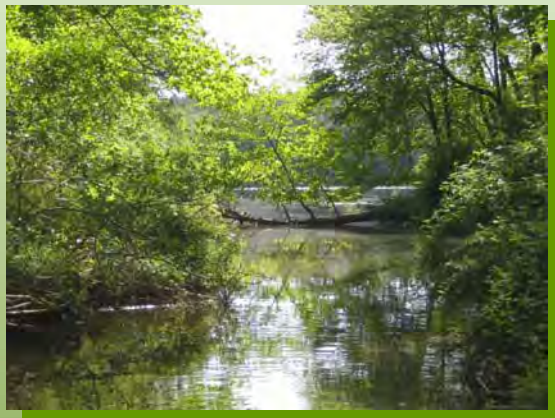
Prettyboy Reservoir Stream Stability Assessment

(Compass Run & Frog Hollow Subwatersheds)

September 2006



Prepared for: Baltimore County DEPRM
Towson, Maryland

Prepared by: Parsons Brinckerhoff, Inc.
Baltimore, Maryland

In Association with: EBA Engineering, Inc.
Baltimore, Maryland

TABLE OF CONTENTS

I. INTRODUCTION 1

Study Components 1

II. STREAM STABILITY ASSESSMENT 3

Cruised Assessment 3

Channel Morphology 3
Flow Regime 3
Stream Size 4
Entrenchment Ratio Range 4
Sinuosity Range 5
Depositional Features 5
Channel Substrate 6
Stream Classification Type (Rosgen) 6
Channel Slope Range 6
Width to Depth Ratio Range 7
Meander Pattern 7
Bank Failure Assessment 8
Channel Stability – Vertical and Lateral 10
Geologic Controls 11
Channel Evolution Stage (Schumm, et al 1984) 12
Channel Successional Stage (Rosgen) 12

Channel Disturbances 13
Bank Instabilities 13
Channel Disturbances 13
Debris Blockages 14
Utilities 14

Channel Habitat 14
Fish Blockages 14
Vegetation 15
Habitat Assessment 15

Restoration Opportunities 17

III. SUMMARY OF STREAM CONDITIONS 18

Compass Run 18
Existing Condition Summary 19
Subwatershed Deficiencies 22

Frog Hollow 22

Existing Condition Summary 23
Subwatershed Deficiencies 25

IV. IDENTIFICATION OF REACH NEEDS FOR MANAGEMENT MEASURES.....26

Management Measures 26
Management Measure 1: Stream Restoration/Stabilization.....26
Management Measure 2: Buffer Enhancement 27
Management Measure 3: Bank Plantings.....28
Management Measure 4: Utility Conflict Resolution 28
Management Measure 5: Habitat Enhancement 29
Management Measure 6: Trash Cleanup 29
Management Measure 7: Yard Waste Cleanup.....30
Management Measure 8: Invasive Plant Removal 31

Reach Needs Identification.....31

Reach Cost Estimates.....33

V. REACH IMPROVEMENT BENEFITS.....34

LIST OF FIGURES

Figure 1: Study Area Location Map 2
Figure 2: Prettyboy Reservoir Subwatersheds.....2
Figure 3: Stream Type Succession Stages (Rosgen 2001) 13
Figures 4 A & B CR-00-00-02 upstream and CR-00-02-02 upstream, respectively.....19
Figure 5 A & B: FH-00-02-02 upstream and FH-00-06-03 upstream respectively 22
Figures 7A, B & C: Eroded SWM areas in upstream reach of FH-00-03-03. 32
Figure 8: Lower end of FH-00-03-03, downstream from spring seep.....32
Figures 9A & B: Field sketch of erosion problem and roadway drainage ditch. 33
Figure 10: Erosion at FH-00-06-01 and FH-00-06-03 respectively. 33

LIST OF TABLES

Table 1: Flow regime categories for the Prettyboy assessed reaches 4
Table 2: Stream size classification for the Prettyboy assessed reaches.....4
Table 3: Entrenchment ratio ranges for the Prettyboy assessed reaches 5
Table 4: Sinuosity range for the Prettyboy assessed reaches 5
Table 5: Depositional features of the Prettyboy assessed reaches 5
Table 6: Channel substrate for the Prettyboy assessed reaches 6
Table 7: Rosgen stream classification for Prettyboy assessed reaches 6
Table 8: Channel slope ranges for the Prettyboy assessed reaches.....7
Table 9: Width to Depth ratios for the Prettyboy assessed reaches 7
Table 10: Meander patterns of the Prettyboy assessed reaches 8
Table 11: Field Indicators to assess vertical and lateral stream stability.....11

Table 12: Debris blockages in the Prettyboy assessed reaches 14
Table13: Fish blockage causes on Prettyboy assessed reaches.....15
Table 14: Vegetation cover in the Prettyboy assessed reaches.....15
Table 15: Canopy cover in the Prettyboy assessed reaches 15
Table 16: Habitat Characteristics of the Assessed Prettyboy Subwatersheds.....16
Table 17: Assessed Reach Length Statistics Compass Run 18
Table 18: Dominant Channel Morphology Characteristics of the Compass Run Subwatershed ..19
Table 19: Existing Channel Stability, Compass Run Subwatershed.....20
Table 20: Potential Channel Stability, Compass Run Subwatershed 20
Table 21: Riparian Composition and Density, Compass Run Subwatershed 21
Table 22: Canopy Cover, Compass Run Subwatershed 21
Table 23: Riparian Width, Compass Run Subwatershed.....21
Table 24: Assessed Reach Length Statistics Frog Hollow 22
Table 25: Dominant Channel Morphology Characteristics of the Frog Hollow Subwatershed 23
Table 26: Existing Channel Stability, Frog Hollow Subwatershed.....23
Table 27: Potential Channel Stability, Frog Hollow Subwatershed 24
Table 28: Riparian Composition and Density, Frog Hollow Subwatershed.....24
Table 29: Canopy Cover, Frog Hollow Subwatershed 25
Table 30: Riparian Width, Frog Hollow Subwatershed.....25
Table 31: Reach Unit Costs 34
Table 32: Recommended projects by management measure 35

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STREAM STABILITY ASSESSMENT

I. INTRODUCTION

The Baltimore County Department of Environmental Protection and Resource Management (DEPRM) has requested that Parsons Brinckerhoff, Quade and Douglas, Inc. (PB) prepare a scope of services for providing a planning level stream stability assessment of two subsheds in the Prettyboy Reservoir Watershed. The Prettyboy Reservoir Watershed system is located in the northwestern portion of Baltimore County, Maryland, in the northeastern part of Carroll County, and the southwestern part of York County. The streams of interest include the Compass Run and Frog Hollow Branch subwatersheds. Compass Run is in the vicinity of Beckleysville, Maryland and Frog Hollow Branch is in the vicinity of Rayville, Maryland. Assessment areas were limited to those areas with approved landowner access.

PB conducts planning level stream stability assessments in support of County initiatives in watershed action planning, addressing TMDL's, for comparison of baseline conditions, and stream management/restoration needs.

This document will be used in partial fulfillment of the federally mandated National Pollutant Discharge Elimination System Permit (NPDES) – Municipal Stormwater Discharge Permit (99-DP-3317) for Baltimore County.

Figures 1 and 2 show the location of the study watersheds within Baltimore County. More detailed mapping is included in the Appendices.

Study Components

This study is divided into 6 primary sections. Section 1 includes the introduction and general watershed overview. Section 2 describes the stream stability assessment methodology. Section 3 provides a summary of current stream conditions. Section 4 details management measures that can be incorporated into the watershed. Section 5 describes the identification of stream reach needs. The appendices contain the detailed data, mapping and prioritization tables for planning purposes.

Figure 1: Study Area Location Map

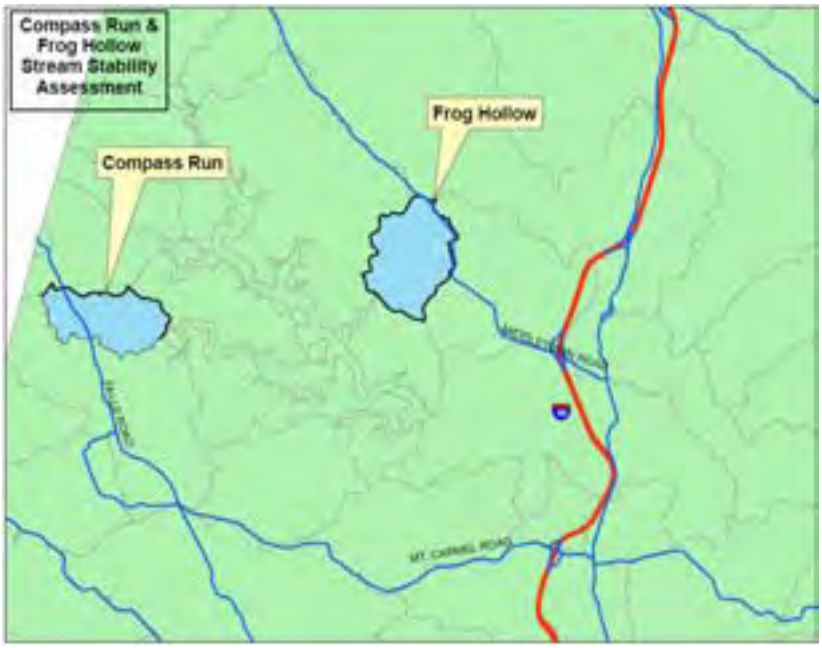


Figure 2: Prettyboy Reservoir Subwatersheds

II. STREAM STABILITY ASSESSMENT

The Compass Run and Frog Hollow subwatersheds were selected for assessment with the goals to identify stream instabilities and to provide opportunities for phosphorus reduction in the watersheds. Due to the rural nature of the area, DEPRM sent out mailings to property owners requesting access to the stream via their properties. If property owners replied with a no access or did not respond to the survey, stream segments within their property were not included in this study. Property access was obtained for 29% of the Compass Run and 44% of the properties within the Frog Hollow watersheds.

Approximately 2.93 miles of stream channel within the watershed was assessed. The 2.93 miles were to be broken down into individual assessment reaches averaging 500 linear feet for a total of 32 reaches. If stream segments on an approved property were less than 250 feet long, they were excluded from this study.

Cruised Assessment

Cruised reach assessments were conducted on 2.93 miles of first, second and third order stream reaches that were not previously assessed by the County. "Cruising" is defined as a team of two stream surveyors walking the entire length of each reach and performing rapid field assessments. The items included in the rapid assessment were divided into four major categories:

- Channel Morphology,
- Channel Disturbances,
- Channel Habitat,
- Restoration Opportunities.

Field crews of two team members were used to assess the cruised reaches. Field crews consisted of one senior staff member who served as the team leader and one junior staff member. Team leader training was done prior to beginning the field work to provide consistency in the assessments. Supervisory staff worked with the team leaders to ensure continuity in data collection. Measurements using a stretched tape and survey rod were performed to assess geomorphic features such as bankfull width, depth and floodprone width. Detailed cross sections were not taken at each reach. A representative riffle section of the reach was selected for assessment and the section was photographed for future reference.

Prior to beginning field work, all streams were divided into reaches of approximately 500 feet. Reach breaks were adjusted in the field if stream type and characteristics changed significantly. The final cruised reach assessment yielded an average stream reach of 485 feet.

The methodology and data collection parameters for each category are defined below.

Channel Morphology

Flow Regime

Streamflow exhibits a strong influence on channel morphology, aquatic habitat and riparian vegetation. Flow regime categories were based on the Level III Rosgen Methodologies. Table 1 lists the categories used in this field assessment.

Table 1: Flow regime categories for the Prettyboy assessed reaches

Code	Flow Regime Category
E	Ephemeral stream channel, flow only in response to precipitation
S	Subterranean stream channel, flows parallel to and near the surface for various seasons
I	Intermittent stream channel, flow which exists seasonally or sporadically
PI	Piped
P	Perennial stream channel, flow which exists year round

Stream Size

Bankfull width is often used to assess stream size because of the many hydrologic and geomorphic interpretations that can be derived from width measurements. Stream size can be used to provide perspective for interpreting hydraulic processes, sediment transport and biological processes. Table 2 lists the stream size categories based on Rosgen Level III classification that were determined from measurement of bankfull widths for each stream reach. All bankfull widths assessed as part of this study were less than 19 feet wide.

Table 2: Stream size classification for the Prettyboy assessed reaches

Code	Stream Size
S-1	Bankfull Width less than 1 foot
S-2	Bankfull Width from 1 to 5 feet
S-3	Bankfull Width from 5 to 15 feet
S-4	Bankfull Width from 15 to 30 feet

Entrenchment Ratio Range

Entrenchment describes the relationship of a river to its valley and landform features. The entrenchment ratio describes the vertical containment of a stream. It has been defined by Rosgen to be the ratio of the width of the floodprone area to the surface width of the bankfull channel. The entrenchment ratio was computed for each stream reach and then divided into three categories: slight entrenchment, moderate entrenchment and entrenched. Table 3 shows the entrenchment characteristics of the Prettyboy Watershed.

Table 3: Entrenchment ratio ranges for the Prettyboy assessed reaches

Category
Slight to No Entrenchment (> 2.2)
Moderate Entrenchment (1.41 - 2.2)
Entrenched (1.0 - 1.4)

Sinuosity Range

Channel sinuosity is the ratio of stream channel length to down-valley distance. It is also defined as the ratio of valley slope to channel slope. Sinuosity is a primary indicator of Rosgen stream type and also provides an indication of how the stream slope has adjusted in comparison with the valley slope. The actual sinuosity was not field measured for each cruised reach, however, the sinuosity range was determined visually in the field. Table 4 shows the classification categories used in this analysis.

Table 4: Sinuosity range for the Prettyboy assessed reaches

Code	Category
Low	Sinuosity Ratio of 1.0 to 1.2
Moderate	Sinuosity Ratio of 1.2 to 1.5
High	Sinuosity Ratio greater than 1.5

Depositional Features

Depositional patterns are easily observed channel features that are beneficial in interpreting stream condition. Depositional patterns can be used to illustrate the effects of past land management on sediment supply and storage and the effects on channel form and stability. Table 5 lists the depositional features used to assess the cruised reaches in this study.

Table 5: Depositional features of the Prettyboy assessed reaches

Code	Category
B-1	Point Bars
B-2	Point Bars with Few Mid Channel Bars
B-3	Many Mid Channel Bars
B-4	Side Bars
B-5	Diagonal Bars
B-6	Main Branching with Many Mid Bars and Islands
B-7	Mixed Side Bar and Mid Channel Bars exceeding 2-3 times the width
B-8	Delta Bars
NONE	NONE

Channel Substrate

Channel bed and bank materials influence the cross sectional form, plan view and longitudinal profile of rivers. They also determine the extent of sediment transport and resistance to hydraulic stress. It is also important for addressing the biological function and stability of rivers.

Table 6 shows the channel substrate categories used in the cruised reach assessment. In addition to noting a primary channel substrate, bimodal channel substrates were considered and documented. The channel substrate was visually estimated as the field crew cruised the reach. There were no physical samples taken nor was the channel subpavement assessed.

Table 6: Channel substrate for the Prettyboy assessed reaches

Category
Boulder
Cobble
Gravel
Sand
Silt and Silt/Clay

Stream Classification Type (Rosgen)

The cruised reaches were visually assessed and classified according to Rosgen's stream classification system. The entrenchment ratio, width to depth ratio and sinuosity were used in stream type selection. The majority of the watershed's streams can be classified as B or G stream types. Table 7 shows the stream type classifications used within the Prettyboy Watershed.

Table 7: Rosgen stream classification for Prettyboy assessed reaches

Rosgen Classification
A
B
C
D
E
F
G

Channel Slope Range

The water surface slope is a major determinant of river channel morphology and of its related sediment, hydraulic and biological function. An average slope range was estimated for each stream reach. Detailed profile measurements were not taken for each reach. Table 8 shows the slope ranges used in the Cruised Reach assessment.

Table 8: Channel slope ranges for the Prettyboy assessed reaches.

Category
Channel Slope < 2%
2% < Channel Slope < 4%
Channel Slope > 4%

Width to Depth Ratio Range

The width to depth ratio is defined as the ratio of the bankfull surface width to the mean depth of the bankfull channel. The width to depth ratio is key to understanding the distribution of available energy within a channel and the ability of various discharges within the channel to move sediment. Of Rosgen's Level II parameters, the width to depth ratio is the most sensitive and positive indicator of trends in channel instability.

For channels with high width to depth ratios, the distribution of energy in the channel is such that stress is placed within the near bank region. As the width to depth ratio decreases, the hydraulic stress against the banks also increase and bank erosion is accelerated. The accelerated bank erosion is usually the result of high velocity gradients and high boundary stress.

The actual width to depth ratio was computed using the field measured bankfull width and average bankfull depth. Table 9 summarizes the categories for the width to depth ratio which were taken from the Rosgen classification system. Cutoff values of 12 and 40 are used to distinguish between the various Rosgen stream types.

Table 9: Width to Depth ratios for the Prettyboy assessed reaches

Category
Width/Depth Ratio < 12
40 > Width/Depth Ratio > 12
Width/Depth Ratio >40

Meander Pattern

Channel meander patterns provide a plan view of lateral channel adjustments, meander width ratios and lateral containment characteristics for all of the stream types. The meander patterns provide insight into how the stream channel adjusts its slope in relation to the stream valley. Table 10 shows the Rosgen meander classification within the cruised reaches of the watershed.

Table 10: Meander patterns of the Prettyboy assessed reaches

Rosgen Code	Category
M-1	Regular Meanders
M-2	Tortuous Meanders
M-3	Irregular Meanders
M-4	Truncated Meanders
M-5	Unconfined Meander Scrolls
M-6	Confined Meander Scrolls
M-7	Distorted Meander Loops
M-8	Irregular Meanders with Oxbows and Oxbow Cutoffs

Bank Failure Assessment

Assessment of bank failure is based on a combination of field measured parameters:

- Length and Height of bank instability,
- Unstable to Stable Stream Ratio (or percentage)
- Average Bank Height versus Bankfull Depth (low, medium or high erosion potential),
- Bank Angle,
- Root Density, and
- Bank Material.

Length and Height of Bank Instability

The length and height of unstable banks were estimated for the left and right banks of each reach. The unstable bank measurements were used to determine the average eroded area per foot of stream channel. Normalizing the erosion per length of channel allows the comparison of erosion severity between reaches of varying lengths.

Unstable to Stable Stream Ratio (or percentage)

The final factor in the bank erosion analysis was the ratio of unstable stream length to total stream length. Low erosion potential was given to reaches with an unstable to stable length ratio of less than 25 percent. Medium erosion potential was given to reaches with an unstable to stable ratio between 25 and 50 percent. High erosion potential was given to any reaches that had more than 50% unstable to stable lengths. 9.4% of the Prettyboy Reaches are more than 50 percent unstable.

Average Bank Height versus Bankfull Depth

Estimates of bank erosion potential based on average bank height versus bankfull depth shows that 21.9% of the stream reaches have low or very low erosion potential and 34.4% of the stream reaches have high, very high or extreme erosion potentials. Low erosion potential ratios were between 1.0 and 1.19, medium erosion potential ratios were between 1.2 and 1.59, and high erosion potential ratios are defined as being greater than 1.6.

Bank Angle

The bank angle data were rated for erosion potential as follows: low potential were assigned to banks sloping away from the stream, medium potential were assigned to nearly vertical banks and high potential were assigned to undercut banks, sloping in towards the stream.

Root Density

Root density was another factor considered in the bank failure analyses. Low erosion potential was given to banks with dense roots throughout the entire bank, medium potential was given to banks with dense roots in the upper half of the banks and high erosion potential was given to banks with minimal root density.

Bank Material

Bank material can limit or accelerate bank erosion potential. Banks with sandy layers have higher erosion potential while banks with a high percentage of cobble material will have lower erosion potential. Points were added to the BEHI rating for sandy bank material and subtracted for cobble banks. All other bank types received a neutral rating of zero.

BEHI Rating

A modified bank erosion hazard index (BEHI) was developed based on the following components:

- Bank Height/ Bankfull Height,
- Bank Angle,
- Root Density,
- % Surface Protection,
- Root Depth / Bank Height,
- Bank Material (Sandy or cobble).

The BEHI methodology is based on a modified version of the Rosgen Bank Erosion Hazard Index. The primary difference between the method used for the Prettyboy study and the Rosgen methodology is that the Prettyboy methodology uses average reach values as opposed to bank specific values. Appendix D contains detailed BEHI scoring methodology. The individual BEHI component scores were summed to obtain the overall BEHI score. The scores were then adjusted to account for sandy or cobbley bank materials. The final point totals were then assigned an erosion potential rating as follows:

- High Erosion Potential — 14 to 15 points
- Moderate to High — 12 to 13 points
- Moderate Erosion Potential — 9 to 11 points
- Low to Moderate Erosion Potential — 8 points
- Low Erosion Potential — Less than 8 points

Channel Stability – Vertical and Lateral

Each stream reach was assessed for its vertical and lateral channel stability. Table 12 was used to assist the field crews with the classification of aggrading or degrading. Throughout the watershed, 62.5% of the cruised stream reaches were assessed as vertically stable. 71.9% of the cruised stream reaches were assessed as laterally unstable.

Table 11: Field Indicators to assess vertical and lateral stream stability

Field Indicators for Stream Degradation or Aggradation		
Observed Condition	**Degrading**	**Aggrading**
Channel Form:		
Straightened Channel	X	
Active Head Cuts	X	
Active Meander Development		X
Channel Avulsions		X
Loss of Channel Bars	X	
Channel Bars Developing		X
Mass Wasting of Banks	X	
Vertical or Steepened Banks	X	
Tributary Stream Hanging or Steepened	X	
Hydraulic Conditions:		
Decrease in Energy Slope		X
Increase in Energy Slope	X	
Stage Control Downstream		X
Stage Control Upstream	X	
Dam or Reservoir Upstream	X	
Hydrologic Conditions:		
Logging/Land Clearing		X
Watershed Urbanizing	X	
Clearwater Diversion		X
Drought Period		X
Wet Period	X	
Sediment:		
Reduction in Supply	X	
Increase in Supply		X
Alluvial Fan Downstream	X	
Alluvial Fan Upstream		X
Vegetation:		
Vegetation High Relative to Flow Line	X	
Trees Leaning into Channel	X	

Geologic Controls

Any geologic controls (bedrock) found in a reach were noted in the data collection forms. Approximately 87.5% of the watershed's reaches had bedrock controls. Bedrock outcrops within the stream channel and in the adjacent floodplains were commonly found throughout the Compass Run and Frog Hollow watersheds.

Channel Evolution Stage (Schumm, et al 1984)

The incised channel evolution model (Schumm *et al*, 1984) was used to classify each of the cruised stream reaches. The intent of the channel evolution model is to determine if the reach is in a stable, incising, widening or stabilizing state. The five evolution stages are defined as follows:

- **Stage I**: Well developed baseflow and bankfull change; consistent floodplain features easily identified; *one terrace* apparent above active floodplain; predictable pattern and stream bed morphology; floodplain covered by diverse vegetation; stream banks less than 45 degree angle.
- **Stage II**: Headcuts; exposed cultural features; sediment deposits absent or sparse; exposed bedrock; streambank slopes > 45 degree angle.
- **Stage III**: Streambanks sloughing; sloughed material eroding; streambank slopes greater than 60 degrees, vertical or concave.
- **Stage IV**: Streambanks aggrading; sloughed material not eroded; soughed material colonized by vegetation; baseflow, bankfull and floodplain channel developing; predictable, sinuous pattern developing; streambank slopes less than or equal to 45 degrees.
- **Stage V**: Well developed baseflow and bankfull channel; consistent floodplain features easily identified; *two terraces* apparent above active floodplain; predictable pattern and streambed morphology; streambank angle less than 45 degrees.

Only 40.7 percent of the stream reaches within the watershed were defined as stable. 6.3 percent of the stream reaches are aggrading. The remaining 50.1% are in the process of widening and incising. Stages I and V were assumed to be stable, Stage II and III were assumed to be degrading and Stage IV was assumed to be aggrading.

Channel Successional Stage (Rosgen)

Rosgen defines a series of 9 channel successional stages as a means of determining future channel state. The Rosgen successional stage in conjunction with the current Rosgen stream classification can provide insight into whether the channel in evolving towards a more stable state. Over 65.6% of the assessed reaches in the Prettyboy watershed were successional stage 6 – Type B to Type G to Type Fb to Type B. The Rosgen Successional Stages are shown in Figure 3.

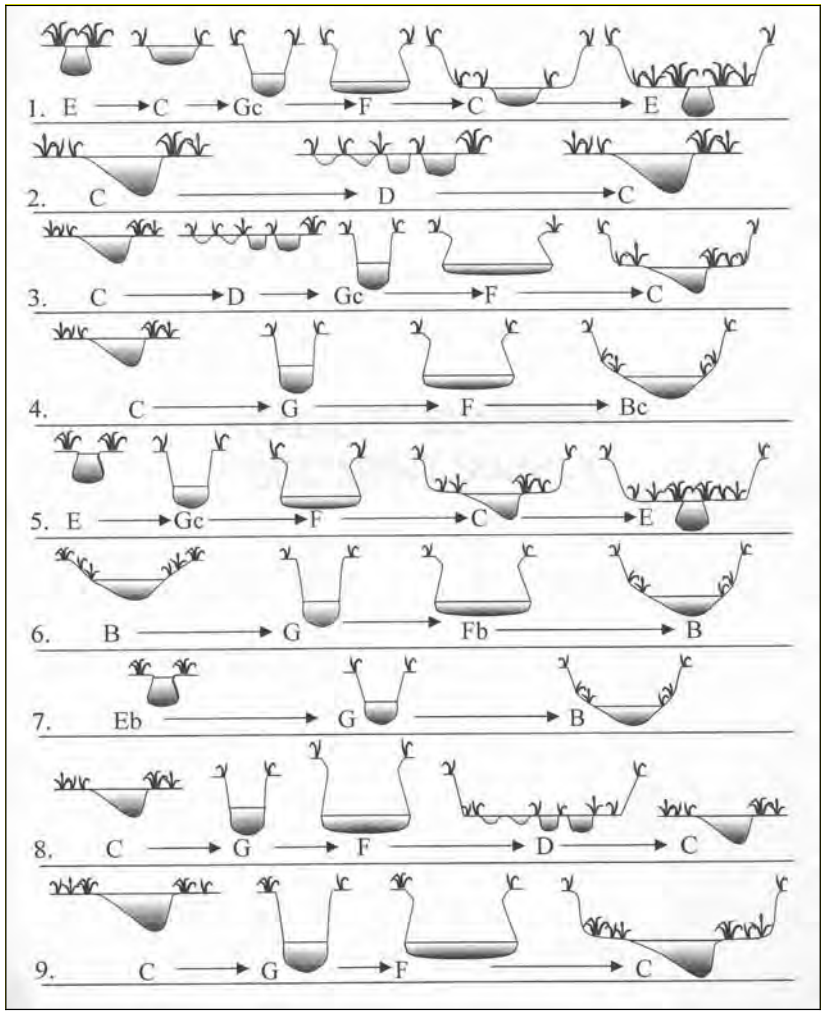


Figure 3: Stream Type Succession Stages (Rosgen 2001)

Channel Disturbances

Bank Instabilities

Localized bank instabilities were recorded in each reach. The length and average height of unstable bank were measured throughout the reaches with separate values recorded for the left and right bank. Bank instabilities that threatened private structures were also recorded.

Additional information on bank instabilities can be found throughout the channel morphology and habitat section of the cruised reach assessment.

Channel Disturbances

Due to the rural nature of the Prettyboy watershed, there were not a significant number of stream channels that have been modified through the use of riprap, gabion or lining by concrete. To maintain consistency with other County watershed assessments, any channel disturbances found during the field assessment were documented. Specific items of interest included:

- Concrete Lined,

- Riprap/Gabion Lined ,
- Piped,
- Private Structure Threatened,
- Culvert within Reach.

There was only 1 riprap lined reach, FH-00-03-01, in the assessed reaches.

Debris Blockages

Debris blockages occurred on many of the stream reaches throughout the cruised reach assessment. The severity of the debris blockage was determined based on frequency descriptions listed in Table 12. Appendix D contains the debris photo descriptions used by field crews during the assessment.

Table 12: Debris blockages in the Prettyboy assessed reaches

Description
None
Infrequent
Moderate
Numerous
Extensive

Utilities

To maintain consistency with other County stream assessments, any reaches with the following items were noted:

- Exposed Crossings,
- Leaking Utility,
- Exposed manholes in or near the channel.

No active sewer leaks and no exposed pipes or manholes were found in the assessed reaches of the Compass Run and Frog Hollow subwatersheds.

Channel Habitat

Habitat refers to the physical components of an organism's surroundings. Three components of habitat were examined as part of this study: presence of fish blockages, vegetation and in-stream channel condition. Each of the components will be explained below.

Fish Blockages

Stream reaches with fish blockages were noted during the field assessment. 21.9 percent of the cruised reaches have some type of fish blockage. The primary cause was shallow depth of flow. Appendix B shows the extent of fish blockages on the assessed reaches throughout the watershed. Each fish blockage was classified as having one of the causes shown in Table 13.

Table13: Fish blockage causes on Prettyboy assessed reaches

Causes of Fish Blockages
Debris Blockages
Shallow Depth of Flow
Excessive Height

Vegetation

Riparian cover along both the left and right overbanks of the stream were assessed. The width, composition and density of each riparian zone were quantified. Density was classified as low, medium or high. Table 14 shows the vegetation categories that was found at the assessed reaches.

Table 14: Vegetation cover in the Prettyboy assessed reaches

Vegetation
Bare
Forbs only
Annual grass with forbs
Brush
Deciduous overstory
Deciduous overstory with brush understory
Wetland vegetation

In addition to the adjacent riparian zone, the canopy cover immediately over the stream was assessed. Canopy cover was broken into five categories: less than 10% cover, 10 to 25% cover, 25 to 50% cover, 50 to 75% cover, and greater than 75% cover. Table 15 shows the results of the canopy cover analysis. More than 71.9% of the assessed cruised reaches have greater than 50% canopy cover.

Table 15: Canopy cover in the Prettyboy assessed reaches

Canopy Cover
0 to 10%
10 to 25%
25 to 50%
50 to 75%
75 to 100%

Habitat Assessment

Habitat quality can be positively correlated with overall aquatic community health. Aquatic habitat was visually evaluated within each reach utilizing the Maryland Biological Stream Survey (MBSS) Physical Habitat Index (PHI). Although this assessment is typically only performed in 75-meter segments within larger reaches, those reaches less than 75 meters (246 feet) in length were also evaluated in this study. This assessment was based on the February 2001 MBSS guidelines

(Kazyak, 2001). The MBSS PHI, in Piedmont streams, is calculated using the following parameters:

- *Instream habitat structure* – looks at the variety of cobbles, boulders, submerged logs, undercut banks, snags, rootwads, aquatic plants and other stable habitat within the stream channel.
- *Epifaunal substrate* – looks at the amount and variety of hard, stable substrates usable by benthic invertebrates.
- *Shading* – percent of summertime shading over the habitat reach.
- *Number of instream rootwads and woody debris* – large woody debris (>4 inches in diameter and > 5 feet long) and rootwads (>6 inch DBH) were counted in each 75 meter habitat reach.
- *Bank stability* – the length and severity of erosion on each side of the 75 meter habitat reach were quantified.
- *Riffle/run quality* - quantifies depth of flow, stability of channel substrate and diversity of current velocities at riffles or runs.
- *Distance to the nearest road (remoteness)* – distance from edge of habitat reach to nearest roadway. Measured via GIS.
- *Embeddedness* – percent that gravel, cobble and boulder particles are surrounded by line sediment or flocculent material.

These metrics were determined by MBSS to be most important in discriminating reference sites from degraded sites. The physical habitat data were analyzed using a method developed for the 1994-2000 MBSS data. Four categories of habitat health were established for the PHI as follows:

- Scores of 72 to 100 are rated good.
- Scores of 42 to 71.9 are rated fair.
- Scores of 12 to 41.9 are rated poor.
- Scores of 0 to 11.9 are rated very poor.

Overall in the assessed reaches of the Prettyboy watershed, the majority of the reaches rated fair and were limited by a lack of instream and epifaunal habitat and woody debris, due to shallow depth or lack of flow. These reaches are lacking the substrate characteristics that provide optimal epifaunal habitat, which include well developed riffles dominated by cobble, and stable woody debris. Table 16 lists the results of the habitat characteristics assessment by subwatershed.

Table 16: Habitat Characteristics of the Assessed Prettyboy Subwatersheds

Subwatershed	MBSS PHI Rating			Limiting Characteristic
	Good	Fair	Poor	
Compass Run	0%	77.8%	22.2%	shallow flow, lack of instream habitat, lack of woody debris
Frog Hollow	4.3%	87.0%	8.7%	shallow flow, lack of epifaunal habitat, lack of woody debris
Combined Subwatersheds	3.1%	84.4%	12.5%	shallow flow, lack of epifaunal habitat, lack of woody debris

Restoration Opportunities

It was determined that the first screening for potential restoration sites would occur during the stream assessments. As the field crews collected the data above, they were also looking at the sites in terms of potential restoration projects. Types of the potential restoration opportunities are listed below. Restoration projects that did not fit into the categories below were noted in the comments section of the form. Restoration opportunities are summarized in management and recommendations section of this report.

- Channel Restoration/Stabilization,
- Buffer Enhancement,
- Bank Planting,
- Utility Conflict Resolution,
- Habitat Enhancement,
- Trash Cleanup,
- Yard Waste Cleanup.

III. SUMMARY OF STREAM CONDITIONS

Section two of this report summarized the assessment parameters used in the Prettyboy cruised reach assessment. This section of the report summarizes the characteristics of the individual Prettyboy subwatersheds. It is divided into the following subsections:

- Channel Morphology – including flow regime, Rosgen stream type, bankfull indicator, channel substrate, meander pattern and depositional features.
- Channel Stability – lateral and vertical stability, ratio of unstable to stable banks, channel evolution stage and BEHI ranking.
- Channel Disturbances – debris jams, utility conflicts, riprap/gabion lined channels.
- Riparian Characteristics – composition, density, width.
- Habitat – MBSS PHI score.
- Deficiencies – major problems within the watershed.

Compass Run

Compass Run has a drainage area of 1.2 square miles and is located in the piedmont physiographic region. It is composed primarily of B type soils and the land uses are split between cropland (28.9%), forested lands (27.3%), low density residential (27.2%) and pasture (16.6%). The watershed contains approximately 2.9% impervious area. The basin has a relief of 155 feet with an average channel slope of 2.3%.

Nine reaches with a total reach length of 4,387 feet (0.83 miles) were assessed in the Compass Run subwatershed. A summary of the reach length statistics is provided in Table 17. Figure 4 shows typical stream reaches.

Table 17: Assessed Reach Length Statistics Compass Run

Reach Length Statistics	Reach Length in feet	Reach Length in Miles
Total	4,387	0.83
Minimum	157	0.03
Maximum	808	0.15
Mean	487	0.09
Standard Deviation	213.56	0.04

Figures 4 A & B CR-00-00-02 upstream and CR-00-02-02 upstream, respectively.

Existing Condition Summary

Channel Morphology

Of the 9 reaches assessed, 66.7% are perennial streams and 22.2% are ephemeral. Slope breaks were identified as the bankfull indicator in the majority of these reaches (77.8%). Depositional features (11.1%) were also selected as bankfull indicators in this subwatershed. A combination of bankfull indicators were used in the remaining 11.1% of the reaches.

All reaches were classified in accordance with the Rosgen Stream Classification of Natural Rivers. Thirty-three percent of the reaches are B channels, and A and G channels are each 22.2%. E and F channels each made up 11.1% of the assessed number of reaches.

Cobble (77.8%) channel materials made up the majority of the reaches, while gravel (11.1%) and silt (11.1%) were also identified as the median channel materials for the remaining reaches. Bedrock outcrops were also identified in 77.8% of the assessed reaches. The majority of the reaches had irregular meander patterns (66.7%) and no depositional features (55.6%), typical characteristics of A, B and G channels. Table 18 summarizes the dominant channel morphology characteristics of the Compass Run subwatershed.

Table 18: Dominant Channel Morphology Characteristics of the Compass Run Subwatershed

Flow Regime	Perennial
Bankfull Indicator	Slope Break
Stream Type	A, B and G channels
Channel Substrate	Cobble – 77.8% with bedrock outcrops
Meander Pattern	Irregular
Depositional Features	None

Channel Stability

The existing stability of the Compass Run subwatershed is predominantly vertically stable (88.9%) and laterally stable (88.9%). The average reach unstable to stable stream ratio is 11.5%. Table 19 lists the existing channel stability characteristics for the Compass Run subwatershed.

Table 19: Existing Channel Stability, Compass Run Subwatershed

Stability Rating	Percent of Reaches		Average Ratio of Unstable to Stable Stream Banks
	Vertical Stability	Lateral Stability	
Aggrading	0%	0%	11.5%
Degrading	11.1%	11.1%	
Stable	88.9%	88.9%	
Not Evaluated	0%	0%	

33.3% each of the Compass Run reaches can be classified as channel evolution stage I or stage III, 11.1% each are stage II or V. Zero percent of the reaches are classified as stage IV. The average BEHI rating is low or low to moderate (33.3% each), as shown in the following table.

Table 20: Potential Channel Stability, Compass Run Subwatershed

Channel Evolution Stage	Percent of Reaches per Channel Evolution Stage	BEHI Rating	Percent of Reaches per BEHI Rating
Stage I	33.3%	Low	33.3%
Stage II	11.1%	Low to Moderate	33.3%
Stage III	33.3%	Moderate	22.2%
Stage IV	0%	Moderate to High	0%
Stage V	11.1%	High	0%
Not Evaluated	11.1%	Not Evaluated	11.1%

Channel Disturbances

A significant number of reaches in the Compass Run subwatershed have moderate debris jams (44.4%). 11.1% of the reaches have infrequent blockages and 33.3% have numerous blockages. Two reaches included culverts (CR-00-02-03 and CR-00-00-02), neither of which have culvert instabilities. CR-00-00-01, CR-00-02-01, CR-00-02-01A have fish blockages due to debris and CR-00-01-01 has a shallow depth of flow, blocking fish passage.

Riparian Characteristics

The majority of this subwatershed's riparian area consists of high-density deciduous overstory with brush/grass understory (55.6% of the left bank and 55.6% of the right bank). The reaches primarily have 50% to 75% canopy cover (44.4% of the reaches) and riparian widths between 150 and 200 feet (66.7% of the reaches). The following tables (21 through 23) present the riparian characteristic data for the Compass Run subwatershed. Lower density vegetation typically occurred when the stream was adjacent to roads, driveways or agricultural fields.

Table 21: Riparian Composition and Density, Compass Run Subwatershed

Riparian Composition	Riparian Density					
	Percent of Reaches Left Bank			Percent of Reaches Right Bank		
	High	Moderate	Low	High	Moderate	Low
Deciduous with Brush/Grass Understory	55.6%	33.3%	0%	55.6%	33.3%	0%
Grass and Forbs	0%	0%	11.1%	0%	0%	11.1%
Total	**55.6%**	**33.3%**	**11.1%**	**55.6%**	**33.3%**	**11.1%**

Table 22: Canopy Cover, Compass Run Subwatershed

Percent Canopy Cover	Percent of Reaches
0-10%	11.1%
10-25%	0%
25-50%	22.2%
50-75%	44.4%
75-100%	22.2%
Total	**100%**

Table 23: Riparian Width, Compass Run Subwatershed

Riparian Width	Percent of Reaches
0-10 feet	0%
10-25 feet	11.1%
25-50 feet	11.1%
50-75 feet	0%
75-100 feet	11.1%
100-150 feet	0%
150-200 feet	66.7%
> 200 feet	0%
Total	**100%**

Habitat Characteristics

The MBSS PHI rating for 77.8% of the Compass Run reaches is fair, and 22.2% of the reaches are rated poor. The fair reaches are mainly limited by a lack of instream habitat and woody debris. Poor reaches are limited by a lack of instream habitat, epifaunal habitat, and woody debris. Fish blockages are present in 44.4% of the reaches: 11.1% are affected by shallow depth of flow, and 33.3% by debris jams.

Subwatershed Deficiencies

Problems within the Compass Run subwatershed included a lack of vertical stability, moderate bank erosion potential, various channel disturbances, fish blockages, and a general lack of instream habitat, epifaunal habitat, and woody debris. Channel disturbances include culverts causing fish passage issues and invasive plants.

Frog Hollow

Frog Hollow has a drainage area of 1.4 square miles and is located in the piedmont physiographic region. It is composed primarily of B type soils and forested lands (43.1%) are the predominant land uses. Cropland (31.89%), low density residential (24.0%) and pasture (2.3%) comprise the remainder of the watershed. The watershed contains approximately 3.2% impervious area. The basin has a relief of 196 feet with an average channel slope of 2.9%.

Twenty-three reaches with a total reach length of 11,092 feet (2.10 miles) were assessed in the Frog Hollow subwatershed. A summary of the reach length statistics is provided in Table 24. Figure 5 shows typical reaches within the watershed.

Table 24: Assessed Reach Length Statistics Frog Hollow

Reach Length Statistics	Reach Length in feet	Reach Length in Miles
Total	11,092	2.10
Minimum	159	0.03
Maximum	854	0.16
Mean	482	0.09
Standard Deviation	210.12	0.04

Figure 5 A & B: FH-00-02-02 upstream and FH-00-06-03 upstream respectively

Existing Condition Summary

Channel Morphology

Of the 23 reaches assessed, 69.6% are perennial streams, 4.3% are intermittent, and 26.1% were ephemeral. Slope breaks were identified as the bankfull indicator in the majority of these reaches (82.6%) and 17.4% were not evaluated.

All reaches were classified with the Rosgen Stream Classification of Natural Rivers. Thirty-nine point one percent of the reaches are B channels. G channels made up 21.7%, C and E were each 17.4% and there were 4.3% F channels. There were no A or D channels.

Cobble (47.8%), gravel (43.5%), and sand (8.7%) channel materials make up the reaches. There were no channels with a silt substrate. Bedrock outcrops were identified in 91.3% of the assessed reaches.

The majority of the reaches have irregular meander patterns (91.3%) and no depositional features (52.2%), which are typical characteristics of B and G channels. Table 25 summarizes the dominant channel morphology characteristics of the Frog Hollow subwatershed.

Table 25: Dominant Channel Morphology Characteristics of the Frog Hollow Subwatershed

Flow Regime	Perennial
Bankfull Indicator	Slope Break
Stream Type	B and G channels
Channel Substrate	Cobble – 91.3% with bedrock outcrops
Meander Pattern	Irregular
Depositional Features	None

Channel Stability

The existing stability of the Frog Hollow subwatershed is predominantly vertically stable (52.2%) and laterally stable (65.2%). The average ratio of unstable to stable stream reaches is 19.1%. The following table lists the existing channel stability characteristics for the Frog Hollow subwatershed.

Table 26: Existing Channel Stability, Frog Hollow Subwatershed

Stability Rating	Percent of Reaches		Average Ratio of Unstable to Stable Stream Banks
	Vertical Stability	Lateral Stability	
Aggrading	0%	0%	19.1%
Degrading	47.8%	34.8%	
Stable	52.2%	65.2%	
Not Evaluated	0%	0%	

Thirty-four point eight percent of the reaches within the Frog Hollow subwatershed are stage I, 39.1% are stage II, 13.0% are stage III, 8.7% are stage IV, and 4.3% are stage V. The average BEHI rating is moderate (58%), as shown in the Table 27.

Table 27: Potential Channel Stability, Frog Hollow Subwatershed

Channel Evolution Stage	Percent of Reaches per Channel Evolution Stage	BEHI Rating	Percent of Reaches per BEHI Rating
Stage I	34.8%	Low	56.5%
Stage II	39.1%	Low to Moderate	13.0%
Stage III	13.0%	Moderate	26.1%
Stage IV	8.7%	Moderate to High	4.3%
Stage V	4.3%	High	0%
Not Evaluated	0%	Not Evaluated	0%

Channel Disturbances

Sixty point nine percent of the Frog Hollow subwatershed reaches evaluated have numerous debris jams. One reach (reach FH-00-03-01) is lined with riprap or gabions, six culverts are present (FH-00-03-03, FH-00-03-01,FH-00-01-01, FH-00-00-04, FH-00-05-02, and FH-00-03-02). A culvert located in reach FH-00-05-02 is causing upstream aggradation and a fish blockage due to shallow depth of flow. The culvert in reach FH-00-03-02 is causing upstream aggradation as well.

Riparian Characteristics

The majority of this subwatershed's riparian area consists of high-density deciduous overstory with brush/grass understory (60.9% of the left bank and 65.2% of the right bank). The reaches primarily have 75% to 100% canopy cover (39.1% of the reaches) and riparian widths between 150 and 200 feet (82.6% of the reaches). The following tables (Tables 28 through 30) present the riparian characteristic data for the Frog Hollow subwatershed.

Table 28: Riparian Composition and Density, Frog Hollow Subwatershed

Riparian Composition	Riparian Density					
	Percent of Reaches Left Bank			Percent of Reaches Right Bank		
	High	Moderate	Low	High	Moderate	Low
Brush	0%	4.3%	0%	0%	4.3%	4.3%
Deciduous Overstory	0%	0%	0%	0%	0%	0%
Deciduous with Brush/Grass Understory	60.9%	26.1%	8.7%	65.2%	17.4%	8.7%
Grass and Forbs	0%	0%	0%	0%	0%	0%
Total	**60.9%**	**30.4%**	**8.7%**	**65.2%**	**21.7%**	**13.0%**

Table 29: Canopy Cover, Frog Hollow Subwatershed

Percent Canopy Cover	Percent of Reaches
0-10%	0%
10-25%	13.0%
25-50%	13.0%
50-75%	34.8%
75-100%	39.1%
Total	**100%**

Table 30: Riparian Width, Frog Hollow Subwatershed

Riparian Width	Percent of Reaches
0-10 feet	0%
10-25 feet	4.3%
25-50 feet	0%
50-75 feet	8.7%
75-100 feet	4.3%
100-150 feet	0%
150-200 feet	82.6%
> 200 feet	0%
Total	**100%**

Habitat Characteristics

The MBSS PHI rating for 4.3% of the Frog Hollow reaches are good, 87.0% are rated fair, and 8.7% of the reaches are rated poor. The habitat is limited by a lack of woody debris as well as lack of optimal instream and epifaunal habitats. Fish blockages are present in 13.0% of the reaches. All are affected by shallow depth of flow.

Subwatershed Deficiencies

Problems within the Frog Hollow subwatershed included a lack of vertical stability, moderate bank erosion potential, various channel disturbances, fish blockages, and a general lack of instream habitat, epifaunal habitat, and woody debris. Channel disturbances include culverts causing fish blockages, and invasive species, as well as a large amount of waste and trash in some locations.

IV. IDENTIFICATION OF REACH NEEDS FOR MANAGEMENT MEASURES

Based on the results of the stream stability assessment, a series of management measures was developed for the Prettyboy watershed. The management measures are a combination of capital improvement projects, community efforts and educational programs.

The data collected during the field surveys was used to determine whether each study reach is in need of specific management measures. Unit costs were developed based on type of project and project components. These unit costs are based on statistics of past projects and experience with stream restoration and water quality retrofit projects in Maryland. Baltimore County DEPRM's stream restoration database was used to compute stream restoration related costs based upon project size.

Management Measures

The scope of the Prettyboy watershed assessment covered headwater streams in local neighborhoods. The focus of this assessment is to identify individual reaches in need of attention and not to combine these reaches into larger projects. As funds become available, DEPRM will be able to use this report and the associated database in order to develop projects based on individual project objectives. Each stream reach was assessed to determine what, if any, management measures were needed.

Management Measure 1: Stream Restoration/Stabilization

High sediment loads and the pollutants they carry create water quality concerns and impair downstream habitat. The assessed streams contain over 1,700 square yards of eroded streambanks. If each of these banks eroded an average of 1 foot per year, unstable streambanks are dumping approximately 565 CY of sediment into downstream channels. In addition, lateral channel migration can threaten utilities and other public infrastructure. Restoration/stabilization is recommended for reaches that are currently experiencing moderate to severe vertical and lateral channel instabilities. Reaches were selected for stream restoration/stabilization based on the following criteria:

- Eroded Area/Reach Length > 2.0
- Unstable to Stable Stream Ratio > 50%
- Identified as in need of stream restoration/stabilization in field

Priority is given to reaches that meet all three criteria. Appendix E shows the reaches in need of stream restoration/stabilization within the Prettyboy subwatersheds. Four reaches did not meet the Eroded Area/Reach Length and Unstable to Stable Stream Ratios, but were field identified as potential reaches based on the severity of localized bank erosion or potential for that erosion to worsen.

Estimated costs are based on the following criteria:

- Unit of measurement = linear foot of stream channel restored
- Assume that projects will be greater than 200 feet long
- Costs exclude land acquisition and access easements

Management Measure 2: Buffer Enhancement

Riparian buffers play an important role in stream stability and water quality. Maintaining adequate stream buffers is important to overall stream health and habitat quality. Many of the reaches assessed have adequate buffer widths as a result of the County's buffer requirements. In some cases, buffer management is in need of improvement. Reaches were selected for buffer enhancement based on the following criteria:

- Grass buffer composition – if the existing stream buffer consisted of grass only, the reach was considered a potential candidate for riparian buffer enhancement
- Buffer width – areas with riparian buffers less than 50 feet were considered candidates for buffer enhancement.
- Identified during field assessment

Estimated costs are based on the following criteria:

- Unit of measurement = linear foot of stream buffer enhancement
- Assume maximum buffer enhancement width of 100 feet
- Costs exclude land acquisition and access easements

Management Measure 3: Bank Plantings

During the field assessment, several reaches were identified that were in need of stream bank plantings. The majority of these reaches have ample stream buffers, but were in need of vegetation to be planted along the stream banks to help provide additional bank stability. All of these stream reaches were identified during the field assessment.

Estimated costs are based on the following criteria:

- Unit of measurement = linear foot of stream bank plantings
- Assume stream bank plantings are needed over 75% of the reach length
- Costs exclude land acquisition and access easements

Management Measure 4: Utility Conflict Resolution

Head cuts and the lateral migration of stream channels often threaten buried utility lines. In other locations, exposed manhole risers are in or adjacent to the stream channel. Unprotected risers have the potential to leak during high flows impacting water quality.

Estimated costs are based on the following criteria:

- Unit of measurement = relocation of each exposed utility line or riser.
- Assume utility line will be protected or relocated outside of the stream channel when possible.
- Costs exclude land acquisition and access easements

There were no utility line or riser conflicts located within the assessed streams during the field inspections.

Management Measure 5: Habitat Enhancement

Habitat throughout the Prettyboy watershed was generally marginal to optimal due to some shallow flows and instream and epifaunal habitat and lack of woody debris. Habitat enhancement projects were considered separately from stream restoration/stabilization. It is anticipated that habitat enhancement measures will be incorporated into the stream restoration/stabilization design when possible. All of the streams were assessed for habitat enhancement and three stream reaches were identified as potential habitat enhancement sites. All of the reaches identified have poor or fair MBSS PHI ratings and fish blockages.

The stream reaches were prioritized based on the following criteria:

- Perennial streams with otherwise good channel stability received the highest ranking
- Streams not recommended for channel stabilization were given higher priority than projects in need of bank stabilization.
- Ephemeral and intermittent streams received very low priority due to the lack on year round streamflow.

Estimated costs are based on the following criteria:

- Unit of measurement = linear foot of enhancement
- Costs exclude land acquisition and access easements

Management Measure 6: Trash Cleanup

Stream cleanups are a simple, community based practice that enhances the appearance of the stream corridor by removing trash, litter and debris. Local community groups such as schools, churches and neighborhood associations are great sources for regular cleanup volunteers. It is recommended that annual or semi-annual stream cleanups be initiated at the identified stream reaches.

One reach was in need of a large amount of trash cleanup. Reaches shall be selected for trash cleanup based on the following criteria:

- Identification during field assessment

Traditional trash clean cost estimates are based on the following criteria:

- Volunteers will remove trash from stream channel on an annual/semi annual basis
- County will supply materials such as gloves, trash bags, etc. to residents who volunteer to clean up their stream corridor.
- County maintenance department will need to remove all trash collected from the site

However, the amount of trash being dumped in FH-00-05-01 is excessive and is beyond the capacity for traditional trash cleanup. It consists of pieces of concrete, household appliances, large woody debris, etc. The adjacent property owner stated that material has been dumped in the channel to "stabilize" it. Due to the extensive erosion found in the channel, the debris removal should accompany stream stabilization.

Management Measure 7: Yard Waste Cleanup

Due to the close proximity of many of the headwater streams to neighborhood homes and businesses, yard waste was found in one stream channel. Excessive dumping of lawn clippings and leaves into the stream channel can damage sensitive habitats and introduce pollutants such as fertilizers and other chemicals directly into the stream system. Local residents need to be educated on the proper way to dispose of yard waste in and around their property. No reaches were in need of traditional yard waste cleanup. Reaches shall be selected for trash cleanup based on the following criteria:

- Identification during field assessment

Estimated costs are based on the following criteria:

- County will supply educational materials to residents along the stream corridor.

FH-00-05-01 has been listed for excessive yard waste. The majority of this material consists of large woody debris such a tree trunks and large limbs. The extent of the debris is not appropriate

for a community cleanup. Due to the extensive erosion found in the channel, the debris removal should accompany stream stabilization.

Management Measure 8: Invasive Plant Removal

Invasive species were found in several reaches although it was not one of the parameters specifically identified in the field assessment. Because these species spread rapidly and take over the native species along the stream channel, reaches with excessive growth were noted in the comments section of the report. Several of the reaches are already recommended for other enhancements or restoration. In these cases, the invasives should be removed as part of the other enhancements.

Reach Needs Identification

Projects were identified based on the rating characteristics established in the above minimum measures. The results of the field assessment and the photographs were used to confirm the project identification methodologies. Appendix E contains list all the potential reaches for each of the eight management measures.

A sampling of potential project reaches area included below:

FH-00-03-02: The stream channel is migrating towards Parsonage Road. There is an unassessed parcel between this segment and Laurel Ridge road that is in similar condition. This segment is easily accessible and has the second highest Eroded Area/Reach Length ratio (4.76) and the highest Unstable to Stable Stream Ratio (87%). Refer to Figure 6 for photo.

FH-00-08-03: This segment has the highest Eroded Area/Reach Legth ratio (5.92) and the second highest Unstable to Stable Stream Ratio (85%). The reach is a steep gully, Rosgen G type channel. Access to this segment is very poor and through a relatively steep, densely wooded area.

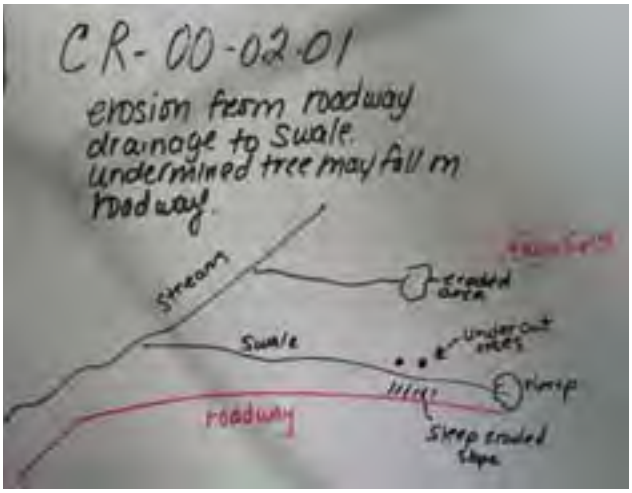
FH-00-03-03: This segment drains a residential area on the south

side of Parsonage Oak road. The area was noted as a stormwater management facility but there is no defined stormwater management pond. The upper portion of the reach consists of a series of eroded gullies. Refer to Figure 6 for more details. A spring seep occurs in the lower portion of the reach. The segment at the lower end of the reach is shown in Figure 8. The downstream reaches of this stream channel are exhibiting erosion, particularly near Parsonage Road. Improving stormwater management in this section could take some of the stress off the lower stream reaches.

Figures 7A, B & C: Eroded SWM areas in upstream reach of FH-00-03-03.

Figure 8: Lower end of FH-00-03-03, downstream from spring seep.

CR-00-02-01: While there is some erosion in this reach, the primary problem at this location is due to roadway drainage from Gunpowder road and an adjacent farm field. Both the farm field and the road have created two separate eroded ditches that drain directly to CR-00-02-01. The roadway drainage drains down a steep embankment and is undermining several large trees. As the erosion continues, the stability of these trees will be threatened and there is the potential for them to fall onto Gunpowder road.



Figures 9A & B: Field sketch of erosion problem and roadway drainage ditch.

FH-00-06-01, 02 and 03: This series of reaches is experiencing head cuts and severe, localized erosion. While the unstable to stable stream ratio is not greater than 50%, there are several locations with substantial eroded banks. The bank erosion is the greatest at the downstream reach FH-00-06-01 but it is continuing to work its way upstream past FH-00-06-03. Figure 10 shows some of the severely eroded banks. The entire stream corridor is wooded, but could be accessed via a trial off Hedricks Court.

Figure 10: Erosion at FH-00-06-01 and FH-00-06-03 respectively.

Reach Cost Estimates

A generalized cost was determined for each proposed enhancement type. Table 31 summarizes the cost per individual management measure. The summation of management measure costs plus maintenance costs will become the total project cost for the individual reach. Cost estimates are in annualized format and include initial capital construction costs. Cost estimates are based

on planning level design & construction cost-curves or other unit cost relationships and do not include land acquisition. Appendix E details the total and annualized project costs per project.

Table 31: Reach Unit Costs

Management Measure	Measurement Unit	Constraints	Unit Cost
Stream restoration/stabilization	Linear Foot per Reach Length	> 800 feet long	$225
		400 to 800 feet long	$300
		< 400 feet long	$400
Buffer Enhancement	Lump Sum Cost based on Reach Length (100' width)	> 800 feet long	$50,000
		400 to 800 feet long	$25,000
		< 400 feet long	$10,000
Bank Plantings	Lump Sum Cost based on Reach Length	> 800 feet long	$10,000
		400 to 800 feet long	$7,500
		< 400 feet long	$5,000
Utility Conflict Resolution	Each	Relocate utility outside stream channel or protect	$25,000
Habitat Enhancement	Lump Sum Cost based on Reach Length	> 800 feet long	$60,000
		400 to 800 feet long	$40,000
		< 400 feet long	$20,000
Trash Cleanup – traditional trash cleanup only	LS per Reach	Per Year	$500
Yard Waste Removal – tradition yard waste cleanup only	LS per Reach	Per Year	$500
Invasive Plant Removal	Lump Sum based on Reach Length	> 800 feet long	$10,000
		400 to 800 feet long	$7,500
		< 400 feet long	$5,000

V. REACH IMPROVEMENT BENEFITS

Based on the assessment of the reaches and application of management measures, a total of 18 reaches have been recommended for enhancement. Frog Hollow has the largest number of recommended reach enhancements (12), and Compass Run (6**)**. Table 32 provides a breakdown of project types recommended throughout the Prettyboy watershed. The total estimated cost for the 18 reach enhancements is $1.85 million.

Table 32: Recommended projects by management measure

Management Measure	No. of Recommended Reaches	Project Benefits
Stream restoration/stabilization	11 (3 CR, 8 FH)	0.90 miles (0.26 mi CR, 0.64 FH mi)
Buffer Enhancement	4 (2 CR, 2 FH)	0.31 miles (0.11 mi CR, 0.20 mi FH)
Bank Plantings	5 (1 CR, 4 FH)	0.41 miles (0.06 mi CR, 0.35 mi FH)
Utility Conflict Resolution	0	N/A
Habitat Enhancement	3 (1 CR, 2 FH)	0.28 miles (0.06 mi CR, 0.22 mi FH)
Trash Cleanup	0	N/A
Yard Waste Removal	0	N/A
Invasive Plant Removal	5 (2 CR, 3 FH)	0.52 (0.18 mi CR, 0.34 mi FH)

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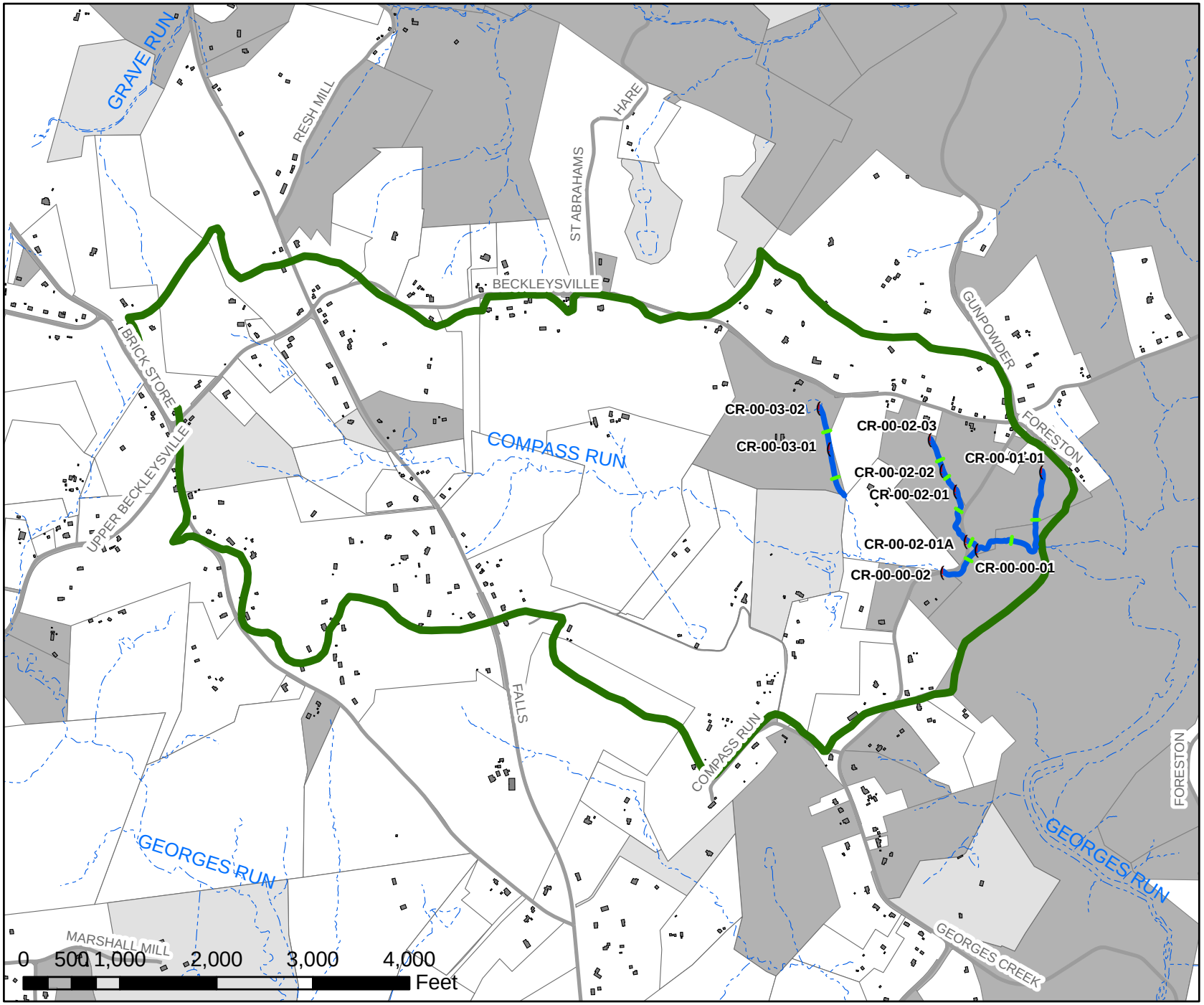
APPENDIX A

- Reach ID Maps



Legend

Assessed Streams

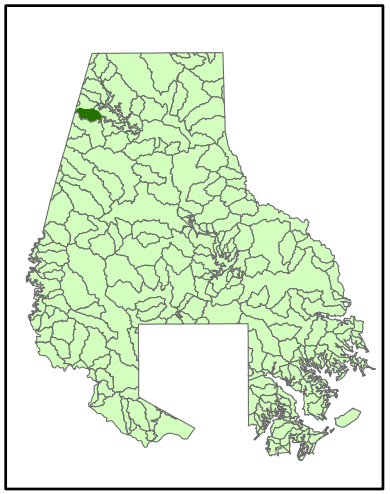
- Y
- Compass Run Reachbreaks
- Compass Run X-sect

SUBSHED

- Compass Run
- Stream Network
- CLine
- Buildings

Property Access

- No Reply
- N
- Y

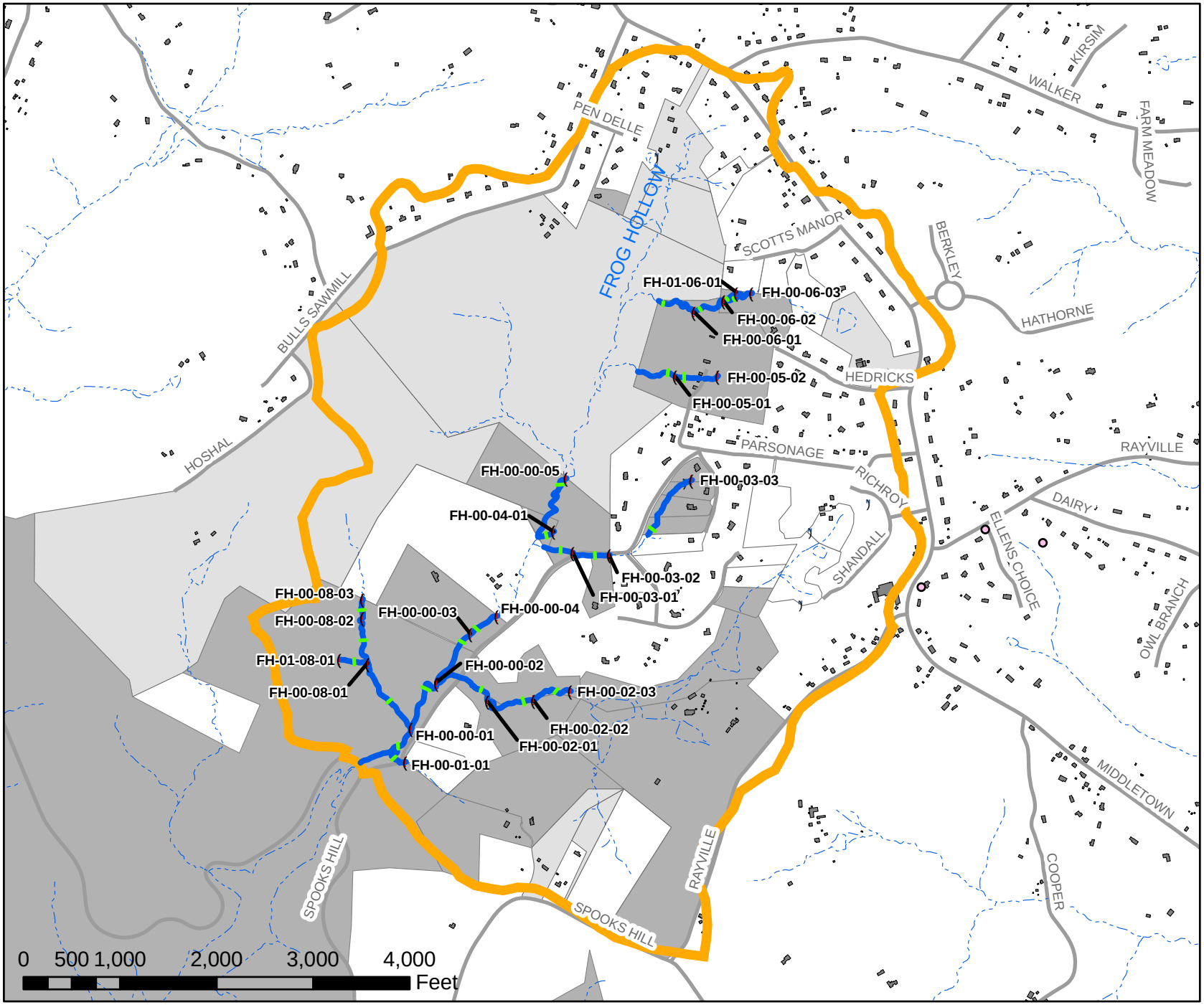


PRETTYBOY RESERVOIR
STREAM STABILITY ASSESSMENT

Subwatershed Map - Compass Run

Date:
June 2006

Figure



Legend

Assessed Streams

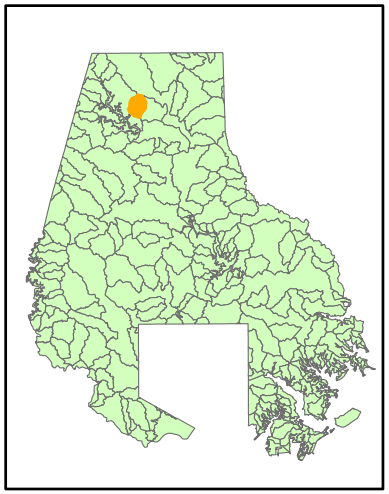
- Y
- Frog Hollow Reachbreaks
- Frog Hollow X-sect

SUBSHED

- Frog Hollow
- Stream Network
- CLine
- Buildings

Property Access

- No Reply
- N
- Y



PRETTYBOY RESERVOIR
STREAM STABILITY ASSESSMENT

Subwatershed Map - Frog Hollow

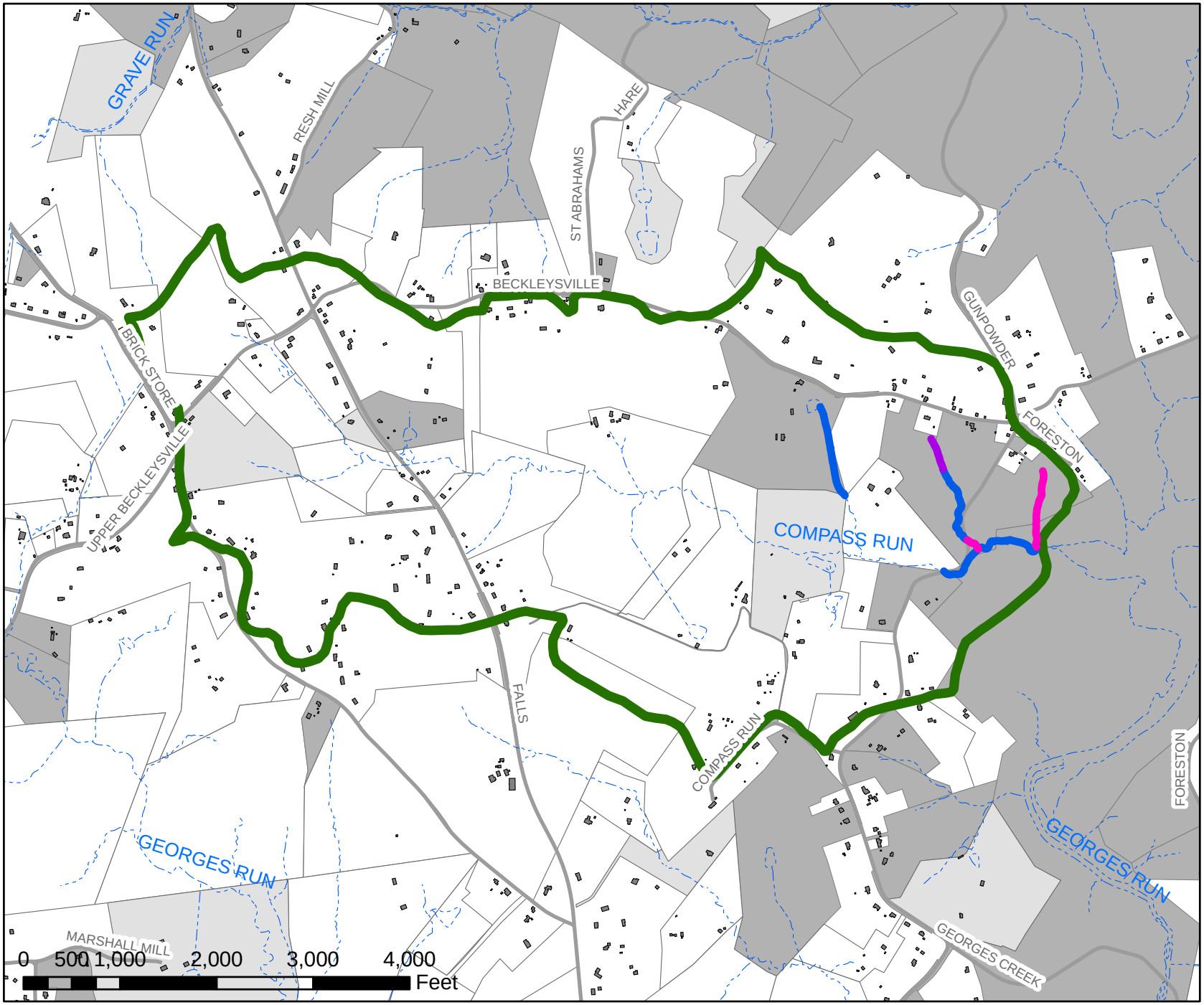
Date:
June 2006

Figure

APPENDIX B

Assessment Maps

- Channel Succession
- Channel Evolution
- BEHI Ranking
- Rosgen Classification
- Fish Blockage



Legend

Compass Run Assessed Streams

Succession

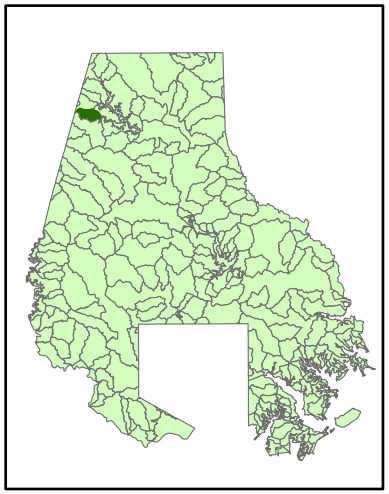
- 6
- 7
- Other

SUBSHED

- Compass Run
- Stream Network
- CLine
- Buildings

Property Access

- No Reply
- N
- Y

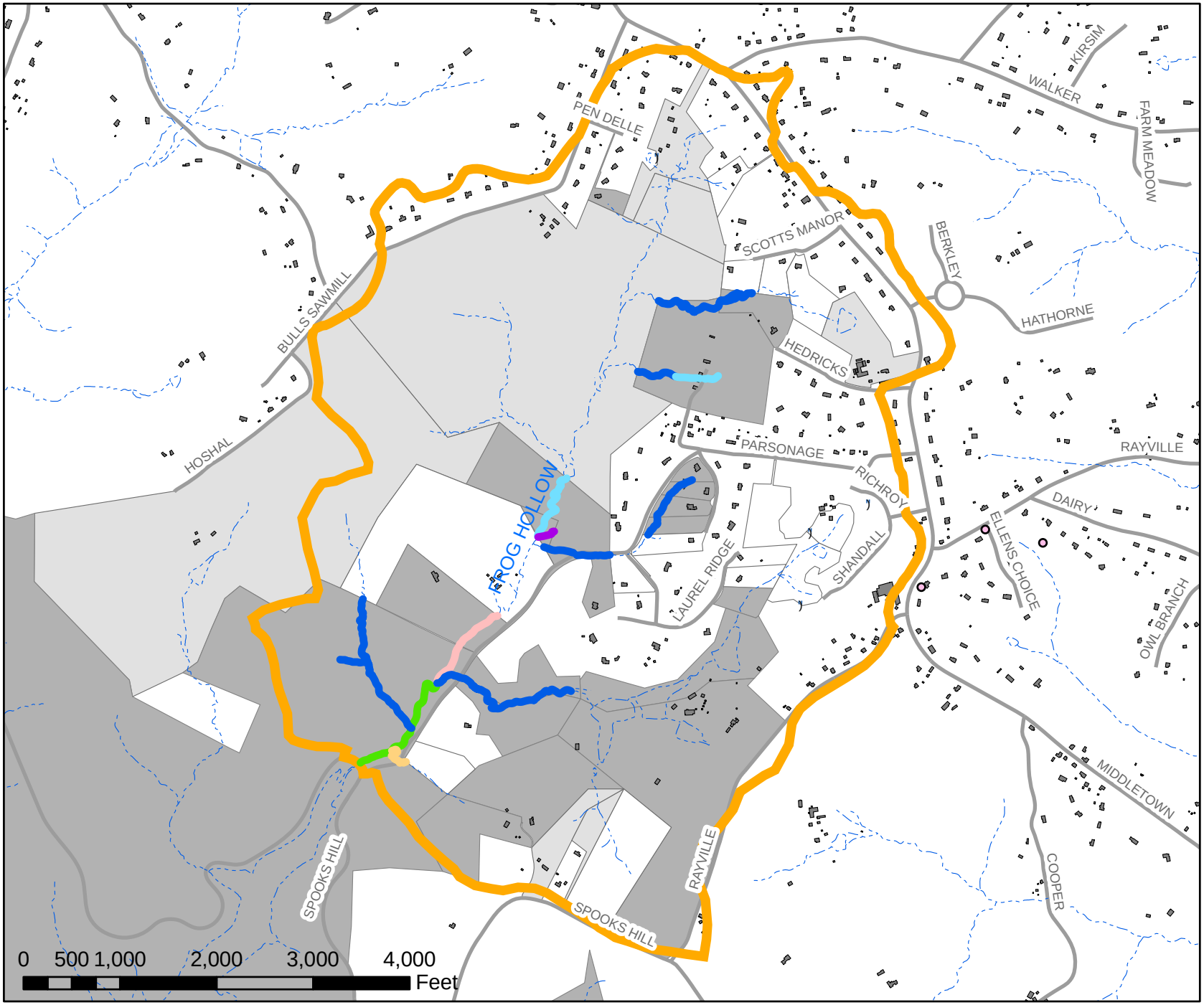


PRETTYBOY RESERVOIR
STREAM STABILITY ASSESSMENT

Succession - Compass Run

Date:
June 2006

Figure



Legend

Frog Hollow Assessed Streams

Succession

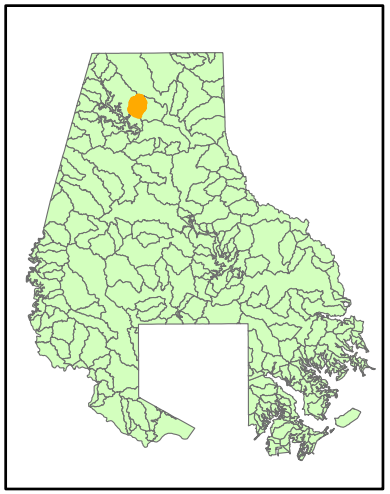
- 1
- 2
- 4
- 5
- 6
- 7

SUBSHED

- Frog Hollow
- Stream Network
- CLine
- Buildings

Property Access

- No Reply
- N
- Y

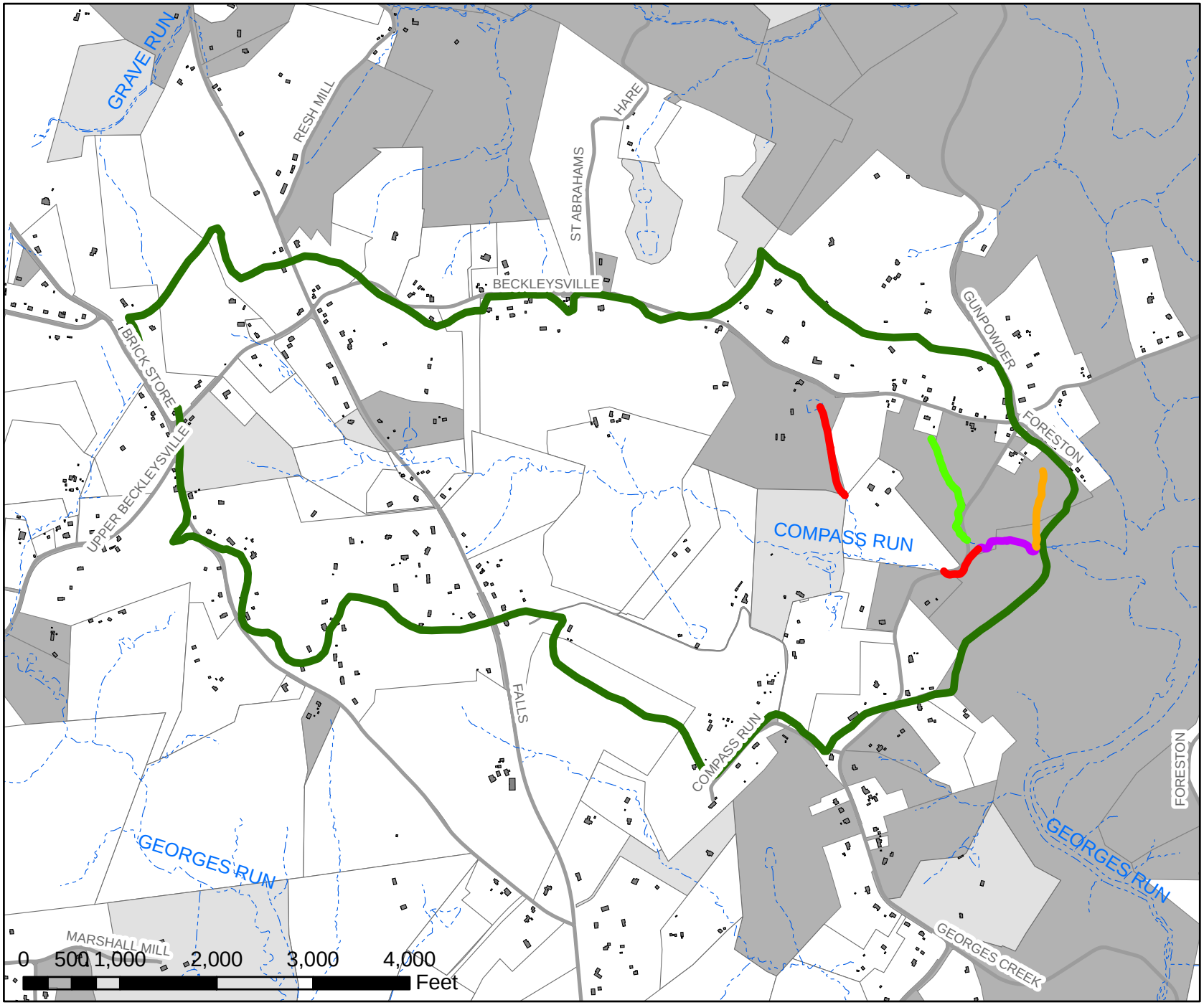


PRETTYBOY RESERVOIR
STREAM STABILITY ASSESSMENT

Succession - Frog Hollow

Date:
June 2006

Figure



Legend

Compass Run Assessed Streams

Channel Evolution

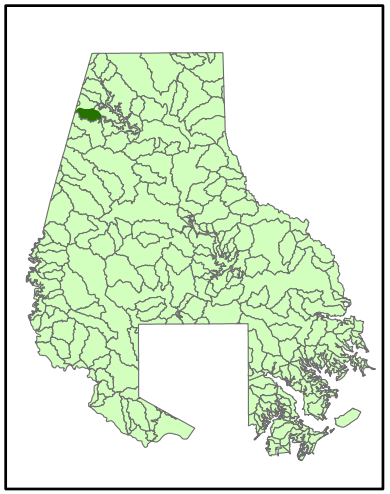
- Stage I
- Stage II
- Stage III
- Stage V

SUBSHED

- Compass Run
- Stream Network
- CLine
- Buildings

Property Access

- No Reply
- N
- Y

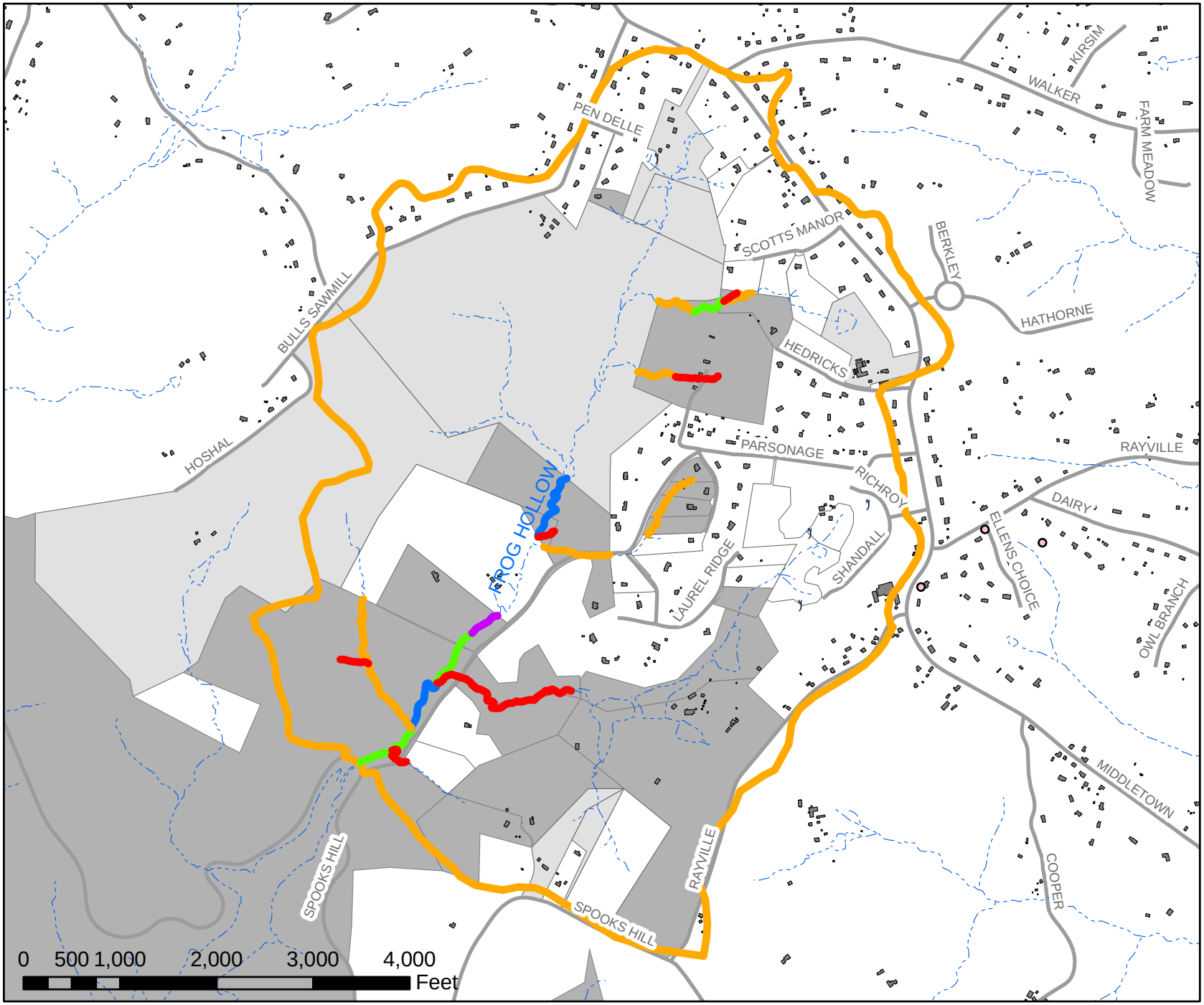


PRETTYBOY RESERVOIR
STREAM STABILITY ASSESSMENT

Channel Evolution - Compass Run

Date:
June 2006

Figure



Legend

Frog Hollow Assessed Streams

Channel Evolution

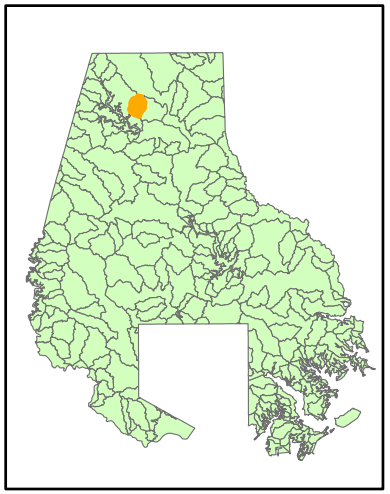
- Stage I
- Stage II
- Stage III
- Stage IV
- Stage V

SUBSHED

- Frog Hollow
- Stream Network
- CLine
- Buildings

Property Access

- No Reply
- N
- Y

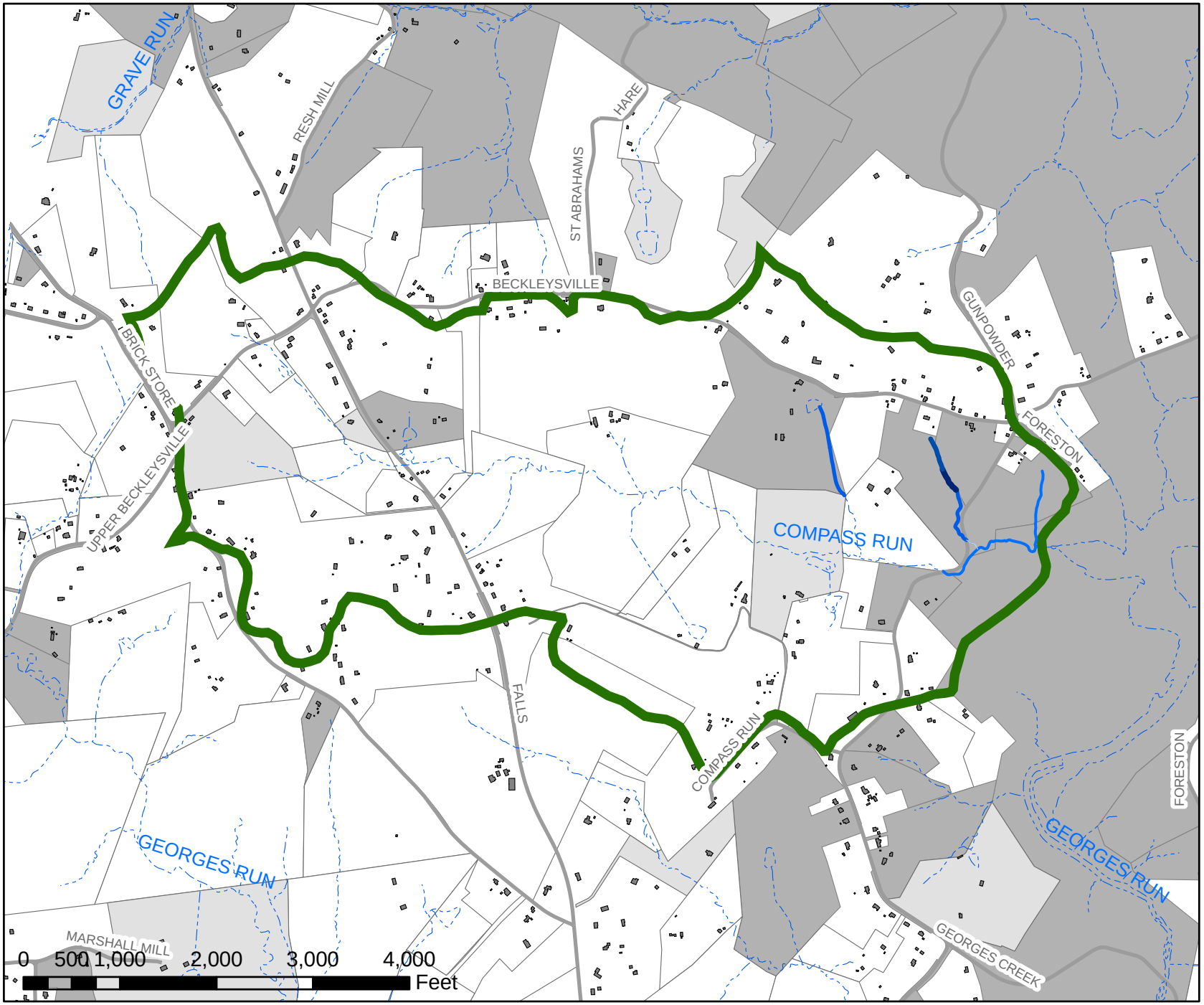


PRETTYBOY RESERVOIR
STREAM STABILITY ASSESSMENT

Channel Evolution - Frog Hollow

Date:
June 2006

Figure



Legend

Compass Run Assessed Streams

BEHI Score

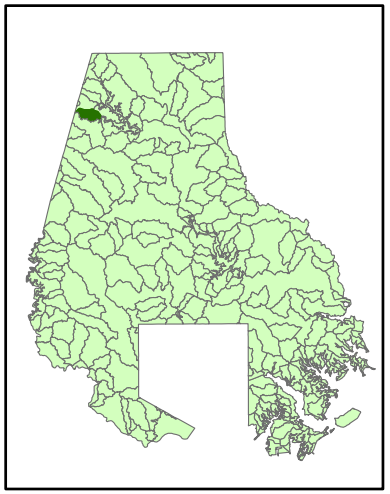
- 0
- 7
- 8
- 9
- 11

SUBSHED

- Compass Run
- Stream Network
- CLine
- Buildings

Property Access

- No Reply
- N
- Y

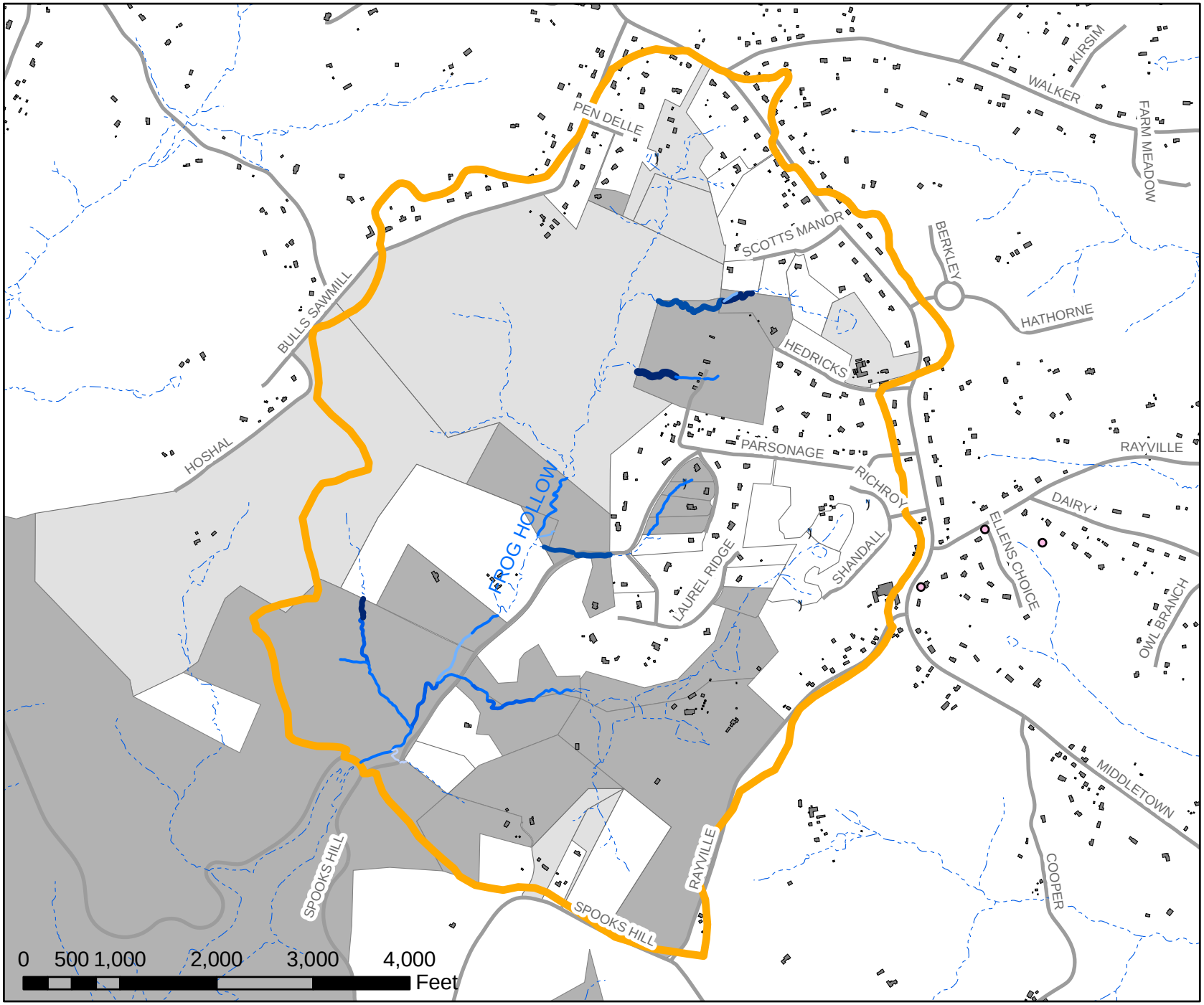


PRETTYBOY RESERVOIR
STREAM STABILITY ASSESSMENT

BEHI Score - Compass Run

Date:
June 2006

Figure



Legend

Frog Hollow Assessed Streams

BEHI Score

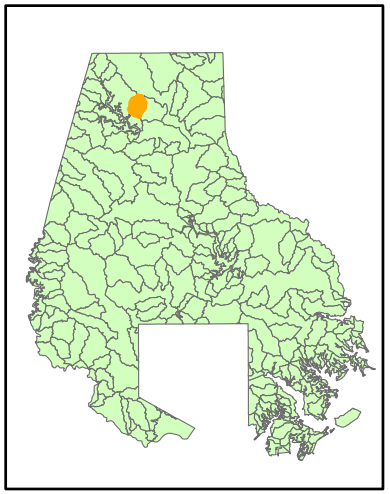
- 4
- 5
- 6
- 7
- 8
- 9
- 10
- 11
- 12

SUBSHED

- Frog Hollow
- Stream Network
- CLine
- Buildings

Property Access

- No Reply
- N
- Y

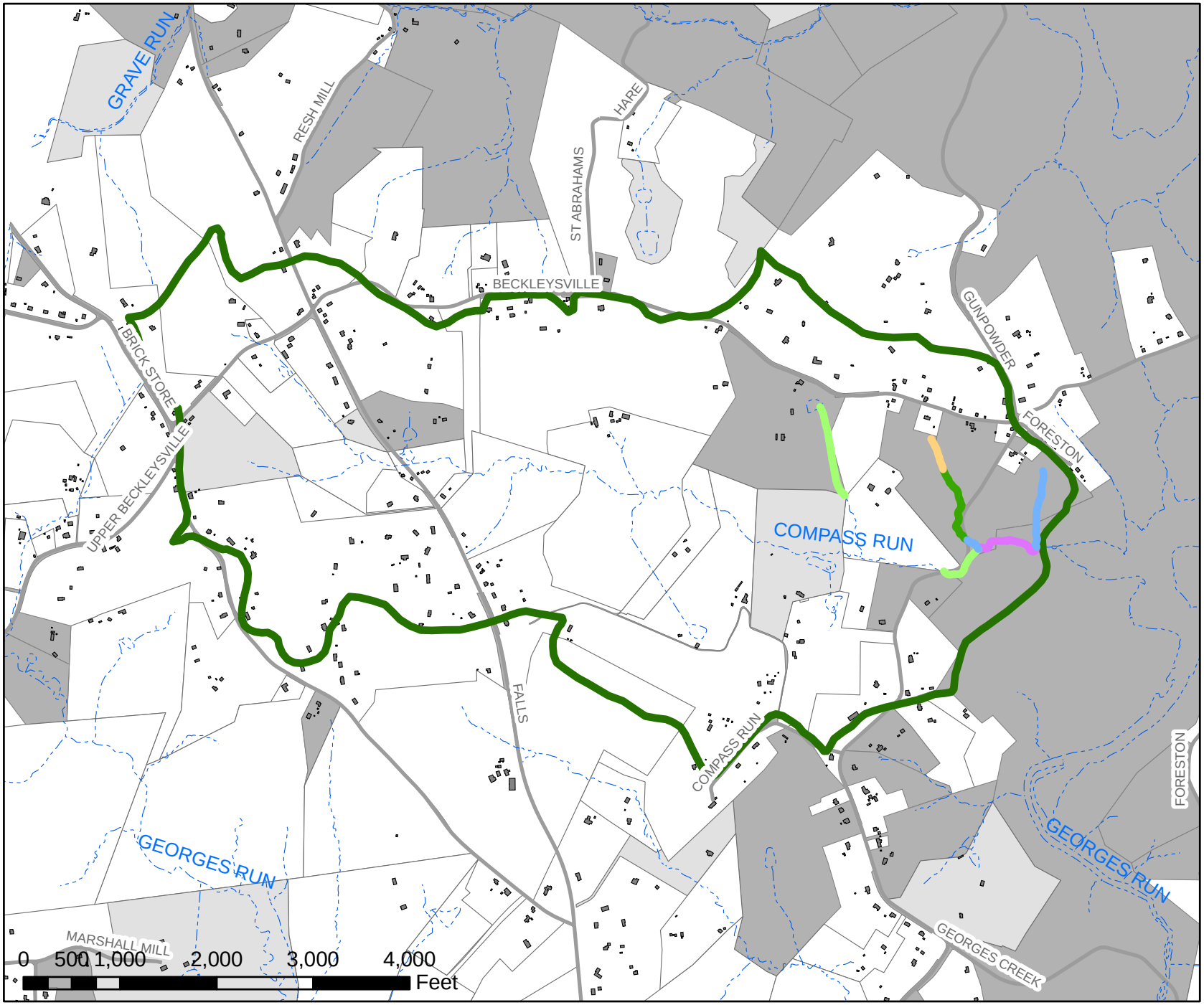


PRETTYBOY RESERVOIR
STREAM STABILITY ASSESSMENT

BEHI Score - Frog Hollow

Date:
June 2006

Figure



Legend

Compass Run Assessed Streams

Rosgen Classification

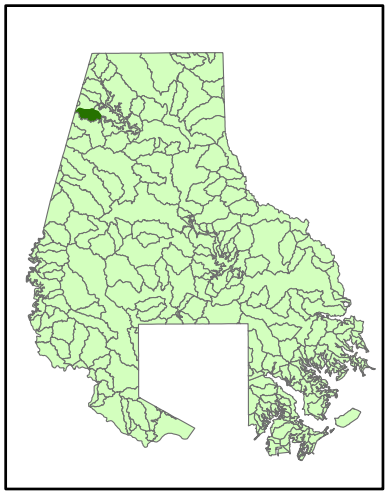
- A
- B
- E
- F
- G

SUBSHED

- Compass Run
- Stream Network
- CLine
- Buildings

Property Access

- No Reply
- N
- Y

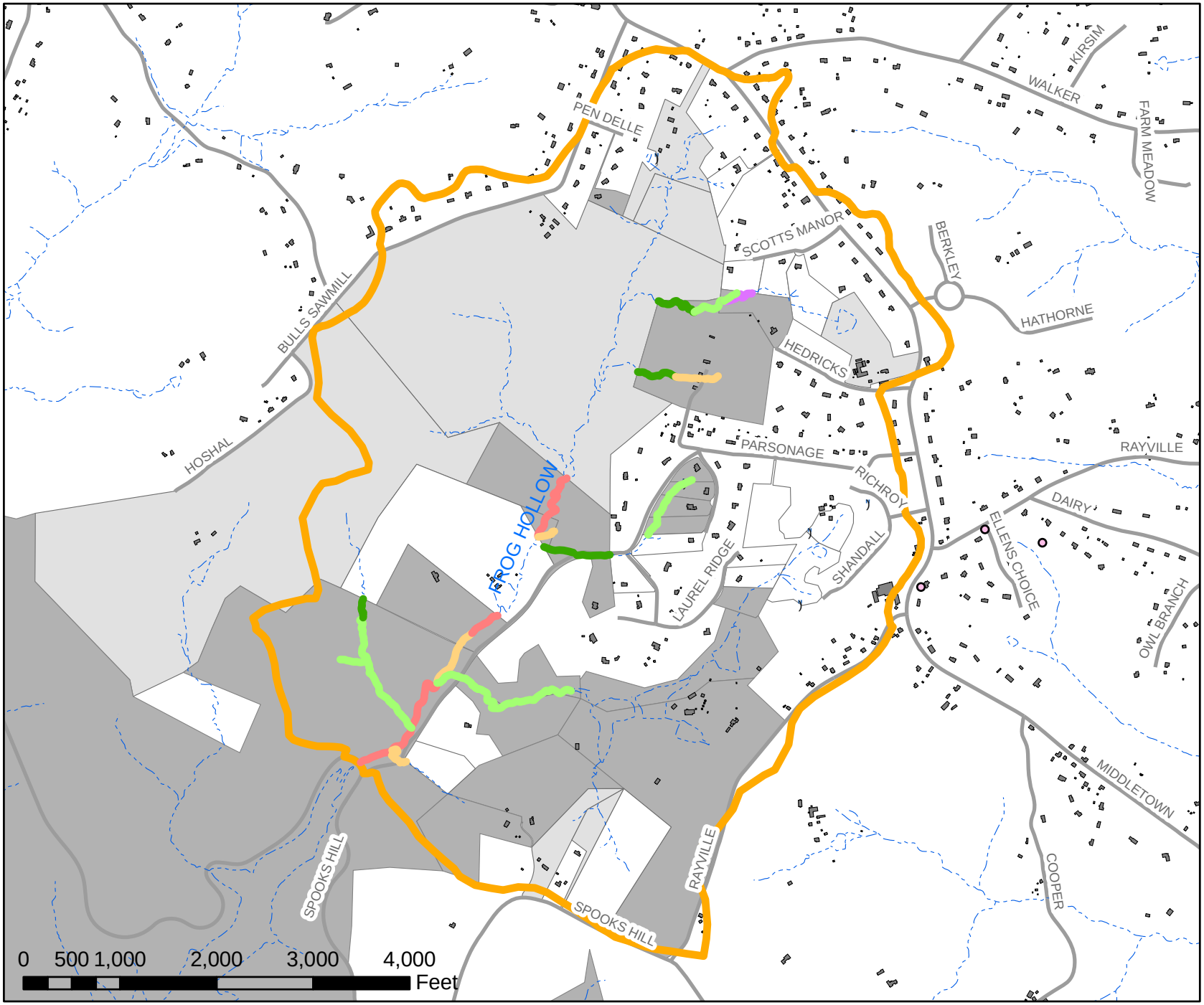


PRETTYBOY RESERVOIR
STREAM STABILITY ASSESSMENT

Rosgen Classification - Compass Run

Date:
June 2006

Figure



Legend

Frog Hollow Assessed Streams

Rosgen Classification

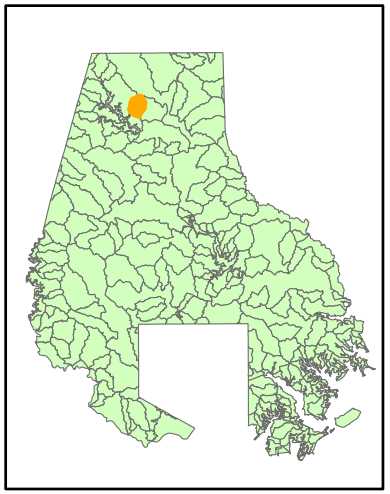
- B
- C
- E
- F
- G

SUBSHED

- Frog Hollow
- Stream Network
- CLine
- Buildings

Property Access

- No Reply
- N
- Y

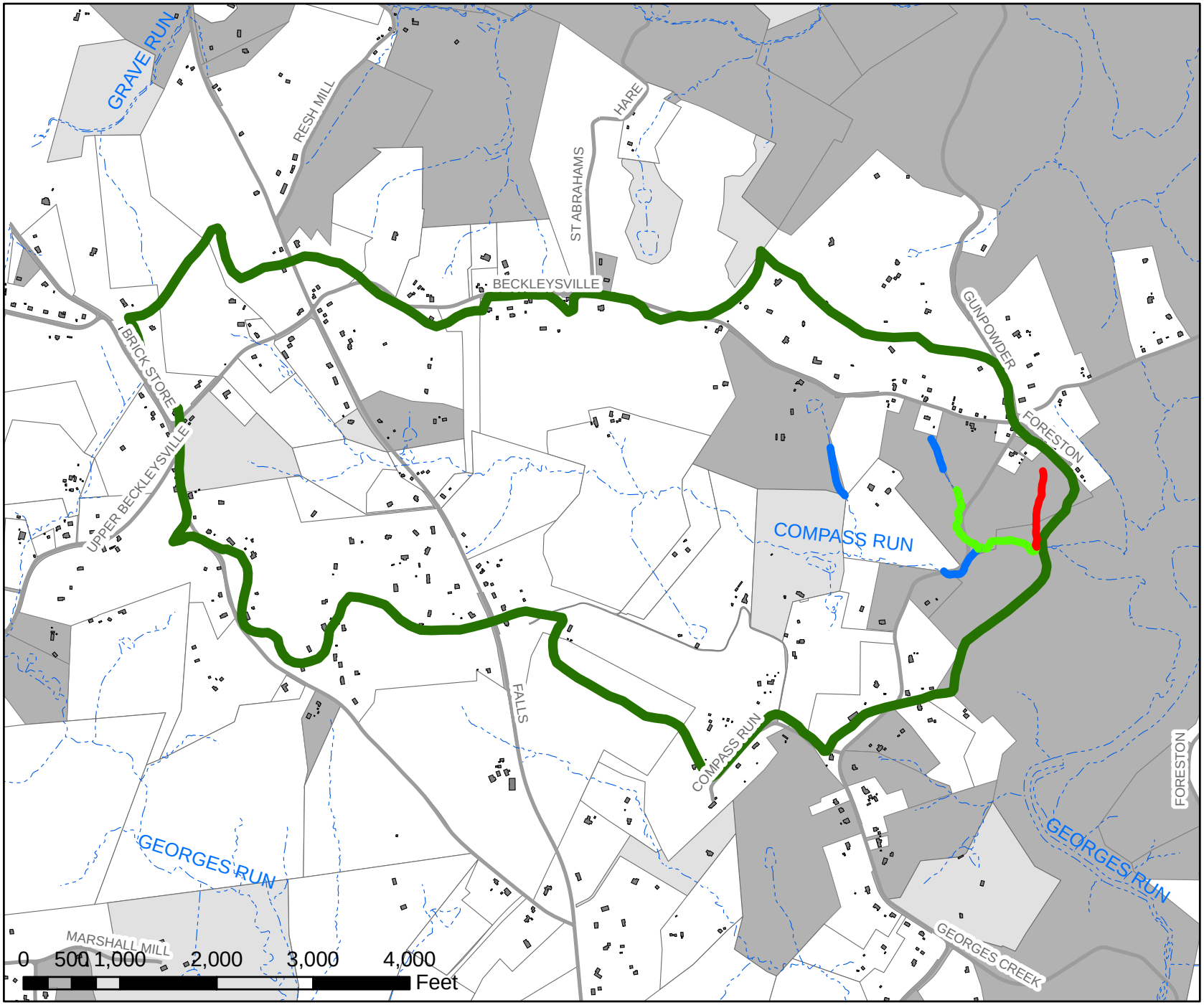


PRETTYBOY RESERVOIR
STREAM STABILITY ASSESSMENT

Rosgen Classification - Frog Hollow

Date:
June 2006

Figure



Legend

Compass Run Assessed Streams

Fish Blockage

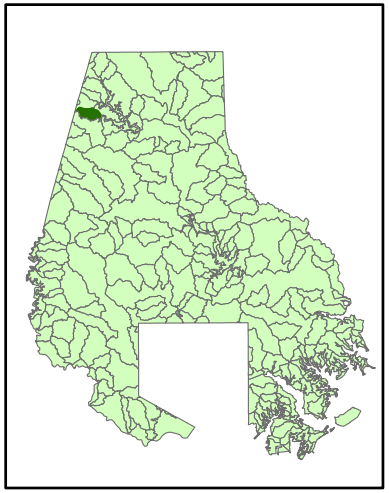
- Shallow Depth of Flow
- Debris Blockage
- None

SUBSHED

- Compass Run
- Stream Network
- CLine
- Buildings

Property Access

- No Reply
- N
- Y

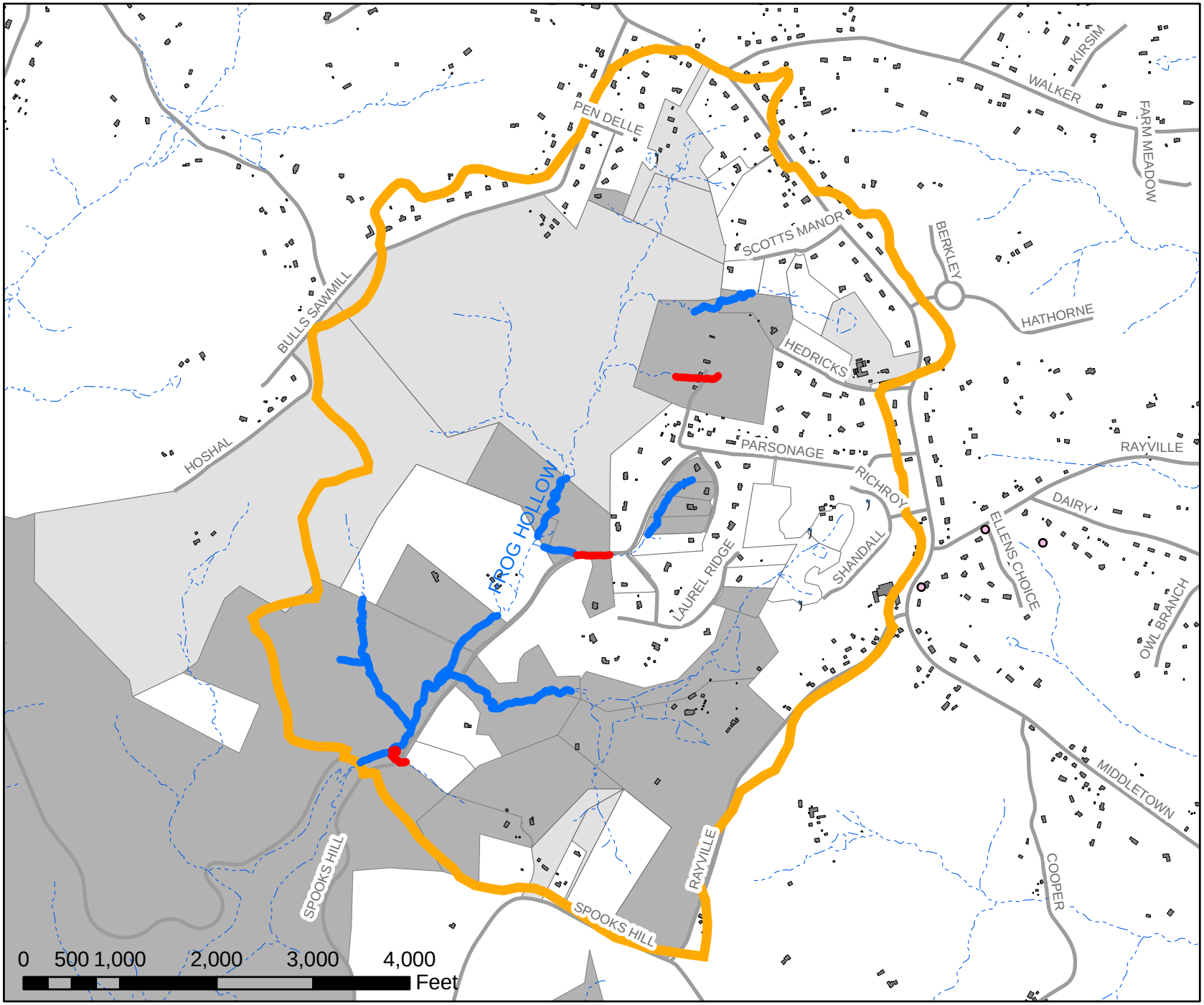


PRETTYBOY RESERVOIR
STREAM STABILITY ASSESSMENT

Fish Blockage - Compass Run

Date:
June 2006

Figure



Legend

Frog Hollow Assessed Streams

Fish Blockage

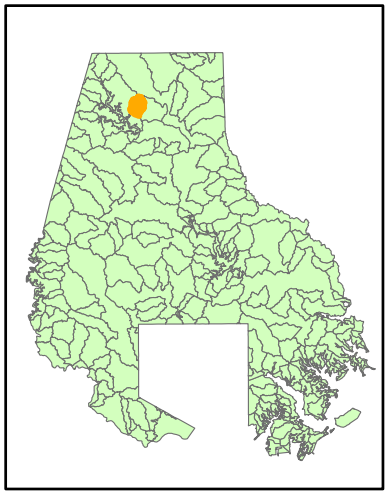
- Shallow Depth of Flow
- None

SUBSHED

- Frog Hollow
- Stream Network
- CLine
- Buildings

Property Access

- No Reply
- N
- Y



PRETTYBOY RESERVOIR
STREAM STABILITY ASSESSMENT

Fish Blockage - Frog Hollow

Date:
June 2006

Figure

APPENDIX C

- Database

Pretty Reservoir Subwatershed Stream Stability Assessment
Compass Run Frog Hollow

Reach	Length	Subshed	Team	Date	FlowRegime	Bankfull Depth	Max Bankfull Depth	Sinuosity	Meander Pattern	Depositional Features	Channel Stability V	Channel Stability L	Left Unstable Bank Length	Left Unstable Bank Height	Right Unstable Bank Length	Unstable-Stable Ratio	Right Unstable Bank Height	Bank Bankfull Ratio	Bank Angle	Bank Material
CR-00-00-01	738	Compass Run	keb / mt	5/10/2006 11:22	Perennial	1.1	1.5	Low, 1.0 to 1.2	M3, Irregular	B4, Side Bars	Stable	Stable	150	2.5	30	12.20%	2	Med, BF in Upper 1/2 of Bank	Med, Nearly Vertical	None
CR-00-00-02	508	Compass Run	keb / mt	5/10/2006 8:30	Perennial	1.1	1.4	Low, 1.0 to 1.2	M3, Irregular	B1, Point Bars	Stable	Stable	80	3.5	200	27.56%	4	High, BF Lower 1/2 of Bank	Med, Nearly Vertical	None
CR-00-01-01	808	Compass Run	keb / mt	5/10/2006 10:39	Ephemeral	0.9	1.1	Low, 1.0 to 1.2	M3, Irregular	None	Degrading	Stable	0	0	0	0.00%	0	High, BF Lower 1/2 of Bank	Med, Nearly Vertical	None
CR-00-02-01	602	Compass Run	kb/mt	5/10/2006 13:30	Perennial	1.2	1.5	Low, 1.0 to 1.2	M1, Regular	B4, Side Bars	Stable	Degrading	40	5	85	10.38%	4.5	High, BF Lower 1/2 of Bank	Med, Nearly Vertical	None
CR-00-02-010	157	Compass Run	keb / mt	5/10/2006 12:38	Perennial	0.5	0.9	Moderate, 1.2 to 1.5	M3, Irregular	None	Stable	Stable	0	0	0	0.00%	0			
CR-00-02-02	262	Compass Run	kb/mt	5/10/2006 14:56		1.3	1.5	Low, 1.0 to 1.2	M1, Regular	B4, Side Bars	Stable	Stable	100	3	100	38.17%	2.5	High, BF Lower 1/2 of Bank	Med, Nearly Vertical	None
CR-00-02-03	342	Compass Run	kb/mt	5/10/2006 14:34	Ephemeral	1.3	1.95	Low, 1.0 to 1.2	M1, Regular	None	Stable	Stable	30	2	75	15.35%	2	Low, BF at Top of Bank	Med, Nearly Vertical	None
CR-00-03-01	533	Compass Run	av/mt	6/9/2006 9:41	Perennial	0.8	0.9	Low, 1.0 to 1.2	M3, Irregular	None	Stable	Stable	0	0	0	0.00%	0	Med, BF in Upper 1/2 of Bank	Med, Nearly Vertical	None
CR-00-03-02	437	Compass Run	av/mt	6/9/2006 10:00	Perennial	0.5	0.6	Low, 1.0 to 1.2	M3, Irregular	None	Stable	Stable	0	0	0	0.00%	0	Med, BF in Upper 1/2 of Bank	Med, Nearly Vertical	None
FH-00-00-01	691	Frog Hollow	kb/mt	5/17/2006 9:15	Perennial	1.3	1.6	Low, 1.0 to 1.2	M3, Irregular	B1, Point Bars	Stable	Stable	150	2.5	80	16.64%	2.5	Med, BF in Upper 1/2 of Bank	Med, Nearly Vertical	None
FH-00-00-02	678	Frog Hollow	kb/mt	5/17/2006 10:16	Perennial	1	1.6	Low, 1.0 to 1.2	M3, Irregular	B1, Point Bars	Stable	Stable	75	2.5	100	12.91%	2.3	Med, BF in Upper 1/2 of Bank	Med, Nearly Vertical	None
FH-00-00-03	647	Frog Hollow	kb/mt	5/17/2006 11:46	Perennial	1.3	1.6	Low, 1.0 to 1.2	M3, Irregular	B1, Point Bars	Stable	Stable	100	4	40	10.82%	1.5	Low, BF at Top of Bank	Med, Nearly Vertical	None
FH-00-00-04	332	Frog Hollow	kb/mt	5/17/2006 12:07	Perennial	1.2	91.3	Low, 1.0 to 1.2	M3, Irregular	B1, Point Bars	Stable	Stable	75	1.5	100	26.36%	1.5	Low, BF at Top of Bank	Med, Nearly Vertical	None
FH-00-00-05	845	Frog Hollow	kb/mt	5/31/2006 8:12	Perennial	0.8	1.9	High, >1.5	M3, Irregular	B1, Point Bars	Degrading	Stable	115	3.5	150	15.68%	3.75	Med, BF in Upper 1/2 of Bank	Low, Sloping Away From Stream	None
FH-00-01-01	309	Frog Hollow	kb/mt	5/23/2006 13:59	Ephemeral	0	0		M3, Irregular	None	Stable	Stable	0	0	0	0.00%	0	Low, BF at Top of Bank	Low, Sloping Away From Stream	None
FH-00-02-01	685	Frog Hollow	kb/mt	5/23/2006 10:41	Perennial	1.3	1.5	Low, 1.0 to 1.2	M3, Irregular	None	Stable	Stable	0	0	0	0.00%	0	Med, BF in Upper 1/2 of Bank	Med, Nearly Vertical	None
FH-00-02-02	643	Frog Hollow	kb/mt	5/23/2006 11:57	Perennial	1.4	1.6	Low, 1.0 to 1.2	M3, Irregular	B4, Side Bars	Stable	Stable	50	2	65	8.94%	6	Med, BF in Upper 1/2 of Bank	Med, Nearly Vertical	None
FH-00-02-03	459	Frog Hollow	kb/mt	5/23/2006 12:10	Perennial	1	1.25	Low, 1.0 to 1.2	M3, Irregular	B4, Side Bars	Stable	Stable	80	2.5	55	14.71%	3	Med, BF in Upper 1/2 of Bank	Med, Nearly Vertical	None
FH-00-03-01	314	Frog Hollow	kb/mt	5/31/2006 8:02	Perennial	1	1.3	Low, 1.0 to 1.2	M3, Irregular	None	Degrading	Stable	100	3	50	23.89%	1.5	High, BF Lower 1/2 of Bank	Med, Nearly Vertical	None
FH-00-03-02	345	Frog Hollow	kb/mt	5/17/2006 12:19	Perennial	1.4	1.6	Low, 1.0 to 1.2	M3, Irregular	None	Degrading	Degrading	300	2.5	300	86.96%	3	High, BF Lower 1/2 of Bank	High, Undercut Sloping to Strm	None
FH-00-03-03	785	Frog Hollow	kb/mt	5/23/2006 14:40	Ephemeral	0.65	0.8	Low, 1.0 to 1.2	M3, Irregular	None	Degrading	Degrading	500	2.5	500	63.69%	2.5	Med, BF in Upper 1/2 of Bank	Med, Nearly Vertical	None
FH-00-04-01	190	Frog Hollow	kb/mt	5/31/2006 9:06	Ephemeral	0.65	0.75	Low, 1.0 to 1.2	M3, Irregular	None	Stable	Stable	0	0	0	0.00%	0	Low, BF at Top of Bank	Med, Nearly Vertical	None
FH-00-05-01	434	Frog Hollow	kb/mt	5/23/2006 14:51	Intermittent	0	0		M3, Irregular	None	Degrading	Degrading	0	0	0	0.00%	0	High, BF Lower 1/2 of Bank	High, Undercut Sloping to Strm	None
FH-00-05-02	406	Frog Hollow	kb/mt	5/17/2006 14:06	Ephemeral	0.6	0.6	Low, 1.0 to 1.2	M3, Irregular	None	Stable	Stable	0	0	0	0.00%	0	Low, BF at Top of Bank	Low, Sloping Away From Stream	None
FH-00-06-01	499	Frog Hollow	kb	5/31/2006 10:52	Perennial	1	1.2	Moderate, 1.2 to 1.5	M3, Irregular	B1, Point Bars	Degrading	Degrading	100	6.5	80	18.04%	3.5	High, BF Lower 1/2 of Bank	Med, Nearly Vertical	None
FH-00-06-02	386	Frog Hollow	kb/mt	5/31/2006 10:32	Perennial	1.1	1.2	Moderate, 1.2 to 1.5	M1, Regular	B1, Point Bars	Degrading	Degrading	80	5.5	55	17.49%	4	High, BF Lower 1/2 of Bank	Med, Nearly Vertical	None
FH-00-06-03	372	Frog Hollow	kb/mt	5/31/2006 9:32	Perennial	1	1.2	Moderate, 1.2 to 1.5	M3, Irregular	B1, Point Bars	Degrading	Degrading	70	4.5	70	18.82%	3.5	High, BF Lower 1/2 of Bank	High, Undercut Sloping to Strm	None
FH-00-08-01	854	Frog Hollow	kb/mt	5/23/2006 10:04	Perennial	1.2	1.4	Low, 1.0 to 1.2	M3, Irregular	None	Degrading	Degrading	135	3.5	120	14.93%	2.75	Med, BF in Upper 1/2 of Bank	Med, Nearly Vertical	None
FH-00-08-02	552	Frog Hollow	kb/mt	5/23/2006 9:30	Perennial	1.15	1.35	Low, 1.0 to 1.2	M3, Irregular	None	Degrading	Stable	75	3.5	35	9.96%	3.5	Med, BF in Upper 1/2 of Bank	Med, Nearly Vertical	None
FH-00-08-03	207	Frog Hollow	kb/mt	5/23/2006 9:15	Ephemeral	1.25	1.45	Moderate, 1.2 to 1.5	M3, Irregular	B1, Point Bars	Degrading	Degrading	175	3.5	175	84.54%	3.5	High, BF Lower 1/2 of Bank	High, Undercut Sloping to Strm	None
FH-01-06-01	159	Frog Hollow	kb/mt	5/31/2006 11:20	Ephemeral	0.6	0.7	Low, 1.0 to 1.2	M3, Irregular	None	Stable	Stable	0	0	0	0.00%	0	Low, BF at Top of Bank	Low, Sloping Away From Stream	None
FH-01-08-01	300	Frog Hollow	kb/mt	5/23/2006 8:17	Perennial	1.1	1.2	Low, 1.0 to 1.2	M1, Regular	None	Stable	Stable	0	0	0	0.00%	0	Med, BF in Upper 1/2 of Bank	Med, Nearly Vertical	None

Reach	Root Density	Debris Blockages	Leaking Utility	Exposed MH Riser	Left Bank Riparian Width	Right Bank Riparian Width	Left Bank Riparian Comp	Right Bank Riparian Comp	Bedrock Outcrop	Left Bank Riparian Density	Right Bank Riparian Density	Channel Mod	Photo Taken	Comment	Private Structure Threatend	Leaking Utility	Exposed MH Riser	Private Structure Threatend	Fish Blockage	BF Indicator	Chnl Restoration
CR-00-00-01	Low, Dense Roots Throughout	Numerous	0	0	200	200	Decid w\Brush-Grass Under	Decid. w\Brush-Grass Understory	1	High	High	0	1	1	0	0	0	0	Debris Blockage	Slope Break	0
CR-00-00-02	Low, Dense Roots Throughout	Moderate	0	0	5	200	Decid w\Brush-Grass Under	Decid. w\Brush-Grass Understory	1	High	High	0	1	1	0	0	0	0	None	Depositional Features	1
CR-00-01-01	Low, Dense Roots Throughout	Numerous	0	0	200	200	Decid w\Brush-Grass Under	Decid. w\Brush-Grass Understory	1	High	High	0	1	1	0	0	0	0	Shallow Depth of Flow	Slope Break	0
CR-00-02-01	Low, Dense Roots Throughout	Numerous	0	0	10	50	Decid w\Brush-Grass Under	Decid. w\Brush-Grass Understory	1	Moderate	Moderate	0	1	0	0	0	0	0	Debris Blockage	Slope Break	1
CR-00-02-010			0	0	200	200	Decid w\Brush-Grass Under	Decid. w\Brush-Grass Understory	1	High	High	0	1	0	0	0	0	0	Debris Blockage	Slope Break	0
CR-00-02-02	High, Minimal Roots	Moderate	0	0	20	15	Decid w\Brush-Grass Under	Decid. w\Brush-Grass Understory	1	High	High	1	1	0	0	0	0	0			1
CR-00-02-03	High, Minimal Roots	Infrequent	0	0	100	100	Grass and Forbs	Grass and Forbs	0	Low	Low	1	1	0	0	0	0	0	None	Slope Break	0
CR-00-03-01	Med, Dense Roots Upper 1/2 Bank	Moderate	0	0	200	100	Decid w\Brush-Grass Under	Decid. w\Brush-Grass Understory	0	Moderate	Moderate	0	1	0	0	0	0	0	None	Slope Break	0
CR-00-03-02	Low, Dense Roots Throughout	Moderate	0	0	150	100	Decid w\Brush-Grass Under	Decid. w\Brush-Grass Understory	1	Moderate	Moderate	0	1	0	0	0	0	0	None	Slope Break	0
FH-00-00-01	Low, Dense Roots Throughout	Moderate	0	0	50	200	Decid w\Brush-Grass Under	Decid. w\Brush-Grass Understory	1	High	High	0	1	0	0	0	0	0	None		1
FH-00-00-02	Med, Dense Roots Upper 1/2 Bank	Numerous	0	0	100	200	Decid w\Brush-Grass Under	Decid. w\Brush-Grass Understory	1	High	High	0	1	0	0	0	0	0	None	Slope Break	0
FH-00-00-03	Low, Dense Roots Throughout	Numerous	0	0	100	200	Decid w\Brush-Grass Under	Decid. w\Brush-Grass Understory	1	Moderate	Moderate	0	1	0	0	0	0	0	None	Slope Break	0
FH-00-00-04	Med, Dense Roots Upper 1/2 Bank	Numerous	0	0	150	200	Decid w\Brush-Grass Under	Decid. w\Brush-Grass Understory	1	High	High	0	1	0	0	0	0	0	None	Slope Break	1
FH-00-00-05	Med, Dense Roots Upper 1/2 Bank	Numerous	0	0	200	200	Decid w\Brush-Grass Under	Decid. w\Brush-Grass Understory	1	High	High	0	1	0	0	0	0	0	None	Slope Break	1
FH-00-01-01	Low, Dense Roots Throughout	Infrequent	0	0	75	75	Decid w\Brush-Grass Under	Decid. w\Brush-Grass Understory	1	High	High	0	1	1	0	0	0	0	Shallow Depth of Flow		0
FH-00-02-01	Low, Dense Roots Throughout	Numerous	0	0	75	200	Decid w\Brush-Grass Under	Decid. w\Brush-Grass Understory	1	Low	Moderate	0	0	1	0	0	0	0	None	Slope Break	0
FH-00-02-02	Med, Dense Roots Upper 1/2 Bank	Moderate	0	0	200	200	Decid w\Brush-Grass Under	Decid. w\Brush-Grass Understory	1	High	High	0	1	0	0	0	0	0	None	Slope Break	0
FH-00-02-03	Med, Dense Roots Upper 1/2 Bank	Numerous	0	0	200	200	Decid w\Brush-Grass Under	Decid. w\Brush-Grass Understory	1	High	Moderate	0	1	0	0	0	0	0	None	Slope Break	0
FH-00-03-01	Med, Dense Roots Upper 1/2 Bank	Infrequent	0	0	50	5	Decid w\Brush-Grass Under	Decid. w\Brush-Grass Understory	1	Moderate	Low	0	1	0	0	0	0	0	None	Slope Break	1
FH-00-03-02	Med, Dense Roots Upper 1/2 Bank	Numerous	0	0	200	4	Decid w\Brush-Grass Under	Brush	1	Moderate	Low	0	1	1	0	0	0	0	Shallow Depth of Flow	Slope Break	1
FH-00-03-03	Low, Dense Roots Throughout		0	0	75	200	Decid w\Brush-Grass Under	Decid. w\Brush-Grass Understory	1	Moderate	High	0	1	1	0	0	0	0	None	Slope Break	1
FH-00-04-01	Low, Dense Roots Throughout	None	0	0	100	200	Brush	Brush	0	Moderate	Moderate	0	1	0	0	0	0	0		Slope Break	0
FH-00-05-01	High, Minimal Roots	Extensive	0	0	200	200	Decid w\Brush-Grass Under	Decid. w\Brush-Grass Understory	1	Moderate	Moderate	0	1	1	0	0	0	0			1
FH-00-05-02	Med, Dense Roots Upper 1/2 Bank	Numerous	0	0	15	15	Decid w\Brush-Grass Under	Decid. w\Brush-Grass Understory	0	Low	Low	0	1	0	0	0	0	0	Shallow Depth of Flow	Slope Break	0
FH-00-06-01	Med, Dense Roots Upper 1/2 Bank	Numerous	0	0	200	200	Decid w\Brush-Grass Under	Decid. w\Brush-Grass Understory	1	High	High	0	1	0	0	0	0	0		Slope Break	1
FH-00-06-02	Med, Dense Roots Upper 1/2 Bank	Numerous	0	0	200	200	Decid w\Brush-Grass Under	Decid. w\Brush-Grass Understory	1	High	High	0	1	0	0	0	0	0	None	Slope Break	1
FH-00-06-03	Med, Dense Roots Upper 1/2 Bank	Moderate	0	0	100	100	Decid w\Brush-Grass Under	Decid. w\Brush-Grass Understory	1	High	High	0	1	0	0	0	0	0	None		1
FH-00-08-01	Low, Dense Roots Throughout	Moderate	0	0	200	200	Decid w\Brush-Grass Under	Decid. w\Brush-Grass Understory	1	High	High	0	1	0	0	0	0	0	None	Slope Break	0
FH-00-08-02	Med, Dense Roots Upper 1/2 Bank	Numerous	0	0	200	200	Decid w\Brush-Grass Under	Decid. w\Brush-Grass Understory	1	High	High	1	1	0	0	0	0	0	None	Slope Break	0
FH-00-08-03	Med, Dense Roots Upper 1/2 Bank	Numerous	0	0	200	200	Decid w\Brush-Grass Under	Decid. w\Brush-Grass Understory	1	High	High	1	1	1	0	0	0	0	None	Slope Break	1
FH-01-06-01	Med, Dense Roots Upper 1/2 Bank	Numerous	0	0	200	100	Decid w\Brush-Grass Under	Decid. w\Brush-Grass Understory	1	Moderate	High	0	1	0	0	0	0	0		Slope Break	0
FH-01-08-01	Med, Dense Roots Upper 1/2 Bank	Numerous	0	0	200	200	Decid w\Brush-Grass Under	Decid. w\Brush-Grass Understory	1	High	High	0	1	0	0	0	0	0	None	Slope Break	0

Reach	Buffer Enhncmnt	Utility Resol	Habitat Enhcmnt	Bankfull Width	Width Depth Ratio	Substrate	Canopy Cover	Chnl Restoration	Floodprone Width	Entrenchment	Chnl Evol	Channel Slope	Rosgen Class	Succession	Surface Protection	Root Depth Bnk HT Ratio	Concrete Lined	Riprap Gabion Lined	Culvert	Culvert Instabilities	Trash Cleanup	Approximate DA (ac)
CR-00-00-01	0	0	0	19	17.272727	Gravel	50-75%	0	26	1.368421	Stage V	2% to 4%	F	6	Med, 30% to 60% protection	Med, Roots Extend to Middle 1/3	0	0	0		0	85
CR-00-00-02	0	0	0	12	10.909091	Cobble	75-100%	1	18	1.5	Stage I	> 4%	B	6	Low, >60% protection	Low, Roots Extend to Lower 1/3	0	0	1		0	85
CR-00-01-01	0	0	0	5	5.555556	Cobble	50-75%	0	8	1.6	Stage II	> 4%	A		Low, >60% protection	Low, Roots Extend to Lower 1/3	0	0	0		0	85
CR-00-02-01	0	0	0	14	11.666667	Cobble	50-75%	1	17	1.214286	Stage III	2% to 4%	G	6	Med, 30% to 60% protection	Low, Roots Extend to Lower 1/3	0	0	0		0	85
CR-00-02-010	0	0	0	6	12	Cobble	50-75%	0	15	2.5		> 4%	A				0	0	0		0	85
CR-00-02-02	1	0	0	10.5	8.076923	Cobble	75-100%	1	14.5	1.380952	Stage III	<2%	G	6	High, <30% protection	Med, Roots Extend to Middle 1/3	0	0	0		0	85
CR-00-02-03	1	0	0	9	6.923077	Silt	0-10%	0	100	11.111111	Stage III	<2%	E	7	High, <30% protection	High, Roots in Upper 1/3	0	0	1		0	85
CR-00-03-01	0	0	0	10	12.5	Cobble	25-50%	0	14	1.4	Stage I	2% to 4%	B	6	Low, >60% protection	Med, Roots Extend to Middle 1/3	0	0	0		0	85
CR-00-03-02	0	0	0	8	16	Cobble	25-50%	0	14	1.75	Stage I	2% to 4%	B	6	Med, 30% to 60% protection	Med, Roots Extend to Middle 1/3	0	0	0		0	85
FH-00-00-01	0	0	0	15	11.538462	Cobble	25-50%	0	50	3.333333	Stage III	2% to 4%	C	4	Low, >60% protection	Med, Roots Extend to Middle 1/3	0	0	0		0	50
FH-00-00-02	0	0	0	17	17	Gravel	50-75%	0	75	4.411765	Stage IV	2% to 4%	C	4	Med, 30% to 60% protection	Low, Roots Extend to Lower 1/3	0	0	0		0	50
FH-00-00-03	1	0	0	10.5	8.076923	Gravel	10-25%	1	70	6.666667	Stage III	<2%	E	1	Med, 30% to 60% protection	Med, Roots Extend to Middle 1/3	0	0	0		0	50
FH-00-00-04	0	0	0	14.5	12.083333	Gravel	25-50%	0	60	4.137931	Stage V	<2%	C	1	Med, 30% to 60% protection	Med, Roots Extend to Middle 1/3	0	0	1		0	50
FH-00-00-05	0	0	0	9	11.25	Gravel	50-75%	1	50	5.555556	Stage IV	2% to 4%	C	5	Med, 30% to 60% protection	Low, Roots Extend to Lower 1/3	0	0	0		0	50
FH-00-01-01	0	0	0	0	*****	Gravel	50-75%	0	0	*****	Stage I		E	2	Low, >60% protection	Low, Roots Extend to Lower 1/3	0	0	1		0	50
FH-00-02-01	0	0	0	12.5	9.615385	Cobble	50-75%	0	22	1.76	Stage I	2% to 4%	B	6	Low, >60% protection	Low, Roots Extend to Lower 1/3	0	0	0		0	50
FH-00-02-02	0	0	0	13	9.285714	Cobble	75-100%	0	24	1.846154	Stage I	2% to 4%	B	6	Med, 30% to 60% protection	Med, Roots Extend to Middle 1/3	0	0	0		0	50
FH-00-02-03	0	0	0	12.5	12.5	Cobble	50-75%	0	24	1.92	Stage I	2% to 4%	B	6	Low, >60% protection	Med, Roots Extend to Middle 1/3	0	0	0		0	50
FH-00-03-01	0	0	0	5	5	Gravel	50-75%	1	9	1.8	Stage II	2% to 4%	G	6	Med, 30% to 60% protection	Med, Roots Extend to Middle 1/3	0	1	1		0	50
FH-00-03-02	0	0	0	7.5	5.357143	Gravel	25-50%	1	11	1.466667	Stage II	2% to 4%	G	6	Med, 30% to 60% protection	High, Roots in Upper 1/3	0	0	1	Upstream Aggradation	0	50
FH-00-03-03	0	0	0	7.5	11.538462	Gravel	50-75%	1	13	1.733333	Stage II	<2%	B	6	Med, 30% to 60% protection	Med, Roots Extend to Middle 1/3	0	0	1		0	50
FH-00-04-01	0	0	0	2.5	3.846154	Sand	10-25%	0	40	16	Stage I	<2%	E	7	Low, >60% protection	Low, Roots Extend to Lower 1/3	0	0	0		0	50
FH-00-05-01	0	0	1	0	*****	Gravel	75-100%	1	0	*****	Stage II	2% to 4%	G	6	High, <30% protection	High, Roots in Upper 1/3	0	0	0		1	50
FH-00-05-02	1	0	0	5	8.333333	Sand	10-25%	0	10	2	Stage I	<2%	E	5	Med, 30% to 60% protection	Med, Roots Extend to Middle 1/3	0	0	1	Upstream Aggradation;Fish Passage Issue	0	50
FH-00-06-01	0	0	0	10	10	Cobble	75-100%	1	14	1.4	Stage II	2% to 4%	G	6	High, <30% protection	Med, Roots Extend to Middle 1/3	0	0	0		0	50
FH-00-06-02	0	0	0	11	10	Cobble	75-100%	1	18	1.636364	Stage III	2% to 4%	B	6	High, <30% protection	High, Roots in Upper 1/3	0	0	0		0	50
FH-00-06-03	0	0	0	13.5	13.5	Cobble	75-100%	1	16	1.185185	Stage II	2% to 4%	F	6	High, <30% protection	High, Roots in Upper 1/3	0	0	0		0	50
FH-00-08-01	0	0	0	11	9.166667	Cobble	75-100%	0	19	1.727273	Stage II	2% to 4%	B	6	Med, 30% to 60% protection	Low, Roots Extend to Lower 1/3	0	0	0		0	50
FH-00-08-02	0	0	0	8	6.956522	Cobble	75-100%	0	16	2	Stage II	2% to 4%	B	6	Med, 30% to 60% protection	Med, Roots Extend to Middle 1/3	0	0	0		0	50
FH-00-08-03	0	0	0	8	6.4	Cobble	75-100%	1	10	1.25	Stage II	2% to 4%	G	6	High, <30% protection	Med, Roots Extend to Middle 1/3	0	0	0		0	50
FH-01-06-01	0	0	0	7	11.666667	Gravel	50-75%	0	10	1.428571	Stage I	2% to 4%	B	6	Med, 30% to 60% protection	Low, Roots Extend to Lower 1/3	0	0	0		0	50
FH-01-08-01	0	0	0	11	10	Cobble	75-100%	0	17	1.545455	Stage I	> 4%	B	6	Low, >60% protection	Low, Roots Extend to Lower 1/3	0	0	0		0	50

Pretty Reservoir Subwatershed Stream Stability Assessment
Compass Run Frog Hollow

Reach	Dist to Nearest Road (ft)	Dist to Nearest Road (m)	Left Erosion Extent	Left Erosion Extent (m)	Left Erosion Severity	Lt Erosion Severity Conversion	Right Erosion Extent	Right Erosion Extent (m)	Right Erosion Severity	Rt Erosion Severity Conversion	Instream Habitat	Epifaunal Substrate	Riffle Run Quality	Embeddedness	Shading	Instream Woody Debris	Instream Rootwads	Total Woody Debris	Yard Waste	Reference Reach	Bank Planting	Root Depth/ Bank Ht Score	Surface Protection Score	Root Density Score	Bank Angle Score	Bank Material	Bank Ht/BF Ht Score	BEHI Score	BEHI Ranking
CR-00-00-01	459	139.9032	150	45.72	2	1.5	30	9.14	2	1.5	12	12	13	50	70	1	4	5	0	0	0	2	2	1	2	0	2	9	Mod
CR-00-00-02	27	8.2296	80	24.38	2	1.5	100	30.48	3	2	15	16	15	30	80	1	0	1	0	0	0	1	1	1	2	0	3	8	Low to Mod
CR-00-01-01	660	201.168	25	7.62	3	2	0	0.00	0	0	5	11	6	40	60	0	0	0	0	0	0	1	1	1	2	0	3	8	Low to Mod
CR-00-02-01	57	17.3736	50	15.24	3	2	85	25.91	3	2	15	12	12	50	50	1	1	2	0	0	0	1	2	1	2	0	3	9	Mod
CR-00-02-010	36	10.9728	0	0.00	0	0	0	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0					0		0	
CR-00-02-02	343	104.5464	100	30.48	2	1.5	100	30.48	2	1.5	10	8	10	60	75	2	0	2	0	0	0	2	3	3	2	0	3	13	Mod to High
CR-00-02-03	507	154.5336	50	15.24	2	1.5	100	30.48	2	1.5	6	2	2	100	0	0	0	0	0	1	1	3	3	3	2	0	1	12	Mod to High
CR-00-03-01	859	261.8232	0	0.00	0	0	0	0.00	0	0	9	10	11	30	60	0	0	0	0	0	0	2	1	2	2	0	2	9	Mod
CR-00-03-02	396	120.7008	0	0.00	0	0	0	0.00	0	0	12	10	9	30	60	3	1	4	0	0	0	2	2	1	2	0	2	9	Mod
FH-00-00-01	77	23.4696	75	22.86	2	1.5	50	15.24	2	1.5	16	15	15	30	60	3	2	5	0	0	0	2	1	1	2	0	2	8	Low to Mod
FH-00-00-02	182	55.4736	75	22.86	2	1.5	100	30.48	2	1.5	16	14	14	30	60	4	2	6	0	0	0	1	2	2	2	0	2	9	Mod
FH-00-00-03	176	53.6448	100	30.48	3	2	40	12.19	2	1.5	11	11	13	33	25	0	1	1	0	1	1	2	2	1	2	0	1	8	Low to Mod
FH-00-00-04	174	53.0352	75	22.86	1	1	50	15.24	1	1	9	11	10	40	60	3	2	5	0	0	0	2	2	2	2	0	1	9	Mod
FH-00-00-05	737	224.6376	100	30.48	2	1.5	130	39.62	2	1.5	15	13	12	50	75	3	5	8	0	0	0	1	2	2	1	0	2	8	Low to Mod
FH-00-01-01	52	15.8496	0	0.00	0	0	0	0.00	0	0	8	6	6	45	80	0	0	0	0	0	0	1	1	1	1	0	1	5	Low
FH-00-02-01	252	76.8096	0	0.00	0	0	0	0.00	0	0	11	10	10	40	60	0	0	0	0	0	0	1	1	1	2	0	2	7	Low
FH-00-02-02	694	211.5312	75	22.86	2	1.5	50	15.24	2	1.5	12	10	10	35	75	2	1	3	0	0	0	2	2	2	2	0	2	10	Mod
FH-00-02-03	851	259.3848	85	25.91	2	1.5	55	16.76	2	1.5	12	11	11	45	70	3	1	4	0	0	0	2	1	2	2	0	2	9	Mod
FH-00-03-01	109	33.2232	100	30.48	2	1.5	50	15.24	2	1.5	10	9	10	50	50	1	0	1	0	0	0	2	2	2	2	0	3	11	Mod
FH-00-03-02	26	7.9248	200	60.96	2	1.5	250	76.20	3	2	8	6	6	45	60	0	0	0	0	1	1	3	2	2	3	0	3	13	Mod to High
FH-00-03-03	103	31.3944	160	48.77	2	1.5	160	48.77	2	1.5	8	7	6	50	60	0	0	0	0	0	0	2	2	1	2	0	2	9	Mod
FH-00-04-01	315	96.012	0	0.00	0	0	0	0.00	0	0	6	6	5	65	55	0	0	0	0	0	0	1	1	1	2	0	1	6	Low
FH-00-05-01	346	105.4608	0	0.00	0	0	0	0.00	0	0	0	0	0	0	0	0	0	0	1	1	1	3	3	3	3	0	3	15	High
FH-00-05-02	194	59.1312	0	0.00	0	0	0	0.00	0	0	6	6	5	60	30	2	0	2	0	1	1	2	2	2	1	0	1	8	Low to Mod
FH-00-06-01	818	249.3264	100	30.48	3	2	80	24.38	2	1.5	12	11	10	45	75	2	1	3	0	0	0	2	3	2	2	0	3	12	Mod to High
FH-00-06-02	625	190.5	80	24.38	3	2	55	16.76	3	2	12	11	10	45	75	1	1	2	0	0	0	3	3	2	2	0	3	13	Mod to High
FH-00-06-03	457	139.2936	70	21.34	3	2	70	21.34	3	2	11	10	10	50	75	1	1	2	0	0	0	3	3	2	3	0	3	14	High
FH-00-08-01	435	132.588	135	41.15	2	1.5	120	36.58	2	1.5	13	11	13	35	75	4	1	5	0	0	0	1	2	1	2	0	2	8	Low to Mod
FH-00-08-02	1006	306.6288	75	22.86	2	1.5	35	10.67	2	1.5	11	11	8	30	75	0	0	0	0	0	0	2	2	2	2	0	2	10	Mod
FH-00-08-03	1223	372.7704	175	53.34	3	2	175	53.34	3	2	11	10	6	35	75	1	0	1	0	0	0	2	3	2	3	0	3	13	Mod to High
FH-01-06-01	491	149.6568	0	0.00	0	0	0	0.00	0	0	7	7	7	60	55	4	0	4	0	0	0	1	2	2	1	0	1	7	Low
FH-01-08-01	948	288.9504	0	0.00	0	0	0	0.00	0	0	10	11	8	30	75	5	0	5	0	0	0	1	1	2	2	0	2	8	Low to Mod

Pretty Reservoir Subwatershed Stream Stability Assessment
Compass Run Frog Hollow

Reach	Remoteness Calc.	Shading Calc.	Epifaunal Calc.	Instream Habitat Calc.	Woody Calc.	Bank Stability Calc.	Riffle Quality Calc.	Embeddness Calc.	PHI	Habitat Rating	Lt Eroded Area	Rt Eroded Area	Eroded Area/Reach Length	Measure 1: Stream Restoration	Buffer Enhancement Recommended?	Grass Composition?	Measure 2: Buffer Enhancement	Measure 3: Bank Planting	Measure 4: Exposed Riser	Meaure 4: Utility Conflict Resolution	Measure 5: Habitat Enhancement	Measure 6: Trash Cleanup	Measure 7: Yard Waste Cleanup	Unstable Stable Ratio > 50%	Eroded Area/Reach Length > 2.0	Stream Stabilization Recommended?	Measure 8: Invasive Species Removal	Total No of Recommended Measures	Total Cost	Project Notes	Field Notes
CR-00-00-01	58.03	54.40	64.71	75.14	41.67	86.64	95.54	55.56	66.46	Fair	375.00	60.00	0.59	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	$0		us of reservoir.
CR-00-00-02	16.99	62.66	88.24	94.20	8.33	86.64	100.00	77.78	66.85	Fair	280.00	800.00	2.13	1	0	0	0	0	0	0	0	0	0	1	1	1	0	1	$152,400		low priority.
CR-00-01-01	68.82	46.92	58.82	30.69	0.00	100.00	59.89	66.67	53.98	Fair	0.00	0.00	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	$0		very dense veg. immediatey us of reservoir . hard to walk reach.
CR-00-02-01	22.94	39.75	64.71	94.20	16.67	92.06	90.44	55.56	59.54	Fair	200.00	382.50	0.97	1	0	0	0	0	0	0	0	0	0	0	0	1	0	1	$180,600	Stream is migrating towards road. Roadside stabilization is recommended.	
CR-00-02-010	19.02	0.00	0.00	0.00	0.00	100.00	29.33	100.00	31.04	Poor	0.00	0.00	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	$0		steep ds from roadway.
CR-00-02-02	50.69	58.39	41.18	62.44	16.67	84.14	80.26	44.44	54.78	Fair	300.00	250.00	2.10	1	1	0	1	0	0	0	0	0	0	1	1	1	0	2	$114,800	There is a small forested buffer but it is less than 25 feet on each side.	
CR-00-02-03	60.79	0.00	5.88	37.04	0.00	90.28	39.52	0.00	29.19	Poor	60.00	150.00	0.61	0	1	1	1	1	0	0	1	0	0	0	0	0	0	3	$35,000		
CR-00-03-01	77.97	46.92	52.94	56.09	0.00	100.00	85.35	77.78	62.13	Fair	0.00	0.00	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	$7,500		
CR-00-03-02	54.18	46.92	52.94	75.14	33.33	100.00	75.17	77.78	64.43	Fair	0.00	0.00	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	$7,500		
FH-00-00-01	26.04	43.66	82.35	100.00	41.67	93.24	100.00	77.78	70.59	Fair	375.00	200.00	0.83	0	0	0	0	0	0	0	1	0	0	0	0	0	1	2	$47,500		
FH-00-00-02	37.97	43.66	76.47	100.00	50.00	87.25	100.00	77.78	71.64	Fair	187.50	230.00	0.62	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	$0		
FH-00-00-03	37.40	17.86	58.82	71.06	8.33	91.47	98.36	74.44	57.22	Fair	400.00	60.00	0.71	0	1	0	1	1	0	0	0	0	0	0	0	0	0	2	$32,500	Only need localized buffer enhancement and bank planting (assume 25%), not entire reach.	
FH-00-00-04	37.21	43.66	58.82	58.36	41.67	98.01	83.08	66.67	60.93	Fair	112.50	150.00	0.79	1	0	0	0	0	0	0	0	0	0	1	0	1	0	1	$132,800		eroded 100' at 4' (photos taken). Non-wooded area in need of buffer
FH-00-00-05	72.51	55.12	70.59	96.46	66.67	80.30	93.27	55.56	73.81	Good	402.50	562.50	1.14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	$0		
FH-00-01-01	22.08	59.39	29.41	52.00	0.00	100.00	62.71	61.11	48.34	Fair	0.00	0.00	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	$0		braided channel in wetland flow spreads throughout wetland area down to stream. Photos taken.
FH-00-02-01	43.99	43.66	52.94	71.06	0.00	100.00	83.08	66.67	57.67	Fair	0.00	0.00	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	$7,500		
FH-00-02-02	70.47	55.12	52.94	77.41	25.00	93.24	83.08	72.22	66.19	Fair	100.00	390.00	0.76	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	$0		
FH-00-02-03	77.63	51.14	58.82	77.41	33.33	91.47	88.18	61.11	67.39	Fair	200.00	165.00	0.80	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	$0		
FH-00-03-01	30.25	36.49	47.06	64.71	8.33	90.28	83.08	55.56	51.97	Fair	300.00	75.00	1.19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	$0		
FH-00-03-02	16.74	43.66	29.41	52.00	0.00	46.46	62.71	61.11	39.01	Poor	750.00	900.00	4.78	1	0	0	0	1	0	0	0	0	0	1	1	1	0	2	$143,000		stream migrating toward road. Photos taken of channel and erosion. Channel has split into 2, the right branch has a majority of the flow. Potential project along the road. Goal is to prevent road erosion. Make a B channel
FH-00-03-03	29.51	43.66	35.29	52.00	0.00	67.87	62.71	55.56	43.33	Fair	1,250.00	1,250.00	3.18	1	0	0	0	0	0	0	0	0	0	1	1	1	0	1	$235,500		eroded
FH-00-04-01	48.73	40.06	29.41	39.30	0.00	100.00	57.62	38.89	44.25	Fair	0.00	0.00	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	$0		
FH-00-05-01	50.89	0.00	0.00	1.19	0.00	100.00	32.16	100.00	35.53	Poor	0.00	0.00	0.00	1	0	0	0	1	0	0	1	0	0	1	0	1	0	3	$177,700	Reach is in a wooded section but there is extensive bank erosion. Bank plantings are only appropriate if reach is stabilized and debris is removed.	extensive debris in channel (manmade). Spoke with residents and they have asked about fill. Trash dumped
FH-00-05-02	39.07	21.85	29.41	39.30	16.67	100.00	57.62	44.44	43.55	Fair	0.00	0.00	0.00	0	1	0	1	1	0	0	0	0	0	0	0	0	1	3	$40,000	Small brush buffer in open field. Area near stream looks wet, so there is potential to expand wooded buffer.	invasives along stream channel not mowed to edge
FH-00-06-01	76.18	55.12	58.82	77.41	25.00	86.64	83.08	61.11	65.42	Fair	650.00	280.00	1.86	1	0	0	0	0	0	0	0	0	0	0	1	1	0	1	$149,700		
FH-00-06-02	67.07	55.12	58.82	77.41	16.67	92.06	83.08	61.11	63.92	Fair	440.00	220.00	1.71	1	0	0	0	0	0	0	0	0	0	0	1	1	0	1	$154,400		
FH-00-06-03	57.91	55.12	52.94	71.06	16.67	91.47	83.08	55.56	60.48	Fair	315.00	245.00	1.51	1	0	0	0	0	0	0	0	0	0	0	0	1	0	1	$148,800		
FH-00-08-01	56.60	55.12	58.82	83.76	41.67	76.99	98.36	72.22	67.94	Fair	472.50	330.00	0.94	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	$0		
FH-00-08-02	84.07	55.12	58.82	71.06	0.00	94.98	72.90	77.78	64.34	Fair	262.50	122.50	0.70	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	$0		
FH-00-08-03	92.30	55.12	52.94	71.06	8.33	63.36	62.71	72.22	59.76	Fair	612.50	612.50	5.92	1	0	0	0	0	0	0	0	0	0	1	1	1	0	1	$82,800		
FH-01-06-01	59.89	40.06	35.29	45.65	33.33	100.00	67.81	44.44	53.31	Fair	0.00	0.00	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	$0		
FH-01-08-01	81.72	55.12	58.82	64.71	41.67	100.00	72.90	77.78	69.09	Fair	0.00	0.00	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	$0		several cutoff channels throughout reach

APPENDIX D

Assessment Criteria

- BEHI Scoring
- Debris Assessment

PRETTYBOY BANK EROSION HAZARD POTENTIAL

Use general rating criteria to look at 5 main components of the BEHI.

1) Bank Height/Bankfull Height:
    a. High (3 pts) BF in lower half of bank
    b. Med (2 pts) BF in upper half of bank
    c. Low (1 pt) BF at top of bank

2) Bank Angle
    a. High (3 pts) Undercut bank
    b. Med (2 pts) Nearly vertical bank
    c. Low (1 pt) Gently sloping bank

3) Root Density
    a. High (3 pts) Minimal roots
    b. Med (2 pts) Dense roots in upper half of bank
    c. Low (1 pt) Dense roots throughout bank

4) % Surface Protection
    a. High (3 pts) < 30% of bank has surface protection
    b. Med (2 pts) 30 to 60% of bank has surface protection
    c. Low (1 pt) 60% or more of bank has surface protection

5) Root Depth/Bank Height
    a. High (3 pts) Roots only extend in upper third of bank
    b. Med (2 pts) Roots extend in middle third of bank
    c. Low (1 pt) Roots extend into lower third of bank

To determine the overall Bank Erosion Hazard potential, sum up the points from each of the 5 categories.

Adjust for Bank Material:
If banks are sandy, add 1.5 pts
If banks are cobble, subtract 1.5 pts.

<u>Final Ranking:</u>

- High Erosion Potential — 14 to 15 points
- Moderate to High — 12 to 13 points
- Moderate Erosion Potential — 9 to 11 points
- Low to Moderate Erosion Potential — 8 points
- Low Erosion Potential — Less than 8 points

PRETTYBOY DEBRIS ASSESSMENT

PREDOMINANT DEBRIS BLOCKAGE PATTERN FOUND THROUGHOUT ENTIRE REACH

- **None**

- **Infrequent –** Debris consists of small, easily moved, floatable material, i.e. leaves, needles, small limbs, twigs, etc.

- **Moderate –** Increasing frequency of small to medium sized material, such as medium limbs, branches and small logs.

- **Numerous** – Significant build up of medium to large sized materials, i.e. large limbs, branches, small logs or portions of trees

- **Extensive** – Debris jams consist of larger materials such as branches, logs, trees, etc. Debris jams often extend across the entire channel.

APPENDIX E

Project Identification, Project Costs & Prioritization

- Stream Restoration/Stabilization
- Buffer Enhancement
- Bank Plantings
- Utility Conflict Resolution
- Habitat Enhancement
- Trash Cleanup
- Yard Waste Cleanup
- Invasive Species Removal
- Combination Projects

TABLE E.1:

STREAM RESTORATION/STABILIZATION PROJECTS

Reach	Length	Subshed	Unstable-Stable Ratio	Eroded Area/Reach Length	Measure 1: Stream Restoration	Total Cost	Comments
CR-00-00-02	508	Compass Run	27.56%	2.13	1	$152,400	
CR-00-02-01	602	Compass Run	10.38%	0.97	1	$180,600	Reach is recommended for stabilization due to erosion from roadway drainage and adjacent farm fields that drain into the reach, not for the erosion occurring directly on the reach.
CR-00-02-02	262	Compass Run	38.17%	2.10	1	$114,800	
FH-00-00-04	332	Frog Hollow	26.36%	0.79	1	$132,800	Upstream reach was unassessed but consisted of open fields. This may be contributing to the eroded banks in this reach.
FH-00-03-02	345	Frog Hollow	86.96%	4.78	1	$143,000	
FH-00-03-03	785	Frog Hollow	63.69%	3.18	1	$235,500	
FH-00-05-01	434	Frog Hollow	Not measured due to debris	Not measured due to debris	1	$177,700	
FH-00-06-01	499	Frog Hollow	18.04%	1.86	1	$149,700	Many eroded bank heights were in the range of 7 to 8 feet high.
FH-00-06-02	386	Frog Hollow	17.49%	1.71	1	$154,400	Many eroded bank heights were in the range of 4 to 5 feet high.
FH-00-06-03	372	Frog Hollow	18.82%	1.51	1	$148,800	While unstable/stable ratio and Eroded Area/Reach Length ratios are not in the project identification range, the eroded banks in this stream range from 3 to 5 feet and there is significant erosion in the downstream reaches.
FH-00-08-03	207	Frog Hollow	84.54%	5.92	1	$82,800	

TABLE E.2:

BUFFER ENHANCEMENT PROJECTS

Reach	Length	Subshed	Measure 2: Buffer Enhancement	Total Cost
CR-00-02-02	262	Compass Run	1	$114,800
CR-00-02-03	342	Compass Run	1	$35,000
FH-00-00-03	647	Frog Hollow	1	$32,500
FH-00-05-02	406	Frog Hollow	1	$40,000

TABLE E.3:

BANK PLANTING PROJECTS

Reach	Length	Subshed	Measure 3: Bank Planting	Total Cost
CR-00-02-03	342	Compass Run	1	$35,000
FH-00-00-03	647	Frog Hollow	1	$32,500
FH-00-03-02	345	Frog Hollow	1	$143,000
FH-00-05-01	434	Frog Hollow	1	$177,700
FH-00-05-02	406	Frog Hollow	1	$40,000

TABLE E.4:

UTILITY CONFLICT RESOLUTION NEEDS

No utility conflict projects were recommended for the Compass Run or Frog Hollow subwatersheds.

TABLE E.5:

HABITAT ENHANCEMENT NEEDS

Reach	Length	Subshed	Measure 5: Habitat Enhancement	Total Cost
CR-00-02-03	342	Compass Run	1	$35,000
FH-00-00-01	691	Frog Hollow	1	$47,500
FH-00-05-01	434	Frog Hollow	1	$177,700

TABLE E.6:

TRASH CLEANUP NEEDS

There were no traditional trash cleanup projects recommended in the Compass Run or Frog Hollow subwatersheds.

TABLE E.7:

YARD WASTE EDUCATION NEEDS

There were no yard waste education programs needed in the Compass Run or Frog Hollow subwatersheds.

TABLE E.8:

INVASIVE PLANT REMOVAL NEEDS

Reach	Length	Subshed	Measure 8: Invasive Species Removal	Total Cost
CR-00-03-01	533	Compass Run	1	$7,500
CR-00-03-02	437	Compass Run	1	$7,500
FH-00-00-01	691	Frog Hollow	1	$47,500
FH-00-02-01	685	Frog Hollow	1	$7,500
FH-00-05-02	406	Frog Hollow	1	$40,000

TABLE E.9:

PROPOSED REACH ENHANCEMENTS, COMPASS RUN & FROG HOLLOW SUBWATERSHEDS

Reach	Length	Subshed	Measure 1: Stream Restoration	Measure 2: Buffer Enhancement	Measure 3: Bank Planting	Measure 4: Exposed Riser	Meaure 4: Utility Conflict Resolution	Measure 5: Habitat Enhancement	Measure 6: Trash Cleanup	Measure 7: Yard Waste Cleanup	Measure 8: Invasive Species Removal	Total Recommended Measures	Total Cost
CR-00-00-01	738	Compass Run	0	0	0	0	0	0	0	0	0	0	$0
CR-00-00-02	508	Compass Run	1	0	0	0	0	0	0	0	0	1	$152,400
CR-00-01-01	808	Compass Run	0	0	0	0	0	0	0	0	0	0	$0
CR-00-02-01	602	Compass Run	1	0	0	0	0	0	0	0	0	1	$180,600
CR-00-02-010	157	Compass Run	0	0	0	0	0	0	0	0	0	0	$0
CR-00-02-02	262	Compass Run	1	1	0	0	0	0	0	0	0	2	$114,800
CR-00-02-03	342	Compass Run	0	1	1	0	0	1	0	0	0	3	$35,000
CR-00-03-01	533	Compass Run	0	0	0	0	0	0	0	0	1	1	$7,500
CR-00-03-02	437	Compass Run	0	0	0	0	0	0	0	0	1	1	$7,500
FH-00-00-01	691	Frog Hollow	0	0	0	0	0	1	0	0	1	2	$47,500
FH-00-00-02	678	Frog Hollow	0	0	0	0	0	0	0	0	0	0	$0
FH-00-00-03	647	Frog Hollow	0	1	1	0	0	0	0	0	0	2	$32,500
FH-00-00-04	332	Frog Hollow	1	0	0	0	0	0	0	0	0	1	$132,800
FH-00-00-05	845	Frog Hollow	0	0	0	0	0	0	0	0	0	0	$0
FH-00-01-01	309	Frog Hollow	0	0	0	0	0	0	0	0	0	0	$0
FH-00-02-01	685	Frog Hollow	0	0	0	0	0	0	0	0	1	1	$7,500
FH-00-02-02	643	Frog Hollow	0	0	0	0	0	0	0	0	0	0	$0
FH-00-02-03	459	Frog Hollow	0	0	0	0	0	0	0	0	0	0	$0
FH-00-03-01	314	Frog Hollow	0	0	0	0	0	0	0	0	0	0	$0
FH-00-03-02	345	Frog Hollow	1	0	1	0	0	0	0	0	0	2	$143,000
FH-00-03-03	785	Frog Hollow	1	0	0	0	0	0	0	0	0	1	$235,500
FH-00-04-01	190	Frog Hollow	0	0	0	0	0	0	0	0	0	0	$0
FH-00-05-01	434	Frog Hollow	1	0	1	0	0	1	0	0	0	3	$177,700
FH-00-05-02	406	Frog Hollow	0	1	1	0	0	0	0	0	1	3	$40,000
FH-00-06-01	499	Frog Hollow	1	0	0	0	0	0	0	0	0	1	$149,700
FH-00-06-02	386	Frog Hollow	1	0	0	0	0	0	0	0	0	1	$154,400
FH-00-06-03	372	Frog Hollow	1	0	0	0	0	0	0	0	0	1	$148,800
FH-00-08-01	854	Frog Hollow	0	0	0	0	0	0	0	0	0	0	$0
FH-00-08-02	552	Frog Hollow	0	0	0	0	0	0	0	0	0	0	$0
FH-00-08-03	207	Frog Hollow	1	0	0	0	0	0	0	0	0	1	$82,800
FH-01-06-01	159	Frog Hollow	0	0	0	0	0	0	0	0	0	0	$0
FH-01-08-01	300	Frog Hollow	0	0	0	0	0	0	0	0	0	0	$0
Totals	**15,479**		**11**	**4**	**5**	**0**	**0**	**3**	**0**	**0**	**5**	**28**	**$1,850,000**