



**TO:** Joe Brogan, Chief of Stormwater Programs  
York County, Virginia  
Department of Public Works (DPW)

**FROM:** AH Environmental Consultants, Inc. (AH)

**SUBJECT:** Preliminary Assessment of Queens Lake Stream Improvements

**CONTRACT:** P1742-03

**AH PROJECT:** 141-01

**DATE:** 23 November 2022

## **1. INTRODUCTION**

York County, Virginia contracted AH to assess the condition of, and propose improvements to, several natural drainageways that convey runoff from the residential area south of Queens Lake to the lake and/or Queens Creek. The county previously identified 10 areas of concern on which this assessment will focus. The goal of recommended improvements is to reduce flow velocities, decrease rates of stream erosion, capture sediment and minimize its transport, and improve selected water quality parameters.

AH visited each area of concern on two occasions, 17 August and 2 November 2022. This technical memorandum summarizes existing conditions; prioritizes the sites by degree of degradation, safety concerns, and threat to adjacent structures; and recommends improvements. Estimates of probable construction costs accompany each recommendation. Standard details of recommended stream restoration measures from the Virginia Stream Restoration and Stabilization Best Management Practices Guide (DCR, 2004) are included as Attachment 1. All recommendations are preliminary and provided for planning and budgetary purposes only.

## **2. REGULATORY INFORMATION**

Implementation of recommended stream improvements may be subject to regulatory review and permitting by the following entities:

- United States Army Corps of Engineers (USACE) Norfolk District, Regulatory Branch, Southern Regulatory Section
- Virginia Department of Environmental Quality
- Virginia Marine Resources Commission, if it determines that the streams are within its purview

The ordinary high water (OHW) line for all streams and all adjacent vegetated wetlands will need to be field located, surveyed, and included on design/permit drawings. A pre-application request must be prepared and presented to the USACE Norfolk District for review and comment prior to the submission of a Pre-Construction Notification (PCN). All agencies will review the PCN.

### 3. SITE ASSESSMENTS AND RECOMMENDED IMPROVEMENTS

**Figure 1** is a map indicating the 10 locations assessed under this task order. AH ranks the sites as follows based on the severity of stream degradation, hazard to resident safety, and proximity to adjacent structures (i.e., buildings, road, utilities):

1. Site 4 (opposite side of East Queens Drive and Willoughby Drive)
2. Site 7 (between Sheriff Place and Little John Road)
3. Site 8 (Copse Way between Spur Court and Ring Finger Court)
4. Site 5 (Nottingham Road between Kings Court and Princess Place)
5. Site 6 (behind Princess Place)
6. Site 2 (intersection of East Queens Drive and Horseshoe Drive)
7. Site 1 (Horseshoe Drive)
8. Site 3 (between Willoughby Drive and Nottingham Road)
9. Site 9 (Sherwood Drive)
10. Site 10 (Cambridge Lane)

Recommended stream improvements aim to curtail stream degradation and incision in the areas of concern and minimize downstream conveyance and aggradation of sediment through bank protection, bank stabilization, grade control, and flow deflection/concentration. The pollutants of concern for this project are sediment and nutrients (i.e., total nitrogen and total phosphorus). Improvements shall be designed and constructed in accordance with the Virginia Stream Restoration Guide. In addition to standard details for the recommended restoration measures, Attachment 1 includes photographs of some of these practices that were recently installed for a stream restoration project in Newport News, Virginia.

The following subsections are sorted by priority ranking and include site-specific maps of each area indicating the limits of the assessment and the locations of preliminary recommended stream improvements. Accompanying the maps are photographs of issues observed, recommended corrective actions, and budgetary cost estimates (Association for the Advancement of Cost Engineering [AACE] International Class 4<sup>1</sup>) relative to each site.

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<sup>1</sup> AACE International Recommended Practice No. 18R-97 “Cost Estimation Classification System – As Applied in Engineering, Procurement, and Construction for the Process Industries” TCM Framework: 7.3 – Cost Estimating and Budgeting provides guidelines for applying the general principals of estimate classification to project cost estimates (i.e., cost estimates that are used to evaluate, approve, and/ or fund projects).

Refer to Table 1 for a summary of these cost estimates that include consideration of bonds and insurance (3%); mobilization/demobilization (6%); supervision, inspection, and overhead (6%); and contingency (20%). The cost estimates provided are for construction and do not include site surveying, geotechnical evaluation, wetland delineation, or engineering design services.

**Table 1      Summary of Budgetary Construction Cost Estimates – All Sites**

<b>Site</b>	<b>Construction Cost Estimate</b>
Site 4	\$236,250
Site 7	\$217,350
Site 8	\$153,900
Site 5	\$202,500
Site 6	\$93,150
Site 2	\$105,300
Site 1	\$156,600
Site 3	\$164,700
Site 9	\$99,900
Site 10	\$0
<b>Total</b>	<b>\$1,429,650</b>

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### 3.1 SITE 4

Site 4 is located east of East Queens Drive between Crown Court and Montague Circle. The area of concern begins where previous efforts to control erosion end (i.e., existing geotextile-line swale). The site includes various forms of erosion including channel, stream bank, and slope erosion. Significant slope erosion was observed behind 266 and 268 East Queens Drive and 102 Montague Drive. **Section 3.1.1** provides Site 4 photographs capturing these conditions.

**Figure 2** identifies the primary areas of concern, location of photographs, and preliminary recommended corrective actions. Site 4 requires approximately 400 to 500 linear feet (LF) of restoration activities, including the following:

- Approximately 2 plunge pools / scour holes
- Rock toe protection
- 5-10 rock steps (and/or cross vanes)
- Up to 200 LF of bank shoring and live stakes
- Up to 200 LF of geotextile or rip rap channel stabilization
- Up to 12 large (>12-inch (") diameter) trees for potential removal

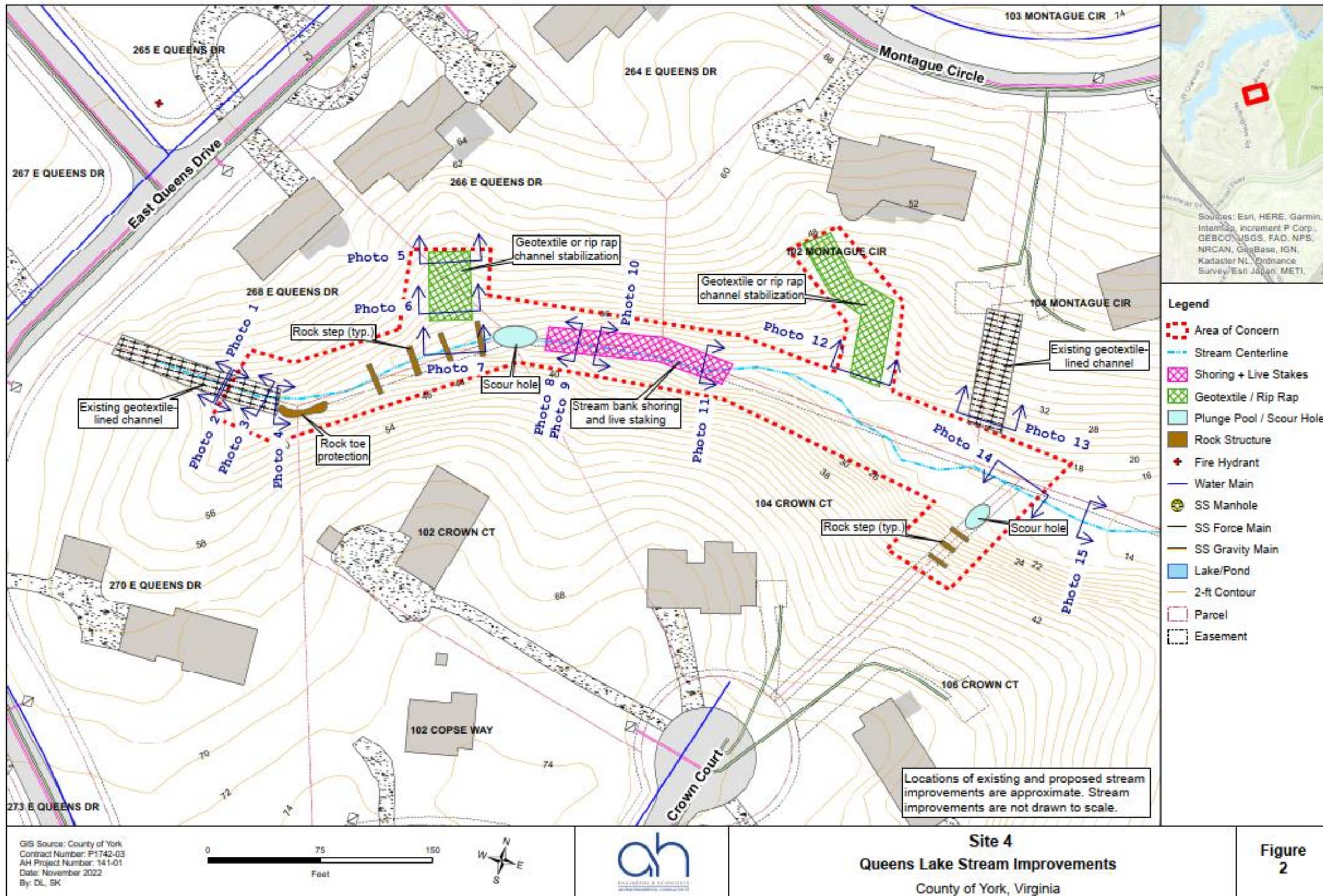
**Table 2** provides an estimate of probable costs associated with the recommended restoration activities.

**Table 2 Site 4 Budgetary Construction Cost Estimate**

Item No.	Description	Cost
1	Clearing and Grubbing / Tree Removal	\$42,000
2	Earthwork	\$12,000
3	Restoration Structures and Rock Stabilization	\$31,000
4	Temporary Erosion and Sediment Control (E&SC) Measures	\$57,000
5	Planting (including tree mitigation), Seeding, Site Stabilization	\$33,000
<b>Cost Summary</b>		
6	Subtotal	\$175,000
7	Bonds & Insurance (3% of Contract)	\$5,250
8	Mobilization/Demobilization (6% of Contract)	\$10,500
9	Supervision, Inspection, and Overhead (6% of Contract)	\$10,500
10	Construction Contingency (20% of Contract)	\$35,000
11	<b>Total</b>	\$236,250

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### 3.1.1 Site 4 Existing Conditions Photographs



**Site 4, Photo 1: Existing Geotextile Lined Channel from East Queens Drive (Looking Upstream (West))**



**Site 4, Photo 2: Existing Geotextile Lined Channel Continues into the Woods (Looking Downstream (East))**



**Site 4, Photo 3: End of Existing Geotextile Lined Channel (Looking Upstream (West))**



**Site 4, Photo 4: Continuing into the woods (Looking Downstream (East))**



**Site 4, Photo 5: Slope Erosion behind 266 East Queens Drive (Top of Slope, Looking North)**



**Site 4, Photo 6: Slope Erosion behind 266 East Queens Drive (Bottom of Slope, Looking North)**



**Site 4, Photo 7: Slope Erosion behind 266 East Queens Drive (Tie-in to Primary Stream, Looking North)**



**Site 4, Photo 8: Stream Erosion (Looking Upstream (West))**



**Site 4, Photo 9: Stream Erosion (zoom-in) (Looking Upstream (West))**



**Site 4, Photo 10: Stream Erosion (Looking Downstream (East))**



**Site 4, Photo 11: Continuation of Stream with Debris (Looking Downstream (East))**



**Site 4, Photo 12: Slope Erosion behind 102 Montague Circle**





**Site 4, Photo 13: Existing Geotextile Lined Channel at 104 Montague Circle (Bottom of Slope, Looking North)**



**Site 4, Photo 14: Severe Erosion between 104 and 106 Crown Court (Bottom of Slope, Looking South)**



**Site 4, Photo 15: View of Stream (Looking Downstream (East))**

### 3.2 SITE 7

Site 7 is located between Sheriffs Place and Little John Road. The site includes approximately 150 LF of severe gully erosion, an area of severe slope erosion (behind 113 Little John Road), and approximately 200 LF of moderate stream bank incision. **Section 3.2.1** provides Site 7 photographs capturing these conditions.

**Figure 3** identifies the primary areas of concern, location of photographs, and preliminary recommended corrective actions. Site 7 requires approximately 400-500 LF of restoration activities, including the following:

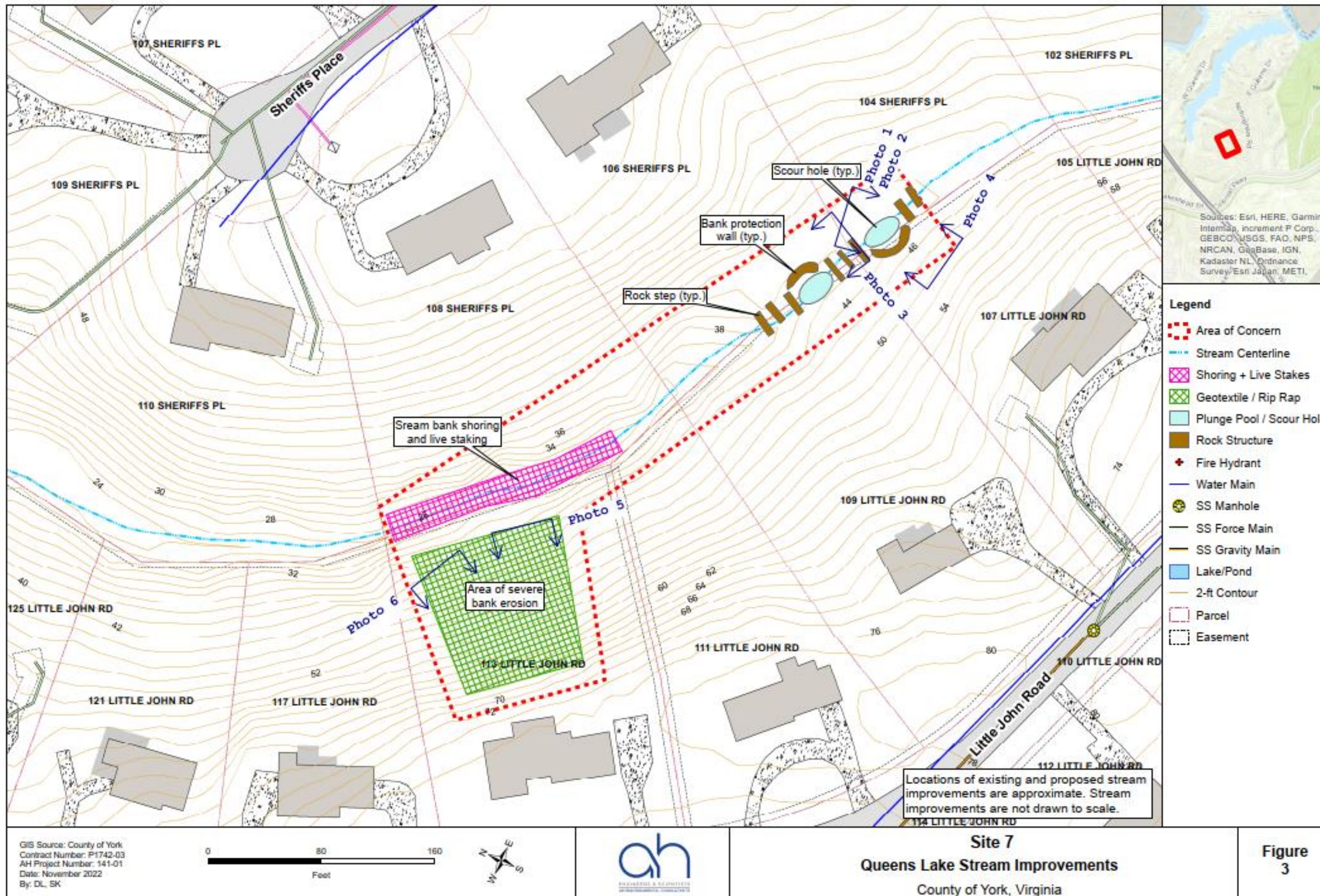
- 2-3 plunge pools / scour holes
- 2 bank protection walls (stacked stone or other material)
- 8-10 rock steps (and/or cross vanes)
- Up to 250 LF of bank shoring and live stakes
- Approximately 10,000 square feet (SF) of steep slope stabilization
- Up to 6 large (>12" diameter) trees for potential removal

**Table 3** provides an estimate of probable costs associated with the recommended restoration activities.

**Table 3 Site 7 Budgetary Construction Cost Estimate**

Item No.	Description	Cost
1	Clearing and Grubbing / Tree Removal	\$34,000
2	Earthwork	\$18,000
3	Restoration Structures and Rock Stabilization	\$37,000
4	Temporary E&SC Measures	\$41,000
5	Planting (including tree mitigation), Seeding, Site Stabilization	\$31,000
<b>Cost Summary</b>		
6	Subtotal	\$161,000
7	Bonds & Insurance (3% of Contract)	\$4,830
8	Mobilization/Demobilization (6% of Contract)	\$9,660
9	Supervision, Inspection, and Overhead (6% of Contract)	\$9,660
10	Construction Contingency (20% of Contract)	\$32,200
11	<b>Total</b>	\$217,350

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### 3.2.1 Site 7 Existing Conditions Photographs



**Site 7, Photo 1: Channel Erosion (Looking Upstream (Southeast))**



**Site 7, Photo 2: Channel Erosion Zoom-In (Looking Upstream (Southeast))**



**Site 7, Photo 3: Channel Erosion (Looking Downstream (Northwest))**



**Site 7, Photo 4: Channel Erosion (Looking Northeast)**





**Site 7, Photo 5: Severe Slope Erosion (Southwest toward 113 Little John Road)**



**Site 7, Photo 6: Severe Slope Erosion (Southwest toward 113 Little John Road)**

### 3.3 SITE 8

Site 8, located between 101 Spur Court and 110 Copse Way, comprises an approximately 120-LF reach of channel erosion immediately downstream of an existing rip rap-lined stormwater swale. Gully erosion is occurring and migrating in the upstream direction. The gully is approximately 13 feet deep at its deepest point. The top width of the gully ranges from 4 to 10 feet. **Section 3.3.1** contains Site 8 photographs capturing these conditions.

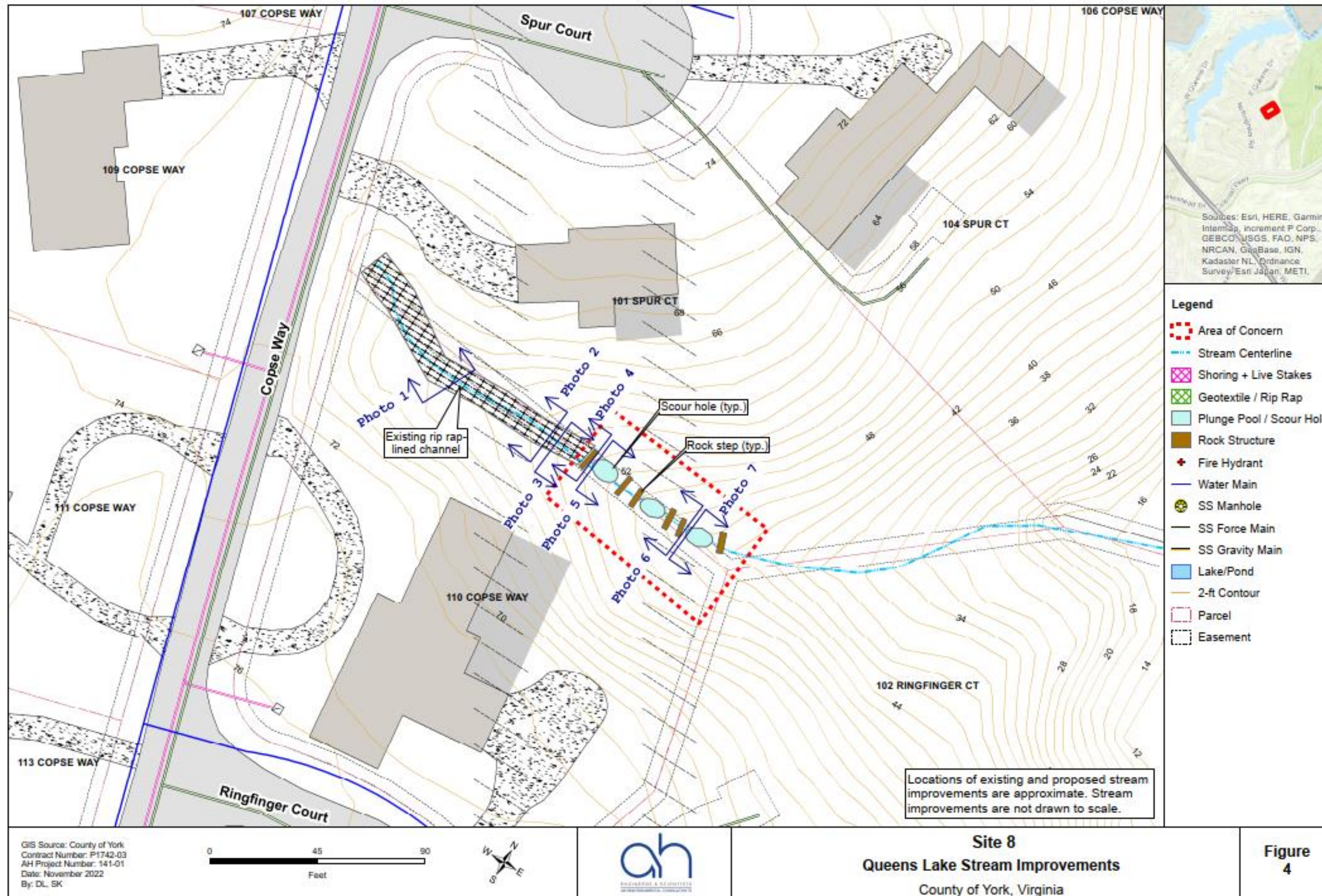
**Figure 4** identifies the primary areas of concern, location of photographs, and preliminary recommended corrective actions. Site 8 requires approximately 120 LF of restoration activities, including the following:

- 6-10 rock steps (and/or cross vanes)
- 2-3 scour holes/plunge pools extending from the end of the upstream existing rip rap stabilization to the downstream end of the eroded channel section.

**Table 4** provides an estimate of probable costs associated with the recommended restoration activities.

**Table 4 Site 8 Budgetary Construction Cost Estimate**

Item No.	Description	Cost
1	Clearing and Grubbing / Tree Removal	\$23,000
2	Earthwork	\$9,000
3	Restoration Structures and Rock Stabilization	\$38,000
4	Temporary E&SC Measures	\$27,000
5	Planting (including tree mitigation), Seeding, Site Stabilization	\$17,000
<b>Cost Summary</b>		
6	Subtotal	\$114,000
7	Bonds & Insurance (3% of Contract)	\$3,420
8	Mobilization/Demobilization (6% of Contract)	\$6,840
9	Supervision, Inspection, and Overhead (6% of Contract)	\$6,840
10	Construction Contingency (20% of Contract)	\$22,800
11	<b>Total</b>	\$153,900



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### 3.3.1 Site 8 Existing Conditions Photographs



**Site 8, Photo 1: Existing Rip Rap (Looking Upstream to Copse Way)**



**Site 8, Photo 2: Existing Rip Rap (Looking Upstream to Copse Way)**



**Site 8, Photo 3: End of Rip Rap (Looking Downstream into Woods)**



**Site 8, Photo 4: Beginning of Channel Erosion (Looking Upstream)**



**Site 8, Photo 5: Channel Erosion (Looking Downstream)**



**Site 8, Photo 6: Channel Erosion (Looking Upstream)**



**Site 8, Photo 7: Channel Erosion (Looking Downstream)**



### 3.4 SITE 5

Site 5, located west of Nottingham Road between Kings Court and Princess Place, comprises the confluence of two channels and the reaches approximately 200 feet upstream of the confluence point. Moderate stream bank incision was observed on the reach downstream of Nottingham Road. In the vicinity of the confluence point, severe gully erosion was observed, particularly associated with the channel northeast of 271 Princess Place. There are also several fallen trees, including one that fell between the August and November 2022 site visits. **Section 3.4.1** presents Site 5 photographs capturing these conditions.

**Figure 5** identifies the primary areas of concern, location of photographs, and preliminary recommended corrective actions. Site 5 requires approximately 400 LF of restoration activities, including the following:

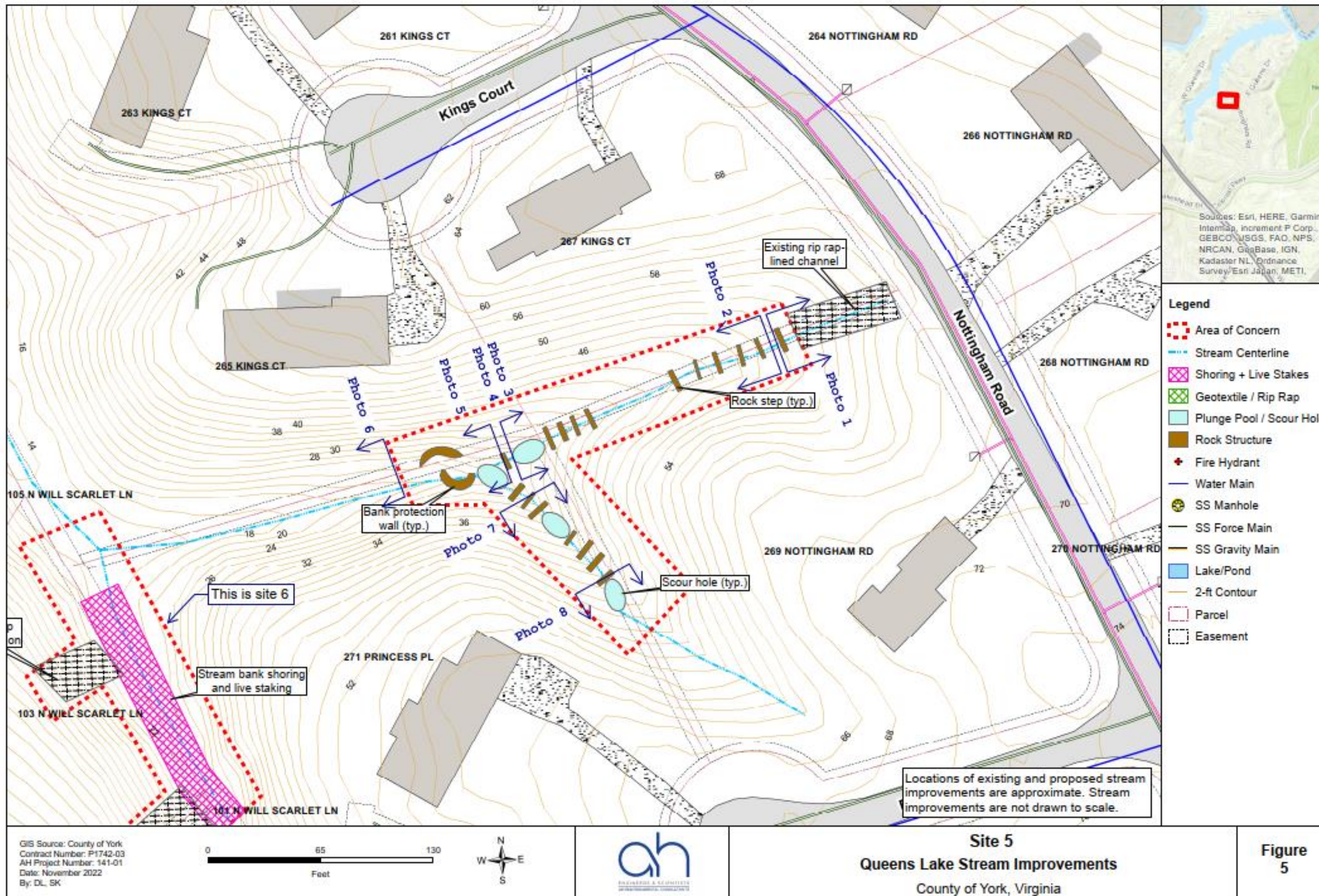
- Approximately 4 plunge pools / scour holes
- 2 bank protection walls (stacked stone or other material)
- Up to 20 rock steps (and/or cross vanes)
- Up to 500 LF of bank shoring and live stakes
- Up to 8 large (>12" diameter) trees for potential removal

**Table 5** provides an estimate of probable costs associated with the recommended restoration activities.

**Table 5 Site 5 Budgetary Construction Cost Estimate**

Item No.	Description	Cost
1	Clearing and Grubbing / Tree Removal	\$27,000
2	Earthwork	\$11,000
3	Restoration Structures and Rock Stabilization	\$43,000
4	Temporary E&SC Measures	\$48,000
5	Planting (including tree mitigation), Seeding, Site Stabilization	\$21,000
<b>Cost Summary</b>		
6	Subtotal	\$150,000
7	Bonds & Insurance (3% of Contract)	\$4,500
8	Mobilization/Demobilization (6% of Contract)	\$9,000
9	Supervision, Inspection, and Overhead (6% of Contract)	\$9,000
10	Construction Contingency (20% of Contract)	\$30,000
11	<b>Total</b>	\$202,500

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### 3.4.1 Site 5 Existing Conditions Photographs



**Site 5, Photo 1: Existing Rip Rap (Looking Upstream (East toward Nottingham Road))**



**Site 5, Photo 2: End of Existing Rip Rap (Looking downstream (West))**



**Site 5, Photo 3: Severe Erosion / Fallen Tree (Looking Upstream (East)) (Aug. 2022)**



**Site 5, Photo 4: Severe Erosion / Additional Fallen Tree (Looking Upstream (East)) (Nov. 2022)**



**Site 5, Photo 5: Bank Erosion (Looking Downstream (West))**



**Site 5, Photo 6: Debris (Looking Downstream (West))**



**Site 5, Photo 7: Bottom of Eroded Ditch towards 271 Princess Place (Looking Upstream (Southeast))**



**Site 5, Photo 8: Top of Eroded Ditch towards 271 Princess Place (Looking Upstream (Southeast))**



### 3.5 SITE 6

Site 6, located between North Will Scarlet Lane and Princess Place, comprises approximately 200 LF of channel/stream bank erosion downstream of an area where prior slope stabilization efforts (rip rap) have been applied. Upstream of the eroded slope is a failed concrete channel. Concentrated flow from this failed channel runs over the existing rip rap slope stabilization and into the stream in question. **Section 3.5.1** provides Site 6 photographs capturing these conditions.

**Figure 6** identifies the primary areas of concern, location of photographs, and preliminary recommended corrective actions. Site 6 requires approximately 200 LF of restoration activities, including the following:

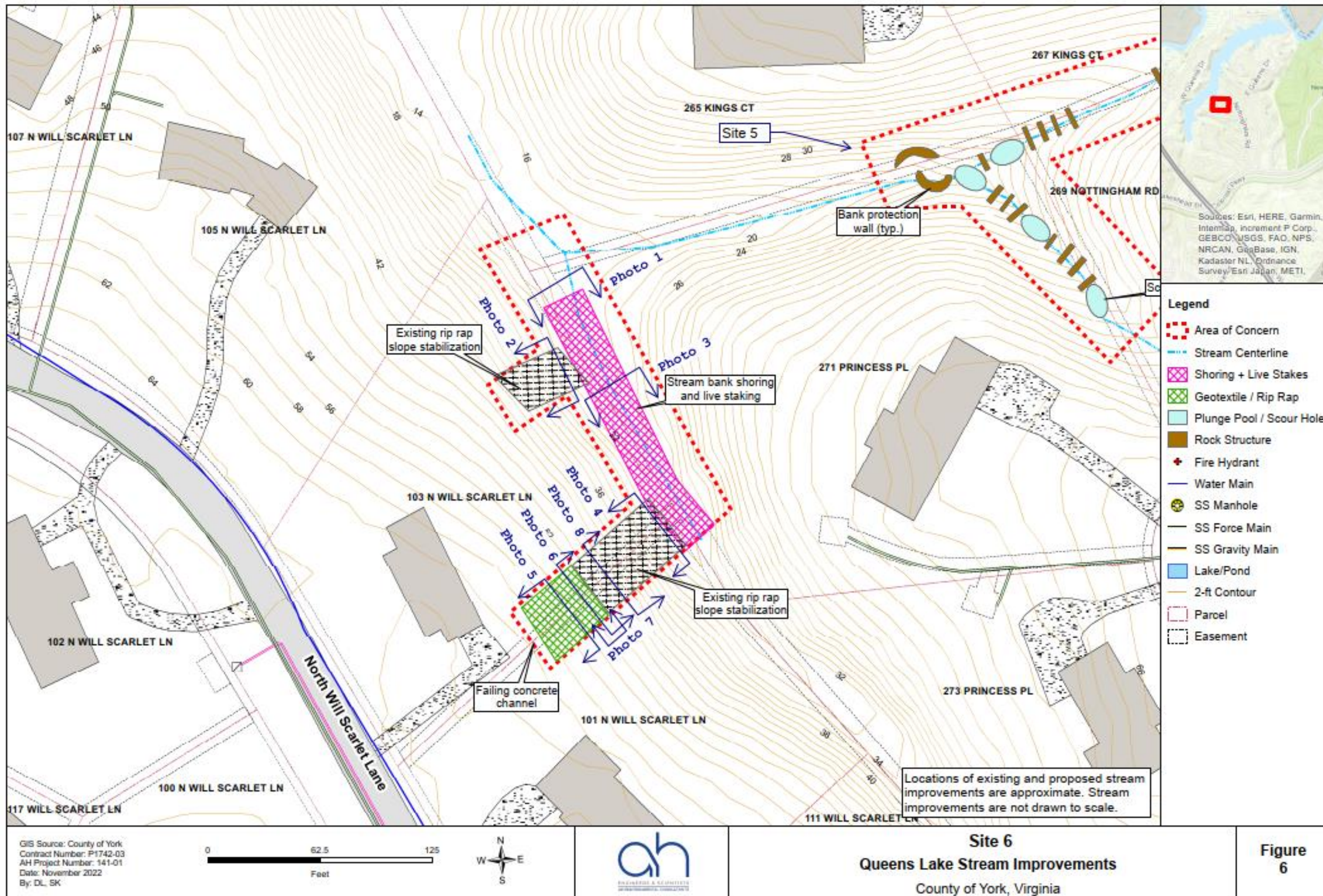
- Up to 200 LF of bank shoring and live stakes
- Approximately 2,000 SF of rip rap slope stabilization

**Table 6** provides an estimate of probable costs associated with the recommended restoration activities.

**Table 6 Site 6 Budgetary Construction Cost Estimate**

Item No.	Description	Cost
1	Clearing and Grubbing / Tree Removal	\$12,000
2	Earthwork	\$9,000
3	Restoration Structures and Rock Stabilization	\$5,000
4	Temporary E&SC Measures	\$29,000
5	Planting (including tree mitigation), Seeding, Site Stabilization	\$14,000
<b>Cost Summary</b>		
6	Subtotal	\$69,000
7	Bonds & Insurance (3% of Contract)	\$2,070
8	Mobilization/Demobilization (6% of Contract)	\$4,140
9	Supervision, Inspection, and Overhead (6% of Contract)	\$4,140
10	Construction Contingency (20% of Contract)	\$13,800
11	<b>Total</b>	\$93,150

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### 3.5.1 Site 6 Existing Conditions Photographs



**Site 6, Photo 1: View of Stream (Looking Upstream (Southeast))**



**Site 6, Photo 2: Existing Rip Rap Slope Stabilization (Bottom of Slope, Looking Southwest)**



**Site 6, Photo 3: View of Stream (Looking Upstream (Southeast))**



**Site 6, Photo 4: Existing Rip Rap Slope Stabilization (Bottom of Slope, Looking Southwest)**



**Site 6, Photo 5: Existing Concrete Channel at 103 North Will Scarlet Lane (Looking Upstream (Southwest))**



**Site 6, Photo 6: End of Existing Damaged Concrete Channel at 103 North Will Scarlet Lane (Looking Downstream (Northeast))**



**Site 6, Photo 7: End of Existing Damaged Concrete Channel at 103 North Will Scarlet Lane (Side View, Looking Northwest)**



**Site 6, Photo 8: End of Existing Concrete Channel / Existing Rip Rap Slope Stabilization (Top of Slope, Looking Northeast)**



### 3.6 SITE 2

Site 2, located near the intersection of East Queens Drive and Horseshoe Drive, comprises approximately 200 LF of channel/ stream bank erosion downstream of a rip rap channel. In addition to the existing rip rap channel stabilization, an adjacent homeowner has attempted to stabilize the slope behind their home (139 Horseshoe Drive) with logs and other organic materials. Gully erosion was also observed on the north side of Horseshoe Drive, upstream of the inlet to the culvert under the road. **Section 3.6.1** provides Site 2 photographs capturing these conditions.

**Figure 7** identifies the primary areas of concern, location of photographs, and preliminary recommended corrective actions. Site 2 requires approximately 200 LF of restoration activities, including the following:

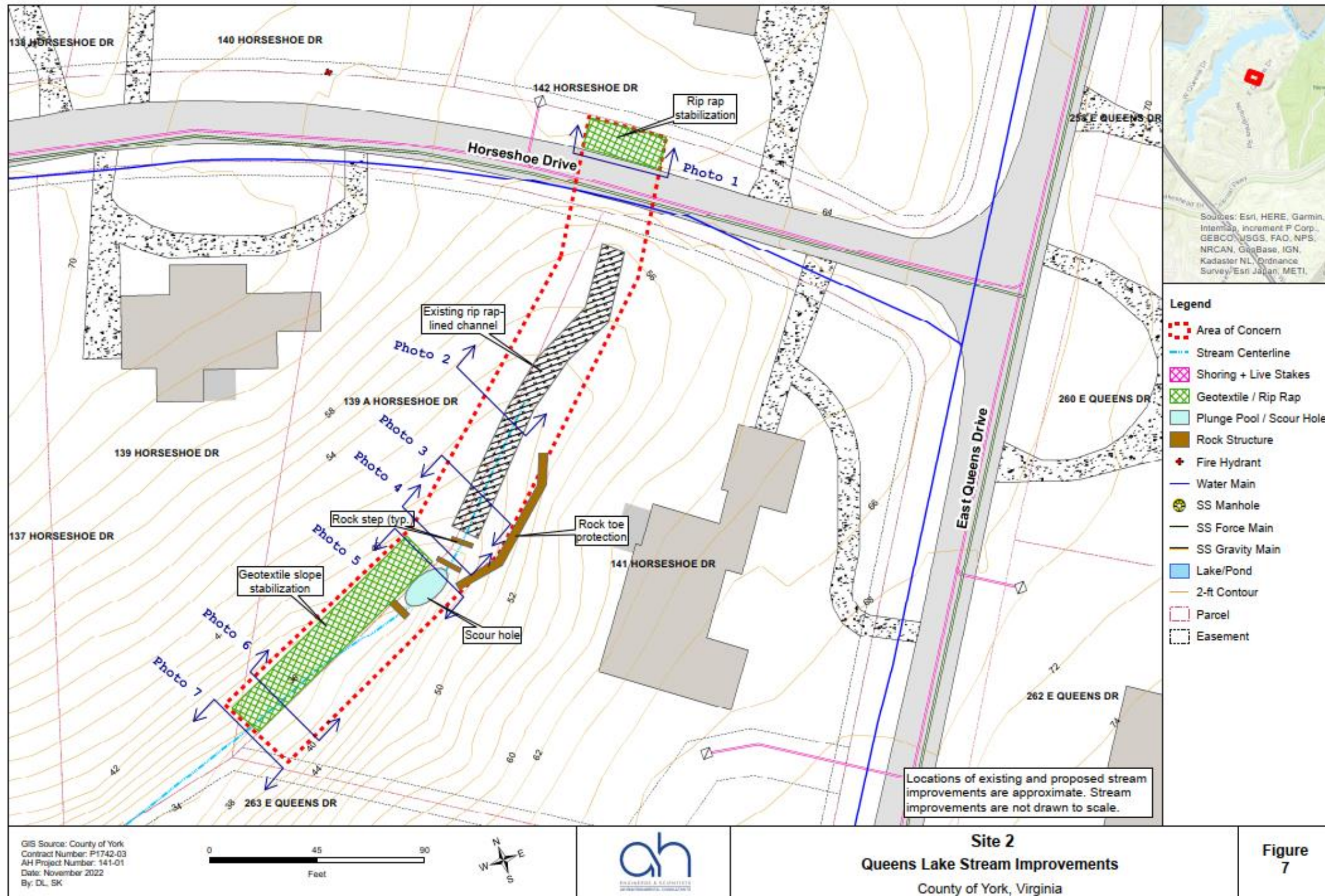
- 1 plunge pool / scour hole
- Rock toe protection
- 2-4 rock steps (and/or cross vanes)
- Approximately 2,000 SF of geotextile slope stabilization
- Approximately 400 SF of rip rap stabilization
- Up to 4 large (>12" diameter) trees for potential removal

**Table 7** provides an estimate of probable costs associated with the recommended restoration activities.

**Table 7 Site 2 Budgetary Construction Cost Estimate**

Item No.	Description	Cost
1	Clearing and Grubbing / Tree Removal	\$14,000
2	Earthwork	\$5,000
3	Restoration Structures and Rock Stabilization	\$21,000
4	Temporary E&SC Measures	\$25,000
5	Planting (including tree mitigation), Seeding, Site Stabilization	\$13,000
<b>Cost Summary</b>		
6	Subtotal	\$78,000
7	Bonds & Insurance (3% of Contract)	\$2,340
8	Mobilization/Demobilization (6% of Contract)	\$4,680
9	Supervision, Inspection, and Overhead (6% of Contract)	\$4,680
10	Construction Contingency (20% of Contract)	\$15,600
11	<b>Total</b>	\$105,300

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### 3.6.1 Site 2 Existing Conditions Photographs



**Site 2, Photo 1: Erosion on the Northeast side of Horseshoe Drive**



**Site 2, Photo 2: Existing Rip Rap Channel (Looking Upstream (Northeast))**



**Site 2, Photo 3: End of Existing Rip Rap Channel (Looking Downstream (Southwest))**



**Site 2, Photo 4: Erosion at End of Existing Rip Rap (Looking Upstream (Northeast))**



**Site 2, Photo 5: View of Channel (Looking Downstream (Southwest))**



**Site 2, Photo 6: View of Channel (Looking Upstream (Northeast))**



**Site 2, Photo 7: View of Channel (Looking Downstream (Southwest))**



### 3.7 SITE 1

Site 1, located west of Horseshoe Drive and north of Hunter Lane, comprises a failed culvert at the upstream end of the reach, followed by approximately 150-200 LF of gully erosion and stream bank incision. **Section 3.7.1** provides Site 1 photographs capturing these conditions.

**Figure 8** identifies the primary areas of concern, location of photographs, and preliminary recommended corrective actions. Site 1 requires approximately 150-200 LF of restoration activities, including the following:

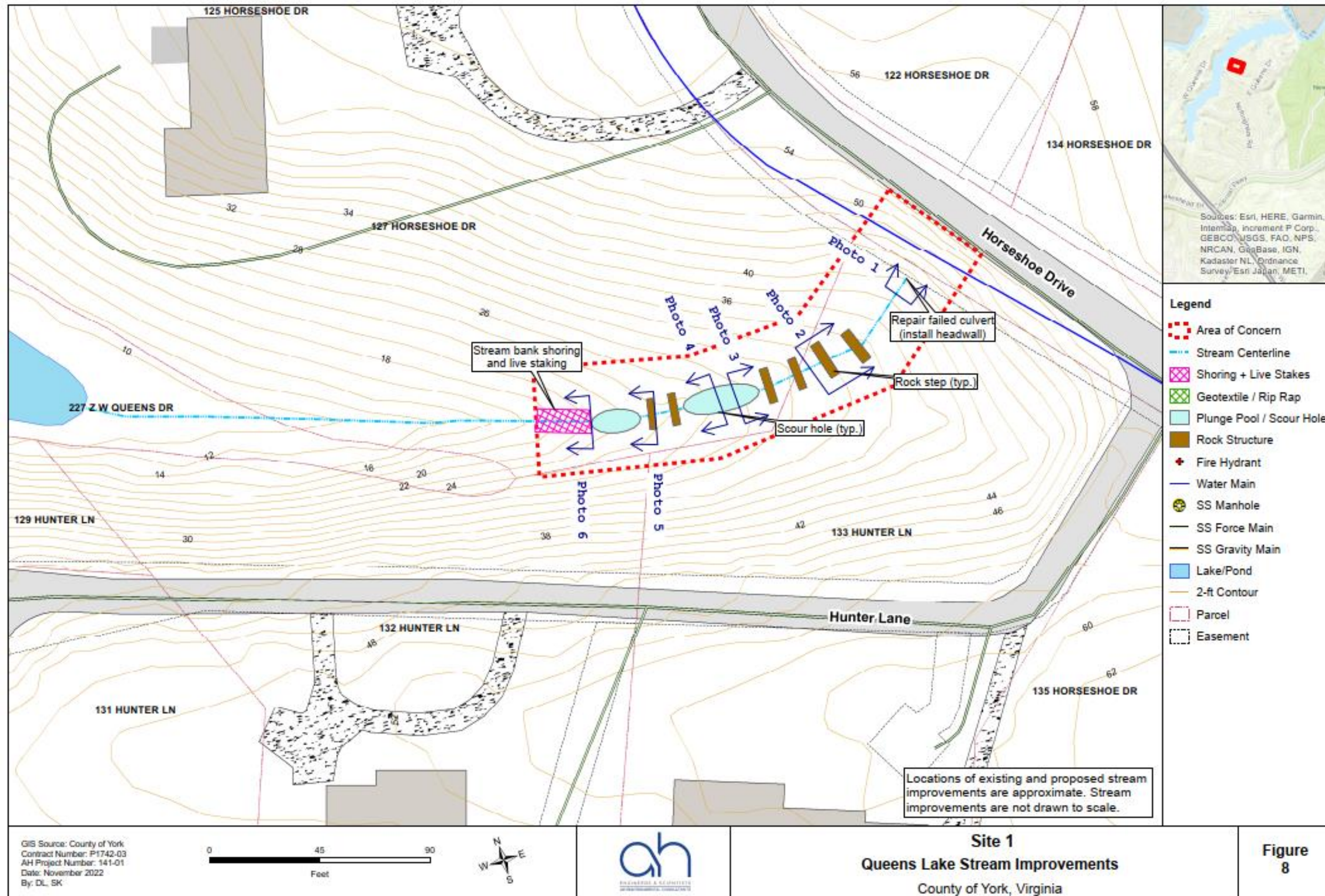
- 2-3 plunge pools / scour holes
- 5-8 rock steps (and/or cross vanes)
- Up to 50 LF of bank shoring and live stakes
- Up to 10 large (>12" diameter) trees for potential removal

**Table 8** provides an estimate of probable costs associated with the recommended restoration activities.

**Table 8 Site 1 Budgetary Construction Cost Estimate**

Item No.	Description	Cost
1	Clearing and Grubbing / Tree Removal	\$29,000
2	Earthwork	\$11,000
3	Restoration Structures and Rock Stabilization	\$30,000
4	Temporary E&SC Measures	\$26,000
5	Planting (including tree mitigation), Seeding, Site Stabilization	\$20,000
<b>Cost Summary</b>		
6	Subtotal	\$116,000
7	Bonds & Insurance (3% of Contract)	\$3,480
8	Mobilization/Demobilization (6% of Contract)	\$6,960
9	Supervision, Inspection, and Overhead (6% of Contract)	\$6,960
10	Construction Contingency (20% of Contract)	\$23,200
11	<b>Total</b>	\$156,600

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### 3.7.1 Site 1 Existing Conditions Photographs



**Site 1, Photo 1: Failed culvert near Horseshoe Drive (Looking Upstream (Northeast))**



**Site 1, Photo 2: Area downstream of failed culvert (Looking Upstream (Northeast))**



**Site 1, Photo 3: Start of large erosion downstream of failed culvert (Looking Upstream (East))**



**Site 1, Photo 4: Eroded ditch downstream of failed culvert (Looking Downstream (West))**



**Site 1, Photo 5: Continuation of eroded ditch (Looking Downstream (West))**



**Site 1, Photo 6: Continuation of eroded ditch (Looking Downstream (West))**

### 3.8 SITE 3

Site 3, located between Willoughby Drive and Nottingham Road, comprises approximately 100 LF of moderate stream bank incision followed by two areas of severe bank slope erosion. **Section 3.8.1** presents Site 3 photographs capturing these conditions.

**Figure 9** identifies the primary areas of concern, location of photographs, and preliminary recommended corrective actions. Site 3 requires approximately 200 LF of restoration activities, including the following:

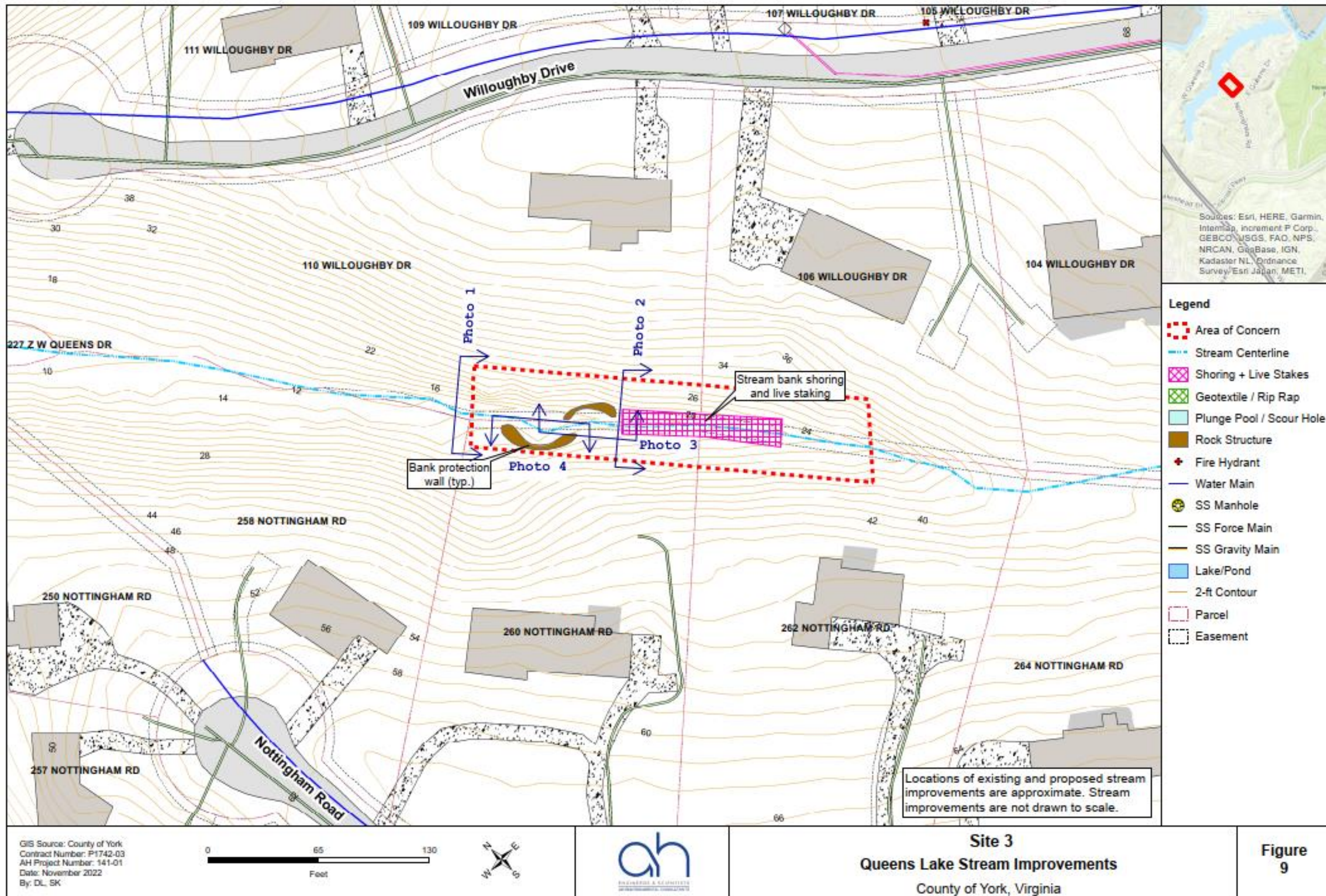
- 2 bank protection walls (stacked stone or other material)
- Up to 150 LF of bank shoring and live stakes
- Approximately 4 large (>12” diameter) trees for potential removal

**Table 9** provides an estimate of probable costs associated with the recommended restoration activities.

**Table 9 Site 3 Budgetary Construction Cost Estimate**

Item No.	Description	Cost
1	Clearing and Grubbing / Tree Removal	\$26,000
2	Earthwork	\$13,000
3	Restoration Structures and Rock Stabilization	\$35,000
4	Temporary E&SC Measures	\$31,000
5	Planting (including tree mitigation), Seeding, Site Stabilization	\$17,000
<b>Cost Summary</b>		
6	Subtotal	\$122,000
7	Bonds & Insurance (3% of Contract)	\$3,660
8	Mobilization/Demobilization (6% of Contract)	\$7,320
9	Supervision, Inspection, and Overhead (6% of Contract)	\$7,320
10	Construction Contingency (20% of Contract)	\$24,400
11	<b>Total</b>	\$164,700





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### 3.8.1 Site 3 Existing Conditions Photographs



**Site 3, Photo 1: View of Stream (Looking Upstream (Southeast))**



**Site 3, Photo 2: View of Stream (Looking Upstream (Southeast))**



**Site 3, Photo 3: Slope Erosion behind 110 Willoughby Drive (Looking Northeast)**



**Site 3, Photo 4: Slope Erosion behind 260 Nottingham Road (Looking Southwest)**

### 3.9 SITE 9

Site 9, located on the east side of Sherwood Drive between addresses 112 and 114, comprises approximately 100 LF of stream bank incision and gully erosion. **Section 3.9.1** includes Site 9 photographs capturing these conditions.

**Figure 10** identifies the primary areas of concern, location of photographs, and preliminary recommended corrective actions. Site 9 requires approximately 100 LF of restoration activities, including the following:

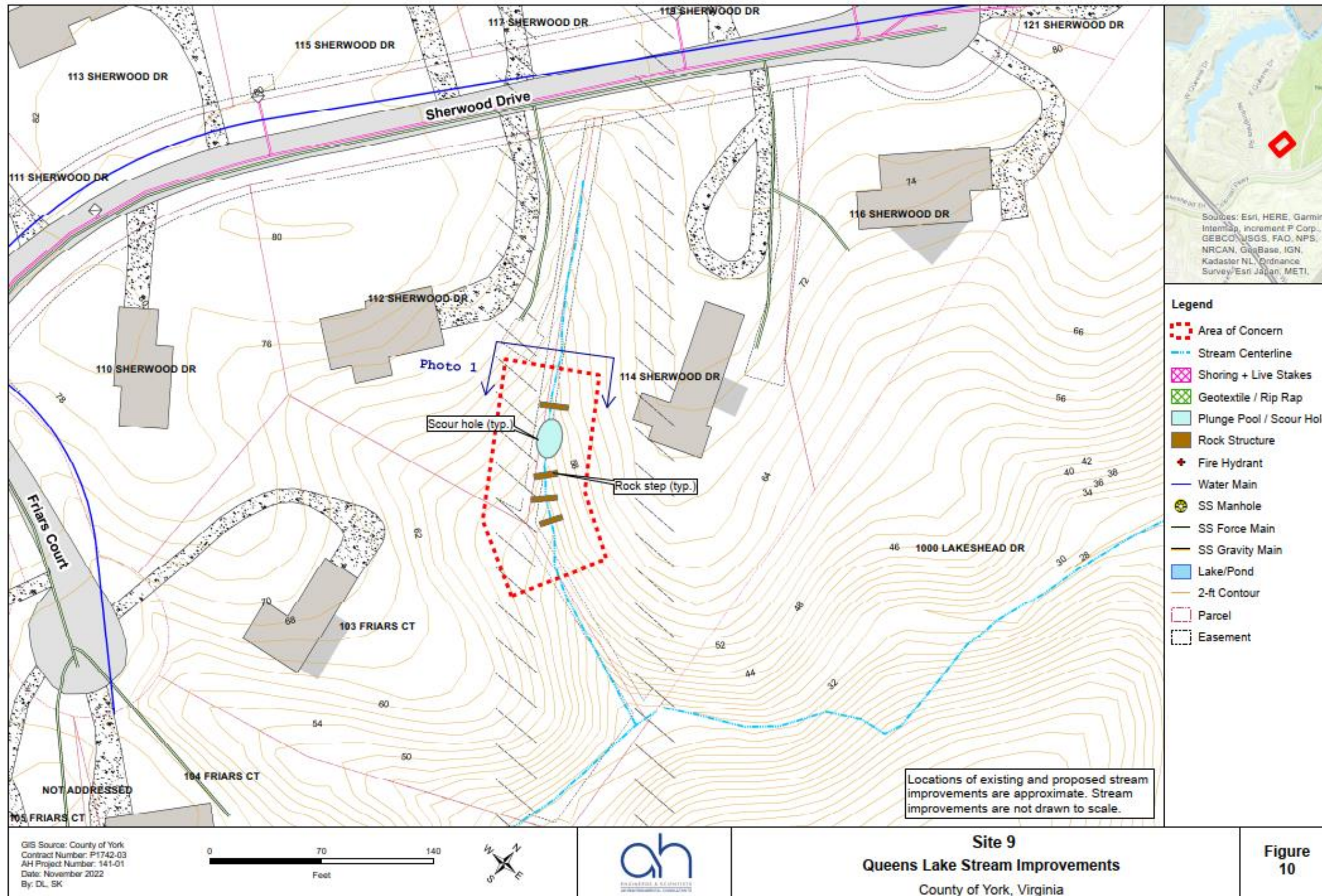
- 1-2 plunge pools / scour holes
- 4-6 rock steps (and/or cross vanes)
- Up to 50 LF of bank shoring and live stakes
- Up to 4 large (>12" diameter) trees for potential removal

**Table 10** provides an estimate of probable costs associated with the recommended restoration activities.

**Table 10 Site 9 Budgetary Construction Cost Estimate**

Item No.	Description	Cost
1	Clearing and Grubbing / Tree Removal	\$14,000
2	Earthwork	\$4,000
3	Restoration Structures and Rock Stabilization	\$14,000
4	Temporary E&SC Measures	\$28,000
5	Planting (including tree mitigation), Seeding, Site Stabilization	\$14,000
<b>Cost Summary</b>		
6	Subtotal	\$74,000
7	Bonds & Insurance (3% of Contract)	\$2,220
8	Mobilization/Demobilization (6% of Contract)	\$4,440
9	Supervision, Inspection, and Overhead (6% of Contract)	\$4,440
10	Construction Contingency (20% of Contract)	\$14,800
11	<b>Total</b>	\$99,900

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### 3.9.1 Site 9 Existing Conditions Photographs

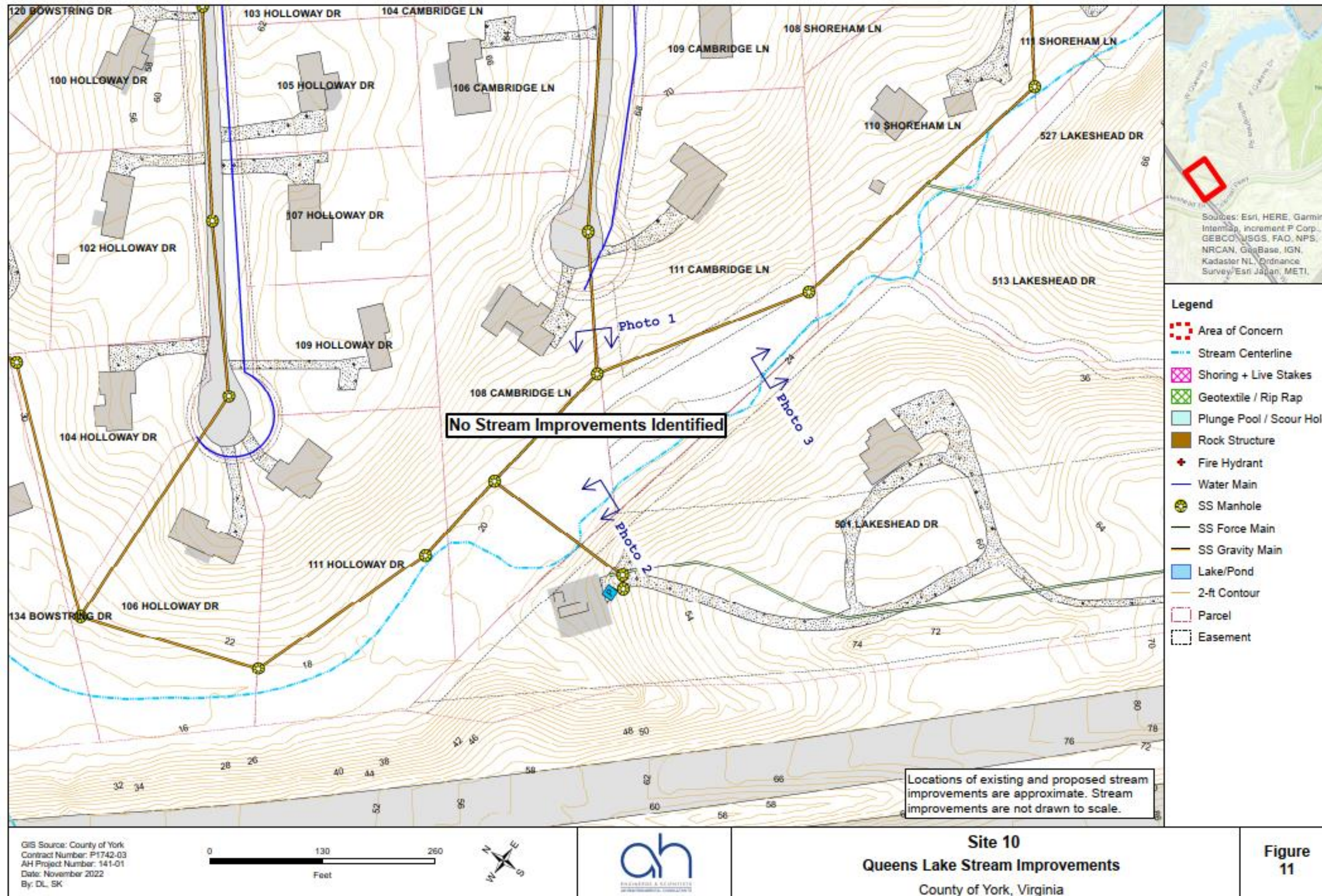


**Site 9, Photo 1: View of Channel (Looking Downstream (Southeast))**

### **3.10 SITE 10**

Site 10, located southwest of Cambridge Lane, was observed to be in adequate condition; no recommended improvements are offered. **Section 3.10.1** provides Site 10 photographs capturing current conditions.

**Figure 11** identifies the primary areas of concern and location of photographs. Site 10 requires no restoration activities.

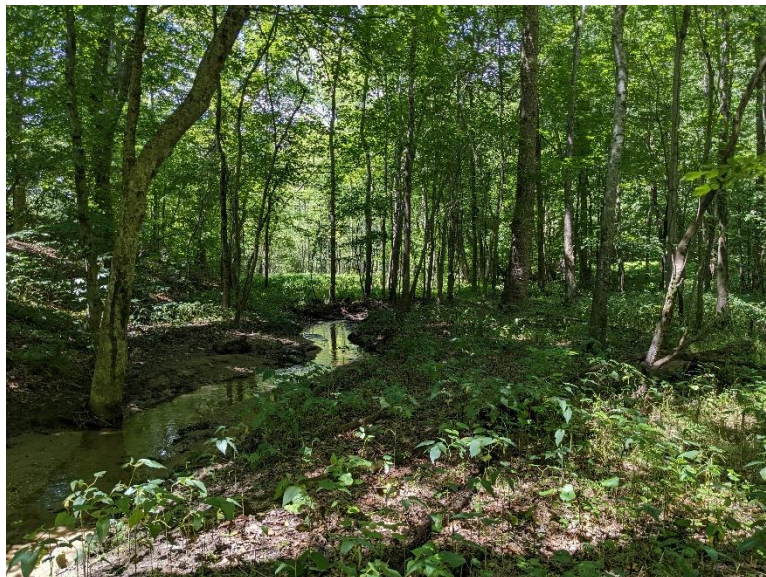


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### 3.10.1 Site 10 Existing Conditions Photographs



**Site 10, Photo 1: Concrete Swale from Cambridge Lane (Looking Downstream (Southwest))**



**Site 10, Photo 2: View of Stream (Looking West)**

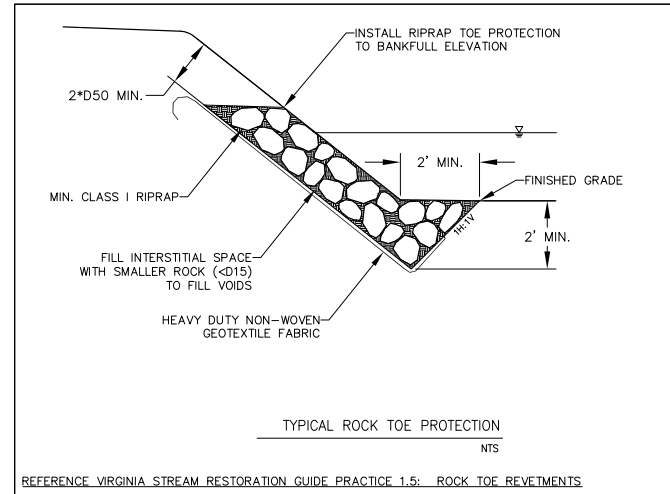
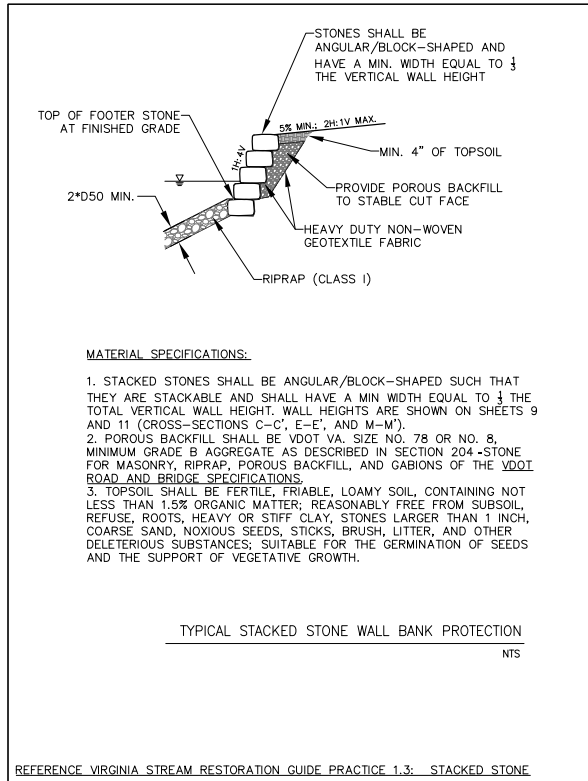
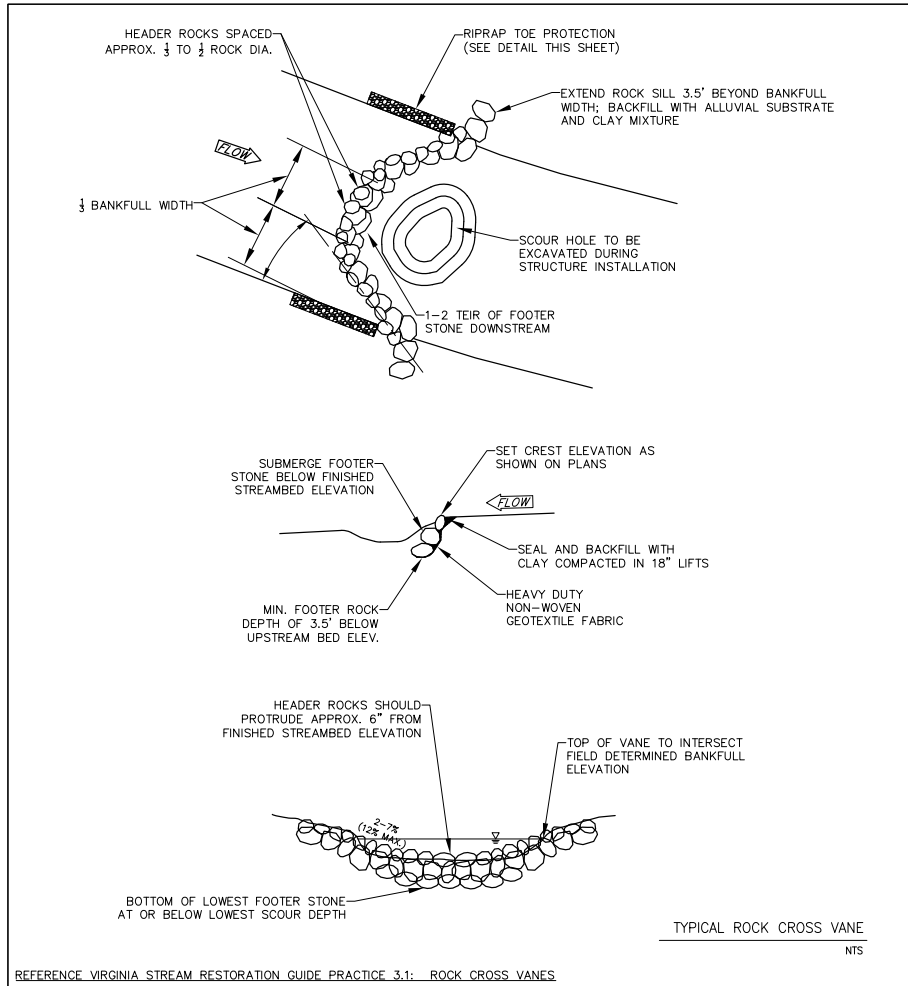
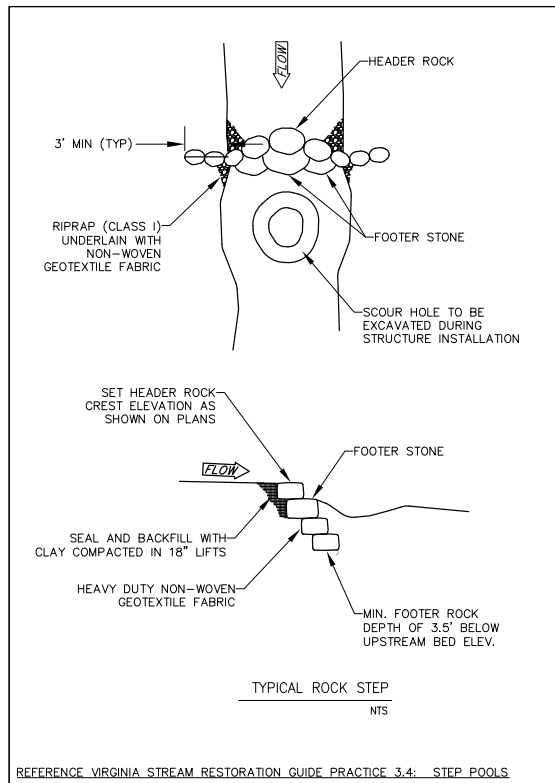
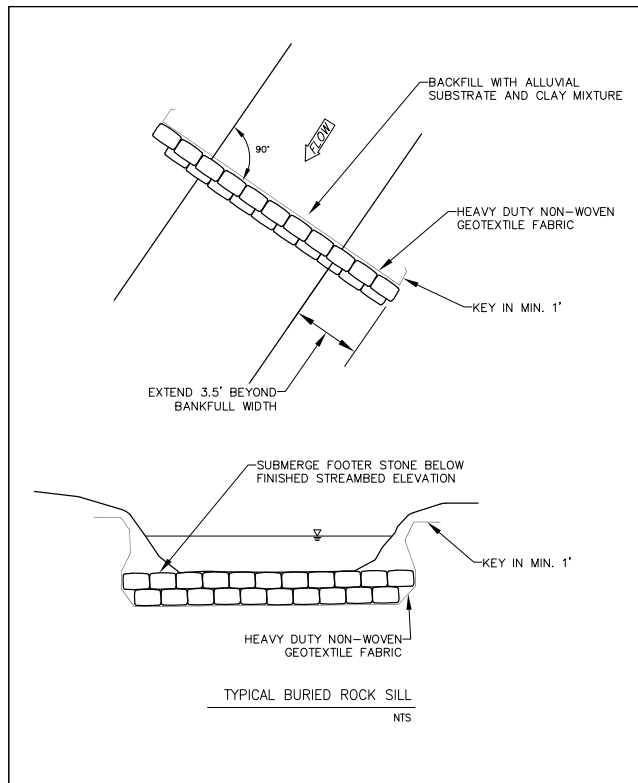
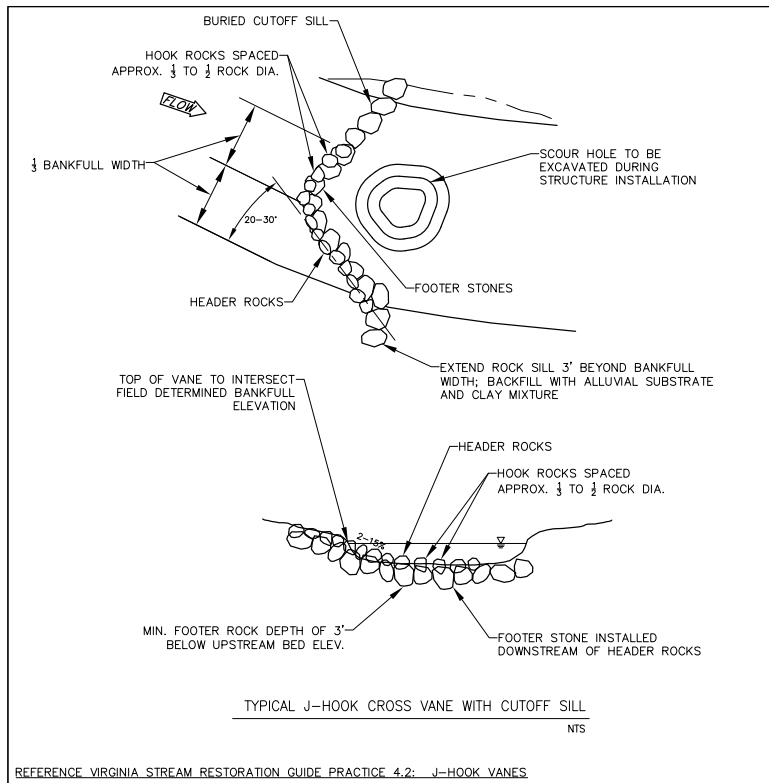


**Site 10, Photo 3: View of Stream (Looking East)**

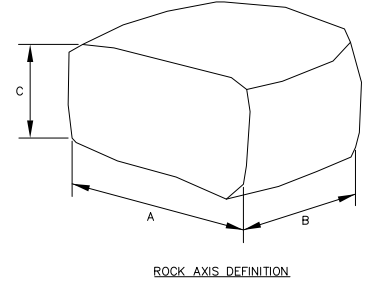
# **ATTACHMENT 1**

Standard Details and Example  
Photographs of Recommended Stream  
Restoration Measures

(2 PAGES)



- MATERIAL SPECIFICATIONS:**
1. HEADER AND HOOK ROCKS SHALL BE RELATIVELY RECTANGULAR IN SHAPE, UNIFORM IN SIZE, AND HAVE A MINIMUM INTERMEDIATE (B) AXIS GREATER THAN 2.0 FEET AT A MINIMUM.
  2. FOOTER BOULDERS SHALL BE INSTALLED AT A MINIMUM OF 1 TO 2 FOOTERS PER EVERY 2 VANE BOULDERS.
  3. FOOTERS SHALL BE INSTALLED IN PRE-EXCAVATED TRENCHES AND SHALL BE COMPLETELY SUBMERGED.
  4. PLACE FOOTER SLIGHTLY DOWNSTREAM OF TOP ROCK PRIOR TO ANCHORING TO PREVENT THE STRUCTURE FROM SINKING INTO THE SCOUR HOLE.
  5. FOOTERS MAY CONSIST OF LARGE BOULDERS (MIN. 1,500 LBS.), CONCRETE SLABS, OR GABIONS PLACED IN FOOTER TRENCH AS NEEDED TO SECURE WEIR BOULDERS FROM MOVING DOWNSTREAM.
  6. FILTER FABRIC SHALL CONSIST OF A MATERIAL MEETING THE REQUIREMENT FOR FILTER FABRIC USED WITH RIP RAP AS DETAILED IN TABLE 3.19 D IN SECTION 3.19 OF THE VIRGINIA EROSION AND SEDIMENT CONTROL HANDBOOK THIRD EDITION, 1992, PAGE III-171.
  7. FILTER FABRIC STAPLES SHALL BE 0.125 INCH DIAMETER NEW STEEL WIRE FORMED INTO A U-SHAPE NOT LESS THAN 6 INCHES IN LENGTH WITH A THROAT OF 1 INCH IN WIDTH.
  8. BACKFILL SHALL BE PLACED AND COMPACTED USING A MIXTURE OF EXISTING CHANNEL ALLUVIUM, AND IMPORTED CLAY FILL. CLAY MATERIALS SHALL CONSIST OF MATERIAL CLASSIFIED AS SC, SM, OR CL PER THE USCS.



**FOOTER ROCKS**  
SHALL BE ANGULAR TYPE I SOURCE (OR APPROVED ALTERNATIVE) WITH A MIN. WEIGHT OF 1,500 LBS.  
A = 2.5 - 3.0 FEET  
B = 1.5 - 2.0 FEET  
C = 1.5 - 2.0 FEET

**HEADER AND HOOK ROCKS**  
SHALL BE ANGULAR IMBRICATED SOURCE (OR APPROVED ALTERNATIVE) WITH A MIN. WEIGHT OF 1,000 LBS.  
A = 2.0 - 2.5 FEET  
B = 2.0 FEET  
C = 1.0 - 1.5 FEET



11837 Rock Landing Dr., Ste. 300  
Newport News, VA 23608

DESIGN	SKDL	SKDL	JA	
DRAWN BY			CHECKED	APPROVED
DATE				

**YORK COUNTY**  
**DEPARTMENT OF PUBLIC WORKS**  
105 SERVICE DRIVE YORKTOWN, VA 23692  
PHONE: 757-890-3750

**QUEENS LAKE**  
**STREAM IMPROVEMENTS**

FILE NO. \_\_\_\_\_  
DATE **NOVEMBER 2022**  
SCALE **AS SHOWN**

**ATTACHMENT**  
1





DESIGN	SKDL	SKDL	
DRAWN BY	JA		
CHECKED			
APPROVED			
DATE			

YORK COUNTY  
 DEPARTMENT OF PUBLIC WORKS  
 105 SERVICE DRIVE YORKTOWN, VA 23692  
 PHONE: 757-890-3750

JOB TITLE  
 QUEENS LAKE  
 STREAM IMPROVEMENTS

FILE NO. \_\_\_\_\_  
 DATE NOVEMBER 2022  
 SCALE AS SHOWN