HASTINGS FLOOD STUDY 2023 – PHASE I

FOR

THE VILLAGE OF HASTINGS-ON-HUDSON
WESTCHESTER, NY

PREPARED BY

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I. EXECUTIVE SUMMARY

James J. Hahn Engineering, P.C. was hired by the Village of Hastings-on-Hudson to analyze the Village watersheds and watercourses, identify and evaluate specific flooding locations and recommend methods to mitigate the flooding conditions in accordance with objectives set by the Village.

Village mapping documents and sources that are available are dated, have limited information, and are inaccurate. Most information about the drainage system is known by Village personnel and undocumented. This study is the first phase of four and intended to identify problematic flood areas, determine watersheds and watercourses, develop conceptual plans for major flood locations, and provide a plan to obtain necessary information to ultimately mitigate flooding throughout the Village.

Phase II will consist of field work and research needed to verify hydrology and design for specific locations. This includes obtaining surveys, inspections of the drainage infrastructure, and performing miscellaneous field work. Phase III will use the information obtained from Phase II to update the watershed map and model the watersheds. Phase IV is site specific design, bid and construction.

Watercourses include Shecklers Brook, Billie Burke Brook, Boutilliers Brook, Rowleys Brook, and Zinsser Brook, which make up most of the Village's watersheds. The railroad, Old Croton Aqueduct, Broadway, Warburton Avenue, Farragut Parkway, and the Saw Mill River Parkway are features that bisect the Village watersheds and form impediments. Hastings land cover has exposed rock, impervious surfaces, low draining soils, and mild to steep slopes. These features make it challenging to mitigate flooding conditions.

A total of twenty-one sites were identified as problematic or requiring further study. Conceptual plans and costs are included for three of the sites that can be used for planning and grant opportunities. Large portions of the watercourses require additional field work and are recommended for further study.

We recommend updating the drainage and watershed maps (Phase II). Those documents will provide necessary information for floodplain modeling (Phase III) and would be extremely useful for the Highway and Building Departments. We also recommend the Village pursue funding opportunities to complete the design and construction of priority drainage projects (Phase IV).

II. INTRODUCTION

This study was conducted on behalf of the Village of Hastings-on-Hudson to prepare a plan-of-action for alleviating and mitigating flooding throughout the Village. The Village objective is to mitigate flooding on public property and provide relief for private property. The purpose of this report is to: (1) identify problematic flooding areas throughout the Village; (2) develop an initial list of drainage projects and flood locations that require additional evaluation; (3) prepare a preliminary watershed map to outline drainage areas and flow paths; (4) develop conceptual plans and preliminary costs for the major flood-prone areas; and (5) determine what information is not currently available, but necessary to obtain, to accurately model each watershed using the most up-to-date computer technology. This report is also intended to be used to support future grant applications.

This study utilized Westchester County GIS topography, NRCS soil surveys, and aerial imagery for determining watershed boundaries, flow paths, curve numbers, and other variables required for hydrologic analysis. The Village identified areas that are prone to constant flooding and water damage. Field inspections were performed with GPS technology to determine preliminary watershed boundaries, channel dimensions, pipe sizes, and other existing conditions. In addition, the Village Stormwater Sewer and Surface Drainage 1934 map was used where possible to identify channel sizes and capacities.

The drainage map of the Village appears to have been updated in the 1970's, however the title of the map says 1934 (Appendix A). Westchester County data of drainage structures and their location is limited and inaccurate. This study is considered Phase I and will include recommendations for surveys, inspections, and other items to obtain up-to-date information that can be used in studies and design. Phase II will be field work and research needed to verify hydrology and design for needed locations. This includes obtaining surveys, inspections of the drainage infrastructure, and performing miscellaneous field work. Phase III would use the information obtained from Phase II to update the watershed map and model the watersheds. Phase IV is site specific design and construction.

III. BACKGROUND

The Hastings-on-Hudson watersheds consist mainly of forest and urban land, with mild to steep sloping hills. A ridge exists in the north-south direction that runs from Hillside Woods, in a southwest direction towards the Graham property. Stormwater east of the

ridge drains towards the Saw Mill River and stormwater west of the ridge drains towards the Hudson River. There are four significant watercourses in the Village: Shecklers Brook and its tributary Billie Burke Brook, Boutilliers Brook, Rowleys Brook, and a brook originating in Zinsser Park, identified as Zinsser Brook.

Shecklers Brook originates west of the Children's Village in Dobbs Ferry. It flows through Sugar Pond, Reynold's Field, under Broadway, Foodtown, Main Street, and ultimately under the Metro North Railroad and into the Hudson River. This watershed is approximately 406 acres, including its tributary, Billie Burke Brook. Billie Burke Brook converges with Shecklers Brook behind the Hook and Ladder Fire House.

Boutilliers Brook originates along Rosedale Avenue, but is not visible until after passing through Dan Rile Park and Fenwick Road on private property. It crosses Brandford Road, Ashley Road, and Farragut Avenue, through private property, and ultimately discharges into the Saw Mill River at Farragut Parkway. The watershed is approximately 166 acres.

Rowleys Brook is located on the north and west sides of Graham School and originates on the west side of Broadway. It runs under the Rowleys Bridge, under the Metro North Railroad and into the Hudson River. The watershed is approximately 110 acres.

Zinsser Brook originates near Zinsser Way and runs through Zinsser Park, crosses Broadway and flows by the culvert under private property to a channel that runs under the Metro North Railroad and into the Hudson River. The total watershed is approximately 150 acres.

The watersheds for these four brooks make up most of the Hastings drainage area. However, there are several other smaller watersheds that include Graham Park, Thompkins Avenue, Farragut Avenue, Ravensdale, Mt. Hope East, Cliff Street, and Hillside Woods East Watersheds. These brooks and watersheds are shown in Appendix B.

The FEMA floodplains as identified in the 2007 Floor Insurance Study are shown on the Watershed Map. Flooding from the 100-year storm event is shown west of the railroad and along the Saw Mill River. Flooding from the 500-year storm is shown along Shecklers, Boutilliers, and the Billie Burke Brooks.

The soils in Hastings are classified by the United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS). Soils are grouped in four categories: Group A, Group B, Group C, and Group D. The ability of these soils to accept stormwater (well draining soil) is greatest in Group A, and least in Group D. Group A

soils found in Hastings are mainly paralleling the railroad tracks on the west side of the Village. The soils map of Hastings is shown in Appendix C.

In the NRCS study, there is a category for "Urban" areas that do not include information on soil drainage characteristics. In general, urban areas have more impervious surfaces and would not drain as well as non-impervious land. Hastings mainly consists of urban land, B, and D soils. Reflected in these classifications is the high amount of exposed rock and mild to steep slopes. Impervious surfaces, rock, and steep slopes are factors that decrease the ability of the natural landscape to accept stormwater. They would have a higher volume of runoff than a flat, soil Group A might exhibit.

Hastings was incorporated in 1879. Planned drainage was not typically considered until around the 1940's. One of the early known drainage manuals, "National Engineering Handbook, Hydrology", was published by the Soil Conservation Service in 1964. As such, development was allowed to occur in, or on streams or natural drainage paths, leaving most drainage to be constructed around developed areas. This unregulated development makes it difficult or costly to mitigate flooding. It was not until the 1980's that stormwater detention measures and individual stormwater mitigation started to be implemented for new development. Today, site development projects in Hastings and through New York State require maintaining stormwater runoff with onsite detention and retention practices for the 100-year storm event.

Much of the drainage infrastructure that exists is undersized for today's standards or towards the end of its life expectancy. In some places, localized flooding occurs where no drainage infrastructure exists to convey the stormwater. In addition, the Metro North Railroad and Old Croton Aqueduct are manmade features that bisect the drainage flow on the west side of the Hasting's ridgeline. These features effectively form a type of dam, or obstacle, for stormwater that flows towards the Hudson River. Many of the unknown culverts that carry stormwater past these features are clogged or undersized, and the conditions are unknown.

IV. STORM CRITERIA

Sizing of stormwater pipe and culverts are typically based on a particular storm event. Storm events represent a depth of rainfall during a storm that occurs for a duration of time. As described in the FEMA FIS of 2007, "Flood events of a magnitude which are expected to be equaled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for flood plain management and for flood insurance rates. These events commonly

termed the 10-, 50-, 100-, and 500-year floods, have a 10-, 2-, 1-, and 0.2-percent chance, respectively, of being equaled or exceeded during any year."

Although this study is not being conducted to determine flood plains, the recurrence intervals are used to determine flows. Westchester County storm events and NYSDEC criteria are shown below.

STORM EVENT	RAINFALL DEPTH (INCHES)
1-Year	2.8
2-Year	3.5
5-Year	4.5
10-Year	5.0
25-Year	6.5
50-Year	7.5
100-Year	9.0

The storm events shown are used to calculate stormwater runoff flow rates, which are required to determine pipe/channel sizes. The 500-year storm event is not typically used. Depending on the situation, road drainage is sized using a 10- or 25-year storm event. Culverts may be sized using the 10-, 25-, 50-, or even a 100-year storm event. A culvert crossing a local road may be sized for a 25-year storm, while a culvert crossing beneath a railroad may be sized for the 100-year storm event. The design storm used to size a culvert is site dependent.

There have been varying high intensity storms within the past several years. Tropical Storm Ida that occurred on September 1st and 2nd of 2021 was the highest storm recorded during that time period when 8.09, 7.79, and 6.97 inches of rainfall in 24 hours was recorded in Scarsdale, New Rochelle, and Tarrytown, respectively

In locations with a curb or swale alongside of a local roadway, a 10- or 25-year storm event generally will be used for sizing drainage pipe. In locations where drainage pipe/culvert crosses a road; and floods the roadway, a larger storm such as the 50- or 100-year storm event generally will be used. The design storm events used will vary based on the extent of mitigation and cost.

V. ENGINEERING METHODS OF STORMWATER ANALYSIS

Peak discharges for the 25, 50, and 100-year storm events were developed using Technical Release 20 (TR-20), with data derived from Technical Release 55 (TR-55). The computer program HydroCAD was used to model the streams and calculate preliminary flows and channel capacities.

The stormwater analysis performed as part of this evaluation is to determine the preliminary pipe and channel sizing for preliminary cost estimates. Further detailed evaluation is required for designing improvements, as mentioned within this report. For certain flood locations, a downstream evaluation will be required to verify there will not be any negative impacts to downstream residents or properties. That evaluation should include surface model such as Hydrologic Engineering Center's River Analysis System (HEC-RAS), as used by FEMA. Field surveying and camera inspections (CCTV) will be required to obtain stream/channel dimensions and profiles.

There are various means to address flooding. Primarily, a drainage pipe or channel is increased in size. Where no drainage infrastructure exists, a system is installed. Detention ponds or storage systems can also be utilized when appropriate. These systems are based on the amount of rainfall in a watershed for a design storm event. The pond or storage system fills with stormwater during a storm event, but only allows a specific flow to leave the system. The flow leaving the system is less than what comes in, thereby reducing the peak flow from a storm event. When the storm event ends, the detention system will maintain the flow out until the detention system is empty. Detention systems are typically located at the lower areas in a watershed and are relatively large depending on the contributing area.

Treating stormwater in smaller systems close to where it falls is another method to mitigate flooding. When developing land, the area being developed where rainfall would land, is considered the source. Types of practices that treat stormwater at the source include "Standard Practices" and "Green Practices", which are based on the New York State Department of Conservation (NYSDEC) Stormwater Design Manual. These practices are typically used for new development or re-development; not to address a long-standing flooding problems. However, if properly designed and implemented, these practices can help reduce flooding within a watershed.

NYSDEC Standard practices in this case may include stormwater ponds and wetlands, swales, or infiltration systems. They can be difficult to implement where major flooding conditions exist due to the amount of area needed to construct the practice. Rock and groundwater may also limit the use of these practices.

NYSDEC Green Practices in this case would include raingardens, bioretention systems, permeable surfaces, or possibly cisterns. It may also include re-forestation, which would convert impervious areas or barren areas to forest. Green Practices are typically designed to treat the water quality volume (rainfall amount of 1.5 inches), not the 100-year storm event (rainfall amount of 9.0 inches). The volume of a Green Practice would reach capacity before it is able to reduce the peak flow. However, Green Practices can collectively help abate flooding when installed in numerous locations throughout the watershed.

VI. FLOOD AREAS

Flood areas identified in this report are shown as "sites". The sites included may be major, such as frequent problematic flood areas, or minor, such as information required for further evaluation. .

Conceptual plans and cost estimates have been included for three sites that can be used for planning and grant opportunities.

Ideally, all flood-prone areas are mitigated on public property. Due to the topography and existing conditions, that is not always possible. Where public drainage infrastructure is required to be located on private properties, easements and permissions will be needed from each private property owner. Curbs, swales or other roadside features are considered maintenance and have not specifically been evaluated in this report.

Typically, drainage improvements within a watershed start at the lowest point "downstream" and work their way to the top "upstream", since improving a drainage issue upstream can cause flooding downstream. Therefore, improvements have been recommended starting downstream and moving upstream, unless it has been determined there will not be a negative impact from an upstream improvement.

The sites are grouped by watershed, from downstream to upstream. The watersheds are in order of size. A location map of each site can be found in Appendix D. A brief recommendation to improve, replace, or further evaluate is provided for each site.

SHECKLERS BROOK WATERSHED

SITE SB-1

Site SB-1 includes multiple sections of Shecklers Brook. Flooding has occurred from Cropsy Lane to the Metro North Railroad Station, across Main Street, to Broadway through Reynolds Field, and Farlane Drive across the Chemka Pool and tennis courts up to Sugar Pond. Tropical Storm Ida caused significant damage in this watershed which has since been restored and mitigated to some degree.

An evaluation to determine flood locations for various storm events will require a stream profile and sections. Information about the brook and the conditions of its conveyance structures is limited. Topographic surveying and CCTV of piping will be required. We recommend a complete flood analysis model be completed and critical culverts be inspected to determine their condition.

SITE SB-2

Site SB-2 is located on the south side of Main Street and east of the Hook & Ladder. During Tropical Storm Ida, water flowed along the street, across the front of the Hook & Ladder, and eroded the slope between the buildings. The drainage pipe and upstream drainage area should be analyzed to determine if additional drainage structures are necessary. The existing drains have surcharged since Tropical Storm Ida.

SITE SB-3

Site SB-3 is located within Shecklers Brook between Farlane Avenue and Reynolds Field. The channel is undersized and there are structures that impede flow. The existing channel is on private property. Approvals and funding would need to be obtained to address the issue in this location. Further evaluation is required and should be completed with SB-1.

SITE SB-4

Site SB-4 includes two separate culverts that carry stormwater from the east to the west side of Farlane Drive, towards Reynolds Field. The culvert adjacent Reynolds Field is undersized and floods the roadway. The culvert adjacent to the intersection with Hillside Avenue also appears to be undersized, as it is smaller than the upstream culverts and appears to have overflowed and washed out the side of the road along Farlane Avenue.

These culverts should be replaced. A complete evaluation of the culverts and potential downstream impacts (SB-1 and SB-3) should be completed.

SITE SB-5

Site SB-5 is Sugar Pond, which is located north of Chemka Pool Road. The spillway is in poor condition and under sized based on a preliminary evaluation. Damage occurred during Tropical Storm Ida when the spillway reached capacity and overflowed. The spillway should be reconstructed for up to the 100-year storm event. Possible detention should be evaluated.

SITE SB-6

Site SB-6 is located on Buena Vista and Ravine Drive. The watershed is approximately 13 acres, 7 of those acres are collected at the lower section of Kitching Place (located in Dobbs Ferry) and directed into a channel that flows to Ravine Drive. An 8 inch drainage pipe in Ravine Drive connects to a series of catch basins. They are directed to an undersized drainage pipe that runs through private property from Buena Vista Drive to Euclid Avenue. The curbs along both roads have limited to no reveal, are damaged, or are missing. The pipe is located on 19 Buena Vista and either 96 or 100 Euclid Avenue.

Stormwater that cannot be conveyed in the drainage infrastructure is channeled along the sides of the roadways. Due to the condition of the curbs, and topography, stormwater flows onto the property of the residences at Buena Vista and Euclid Avenue.

The Village and County maps of the drainage system are inconsistent and do not appear accurate or up to date. The watershed could be larger than it appears. Further field work and coordination with the Village of Dobbs Ferry is required to verify. Based on preliminary calculations, the culvert at 19 Buena Vista Drive cannot handle the 1-year storm event. Further evaluation is required to verify existing and proposed capacities.

Proposed improvements include a series of catch basins, piping and curbing along both roadways. Due to the private property and the complexity of work required to replace the existing culvert, we recommend installing the drainage down Pleasant Avenue and connect to the Euclid drainage system. Prior to design, the potential downstream impacts need to be evaluated.

Due to the limited pitch in the roadway, the conceptual plan shows a 24 inch diameter pipe on Buena Vista Drive and a 15 inch diameter pipe on Pleasant Avenue which is

downstream. This is not typical and will need to be reviewed along with the downstream pipe capacities.

Due to the amount of drainage infrastructure needed to mitigate flooding in this location, the potential to reduce flow and volume were evaluated. It appears the portion of the watershed east of Villard Avenue can be diverted north which would direct half of the watershed away from Ravine Drive. Curbs and minor grading would still be needed. Downstream impacts would need to be evaluated to verify the change in flow patterns would not cause negative impacts. If the portion of the watershed east of Villard Avenue is re-directed, and no other drainage installed, the culvert can handle the 1-year storm event.

The estimated cost of Site SB-6 is $726,000. The conceptual plan and preliminary cost can be found in Appendix E. This does not include possible utility relocation costs. During the design phase of this project, soil borings should be considered to determine if rock may be encountered which could significantly impact the cost.

BOUTILLIERS BROOK WATERSHED

SITE BB-1

Site BB-1 is located within Boutilliers Brook from Farragut Parkway to Dan Rile Park. The watershed is approximately 166 acres and flooding occurs along much of the brook, starting at the culvert at Farragut Parkway, through private properties and roadways to the park. The brook appears to originate in the drainage system along Rosedale Avenue. There is a known high groundwater table and rock in the area.

Previous studies of the area were done by Hazen & Sawyer in 1986 and C.G. Engineers in 2003. The Hazen & Sawyer report recommended using the park for detention and increasing the culverts and channels downstream. The C.G. Engineer report had similar recommendations with options to re-route the culverts away from Fenwick Road. Both reports recognized the challenges with the brook being located on private property. The C.G. Engineer report also mentioned that there was “financial concern that taxpayers would incur large capital expenses for localized problems.”

Starting from the lowest point, flooding occurs at the culvert in Farragut Parkway. The culvert backs up and floods the residence at the end of Nepperhan Avenue. The homeowner at 12 Nepperhan Road recently installed a wall to keep water in the brook and away from the house.

The channel from Farragut Parkway to Farragut Avenue is mainly on private property. There are structures within the brook that most likely restrict the channel capacity. The roadway culverts and channel from Farragut Avenue to Fenwick Road are known to flood and are undersized based on preliminary calculations. This portion of the brook is relatively flat which may require a larger channel to convey storm events.

The culvert in Fenwick Road that conveys stormwater from Dan Rile Park is undersized. It appears to be 15 or 18 inches in diameter, while the upstream culvert in the park is 27 inches in diameter. This is a bottleneck that appears to be the cause of flooding in Fenwick Road.

Based on preliminary calculations, the existing drainage system within the brook cannot handle minor storm events. Much of this is due to inadequate slope within the brook, and undersized culverts.

To avoid work on private property, re-routing the brook within the Village roadway was evaluated. That included utilizing Dan Rile Park as a control structure, allowing the low flow to Fenwick Road, and directing overflow to either Branford Road or Farragut Avenue. This option would have the following impacts: (1) The Dan Rile Park would be altered, most likely significantly, and it would change the nature of the Park. (2) The installation towards Branford Road would require approximately 14 feet of excavation in the roadway, which adds a significant cost and other unknown conditions, including the potential to encounter rock. In addition, the stormwater would be directed back into the brook, thereby providing no mitigation downstream. (3) The installation towards Farragut Avenue would be similar, except the excavation would be deeper, and homes between Farragut Parkway and Farragut Avenue would not be mitigated.

Any solution to mitigate flooding of the properties from Dan Rile Park to Farragut Avenue could result in increased flooding to the properties between Farragut Parkway and Nepperhan Avenue.

To avoid increasing flooding to the properties on Nepperhan Avenue, detention was considered. However, the only location available appears to be Dan Rile Park. This option would most likely require extensive grading and retaining walls, and the feasibility would need further review.

Therefore, to reduce flow and volume to the brook adjacent Nepperhan Avenue, the portion of the watershed west of Farragut Parkway (from High Street) is proposed to be re-routed further downstream. This would reduce the tributary drainage area by approximately 44 acres.

Site BB-1 improvements proposed should be evaluated and possible sequenced as described below.

1. Evaluate the brook using HEC-RAS.
2. Size culvert in Fenwick Road from Dan Rile Park to downstream channel. Evaluate downstream impacts. If replacing the culvert in Fenwick Road does not exacerbate the downstream flooding, replace the culvert.
3. If there are impacts downstream between Farragut Parkway and Farragut Avenue, but not between Fenwick Road and Farragut Avenue, the bypass on Farragut Parkway should be considered.
4. If there are any impacts directly downstream of Fenwick Road, the length of the channel and culverts will need to be increased. Easements will be required.

The estimated cost of Site BB-1 is $3.4 million. Conceptual plans and a preliminary cost estimate can be found in Appendix E. Separate costs are provided for each segment.

SITE BB-2

Site BB-2 is located at the south end of Cochrane Avenue. The catch basin directs water to Glenn Place, within the Ravensdale Watershed. Once the catch basin overflows, it runs overland to the Boutilliers Brook Watershed. Based on the signs of overland flow and channel in the woods, it may overflow frequently. This would add to flooding in the Boutilliers Brook Watershed during larger storm events. This should be evaluated and the catch basin should be designed to keep the stormwater in its watershed.

SITE BB-3

Site BB-3 is Rosedale Avenue from Ravensdale Road to Mt. Hope Parkway. The roadway is located in a valley that is lower than the surrounding area and relatively flat. Therefore, stormwater collects along the road and has very little pitch for water to drain. Some homes along the roadway have driveways that pitch down to the garage which experience flooding. This condition requires further evaluation.

SITE BB-4

Site BB-4 is located on Hamilton Road, south of Mt. Hope Boulevard. Stormwater channels along the west side of Hamilton Avenue and flows past the broken or missing curbs towards private homes at the end of Prescott Place. The catch basins on Hamilton Avenue are being bypassed, or the drainage pipes are undersized. To address water

running off the roadway, curbs should be installed and water should be pitched towards the catch basins. The drainage system should be evaluated to determine if it is undersized.

SITE BB-5

Site BB-5 is located in Uniontown Park. Runoff from the slope west of the basketball court and baseball field flows towards the field and temporarily flood the area behind the field. Drainage was installed to direct water away from the field to prevent closure of the field. The drain overflows between the field and court. This drainage should be extended to outlet to the slope or connect to the exiting drain.

SITE BB-6

Site BB-6 is located between High and Green Streets, from High Street to Farragut Parkway. The culvert that bisects James, Rose, and Prince Streets collects runoff from a large catchment area. The lower portion around Prince Street is less steep. Some flooding and erosion occurs in the upper portion of the watershed. The erosion should be stabilized. The drainage infrastructure in the area should be identified, surveyed, and evaluated.

SITE BB-7

Site BB-7 is located north of Green Street. The catchment area south of Saunders Street may be directed to Green Street or may cross Farragut Parkway. The flow path should be determined to verify the watershed boundary.

ZINSSER BROOK WATERSHED

SITE Z-1

Site Z-1 is located at Broadway and Riverview Place. The total tributary watershed is estimated at 123 acres.

Major flooding occurs at Broadway before flowing down Riverview Place to the catch basins at the end of the roadway. During Tropical Storm Ida in September 2021, the entire roadway acted as a conveyance channel. Stormwater overflowed the structures at the end and washed out a large portion of the downstream slope. In addition, the Zinsser Brook overflowed to Edgars Lane. Flooding and erosion also occur in Edgars Lane, north of the roadway.

Based on field inspections and discussions with the Department of Public Works (DPW), it is known at a minimum there are two, 24" drainage pipes that convey stormwater from Broadway, through the River Glen property to a culvert under the railroad. It appears, based on previous Village maps, two additional drainage pipes may exist. These pipes, along with others within the watershed, need to be verified by survey and CCTV. Based on unverified maps and documents, the North Broadway Watershed may contribute to the runoff.

Based on preliminary calculations, the existing infrastructure can almost pass a 5 year or 10 year storm event, depending on whether 2 or 4 pipes exist. As mentioned above, all of these are located on private property.

We recommend a culvert be installed on Riverview Place from Broadway to the drainage at the dead end of Riverview Place, along with additional catch basin inlets. At this time, the culvert required is 48 to 54 inches in diameter, depending upon the chosen design storm. We recommend the design storm of 50 or 100-year storm if possible, but not less than the 25-year storm event. Sizing will be dependent on verification of the existing system and condition of the system.

This proposed culvert would be larger than the existing 36 inch pipe that directs water from Riverview Place to the channel along the railroad. However, as the overflow already is directed towards Riverview Place, no change in the water flow would occur. In addition, the 36 inch pipe downstream of Riverview Place has greater pitch and may have more capacity than a culvert in Riverview Place. Upon verifying the existing conditions, the evaluation needs to be updated for pipe sizing and necessity to replace the existing 36 inch pipe should be determined.

In addition to a culvert through Riverview Place, we recommend drainage be installed in Zinsser Brook, Edgars Lane, and Broadway. This will remove surface flow prior to flooding the roadways and causing damage from erosion. For budgeting purposes, these have been separated into primary work and secondary work.

The estimated cost of Site 1 is $2.1 million. The conceptual plan and preliminary cost estimate can be found in Appendix E. Utility relocations are currently unknown, however additional costs may be in the range of $100,000 to $250,000. These costs will be subject to more detailed information as described. In addition, after inspection by CCTV, the anticipated lifespan of the existing drainage infrastructure should be evaluated and made part of the decision on sizing the culvert in Riverview Place.

SITE Z-2

Site Z-2 is to evaluate the existing drainage infrastructure within the watershed, mainly to Flower Avenue. Prior to this evaluation, the drainage system should be surveyed to determining pipe size and locations.

MT. HOPE EAST WATERSHED

SITE MH-1

Site MH-1 is located at Stanley Avenue and Mt. Hope Boulevard. The area drains directly to the Saw Mill River Parkway drainage system and a portion of Stanley Avenue is within the FEMA flood plain. The Saw Mill River Parkway is outside the scope of this evaluation as it is a State-owned parkway. However, we recommend the drainage infrastructure to be identified and surveyed for further evaluation.

SITE MH-2

Site MH-2 is located from Clarance Avenue to Farmont Avenue. This area appears to channel water to Stanley Avenue and should be evaluated. We recommend the drainage infrastructure be surveyed and the area be further evaluated.

SITE MH-3

Site MH-3 is located at Lincoln and Horner Avenues and makes up about 16 acres in the Mt. Hope East Watershed. The watershed is bordered by the Mt. Hope Boulevard, Lefurgy Avenue, Edgewood Avenue, and Horner Avenue. Due to the topography, Lincoln Avenue is the low point within the watershed. This creates a type of bowl that water cannot leave without a place to drain.

The existing drainage includes catch basins that collect runoff on Lincoln Avenue and convey it through a 6 inch diameter pipe through private property to Horner Avenue and Glenwood Avenue. Catch Basins at Lincoln and Horner direct stormwater to Glenwood with an 8 inch diameter pipe. At the bottom of Glenwood is a catch basin that directed stormwater down Mt. Hope Boulevard.

Flooding occurs within the roadways and has been reported to flood private residences. The existing drainage identified is undersized. The larger issue is the limited ability to

convey stormwater by means of gravity, as there is very limited pitch. Recent improvements to curbing have been completed and should be monitored to determine their significance to abate flooding in the localized areas.

Based on preliminary calculations, the existing drainage pipes should be replaced with larger pipe sizes. That includes all pipes on Horner and Glenwood Avenues, and the private property between Lincoln and Horner Avenues. Due to the limited pitch, the depth of the drainage system at the corner of Horner and Glenwood is required to be much deeper. To minimize the depth, we recommend the pipe that exists through the private property be replaced instead of being installed in the roadway. This will require an easement. Based on the surrounding area, it is possible rock will also be encountered, and borings should be considered.

Replacing the existing drainage system at Lincoln Avenue, Horner Avenue, and Glenwood Avenue may cost $500,000 to $800,000, depending on the extent of work required and existing conditions. In addition, Site MH-1 should be evaluated prior to MH-3 to determine if downstream improvements are required.

SOUTHSIDE AVENUE WATERSHED

SITE SA-1

Site SA-1 is located along Southside Avenue. Water floods in three locations at the culvert entrances that convey stormwater under the Metro North Railroad to the Hudson River. These culverts should be cleaned, surveyed, and inspected. Then they should be evaluated and sized appropriately. Increasing the size will be costly and require review and approval of the Metro North Railroad. Responsibility for replacement and maintenanceshould be determined.

SITE SA-2

Site SA-2 is the Quarry Park Trailway that is located between Quarry Park and Southside Avenue. Some improvements were made to help stabilize the trailway, however the trail is very steep and is lower than the area around itwhich forms a steep channel for runoff. In addition, the Quarry Park, originally a rock quarry, funnels its watershed to the trailway. Due to the construction of the trail, there is limited access and installation of drainage would be exceedingly difficult. If funding becomes available, or conditions deteriorate the site should be further evaluated for additional drainage improvements.

SITE SA-3

Site SA-3 is located on the south side of Washington Avenue at the intersection of the Draper Park exit. Stormwater from the roadway and surrounding area collects in the swale on the side of the exit driveway. The western embankment at the drive and roadway is raised and directs stormwater to the roadway.

The crown in the road is not sufficient to keep the runoff on the south side of the road. The stormwater flows to the north side of the road where the curbs, sidewalk and sidewalk aprons are not constructed to keep the water in the roadway, and as a result it flows onto private property.

A defined swale should be constructed at the west side of the park exit, to keep water on the south side of Washington Avenue. Other possible improvements may be to raise the crown in the roadway, replace curbs and sidewalk on the north side of the roadway, or install drainage within the roadway. Further evaluation is required if drainage infrastructure is required.

VII. CONCLUSIONS AND RECOMMENDATIONS

The Village of Hastings-on-Hudson intends to alleviate or mitigate flooding throughout the Village to the greatest extent practical. This study is the first in a series of phases to accomplish this goal. Major obstacles include funding and property ownership necessary to proceed with this work. Easements and coordination is required between the Village and applicable entities, such as the Metro North Railroad, School District, NYS Department of Transportation, the State, Westchester County, neighboring municipalities, and private property owners.

There are inherent obstacles the Village must also contend with including rock and groundwater, and limited main channels of conveyance. For example, stormwater pipe sizing of a 25-year storm event may require a 24 inch diameter pipe, while the existing downstream pipe is only 15 inches. Most likely the downstream drainage pipe would also need to be replaced, thereby increasing the size and cost of the project. Without upsizing the downstream pipe, flooding may occur in various other locations.

Based on our evaluation, we recommend the following for the remaining phases:

Phase II

1. Update the drainage infrastructure mapping. This includes the location and elevation of all drainage structures, piping, and outlets. This should be completed by a New York State Licensed Land Surveyor and will require coordination with the Village Department of Public Works. This will also require outfalls along the Hudson River and tidal information.

2. Closed circuit television (CCTV) pipes and structures necessary to complete drainage infrastructure map.

3. Survey centerline profile of brooks and watercourses. At this time this appears necessary for Shecklers Brook, Boutilliers Brook, Zinsser Brook, and Billie Burke Brook.

4. Locating outfalls along the Hudson River.

   Coordination between entities to access properties and/or obtain information (e.g. other municipalities, schools, Metro North, private property owners, etc.).

Phase III

1. Update the Village Watershed Map based on an updated drainage map.

2. Prepare Hydrologic Engineering Center's River Analysis System (HEC-RAS) model for Shecklers Brook, Boutilliers Brook, Zinsser Brook, and Billie Burke Brook.
   a. Identify flooding locations for various storm events.
   b. Determine design storm event requirements.
   c. Determine culvert or channel sizing for undersized sections of brook.

3. Update the list of drainage projects and add additional sites as needed. Separate them based on size, scope, and cost. Complete cost-benefit analysis if needed.

4. Review results of Phase II and Phase III with the Village. Determine which projects to complete at that time and how to phase.

Phase IV

1. Complete site specific projects as described when funding becomes available.

Additional Recommendations to complete throughout all phases

1. Identify and apply for grant funding and opportunities.

2. Develop minimum standards for development and public improvements for use by the Village Department of Public Works and Building Department. For example, the Village has numerous 6 or 8 inch pipe. These pipes are categorically too small to convey stormwater and due to their size, clog more easily and require more maintenance than larger pipes.

3. Village should continue stormwater requirements of the 100 year storm event for new development and redevelopment projects. Standard and Green infrastructure projects should be encouraged where possible.

4. Add stormwater projects to the list as they arise.

5. CCTV has been performed for many culverts and pipes in the Village. These inspections should be listed with the date of each inspection. Annual CCTV should continue for critical culverts and piping as determined by Village DPW.

6. Complete a full topographic survey of projects that may need to be "shovel ready."

APPENDIX A


VILLAGE OF
HASTINGS-ON-HUDSON
COUNTY OF WESTCHESTER
STATE OF NEW YORK
STORM WATER SEWERS
AND
SURFACE DRAINAGE
1934
SCALE
ONE INCH TO 200 FEET
FROM THE FILES OF
GABRIEL E. SENOR, P.C.
ENGINEERS · PLANNERS · SURVEYORS
80 EAST HARTSDALE AVE
HARTSDALE, N.Y. 10530
(914) 422-0070
LEGEND
CATCH BASINS
MANHOLES
PIPES OR SEWERS
DATUM
TOWN OF GREENBURGH
VILLAGE OF DOBBS FERRY
CITY OF YONKERS
HUDSON RIVER
SAW MILL RIVER ROAD
CHILDREN'S VILLAGE
HILLSIDE PARK
LEFURGY PARK
DRAPER PARK
FUTURE QUARRY PARK
FULTON PARK
HASTINGS TERRACE APARTMENTS
LA BARANCA APARTMENTS
RIVER GLEN APTS.
HASTINGS HOUSE APTS.
TOWER RIDGE YACHT CLUB
ANACONDA
ZINSSER
JOHN E. ANDRUS MEMORIAL HOME
JULIA DYKEMAN ANDRUS MEMORIAL ASSOCIATION
NEW YORK ORPHAN ASYLUM
BROADWAY
WARBURTON AVE.
THIS PLAN WAS PREPARED AS SUGGESTED BY JOHN P. DAVIES, M.E., OF HASTINGS-ON-HUDSON, N.Y.
SURVEYS AND PLANS WERE MADE BY:
W. C. BERG, C.E., OF HASTINGS-ON-HUDSON
VINCENT BIELECKI, " "
RICHARD M. OSTRANDER, OF TARRYTOWN
WILLIAM J. FYFE, " IRVINGTON
COST OF WORK WAS BORN BY:
VILLAGE OF HASTINGS-ON-HUDSON - WILLIAM STEINSCHNEIDER, MAYOR
WESTCHESTER COUNTY EMERGENCY WORK BUREAU - WAYNE D. HEYDECKER, DIRECTOR
NEW YORK STATE TEMPORARY EMERGENCY RELIEF ADMINISTRATION
FEDERAL EMERGENCY RELIEF ADMINISTRATION

APPENDIX B

VILLAGE OF HASTINGS-ON-HUDSON
WATERSHED MAP

HUDSON RIVER

GRAHAM PARK WATERSHED
60.11 ACRES

ROWLEYS BROOK BRIDGE WATERSHED
110.01 ACRES

SOUTHSIDE AVE. WATERSHED
70.03 ACRES

SHECKLERS BROOK WATERSHED
405.48 ACRES

N. BROADWAY WATERSHED
32.80 ACRES

ZINSSER WATERSHED
149.52 ACRES

TOMPKINS AVE. WATERSHED
55.43 ACRES

BOUTILLIERS BROOK WATERSHED
165.93 ACRES

RAVENSDALE RD. WATERSHED
33.78 ACRES

FARRAGUT AVE. WATERSHED
23.73 ACRES

MT. HOPE EAST WATERSHED
72.40 ACRES

CLIFF ST. WATERSHED
13.45 ACRES

HILLSIDE WOODS EAST WATERSHED
68.37 ACRES

Rowleys Brook
Billie Burke Brook
Zinsser Brook
Shecklers Brook
Boutilliers Brook
Saw Mill River
Sugar Pond

VILLAGE OF HASTINGS-ON-HUDSON
CITY OF YONKERS

VILLAGE OF HASTINGS-ON-HUDSON
TOWN OF GREENBURGH

VILLAGE OF DOBBS FERRY
VILLAGE OF HASTINGS-ON-HUDSON

HASTINGS RIDGELINE

OUTFALL
OUTFALL INTERCONNECT
OUTFALL (56")
OUTFALL (60")
OUTFALL (39")
OUTFALL (54")
DP

MINOR WATERSHED BNDY.
DESIGN POINT
WATERCOURSE
MAJOR WATERSHED BNDY.
100 YR. FLOODPLAIN
500 YR. FLOODPLAIN

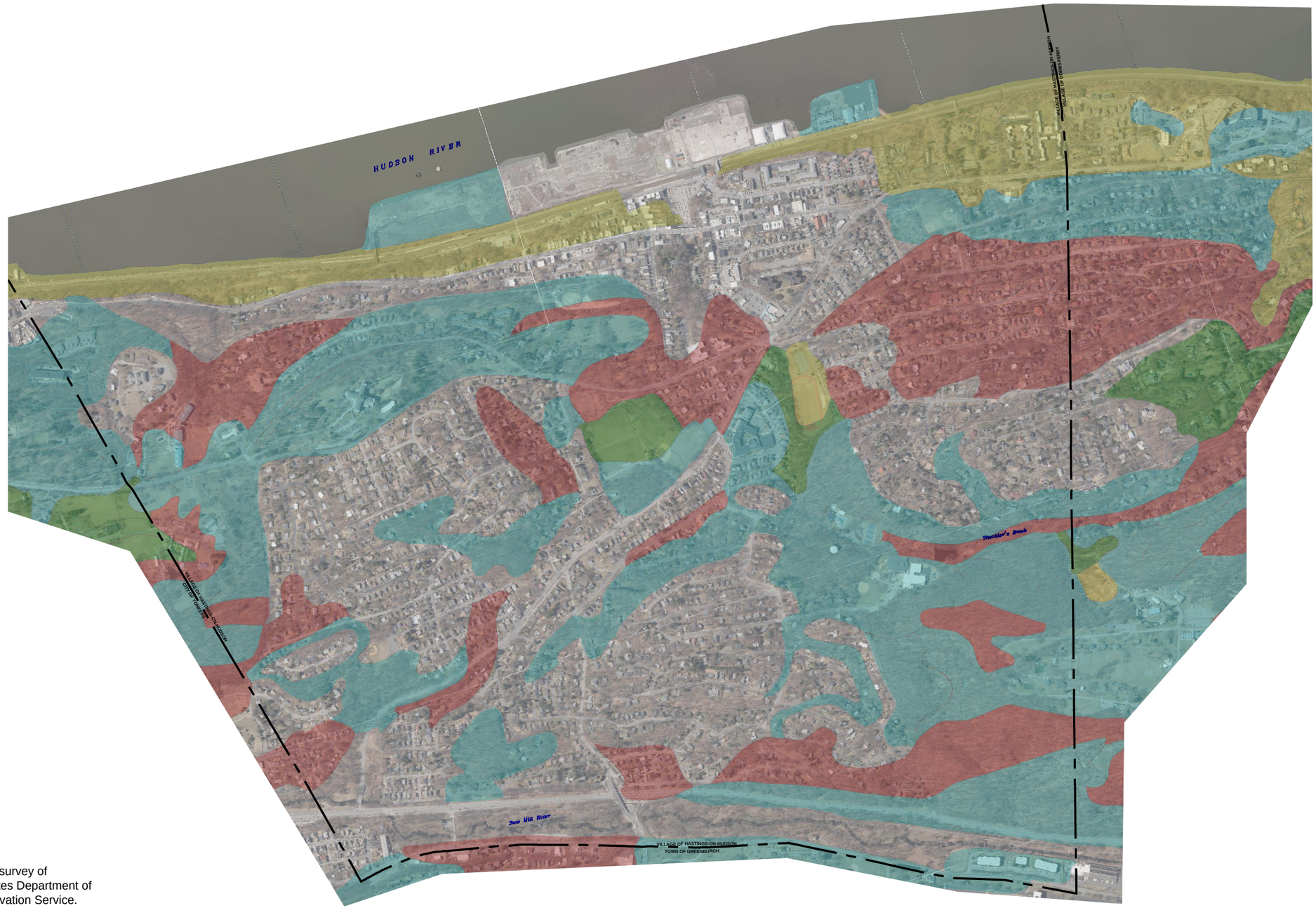
PLAN KEY

Scale 1" = 300'
300 0 300 600 900

DATE: 12/18/23

JAMES J. HAHN ENGINEERING, P.C.
Putnam Business Park
1689 Route 22
Brewster, New York 10509
Tel: (845) 279-2220

APPENDIX C



LEGEND

- GROUP A SOIL
- GROUP B SOIL
- GROUP C SOIL
- GROUP D SOIL
- URBAN LAND

NOTE:
Soil classifications are based on a soil survey of Westchester County by the United States Department of Agriculture, Natural Resources Conservation Service.

JAMES J. HAHN ENGINEERING, P.C.
Putnam Business Park
1689 Route 22
Brewster, New York 10509
Tel: (845) 279-2220

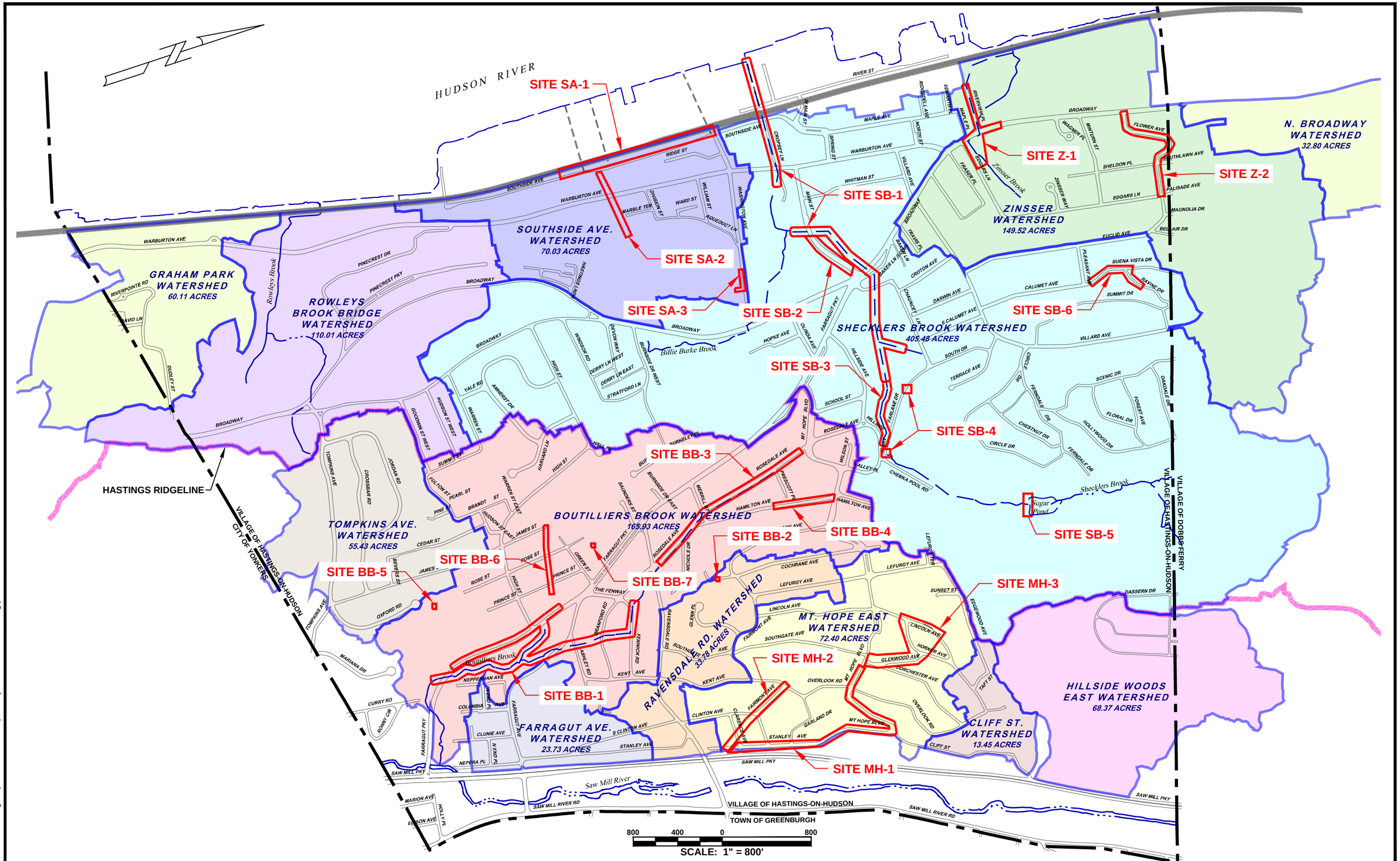
VILLAGE OF HASTINGS-ON-HUDSON SOILS MAP

DATE: 8/31/23

1000 0 1000 2000 3000

Scale 1" = 1000'

APPENDIX D



JAMES J. HAHN ENGINEERING, P.C. Putnam Business Park 1689 Route 22 Brewster, New York 10509 Tel: (845) 279-2220	UNAUTHORIZED ALTERATIONS OR ADDITIONS TO THIS DRAWING IS A VIOLATION OF SECTION 7209 (2) OF THE NEW YORK STATE EDUCATION LAW. THIS PLAN IS NULL AND VOID FOR CONSTRUCTION PURPOSES WITHOUT THE SIGNATURE AND SEAL OF THE DESIGN ENGINEER.	REV. / DATE / DESCRIPTION
TITLE: SITE LOCATIONS MAP PROJECT: HASTINGS-ON-HUDSON FLOOD STUDY VILLAGE OF HASTINGS-ON-HUDSON, WESTCHESTER COUNTY, NY	SCALE: 1" = 800' DRAWING NO.: - DATE: 11/6/23 SHEET NO.: 1 OF 1	

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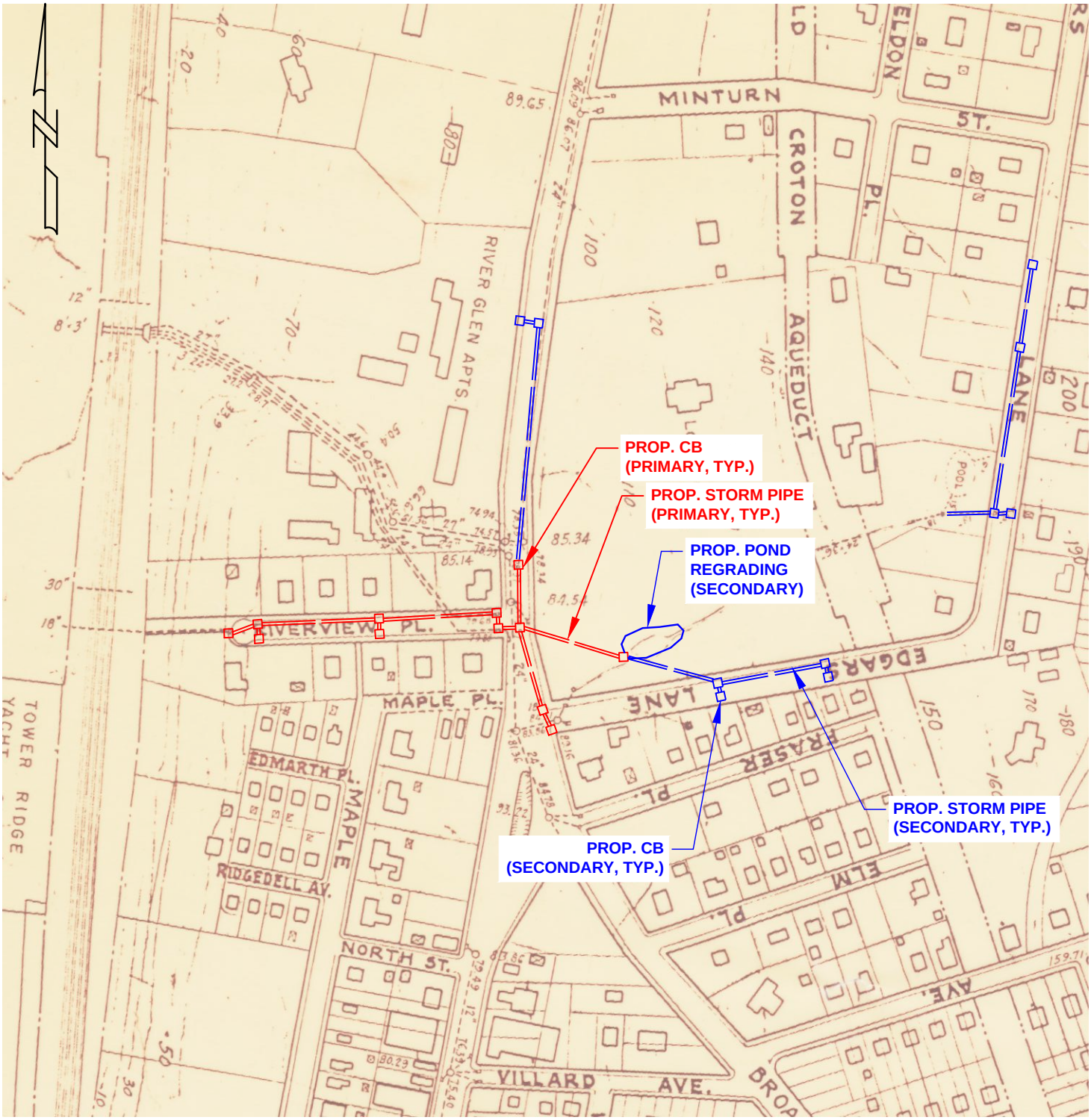
APPENDIX E



250 0 250

SCALE: 1" = 250'

REV.	DATE	DESCRIPTION

TITLE: SITE Z-1 (RIVERVIEW PLACE & ZINSSER PARK)

PROJECT: HASTINGS-ON-HUDSON FLOOD STUDY
PHASE I
VILLAGE OF HASTINGS-ON-HUDSON, WESTCHESTER COUNTY, NY

JAMES J. HAHN ENGINEERING, P.C.
Putnam Business Park
1689 Route 22
Brewster, New York 10509
Tel: (845) 279-2220

SCALE	DATE
1" = 250'	11/6/23
DRAWING NO.	SHEET NO.
-	1 OF 4

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CONCEPTUAL COST ESTIMATE
FOR HASTINGS ON HUDSON FLOOD STUDY

SITE Z-1 - BROADWAY, RIVERVIEW PLACE, EDGARS LANE, ZINSSER PARK

SPEC. SEC	ITEM	UNIT	EST. QUAN.	UNIT PRICE	TOTAL PRICE
SEGMENT 1 - BROADWAY AND RIVERVIEW PLACE					
BBC	Bituminous Base Course	ton	170	$210.00	$35,700.00
BTC	Bituminous Top Course	ton	255	$210.00	$53,550.00
CB	Furnish and Install Catch Basin(s)	ea	10	$6,500.00	$65,000.00
CC	Concrete Curbs	lf	475	$75.00	$35,625.00
CEDS	Connect to Existing Drainage System	ea	4	$500.00	$2,000.00
CLF	Chain Link Fence (4ft)	lf	20	$95.00	$1,900.00
CPP	Furnish and Install Corrugated Polyethylene Pipe (12" Only)	lf	100	$125.00	$12,500.00
CPP	Furnish and Install Corrugated Polyethylene Pipe (24" Only)	lf	130	$160.00	$20,800.00
CPP	Furnish and Install Corrugated Polyethylene Pipe (48 Only)	lf	630	$395.00	$248,850.00
CS	Furnish and Install Control Structure	ea	2	$8,000.00	$16,000.00
CSG	Furnish and Place Crushed Stone or Gravel (3/4" Stone)	cy	50	$100.00	$5,000.00
CSG	Furnish and Place Crushed Stone or Gravel (NYSDOT Item 304.15)	cy	340	$100.00	$34,000.00
CSR	Concrete Sidewalks and Ramp	sf	1,900	$30.00	$57,000.00
DF	Dense Fill	cy	30	$150.00	$4,500.00
ECD	Erosion Control Devices	ls	1	$10,000.00	$10,000.00
LS	Landscaping	ls	1	$15,000.00	$15,000.00
MEE	Miscellaneous Earth Excavation	cy	50	$50.00	$2,500.00
MPT	Maintenance & Protection of Traffic	ls	1	$100,000.00	$100,000.00
PM	Pavement Markings (4")	lf	360	$3.00	$1,080.00
PM	Pavement Markings (12")	lf	15	$10.00	$150.00
PML	Pavement Milling (2")	sy	800	$18.00	$14,400.00
RC	Reinforced Concrete (Road Subbase Broadway)	cy	120	$500.00	$60,000.00

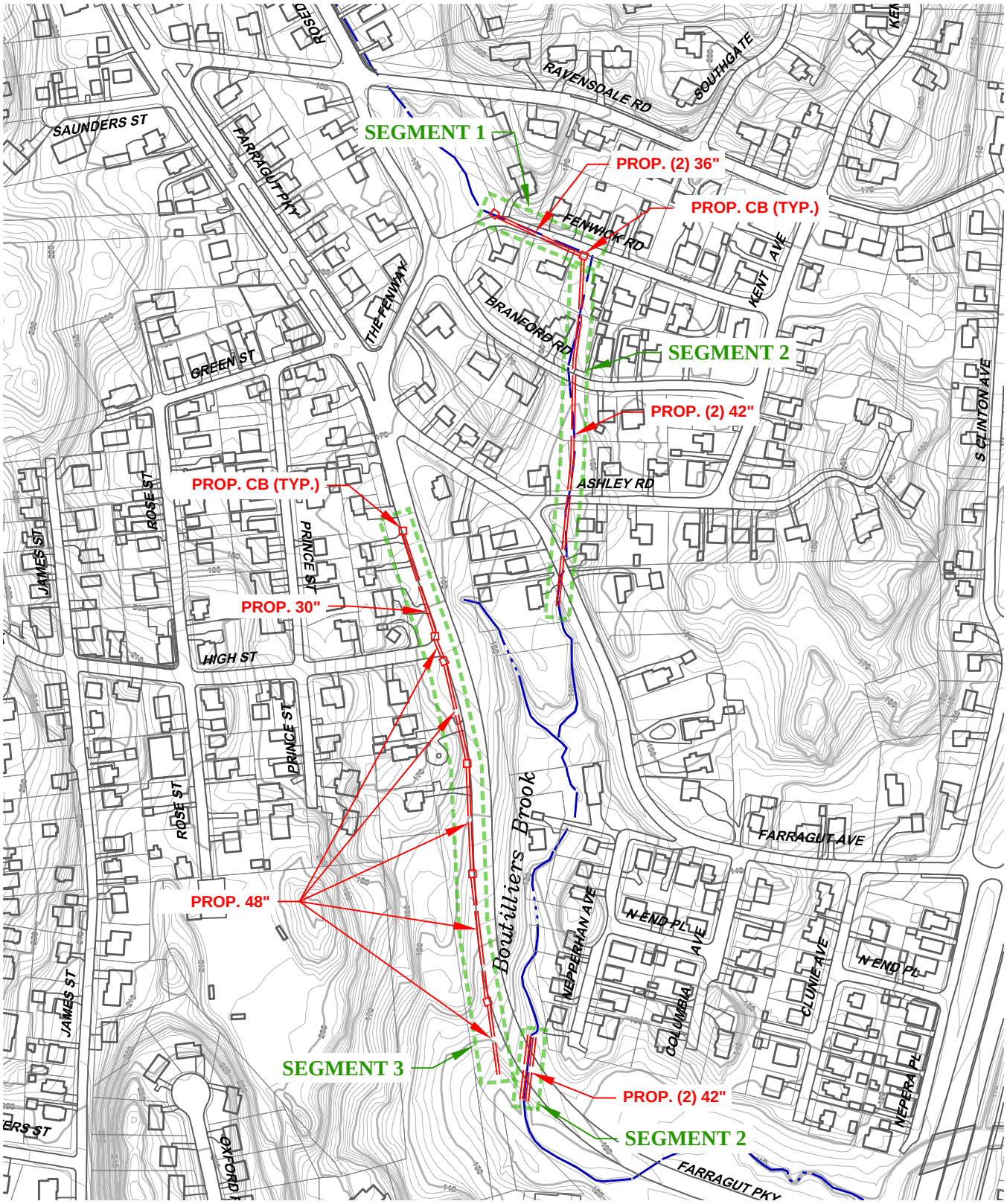
CONCEPTUAL COST ESTIMATE
FOR HASTINGS ON HUDSON FLOOD STUDY

SPEC. SEC	ITEM	UNIT	EST. QUAN.	UNIT PRICE	TOTAL PRICE
RER	Rock Excavation & Removal	cy	100	$500.00	$50,000.00
RR	Furnish and Install Rip Rap	sy	15	$250.00	$3,750.00
TR	Tree Removal	ls	1	$3,500.00	$3,500.00
TSS	Furnish and Place Topsoil & Seed	sf	1,600	$2.75	$4,400.00
UFG	Unclassified Excavation, Filling & Grading (land grading)	ls	1	$25,000.00	$25,000.00
	CONCEPTUAL CONSTRUCTION ESTIMATE				**$882,205.00**
SPEC. SEC	**ITEM**	**UNIT**	**EST. QUAN.**	**UNIT PRICE**	**TOTAL PRICE**
SEGMENT 2 - BROADWAY AND EDGARS LANE					
BBC	Bituminous Base Course	ton	125	$210.00	$26,250.00
BTC	Bituminous Top Course	ton	185	$210.00	$38,850.00
CB	Furnish and Install Catch Basin(s)	ea	10	$6,500.00	$65,000.00
CEDS	Connect to Existing Drainage System	ea	2	$500.00	$1,000.00
CPP	Furnish and Install Corrugated Polyethylene Pipe (12" Only)	lf	100	$125.00	$12,500.00
CPP	Furnish and Install Corrugated Polyethylene Pipe (15" Only)	lf	850	$150.00	$127,500.00
CPP	Furnish and Install Corrugated Polyethylene Pipe (24" Only)	lf	465	$160.00	$74,400.00
CSG	Furnish and Place Crushed Stone or Gravel (3/4" Stone)	cy	50	$100.00	$5,000.00
CSG	Furnish and Place Crushed Stone or Gravel (NYSDOT Item 304.15)	cy	50	$100.00	$5,000.00
DF	Dense Fill	cy	20	$150.00	$3,000.00
ECD	Erosion Control Devices	ls	1	$6,500.00	$6,500.00
GC	Granite Curbs	lf	130	$145.00	$18,850.00
MEE	Miscellaneous Earth Excavation	cy	50	$50.00	$2,500.00
MPT	Maintenance & Protection of Traffic	ls	1	$50,000.00	$50,000.00
PM	Pavement Markings (4")	lf	465	$3.00	$1,395.00
PML	Pavement Milling (2")	sy	535	$18.00	$9,630.00

CONCEPTUAL COST ESTIMATE
FOR HASTINGS ON HUDSON FLOOD STUDY

SPEC. SEC	ITEM	UNIT	EST. QUAN.	UNIT PRICE	TOTAL PRICE
RC	Reinforced Concrete (Road Subbase Broadway)	cy	80	$500.00	$40,000.00
RER	Rock Excavation & Removal	cy	25	$500.00	$12,500.00
RR	Furnish and Install Rip Rap	sy	15	$250.00	$3,750.00
TSS	Furnish and Place Topsoil & Seed	sf	1,500	$2.75	$4,125.00
	CONCEPTUAL CONSTRUCTION ESTIMATE				**$507,750.00**
SEGMENTS 1 AND 2					
	COMBINED SEGMENTS 1 & 2				**$1,389,955.00**
	SOFT COSTS (SURVEY, ENGINEERING, LEGAL, CONSTRUCTION ADMIN. 18%)				**$250,191.90**
	CONTINGENCY (25%)				**$410,036.73**
	TOTAL ESTIMATE				**$2,050,183.63**

This estimate is preliminary and approximate. The prices shown above are not actual construction prices and are subject to change. These prices are based on our engineering experience and knowledge of previous construction projects of similar work and scope. The estimate does not include utility construction costs for telephone, electric and gas, permit fees and any other fees or costs related to the infrastructure work. This estimate is for budgeting purposes only.



REV.	DATE	DESCRIPTION

TITLE: SITE BB-1 (BOUTILLIERS BROOK)

PROJECT: HASTINGS-ON-HUDSON FLOOD STUDY
PHASE I
VILLAGE OF HASTINGS-ON-HUDSON, WESTCHESTER COUNTY, NY

JAMES J. HAHN ENGINEERING, P.C.
Putnam Business Park
1689 Route 22
Brewster, New York 10509
Tel: (845) 279-2220

SCALE	DATE
1" = 300'	11/6/23
DRAWING NO.	SHEET NO.
-	2 OF 4

CONCEPTUAL COST ESTIMATE
FOR HASTINGS ON HUDSON FLOOD STUDY

SITE BB-1 - SHECKLER'S BROOK, FENWICK, BRANFORD, ASHLEY, FARRAGUT (AVE, PKY)

SPEC. SEC	ITEM	UNIT	EST. QUAN.	UNIT PRICE	TOTAL PRICE
SEGMENT 1 - FENWICK ROAD					
BBC	Bituminous Base Course	ton	40	$210.00	$8,400.00
BTC	Bituminous Top Course	ton	65	$210.00	$13,650.00
CB	Furnish and Install Catch Basin(s)	ea	3	$6,500.00	$19,500.00
CC	Concrete Curbs	lf	300	$75.00	$22,500.00
CGR	Clearing Grubbing & Removal	ls	1	$6,000.00	$6,000.00
CLF	Chain Link Fence (4ft)	lf	20	$95.00	$1,900.00
CPP	Furnish and Install Corrugated Polyethylene Pipe (Double 36" Only)	lf	250	$400.00	$100,000.00
CSG	Furnish and Place Crushed Stone or Gravel (3/4" Stone)	cy	50	$100.00	$5,000.00
CSG	Furnish and Place Crushed Stone or Gravel (NYSDOT Item 304.15)	cy	75	$100.00	$7,500.00
DR	Demolition & Removal	ls	1	$6,000.00	$6,000.00
DMH	Furnish and Install Drainage Manhole	ea	1	$20,000.00	$20,000.00
ECD	Erosion Control Devices	ls	1	$3,000.00	$3,000.00
MPT	Maintenance & Protection of Traffic	ls	1	$6,500.00	$6,500.00
PCBC	Furnish and Install Precast Concrete Box Culvert (Headwalls/Wingwalls)	ea	1	$10,000.00	$10,000.00
RER	Rock Excavation & Removal	cy	150	$500.00	$75,000.00
RR	Furnish and Install Rip Rap (Grouted)	sy	12	$275.00	$3,300.00
TR	Tree Removal	ls	1	$3,000.00	$3,000.00
TSS	Furnish and Place Topsoil & Seed	sf	500	$2.75	$1,375.00
UFG	Unclassified Excavation, Filling & Grading (land grading)	ls	1	$15,000.00	$15,000.00
				CONCEPTUAL CONSTRUCTION ESTIMATE	**$327,625.00**

CONCEPTUAL COST ESTIMATE
FOR HASTINGS ON HUDSON FLOOD STUDY

SPEC. SEC	ITEM	UNIT	EST. QUAN.	UNIT PRICE	TOTAL PRICE
SEGMENT 2 - FENWICK ROAD TO FARRAGUT AVENUE					
BBC	Bituminous Base Course	ton	30	$210.00	$6,300.00
BTC	Bituminous Top Course	ton	60	$210.00	$12,600.00
CB	Furnish and Install Catch Basin(s)	ea	10	$6,500.00	$65,000.00
CC	Concrete Curbs	lf	250	$75.00	$18,750.00
CGR	Clearing Grubbing & Removal	ls	1	$30,000.00	$30,000.00
CLF	Chain Link Fence (4ft)	lf	80	$95.00	$7,600.00
CPP	Furnish and Install Corrugated Polyethylene Pipe (12" Only)	lf	60	$125.00	$7,500.00
CPP	Furnish and Install Corrugated Polyethylene Pipe (Double 42" Only)	lf	870	$480.00	$417,600.00
CSG	Furnish and Place Crushed Stone or Gravel (3/4" Stone)	cy	75	$100.00	$7,500.00
CSG	Furnish and Place Crushed Stone or Gravel (NYSDOT Item 304.15)	cy	200	$100.00	$20,000.00
DF	Dense Fill	cy	100	$150.00	$15,000.00
DR	Demolition & Removal	ls	1	$20,000.00	$20,000.00
DMH	Furnish and Install Drainage Manhole	ea	5	$14,000.00	$70,000.00
ECD	Erosion Control Devices	ls	1	$20,000.00	$20,000.00
LS	Landscaping	ls	1	$30,000.00	$30,000.00
MEE	Miscellaneous Earth Excavation	cy	50	$85.00	$4,250.00
MPT	Maintenance & Protection of Traffic	ls	1	$45,000.00	$45,000.00
PCBC	Furnish and Install Precast Concrete Box Culvert (Headwalls/Wingwalls)	ea	1	$15,000.00	$15,000.00
PM	Pavement Markings (4")	lf	200	$3.00	$600.00
RER	Rock Excavation & Removal	cy	300	$500.00	$150,000.00
RR	Furnish and Install Rip Rap	sy	20	$250.00	$5,000.00
RR	Furnish and Install Rip Rap (Grouted)	sy	25	$275.00	$6,875.00

CONCEPTUAL COST ESTIMATE
FOR HASTINGS ON HUDSON FLOOD STUDY

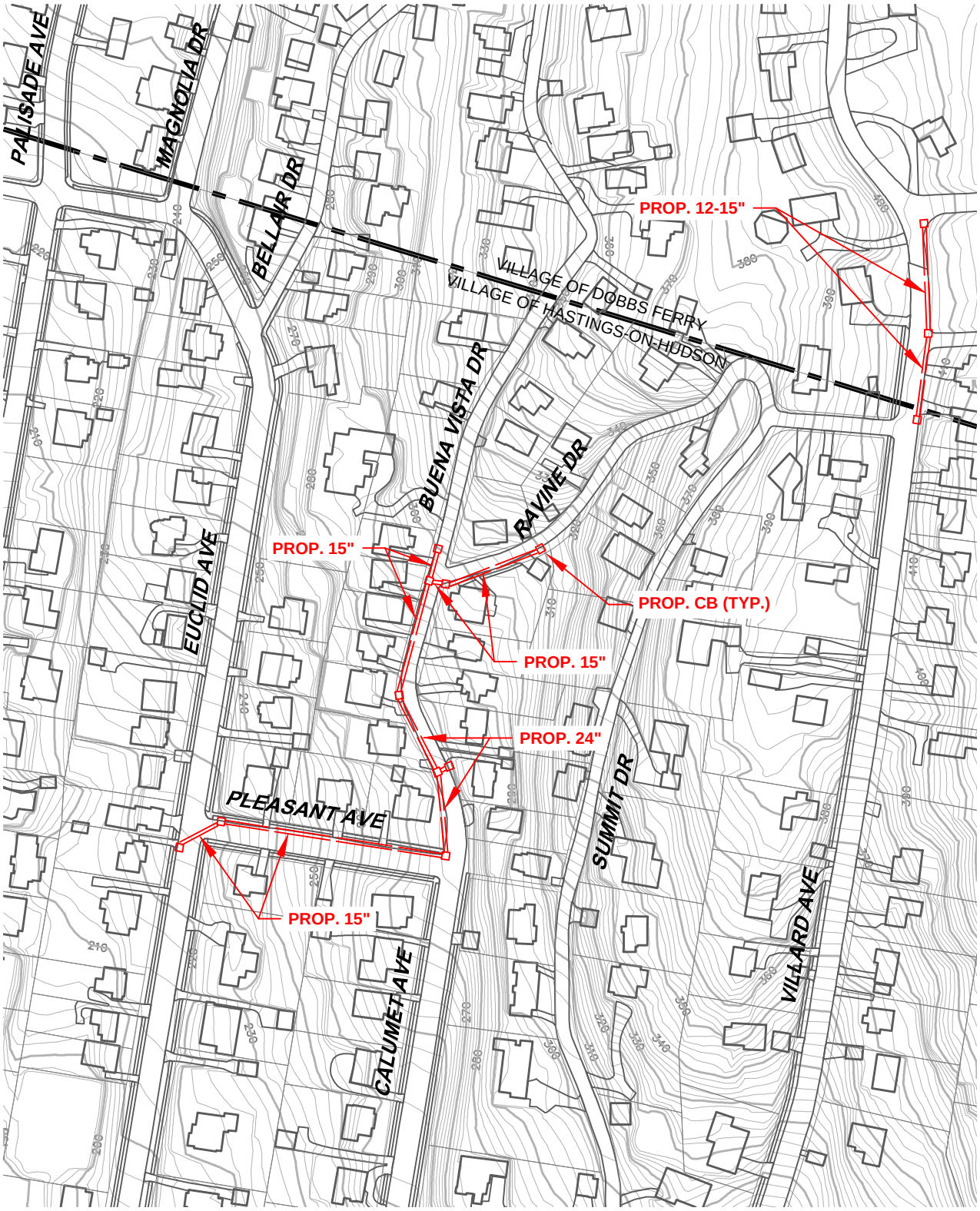
SPEC. SEC	ITEM	UNIT	EST. QUAN.	UNIT PRICE	TOTAL PRICE
TR	Tree Removal	ls	1	$25,000.00	$25,000.00
TSS	Furnish and Place Topsoil & Seed	sf	20,000	$2.75	$55,000.00
UFG	Unclassified Excavation, Filling & Grading (land grading)	ls	1	$35,000.00	$35,000.00
UFG	Unclassified Excavation, Filling & Grading (Export fill)	cy	150	$100.00	$15,000.00
UFG	Unclassified Excavation, Filling & Grading (Import fill)	cy	200	$100.00	$20,000.00
				CONCEPTUAL CONSTRUCTION ESTIMATE	**$1,124,575.00**

SPEC. SEC	ITEM	UNIT	EST. QUAN.	UNIT PRICE	TOTAL PRICE
SEGMENT 3 - FARRAGUT PARKWAY BYPASS					
BBC	Bituminous Base Course	ton	110	$210.00	$23,100.00
BTC	Bituminous Top Course	ton	70	$210.00	$14,700.00
CB	Furnish and Install Catch Basin(s)	ea	8	$7,500.00	$60,000.00
CC	Concrete Curbs	lf	1,000	$75.00	$75,000.00
CEDS	Connect to Existing Drainage System	ea	2	$500.00	$1,000.00
CGR	Clearing Grubbing & Removal	ls	1	$6,000.00	$6,000.00
CLF	Chain Link Fence (4ft)	lf	25	$95.00	$2,375.00
CPP	Furnish and Install Corrugated Polyethylene Pipe (15" Only)	lf	50	$150.00	$7,500.00
CPP	Furnish and Install Corrugated Polyethylene Pipe (30" Only)	lf	450	$175.00	$78,750.00
CPP	Furnish and Install Corrugated Polyethylene Pipe (48 Only)	lf	950	$395.00	$375,250.00
CSG	Furnish and Place Crushed Stone or Gravel (3/4" Stone)	cy	50	$100.00	$5,000.00
CSG	Furnish and Place Crushed Stone or Gravel (NYSDOT Item 304.15)	cy	150	$100.00	$15,000.00
DF	Dense Fill	cy	25	$150.00	$3,750.00
DR	Demolition & Removal	ls	1	$15,000.00	$15,000.00
DMH	Furnish and Install Drainage Manhole	ea	1	$8,000.00	$8,000.00

CONCEPTUAL COST ESTIMATE
FOR HASTINGS ON HUDSON FLOOD STUDY

SPEC. SEC	ITEM	UNIT	EST. QUAN.	UNIT PRICE	TOTAL PRICE
ECD	Erosion Control Devices	ls	1	$7,500.00	$7,500.00
MEE	Miscellaneous Earth Excavation	cy	25	$50.00	$1,250.00
MPT	Maintenance & Protection of Traffic	ls	1	$20,000.00	$20,000.00
PM	Pavement Markings (4")	lf	1,400	$3.00	$4,200.00
PM	Pavement Markings (12")	lf	12	$10.00	$120.00
RC	Reinforced Concrete (Headwall)	ea	1	$10,000.00	$10,000.00
RER	Rock Excavation & Removal	cy	150	$500.00	$75,000.00
RR	Furnish and Install Rip Rap (Grouted)	sy	15	$275.00	$4,125.00
TR	Tree Removal	ls	1	$7,500.00	$7,500.00
TSS	Furnish and Place Topsoil & Seed	sf	2,000	$2.75	$5,500.00
UFG	Unclassified Excavation, Filling & Grading (land grading)	ls	1	$15,000.00	$15,000.00
				CONCEPTUAL CONSTRUCTION ESTIMATE	**$840,620.00**
SEGMENTS 1, 2, AND 3					
				COMBINED SEGMENTS 1, 2, & 3	**$2,292,820.00**
				SOFT COSTS (SURVEY, ENGINEERING, LEGAL, CONSTRUCTION ADMIN. 18%)	**$412,707.60**
				CONTINGENCY (25%)	**$676,381.90**
				TOTAL ESTIMATE	**$3,381,909.50**

This estimate is preliminary and approximate. The prices shown above are not actual construction prices and are subject to change. These prices are based on our engineering experience and knowledge of previous construction projects of similar work and scope. The estimate does not include utility construction costs for telephone, electric and gas, permit fees and any other fees or costs related to the infrastructure work. This estimate is for budgeting purposes only.



200 100 0 200

SCALE: 1" = 200'

REV.	DATE	DESCRIPTION

TITLE: SITE SB-6 (BUENA VISTA DRIVE)

PROJECT: HASTINGS-ON-HUDSON FLOOD STUDY
PHASE I
VILLAGE OF HASTINGS-ON-HUDSON, WESTCHESTER COUNTY, NY

JAMES J. HAHN ENGINEERING, P.C.
Putnam Business Park
1689 Route 22
Brewster, New York 10509
Tel: (845) 279-2220

SCALE	DATE
1" = 200'	11/6/23
DRAWING NO.	SHEET NO.
-	3 OF 4

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CONCEPTUAL COST ESTIMATE
FOR HASTINGS ON HUDSON FLOOD STUDY

SITE SB-6 - BUENA VISTA DRIVE

SPEC. SEC	ITEM	UNIT	EST. QUAN.	UNIT PRICE	TOTAL PRICE
BBC	Bituminous Base Course	ton	100	$210.00	$21,000.00
BTC	Bituminous Top Course	ton	70	$210.00	$14,700.00
CB	Furnish and Install Catch Basin(s)	ea	10	$6,500.00	$65,000.00
CC	Concrete Curbs	lf	1,250	$75.00	$93,750.00
CEDS	Connect to Existing Drainage System	ea	3	$500.00	$1,500.00
CGR	Clearing Grubbing & Removal	ls	1	$2,000.00	$2,000.00
CPP	Furnish and Install Corrugated Polyethylene Pipe (15" Only)	lf	750	$150.00	$112,500.00
CPP	Furnish and Install Corrugated Polyethylene Pipe (24" Only)	lf	550	$160.00	$88,000.00
CSG	Furnish and Place Crushed Stone or Gravel (3/4" Stone)	cy	30	$100.00	$3,000.00
CSG	Furnish and Place Crushed Stone or Gravel (NYSDOT Item 304.15)	cy	100	$100.00	$10,000.00
DF	Dense Fill	cy	10	$150.00	$1,500.00
ECD	Erosion Control Devices	ls	1	$5,000.00	$5,000.00
MEE	Miscellaneous Earth Excavation	cy	25	$50.00	$1,250.00
MPT	Maintenance & Protection of Traffic	ls	1	$20,000.00	$20,000.00
RER	Rock Excavation & Removal	cy	80	$500.00	$40,000.00
TR	Tree Removal	ls	1	$2,000.00	$2,000.00
TSS	Furnish and Place Topsoil & Seed	sf	1,000	$2.75	$2,750.00
UFG	Unclassified Excavation, Filling & Grading (land grading)	ls	1	$8,000.00	$8,000.00
	CONCEPTUAL CONSTRUCTION ESTIMATE				**$491,950.00**
	SOFT COSTS (SURVEY, ENGINEERING, LEGAL, CONSTRUCTION ADMIN. 18%)				**$88,551.00**
	CONTINGENCY (25%)				**$145,125.25**
	TOTAL ESTIMATE				**$725,626.25**

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