19**
*Assume: Lag Time = 0.6*Time to Travel* **LAG TIME (min) =**	**11**

HYDROLOGY - TIME OF CONCENTRATION - SEGMENTAL APPROACH (TR-55)

Project Name:	Applebranch
Project Number:	47097.003
Location:	City of Danville, Virginia
Date:	8/26/2021
Prepared By:	A. Willard, EIT
Checked By:	Abrham Asfaw, EI
Existing or Proposed:	Existing
Hydrologic Element:	DA-12

TIMMONS GROUP
YOUR VISION ACHIEVED THROUGH OURS.

SHEET FLOW

Travel Time (min) = $\frac{0.42\,(nL)^{0.8}}{(P_2)^{0.5}s^{0.4}}$

	A	B	C	
Manning's roughness coefficient, n =	0.08	0.08	0.08	
flow length L, ft =	262	0	0	
2-year, 24-hour rainfall $P_{2,}$ in =	3.34	3.34	3.34	
segment start elev., ft (NAVD88) =	638.0	626.0	626.0	
segment end elev., ft (NAVD88) =	626.0	626.0	626.0	
land slope s, % =	4.58%	#DIV/0!	#DIV/0!	
Segment Time =	*9.00 min*	*0.00 min*	*0.00 min*	**9.00 min** <-Sheet Flow Time

SHALLOW CONCENTRATED FLOW

Travel Time (min) = $\frac{L}{60V}$ V = 0.0203 √s paved; V = 0.0161 √s unpaved

	A	B	C	
segment start elev., ft (NAVD88) =	626.0	602.0	580.0	
segment end elev., ft (NAVD88) =	602.0	580.0	561.0	
land slope s, % =	8.30%	7.05%	5.26%	
segment is	unpaved	unpaved	unpaved	
flow length L, ft =	289.3	312.25	361.5	
average velocity V, ft/s =	4.65	4.28	3.70	
Segment Time =	*1.04 min*	*1.22 min*	*1.63 min*	**3.88 min** <-Shallow Conc Time

CHANNEL FLOW

Travel Time (min) = $\frac{L}{60V}$ V = $\frac{1.49\,r^{2/3}\sqrt{s}}{n}$ r = $\frac{a}{P_w}$

	A	B	C	
Bottom Width (assume trapezoidal channel w/1' flow depth), ft =	6	8	10	
side slopes (assume full flow), ft =	2	2	2	
cross sectional flow area A, ft^2	8.00	10.00	12.00	
wetted perimeter $P_{w,\,ft}$ =	6.28	6.28	6.28	
hydraulic radius Rh, ft =	1.27	1.59	1.91	
segment start elev., ft (NAVD88) =	561.0	536.0	512.0	
segment end elev., ft (NAVD88) =	536.0	512.0	496.0	
s =	2.55%	1.98%	0.97%	
Manning's roughness coefficient, n =	0.05	0.05	0.05	
flow length L, ft =	981	1210	1645	
average velocity V, ft/s =	5.59	5.72	4.52	
Segment Time =	*2.93 min*	*3.52 min*	*6.06 min*	**12.51 min** <-Channel Time

TOTAL TIME

TIME TO TRAVEL (min) =	**25**
TIME OF CONCENTRATION (MINIMUM TIME = 5 min) =	**25**
*Assume: Lag Time = 0.6*Time to Travel* **LAG TIME (min) =**	**15**

HYDROLOGY - TIME OF CONCENTRATION - SEGMENTAL APPROACH (TR-55)

Project Name:	Applebranch
Project Number:	47097.003
Location:	City of Danville, Virginia
Date:	8/26/2021
Prepared By:	A. Willard, EIT
Checked By:	Abrham Asfaw, EI
Existing or Proposed:	Existing
Hydrologic Element:	DA-13

TIMMONS GROUP
YOUR VISION ACHIEVED THROUGH OURS.

SHEET FLOW

Travel Time (min) = $\frac{0.42\,(nL)^{0.8}}{(P_2)^{0.5}s^{0.4}}$

	A	B	C
Manning's roughness coefficient, n =	0.08	0.08	0.08
flow length L, ft =	271	0	0
2-year, 24-hour rainfall $P_{2,}$ in =	3.34	3.34	3.34
segment start elev., ft (NAVD88) =	638.0	628.0	628.0
segment end elev., ft (NAVD88) =	628.0	628.0	628.0
land slope s, % =	3.69%	#DIV/0!	#DIV/0!
Segment Time =	*10.08 min*	*0.00 min*	*0.00 min*

10.08 min <-Sheet Flow Time

SHALLOW CONCENTRATED FLOW

Travel Time (min) = $\frac{L}{60V}$ V = 0.0203 √s paved
V = 0.0161 √s unpaved

	A	B	C
segment start elev., ft (NAVD88) =	628.0	612.0	582.0
segment end elev., ft (NAVD88) =	612.0	582.0	562.0
land slope s, % =	1.87%	7.63%	6.78%
segment is	unpaved	unpaved	unpaved
flow length L, ft =	855	393	295
average velocity V, ft/s =	2.21	4.46	4.20
Segment Time =	*6.46 min*	*1.47 min*	*1.17 min*

9.10 min <-Shallow Conc Time

CHANNEL FLOW

Travel Time (min) = $\frac{L}{60V}$ V = $\frac{1.49\,r^{2/3}\sqrt{s}}{n}$ r = $\frac{a}{P_w}$

	A	B	C
Bottom Width (assume trapezoidal channel w/1' flow depth), ft =	65	4	4
side slopes (assume full flow), ft =	2	2	2
cross sectional flow area A, ft^2	67.00	6.00	6.00
wetted perimeter $P_{w,\,ft}$ =	6.28	6.28	6.28
hydraulic radius Rh, ft =	10.66	0.95	0.95
segment start elev., ft (NAVD88) =	562.0	500.0	530.0
segment end elev., ft (NAVD88) =	500.0	530.0	530.0
s =	2.69%	#DIV/0!	#DIV/0!
Manning's roughness coefficient, n =	0.05	0.05	0.05
flow length L, ft =	2306	0	0
average velocity V, ft/s =	23.67	#DIV/0!	#DIV/0!
Segment Time =	*1.62 min*	*0.00 min*	*0.00 min*

1.62 min <-Channel Time

TOTAL TIME

TIME TO TRAVEL (min) =	**21**
TIME OF CONCENTRATION (MINIMUM TIME = 5 min) =	**21**
*Assume: Lag Time = 0.6*Time to Travel* **LAG TIME (min) =**	**12**

HYDROLOGY - TIME OF CONCENTRATION - SEGMENTAL APPROACH (TR-55)

Project Name:	Applebranch
Project Number:	47097.003
Location:	City of Danville, Virginia
Date:	8/26/2021
Prepared By:	A. Willard, EIT
Checked By:	Abrham Asfaw, EI
Existing or Proposed:	Existing
Hydrologic Element:	DA-14

TIMMONS GROUP
YOUR VISION ACHIEVED THROUGH OURS.

SHEET FLOW

Travel Time (min) = $\frac{0.42\,(nL)^{0.8}}{(P_2)^{0.5}s^{0.4}}$

	A	B	C
Manning's roughness coefficient, n =	0.08	0.08	0.08
flow length L, ft =	220	0	0
2-year, 24-hour rainfall $P_{2,}$ in =	3.34	3.34	3.34
segment start elev., ft (NAVD88) =	642.0	638.0	638.0
segment end elev., ft (NAVD88) =	638.0	638.0	638.0
land slope s, % =	1.82%	#DIV/0!	#DIV/0!
Segment Time =	*11.32 min*	*0.00 min*	*0.00 min*

11.32 min <-Sheet Flow Time

SHALLOW CONCENTRATED FLOW

Travel Time (min) = $\frac{L}{60V}$ V = 0.0203 √s paved
V = 0.0161 √s unpaved

	A	B	C
segment start elev., ft (NAVD88) =	638.0	616.0	586.0
segment end elev., ft (NAVD88) =	616.0	586.0	566.0
land slope s, % =	7.77%	4.83%	2.88%
segment is	unpaved	unpaved	unpaved
flow length L, ft =	283	621	695
average velocity V, ft/s =	4.50	3.55	2.74
Segment Time =	*1.05 min*	*2.92 min*	*4.23 min*

8.20 min <-Shallow Conc Time

CHANNEL FLOW

Travel Time (min) = $\frac{L}{60V}$ V = $\frac{1.49\,r^{2/3}\sqrt{s}}{n}$ r = $\frac{a}{P_w}$

	A	B	C
Bottom Width (assume trapezoidal channel w/1' flow depth), ft =	4	6	8
side slopes (assume full flow), ft =	2	2	2
cross sectional flow area A, ft^2	6.00	8.00	10.00
wetted perimeter $P_{w,\,ft}$ =	6.28	6.28	6.28
hydraulic radius Rh, ft =	0.95	1.27	1.59
segment start elev., ft (NAVD88) =	566.0	542.0	524.0
segment end elev., ft (NAVD88) =	542.0	524.0	500.0
s =	3.97%	2.46%	2.40%
Manning's roughness coefficient, n =	0.05	0.05	0.05
flow length L, ft =	604	731	1000
average velocity V, ft/s =	5.76	5.49	6.29
Segment Time =	*1.75 min*	*2.22 min*	*2.65 min*

6.61 min <-Channel Time

TOTAL TIME

TIME TO TRAVEL (min) =	**26**
TIME OF CONCENTRATION (MINIMUM TIME = 5 min) =	**26**
*Assume: Lag Time = 0.6*Time to Travel* **LAG TIME (min) =**	**16**

HYDROLOGY - TIME OF CONCENTRATION - SEGMENTAL APPROACH (TR-55)

Project Name:	Applebranch
Project Number:	47097.003
Location:	City of Danville, Virginia
Date:	8/26/2021
Prepared By:	A. Willard, EIT
Checked By:	Abrham Asfaw, EI
Existing or Proposed:	Existing
Hydrologic Element:	DA-15

TIMMONS GROUP
YOUR VISION ACHIEVED THROUGH OURS.

SHEET FLOW

Travel Time (min) = $\frac{0.42\,(nL)^{0.8}}{(P_2)^{0.5}s^{0.4}}$

	A	B	C
Manning's roughness coefficient, n =	0.08	0.08	0.08
flow length L, ft =	91	0	0
2-year, 24-hour rainfall $P_{2,}$ in =	3.34	3.34	3.34
segment start elev., ft (NAVD88) =	662.0	660.0	660.0
segment end elev., ft (NAVD88) =	660.0	660.0	660.0
land slope s, % =	2.20%	#DIV/0!	#DIV/0!
Segment Time =	*5.18 min*	*0.00 min*	*0.00 min*

5.18 min <-Sheet Flow Time

SHALLOW CONCENTRATED FLOW

Travel Time (min) = $\frac{L}{60V}$ V = 0.0203 √s paved
V = 0.0161 √s unpaved

	A	B	C
segment start elev., ft (NAVD88) =	660.0	574.0	652.0
segment end elev., ft (NAVD88) =	574.0	652.0	652.0
land slope s, % =	10.49%	#DIV/0!	#DIV/0!
segment is	unpaved	unpaved	unpaved
flow length L, ft =	820	0	0
average velocity V, ft/s =	5.23	#DIV/0!	#DIV/0!
Segment Time =	*2.62 min*	*0.00 min*	*0.00 min*

2.62 min <-Shallow Conc Time

CHANNEL FLOW

Travel Time (min) = $\frac{L}{60V}$ V = $\frac{1.49\,r^{2/3}\sqrt{s}}{n}$ r = $\frac{a}{P_w}$

	A	B	C
Bottom Width (assume trapezoidal channel w/1' flow depth), ft =	15	15	15
side slopes (assume full flow), ft =	2	2	2
cross sectional flow area A, ft^2	17.00	17.00	17.00
wetted perimeter $P_{w,\,ft}$ =	6.28	6.28	6.28
hydraulic radius Rh, ft =	2.71	2.71	2.71
segment start elev., ft (NAVD88) =	574.0	543.0	530.0
segment end elev., ft (NAVD88) =	543.0	530.0	530.0
s =	0.73%	#DIV/0!	#DIV/0!
Manning's roughness coefficient, n =	0.05	0.05	0.05
flow length L, ft =	4250	0	0
average velocity V, ft/s =	4.94	#DIV/0!	#DIV/0!
Segment Time =	*14.33 min*	*0.00 min*	*0.00 min*

14.33 min <-Channel Time

TOTAL TIME

TIME TO TRAVEL (min) =	**22**
TIME OF CONCENTRATION (MINIMUM TIME = 5 min) =	**22**
*Assume: Lag Time = 0.6*Time to Travel* **LAG TIME (min) =**	**13**

HYDROLOGY - TIME OF CONCENTRATION - SEGMENTAL APPROACH (TR-55)

Project Name:	Applebranch
Project Number:	47097.003
Location:	City of Danville, Virginia
Date:	8/26/2021
Prepared By:	A. Willard, EIT
Checked By:	Abrham Asfaw, EI
Existing or Proposed:	Existing
Hydrologic Element:	DA-16

TIMMONS GROUP
YOUR VISION ACHIEVED THROUGH OURS.

SHEET FLOW

Travel Time (min) = $\frac{0.42\,(nL)^{0.8}}{(P_2)^{0.5}s^{0.4}}$

	A	B	C
Manning's roughness coefficient, n =	0.08	0.08	0.08
flow length L, ft =	327	0	0
2-year, 24-hour rainfall $P_{2,}$ in =	3.34	3.34	3.34
segment start elev., ft (NAVD88) =	636.0	620.0	620.0
segment end elev., ft (NAVD88) =	620.0	620.0	620.0
land slope s, % =	4.89%	#DIV/0!	#DIV/0!
Segment Time =	*10.46 min*	*0.00 min*	*0.00 min*

10.46 min <-Sheet Flow Time

SHALLOW CONCENTRATED FLOW

Travel Time (min) = $\frac{L}{60V}$ V = 0.0203 √s paved
V = 0.0161 √s unpaved

	A	B	C
segment start elev., ft (NAVD88) =	620.0	580.0	580.0
segment end elev., ft (NAVD88) =	580.0	580.0	580.0
land slope s, % =	4.71%	#DIV/0!	#DIV/0!
segment is	unpaved	unpaved	unpaved
flow length L, ft =	850	0	0
average velocity V, ft/s =	3.50	#DIV/0!	#DIV/0!
Segment Time =	*4.05 min*	*0.00 min*	*0.00 min*

4.05 min <-Shallow Conc Time

CHANNEL FLOW

Travel Time (min) = $\frac{L}{60V}$ V = $\frac{1.49\,r^{2/3}\sqrt{s}}{n}$ r = $\frac{a}{P_w}$

	A	B	C
Bottom Width (assume trapezoidal channel w/1' flow depth), ft =	10	4	4
side slopes (assume full flow), ft =	2	2	2
cross sectional flow area A, ft^2	12.00	6.00	6.00
wetted perimeter $P_{w,\,ft}$ =	6.28	6.28	6.28
hydraulic radius Rh, ft =	1.91	0.95	0.95
segment start elev., ft (NAVD88) =	580.0	529.0	529.0
segment end elev., ft (NAVD88) =	529.0	529.0	529.0
s =	2.90%	#DIV/0!	#DIV/0!
Manning's roughness coefficient, n =	0.05	0.05	0.05
flow length L, ft =	1760	0	0
average velocity V, ft/s =	7.81	#DIV/0!	#DIV/0!
Segment Time =	*3.76 min*	*0.00 min*	*0.00 min*

3.76 min <-Channel Time

TOTAL TIME

TIME TO TRAVEL (min) =	**18**
TIME OF CONCENTRATION (MINIMUM TIME = 5 min) =	**18**
*Assume: Lag Time = 0.6*Time to Travel* **LAG TIME (min) =**	**11**

HYDROLOGY - TIME OF CONCENTRATION - SEGMENTAL APPROACH (TR-55)

Project Name:	Applebranch
Project Number:	47097.003
Location:	City of Danville, Virginia
Date:	8/26/2021
Prepared By:	A. Willard, EIT
Checked By:	Abrham Asfaw, EI
Existing or Proposed:	Existing
Hydrologic Element:	DA-17

TIMMONS GROUP
YOUR VISION ACHIEVED THROUGH OURS.

SHEET FLOW

Travel Time (min) = $\frac{0.42\,(nL)^{0.8}}{(P_2)^{0.5}s^{0.4}}$

	A	B	C
Manning's roughness coefficient, n =	0.08	0.08	0.08
flow length L, ft =	300	0	0
2-year, 24-hour rainfall $P_{2,}$ in =	3.34	3.34	3.34
segment start elev., ft (NAVD88) =	658.0	650.0	650.0
segment end elev., ft (NAVD88) =	650.0	650.0	650.0
land slope s, % =	2.67%	#DIV/0!	#DIV/0!
Segment Time =	*12.45 min*	*0.00 min*	*0.00 min*

12.45 min <-Sheet Flow Time

SHALLOW CONCENTRATED FLOW

Travel Time (min) = $\frac{L}{60V}$ V = 0.0203 √s paved
V = 0.0161 √s unpaved

	A	B	C
segment start elev., ft (NAVD88) =	650.0	638.0	620.0
segment end elev., ft (NAVD88) =	638.0	620.0	604.0
land slope s, % =	4.49%	3.44%	3.97%
segment is	unpaved	unpaved	unpaved
flow length L, ft =	267	524	403
average velocity V, ft/s =	3.42	2.99	3.21
Segment Time =	*1.30 min*	*2.92 min*	*2.09 min*

6.31 min <-Shallow Conc Time

CHANNEL FLOW

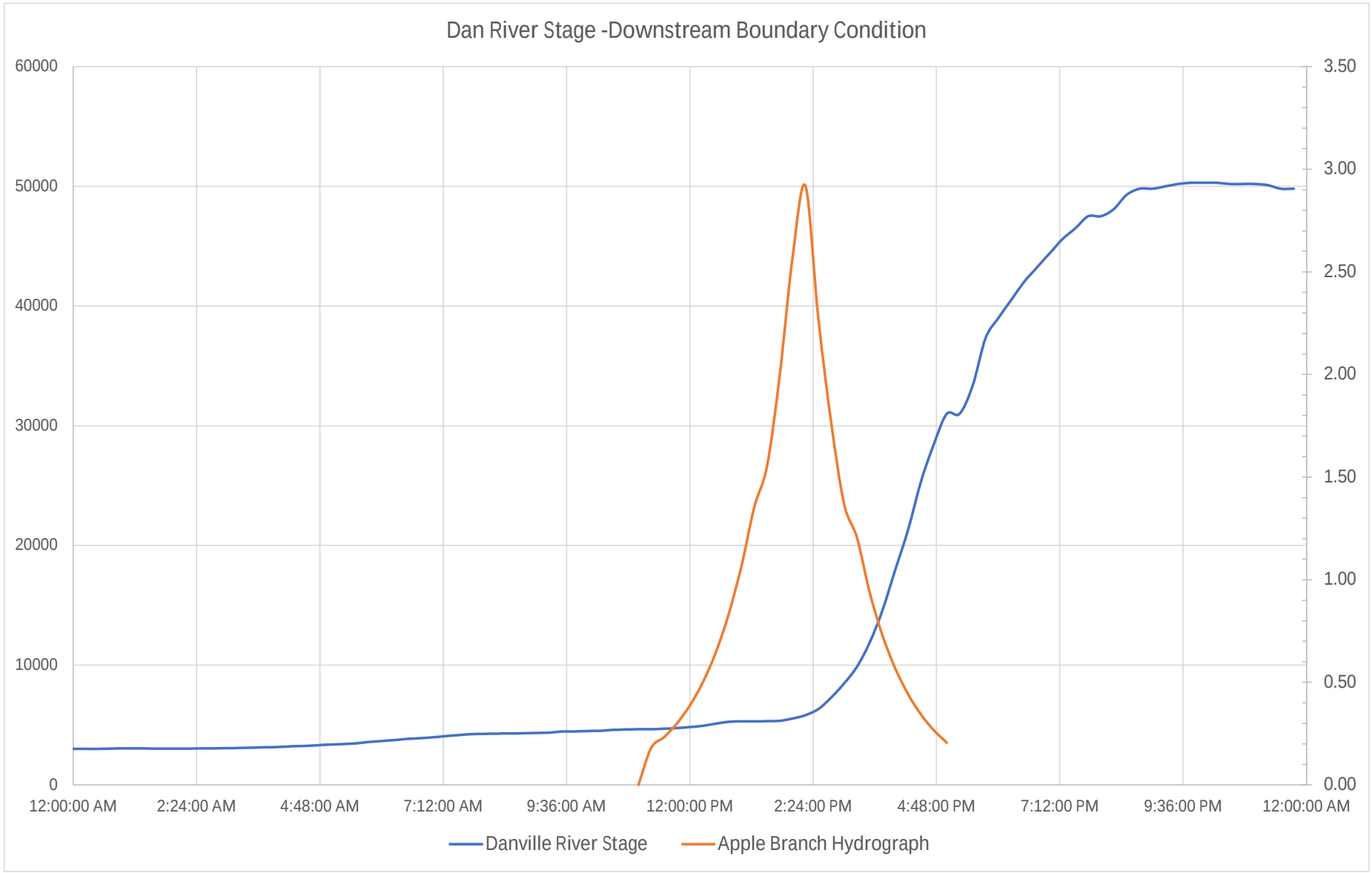
Travel Time (min) = $\frac{L}{60V}$ V = $\frac{1.49\,r^{2/3}\sqrt{s}}{n}$ r = $\frac{a}{P_w}$

	A	B	C
Bottom Width (assume trapezoidal channel w/1' flow depth), ft =	4	4	6
side slopes (assume full flow), ft =	2	2	2
cross sectional flow area A, ft^2	6.00	6.00	8.00
wetted perimeter $P_{w,\,ft}$ =	6.28	6.28	6.28
hydraulic radius Rh, ft =	0.95	0.95	1.27
segment start elev., ft (NAVD88) =	604.0	572.0	548.0
segment end elev., ft (NAVD88) =	572.0	548.0	542.0
s =	2.65%	4.07%	0.74%
Manning's roughness coefficient, n =	0.05	0.05	0.05
flow length L, ft =	1206	589	809
average velocity V, ft/s =	4.71	5.83	3.01
Segment Time =	*4.27 min*	*1.68 min*	*4.47 min*

10.43 min <-Channel Time

TOTAL TIME

TIME TO TRAVEL (min) =	**29**
TIME OF CONCENTRATION (MINIMUM TIME = 5 min) =	**29**
*Assume: Lag Time = 0.6*Time to Travel* **LAG TIME (min) =**	**18**


Dan River Stage -Downstream Boundary Condition
60000
50000
40000
30000
20000
10000
0
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
12:00:00 AM
2:24:00 AM
4:48:00 AM
7:12:00 AM
9:36:00 AM
12:00:00 PM
2:24:00 PM
4:48:00 PM
7:12:00 PM
9:36:00 PM
12:00:00 AM
Danville River Stage
Apple Branch Hydrograph

Project Name:	Apple Branch
Project Number:	47097.003
Location:	City of Danville, Virginia
Date:	44484
Prepared by:	Alston Willard, EIT
Checked by:	Abrham Asfaw, PE
Existing or Proposed:	EXISTING
Storm Event	Hurricane Michael

TIMMONS GROUP
YOUR VISION ACHIEVED THROUGH OURS.

October 11, 2018 Hurricane Michael Storm Percent Pattern

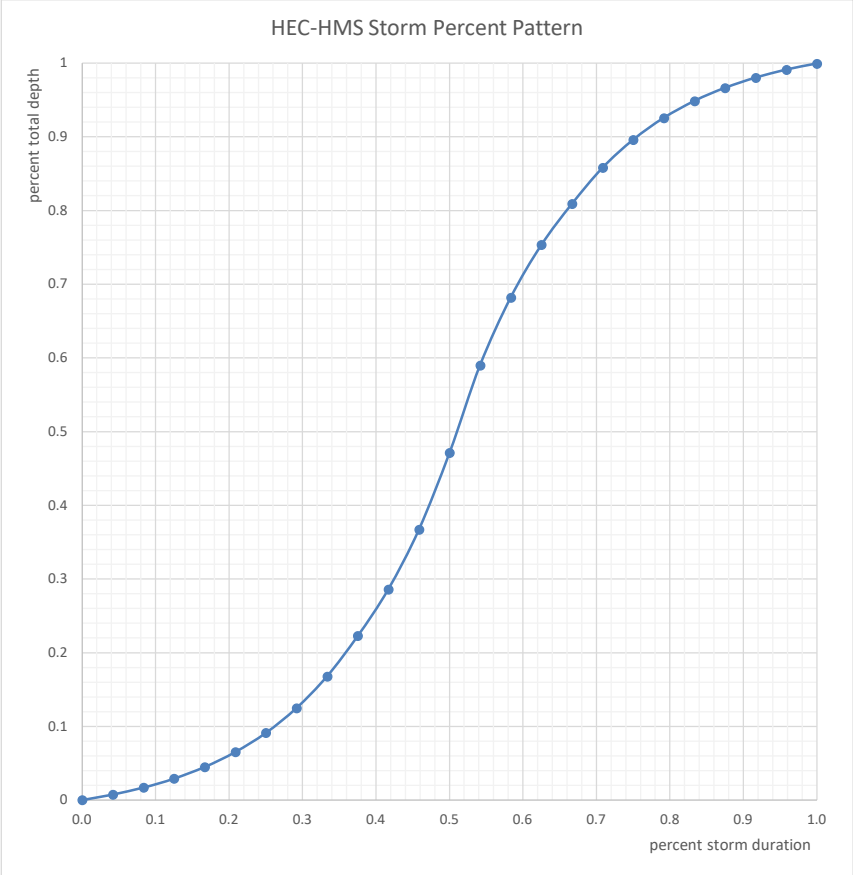
HURRICANE MICHAEL CENTER WEIGHTED STORM

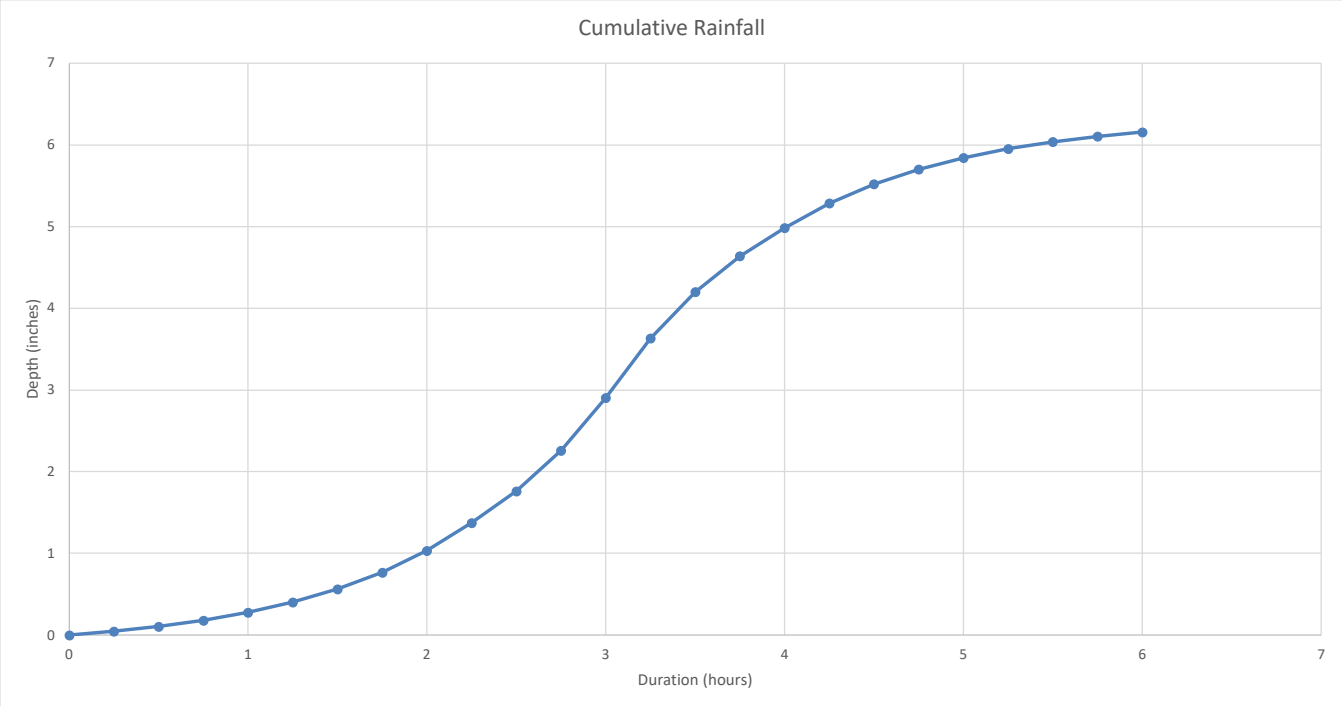
Time (hr)	Hurican Michael (Inches) Cumulative rainfall	Hurican Michael (Inches) Cumulative rainfall	Rainfall inches for each 15 minute increment	Rainfall Intensity (in/hr)	Sorted Intensity High to low	Sorted Intensity to a center weighted storm	Center weighted inches per 15 min increment (Rainfall intensity)	Design Storm Center Weighted Cumulative Rainfall (Hurican Michael) inches
0	0	0	0	0	0	0	0.00	0
0.25	0.34	0.34	0.34	1.35	0.18	0.18	0.05	0.05
0.50	0.38	0.38	0.05	0.18	0.21	0.23	0.06	0.10
0.75	0.44	0.44	0.05	0.21	0.23	0.30	0.08	0.18
1.00	0.49	0.49	0.06	0.23	0.27	0.39	0.10	0.28
1.25	0.56	0.56	0.07	0.27	0.30	0.50	0.12	0.40
1.50	0.64	0.64	0.08	0.30	0.34	0.64	0.16	0.56
1.75	0.72	0.72	0.09	0.34	0.39	0.83	0.21	0.77
2.00	0.82	0.82	0.10	0.39	0.44	1.06	0.27	1.03
2.25	0.93	0.93	0.11	0.44	0.50	1.35	0.34	1.37
2.50	1.05	1.05	0.12	0.50	0.57	1.55	0.39	1.76
2.75	1.19	1.19	0.14	0.57	0.64	2.00	0.50	2.26
3.00	1.35	1.35	0.16	0.64	0.73	2.57	0.64	2.90
3.25	1.54	1.54	0.18	0.73	0.83	2.92	0.73	3.63
3.50	1.74	1.74	0.21	0.83	0.94	2.27	0.57	4.20
3.75	1.98	1.98	0.23	0.94	1.06	1.76	0.44	4.64
4.00	2.24	2.24	0.27	1.06	1.21	1.37	0.34	4.98
4.25	2.55	2.55	0.30	1.21	1.35	1.21	0.30	5.29
4.50	2.89	2.89	0.34	1.37	1.37	0.94	0.23	5.52
4.75	3.28	3.28	0.39	1.55	1.55	0.73	0.18	5.70
5.00	3.72	3.72	0.44	1.76	1.76	0.57	0.14	5.84
5.25	4.22	4.22	0.50	2.00	2.00	0.44	0.11	5.95
5.50	4.78	4.78	0.57	2.27	2.27	0.34	0.09	6.04
5.75	5.43	5.43	0.64	2.57	2.57	0.27	0.07	6.11
6.00	6.16	6.16	0.73	2.92	2.92	0.21	0.05	6.16

Source: NOAA National Environmental Satellite, Data, and Information Service, DANVILLE REGIONAL AIRPORT, VA US WBAN: 72410613728 (KDAN)

HEC-HMS Strom Percent Pattern

duration		depth
0.0	0.0	0
4.2	0.7	0.7
8.3	0.9	1.7
12.5	1.2	2.9
16.7	1.6	4.5
20.8	2.0	6.5
25.0	2.6	9.1
29.2	3.4	12.5
33.3	4.3	16.8
37.5	5.5	22.3
41.7	6.3	28.6
45.8	8.1	36.7
50.0	10.4	47.1
54.2	11.8	59.0
58.3	9.2	68.2
62.5	7.2	75.3
66.7	5.6	80.9
70.8	4.9	85.8
75.0	3.8	89.6
79.2	3.0	92.6
83.3	2.3	94.9
87.5	1.8	96.6
91.7	1.4	98.0
95.8	1.1	99.1
100.0	0.8	99.9





Project Name:	Apple Branch
Project Number:	47097.003
Location:	City of Danville, Virginia
Date:	44484
Prepared by:	Alston Willard, EIT
Checked by:	Abrham Asfaw, PE
Storm Event	May, 18 Storm

TIMMONS GROUP
YOUR VISION ACHIEVED THROUGH OURS.

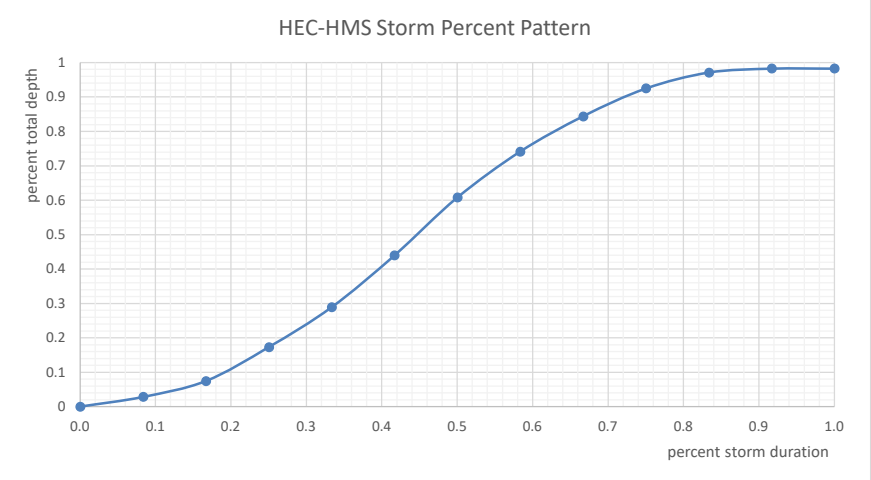
May 18, 2018 Storm Percent Pattern

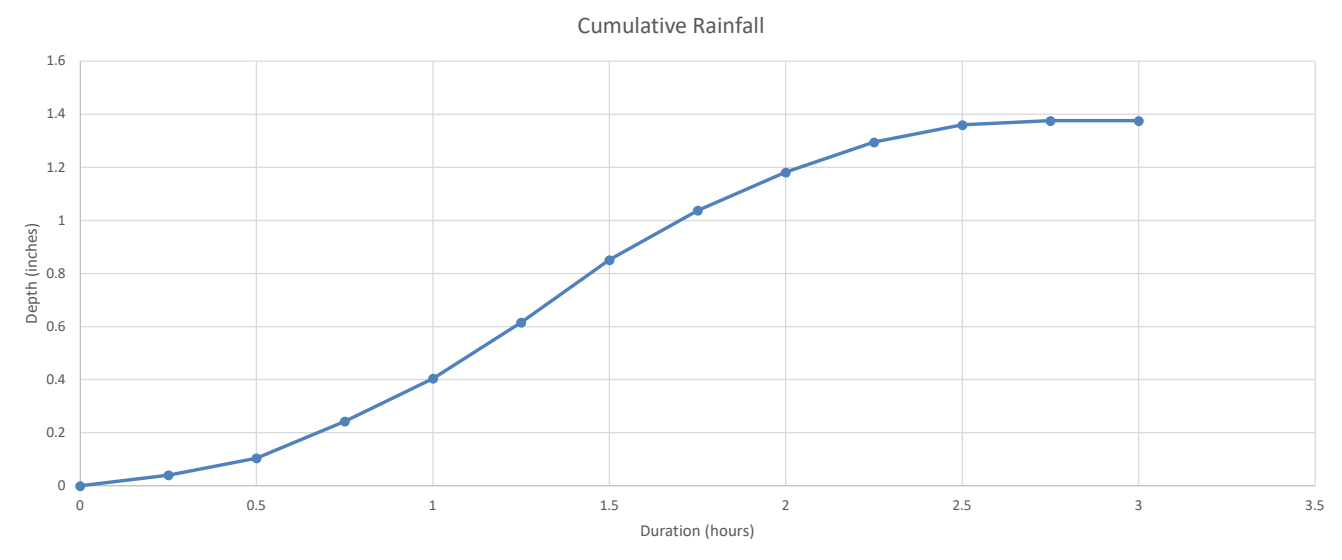
Time (hr)	May 18,2018 (Inches) Cumulative rainfall	May 18, 2018 (Inches) Cumulative rainfall	Rainfall inches for each 15 minute increment	Rainfall Intensity (in/hr)	Sorted Intensity High to low	Sorted Intensity to a center weighted storm	inches per 15 min increment (Rainfall intensity)	Design Storm Center Weighted Cumulative Rainfall (Hurican Michael) inches
0	0	0	0	0	0.94	0.00	0.00	0
0.25	0.00	0.00	0.00	0.00	0.84	0.16	0.04	0.04
0.50	0.00	0.00	0.00	0.00	0.75	0.26	0.06	0.10
0.75	0.00	0.00	0.00	0.00	0.65	0.55	0.14	0.24
1.00	0.00	0.00	0.00	0.00	0.58	0.65	0.16	0.40
1.25	0.00	0.00	0.00	0.00	0.55	0.84	0.21	0.62
1.50	0.20	0.20	0.20	0.81	0.45	0.94	0.24	0.85
1.75	0.40	0.40	0.20	0.80	0.36	0.75	0.19	1.04
2.00	0.58	0.58	0.17	0.69	0.26	0.58	0.14	1.18
2.25	0.73	0.73	0.15	0.61	0.16	0.45	0.11	1.29
2.50	0.87	0.87	0.14	0.55	0.06	0.26	0.06	1.36
2.75	0.99	0.99	0.12	0.50	0.00	0.06	0.02	1.38
3.00	1.10	1.10	0.11	0.45	0.00	0.00	0.00	1.38

Source: NOAA National Environmental Satellite, Data, and Information Service, DANVILLE REGIONAL AIRPORT, VA US WBAN: 72410613728 (KDAN)

HEC-HMS Strom Percent Pattern

percent storm duration		percent total depth
0.0	0.0	0
8.3	2.9	2.9
16.7	4.6	7.5
25.0	9.8	17.3
33.3	11.6	28.9
41.7	15.1	44.0
50.0	16.8	60.8
58.3	13.3	74.1
66.7	10.3	84.4
75.0	8.1	92.5
83.3	4.6	97.1
91.7	1.1	98.2
100.0	0.0	98.2





NOAA Atlas 14, Volume 2, Version 3
Location name: Danville, Virginia, USA*
Latitude: 36.586°, Longitude: -79.4172°
Elevation: 431.87 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

G.M. Bonnin, D. Martin, B. Lin, T. Parzybok, M.Yekta, and D. Riley

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**0.367** (0.335-0.402)	**0.438** (0.400-0.480)	**0.518** (0.471-0.567)	**0.573** (0.521-0.626)	**0.638** (0.578-0.696)	**0.681** (0.615-0.743)	**0.724** (0.650-0.789)	**0.760** (0.679-0.830)	**0.802** (0.710-0.878)	**0.832** (0.732-0.913)
10-min	**0.587** (0.534-0.642)	**0.700** (0.639-0.768)	**0.829** (0.754-0.908)	**0.916** (0.833-1.00)	**1.02** (0.922-1.11)	**1.09** (0.979-1.18)	**1.15** (1.03-1.25)	**1.20** (1.08-1.32)	**1.27** (1.12-1.39)	**1.31** (1.15-1.44)
15-min	**0.734** (0.668-0.803)	**0.881** (0.803-0.965)	**1.05** (0.954-1.15)	**1.16** (1.05-1.27)	**1.29** (1.17-1.41)	**1.37** (1.24-1.50)	**1.45** (1.31-1.59)	**1.52** (1.36-1.66)	**1.60** (1.41-1.75)	**1.65** (1.45-1.81)
30-min	**1.01** (0.916-1.10)	**1.22** (1.11-1.33)	**1.49** (1.36-1.63)	**1.68** (1.53-1.83)	**1.91** (1.73-2.08)	**2.07** (1.87-2.26)	**2.23** (2.00-2.43)	**2.37** (2.11-2.59)	**2.54** (2.25-2.78)	**2.67** (2.34-2.92)
60-min	**1.25** (1.14-1.37)	**1.53** (1.39-1.67)	**1.91** (1.74-2.09)	**2.19** (1.99-2.39)	**2.54** (2.30-2.77)	**2.80** (2.53-3.06)	**3.07** (2.75-3.34)	**3.32** (2.96-3.63)	**3.65** (3.23-3.99)	**3.89** (3.42-4.27)
2-hr	**1.48** (1.34-1.63)	**1.80** (1.63-1.98)	**2.26** (2.05-2.48)	**2.62** (2.37-2.87)	**3.09** (2.78-3.38)	**3.46** (3.10-3.78)	**3.84** (3.41-4.19)	**4.21** (3.72-4.60)	**4.72** (4.12-5.16)	**5.11** (4.42-5.60)
3-hr	**1.58** (1.44-1.74)	**1.93** (1.76-2.12)	**2.43** (2.21-2.67)	**2.81** (2.55-3.08)	**3.32** (2.99-3.63)	**3.71** (3.33-4.06)	**4.11** (3.67-4.49)	**4.51** (4.00-4.93)	**5.06** (4.42-5.53)	**5.47** (4.74-5.98)
6-hr	**1.94** (1.77-2.15)	**2.35** (2.15-2.60)	**2.96** (2.69-3.27)	**3.44** (3.12-3.79)	**4.11** (3.70-4.51)	**4.65** (4.15-5.10)	**5.22** (4.62-5.71)	**5.80** (5.09-6.34)	**6.63** (5.72-7.23)	**7.28** (6.21-7.95)
12-hr	**2.33** (2.13-2.58)	**2.83** (2.58-3.12)	**3.58** (3.26-3.94)	**4.19** (3.80-4.60)	**5.07** (4.56-5.54)	**5.80** (5.17-6.32)	**6.59** (5.81-7.16)	**7.43** (6.47-8.06)	**8.65** (7.40-9.39)	**9.66** (8.12-10.5)
24-hr	**2.76** (2.57-2.97)	**3.34** (3.11-3.60)	**4.24** (3.95-4.57)	**4.99** (4.64-5.36)	**6.08** (5.61-6.51)	**6.99** (6.41-7.49)	**7.98** (7.26-8.56)	**9.06** (8.18-9.72)	**10.6** (9.48-11.4)	**12.0** (10.5-12.9)
2-day	**3.25** (3.03-3.49)	**3.93** (3.66-4.21)	**4.95** (4.62-5.31)	**5.79** (5.38-6.19)	**6.97** (6.45-7.44)	**7.95** (7.32-8.50)	**8.99** (8.23-9.63)	**10.1** (9.18-10.8)	**11.7** (10.5-12.6)	**13.0** (11.6-14.1)
3-day	**3.43** (3.20-3.68)	**4.15** (3.87-4.45)	**5.22** (4.87-5.60)	**6.10** (5.67-6.54)	**7.34** (6.80-7.87)	**8.38** (7.71-8.97)	**9.47** (8.66-10.2)	**10.6** (9.67-11.4)	**12.3** (11.1-13.3)	**13.7** (12.2-14.9)
4-day	**3.61** (3.37-3.88)	**4.36** (4.07-4.69)	**5.49** (5.12-5.90)	**6.41** (5.97-6.89)	**7.72** (7.14-8.29)	**8.80** (8.10-9.45)	**9.96** (9.10-10.7)	**11.2** (10.2-12.0)	**12.9** (11.6-14.0)	**14.4** (12.8-15.6)
7-day	**4.14** (3.89-4.42)	**4.97** (4.67-5.31)	**6.16** (5.78-6.58)	**7.14** (6.68-7.61)	**8.51** (7.93-9.08)	**9.64** (8.94-10.3)	**10.8** (9.99-11.6)	**12.1** (11.1-12.9)	**13.9** (12.6-14.9)	**15.4** (13.8-16.6)
10-day	**4.69** (4.42-4.99)	**5.60** (5.28-5.97)	**6.87** (6.47-7.31)	**7.90** (7.42-8.39)	**9.32** (8.73-9.90)	**10.5** (9.77-11.1)	**11.7** (10.8-12.4)	**13.0** (11.9-13.8)	**14.7** (13.4-15.7)	**16.1** (14.6-17.3)
20-day	**6.31** (5.98-6.68)	**7.51** (7.12-7.95)	**9.03** (8.55-9.55)	**10.2** (9.66-10.8)	**11.9** (11.2-12.5)	**13.1** (12.3-13.9)	**14.4** (13.5-15.3)	**15.8** (14.7-16.7)	**17.5** (16.2-18.7)	**18.9** (17.4-20.2)
30-day	**7.81** (7.43-8.21)	**9.23** (8.78-9.70)	**10.9** (10.3-11.4)	**12.1** (11.5-12.7)	**13.7** (13.0-14.4)	**15.0** (14.2-15.7)	**16.2** (15.3-17.1)	**17.4** (16.3-18.3)	**19.0** (17.7-20.0)	**20.1** (18.7-21.3)
45-day	**9.86** (9.39-10.4)	**11.6** (11.1-12.2)	**13.5** (12.8-14.2)	**14.9** (14.2-15.7)	**16.8** (15.9-17.6)	**18.2** (17.2-19.1)	**19.5** (18.4-20.5)	**20.8** (19.6-21.9)	**22.4** (21.0-23.7)	**23.6** (22.1-25.0)
60-day	**11.8** (11.3-12.3)	**13.8** (13.2-14.5)	**15.9** (15.2-16.6)	**17.4** (16.6-18.2)	**19.4** (18.4-20.3)	**20.8** (19.8-21.8)	**22.2** (21.0-23.2)	**23.5** (22.2-24.7)	**25.1** (23.7-26.4)	**26.3** (24.7-27.8)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

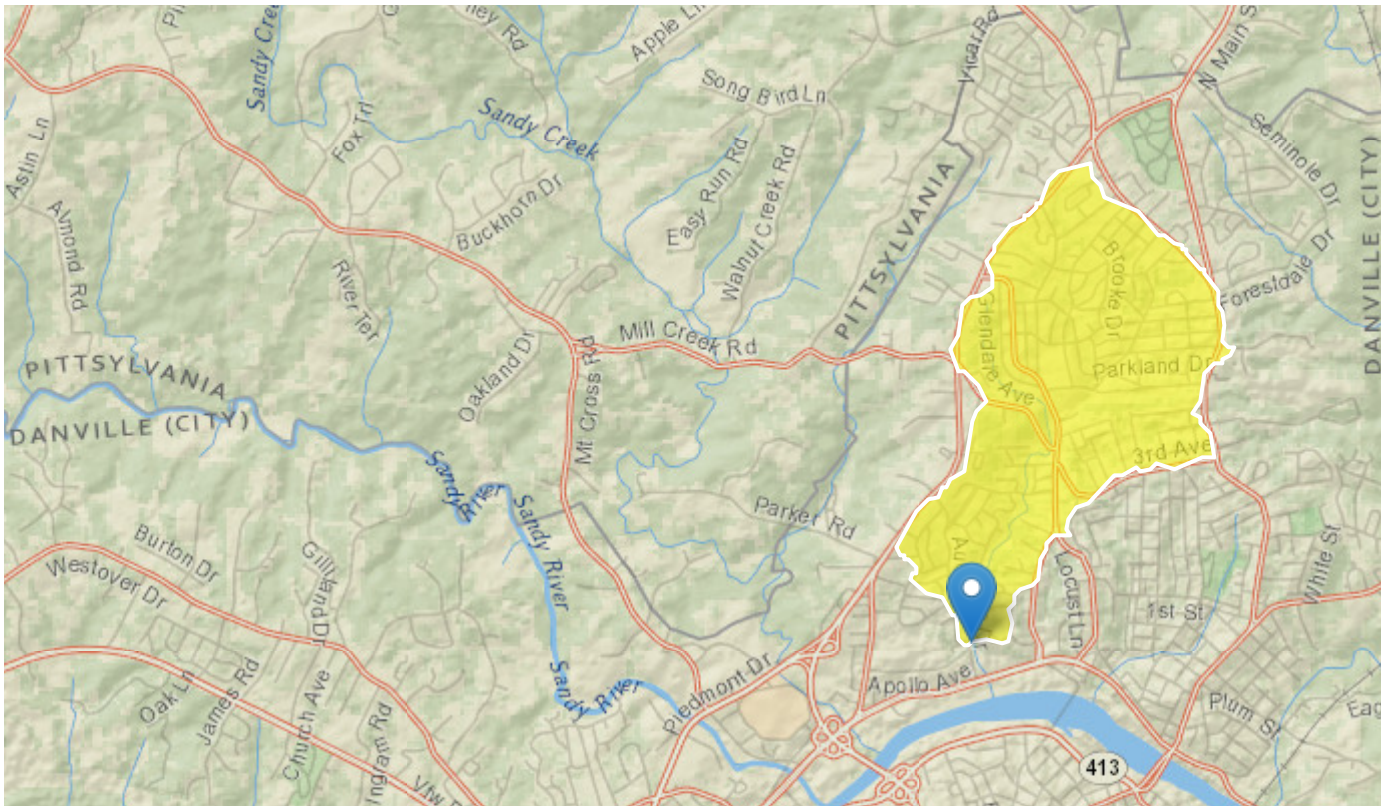
Please refer to NOAA Atlas 14 document for more information.

Back to Top

PF graphical

StreamStats Report - Apple Branch at Head of Study Area

Region ID: VA
Workspace ID: VA20211014142541244000
Clicked Point (Latitude, Longitude): 36.59849, -79.40470
Time: 2021-10-14 10:26:03 -0400



Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	1.85	square miles
LC01DEV	Percentage of land-use from NLCD 2001 classes 21-24	92.7	percent
LC06DEV	Percentage of land-use from NLCD 2006 classes 21-24	92.68	percent
LC11DEV	Percentage of developed (urban) land from NLCD 2011 classes 21-24	92.7	percent

Peak-Flow Statistics Parameters [Piedmont nonMesozoic 2011 5144]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	1.85	square miles	0.06	7866

Peak-Flow Statistics Flow Report [Piedmont nonMesozoic 2011 5144]

PII: Prediction Interval-Lower, PIu: Prediction Interval-Upper, ASEp: Average Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	ASEp
50-percent AEP flood	227	ft^3/s	43
42.9-percent AEP flood	276	ft^3/s	42
20-percent AEP flood	487	ft^3/s	32
10-percent AEP flood	727	ft^3/s	31
4-percent AEP flood	1130	ft^3/s	32
2-percent AEP flood	1500	ft^3/s	34
1-percent AEP flood	1940	ft^3/s	36
0.5-percent AEP flood	2460	ft^3/s	38

Peak-Flow Statistics Citations

Austin, S.H., Krstolic, J.L., and Wiegand, Ute,2011, Peak-flow characteristics of Virginia streams: U.S. Geological Survey Scientific Investigations Report 2011–5144, 106 p. + 3 tables and 2 appendixes on CD. (http://pubs.usgs.gov/sir/2011/5144/)

Low-Flow Statistics Parameters [Piedmont nonMesozoic 2011 5143]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	1.85	square miles	0.09	7393

Low-Flow Statistics Flow Report [Piedmont nonMesozoic 2011 5143]

PII: Prediction Interval-Lower, PIu: Prediction Interval-Upper, ASEp: Average Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	ASEp
1 Day 1.11 Year Low Flow	0.368	ft^3/s	112
1 Day 1.25 Year Low Flow	0.235	ft^3/s	135

Statistic	Value	Unit	ASEp
1 Day 1.43 Year Low Flow	0.166	ft^3/s	156
1 Day 1.67 Year Low Flow	0.119	ft^3/s	178
1 Day 2 Year Low Flow	0.084	ft^3/s	207
4 Day 1.11 Year Low Flow	0.753	ft^3/s	131
4 Day 1.25 Year Low Flow	0.569	ft^3/s	148
4 Day 1.43 Year Low Flow	0.443	ft^3/s	167
4 Day 1.67 Year Low Flow	0.341	ft^3/s	189
4 Day 2 Year Low Flow	0.253	ft^3/s	220
4 Day 2.5 Year Low Flow	0.167	ft^3/s	274
7 Day 1.11 Year Low Flow	0.948	ft^3/s	101
7 Day 1.25 Year Low Flow	0.711	ft^3/s	113
7 Day 1.43 Year Low Flow	0.564	ft^3/s	123
7 Day 1.67 Year Low Flow	0.451	ft^3/s	134
7 Day 2 Year Low Flow	0.361	ft^3/s	146
7 Day 2.5 Year Low Flow	0.28	ft^3/s	159
7 Day 3.33 Year Low Flow	0.209	ft^3/s	175
7 Day 5 Year Low Flow	0.141	ft^3/s	199
7 Day 10 Year Low Flow	0.0754	ft^3/s	242
7 Day 20 Year Low Flow	0.0414	ft^3/s	302
30 Day 1.11 Year Low Flow	0.825	ft^3/s	82.1
30 Day 1.25 Year Low Flow	0.556	ft^3/s	93.3
30 Day 1.43 Year Low Flow	0.397	ft^3/s	106
30 Day 1.67 Year Low Flow	0.292	ft^3/s	119
30 Day 2 Year Low Flow	0.207	ft^3/s	136
30 Day 2.5 Year Low Flow	0.153	ft^3/s	156

Low-Flow Statistics Citations

Austin, S.H., Krstolic, J.L., and Wiegand, Ute,2011, Low-flow characteristics of Virginia streams: U.S. Geological Survey Scientific Investigations Report 2011–5143, 122 p. + 9 tables on CD. (http://pubs.usgs.gov/sir/2011/5143/)

Bankfull Statistics Parameters [Appalachian Highlands D Bieger 2015]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	1.85	square miles	0.07722	940.1535

Bankfull Statistics Parameters [Piedmont P Bieger 2015]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	1.85	square miles	0.289575	939.99906

Bankfull Statistics Parameters [USA Bieger 2015]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	1.85	square miles	0.07722	59927.7393

Bankfull Statistics Flow Report [Appalachian Highlands D Bieger 2015]

Statistic	Value	Unit
Bieger_D_channel_width	19.6	ft
Bieger_D_channel_depth	1.34	ft
Bieger_D_channel_cross_sectional_area	26.6	ft^2

Bankfull Statistics Flow Report [Piedmont P Bieger 2015]

Statistic	Value	Unit
Bieger_P_channel_width	17.7	ft
Bieger_P_channel_depth	1.39	ft
Bieger_P_channel_cross_sectional_area	24.7	ft^2

Bankfull Statistics Flow Report [USA Bieger 2015]

Statistic	Value	Unit
Bieger_USA_channel_width	15.4	ft
Bieger_USA_channel_depth	1.37	ft
Bieger_USA_channel_cross_sectional_area	23.8	ft^2

Bankfull Statistics Flow Report [Area-Averaged]

Statistic	Value	Unit

Statistic	Value	Unit
Bieger_D_channel_width	19.6	ft
Bieger_D_channel_depth	1.34	ft
Bieger_D_channel_cross_sectional_area	26.6	ft^2
Bieger_P_channel_width	17.7	ft
Bieger_P_channel_depth	1.39	ft
Bieger_P_channel_cross_sectional_area	24.7	ft^2
Bieger_USA_channel_width	15.4	ft
Bieger_USA_channel_depth	1.37	ft
Bieger_USA_channel_cross_sectional_area	23.8	ft^2

Bankfull Statistics Citations

Bieger, Katrin; Rathjens, Hendrik; Allen, Peter M.; and Arnold, Jeffrey G.,2015, Development and Evaluation of Bankfull Hydraulic Geometry Relationships for the Physiographic Regions of the United States, Publications from USDA-ARS / UNL Faculty, 17p. (https://digitalcommons.unl.edu/usdaarsfacpub/1515?utm_source=digitalcommons.unl.edu%2Fusdaarsfacpub%2F1515&utm_medium=PDF&utm_can

Urban Peak-Flow Statistics Parameters [Peak Urban01 2014 5090]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	1.85	square miles	0.07	2404
LC01DEV	Percent_Developed_from_NLCD2001	92.7	percent	10	96

Urban Peak-Flow Statistics Parameters [Peak Urban06 2014 5090]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	1.85	square miles	0.07	2404
LC06DEV	Percent Developed from NLCD2006	92.68	percent	10	96

Urban Peak-Flow Statistics Parameters [Peak Urban11 2014 5090]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	1.85	square miles	0.07	2404
LC11DEV	Percent Developed from NLCD2011	92.7	percent	10	96

Urban Peak-Flow Statistics Flow Report [Peak Urban01 2014 5090]

PIl: Prediction Interval-Lower, PIu: Prediction Interval-Upper, ASEp: Average Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	ASEp
Urban 99.5-percent AEP flood	323	ft^3/s	70.4
Urban 99-percent AEP flood	336	ft^3/s	67.8
Urban 95-percent AEP flood	357	ft^3/s	60.5
Urban 90-percent AEP flood	397	ft^3/s	59.3
Urban 80-percent AEP flood	458	ft^3/s	57.5
Urban 66.7-percent AEP flood	585	ft^3/s	57.3
Urban 50-percent AEP flood	686	ft^3/s	57.3
Urban 42.9-percent AEP flood	744	ft^3/s	57.1
Urban 20-Percent AEP flood	1040	ft^3/s	60.6
Urban 10-percent AEP flood	1340	ft^3/s	64.1
Urban 4-percent AEP flood	1720	ft^3/s	74.4
Urban 2-percent AEP flood	2140	ft^3/s	84.8
Urban 1-percent AEP flood	2880	ft^3/s	97.9
Urban 0.5-percent AEP flood	3700	ft^3/s	102
Urban 0.2-percent AEP flood	5620	ft^3/s	134

Urban Peak-Flow Statistics Flow Report [Peak Urban06 2014 5090]

PIl: Prediction Interval-Lower, PIu: Prediction Interval-Upper, ASEp: Average Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	ASEp
Urban 99.5-percent AEP flood	323	ft^3/s	70.4
Urban 99-percent AEP flood	336	ft^3/s	67.8
Urban 95-percent AEP flood	357	ft^3/s	60.5

Statistic	Value	Unit	ASEp
Urban 90-percent AEP flood	397	ft^3/s	59.3
Urban 80-percent AEP flood	458	ft^3/s	57.5
Urban 66.7-percent AEP flood	584	ft^3/s	57.3
Urban 50-percent AEP flood	685	ft^3/s	57.3
Urban 42.9-percent AEP flood	744	ft^3/s	57.1
Urban 20-Percent AEP flood	1040	ft^3/s	60.6
Urban 10-percent AEP flood	1340	ft^3/s	64.1
Urban 4-percent AEP flood	1720	ft^3/s	74.4
Urban 2-percent AEP flood	2140	ft^3/s	84.8
Urban 1-percent AEP flood	2880	ft^3/s	97.9
Urban 0.5-percent AEP flood	3700	ft^3/s	102
Urban 0.2-percent AEP flood	5620	ft^3/s	134

Urban Peak-Flow Statistics Flow Report [Peak Urban11 2014 5090]

PIl: Prediction Interval-Lower, PIu: Prediction Interval-Upper, ASEp: Average Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	ASEp
Urban 99.5-percent AEP flood	323	ft^3/s	70.4
Urban 99-percent AEP flood	336	ft^3/s	67.8
Urban 95-percent AEP flood	357	ft^3/s	60.5
Urban 90-percent AEP flood	397	ft^3/s	59.3
Urban 80-percent AEP flood	458	ft^3/s	57.5
Urban 66.7-percent AEP flood	585	ft^3/s	57.3
Urban 50-percent AEP flood	686	ft^3/s	57.3
Urban 42.9-percent AEP flood	744	ft^3/s	57.1
Urban 20-Percent AEP flood	1040	ft^3/s	60.6
Urban 10-percent AEP flood	1340	ft^3/s	64.1
Urban 4-percent AEP flood	1720	ft^3/s	74.4
Urban 2-percent AEP flood	2140	ft^3/s	84.8
Urban 1-percent AEP flood	2880	ft^3/s	97.9
Urban 0.5-percent AEP flood	3700	ft^3/s	102

Statistic	Value	Unit	ASEp
Urban 0.2-percent AEP flood	5620	ft^3/s	134

Urban Peak-Flow Statistics Citations

Austin, S.H.,2014, Methods and equations for estimating peak streamflow per square mile in Virginia's urban basins: U.S. Geological Survey Scientific Investigations Report 2014–5090, 25 p. (http://pubs.usgs.gov/sir/2014/5090/http://pubs.usgs.gov/sir/2014/5090/)

Application Version: 4.6.2
StreamStats Services Version: 1.2.22
NSS Services Version: 2.1.2

Project: Danville_Apple_Branch
Simulation Run: HURRICANE MICHAEL - Lag
Simulation Start: 7 August 2021, 24:00
Simulation End: 8 August 2021, 08:00

HMS Version: 4.9
Executed: 07 April 2022, 12:25

Global Parameter Summary - Subbasin

	Area (MIē)
Element Name	**Area (MIē)**
DA - 17	0.2
DA - 16	0.15
DA - 15	0.41
DA - 14	0.16
DA - 13	0.14
DA - 12	0.17
DA - 11	0.08
DA - 10	0.16
DA - 9	0.03
DA - 8	0.11
DA - 7	0.06
DA - 6	0.13
DA - 5	0.07
DA - 4	0.14
DA - 3	0.03
DA - 2	0.01

Downstream

Element Name	Downstream
DA - 17	POI - 14
DA - 16	POI - 13
DA - 15	POI - 12
DA - 14	POI - 11
DA - 13	POI - 10
DA - 12	POI - 9
DA - 11	POI - 9
DA - 10	POI - 8
DA - 9	POI - 7
DA - 8	POI - 6
DA - 7	POI - 6
DA - 6	POI - 5
DA - 5	POI - 4
DA - 4	POI - 3
DA - 3	POI - 2
DA - 2	POI - 1

Loss Rate: Scs

Element Name	Percent Impervious Area	Curve Number
DA - 17	0	75
DA - 16	0	78
DA - 15	0	77
DA - 14	0	65
DA - 13	0	75
DA - 12	0	64
DA - 11	0	70
DA - 10	0	63
DA - 9	0	70
DA - 8	0	70
DA - 7	0	60
DA - 6	0	71
DA - 5	0	67
DA - 4	0	84
DA - 3	0	74
DA - 2	0	93

Transform: Scs

Element Name	Lag	Unitgraph Type
DA - 17	13.52	Standard
DA - 16	19.12	Standard
DA - 15	29.99	Standard
DA - 14	9.33	Standard
DA - 13	25.32	Standard
DA - 12	16.08	Standard
DA - 11	7.13	Standard
DA - 10	9.76	Standard
DA - 9	12.54	Standard
DA - 8	7.21	Standard
DA - 7	12.6	Standard
DA - 6	11.42	Standard
DA - 5	12.25	Standard
DA - 4	5.93	Standard
DA - 3	7.19	Standard
DA - 2	8.43	Standard

Global Parameter Summary - Reach

Downstream

Element Name	Downstream
Reach - 13	POI - 13
Reach - 12	POI - 12
Reach - 11	POI - 11
Reach - 10	POI - 10
Reach - 9	POI - 9
Reach - 8	POI - 8
Reach - 7	POI - 7
Reach - 6	POI - 6
Reach - 5	POI - 5
Reach - 4	POI - 4
Reach - 3	POI - 3
Reach - 2	POI - 2
Reach - 1	POI - 1

Route Time Step

Element Name	Maximum Depth Iterations	Maximum Route Step Iterations	Channel Loss
Reach - 13	20	30	None
Reach - 12	20	30	None
Reach - 11	20	30	None
Reach - 10	20	30	None
Reach - 9	20	30	None
Reach - 8	20	30	None
Reach - 7	20	30	None
Reach - 6	20	30	None
Reach - 5	20	30	None
Reach - 4	20	30	None
Reach - 3	20	30	None
Reach - 2	20	30	None
Reach - 1	20	30	None

Global Results Summary

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
DA - 17	0.2	234.79	08Aug2021, 03:25	3.42
POI - 14	0.2	234.79	08Aug2021, 03:25	3.42
Reach - 13	0.2	233.44	08Aug2021, 03:25	3.42
DA - 16	0.15	180.6	08Aug2021, 03:35	3.72
POI - 13	0.35	413.85	08Aug2021, 03:30	3.55
DA - 15	0.41	445.56	08Aug2021, 03:45	3.62
Reach - 12	0.35	412.47	08Aug2021, 03:30	3.55
POI - 12	0.76	838.65	08Aug2021, 03:40	3.59
Reach - 11	0.76	838.45	08Aug2021, 03:40	3.59
DA - 14	0.16	140.77	08Aug2021, 03:20	2.47
POI - 11	0.92	969.11	08Aug2021, 03:35	3.39
Reach - 10	0.92	965.44	08Aug2021, 03:40	3.39
DA - 13	0.14	150.62	08Aug2021, 03:40	3.42
POI - 10	1.06	1116.06	08Aug2021, 03:40	3.4
Reach - 9	1.06	1113.53	08Aug2021, 03:40	3.4
DA - 12	0.17	133.73	08Aug2021, 03:35	2.38
DA - 11	0.08	83.8	08Aug2021, 03:20	2.93
POI - 9	1.3	1313.27	08Aug2021, 03:40	3.24
Reach - 8	1.3	1309.62	08Aug2021, 03:40	3.24
DA - 10	0.16	126.83	08Aug2021, 03:25	2.29
POI - 8	1.46	1426.22	08Aug2021, 03:40	3.14
Reach - 7	1.46	1422.99	08Aug2021, 03:40	3.14
DA - 9	0.03	29.34	08Aug2021, 03:25	2.93

POI - 7	1.49	1450.21	08Aug2021, 03:40	3.13
Reach - 6	1.49	1445.7	08Aug2021, 03:45	3.13
DA - 8	0.11	117	08Aug2021, 03:20	2.93
DA - 7	0.06	45.28	08Aug2021, 03:30	2.03
POI - 6	1.66	1583.18	08Aug2021, 03:40	3.08
Reach - 5	1.66	1579.57	08Aug2021, 03:45	3.08
DA - 6	0.13	136.53	08Aug2021, 03:25	3.03
POI - 5	1.79	1700.41	08Aug2021, 03:40	3.07
Reach - 4	1.79	1696.93	08Aug2021, 03:45	3.07
DA - 5	0.07	65.6	08Aug2021, 03:25	2.65
POI - 4	1.86	1755.18	08Aug2021, 03:45	3.06
Reach - 3	1.86	1755.18	08Aug2021, 03:45	3.06
DA - 4	0.14	210.09	08Aug2021, 03:15	4.35
POI - 3	2	1901.91	08Aug2021, 03:40	3.15
Reach - 2	2	1896.81	08Aug2021, 03:45	3.14
DA - 3	0.03	35.14	08Aug2021, 03:20	3.32
POI - 2	2.03	1923.02	08Aug2021, 03:45	3.15
Reach - 1	2.03	1921.25	08Aug2021, 03:45	3.15
DA - 2	0.01	18.36	08Aug2021, 03:15	5.34
POI - 1	2.04	1933.84	08Aug2021, 03:45	3.16

Project: Danville_Apple_Branch
Simulation Run: 100YR - Mod_Lag
Simulation Start: 7 August 2021, 24:00
Simulation End: 8 August 2021, 24:00

HMS Version: 4.9
Executed: 07 April 2022, 17:27

Global Parameter Summary - Subbasin

	Area (MIē)
Element Name	**Area (MIē)**
DA - 17	0.2
DA - 16	0.15
DA - 15	0.41
DA - 14	0.16
DA - 13	0.14
DA - 12	0.17
DA - 11	0.08
DA - 10	0.16
DA - 9	0.03
DA - 8	0.11
DA - 7	0.06
DA - 6	0.13
DA - 5	0.07
DA - 4	0.14
DA - 3	0.03
DA - 2	0.01

Downstream

Element Name	Downstream
DA - 17	POI - 14
DA - 16	POI - 13
DA - 15	POI - 12
DA - 14	POI - 11
DA - 13	POI - 10
DA - 12	POI - 9
DA - 11	POI - 9
DA - 10	POI - 8
DA - 9	POI - 7
DA - 8	POI - 6
DA - 7	POI - 6
DA - 6	POI - 5
DA - 5	POI - 4
DA - 4	POI - 3
DA - 3	POI - 2
DA - 2	POI - 1

Loss Rate: Scs

Element Name	Percent Impervious Area	Curve Number
DA - 17	0	75
DA - 16	0	78
DA - 15	0	77
DA - 14	0	65
DA - 13	0	75
DA - 12	0	64
DA - 11	0	70
DA - 10	0	63
DA - 9	0	70
DA - 8	0	70
DA - 7	0	60
DA - 6	0	71
DA - 5	0	67
DA - 4	0	84
DA - 3	0	74
DA - 2	0	93

Transform: Scs

Element Name	Lag	Unitgraph Type
DA - 17	13.52	Standard
DA - 16	19.12	Standard
DA - 15	29.99	Standard
DA - 14	9.33	Standard
DA - 13	25.32	Standard
DA - 12	16.08	Standard
DA - 11	7.13	Standard
DA - 10	9.76	Standard
DA - 9	12.54	Standard
DA - 8	7.21	Standard
DA - 7	12.6	Standard
DA - 6	11.42	Standard
DA - 5	12.25	Standard
DA - 4	5.93	Standard
DA - 3	7.19	Standard
DA - 2	8.43	Standard

Global Parameter Summary - Reach

Downstream

Element Name	Downstream
Reach - 13	POI - 13
Reach - 12	POI - 12
Reach - 11	POI - 11
Reach - 10	POI - 10
Reach - 9	POI - 9
Reach - 8	POI - 8
Reach - 7	POI - 7
Reach - 6	POI - 6
Reach - 5	POI - 5
Reach - 4	POI - 4
Reach - 3	POI - 3
Reach - 2	POI - 2
Reach - 1	POI - 1

Route Time Step			
Element Name	Maximum Depth Iterations	Maximum Route Step Iterations	Channel Loss
Reach - 13	20	30	None
Reach - 12	20	30	None
Reach - 11	20	30	None
Reach - 10	20	30	None
Reach - 9	20	30	None
Reach - 8	20	30	None
Reach - 7	20	30	None
Reach - 6	20	30	None
Reach - 5	20	30	None
Reach - 4	20	30	None
Reach - 3	20	30	None
Reach - 2	20	30	None
Reach - 1	20	30	None

Global Results Summary

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
DA - 17	0.2	452.41	08Aug2021, 12:15	5
POI - 14	0.2	452.41	08Aug2021, 12:15	5
Reach - 13	0.2	444.12	08Aug2021, 12:20	5
DA - 16	0.15	311.22	08Aug2021, 12:25	5.34
POI - 13	0.35	754.86	08Aug2021, 12:20	5.14
DA - 15	0.41	684.08	08Aug2021, 12:35	5.2
Reach - 12	0.35	744.57	08Aug2021, 12:20	5.14
POI - 12	0.76	1345.06	08Aug2021, 12:25	5.17
Reach - 11	0.76	1340.97	08Aug2021, 12:25	5.17
DA - 14	0.16	311.82	08Aug2021, 12:10	3.86
POI - 11	0.92	1548.13	08Aug2021, 12:25	4.94
Reach - 10	0.92	1540.41	08Aug2021, 12:25	4.94
DA - 13	0.14	245.45	08Aug2021, 12:30	4.98
POI - 10	1.06	1779.82	08Aug2021, 12:25	4.95
Reach - 9	1.06	1760.8	08Aug2021, 12:30	4.94
DA - 12	0.17	263.04	08Aug2021, 12:20	3.74
DA - 11	0.08	196.22	08Aug2021, 12:10	4.43
POI - 9	1.3	2106.21	08Aug2021, 12:25	4.76
Reach - 8	1.3	2075.49	08Aug2021, 12:30	4.76
DA - 10	0.16	283.77	08Aug2021, 12:15	3.64
POI - 8	1.46	2267.99	08Aug2021, 12:25	4.64
Reach - 7	1.46	2249.19	08Aug2021, 12:25	4.64
DA - 9	0.03	59.73	08Aug2021, 12:15	4.42

POI - 7	1.49	2297.07	08Aug2021, 12:25	4.63
Reach - 6	1.49	2284.36	08Aug2021, 12:30	4.63
DA - 8	0.11	273.14	08Aug2021, 12:10	4.43
DA - 7	0.06	97.04	08Aug2021, 12:15	3.3
POI - 6	1.66	2480.75	08Aug2021, 12:25	4.56
Reach - 5	1.66	2467.93	08Aug2021, 12:30	4.56
DA - 6	0.13	283.66	08Aug2021, 12:15	4.54
POI - 5	1.79	2655.81	08Aug2021, 12:25	4.56
Reach - 4	1.79	2643.68	08Aug2021, 12:30	4.56
DA - 5	0.07	137.07	08Aug2021, 12:15	4.08
POI - 4	1.86	2734.56	08Aug2021, 12:25	4.54
Reach - 3	1.86	2733.18	08Aug2021, 12:30	4.54
DA - 4	0.14	459.58	08Aug2021, 12:10	6.06
POI - 3	2	2921.4	08Aug2021, 12:25	4.64
Reach - 2	2	2896.55	08Aug2021, 12:30	4.64
DA - 3	0.03	80.43	08Aug2021, 12:10	4.89
POI - 2	2.03	2928.12	08Aug2021, 12:30	4.64
Reach - 1	2.03	2926.33	08Aug2021, 12:30	4.64
DA - 2	0.01	37.17	08Aug2021, 12:10	7.12
POI - 1	2.04	2941.74	08Aug2021, 12:30	4.66

Project: Danville_Apple_Branch
Simulation Run: 25YR - Mod_Lag
Simulation Start: 7 August 2021, 24:00
Simulation End: 8 August 2021, 24:00

HMS Version: 4.9
Executed: 07 April 2022, 17:27

Global Parameter Summary - Subbasin

	Area (MIē)
Element Name	**Area (MIē)**
DA - 17	0.2
DA - 16	0.15
DA - 15	0.41
DA - 14	0.16
DA - 13	0.14
DA - 12	0.17
DA - 11	0.08
DA - 10	0.16
DA - 9	0.03
DA - 8	0.11
DA - 7	0.06
DA - 6	0.13
DA - 5	0.07
DA - 4	0.14
DA - 3	0.03
DA - 2	0.01

Downstream

Element Name	Downstream
DA - 17	POI - 14
DA - 16	POI - 13
DA - 15	POI - 12
DA - 14	POI - 11
DA - 13	POI - 10
DA - 12	POI - 9
DA - 11	POI - 9
DA - 10	POI - 8
DA - 9	POI - 7
DA - 8	POI - 6
DA - 7	POI - 6
DA - 6	POI - 5
DA - 5	POI - 4
DA - 4	POI - 3
DA - 3	POI - 2
DA - 2	POI - 1

Loss Rate: Scs

Element Name	Percent Impervious Area	Curve Number
DA - 17	0	75
DA - 16	0	78
DA - 15	0	77
DA - 14	0	65
DA - 13	0	75
DA - 12	0	64
DA - 11	0	70
DA - 10	0	63
DA - 9	0	70
DA - 8	0	70
DA - 7	0	60
DA - 6	0	71
DA - 5	0	67
DA - 4	0	84
DA - 3	0	74
DA - 2	0	93

Transform: Scs

Element Name	Lag	Unitgraph Type
DA - 17	13.52	Standard
DA - 16	19.12	Standard
DA - 15	29.99	Standard
DA - 14	9.33	Standard
DA - 13	25.32	Standard
DA - 12	16.08	Standard
DA - 11	7.13	Standard
DA - 10	9.76	Standard
DA - 9	12.54	Standard
DA - 8	7.21	Standard
DA - 7	12.6	Standard
DA - 6	11.42	Standard
DA - 5	12.25	Standard
DA - 4	5.93	Standard
DA - 3	7.19	Standard
DA - 2	8.43	Standard

Global Parameter Summary - Reach

Downstream

Element Name	Downstream
Reach - 13	POI - 13
Reach - 12	POI - 12
Reach - 11	POI - 11
Reach - 10	POI - 10
Reach - 9	POI - 9
Reach - 8	POI - 8
Reach - 7	POI - 7
Reach - 6	POI - 6
Reach - 5	POI - 5
Reach - 4	POI - 4
Reach - 3	POI - 3
Reach - 2	POI - 2
Reach - 1	POI - 1

Route Time Step

Element Name	Maximum Depth Iterations	Maximum Route Step Iterations	Channel Loss
Reach - 13	20	30	None
Reach - 12	20	30	None
Reach - 11	20	30	None
Reach - 10	20	30	None
Reach - 9	20	30	None
Reach - 8	20	30	None
Reach - 7	20	30	None
Reach - 6	20	30	None
Reach - 5	20	30	None
Reach - 4	20	30	None
Reach - 3	20	30	None
Reach - 2	20	30	None
Reach - 1	20	30	None

Global Results Summary

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
DA - 17	0.2	340.59	08Aug2021, 12:15	3.33
POI - 14	0.2	340.59	08Aug2021, 12:15	3.33
Reach - 13	0.2	336.19	08Aug2021, 12:20	3.33
DA - 16	0.15	238.2	08Aug2021, 12:25	3.62
POI - 13	0.35	572.47	08Aug2021, 12:20	3.46
DA - 15	0.41	509.87	08Aug2021, 12:35	3.51
Reach - 12	0.35	562.04	08Aug2021, 12:20	3.46
POI - 12	0.76	1004.32	08Aug2021, 12:25	3.48
Reach - 11	0.76	999.59	08Aug2021, 12:25	3.48
DA - 14	0.16	218.23	08Aug2021, 12:15	2.4
POI - 11	0.92	1142	08Aug2021, 12:25	3.29
Reach - 10	0.92	1127.7	08Aug2021, 12:25	3.29
DA - 13	0.14	181.29	08Aug2021, 12:30	3.32
POI - 10	1.06	1303.07	08Aug2021, 12:25	3.29
Reach - 9	1.06	1299.18	08Aug2021, 12:30	3.29
DA - 12	0.17	177.91	08Aug2021, 12:20	2.3
DA - 11	0.08	144.74	08Aug2021, 12:10	2.86
POI - 9	1.3	1526.09	08Aug2021, 12:25	3.14
Reach - 8	1.3	1510.49	08Aug2021, 12:30	3.14
DA - 10	0.16	194.58	08Aug2021, 12:15	2.22
POI - 8	1.46	1627.77	08Aug2021, 12:25	3.04
Reach - 7	1.46	1618.11	08Aug2021, 12:30	3.04
DA - 9	0.03	43.31	08Aug2021, 12:15	2.85

POI - 7	1.49	1646.17	08Aug2021, 12:30	3.04
Reach - 6	1.49	1644.95	08Aug2021, 12:30	3.04
DA - 8	0.11	201.34	08Aug2021, 12:10	2.86
DA - 7	0.06	62.39	08Aug2021, 12:15	1.96
POI - 6	1.66	1766.07	08Aug2021, 12:30	2.98
Reach - 5	1.66	1764.6	08Aug2021, 12:30	2.98
DA - 6	0.13	209.04	08Aug2021, 12:15	2.95
POI - 5	1.79	1887.01	08Aug2021, 12:30	2.98
Reach - 4	1.79	1885.82	08Aug2021, 12:30	2.98
DA - 5	0.07	96.63	08Aug2021, 12:15	2.58
POI - 4	1.86	1948.07	08Aug2021, 12:30	2.96
Reach - 3	1.86	1947.25	08Aug2021, 12:30	2.96
DA - 4	0.14	380.12	08Aug2021, 12:10	4.26
POI - 3	2	2071.66	08Aug2021, 12:25	3.05
Reach - 2	2	2057.6	08Aug2021, 12:30	3.05
DA - 3	0.03	61.42	08Aug2021, 12:10	3.24
POI - 2	2.03	2080.31	08Aug2021, 12:30	3.05
Reach - 1	2.03	2071.37	08Aug2021, 12:30	3.05
DA - 2	0.01	31.89	08Aug2021, 12:10	5.25
POI - 1	2.04	2083.58	08Aug2021, 12:30	3.06

APPENDIX C
HYDRAULICS

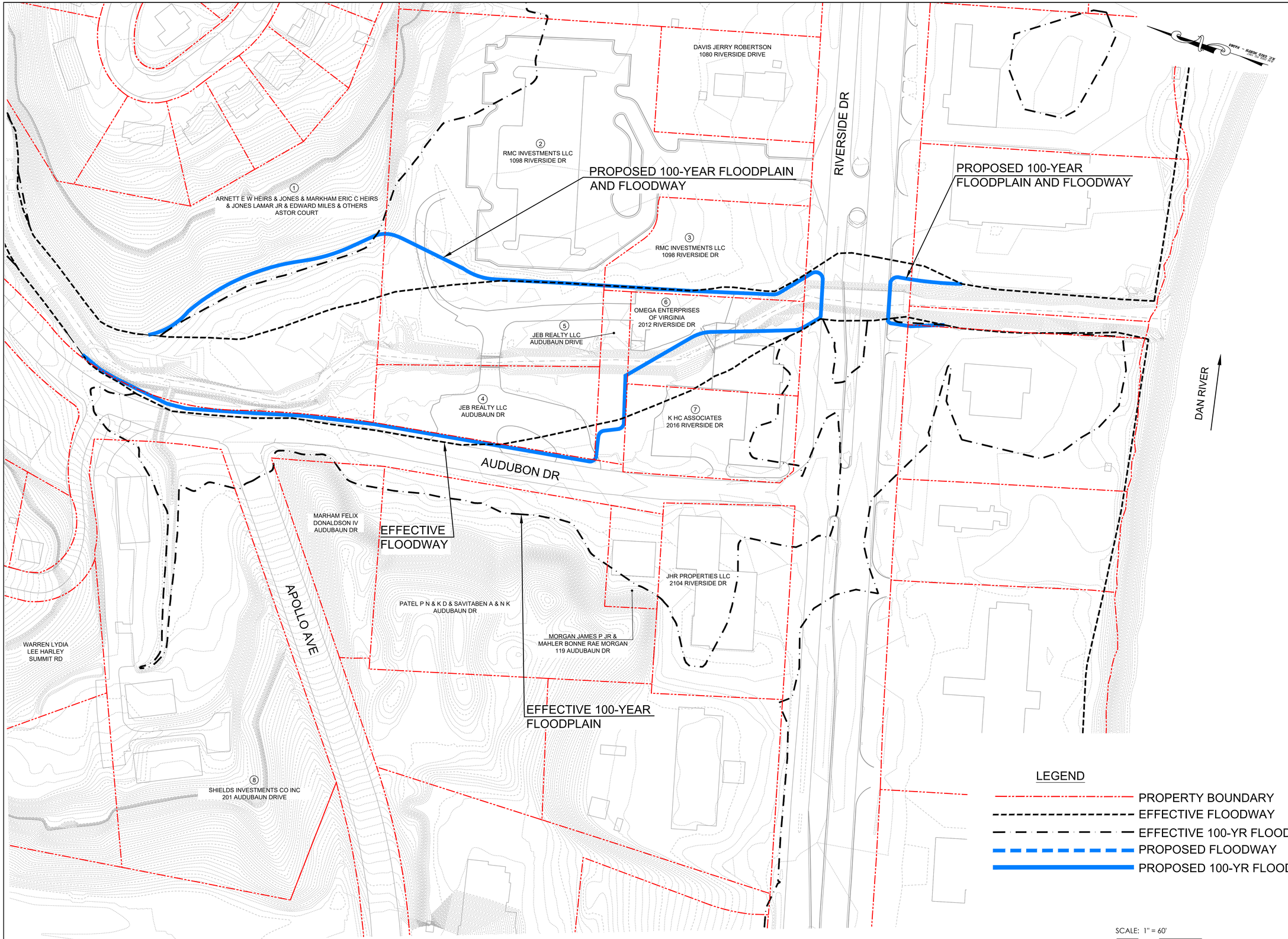
APPLE BRANCH STREAM

Floodplain Boundary Work Map Partial Building Removal
100 Year Flood Inundation -Existing and Proposed
Floodplain Boundary Work Map Full Building Removal
Existing and Proposed Water surface Profile Partial Building Removal
Existing and Proposed Water surface Profile Full Building Removal

PIPE SYSTEMS

PCSWMM Report – Audubon Drive Proposed Conditions
PCSWMM Report – Arnett Boulevard Existing Conditions
PCSWMM Report – Arnett Boulevard Proposed Conditions Option 1& 2
PCSWMM Report – Arnett Boulevard Proposed Conditions Option 3
Profile A -Arnett Boulevard Existing Hydraulic Grade Line
Profile B - Audubon Drive Proposed Hydraulic Grade Line
Profile C - Arnett Boulevard Proposed Hydraulic Grade Line Option 1 and 2
Profile D - Arnett Boulevard Proposed Hydraulic Grade Line Option 3

Apple Branch Stream



THIS DRAWING PREPARED AT THE
RALEIGH OFFICE
5410 Trinity Road, Suite 102, Raleigh, NC 27607
TEL 919.866.4951 FAX 919.833.8124 www.timmons.com
North Carolina License No. C-1652

REVISION DESCRIPTION

DATE

YOUR VISION ACHIEVED THROUGH OURS.

TIMMONS GROUP

DATE
3-16-2022

DRAWN BY
S. Vandergrift

DESIGNED BY
C. Rogers

CHECKED BY
C. Rogers

SCALE
1" = 60'

APPLE BRANCH ENGINEERING STUDY

CITY OF DANVILLE - VIRGINIA

FLOODPLAIN BOUNDARY WORK MAP PARTIAL BUILDING REMOVAL

JOB NO.
47097

SHEET NO.
EXHIBIT C.1

EFFECTIVE FLOODWAY

100-YEAR FLOODPLAIN AND FLOODWAY POST FLOODWALL AND BERM INSTALLATION (PARTIAL BUILDING REMOVAL)

EFFECTIVE 100-YEAR FLOODPLAIN

100-YEAR FLOODPLAIN AND FLOODWAY POST FLOODWALL AND BERM INSTALLATION (FULL BUILDING REMOVAL - ADDITIONAL AREA)

100-YEAR FEMA BOUNDARY

100-YEAR FLOODPLAIN AND FLOODWAY POST FLOODWALL AND BERM INSTALLATION

APPLE BRANCH PRE-PROJECT APPROXIMATE FLOOD BOUNDARY

DAN RIVER

LEGEND

- PROPERTY BOUNDARY
- EFFECTIVE FLOODWAY
- EFFECTIVE 100-YR FLOODPLAIN
- PROPOSED FLOODWAY
- 100-YR FLOODPLAIN POST FLOODWALL AND BERM INSTALLATION
- APPLE BRANCH EXISTING FLOODED AREA PROTECTED WITH PROPOSED IMPROVEMENTS
- 100-YR FLOODED AREA WITH PARTIAL BUILDING REMOVAL
- 100-YR FLOODED INCREASED AREA WITH FULL BUILDING REMOVAL

SCALE: 1" = 150'

0 75 150 300

THIS DRAWING PREPARED AT THE
RALEIGH OFFICE
5410 Trinity Road, Suite 102, Raleigh, NC 27607
TEL 919.866.4951 FAX 919.833.8124 www.timmons.com
North Carolina License No. C-1652

YOUR VISION ACHIEVED THROUGH OURS.

DATE	REVISION DESCRIPTION

DATE: 3-16-2022
DRAWN BY: S. Vandergrift
DESIGNED BY: C. Rogers
CHECKED BY: C. Rogers
SCALE: 1" = 150'

TIMMONS GROUP

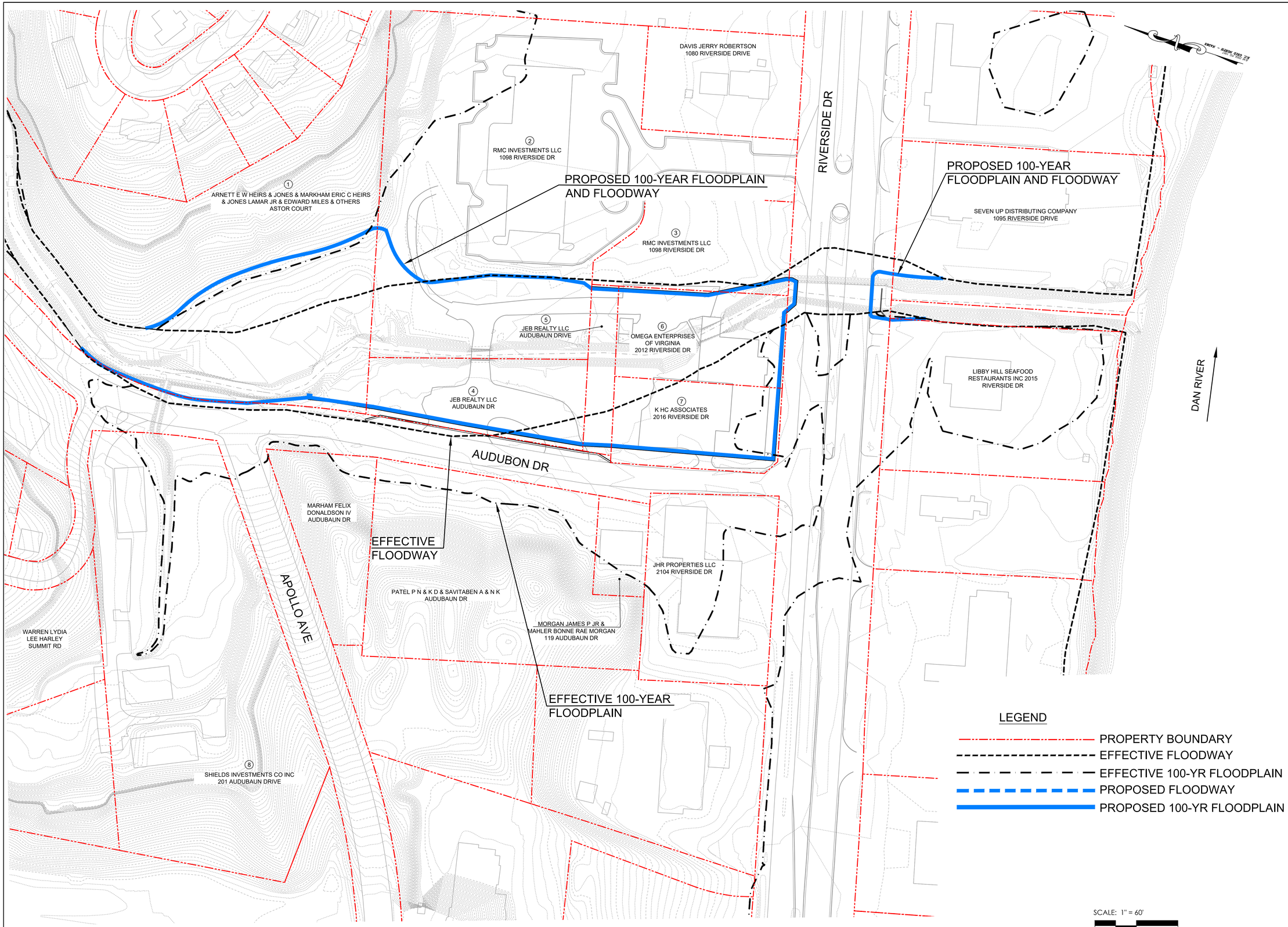
APPLE BRANCH ENGINEERING STUDY

CITY OF DANVILLE - VIRGINIA

FLOODPLAIN BOUNDARY WORK MAP 100-YR FLOOD INUNDATION MAP EXISTING AND PROPOSED IMPROVEMENTS

JOB NO. 47097

SHEET NO. EXHIBIT C.2.1



THIS DRAWING PREPARED AT THE
RALEIGH OFFICE
5410 Trinity Road, Suite 102 Raleigh, NC 27607
TEL 919.866.4951 FAX 910.833.8124 www.timmons.com
North Carolina License No. C-1652

YOUR VISION ACHIEVED THROUGH OURS.

TIMMONS GROUP

REVISION DESCRIPTION

DATE

DATE 3-16-2022

DRAWN BY S. Vandergrift

DESIGNED BY C. Rogers

CHECKED BY C. Rogers

SCALE 1" = 60'

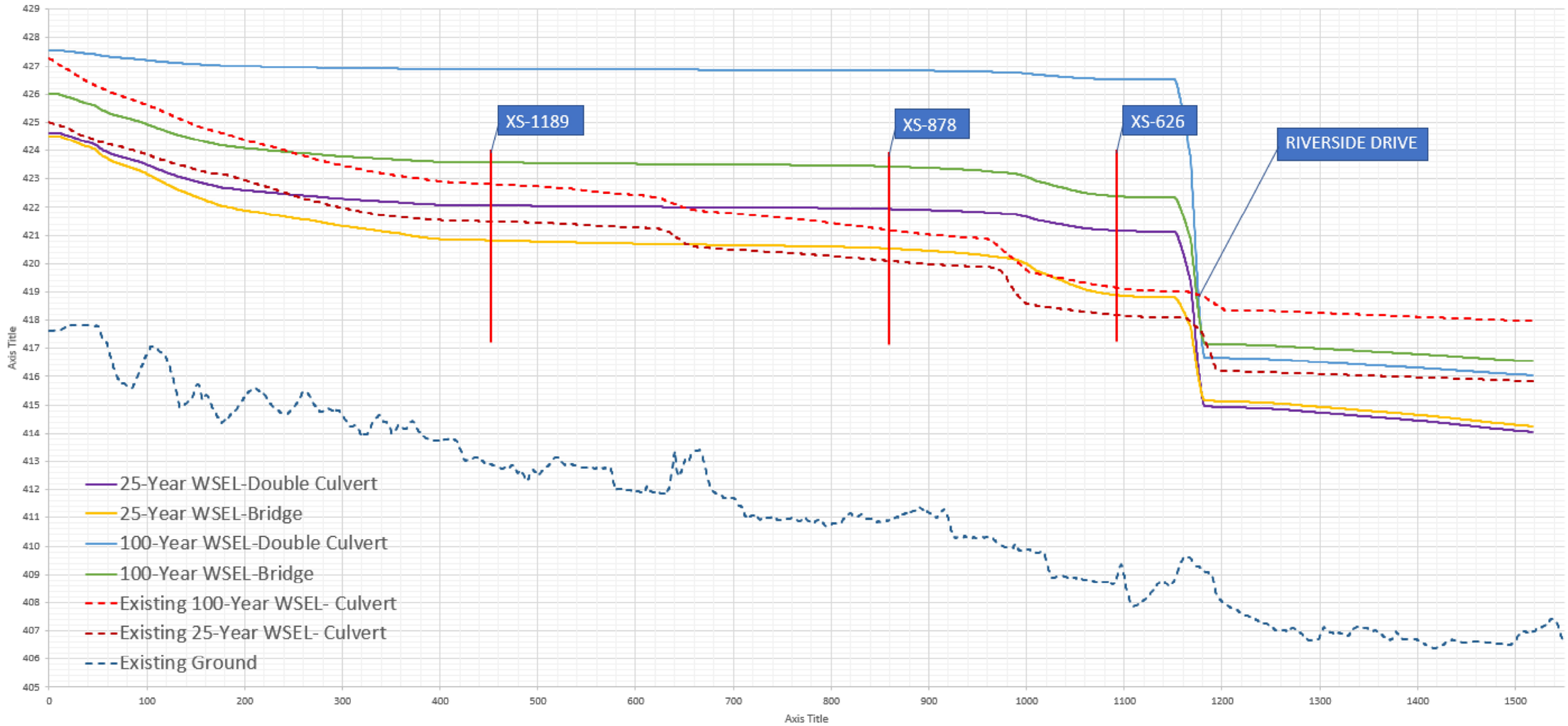
APPLE BRANCH ENGINEERING STUDY

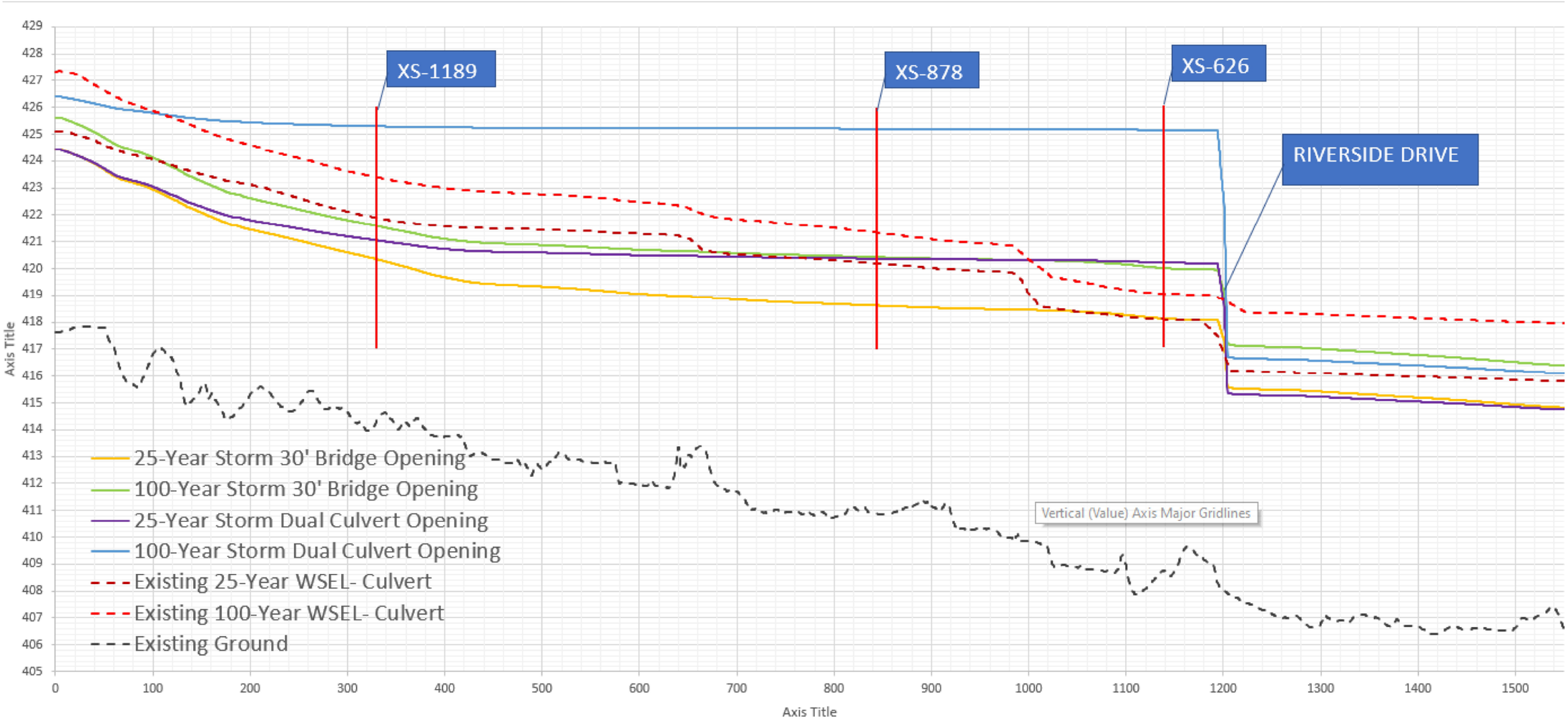
CITY OF DANVILLE - VIRGINIA

FLOODPLAIN BOUNDARY WORK MAP FULL BUILDING REMOVAL

JOB NO. 47097

SHEET NO. EXHIBIT C.2


XS-1189
XS-878
XS-626
RIVERSIDE DRIVE
25-Year WSEL-Double Culvert
25-Year WSEL-Bridge
100-Year WSEL-Double Culvert
100-Year WSEL-Bridge
Existing 100-Year WSEL- Culvert
Existing 25-Year WSEL- Culvert
Existing Ground
Axis Title
Axis Title
429
428
427
426
425
424
423
422
421
420
419
418
417
416
415
414
413
412
411
410
409
408
407
406
405
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500


XS-1189
XS-878
XS-626
RIVERSIDE DRIVE
25-Year Storm 30' Bridge Opening
100-Year Storm 30' Bridge Opening
25-Year Storm Dual Culvert Opening
100-Year Storm Dual Culvert Opening
Existing 25-Year WSEL- Culvert
Existing 100-Year WSEL- Culvert
Existing Ground
Vertical (Value) Axis Major Gridlines
Axis Title
Axis Title
429
428
427
426
425
424
423
422
421
420
419
418
417
416
415
414
413
412
411
410
409
408
407
406
405
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500

Pipe Systems

PCSWMM Report

PCSWMM Report – Audubon Drive Proposed Conditions

Model Audoboun Drive Proposed Condition - 100year.inp

April 20, 2022

Table of Contents

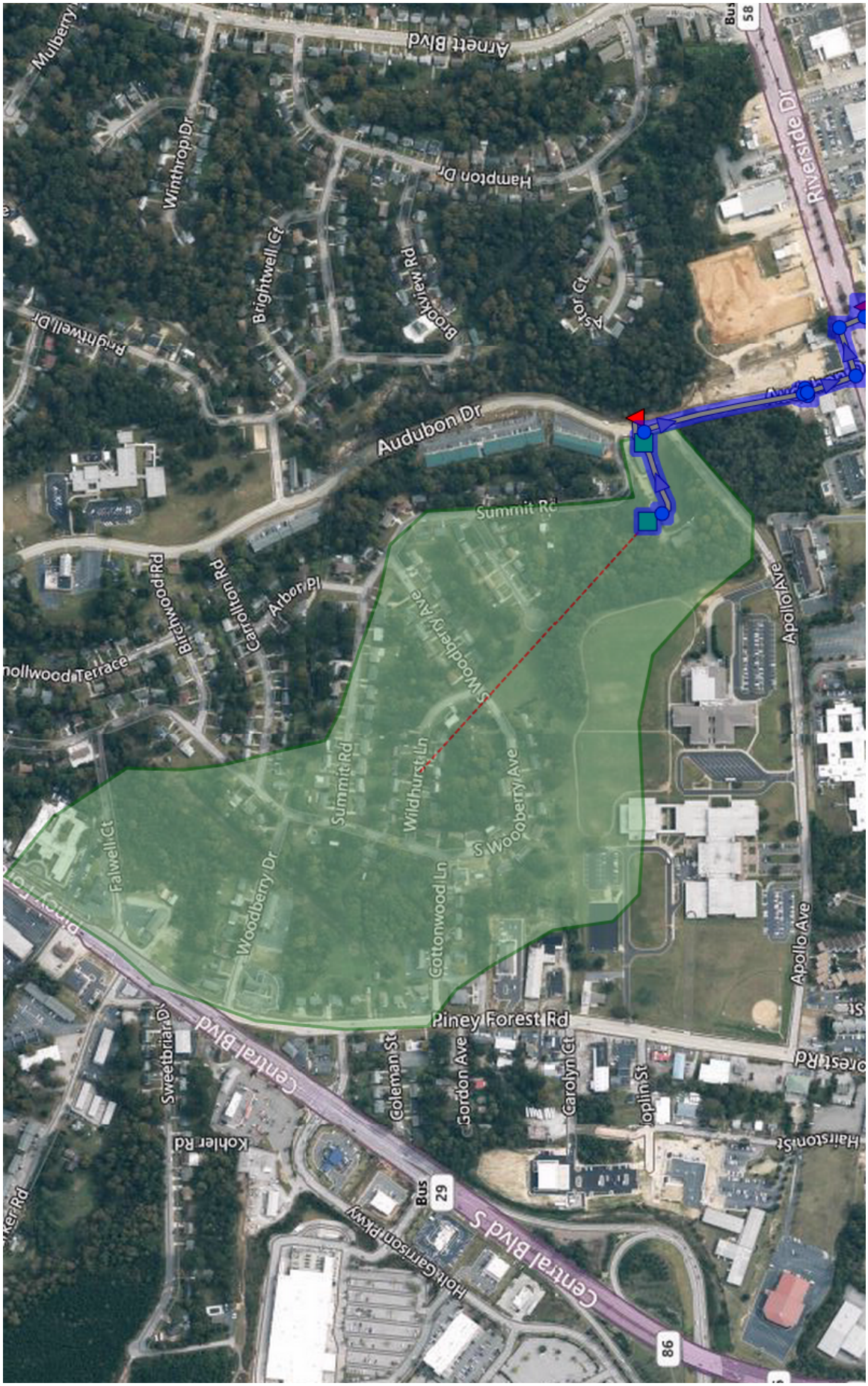


Figure 1: Map View

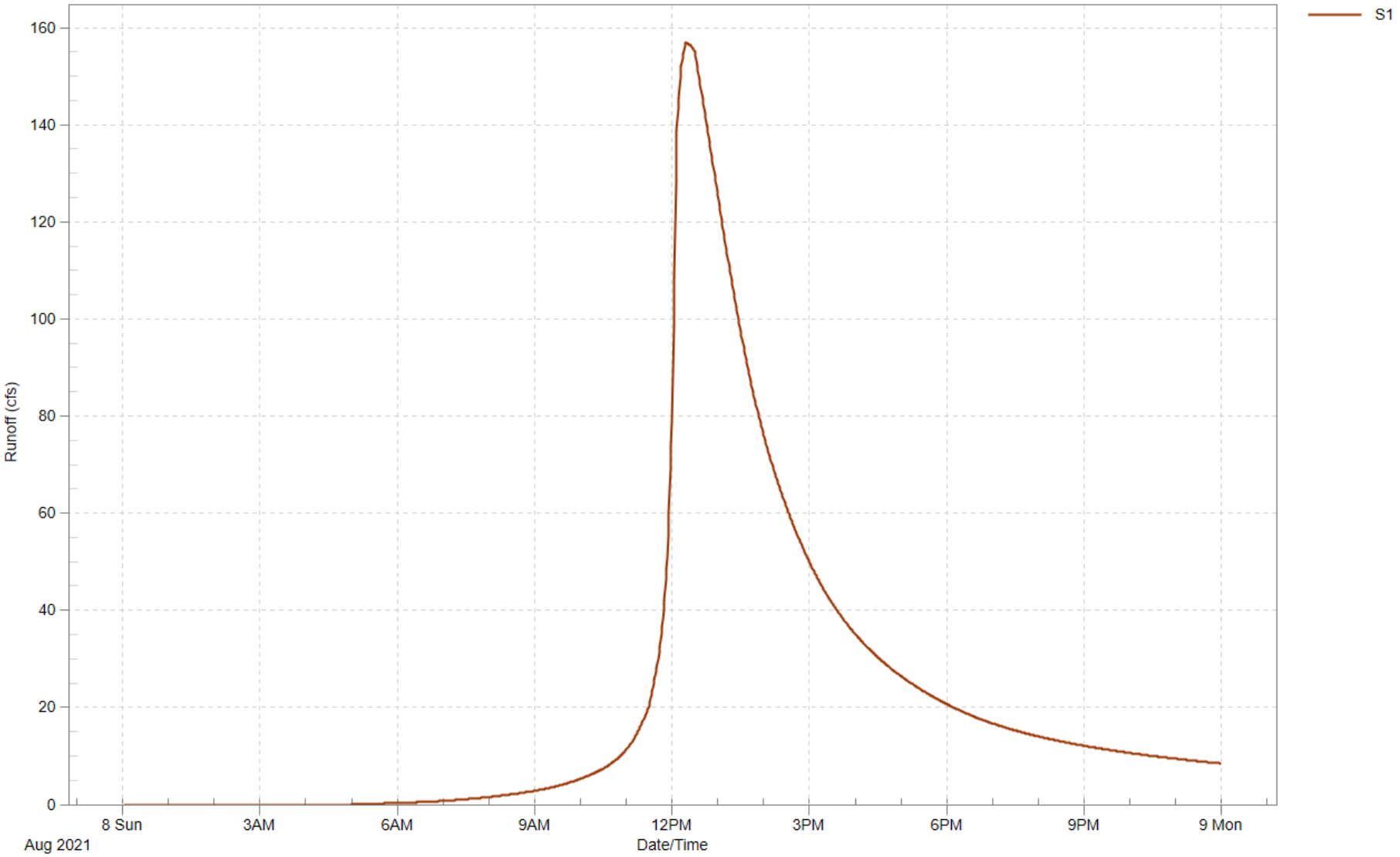


Figure 2: Audoubon Drive 25-year Storm Hydrograph

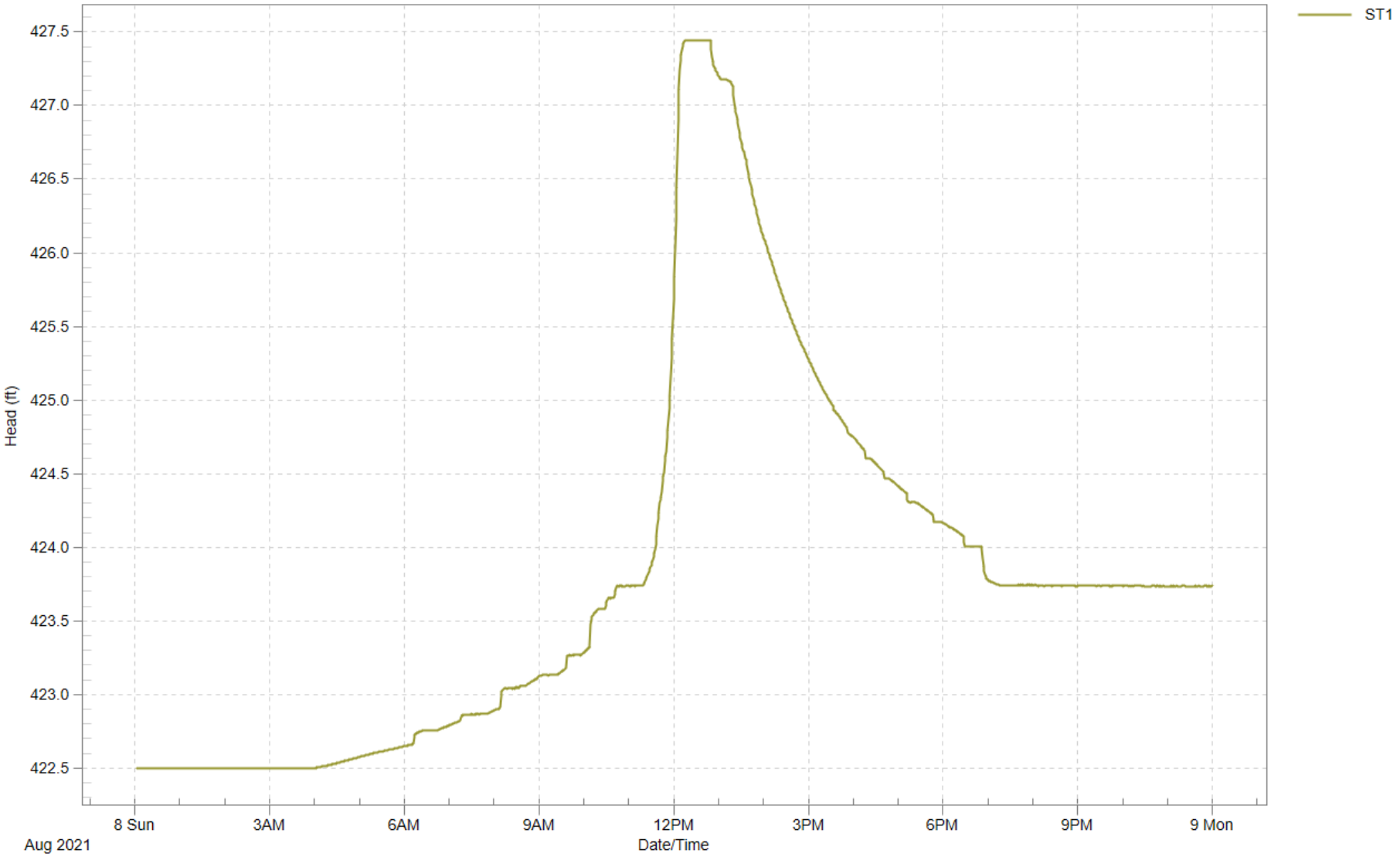


Figure 3: Storage-1 25-year Storage Level

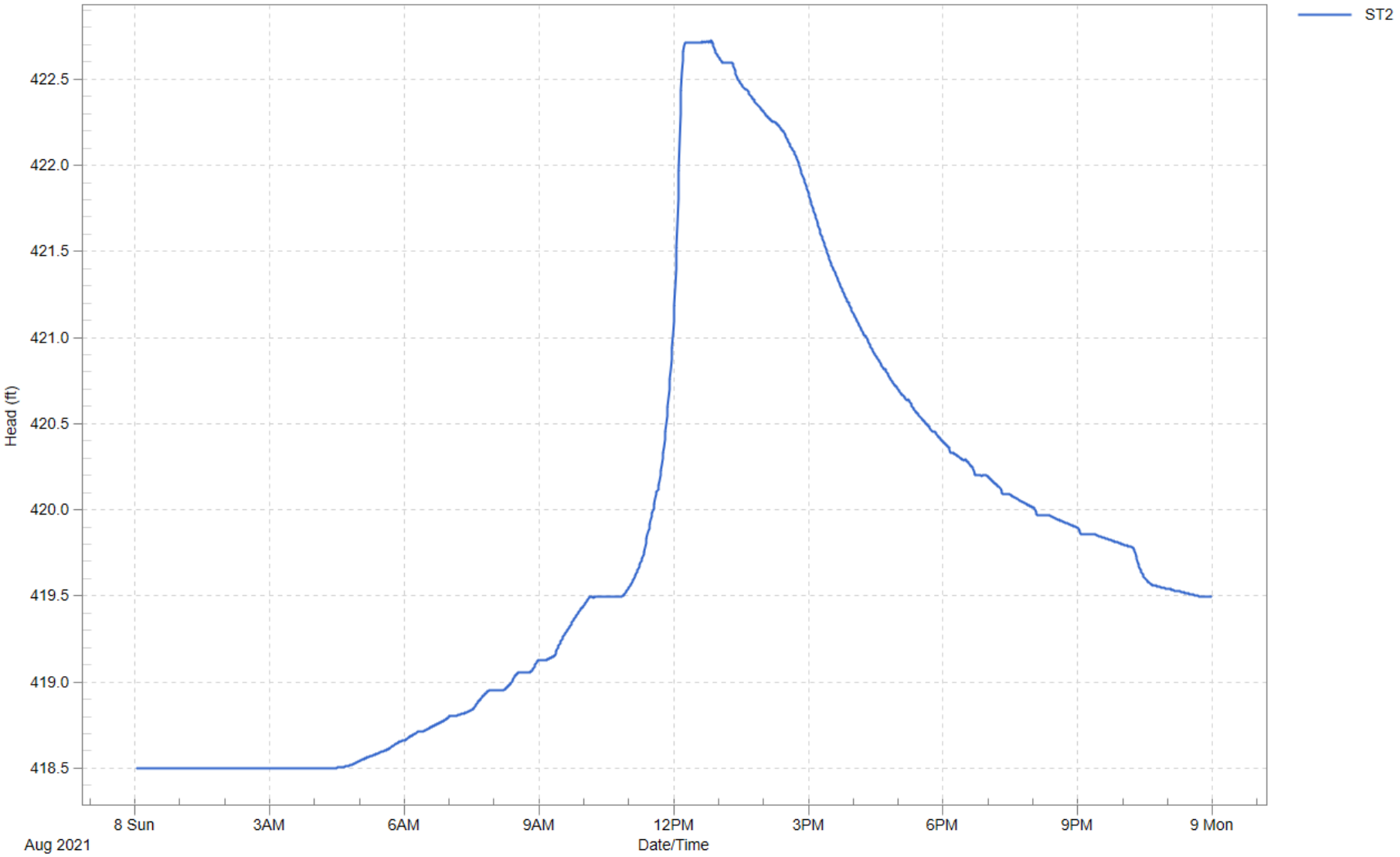


Figure 4: Storage-2 25-year Storage Level

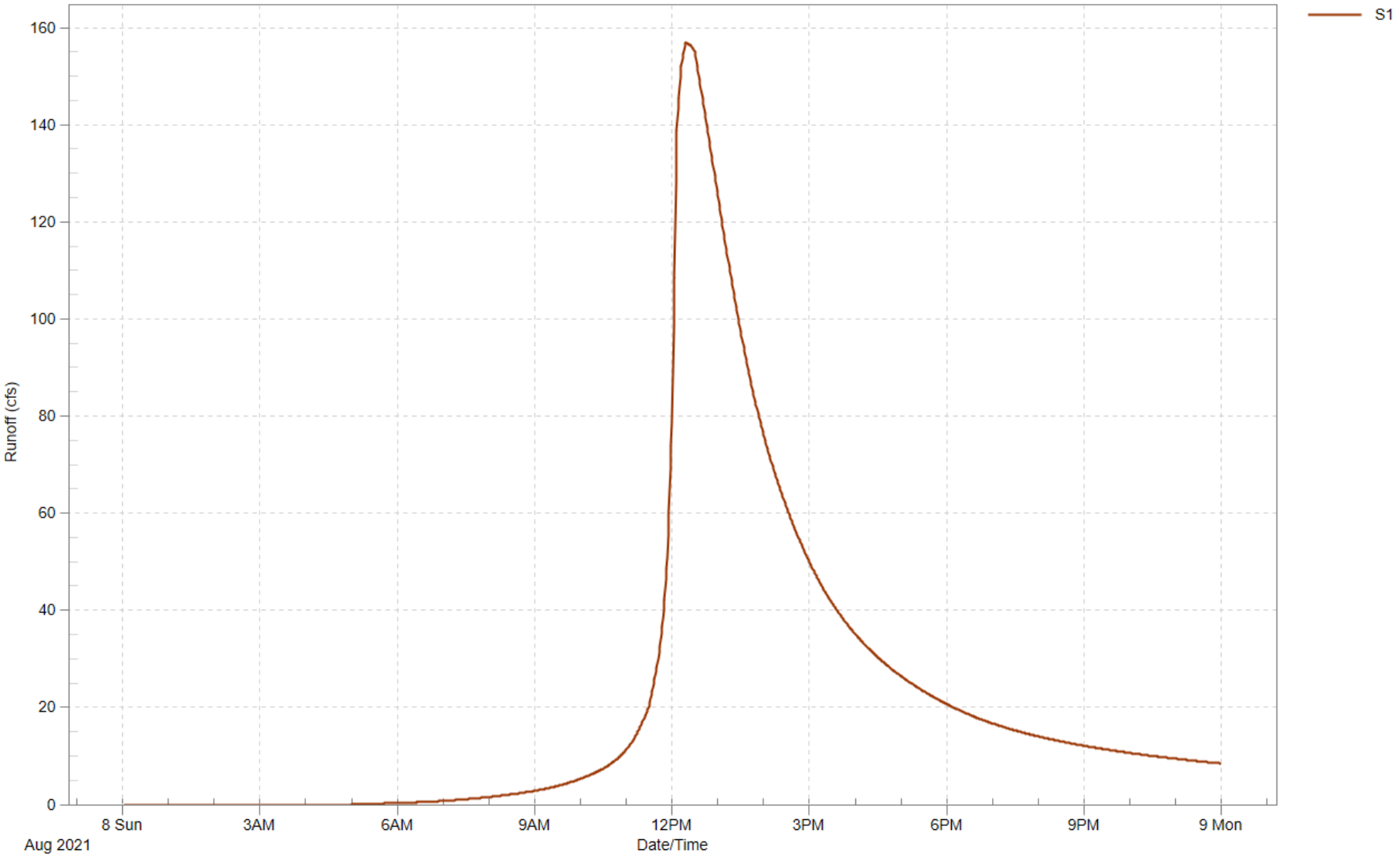


Figure 5: Audoubon Drive 100-year Storm Hydrograph

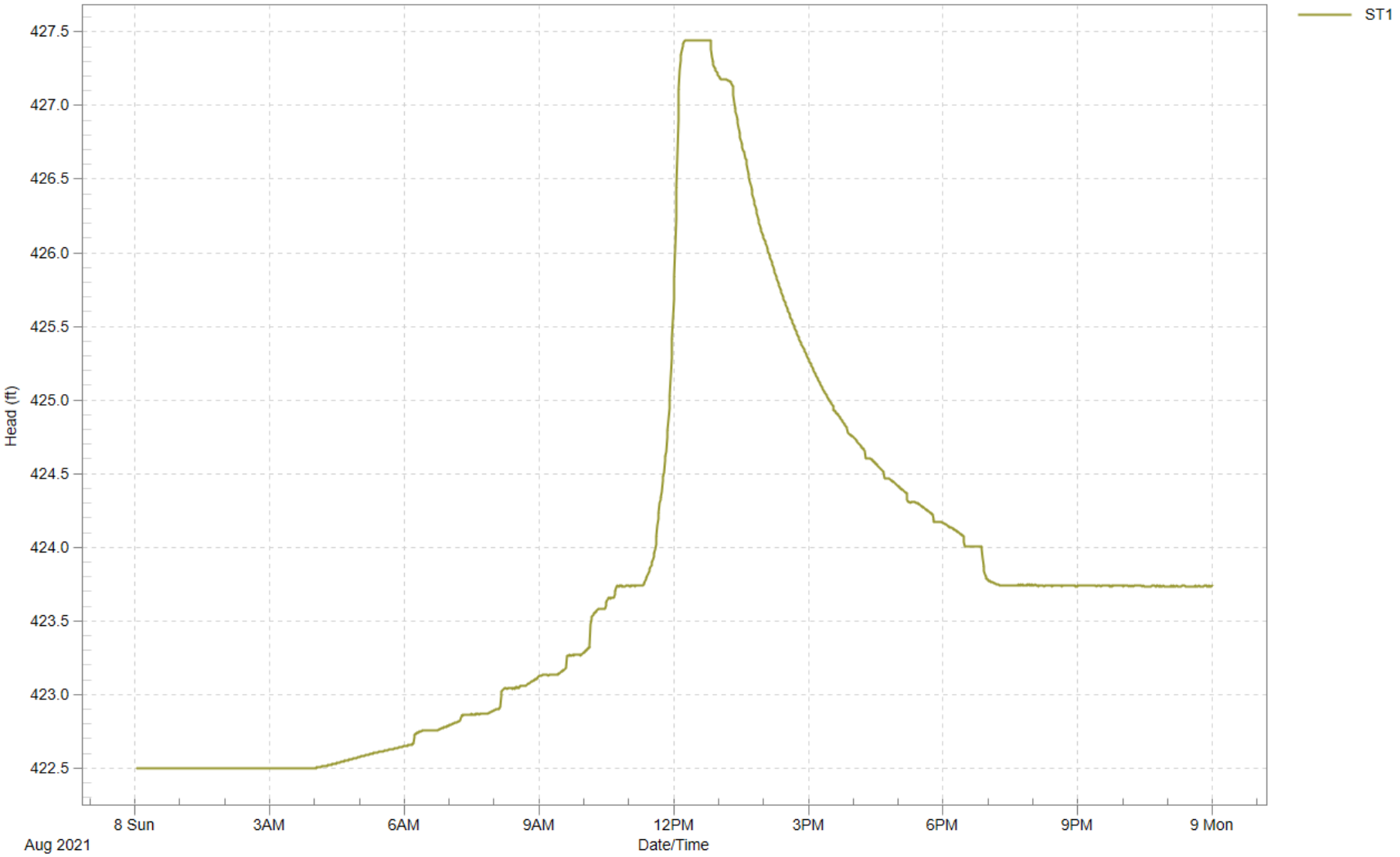


Figure 6: Storage-1 100-year Storage Level

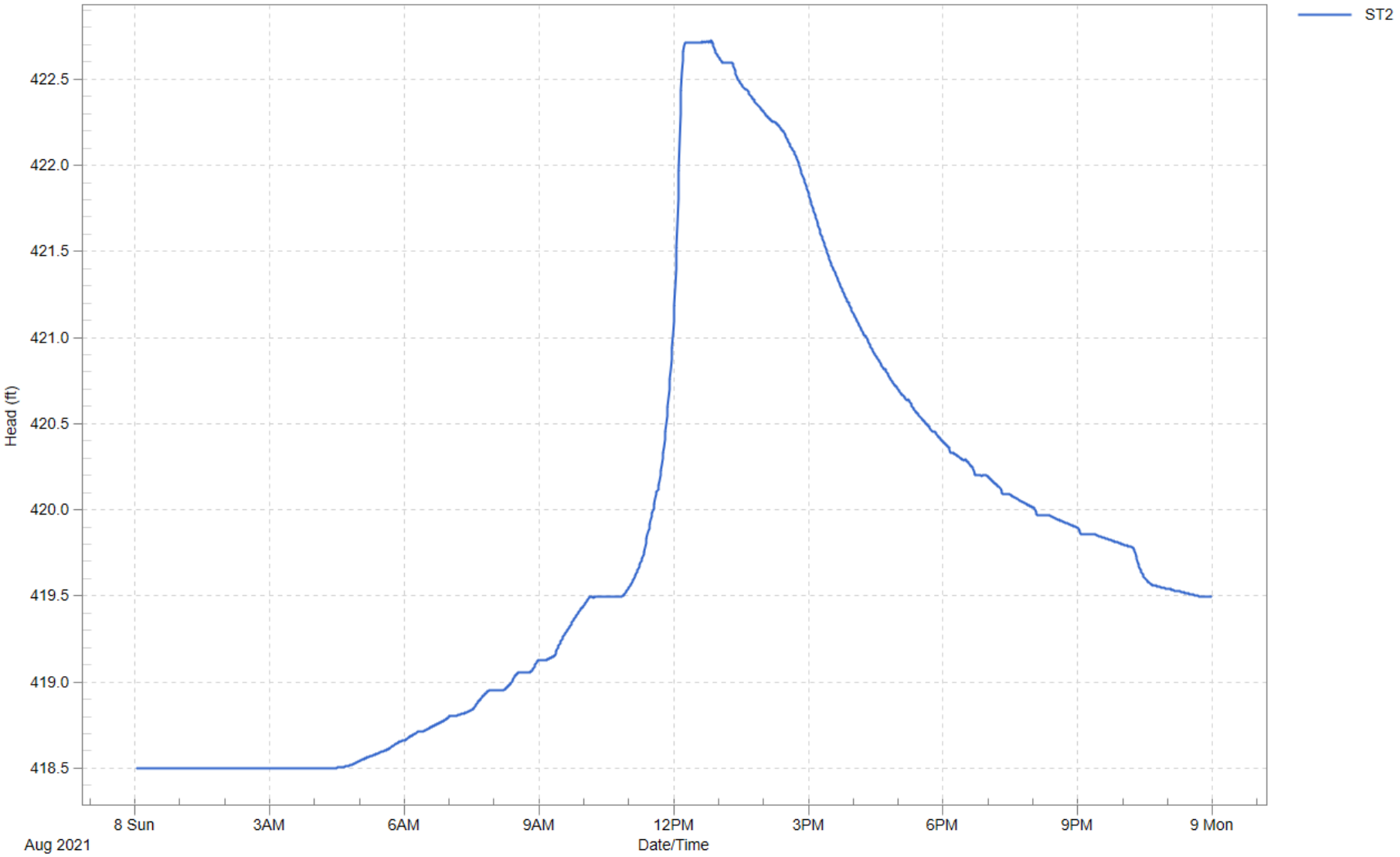


Figure 7: Storage-2 100-year Storage Level

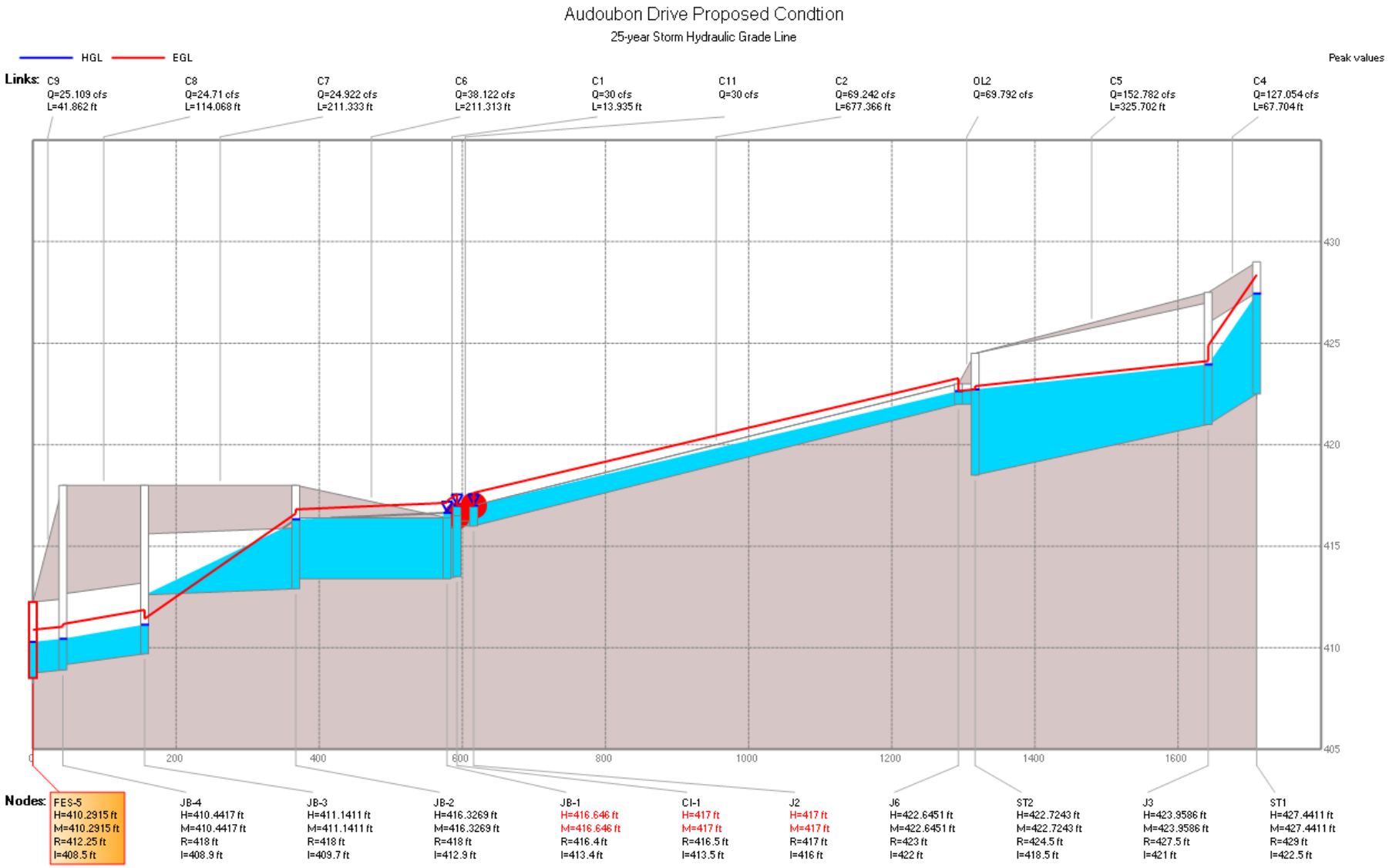


Figure 8: Audoboun Drive 25-year Storm

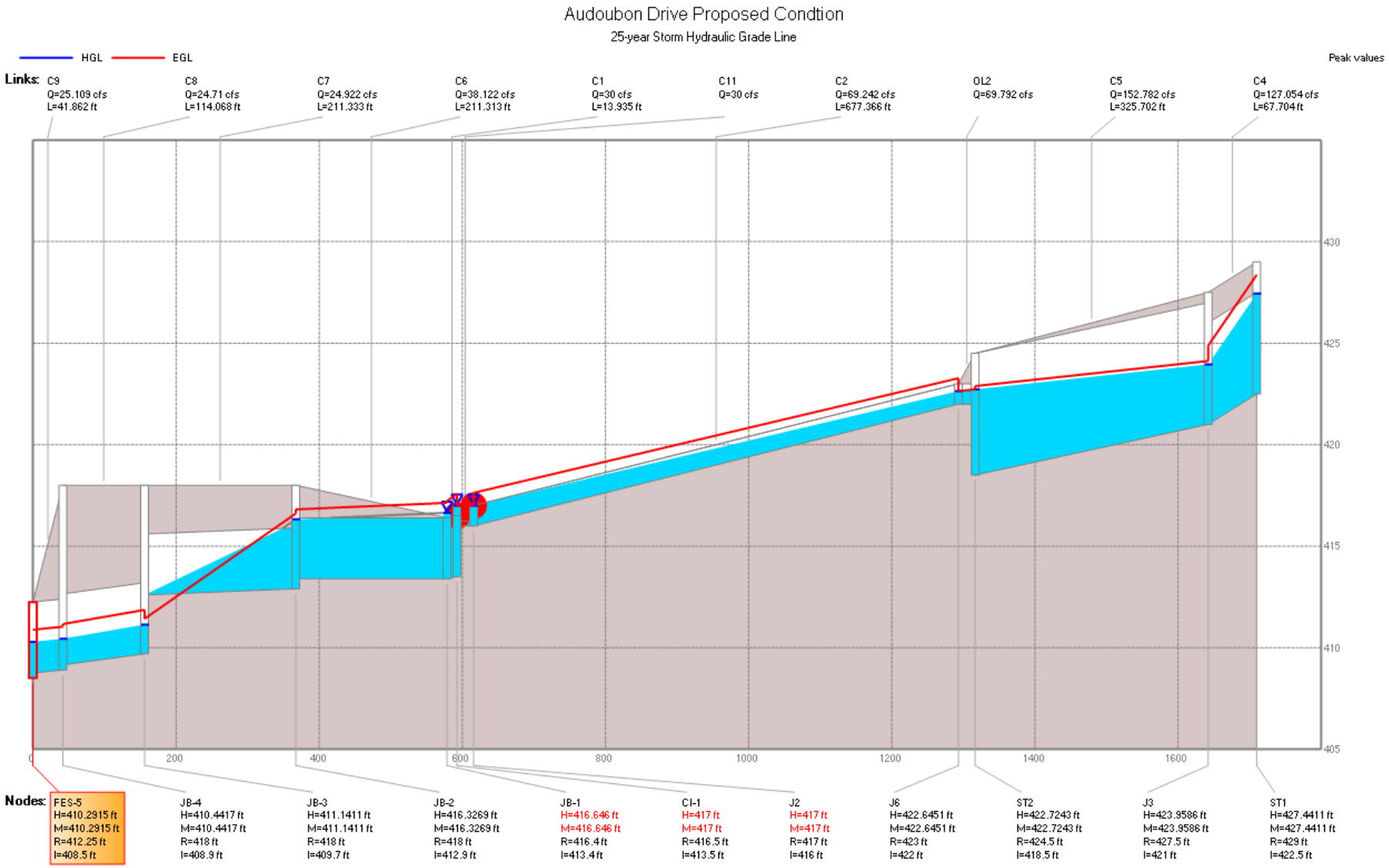


Figure 9: Audoboun Drive 100-year Storm

Table 1: Conduits

Name	Inlet Node	Outlet Node	Length (ft)	Roughness	Inlet Offset (ft)	Outlet Offset (ft)	Cross-Section	Geom1 (ft)	Geom2 (ft)	Transect	Shape Curve	Slope (ft/ft)	Max. |Flow| (cfs)	Contributing Area (ac)
C9	JB-4	FES-5	41.862	0.013	0	0.25	CIRCULAR	3.5	0			0.00358	26.7	85.174
C8	JB-3	JB-4	114.068	0.013	0	0.25	CIRCULAR	3.5	0			0.00482	26.46	85.174
C7	JB-2	JB-3	211.333	0.03	0	2.9	CIRCULAR	3	0			0.00142	25.43	85.174
C6	JB-1	JB-2	211.313	0.013	0	0.5	CIRCULAR	3	0			0	38.28	85.174
C5	J3	ST2	325.702	0.045	0	0	TRAPEZOIDAL	6	6			0.00768	152.84	85.174
C4	ST1	J3	67.704	0.013	0	0	CIRCULAR	5	0			0.02216	127.05	85.174
C3	CI-2	JB-1	18.78	0.013	0	0	CIRCULAR	2.5	0			-0.0213	31.05	85.174
C2	J6	J2	677.366	0.013	0	0	IRREGULAR	0	0	AudoubonRd		0.00886	69.43	85.174
C10	ST2	OF1	135.337	0.013	0	2.63	CIRCULAR	4	0			0.01382	78.47	85.174
C1	CI-1	JB-1	13.935	0.013	0	0	CIRCULAR	2.5	0			0.00718	30.21	85.174

PCSWMM Report

PCSWMM Report – Arnett Drive Existing Conditions

Model Arnett Drive Storm Pipe System Existing Conditon.inp

April 19, 2022

Table of Contents

Summary 1: Subcatchment statistics

Name	Arnett Drive Storm Pipe System Existing Conditon
Max. width (ft)	5410.87
Min. width (ft)	17.21
Max. area (ac)	54.1087
Min. area (ac)	0.1721
Total area (ac)	89.6703
Max. length of overland flow (ft)	435.6
Min. length of overland flow (ft)	435.6
Max. slope (%)	0.5
Min. slope (%)	0.5
Max. imperviousness (%)	25
Min. imperviousness (%)	25
Max. imp. roughness	0.01
Min. imp. roughness	0.01
Max. perv. roughness	0.1
Min. perv. roughness	0.1
Max. imp. depression storage (in)	0.05
Min. imp. depression storage (in)	0.05
Max. perv. depression storage (in)	0.05
Min. perv. depression storage (in)	0.05

Summary 2: Conduit Inventory

Name	Arnett Drive Storm Pipe System Existing Conditon
Trapezoidal (ft)	343.177
Circular (ft)	2939.168
Closed Rectangular (ft)	235.884
Arch (ft)	53.796

Summary 3: Pipe inventory

Name	Arnett Drive Storm Pipe System Existing Conditon
Max. pipe diameter (ft)	5
Min. pipe diameter (ft)	1
Total 12” pipe length (ft)	201.456
Total 15” pipe length (ft)	511.297
Total 18” pipe length (ft)	350
Total 30” pipe length (ft)	382.85
Total 48” pipe length (ft)	881.17
Total 54” pipe length (ft)	84.214
Total 60” pipe length (ft)	528.181
Total pipe length (ft)	2939.168

Summary 4: Runoff quantity continuity

Name	Arnett Drive Storm Pipe System Existing Conditon
Initial LID storage (in)	n/a
Initial snow cover (in)	n/a
Total precipitation (in)	6.080
Outfall runon (in)	n/a
Evaporation loss (in)	0.000
Infiltration loss (in)	1.756
Surface runoff (in)	4.204
LID drainage (in)	n/a
Snow removed (in)	n/a
Final snow cover (in)	n/a
Final storage (in)	0.126
Continuity error (%)	-0.093

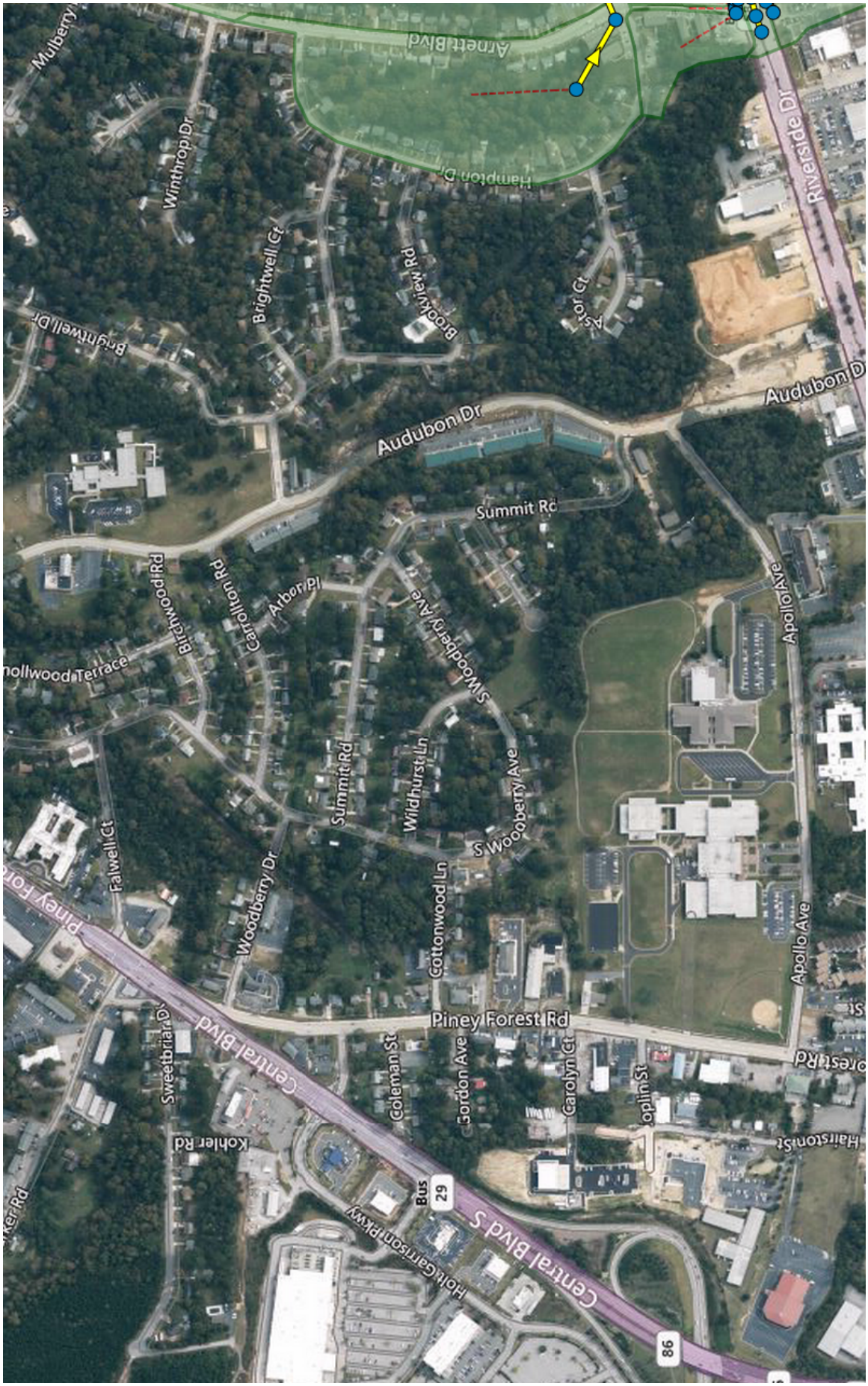


Figure 1: Site Map

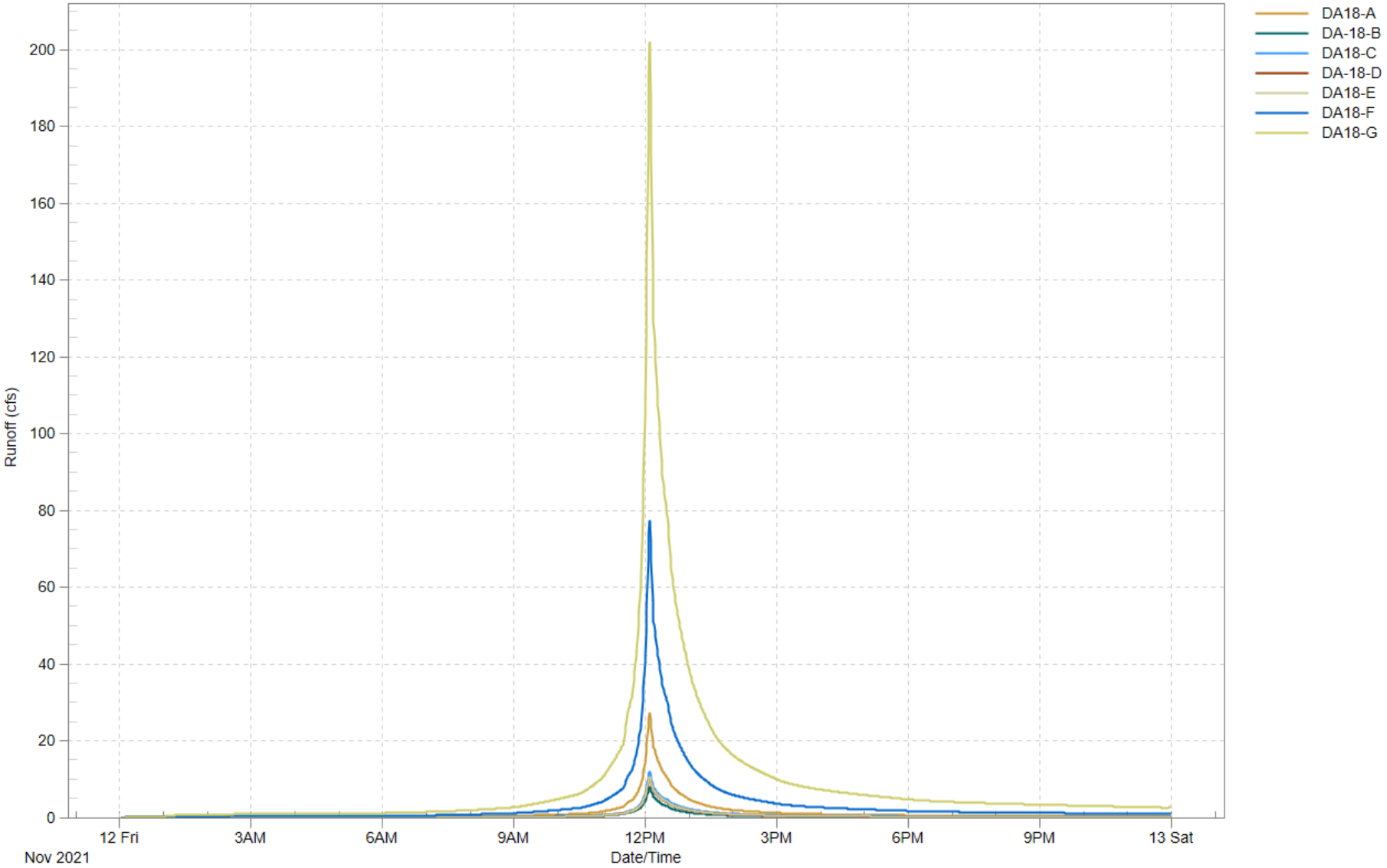


Figure 2: Subwaterrshed 25 Year Storm Runoff

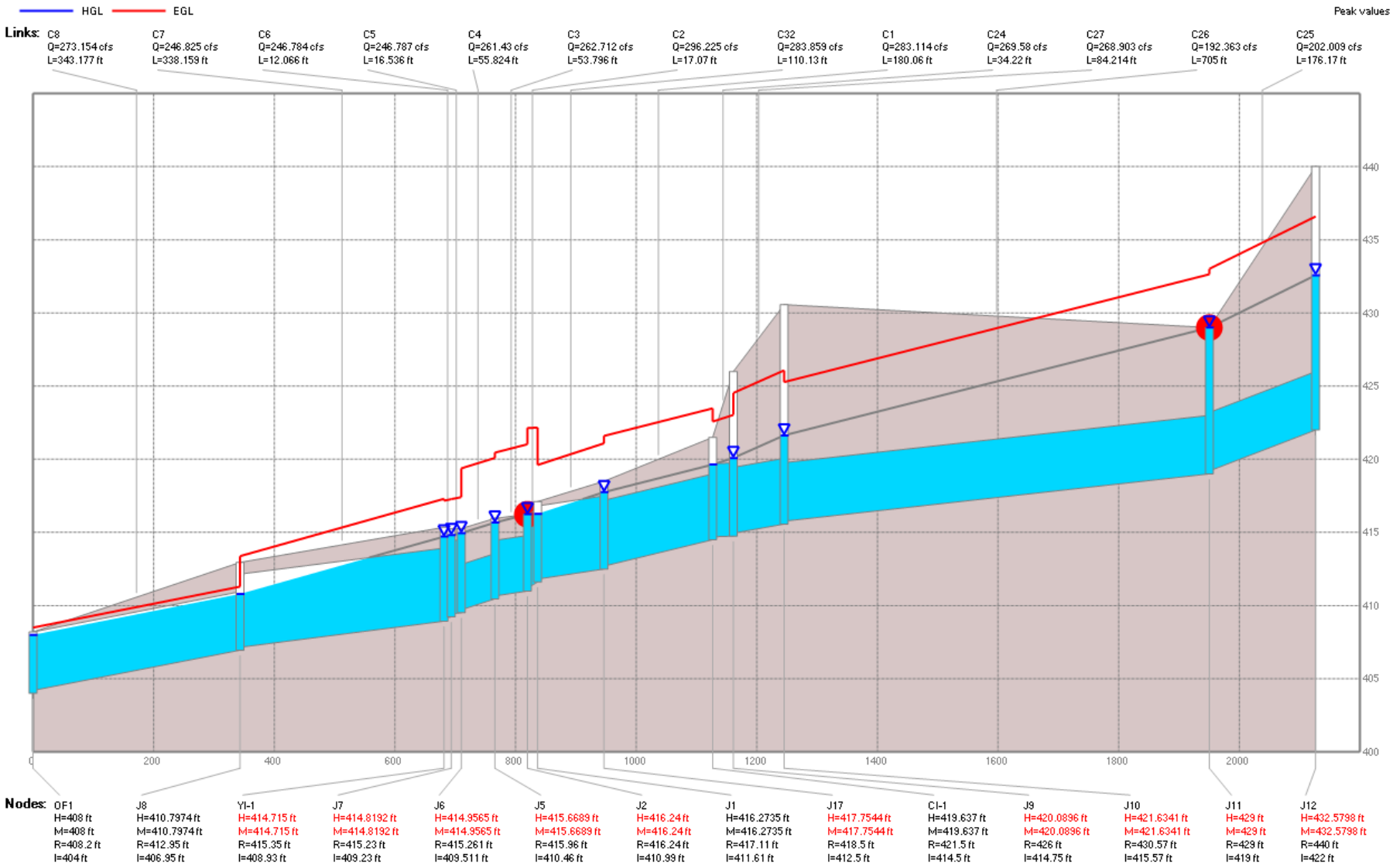


Figure 3: Arnett Drive Existing Conditon 25-Year Storm HGL

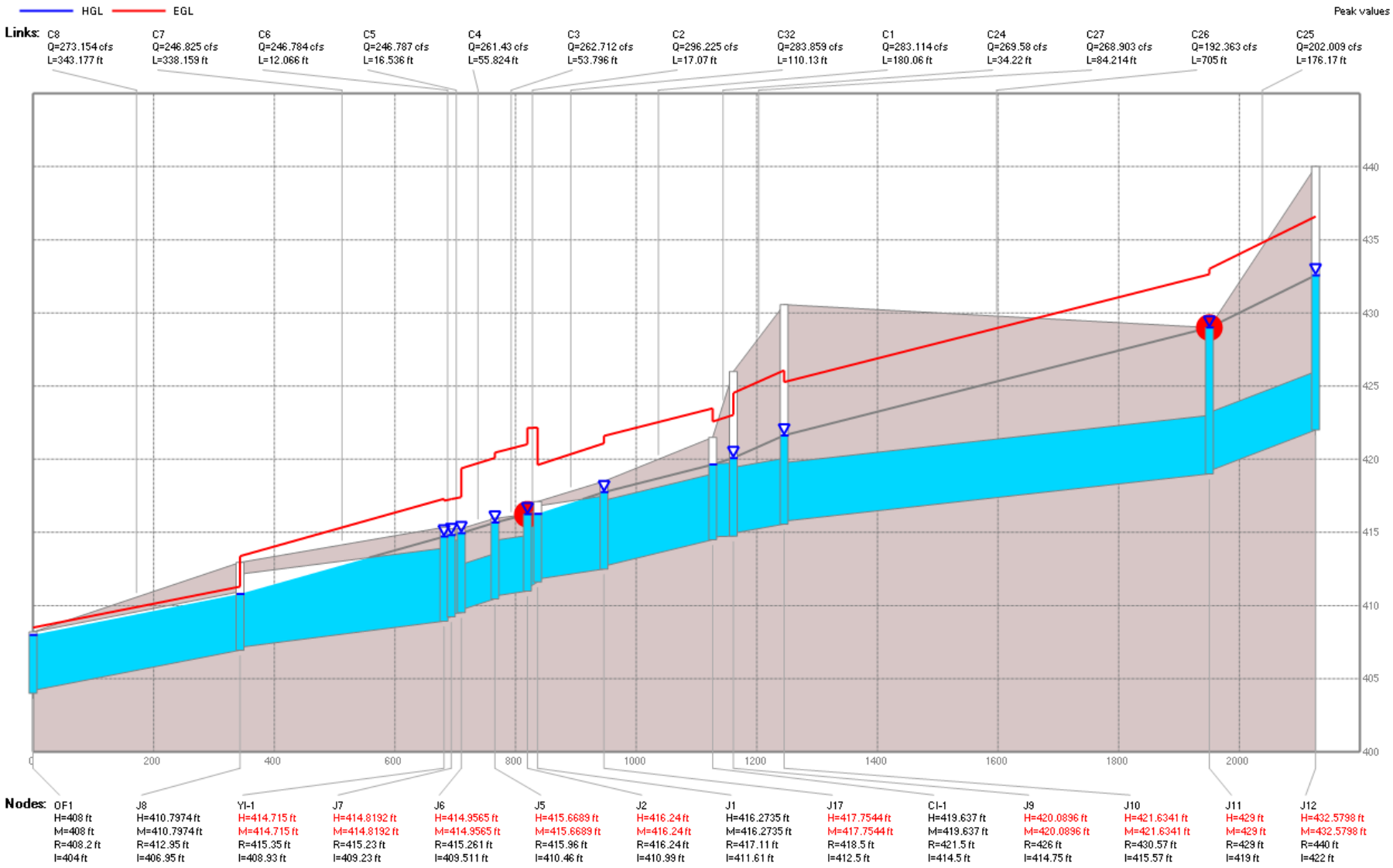


Figure 4: Arnet Drive Existing Conditon 100-Year Storm HGL

PCSWMM Report

PCSWMM Report – Arnett Drive Proposed Conditions Option 1& 2

Model PCSWMM Report – Arnett Drive Proposed Conditions Option 1& 2.inp

April 19, 2022

Table of Contents

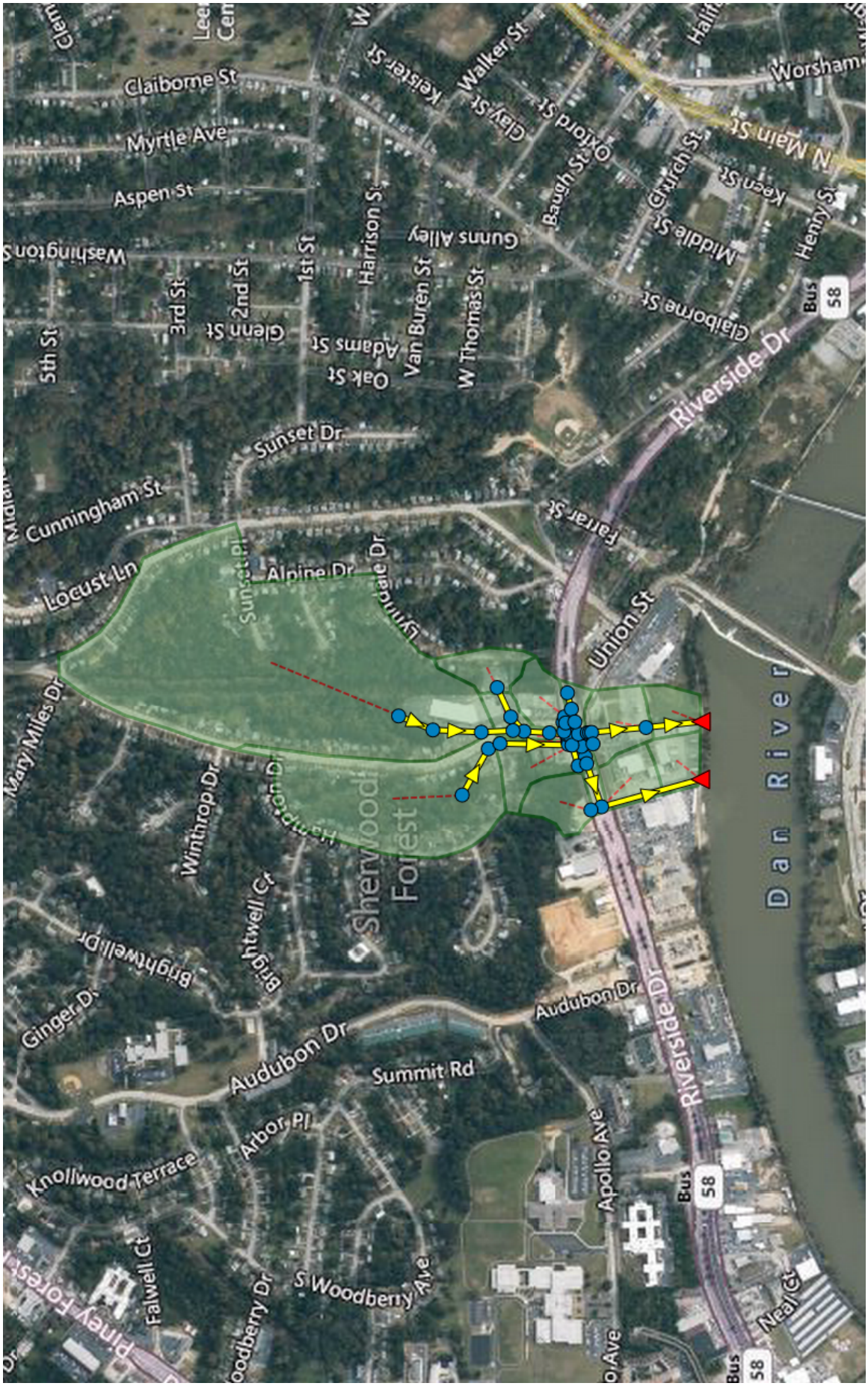


Figure 1: MAP VIEW

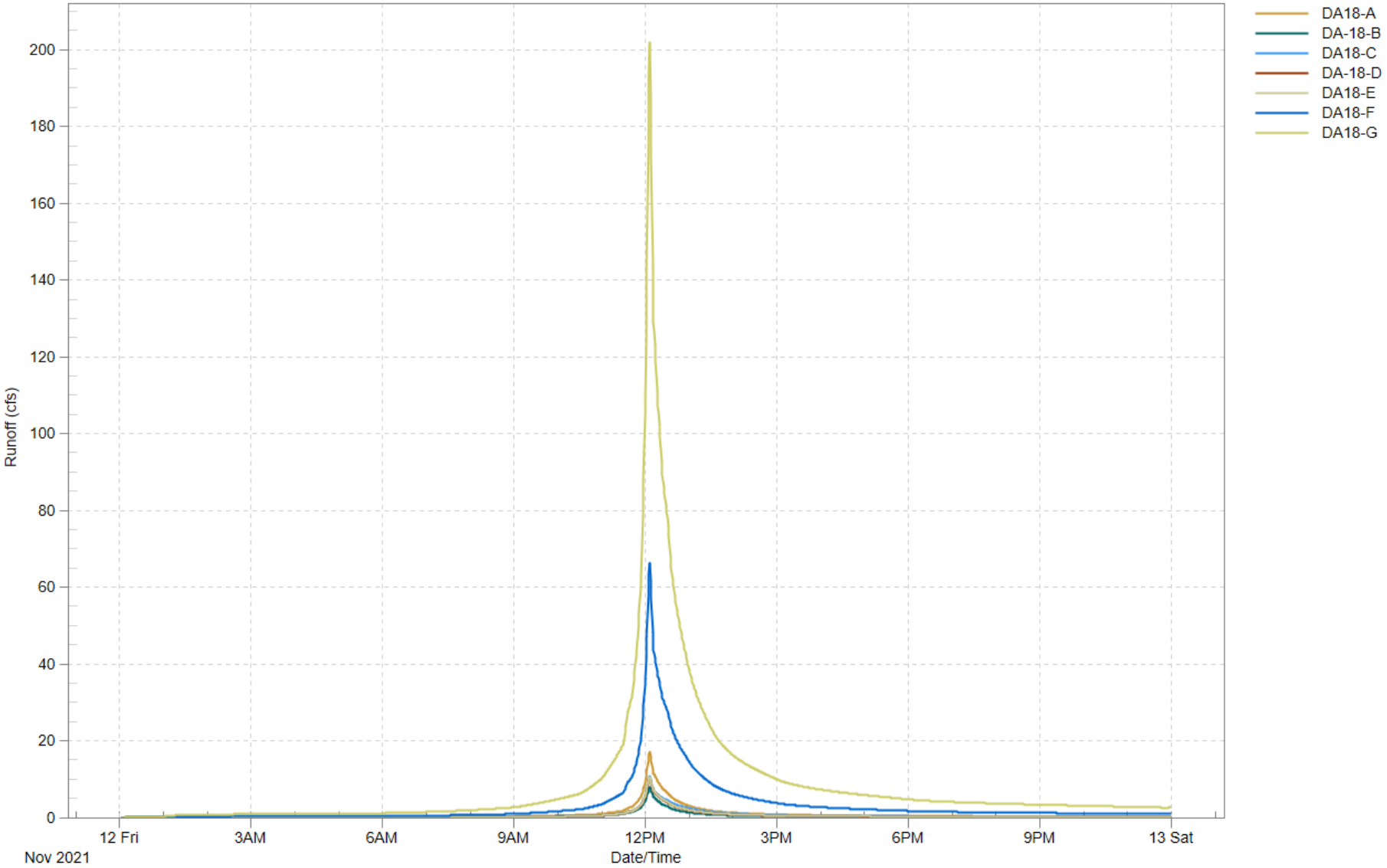


Figure 2: Arnett Drive Proposed Conditon 25-year storm Hydrograph

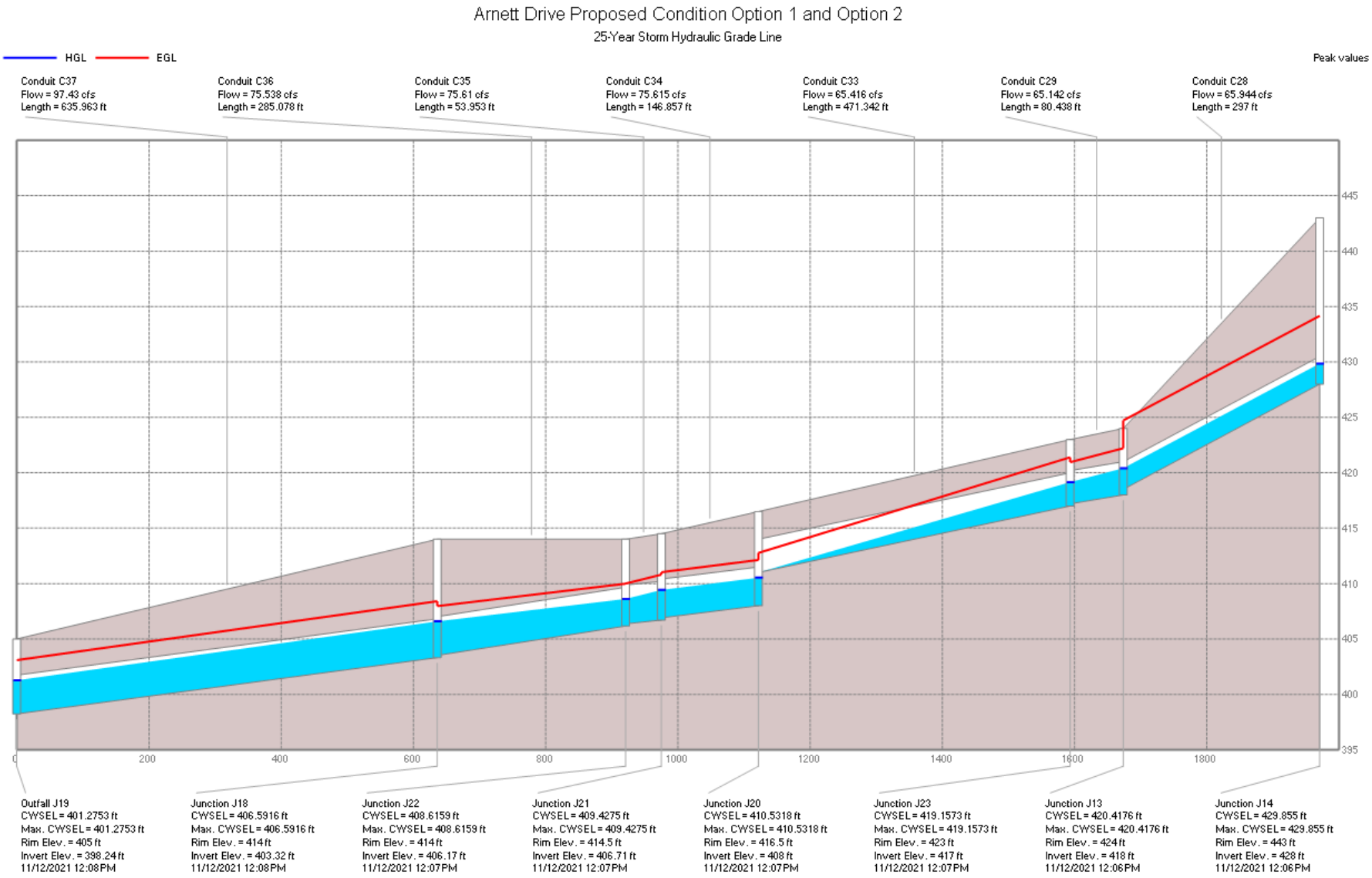


Figure 3: Arnett Drive Proposed Condition Option 1 and Option 2

Table 1: Pipe Hydraulics Summary 25 Year Storm

Name	Inlet Node	Outlet Node	Length (ft)	Roughness	Outlet Offset (ft)	Geom1 (ft)	Geom3	Geom4	Slope (ft/ft)	Max. |Flow| (cfs)	Contributing Area (ac)
C1	CI-1	J17	180.06	0.01	0.2	4.5	0	0	0.01	218.81	57.937
C10	CI-4	CI-3	22.299	0.013	0.2	1.25	0	0	0.02961	1.44	0.246
C11	CI-3	J1	18.955	0.013	0.2	1.25	0	0	0.01847	2.76	0.569
C12	CI-7	CI-6	35.627	0.013	0.2	1.25	0	0	0.00421	9.5	2.436
C13	CI-6	J4	17.424	0.013	0.2	1.25	0	0	-0.0132	9.5	2.436
C14	J4	J3	54.095	0.013	0.2	1.25	0	0	0.00998	9.48	2.436
C15	J3	CI-2	12.924	0.013	0.2	1.25	0	0	-0.00619	9.48	2.436
C16	CI-2	J1	16.099	0.013	0.2	1.25	0	0	-0.00248	10.37	2.651
C17	CI-10	CI-9	70.993	0.013	0.2	1.25	0	0	0.01479	1.59	0
C18	CI-9	J5	80.98	0.013	0.2	1.25	0	0	0.02582	4.11	0
C19	CI-8	J6	24.227	0.013	0.2	1	0	0	0.00161	12.73	0
C2	J1	J2	17.07	0.01	0.2	5	0	0	0.02461	231.06	61.158
C20	YI-2	YI-3	104.091	0.01	0.2	1	0	0	0.00807	5.54	1.458
C21	YI-3	YI-4	82.897	0.013	0.2	1.25	0	0	0.0076	5.54	1.458
C22	YI-4	J5	78.42	0.013	0.2	1.25	0	0	0.00701	5.54	1.458
C23	YI-5	J7	73.138	0.013	0.2	1	0	0	0.00725	0.07	0
C24	J9	CI-1	34.22	0.013	0.2	5	0	0	0.00146	202.4	54.281
C25	J12	J11	176.17	0.013	0.2	4	0	0	0.0159	202.05	54.109
C26	J11	J10	705	0.01	0.2	4	0	0	0.00458	202.07	54.109
C27	J10	J9	84.214	0.013	0.2	4.5	0	0	0.00736	201.52	54.109
C28	J14	J13	297	0.013	0.5	2.5	0	0	0.032	66.13	18.245
C29	J13	J23	80.438	0.013	0.2	3	0	0	0.00995	65.79	18.245
C3	J2	J5	53.796	0.01	0.2	3.8	0	0	0.00613	232.09	61.158
C30	J15	J16	290	0.013	0.2	1.5	0	0	0.00931	10.62	2.574
C31	J16	CI-1	60	0.013	0.2	1.5	0	0	0.00667	15.4	3.656
C32	J17	J1	110.13	0.013	0.2	5	0	0	0.00627	218.4	57.937
C33	J23	J20	471.342	0.013	3	3	0	0	0.01273	65.47	18.245
C34	J20	J21	146.857	0.013	0.2	3.5	0	0	0.00742	75.62	21.326
C35	J21	J22	53.953	0.013	0.2	3.5	0	0	0.0063	75.64	21.326
C36	J22	J18	285.078	0.013	0.2	3.5	0	0	0.0093	75.88	21.326
C37	J18	J19	635.963	0.013	0	3.5	0	0	0.00799	97.44	27.209
C38	J24	J18	69.264	0.013	0.2	2	0	0	0.07209	10.62	2.767
C4	J5	J6	55.824	0.01	0.2	3.1	0	0	0.01342	236.9	62.616
C5	J6	J7	16.536	0.013	0.2	5	0	0	0.0049	224.51	62.616
C6	J7	YI-1	12.066	0.013	0.2	5	0	0	0.00829	224.3	62.616
C7	YI-1	J8	338.159	0.013	0.2	5	0	0	0.00526	220.52	62.616
C8	J8	OF1	343.177	0.04	0.2	4	2	2	0.00801	232.84	66.213

Table 1: Pipe Hydraulics Summary 25 Year Storm (continued...)

Name	Inlet Node	Outlet Node	Length (ft)	Roughness	Outlet Offset (ft)	Geom1 (ft)	Geom3	Geom4	Slope (ft/ft)	Max. |Flow| (cfs)	Contributing Area (ac)
C9	CI-5	CI-4	20.584	0.013	0.2	1.25	0	0	0.00874	1.67	0

PCSWMM Report

PCSWMM Report – Arnett Drive Proposed Conditions Option 3

Model Arnett Drive Proposed Conditions Option 3.inp

April 20, 2022

Table of Contents

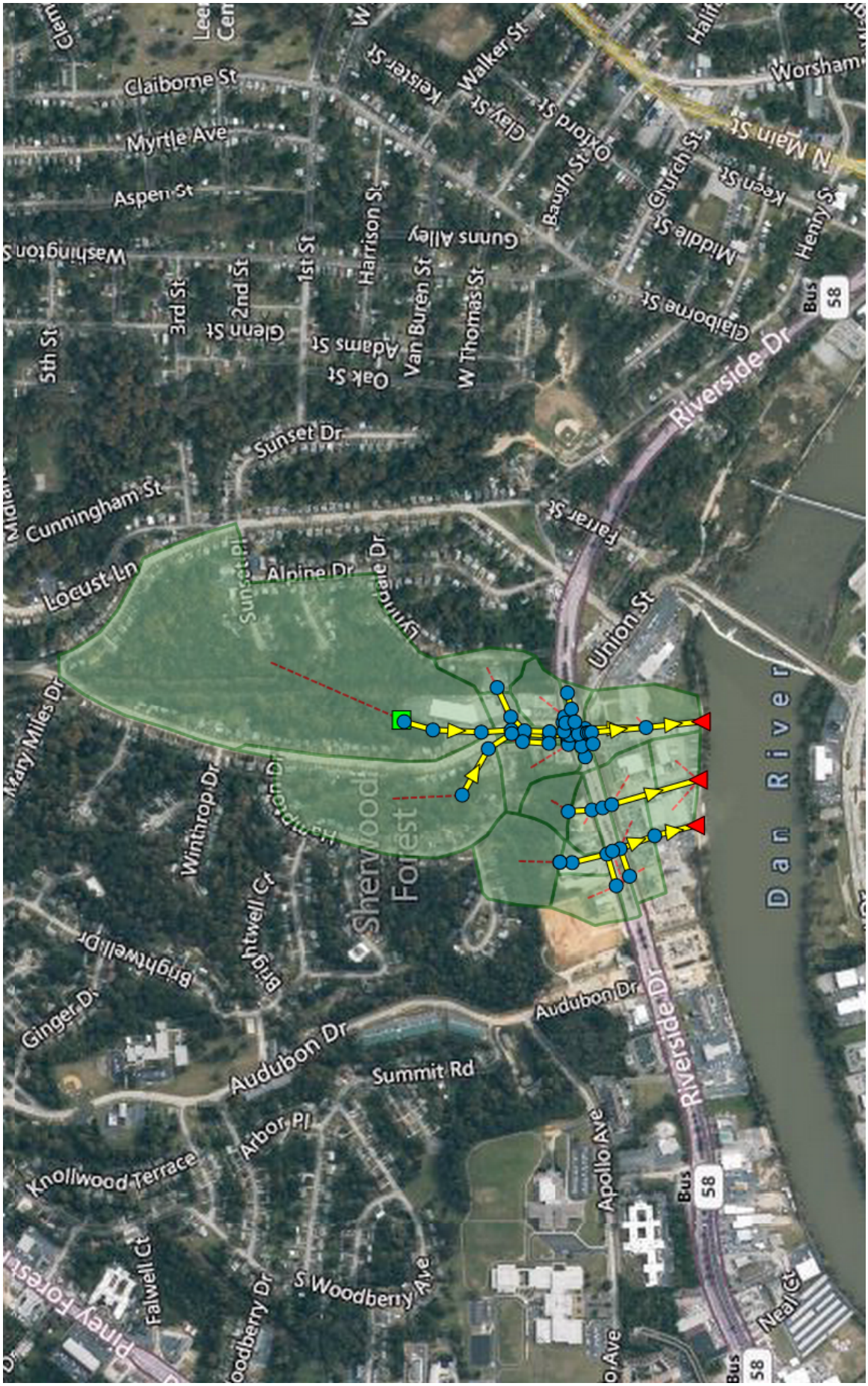


Figure 1: MAP VIEW

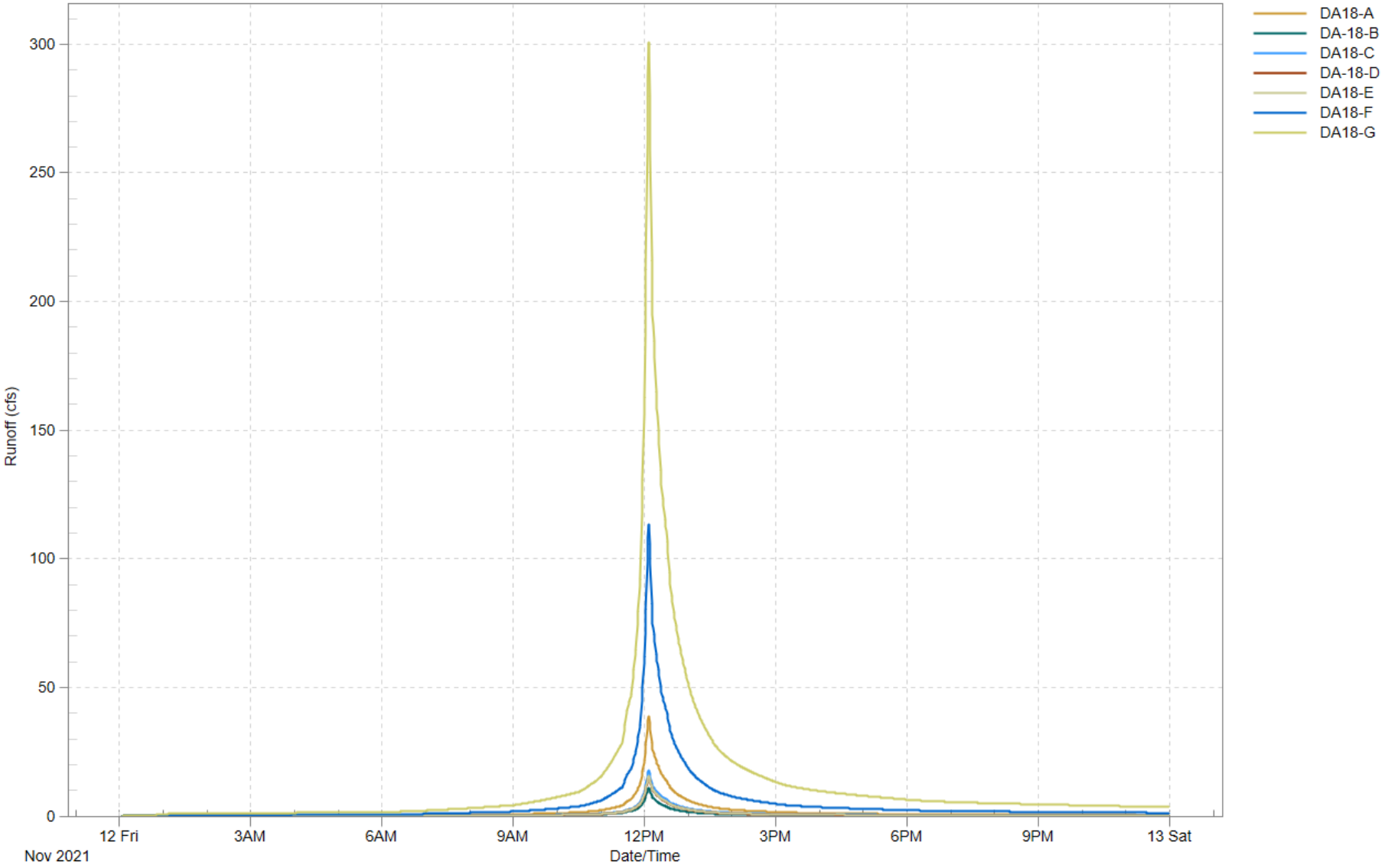


Figure 2: Arnett Blvd 25 Year Storm Hydrograph

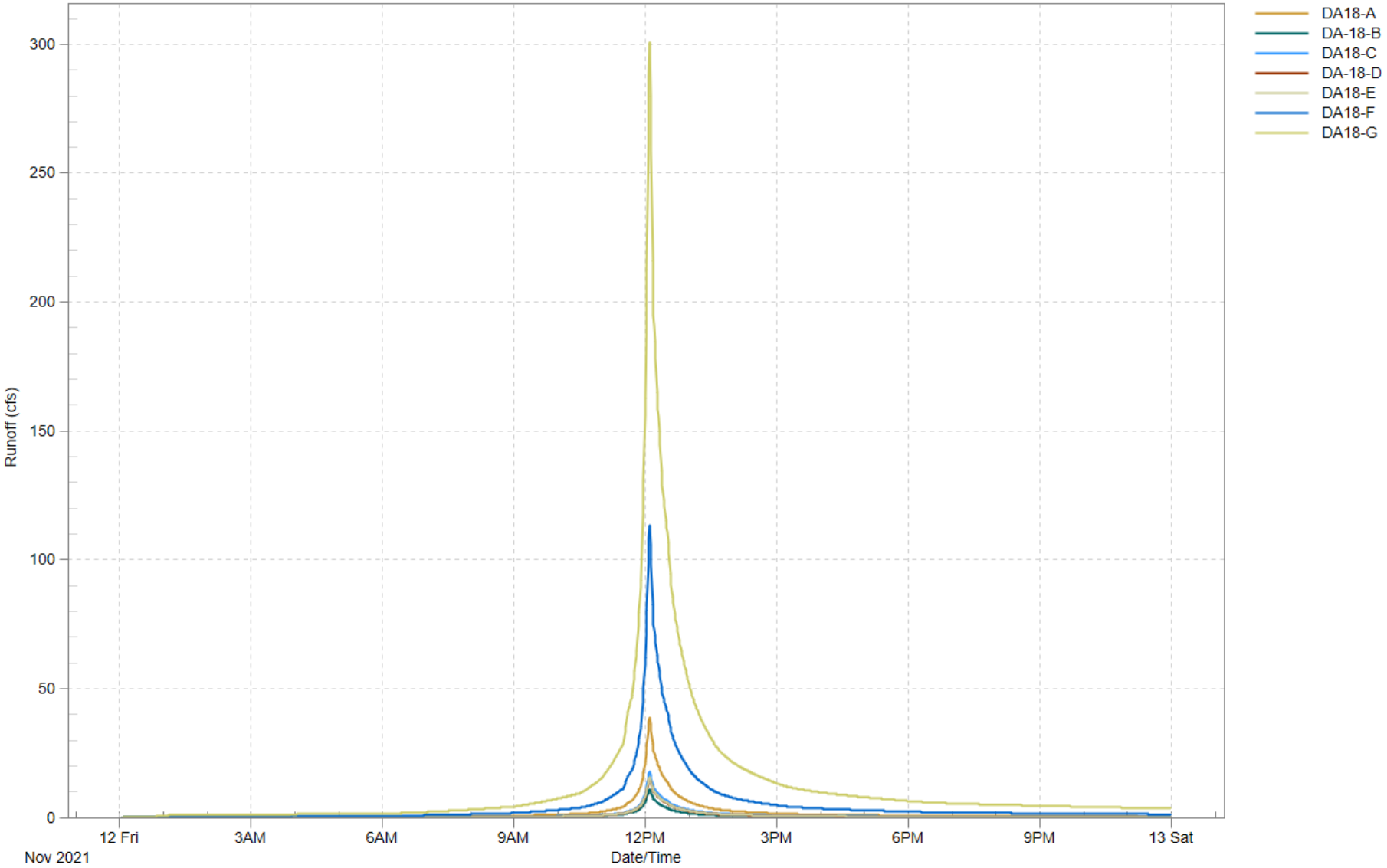


Figure 3: Arnett Blvd 100 Year Storm Hydrograph

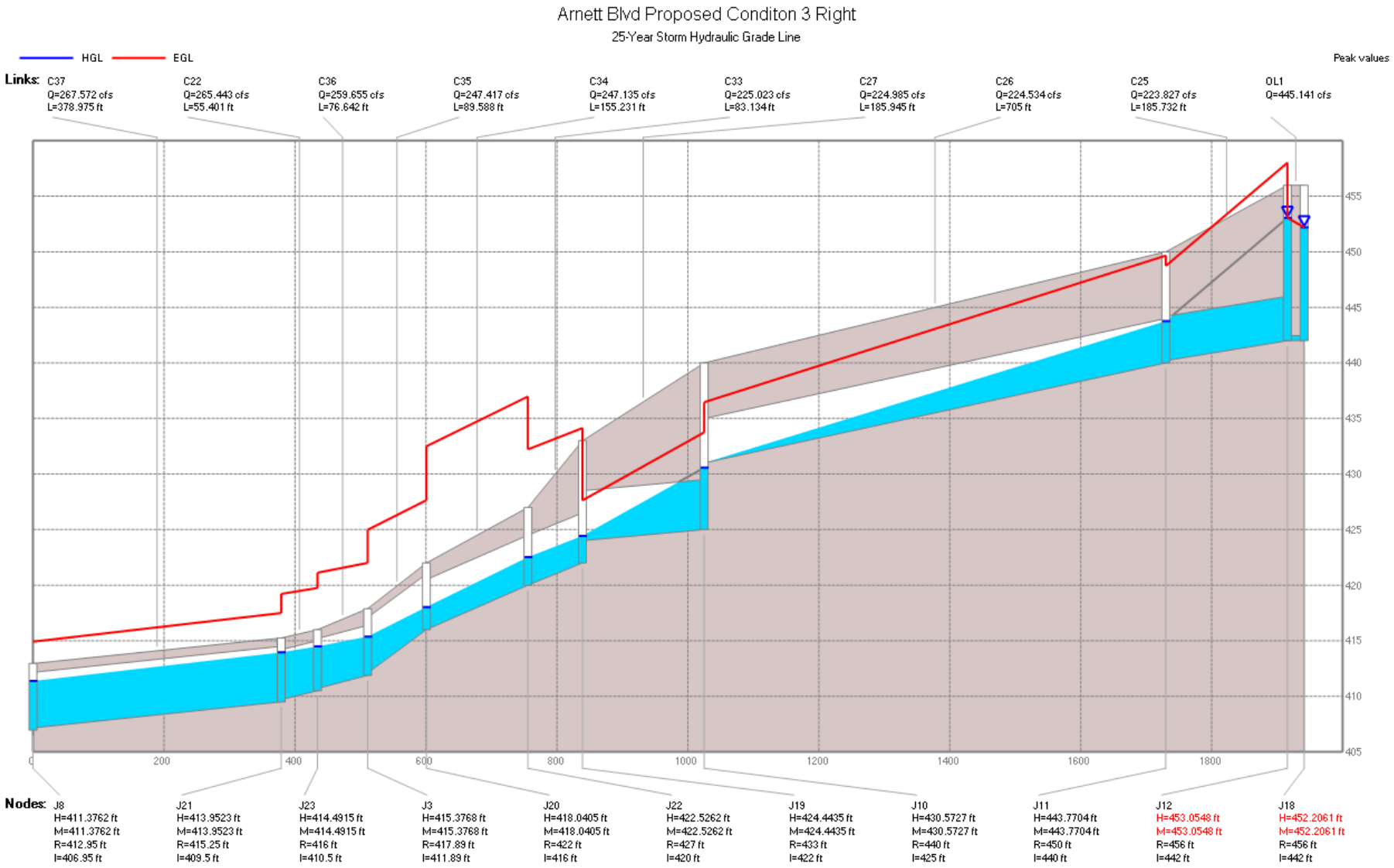


Figure 4: Arnett Blvd 25-Year Storm Hydraulic Grade Line Left

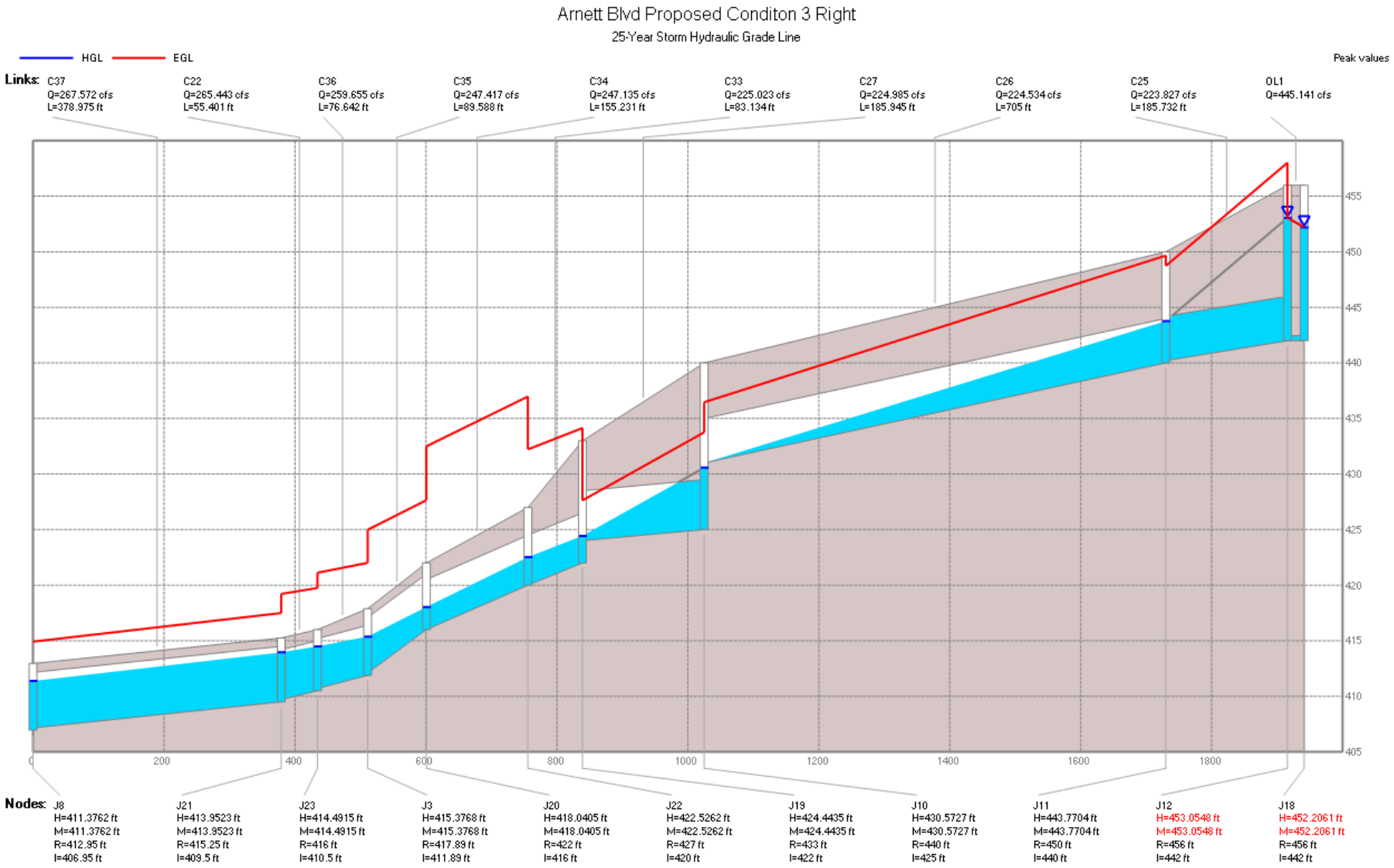


Figure 5: Arnett Blvd 100-Year Storm Hydraulic Grade Line Left

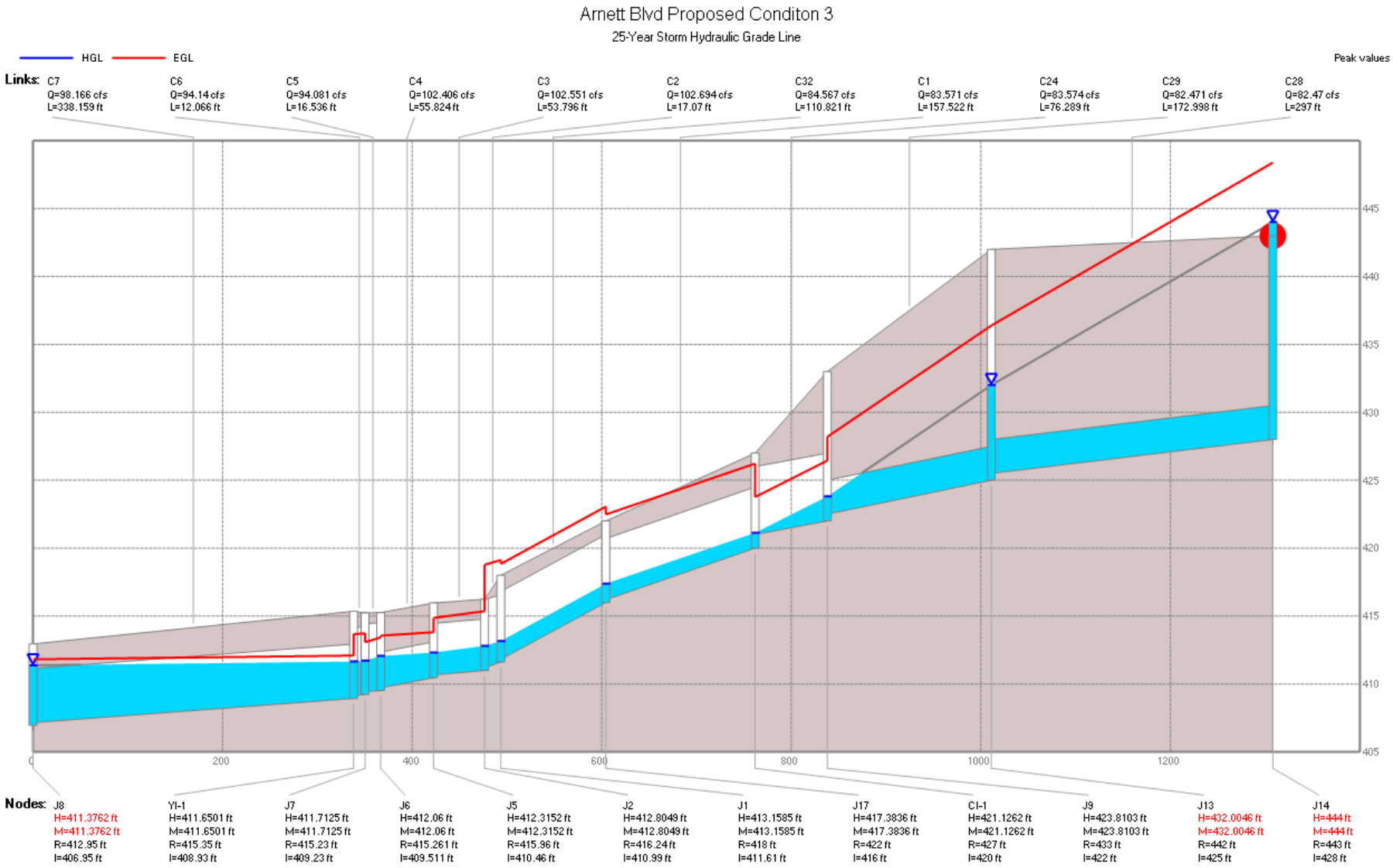


Figure 6: Arnett Blvd 25-Year Storm Hydraulic Grade Line Rigt

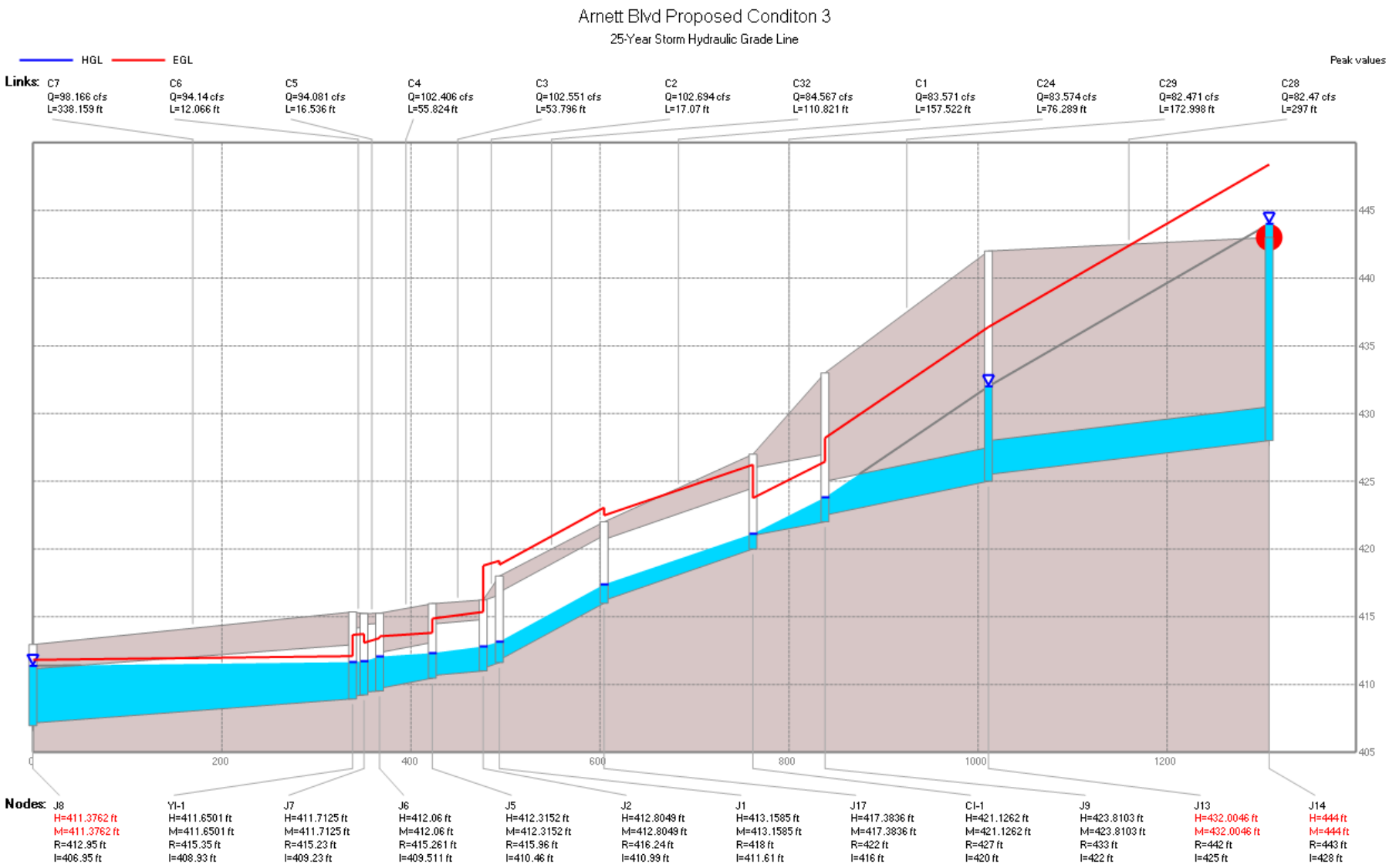


Figure 7: Arnett Blvd 100-Year Storm Hydraulic Grade Line Rigt

Table 1: Arnett Blvd Proposed Conditon Pipe Hydraulics

Name	Inlet Node	Outlet Node	Length (ft)	Roughness	Outlet Offset (ft)	Geom1 (ft)	Geom2 (ft)	Slope (ft/ft)	Max. |Flow| (cfs)	Contributing Area (ac)
C1	CI-1	J17	157.522	0.01	0.2	4.5	4	0.02413	84.1	18.417
C10	CI-4	CI-3	22.299	0.013	0.2	1.25	0	0.02961	14.79	3.197
C11	CI-3	J1	18.955	0.013	0.2	1.25	0	0.01847	16.76	3.52
C12	CI-7	CI-6	35.627	0.013	0.2	1.25	0	0.00421	11.11	2.436
C13	CI-6	J4	17.424	0.013	0.2	1.25	0	0.00402	11.11	2.436
C14	J4	J3	53.882	0.013	0.2	1.25	0	0.00445	11.11	2.436
C15	YI-4	J23	49.023	0.01	0	1	0	0.01448	6.47	1.458
C16	CI-2	J1	16.099	0.013	0.2	1.25	0	-0.00248	1.39	0.216
C17	CI-10	CI-9	70.993	0.013	0.2	1.25	0	0.01479	0	0
C18	CI-9	J5	80.98	0.013	0.2	1.25	0	0.02582	0	0
C19	CI-8	J6	24.227	0.013	0.2	1	0	0.00161	8.31	0
C2	J1	J2	17.07	0.01	0.2	5	0	0.02461	102.84	22.308
C20	YI-2	YI-3	104.091	0.01	0.2	1	0	0.00807	6.47	1.458
C21	YI-3	YI-4	82.897	0.013	0.2	1.25	0	0.0076	6.47	1.458
C22	J23	J21	55.401	0.01	0.2	4.5	0	0.01444	268.73	61.659
C23	YI-5	J7	73.138	0.013	0.2	1	0	0.00725	0.31	0
C24	J9	CI-1	76.289	0.013	1	5	0	0.01311	83.67	18.417
C25	J12	J11	185.732	0.013	0.2	4	0	0.00969	233.09	54.109
C26	J11	J10	705	0.01	6	4	0	0.01277	224.74	54.109
C27	J10	J19	185.945	0.013	2	4.5	0	0.00538	225.03	54.109
C28	J14	J13	297	0.013	0.5	2.5	0	0.00842	82.47	18.245
C29	J13	J9	172.998	0.013	0.5	2.5	0	0.01445	82.47	18.245
C3	J2	J5	53.796	0.01	0.2	3.8	5	0.00613	102.93	22.308
C30	J15	J16	290	0.013	0.2	1.5	0	0.03036	15.49	2.574
C31	J16	J22	122.23	0.013	0.2	1.5	0	0.05572	22.38	3.656
C32	J17	J1	110.821	0.013	0.2	5	0	0.03784	84.95	18.572
C33	J19	J22	83.134	0.01	0	4.5	0	0.02406	225.03	54.109
C34	J22	J20	155.231	0.01	0	4.5	0	0.02578	247.35	57.765
C35	J20	J3	89.588	0.01	0.2	5	0	0.04369	249.32	57.765
C36	J3	J23	76.642	0.01	0.2	4.5	0	0.01553	261.98	60.201
C37	J21	J8	378.975	0.01	0.2	5	0	0.0062	270.61	61.659
C38	J25	J24	164.194	0.013	1.5	1.5	0	0.02132	0.47	0.074
C39	J24	J17	49.409	0.013	0.5	1.5	0	0.01012	1.12	0.155
C4	J5	J6	55.824	0.01	0.2	2.64	5	0.01342	103.03	22.308
C40	J26	J27	146.999	0.01	0.25	1	0	0.01191	6.42	2.102
C41	J27	J28	68.361	0.01	0.5	2	0	0.01463	16.38	3.657
C42	J28	J29	59.976	0.013	0.5	1.5	0	0.01668	16.52	4.781

Table 1: Arnett Blvd Proposed Conditon Pipe Hydraulics (continued...)

Name	Inlet Node	Outlet Node	Length (ft)	Roughness	Outlet Offset (ft)	Geom1 (ft)	Geom2 (ft)	Slope (ft/ft)	Max. |Flow| (cfs)	Contributing Area (ac)
C43	J29	OF2	557.769	0.013	0	2	0	0.00717	26.59	7.043
C44	J30	J31	205.932	0.013	0.25	1	0	0.00607	4.08	2.63
C45	J31	J35	39.26	0.013	0.25	2	0	0.00637	16.37	9.468
C46	J35	J32	49.472	0.013	0.5	2	0	0.00505	16.93	10.376
C47	J36	J32	181.019	0.013	0.25	1	0	0.00414	4.85	1.724
C48	J32	J33	229.294	0.013	0.25	2	0	0.00872	25.72	13.416
C49	J33	J34	260.099	0.013	0	2	0	0.01153	25.72	13.416
C5	J6	J7	16.536	0.013	0.2	5	0	0.0049	94.73	22.308
C50	J39	J38	75.376	0.013	0.25	1.5	0	0.02322	14.58	5.789
C51	J38	J31	222.913	0.013	0.25	1.5	0	0.01907	14.53	5.789
C6	J7	YI-1	12.066	0.013	0.2	5	0	0.00829	94.67	22.308
C7	YI-1	J8	338.159	0.013	0.2	4	0	0.00526	98.98	22.308
C8	J8	OF1	343.177	0.04	0.2	5	6	0.00801	394.89	89.695
C9	CI-5	CI-4	20.584	0.013	0.2	1.25	0	0.00874	14.18	3.081

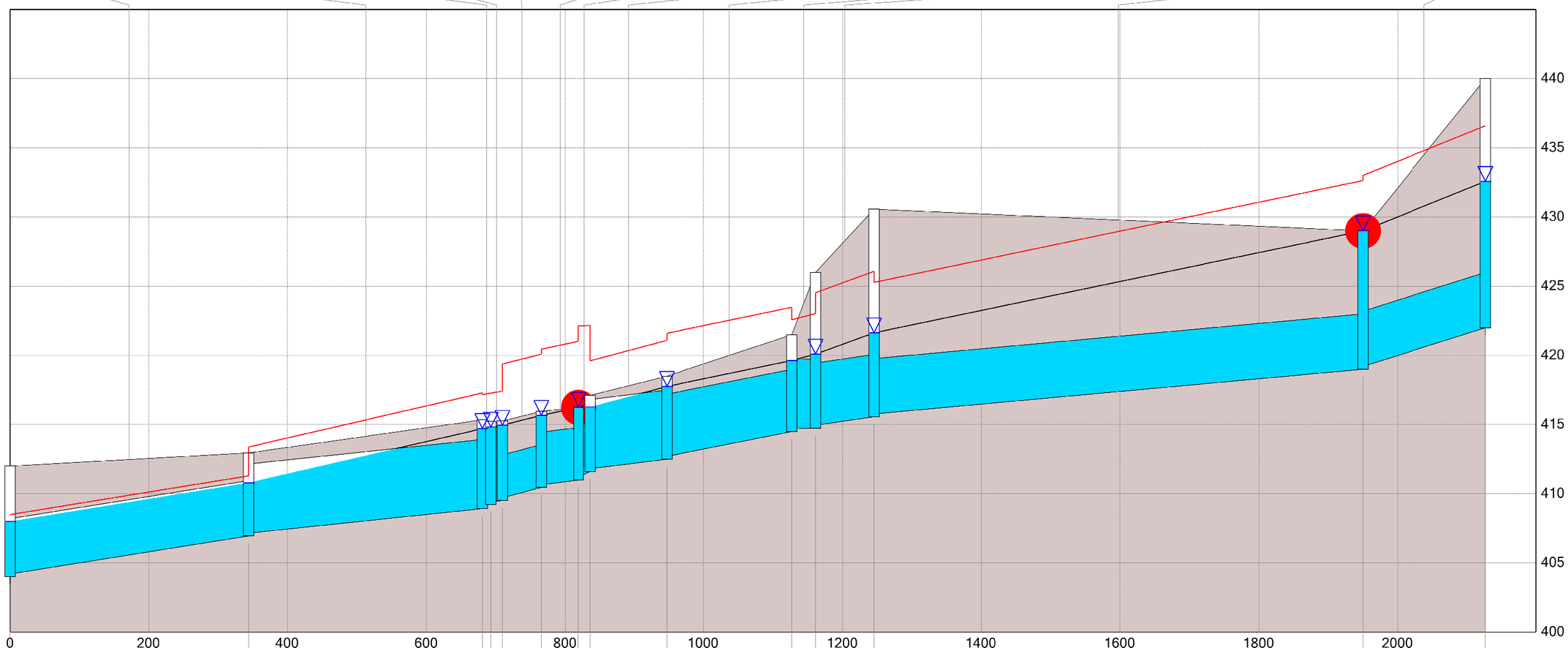
Arnett Drive Existing Conditon

25-Year Storm Event Hydraulic Grade Line

HGL EGL

Peak values

Links:	C8	C7	C6	C5	C4	C3	C2	C32	C1	C24	C27	C26	C25
	Q=273.151 cfs	Q=246.823 cfs	Q=246.782 cfs	Q=246.782 cfs	Q=261.431 cfs	Q=262.712 cfs	Q=296.225 cfs	Q=283.859 cfs	Q=283.114 cfs	Q=269.58 cfs	Q=268.903 cfs	Q=192.363 cfs	Q=202.009 cfs
	L=343.177 ft	L=338.159 ft	L=12.066 ft	L=16.536 ft	L=55.824 ft	L=53.796 ft	L=17.07 ft	L=110.13 ft	L=180.06 ft	L=34.22 ft	L=84.214 ft	L=705 ft	L=176.17 ft



Nodes:	OF1	J8	YI-1	J7	J6	J5	J2	J1	J17	CI-1	J9	J10	J11	J12
	H=408 ft	H=410.7974 ft	H=414.715 ft	H=414.8192 ft	H=414.9565 ft	H=415.6689 ft	H=416.24 ft	H=416.2735 ft	H=417.7544 ft	H=419.637 ft	H=420.0896 ft	H=421.6341 ft	H=429 ft	H=432.5798 ft
	M=408 ft	M=410.7974 ft	M=414.715 ft	M=414.8192 ft	M=414.9565 ft	M=415.6689 ft	M=416.24 ft	M=416.2735 ft	M=417.7544 ft	M=419.637 ft	M=420.0896 ft	M=421.6341 ft	M=429 ft	M=432.5798 ft
	R=412 ft	R=412.95 ft	R=415.35 ft	R=415.23 ft	R=415.261 ft	R=415.96 ft	R=416.24 ft	R=417.11 ft	R=418.5 ft	R=421.5 ft	R=426 ft	R=430.57 ft	R=429 ft	R=440 ft
	I=404 ft	I=406.95 ft	I=408.93 ft	I=409.23 ft	I=409.511 ft	I=410.46 ft	I=410.99 ft	I=411.61 ft	I=412.5 ft	I=414.5 ft	I=414.75 ft	I=415.57 ft	I=419 ft	I=422 ft

Proposed Conditon Arnett Bluvard Option 1 and 2

25-year Storm Hydraulic Grade Line

HGL EGL

Peak values

Conduit C37
Flow = 97.43 cfs
Length = 635.963 ft

Conduit C36
Flow = 75.538 cfs
Length = 285.078 ft

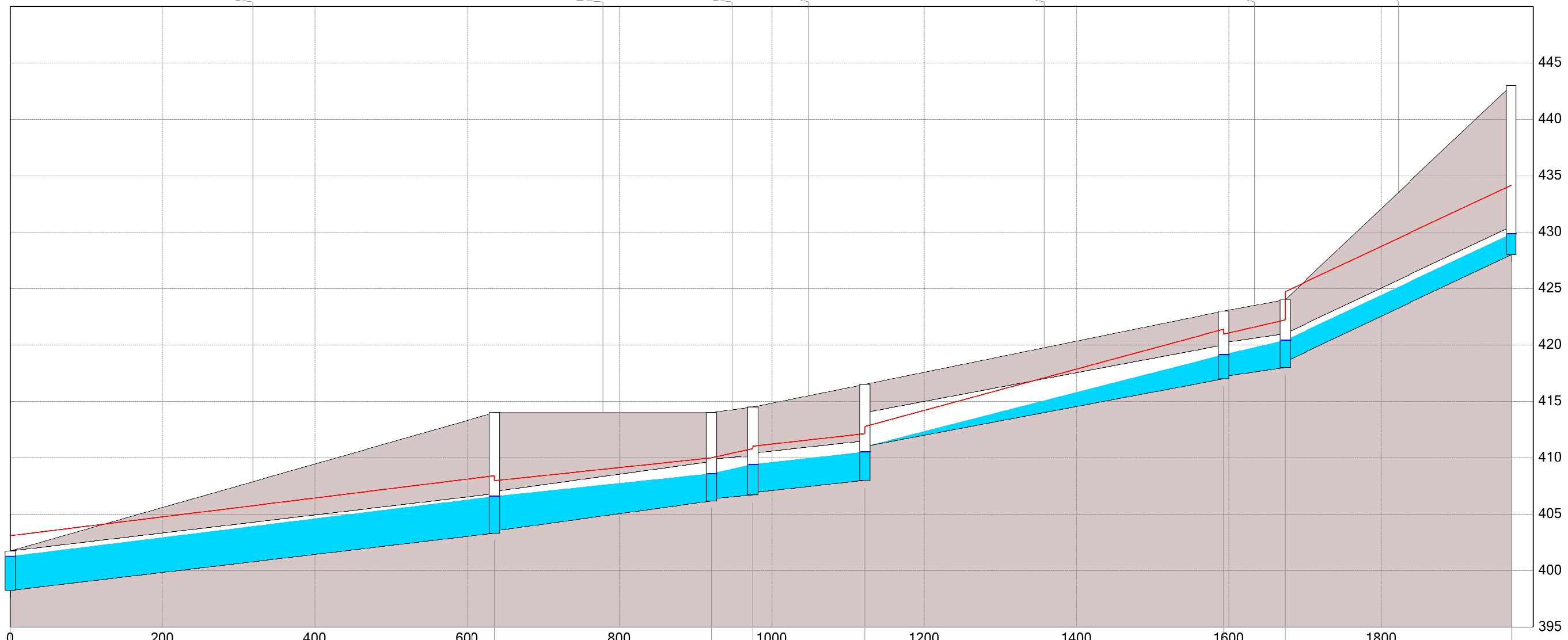
Conduit C35
Flow = 75.61 cfs
Length = 53.953 ft

Conduit C34
Flow = 75.615 cfs
Length = 146.857 ft

Conduit C33
Flow = 65.416 cfs
Length = 471.342 ft

Conduit C29
Flow = 65.142 cfs
Length = 80.438 ft

Conduit C28
Flow = 65.944 cfs
Length = 297 ft



Outfall J19
CWSEL = 401.2753 ft
Max. CWSEL = 401.2753 ft
Rim Elev. = 401.74 ft
Invert Elev. = 398.24 ft
11/12/2021 12:08PM

Junction J18
CWSEL = 406.5916 ft
Max. CWSEL = 406.5916 ft
Rim Elev. = 414 ft
Invert Elev. = 403.32 ft
11/12/2021 12:08PM

Junction J22
CWSEL = 408.6159 ft
Max. CWSEL = 408.6159 ft
Rim Elev. = 414 ft
Invert Elev. = 406.17 ft
11/12/2021 12:07PM

Junction J21
CWSEL = 409.4275 ft
Max. CWSEL = 409.4275 ft
Rim Elev. = 414.5 ft
Invert Elev. = 406.71 ft
11/12/2021 12:07PM

Junction J20
CWSEL = 410.5318 ft
Max. CWSEL = 410.5318 ft
Rim Elev. = 416.5 ft
Invert Elev. = 408 ft
11/12/2021 12:07PM

Junction J23
CWSEL = 419.1573 ft
Max. CWSEL = 419.1573 ft
Rim Elev. = 423 ft
Invert Elev. = 417 ft
11/12/2021 12:07PM

Junction J13
CWSEL = 420.4176 ft
Max. CWSEL = 420.4176 ft
Rim Elev. = 424 ft
Invert Elev. = 418 ft
11/12/2021 12:06PM

Junction J14
CWSEL = 429.855 ft
Max. CWSEL = 429.855 ft
Rim Elev. = 443 ft
Invert Elev. = 428 ft
11/12/2021 12:06PM

Arnett Blvd Proposed Conditon 3 Right

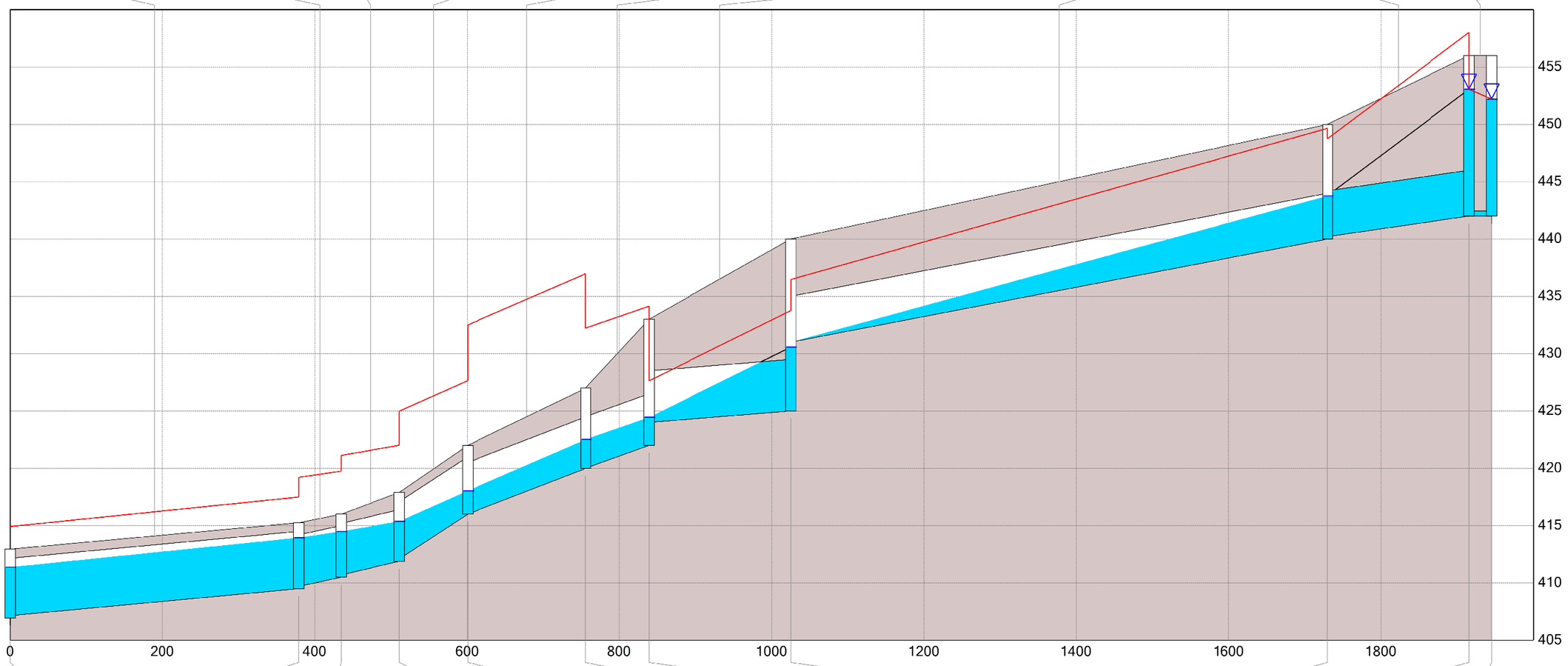
25-Year Storm Hydraulic Grade Line

HGL EGL

Peak values

Links:

C37	C22	C36	C35	C34	C33	C27	C26	C25	OL1
Q=267.572 cfs	Q=265.443 cfs	Q=259.655 cfs	Q=247.417 cfs	Q=247.135 cfs	Q=225.023 cfs	Q=224.985 cfs	Q=224.534 cfs	Q=223.827 cfs	Q=445.141 cfs
L=378.975 ft	L=55.401 ft	L=76.642 ft	L=89.588 ft	L=155.231 ft	L=83.134 ft	L=185.945 ft	L=705 ft	L=185.732 ft	



Nodes:

J8	J21	J23	J3	J20	J22	J19	J10	J11	J12	J18
H=411.3762 ft	H=413.9523 ft	H=414.4915 ft	H=415.3768 ft	H=418.0405 ft	H=422.5262 ft	H=424.4435 ft	H=430.5727 ft	H=443.7704 ft	H=453.0548 ft	H=452.2061 ft
M=411.3762 ft	M=413.9523 ft	M=414.4915 ft	M=415.3768 ft	M=418.0405 ft	M=422.5262 ft	M=424.4435 ft	M=430.5727 ft	M=443.7704 ft	M=453.0548 ft	M=452.2061 ft
R=412.95 ft	R=415.25 ft	R=416 ft	R=417.89 ft	R=422 ft	R=427 ft	R=433 ft	R=440 ft	R=450 ft	R=456 ft	R=456 ft
I=406.95 ft	I=409.5 ft	I=410.5 ft	I=411.89 ft	I=416 ft	I=420 ft	I=422 ft	I=425 ft	I=440 ft	I=442 ft	I=442 ft

Proposed Conditon Audubon Drive

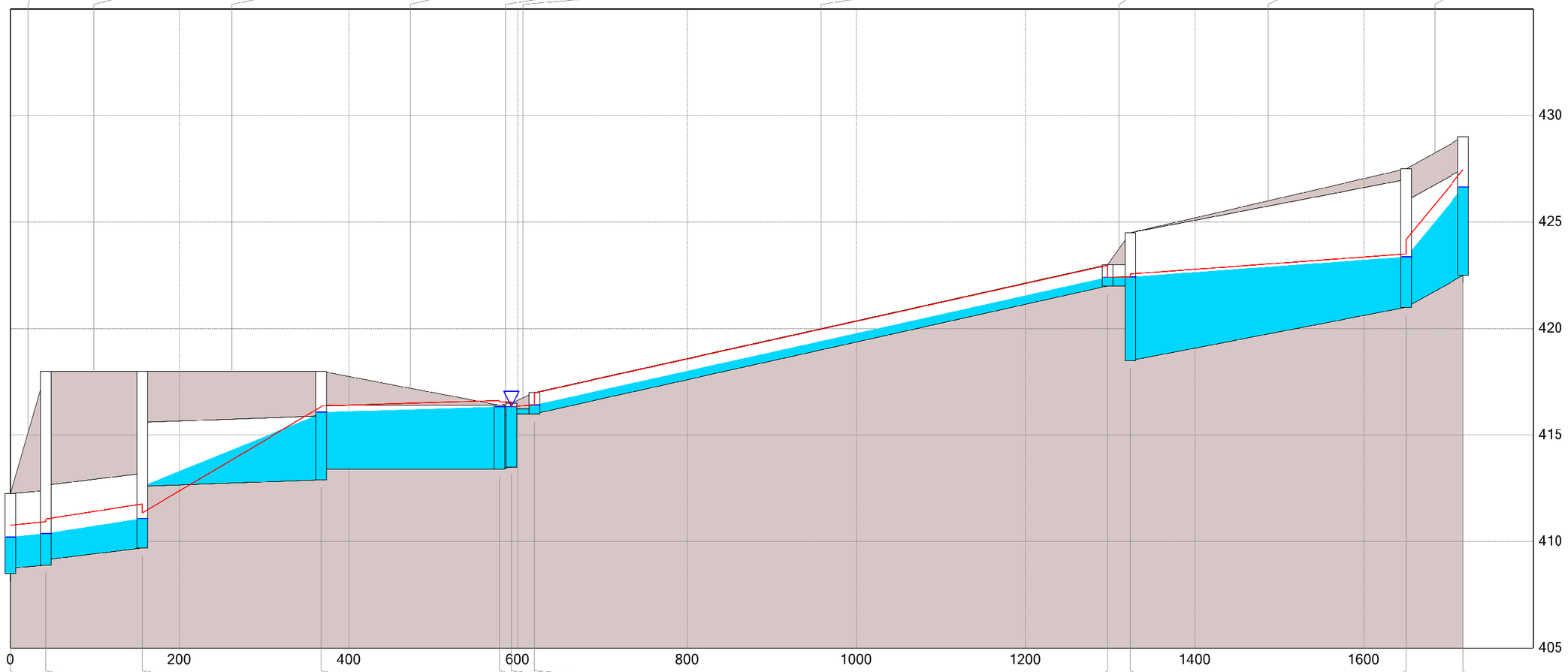
25-Year Storm Hydraulic Grade Line

HGL EGL

Peak values

Links:

C9	C8	C7	C6	C1	C11	C2	OL2	C5	C4
Q=23.032 cfs	Q=23.076 cfs	Q=23.314 cfs	Q=24.3 cfs	Q=18.062 cfs	Q=18.117 cfs	Q=25.959 cfs	Q=25.353 cfs	Q=97.888 cfs	Q=97.998 cfs
L=41.862 ft	L=114.068 ft	L=211.333 ft	L=211.313 ft	L=13.935 ft		L=677.366 ft		L=325.702 ft	L=67.704 ft



Nodes:

FES-5	JB-4	JB-3	JB-2	JB-1	CI-1	J2	J6	ST2	J3	ST1
H=410.2221 ft	H=410.3845 ft	H=411.0924 ft	H=416.0761 ft	H=416.3332 ft	H=416.3437 ft	H=416.4167 ft	H=422.4128 ft	H=422.4298 ft	H=423.3696 ft	H=426.6489 ft
M=410.2221 ft	M=410.3845 ft	M=411.0924 ft	M=416.0761 ft	M=416.3332 ft	M=416.3437 ft	M=416.4167 ft	M=422.4128 ft	M=422.4298 ft	M=423.3696 ft	M=426.6489 ft
R=412.25 ft	R=418 ft	R=418 ft	R=418 ft	R=416.4 ft	R=416.5 ft	R=417 ft	R=423 ft	R=424.5 ft	R=427.5 ft	R=429 ft
I=408.5 ft	I=408.9 ft	I=409.7 ft	I=412.9 ft	I=413.4 ft	I=413.5 ft	I=416 ft	I=422 ft	I=418.5 ft	I=421 ft	I=422.5 ft

APPENDIX D
CONCEPTUAL EXHIBITS

Exhibit A - Floodplain Storage with Partial Building Removal Concept
Exhibit B - Floodplain Storage with Full Building Removal Concept
Exhibit C - Audubon Pipe System Improvements and Upstream Detention Concept
Exhibit D - Arnett Boulevard Pipe System Improvements Concept - Option-1
Exhibit E - Arnett Boulevard Pipe System Improvements Concept - Option-2
Exhibit F - Arnett Boulevard Pipe System Improvements Concept - Option-3

1
ARNETT E W HEIRS & JONES & MARKHAM
ERIC C HEIRS & JONES LAMAR JR &
EDWARD MILES & OTHERS
ASTOR COURT

2
RMC INVESTMENTS LLC
1098 RIVERSIDE DRIVE

3
RMC INVESTMENTS LLC
1098 RIVERSIDE DR

4
JEB REALTY LLC
AUDUBAUN DR

5

6
OMEGA ENTERPRISES
OF VIRGINIA
2012 RIVERSIDE DR

7
K HC ASSOCIATES
2016 RIVERSIDE DR

MARHAM FELIX
DONALDSON IV
AUDUBAUN DR

PATEL P N & K D &
SAVITABEN A & N K
AUDUBAUN DR

JEB REALTY LLC
AUDUBAUN DRIVE

XS-878

XS-626

XS-1189

PROPOSED
40' BERM
TOP=425.0 FT.

EFFECTIVE 100 YR
FLOODPLAIN

GRADING IN FLOODWAY
TO PROVIDE VOLUME
FOR BACKWATER

EFFECTIVE
FLOODWAY

PROPOSED WALL
CAST IN PLACE

PROPOSED STREAM
RELOCATION

TOP=421.0 FT.

TOP=420.5 FT.

TOP=419.5 FT.

TOP=419.0 FT.

PROPOSED 1 COURSE
GABION BASKETS
TO EXTEND 360 LF
UPSTREAM

PROPOSED WALL
SEGMENTAL BLOCK
TOP=421.0 FT.

PROPOSED
CURB AND GUTTER

AUDUBON DR

APOLLO AVE

RIVERSIDE DR

SCALE: 1" = 60'

0 30 60 120

LEGEND

- PROPERTY BOUNDARY
- PROPOSED BERM
- PROPOSED WALL CAST IN PLACE
- PROPOSED WALL SEGMENTAL BLOCK
- PROPOSED GABION BASKETS
- EFFECTIVE FLOODWAY
- EFFECTIVE 100-YR FLOODPLAIN
- CUT

THIS DRAWING PREPARED AT THE
RALEIGH OFFICE
5410 Trinity Road, Suite 102, Raleigh, NC 27607
TEL 919.866.4951 FAX 919.833.8174 www.timmons.com
North Carolina License No. C-1652

YOUR VISION ACHIEVED THROUGH OURS.

REVISION DESCRIPTION

DATE

DATE 3-16-2022
DRAWN BY S. Vandergrift
DESIGNED BY A.Asfaw
CHECKED BY B.Ward
SCALE

TIMMONS GROUP

APPLE BRANCH ENGINEERING STUDY
CITY OF DANVILLE - VIRGINIA
FLOODPLAIN STORAGE WITH PARTIAL BUILDING REMOVAL CONCEPT

JOB NO. 47097
SHEET NO. EXHIBIT A

1
ARNETT E W HEIRS & JONES & MARKHAM
ERIC C HEIRS & JONES LAMAR JR &
EDWARD MILES & OTHERS
ASTOR COURT

2
RMC INVESTMENTS LLC
1098 RIVERSIDE DRIVE

3
RMC INVESTMENTS LLC
1098 RIVERSIDE DR

4
JEB REALTY LLC
AUDUBAUN DR

5

6
OMEGA ENTERPRISES
OF VIRGINIA
2012 RIVERSIDE DR

7
K HC ASSOCIATES
2016 RIVERSIDE DR

EFFECTIVE 100 YR
FLOODPLAIN

GRADING IN FLOODWAY
TO PROVIDE VOLUME
FOR BACKWATER

EFFECTIVE
FLOODWAY

PROPOSED
40' BERM
TOP=425.0 FT.

PROPOSED WALL
CAST IN PLACE

XS-1189

XS-878

XS-626

TOP=420.0 FT.

TOP=419.5 FT.

TOP=418.5 FT.

TOP=418.0 FT.

AUDUBON DR

APOLLO AVE

RIVERSIDE DR

JEB REALTY LLC
AUDUBAUN DRIVE

PROPOSED 1 COURSE
GABION BASKETS
TO EXTEND 360 LF
UPSTREAM

PROPOSED WALL
SEGMENTAL BLOCK
TOP=420.0 FT.

PROPOSED
CURB AND GUTTER

PROPOSED WALL
CAST IN PLACE

MARHAM FELIX
DONALDSON IV
AUDUBAUN DR

PATEL P N & K D &
SAVITABEN A & N K
AUDUBAUN DR

DATUM:
HORIZONTAL - NAD83
VERTICAL - NAVD88

SCALE: 1" = 60'

0 30 60 120

LEGEND

- PROPERTY BOUNDARY
- PROPOSED BERM
- PROPOSED WALL CAST IN PLACE
- PROPOSED WALL SEGMENTAL BLOCK
- PROPOSED GABION BASKETS
- EFFECTIVE FLOODWAY
- EFFECTIVE 100-YR FLOODPLAIN
- CUT
- PROPOSED CONTOURS

THIS DRAWING PREPARED AT THE
RALEIGH OFFICE
5410 Trinity Road, Suite 102 Raleigh, NC 27607
TEL 919.866.4951 FAX 919.833.8714 www.timmons.com
North Carolina License No. C-1652

YOUR VISION ACHIEVED THROUGH OURS.

REVISION DESCRIPTION

DATE

DATE 3-16-2022
DRAWN BY S. Vandergrift
DESIGNED BY A.Asfaw
CHECKED BY B.Ward
SCALE

TIMMONS GROUP

APPLE BRANCH ENGINEERING STUDY
CITY OF DANVILLE - VIRGINIA
FLOODPLAIN STORAGE WITH FULL BUILDING REMOVAL CONCEPT

JOB NO. 47097
SHEET NO. EXHIBIT B

FLOODPLAIN STORAGE WITH PARTIAL OR FULL BUILDING REMOVAL EXHIBITS A OR B

EFFECTIVE 100-YR FLOODPLAIN

EFFECTIVE FLOODWAY

ARNETT E W HEIRS & JONES & MARKHAM ERIC C HEIRS & JONES LAMAR JR & EDWARD MILES & OTHERS ASTOR COURT

RMC INVESTMENTS LLC 1098 RIVERSIDE DR

RMC INVESTMENTS LLC 1098 RIVERSIDE DR

OMEGA ENTERPRISES OF VIRGINIA 2012 RIVERSIDE DR

JEB REALTY LLC AUDUBAUN DRIVE

JEB REALTY LLC AUDUBAUN DR

K HC ASSOCIATES 2016 RIVERSIDE DR

RIVERSIDE DR

AUDUBON DR

APOLLO AVE

MARHAM FELIX DONALDSON IV AUDUBAUN DR

PATEL P N & K D & SAVITABEN A & N K AUDUBAUN DR

JHR PROPERTIES LLC 2104 RIVERSIDE DR

MORGAN JAMES P JR & MAHLER BONNE RAE MORGAN 119 AUDUBAUN DR

WARREN LYDIA LEE HARLEY SUMMIT RD

L AND G RENTALS LLC SUMMIT RD

SHIELDS INVESTMENTS CO INC 201 AUDUBAUN DRIVE

INV.=414.32 FT.

EXISTING CB TOP=422.44 FT. EXISTING 48" RCP

EXISTING 18" RCP

EXISTING CB TOP=419.22 FT.

INV.=415.07 FT.

EXISTING CB TOP=420.93 FT.

EXISTING 15" RCP

EXISTING CB TOP=422.75 FT.

PROPOSED JB

PROPOSED 48" RCP

PROPOSED DRAINAGE PIPE

EXISTING CB TOP=420.76 FT.

EXISTING CB TOP=419.81 FT.

PROPOSED 18 INCH BACKFLOW VALVE.

PROPOSED 15 INCH BACKFLOW VALVE.

PROPOSED POND STORAGE

PROPOSED ADDITIONAL 48" RCP

EXISTING 48" RCP

PROPOSED POND STORAGE

130 LF OF PROPOSED 42" CLASS IV RCP

PROPOSED JB-3

PROPOSED FES-5 WITH BACKFLOW VALVE

42 LF OF PROPOSED 42" CLASS IV RCP

PROPOSED JB-4

206 LF OF PROPOSED 36" CLASS IV RCP

REMOVE OR GROUT

10 LF OF PROPOSED 30" CLASS IV RCP

PROPOSED JB-1

EXISTING CI TO BE REPLACED

EXISTING CB TOP=416.03 FT.

PROPOSED JB-2

72 LF OF PROPOSED 36" CLASS IV RCP

LEGEND

- PROPERTY BOUNDARY
- EXISTING SANITARY SEWER
- EXISTING GAS LINE
- EXISTING WATERLINE
- EXISTING FIBER OPTIC
- EXISTING UNDERGROUND ELECTRIC
- EXISTING STORM DRAINAGE
- PROPOSED STORM DRAINAGE
- PROPOSED SANITARY SEWER
- UTILITY CONFLICT SANITARY SEWER
- UTILITY CONFLICT GAS
- UTILITY CONFLICT FIBER OPTIC
- UTILITY CONFLICT WATER
- EFFECTIVE FLOODWAY
- EFFECTIVE 100-YR FLOODPLAIN

SCALE: 1" = 50'

0 25 50 100

THIS DRAWING PREPARED AT THE
RALEIGH OFFICE
5410 Trinity Road, Suite 102 Raleigh, NC 27607
TEL 919.866.4951 FAX 919.833.8124 www.timmons.com
North Carolina License No. C-1652

YOUR VISION ACHIEVED THROUGH OURS.

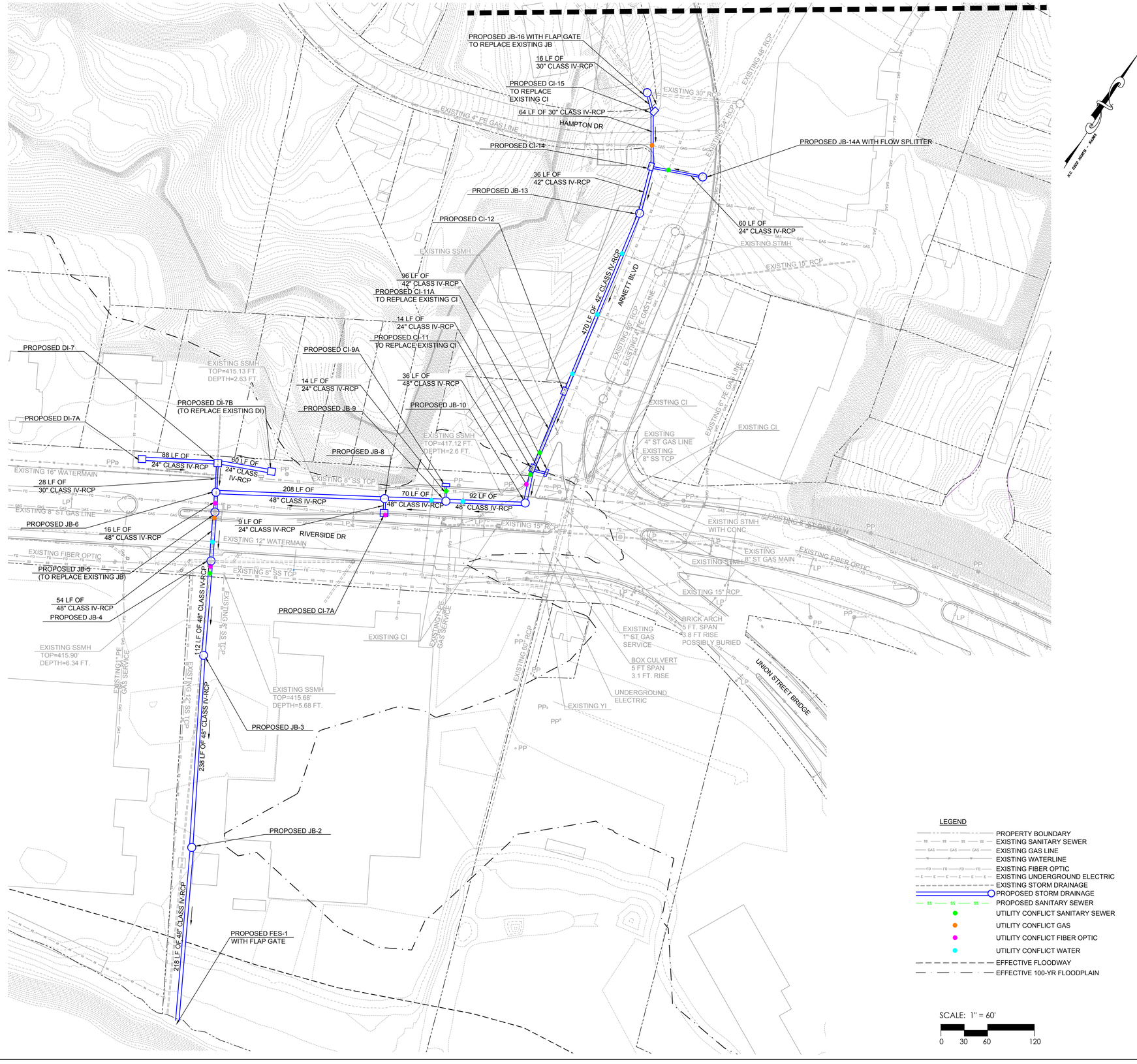
DATE	REVISION DESCRIPTION

DATE: 3-16-2022
DRAWN BY: S. Vandergrift
DESIGNED BY: C. Rogers
CHECKED BY: C. Rogers
SCALE: 1" = 50'

TIMMONS GROUP

APPLE BRANCH ENGINEERING STUDY
CITY OF DANVILLE - VIRGINIA
AUDUBON PIPE SYSTEM IMPROVEMENTS AND UPSTREAM DETENTION CONCEPT

JOB NO. 47097
SHEET NO. EXHIBIT C



THIS DRAWING PREPARED AT THE
RALEIGH OFFICE
5410 Trinity Road, Suite 102 Raleigh, NC 27607
TEL 919.866.4951 FAX 919.833.8124 www.timmons.com
North Carolina License No. C-1652

YOUR VISION ACHIEVED THROUGH OURS.

DATE	REVISION DESCRIPTION

DATE: 12-17-21
DRAWN BY: S.VANDERGRIFT
DESIGNED BY: A.ASFAW
CHECKED BY: B.WARD
SCALE:

TIMMONS GROUP

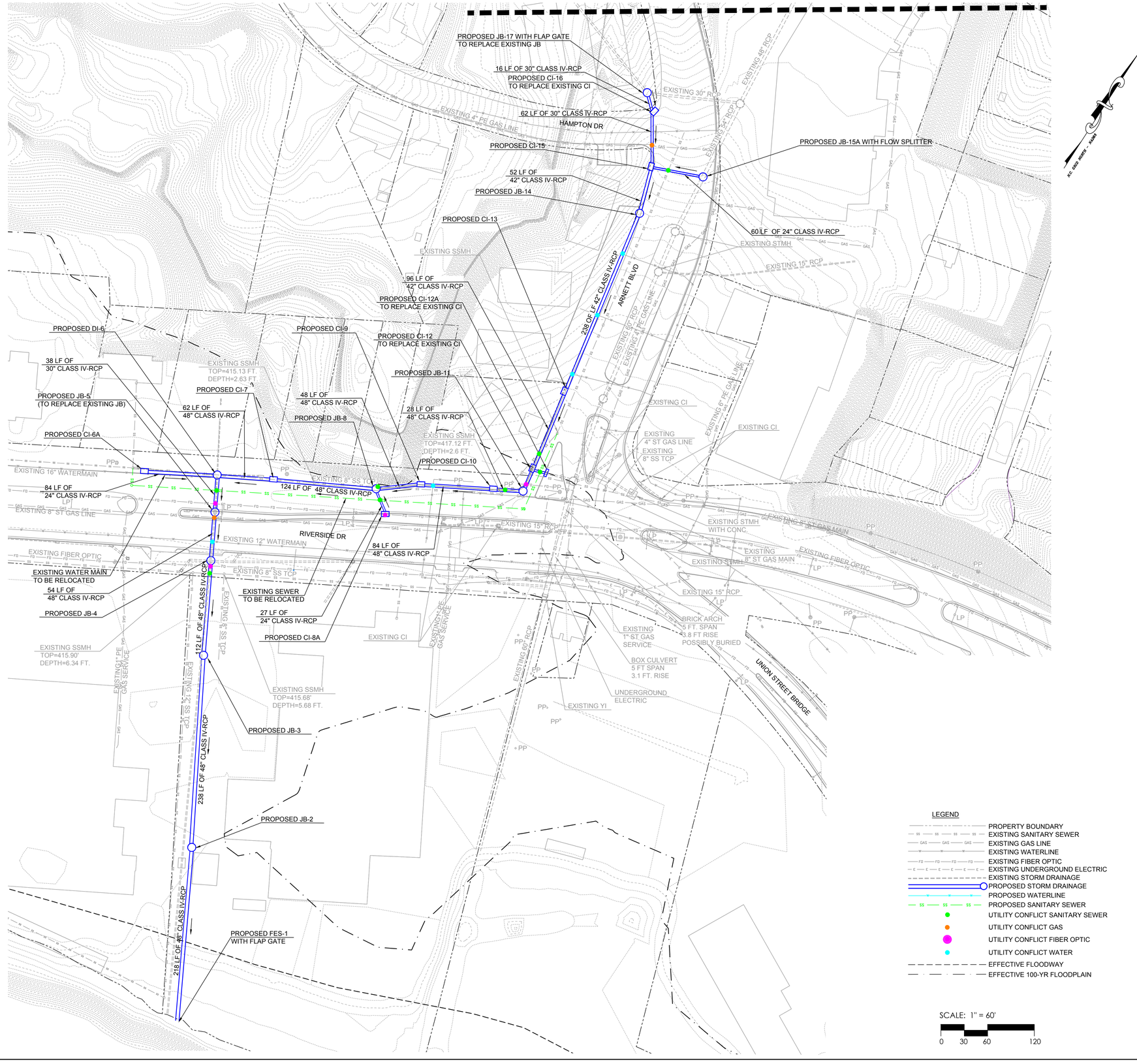
APPLE BRANCH ENGINEERING STUDY

CITY OF DANVILLE- VIRGINIA

ARNETT DRIVE PIPE SYSTEM IMPROVEMENTS CONCEPT - OPTION 1

JOB NO. 47097

SHEET NO. EXHIBIT D



LEGEND

- PROPERTY BOUNDARY
- EXISTING SANITARY SEWER
- EXISTING GAS LINE
- EXISTING WATERLINE
- EXISTING FIBER OPTIC
- EXISTING UNDERGROUND ELECTRIC
- EXISTING STORM DRAINAGE
- PROPOSED STORM DRAINAGE
- PROPOSED WATERLINE
- PROPOSED SANITARY SEWER
- UTILITY CONFLICT SANITARY SEWER
- UTILITY CONFLICT GAS
- UTILITY CONFLICT FIBER OPTIC
- UTILITY CONFLICT WATER
- EFFECTIVE FLOODWAY
- EFFECTIVE 100-YR FLOODPLAIN

SCALE: 1" = 60'

0 30 60 120

THIS DRAWING PREPARED AT THE
RALEIGH OFFICE
5410 Trinity Road, Suite 102 Raleigh, NC 27607
TEL 919.866.4951 FAX 919.833.8124 www.timmons.com
North Carolina License No. C-1652

YOUR VISION ACHIEVED THROUGH OURS.

TIMMONS GROUP

DATE	REVISION DESCRIPTION

DATE: 12-17-21
DRAWN BY: S.VANDERGRIFT
DESIGNED BY: A.ASFAW
CHECKED BY: B.WARD
SCALE:

APPLE BRANCH ENGINEERING STUDY

CITY OF DANVILLE- VIRGINIA

ARNETT DRIVE PIPE SYSTEM IMPROVEMENTS CONCEPT - OPTION 2

JOB NO. 47097

SHEET NO. EXHIBIT E

MATCHLINE

PROPOSED JB-14
PROPOSED 30" RCP
20 LF
PROPOSED CI-13
PROPOSED 30" RCP
104 LF
EXISTING 30" RCP TO BE ABANDONED
110 LF
HAMPTON DR
PROPOSED CI-12
EXISTING 54" RCP TO BE ABANDONED
102 LF
PROPOSED CI
PROPOSED 54" RCP
160 LF
PROPOSED 30" RCP
52 LF
PROPOSED JB-11
PROPOSED DI-9
EXISTING SSMH
EXISTING STMH
EXISTING 15" RCP
ARNETT BLVD
PROPOSED 18" RCP
92 LF
PROPOSED JB-10
PROPOSED CI-8
EXISTING 15" RCP
(TO BE ABANDONED)
EXISTING SSMH
TOP=415.13 FT.
DEPTH=2.63 FT.
PROPOSED 48" RCP
168 LF
PROPOSED 18 " RCP
60 LF
PROPOSED JB-6
PROPOSED 18 " RCP
88 LF
PROPOSED DI-16
PROPOSED 24" RCP
40 LF
PROPOSED DI-15
(TO REPLACE EXISTING DI
EXISTING JB-7 TO BE REPLACED
PROPOSED 48" RCP
76 LF
PROPOSED DI-17
EXISTING CI
EXISTING RCP TO BE ABANDONED
EXISTING SSMH
TOP=417.12 FT.
DEPTH=2.6 FT.
EXISTING
4" ST GAS LINE
EXISTING
8" SS TCP
PROPOSED CI-5
PROPOSED BACK FLOW VALVE
PROPOSED 48" RCP
72 LF
EXISTING 16" WATERMAIN
EXISTING 8" SS TCP
PROPOSED JB-4
PROPOSED 48" RCP
48 LF
EXISTING 8" ST GAS LINE
EXISTING STMH
WITH CONC.
PROPOSED JB-18
EXISTING 15" RCP
EXISTING
8" ST GAS MAIN
RIVERSIDE DR
PROPOSED 54" RCP
38 LF
EXISTING 12" WATERMAIN
EXISTING FIBER OPTIC
EXISTING STMH
PROPOSED 30" RCP
EXISTING 8" SS TCP
PROPOSED CI-3
BRICK ARCH
5 FT. SPAN
3.8 FT RISE
POSSIBLY BURIED
PROPOSED JB-19
EXISTING
1" ST GAS
SERVICE
EXISTING SSMH
TOP=415.90'
DEPTH=6.34 FT.
EXISTING CI
EXISTING 12" SS TCP
EXISTING 60" RCP
BOX CULVERT
5 FT SPAN
3.1 FT. RISE
UNION STREET BRIDGE
EXISTING SSMH
TOP=415.68'
DEPTH=5.68 FT.
UNDERGROUND
ELECTRIC
EXISTING YI
PROPOSED YI -2 T
PROPOSED 48" RCP PARALLEL TO EXISTING
TO BE PLACED ON A CONCRETE FILL TO
SPRING LINE OR PIPE 336 LF
PROPOSED HW-T
EXISTING SWALE TO BE IMPROVED

EXISTING STORAGE AREA TO
BE PRESERVED AS PERMANENT
DRAINAGE EASEMENT
ARNETT DR
MATCHLINE
EXISTING 48" RCP
EXISTING 30" RCP TO BE ABANDONED
110 LF
EXISTING 30" RCP

POND STORAGE AREA
SCALE: 1" = 60'
0 30 60 120

LEGEND
- PROPERTY BOUNDARY
- EXISTING SANITARY SEWER
- EXISTING GAS LINE
- EXISTING WATERLINE
- EXISTING FIBER OPTIC
- EXISTING UNDERGROUND ELECTRIC
- EXISTING STORM DRAINAGE
- PROPOSED STORM DRAINAGE
- UTILITY CONFLICT SANITARY SEWER
- UTILITY CONFLICT GAS
- UTILITY CONFLICT FIBER OPTIC
- UTILITY CONFLICT WATER
- EFFECTIVE FLOODWAY
- EFFECTIVE 100-YR FLOODPLAIN

SCALE: 1" = 60'
0 30 60 120

THIS DRAWING PREPARED AT THE
RALEIGH OFFICE
5410 Trinity Road, Suite 102 Raleigh, NC 27607
TEL 919.866.4951 FAX 919.833.8124 www.timmons.com
North Carolina License No. C-1652

YOUR VISION ACHIEVED THROUGH OURS.

TIMMONS GROUP

REVISION DESCRIPTION

DATE

DATE
12-17-21
DRAWN BY
S.VANDERGRIFT
DESIGNED BY
A.ASFAW
CHECKED BY
B.WARD
SCALE

APPLE BRANCH ENGINEERING STUDY

CITY OF DANVILLE- VIRGINIA

ARNETT DRIVE PIPE SYSTEM IMPROVEMENTS CONCEPT - OPTION 3

JOB NO.
47097
SHEET NO.
EXHIBIT F

APPENDIX E
BUDGETARY COST ESTIMATE

Apple Branch - Floodplain Storage with Partial Building Removal
Apple Branch - Floodplain Storage with Total Building Removal
Apple Branch - Arnett Boulevard Storm Drain Improvement Concept-1
Apple Branch - Arnett Boulevard Storm Drain Improvement Concept-2
Apple Branch - Arnett Boulevard Storm Drain Improvement Concept-3

City of Danville, Virginia
Apple Branch-Floodplain Storage with Partial Building Removal
Engineer's Budgetary Estimate
Date: 3/15/2022

Item	Item Description	Units	Scheduled Quantity	Unit Price ($)	Total Amount
1.00	**Site Preparation and Demolition**				
1.01	Clearing and Grubbing	SY	8000	$10.00	$80,000.00
1.02	Tree Removal	EA	50	$1,500.00	$75,000.00
1.03	Building Overhang Removal (Outbuilding and Stream Crossing at 2012 Riverside Drive)	LS	1	$4,920.00	$4,920.00
1.04	Pavement Removal (Existing Parking Lot)	SY	2220	$40.00	$88,800.00
1.05	Pedestrian Bridge Removal	LS	1	$10,000.00	$10,000.00
1.06	Vehicle Bridge Removal	LS	1	$20,000.00	$20,000.00
1.07	Retaining Wall Removal (at 2012 Riverside Drive)	LF	1	$5,000.00	$5,000.00
1.08	Debris Removal	LS	1	$5,000.00	$5,000.00
2.00	**Floodplain Grading**				
2.01	Unclassified Excavation	CY	10000	$45.00	$450,000.00
2.02	Fill and Compaction	CY	2250	$50.00	$112,500.00
2.03	Haul-Off of Excess Material	CY	11570	$50.00	$578,500.00
2.04	Fine Grading	SY	4500	$25.00	$112,500.00
3.00	**Retaining Wall and Berm Flood Barrier (Permanent Height)**				
3.01	Retaining Wall (CIP - Engineered Reinforced Concrete)	CY	360	$900.00	$324,000.00
3.02	Retaining Wall (segmental block)	SF	4300	$25.00	$107,500.00
3.03	Footer (8'x2')	CY	700	$900.00	$630,000.00
3.04	Undercut (under retaining wall footer - assume 1 foot depth for the width of the footer)	CY	350	$50.00	$17,500.00
3.05	Berm Fill and Compaction	CY	900	$30.00	$27,000.00
3.06	Gabion Baskets	LF	200	$60.00	$12,000.00
3.07	Backflow Valve (Tideflex Checkmate In-Line Check Valves) (In existing 15-inch RCP)	EA	1	$2,900.00	$2,900.00
3.08	Flowable Fill Grout (To abandon existing storm pipe under corner buildings)	CY	9	$350.00	$3,150.00
3.09	Repair wall for overhang	LS	1	$3,600.00	$3,600.00
4.00	**Temporary Wall Height Extension (Required with Existing Culvert)**				
4.01	Flashboard Riser (Lumber and Steel Grooved Posts 2.5 ft high)	SF	1150	$450.00	$517,500.00
5.00	**Detention Basins at Audubon and Apollo Drive**				
5.01	Clearing and Grubbing	SY	4550	$10.00	$45,500.00
5.02	Unclassified Excavation	CY	5060	$45.00	$227,700.00
5.03	Haul-Off of Excess Material	CY	4060	$50.00	$203,000.00
5.04	Fill and Compaction	CY	1000	$50.00	$50,000.00
5.05	Fine Grading	SY	4550	$25.00	$113,750.00
5.06	Junction Box	EA	2	$6,000.00	$12,000.00
5.07	Backflow Valve (Tideflex Checkmate In-Line Check Valves) (In existing 48-inch RCP Culvert)	EA	2	$26,500.00	$53,000.00
6.00	**Stream Relocation/Stabilization**				
6.01	Stream Channel Excavation/Fill/Grading	CY	3820	$60.00	$229,200.00
6.02	Furnish and Install Rooted Plant Plugs	EA	1500	$15.00	$22,500.00
6.03	Furnish and Install Riparian Seed Mix	SY	5000	$6.00	$30,000.00

City of Danville, Virginia
Apple Branch-Floodplain Storage with Partial Building Removal
Engineer's Budgetary Estimate
Date: 3/15/2022

Item	Item Description	Units	Scheduled Quantity	Unit Price ($)	Total Amount
6.04	Furnish and Install Class II Constructed Riffle	SY	220	$200.00	$44,000.00
6.05	Furnish, Install, Maintain, and Remove Temporary Bridge Mat Stream Crossing	WEEK	8	$2,000.00	$16,000.00
6.06	Furnish and Install C-700 Erosion Control Fabric with notched wooden stakes for installation	SY	3000	$10.00	$30,000.00
6.07	Rock Toe Protection (Class II)	CY	170	$120.00	$20,400.00
6.08	Boulders	EA	20	$200.00	$4,000.00
6.09	Riprap Approach Apron	CY	120	$120.00	$14,400.00
7.00	**Erosion and Sediment Control**				
7.01	Furnish, Install, Maintain, and Remove Temporary Construction Entrance	TN	150	$80.00	$12,000.00
7.02	Furnish, Install, Maintain, and Remove Pump Around (Sufficient to Pump Apple Branch Normal Flow)	Week	8	$2,000.00	$16,000.00
7.03	Furnish, Install, Maintain, and Remove Temporary Check Dam	EA	5	$300.00	$1,500.00
7.04	Furnish and Install Temporary Seeding	SY	6000	$1.50	$9,000.00
7.05	Furnish and Install Permanent Seeding	SY	6000	$2.50	$15,000.00
7.06	Furnish and Install Straw Mulch	BALE	4000	$10.00	$40,000.00
7.07	Silt Fence	LF	2500	$5.00	$12,500.00
7.08	Tree Protection Fence	LF	2500	$4.00	$10,000.00
7.09	Erosion Control Matting (Curlex Type II)	SY	5000	$7.00	$35,000.00
7.10	Inlet Protection	EA	10	$400.00	$4,000.00
8.00	**Storm Drainage System (Improvements at Audubon/Riverside Intersection)**				
8.01	36" RCP (Gasketed)	LF	400	$120.00	$48,000.00
8.02	42" RCP (Gasketed)	LF	48	$130.00	$6,240.00
8.03	Curb Inlet Catch Basin (VDOT Standard)	EA	2	$6,000.00	$12,000.00
8.04	Junction Box Manhole (VDOT Standard)	EA	4	$6,000.00	$24,000.00
8.05	Flared End Section (VDOT Standard)	EA	1	$4,000.00	$4,000.00
8.06	Backflow Valve (Tideflex Checkmate In-Line Check Valves)	EA	1	$17,500.00	$17,500.00
8.07	Pavement Removal (Riverside Drive/Audubon Drive)	SY	1000	$40.00	$40,000.00
8.08	Utility Relocate - Water Main	EA	3	$5,000.00	$15,000.00
8.09	Utility Relocate - Sewer Main	EA	4	$9,000.00	$36,000.00
8.10	Utility Relocate - Fiber Optics	EA	2	$10,000.00	$20,000.00
8.11	Utility Relocate - Gas Main	EA	3	$6,000.00	$18,000.00
8.12	Pipe Bedding - #57 Stone (Up to Spring line of Pipe)	CY	300	$50.00	$15,000.00
8.13	Trench Backfill - ABC (In Roadway/Parking Lot Areas)	SY	700	$80.00	$56,000.00
8.14	Asphalt Pavement (Riverside Drive/Audubon Drive) (Includes ABC, Intermediate, and Surface Courses)	SY	1000	$250.00	$250,000.00
8.15	Traffic Control	LS	1	$20,000.00	$20,000.00
9.00	**Site Improvements - 2012 Riverside Drive**				
9.01	Curb and Gutter	LF	380	$60.00	$22,800.00
9.02	Asphalt Pavement for Parking Lot (Includes ABC and Surface Course)	SY	900	$180.00	$162,000.00

City of Danville, Virginia
Apple Branch-Floodplain Storage with Partial Building Removal
Engineer's Budgetary Estimate
Date: 3/15/2022

Item	Item Description	Units	Scheduled Quantity	Unit Price ($)	Total Amount
9.03	Concrete Sidewalk 5' Wide	SY	90	$90.00	$8,100.00
10.00	**Miscellaneous**				
10.01	Project Video and Photographs (per project)	EA	1	$500.00	$500.00
10.02	Construction Project Staking and Surveying	LS	1	$5,000.00	$5,000.00
10.03	Contract Mobilization (maximum 5%)	LS	1		$261,898.00
10.04	Contingency (20%)	%	20%		$1,047,592.00
				Construction Estimate Total =	**$6,547,450.00**
12.00	**Building Purchase cost and Easement**				
12.01	Omega Enterprises of Virginia 20112 Riverside Dr	LS	1	$40,000.00	$40,000.00
12.02	Jeb Reality LLS Audubon Dr-1	LS	1	$180,000.00	$180,000.00
12.03	Jeb Reality LLS Audubon Dr-2	LS	1	$10,000.00	$10,000.00
12.04	Shields Investments Co. Inc, 221 Audubon Dr	LS	1	$130,000.00	$130,000.00
12.05	Land G rental LLC Summit Rd	LS	1	$8,000.00	$8,000.00
12.06	Adjacent building easement	LS	1	$8,000.00	$8,000.00
				Property Purchase and Easement Total =	**$376,000.00**
				Project Budget Total =	**$6,923,450.00**

City of Danville, Virginia
Apple Branch-Floodplain Storage with Total Building Removal
Engineer's Budgetary Estimate
Date: 3/15/2022

Item	Item Description	Units	Scheduled Quantity	Unit Price ($)	Total Amount
1.00	**Site Preparation and Demolition**				
1.01	Clearing and Grubbing	SY	8000	$10.00	$80,000.00
1.02	Tree Removal	EA	50	$1,500.00	$75,000.00
1.03	Building Removal (Total building removal at 2012 Riverside Drive)	LS	1	$80,000.00	$80,000.00
1.04	Pavement Removal (Existing Parking Lot)	SY	2220	$40.00	$88,800.00
1.05	Pedestrian Bridge Removal	LS	1	$10,000.00	$10,000.00
1.06	Vehicle Bridge Removal	LS	1	$20,000.00	$20,000.00
1.07	Retaining Wall Removal (at 2012 Riverside Drive)	LS	1	$5,000.00	$5,000.00
1.08	Debris Removal	LS	1	$5,000.00	$5,000.00
2.00	**Floodplain Grading**				
2.01	Unclassified Excavation	CY	10000	$45.00	$450,000.00
2.02	Fill and Compaction	CY	2250	$50.00	$112,500.00
2.03	Haul-Off of Excess Material	CY	11570	$50.00	$578,500.00
2.04	Fine Grading	SY	4500	$25.00	$112,500.00
3.00	**Retaining Wall and Berm Flood Barrier (Permanent Height)**				
3.01	Retaining Wall (CIP - Engineered Reinforced Concrete)	CY	360	$900.00	$324,000.00
3.02	Retaining Wall (segmental block)	SF	4300	$25.00	$107,500.00
3.03	Footer (8'x2')	CY	700	$900.00	$630,000.00
3.04	Undercut (under retaining wall footer - assume 1 foot depth for the width of the footer)	CY	350	$50.00	$17,500.00
3.05	Berm Fill and Compaction	CY	900	$30.00	$27,000.00
3.06	Gabion Baskets	LF	200	$60.00	$12,000.00
4.07	Backflow Valve (Tideflex Checkmate In-Line Check Valves) (In existing 15-inch RCP)	EA	1	$2,900.00	$2,900.00
4.08	Flowable Fill Grout (To abandon existing storm pipe under corner buildings)	CY	9	$350.00	$3,150.00
4.00	**Temporary Wall Height Extension (Required with Existing Culvert)**				
4.01	Flashboard Riser (Lumber and Steel Grooved Posts 2.5 ft high)	SF	1150	$450.00	$517,500.00
5.00	**Detention Basins at Audubon and Apollo Drive**				
5.01	Clearing and Grubbing	SY	4550	$10.00	$45,500.00
5.02	Unclassified Excavation	CY	5060	$45.00	$227,700.00
5.03	Haul-Off of Excess Material	CY	4060	$50.00	$203,000.00
5.04	Fill and Compaction	CY	1000	$50.00	$50,000.00
5.05	Fine Grading	SY	4550	$25.00	$113,750.00
5.06	Junction Box	EA	2	$6,000.00	$12,000.00
5.07	Backflow Valve (Tideflex Checkmate In-Line Check Valves) (In existing 48-inch RCP Culvert)	EA	2	$26,500.00	$53,000.00
6.00	**Erosion and Sediment Control**				
6.01	Furnish, Install, Maintain, and Remove Temporary Construction Entrance	TN	150	$80.00	$12,000.00
6.02	Furnish, Install, Maintain, and Remove Pump Around (Sufficient to Pump Apple Branch Normal Flow)	Week	8	$2,000.00	$16,000.00
6.03	Furnish, Install, Maintain, and Remove Temporary Check Dam	EA	5	$300.00	$1,500.00
6.04	Furnish and Install Temporary Seeding	SY	6000	$1.50	$9,000.00

City of Danville, Virginia
Apple Branch-Floodplain Storage with Total Building Removal
Engineer's Budgetary Estimate
Date: 3/15/2022

Item	Item Description	Units	Scheduled Quantity	Unit Price ($)	Total Amount
6.05	Furnish and Install Permanent Seeding	SY	6000	$2.50	$15,000.00
6.06	Furnish and Install Straw Mulch	BALE	4000	$10.00	$40,000.00
6.07	Silt Fence	LF	2500	$5.00	$12,500.00
6.08	Tree Protection Fence	LF	2500	$4.00	$10,000.00
6.09	Erosion Control Matting (Curlex Type II)	SY	5000	$7.00	$35,000.00
6.10	Inlet Protection	EA	10	$400.00	$4,000.00
7.00	**Storm Drainage System (Improvements at Audubon/Riverside Intersection)**				
7.01	36" RCP (Gasketed)	LF	400	$120.00	$48,000.00
7.02	42" RCP (Gasketed)	LF	48	$130.00	$6,240.00
7.03	Curb Inlet Catch Basin (VDOT Standard)	EA	2	$6,000.00	$12,000.00
7.04	Junction Box Manhole (VDOT Standard)	EA	4	$6,000.00	$24,000.00
7.05	Flared End Section (VDOT Standard)	EA	1	$4,000.00	$4,000.00
7.06	Backflow Valve (Tideflex Checkmate In-Line Check Valves)	EA	1	$17,500.00	$17,500.00
7.07	Pavement Removal (Riverside Drive/Audubon Drive)	SY	1000	$40.00	$40,000.00
7.08	Utility Relocate - Water Main	EA	3	$5,000.00	$15,000.00
7.09	Utility Relocate - Sewer Main	EA	4	$9,000.00	$36,000.00
7.10	Utility Relocate - Fiber Optics	EA	2	$10,000.00	$20,000.00
7.11	Utility Relocate - Gas Main	EA	3	$6,000.00	$18,000.00
7.12	Pipe Bedding - #57 Stone (Up to Spring line of Pipe)	CY	300	$50.00	$15,000.00
7.13	Trench Backfill - ABC (In Roadway/Parking Lot Areas)	SY	700	$80.00	$56,000.00
7.14	Asphalt Pavement (Riverside Drive/Audubon Drive) (Includes ABC, Intermediate, and Surface Courses)	SY	1000	$250.00	$250,000.00
7.15	Traffic Control	LS	1	$20,000.00	$20,000.00
8.00	**Site Improvements - 2012 Riverside Drive**				
8.01	Curb and Gutter	LF	380	$60.00	$22,800.00
8.02	Asphalt Pavement for Parking Lot (Includes ABC and Surface Course)	SY	900	$180.00	$162,000.00
8.03	Concrete Sidewalk 5' Wide	SY	90	$90.00	$8,100.00
9.00	**Miscellaneous**				
9.01	Project Video and Photographs (per project)	EA	1	$500.00	$500.00
9.02	Construction Project Staking and Surveying	LS	1	$5,000.00	$5,000.00
9.03	Contract Mobilization (maximum 5%)	LS	1		$244,947.00
9.04	Contingency (20%)	%	20%		$979,788.00
				Construction Estimate Total =	**$6,123,675.00**
10.00	**Building Purchase cost and Easement**				
10.01	K HC Associates 2016 Riverside Dr	LS	1	$400,000.00	$400,000.00
10.02	OMEGA Enterprises of Virginia 20112 Riverside Dr	LS	1	$490,000.00	$490,000.00
10.03	Jeb Reality LLS Audubon Dr-1	LS	1	$180,000.00	$180,000.00
10.04	Jeb Reality LLS Audubon Dr-2	LS	1	$10,000.00	$10,000.00

City of Danville, Virginia
Apple Branch-Floodplain Storage with Total Building Removal
Engineer's Budgetary Estimate
Date: 3/15/2022

Item	Item Description	Units	Scheduled Quantity	Unit Price ($)	Total Amount
10.05	Shields Investments Co. Inc, 221 Audubon Dr	LS	1	$130,000.00	$130,000.00
10.06	Land G rental LLC Summit Rd	LS	1	$8,000.00	$8,000.00
10.07	Adjacent building easement	LS	1	$8,000.00	$8,000.00
				Property Purchase and Easement Total =	**$1,226,000.00**
				Project Budget Total =	**$7,349,675.00**

City of Danville, Virginia

Apple Branch- Arnett Drive Storm drain Improvement Concept-1

Engineer's Budgetary Estimate

Date: 3/14/2022

Item	Item Description	Units	Scheduled Quantity	Unit Price ($)	Total Amount
1.00	**Site Preparation and Demolition**				
1.01	Clearing and Grubbing	SY	1000	$10.00	$10,000.00
1.02	Pavement Removal (Riverside Drive/Arnet Drive)	SY	1200	$40.00	$48,000.00
1.03	Curb Inlet	EA	3	$1,000.00	$3,000.00
1.04	Drop Inlet	EA	2	$1,000.00	$2,000.00
1.05	Curb	LF	400	$250.00	$100,000.00
1.06	Storm Manhole	EA	3	$1,500.00	$4,500.00
1.07	RCP Pipe (Storm Sewer)	LF	850	$80.00	$68,000.00
1.08	SVT/TRC Pipe (Sanitary Sewer)	LF	600	$60.00	$36,000.00
1.09	Sanitary Sewer Manhole	EA	5	$1,500.00	$7,500.00
1.10	Debris Removal	LS	1	$5,000.00	$5,000.00
2.00	**Erosion and Sediment Control**				
2.01	Furnish, Install, Maintain, and Remove Temporary Construction Entrance	TN	150	$80.00	$12,000.00
2.02	Silt Fence	LF	50	$5.00	$250.00
2.03	Safety Fence	LF	3500	$4.00	$14,000.00
2.04	Erosion Control Matting	SY	1000	$7.00	$7,000.00
2.05	Inlet Protection	EA	10	$400.00	$4,000.00
3.00	**Storm Drainage System (Improvements at Arnett/Riverside Intersection)**				
3.01	24" RCP (Gasketed)	LF	300	$110.00	$33,000.00
3.02	36" RCP (Gasketed)	LF	100	$120.00	$12,000.00
3.03	42" RCP (Gasketed)	LF	400	$130.00	$52,000.00
3.04	48" RCP (Gasketed)	LF	110	$150.00	$16,500.00
3.05	Curb Inlet Catch Basin (VDOT Standard)	EA	10	$10,000.00	$100,000.00
3.06	Junction Box Manhole (VDOT Standard)	EA	9	$12,000.00	$108,000.00
3.07	Head Wall (VDOT Standard)	EA	1	$15,000.00	$15,000.00
3.08	Backflow Valve	EA	1	$17,500.00	$17,500.00
3.09	Utility Crossing - Fiber Optics	EA	4	$10,000.00	$40,000.00
3.10	Utility Crossing - Gas Lines	EA	3	$6,000.00	$18,000.00
3.11	Utility Crossing - Water Lines	EA	5	$5,000.00	$25,000.00
3.12	Utility Crossing - Sewer Lines	EA	6	$9,000.00	$54,000.00
3.13	Pipe Bedding - #57 Stone (Up to Spring line of Pipe)	CY	1000	$50.00	$50,000.00
3.14	Trench Backfill - ABC (In Roadway/Parking Lot Areas)	SY	1200	$80.00	$96,000.00
3.15	Asphalt Pavement (Riverside Drive/Arnett Drive) (Includes ABC, Intermediate, and Surface Courses)	SY	1200	$250.00	$300,000.00
3.16	Traffic Control	LS	1	$20,000.00	$20,000.00
3.17	Curb and Gutter	LF	200	$60.00	$12,000.00
4.00	**Miscellaneous**				
4.01	Project Video and Photographs (per project)	EA	1	$500.00	$500.00

4.02	Construction Project Staking and Surveying	LS	1	$5,000.00	$5,000.00
4.03	Contract Mobilization (maximum 5%)	LS	1		$64,787.50
4.04	Contingency (20%)	%	20%		$259,150.00
				Construction Estimate Total =	**$1,619,687.50**
5.00	**Estimated Permanent Easement Cost**				
5.01	1063 Riverside Dr, Danville, VA 24540 and 1001 Riverside Dr, Danville, VA 24540	EA	1	$96,000.00	$96,000.00
5.02	125 Arnett Blvd, Danville, VA 24540	EA	1	$15,000.00	$15,000.00
5.03	1002 Riverside Dr, Danville, VA 24540	EA	1	$10,000.00	$10,000.00
5.04	145 Arnett Blvd, Danville, VA 24540	EA	1	$40,000.00	$40,000.00
				Property Purchase and Easement Total =	**$161,000.00**
				Project Budget Total =	**$1,780,687.50**

City of Danville, Virginia

Apple Branch- Arnett Drive Storm drain Improvement Concept-2

Engineer's Budgetary Estimate

Date: 3/14/2022

Item	Item Description	Units	Scheduled Quantity	Unit Price ($)	Total Amount
1.00	**Site Preparation and Demolition**				
1.01	Clearing and Grubbing	SY	1000	$10.00	$10,000.00
1.02	Pavement Removal (Riverside Drive/Arnet Drive)	SY	1500	$40.00	$60,000.00
1.03	Curb Inlet	EA	3	$1,000.00	$3,000.00
1.04	Drop Inlet	EA	2	$1,000.00	$2,000.00
1.05	Curb	LF	400	$250.00	$100,000.00
1.06	Storm Manhole	EA	3	$1,500.00	$4,500.00
1.07	RCP Pipe (Storm Sewer)	LF	850	$80.00	$68,000.00
1.08	SVT/TRC Pipe (Sanitary Sewer)	LF	600	$60.00	$36,000.00
1.09	Sanitary Sewer Manhole	EA	5	$1,500.00	$7,500.00
1.10	Debris Removal	LS	1	$5,000.00	$5,000.00
2.00	**Erosion and Sediment Control**				
2.01	Furnish, Install, Maintain, and Remove Temporary Construction Entrance	TN	150	$80.00	$12,000.00
2.02	Silt Fence	LF	50	$5.00	$250.00
2.03	Safety Fence	LF	3500	$4.00	$14,000.00
2.04	Erosion Control Matting	SY	1000	$7.00	$7,000.00
2.05	Inlet Protection	EA	10	$400.00	$4,000.00
3.00	**Storm Drainage System (Improvements at Arnett/Riverside Intersection)**				
3.01	24" RCP (Gasketed)	LF	250	$110.00	$27,500.00
3.02	36" RCP (Gasketed)	LF	100	$120.00	$12,000.00
3.03	42" RCP (Gasketed)	LF	400	$130.00	$52,000.00
3.04	48" RCP (Gasketed)	LF	1050	$150.00	$157,500.00
3.05	Curb Inlet Catch Basin (VDOT Standard)	EA	12	$6,000.00	$72,000.00
3.06	Junction Box Manhole (VDOT Standard)	EA	9	$10,000.00	$90,000.00
3.07	Head wall (VDOT Standard)	EA	1	$15,000.00	$15,000.00
3.08	Backflow Valve	EA	1	$17,500.00	$17,500.00
3.09	Utility Crossing - Fiber Optics	EA	4	$10,000.00	$40,000.00
3.10	Utility Crossing - Gas Lines	EA	3	$6,000.00	$18,000.00
3.11	Utility Crossing - Water Lines	EA	5	$5,000.00	$25,000.00
3.12	Utility Crossing - Sewer Lines	EA	1	$9,000.00	$9,000.00
3.13	Sanitary Sewer Main Relocate	LF	650	$200.00	$130,000.00
3.14	Sanitary Sewer Manhole	EA	4	$5,000.00	$20,000.00
3.15	Water Main Relocation	LF	750	$150.00	$112,500.00
3.16	Pipe Bedding - #57 Stone (Up to Spring line of Pipe)	CY	1000	$50.00	$50,000.00
3.17	Trench Backfill - ABC (In Roadway/Parking Lot Areas)	SY	1500	$80.00	$120,000.00
3.18	Asphalt Pavement (Riverside Drive/Arnett Drive) (Includes ABC, Intermediate, and Surface Courses)	SY	1500	$250.00	$375,000.00
3.19	Traffic Control	LS	1	$20,000.00	$20,000.00

3.20	Curb and Gutter	LF	200	$60.00	$12,000.00
4.00	**Miscellaneous**				
4.01	Project Video and Photographs (per project)	EA	1	$500.00	$500.00
4.02	Construction Project Staking and Surveying	LS	1	$5,000.00	$5,000.00
4.03	Contract Mobilization (maximum 5%)	LS	1		$85,687.50
4.04	Contingency (20%)	%	20%		$342,750.00
				Construction Estimate Total =	**$2,142,187.50**
5.00	**Estimated Permanent Easement Cost**				
5.01	1063 Riverside Dr, Danville, VA 24540 and 1001 Riverside Dr, Danville, VA 24540	EA	1	$96,000.00	$96,000.00
5.02	125 Arnett Blvd, Danville, VA 24540	EA	1	$15,000.00	$15,000.00
5.03	1002 Riverside Dr, Danville, VA 24540	EA	1	$10,000.00	$10,000.00
5.04	145 Arnett Blvd, Danville, VA 24540	EA	1	$40,000.00	$40,000.00
				Property Purchase and Easement Total =	**$161,000.00**
				Project Budget Total =	**$2,303,187.50**

City of Danville, Virginia

Apple Branch- Arnett Drive Storm drain Improvement Concept-3

Engineer's Budgetary Estimate

Date: 3/14/2022

Item	Item Description	Units	Scheduled Quantity	Unit Price ($)	Total Amount
1.00	**Site Preparation and Demolition**				
1.01	Clearing and Grubbing	SY	1000	$10.00	$10,000.00
1.02	Pavement Removal (Riverside Drive/Arnet Drive)	SY	1000	$40.00	$40,000.00
1.03	Curb Inlet	EA	5	$1,000.00	$5,000.00
1.04	Drop Inlet	EA	1	$1,000.00	$1,000.00
1.05	Curb	LF	300	$250.00	$75,000.00
1.06	Storm Manhole	EA	6	$1,500.00	$9,000.00
1.07	Debris Removal	LS	1	$5,000.00	$5,000.00
2.00	**Erosion and Sediment Control**				
2.01	Furnish, Install, Maintain, and Remove Temporary Construction Entrance	TN	150	$80.00	$12,000.00
2.02	Silt Fence	LF	100	$5.00	$500.00
2.03	Safety Fence	LF	3500	$4.00	$14,000.00
2.04	Erosion Control Matting	SY	3000	$7.00	$21,000.00
2.05	Inlet Protection	EA	7	$400.00	$2,800.00
3.00	**Storm Drainage System (Improvements at Arnett/Riverside Intersection)**				
3.01	18" RCP (Gasketed)	LF	345	$110.00	$37,950.00
3.02	24" RCP (Gasketed)	LF	100	$120.00	$12,000.00
3.03	30" RCP (Gasketed)	LF	200	$130.00	$26,000.00
3.04	54" RCP (Gasketed)	LF	1000	$150.00	$150,000.00
3.05	Curb Inlet Catch Basin (VDOT Standard)	EA	9	$10,000.00	$90,000.00
3.06	Junction Box Manhole (VDOT Standard)	EA	8	$12,000.00	$96,000.00
3.07	Head wall (VDOT Standard)	EA	1	$15,000.00	$15,000.00
3.08	Utility Crossing - Fiber Optics	EA	3	$10,000.00	$30,000.00
3.09	Utility Crossing - Gas Lines	EA	4	$6,000.00	$24,000.00
3.10	Utility Crossing - Water Lines	EA	9	$5,000.00	$45,000.00
3.11	Utility Crossing - Sewer Lines	EA	3	$9,000.00	$27,000.00
3.12	Pipe Bedding - #57 Stone (Up to Spring line of Pipe)	CY	750	$50.00	$37,500.00
3.13	Trench Backfill - ABC (In Roadway/Parking Lot Areas)	SY	1000	$80.00	$80,000.00
3.14	Asphalt Pavement (Riverside Drive/Arnett Drive) (Includes ABC, Intermediate, and Surface Courses)	SY	1000	$250.00	$250,000.00
3.15	Traffic Control	LS	1	$20,000.00	$20,000.00
3.16	Under Excavation and grading for swale	CY	200	$100.00	$20,000.00
4.00	**Miscellaneous**				
4.01	Project Video and Photographs (per project)	EA	1	$500.00	$500.00
4.02	Construction Project Staking and Surveying	LS	1	$5,000.00	$5,000.00
4.03	Contract Mobilization (maximum 5%)	LS	1		$58,062.50
4.04	Contingency (20%)	%	20%		$232,250.00
				Construction Estimate Total =	**$1,451,562.50**

5.00	**Estimated Permanent Easement Cost**				
5.01	125 Arnett Blvd, Danville, VA 24540	EA	1	$7,500.00	$7,500.00
5.02	158 Arnett Blvd, Danville, VA 24540	LS	1	$2,500.00	$2,500.00
		Property Purchase and Easement Total =			**$10,000.00**
				Project Budget Total =	**$1,461,562.50**

APPENDIX F
POWER POINT PRESENTATION

Apple Branch Watershed Study-Analysis and Review PowerPoint Presentation

Apple Branch Watershed Study

ANALYSIS OVERVIEW

TIMMONS GROUP

OUTLINE

DATA COLLECTION & APPROACH

EXISTING CONDITIONS HYDROLOGIC ANALYSIS

EXISTING CONDITIONS HYDRAULIC ANALYSIS
- APPLE BRANCH
- AUDUBON & RIVERSIDE STORM DRAINAGE
- ARNETT & RIVERSIDE STORM DRAINAGE

PROPOSED IMPROVEMENTS MODELING AND ANALYSIS
- APPLE BRANCH
- AUDUBON AND RIVERSIDE
- ARNETT AND RIVERSIDE

BUDGETARY ESTIMATES

TIMMONS GROUP

DATA COLLECTION & APPROACH

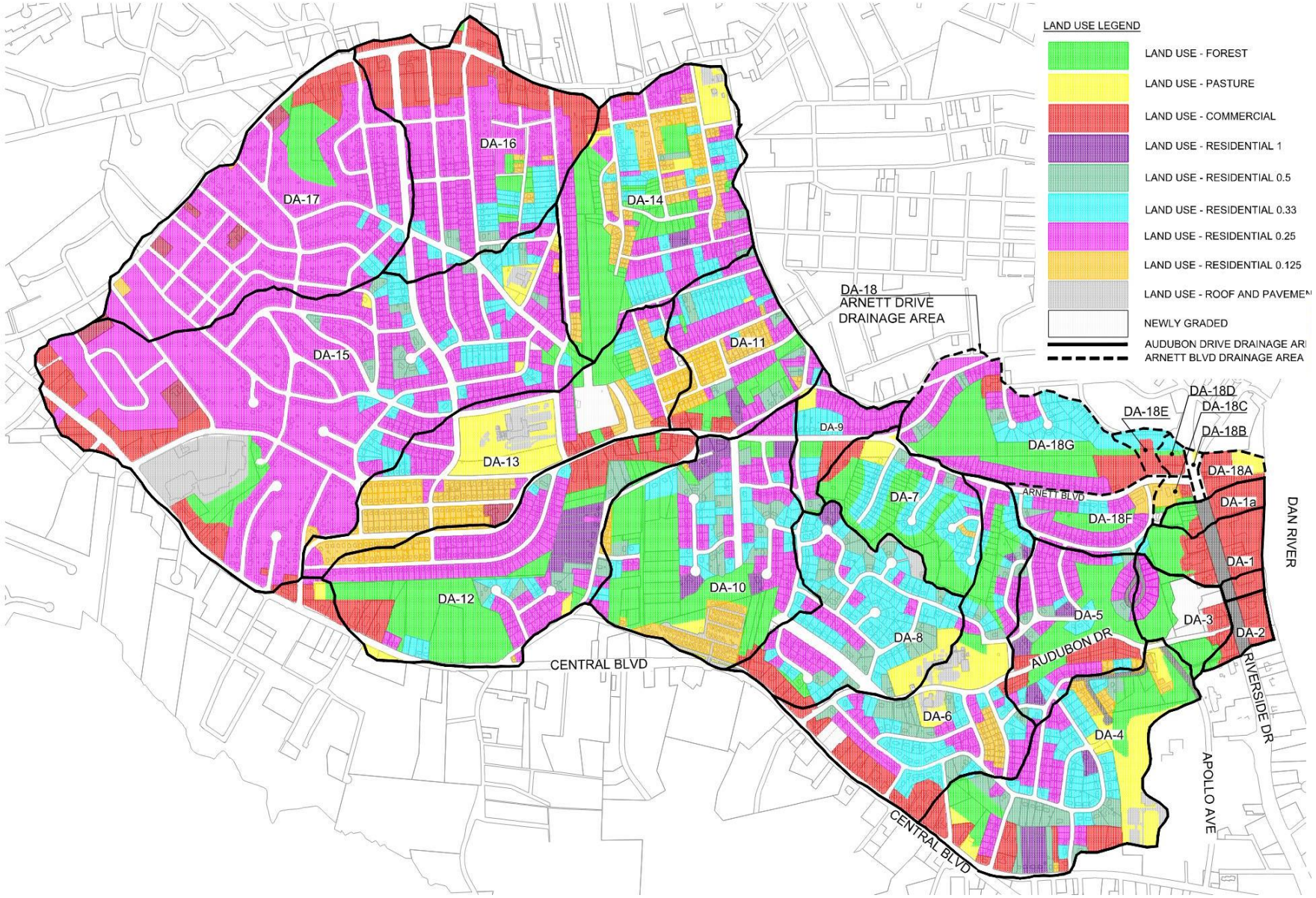
DESKTOP, FIELD AND FLOODING INVESTIGATIONS

EXISTING CONDITIONS HYDROLOGIC ANALYSIS

Desktop
- Drainage Area Boundaries
- Land Use
- Watershed Slope

Field
- Channel Dimensions
- Channel and Floodplain Roughness Coefficients
- Structures-Culverts, Bridges, Inlets, Gabion Walls
- Stream Morphological Data

Flooding
- Known High Water Marks
- Confirmation of Flooding Extents



TIMMONS GROUP

EXISTING CONDITIONS HYDROLOGIC ANALYSIS

HISTORIC STORM INVESTIGATION

Rainfall Events

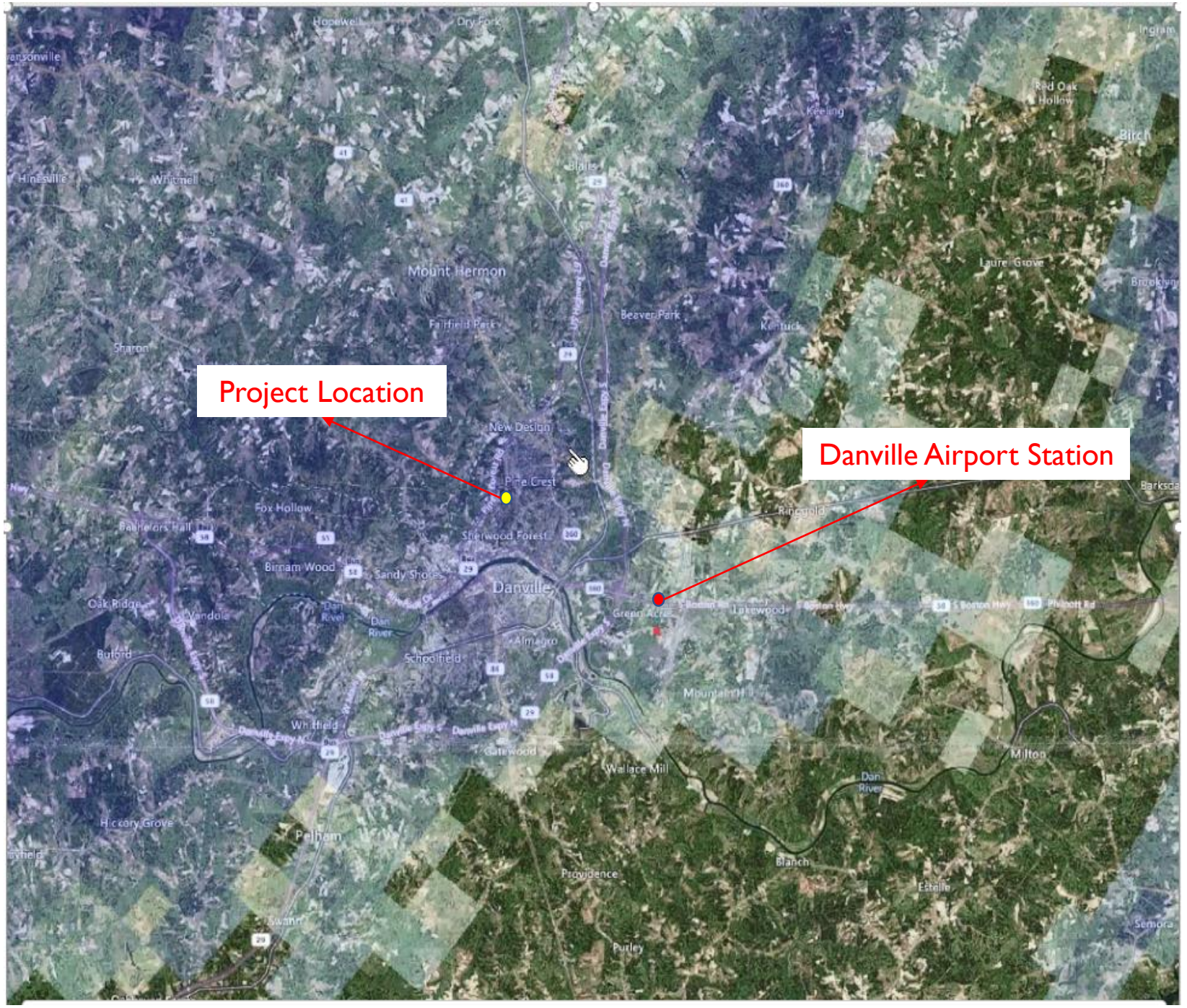
- Hurricane Michael
- May-18, 2012 Storm
- Historical rainfall event used to validate models with known high-water marks

Data Sources

- Danville Airport Station
- Doppler Radar

HEC-HMS ANALYSIS

- Curve Number Method
- Time of Concentration - basin average slope
- SCS Hydrograph Method
- NOAA PPFE – For Frequency Storms

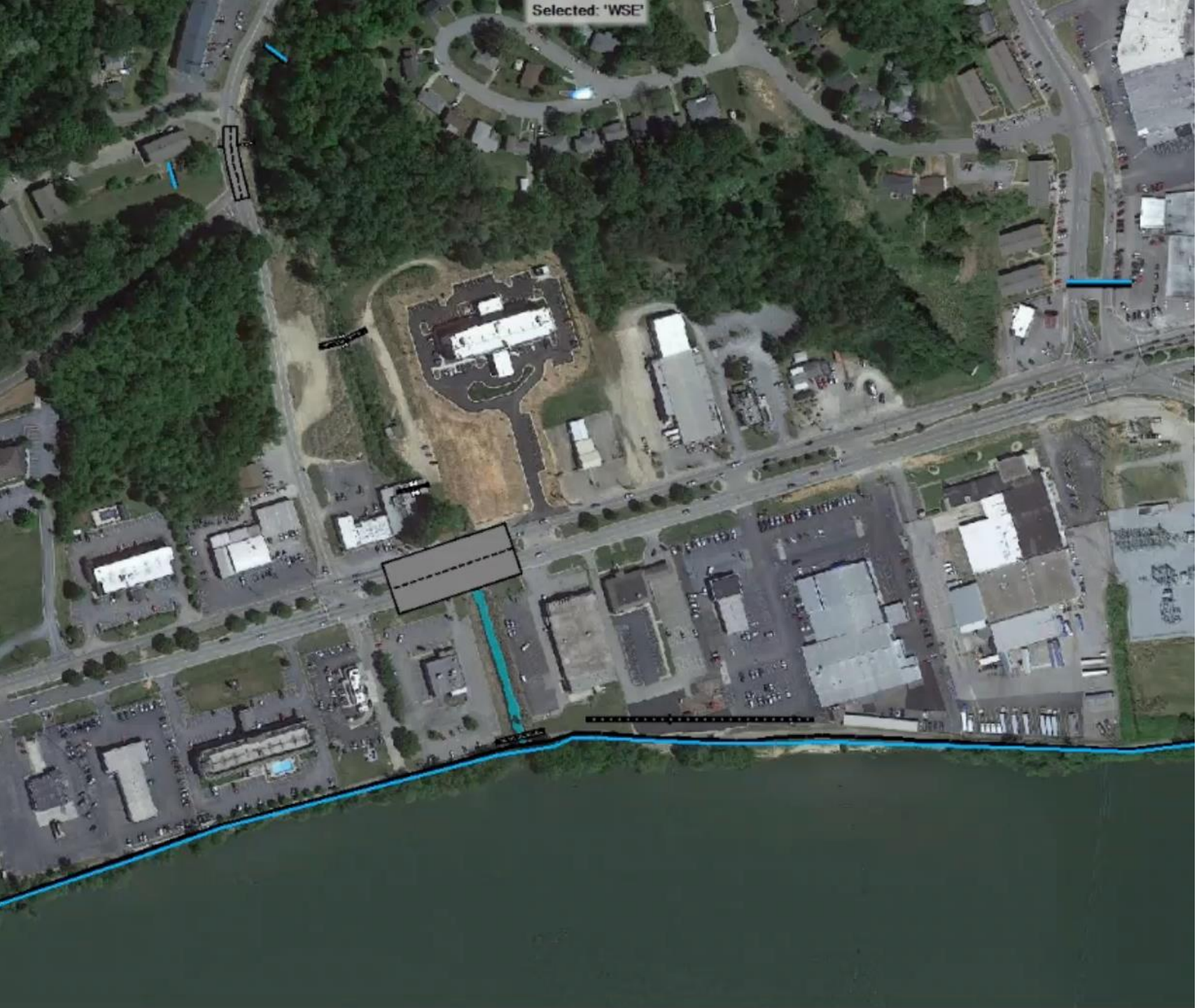


EXISTING CONDITIONS HYDRAULIC ANALYSIS COMPLETED

- Apple Branch Stream Analysis and Flooding Extents

- Audubon and Riverside Storm System Analysis and Flooding Extents

- Arnett and Riverside Storm Drainage System Analysis and Flooding Extents



APPLE BRANCH STREAM ANALYSIS

EXISTING CONDITIONS SIMULATION

Hurricane Michael –Storm Event

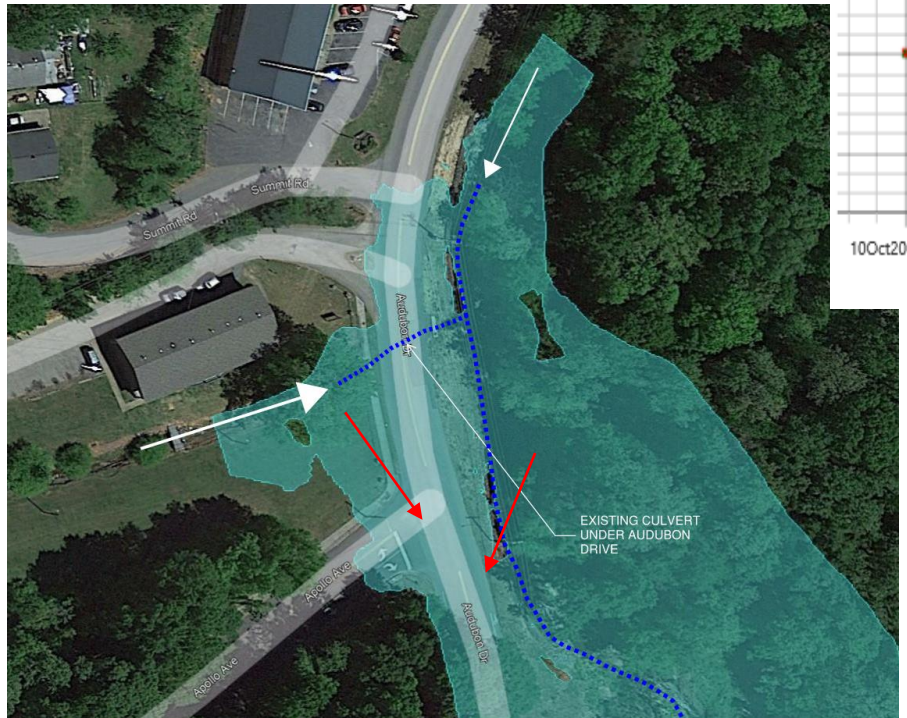
Storm Simulations were also created for:

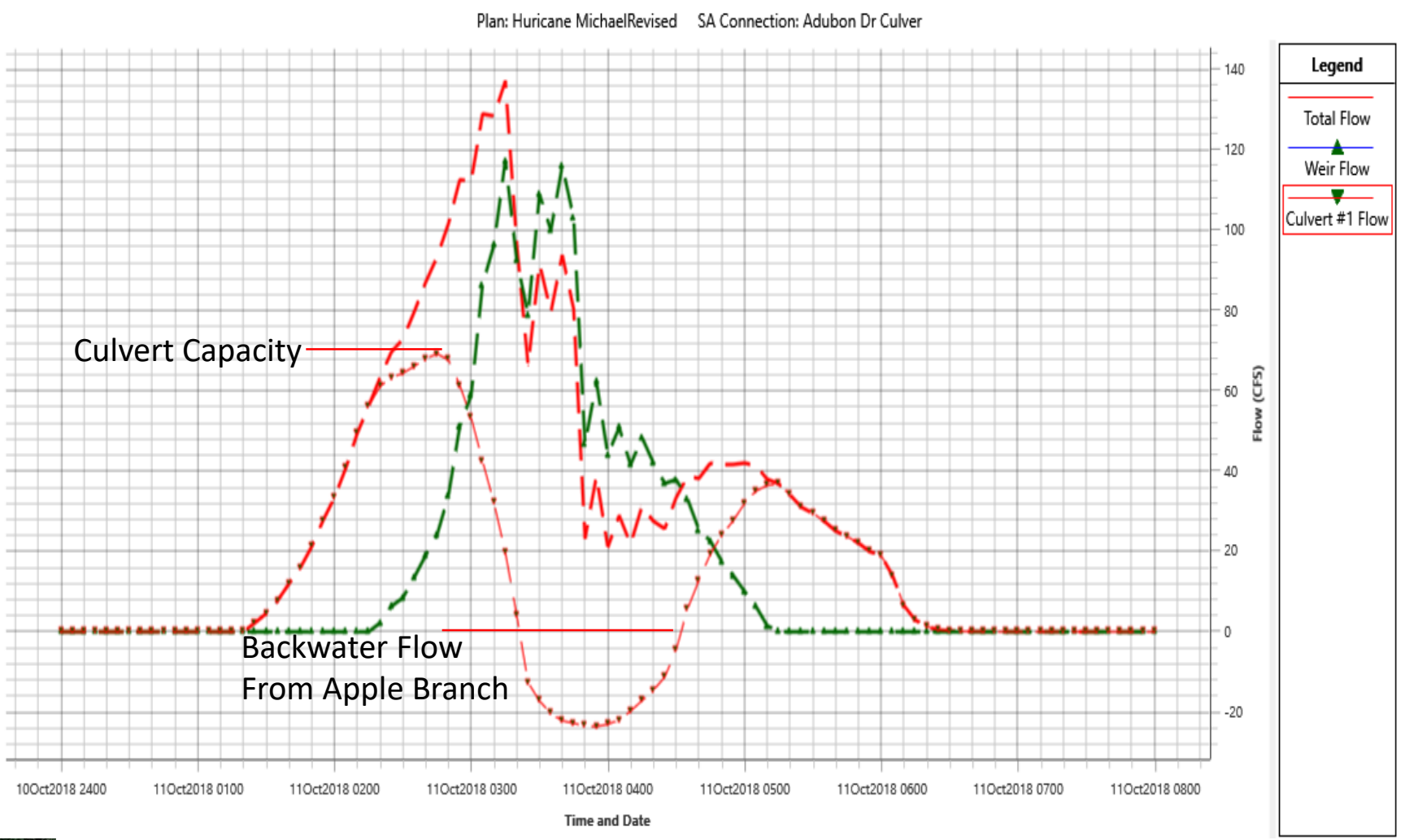
- May 18, 2012, storm
- 25-Year Event frequency storm –HMS
- 100-Year Event frequency storm –HMS

TIMMONS GROUP

AUDUBON & RIVERSIDE DRIVE ANALYSIS

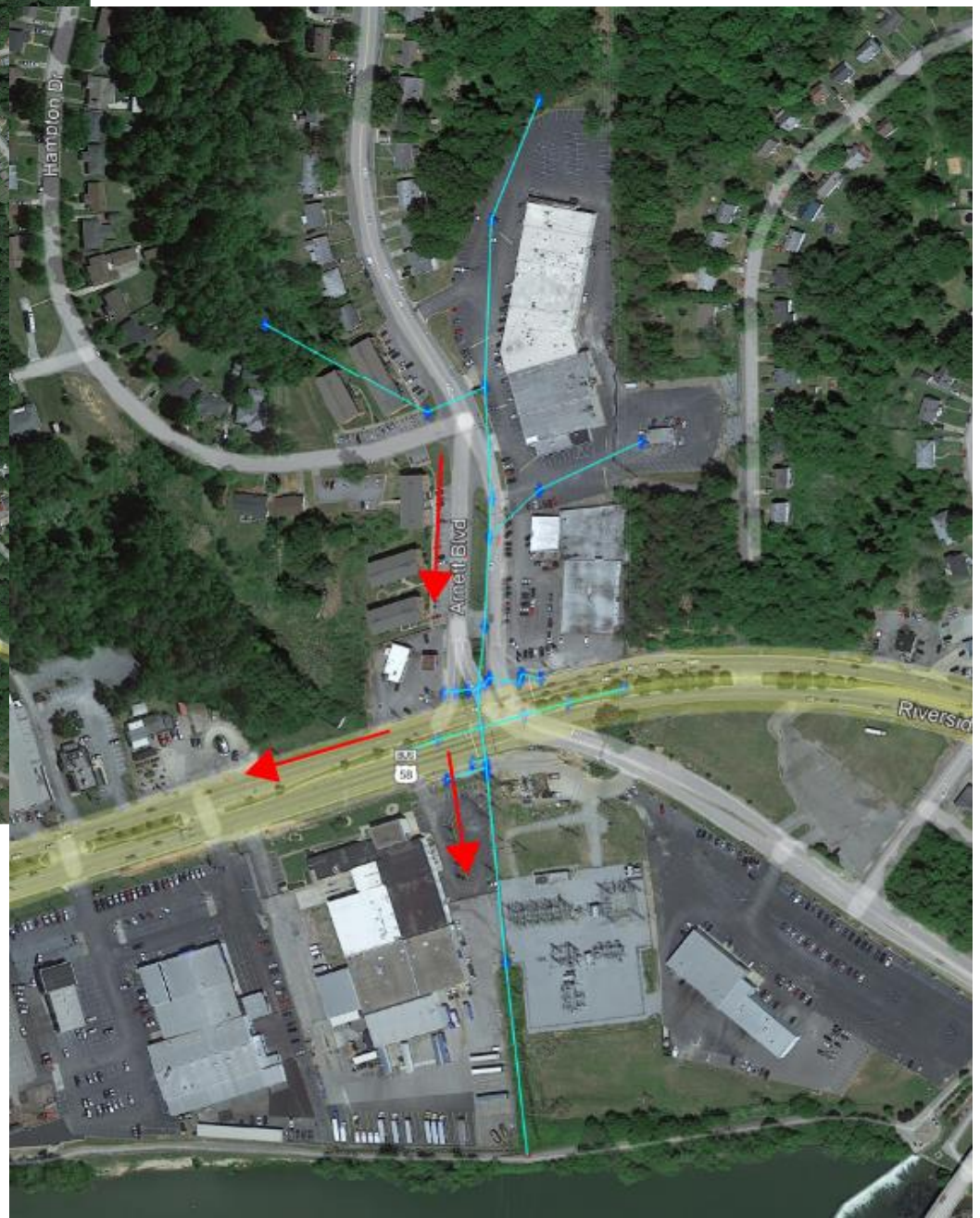
Existing flooding extents: Apple Branch overflow to Audubon Drive; storm flow path shown with white arrows; red arrows show overtopping flow path





Audubon Drive 48-inch Culvert Performance

TIMMONS GROUP



ARNETT & RIVERSIDE DRIVE ANALYSIS

- Flooding begins on Arnett Blvd due to inadequate inlets
- Overflow re-directed west down Riverside Drive and south towards existing structures
- Existing 60-inch outlet pipe capacity 195 CFS- 25-year Storm Event
- 100-year Storm Event - 265 CFS
- During large storm events, Arnett Blvd contributes to flooding on Riverside Drive

TIMMONS GROUP

PROPOSED CONDITONS

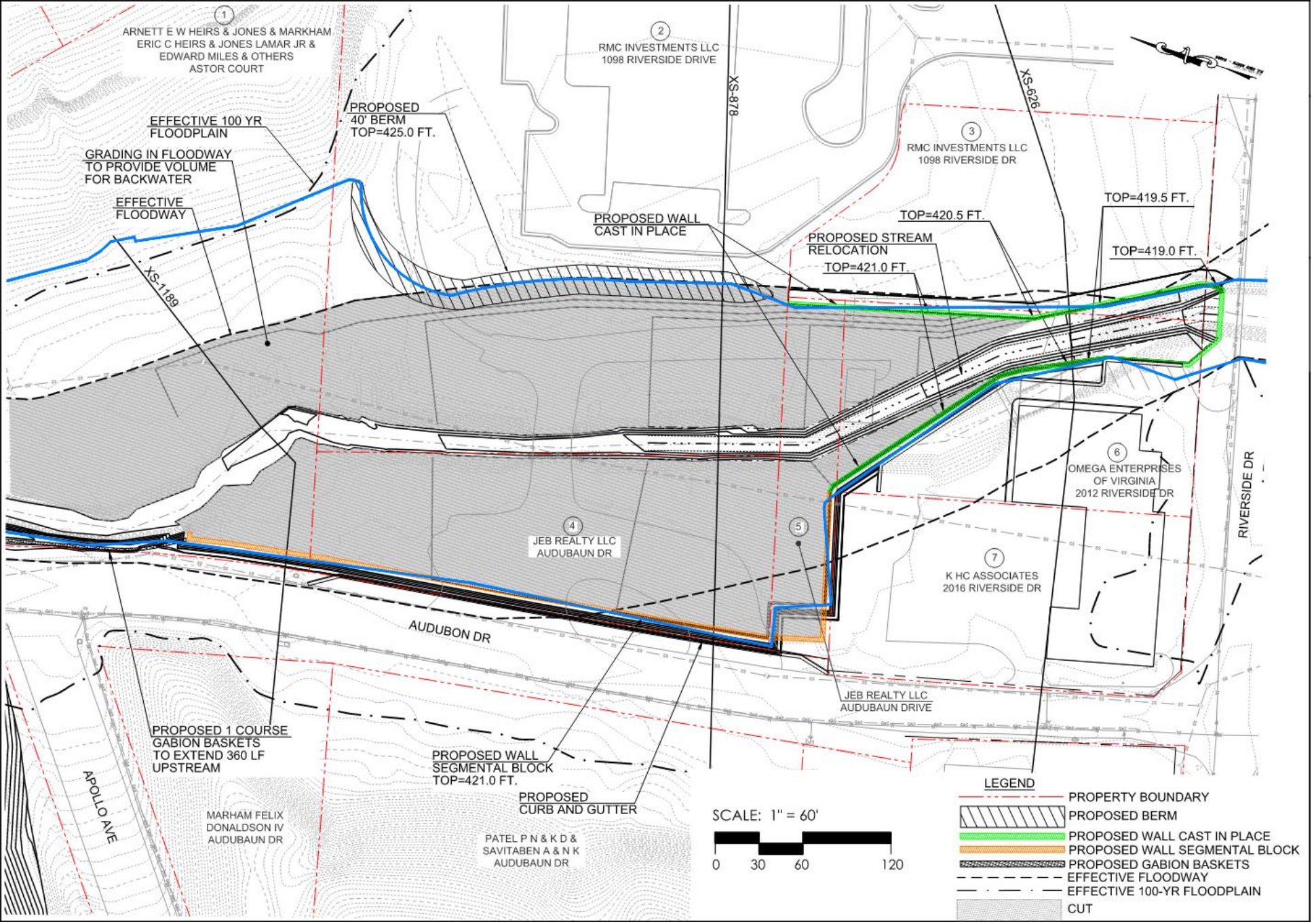
OPPORTUNITES CONSIDERED

FLOODPLAIN STORAGE OPPORTUNITIES

PIPE SYSTEM IMPROVEMENTS

BUILDING REMOVAL

TIMMONS GROUP

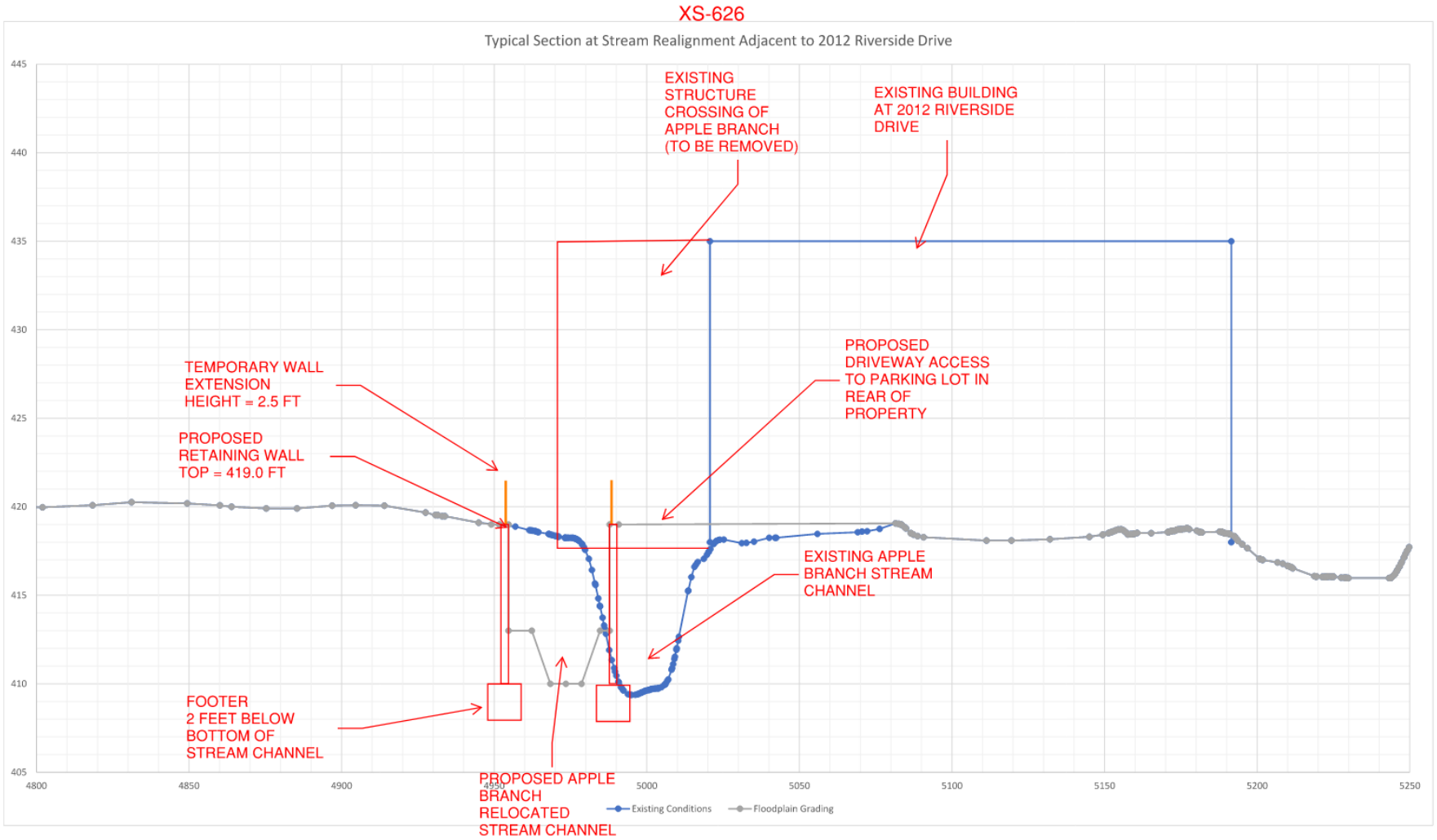


PROPOSED CONDITIONS

APPLE BRANCH OPTION I

- Removal of Existing Building Extension
- Re-configuration of access and entrance for property 6
- Storage from floodplain grading
- Berm on hotel property side
- Floodwall -permanent height to accommodate future bridge and temporary extension for existing box culverts
- This option includes improvements to the existing Audubon Drive pipe system and installation of detention adjacent to Apollo Ave

TIMMONS GROUP



PROPOSED CONDITIONS

APPLE BRANCH

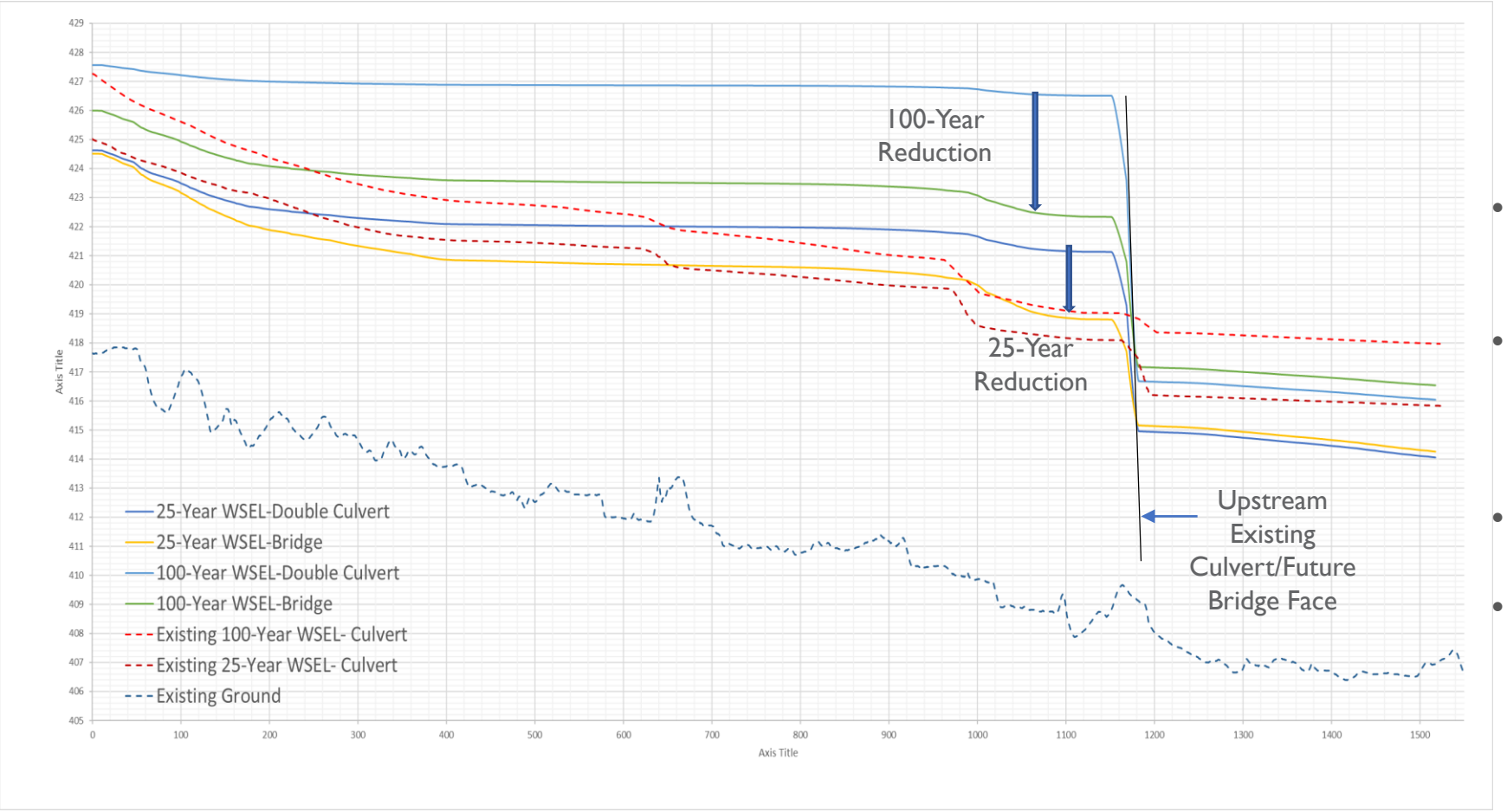
OPTION-1

- Channel Relocation with building extension removal
- Permanent wall height based on future 30-foot bridge
- Temporary wall height extension based on existing culverts - needed prior to bridge installation- 2.5 feet higher

TIMMONS GROUP

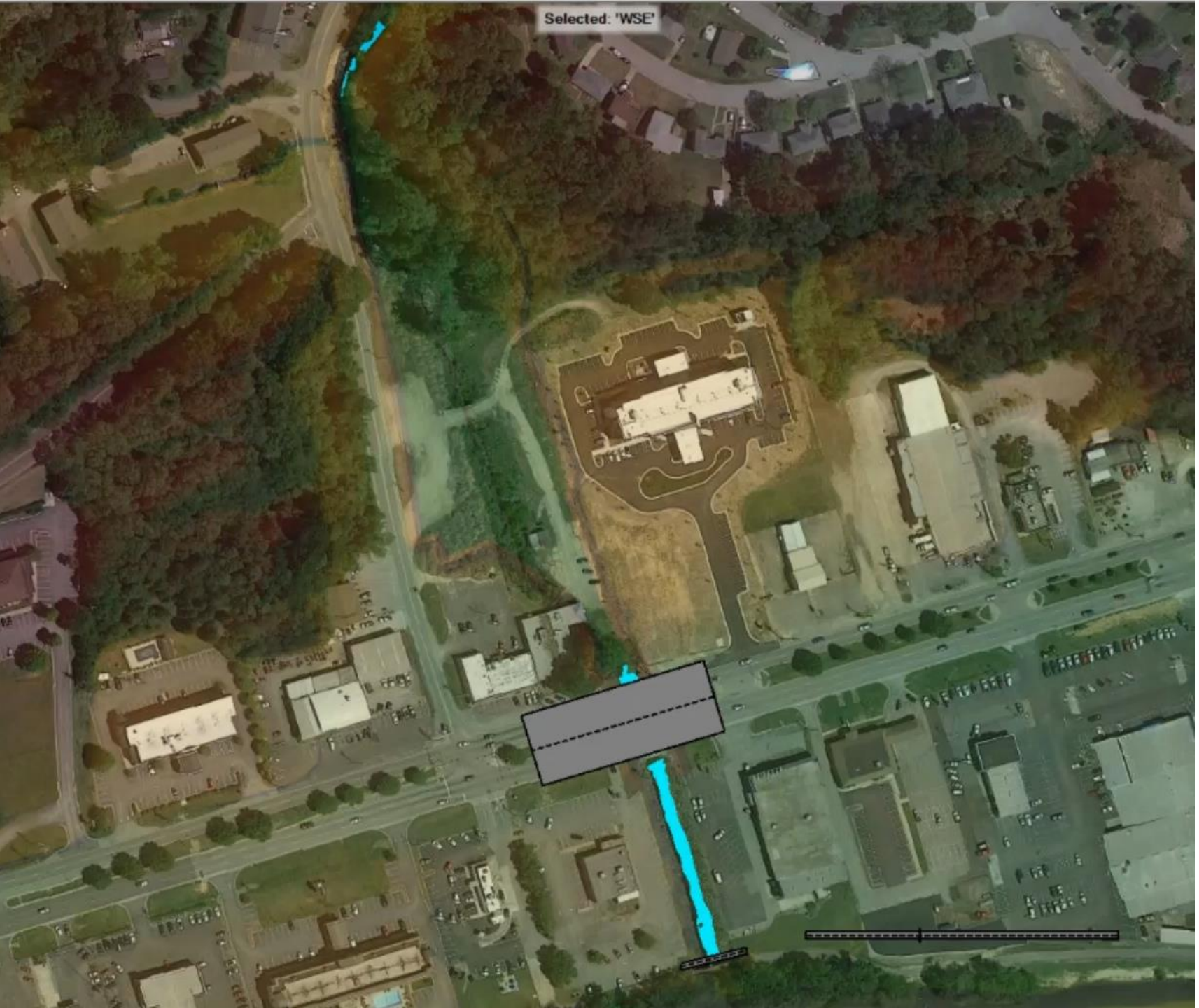
PROPOSED CONDITIONS

APPLE BRANCH OPTION-1



- Backwater elevations shown in profile at Riverside Drive crossing
- Existing dual culverts heights compared to future 30-foot-wide bridge
- 100-year drop in WSEL: 3.5 to 4 feet
- 25-year drop in WSEL: 1.5-2 feet

TIMMONS GROUP

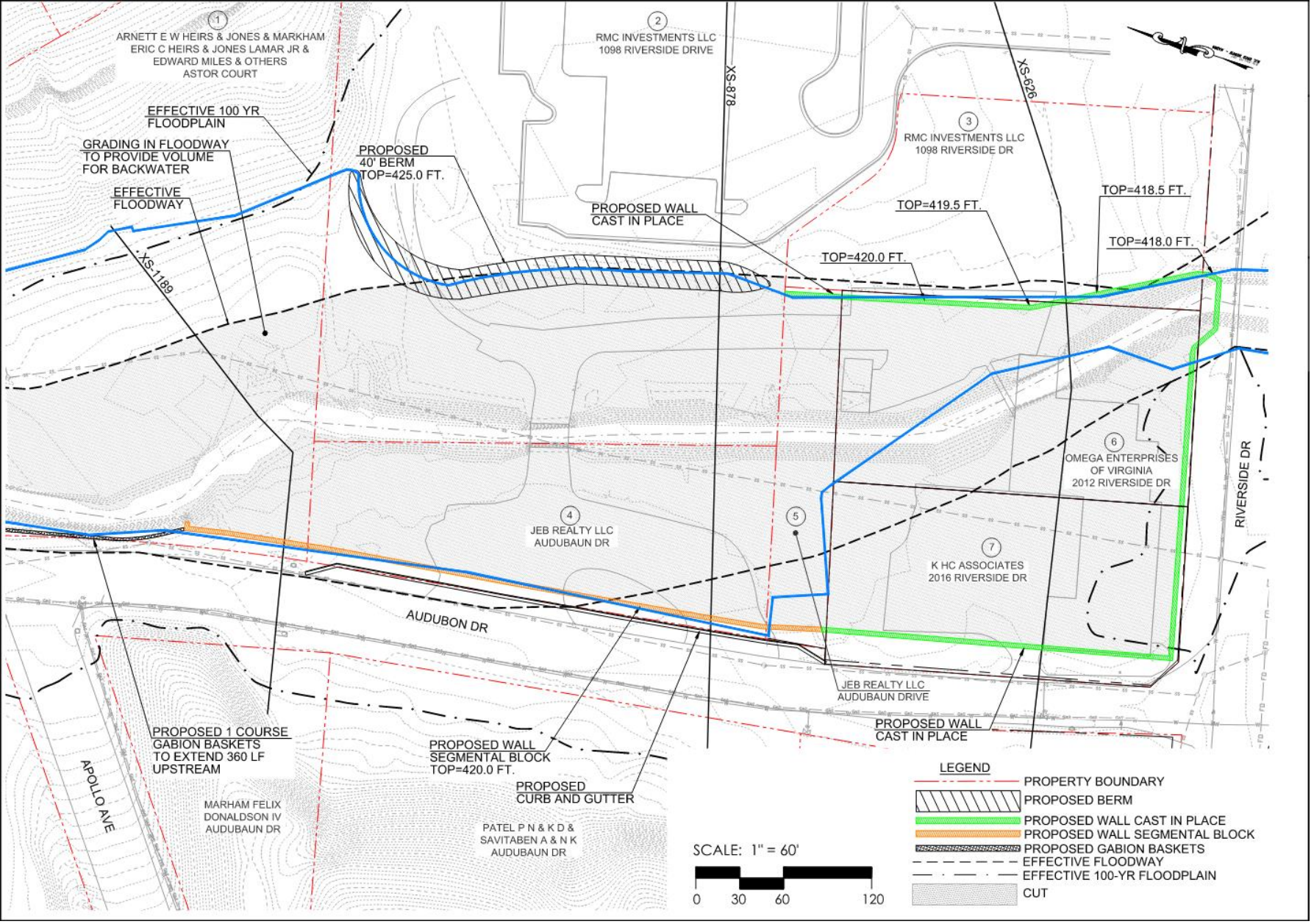


PROPOSED CONDITIONS

APPLE BRANCH OPTION-1

- 100-year storm event
- Modeled with existing culverts
- Proposed wall contains the storm

TIMMONS GROUP

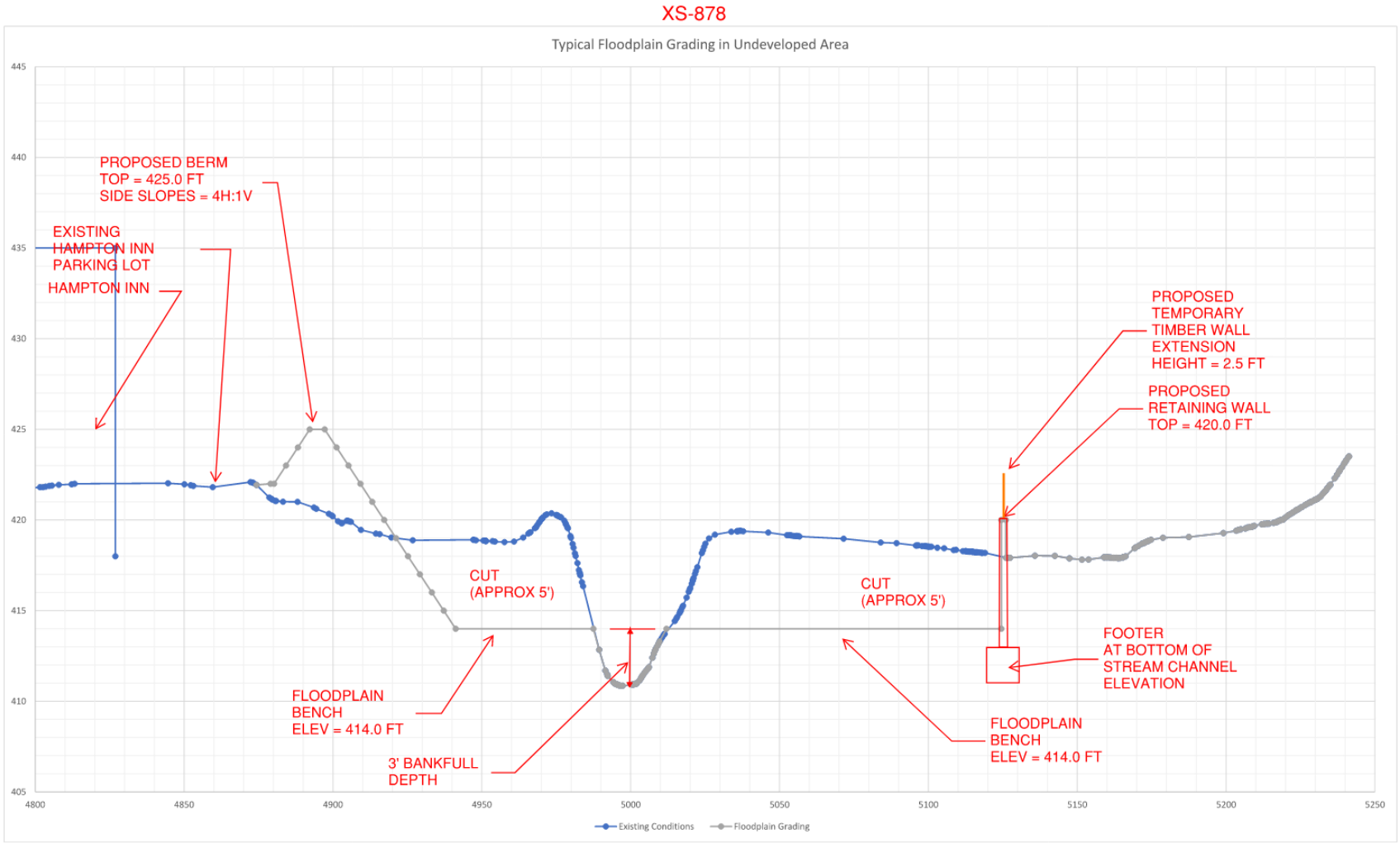


PROPOSED CONDITIONS

APPLE BRANCH - OPTION-2

- Total building removal
- Proposed flood wall
- Storage provided by extending grading of the floodplain to Riverside Drive
- Berm on hotel property side
- Floodwall -permanent height to accommodate future bridge and temporary extension for existing box culverts
- This option includes improvements to the existing Audubon Drive pipe system and installation of detention adjacent to Apollo Ave

TIMMONS GROUP



PROPOSED CONDITIONS

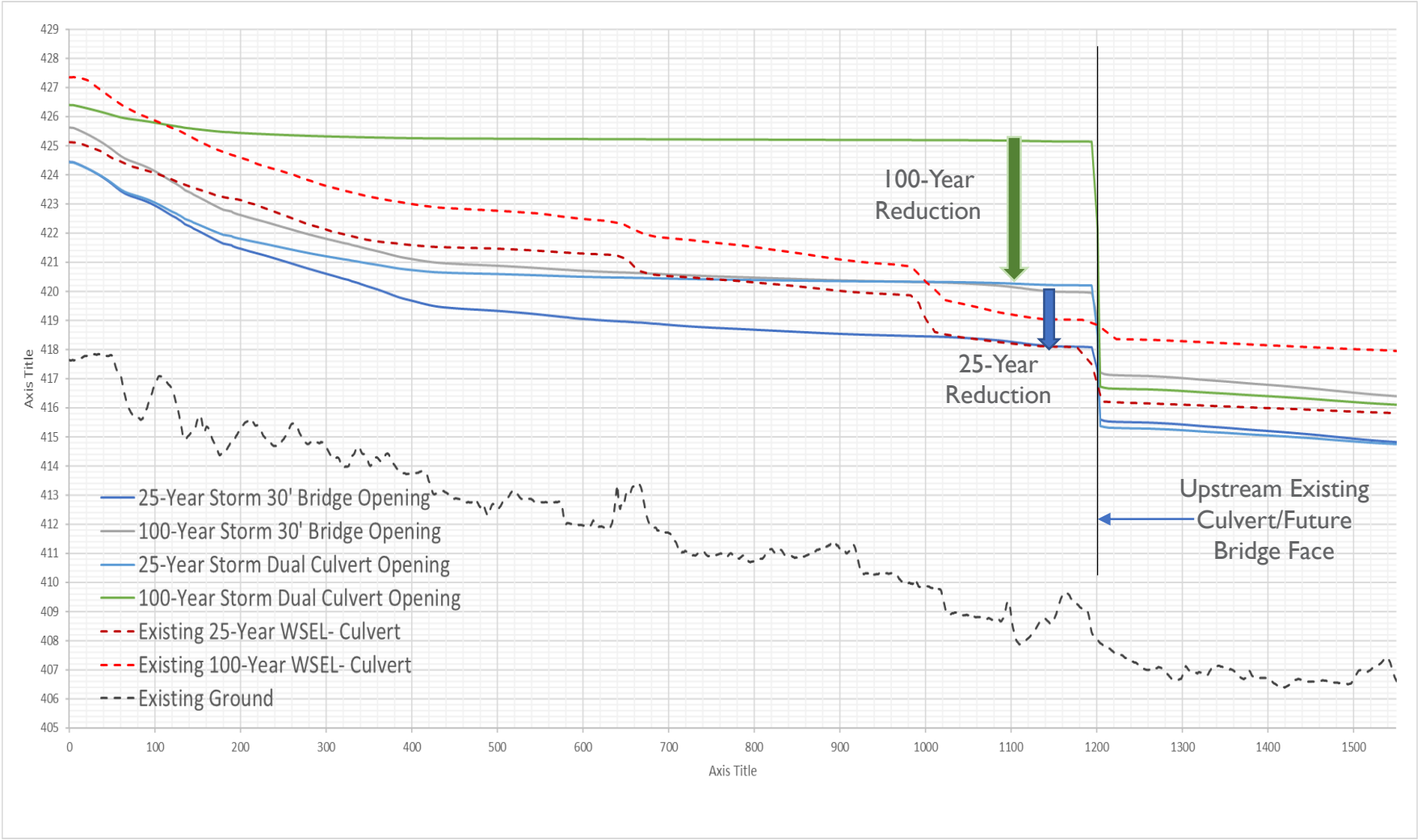
APPLE BRANCH - OPTION-2

- Total building removal
- Floodplain excavation to bankfull, similar to option 1; excavation for this option extended to Riverside Drive
- Permanent wall height based on future 30-foot bridge
- Temporary wall height extension based on existing culvert-needed prior to bridge installation-Approximately 2.5 feet higher

TIMMONS GROUP

PROPOSED CONDITIONS

APPLE BRANCH - OPTION-2



- Backwater elevations shown in profile at Riverside Drive crossing
- Existing dual culverts heights compared to future 30-foot-wide bridge
- 100-year drop in WSEL: 4.5 to 5 feet
- 25-year drop in WSEL: 1.5-2 feet
- Benefit- returns WSEL closer to existing conditions and provides a reduction in peak heights in the 25 and 100-year events

TIMMONS GROUP

PROPOSED CONDITIONS

APPLE BRANCH SIMULATION-OPTION-2

- 100-year Storm Event
- Modeled with existing culverts
- Wall contains storm
- Average wall height lowered approximately 2.5-feet with additional storage provided with full building removal

TIMMONS GROUP

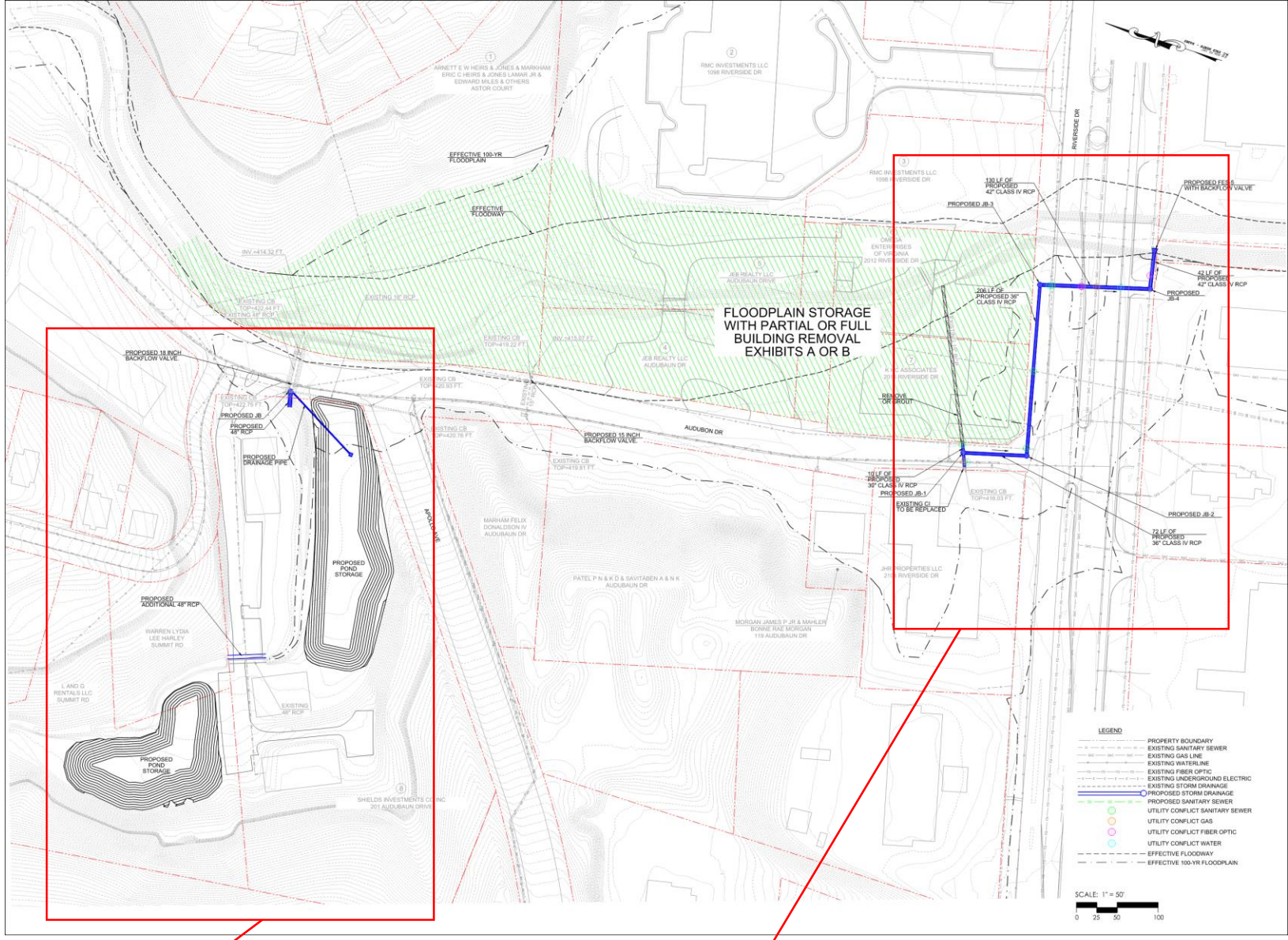
AUDUBON AND RIVERSIDE DRIVE SYSTEM IMPROVEMENTS

Proposed Storage Improvements

- Backflow prevention existing 48-inch culvert
- Detention basins adjacent to Apollo Ave
- Upper detention basin and supplementary 48-inch pipe alleviates flooding up through 25-year event.
- Reduces street overflow however no impacts on downstream pipe size reduction

Proposed Pipe System Improvements

- Backflow on existing 15-inch culvert
- Disconnection of existing pipe under building
- Proposed 36-inch pipe system, outlet to open channel
- SUE needed to verify utility conflicts



Provide Floodplain Storage

Upgrade Existing Pipe System

TIMMONS GROUP

ARNETT AND RIVERSIDE DRIVE SYSTEM IMPROVEMENTS Option - 1

Improvements:

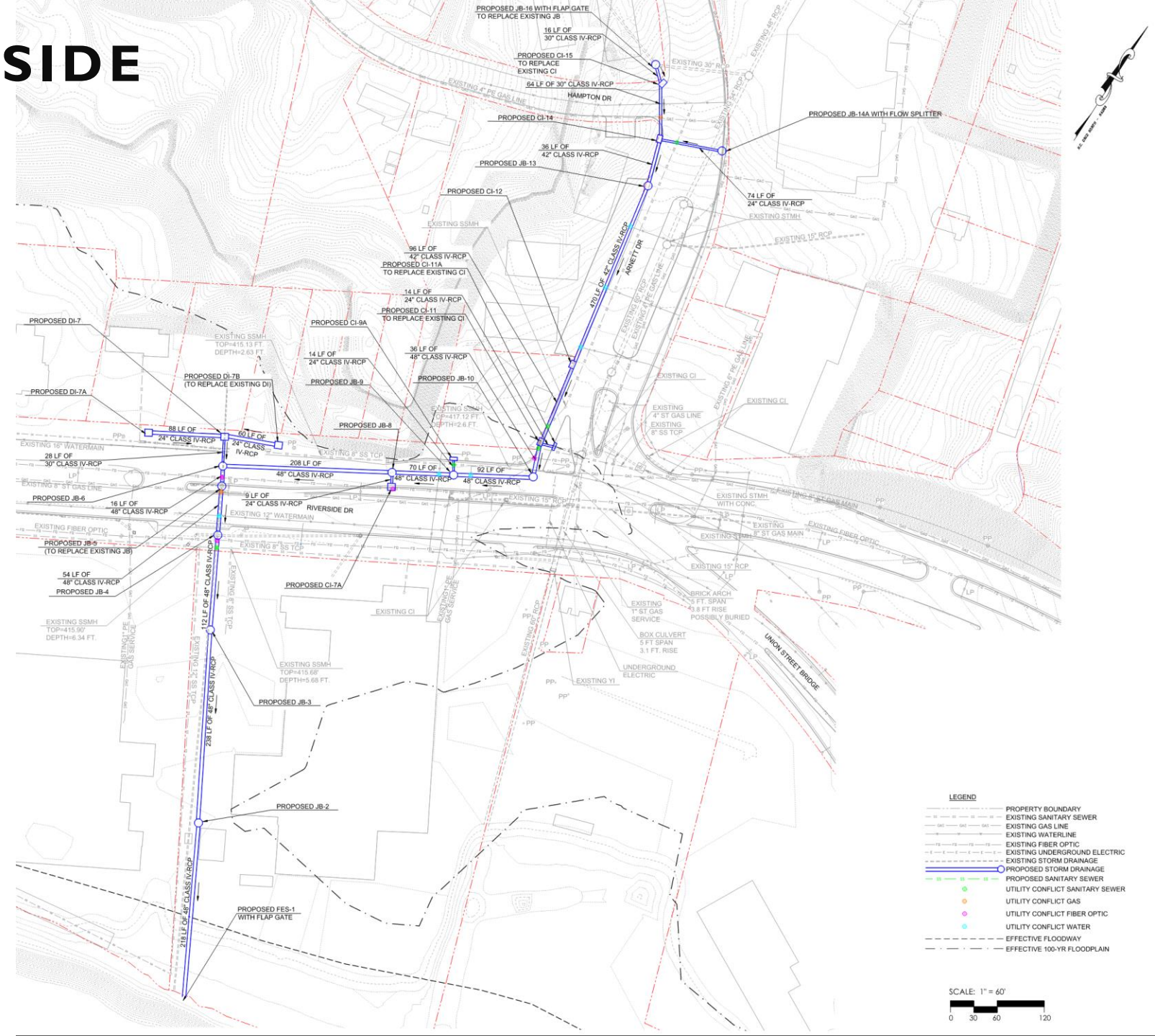
- Extension of pipe system on Arnett Blvd
- Installation of 48-inch pipe on Riverside Drive in the center of the street
- Replacement and installation of new inlets
- Replacement of existing outfall pipe with a 48-inch pipe

Advantage:

Placement of pipe in middle of roadway limits other utility relocation due to conflicts

Disadvantage

Limits placement of additional catch basins along Riverside Drive



ARNETT AND RIVERSIDE DRIVE SYSTEM IMPROVEMENTS Option -II

Improvements:

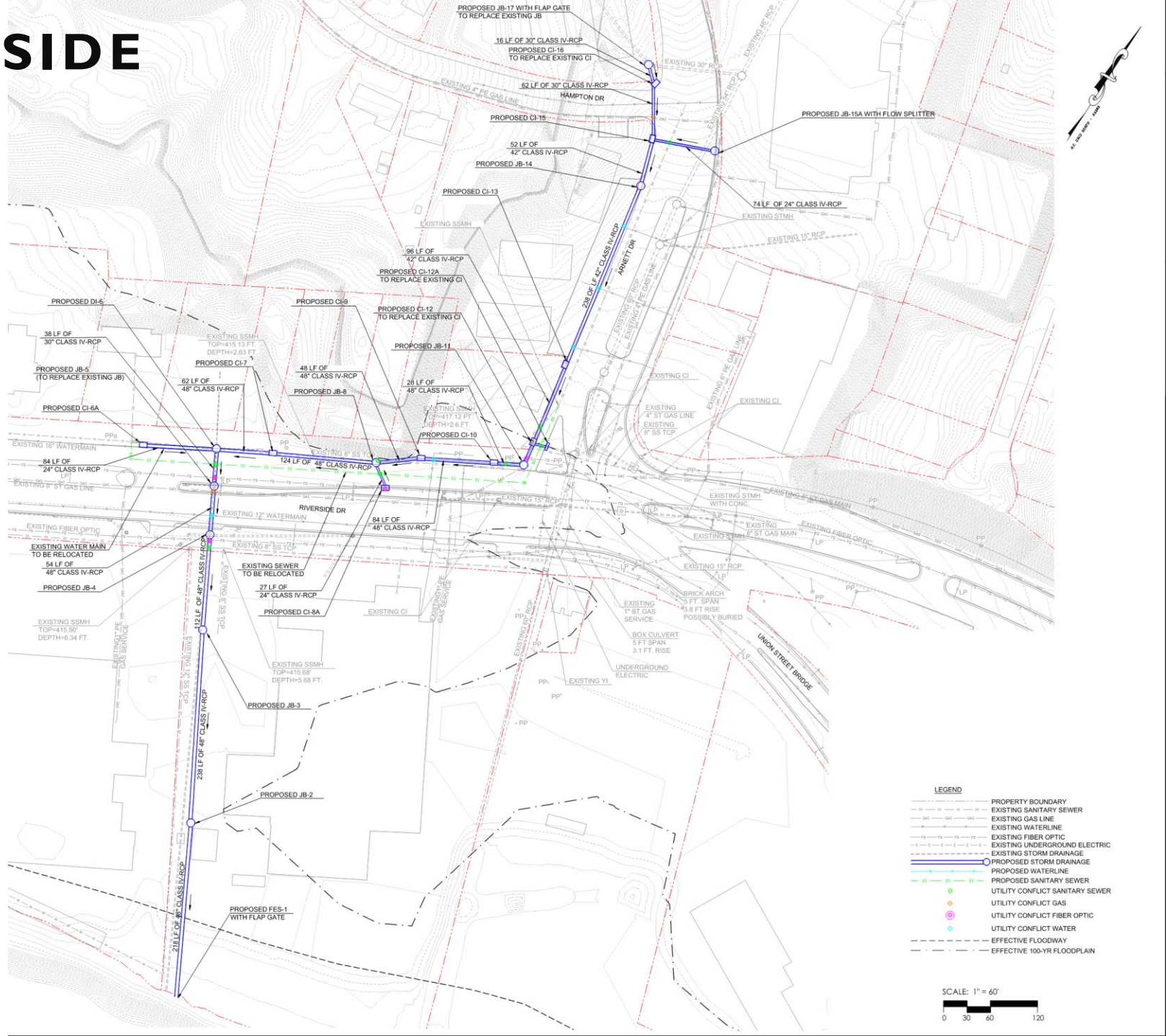
- Extension of pipe system on Arnett Blvd
- Installation of 48-inch pipe under the north curb of Riverside Drive
- Replacement and installation of new inlets
- Replacement of existing outfall pipe with a 48-inch pipe

Advantage:

- Additional inlets on Riverside Drive possible

Disadvantage

- Requires relocation of existing sanitary sewer line
- Higher cost due to utility relocations



ARNETT AND RIVERSIDE DRIVE SYSTEM IMPROVEMENTS Option -III

Improvements:

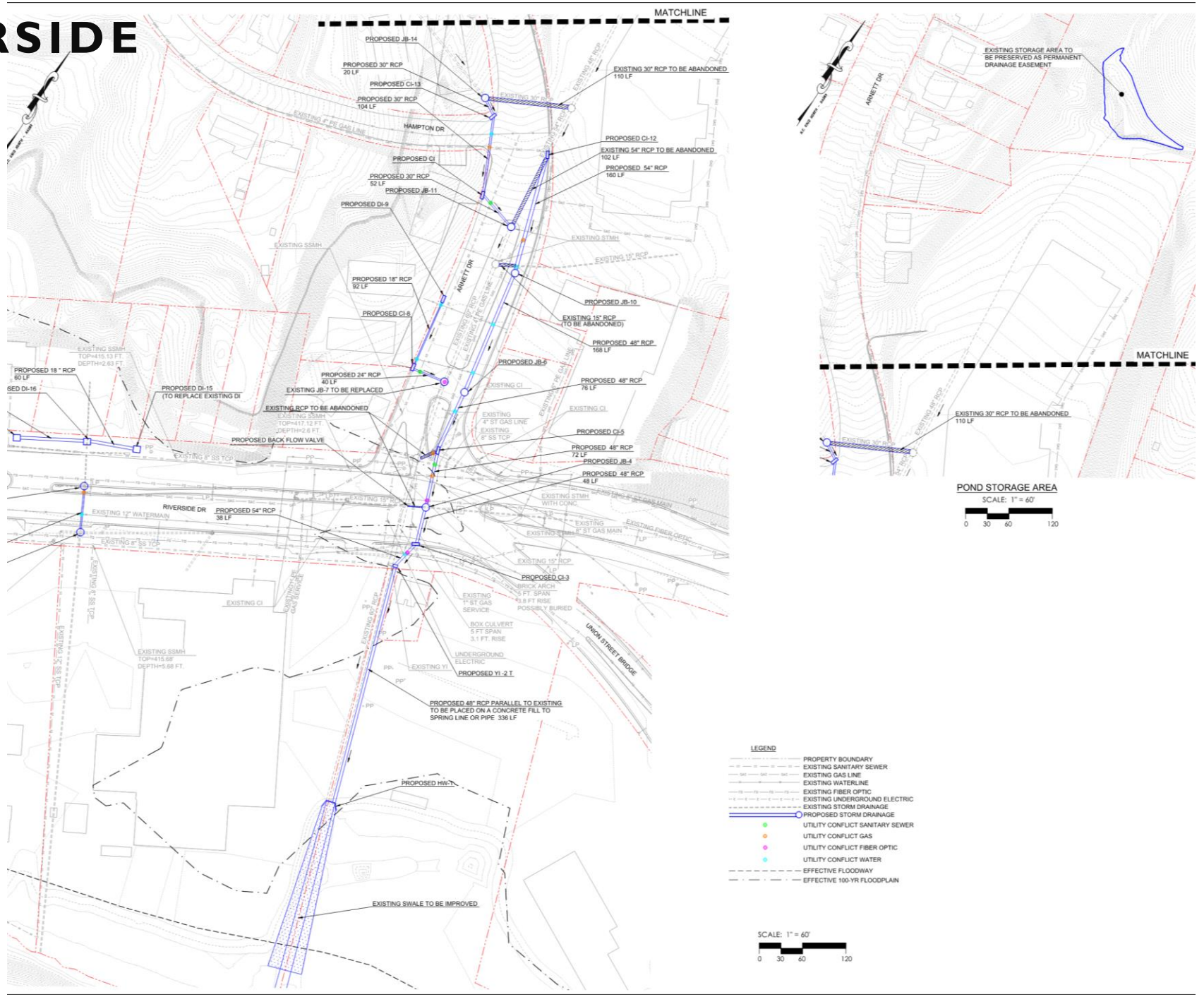
- Installation of new 48-inch pipe system on Arnett Blvd east lanes to convey flow from northeast 54-ac watershed. Storage upstream of private road preserved
- Reconnection of northwest 18-ac watershed to existing system
- Installation of supplemental inlets
- Existing swale improvements

Advantage:

- Limits work on Riverside Drive
- Direct rout, shorter pipe system
- Conveyance of larger watershed with new pipe system-reduction old system

Disadvantage

- Additional traffic closure issues due to proximity to the intersection
- No additional inlets on Riverside Drive
- Work with dual lines near existing stormwater structures



Budgetary Cost Estimates

- Apple Branch and Arnett Blvd Improvements

Apple Branch Improvements	Construction Budget	Easement and Property Acquisition	Design Budget	Total Estimate
Floodplain Storage with Partial Building Removal	$6,547,450	$376,000	$675,000	$7,600,000
Floodplain Storage with Total Building Removal	$6,123,675	$1,226,000	$500,000	$7,850,000
Arnett Blvd Storm Drainage Improvement				
Option -1	$1,619,688	$161,000	$200,000	$1,990,000
Option-2	$2,142,188	$161,000	$250,000	$2,600,000
Option-3	$1,451,563	$10,000	$200,000	$1,700,000

Total Estimate for both Apple Branch and Arnett Blvd Improvements ranges from $9.3 to 10.4 million

TIMMONS GROUP