Howard County Biological Monitoring and Assessment

Upper Brighton Dam, Cattail Creek, and Lower Brighton Dam Watersheds- 2017

FINAL

Howard County, Maryland

Howard County MARYLAND

KCI Technologies, Inc.
November 2017 - Final

KCI TECHNOLOGIES

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Department of Public Works
Bureau of Environmental Services
Stormwater Management Division
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Howard County MARYLAND

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KCI TECHNOLOGIES

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Acknowledgements

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Executive Summary

The Howard County Department of Public Works Stormwater Management Division initiated the Howard County Biological Monitoring and Assessment Program in the spring of 2001. The County initiated the monitoring program to establish a baseline ecological stream condition for all of the County's watersheds. The program involves monitoring the biological health and physical condition of the County's water resources and is designed on a five year rotating basis such that each of the County's 15 watersheds, or primary sampling units (PSU) will be sampled once every five years.

Round 1 was completed from 2001 to 2003, Round 2 from 2005-2009, and Round 3 from 2012-2016, with 10 randomly selected sites sampled in each PSU. The current year of sampling (2017) is the first year of Round 4. To allow for paired site comparisons with previous Rounds, a total of four sites from Round One (2001), Round Two (2005), and Round Three (2012) were selected for resampling in each PSU. The remaining six sites in each PSU were randomly selected. The monitoring in each round involved sampling instream water quality, collection and analysis of the biological community (benthic macroinvertebrates) using Maryland Biological Stream Survey (MBSS) protocols, cross section analysis, particle size distribution, and assessment of the physical habitat using the United States Environmental Protection Agency's (EPA) Rapid Bioassessment Protocols (RBP). The sampling methods used are compatible with those used in the third round (2012-2016) with updates where applicable.

All data collection occurred between March 1st and April 30th of 2017, as required by the MBSS protocols. Sampling sites were marked in the field using survey flagging at the upstream and downstream limits of the reach. The positions of the site midpoints were collected using a GPS unit accurate to within 1-meter.

Biological and physical habitat assessment results for 2017 in Upper Brighton Dam, Cattail Creek, and Lower Brighton Dam indicate watersheds that are minimally impaired. Only one out of thirty benthic macroinvertebrate samples received a rating of 'Very Poor' and four received a 'Poor' rating. The remaining sites (83%) were rated as either 'Good' or 'Fair'.

Overall, the average watershed physical habitat conditions were 'Partially Supporting' (Upper Brighton Dam and Cattail Creek) and 'Non-supporting' (Lower Brighton Dam). The geomorphic assessment reveals a variable system. Using the Rosgen classification system for natural rivers (Rosgen, 1996), more than half (53%) of the channels sampled throughout the subwatersheds were classified as incised F or G channels and the remaining 47% were classified as stable type B or C channels. Gravel, sand, and silt/clay were the dominant substrate types in the majority of sampling reaches.

The average percentage of impervious area in the Upper Brighton Dam, Cattail Creek, and Lower Brighton Dam subwatersheds is 3.6%, 6.9%, and 6.3%, respectively. Imperviousness for the areas draining to each sampling site range from 2.0% in Upper Brighton Dam to 8.3% in Lower Brighton Dam (see Appendix A for impervious values).

Pearson correlations between the BIBI scores and all parameters (percent imperviousness, specific conductivity, PHI habitat, and RBP habitat) showed significant relationships. The percentage of imperviousness to each sampling site indicates a negative relationship (correlation coeff.= -0.428, p 0.018) to BIBI scores, suggesting biological condition decreases with increased watershed imperviousness. Specific conductivity and BIBI scores also showed a strong negative correlation (correlation coeff.= -0.613, p = 0.0003). These results support the notion that overall water quality and biological health are likely being affected by the amount of development, and hence imperviousness, in the watershed. A strong correlation was also observed between impervious percent and specific conductivity (correlation coeff.= 0.702, p <0.0001), suggesting that increased conductivity is due in large part to urban runoff.

Results of the 2017 assessment indicate minimally impaired biological conditions in all three watersheds, and no statistical significant changes in mean BIBI scores were observed in any of the subwatersheds over time. Average habitat assessment scores were found to be significantly higher in 2012 when compared to all other years. This may be a result of the subjectivity of habitat assessment scoring and the fact that different teams conducted the assessments each year.

1 Background and Objectives

The Howard County Biological Monitoring and Assessment Program was initiated in the spring of 2001 by the Howard County Department of Public Works Stormwater Management Division. The program involves monitoring the biological health and physical condition of the County's water resources to detect the status and trends at the stream level, the watershed level and ultimately at the County level.

The County initiated the program to establish a baseline ecological stream condition for all of the County's watersheds. The program is designed on a five year rotating basis such that each of the County's 15 watersheds or primary sampling units (PSU) will be sampled once every five years. In general, three PSUs would be sampled each year with 10 sites sampled in each PSU. Table 1 includes the full list of PSUs sampled per year and per round. Figure 1 illustrates the program progress to date.

The first sampling rotation was completed in only three years (2001 to 2003). Requirements of the Patuxent Reservoir Watershed Group were addressed in 2001 with sampling conducted in PSUs 2, 5 and 3. This was in addition to sampling conducted in the Little Patuxent subwatersheds (PSUs 11, 12, and 13) under a Watershed Restoration Action Strategy (WRAS) grant. In 2002, only the Middle Patuxent sites (PSUs 6, 7 and 8) were sampled. Additional WRAS funding in 2003 allowed sampling to be completed in the Patapsco River Tributaries (PSUs 1, 4, and 10) in addition to Rocky Gorge, Hammond Branch, and Dorsey Run, which were sampled to supplement the data collected in 2001 for the Little Patuxent.

Upper and Lower Brighton Dam (PSUs 2 and 5, respectively) and Cattail Creek (PSU 3) were all sampled as part of the first year of the second round of sampling in 2005. The Little Patuxent River subwatersheds (PSUs 11, 12, and 13) were sampled in 2006 during year two of the second round of sampling. The Middle Patuxent subwatersheds (PSUs 6, 7, and 8) and the Patapsco River subwatersheds (PSUs 1, 4, and10) were re-sampled in 2007 and 2008, respectively. In 2009, 30 newly selected sites were sampled in the Rocky Gorge Dam (PSU 9), Hammond Branch (PSU 14), and Dorsey Run (PSU 15) subwatersheds to fulfill the 2009 sampling requirements.

Round 3 (2012 to 2016) of county-wide sampling began with sampling at Upper Brighton Dam (PSU 2), Lower Brighton Dam (PSU 5), and Cattail Creek (PSU 3) during 2012 and with the Little Patuxent River watersheds in 2013 (PSUs 11, 12, and 13). During 2014, Round 3 sampling continued with the sampling of the Middle Patuxent River subwatersheds (PSUs 6, 7, and 8). In 2015, the South Branch Patapsco, Patapsco River Lower Branch A, and Patapsco River Lower Branch B subwatersheds were sampled (PSUs 10, 1, and 4). In 2016, sampling continued in the same order as in Round 2, with Rocky Gorge Dam, Hammond Branch and Dorsey Run.

Round 4 began in 2017 with sampling in Upper Brighton Dam, Cattail Creek, and Lower Brighton Dam (PSUs 2, 3, and 5) watersheds. Round 4 sampling includes a combination of repeat site samples and new random site samples to improve trend detection.

Assessment methods follow those developed by Maryland Department of Natural Resources' (DNR) Maryland Biological Stream Survey (MBSS) and the Standard Operating Procedures (SOPs) found in the Quality Assurance Project Plan (QAPP) for the Howard County Biological Monitoring and Assessment Program (Howard County, 2001). The sampling methods used in 2017 are compatible with those used in Round 1 and Round 2, with updates where applicable.

Table 1 – Summary of Bioassessment Progress

Year	Number of Sites	Primary Sampling Unit (code and name)
Round One		
2001	60	11 – Upper Little Patuxent 12 – Middle Little Patuxent 13 – Lower Little Patuxent 2 – Upper Brighton Dam 5 – Lower Brighton Dam 3 – Cattail Creek
2002	30	6 – Upper Middle Patuxent 7 – Middle Middle Patuxent 8 – Lower Middle Patuxent
2003	60	9 – Rocky Gorge Dam 14 – Hammond Branch 15 – Dorsey Run 10 – S Branch Patapsco River Tributaries 1 – Patapsco River L Branch A 4 – Patapsco River L Branch B
Round Two		
2005	30	2 – Upper Brighton Dam 5 – Lower Brighton Dam 3 – Cattail Creek
2006	30	11 – Upper Little Patuxent 12 – Middle Little Patuxent 13 – Lower Little Patuxent
2007	30	6 – Upper Middle Patuxent 7 – Middle Middle Patuxent 8 – Lower Middle Patuxent
2008	30	10 – S Branch Patapsco River Tributaries 1 – Patapsco River L Branch A 4 – Patapsco River L Branch B
2009	30	9 – Rocky Gorge Dam 14 – Hammond Branch 15 – Dorsey Run
Round Three		
2012	30	2 – Upper Brighton Dam 5 – Lower Brighton Dam 3 – Cattail Creek
2013	30	11 – Upper Little Patuxent 12 – Middle Little Patuxent 13 – Lower Little Patuxent
2014	30	6 – Upper Middle Patuxent 7 – Middle Middle Patuxent 8 – Lower Middle Patuxent
2015	30	10 – S Branch Patapsco River Tributaries 1 – Patapsco River L Branch A 4 – Patapsco River L Branch B
2016	30	9 – Rocky Gorge Dam 14 – Hammond Branch 15 – Dorsey Run
Round Four		
2017	30	2 – Upper Brighton Dam 5 – Lower Brighton Dam 3 – Cattail Creek

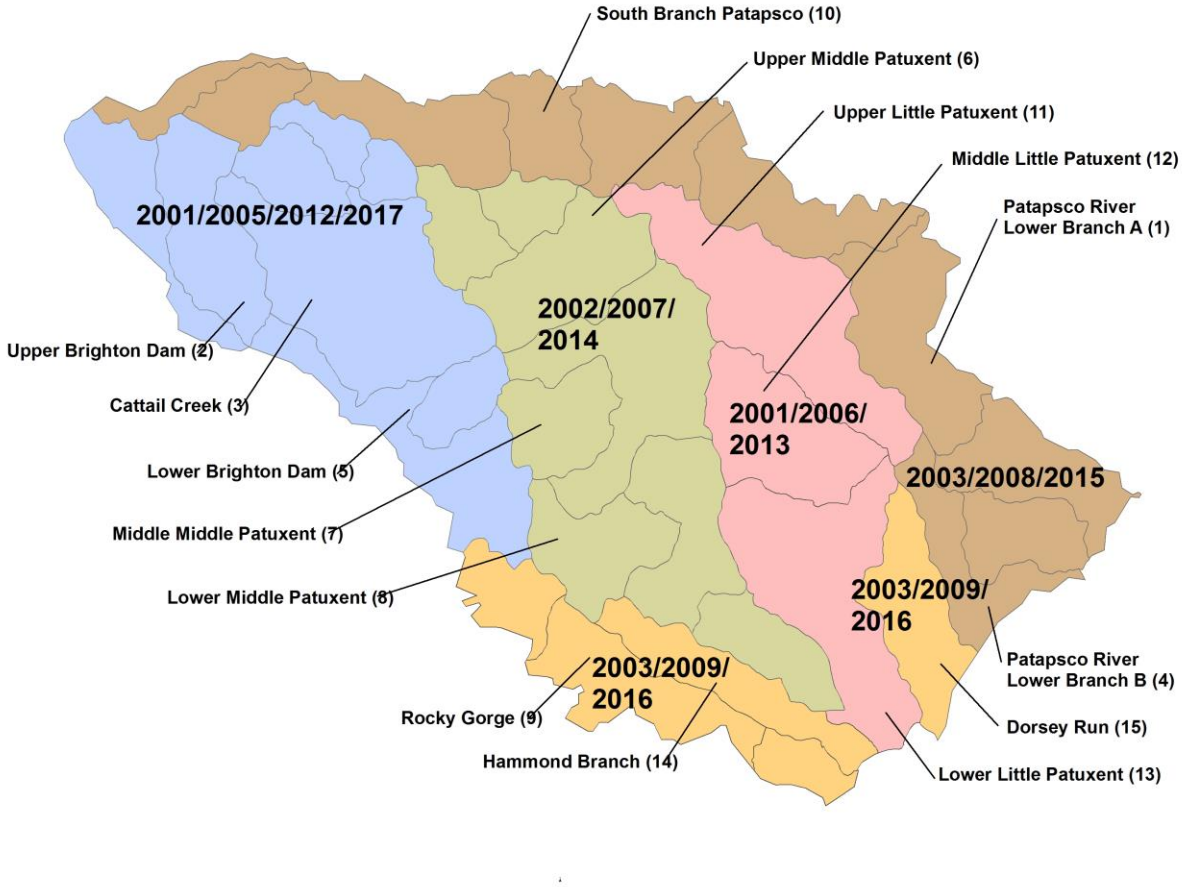

Figure 1 - Howard County Bioassessment

All three subwatersheds sampled in 2017 are located in the northwestern portion of the county and are crossed by several major transportation routes (Figure 2). Interstate I-70 crosses the northern end of Cattail Creek. Woodbine Road (Route 94) bisects Upper Brighton Dam and crosses the northern portion of Cattail Creek. Finally, Route 97 crosses through both Cattail Creek and Lower Brighton Dam.

The Cattail Creek, Upper Brighton Dam, and Lower Brighton Dam subwatersheds are all located in the piedmont region of Maryland, although Upper Brighton Dam is located very close to the boundary between the Highlands and Piedmont regions. MBSS has developed strata for sampling and analysis of Maryland's streams based on broad physiographic regions, which include the coastal plain, piedmont and combined highlands regions. MBSS's physiographic region strata layer showed that all subwatersheds sampled in 2017 fell within the piedmont physiogeographic region (Figure 2).

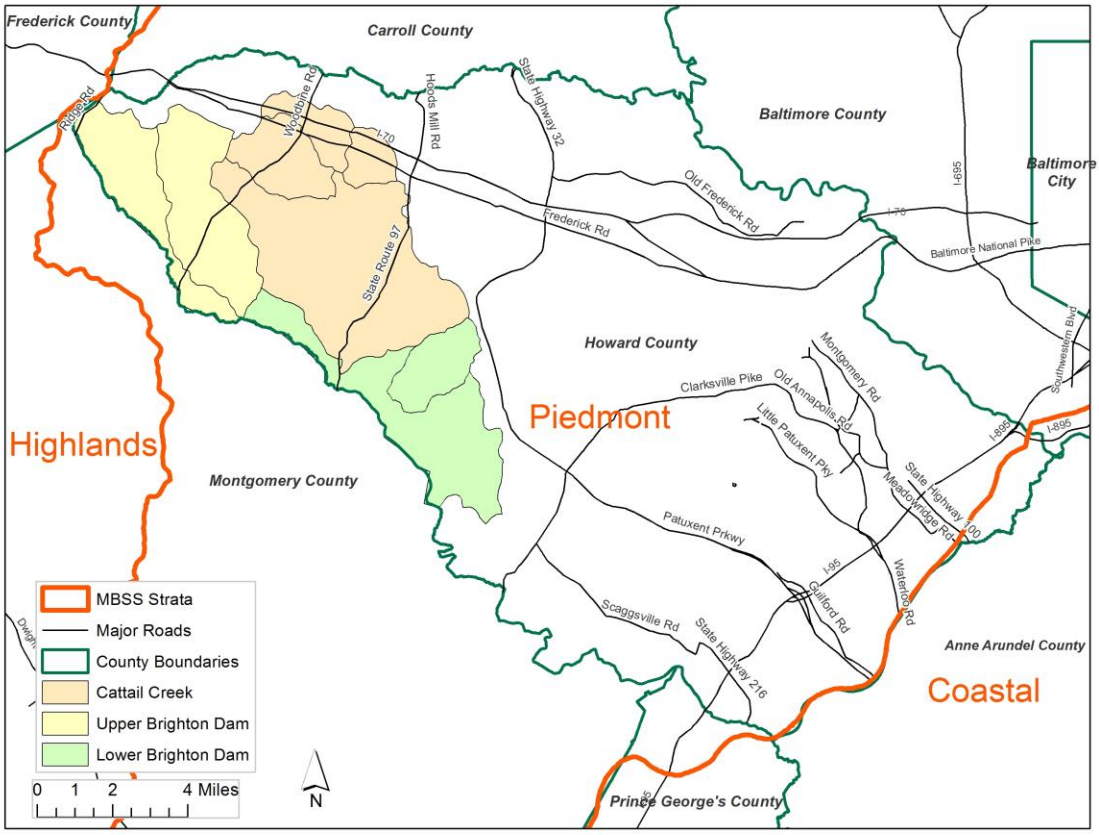

Figure 2 - Location Map of Cattail Creek, Upper Brighton Dam, and Lower Brighton Dam Watersheds

2 Methodologies

Stream monitoring was conducted throughout the watershed and involved measuring instream water quality, sampling and assessing the biological community (benthic macroinvertebrates), visually assessing the instream and riparian physical habitat, and performing cross sectional and substrate particle size measurement and analysis. Monitoring was conducted at 10 sites within each of the three PSUs (Upper Brighton Dam, Cattail Creek, and Lower Brighton Dam). The assessment methods followed the current MBSS protocols (DNR, 2017) and the SOPs described in the County's QAPP (DPW, 2001). All data collection occurred between March 21 and April 14, 2017, within the Spring Index Period (March 1 to April 30) as required by the MBSS sampling protocols. Monitoring sites were marked in the field using tree tags (when possible) or survey flagging at the upstream and downstream limits of the reach. The position of each site was collected at the midpoint using a GPS unit accurate to within 1 meter. All field data were entered into a laptop directly in the field. Photographs were taken to document conditions at the time of data collection. A summary of the methods used and the results of the monitoring are documented in this report.

2.1 Selection of Sampling Sites

The sampling design employed both a repeat and randomized census approach stratified by stream order, with a total of 30 sites distributed among the three PSUs. Ten sites were located in each subwatershed.

To select primary and alternate sampling sites, stream lengths were summed by stream order within each subwatershed. The length of stream by stream order and its percentage of the total length within the subwatershed determined the number of sites selected on that order stream.

To allow for direct comparison of results between sampling rounds, a total of four sites from Round One (2001), Round Two (2005), and Round Three (2012) were selected for resampling in each PSU. The remaining six sites in each PSU were randomly selected. The randomized approach was then applied within each subwatershed. The National Hydrography Dataset (NHD) stream layer was divided into 1-meter reaches and each reach was assigned a number. A random number generator was used to select sampling reaches for 2016. Both primary and alternate sites were selected in case the primary site was ephemeral (dry), inaccessible, or unsafe to sample. Site codes contain the PSU code (03), stream order (1), a two-digit sequential number (23), either an "R" or an "F" indicating that the site is a randomly selected site (i.e., R) or a fixed "revisit" site (i.e., F), the year sampled (2017) to create a unique site name (e.g., 03-123-F-2017).

Three additional biological samples were collected as quality assurance/quality control (QA/QC) samples at duplicate sites, one in each of the three subwatersheds. Biological sampling, habitat assessments and water quality measurements were repeated at the duplicate sites. These sites were selected in the field. Duplicate sampling reaches were the same length as the paired sampling sites (75 meters), were located immediately upstream of their paired sampling sites, had similar habitat characteristics and were not impacted by road crossings or confluences.

2.2 Impervious Surface and Land Use Analysis

An analysis was conducted to derive the impervious surface acreage, percent impervious, and land use make up for each of the site drainage areas to evaluate their effect on biological condition. Drainage areas were first delineated to each sampling site using a combination of ArcGIS Hydro tools and two-foot contours. Land use was derived from Maryland Department of Planning (MDP) 2010 land use for Howard County. Since the Patuxent River is a large watershed draining several counties, additional GIS data from Montgomery County was also used to delineate drainage areas and calculate imperviousness based on land use. Impervious values were derived primarily using Howard County's 2014 planimetric impervious surface layer which includes detailed polygons of roadways, rooftops, parking lots, sidewalks etc. A table with the percent of land use in each subwatershed and the calculated imperviousness is included in Appendix A.

2.3 Water Quality Sampling

To supplement the macroinvertebrate sampling and habitat assessment, instream water quality measurements were performed. Field water quality measurements were collected *in situ* at all sites according to methods in the County QAPP. Each parameter listed in Table 2 was recorded at the upstream portion of each sampling reach (including field QC sites). Most *in situ* parameters were measured using a YSI® Professional Plus series multiprobe water quality meter. Turbidity was measured with a Hach® 2100 Turbidimeter. Water quality meters were regularly inspected, maintained, and calibrated to ensure proper usage and accuracy of the readings. Calibration logs were kept by field crew leaders and checked by the project manager regularly.

The Maryland Department of the Environment (MDE) has established acceptable standards for several water quality parameters for each designated Stream Use Classification. These standards are listed in the *Code of Maryland Regulations (COMAR) 26.08.02.03-03 - Water Quality* (MDE, 1994). The

Upper Brighton Dam, Cattail Creek, and Lower Brighton Dam drainage areas are in *COMAR* Sub-Basin 02-13-11: Patuxent River Area. The Cattail Creek and Upper Bright Dam subwatersheds are classified as Use III-P, Nontidal Cold Water and Public Water Supply. The southern portion of the Lower Brighton Dam subwatershed is classified as Use IV-P, Recreational Trout Waters and Public Water Supply, while the northwestern portion upstream from Brighton Dam is classified as Use III-P, Nontidal Cold Water and Public Water Supply. The acceptable standards for Use III-P and IV-P streams are listed in Table 2. A comparison of these standards to data collected at each station is included in the site summary text in Section 3.1.

Table 2 - Water Quality Sampling and COMAR Standards, Use III-P and IV-P Waters

Parameter	Units	Acceptable COMAR Standard
pH	standard pH units	6.5 to 8.5
Temperature	degrees Celsius, °C	Use III-P: maximum of 68°F (20°C) or ambient temperature of the surface water, whichever is greater
		Use IV-P: maximum of 75°F (23.9°C) or ambient temperature of the surface water, whichever is greater
Dissolved Oxygen (DO)	milligrams per liter, mg/L	may not be less than 5 mg/L at any time
Conductivity	microSiemans per centimeter, µS/cm	no COMAR standard set
Turbidity	Nephelometer Turbidity Units, NTU	maximum of 150 NTUs and maximum monthly average of 50 NTUs

2.4 Biological Sampling

Biological monitoring was conducted throughout the Rocky Gorge, Hammond Branch, and Dorsey Run watersheds following methods detailed in the County's QAPP (DPW, 2001). Biological assessment methods within Howard County are designed to be consistent and comparable with the methods used by Maryland Department of Natural Resources (DNR) in their Maryland Biological Stream Survey (MBSS). The County has adopted the MBSS methodology to be consistent with statewide monitoring programs and programs adopted by other Maryland counties. The methods have been developed locally and are calibrated to Maryland's physiographic regions and stream types. Because MBSS methods dictate that habitat assessments occur during the Summer Index Period while sampling fish communities, which the County does not complete, physical habitat condition was assessed using the EPA's Rapid Bioassessment Protocol (RBP) (Barbour et. al, 1999) habitat assessment for high-gradient streams. Certain MBSS habitat parameters, namely percent shading, require full leaf out to accurately assess, which is often misrepresented during the Spring Index Period when leaves typically have not yet opened. However, it should be noted that MBSS physical habitat data is collected to supplement RBP data, and potentially for use in future investigations or comparisons. Locations of the bioassessment sites are shown in Figure 3 with the (NHD) stream layer.

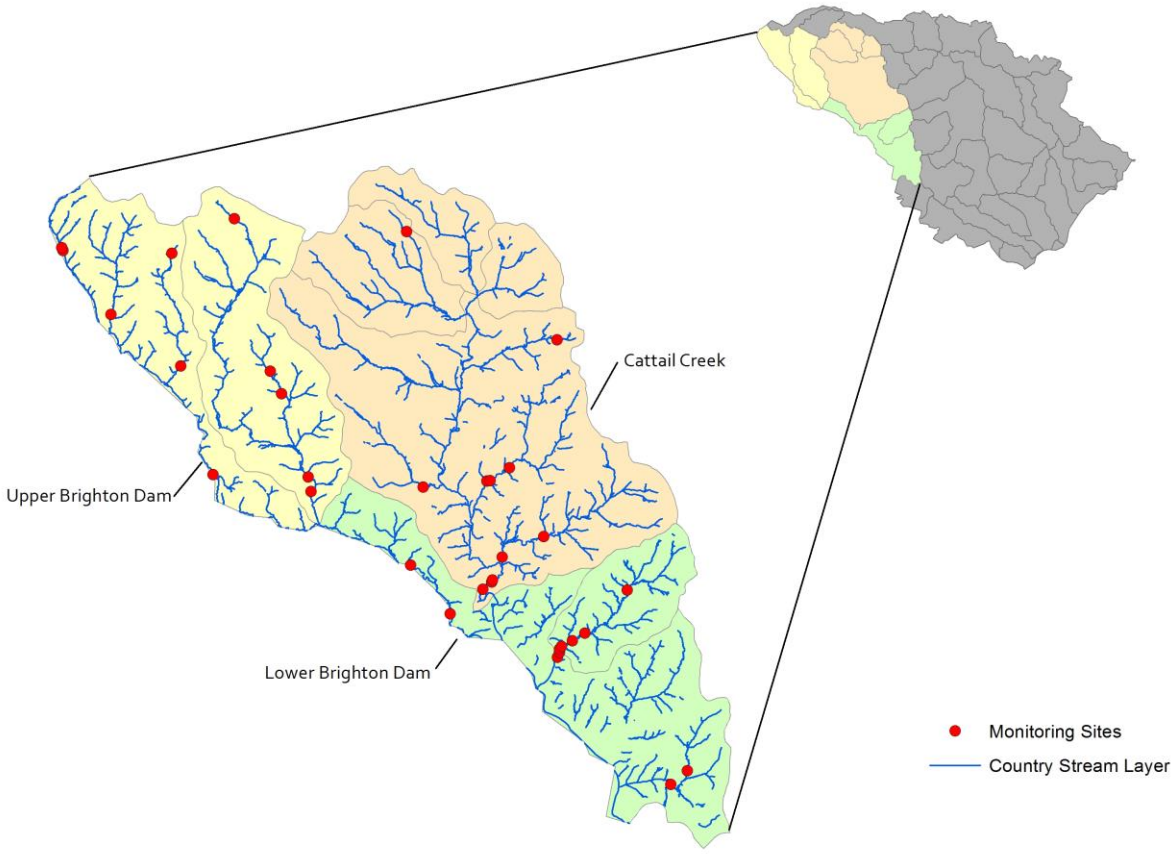

Figure 3 – Cattail Creek, Upper Brighton Dam, and Lower Brighton Dam Bioassessment Sampling Locations

2.4.1 Benthic Macroinvertebrate Sampling

Benthic macroinvertebrate collection followed the QAPP which closely mirrors MBSS procedures (DNR, 2017). Benthic macroinvertebrate sampling is conducted during the Spring Index Period (March 1st to April 30th) along a 75-meter reach. The multi-habitat D-frame net approach was used to sample a range of the most productive habitat types within the reach. In this sampling approach, a total of twenty jabs are distributed among the best available habitats within the stream system and combined into one composite sample. Sampled habitats include submerged vegetation, overhanging bank vegetation, leaf packs, mats of organic matter, stream bed substrate, submerged materials (i.e., logs, stumps, snags, dead branches, and other debris) and rocks.

2.4.2 Sample Processing and Laboratory Identification

Benthic macroinvertebrate samples were processed and subsampled according to methods described in the MBSS *Laboratory Methods for Benthic Macroinvertebrate Processing and Taxonomy* (Boward and Friedman, 2000). Subsampling is conducted to standardize the sample size and reduce variation caused by samples of different sizes. In this method the sample is spread evenly across a gridded tray

and each grid is picked clean of organisms until a count of 120 is reached. The 120-organism target is used to allow for specimens that are missing parts or are not a late enough instar for proper identification. If samples were sorted beyond the 120-organism target, the sample was spread in a petri dish subdivided into grids and re-subsampled by randomly selecting grids and counting all specimens in each grid until the sample was within an acceptable range.

The samples were sent to a lab (Aquatic Resources Center[1]) for processing and identification. Identification of the samples was conducted to the genus level for most organisms. Groups including Oligochaeta and Nematomorpha were identified to the family level while Nematoda was left at phylum. Individuals of early instars or those that were damaged were identified to the lowest possible level, which in most cases was family. Chironomidae was further subsampled depending on the number of individuals in the sample and the numbers in each subfamily or tribe. Most taxa were identified using a stereoscope. Temporary slide mounts were used to identify Oligochaeta to family with a compound scope. Chironomid sorting to subfamily and tribe was also conducted using temporary slide mounts. Permanent slide mounts were then used for final genus level identification. Results were logged on a bench sheet and entered into a spreadsheet for analysis.

2.4.3 Biological Data Analysis

Data were analyzed using methods developed by MBSS as outlined in the *New Biological Indicators to Better Assess the Condition of Maryland Streams* (Southerland et al., 2005). The Benthic Index of Biotic Integrity (BIBI) approach involves statistical analysis using metrics that have a predictable response to water quality and/or habitat impairment. The metrics selected fall into five major groups including taxa richness, taxa composition, tolerance to perturbation, trophic (feeding) classification and taxa habit.

Raw values from each metric are given a score of 1, 3 or 5 based on ranges of values developed for each metric. The results are combined into a scaled BIBI score ranging from 1.0 to 5.0, and a corresponding narrative rating is applied. Three sets of metric calculations have been developed for Maryland streams based on broad physiographic regions. These include the coastal plain, piedmont and combined highlands physiogeographic regions. The Upper Brighton Dam, Cattail Creek, and Lower Brighton Dam subwatersheds are all located in the piedmont physiogeographic region (see Figure 2).

The benthic metrics, scoring criteria, and individual species tolerance were updated by DNR in 2005. The data collected in the first round of sampling of the Upper Brighton Dam, Cattail Creek, and Lower Brighton Dam subwatersheds were analyzed using the old metrics (Stribling et. al 1998), and as such, the results were not directly comparable to the 2005, 2012, and 2017 sampling data. Therefore, all data from the 2001 sampling were recalculated using the updated metrics to allow for direct comparison to the current data (KCI, 2008). For this report, any mention of 2001 BIBI scores refer to these recalculated values.

The following metrics and BIBI scoring were used for data analysis:

Piedmont BIBI Metrics:

Number of Ephemeroptera Taxa – Equals the total number Ephemeroptera Taxa in the sample. Ephemeroptera are generally considered pollution sensitive, thus communities dominated by Ephemeroptera usually indicate lower disturbances in water quality.

[1] Address: 545 Cathy Jo Circle, Nashville, TN

Total Number of Taxa – Equals the richness of the community in terms of the total number of genera at the genus level or higher. A large variety of genera typically indicate better overall water quality, habitat diversity and/or suitability, and community health.

Number of EPT Taxa – Equals the richness of genera within the Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies). EPT taxa are generally considered pollution sensitive, thus higher levels of EPT taxa would be indicative of higher water quality.

Percent Intolerant Urban – Equals the percentage of individuals in the sample that are considered intolerant to urbanization (tolerance values [TV] = 0 – 3). The percent of intolerant urban is expected to decrease with decreasing water quality.

Percent Chironomidae – Equals the percentage of individuals in the sample that are in the Chironomidae family. An increase in the percentage of Chironomidae is generally an indicator of decreasing water quality.

Percent Clingers – Equals the percentage of the total number of individuals who are adapted to attaching to surfaces in stream riffles. Higher percentages of clingers are representative of a decrease in stressors and higher water quality.

Information on trophic or functional feeding group and habit were based heavily on information compiled by DNR and from Merritt and Cummins (1996). Scoring criteria for the piedmont BIBI is shown below in Tables 3. The raw metric value ranges are given with the corresponding score of 1, 3 or 5. Table 4 provides the BIBI scoring ranges and corresponding biological condition ratings.

Table 3 – Biological Index Scoring for Piedmont Benthic Macroinvertebrates

Metric	Score		
	5	3	1
Total Number of Taxa	≥25	15 – 24	<15
Number of EPT Taxa	≥11	5 – 10	<5
Number of Ephemeroptera Taxa	≥4	2 – 3	<2
Percent Intolerant Urban	≥51	12 – 50	<12
Percent Chironomidae	≤4.6	4.7 – 63	>63
Percent Clingers	≥74	31 – 73	<31

Table 4 – BIBI Scoring and Rating

BIBI Score	Narrative Rating
4.0 – 5.0	Good
3.0 – 3.9	Fair
2.0 – 2.9	Poor
1.0 – 1.9	Very Poor

2.5 Physical Habitat Assessment

Each biological monitoring site is characterized based on physical characteristics and various habitat parameters following the Environmental Protection Agency's Rapid Bioassessment Protocol (RBP)

habitat assessment for high gradient streams (Barbour et. al, 1999). The RBP habitat assessment consists of visually assessing ten biologically significant habitat parameters that evaluate a stream's ability to support an acceptable level of biological health. Each parameter is given a numerical score from 0-20 and a categorical rating of optimal, suboptimal, marginal or poor. The parameters assessed for high gradient streams are listed in Table 5.

Table 5 – RBP Habitat Parameters - High Gradient Streams

Parameters Assessed	
Epifaunal substrate/available cover	Channel alteration
Embeddedness	Frequency of riffles/bends
Velocity/depth regime	Bank stability
Sediment deposition	Vegetative protection
Channel flow status	Riparian vegetative zone width

The above parameters for each site (including QC sites) were summed to obtain a total habitat score. Since a reference score analysis has not been developed for Howard County watersheds, the percent comparability was calculated based on the highest attainable score (200). The percent of reference score, or percent comparability score, is then used to place each site into corresponding narrative rating categories as shown in Table 6.

Table 6 – RBP Habitat Score and Ratings

Percent of Reference	Narrative Rating
>90.0	Comparable to Reference
75.1 – 89.9	Supporting
60.1 – 75.0	Partially Supporting
<60.0	Non-supporting

2.6 Geomorphic Analysis

The goal of the physical monitoring was to create a geomorphic characterization of the stream channels in the watershed. Assessment techniques include the cross sectional survey, substrate particle size analysis and measurement of channel slope.

2.6.1 Cross Section Analysis

Cross sections were surveyed at each monitoring station to develop a channel characterization and measurement of cross sectional area and discharge. Methods followed the Howard County SOP. Each cross section was located on a representative cross-over reach and was surveyed with a laser level and stadia rod.

The cross sections include survey of the floodplain and all pertinent channel features including:

- Top of bank
- Bankfull elevation
- Edge of water
- Limits of point and instream depositional features
- Thalweg
- Floodprone elevation

Sinuosity was calculated based on the length of the field-surveyed profile and the straight-line distance between the top and bottom of each profile. The floodprone width is estimated at an elevation two times the bankfull depth.

Where possible, additional survey points were taken near the upstream, midpoint, and downstream end of the sampling reach to obtain the slope through the reach so that estimates of discharge could be derived. Survey points for slope calculations were typically taken at the top of riffle features, although this was not always possible, especially for sampling reaches on the Patuxent River mainstem that contained only one riffle in the vicinity of the sampling reach.

The stream cross section, bed and bank material data and profile information (including slope) were analyzed using the Ohio Department of Natural Resources Reference Reach Spreadsheet Version 4.3L (Mecklenburg, 2006). The following values and ratios were calculated:

Sinuosity	Entrenchment ratio	Bankfull cross section area
Slope	Bankfull height	Velocity
Floodprone width	Bankfull width	Discharge
Width / depth ratio	Mean depth	Shear stress

2.6.2 Particle Size Analysis

The channel bed and bank materials were characterized at each cross section using pebble count analysis. A single pebble count, modified from the technique developed by Wolman (1954), was conducted in each reach to determine the composition of channel materials and the median particle size for each site. The pebble count procedure was adapted from *Stream Channel Reference Sites: An Illustrated Guide to Field Technique* (Harrelson et al, 1994). The pebble count was conducted at 10 transects across the entire assessment reach. Transects were positioned based on the proportion of riffles/pools/runs in the assessment reach as estimated by visual inspection. The count was conducted within the entire bankfull channel. The pebble counts provide roughness values necessary for calculations of velocity and discharge.

2.6.3 Rosgen Classification

Additionally, a Rosgen Level II characterization (Rosgen, 1996) was completed for each stream reach based on field-collected data. Table 7 includes general descriptions for each channel type classification based on the Rosgen classification system for natural rivers (Rosgen, 1996).

Table 7 – Rosgen Level II Channel Type Description

Channel Type	General Description (from Rosgen, 1996)
Aa+	Very steep, deeply entrenched, debris transport, torrent streams.
A	Steep, entrenched, confined, cascading, step/pool streams. High energy/debris transport associated with depositional soils. Very stable if bedrock or boulder dominated channel.
B	Moderately entrenched, moderate gradient, riffle dominated channel with infrequently spaced pools. Moderate width/depth ratio. Narrow, gently sloping valleys. Very stable plan and profile. Stable banks.
C	Low gradient, meandering, slightly entrenched, point-bar, riffle/pool, alluvial channels with broad, well-defined floodplains.
D	Braided channel with longitudinal and transverse bars. Very wide channel with eroding banks. Active lateral adjustment, high bedload and bank erosion.
DA	Anastomosing (multiple channels) narrow and deep with extensive, well-vegetated floodplains and associated wetlands. Very gentle relief with highly variable sinuosities and width/depth ratios. Very stable streambanks.
E	Low gradient, Highly sinuous, riffle/pool stream with low width/depth ratio and little deposition. Very efficient and stable. High meander/width ratio.
F	Entrenched, meandering riffle/pool channel on low gradients with high width/depth ratio and high bank erosion rates.
G	Entrenched "gully" step/pool and low width/depth ratio on moderate gradients. Narrow valleys. Unstable, with grade control problems and high bank erosion rates.

3 Results

3.1 Subwatershed Summaries

A total of 30 sites were sampled in the Upper Brighton Dam, Cattail Creek, and Lower Brighton Dam subwatersheds, ten within each individual subwatershed. Additionally, one biological QA/QC sample was collected in each subwatershed at stations where upstream habitat was considered similar. The summary results of the habitat assessment, biological assessment, land use, and Rosgen characterization (Rosgen, 1996) are divided among the three subwatersheds and presented in detail in this section. Maps of each subwatershed displaying the results of the RBP habitat assessment and BIBI are presented in Figures 4, 5 and 6. Summary data for each PSU is included in Tables 8, 9 and 10. Full data results are displayed in Appendices A through F.

3.1.1 Upper Brighton Dam

In 2017, six of the ten sampling sites in the Upper Brighton Dam subwatershed were on first order streams, three were on second order streams, and one was on a third order stream. The field QC sample was collected at site 02-121-F-2017. The subwatershed had an average BIBI score of 3.97 and a 'Fair' condition rating, with scores ranging from 2.67 to 4.67. The average RBP habitat assessment comparability score was 66, or 'Partially-Supporting', with scores ranging from 53 ('Non-supporting') to 83 ('Supporting'). Channels were generally classified as Rosgen type B, C, F, or G types with predominantly gravel substrate. A summary of the results for the Upper Brighton Dam subwatershed is found in Table 8.

Upper Brighton Site Descriptions:

02-103-R-2017
This site is located behind a residential property on Cabin Branch, a tributary to the Patuxent River northwest of Brighton Dam. Gravel was the dominant substrate type of this B4c channel. Within the 650-acre drainage area, the predominant land use is agriculture (61.1%) followed by forest (28.9%), and low density residential (10.0%). Impervious land cover accounted for 3.7% of the drainage area, in line with the subwatershed average of 3.6%. This site received the highest RBP physical habitat assessment score out of all 2017 sites sampled, with a score of 82.5 and a rating of 'Supporting'. Raw, eroded banks were observed upstream and downstream of the site, however the banks within the site were observed to be stable with suboptimal benthic substrate. The right bank was forested and the left bank was an old pasture with large trees but no understory present. The PHI score was 73.1 with a rating of 'Partially Degraded'. There were a total of 34 taxa in the benthic macroinvertebrate sample with 14 EPT taxa present. A third of the sample (33%) consisted of individuals intolerant to urban stressors. This station had 25% of sampled individuals in the Chironomidae family (midges). This station received an overall BIBI score of 4.0 and a 'Good' biological classification. Water quality results indicated all parameters were within acceptable COMAR standards.

02-104-R-2017
This site is located on an unnamed B4c stream that drains into the Patuxent River in the western extent of the subwatershed. The site is surrounded by forest, agriculture, and low density wooded residential properties. Water quality results indicated no parameters exceeding acceptable COMAR standards. At 86 acres, this site had the smallest drainage area of the subwatershed, and had 2.9% impervious land cover. The predominant land use is agriculture (67.1%) followed by low density residential (28.7%) and forest (4.2%). RBP habitat was rated as 'Partially Supporting' and received a comparability score of 65.5 due to marginal habitat and bank stability. The reach received a PHI score of 55.7, rating it as 'Degraded'. Gravel was the dominant substrate types for this sampling reach. The station received an overall BIBI score of 4.00 and a 'Good' classification. This is a result of the benthic macroinvertebrate sample consisting of a total of 22 taxa, with nine (9) EPT taxa and four Ephmemeroptera taxa present as well as a high percentage of individuals intolerant to urban stressors (55%).

02-106-R-2017
This sampling reach is located on a F4 stream in Patuxent River State Park. The surrounding area is primarily forested. The site was predominately gravel substrate. The drainage area to this site is 1,021 acres. Agricultural land use accounts for 46.6%, followed by forest (33.9%) and low density residential at 19.5%. Impervious land cover accounted for 3.9% of the drainage area, in line with the subwatershed average of 3.6%. Water quality results indicated all parameters were within acceptable COMAR standards. The RBP habitat assessment indicated a 'Partially Supporting' habitat with a comparability score of 70.5 due to eroded meander bends resulting in poor bank stability scores on the right bank. The PHI score was 71.2, with a narrative rating of 'Partially Degraded'. The station received an overall BIBI score of 4.33 and a 'Good' classification. There were a total of 32 taxa present in this benthic macroinvertebrate sample including 15 EPT taxa. This station also had 44% individuals intolerant to urban stressors, while having 23% tolerant Chironomids (midges).

02-107-R-2017
This site is located on a small, incised G 4/6 headwater stream with a substrate consisting of mostly gravel and silt/clay. The surrounding 129 acres drainage area consists primarily of forest and agriculture. Agriculture land use accounts for 83.0% of the drainage area, followed by low density residential at 13.3%, and forest land cover at 3.7%. Impervious land cover for this subwatershed, is 4.6%, only slightly higher than the subwatershed average of 3.6%. This site received an RBP habitat score of 53.0 with a rating of 'Non- supporting'. The PHI score was the lowest of the subwatershed (48.3), with a rating of 'Severely Degraded'. Water quality results indicated all parameters within acceptable COMAR standards. Although there were 28 taxa present in the benthic macroinvertebrate sample, only five (5) EPT taxa were present. Furthermore, only 16% percent of the individuals were intolerant to urban stressors, and almost half (47%) of the individuals were Chironomids (midges). As a result, this site received the lowest BIBI score of the watershed of 2.67 with a narrative rating of 'Poor'.

02-121-F-2017
This site is located on the headwaters of the Patuxent River within the Patuxent River State Park. This stream was classified as a F4 channel with predominately gravel substrate. Within the 670-acre drainage area, the predominant land use is forest (31.7%) followed by agriculture (30.0%), low density residential (20.2%), and open urban land (13.2%). The high percentage of low density residential land use results in a drainage area with 5.1% imperviousness, the highest of all Upper Brighton Dam sites. Poor and marginal bank stability and vegetative protection, and marginal and suboptimal sediment deposition and velocity/depth regime resulted in a RBP habitat score of 67.0 and a rating of 'Partially Supporting'. The PHI was scored at 54.1 with a narrative rating of 'Degraded'. The benthic macroinvertebrate sample contained 34 taxa, 13 of which were EPT taxa. Chironomids (midges) accounted for only 18% of the sample, while 62% consisted of individuals intolerant to urban stressors. Based on the BIBI score of 4.33, this site was given a 'Good' biological condition rating. Water quality results indicated all parameters within acceptable COMAR standards. A QC sample was completed in the adjacent 75-meters reach upstream of this site, where water conditions and habitat resembled the original reach. The QC reach received an identical BIBI score of 4.33, resulting in a 'Good' biological condition rating. RBP habitat was also conducted at the QC site which received a score of 65.0 and a rating of 'Partially Supporting'. The PHI score at the QC reach was 58.5, with a narrative rating of 'Degraded'.

02-123-F-2017
This sampling reach is located in the upstream portion of Cabin Branch, just south of Woodbine Rd (Route 94). The reach is classified as a F4 channel, with a substrate predominately consisting of gravel. Of the 460-acre drainage area, 3.7% was comprised of impervious land cover. Land use in the drainage area is primarily agriculture and forested land cover (55.0% and 33.2%, respectively) followed by low density residential (11.8%). This site was given a PHI score of 68.3 and a rating of 'Partially Degraded'. This site received a RBP score of 67.0, resulting in a rating of 'Partially Supporting'. The water quality results indicated no parameters that exceeded acceptable COMAR standards. There were a total of 28 taxa in the benthic macroinvertebrate sample, nine (9) of which were EPT taxa. The sample was comprised of 32% Chironomids (midges) and 26% of the sample consisted of individuals intolerant to urban stressors. The overall BIBI score was 3.67 for this site, resulting in a 'Fair' biological condition rating.

02-201-R-2017
This site, located on the downstream end of Cabin Branch just above where it meets the Patuxent River, was classified as a C4 channel with predominately gravel substrate. This reach was very straight with no meander bends. At 5,527 acres, this site had the second largest drainage area for the entire Upper Brighton Dam subwatershed with 3.5% of the drainage area consisting of impervious

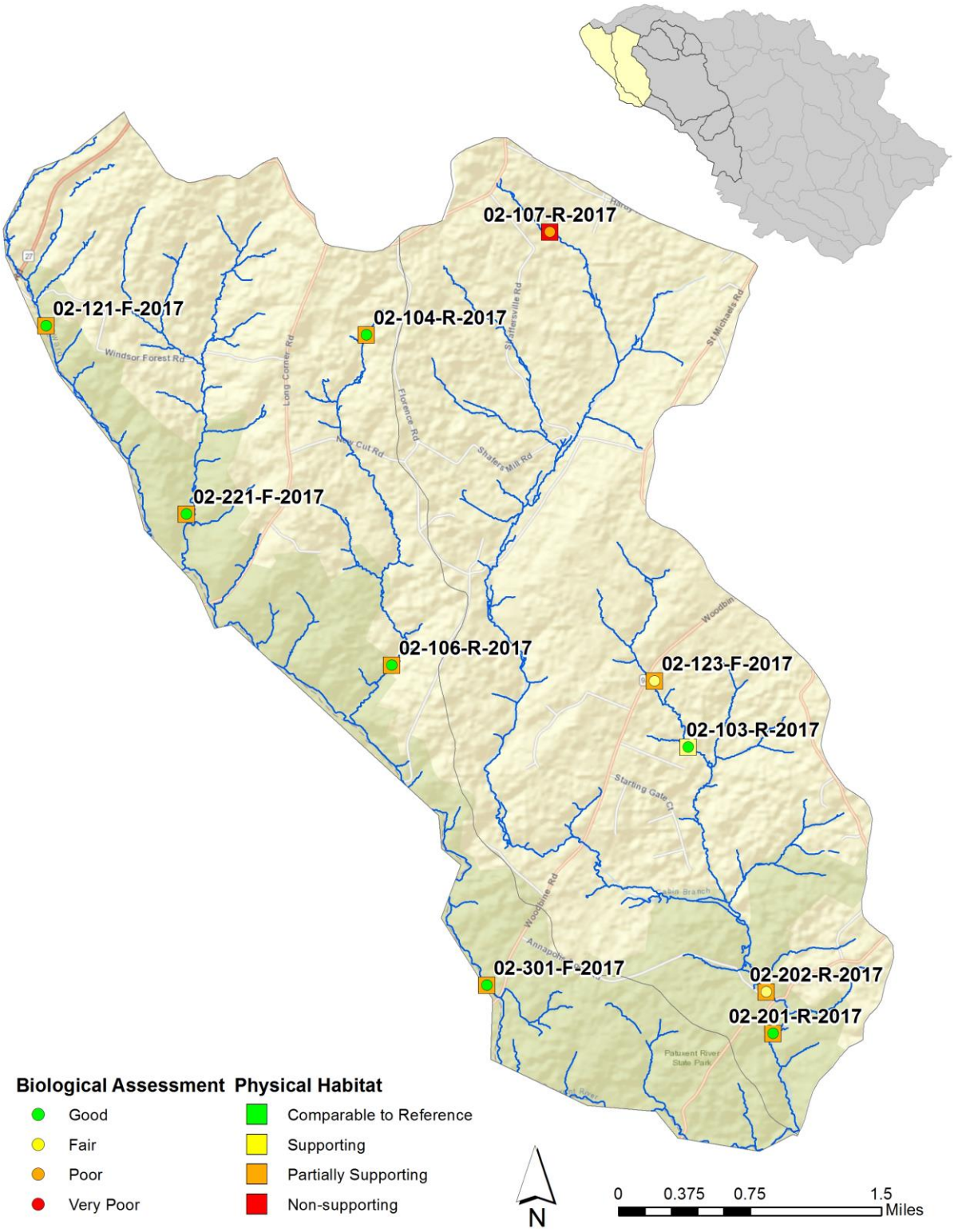

Figure 4 – Upper Brighton Dam PSU Sampling Results

land cover. This drainage area consisted primarily of agriculture (53.5%) and forested land cover (31.5%) followed by low density residential (14.5%). This site received a PHI score of 68.4 and a rating of 'Partially Degraded'. Poor bank stability and vegetative protection scores resulted in a RBP habitat score of 65.5 and a rating of 'Partially Supporting'. Water quality results indicated all parameters fell within acceptable COMAR standards. This station received a BIBI rating of 'Good' with a score of 4.00. Thirty-two total taxa were present in this benthic macroinvertebrate sample, 11 of which were EPT taxa and five of which were Ephemeroptera taxa. Twenty-two percent of the sample consisted of individuals intolerant to urban stressors. The benthic sample consisted of 62% clingers and 51% tolerant midges.

02-202-R-2017

This sampling reach is located just upstream from 02-201-R-2017 on Cabin Branch just north of Hipsley Mill Road. The reach had vertical, eroded banks and a debris jam was present at approximately 25 meters. The predominant land use is agriculture (54.4%), followed by forested land cover (30.5%) and low density residential (14.6%). Of the 5,338-acre drainage area, 3.4% was comprised of impervious land cover. This site received a PHI score of 61.3 resulting in a rating of 'Degraded'. Classified as a C4 channel, this sampling reach was primarily gravel and silt/clay substrate. Poor bank stability and vegetative protection scores resulted in a RBP habitat score of 68.5 and a rating of 'Partially Supporting'. There were a total of 30 taxa present in this benthic macroinvertebrate sample, consisting of 10 EPT taxa and five Ephemeroptera. Twenty-eight percent of the sample consisted of midges, 25% were intolerant to urban stressors, and 70% were clingers, resulting in a BIBI score of 3.67 with a rating of 'Fair'. Water quality results indicated all parameters were within acceptable COMAR standards.

02-221-F-2017

This site is located on an unnamed tributary to the Patuxent River mainstem within a heavily forested portion of Patuxent River State Park. This reach was classified as a F4 channel type with a predominately gravel and sand substrate. Land use in the 1,128-acre drainage area is primarily forest (52.0%) and agriculture land cover (44.8%), with the remainder as low density residential (3.2%). The overall imperviousness in this drainage area is 2.0%, which is the lowest of all Upper Brighton Dam subwatershed sites. Poor and marginal bank stability, vegetative protection, and sediment deposition scores resulted in a RBP habitat assessment score of 60.5 and a rating of 'Partially Supporting'. For PHI, a score of 59.2 and a rating of 'Degraded' was given. Water quality results indicated no parameters that exceeded acceptable COMAR standards. There were a total of 25 taxa in the sample. Within the benthic sample, nine EPT taxa and five Ephemeroptera taxa were present. Sixty-four percent of the individuals were intolerant to urban stressors and only 12% of individuals were of the Chironomidae family (midges). Because of the high percentage of intolerant taxa present, this site received a BIBI score of 4.67 and a biological rating of 'Good'.

02-301-F-2017

This sampling reach is located in a third-order section of the Patuxent River mainstem, upstream of Route 94, within the Patuxent River State Park. At 8,834 acres, this site has the largest drainage area of all sites within the Upper Brighton Dam subwatershed. The primary land use is agriculture (44.0%) followed by forested land cover (42.5%), and low density residential (10.2%), which resulted in 3.6% imperviousness. This reach was classified as a C4 channel and the substrate was dominated by gravel. Poor bank stability and vegetative protection scores resulted in a RBP habitat score of 63.0 and a rating of 'Partially Supporting'. A PHI score of 57.9 and rating of 'Degraded' was given to this site. Based on the BIBI score of 4.33, this site was given a 'Good' biological condition rating. In this benthic macroinvertebrate sample, 34 taxa were present, the most of all Upper Brighton Dam watershed sites. Of the 34 taxa, 13 were EPT taxa, four of which were Ephemeroptera. Individuals of

Table 8 – Upper Brighton Summary

Site ID	Drainage Area (ac)	Impervious Surface Percent	BIBI Score	BIBI Rating	RBP Comparability Score	RBP Rating	PHI Score	PHI Rating	Rosgen Channel Type
02-103-R-2017	650	3.7	4.0	Good	82.5	Supporting	73.1	Partially Degraded	B4c
02-104-R-2017	86	2.9	4.0	Good	65.6	Partially Supporting	55.7	Degraded	B4c
02-106-R-2017	1,021	3.9	4.33	Good	70.5	Partially Supporting	71.2	Partially Degraded	F4
02-107-R-2017	129	4.6	2.67	Poor	53.0	Non-supporting	48.3	Severely Degraded	G4/6
02-121-F-2017*	670	5.1	4.33	Good	67.0	Partially Supporting	54.1	Degraded	F4
02-123-F-2017	460	3.7	3.67	Fair	67.0	Partially Supporting	68.3	Partially Degraded	F4
02-201-R-2017	5,527	3.5	4.0	Good	65.5	Partially Supporting	68.4	Partially Degraded	C4
02-202-R-2017	5,338	3.4	3.67	Fair	68.5	Partially Supporting	61.1	Degraded	C4
02-221-F-2017	1,128	2.0	4.33	Good	60.5	Partially Supporting	59.2	Degraded	F4
02-301-F-2017	8,834	3.6	2.67	Good	63.0	Partially Supporting	57.9	Degraded	C4
Minimum	86	2.0	2.67	Poor	53.0	Non-supporting	48.3	Degraded	--
Maximum	8,834	5.1	4.67	Good	82.50	Supporting	73.1	Partially Degraded	--
Mean	2,384	3.6	3.97	Fair	66.3	Partially Supporting	61.7	Partially Degraded	--
Standard Deviation	3,049	0.01	0.55	--	7.5	--	8.2	--	--

*QC sampling was conducted at this site

the Chironomidae family (midges) made up only 16% of the sample, and individuals intolerant to urban stressors accounted for 26% of the sample. Water quality results indicated all parameters were within acceptable COMAR standards.

3.1.2 Cattail Creek

Seven of the ten sites sampled in 2017 within the Cattail Creek PSU were on first order streams as defined by the NHD stream layer, one site was on a second order stream, and two sites were on third order streams. The field QC sample was collected immediately upstream of site 03-301-R-2017. RBP habitat assessment scores ranged from 49.0, with a classification of 'Non-supporting' to 79.0 and a classification of 'Supporting'. The mean RBP habitat score was 61.9 with a rating of 'Partially Supporting'. There were only two sites that received biological condition ratings of 'Good', with scores of 4.00. Six sites received 'Fair' scores that ranged from 3.33 to 3.67. The remaining two sites received 'Poor' scores that ranged from 2.00 to 2.33. The mean BIBI score was 3.30, with an average biological condition rating of 'Fair'. Stream reaches were classified as either B, C, G, or F channels, with bedrock, gravel, sand, or silt/clay dominated substrates. A summary of the results for the Cattail Creek subwatershed is found in Figure 5 and Table 9.

Cattail Creek Site Descriptions:

03-102-R-2017
This site is located on Little Cattail Creek and is approximately 50 meters away from the edge of the golf course on Cattail Creek Country Club property. This reach was classified as a F4/6 channel with silt/clay and gravel substrate. Water quality results indicated no parameters that exceeded acceptable COMAR standards. The land use within the 1,866-acre drainage area is predominantly agriculture (43.4%) followed by low density residential (27.0%) and forest (20.4%). The percentage of impervious surface in the drainage area is 8.1%, which is above the subwatershed average of 6.9%. This sampling reach received poor bank stability and vegetative protection scores, and as a result, this site received an RBP habitat a score of 60.0 and a rating of 'Partially Supporting'. A PHI score of 56.2 was given to this site, resulting in a rating of 'Degraded'. The BIBI score was 3.33, with a biological rating of 'Fair'. Of the 34 taxa present, nine EPT taxa and three Ephemeroptera were present, with 35% of the sampling comprising individuals intolerant to urban stressors. The majority of the sample (73%) consisted of clingers.

03-103-R-2017
Located in a forested area immediately upstream from site 03-102-R-2017, this site is approximately 50 meters from a paved golf course road on Cattail Creek Country Club property. This sampling reach is a F4/5 channel. The predominant substrate of this stream is gravel, sand, and silt/clay. Poor bank stability and vegetative protection attributed to the RBP habitat assessment rating of 'Partially Supporting' with a score of 62.0. The PHI score was 57.3, resulting in a rating of 'Degraded'. A total of 8.1% of the 1,818 acre drainage area consists of impervious land cover, above the subwatershed average. The dominant land use for this drainage area is agriculture (44.6%) followed by low density residential (27.6%) and forested land cover (20.9%). There were 25 taxa in the benthic macroinvertebrate sample, eight of which were EPT taxa and three of which were Ephemeroptera. Thirty-eight percent of the individuals in this sample were of the Chironomidae family (midges), while 71% of the sample consisted of clingers and 25% consisted of individuals intolerant to urban stressors. Overall, this site received a BIBI score of 3.33 with a narrative rating of 'Fair'. Water quality results indicated all parameters were within acceptable COMAR standards.

03-104-R-2017
This site is on a forested property owned by Cattail Creek Country Club adjacent to a low density residential neighborhood. A stormwater management facility is present on the right bank and outfalls to the middle of the reach. There was a large debris jam present within the lower one-third of the sample reach. Classified as a F4/5channel, the dominant substrates for this sampling reach are sand and gravel. Of the 1,602 acres, impervious surfaces comprised 8.0% of the drainage area. Agriculture is the predominant land use in this drainage area (47.5%) followed by low density residential (28.1%) and forested land cover (18.9%). Physical habitat was rated as 'Partially Supporting' and received a RBP habitat score of 63.0 due to unstable banks and poor vegetative protection. A PHI score of 66.0 resulted in a 'Degraded' condition rating. Water quality results indicated no parameters that exceeded acceptable COMAR standards. There were 29 taxa in this benthic macroinvertebrate sample with eight EPT taxa and four Ephemeroptera taxa present. Seventy-one percent of the sample consisted of clingers, 34% of individuals intolerant to urban stressors, and 28% individuals of the Chironomidae family (midges), resulting in a score of 3.67 and a corresponding biological condition rating of 'Fair'.

03-108-R-2017
Located in the headwaters of Cattail Creek, southwest of the intersection of Route 97 and Route 144, this sampling reach was classified as a B5c channel with a predominately sand substrate. This reach begins at a road culvert at Millers Mill Road. The majority of the surrounding land use in the 95-acre drainage area is agriculture (46.2%) followed by low density residential (23.2%) and forested land cover (26.9%). Impervious surface accounted for 6.5% of the drainage area, which is in line with the subwatershed average of 6.9%. This reach had poor instream habitat, embeddedness, sediment deposition, frequency of riffles, and therefore received the second lowest habitat comparability score of all 2017 sites of 49.0, and a 'Not Supporting' habitat rating. The PHI score was 34.7 with a rating of 'Severely Degraded'. This sampling reach also received a BIBI score of 2.33 and a biological rating of 'Poor'. Of the 21 taxa present in the sample, five were EPT taxa and only one of which was Ephemeroptera. Individuals of the Chironomidae family (midges) made up the majority of this sample (61%) and only 19% of the sample consisted of individuals intolerant to urban stressors. Water quality results indicated all parameters were within COMAR standards.

03-113-R-2017
This site is located on a highly incised portion of Lisbons Little Creek southwest of the intersection of Route 94 and Route 144. The channel was characterized as a G6 channel with predominately silt/clay and sand substrate. Very little buffer was present on the left bank due to the proximity to Route 144. While no water quality parameters exceeded acceptable COMAR standards, slightly elevated conductivity (410.2 µS/cm) was measured at this site. The predominant land use in this drainage area is classified as agriculture (71.8%) with the remainder classified as low density residential accounting for 28.1%. The overall imperviousness within the 96-acre drainage area is 5.2%, which is below the subwatershed average of 6.9%. Because of marginal and poor scores for habitat, velocity/depth diversity, channel flow status, frequency of riffles, bank stability, vegetative protection, and right bank riparian width (facing downstream), this sampling reach received a RBP score of 57.0 and corresponding rating of 'Not Supporting'. The PHI score was 42.0, which results in a rating of 'Severely Degraded'. Of the 21 taxa present in this benthic macroinvertebrate sample, three EPT taxa were present, only one of which was Ephemeroptera taxa. Additionally, chironomids (midges) accounted for 34% of the sample and 14% consisted of individuals tolerant to urban stressors. This site received the lowest BIBI scores within this subwatershed with a score of 2.00 and a narrative rating of 'Poor'.

03-123-F-2017
This sampling site is located on an unnamed tributary to Cattail Creek in a forested area east of Daisy Rd. The reach was classified as a B1 channel dominated by gravel and bedrock. In the 1,315-acre drainage area to this site, the majority of the surrounding land use is agriculture (71.3%) and forest land cover (18.9%), with the remainder classified as low density residential (9.4%). The percentage of impervious surface in the drainage area is 4.7%, which is the lowest of all Cattail Creek subwatershed sites. All water quality parameters were within COMAR limits. This site received the second highest RBP score of all 2017 sites (81.5) with a rating of 'Supporting' and a PHI score of 67.3 and rating of 'Partially Degraded'. This benthic macroinvertebrate sample had a high number of taxa (35) and EPT taxa (16), eight of which were Ephemeroptera. Forty percent of the sample consisted of individuals intolerant to urban stressors, and 58% of the sample were clingers. The Chironomidae family (midges) made up 26% of the sample. As a result of a large percentage of individuals intolerant to urban stressors, this site received a BIBI score of 4.00 and a narrative rating of 'Good'.

03-124-F-2017
This site was located on an incised portion of Dorsey Branch, adjacent to the Cattail Creek Country Club golf course. Classified as a B5/4c channel, the substrate of this sampling reach consisted of sand, gravel, and silt/clay. This site has a drainage area of 184 acres, 8.1% of which is impervious surface. Low density residential land use dominates this drainage area at 83.7%, followed by open urban land (10.8%) and agriculture (3.6%), which results in 8.1% impervious land cover. No water quality parameters exceeded acceptable COMAR standards. The PHI score was 47.1 with a rating of 'Severely Degraded'. The RBP habitat assessment indicated a 'Partially Supporting' habitat with a score of 62.5. A total of 31 taxa were present in this benthic macroinvertebrate sample. Eight EPT taxa and two Ephemeroptera were present. Almost half of this sample consisted of chironomids (midges), accounting for 42% of the sample and 24% were individuals intolerant to urban stressors. Overall, this sample received a BIBI score of 3.33, with a rating of 'Fair'.

03-221-F-2017
Located on the East Branch Cattail Creek in a forested buffer between two neighborhoods east of Route 97, this sampling reach was classified as a F5/6 channel dominated by sand and silt/clay substrate. A debris jam was present at the downstream end of the site. Water quality results indicated no parameters that exceeded acceptable COMAR standards. As a result of poor instream habitat, embeddedness, and bank stability, this site received a RBP habitat score of 56.5 with a rating of 'Not Supporting'. A PHI score of 44.2 resulted in a rating of 'Severely Degraded'. In this 2,751-acre drainage area, low density residential was the predominant land use (39.3%) followed by agriculture (42.5%) and 13.8% consisting of forested land cover. The overall impervious drainage is 8.0%, which is above the subwatershed average. This site received a BIBI score of 3.67 with a narrative rating of 'Fair'. There were 25 taxa in this benthic macroinvertebrate sample, eight of which were EPT taxa and five Ephemeroptera taxa were present. The Chironomidae family (midges) made up 63% of the sample, while only 19% of this sample consisted of individuals intolerant to urban stressors and 73% of the sample consisted of clingers.

03-301-R-2017
This site is located on Cattail Creek upstream from Triadelphia Reservoir in a riparian zone east of Route 97. A two-meter section of the bottom of the channel was concrete lined where a walking path crossed the middle of the reach and approximately two meters of gabion is present on the right bank just upstream from this crossing. There is also a debris jam at the downstream end of the site. This sampling reach was classified as a C4 channel. Gravel and sand are the dominate substrate types for this channel. At 17,734 acres, this is the second largest drainage area of this subwatershed. Agriculture was the predominant land use (54.0%), followed by forest (21.9%) and low density residential (20.5%). The overall impervious drainage is 6.1%, which is slightly lower the subwatershed average.

RBP Habitat was rated as 'Partially Supporting' with a score of 65.0. The PHI score was 69.2, which resulted in a rating of 'Partially Degraded'. While there was a moderately high number of total taxa (31), there was a low number of EPT taxa present (eight), and only three Ephemeroptera taxa present in the benthic macroinvertebrate sample. Chironomids (midges) made up 34% of the sample. Eighteen percent of this sample was comprised of individuals intolerant to urban stressors. This site received a BIBI score of 3.33, which resulted in a 'Fair' biological condition rating. Water quality results indicated all parameters were within acceptable COMAR standards. A QC sample was completed in the adjacent 75-meters reach upstream of this site, where water conditions and habitat resembled the original reach. The QC reach received a BIBI score of 4.00, resulting in a 'Good' biological condition rating. RBP habitat was also conducted at the QC site which received a score of 67.0 and a rating of 'Partially Supporting'. The QC reach received a PHI score of 61.3, which resulted in a rating of 'Degraded'.

03-321-F-2017

This site is located on Cattail Creek immediately upstream from Triadelphia Reservoir, and downstream from site 03-301-R-2017 in a riparian zone east of Route 97. This site had raw, vertical eroded banks and consisted primarily of pool and glide features, with only one small riffle at the downstream end. This sampling reach was classified as a C4 channel with a mix of gravel and silt/clay substrates. Water quality results indicated all parameters within acceptable COMAR standards. Because of poor bank stability and vegetative protection scores, this reach received a habitat comparability score of 64.5 with a 'Partially Supporting' classification. A PHI score of 56.3 and corresponding 'Degraded' rating was applied to this reach. At 17,777 acres, this is the largest drainage area of this subwatershed. Over half of the land use is agricultural land use (53.4%), with an additional 22.1% as forested land cover and 20.4% as low density residential. The overall impervious drainage is 6.1%, which is slightly lower than the subwatershed average. This sample had the highest total taxa identified of all 2017 sites (37), with twelve EPT taxa and six Ephemeroptera taxa. Individuals of the Chironomidae family (midges) dominated this sample at 48%. Sixteen percent of this sample consisted of individuals intolerant to urban stressors. The site received a BIBI score of 4.00 with a corresponding biological rating of 'Good'.

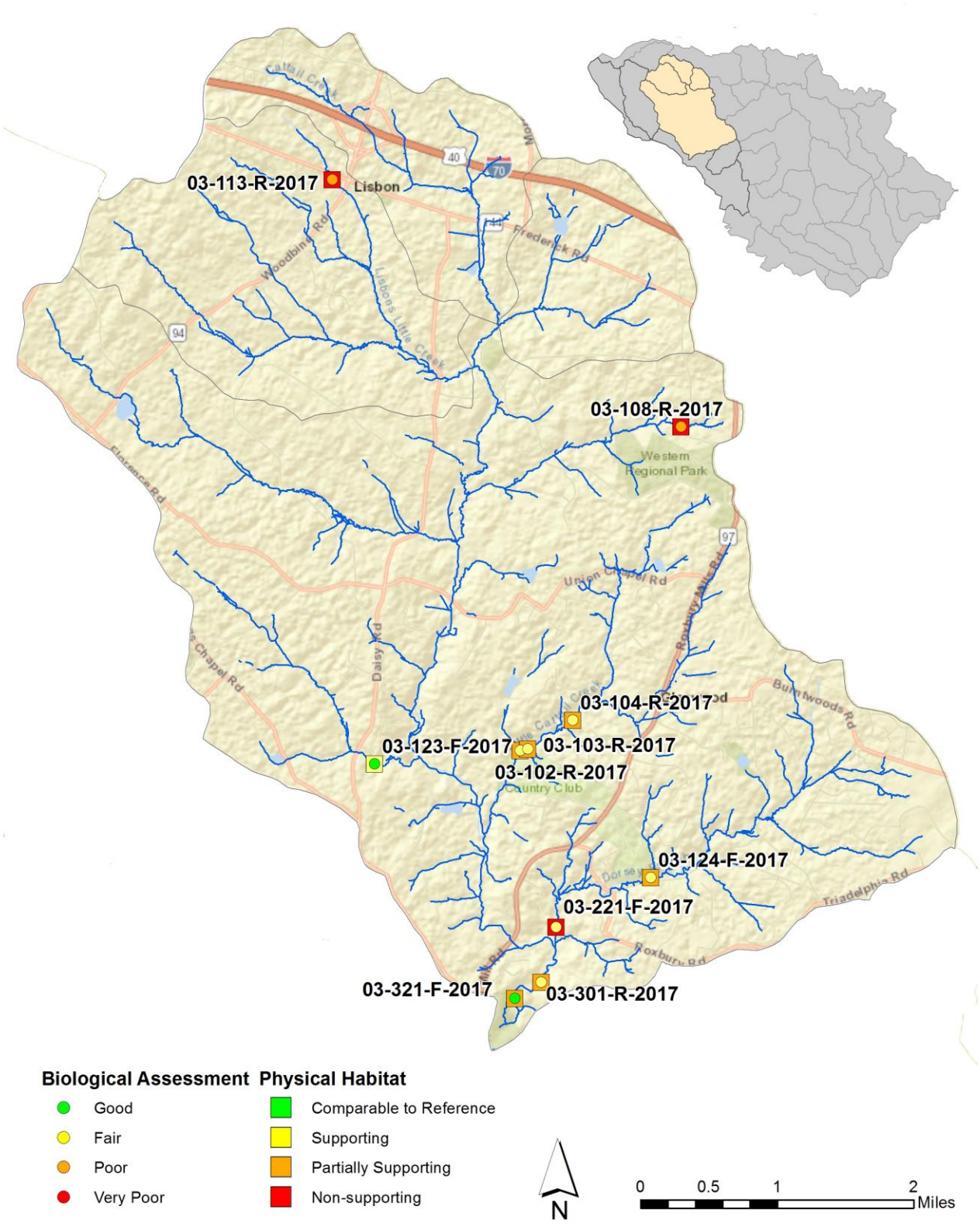

Figure 5 – Cattail Creek PSU Sampling Results

Table 9 – Cattail Creek Summary

Site ID	Drainage Area (ac)	Impervious Surface Percent	BIBI Score	BIBI Rating	RBP Comparability Score	RBP Rating	PHI Score	PHI Rating	Rosgen Channel Type
03-102-R-2017	1,866	8.1	3.33	Fair	60.0	Partially Supporting	56.2	Degraded	F4/6
03-103-R-2017	1,817	8.1	3.33	Fair	62.0	Partially Supporting	57.3	Degraded	F4/5
03-104-R-2017	1,602	8.0	3.67	Fair	63.0	Partially Supporting	66.0	Degraded	F4/5
03-108-R-2017	95	6.5	2.33	Poor	49.0	Non-supporting	34.7	Severely Degraded	B5c
03-113-R-2017	96	5.2	2.00	Poor	57.0	Non-supporting	42.0	Severely Degraded	G6
03-123-F-2017	1,315	4.7	4.00	Good	79.0	Supporting	61.3	Degraded	B1
03-124-F-2017	184	8.1	3.33	Fair	62.5	Partially Supporting	47.1	Severely Degraded	B5/4c
03-221-F-2017	2,751	8.0	3.67	Fair	56.5	Non-Supporting	44.2	Severely Degraded	F5/6
03-301-R-2017*	17,734	6.1	3.33	Fair	65.0	Partially Supporting	69.2	Partially Degraded	C4
03-321-F-2017	17,777	6.1	4.00	Good	64.5	Partially Supporting	56.3	Degraded	C4
Minimum	95	4.7	2.00	Poor	49.0	Non-supporting	34.7	Severely Degraded	--
Maximum	17,777	8.1	4.00	Good	79.0	Supporting	69.2	Partially Degraded	--
Mean	4,524	6.9	3.33	Fair	61.9	Partially Supporting	53.4	Degraded	--
Standard Deviation	7,028	0.01	0.66	--	7.7	--	11.1	--	--

*QC sampling was conducted at this site

3.1.3 Lower Brighton Dam

Seven of the ten sites sampled in the Lower Brighton Dam subwatershed in 2017 were located on first-order streams as defined by the NHD stream layer, one site was on a second-order stream, and two sites were on third-order streams. The field QC sample was collected at site 05-122-F-2017. All stream reaches were classified as B, C, F or G channels, with silt/clay, sand, or gravel dominated substrates. A summary of the results for the Lower Brighton Dam subwatershed is presented in Figure 6 and Table 10. Four sites within the Lower Brighton Dam PSU were rated as 'Partially Supporting' and six sites were rated as 'Not Supporting' based on the RBP habitat assessment scores. The mean RBP habitat comparability score of 56.9 for the subwatershed resulted in a 'Not Supporting' rating. Five of the ten sites sampled in the Brighton Dam subwatershed received biological condition ratings of 'Fair', one site received a rating of 'Very Poor', one site received a rating of 'Poor', and the remaining three sites received 'Good' biological ratings. BIBI scores ranged from a low of 1.67 to 4.67, which resulted in a mean BIBI score of 3.42 and an overall biological condition rating of 'Fair' for the subwatershed.

Lower Brighton Dam Site Descriptions:

05-103-R-2017
This site is located on a narrowly buffered unnamed tributary to the Lower Triadelphia Reservoir between low density residential properties on Lakeside Drive and Nichols Drive. A natural gas pipeline right-of-way was present at the upstream end of the site. The stream was classified as a G4/5 channel with gravel and sand as the dominant substrates. Water quality results indicated all parameters were within acceptable COMAR standards. Of the 484-acre drainage area, the dominant land use is low density residential (48.7%) followed by agriculture (46.2%) and forested land cover (5.1%). The high percentage of low density residential contributed to an impervious percentage of 7.5% that exceeds the subwatershed average of 6.3%. This sampling reach received a RBP habitat score of 54.5 and a rating of 'Not Supporting' due to poor vegetative protection and riparian vegetative zone width. The PHI also shows a 'Degraded' channel with a score of 51.2. The BIBI score of 4.67 was the highest in the Lower Brighton Dam subwatershed, with the biological condition rated as 'Good'. Of the 25 total taxa identified in the sample, eleven were EPT taxa and six Ephemeroptera taxa were present. Only 16% of the sample consisted of individuals of the Chironomidae family (midges). Eight-percent of individuals were clingers and 20% of the individuals were intolerant to urban stressors.

05-105-R-2017
This site is located on a F6 channel with predominately silt/clay and sand substrate due to backwatered conditions of Triadelphia Reservoir. A beaver dam was present just downstream from the reach, and much of the benthic sample was taken from the banks due to the deep conditions caused by the beaver dam. The Triadelphia Mill Road culvert is approximately 20 meters upstream from the upstream end of the site. Water quality results indicated all parameters were within acceptable COMAR standards. Because of poor scores for instream habitat, embeddedness, channel alteration, sediment deposition, frequency of riffles, bank stability, and vegetative protection, this site received the lowest habitat assessment of all 2017 sites, with score of 29.0 and a 'Non-supporting' classification. The lowest PHI score in the 2017 set of sites was given to this site with a score of 26.3 and a rating of 'Severely Degraded'. The dominant land use in the 2,205-acres drainage area is agriculture (45.3%), followed by low density residential (27.2%), and forested land cover (26.9%). Impervious surface accounted for 6.6% of the drainage area, which is slightly above the subwatershed average of 6.3%. There were 22 total taxa identified in the benthic macroinvertebrate sample, although only three EPT taxa were present, all of which were Ephemeroptera. Individuals intolerant to urban stressors only comprised 3% of the sample. Individuals of the Chironomidae family (midges) dominated this sample at 64%. Only

16% of the sample consisted of clingers. As a result, this site received the lowest BIBI score in the Lowest Brighton Dam subwatershed (1.67) with a corresponding biological rating of 'Very Poor'.

05-106-R-2017
This site is located on an unnamed tributary upstream from Triadelphia Reservoir, north of Triadelphia Mill Road and upstream from site 05-105-R-2017. Water quality results indicated all parameters were within acceptable COMAR standards. With a predominantly gravel and cobble substrate, the sampling reach was classified as a F4 channel. This site received a RBP score of 60.5 and rating of 'Partially Supporting' due to marginal instream habitat, sediment deposition, channel flow status, riffle frequency, and bank stability. The PHI score was 57.3, which resulted in a rating of 'Degraded'. This site had a drainage area of 1,845-acres with 46.0% classified as agriculture, 26.7% as low density residential, and 26.7% as forested land cover. Impervious surface percentage exceeded the subwatershed average at 6.7%. Of the 27 total taxa identified, nine EPT taxa were present in the sample, five of which were Ephemeroptera. Individuals intolerant to urban stressors accounted for 18% of the sample while 57% of the sample consisted of clingers. Fifty-five percent of the sample was made up of Chironomids (midges). Based on the BIBI score of 3.67, this site was given a 'Fair' biological condition rating.

05-108-R-2017
This site is located upstream from site 05-106-R-2017 on an eroded and incised unnamed tributary upstream from Triadelphia Reservoir. This reach was classified as a F4/5 channel with a sand, gravel, and cobble dominated substrate. Suboptimal instream habitat, embeddedness, velocity/depth diversity, and sediment deposition, but poor and marginal bank stability and vegetative protection led to a habitat assessment rating of 'Partially Supporting' with a percent comparability score of 70.0. The PHI score was 60.0, which resulted in a rating of 'Degraded'. The predominant land use in the 1,815-acre drainage area is agriculture (45.7%), followed by low density residential (26.9%), and forested land cover (26.8%). Overall, the drainage area has 6.8% impervious surface, which is above the average for the subwatershed. The benthic macroinvertebrate sample consisted of 48% individuals of the Chironomidae family. There were 27 total taxa in this sample with ten EPT taxa and only three Ephemeroptera taxa. Twenty-five percent of the individuals were considered intolerant to urban stressors and 63% were clingers—resulting in a BIBI score of 3.33 and a biological condition rating of 'Fair'. Water quality results indicated all parameters were within acceptable COMAR standards.

05-111-R-2017
This site is located upstream from site 05-108-R-2017 on an unnamed tributary upstream of Triadelphia Reservoir. The reach runs parallel to Howard Road, which is approximately 40 meters from the right bank. Green algae was abundant throughout the reach. Water quality results indicated all parameters were within acceptable COMAR standards. Classified as a C4/5 channel, the substrate of this sampling reach was dominated by gravel and sand. This sampling reach received an RBP habitat score of 60.0 and rating of 'Partially Supporting'. A PHI score of 47.9 was given, resulting in a rating of 'Severely Degraded'. The 900-acre drainage area is predominantly agricultural land use (54.7%), followed by low density residential (24.9%) and forested land cover (19.2%), resulting in 8.3% impervious surface, the highest percentage found in the Lower Brighton Dam subwatershed. There were 24 total taxa in this sample, five of which were an EPT taxa. There was only one Ephemeroptera taxon and 17% of the individuals were intolerant to urban stressors. Individuals of the Chironomidae family (midges) dominated this sample at 62%. This site received a BIBI score of 2.33 with a corresponding biological condition rating of 'Poor'.

05-121-F-2017
This site is located just upstream from site 05-122-F-2017 on an unnamed tributary to Triadelphia Reservoir, upstream from Triadelphia Mill Road. Water quality results indicated all parameters were

within acceptable COMAR standards. Classified as a F4 channel, the substrate of this sampling reach was dominated by gravel, sand, and cobble. Gravel and cobble mid-channel and point bars were found throughout the site. This sampling reach received an RBP habitat score of 57.0 and rating of 'Non-Supporting'. A PHI score of 63.2 was given, resulting in a rating of 'Degraded'. Raw, eroded banks and meander bends were present. The 2,105-acre drainage area is predominantly agricultural land use (47.4%), followed by low density residential (27.0%) and forested land cover (25.0%), resulting in 6.6% impervious surface, only slightly higher than the average found in the Lower Brighton Dam subwatershed. There were 29 total taxa in this sample, 12 of which were EPT taxa. There were seven Ephemeroptera taxa and 25% of the individuals were intolerant to urban stressors. Individuals of the Chironomidae family (midges) dominated this sample at 57%. This site received a BIBI score of 4.00 with a corresponding biological condition rating of 'Good'.

05-122-F-2017

This site is located just upstream from Triadelphia Mill Road and downstream from site 05-121-F-2017 on an unnamed tributary to Triadelphia Reservoir. Water quality results indicated all parameters were within acceptable COMAR standards. Classified as a F4/5 channel, the substrate of this sampling reach was dominated by gravel and sand. Mid-channel and point bars consisting of sand and gravel were found throughout the site. This sampling reach received an RBP habitat score of 57.0 and rating of 'Non-Supporting'. A PHI score of 42.8 was given, resulting in a rating of 'Severely Degraded'. Raw and eroded stream banks were present throughout the reach. The 2,108-acre drainage area is predominantly agricultural land use (47.4%), followed by low density residential (27.0%) and forested land cover (25.1%), resulting in 6.6% impervious surface. There were 23 total taxa in this sample, ten of which were EPT taxa. There were seven Ephemeroptera taxa and 19% of the individuals were intolerant to urban stressors. Individuals of the Chironomidae family (midges) dominated this sample at 58%. This site received a BIBI score of 3.33 with a corresponding biological condition rating of 'Fair'. A QC sample was collected in the adjacent 75-meters reach upstream of this site, where water conditions and habitat resembled the original reach. The QC reach received a BIBI score of 3.67 resulting in a 'Fair' biological condition rating. RBP habitat was also conducted at the QC site which received a score of 62.0 and a rating of 'Partially Supporting'. The QC reach received a PHI score of 57.3, which resulted in a rating of 'Degraded'.

05-201-F-2017

This site is located on an unnamed tributary to Triadelphia Reservoir downstream of Nichols Drive. A gas utility crosses the stream at the downstream end, and the pipe is exposed across the channel bed. Water quality results indicated all parameters were within acceptable COMAR standards. Classified as a B4c channel, the substrate of this sampling reach was dominated by gravel. This sampling reach received an RBP habitat score of 53.5 and rating of 'Non-Supporting'. A PHI score of 49.4 was given, resulting in a rating of 'Severely Degraded'. The 1,234-acre drainage area is predominantly low density residential (61.8%), followed by agricultural land use (23.8%) and forested land cover (12.5%), resulting in 8.3% impervious surface, the highest percentage found in the Lower Brighton Dam subwatershed. There were 32 total taxa in this sample, seven of which were EPT taxa. There were only three Ephemeroptera taxa and only 3% of the individuals were intolerant to urban stressors. Individuals of the Chironomidae family (midges) dominated this sample at 56%. This site received a BIBI score of 3.00, with a corresponding biological condition rating of 'Fair'.

05-301-R-2017

This site is located on the Patuxent River within the Patuxent River State Park upstream from Roxbury Mill Road (Route 97) and upstream of the Triadelphia Reservoir. Water quality results indicated all parameters were within acceptable COMAR standards. Classified as a C4 channel, the substrate of this sampling reach was dominated by gravel, sand, and silt/clay. This sampling reach received an RBP habitat score of 68.0 and rating of 'Partially Supporting'. A PHI score of 69.3 was given, resulting in a

rating of ‘Partially Degraded’. This site had the largest drainage area of all Lower Brighton Dam sites, at 21,542 acres. The drainage area consists of predominantly agricultural land use (47.9%), followed by forested land cover (41.8%) and low density residential (8.7%), resulting in 2.8% impervious surface, the lowest percentage found in the Lower Brighton Dam subwatershed. The highest number of tax out of all Lower Brighton Dam sites was found at this site, with 33 total taxa in this sample, ten of which were EPT taxa. There were only four Ephemeroptera taxa and 42% of the individuals were intolerant to urban stressors. Individuals of the Chironomidae family (midges) comprised 19% of this sample. This site received a BIBI score of 4.00 and a corresponding biological condition rating of ‘Good’.

05-321-R-2017

This site is located on the Patuxent River mainstem within the Patuxent River State Park upstream of the Triadelphia Reservoir. Water quality results indicated all parameters were within acceptable COMAR standards. Classified as a C4/5c- channel, the substrate of this sampling reach was dominated by sand and gravel. This sampling reach received an RBP habitat score of 59.0 and rating of ‘Non-Supporting’. A PHI score of 49.3 was given, resulting in a rating of ‘Severely Degraded’. This site had the second largest drainage area of all Lower Brighton Dam sites, at 19,395 acres. The drainage area is predominantly agricultural land use (46.3%), followed by forested land cover (42.6%) and low density residential (9.5%), resulting in 3.0% impervious surface, the second lowest percentage found in the Lower Brighton Dam subwatershed. There were 32 total taxa in this sample, 15 of which were EPT taxa. There were seven Ephemeroptera taxa, and 20% of the individuals were intolerant to urban stressors. Individuals of the Chironomidae family (midges) comprised 41% of this sample. This site received a BIBI score of 4.00, with a corresponding biological condition rating of ‘Good’.

Figure 6 – Lower Brighton Dam PSU Sampling Results

Table 10 – Lower Brighton Summary

Site ID	Drainage Area (ac)	Impervious Surface Percent	BIBI Score	BIBI Rating	RBP Comparability Score	RBP Rating	PHI Score	PHI Rating	Rosgen Channel Type
05-103-R-2017	484	7.5	4.67	Good	54.5	Non-supporting	51.2	Degraded	G4/5
05-105-R-2017	2,205	6.6	1.67	Very Poor	29.00	Non-supporting	26.3	Severely Degraded	F6
05-106-R-2017	1,845	6.7	3.67	Fair	60.50	Partially Supporting	57.3	Degraded	F4
05-108-R-2017	1,815	6.8	3.33	Fair	70.00	Partially Supporting	60.0	Degraded	F4/5
05-111-R-2017	900	8.3	2.33	Poor	60.00	Partially Supporting	47.9	Severely Degraded	C4/5
05-121-F-2017	2,105	6.6	4.00	Good	57.00	Partially Supporting	63.2	Degraded	F4
05-122-F-2017*	2,108	6.6	3.33	Fair	57.00	Non-supporting	42.8	Severely Degraded	F4/5
05-201-F-2017	1,234	8.3	3.00	Fair	53.50	Non-supporting	49.4	Severely Degraded	B4c
05-301-R-2017	21,542	2.8	4.00	Good	68.00	Partially Supporting	69.3	Partially Degraded	C4
05-321-R-2017	19,394	3.0	4.00	Good	59.00	Non-supporting	49.3	Severely Degraded	C4/5c-
Minimum	484	2.8	1.67	Very Poor	29.00	Non-supporting	26.3	Severely Degraded	--
Maximum	21,542	8.3	4.67	Good	70.0	Partially Supporting	69.3	Partially Degraded	--
Mean	5,363	6.3	3.40	Fair	56.9	Partially Supporting	51.7	Degraded	--
Standard Deviation	7,997	0.02	0.89	--	11.1	--	12.0	--	--

*QC sampling was conducted at this site

4 Discussion and Comparison

4.1 Discussion

4.1.1 2017 Assessment Results

Bioassessment

Biological and physical habitat assessment results for 2017 in Cattail Creek, Upper Brighton Dam, and Lower Brighton Dam indicate subwatersheds that are minimally impaired. Only one of the thirty benthic macroinvertebrate samples received a rating of 'Very Poor' and four received a 'Poor' rating. The remaining sites (83%) were rated as either 'Fair' (12 sites) or 'Good' (13 sites). Site 05-105-R-2017 was the only site to receive a biological condition rating of 'Very Poor'. The average rating for each of the three subwatersheds was 'Fair', which is above the MBSS threshold for biological impairment.

Physical Habitat

RBP habitat assessment results indicate average subwatershed physical habitat conditions that were 'Partially Supporting' (Upper Brighton Dam and Cattail Creek) and 'Non-supporting' (Lower Brighton Dam). Only two sites received 'Supporting' physical habitat ratings (02-103-R-2017 and 03-123-F-2017) within the Upper Brighton Dam and Cattail Creek subwatersheds.

Water Quality

All sites showed pH readings within the allowable COMAR range. Specific conductivity was elevated at several sites throughout the watersheds with values ranging from 122 to 470 µS/cm. A site-by-site breakdown of field-measured water quality parameters is included in Appendix B. While no COMAR standard for conductivity currently exists, a threshold for biological impairment in Maryland streams has been established at 247 µS/cm (Morgan et al., 2007). Thus, PSUs with mean values exceeding 247 µS/cm are not only indicative of increased anthropogenic disturbance, but also likely to see degraded biological conditions. Within this range of values, 60% of sites sampled in 2017 had a value less than 247 µS/cm. Average subwatershed conductivity values were 163 µS/cm, 273 µS/cm, and 268 µS/cm, for Upper Brighton Dam, Cattail Creek, and Lower Brighton Dam, respectively.

Specific conductivity is related to the type and concentrations of inorganic ions in solution. Natural sources within a watershed can include salt from poorly drained soils, salt from ground water, and erosion from geologic formations of marine origin. Increased stream inorganic ion concentrations (i.e., conductivity) in urban systems typically results from runoff over impervious surfaces, passage through pipes, and exposure to other infrastructure (Cushman, 2006). Roadway pollutants tend to concentrate along the edge of a road, making them susceptible to runoff to streams from rainfall or snow melt and flow-off from wind or vehicle turbulence. While elevated conductivity may not directly affect stream biota, its constituents (e.g., chloride, metals, and nutrients) may be present at levels that can cause considerable biological impairment.

Geomorphology

The geomorphic assessment results indicate a variable system. More than half (53%) of the channels sampled throughout the subwatersheds were classified as incised F or G channels and the remaining 47% were classified as stable type B or C channels. Gravel, sand, and silt/clay were the dominant substrate types in the majority of sampling reaches.

Imperviousness

The average percentage of impervious area in the Upper Brighton Dam, Cattail Creek, and Lower Brighton Dam subwatersheds is 3.6%, 6.9%, and 6.3%, respectively. Imperviousness for the areas draining to each sampling site range from 2.0% in Upper Brighton Dam to 8.3% in Lower Brighton Dam (see Appendix A for impervious values). The benthic community in a freshwater stream can be adversely affected by impervious cover and associated runoff at values as low as 10% (CWP, 2003). A statistical correlation between imperviousness and the BIBI was identified and is discussed in the following section.

Results Correlations

The Pearson correlation coefficient measures the linear association between two variables. Values of the coefficient range from -1 to 1. Negative values indicate an inverse relationship between the two values (i.e., when one variable increases the other decreases), while positive values indicate a positive relationship (i.e., both variables increase). The Pearson correlation coefficient indicates the strength of the association, with larger absolute values indicating stronger associations between the two variables. The significance level is a measure of the likelihood that the two variables are related, with smaller values indicating a stronger likelihood of relation. A significance level of 0.05 is typically used as a cutoff for strong correlations. The interpretation of a correlation is somewhat arbitrary, especially as values move away from +/- 1. Table 11 includes Pearson correlation coefficients and significance values. Figures 7 through 9 provide a visual display of the relationships between data variables and the best fit line, including R^2 values, associated with the correlation.

Pearson correlations between the BIBI scores and all parameters (percent imperviousness, specific conductivity, PHI habitat, and RBP habitat) showed significant relationships. The percentage of imperviousness to each sampling site indicates a negative relationship (correlation coeff.= -0.428, p 0.018) to BIBI scores, suggesting biological condition decreases with increased watershed imperviousness (Figure 7.)

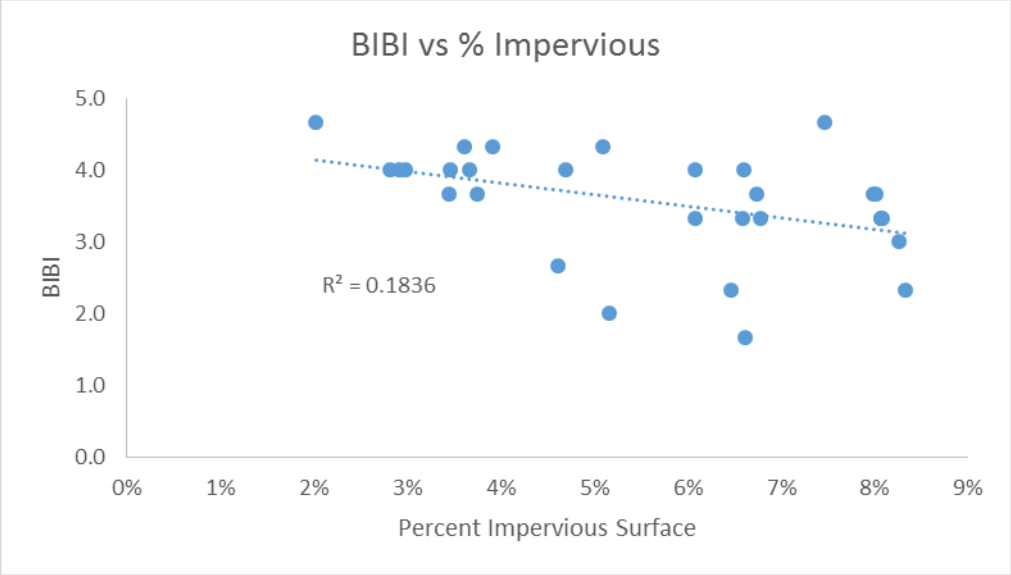

Figure 7 - Relationship between the Benthic Index of Biotic Integrity (BIBI) and impervious surface in PSUs sampled during 2017 Howard County Biological Monitoring

Specific conductivity and BIBI scores also showed a strong negative correlation (correlation coeff.= -0.613, p = 0.0003, Figure 8). These results support the notion that overall water quality and biological health are likely being affected by the amount of development, and hence imperviousness, in the

watershed. These findings are in concurrence with the Impervious Cover Model (CWP, 2003) which suggests that overall stream quality decreases with increased watershed impervious cover. A strong correlation was also observed between impervious percent and specific conductivity (correlation coeff.= 0.702, p <0.0001), suggesting that increased conductivity is due in large part to urban runoff. Upper Brighton Dam, Cattail Creek, and Lower Brighton Dam all have relatively low impervious coverage, which may result in a weaker correlation. A larger sample size which includes more subwatersheds with a larger range of impervious cover may result in an even stronger negative correlation.

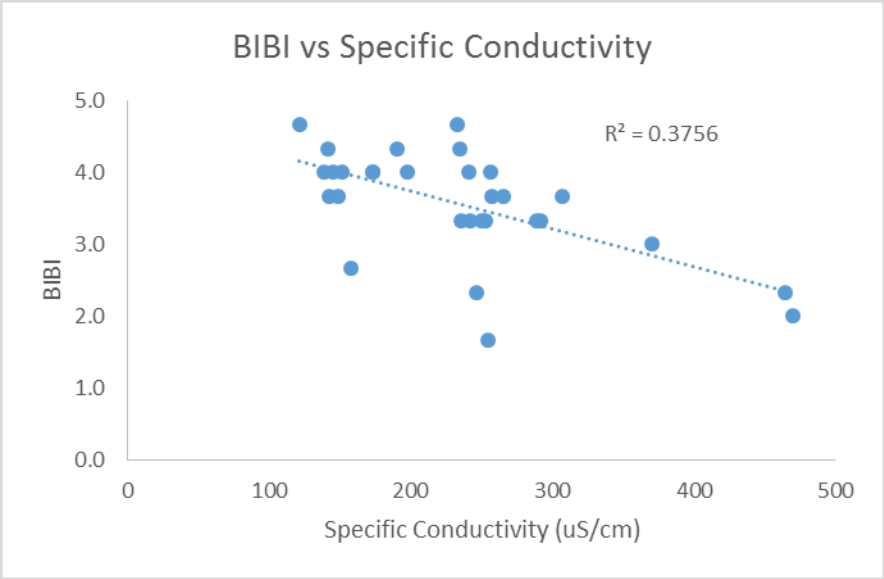

Figure 8 - Relationship between the Benthic Index of Biotic Integrity (BIBI) and specific conductivity in PSUs sampled during 2017 Howard County Biological Monitoring

The correlation with RBP habitat scores and BIBI scores (correlation coeff.= 0.587, p = 0.001) was significant, as was the correlation between PHI scores and BIBI (correlation of 0.658, p =<0.0001) (Figure 9), suggesting that physical habitat assessments are a predictor of biological condition in these watersheds.

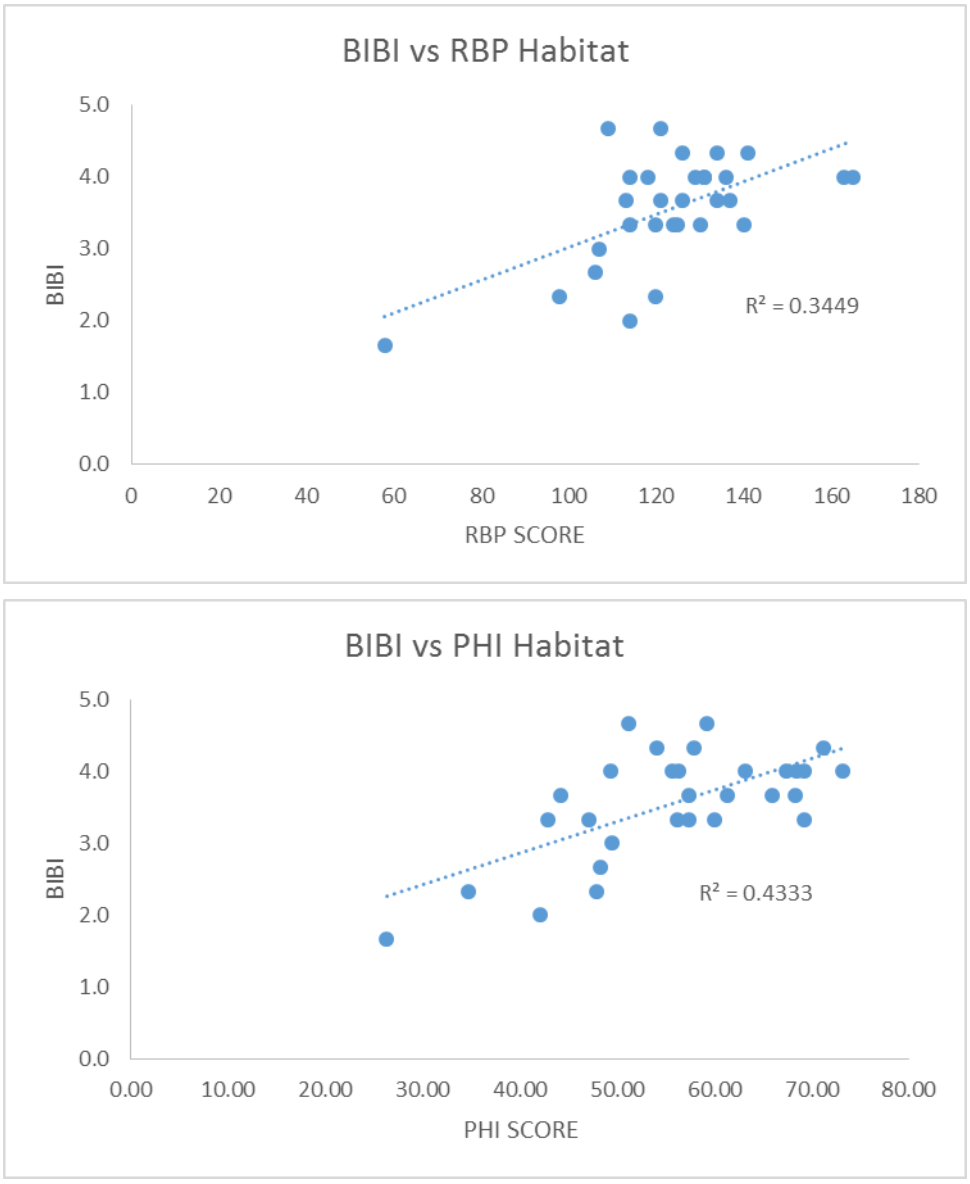

Figure 9 - Relationship between the Benthic Index of Biotic Integrity (BIBI) and physical habitat in PSUs sampled during 2017 Howard County Biological Monitoring

Table 11 - Pearson Correlations

		RBP Habitat	PHI Habitat	Specific Conductance	Percent Impervious
BIBI n=30	Correlation	**0.587**	**0.658**	**-0.613**	**-0.428**
	Significance	**0.001**	**< 0.0001**	**0.0003**	**0.018**
RBP Habitat n=30	Correlation		**0.825**	-0.336	**-0.376**
	Significance		**< 0.0001**	0.070	**0.041**
PHI Habitat n=30	Correlation			**-0.435**	**-0.401**
	Significance			**0.016**	**0.028**
Specific Conductance n=30	Correlation				**0.702**
	Significance				**< 0.0001**

Bold values are significant at the 0.05 level

4.1.2 Comparison of 2001, 2005, 2012, and 2017 Bioassessment data

BIBI

A summary of the results for 2001, 2005, 2012, and 2017 biological index data is shown in Table 12, and a box plot comparing BIBI scores for each subwatershed is displayed in Figure 10. It should be noted that current BIBI calculation methods were used for all rounds. An Analysis of Variance (ANOVA) was performed to evaluate differences in mean BIBI scores amongst the years. Significance testing was performed using Tukey's HSD (Honestly Significant Difference) test with a confidence interval of 95%. Results of Tukey's HSD test are presented in Table 13.

Table 12 - Comparison of 2001, 2005, 2012, and 2017 BIBI Data

Sampling Year	Patapsco Subwatershed	Number of sites sampled	Min. BIBI	Max. BIBI	Median BIBI	Mean BIBI	Narrative Rating	Standard Deviation
2001	Upper Brighton	10	3.67	5.00	4.17	4.20	Good	0.40
	Cattail Creek	10	1.67	4.00	3.67	3.50	Fair	0.65
	Lower Brighton	10	1.67	4.67	4.00	3.67	Fair	0.89
2005	Upper Brighton	10	2.67	5.00	4.17	4.17	Good	0.60
	Cattail Creek	10	2.00	4.33	3.67	3.57	Fair	0.70
	Lower Brighton	10	3.33	5.00	4.67	4.17	Good	0.69
2012	Upper Brighton	10	3.33	5.00	4.67	4.47	Good	0.52
	Cattail Creek	10	2.67	4.67	4.00	4.03	Good	0.55
	Lower Brighton	10	2.00	5.00	4.17	3.97	Fair	0.89
2017	Upper Brighton	10	2.67	4.67	4.00	3.97	Fair	0.53
	Cattail Creek	10	2.00	4.00	3.33	3.30	Fair	0.62
	Lower Brighton	10	1.67	4.67	3.50	3.40	Fair	0.84

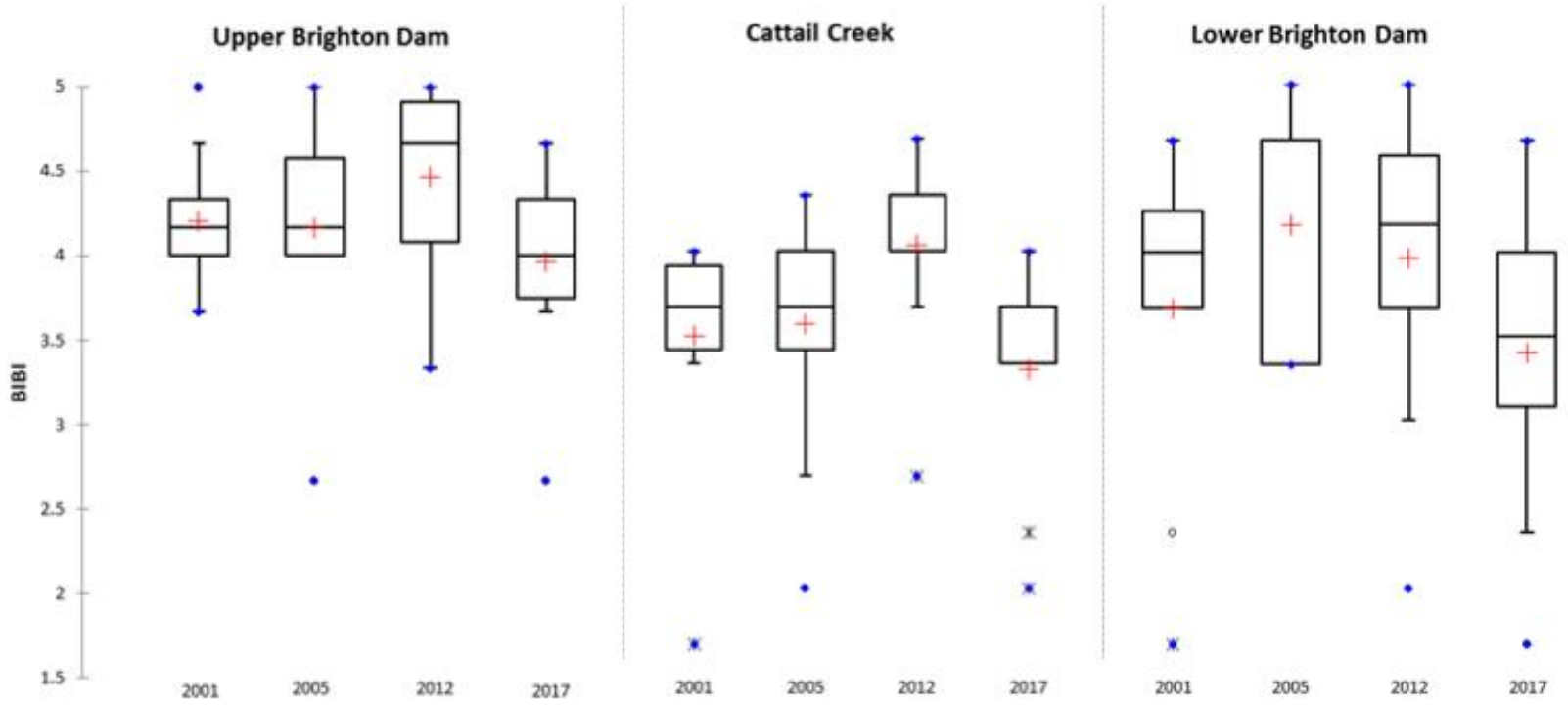

Figure 10 - Comparison of 2001, 2005, 2012, and 2017 BIBI scores.

Results from the Round 1 assessment (2001) indicated that the Upper Brighton Dam subwatershed was in a 'Good' overall biological condition, according to the updated BIBI scores (BIBI = 4.20 ± 0.40). Round Two results (2005) show a similar 'Good' biological condition (BIBI = 4.17 ± 0.60). Round 3 (2012) results also show a 'Good' biological condition (BIBI = 4.47 ± 0.52) and a small increase in score compared to the 2005 score. Finally, Round 4 (2017) results show a 'Fair' biological condition (BIBI = 3.97 ± 0.53), a fairly moderate, but not statistically significant, decline in score compared to the 2012 score. Tukey's HSD test showed that the four Rounds were not significantly different from each other (Table 13).

In the Cattail Creek subwatershed, the mean BIBI score was similar between 2001 (BIBI = 3.50 ± 0.65) and 2005 (BIBI = 3.57 ± 0.70), both with a narrative rating of 'Fair'. The Round 3 assessment (2012) mean score was slightly higher (BIBI = 4.03 ± 0.55), with a narrative rating of 'Good'. Results from 2017 show a decrease (BIBI = 3.30 ± 0.62) which is closer to what was observed in 2001. Tukey's HSD test showed that the four Rounds were not significantly different from each other (Table 13).

The Round 1 assessment (2001) revealed overall 'Fair' conditions in the Lower Brighton Dam subwatershed, according to the BIBI scores (BIBI= 3.67 ± 0.89). Scores increased slightly in 2005, resulting in a 'Good' biological condition (BIBI= 4.17 ± 0.69). In 2012, the mean BIBI was calculated at 3.97 ± 0.89, and received a 'Fair' biological condition rating. Finally, in 2017, the lowest BIBI scores were observed, with an average score of 3.40 ± 0.84, resulting in a 'Fair' biological condition rating. Tukey's HSD test showed that the four Rounds were not significantly different from each other (Table 13).

Table 13. Tukey (HSD) / Analysis of the differences between years with a confidence interval of 95%

Subwatershed	Contrast	Difference	Standardized difference	Critical value	Pr > Diff	Significant
Upper Brighton	2012 vs 2017	0.50	2.05	2.69	0.19	No
	2012 vs 2005	0.30	1.23	2.69	0.61	No
	2012 vs 2001	0.27	1.09	2.69	0.70	No
	2001 vs 2017	0.23	0.96	2.69	0.77	No
	2001 vs 2005	0.03	0.14	2.69	1.00	No
	2005 vs 2017	0.20	0.82	2.69	0.84	No
Cattail Creek	2012 vs 2017	0.73	2.46	2.69	0.08	No
	2012 vs 2001	0.53	1.79	2.69	0.30	No
	2012 vs 2005	0.47	1.56	2.69	0.41	No
	2005 vs 2017	0.27	0.89	2.69	0.81	No
	2005 vs 2001	0.07	0.22	2.69	1.00	No
	2001 vs 2017	0.20	0.67	2.69	0.91	No
Lower Brighton	2005 vs 2017	0.77	1.96	2.69	0.22	No
	2005 vs 2001	0.50	1.28	2.69	0.58	No
	2005 vs 2012	0.20	0.51	2.69	0.96	No
	2012 vs 2017	0.57	1.45	2.69	0.48	No
	2012 vs 2001	0.30	0.77	2.69	0.87	No
	2001 vs 2017	0.27	0.68	2.69	0.90	No

Tukey's d critical value: 3.809

RBP Physical Habitat Assessment

A summary of the results for 2001, 2005, 2012 and 2017 RBP physical habitat assessment data is shown in Table 14, and a box plot comparing RBP percent comparability scores for each subwatershed is displayed in Figure 11. An Analysis of Variance (ANOVA) was performed to evaluate differences in mean RBP scores amongst the years. In general, habitat assessment scores were found to be significantly higher in 2012 when compared to all other years. This may be a result of the subjectivity of habitat assessment scoring and the fact that different teams conducted the assessments each year. It is also possible that the randomly selected sites assessed in 2012 happened to actually have better habitat than those randomly selected during Round 1, 2, and 4.

Results from the Round 1 assessment (2001) indicated that the Upper Brighton Dam subwatershed was 'Partially Supporting' (RBP = 61 ± 2.7), and Round 2 results (2005) show similar habitat conditions of 'Partially Supporting' (RBP = 66 ± 8.6). Round 3 results show a 'Supporting' habitat condition (RBP = 80 ± 2.7), but Round 4 results were more similar to Round 1 and 2, with 'Partially Supporting' habitat condition (RBP = 66 ± 7.1).

Table 14 - Comparison of 2001, 2005, 2012, and 2017 RBP Physical Habitat Assessment Data

Sampling Year	Patapsco Subwatershed	Number of sites Assessed	Min. RBP %	Max. RBP %	Median RBP %	Mean RBP %	Narrative Rating	Standard Deviation
2001	Upper Brighton	10	56	65	61	61	Partially Supporting	2.7
	Cattail Creek	10	37	71	55	54	Non-Supporting	10.7
	Lower Brighton	10	41	63	59	55	Non-Supporting	6.8
2005	Upper Brighton	10	55	81	62	66	Partially Supporting	8.6
	Cattail Creek	10	51	78	57	60	Non-Supporting	8.3
	Lower Brighton	10	56	77	63	65	Partially Supporting	7.4
2012	Upper Brighton	10	77	84	79	80	Supporting	2.7
	Cattail Creek	10	52	87	80	76	Supporting	9.7
	Lower Brighton	10	48	85	74	72	Partially Supporting	9.4
2017	Upper Brighton	10	53	83	66	66	Partially Supporting	7.1
	Cattail Creek	10	49	82	62	62	Partially Supporting	7.9
	Lower Brighton	10	29	70	58	57	Non-Supporting	10.6

Results from the Round 1 assessment (2001) indicated that the Cattail Creek subwatershed was 'Non-Supporting' (RBP = 54 ± 10.7). Round 2 results (2005) show similar habitat conditions of 'Non-Supporting' (RBP = 60 ± 8.3), while Round 3 results showed an improvement to 'Supporting' habitat condition (RBP = 76 ± 9.7). Finally, 2017 results indicated 'Partially Supporting' habitat conditions (RBP = 62 ± 7.9).

The Lower Brighton Dam subwatershed saw 'Non-Supporting' RBP conditions in 2001 (RBP = 55 ± 6.8). Round 2 results (2005) show slight improvement in RBP conditions and was rated 'Partially Supporting' (RBP = 65 ± 7.4). RBP containers were scored 'Partially Supporting' again in 2012 (RBP = 72 ± 9.4). However, RBP conditions decreased to 'Non-Supporting' in 2017 (RBP = 57 ± 10.6), similar to the scores of 2001.

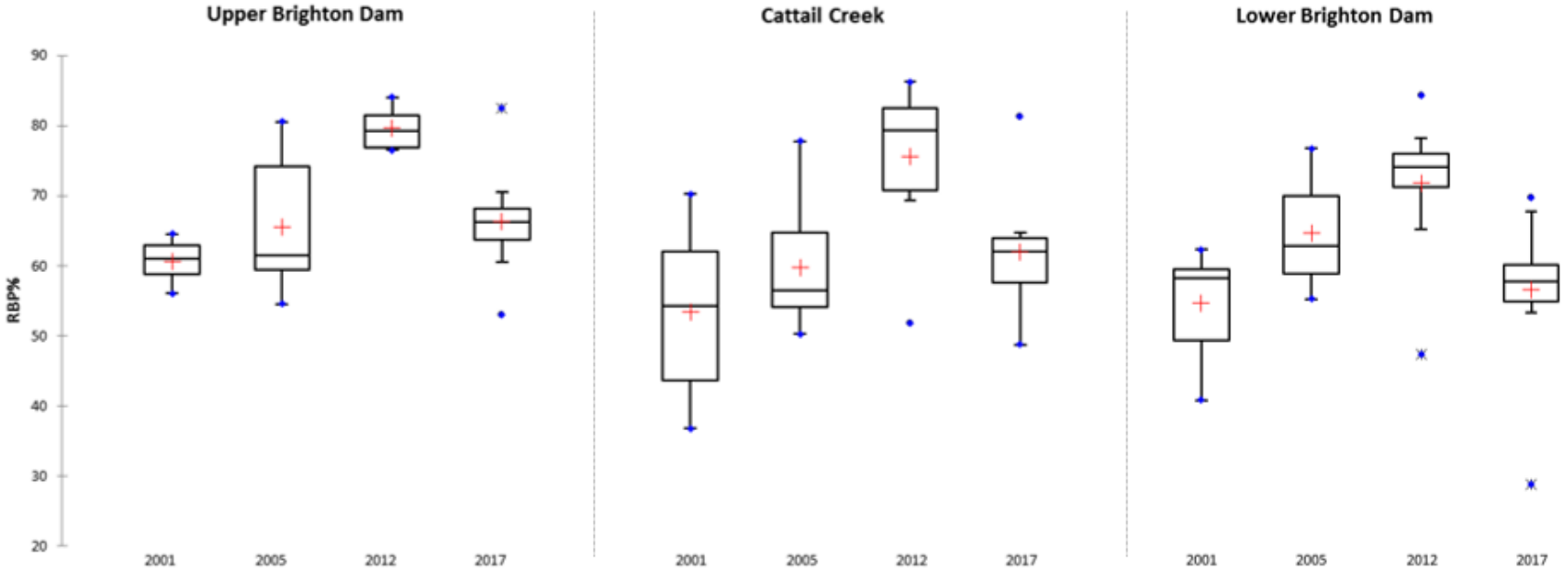

Figure 11 - Comparison of 2001, 2005, 2012 and 2017 RBP Physical Habitat Assessment scores.

5 Conclusion and Recommendations

This report is the first annual report of Round 4 (2017) of the Howard County Biological Monitoring and Assessment Program. These conclusions and recommendations provide context for interpreting results and identifying possible future revisions.

Results of the 2017 assessment indicate minimally impaired biological conditions in all three watersheds, but no statistically significant changes in mean BIBI scores were observed in any subwatersheds since Round 1 sampling. Physical habitat scores showed some statistically significant changes; in particular, 2012 results are much higher than other years. This is likely a result of the inherent subjectivity of the habitat scoring and changes in field teams over the years. While a trend of slightly increased BIBI results in 2012 can be observed in Upper Brighton Dam and Cattail Creek, there was no significant difference between the BIBI scores over the years.

Biological communities respond to a combination of environmental factors, commonly referred to as stressors. Stressors can be organized according to the five major determinants of biological integrity in aquatic ecosystems, which include water chemistry, energy source, habitat structure, flow regime, and biotic interactions (Karr et al., 1986; Angermeier and Karr, 1994; Karr and Chu, 1998). The cumulative effects of human activities within the County's sampling units often results in an alteration of at least one, if not several, of these factors with detrimental consequences for the aquatic biota. Determining which specific stressors are responsible for the observed degradation within a stream or PSU is a challenging task, given that many stressors co-exist and synergistic effects can occur. Furthermore, an added challenge in identifying the stressors affecting stream biota is that the water quality and physical habitat data collected by the County's monitoring program are not comprehensive (i.e., they do not include many possible stressors). For instance, virtually no data are available regarding biotic interactions and energy sources and only limited data regarding flow regime variables, such as land use and impervious cover, are included. Stressor relationships with stream biotic components, and their derived indices (i.e., BIBI), are often difficult to partition from complex temporal–spatial data sets primarily due to the potential array of multiple stressors working at the reach to landscape scale in small streams (Helms et al. 2005; Miltner et al., 2004; Morgan and Cushman, 2005; Volstad et al., 2003; Morgan et al., 2007). Therefore, it should be noted that the current level of analysis cannot identify all stressors for the impaired sites, nor will the stressors identified include all of the stressors present.

5.1 Recommendations for Future Program Development

Comparability with Statewide Methods

Howard County adopted the DNR's MBSS methods in 2001. The MBSS program continues to evolve and refine their sampling design, field procedures, and data analysis protocols, with the most recent field sampling protocols having been updated in 2014. While no changes have occurred to the benthic macroinvertebrate collection methods implemented herein, additional surveys have been added to the data collection efforts (i.e., vernal pool search, invasive vegetation search), which may be of interest to the County. The County should continue to update their methods in the future to stay current with the latest MBSS sampling protocols, especially with regard to benthic macroinvertebrate sampling. In addition, the County should continue to ensure that all personnel collecting macroinvertebrate samples have been certified by MBSS in benthic macroinvertebrate sample collection procedures.

Quality Assurance and Quality Control

The QA/QC procedures outlined in the Quality Assurance Project Plan (QAPP) for the Howard County Biological Monitoring and Assessment Program (Howard County, 2001) should be re-evaluated considering the evolution of the metric scoring system, which may not be appropriate for incremental data such as that found in the scaled BIBI metrics.

The BIBI scoring system does not use a continuous interval (e.g., 0 – 100 scale). That is, each metric is assigned a value of 1, 3, or 5 based on threshold breaks, which are then averaged for a final BIBI score. This means that scores increase incrementally by 0.3 or 0.4. Additionally, the relative percent difference (RPD) between low scores (2.0 and 2.3) will be higher than a comparison of higher scores (4.7 and 5.0). This can lead to a site not meeting the measurement quality objective (MQO) despite the scores being only one scoring increment apart. A relatively minor difference between samples can lead to the MQO not being met.

Fish Community Assessments

MBSS conducts fish sampling during the summer index period, which provides additional information regarding stream biodiversity. Fish species exhibit diverse morphological, ecological, and behavioral adaptations to their natural habitat and, consequently, are particularly effective indicators of the condition of aquatic systems (Karr et al., 1986; Fausch et al., 1990; Simon and Lyons, 1995; McCormick et al., 2001). Given that fish assemblages respond differently to some stressors than benthic macroinvertebrate assemblages, data from fish sampling can assist in identifying stressors that may be impacting specific streams as well as provide an improved understanding of the biological condition of streams throughout the County via the combined index of biotic integrity (CIBI), which incorporates both BIBI and fish IBI (FIBI) results into a single biological index. Furthermore, fish sampling data can be used to evaluate biotic interactions, particularly the effects of non-native and invasive species on native fauna. It is recommended that the County consider the addition of fish sampling to their program to not only allow for a more comprehensive assessment of the biological condition of the County's streams, but also to assist in the identification of additional stressors impacting their streams. Furthermore, the addition of fish sampling will allow for improved data sharing between the County and State agencies (i.e., DNR, MDE), which is essential to the protection and preservation of the Chesapeake Bay.

Geomorphic Assessments

While Rosgen Level II assessments provide useful information for characterizing the overall channel morphology, stream classification was not shown to be a useful predictor of biological condition or current land use characteristics in neighboring Anne Arundel County (Hill and Pieper, 2011; Hill et al., 2014). It is likely that the dominant geomorphological processes (i.e., erosion, transport, or deposition) are more important to the condition of the benthic macroinvertebrate communities than the current stream type as classified by the Rosgen approach. Perhaps a more rapid assessment of each reach using the channel evolution model (CEM; Schumm et al. 1984, Simon and Hupp 1986, and Simon 1989) would provide sufficient data regarding the geomorphological processes in each stream. The CEM identifies distinct stages of a channel's progression from a pre-modified condition through incising, widening, aggrading, re-stabilizing, and back to a quasi-equilibrium state, which may be observed in one reach overtime or various stages may be observed within an entire drainage network at a given time.

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Appendix A: Land Use and Imperviousness

Site ID	Drainage Area (Acres)[1]	VLDR	LDR	MDR	HDR	CI	INST	OUL	AGR	FOR	OW	WET	BG	TR	% Impervious[2]
Upper Brighton Dam															
02-103-R-2017	650	0%	10.0%	0%	0%	0%	0%	0%	61.1%	28.9%	0%	0%	0%	0%	3.7%
02-104-R-2017	86	0%	28.7%	0%	0%	0%	0.0%	0%	67.1%	4.2%	0%	0%	0%	0%	2.9%
02-106-R-2017	1,021	0%	19.5%	0%	0%	0%	0.1%	0%	46.6%	33.9%	0%	0%	0%	0%	3.9%
02-107-R-2017	129	0%	13.3%	0%	0%	0%	0%	0%	83.0%	3.7%	0%	0%	0%	0%	4.6%
02-121-F-2017	670	0%	20.2%	0.9%	0%	3.2%	0.2%	13.2%	30.0%	31.7%	0.6%	0%	0%	0%	5.1%
02-123-F-2017	460	0%	11.8%	0%	0%	0%	0%	0%	55.1%	33.2%	0%	0%	0%	0%	3.7%
02-201-R-2017	5,527	0%	14.5%	0%	0%	0%	0.1%	0%	53.5%	31.5%	0%	0.4%	0%	0%	3.5%
02-202-R-2017	5,338	0%	14.6%	0%	0%	0%	0.1%	0%	54.3%	30.5%	0%	0.4%	0%	0%	3.4%
02-221-F-2017	1,128	0%	3.2%	0%	0%	0%	0%	0%	44.8%	52.0%	0%	0%	0%	0%	2.0%
02-301-F-2017	8,834	0%	10.2%	0.8%	0%	0.7%	0.6%	1.0%	44.0%	42.5%	0.1%	0%	0%	0%	3.6%
Cattail Creek															
03-102-R-2017	1,866	0%	27.0%	0%	1.5%	0.5%	4.1%	2.8%	43.4%	20.4%	0.2%	0%	0%	0%	8.1%
03-103-R-2017	1,818	0%	27.5%	0%	1.6%	0.5%	4.2%	0.5%	44.6%	20.9%	0.2%	0%	0%	0%	8.1%
03-104-R-2017	1,602	0%	28.1%	0%	0%	0.6%	4.7%	0%	47.5%	18.9%	0.3%	0%	0%	0%	8.0%
03-108-R-2017	95	0%	23.2%	0%	0%	3.3%	0.5%	0%	46.2%	26.9%	0%	0%	0%	0%	6.5%
03-113-R-2017	96	0%	28.1%	0%	0%	0%	0%	0%	71.8%	0.1%	0%	0%	0%	0%	5.2%
03-123-F-2017	1,315	0%	9.4%	0%	0%	0%	0%	0%	71.7%	18.8%	0%	0%	0%	0%	4.7%
03-124-F-2017	184	0%	83.7%	0%	0%	0%	0%	10.8%	3.6%	1.9%	0%	0%	0%	0%	8.1%
03-221-F-2017	2,751	0%	39.3%	0%	0%	0%	2.0%	2.4%	42.5%	13.8%	0%	0%	0%	0%	8.0%
03-301-R-2017	17,734	0%	20.4%	0.0%	0.2%	0.4%	1.3%	1.1%	54.0%	21.9%	0.2%	0%	0%	0.5%	6.1%
03-321-F-2017	17,777	0%	20.4%	0.0%	0.2%	0.4%	1.3%	1.1%	53.9%	22.1%	0.2%	0%	0%	0.5%	6.1%
Lower Brighton Dam															
05-103-R-2017	484	0%	48.7%	0%	0%	0%	0%	0%	46.2%	5.0%	0%	0%	0%	0%	7.5%
05-105-R-2017	2,205	0%	27.2%	0%	0%	0.5%	0.1%	0%	45.3%	26.9%	0%	0%	0%	0%	6.6%
05-106-R-2017	1,845	0%	26.7%	0%	0%	0.6%	0.1%	0%	46.0%	26.7%	0%	0%	0%	0%	6.7%
05-108-R-2017	1,815	0%	26.9%	0%	0%	0.6%	0.1%	0%	45.7%	26.8%	0%	0%	0%	0%	6.8%
05-111-R-2017	900	0%	24.9%	0%	0%	1.2%	0%	0%	54.7%	19.2%	0%	0%	0%	0%	8.3%
05-121-F-2017	2,105	0%	27.0%	0%	0%	0.5%	0.1%	0%	47.4%	25.0%	0%	0%	0%	0%	6.6%
05-122-F-2017	2,108	0%	27.0%	0%	0%	0.5%	0.1%	0%	47.4%	25.1%	0%	0%	0%	0%	6.6%
05-201-R-2017	1,234	0%	61.8%	0%	0%	0%	0%	0%	23.8%	12.5%	1.9%	0%	0%	0%	8.3%
05-301-R-2017	21,542	0%	8.7%	0.3%	0%	0.3%	0.3%	0.4%	47.9%	41.8%	0.1%	0.1%	0%	0%	2.8%
05-321-F-2017	19,395	0%	9.5%	0.4%	0%	0.3%	0.3%	0.5%	46.3%	42.6%	0.1%	0.1%	0%	0%	3.0%

VLDR: Very Low Density Residential (191,192)[3,4]
LDR: Low Density Residential (11)
MDR: Medium Density Residential (12)
HDR: High Density Residential (13)
CI: Commercial & Industrial (14, 15)
INST: Institutional (16)
TR: Transportation (80)

OUL: Open Urban Land (18)
AGR: Agriculture (21, 22, 23, 25, 241, 242)
FOR: Forest (41 - 44)
OW: Open Water (50)
WET: Wetlands (60)
BG: Bare Ground (73)
TR: Transportation (80)

1 Drainage areas provided are delineated to each sampling site.
2 See text for discussion of impervious percent.
3 Land use is based on Maryland Department of Planning (MDP) 2010 data.
4 Numbers in parentheses correspond to MDP land use codes.

Appendix B: Water Quality Data

Site ID	Collection Date	pH	Water Temperature *°C*	Dissolved Oxygen *mg/l*	Turbidity *NTU*	Conductivity *µS/cm*
Upper Brighton Dam						
02-103-R-2017	4/12/2017	**7.48**	**13.00**	**10.23**	**2.3**	**197.2**
02-104-R-2017	4/14/2017	**7.12**	**16.00**	**9.81**	**4.4**	**151.2**
02-106-R-2017	4/12/2017	**6.91**	**13.70**	**9.90**	**1.8**	**141.6**
02-107-R-2017	4/13/2017	**6.96**	**17.00**	**9.63**	**3.1**	**157.6**
02-121-F-2017	4/14/2017	**7.33**	**12.10**	**11.24**	**2.1**	**235.1**
02-121-F-2017 QC	4/14/2017	**7.01**	**13.90**	**10.89**	**3.0**	**237.1**
02-123-F-2017	4/13/2017	**7.26**	**16.20**	**10.44**	**4.0**	**149.1**
02-201-R-2017	4/7/2017	**7.68**	**9.20**	**10.83**	**17.8**	**139.1**
02-202-R-2017	4/7/2017	**7.29**	**9.50**	**11.17**	**13.8**	**142.8**
02-221-F-2017	4/14/2017	**7.77**	**11.00**	**10.91**	**1.8**	**121.6**
02-301-F-2017	4/13/2017	**7.63**	**12.80**	**11.42**	**1.8**	**190.2**
Cattail Creek						
03-102-R-2017	3/30/2017	**7.68**	**9.10**	**10.82**	**1.9**	**289.0**
03-103-R-2017	3/30/2017	**7.48**	**9.20**	**11.47**	**1.7**	**291.3**
03-104-R-2017	3/30/2017	**7.40**	**9.40**	**11.86**	**1.9**	**307.4**
03-108-R-2017	4/5/2017	**6.91**	**17.00**	**10.76**	**2.6**	**246.7**
03-113-R-2017	4/7/2017	**7.66**	**8.60**	**8.62**	**18.0**	**470.2**
03-123-F-2017	4/5/2017	**6.94**	**13.90**	**11.67**	**4.0**	**145.5**
03-124-F-2017	4/5/2017	**7.57**	**11.10**	**10.95**	**1.8**	**236.0**
03-221-F-2017	3/29/2017	**6.94**	**15.00**	**10.97**	**1.8**	**265.8**
03-301-R-2017	3/29/2017	**7.12**	**12.40**	**10.39**	**4.4**	**241.9**
03-301-R-2017 QC	3/29/2017	**6.98**	**12.80**	**10.85**	**5.2**	**242.3**
03-321-F-2017	3/29/2017	**7.43**	**2.50**	**9.58**	**5.9**	**240.8**
Lower Brighton Dam						
05-103-R-2017	3/21/2017	**7.38**	**8.50**	**11.97**	**2.8**	**232.5**
05-105-R-2017	3/21/2017	**7.23**	**10.80**	**10.36**	**1.7**	**254.4**
05-106-R-2017	3/23/2017	**6.91**	**6.80**	**12.94**	**1.1**	**257.0**
05-108-R-2017	4/12/2017	**7.24**	**16.30**	**10.84**	**3.5**	**250.4**
05-111-R-2017	3/24/2017	**7.53**	**5.20**	**11.69**	**0.4**	**464.0**
05-121-F-2017	3/23/2017	**7.81**	**4.00**	**12.27**	**1.2**	**256.0**
05-122-F-2017	3/23/2017	**8.15**	**3.90**	**12.14**	**1.4**	**253.1**
05-122-F-2017 QC	3/23/2017	**7.97**	**3.90**	**12.26**	**1.2**	**255.3**
05-201-F-2017	3/21/2017	**8.13**	**7.60**	**11.09**	**1.4**	**370.6**
05-301-R-2017	3/24/2017	**7.50**	**5.10**	**13.02**	**1.9**	**172.9**
05-321-F-2017	3/24/2017	**7.00**	**6.80**	**13.75**	**1.8**	**173.2**

Appendix C: Benthic Macroinvertebrate Data

Project Name: Howard County Countywide Biomonitoring
Project Number: 16158563.28
Prepared by: BC Checked by: CRH
Prepared date: 7/31/2017 Checked date: 8/7/2017

Cattail Creek BIBI_03.xlsx
Version: 1
Site Name:

Metric	03-102-R-2017	03-103-R-2017	03-104-R-2017	03-108-R-2017	03-113-R-2017	03-123-F-2017	03-124-F-2017	03-221-F-2017	03-301-R-2017	03-301-R-2017QC	03-321-F-2017
Raw Scores	**Raw Scores**										
Total Number of Taxa	34	25	29	21	21	35	31	25	31	36	37
Number of EPT Taxa	9	8	8	5	3	16	8	8	8	11	12
Number of Ephemeroptera Taxa	3	3	4	1	1	8	2	5	3	5	6
Percent Intolerant Urban	35.1	25.4	33.9	18.9	14.0	40.2	24.0	18.5	18.3	16.5	15.8
Percent Chironomidae	31.6	37.7	27.7	61.1	34.4	26.2	42.3	63.0	33.9	40.9	48.3
Percent Clingers	72.8	71.1	72.3	23.2	10.8	57.9	43.3	73.1	43.5	51.3	52.5
BIBI Scores	**BIBI Scores**										
Total Number of Taxa	5	5	5	3	3	5	5	5	5	5	5
Number of EPT Taxa	3	3	3	3	1	5	3	3	3	5	5
Number of Ephemeroptera Taxa	3	3	5	1	1	5	3	5	3	5	5
Percent Intolerant Urban	3	3	3	3	3	3	3	3	3	3	3
Percent Chironomidae	3	3	3	3	3	3	3	3	3	3	3
Percent Clingers	3	3	3	1	1	3	3	3	3	3	3
BIBI Score	***3.3***	***3.3***	***3.7***	***2.3***	***2.0***	***4.0***	***3.3***	***3.7***	***3.3***	***4.0***	***4.0***
Narrative Rating	***Fair***	***Fair***	***Fair***	***Poor***	***Poor***	***Good***	***Fair***	***Fair***	***Fair***	***Good***	***Good***

Project Name: Howard County Countywide
Project Number: 16158563.28
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Cattail Creek BIBI_03.xlsx
Version: 1
Site Name: 03-102-R-2017

Subphylum/ Class	Order	Family	Genus	Final ID	Note[1]	# of Org	FFG[2]	Habit[3]	Tolerance Value[4]
Insecta	Diptera	Chironomidae	Ablabesmyia	Ablabesmyia	L	1	Predator	sp	8.1
Insecta	Coleoptera	Elmidae	Ancyronyx	Ancyronyx	L	1	Scraper	cn, sp	7.8
Insecta	Coleoptera	Elmidae	Ancyronyx	Ancyronyx	A	1	Scraper	cn, sp	7.8
Insecta	Diptera	Tipulidae	Antocha	Antocha	L	1	Collector	cn	8
Malacostraca	Isopoda	Asellidae	Caecidotea	Caecidotea	A	1	Collector	sp	2.6
Insecta	Trichoptera	Hydropsychidae	Cheumatopsyche	Cheumatopsyche	L	8	Filterer	cn	6.5
Insecta	Trichoptera	Philopotamidae	Chimarra	Chimarra	L	3	Filterer	cn	4.4
Insecta	Diptera	Chironomidae	not identified	Chironominae	P	1	Collector	0	6.6
Insecta	Diptera	Chironomidae	Cricotopus/Orthocladi	Cricotopus/Orthocladius	L	5	Shredder	0	7.7
Insecta	Diptera	Chironomidae	Dicrotendipes	Dicrotendipes	L	1	Collector	bu	9
Insecta	Coleoptera	Elmidae	Dubiraphia	Dubiraphia	A	1	Scraper	cn, cb	5.7
Insecta	Ephemeroptera	Ephemerellidae	Ephemerella	Ephemerella	L	27	Collector	cn, sw	2.3
Insecta	Trichoptera	Glossosomatidae	Glossosoma	Glossosoma	L	4	Scraper	cn	0.01
Insecta	Trichoptera	Glossosomatidae	not identified	Glossosomatidae	P	1	Scraper	cn	1
Insecta	Ephemeroptera	Heptageniidae	not identified	Heptageniidae	L	2	Scraper	cn	2.6
Insecta	Diptera	Chironomidae	Hydrobaenus	Hydrobaenus	P	1	Scraper	sp	7.2
Insecta	Trichoptera	Hydropsychidae	Hydropsyche	Hydropsyche	L	2	Filterer	cn	7.5
Insecta	Trichoptera	Hydropsychidae	not identified	Hydropsychidae	P	3	Filterer	cn	5.7
Insecta	Plecoptera	Perlodidae	Isoperla	Isoperla	L	1	Predator	cn, sp	2.4
Gastropoda	Basommatophora	Planorbidae	Menetus	Menetus	A	3	Scraper	cb	7.6
Insecta	Diptera	Chironomidae	Microtendipes	Microtendipes	L	4	Filterer	cn	4.9
Oligochaeta	Haplotaxida	Naididae	not identified	Naididae	A	3	Collector	bu	8.5
Insecta	Diptera	Chironomidae	Nanocladius	Nanocladius	L	1	Collector	sp	7.6
Insecta	Trichoptera	Uenoidae	Neophylax	Neophylax	L	2	Scraper	cn	2.7
Insecta	Coleoptera	Elmidae	Optioservus	Optioservus	A	1	Scraper	cn	5.4
Insecta	Coleoptera	Elmidae	Optioservus	Optioservus	L	1	Scraper	cn	5.4
Insecta	Diptera	Chironomidae	not identified	Orthocladiinae	P	1	Collector	0	7.6
Insecta	Coleoptera	Elmidae	Oulimnius	Oulimnius	A	1	Scraper	cn	2.7
Insecta	Diptera	Chironomidae	Paratanytarsus	Paratanytarsus	P	1	Collector	sp	7.7
Insecta	Diptera	Chironomidae	Polypedilum	Polypedilum	L	7	Shredder	cb, cn	6.3
Insecta	Diptera	Chironomidae	Potthastia	Potthastia	L	1	Collector	sp	0.01
Insecta	Diptera	Chironomidae	Rheotanytarsus	Rheotanytarsus	L	2	Filterer	cn	7.2
Insecta	Diptera	Simuliidae	Simulium	Simulium	L	1	Filterer	cn	5.7
Insecta	Diptera	Chironomidae	Stempellinella	Stempellinella	L	1	Collector	cb, sp, cn	4.2
Insecta	Coleoptera	Elmidae	Stenelmis	Stenelmis	A	3	Scraper	cn	7.1
Insecta	Diptera	Chironomidae	Sublettea	Sublettea	L	1	Collector	-	10
Insecta	Diptera	Chironomidae	Tanytarsus	Tanytarsus	L	5	Filterer	cb, cn	4.9
Insecta	Ephemeroptera	Ephemerellidae	Teloganopsis	Teloganopsis	L	7	Collector	0	na
Insecta	Diptera	Chironomidae	Thienemannimyia gro	Thienemannimyia group	L	1	Predator	sp	8.2
Insecta	Diptera	Chironomidae	Tvetenia	Tvetenia	L	1	Collector	sp	5.1
Insecta	Diptera	Chironomidae	Tvetenia	Tvetenia	P	1	Collector	sp	5.1

1 Life Stage, I - Immature, P- Pupa, A - Adult, U - Undetermined; 2 Functional Feeding Group; 3 Primary habit or form of locomotion, includes bu - burrower, cn - clinger, cb - climber, sk - skater, sp - sprawler, sw - swimmer; 4 Tolerance Values, based on Hilsenhoff, modified for Maryland. An entry of "0" indicates information for the particular taxa was not available.

Project Name: Howard County Countywide
Project Number: 16158563.28
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Prepared date: 7/28/2017 Checked date: 8/7/2017

Cattail Creek BIBI_03.xlsx
Version: 1
Site Name: 03-103-R-2017

Subphylum/ Class	Order	Family	Genus	Final ID	Note[1]	# of Org	FFG[2]	Habit[3]	Tolerance Value[4]
Insecta	Plecoptera	Perlidae	Acroneuria	Acroneuria	L	1	Predator	cn	2.5
Insecta	Diptera	Tipulidae	Antocha	Antocha	L	4	Collector	cn	8
Insecta	Trichoptera	Hydropsychidae	Cheumatopsyche	Cheumatopsyche	L	8	Filterer	cn	6.5
Insecta	Diptera	Chironomidae	Corynoneura	Corynoneura	L	1	Collector	sp	4.1
Insecta	Diptera	Chironomidae	Cricotopus/Orthocladius	Cricotopus/Orthocladius	L	10	Shredder	0	7.7
Insecta	Diptera	Chironomidae	Cricotopus/Orthocladius	Cricotopus/Orthocladius	P	2	Shredder	0	7.7
Insecta	Ephemeroptera	Ephemerellidae	Ephemerella	Ephemerella	L	20	Collector	cn, sw	2.3
Insecta	Diptera	Chironomidae	Eukiefferiella	Eukiefferiella	L	1	Collector	sp	6.1
Insecta	Trichoptera	Glossosomatidae	Glossosoma	Glossosoma	L	2	Scraper	cn	0.01
Insecta	Diptera	Empididae	Hemerodromia	Hemerodromia	L	2	Predator	sp, bu	7.9
Insecta	Ephemeroptera	Heptageniidae	not identified	Heptageniidae	L	1	Scraper	cn	2.6
Insecta	Trichoptera	Hydropsychidae	Hydropsyche	Hydropsyche	L	5	Filterer	cn	7.5
Insecta	Plecoptera	Perlodidae	Isoperla	Isoperla	L	2	Predator	cn, sp	2.4
Insecta	Ephemeroptera	Heptageniidae	Maccaffertium	Maccaffertium	L	1	Scraper	cn	3
Insecta	Hemiptera	Veliidae	Microvelia	Microvelia	A	1	Predator	SK	6
Oligochaeta	Haplotaxida	Naididae	not identified	Naididae	A	2	Collector	bu	8.5
Insecta	Coleoptera	Elmidae	Optioservus	Optioservus	L	1	Scraper	cn	5.4
Insecta	Coleoptera	Elmidae	Oulimnius	Oulimnius	L	1	Scraper	cn	2.7
Insecta	Coleoptera	Elmidae	Oulimnius	Oulimnius	A	1	Scraper	cn	2.7
Insecta	Diptera	Chironomidae	Polypedilum	Polypedilum	L	22	Shredder	cb, cn	6.3
Insecta	Coleoptera	Psephenidae	Psephenus	Psephenus	L	7	Scraper	cn	4.4
Insecta	Diptera	Chironomidae	Rheotanytarsus	Rheotanytarsus	L	1	Filterer	cn	7.2
Insecta	Diptera	Simuliidae	Simulium	Simulium	L	1	Filterer	cn	5.7
Insecta	Coleoptera	Elmidae	Stenelmis	Stenelmis	A	1	Scraper	cn	7.1
Insecta	Diptera	Chironomidae	Tanytarsus	Tanytarsus	L	2	Filterer	cb, cn	4.9
Insecta	Ephemeroptera	Ephemerellidae	Teloganopsis	Teloganopsis	L	10	Collector	0	na
Insecta	Diptera	Chironomidae	Thienemannimyia group	Thienemannimyia group	L	1	Predator	sp	8.2
Insecta	Diptera	Chironomidae	Tvetenia	Tvetenia	L	3	Collector	sp	5.1

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Cattail Creek BIBI_03.xlsx
Version: 1
Site Name: 03-104-R-2017

Subphylum/ Class	Order	Family	Genus	Final ID	Note[1]	# of Org	FFG[2]	Habit[3]	Tolerance Value[4]
Insecta	Ephemeroptera	Baetidae	Acerpenna	Acerpenna	larva	1	Collector	sw, cn	2.6
Insecta	Diptera	Tipulidae	Antocha	Antocha	larva	1	Collector	cn	8
Insecta	Odonata	Calopterygidae	Calopteryx	Calopteryx	larva	1	Predator	cb	8.3
Insecta	Trichoptera	Hydropsychidae	Cheumatopsyche	Cheumatopsyche	larva	9	Filterer	cn	6.5
Insecta	Diptera	Chironomidae	Corynoneura	Corynoneura	larva	1	Collector	sp	4.1
Insecta	Diptera	Chironomidae	Corynoneura	Corynoneura	pupa	1	Collector	sp	4.1
Insecta	Diptera	Chironomidae	Cricotopus/Orthocladius	Cricotopus/Orthocladius	larva	1	Shredder	0	7.7
Turbellaria	Tricladida	Dugesiidae	not identified	Dugesiidae	adult	1	0	0	na
Oligochaeta	Haplotaxida	Enchytraeidae	not identified	Enchytraeidae	adult	1	Collector	bu	9.1
Insecta	Ephemeroptera	Ephemerellidae	Ephemerella	Ephemerella	larva	25	Collector	cn, sw	2.3
Insecta	Diptera	Chironomidae	Eukiefferiella	Eukiefferiella	larva	1	Collector	sp	6.1
Insecta	Trichoptera	Glossosomatidae	Glossosoma	Glossosoma	larva	2	Scraper	cn	0.01
Insecta	Trichoptera	Glossosomatidae	not identified	Glossosomatidae	pupa	1	Scraper	cn	1
Insecta	Ephemeroptera	Heptageniidae	not identified	Heptageniidae	larva	1	Scraper	cn	2.6
Insecta	Trichoptera	Hydropsychidae	Hydropsyche	Hydropsyche	larva	7	Filterer	cn	7.5
Insecta	Trichoptera	Hydropsychidae	not identified	Hydropsychidae	pupa	1	Filterer	cn	5.7
Insecta	Diptera	Chironomidae	Microtendipes	Microtendipes	larva	6	Filterer	cn	4.9
Oligochaeta	Haplotaxida	Naididae	not identified	Naididae	adult	7	Collector	bu	8.5
Insecta	Trichoptera	Uenoidae	Neophylax	Neophylax	larva	4	Scraper	cn	2.7
Insecta	Coleoptera	Elmidae	Optioservus	Optioservus	larva	2	Scraper	cn	5.4
Insecta	Coleoptera	Elmidae	Optioservus	Optioservus	adult	1	Scraper	cn	5.4
Insecta	Coleoptera	Elmidae	Oulimnius	Oulimnius	larva	1	Scraper	cn	2.7
Insecta	Coleoptera	Elmidae	Oulimnius	Oulimnius	adult	2	Scraper	cn	2.7
Insecta	Diptera	Chironomidae	Parametriocnemus	Parametriocnemus	larva	3	Collector	sp	4.6
Insecta	Diptera	Chironomidae	Paratanytarsus	Paratanytarsus	larva	1	Collector	sp	7.7
Insecta	Diptera	Chironomidae	Polypedilum	Polypedilum	larva	10	Shredder	cb, cn	6.3
Insecta	Diptera	Chironomidae	Potthastia	Potthastia	larva	1	Collector	sp	0.01
Insecta	Coleoptera	Psephenidae	Psephenus	Psephenus	larva	1	Scraper	cn	4.4
Insecta	Diptera	Chironomidae	Stempellinella	Stempellinella	larva	1	Collector	cb, sp, cn	4.2
Insecta	Diptera	Chironomidae	Stempellinella	Stempellinella	pupa	1	Collector	cb, sp, cn	4.2
Insecta	Coleoptera	Elmidae	Stenelmis	Stenelmis	larva	2	Scraper	cn	7.1
Insecta	Coleoptera	Elmidae	Stenelmis	Stenelmis	adult	1	Scraper	cn	7.1
Insecta	Diptera	Chironomidae	Stilocladius	Stilocladius	larva	1	Collector	sp	6.6
Insecta	Diptera	Chironomidae	Tanytarsus	Tanytarsus	larva	1	Filterer	cb, cn	4.9
Insecta	Ephemeroptera	Ephemerellidae	Teloganopsis	Teloganopsis	larva	9	Collector	0	na
Insecta	Diptera	Chironomidae	Thienemannimyia group	Thienemannimyia group	larva	2	Predator	sp	8.2

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Project Number: 16158563.28
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Cattail Creek BIBI_03.xlsx
Version: 1
Site Name: 03-108-R-2017

Subphylum/ Class	Order	Family	Genus	Final ID	Note[1]	# of Org	FFG[2]	Habit[3]	Tolerance Value[4]
Insecta	Plecoptera	Nemouridae	Amphinemura	Amphinemura	L	9	Shredder	sp, cn	3
Insecta	Diptera	Chironomidae	Chaetocladius	Chaetocladius	L	7	Collector	sp	7
Insecta	Diptera	Chironomidae	Cladotanytarsus	Cladotanytarsus	L	2	Filterer	-	6.6
Insecta	Diptera	Chironomidae	Corynoneura	Corynoneura	L	2	Collector	sp	4.1
Insecta	Diptera	Chironomidae	Cricotopus/Orthocladi	Cricotopus/Orthocladius	L	28	Shredder	0	7.7
Insecta	Diptera	Chironomidae	Cricotopus/Orthocladi	Cricotopus/Orthocladius	P	5	Shredder	0	7.7
Insecta	Diptera	Chironomidae	Diamesa	Diamesa	L	1	Collector	sp	8.5
Insecta	Trichoptera	Hydropsychidae	Diplectrona	Diplectrona	L	3	Filterer	cn	2.7
Insecta	Ephemeroptera	Ephemerellidae	Ephemerella	Ephemerella	L	1	Collector	cn, sw	2.3
Insecta	Plecoptera	not identified	not identified	Plecoptera	L	1	0	0	2.4
Insecta	Trichoptera	Psychomyiidae	Lype	Lype	L	1	Scraper	cn	4.7
Oligochaeta	Haplotaxida	Naididae	not identified	Naididae	A	19	Collector	bu	8.5
Insecta	Coleoptera	Elmidae	Oulimnius	Oulimnius	L	2	Scraper	cn	2.7
Insecta	Diptera	Chironomidae	Parachaetocladius	Parachaetocladius	L	1	Collector	sp	3.3
Insecta	Diptera	Chironomidae	Parakiefferiella	Parakiefferiella	L	2	Collector	sp	2.1
Insecta	Diptera	Chironomidae	Polypedilum	Polypedilum	L	4	Shredder	cb, cn	6.3
Insecta	Diptera	Chironomidae	Rheocricotopus	Rheocricotopus	L	1	Collector	sp	6.2
Insecta	Diptera	Chironomidae	Stempellinella	Stempellinella	L	1	Collector	cb, sp, cn	4.2
Insecta	Diptera	Chironomidae	Stilocladius	Stilocladius	L	2	Collector	sp	6.6
Insecta	Diptera	Chironomidae	Tanytarsus	Tanytarsus	P	1	Filterer	cb, cn	4.9
Insecta	Diptera	Chironomidae	Thienemannimyia	Thienemannimyia	L	1	Predator	sp	6.7
Insecta	Diptera	Tipulidae	Tipula	Tipula	L	1	Shredder	bu	6.7

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Cattail Creek BIBI_03.xlsx
Version: 1
Site Name: 03-113-R-2017

Subphylum/ Class	Order	Family	Genus	Final ID	Note[1]	# of Org	FFG[2]	Habit[3]	Tolerance Value[4]
Insecta	Plecoptera	Nemouridae	Amphinemura	Amphinemura	L	1	Shredder	sp, cn	3
Insecta	Diptera	Chironomidae	Chaetocladius	Chaetocladius	L	4	Collector	sp	7
Insecta	Diptera	Chironomidae	Corynoneura	Corynoneura	L	3	Collector	sp	4.1
Insecta	Diptera	Chironomidae	Cricotopus/Orthocladius	Cricotopus/Orthocladius	L	1	Shredder	0	7.7
Oligochaeta	Haplotaxida	Lumbricidae	not identified	Lumbricidae	A	1	Collector	0	10
Insecta	Diptera	Chironomidae	Eukiefferiella	Eukiefferiella	L	1	Collector	sp	6.1
Insecta	Diptera	Empididae	Hemerodromia	Hemerodromia	L	1	Predator	sp, bu	7.9
Insecta	Coleoptera	Dytiscidae	not identified	Dytiscidae	L	1	Predator	sw, dv	5.4
Insecta	Ephemeroptera	Leptophlebiidae	not identified	Leptophlebiidae	L	1	Collector	sw, cn	1.7
Insecta	Diptera	Chironomidae	Micropsectra	Micropsectra	L	6	Collector	cb, sp	2.1
Insecta	Diptera	Chironomidae	Micropsectra	Micropsectra	P	1	Collector	cb, sp	2.1
Oligochaeta	Haplotaxida	Naididae	not identified	Naididae	A	50	Collector	bu	8.5
Insecta	Trichoptera	Uenoidae	Neophylax	Neophylax	L	2	Scraper	cn	2.7
Insecta	Diptera	Chironomidae	not identified	Orthocladiinae	P	1	Collector	0	7.6
Insecta	Diptera	Chironomidae	Parametriocnemus	Parametriocnemus	P	1	Collector	sp	4.6
Insecta	Diptera	Chironomidae	Paraphaenocladius	Paraphaenocladius	L	4	Collector	sp	4
Insecta	Diptera	Chironomidae	Polypedilum	Polypedilum	L	6	Shredder	cb, cn	6.3
Enopla	Hoplonemertea	Tetrastemmatidae	Prostoma	Prostoma	A	1	Predator	0	7.3
Insecta	Diptera	Tipulidae	Pseudolimnophila	Pseudolimnophila	L	2	Predator	bu	2.8
Insecta	Diptera	Chironomidae	Rheocricotopus	Rheocricotopus	L	2	Collector	sp	6.2
Insecta	Diptera	Chironomidae	Thienemanniella	Thienemanniella	L	1	Collector	sp	5.1
Insecta	Diptera	Tipulidae	Tipula	Tipula	L	1	Shredder	bu	6.7
Insecta	Diptera	Chironomidae	Zavrelimyia	Zavrelimyia	L	1	Predator	sp	5.3

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Project Name: Howard County Countywide
Project Number: 16158563.28
Prepared by: BC Checked by: CRH
Prepared date: 7/28/2017 Checked date: 8/7/2017

Cattail Creek BIBI_03.xlsx
Version: 1
Site Name: 03-123-F-2017

Subphylum/ Class	Order	Family	Genus	Final ID	Note[1]	# of Org	FFG[2]	Habit[3]	Tolerance Value[4]
Insecta	Ephemeroptera	Baetidae	Acentrella	Acentrella	L	1	Collector	sw, cn	4.9
Insecta	Plecoptera	Perlidae	Acroneuria	Acroneuria	L	1	Predator	cn	2.5
Insecta	Plecoptera	Nemouridae	Amphinemura	Amphinemura	L	5	Shredder	sp, cn	3
Insecta	Coleoptera	Ptilodactylidae	Anchytarsus	Anchytarsus	L	1	Shredder	cn	3.1
Insecta	Diptera	Tipulidae	Antocha	Antocha	L	3	Collector	cn	8
Insecta	Trichoptera	Hydropsychidae	Cheumatopsyche	Cheumatopsyche	L	2	Filterer	cn	6.5
Insecta	Trichoptera	Philopotamidae	Chimarra	Chimarra	L	1	Filterer	cn	4.4
Insecta	Megaloptera	Corydalidae	Corydalus	Corydalus	L	1	Predator	cn, cb	1.4
Insecta	Diptera	Chironomidae	Corynoneura	Corynoneura	L	2	Collector	sp	4.1
Insecta	Diptera	Chironomidae	Corynoneura	Corynoneura	P	1	Collector	sp	4.1
Insecta	Diptera	Chironomidae	Cricotopus/Orthocladi	Cricotopus/Orthocladius	L	6	Shredder	0	7.7
Insecta	Diptera	Chironomidae	Cricotopus/Orthocladi	Cricotopus/Orthocladius	P	2	Shredder	0	7.7
Insecta	Ephemeroptera	Baetidae	Diphetor	Diphetor	L	1	Collector	sw, cn	2.3
Insecta	Trichoptera	Hydropsychidae	Diplectrona	Diplectrona	L	3	Filterer	cn	2.7
Insecta	Coleoptera	Elmidae	Dubiraphia	Dubiraphia	A	2	Scraper	cn, cb	5.7
Insecta	Ephemeroptera	Ephemerellidae	Ephemerella	Ephemerella	L	6	Collector	cn, sw	2.3
Insecta	Ephemeroptera	Ephemerellidae	Eurylophella	Eurylophella	L	2	Scraper	cn, sp	4.5
Insecta	Trichoptera	Hydropsychidae	Hydropsyche	Hydropsyche	L	4	Filterer	cn	7.5
Insecta	Ephemeroptera	Leptophlebiidae	not identified	Leptophlebiidae	L	1	Collector	sw, cn	1.7
Insecta	Ephemeroptera	Heptageniidae	Leucrocuta	Leucrocuta	L	2	Scraper	cn	1.8
Insecta	Plecoptera	not identified	not identified	Plecoptera	L	8	0	0	2.4
Insecta	Ephemeroptera	Heptageniidae	Maccaffertium	Maccaffertium	L	1	Scraper	cn	3
Insecta	Diptera	Chironomidae	Microtendipes	Microtendipes	L	1	Filterer	cn	4.9
Oligochaeta	Haplotaxida	Naididae	not identified	Naididae	A	8	Collector	bu	8.5
Insecta	Trichoptera	Uenoidae	Neophylax	Neophylax	L	2	Scraper	cn	2.7
Insecta	Coleoptera	Elmidae	Oulimnius	Oulimnius	L	5	Scraper	cn	2.7
Insecta	Coleoptera	Elmidae	Oulimnius	Oulimnius	A	7	Scraper	cn	2.7
Turbellaria	Tricladida	Planariidae	not identified	Planariidae	A	5	Predator	sp	8.4
Insecta	Diptera	Chironomidae	Polypedilum	Polypedilum	L	4	Shredder	cb, cn	6.3
Insecta	Diptera	Chironomidae	Rheotanytarsus	Rheotanytarsus	L	1	Filterer	cn	7.2
Insecta	Diptera	Chironomidae	Stempellinella	Stempellinella	P	1	Collector	cb, sp, cn	4.2
Insecta	Coleoptera	Elmidae	Stenelmis	Stenelmis	A	2	Scraper	cn	7.1
Insecta	Diptera	Chironomidae	Stilocladius	Stilocladius	L	2	Collector	sp	6.6
Insecta	Diptera	Chironomidae	not identified	Tanytarsini	P	1	Collector	0	3.5
Insecta	Diptera	Chironomidae	Tanytarsus	Tanytarsus	L	2	Filterer	cb, cn	4.9
Insecta	Ephemeroptera	Ephemerellidae	Teloganopsis	Teloganopsis	L	4	Collector	0	na
Insecta	Diptera	Chironomidae	Thienemannimyia gro	Thienemannimyia group	L	3	Predator	sp	8.2
Insecta	Diptera	Tipulidae	Tipula	Tipula	L	1	Shredder	bu	6.7
Insecta	Diptera	Chironomidae	Tvetenia	Tvetenia	L	2	Collector	sp	5.1

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Project Name: Howard County Countywide
Project Number: 16158563.28
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Cattail Creek BIBI_03.xlsx
Version: 1
Site Name: 03-124-F-2017

Subphylum/ Class	Order	Family	Genus	Final ID	Note[1]	# of Org	FFG[2]	Habit[3]	Tolerance Value[4]
Insecta	Plecoptera	Nemouridae	Amphinemura	Amphinemura	L	2	Shredder	sp, cn	3
Insecta	Diptera	Tipulidae	Antocha	Antocha	L	1	Collector	cn	8
Insecta	Odonata	Calopterygidae	Calopteryx	Calopteryx	L	1	Predator	cb	8.3
Oligochaeta	Tubificida	Naididae	Chaetogaster	Chaetogaster	A	1	0	0	na
Insecta	Trichoptera	Hydropsychidae	Cheumatopsyche	Cheumatopsyche	L	3	Filterer	cn	6.5
Insecta	Trichoptera	Philopotamidae	Chimarra	Chimarra	L	2	Filterer	cn	4.4
Insecta	Diptera	Empididae	Clinocera	Clinocera	L	2	Predator	cn	7.4
Insecta	Diptera	Chironomidae	Corynoneura	Corynoneura	L	3	Collector	sp	4.1
Insecta	Diptera	Chironomidae	Corynoneura	Corynoneura	P	1	Collector	sp	4.1
Insecta	Diptera	Chironomidae	Cricotopus/Orthocladius	Cricotopus/Orthocladius	L	6	Shredder	0	7.7
Insecta	Diptera	Chironomidae	Cricotopus/Orthocladius	Cricotopus/Orthocladius	P	2	Shredder	0	7.7
Insecta	Trichoptera	Hydropsychidae	Diplectrona	Diplectrona	L	4	Filterer	cn	2.7
Insecta	Coleoptera	Elmidae	Dubiraphia	Dubiraphia	L	2	Scraper	cn, cb	5.7
Turbellaria	Tricladida	Dugesiidae	not identified	Dugesiidae	A	1	0	0	na
Insecta	Coleoptera	Elmidae	not identified	Elmidae	A	1	Collector	cn	4.8
Oligochaeta	Haplotaxida	Enchytraeidae	not identified	Enchytraeidae	A	1	Collector	bu	9.1
Insecta	Ephemeroptera	Ephemerellidae	Ephemerella	Ephemerella	L	1	Collector	cn, sw	2.3
Insecta	Trichoptera	Hydropsychidae	Hydropsyche	Hydropsyche	L	1	Filterer	cn	7.5
Insecta	Trichoptera	Hydropsychidae	not identified	Hydropsychidae	P	1	Filterer	cn	5.7
Insecta	Ephemeroptera	Heptageniidae	Maccaffertium	Maccaffertium	L	2	Scraper	cn	3
Insecta	Diptera	Chironomidae	Micropsectra	Micropsectra	L	7	Collector	cb, sp	2.1
Insecta	Diptera	Chironomidae	Micropsectra	Micropsectra	P	3	Collector	cb, sp	2.1
Insecta	Diptera	Chironomidae	Microtendipes	Microtendipes	L	1	Filterer	cn	4.9
Oligochaeta	Haplotaxida	Naididae	not identified	Naididae	A	18	Collector	bu	8.5
Insecta	Trichoptera	Uenoidae	Neophylax	Neophylax	L	1	Scraper	cn	2.7
Insecta	Coleoptera	Elmidae	Oulimnius	Oulimnius	L	2	Scraper	cn	2.7
Insecta	Coleoptera	Elmidae	Oulimnius	Oulimnius	A	3	Scraper	cn	2.7
Insecta	Diptera	Chironomidae	Parametriocnemus	Parametriocnemus	L	5	Collector	sp	4.6
Gastropoda	Basommatophora	Physidae	Physa	Physa	A	3	Scraper	cb	7
Turbellaria	Tricladida	Planariidae	not identified	Planariidae	A	4	Predator	sp	8.4
Insecta	Diptera	Chironomidae	Polypedilum	Polypedilum	L	10	Shredder	cb, cn	6.3
Enopla	Hoplonemertea	Tetrastemmatidae	Prostoma	Prostoma	A	1	Predator	0	7.3
Insecta	Diptera	Chironomidae	Rheotanytarsus	Rheotanytarsus	P	1	Filterer	cn	7.2
Insecta	Coleoptera	Elmidae	Stenelmis	Stenelmis	L	2	Scraper	cn	7.1
Insecta	Diptera	Chironomidae	Tanytarsus	Tanytarsus	L	3	Filterer	cb, cn	4.9
Insecta	Diptera	Chironomidae	Thienemannimyia group	Thienemannimyia group	L	1	Predator	sp	8.2
Insecta	Diptera	Chironomidae	Tvetenia	Tvetenia	L	1	Collector	sp	5.1

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Project Name: Howard County Countywide
Project Number: 16158563.28
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Prepared date: 7/28/2017 Checked date: 8/7/2017

Cattail Creek BIBI_03.xlsx
Version: 1
Site Name: 03-221-F-2017

Subphylum/ Class	Order	Family	Genus	Final ID	Note[1]	# of Org	FFG[2]	Habit[3]	Tolerance Value[4]
Insecta	Ephemeroptera	Ameletidae	Ameletus	Ameletus	L	1	Collector	sw, cb	2.6
Insecta	Diptera	Tipulidae	Antocha	Antocha	L	1	Collector	cn	8
Oligochaeta	Haplotaxida	Naididae	not identified	Naididae	A	6	Collector	bu	8.5
Oligochaeta	Tubificida	Naididae	Chaetogaster	Chaetogaster	A	2	0	0	na
Insecta	Trichoptera	Hydropsychidae	Cheumatopsyche	Cheumatopsyche	L	5	Filterer	cn	6.5
Insecta	Diptera	Chironomidae	not identified	Chironominae	P	1	Collector	0	6.6
Insecta	Diptera	Chironomidae	Cricotopus/Orthocladius	Cricotopus/Orthocladius	L	1	Shredder	0	7.7
Insecta	Diptera	Chironomidae	Cryptochironomus	Cryptochironomus	L	1	Predator	sp, bu	7.6
Insecta	Ephemeroptera	Ephemerellidae	Ephemerella	Ephemerella	L	14	Collector	cn, sw	2.3
Insecta	Ephemeroptera	Ephemerellidae	Eurylophella	Eurylophella	L	1	Scraper	cn, sp	4.5
Insecta	Diptera	Empididae	Hemerodromia	Hemerodromia	L	1	Predator	sp, bu	7.9
Insecta	Ephemeroptera	Heptageniidae	not identified	Heptageniidae	L	1	Scraper	cn	2.6
Insecta	Diptera	Tipulidae	Hexatoma	Hexatoma	A	1	Predator	bu, sp	1.5
Insecta	Diptera	Chironomidae	Hydrobaenus	Hydrobaenus	L	7	Scraper	sp	7.2
Insecta	Plecoptera	Perlodidae	Isoperla	Isoperla	L	1	Predator	cn, sp	2.4
Insecta	Diptera	Chironomidae	Microtendipes	Microtendipes	L	2	Filterer	cn	4.9
Insecta	Diptera	Chironomidae	Nilotanypus	Nilotanypus	L	1	Predator	sp	6.6
Insecta	Coleoptera	Elmidae	Oulimnius	Oulimnius	A	1	Scraper	cn	2.7
Insecta	Plecoptera	Nemouridae	Paranemoura	Paranemoura	L	1	0	0	2.9
Insecta	Diptera	Chironomidae	Polypedilum	Polypedilum	L	20	Shredder	cb, cn	6.3
Insecta	Diptera	Chironomidae	Rheotanytarsus	Rheotanytarsus	L	14	Filterer	cn	7.2
Insecta	Diptera	Chironomidae	Rheotanytarsus	Rheotanytarsus	P	2	Filterer	cn	7.2
Insecta	Diptera	Chironomidae	Stempellinella	Stempellinella	L	5	Collector	cb, sp, cn	4.2
Insecta	Diptera	Chironomidae	Stempellinella	Stempellinella	P	1	Collector	cb, sp, cn	4.2
Insecta	Coleoptera	Elmidae	Stenelmis	Stenelmis	A	1	Scraper	cn	7.1
Insecta	Diptera	Chironomidae	Tanytarsus	Tanytarsus	L	10	Filterer	cb, cn	4.9
Insecta	Ephemeroptera	Ephemerellidae	Teloganopsis	Teloganopsis	L	3	Collector	0	na
Insecta	Diptera	Chironomidae	Thienemannimyia group	Thienemannimyia group	L	3	Predator	sp	8.2

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Project Name: Howard County Countywide
Project Number: 16158563.28
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Cattail Creek BIBI_03.xlsx
Version: 1
Site Name: 03-301-F-2017

Subphylum/ Class	Order	Family	Genus	Final ID	Note[1]	# of Org	FFG[2]	Habit[3]	Tolerance Value[4]
Insecta	Diptera	Tipulidae	Antocha	Antocha	L	1	Collector	cn	8
Malacostraca	Isopoda	Asellidae	Caecidotea	Caecidotea	A	4	Collector	sp	2.6
Insecta	Trichoptera	Hydropsychidae	Cheumatopsyche	Cheumatopsyche	L	6	Filterer	cn	6.5
Insecta	Trichoptera	Philopotamidae	Chimarra	Chimarra	L	1	Filterer	cn	4.4
Insecta	Diptera	Chironomidae	Cladotanytarsus	Cladotanytarsus	L	1	Filterer	-	6.6
Bivalvia	Veneroida	Corbiculidae	Corbicula	Corbicula	A	1	Filterer	bu	6
Malacostraca	Amphipoda	Crangonyctidae	Crangonyx	Crangonyx	A	20	Collector	sp	6.7
Insecta	Diptera	Chironomidae	Cricotopus/Orthocladius	Cricotopus/Orthocladius	L	12	Shredder	0	7.7
Insecta	Coleoptera	Elmidae	Dubiraphia	Dubiraphia	A	1	Scraper	cn, cb	5.7
Insecta	Ephemeroptera	Ephemerellidae	Ephemerella	Ephemerella	L	1	Collector	cn, sw	2.3
Gastropoda	Basommatophora	Ancylidae	Ferrissia	Ferrissia	A	1	Scraper	cb	7
Insecta	Plecoptera	Chloroperlidae	Haploperla	Haploperla	L	1	Predator	cn	1.6
Insecta	Ephemeroptera	Heptageniidae	not identified	Heptageniidae	L	1	Scraper	cn	2.6
Malacostraca	Amphipoda	Hyalellidae	Hyalella	Hyalella	A	1	Shredder	sp	4.2
Insecta	Trichoptera	Hydropsychidae	Hydropsyche	Hydropsyche	L	3	Filterer	cn	7.5
Insecta	Ephemeroptera	Heptageniidae	Maccaffertium	Maccaffertium	L	4	Scraper	cn	3
Insecta	Coleoptera	Elmidae	Macronychus	Macronychus	L	1	Scraper	cn	6.8
Insecta	Diptera	Chironomidae	Microtendipes	Microtendipes	L	1	Filterer	cn	4.9
Oligochaeta	Haplotaxida	Naididae	not identified	Naididae	A	10	Collector	bu	8.5
Insecta	Diptera	Chironomidae	Nanocladius	Nanocladius	L	2	Collector	sp	7.6
Insecta	Diptera	Empididae	Neoplasta	Neoplasta	L	1	Predator	0	na
Insecta	Coleoptera	Elmidae	Optioservus	Optioservus	L	1	Scraper	cn	5.4
Insecta	Diptera	Chironomidae	not identified	Orthocladiinae	L	1	Collector	0	7.6
Insecta	Diptera	Chironomidae	not identified	Orthocladiinae	P	1	Collector	0	7.6
Insecta	Coleoptera	Elmidae	Oulimnius	Oulimnius	L	2	Scraper	cn	2.7
Insecta	Coleoptera	Elmidae	Oulimnius	Oulimnius	A	4	Scraper	cn	2.7
Insecta	Diptera	Chironomidae	Parakiefferiella	Parakiefferiella	L	1	Collector	sp	2.1
Insecta	Diptera	Chironomidae	Parametriocnemus	Parametriocnemus	L	1	Collector	sp	4.6
Insecta	Plecoptera	Nemouridae	Paranemoura	Paranemoura	L	3	0	0	2.9
Insecta	Diptera	Chironomidae	Polypedilum	Polypedilum	L	9	Shredder	cb, cn	6.3
Insecta	Diptera	Chironomidae	Rheotanytarsus	Rheotanytarsus	L	5	Filterer	cn	7.2
Insecta	Coleoptera	Elmidae	Stenelmis	Stenelmis	L	5	Scraper	cn	7.1
Insecta	Diptera	Chironomidae	Tanytarsus	Tanytarsus	L	3	Filterer	cb, cn	4.9
Insecta	Ephemeroptera	Ephemerellidae	Teloganopsis	Teloganopsis	L	2	Collector	0	na
Insecta	Diptera	Tipulidae	not identified	Tipulidae	P	1	Predator	bu, sp	4.8
Insecta	Diptera	Chironomidae	Tvetenia	Tvetenia	L	1	Collector	sp	5.1
Insecta	Diptera	Chironomidae	Tvetenia	Tvetenia	P	1	Collector	sp	5.1

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Cattail Creek BIBI_03.xlsx
Version: 1
Site Name: 03-301-R-2017QC

Subphylum/ Class	Order	Family	Genus	Final ID	Note[1]	# of Org	FFG[2]	Habit[3]	Tolerance Value[4]
Insecta	Ephemeroptera	Baetidae	Acerpenna	Acerpenna	L	1	Collector	sw, cn	2.6
Insecta	Plecoptera	Perlidae	Acroneuria	Acroneuria	L	1	Predator	cn	2.5
Insecta	Diptera	Tipulidae	Antocha	Antocha	L	1	Collector	cn	8
Insecta	Diptera	Chironomidae	Brillia	Brillia	L	1	Shredder	bu, sp	7.4
Insecta	Diptera	Chironomidae	Chaetocladius	Chaetocladius	L	1	Collector	sp	7
Insecta	Trichoptera	Hydropsychidae	Cheumatopsyche	Cheumatopsyche	L	12	Filterer	cn	6.5
Insecta	Trichoptera	Philopotamidae	Chimarra	Chimarra	L	2	Filterer	cn	4.4
Insecta	Diptera	Chironomidae	Corynoneura	Corynoneura	P	1	Collector	sp	4.1
Malacostraca	Amphipoda	Crangonyctidae	Crangonyx	Crangonyx	A	6	Collector	sp	6.7
Insecta	Diptera	Chironomidae	Cricotopus/Orthocladius	Cricotopus/Orthocladius	L	11	Shredder	0	7.7
Insecta	Diptera	Chironomidae	Diamesa	Diamesa	L	1	Collector	sp	8.5
Insecta	Diptera	Chironomidae	Diplocladius	Diplocladius	L	1	Collector	sp	5.9
Insecta	Ephemeroptera	Ephemerellidae	Ephemerella	Ephemerella	L	3	Collector	cn, sw	2.3
Insecta	Diptera	Ceratopogonidae	not identified	Ceratopogonidae	L	1	Predator	sp, bu	3.6
Insecta	Diptera	Chironomidae	Hydrobaenus	Hydrobaenus	L	1	Scraper	sp	7.2
Insecta	Trichoptera	Hydropsychidae	Hydropsyche	Hydropsyche	L	1	Filterer	cn	7.5
Insecta	Ephemeroptera	Isonychiidae	Isonychia	Isonychia	L	2	Filterer	sw, cn	2.5
Insecta	Plecoptera	not identified	not identified	Plecoptera	L	3	0	0	2.4
Insecta	Ephemeroptera	Heptageniidae	Maccaffertium	Maccaffertium	L	6	Scraper	cn	3
Insecta	Diptera	Chironomidae	Microtendipes	Microtendipes	L	3	Filterer	cn	4.9
Insecta	Trichoptera	Leptoceridae	Mystacides	Mystacides	L	1	Collector	sp, cb	4.1
Oligochaeta	Haplotaxida	Naididae	not identified	Naididae	A	16	Collector	bu	8.5
Insecta	Diptera	Chironomidae	Nanocladius	Nanocladius	L	1	Collector	sp	7.6
Insecta	Coleoptera	Elmidae	Optioservus	Optioservus	L	2	Scraper	cn	5.4
Insecta	Diptera	Chironomidae	not identified	Orthocladiinae	P	1	Collector	0	7.6
Insecta	Coleoptera	Elmidae	Oulimnius	Oulimnius	A	1	Scraper	cn	2.7
Insecta	Coleoptera	Elmidae	Oulimnius	Oulimnius	L	1	Scraper	cn	2.7
Insecta	Diptera	Chironomidae	Parametriocnemus	Parametriocnemus	L	1	Collector	sp	4.6
Insecta	Trichoptera	Philopotamidae	not identified	Philopotamidae	P	1	Filterer	cn	2.6
Insecta	Diptera	Chironomidae	Polypedilum	Polypedilum	L	10	Shredder	cb, cn	6.3
Insecta	Coleoptera	Psephenidae	Psephenus	Psephenus	L	1	Scraper	cn	4.4
Insecta	Diptera	Chironomidae	Rheocricotopus	Rheocricotopus	L	1	Collector	sp	6.2
Insecta	Diptera	Chironomidae	Rheotanytarsus	Rheotanytarsus	L	4	Filterer	cn	7.2
Insecta	Diptera	Simuliidae	Simulium	Simulium	L	1	Filterer	cn	5.7
Insecta	Diptera	Chironomidae	Stempellinella	Stempellinella	L	2	Collector	cb, sp, cn	4.2
Insecta	Diptera	Chironomidae	Stilocladius	Stilocladius	L	1	Collector	sp	6.6
Insecta	Diptera	Chironomidae	Tanytarsus	Tanytarsus	L	3	Filterer	cb, cn	4.9
Insecta	Diptera	Chironomidae	Tanytarsus	Tanytarsus	P	1	Filterer	cb, cn	4.9
Insecta	Ephemeroptera	Ephemerellidae	Teloganopsis	Teloganopsis	L	4	Collector	0	na
Oligochaeta	Haplotaxida	Naididae	not identified	Naididae	U	1	Collector	bu	8.5
Insecta	Diptera	Chironomidae	Tvetenia	Tvetenia	L	1	Collector	sp	5.1
Insecta	Diptera	Chironomidae	Tvetenia	Tvetenia	P	1	Collector	sp	5.1

1 Life Stage, I - Immature, P- Pupa, A - Adult, U - Undetermined; 2 Functional Feeding Group; 3 Primary habit or form of locomotion, includes bu - burrower, cn - clinger, cb - climber, sk - skater, sp - sprawler, sw - swimmer; 4 Tolerance Values, based on Hilsenhoff, modified for Maryland. An entry of "0" indicates information for the particular taxa was not available.

Project Name: Howard County Countywide
Project Number: 16158563.28
Prepared by: BC Checked by: CRH
Prepared date: 7/31/2017 Checked date: 8/7/2017

Cattail Creek BIBI_03.xlsx
Version: 1
Site Name: 03-321-F-2017

Subphylum/ Class	Order	Family	Genus	Final ID	Note[1]	# of Org	FFG[2]	Habit[3]	Tolerance Value[4]
Insecta	Diptera	Chironomidae	Ablabesmyia	Ablabesmyia	L	2	Predator	sp	8.1
Insecta	Ephemeroptera	Baetidae	Acentrella	Acentrella	L	1	Collector	sw, cn	4.9
Oligochaeta	Tubificida	Naididae	Chaetogaster	Chaetogaster	A	1	0	0	na
Insecta	Trichoptera	Hydropsychidae	Cheumatopsyche	Cheumatopsyche	L	5	Filterer	cn	6.5
Insecta	Trichoptera	Philopotamidae	Chimarra	Chimarra	L	1	Filterer	cn	4.4
Malacostraca	Amphipoda	Crangonyctidae	Crangonyx	Crangonyx	A	6	Collector	sp	6.7
Insecta	Diptera	Chironomidae	Cricotopus/Orthocladi	Cricotopus/Orthocladius	L	8	Shredder	0	7.7
Insecta	Coleoptera	Elmidae	Dubiraphia	Dubiraphia	A	1	Scraper	cn, cb	5.7
Insecta	Ephemeroptera	Ephemerellidae	Ephemerella	Ephemerella	L	2	Collector	cn, sw	2.3
Insecta	Ephemeroptera	Ephemerellidae	Eurylophella	Eurylophella	L	1	Scraper	cn, sp	4.5
Insecta	Diptera	Chironomidae	Hydrobaenus	Hydrobaenus	L	2	Scraper	sp	7.2
Insecta	Diptera	Chironomidae	Hydrobaenus	Hydrobaenus	P	1	Scraper	sp	7.2
Insecta	Trichoptera	Hydropsychidae	Hydropsyche	Hydropsyche	L	4	Filterer	cn	7.5
Insecta	Trichoptera	Hydropsychidae	not identified	Hydropsychidae	P	1	Filterer	cn	5.7
Insecta	Trichoptera	Hydroptilidae	Hydroptila	Hydroptila	L	1	Scraper	cn	6
Insecta	Ephemeroptera	Isonychiidae	Isonychia	Isonychia	L	1	Filterer	sw, cn	2.5
Insecta	Plecoptera	not identified	not identified	Plecoptera	L	1	0	0	2.4
Insecta	Ephemeroptera	Heptageniidae	Maccaffertium	Maccaffertium	L	10	Scraper	cn	3
Oligochaeta	Haplotaxida	Naididae	not identified	Naididae	A	15	Collector	bu	8.5
Insecta	Diptera	Chironomidae	Nanocladius	Nanocladius	L	1	Collector	sp	7.6
not identified	not identified	not identified	not identified	Nemata	A	1	0	0	na
Insecta	Coleoptera	Elmidae	Oulimnius	Oulimnius	L	1	Scraper	cn	2.7
Insecta	Coleoptera	Elmidae	Oulimnius	Oulimnius	A	1	Scraper	cn	2.7
Insecta	Diptera	Chironomidae	Parakiefferiella	Parakiefferiella	L	1	Collector	sp	2.1
Insecta	Diptera	Chironomidae	Parametriocnemus	Parametriocnemus	P	4	Collector	sp	4.6
Insecta	Diptera	Chironomidae	Paratanytarsus	Paratanytarsus	L	2	Collector	sp	7.7
Gastropoda	Basommatophora	Physidae	Physa	Physa	A	1	Scraper	cb	7
Insecta	Diptera	Chironomidae	Polypedilum	Polypedilum	L	8	Shredder	cb, cn	6.3
Insecta	Diptera	Chironomidae	Potthastia	Potthastia	L	2	Collector	sp	0.01
Enopla	Hoplonemertea	Tetrastemmatidae	Prostoma	Prostoma	A	1	Predator	0	7.3
Insecta	Diptera	Chironomidae	Rheotanytarsus	Rheotanytarsus	L	16	Filterer	cn	7.2
Insecta	Diptera	Chironomidae	Rheotanytarsus	Rheotanytarsus	P	1	Filterer	cn	7.2
Insecta	Diptera	Simuliidae	Simulium	Simulium	L	1	Filterer	cn	5.7
Bivalvia	Veneroida	Pisidiidae	not identified	Sphaeriidae	U	1	Filterer	bu	6.5
Insecta	Coleoptera	Elmidae	Stenelmis	Stenelmis	A	1	Scraper	cn	7.1
Insecta	Diptera	Chironomidae	Stilocladius	Stilocladius	P	1	Collector	sp	6.6
Insecta	Diptera	Chironomidae	Sympotthastia	Sympotthastia	L	1	Collector	sp	8.2
Insecta	Diptera	Chironomidae	not identified	Tanytarsini	P	1	Collector	0	3.5
Insecta	Diptera	Chironomidae	Tanytarsus	Tanytarsus	L	6	Filterer	cb, cn	4.9
Insecta	Ephemeroptera	Ephemerellidae	Teloganopsis	Teloganopsis	L	2	Collector	0	na
Insecta	Diptera	Chironomidae	Thienemannimyia gro	Thienemannimyia group	L	1	Predator	sp	8.2
Insecta	Trichoptera	Leptoceridae	Triaenodes	Triaenodes	L	1	Shredder	sw, cb	5

1 Life Stage, I - Immature, P- Pupa, A - Adult, U - Undetermined; 2 Functional Feeding Group; 3 Primary habit or form of locomotion, includes bu - burrower, cn - clinger, cb - climber, sk - skater, sp - sprawler, sw - swimmer; 4 Tolerance Values, based on Hilsenhoff, modified for Maryland. An entry of "0" indicates information for the particular taxa was not available.

Project Name: Howard County Countywide Biomonitoring
Project Number: 16158563.28
Prepared by: BC Checked by: CRH
Prepared date: 7/24/2017 Checked date: 8/4/2017

Upper Brighton BIBI_02.xlsx
Version: 1
Site Name:

Metric	02-103-R-2017	02-104-R-2017	02-106-R-2017	02-107-R-2017	02-121-F-2017	02-123-F-2017	02-201-R-2017	02-202-R-2017	02-221-F-2017	02-301-F-2017	02-121-F-2017QC
Raw Scores	**Raw Scores**										
Total Number of Taxa	34	22	32	28	34	28	32	30	25	34	29
Number of EPT Taxa	14	9	15	5	13	9	11	10	9	13	12
Number of Ephemeroptera Taxa	6	4	7	1	1	4	6	5	5	4	2
Percent Intolerant Urban	32.7	54.8	43.9	16.1	62.0	26.0	22.3	25.0	63.6	25.7	52.9
Percent Chironomidae	24.5	21.7	23.5	47.3	17.6	32.0	51.5	27.7	12.1	15.8	21.6
Percent Clingers	51.8	72.2	67.3	26.9	77.8	43.0	62.1	69.6	77.8	63.4	71.6
BIBI Scores	**BIBI Scores**										
Total Number of Taxa	5	3	5	5	5	5	5	5	5	5	5
Number of EPT Taxa	5	3	5	3	5	3	5	3	3	5	5
Number of Ephemeroptera Taxa	5	5	5	1	1	5	5	5	5	5	3
Percent Intolerant Urban	3	5	3	3	5	3	3	3	5	3	5
Percent Chironomidae	3	5	5	3	5	3	3	3	5	5	5
Percent Clingers	3	3	3	1	5	3	3	3	5	3	3
BIBI Score	***4.0***	***4.0***	***4.3***	***2.7***	***4.3***	***3.7***	***4.0***	***3.7***	***4.7***	***4.3***	***4.3***
Narrative Rating	***Good***	***Good***	***Good***	***Poor***	***Good***	***Fair***	***Good***	***Fair***	***Good***	***Good***	***Good***

Project Name: Howard County Countywide
Project Number: 16158563.28
Prepared by: BC Checked by: CRH
Prepared date: 7/24/2017 Checked date: 8/4/2017

Upper Brighton BIBI_02.xlsx
Version: 1
Site Name: 02-103-R-2017

Subphylum/ Class	Order	Family	Genus	Final ID	Note[1]	# of Org	FFG[2]	Habit[3]	Tolerance Value[4]
Insecta	Ephemeroptera	Baetidae	Acentrella	Acentrella	L	1	Collector	sw, cn	4.9
Insecta	Plecoptera	Nemouridae	Amphinemura	Amphinemura	L	8	Shredder	sp, cn	3
Insecta	Diptera	Tipulidae	Antocha	Antocha	L	1	Collector	cn	8
Insecta	Ephemeroptera	Baetidae	Baetis	Baetis	L	1	Collector	sw, cb, cn	3.9
Insecta	Trichoptera	Hydropsychidae	Cheumatopsyche	Cheumatopsyche	L	1	Filterer	cn	6.5
Insecta	Diptera	Chironomidae	Cricotopus/Orthocladius	Cricotopus/Orthocladius	L	1	Shredder	0	7.7
Turbellaria	Tricladida	Dugesiidae	Cura	Cura	A	2	0	sp	6.5
Insecta	Ephemeroptera	Baetidae	Diphetor	Diphetor	L	1	Collector	sw, cn	2.3
Insecta	Trichoptera	Philopotamidae	Dolophilodes	Dolophilodes	L	5	Filterer	cn	1.7
Insecta	Coleoptera	Dytiscidae	not identified	Dytiscidae	L	1	Predator	sw, dv	5.4
Insecta	Ephemeroptera	Ephemerellidae	Ephemerella	Ephemerella	L	4	Collector	cn, sw	2.3
Insecta	Trichoptera	Hydropsychidae	Hydropsyche	Hydropsyche	L	1	Filterer	cn	7.5
Insecta	Plecoptera	Perlodidae	Isoperla	Isoperla	L	4	Predator	cn, sp	2.4
Insecta	Ephemeroptera	Leptophlebiidae	not identified	Leptophlebiidae	L	1	Collector	sw, cn	1.7
Insecta	Plecoptera	Leuctridae	not identified	Leuctridae	L	3	Shredder	sp, cn	0.8
Insecta	Ephemeroptera	Heptageniidae	Maccaffertium	Maccaffertium	L	1	Scraper	cn	3
Oligochaeta	Haplotaxida	Naididae	not identified	Naididae	A	35	Collector	bu	8.5
Insecta	Trichoptera	Uenoidae	Neophylax	Neophylax	L	2	Scraper	cn	2.7
Insecta	Diptera	Empididae	Neoplasta	Neoplasta	L	1	Predator	0	na
Insecta	Diptera	Chironomidae	Orthocladius	Orthocladius	L	1	Collector	sp, bu	9.2
Insecta	Coleoptera	Elmidae	Oulimnius	Oulimnius	A	3	Scraper	cn	2.7
Insecta	Coleoptera	Elmidae	Oulimnius	Oulimnius	L	1	Scraper	cn	2.7
Insecta	Diptera	Chironomidae	Parametriocnemus	Parametriocnemus	L	2	Collector	sp	4.6
Insecta	Diptera	Chironomidae	Paratanytarsus	Paratanytarsus	L	1	Collector	sp	7.7
Insecta	Plecoptera	Perlidae	not identified	Perlidae	L	2	Predator	cn	2.2
Gastropoda	Basommatophora	Physidae	Physa	Physa	A	1	Scraper	cb	7
Insecta	Diptera	Chironomidae	Polypedilum	Polypedilum	L	11	Shredder	cb, cn	6.3
Insecta	Diptera	Tipulidae	Pseudolimnophila	Pseudolimnophila	L	1	Predator	bu	2.8
Insecta	Diptera	Chironomidae	Rheotanytarsus	Rheotanytarsus	L	1	Filterer	cn	7.2
Insecta	Diptera	Chironomidae	Stempellinella	Stempellinella	L	1	Collector	cb, sp, cn	4.2
Insecta	Coleoptera	Elmidae	Stenelmis	Stenelmis	A	1	Scraper	cn	7.1
Insecta	Diptera	Chironomidae	Tanytarsus	Tanytarsus	L	2	Filterer	cb, cn	4.9
Insecta	Diptera	Chironomidae	Thienemannimyia group	Thienemannimyia group	L	6	Predator	sp	8.2
Oligochaeta	Tubificida	Tubificidae	not identified	Tubificidae	U	1	Collector	cn	8.4
Insecta	Diptera	Chironomidae	Tvetenia	Tvetenia	L	1	Collector	sp	5.1

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Project Name: Howard County Countywide
Project Number: 16158563.28
Prepared by: BC Checked by: CRH
Prepared date: 7/24/2017 Checked date: 8/4/2017

Upper Brighton BIBI_02.xlsx
Version: 1
Site Name: 02-104-R-2017

Subphylum/ Class	Order	Family	Genus	Final ID	Note[1]	# of Org	FFG[2]	Habit[3]	Tolerance Value[4]
Insecta	Plecoptera	Nemouridae	Amphinemura	Amphinemura	L	24	Shredder	sp, cn	3
Insecta	Trichoptera	Hydropsychidae	Cheumatopsyche	Cheumatopsyche	L	3	Filterer	cn	6.5
Insecta	Diptera	Chironomidae	Corynoneura	Corynoneura	P	1	Collector	sp	4.1
Insecta	Diptera	Chironomidae	Cricotopus/Orthocladius	Cricotopus/Orthocladius	L	3	Shredder	0	7.7
Insecta	Ephemeroptera	Baetidae	Diphetor	Diphetor	L	1	Collector	sw, cn	2.3
Insecta	Trichoptera	Hydropsychidae	Diplectrona	Diplectrona	L	6	Filterer	cn	2.7
Insecta	Trichoptera	Philopotamidae	Dolophilodes	Dolophilodes	L	1	Filterer	cn	1.7
Insecta	Ephemeroptera	Ephemerellidae	Ephemerella	Ephemerella	L	4	Collector	cn, sw	2.3
Insecta	Ephemeroptera	Ephemerellidae	Eurylophella	Eurylophella	L	9	Scraper	cn, sp	4.5
Insecta	Diptera	Chironomidae	Heleniella	Heleniella	L	1	Predator	sp	0.9
Insecta	Ephemeroptera	Leptophlebiidae	not identified	Leptophlebiidae	L	18	Collector	sw, cn	1.7
Oligochaeta	Haplotaxida	Naididae	not identified	Naididae	A	6	Collector	bu	8.5
Oligochaeta	Haplotaxida	Naididae	not identified	Naididae	U	1	Collector	bu	8.5
Insecta	Trichoptera	Uenoidae	Neophylax	Neophylax	L	4	Scraper	cn	2.7
Insecta	Coleoptera	Elmidae	Oulimnius	Oulimnius	L	4	Scraper	cn	2.7
Insecta	Diptera	Chironomidae	Parametriocnemus	Parametriocnemus	L	2	Collector	sp	4.6
Turbellaria	Tricladida	Planariidae	not identified	Planariidae	U	7	Predator	sp	8.4
Insecta	Diptera	Chironomidae	Polypedilum	Polypedilum	L	2	Shredder	cb, cn	6.3
Insecta	Diptera	Chironomidae	Rheotanytarsus	Rheotanytarsus	L	2	Filterer	cn	7.2
Insecta	Diptera	Chironomidae	Stempellinella	Stempellinella	L	2	Collector	cb, sp, cn	4.2
Insecta	Diptera	Chironomidae	Thienemannimyia group	Thienemannimyia group	L	9	Predator	sp	8.2
Insecta	Diptera	Chironomidae	Tanytarsus	Tanytarsus	L	3	Filterer	cb, cn	4.9
Insecta	Hemiptera	Veliidae	not identified	Veliidae	I	2	0	0	6

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Project Name: Howard County Countywide
Project Number: 16158563.28
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Upper Brighton BIBI_02.xlsx
Version: 1
Site Name: 02-106-R-2017

Subphylum/ Class	Order	Family	Genus	Final ID	Note[1]	# of Org	FFG[2]	Habit[3]	Tolerance Value[4]
Insecta	Ephemeroptera	Baetidae	Acentrella	Acentrella	L	7	Collector	sw, cn	4.9
Insecta	Ephemeroptera	Ameletidae	Ameletus	Ameletus	L	2	Collector	sw, cb	2.6
Insecta	Plecoptera	Nemouridae	Amphinemura	Amphinemura	L	10	Shredder	sp, cn	3
Insecta	Ephemeroptera	Baetidae	Baetis	Baetis	L	1	Collector	sw, cb, cn	3.9
Oligochaeta	Tubificida	Naididae	Chaetogaster	Chaetogaster	A	1	0	0	na
Insecta	Trichoptera	Hydropsychidae	Cheumatopsyche	Cheumatopsyche	L	2	Filterer	cn	6.5
Insecta	Trichoptera	Philopotamidae	Chimarra	Chimarra	L	1	Filterer	cn	4.4
Insecta	Diptera	Chironomidae	Corynoneura	Corynoneura	L	2	Collector	sp	4.1
Insecta	Diptera	Chironomidae	Cricotopus/Orthocladius	Cricotopus/Orthocladius	L	4	Shredder	0	7.7
Insecta	Diptera	Chironomidae	Cricotopus/Orthocladius	Cricotopus/Orthocladius	P	1	Shredder	0	7.7
Insecta	Trichoptera	Philopotamidae	Dolophilodes	Dolophilodes	L	8	Filterer	cn	1.7
Insecta	Coleoptera	Elmidae	Dubiraphia	Dubiraphia	A	1	Scraper	cn, cb	5.7
Insecta	Ephemeroptera	Heptageniidae	Epeorus	Epeorus	L	1	Scraper	cn	1.7
Insecta	Ephemeroptera	Ephemerellidae	Ephemerella	Ephemerella	L	13	Collector	cn, sw	2.3
Insecta	Ephemeroptera	Ephemerellidae	Eurylophella	Eurylophella	L	2	Scraper	cn, sp	4.5
Gastropoda	Basommatophora	Ancylidae	Ferrissia	Ferrissia	A	2	Scraper	cb	7
Insecta	Odonata	Gomphidae	not identified	Gomphidae	L	2	Predator	bu	2.2
Insecta	Coleoptera	Dryopidae	Helichus	Helichus	A	1	Scraper	cn	6.4
Insecta	Trichoptera	Hydropsychidae	not identified	Hydropsychidae	P	1	Filterer	cn	5.7
Insecta	Plecoptera	Perlodidae	Isoperla	Isoperla	L	1	Predator	cn, sp	2.4
Oligochaeta	Lumbriculida	Lumbriculidae	not identified	Lumbriculidae	I	1	Collector	bu	6.6
Oligochaeta	Haplotaxida	Naididae	not identified	Naididae	A	7	Collector	bu	8.5
Insecta	Coleoptera	Elmidae	Oulimnius	Oulimnius	A	2	Scraper	cn	2.7
Insecta	Plecoptera	Perlidae	not identified	Perlidae	L	2	Predator	cn	2.2
Insecta	Trichoptera	Polycentropodida	Polycentropus	Polycentropus	L	1	Filterer	cn	1.1
Insecta	Diptera	Chironomidae	Polypedilum	Polypedilum	L	2	Shredder	cb, cn	6.3
Insecta	Diptera	Chironomidae	Rheotanytarsus	Rheotanytarsus	L	3	Filterer	cn	7.2
Insecta	Diptera	Chironomidae	Rheotanytarsus	Rheotanytarsus	P	1	Filterer	cn	7.2
Insecta	Trichoptera	Rhyacophilidae	Rhyacophila	Rhyacophila	L	1	Predator	cn	2.1
Insecta	Diptera	Simuliidae	not identified	Simuliidae	P	1	Filterer	cn	3.2
Insecta	Coleoptera	Elmidae	Stenelmis	Stenelmis	A	1	Scraper	cn	7.1
Insecta	Diptera	Chironomidae	Tanytarsus	Tanytarsus	L	3	Filterer	cb, cn	4.9
Insecta	Ephemeroptera	Ephemerellidae	Teloganopsis	Teloganopsis	L	3	Collector	0	na
Insecta	Diptera	Chironomidae	Thienemannimyia group	Thienemannimyia group	L	5	Predator	sp	8.2
Insecta	Diptera	Chironomidae	Tvetenia	Tvetenia	L	1	Collector	sp	5.1
Insecta	Diptera	Chironomidae	Tvetenia	Tvetenia	P	1	Collector	sp	5.1

1 Life Stage, I - Immature, P- Pupa, A - Adult, U - Undetermined; 2 Functional Feeding Group; 3 Primary habit or form of locomotion, includes bu - burrower, cn - clinger, cb - climber, sk - skater, sp - sprawler, sw - swimmer; 4 Tolerance Values, based on Hilsenhoff, modified for Maryland. An entry of "0" indicates information for the particular taxa was not available.

Project Name: Howard County Countywide
Project Number: 16158563.28
Prepared by: BC Checked by: CRH
Prepared date: 7/24/2017 Checked date: 8/4/2017

Upper Brighton BIBI_02.xlsx
Version: 1
Site Name: 02-107-R-2017

Subphylum/ Class	Order	Family	Genus	Final ID	Note[1]	# of Org	FFG[2]	Habit[3]	Tolerance Value[4]
Insecta	Diptera	Chironomidae	Chaetocladius	Chaetocladius	L	4	Collector	sp	7
Insecta	Diptera	Chironomidae	not identified	Chironominae	L	1	Collector	0	6.6
Insecta	Diptera	Chironomidae	Corynoneura	Corynoneura	L	3	Collector	sp	4.1
Insecta	Diptera	Chironomidae	Cricotopus/Orthocladius	Cricotopus/Orthocladius	L	3	Shredder	0	7.7
Insecta	Trichoptera	Hydropsychidae	Diplectrona	Diplectrona	L	2	Filterer	cn	2.7
Insecta	Trichoptera	Philopotamidae	Dolophilodes	Dolophilodes	L	1	Filterer	cn	1.7
Insecta	Coleoptera	Dytiscidae	not identified	Dytiscidae	L	1	Predator	sw, dv	5.4
Insecta	Ephemeroptera	Ephemerellidae	Ephemerella	Ephemerella	L	1	Collector	cn, sw	2.3
Insecta	Diptera	Chironomidae	Hydrobaenus	Hydrobaenus	L	1	Scraper	sp	7.2
Insecta	Plecoptera	Leuctridae	not identified	Leuctridae	L	1	Shredder	sp, cn	0.8
Insecta	Diptera	Chironomidae	Micropsectra	Micropsectra	L	4	Collector	cb, sp	2.1
Oligochaeta	Haplotaxida	Naididae	not identified	Naididae	A	30	Collector	bu	8.5
Oligochaeta	Haplotaxida	Naididae	not identified	Naididae	U	6	Collector	bu	8.5
Insecta	Diptera	Chironomidae	Natarsia	Natarsia	L	1	Predator	sp	6.6
Insecta	Trichoptera	Uenoidae	Neophylax	Neophylax	L	1	Scraper	cn	2.7
Insecta	Coleoptera	Elmidae	Optioservus	Optioservus	A	1	Scraper	cn	5.4
Insecta	Coleoptera	Elmidae	Oulimnius	Oulimnius	A	2	Scraper	cn	2.7
Insecta	Coleoptera	Elmidae	Oulimnius	Oulimnius	L	2	Scraper	cn	2.7
Insecta	Diptera	Chironomidae	Parametriocnemus	Parametriocnemus	L	2	Collector	sp	4.6
Insecta	Diptera	Chironomidae	Paraphaenocladius	Paraphaenocladius	L	1	Collector	sp	4
Insecta	Diptera	Chironomidae	Paratendipes	Paratendipes	L	2	Collector	bu	6.6
Insecta	Diptera	Chironomidae	Polypedilum	Polypedilum	L	9	Shredder	cb, cn	6.3
Insecta	Diptera	Chironomidae	Potthastia	Potthastia	L	1	Collector	sp	0.01
Enopla	Hoplonemertea	Tetrastemmatidae	Prostoma	Prostoma	A	1	Predator	0	7.3
Insecta	Diptera	Chironomidae	Rheocricotopus	Rheocricotopus	L	1	Collector	sp	6.2
Insecta	Diptera	Chironomidae	Rheotanytarsus	Rheotanytarsus	L	1	Filterer	cn	7.2
Insecta	Diptera	Chironomidae	Stempellina	Stempellina	L	1	Collector	cb	6.6
Insecta	Diptera	Chironomidae	Thienemannimyia group	Thienemannimyia group	L	1	Predator	sp	8.2
Insecta	Diptera	Chironomidae	Tanytarsus	Tanytarsus	L	4	Filterer	cb, cn	4.9
Insecta	Diptera	Chironomidae	Tvetenia	Tvetenia	L	2	Collector	sp	5.1
Insecta	Diptera	Chironomidae	Zavrelimyia	Zavrelimyia	L	2	Predator	sp	5.3

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Project Name: Howard County Countywide
Project Number: 16158563.28
Prepared by: BC Checked by: CRH
Prepared date: 7/24/2017 Checked date: 8/4/2017

Upper Brighton BIBI_02.xlsx
Version: 1
Site Name: 02-121-F-2017

Subphylum/ Class	Order	Family	Genus	Final ID	Note[1]	# of Org	FFG[2]	Habit[3]	Tolerance Value[4]
Insecta	Ephemeroptera	Baetidae	Acentrella	Acentrella	L	1	Collector	sw, cn	4.9
Insecta	Trichoptera	Glossosomatidae	Agapetus	Agapetus	L	1	Scraper	cn	2
Insecta	Plecoptera	Nemouridae	Amphinemura	Amphinemura	L	25	Shredder	sp, cn	3
Insecta	Coleoptera	Ptilodactylidae	Anchytarsus	Anchytarsus	L	1	Shredder	cn	3.1
Insecta	Trichoptera	Hydropsychidae	Cheumatopsyche	Cheumatopsyche	L	1	Filterer	cn	6.5
Insecta	Diptera	Chironomidae	not identified	Chironomidae	L	1	0	0	6.6
Insecta	Diptera	Chironomidae	Corynoneura	Corynoneura	L	2	Collector	sp	4.1
Insecta	Diptera	Chironomidae	Cricotopus/Orthocladius	Cricotopus/Orthocladius	L	1	Shredder	0	7.7
Insecta	Diptera	Chironomidae	Dicrotendipes	Dicrotendipes	L	1	Collector	bu	9
Insecta	Trichoptera	Hydropsychidae	Diplectrona	Diplectrona	L	4	Filterer	cn	2.7
Insecta	Trichoptera	Philopotamidae	Dolophilodes	Dolophilodes	L	9	Filterer	cn	1.7
Insecta	Coleoptera	Psephenidae	Ectopria	Ectopria	L	1	Scraper	cn	2.2
Insecta	Diptera	Empididae	not identified	Empididae	P	1	Predator	sp, bu	7.5
Gastropoda	Basommatophora	Ancylidae	Ferrissia	Ferrissia	A	1	Scraper	cb	7
Insecta	Odonata	Gomphidae	not identified	Gomphidae	L	1	Predator	bu	2.2
Insecta	Trichoptera	Hydropsychidae	Hydropsyche	Hydropsyche	L	2	Filterer	cn	7.5
Insecta	Trichoptera	Hydroptilidae	Hydroptila	Hydroptila	L	1	Scraper	cn	6
Insecta	Plecoptera	Perlodidae	Isoperla	Isoperla	L	6	Predator	cn, sp	2.4
Oligochaeta	Haplotaxida	Naididae	not identified	Naididae	A	8	Collector	bu	8.5
Insecta	Trichoptera	Uenoidae	Neophylax	Neophylax	L	6	Scraper	cn	2.7
Insecta	Coleoptera	Elmidae	Optioservus	Optioservus	L	1	Scraper	cn	5.4
Insecta	Coleoptera	Elmidae	Oulimnius	Oulimnius	A	3	Scraper	cn	2.7
Insecta	Coleoptera	Elmidae	Oulimnius	Oulimnius	L	2	Scraper	cn	2.7
Insecta	Plecoptera	Perlidae	not identified	Perlidae	L	1	Predator	cn	2.2
Insecta	Trichoptera	Philopotamidae	not identified	Philopotamidae	P	1	Filterer	cn	2.6
Insecta	Plecoptera	not identified	not identified	Plecoptera	L	4	0	0	2.4
Insecta	Trichoptera	Polycentropodida	Polycentropus	Polycentropus	L	2	Filterer	cn	1.1
Insecta	Diptera	Chironomidae	Polypedilum	Polypedilum	L	4	Shredder	cb, cn	6.3
Insecta	Diptera	Chironomidae	Potthastia	Potthastia	L	1	Collector	sp	0.01
Insecta	Diptera	Chironomidae	Rheotanytarsus	Rheotanytarsus	L	2	Filterer	cn	7.2
Insecta	Diptera	Simuliidae	Simulium	Simulium	L	1	Filterer	cn	5.7
Insecta	Coleoptera	Elmidae	Stenelmis	Stenelmis	L	2	Scraper	cn	7.1
Insecta	Coleoptera	Elmidae	Stenelmis	Stenelmis	A	1	Scraper	cn	7.1
Insecta	Diptera	Chironomidae	Tanytarsus	Tanytarsus	L	6	Filterer	cb, cn	4.9
Insecta	Diptera	Tipulidae	Tipula	Tipula	L	1	Shredder	bu	6.7
Turbellaria	not identified	not identified	not identified	Turbellaria	A	1	Predator	sp	4
Insecta	Diptera	Chironomidae	Tvetenia	Tvetenia	L	1	Collector	sp	5.1

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Project Name: Howard County Countywide
Project Number: 16158563.28
Prepared by: BC Checked by: CRH
Prepared date: 7/24/2017 Checked date: 8/4/2017

Upper Brighton BIBI_02.xlsx
Version: 1
Site Name: 02-123-F-2017

Subphylum/ Class	Order	Family	Genus	Final ID	Note[1]	# of Org	FFG[2]	Habit[3]	Tolerance Value[4]
Insecta	Plecoptera	Nemouridae	Amphinemura	Amphinemura	L	4	Shredder	sp, cn	3
Malacostraca	Isopoda	Asellidae	Caecidotea	Caecidotea	A	1	Collector	sp	2.6
Insecta	Odonata	Calopterygidae	Calopteryx	Calopteryx	L	2	Predator	cb	8.3
Insecta	Diptera	Chironomidae	Corynoneura	Corynoneura	L	2	Collector	sp	4.1
Insecta	Diptera	Chironomidae	Cricotopus/Orthocladius	Cricotopus/Orthocladius	L	1	Shredder	0	7.7
Insecta	Diptera	Chironomidae	Diplocladius	Diplocladius	L	1	Collector	sp	5.9
Insecta	Trichoptera	Philopotamidae	Dolophilodes	Dolophilodes	L	5	Filterer	cn	1.7
Insecta	Ephemeroptera	Heptageniidae	Epeorus	Epeorus	L	2	Scraper	cn	1.7
Insecta	Ephemeroptera	Ephemerellidae	Ephemerella	Ephemerella	L	2	Collector	cn, sw	2.3
Insecta	Ephemeroptera	Ephemerellidae	Eurylophella	Eurylophella	L	10	Scraper	cn, sp	4.5
Insecta	Ephemeroptera	Leptophlebiidae	not identified	Leptophlebiidae	L	1	Collector	sw, cn	1.7
Insecta	Diptera	Chironomidae	Micropsectra	Micropsectra	L	1	Collector	cb, sp	2.1
Oligochaeta	Haplotaxida	Naididae	not identified	Naididae	A	22	Collector	bu	8.5
Oligochaeta	Haplotaxida	Naididae	not identified	Naididae	U	5	Collector	bu	8.5
Insecta	Coleoptera	Elmidae	Oulimnius	Oulimnius	L	1	Scraper	cn	2.7
Insecta	Coleoptera	Elmidae	Oulimnius	Oulimnius	A	1	Scraper	cn	2.7
Insecta	Plecoptera	not identified	not identified	Plecoptera	L	7	0	0	2.4
Insecta	Diptera	Chironomidae	Polypedilum	Polypedilum	L	9	Shredder	cb, cn	6.3
Insecta	Trichoptera	Limnephilidae	Pycnopsyche	Pycnopsyche	L	1	Shredder	sp, cb, cn	3.1
Insecta	Diptera	Chironomidae	Rheocricotopus	Rheocricotopus	L	1	Collector	sp	6.2
Insecta	Diptera	Chironomidae	Rheotanytarsus	Rheotanytarsus	L	1	Filterer	cn	7.2
Insecta	Trichoptera	Rhyacophilidae	Rhyacophila	Rhyacophila	L	1	Predator	cn	2.1
Insecta	Diptera	Chironomidae	Sublettea	Sublettea	L	1	Collector	-	10
Insecta	Diptera	Chironomidae	not identified	Tanytarsini	P	1	Collector	0	3.5
Insecta	Diptera	Chironomidae	Tanytarsus	Tanytarsus	L	5	Filterer	cb, cn	4.9
Insecta	Diptera	Chironomidae	Thienemanniella	Thienemanniella	L	1	Collector	sp	5.1
Insecta	Diptera	Chironomidae	Thienemannimyia group	Thienemannimyia group	L	4	Predator	sp	8.2
Insecta	Diptera	Tipulidae	Tipula	Tipula	L	1	Shredder	bu	6.7
Turbellaria	not identified	not identified	not identified	Turbellaria	A	2	Predator	sp	4
Insecta	Diptera	Chironomidae	Tvetenia	Tvetenia	L	3	Collector	sp	5.1
Insecta	Diptera	Chironomidae	Zavrelimyia	Zavrelimyia	L	1	Predator	sp	5.3

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Project Name: Howard County Countywide
Project Number: 16158563.28
Prepared by: BC Checked by: CRH
Prepared date: 7/25/2017 Checked date: 8/4/2017

Upper Brighton BIBI_02.xlsx
Version: 1
Site Name: 02-201-R-2017

Subphylum/ Class	Order	Family	Tribe (HIDE ME!)	Genus	Final ID	Note[1]	# of Org	FFG[2]	Habit[3]	Tolerance Value[4]
Insecta	Diptera	Chironomidae	Pentaneurini	Ablabesmyia	Ablabesmyia	L	1	Predator	sp	8.1
Insecta	Ephemeroptera	Baetidae	0	Acentrella	Acentrella	L	1	Collector	sw, cn	4.9
Insecta	Plecoptera	Nemouridae	0	Amphinemura	Amphinemura	L	4	Shredder	sp, cn	3
Insecta	Coleoptera	Elmidae	0	Ancyronyx	Ancyronyx	L	1	Scraper	cn, sp	7.8
Insecta	Diptera	Ceratopogonidae	0	not identified	Ceratopogonidae	L	1	Predator	sp, bu	3.6
Insecta	Trichoptera	Hydropsychidae	0	Cheumatopsyche	Cheumatopsyche	L	8	Filterer	cn	6.5
Insecta	Diptera	Chironomidae	0	Corynoneura	Corynoneura	L	1	Collector	sp	4.1
Insecta	Diptera	Chironomidae	0	Cricotopus/Orthocladi	Cricotopus/Orthocladius	L	7	Shredder	0	7.7
Insecta	Diptera	Chironomidae	0	Cricotopus/Orthocladi	Cricotopus/Orthocladius	P	2	Shredder	0	7.7
Insecta	Diptera	Chironomidae	Chironomini	Demicryptochironomu	Demicryptochironomus	L	1	Collector	bu	2
Insecta	Diptera	Chironomidae	Chironomini	Dicrotendipes	Dicrotendipes	L	2	Collector	bu	9
Insecta	Coleoptera	Elmidae	0	Dubiraphia	Dubiraphia	A	1	Scraper	cn, cb	5.7
Insecta	Coleoptera	Dytiscidae	0	not identified	Dytiscidae	L	1	Predator	sw, dv	5.4
Insecta	Ephemeroptera	Ephemerellidae	0	Ephemerella	Ephemerella	L	6	Collector	cn, sw	2.3
Insecta	Ephemeroptera	Ephemerellidae	0	Eurylophella	Eurylophella	L	1	Scraper	cn, sp	4.5
Insecta	Trichoptera	Hydropsychidae	0	Hydropsyche	Hydropsyche	L	3	Filterer	cn	7.5
Insecta	Ephemeroptera	Isonychiidae	0	Isonychia	Isonychia	L	2	Filterer	sw, cn	2.5
Insecta	Ephemeroptera	Leptophlebiidae	0	not identified	Leptophlebiidae	L	1	Collector	sw, cn	1.7
Gastropoda	Basommatophora	Planorbidae	0	Menetus	Menetus	A	1	Scraper	cb	7.6
Insecta	Diptera	Chironomidae	Chironomini	Microtendipes	Microtendipes	L	5	Filterer	cn	4.9
Oligochaeta	Haplotaxida	Naididae	0	not identified	Naididae	A	10	Collector	bu	8.5
Insecta	Diptera	Chironomidae	0	Nanocladius	Nanocladius	L	1	Collector	sp	7.6
Insecta	Coleoptera	Elmidae	0	Oulimnius	Oulimnius	L	1	Scraper	cn	2.7
Insecta	Coleoptera	Elmidae	0	Oulimnius	Oulimnius	A	1	Scraper	cn	2.7
Insecta	Diptera	Chironomidae	Tanytarsini	Paratanytarsus	Paratanytarsus	L	1	Collector	sp	7.7
Insecta	Trichoptera	Philopotamidae	0	not identified	Philopotamidae	L	2	Filterer	cn	2.6
Insecta	Plecoptera	not identified	0	not identified	Plecoptera	L	2	0	0	2.4
Insecta	Diptera	Chironomidae	Chironomini	Polypedilum	Polypedilum	L	11	Shredder	cb, cn	6.3
Insecta	Ephemeroptera	Baetidae	0	Procloeon	Procloeon	L	2	Collector	0	2.3
Insecta	Diptera	Simuliidae	Prosimuliini	Prosimulium	Prosimulium	L	1	Filterer	cn	2.4
Insecta	Diptera	Chironomidae	0	Rheocricotopus	Rheocricotopus	L	1	Collector	sp	6.2
Insecta	Diptera	Chironomidae	Tanytarsini	Rheotanytarsus	Rheotanytarsus	L	5	Filterer	cn	7.2
Insecta	Diptera	Chironomidae	0	not identified	Tanypodinae	P	2	Predator	0	7.5
Insecta	Diptera	Chironomidae	Tanytarsini	Tanytarsus	Tanytarsus	L	9	Filterer	cb, cn	4.9
Insecta	Diptera	Chironomidae	Tanytarsini	Tanytarsus	Tanytarsus	P	1	Filterer	cb, cn	4.9
Insecta	Diptera	Chironomidae	0	Thienemannimyia gro	Thienemannimyia group	L	3	Predator	sp	8.2

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Project Name: Howard County Countywide
Project Number: 16158563.28
Prepared by: BC Checked by: CRH
Prepared date: 7/25/2017 Checked date: 8/4/2017

Upper Brighton BIBI_02.xlsx
Version: 1
Site Name: 02-202-R-2017

Subphylum/ Class	Order	Family	Genus	Final ID	Note[1]	# of Org	FFG[2]	Habit[3]	Tolerance Value[4]
Insecta	Trichoptera	Glossosomatidae	Agapetus	Agapetus	larva	1	Scraper	cn	2
Insecta	Plecoptera	Nemouridae	Amphinemura	Amphinemura	larva	7	Shredder	sp, cn	3
Insecta	Diptera	Tipulidae	Antocha	Antocha	larva	2	Collector	cn	8
Insecta	Trichoptera	Hydropsychidae	Cheumatopsyche	Cheumatopsyche	larva	5	Filterer	cn	6.5
Insecta	Trichoptera	Philopotamidae	Chimarra	Chimarra	larva	17	Filterer	cn	4.4
Insecta	Megaloptera	Corydalidae	Corydalus	Corydalus	larva	1	Predator	cn, cb	1.4
Insecta	Diptera	Chironomidae	Cricotopus/Orthocladius	Cricotopus/Orthocladius	larva	2	Shredder	0	7.7
Insecta	Ephemeroptera	Ephemerellidae	Ephemerella	Ephemerella	larva	7	Collector	cn, sw	2.3
Insecta	Diptera	Chironomidae	Eukiefferiella	Eukiefferiella	larva	1	Collector	sp	6.1
Insecta	Ephemeroptera	Ephemerellidae	Eurylophella	Eurylophella	larva	1	Scraper	cn, sp	4.5
Gastropoda	Basommatophora	Ancylidae	Ferrissia	Ferrissia	adult	2	Scraper	cb	7
Insecta	Odonata	Gomphidae	not identified	Gomphidae	larva	1	Predator	bu	2.2
Insecta	Coleoptera	Dryopidae	Helichus	Helichus	adult	1	Scraper	cn	6.4
Insecta	Diptera	Empididae	Hemerodromia	Hemerodromia	larva	1	Predator	sp, bu	7.9
Insecta	Ephemeroptera	Heptageniidae	not identified	Heptageniidae	larva	3	Scraper	cn	2.6
Insecta	Trichoptera	Hydropsychidae	Hydropsyche	Hydropsyche	larva	2	Filterer	cn	7.5
Insecta	Ephemeroptera	Heptageniidae	Leucrocuta	Leucrocuta	larva	1	Scraper	cn	1.8
Insecta	Ephemeroptera	Heptageniidae	Maccaffertium	Maccaffertium	larva	2	Scraper	cn	3
Insecta	Coleoptera	Elmidae	Microcylloepus	Microcylloepus	larva	3	Collector	0	4.8
Insecta	Diptera	Chironomidae	Microtendipes	Microtendipes	larva	1	Filterer	cn	4.9
Oligochaeta	Haplotaxida	Naididae	not identified	Naididae	adult	14	Collector	bu	8.5
Insecta	Coleoptera	Elmidae	Oulimnius	Oulimnius	larva	4	Scraper	cn	2.7
Insecta	Diptera	Chironomidae	Paratanytarsus	Paratanytarsus	larva	2	Collector	sp	7.7
Insecta	Diptera	Chironomidae	Polypedilum	Polypedilum	larva	18	Shredder	cb, cn	6.3
Insecta	Diptera	Simuliidae	Prosimulium	Prosimulium	larva	1	Filterer	cn	2.4
Insecta	Coleoptera	Psephenidae	Psephenus	Psephenus	larva	1	Scraper	cn	4.4
Insecta	Diptera	Chironomidae	Rheocricotopus	Rheocricotopus	larva	1	Collector	sp	6.2
Insecta	Diptera	Chironomidae	Rheotanytarsus	Rheotanytarsus	larva	1	Filterer	cn	7.2
Insecta	Diptera	Chironomidae	Tanytarsus	Tanytarsus	larva	2	Filterer	cb, cn	4.9
Insecta	Ephemeroptera	Ephemerellidae	Teloganopsis	Teloganopsis	larva	4	Collector	0	na
Insecta	Diptera	Chironomidae	Thienemannimyia group	Thienemannimyia group	larva	3	Predator	sp	8.2

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Project Name: Howard County Countywide
Project Number: 16158563.28
Prepared by: BC Checked by: CRH
Prepared date: 7/25/2017 Checked date: 8/4/2017

Upper Brighton BIBI_02.xlsx
Version: 1
Site Name: 02-221-F-2017

Subphylum/ Class	Order	Family	Genus	Final ID	Note[1]	# of Org	FFG[2]	Habit[3]	Tolerance Value[4]
Insecta	Ephemeroptera	Baetidae	Acentrella	Acentrella	L	2	Collector	sw, cn	4.9
Insecta	Plecoptera	Nemouridae	Amphinemura	Amphinemura	L	40	Shredder	sp, cn	3
Insecta	Ephemeroptera	Baetidae	Baetis	Baetis	L	1	Collector	sw, cb, cn	3.9
Insecta	Diptera	Chironomidae	Chaetocladius	Chaetocladius	L	3	Collector	sp	7
Insecta	Diptera	Chironomidae	Cricotopus/Orthocladius	Cricotopus/Orthocladius	L	1	Shredder	0	7.7
Insecta	Ephemeroptera	Baetidae	Diphetor	Diphetor	L	1	Collector	sw, cn	2.3
Insecta	Ephemeroptera	Heptageniidae	Epeorus	Epeorus	L	2	Scraper	cn	1.7
Insecta	Ephemeroptera	Ephemerellidae	Ephemerella	Ephemerella	L	5	Collector	cn, sw	2.3
Insecta	Coleoptera	Dryopidae	Helichus	Helichus	A	2	Scraper	cn	6.4
Insecta	Diptera	Empididae	Hemerodromia	Hemerodromia	L	1	Predator	sp, bu	7.9
Insecta	Ephemeroptera	Heptageniidae	not identified	Heptageniidae	L	2	Scraper	cn	2.6
Insecta	Trichoptera	Hydropsychidae	Hydropsyche	Hydropsyche	L	1	Filterer	cn	7.5
Oligochaeta	Haplotaxida	Naididae	not identified	Naididae	A	11	Collector	bu	8.5
Insecta	Trichoptera	Uenoidae	Neophylax	Neophylax	L	9	Scraper	cn	2.7
Insecta	Coleoptera	Elmidae	Optioservus	Optioservus	L	1	Scraper	cn	5.4
Insecta	Coleoptera	Elmidae	Oulimnius	Oulimnius	L	1	Scraper	cn	2.7
Insecta	Coleoptera	Elmidae	Oulimnius	Oulimnius	A	1	Scraper	cn	2.7
Insecta	Diptera	Chironomidae	Parametriocnemus	Parametriocnemus	L	1	Collector	sp	4.6
Insecta	Diptera	Chironomidae	Paraphaenocladius	Paraphaenocladius	L	1	Collector	sp	4
Insecta	Plecoptera	not identified	not identified	Plecoptera	L	2	0	0	2.4
Insecta	Diptera	Chironomidae	Polypedilum	Polypedilum	L	1	Shredder	cb, cn	6.3
Insecta	Coleoptera	Psephenidae	Psephenus	Psephenus	L	3	Scraper	cn	4.4
Insecta	Diptera	Chironomidae	Pseudorthocladius	Pseudorthocladius	L	1	Collector	sp	6
Insecta	Diptera	Chironomidae	Stempellinella	Stempellinella	L	1	Collector	cb, sp, cn	4.2
Insecta	Coleoptera	Elmidae	Stenelmis	Stenelmis	L	1	Scraper	cn	7.1
Insecta	Coleoptera	Elmidae	Stenelmis	Stenelmis	A	1	Scraper	cn	7.1
Insecta	Diptera	Chironomidae	Tanytarsus	Tanytarsus	L	2	Filterer	cb, cn	4.9
Insecta	Diptera	Chironomidae	Thienemannimyia group	Thienemannimyia group	L	1	Predator	sp	8.2

1 Life Stage, I - Immature, P- Pupa, A - Adult, U - Undetermined; 2 Functional Feeding Group; 3 Primary habit or form of locomotion, includes bu - burrower, cn - clinger, cb - climber, sk - skater, sp - sprawler, sw - swimmer; 4 Tolerance Values, based on Hilsenhoff, modified for Maryland. An entry of "0" indicates information for the particular taxa was not available.

Project Name: Howard County Countywide
Project Number: 16158563.28
Prepared by: BC Checked by: CRH
Prepared date: 7/25/2017 Checked date: 8/4/2017

Upper Brighton BIBI_02.xlsx
Version: 1
Site Name: 02-301-F-2017

Subphylum/ Class	Order	Family	Genus	Final ID	Note[1]	# of Org	FFG[2]	Habit[3]	Tolerance Value[4]
Insecta	Ephemeroptera	Baetidae	Acentrella	Acentrella	L	22	Collector	sw, cn	4.9
Insecta	Plecoptera	Nemouridae	Amphinemura	Amphinemura	L	10	Shredder	sp, cn	3
Insecta	Odonata	Calopterygidae	Calopteryx	Calopteryx	L	4	Predator	cb	8.3
Insecta	Trichoptera	Hydropsychidae	Cheumatopsyche	Cheumatopsyche	L	3	Filterer	cn	6.5
Insecta	Megaloptera	Corydalidae	Corydalus	Corydalus	L	1	Predator	cn, cb	1.4
Insecta	Diptera	Chironomidae	Cricotopus/Orthocladius	Cricotopus/Orthocladius	L	3	Shredder	0	7.7
Insecta	Trichoptera	Philopotamidae	Dolophilodes	Dolophilodes	L	3	Filterer	cn	1.7
Insecta	Diptera	Empididae	not identified	Empididae	P	1	Predator	sp, bu	7.5
Insecta	Ephemeroptera	Ephemerellidae	Ephemerella	Ephemerella	L	1	Collector	cn, sw	2.3
Insecta	Ephemeroptera	Baetidae	not identified	Baetidae	L	1	Collector	sw, cn	2.3
Insecta	Ephemeroptera	Ephemerellidae	Eurylophella	Eurylophella	L	3	Scraper	cn, sp	4.5
Gastropoda	Basommatophora	Ancylidae	Ferrissia	Ferrissia	A	1	Scraper	cb	7
Insecta	Trichoptera	Glossosomatidae	not identified	Glossosomatidae	L	1	Scraper	cn	1
Insecta	Odonata	Gomphidae	not identified	Gomphidae	L	1	Predator	bu	2.2
Insecta	Coleoptera	Dryopidae	Helichus	Helichus	A	2	Scraper	cn	6.4
Insecta	Trichoptera	Hydropsychidae	Hydropsyche	Hydropsyche	L	1	Filterer	cn	7.5
Insecta	Trichoptera	Leptoceridae	not identified	Leptoceridae	L	1	Collector	0	4.1
Insecta	Coleoptera	Elmidae	Macronychus	Macronychus	L	1	Scraper	cn	6.8
Oligochaeta	Haplotaxida	Naididae	not identified	Naididae	A	17	Collector	bu	8.5
Insecta	Coleoptera	Elmidae	Optioservus	Optioservus	A	1	Scraper	cn	5.4
Insecta	Coleoptera	Elmidae	Oulimnius	Oulimnius	A	2	Scraper	cn	2.7
Insecta	Plecoptera	not identified	not identified	Plecoptera	L	1	0	0	2.4
Insecta	Diptera	Chironomidae	Polypedilum	Polypedilum	L	2	Shredder	cb, cn	6.3
Insecta	Diptera	Chironomidae	Potthastia	Potthastia	L	2	Collector	sp	0.01
Insecta	Diptera	Simuliidae	Prosimulium	Prosimulium	L	3	Filterer	cn	2.4
Insecta	Diptera	Simuliidae	Simulium	Simulium	L	1	Filterer	cn	5.7
Insecta	Diptera	Chironomidae	Stempellinella	Stempellinella	L	1	Collector	cb, sp, cn	4.2
Insecta	Diptera	Chironomidae	Stempellinella	Stempellinella	P	1	Collector	cb, sp, cn	4.2
Insecta	Coleoptera	Elmidae	Stenelmis	Stenelmis	A	1	Scraper	cn	7.1
Insecta	Diptera	Chironomidae	Stilocladius	Stilocladius	L	1	Collector	sp	6.6
Insecta	Plecoptera	Taeniopterygidae	Taeniopteryx	Taeniopteryx	L	1	Shredder	sp, cn	4.8
Insecta	Diptera	Chironomidae	Tanytarsus	Tanytarsus	L	2	Filterer	cb, cn	4.9
Insecta	Diptera	Chironomidae	Thienemannimyia group	Thienemannimyia group	L	1	Predator	sp	8.2
Insecta	Trichoptera	Hydroptilidae	not identified	Hydroptilidae	L	1	0	0	4
Insecta	Diptera	Chironomidae	Tvetenia	Tvetenia	L	3	Collector	sp	5.1

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Project Name: Howard County Countywide
Project Number: 16158563.28
Prepared by: BC Checked by: CRH
Prepared date: 7/28/2017 Checked date: 8/4/2017

Upper Brighton BIBI_02.xlsx
Version: 1
Site Name: 02-121-F-2017QC

Subphylum/ Class	Order	Family	Genus	Final ID	Note[1]	# of Org	FFG[2]	Habit[3]	Tolerance Value[4]
Insecta	Plecoptera	Nemouridae	Amphinemura	Amphinemura	larva	9	Shredder	sp, cn	3
Insecta	Coleoptera	Ptilodactylidae	Anchytarsus	Anchytarsus	larva	1	Shredder	cn	3.1
Insecta	Trichoptera	Hydropsychidae	Cheumatopsyche	Cheumatopsyche	larva	1	Filterer	cn	6.5
Insecta	Diptera	Chironomidae	Cricotopus/Orthocladius	Cricotopus/Orthocladius	larva	1	Shredder	0	7.7
Insecta	Trichoptera	Hydropsychidae	Diplectrona	Diplectrona	larva	3	Filterer	cn	2.7
Insecta	Diptera	Chironomidae	Diplocladius	Diplocladius	larva	1	Collector	sp	5.9
Insecta	Trichoptera	Philopotamidae	Dolophilodes	Dolophilodes	larva	8	Filterer	cn	1.7
Insecta	Coleoptera	Psephenidae	Ectopria	Ectopria	larva	1	Scraper	cn	2.2
Insecta	Ephemeroptera	Heptageniidae	not identified	Heptageniidae	larva	1	Scraper	cn	2.6
Insecta	Trichoptera	Hydropsychidae	Hydropsyche	Hydropsyche	larva	1	Filterer	cn	7.5
Insecta	Plecoptera	Perlodidae	Isoperla	Isoperla	larva	2	Predator	cn, sp	2.4
Insecta	Ephemeroptera	Baetidae	not identified	Baetidae	larva	2	Collector	sw, cn	2.3
Oligochaeta	Haplotaxida	Naididae	not identified	Naididae	adult	19	Collector	bu	8.5
not identified	not identified	not identified	not identified	Nemata	adult	1	0	0	na
Insecta	Trichoptera	Uenoidae	Neophylax	Neophylax	larva	7	Scraper	cn	2.7
Insecta	Coleoptera	Elmidae	Optioservus	Optioservus	larva	1	Scraper	cn	5.4
Insecta	Coleoptera	Elmidae	Oulimnius	Oulimnius	larva	4	Scraper	cn	2.7
Insecta	Coleoptera	Elmidae	Oulimnius	Oulimnius	adult	9	Scraper	cn	2.7
Insecta	Plecoptera	Nemouridae	Paranemoura	Paranemoura	larva	1	0	0	2.9
Insecta	Plecoptera	Perlidae	not identified	Perlidae	larva	1	Predator	cn	2.2
Insecta	Plecoptera	Perlodidae	not identified	Perlodidae	larva	2	Predator	cn	2.2
Insecta	Trichoptera	Philopotamidae	not identified	Philopotamidae	larva	1	Filterer	cn	2.6
Insecta	Diptera	Chironomidae	Polypedilum	Polypedilum	larva	1	Shredder	cb, cn	6.3
Insecta	Diptera	Chironomidae	Potthastia	Potthastia	larva	1	Collector	sp	0.01
Insecta	Diptera	Tipulidae	Pseudolimnophila	Pseudolimnophila	larva	1	Predator	bu	2.8
Insecta	Diptera	Chironomidae	Rheotanytarsus	Rheotanytarsus	larva	2	Filterer	cn	7.2
Insecta	Trichoptera	Rhyacophilidae	Rhyacophila	Rhyacophila	larva	1	Predator	cn	2.1
Insecta	Diptera	Chironomidae	Stempellinella	Stempellinella	larva	1	Collector	cb, sp, cn	4.2
Insecta	Coleoptera	Elmidae	Stenelmis	Stenelmis	adult	1	Scraper	cn	7.1
Insecta	Diptera	Chironomidae	Tanytarsus	Tanytarsus	larva	13	Filterer	cb, cn	4.9
Insecta	Diptera	Chironomidae	Thienemannimyia group	Thienemannimyia group	larva	2	Predator	sp	8.2
Turbellaria	not identified	not identified	not identified	Turbellaria	adult	2	Predator	sp	4

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Project Name: Howard County Countywide Biomonitoring
Project Number: 16158563.28
Prepared by: BC Checked by: CRH
Prepared date: 7/31/2017 Checked date: 8/7/2017

Lower Brighton BIBI_05.xlsx
Version: 1
Site Name:

Metric	05-103-R-2017	05-105-R-2017	05-106-R-2017	05-108-R-2017	05-111-R-2017	05-121-F-2017	05-122-F-2017	05-122-F-2017QC	05-201-F-2017	05-301-R-2017	05-321-F-2017
Raw Scores	**Raw Scores**										
Total Number of Taxa	25	22	27	27	24	29	23	32	32	33	32
Number of EPT Taxa	11	3	9	10	5	12	10	9	7	10	15
Number of Ephemeroptera Taxa	6	3	5	3	1	7	7	5	3	4	7
Percent Intolerant Urban	20.4	3.1	17.6	25.0	16.8	25.2	19.3	27.1	3.3	42.2	19.6
Percent Chironomidae	15.7	63.5	54.9	47.9	62.4	56.5	57.8	46.7	34.4	19.0	41.2
Percent Clingers	79.6	15.6	56.9	62.5	26.7	39.1	53.2	32.7	55.7	64.7	41.2
BIBI Scores	**BIBI Scores**										
Total Number of Taxa	5	3	5	5	3	5	3	5	5	5	5
Number of EPT Taxa	5	1	3	3	3	5	3	3	3	3	5
Number of Ephemeroptera Taxa	5	3	5	3	1	5	5	5	3	5	5
Percent Intolerant Urban	3	1	3	3	3	3	3	3	1	3	3
Percent Chironomidae	5	1	3	3	3	3	3	3	3	5	3
Percent Clingers	5	1	3	3	1	3	3	3	3	3	3
BIBI Score	***4.67***	***1.67***	***3.67***	***3.33***	***2.33***	***4.00***	***3.33***	***3.67***	***3.00***	***4.00***	***4.00***
Narrative Rating	***Good***	***Very Poor***	***Fair***	***Fair***	***Poor***	***Good***	***Fair***	***Fair***	***Fair***	***Good***	***Good***

Project Name: Howard County Countywide
Project Number: 16158563.28
Prepared by: BC Checked by: CRH
Prepared date: 7/31/2017 Checked date: 8/7/2017

Lower Brighton BIBI_05.xlsx
Version: 1
Site Name: 05-103-R-2017

Subphylum/ Class	Order	Family	Genus	Final ID	Note[1]	# of Org	FFG[2]	Habit[3]	Tolerance Value[4]
Insecta	Ephemeroptera	Baetidae	Acerpenna	Acerpenna	L	1	Collector	sw, cn	2.6
Insecta	Plecoptera	Nemouridae	Amphinemura	Amphinemura	L	1	Shredder	sp, cn	3
Insecta	Diptera	Tipulidae	Antocha	Antocha	L	2	Collector	cn	8
Insecta	Trichoptera	Hydropsychidae	Cheumatopsyche	Cheumatopsyche	L	20	Filterer	cn	6.5
Insecta	Trichoptera	Philopotamidae	Chimarra	Chimarra	L	6	Filterer	cn	4.4
Insecta	Diptera	Chironomidae	Corynoneura	Corynoneura	P	1	Collector	sp	4.1
Insecta	Diptera	Chironomidae	Cricotopus/Orthocladi	Cricotopus/Orthocladius	L	5	Shredder	0	7.7
Insecta	Diptera	Chironomidae	Cricotopus/Orthocladi	Cricotopus/Orthocladius	P	1	Shredder	0	7.7
Insecta	Ephemeroptera	Ephemerellidae	Ephemerella	Ephemerella	L	7	Collector	cn, sw	2.3
Insecta	Ephemeroptera	Ephemerellidae	Eurylophella	Eurylophella	L	3	Scraper	cn, sp	4.5
Insecta	Trichoptera	Hydropsychidae	Hydropsyche	Hydropsyche	L	23	Filterer	cn	7.5
Insecta	Ephemeroptera	Leptophlebiidae	not identified	Leptophlebiidae	L	1	Collector	sw, cn	1.7
Insecta	Ephemeroptera	Heptageniidae	Maccaffertium	Maccaffertium	L	4	Scraper	cn	3
Oligochaeta	Haplotaxida	Naididae	not identified	Naididae	A	2	Collector	bu	8.5
Insecta	Trichoptera	Uenoidae	Neophylax	Neophylax	L	3	Scraper	cn	2.7
Insecta	Coleoptera	Elmidae	Optioservus	Optioservus	L	2	Scraper	cn	5.4
Insecta	Coleoptera	Elmidae	Oulimnius	Oulimnius	L	2	Scraper	cn	2.7
Insecta	Coleoptera	Elmidae	Oulimnius	Oulimnius	A	2	Scraper	cn	2.7
Insecta	Diptera	Chironomidae	Paratanytarsus	Paratanytarsus	L	1	Collector	sp	7.7
Insecta	Trichoptera	Philopotamidae	not identified	Philopotamidae	P	1	Filterer	cn	2.6
Insecta	Diptera	Chironomidae	Polypedilum	Polypedilum	L	4	Shredder	cb, cn	6.3
Enopla	Hoplonemertea	Tetrastemmatidae	Prostoma	Prostoma	A	1	Predator	0	7.3
Insecta	Coleoptera	Psephenidae	Psephenus	Psephenus	L	1	Scraper	cn	4.4
Insecta	Diptera	Chironomidae	Rheotanytarsus	Rheotanytarsus	L	2	Filterer	cn	7.2
Insecta	Diptera	Chironomidae	Tanytarsus	Tanytarsus	L	1	Filterer	cb, cn	4.9
Insecta	Ephemeroptera	Ephemerellidae	Teloganopsis	Teloganopsis	L	9	Collector	0	na
Insecta	Diptera	Chironomidae	Thienemanniella	Thienemanniella	P	1	Collector	sp	5.1
Insecta	Diptera	Chironomidae	Tvetenia	Tvetenia	P	1	Collector	sp	5.1

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Project Name: Howard County Countywide
Project Number: 16158563.28
Prepared by: BC Checked by: CRH
Prepared date: 7/31/2017 Checked date: 8/7/2017

Lower Brighton BIBI_05.xlsx
Version: 1
Site Name: 05-105-R-2017

Subphylum/ Class	Order	Family	Genus	Final ID	Note[1]	# of Org	FFG[2]	Habit[3]	Tolerance Value[4]
Insecta	Diptera	Tipulidae	Antocha	Antocha	L	1	Collector	cn	8
Insecta	Diptera	Chironomidae	Brillia	Brillia	L	1	Shredder	bu, sp	7.4
Insecta	Ephemeroptera	Caenidae	Caenis	Caenis	L	1	Collector	sp	2.1
Oligochaeta	Tubificida	Naididae	Chaetogaster	Chaetogaster	A	5	0	0	na
Insecta	Diptera	Chironomidae	Corynoneura	Corynoneura	L	2	Collector	sp	4.1
Insecta	Diptera	Chironomidae	Cricotopus/Orthocladi	Cricotopus/Orthocladius	L	13	Shredder	0	7.7
Insecta	Coleoptera	Elmidae	not identified	Elmidae	L	1	Collector	cn	4.8
Oligochaeta	Haplotaxida	Enchytraeidae	not identified	Enchytraeidae	A	1	Collector	bu	9.1
Insecta	Diptera	Chironomidae	Hydrobaenus	Hydrobaenus	L	29	Scraper	sp	7.2
Oligochaeta	Tubificida	Tubificidae	Limnodrilus	Limnodrilus	A	1	Collector	cn	8.6
Insecta	Ephemeroptera	Heptageniidae	Maccaffertium	Maccaffertium	L	1	Scraper	cn	3
Gastropoda	Basommatophora	Planorbidae	Menetus	Menetus	A	2	Scraper	cb	7.6
Oligochaeta	Haplotaxida	Naididae	not identified	Naididae	A	17	Collector	bu	8.5
Insecta	Ephemeroptera	Leptophlebiidae	Paraleptophlebia	Paraleptophlebia	L	1	Collector	sw, cn, sp	2
Insecta	Diptera	Chironomidae	Paratanytarsus	Paratanytarsus	L	1	Collector	sp	7.7
Gastropoda	Basommatophora	Physidae	Physa	Physa	A	2	Scraper	cb	7
Insecta	Diptera	Chironomidae	Polypedilum	Polypedilum	L	4	Shredder	cb, cn	6.3
Insecta	Diptera	Chironomidae	Stempellinella	Stempellinella	L	2	Collector	cb, sp, cn	4.2
Insecta	Diptera	Chironomidae	not identified	Tanypodinae	P	1	Predator	0	7.5
Insecta	Diptera	Chironomidae	Tanytarsus	Tanytarsus	L	4	Filterer	cb, cn	4.9
Insecta	Diptera	Chironomidae	Tribelos	Tribelos	L	3	Collector	bu	7
Oligochaeta	Haplotaxida	Naididae	not identified	Naididae	U	2	Collector	bu	8.5
Insecta	Diptera	Chironomidae	Tvetenia	Tvetenia	L	1	Collector	sp	5.1

1 Life Stage, I - Immature, P- Pupa, A - Adult, U - Undetermined; 2 Functional Feeding Group; 3 Primary habit or form of locomotion, includes bu - burrower, cn - clinger, cb - climber, sk - skater, sp - sprawler, sw - swimmer; 4 Tolerance Values, based on Hilsenhoff, modified for Maryland. An entry of "0" indicates information for the particular taxa was not available.

Project Name: Howard County Countywide
Project Number: 16158563.28
Prepared by: BC Checked by: CRH
Prepared date: 7/31/2017 Checked date: 8/7/2017

Lower Brighton BIBI_05.xlsx
Version: 1
Site Name: 05-106-R-2017

Subphylum/ Class	Order	Family	Genus	Final ID	Note[1]	# of Org	FFG[2]	Habit[3]	Tolerance Value[4]
Insecta	Ephemeroptera	Baetidae	Acentrella	Acentrella	L	1	Collector	sw, cn	4.9
Insecta	Ephemeroptera	Baetidae	Acerpenna	Acerpenna	L	3	Collector	sw, cn	2.6
Insecta	Diptera	Tipulidae	Antocha	Antocha	L	1	Collector	cn	8
Insecta	Trichoptera	Hydropsychidae	Cheumatopsyche	Cheumatopsyche	L	6	Filterer	cn	6.5
Insecta	Trichoptera	Philopotamidae	Chimarra	Chimarra	L	5	Filterer	cn	4.4
Insecta	Diptera	Empididae	Clinocera	Clinocera	L	2	Predator	cn	7.4
Malacostraca	Amphipoda	Crangonyctidae	Crangonyx	Crangonyx	A	1	Collector	sp	6.7
Insecta	Diptera	Chironomidae	Cricotopus/Orthocladius	Cricotopus/Orthocladius	L	21	Shredder	0	7.7
Insecta	Diptera	Chironomidae	Cricotopus/Orthocladius	Cricotopus/Orthocladius	P	4	Shredder	0	7.7
Insecta	Diptera	Chironomidae	Diamesa	Diamesa	L	3	Collector	sp	8.5
Insecta	Ephemeroptera	Ephemerellidae	Ephemerella	Ephemerella	L	7	Collector	cn, sw	2.3
Insecta	Ephemeroptera	Heptageniidae	not identified	Heptageniidae	L	5	Scraper	cn	2.6
Insecta	Trichoptera	Hydropsychidae	Hydropsyche	Hydropsyche	L	3	Filterer	cn	7.5
Insecta	Trichoptera	Hydropsychidae	not identified	Hydropsychidae	P	1	Filterer	cn	5.7
Insecta	Diptera	Chironomidae	Microtendipes	Microtendipes	L	1	Filterer	cn	4.9
Oligochaeta	Haplotaxida	Naididae	not identified	Naididae	A	3	Collector	bu	8.5
Insecta	Trichoptera	Uenoidae	Neophylax	Neophylax	L	1	Scraper	cn	2.7
Insecta	Coleoptera	Elmidae	Oulimnius	Oulimnius	A	1	Scraper	cn	2.7
Insecta	Diptera	Chironomidae	Parametriocnemus	Parametriocnemus	L	1	Collector	sp	4.6
Insecta	Diptera	Chironomidae	Paratanytarsus	Paratanytarsus	L	2	Collector	sp	7.7
Insecta	Diptera	Chironomidae	Paratanytarsus	Paratanytarsus	P	1	Collector	sp	7.7
Insecta	Diptera	Chironomidae	Polypedilum	Polypedilum	L	14	Shredder	cb, cn	6.3
Insecta	Diptera	Simuliidae	Prosimulium	Prosimulium	L	1	Filterer	cn	2.4
Insecta	Diptera	Chironomidae	Rheocricotopus	Rheocricotopus	L	1	Collector	sp	6.2
Insecta	Diptera	Chironomidae	Rheotanytarsus	Rheotanytarsus	L	2	Filterer	cn	7.2
Insecta	Coleoptera	Elmidae	Stenelmis	Stenelmis	A	1	Scraper	cn	7.1
Insecta	Diptera	Chironomidae	Tanytarsus	Tanytarsus	L	3	Filterer	cb, cn	4.9
Insecta	Ephemeroptera	Ephemerellidae	Teloganopsis	Teloganopsis	L	4	Collector	0	na
Insecta	Diptera	Chironomidae	Thienemannimyia group	Thienemannimyia group	L	2	Predator	sp	8.2
Insecta	Diptera	Chironomidae	Tvetenia	Tvetenia	L	1	Collector	sp	5.1

1 Life Stage, I - Immature, P- Pupa, A - Adult, U - Undetermined; 2 Functional Feeding Group; 3 Primary habit or form of locomotion, includes bu - burrower, cn - clinger, cb - climber, sk - skater, sp - sprawler, sw - swimmer; 4 Tolerance Values, based on Hilsenhoff, modified for Maryland. An entry of "0" indicates information for the particular taxa was not available.

Project Name: Howard County Countywide
Project Number: 16158563.28
Prepared by: BC Checked by: CRH
Prepared date: 7/31/2017 Checked date: 8/7/2017

Lower Brighton BIBI_05.xlsx
Version: 1
Site Name: 05-108-R-2017

Subphylum/ Class	Order	Family	Genus	Final ID	Note[1]	# of Org	FFG[2]	Habit[3]	Tolerance Value[4]
Insecta	Ephemeroptera	Baetidae	Acentrella	Acentrella	L	2	Collector	sw, cn	4.9
Insecta	Trichoptera	Hydropsychidae	Cheumatopsyche	Cheumatopsyche	L	4	Filterer	cn	6.5
Insecta	Trichoptera	Philopotamidae	Chimarra	Chimarra	L	3	Filterer	cn	4.4
Insecta	Diptera	Chironomidae	not identified	Chironominae	P	1	Collector	0	6.6
Insecta	Diptera	Chironomidae	Corynoneura	Corynoneura	L	1	Collector	sp	4.1
Insecta	Diptera	Chironomidae	Cricotopus/Orthocladi	Cricotopus/Orthocladius	L	2	Shredder	0	7.7
Insecta	Plecoptera	Perlodidae	Diploperla	Diploperla	L	1	Predator	cn	2.2
Insecta	Trichoptera	Philopotamidae	Dolophilodes	Dolophilodes	L	3	Filterer	cn	1.7
Insecta	Ephemeroptera	Ephemerellidae	Ephemerella	Ephemerella	L	9	Collector	cn, sw	2.3
Insecta	Diptera	Chironomidae	Eukiefferiella	Eukiefferiella	L	3	Collector	sp	6.1
Insecta	Trichoptera	Glossosomatidae	not identified	Glossosomatidae	P	1	Scraper	cn	1
Insecta	Ephemeroptera	Heptageniidae	not identified	Heptageniidae	L	3	Scraper	cn	2.6
Insecta	Diptera	Chironomidae	Hydrobaenus	Hydrobaenus	L	1	Scraper	sp	7.2
Insecta	Trichoptera	Hydropsychidae	Hydropsyche	Hydropsyche	L	3	Filterer	cn	7.5
Insecta	Ephemeroptera	Heptageniidae	Maccaffertium	Maccaffertium	L	1	Scraper	cn	3
Insecta	Diptera	Chironomidae	Micropsectra	Micropsectra	L	2	Collector	cb, sp	2.1
Oligochaeta	Haplotaxida	Naididae	not identified	Naididae	A	11	Collector	bu	8.5
not identified	not identified	not identified	not identified	Nemata	A	1	0	0	na
Insecta	Trichoptera	Uenoidae	Neophylax	Neophylax	L	1	Scraper	cn	2.7
Insecta	Coleoptera	Elmidae	Optioservus	Optioservus	L	1	Scraper	cn	5.4
Insecta	Diptera	Chironomidae	Parametriocnemus	Parametriocnemus	L	2	Collector	sp	4.6
Insecta	Trichoptera	Philopotamidae	not identified	Philopotamidae	P	2	Filterer	cn	2.6
Gastropoda	Basommatophora	Physidae	Physa	Physa	A	1	Scraper	cb	7
Insecta	Diptera	Chironomidae	Polypedilum	Polypedilum	L	22	Shredder	cb, cn	6.3
Insecta	Diptera	Chironomidae	Polypedilum	Polypedilum	P	2	Shredder	cb, cn	6.3
Insecta	Diptera	Chironomidae	Potthastia	Potthastia	L	1	Collector	sp	0.01
Insecta	Diptera	Chironomidae	Rheocricotopus	Rheocricotopus	L	1	Collector	sp	6.2
Insecta	Diptera	Chironomidae	Rheotanytarsus	Rheotanytarsus	L	1	Filterer	cn	7.2
Insecta	Diptera	Chironomidae	Tanytarsus	Tanytarsus	L	1	Filterer	cb, cn	4.9
Insecta	Ephemeroptera	Ephemerellidae	Teloganopsis	Teloganopsis	L	3	Collector	0	na
Insecta	Diptera	Chironomidae	Thienemannimyia gro	Thienemannimyia group	L	1	Predator	sp	8.2
Insecta	Diptera	Chironomidae	Tvetenia	Tvetenia	L	5	Collector	sp	5.1

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Project Name: Howard County Countywide
Project Number: 16158563.28
Prepared by: BC Checked by: CRH
Prepared date: 7/31/2017 Checked date: 8/7/2017

Lower Brighton BIBI_05.xlsx
Version: 1
Site Name: 05-111-R-2017

Subphylum/ Class	Order	Family	Genus	Final ID	Note[1]	# of Org	FFG[2]	Habit[3]	Tolerance Value[4]
Insecta	Diptera	Chironomidae	Ablabesmyia	Ablabesmyia	L	1	Predator	sp	8.1
Insecta	Diptera	Chironomidae	Chaetocladius	Chaetocladius	L	9	Collector	sp	7
Insecta	Diptera	Chironomidae	Chaetocladius	Chaetocladius	p	1	Collector	sp	7
Insecta	Trichoptera	Philopotamidae	Chimarra	Chimarra	L	1	Filterer	cn	4.4
Insecta	Diptera	Chironomidae	Corynoneura	Corynoneura	L	2	Collector	sp	4.1
Insecta	Diptera	Chironomidae	Cricotopus/Orthocladius	Cricotopus/Orthocladius	L	9	Shredder	0	7.7
Insecta	Diptera	Chironomidae	Diamesa	Diamesa	L	2	Collector	sp	8.5
Insecta	Trichoptera	Hydropsychidae	Diplectrona	Diplectrona	L	5	Filterer	cn	2.7
Insecta	Diptera	Chironomidae	Diplocladius	Diplocladius	L	1	Collector	sp	5.9
Insecta	Trichoptera	Philopotamidae	Dolophilodes	Dolophilodes	L	1	Filterer	cn	1.7
Insecta	Ephemeroptera	Ephemerellidae	Ephemerella	Ephemerella	L	2	Collector	cn, sw	2.3
Insecta	Diptera	Chironomidae	Hydrobaenus	Hydrobaenus	L	2	Scraper	sp	7.2
Insecta	Plecoptera	not identified	not identified	Plecoptera	L	3	0	0	2.4
Insecta	Diptera	Chironomidae	Micropsectra	Micropsectra	L	6	Collector	cb, sp	2.1
Oligochaeta	Haplotaxida	Naididae	not identified	Naididae	A	20	Collector	bu	8.5
Insecta	Diptera	Chironomidae	Parametriocnemus	Parametriocnemus	L	3	Collector	sp	4.6
Turbellaria	Tricladida	Planariidae	not identified	Planariidae	A	2	Predator	sp	8.4
Insecta	Diptera	Chironomidae	Polypedilum	Polypedilum	L	12	Shredder	cb, cn	6.3
Insecta	Diptera	Chironomidae	Rheotanytarsus	Rheotanytarsus	L	2	Filterer	cn	7.2
Insecta	Diptera	Simuliidae	Simulium	Simulium	L	1	Filterer	cn	5.7
Insecta	Diptera	Chironomidae	Sympotthastia	Sympotthastia	L	7	Collector	sp	8.2
Insecta	Diptera	Chironomidae	Tanytarsus	Tanytarsus	L	3	Filterer	cb, cn	4.9
Insecta	Diptera	Tipulidae	Tipula	Tipula	L	2	Shredder	bu	6.7
Oligochaeta	Haplotaxida	Naididae	not identified	Naididae	U	1	Collector	bu	8.5
Insecta	Diptera	Chironomidae	Tvetenia	Tvetenia	L	2	Collector	sp	5.1
Insecta	Diptera	Chironomidae	Zavrelimyia	Zavrelimyia	L	1	Predator	sp	5.3

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Project Name: Howard County Countywide
Project Number: 16158563.28
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Prepared date: 7/31/2017 Checked date: 8/7/2017

Lower Brighton BIBI_05.xlsx
Version: 1
Site Name: 05-121-F-2017

Subphylum/ Class	Order	Family	Genus	Final ID	Note[1]	# of Org	FFG[2]	Habit[3]	Tolerance Value[4]
Insecta	Ephemeroptera	Baetidae	Acentrella	Acentrella	L	1	Collector	sw, cn	4.9
Insecta	Ephemeroptera	Baetidae	Acerpenna	Acerpenna	L	2	Collector	sw, cn	2.6
Insecta	Ephemeroptera	Ameletidae	Ameletus	Ameletus	L	2	Collector	sw, cb	2.6
Oligochaeta	Tubificida	Naididae	Chaetogaster	Chaetogaster	A	2	0	0	na
Insecta	Trichoptera	Hydropsychidae	Cheumatopsyche	Cheumatopsyche	L	3	Filterer	cn	6.5
Insecta	Trichoptera	Philopotamidae	Chimarra	Chimarra	L	5	Filterer	cn	4.4
Insecta	Diptera	Chironomidae	not identified	Chironominae	P	1	Collector	0	6.6
Insecta	Diptera	Chironomidae	Cricotopus/Orthoclad	Cricotopus/Orthocladius	L	20	Shredder	0	7.7
Insecta	Diptera	Chironomidae	Cricotopus/Orthoclad	Cricotopus/Orthocladius	P	3	Shredder	0	7.7
Insecta	Diptera	Chironomidae	Diamesa	Diamesa	L	3	Collector	sp	8.5
Insecta	Plecoptera	Perlidae	Eccoptura	Eccoptura	L	1	Predator	cn	0.6
Insecta	Ephemeroptera	Ephemerellidae	Ephemerella	Ephemerella	L	19	Collector	cn, sw	2.3
Insecta	Ephemeroptera	Ephemerellidae	Eurylophella	Eurylophella	L	1	Scraper	cn, sp	4.5
Insecta	Diptera	Chironomidae	Hydrobaenus	Hydrobaenus	L	11	Scraper	sp	7.2
Insecta	Diptera	Chironomidae	Hydrobaenus	Hydrobaenus	P	3	Scraper	sp	7.2
Insecta	Trichoptera	Hydropsychidae	Hydropsyche	Hydropsyche	L	1	Filterer	cn	7.5
Insecta	Ephemeroptera	Heptageniidae	Maccaffertium	Maccaffertium	L	2	Scraper	cn	3
Gastropoda	Basommatophora	Planorbidae	Menetus	Menetus	A	2	Scraper	cb	7.6
Insecta	Diptera	Chironomidae	Microtendipes	Microtendipes	L	1	Filterer	cn	4.9
Oligochaeta	Haplotaxida	Naididae	not identified	Naididae	A	6	Collector	bu	8.5
Insecta	Trichoptera	Uenoidae	Neophylax	Neophylax	L	1	Scraper	cn	2.7
Insecta	Coleoptera	Elmidae	Oulimnius	Oulimnius	A	1	Scraper	cn	2.7
Insecta	Diptera	Chironomidae	Parametriocnemus	Parametriocnemus	L	2	Collector	sp	4.6
Insecta	Diptera	Chironomidae	Paratanytarsus	Paratanytarsus	L	3	Collector	sp	7.7
Insecta	Diptera	Chironomidae	Paratanytarsus	Paratanytarsus	P	1	Collector	sp	7.7
Insecta	Diptera	Chironomidae	Polypedilum	Polypedilum	L	5	Shredder	cb, cn	6.3
Insecta	Diptera	Chironomidae	Potthastia	Potthastia	L	1	Collector	sp	0.01
Insecta	Diptera	Chironomidae	Rheocricotopus	Rheocricotopus	L	1	Collector	sp	6.2
Insecta	Diptera	Chironomidae	Rheotanytarsus	Rheotanytarsus	L	2	Filterer	cn	7.2
Insecta	Diptera	Chironomidae	not identified	Tanytarsini	P	1	Collector	0	3.5
Insecta	Ephemeroptera	Ephemerellidae	Teloganopsis	Teloganopsis	L	1	Collector	0	na
Insecta	Diptera	Chironomidae	Thienemannimyia gro	Thienemannimyia group	L	2	Predator	sp	8.2
Insecta	Diptera	Chironomidae	Tribelos	Tribelos	L	1	Collector	bu	7
Insecta	Diptera	Chironomidae	Tvetenia	Tvetenia	L	2	Collector	sp	5.1
Insecta	Diptera	Chironomidae	Tvetenia	Tvetenia	P	2	Collector	sp	5.1

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Project Name: Howard County Countywide
Project Number: 16158563.28
Prepared by: BC Checked by: CRH
Prepared date: 7/31/2017 Checked date: 8/7/2017

Lower Brighton BIBI_05.xlsx
Version: 1
Site Name: 05-122-F-2017

Subphylum/ Class	Order	Family	Genus	Final ID	Note[1]	# of Org	FFG[2]	Habit[3]	Tolerance Value[4]
Insecta	Ephemeroptera	Baetidae	Acerpenna	Acerpenna	L	2	Collector	sw, cn	2.6
Oligochaeta	Haplotaxida	Naididae	not identified	Naididae	A	3	Collector	bu	8.5
Insecta	Trichoptera	Hydropsychidae	Cheumatopsyche	Cheumatopsyche	L	12	Filterer	cn	6.5
Insecta	Trichoptera	Philopotamidae	Chimarra	Chimarra	L	4	Filterer	cn	4.4
Insecta	Diptera	Chironomidae	Cladotanytarsus	Cladotanytarsus	L	1	Filterer	-	6.6
Insecta	Diptera	Chironomidae	Corynoneura	Corynoneura	L	1	Collector	sp	4.1
Insecta	Diptera	Chironomidae	Corynoneura	Corynoneura	P	1	Collector	sp	4.1
Insecta	Diptera	Chironomidae	Cricotopus/Orthocladius	Cricotopus/Orthocladius	L	16	Shredder	0	7.7
Insecta	Diptera	Chironomidae	Cricotopus/Orthocladius	Cricotopus/Orthocladius	P	8	Shredder	0	7.7
Insecta	Diptera	Chironomidae	Diamesa	Diamesa	L	4	Collector	sp	8.5
Insecta	Trichoptera	Philopotamidae	Dolophilodes	Dolophilodes	L	1	Filterer	cn	1.7
Insecta	Ephemeroptera	Ephemerellidae	Ephemerella	Ephemerella	L	11	Collector	cn, sw	2.3
Insecta	Ephemeroptera	Ephemerellidae	Eurylophella	Eurylophella	L	1	Scraper	cn, sp	4.5
Insecta	Diptera	Chironomidae	Hydrobaenus	Hydrobaenus	L	1	Scraper	sp	7.2
Insecta	Ephemeroptera	Leptophlebiidae	not identified	Leptophlebiidae	L	1	Collector	sw, cn	1.7
Insecta	Ephemeroptera	Heptageniidae	Leucrocuta	Leucrocuta	L	1	Scraper	cn	1.8
Insecta	Ephemeroptera	Heptageniidae	Maccaffertium	Maccaffertium	L	2	Scraper	cn	3
Insecta	Diptera	Chironomidae	Microtendipes	Microtendipes	L	2	Filterer	cn	4.9
Insecta	Diptera	Chironomidae	Parametriocnemus	Parametriocnemus	L	2	Collector	sp	4.6
Insecta	Trichoptera	Philopotamidae	not identified	Philopotamidae	P	1	Filterer	cn	2.6
Gastropoda	Basommatophora	Physidae	Physa	Physa	A	4	Scraper	cb	7
Insecta	Diptera	Chironomidae	Polypedilum	Polypedilum	L	20	Shredder	cb, cn	6.3
Insecta	Diptera	Chironomidae	Potthastia	Potthastia	L	2	Collector	sp	0.01
Insecta	Ephemeroptera	Ephemerellidae	Teloganopsis	Teloganopsis	L	3	Collector	0	na
Insecta	Diptera	Chironomidae	Thienemannimyia group	Thienemannimyia group	L	1	Predator	sp	8.2
Insecta	Diptera	Chironomidae	Tvetenia	Tvetenia	L	2	Collector	sp	5.1
Insecta	Diptera	Chironomidae	Tvetenia	Tvetenia	P	2	Collector	sp	5.1

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Project Number: 16158563.28
Prepared by: BC Checked by: CRH
Prepared date: 7/31/2017 Checked date: 8/7/2017

Lower Brighton BIBI_05.xlsx
Version: 1
Site Name: 05-122-F-2017QC

Subphylum/ Class	Order	Family	Genus	Final ID	Note[1]	# of Org	FFG[2]	Habit[3]	Tolerance Value[4]
Insecta	Ephemeroptera	Baetidae	Acerpenna	Acerpenna	L	1	Collector	sw, cn	2.6
Insecta	Plecoptera	Nemouridae	Amphinemura	Amphinemura	L	1	Shredder	sp, cn	3
Insecta	Coleoptera	Elmidae	Ancyronyx	Ancyronyx	A	1	Scraper	cn, sp	7.8
Malacostraca	Isopoda	Asellidae	not identified	Asellidae	U	1	0	0	3.3
Insecta	Diptera	Chironomidae	Chaetocladius	Chaetocladius	L	5	Collector	sp	7
Oligochaeta	Tubificida	Naididae	Chaetogaster	Chaetogaster	A	1	0	0	na
Insecta	Trichoptera	Hydropsychidae	Cheumatopsyche	Cheumatopsyche	L	2	Filterer	cn	6.5
Insecta	Trichoptera	Philopotamidae	Chimarra	Chimarra	L	1	Filterer	cn	4.4
Insecta	Diptera	Chironomidae	not identified	Chironominae	L	1	Collector	0	6.6
Insecta	Diptera	Chironomidae	Cladotanytarsus	Cladotanytarsus	L	1	Filterer	-	6.6
Insecta	Diptera	Chironomidae	Corynoneura	Corynoneura	L	4	Collector	sp	4.1
Insecta	Diptera	Chironomidae	Corynoneura	Corynoneura	P	1	Collector	sp	4.1
Insecta	Diptera	Chironomidae	Cricotopus/Orthocladi	Cricotopus/Orthocladius	L	3	Shredder	0	7.7
Insecta	Diptera	Chironomidae	Diplocladius	Diplocladius	L	1	Collector	sp	5.9
Insecta	Ephemeroptera	Ephemerellidae	Ephemerella	Ephemerella	L	3	Collector	cn, sw	2.3
Insecta	Diptera	Chironomidae	Heterotrissocladius	Heterotrissocladius	L	1	Collector	sp, bu	2
Insecta	Ephemeroptera	Heptageniidae	Leucrocuta	Leucrocuta	L	2	Scraper	cn	1.8
Insecta	Plecoptera	not identified	not identified	Plecoptera	L	12	0	0	2.4
Insecta	Ephemeroptera	Heptageniidae	Maccaffertium	Maccaffertium	L	1	Scraper	cn	3
Insecta	Diptera	Chironomidae	Micropsectra	Micropsectra	L	4	Collector	cb, sp	2.1
Oligochaeta	Haplotaxida	Naididae	not identified	Naididae	A	22	Collector	bu	8.5
Insecta	Diptera	Chironomidae	not identified	Orthocladiinae	L	1	Collector	0	7.6
Insecta	Coleoptera	Elmidae	Oulimnius	Oulimnius	L	2	Scraper	cn	2.7
Insecta	Diptera	Chironomidae	Parametriocnemus	Parametriocnemus	L	3	Collector	sp	4.6
Insecta	Diptera	Chironomidae	Paratanytarsus	Paratanytarsus	L	2	Collector	sp	7.7
Insecta	Trichoptera	Philopotamidae	not identified	Philopotamidae	L	1	Filterer	cn	2.6
Gastropoda	Basommatophora	Physidae	Physa	Physa	A	1	Scraper	cb	7
Insecta	Diptera	Chironomidae	Polypedilum	Polypedilum	L	15	Shredder	cb, cn	6.3
Insecta	Diptera	Simuliidae	Prosimulium	Prosimulium	L	1	Filterer	cn	2.4
Insecta	Diptera	Chironomidae	Rheocricotopus	Rheocricotopus	L	1	Collector	sp	6.2
Insecta	Diptera	Chironomidae	Rheotanytarsus	Rheotanytarsus	L	1	Filterer	cn	7.2
Insecta	Diptera	Simuliidae	Simulium	Simulium	L	1	Filterer	cn	5.7
Insecta	Diptera	Chironomidae	not identified	Tanytarsini	P	1	Collector	0	3.5
Insecta	Diptera	Chironomidae	Tanytarsus	Tanytarsus	L	2	Filterer	cb, cn	4.9
Insecta	Ephemeroptera	Ephemerellidae	Teloganopsis	Teloganopsis	L	3	Collector	0	na
Insecta	Diptera	Chironomidae	Tvetenia	Tvetenia	L	2	Collector	sp	5.1
Insecta	Diptera	Chironomidae	Tvetenia	Tvetenia	P	1	Collector	sp	5.1

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Project Number: 16158563.28
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Lower Brighton BIBI_05.xlsx
Version: 1
Site Name: 05-201-F-2017

Subphylum/ Class	Order	Family	Genus	Final ID	Note[1]	# of Org	FFG[2]	Habit[3]	Tolerance Value[4]
Insecta	Ephemeroptera	Heptageniidae	Epeorus	Epeorus	L	1	Scraper	cn	1.7
Oligochaeta	Tubificida	Naididae	Chaetogaster	Chaetogaster	A	1	0	0	na
Insecta	Trichoptera	Hydropsychidae	Cheumatopsyche	Cheumatopsyche	L	22	Filterer	cn	6.5
Insecta	Trichoptera	Philopotamidae	Chimarra	Chimarra	L	6	Filterer	cn	4.4
Insecta	Diptera	Chironomidae	Corynoneura	Corynoneura	L	1	Collector	sp	4.1
Malacostraca	Amphipoda	Crangonyctidae	Crangonyx	Crangonyx	A	1	Collector	sp	6.7
Insecta	Diptera	Chironomidae	Cricotopus/Orthocladius	Cricotopus/Orthocladius	L	6	Shredder	0	7.7
Insecta	Diptera	Chironomidae	Cricotopus/Orthocladius	Cricotopus/Orthocladius	P	2	Shredder	0	7.7
Insecta	Diptera	Chironomidae	Diamesa	Diamesa	L	1	Collector	sp	8.5
Insecta	Diptera	Chironomidae	Dicrotendipes	Dicrotendipes	L	2	Collector	bu	9
Insecta	Coleoptera	Elmidae	Dubiraphia	Dubiraphia	A	1	Scraper	cn, cb	5.7
Insecta	Ephemeroptera	Ephemerellidae	Ephemerella	Ephemerella	L	1	Collector	cn, sw	2.3
Insecta	Diptera	Chironomidae	Eukiefferiella	Eukiefferiella	L	2	Collector	sp	6.1
Gastropoda	Basommatophora	Ancylidae	Ferrissia	Ferrissia	A	2	Scraper	cb	7
Insecta	Diptera	Empididae	Hemerodromia	Hemerodromia	L	1	Predator	sp, bu	7.9
Insecta	Diptera	Chironomidae	Hydrobaenus	Hydrobaenus	L	1	Scraper	sp	7.2
Insecta	Trichoptera	Hydropsychidae	Hydropsyche	Hydropsyche	L	16	Filterer	cn	7.5
Insecta	Trichoptera	Hydropsychidae	not identified	Hydropsychidae	P	1	Filterer	cn	5.7
Insecta	Trichoptera	Hydroptilidae	Hydroptila	Hydroptila	L	4	Scraper	cn	6
Insecta	Diptera	Chironomidae	Micropsectra	Micropsectra	L	1	Collector	cb, sp	2.1
Oligochaeta	Haplotaxida	Naididae	not identified	Naididae	A	12	Collector	bu	8.5
not identified	not identified	not identified	not identified	Nemata	A	2	0	0	na
Insecta	Diptera	Chironomidae	Pagastia	Pagastia	P	1	Collector	-	6.6
Insecta	Trichoptera	Philopotamidae	not identified	Philopotamidae	P	1	Filterer	cn	2.6
Gastropoda	Basommatophora	Physidae	Physa	Physa	A	2	Scraper	cb	7
Insecta	Diptera	Chironomidae	Polypedilum	Polypedilum	L	4	Shredder	cb, cn	6.3
Insecta	Diptera	Chironomidae	Rheotanytarsus	Rheotanytarsus	L	4	Filterer	cn	7.2
Insecta	Coleoptera	Elmidae	Stenelmis	Stenelmis	L	1	Scraper	cn	7.1
Insecta	Diptera	Chironomidae	Stilocladius	Stilocladius	L	3	Collector	sp	6.6
Insecta	Diptera	Chironomidae	Sympotthastia	Sympotthastia	L	1	Collector	sp	8.2
Insecta	Diptera	Chironomidae	Tanytarsus	Tanytarsus	L	6	Filterer	cb, cn	4.9
Insecta	Ephemeroptera	Ephemerellidae	Teloganopsis	Teloganopsis	L	4	Collector	0	na
Insecta	Diptera	Chironomidae	Thienemannimyia group	Thienemannimyia group	L	3	Predator	sp	8.2
Insecta	Diptera	Tipulidae	not identified	Tipulidae	P	1	Predator	bu, sp	4.8
Insecta	Diptera	Chironomidae	Tvetenia	Tvetenia	L	3	Collector	sp	5.1
Insecta	Diptera	Chironomidae	Tvetenia	Tvetenia	P	1	Collector	sp	5.1

1 Life Stage, I - Immature, P- Pupa, A - Adult, U - Undetermined; 2 Functional Feeding Group; 3 Primary habit or form of locomotion, includes bu - burrower, cn - clinger, cb - climber, sk - skater, sp - sprawler, sw - swimmer; 4 Tolerance Values, based on Hilsenhoff, modified for Maryland. An entry of "0" indicates information for the particular taxa was not available.

Project Name: Howard County Countywide
Project Number: 16158563.28
Prepared by: BC Checked by: CRH
Prepared date: 7/31/2017 Checked date: 8/7/2017

Lower Brighton BIBI_05.xlsx
Version: 1
Site Name: 05-301-R-2017

Subphylum/ Class	Order	Family	Genus	Final ID	Note[1]	# of Org	FFG[2]	Habit[3]	Tolerance Value[4]
Insecta	Plecoptera	Nemouridae	Amphinemura	Amphinemura	L	8	Shredder	sp, cn	3
Insecta	Ephemeroptera	Baetidae	not identified	Baetidae	L	1	Collector	sw, cn	2.3
Insecta	Diptera	Chironomidae	Brillia	Brillia	L	1	Shredder	bu, sp	7.4
Insecta	Diptera	Chironomidae	Chaetocladius	Chaetocladius	L	1	Collector	sp	7
Insecta	Trichoptera	Hydropsychidae	Cheumatopsyche	Cheumatopsyche	L	16	Filterer	cn	6.5
Insecta	Trichoptera	Philopotamidae	Chimarra	Chimarra	L	4	Filterer	cn	4.4
Insecta	Odonata	Cordulegastridae	Cordulegaster	Cordulegaster	L	1	Predator	bu	2.4
Malacostraca	Amphipoda	Crangonyctidae	Crangonyx	Crangonyx	A	1	Collector	sp	6.7
Insecta	Diptera	Chironomidae	Cricotopus/Orthoclad	Cricotopus/Orthocladius	L	6	Shredder	0	7.7
Insecta	Diptera	Chironomidae	Eukiefferiella	Eukiefferiella	L	1	Collector	sp	6.1
Gastropoda	Basommatophora	Ancylidae	Ferrissia	Ferrissia	A	1	Scraper	cb	7
Insecta	Trichoptera	Hydropsychidae	Hydropsyche	Hydropsyche	L	2	Filterer	cn	7.5
Insecta	Ephemeroptera	Isonychiidae	Isonychia	Isonychia	L	19	Filterer	sw, cn	2.5
Insecta	Diptera	Chironomidae	Limnophyes	Limnophyes	L	1	Collector	sp	8.6
Insecta	Ephemeroptera	Heptageniidae	Maccaffertium	Maccaffertium	L	8	Scraper	cn	3
Oligochaeta	Haplotaxida	Naididae	not identified	Naididae	A	8	Collector	bu	8.5
Insecta	Coleoptera	Elmidae	Optioservus	Optioservus	L	6	Scraper	cn	5.4
Insecta	Coleoptera	Elmidae	Oulimnius	Oulimnius	A	1	Scraper	cn	2.7
Insecta	Coleoptera	Elmidae	Oulimnius	Oulimnius	L	1	Scraper	cn	2.7
Insecta	Diptera	Chironomidae	Parametriocnemus	Parametriocnemus	L	1	Collector	sp	4.6
Insecta	Plecoptera	Nemouridae	Paranemoura	Paranemoura	L	8	0	0	2.9
Gastropoda	Basommatophora	Physidae	Physa	Physa	A	1	Scraper	cb	7
Insecta	Diptera	Chironomidae	Polypedilum	Polypedilum	L	3	Shredder	cb, cn	6.3
Enopla	Hoplonemertea	Tetrastemmatidae	Prostoma	Prostoma	A	1	Predator	0	7.3
Insecta	Diptera	Chironomidae	Rheocricotopus	Rheocricotopus	L	1	Collector	sp	6.2
Insecta	Diptera	Chironomidae	Rheotanytarsus	Rheotanytarsus	L	1	Filterer	cn	7.2
Insecta	Diptera	Simuliidae	Simulium	Simulium	L	2	Filterer	cn	5.7
Insecta	Diptera	Chironomidae	Sublettea	Sublettea	L	1	Collector	-	10
Insecta	Plecoptera	Taeniopterygidae	Taenionema	Taenionema	L	2	Scraper	sp,cn	2
Insecta	Diptera	Chironomidae	Tanytarsus	Tanytarsus	L	1	Filterer	cb, cn	4.9
Insecta	Ephemeroptera	Ephemerellidae	Teloganopsis	Teloganopsis	L	1	Collector	0	na
Insecta	Diptera	Chironomidae	Thienemanniella	Thienemanniella	L	1	Collector	sp	5.1
Insecta	Diptera	Chironomidae	Thienemannimyia gro	Thienemannimyia group	L	1	Predator	sp	8.2
Oligochaeta	Haplotaxida	Naididae	not identified	Naididae	U	2	Collector	bu	8.5
Insecta	Diptera	Chironomidae	Tvetenia	Tvetenia	L	2	Collector	sp	5.1

1 Life Stage, I - Immature, P- Pupa, A - Adult, U - Undetermined; 2 Functional Feeding Group; 3 Primary habit or form of locomotion, includes bu - burrower, cn - clinger, cb - climber, sk - skater, sp - sprawler, sw - swimmer; 4 Tolerance Values, based on Hilsenhoff, modified for Maryland. An entry of "0" indicates information for the particular taxa was not available.

Project Name: Howard County Countywide
Project Number: 16158563.28
Prepared by: BC Checked by: CRH
Prepared date: 7/31/2017 Checked date: 8/7/2017

Lower Brighton BIBI_05.xlsx
Version: 1
Site Name: 05-321-F-2017

Subphylum/ Class	Order	Family	Genus	Final ID	Note[1]	# of Org	FFG[2]	Habit[3]	Tolerance Value[4]
Insecta	Diptera	Chironomidae	Ablabesmyia	Ablabesmyia	L	1	Predator	sp	8.1
Insecta	Ephemeroptera	Baetidae	Acerpenna	Acerpenna	L	1	Collector	sw, cn	2.6
Insecta	Trichoptera	Glossosomatidae	Agapetus	Agapetus	L	1	Scraper	cn	2
Insecta	Ephemeroptera	Ameletidae	Ameletus	Ameletus	L	2	Collector	sw, cb	2.6
Insecta	Plecoptera	Nemouridae	Amphinemura	Amphinemura	L	2	Shredder	sp, cn	3
Insecta	Coleoptera	Elmidae	Ancyronyx	Ancyronyx	L	1	Scraper	cn, sp	7.8
Insecta	Diptera	Tipulidae	Antocha	Antocha	L	2	Collector	cn	8
Insecta	Trichoptera	Hydropsychidae	Cheumatopsyche	Cheumatopsyche	L	5	Filterer	cn	6.5
Malacostraca	Amphipoda	Crangonyctidae	Crangonyx	Crangonyx	A	3	Collector	sp	6.7
Insecta	Diptera	Chironomidae	Cricotopus/Orthocladi	Cricotopus/Orthocladius	L	20	Shredder	0	7.7
Insecta	Diptera	Chironomidae	Cricotopus/Orthocladi	Cricotopus/Orthocladius	P	1	Shredder	0	7.7
Insecta	Diptera	Tipulidae	Dicranota	Dicranota	L	1	Predator	sp, bu	1.1
Insecta	Ephemeroptera	Ephemerellidae	Drunella	Drunella	L	1	Scraper	cn, sp	1.9
Insecta	Ephemeroptera	Ephemerellidae	Ephemerella	Ephemerella	L	2	Collector	cn, sw	2.3
Insecta	Ephemeroptera	Ephemerellidae	Eurylophella	Eurylophella	L	1	Scraper	cn, sp	4.5
Insecta	Trichoptera	Hydropsychidae	Hydropsyche	Hydropsyche	L	1	Filterer	cn	7.5
Insecta	Trichoptera	Hydroptilidae	Hydroptila	Hydroptila	L	1	Scraper	cn	6
Insecta	Ephemeroptera	Isonychiidae	Isonychia	Isonychia	L	1	Filterer	sw, cn	2.5
Insecta	Coleoptera	not identified	not identified	Coleoptera	L	1	0	0	4.1
Insecta	Diptera	Ceratopogonidae	Mallochohelea	Mallochohelea	L	1	Predator	bu	3.6
Insecta	Diptera	Chironomidae	Microtendipes	Microtendipes	L	8	Filterer	cn	4.9
Oligochaeta	Haplotaxida	Naididae	not identified	Naididae	A	19	Collector	bu	8.5
Insecta	Diptera	Chironomidae	Nanocladius	Nanocladius	L	1	Collector	sp	7.6
not identified	not identified	not identified	not identified	Nemata	A	1	0	0	na
Insecta	Trichoptera	Uenoidae	Neophylax	Neophylax	L	4	Scraper	cn	2.7
Insecta	Coleoptera	Elmidae	Optioservus	Optioservus	A	1	Scraper	cn	5.4
Insecta	Plecoptera	Nemouridae	Paranemoura	Paranemoura	L	3	0	0	2.9
Insecta	Diptera	Chironomidae	Phaenopsectra	Phaenopsectra	L	1	Collector	cn	8.7
Insecta	Plecoptera	Pteronarcyidae	not identified	Pteronarcyidae	L	1	0	0	2
Insecta	Diptera	Chironomidae	Rheotanytarsus	Rheotanytarsus	L	3	Filterer	cn	7.2
Insecta	Diptera	Chironomidae	Tanytarsus	Tanytarsus	L	4	Filterer	cb, cn	4.9
Insecta	Ephemeroptera	Ephemerellidae	Teloganopsis	Teloganopsis	L	1	Collector	0	na
Insecta	Diptera	Chironomidae	Thienemannimyia gro	Thienemannimyia group	L	1	Predator	sp	8.2

1 Life Stage, I - Immature, P- Pupa, A - Adult, U - Undetermined; 2 Functional Feeding Group; 3 Primary habit or form of locomotion, includes bu - burrower, cn - clinger, cb - climber, sk - skater, sp - sprawler, sw - swimmer; 4 Tolerance Values, based on Hilsenhoff, modified for Maryland. An entry of "0" indicates information for the particular taxa was not available.

Appendix D: Habitat Assessment Data

Project Name: Howard County Countywide Bioassessement
Project Number: 1615856328
Prepared by: CRH Checked by: BC
Prepared date: 7/6/2017 Checked date: 7/19/2017

RBP_High_Gradient_v1.xlsx
Version: 1
Site Name:

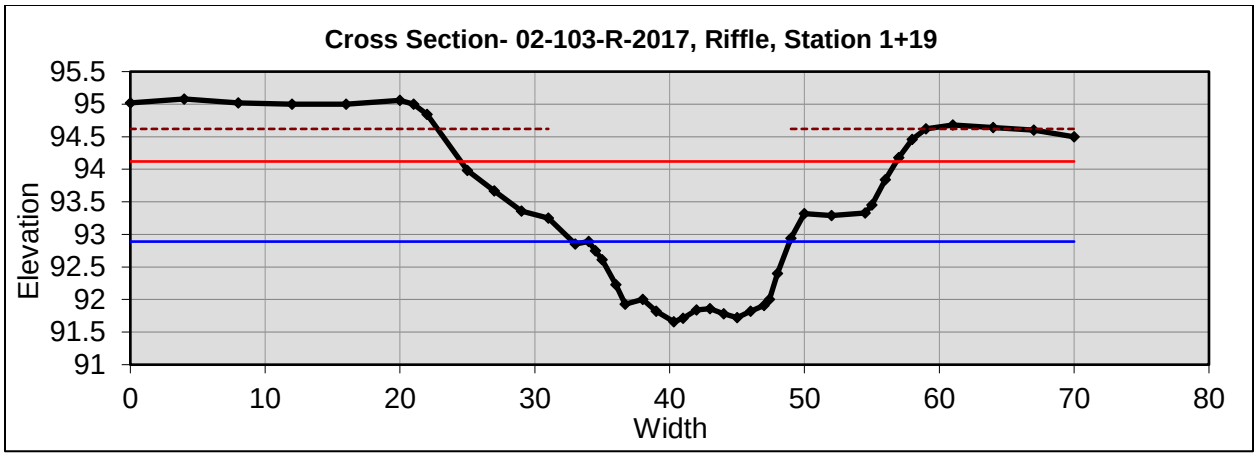
Site ID	Sample Date	Total RBP Habitat Score	RBP Score	RBP Rating	Epifaunal Substrate/ Cover	Embedded-ness	Velocity/ Depth Regime	Sediment Deposition	Channel Flow Status	Channel Alteration	Frequency of Rifles	Bank Stability - Left	Bank Stability - Right	Vegetative Protection - Left	Vegetative Protection - Right	Riparian Vegetative Zone Width - Left	Riparian Vegetative Zone Width - Right
Upper Brighton Dam																	
02-103-R-2017	4/12/2017	165	82.5	Supporting	14	18	17	16	16	20	14	8	8	8	6	10	10
02-104-R-2017	4/14/2017	131	65.5	Partially Supporting	10	12	9	8	14	20	13	6	7	6	6	10	10
02-106-R-2017	4/12/2017	141	70.5	Partially Supporting	13	12	12	13	13	20	13	7	4	7	7	10	10
02-107-R-2017	4/13/2017	106	53.0	Not Supporting	6	10	8	8	13	20	5	2	4	5	5	10	10
02-121-F-2017	4/14/2017	134	67.0	Partially Supporting	12	14	11	10	13	20	14	4	5	5	6	10	10
02-121-F-2017 QC	4/14/2017	130	65.0	Partially Supporting	14	14	13	9	13	20	11	4	4	4	4	10	10
02-123-F-2017	4/13/2017	134	67.0	Partially Supporting	15	15	9	12	13	20	15	2	4	6	3	10	10
02-201-R-2017	4/7/2017	131	65.5	Partially Supporting	11	18	17	9	11	20	12	4	3	3	3	10	10
02-202-R-2017	4/7/2017	137	68.5	Partially Supporting	13	17	16	16	16	20	9	3	3	2	2	10	10
02-221-F-2017	4/14/2017	121	60.5	Partially Supporting	10	12	11	8	7	20	15	5	3	6	4	10	10
02-301-F-2017	4/13/2017	126	63.0	Partially Supporting	10	11	16	12	13	20	10	2	5	5	2	10	10
Cattail Creek																	
03-102-R-2017	3/30/2017	120	60.0	Partially Supporting	11	13	11	10	8	20	10	2	5	5	5	10	10
03-103-R-2017	3/30/2017	124	62.0	Partially Supporting	12	13	11	10	11	20	10	2	5	5	5	10	10
03-104-R-2017	3/30/2017	126	63.0	Partially Supporting	12	12	10	12	8	18	14	4	6	5	5	10	10
03-108-R-2017	4/5/2017	98	49.0	Not Supporting	3	2	7	2	11	20	2	7	8	8	8	10	10
03-113-R-2017	4/7/2017	114	57.0	Not Supporting	6	16	7	15	8	20	9	3	3	7	7	10	3
03-123-F-2017	4/5/2017	163	81.5	Supporting	11	18	13	18	18	20	16	8	7	7	7	10	10
03-124-F-2017	4/5/2017	125	62.5	Partially Supporting	11	10	9	10	15	20	9	5	5	5	6	10	10
03-221-F-2017	3/29/2017	113	56.5	Not Supporting	5	2	11	8	14	20	13	4	4	6	6	10	10
03-301-R-2017	3/29/2017	130	65.0	Partially Supporting	10	14	16	15	13	14	12	4	4	4	4	10	10
03-301-R-2017 QC	3/29/2017	134	67.0	Partially Supporting	10	14	13	15	14	20	13	6	3	3	3	10	10
03-321-F-2017	3/29/2017	129	64.5	Partially Supporting	9	16	13	14	15	20	12	2	2	3	3	10	10
Lower Brighton Dam																	
05-103-R-2017	3/21/2017	109	54.5	Not Supporting	10	8	9	9	16	15	12	7	7	5	5	3	3
05-105-R-2017	3/21/2017	58	29.0	Not Supporting	4	1	6	5	8	5	0	7	2	5	0	5	10
05-106-R-2017	3/23/2017	121	60.5	Partially Supporting	9	14	11	8	8	20	9	6	6	5	5	10	10
05-108-R-2017	4/12/2017	140	70.0	Partially Supporting	14	15	12	13	9	20	13	4	6	7	7	10	10
05-111-R-2017	3/24/2017	120	60.0	Partially Supporting	6	18	6	8	13	20	13	4	4	4	6	10	8
05-121-F-2017	3/23/2017	114	57.0	Not Supporting	10	15	11	5	6	20	8	5	5	4	5	10	10
05-122-F-2017	3/23/2017	114	57.0	Not Supporting	9	15	11	6	10	20	9	6	2	4	2	10	10
05-122-F-2017 QC	3/23/2017	124	62.0	Partially Supporting	10	15	12	8	9	20	8	4	6	6	6	10	10
05-201-F-2017	3/21/2017	107	53.5	Not Supporting	10	7	12	7	12	20	7	3	3	3	3	10	10
05-301-R-2017	3/24/2017	136	68.0	Partially Supporting	12	17	17	9	14	20	12	4	5	3	3	10	10
05-321-F-2017	3/24/2017	118	59.0	Not Supporting	6	9	16	10	15	20	6	6	4	2	4	10	10

Project Name: Howard County Countywide Bioassessement
Project Number: 1615856328 PHI_Piedmont_v3_HCcountywide.xlsx
Prepared by: CRH Checked by: BC Version: 2
Prepared date: 7/18/2017 Checked date: 7/19/2017 Site Name:

		RAW DATA						Calculated Value		SCORES	
Site	Subshed Area (ac)*	Instream Habitat	Epibenthic Substrate	Embeddedness	Percent Shading	# Woody Debris/ Rootwads	Riffle Quality	Bank Stability	Remoteness Score	PHI	PHI Rating
Upper Brighton Dam											
02-103-R-2017	650.4	13	14	20	80	4	14	13	11	73.1	Partially Degraded
02-104-R-2017	86.0	8	10	45	70	4	7	6	13	55.7	Degraded
02-106-R-2017	1021.1	12	13	40	90	7	13	5	16	71.2	Partially Degraded
02-107-R-2017	129.4	7	6	50	80	2	6	8	10	48.3	Severely Degraded
02-121-F-2017	670.0	10	12	40	70	3	12	0	12	54.1	Degraded
02-121-F-2017 QC	670.0	13	14	40	75	2	14	2	10	58.5	Degraded
02-123-F-2017	460.2	15	15	30	70	13	9	3	8	68.3	Partially Degraded
02-201-R-2017	5526.8	16	11	20	70	13	12	0	11	68.4	Partially Degraded
02-202-R-2017	5337.9	15	13	30	60	11	11	0	6	61.3	Degraded
02-221-F-2017	1127.6	11	10	40	70	2	13	4	20	59.2	Degraded
02-301-F-2017	8834.2	12	10	40	70	5	16	2	11	57.9	Degraded
Cattail Creek											
03-102-R-2017	1866.2	6	11	30	70	5	12	0	18	56.2	Degraded
03-103-R-2017	1817.5	6	12	30	70	6	11	0	18	57.3	Degraded
03-104-R-2017	1602.1	11	12	30	70	16	12	1	12	66.0	Degraded
03-108-R-2017	94.6	3	3	90	90	2	7	11	2	34.7	Severely Degraded
03-113-R-2017	95.7	4	6	30	80	4	8	0	6	42.0	Severely Degraded
03-123-F-2017	1314.6	10	11	10	90	2	10	13	12	67.3	Partially Degraded
03-124-F-2017	183.8	9	11	50	80	3	11	0	6	47.1	Severely Degraded
03-221-F-2017	2750.7	5	5	90	70	14	5	2	12	44.2	Severely Degraded
03-301-R-2017	17733.5	13	10	30	50	18	9	6	20	69.2	Partially Degraded
03-301-R-2017 QC	17733.5	12	10	30	40	8	8	4	20	61.3	Degraded
03-321-F-2017	17776.7	10	9	30	50	8	9	0	18	56.3	Degraded
Lower Brighton Dam											
05-103-R-2017	484.3	9	11	60	40	5	10	3	12	51.2	Degraded
05-105-R-2017	2205.4	9	4	100	20	6	1	3	4	26.3	Severely Degraded
05-106-R-2017	1844.7	8	9	30	60	10	10	3	10	57.3	Degraded
05-108-R-2017	1814.8	14	14	30	70	4	15	0	9	60.0	Degraded
05-111-R-2017	899.9	3	6	10	85	4	7	7	4	47.9	Severely Degraded
05-121-F-2017	2105.3	8	10	30	60	12	11	3	13	63.2	Degraded
05-122-F-2017	2108.1	7	9	30	60	1	8	1	10	42.8	Severely Degraded
05-122-F-2017 QC	2108.1	10	10	30	70	4	10	6	10	57.3	Degraded
05-201-F-2017	1234.2	8	10	70	30	9	9	3	11	49.4	Severely Degraded
05-301-R-2017	21542.3	11	12	20	20	12	12	6	18	69.3	Partially Degraded
05-321-F-2017	19394.8	10	6	40	30	8	5	2	21	49.3	Severely Degraded

Score	Narrative Rating
81-100	Minimally Degraded
66.0-80.9	Partially Degraded
51.0-65.9	Degraded
0-50.9	Severely Degraded

Appendix E: Geomorphologic Data



Bankfull Dimensions	
13.2	x-section area (ft.sq.)
16.1	width (ft)
0.8	mean depth (ft)
1.2	max depth (ft)
16.6	wetted parimeter (ft)
0.8	hyd radi (ft)
19.6	width-depth ratio

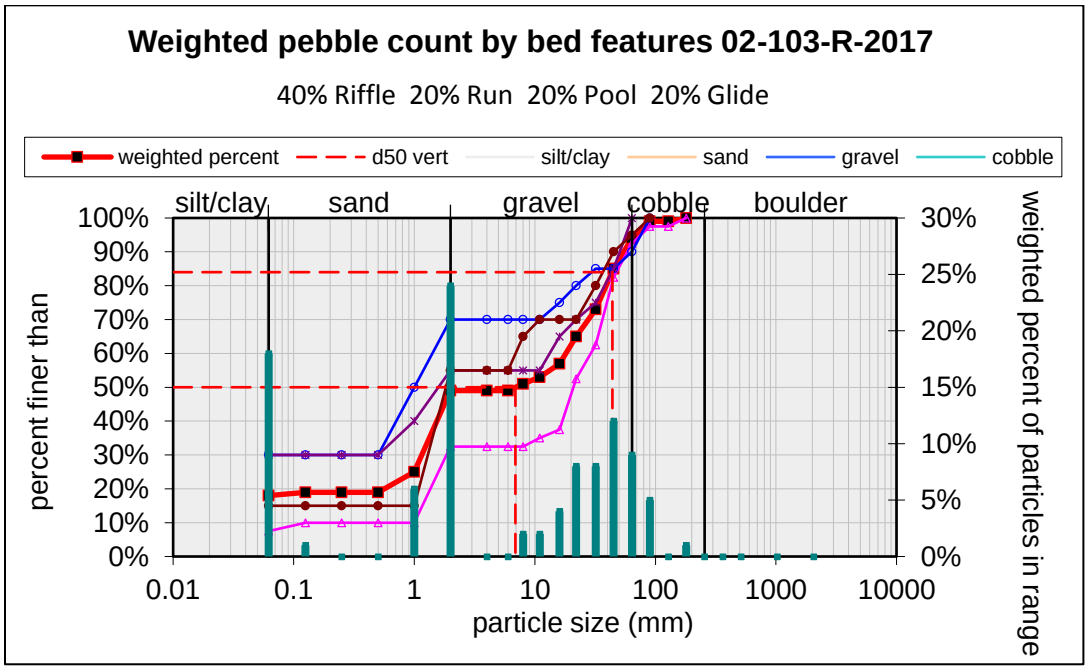
Flood Dimensions	
31.8	W flood prone area (ft)
2.0	entrenchment ratio
3.0	low bank height (ft)
2.4	low bank height ratio

Bankfull Flow	
3.8	velocity (ft/s)
50.3	discharge rate (cfs)
0.75	Froude number

Flow Resistance	
0.034	Manning's roughness

Sinuosity
1.0

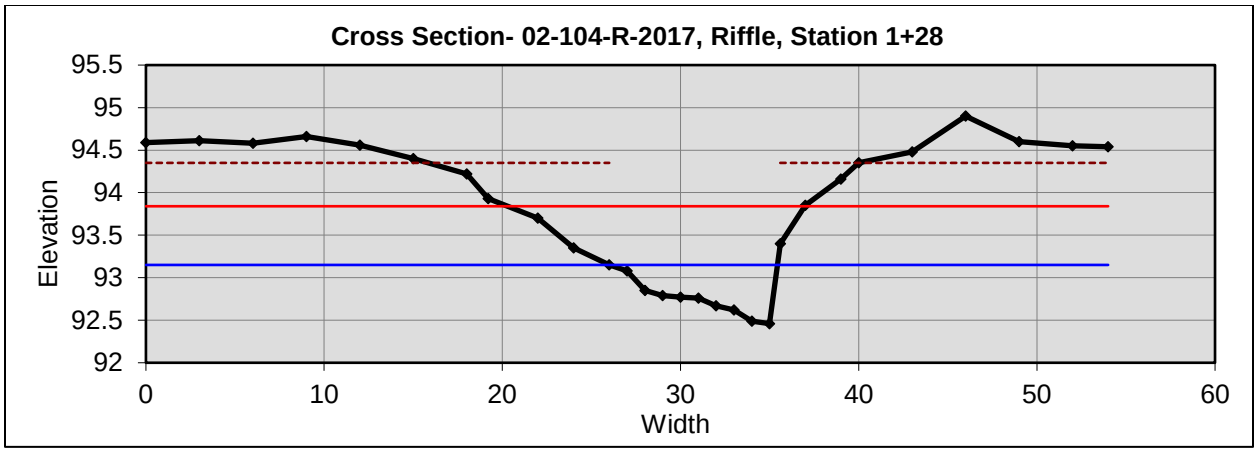
Channel Type
B4c



Size (mm)	
D16	0.062
D35	1.3
D50	6.9
D65	22
D84	44
D95	69

Size Distribution	
mean	1.7
dispersion	58.8
skewness	-0.37

Type	
silt/clay	18%
sand	31%
gravel	45%
cobble	6%
boulder	0%



Bankfull Dimensions	
3.7	x-section area (ft.sq.)
9.4	width (ft)
0.4	mean depth (ft)
0.7	max depth (ft)
9.9	wetted parimeter (ft)
0.4	hyd radi (ft)
24.3	width-depth ratio

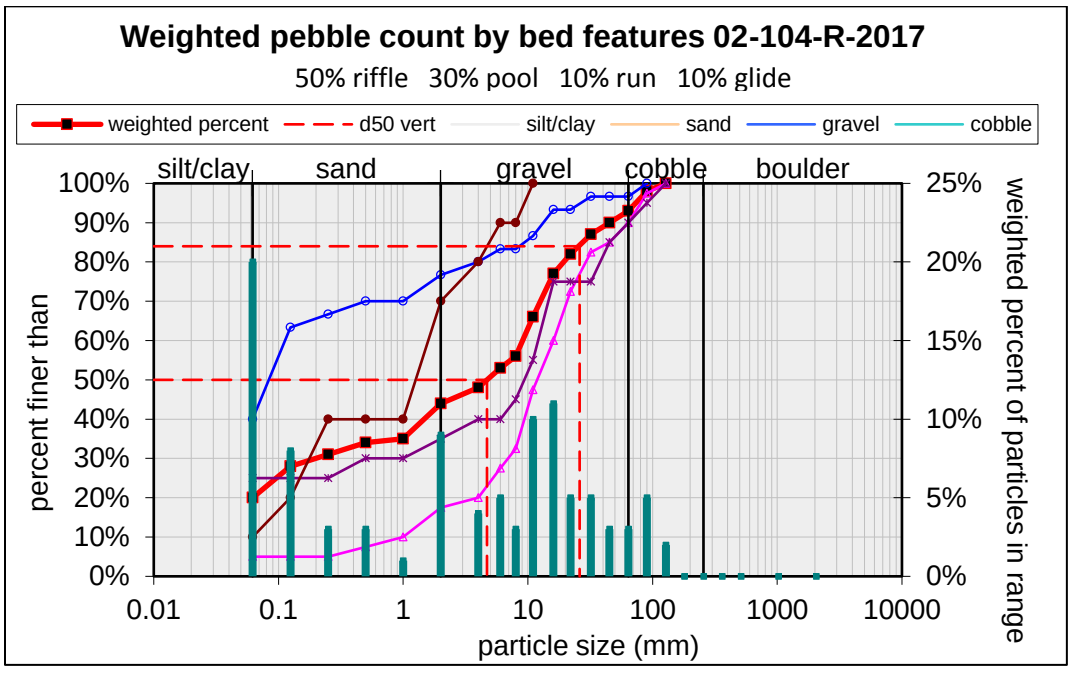
Flood Dimensions	
16.7	W flood prone area (ft)
1.8	entrenchment ratio
1.9	low bank height (ft)
2.7	low bank height ratio

Bankfull Flow	
3.4	velocity (ft/s)
12.3	discharge rate (cfs)
0.97	Froude number

Flow Resistance	
0.032	Manning's roughness

Sinuosity
1.2

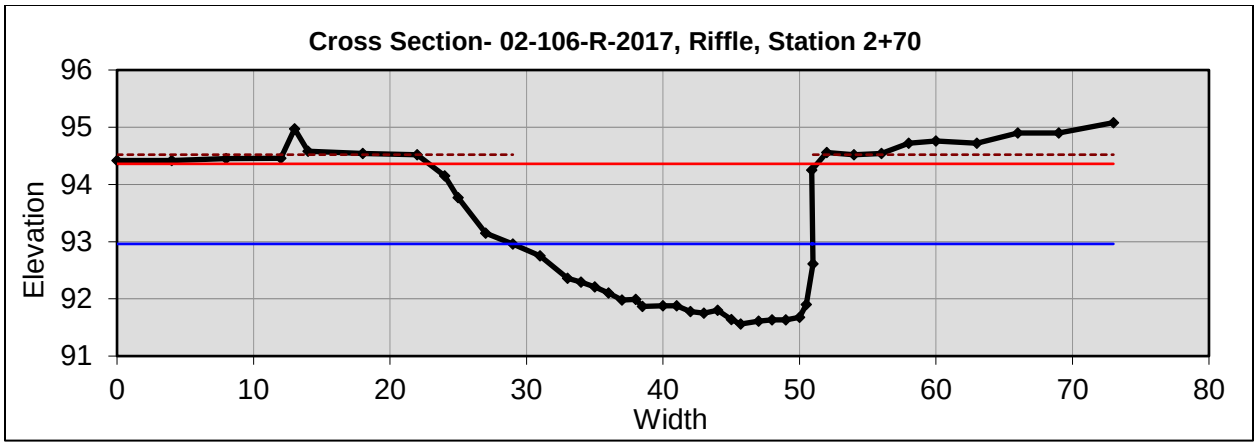
Channel Type
B4c



Size (mm)	
D16	0.062
D35	1
D50	4.7
D65	11
D84	26
D95	73

Size Distribution	
mean	1.3
dispersion	40.7
skewness	-0.35

Type	
silt/clay	20%
sand	24%
gravel	49%
cobble	7%
boulder	0%



Bankfull Dimensions	
20.7	x-section area (ft.sq.)
22.0	width (ft)
0.9	mean depth (ft)
1.4	max depth (ft)
22.9	wetted parimeter (ft)
0.9	hyd radi (ft)
23.4	width-depth ratio

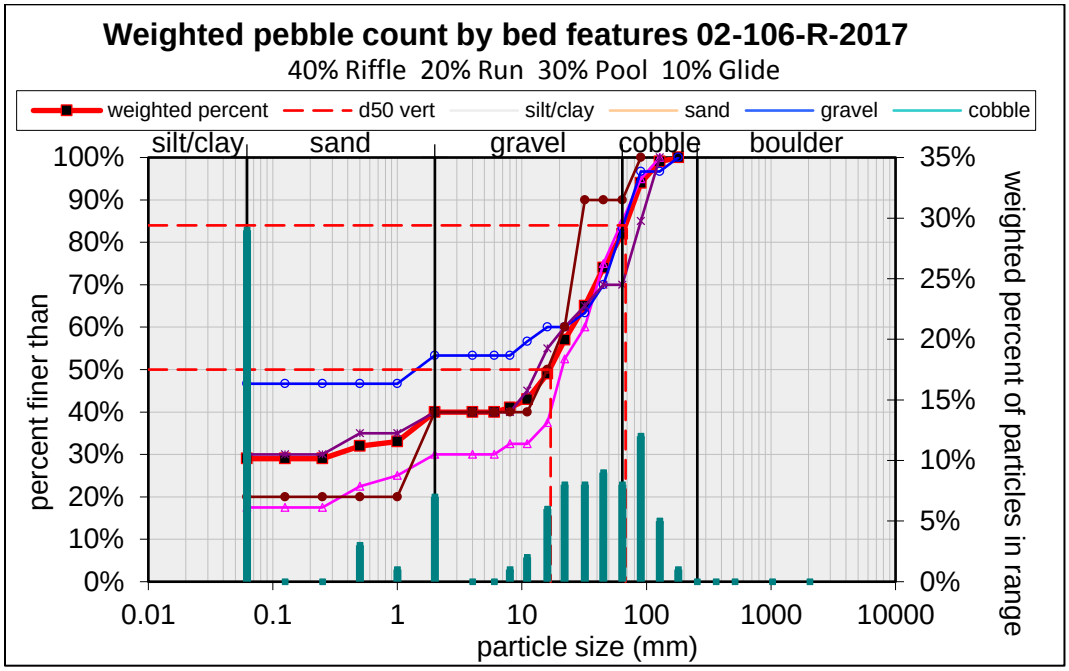
Flood Dimensions	
24.0	W flood prone area (ft)
1.1	entrenchment ratio
3.0	low bank height (ft)
2.1	low bank height ratio

Bankfull Flow	
3.5	velocity (ft/s)
73.1	discharge rate (cfs)
0.66	Froude number

Flow Resistance	
0.038	Manning's roughness

Sinuosity
1.5

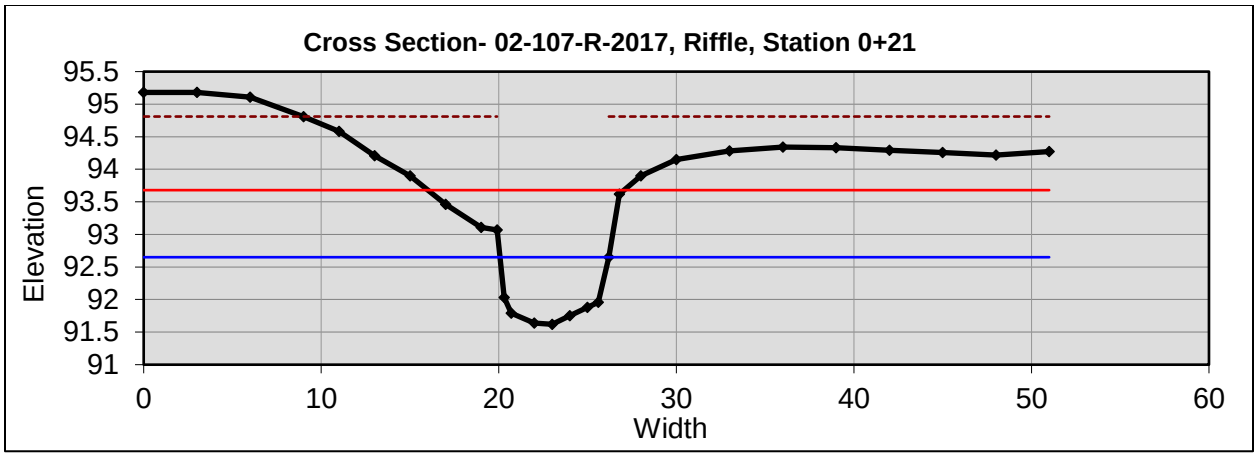
Channel Type
F4



Size (mm)	
D16	0.062
D35	1.2
D50	17
D65	32
D84	68
D95	97

Size Distribution	
mean	2.1
dispersion	139.1
skewness	-0.53

Type	
silt/clay	29%
sand	11%
gravel	42%
cobble	18%
boulder	0%



Bankfull Dimensions	
5.1	x-section area (ft.sq.)
6.1	width (ft)
0.8	mean depth (ft)
1.0	max depth (ft)
7.0	wetted parimeter (ft)
0.7	hyd radi (ft)
7.5	width-depth ratio

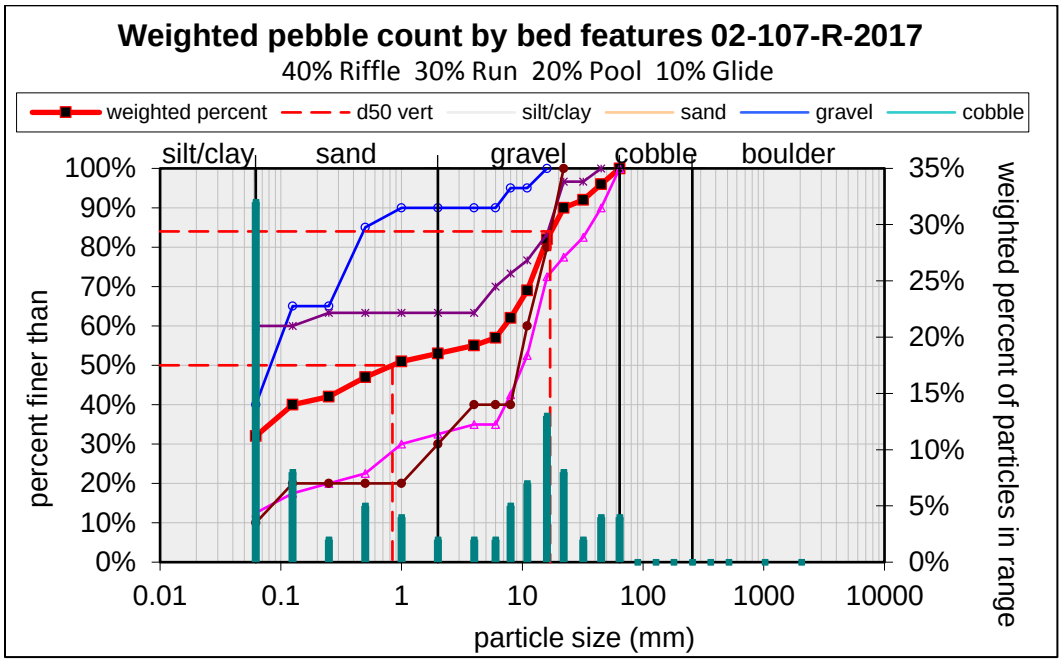
Flood Dimensions	
5.9	W flood prone area (ft)
1.0	entrenchment ratio
3.2	low bank height (ft)
3.1	low bank height ratio

Bankfull Flow	
6.5	velocity (ft/s)
33.0	discharge rate (cfs)
1.35	Froude number

Flow Resistance	
0.026	Manning's roughness

Sinuosity
1.5

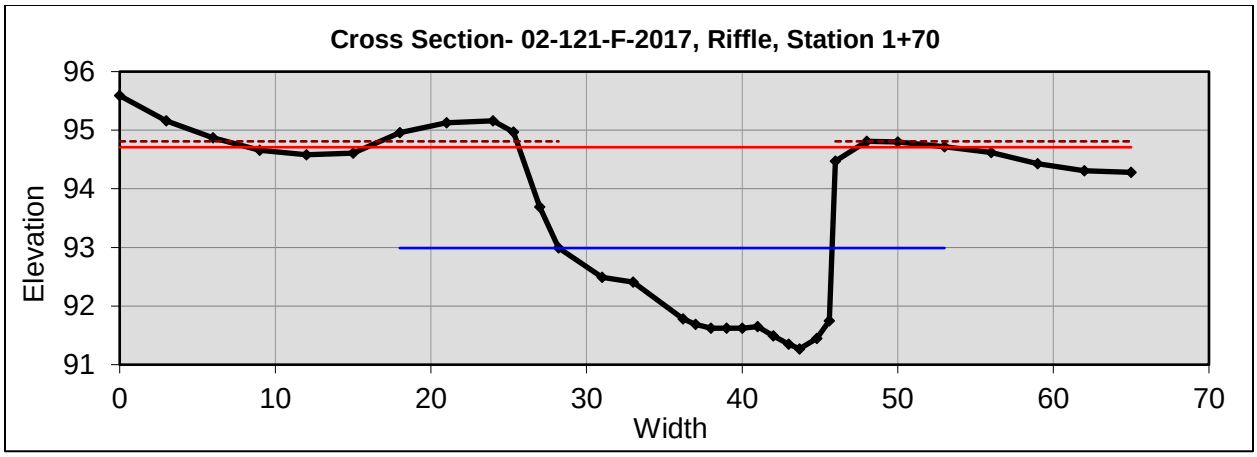
Channel Type
G4/6



Size (mm)	
D16	0.062
D35	0.081
D50	0.84
D65	9.2
D84	17
D95	41

Size Distribution	
mean	1.0
dispersion	16.9
skewness	0.06

Type	
silt/clay	32%
sand	21%
gravel	47%
cobble	0%
boulder	0%



Bankfull Dimensions	
18.3	x-section area (ft.sq.)
17.6	width (ft)
1.0	mean depth (ft)
1.7	max depth (ft)
18.9	wetted parimeter (ft)
1.0	hyd radi (ft)
16.9	width-depth ratio

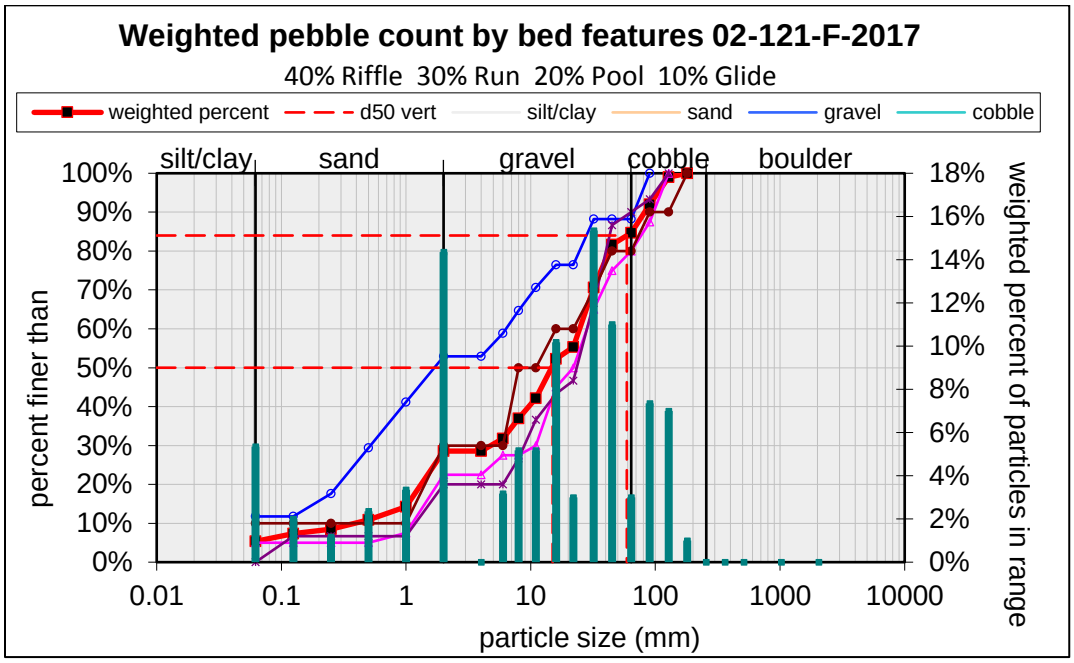
Flood Dimensions	
18.9	W flood prone area (ft)
1.1	entrenchment ratio
3.5	low bank height (ft)
2.1	low bank height ratio

Bankfull Flow	
4.3	velocity (ft/s)
78.2	discharge rate (cfs)
0.77	Froude number

Flow Resistance	
0.036	Manning's roughness

Sinuosity
1.0

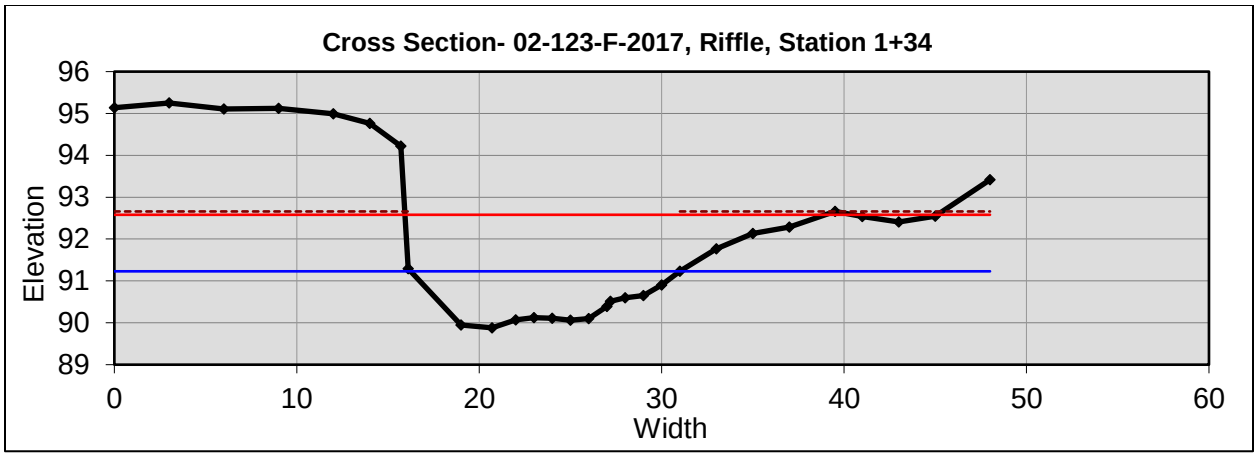
Channel Type
F4



Size (mm)	
D16	1.1
D35	7.2
D50	15
D65	28
D84	59
D95	100

Size Distribution	
mean	8.1
dispersion	8.8
skewness	-0.21

Type			
silt/clay	5%	bedrock	3%
sand	22%		
gravel	54%		
cobble	15%		
boulder	0%		



Bankfull Dimensions	
13.1	x-section area (ft.sq.)
14.8	width (ft)
0.9	mean depth (ft)
1.4	max depth (ft)
15.2	wetted parimeter (ft)
0.9	hyd radi (ft)
16.7	width-depth ratio

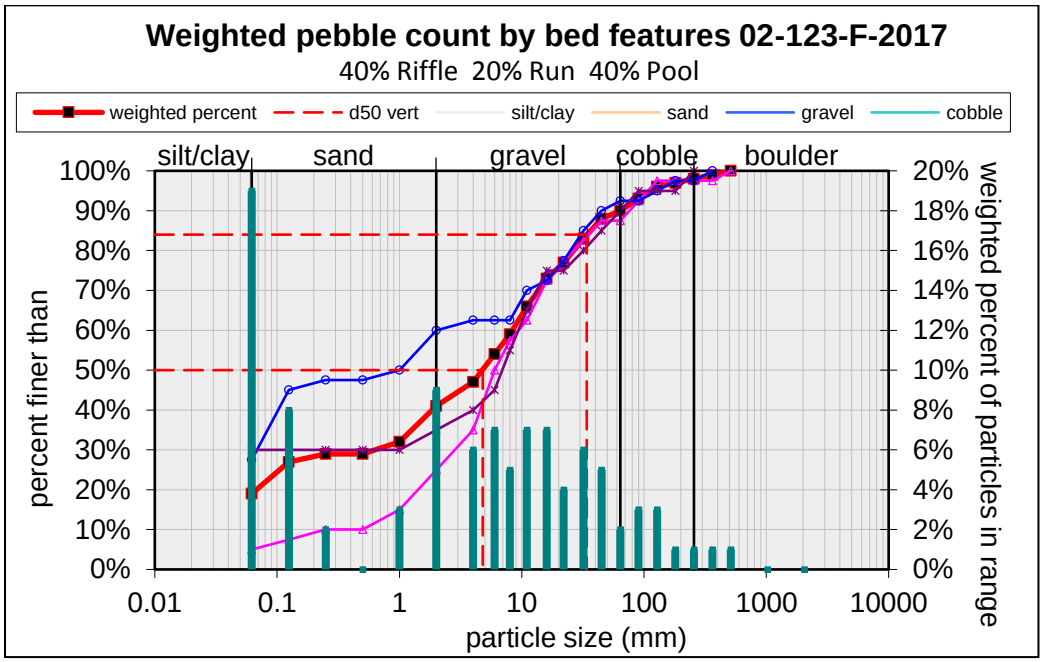
Flood Dimensions	
17.8	W flood prone area (ft)
1.2	entrenchment ratio
2.8	low bank height (ft)
2.1	low bank height ratio

Bankfull Flow	
5.4	velocity (ft/s)
70.3	discharge rate (cfs)
1.02	Froude number

Flow Resistance	
0.031	Manning's roughness

Sinuosity
1.3

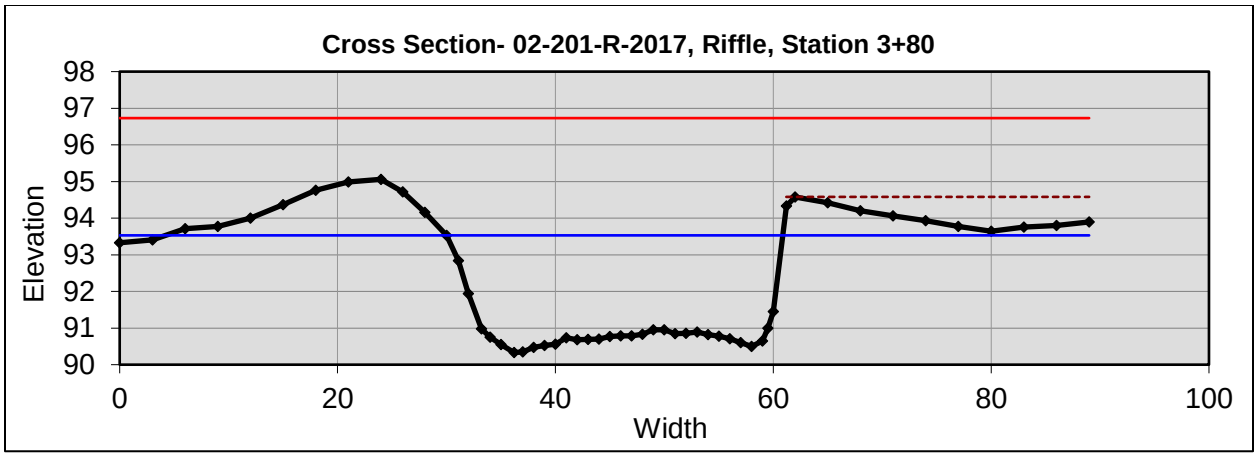
Channel Type
F4



Size (mm)	
D16	0.062
D35	1.3
D50	4.8
D65	11
D84	34
D95	110

Size Distribution	
mean	1.5
dispersion	42.3
skewness	-0.31

Type	
silt/clay	19%
sand	22%
gravel	49%
cobble	8%
boulder	2%



Bankfull Dimensions	
80.8	x-section area (ft.sq.)
35.1	width (ft)
2.3	mean depth (ft)
3.2	max depth (ft)
37.8	wetted parimeter (ft)
2.1	hyd radi (ft)
15.2	width-depth ratio

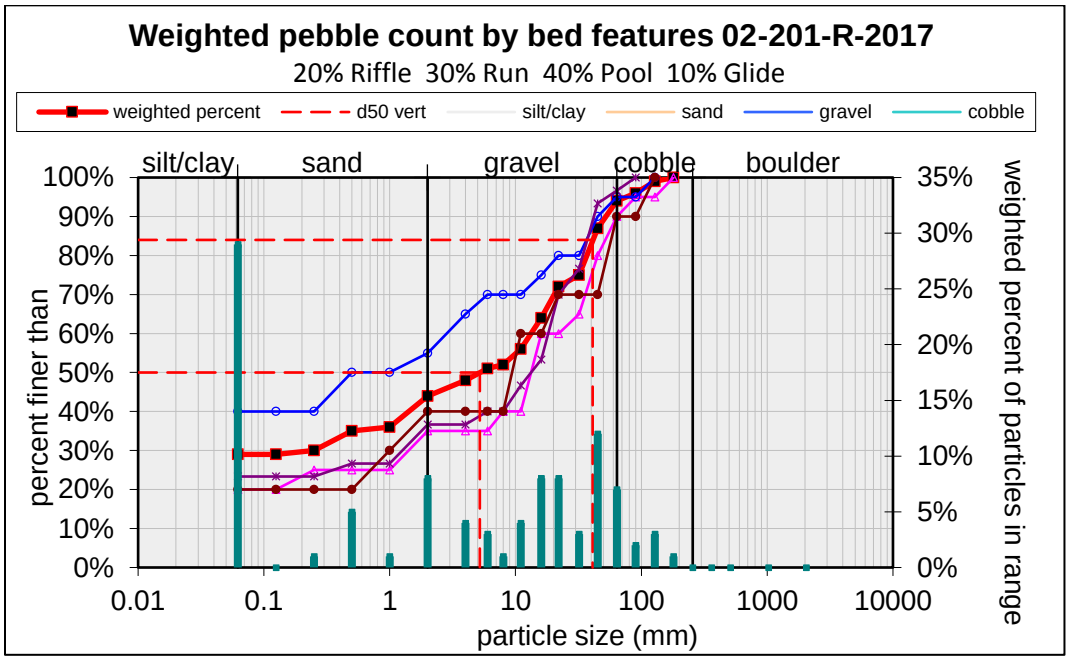
Flood Dimensions	
167.0	W flood prone area (ft)
4.8	entrenchment ratio
4.3	low bank height (ft)
1.3	low bank height ratio

Bankfull Flow	
4.4	velocity (ft/s)
352.2	discharge rate (cfs)
0.52	Froude number

Flow Resistance	
0.029	Manning's roughness

Sinuosity
1.1

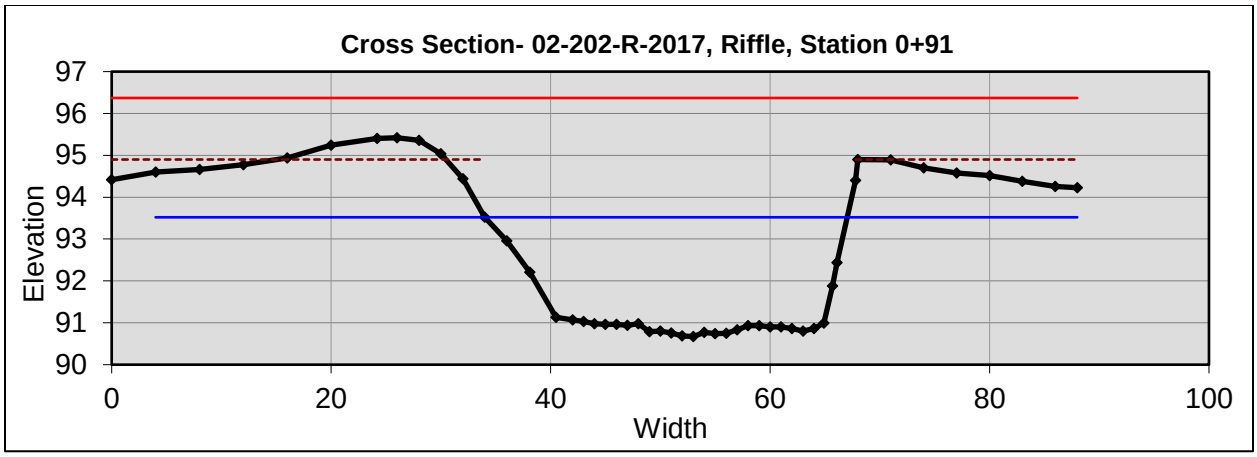
Channel Type
C4



Size (mm)	
D16	0.062
D35	0.5
D50	5.2
D65	17
D84	41
D95	76

Size Distribution	
mean	1.6
dispersion	45.9
skewness	-0.31

Type	
silt/clay	29%
sand	15%
gravel	50%
cobble	6%
boulder	0%



Bankfull Dimensions	
74.2	x-section area (ft.sq.)
33.0	width (ft)
2.2	mean depth (ft)
2.8	max depth (ft)
34.7	wetted parimeter (ft)
2.1	hyd radi (ft)
14.7	width-depth ratio

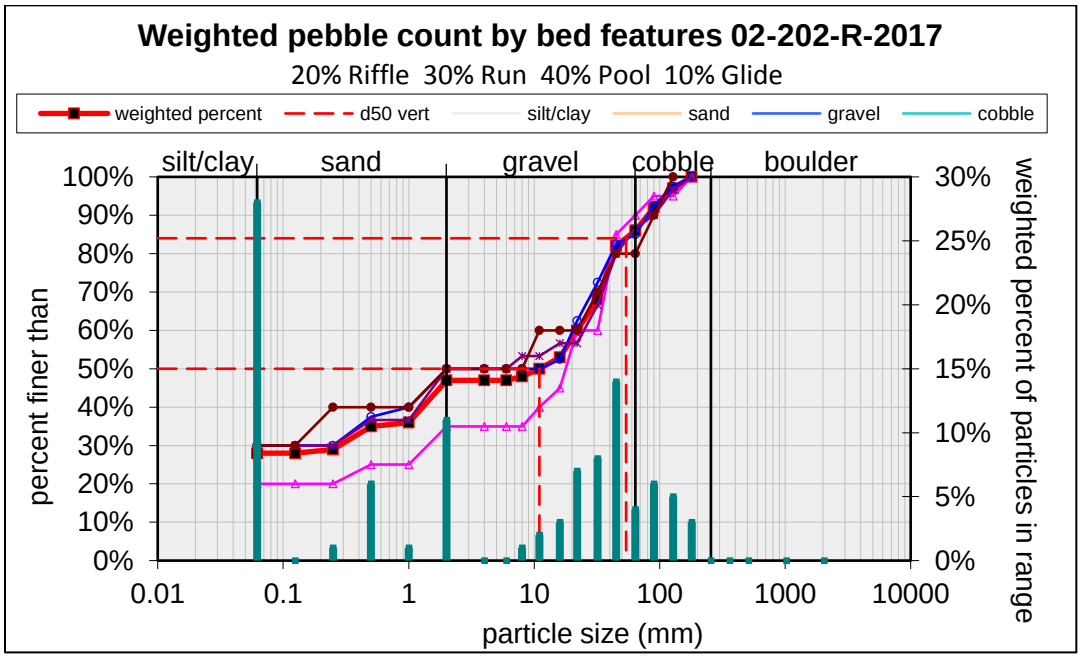
Flood Dimensions	
160.0	W flood prone area (ft)
4.8	entrenchment ratio
4.2	low bank height (ft)
1.5	low bank height ratio

Bankfull Flow	
5.0	velocity (ft/s)
367.1	discharge rate (cfs)
0.60	Froude number

Flow Resistance	
0.032	Manning's roughness

Sinuosity
1.1

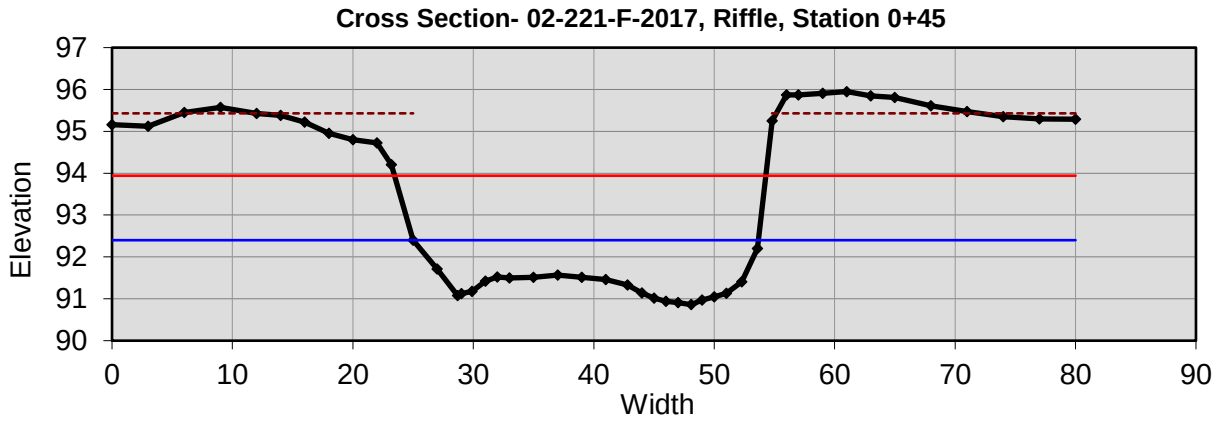
Channel Type
C4



Size (mm)	
D16	0.062
D35	0.5
D50	11
D65	28
D84	54
D95	110

Size Distribution	
mean	1.8
dispersion	91.2
skewness	-0.45

Type	
silt/clay	28%
sand	19%
gravel	39%
cobble	14%
boulder	0%



Bankfull Dimensions	
29.4	x-section area (ft.sq.)
28.7	width (ft)
1.0	mean depth (ft)
1.5	max depth (ft)
29.4	wetted parimeter (ft)
1.0	hyd radi (ft)
28.0	width-depth ratio

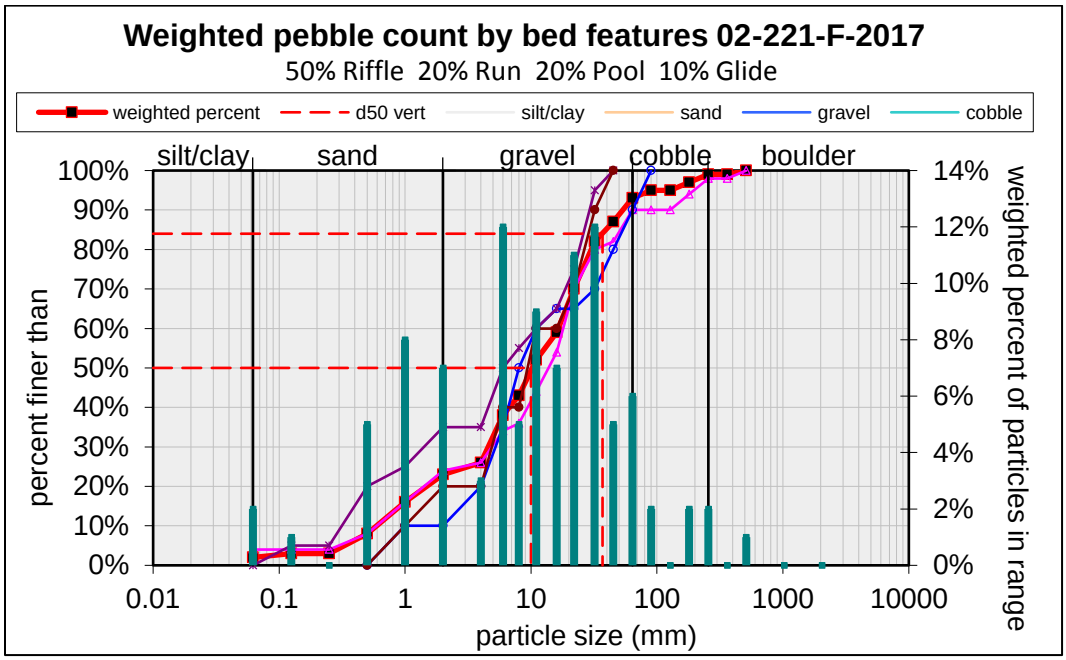
Flood Dimensions	
28.9	W flood prone area (ft)
1.0	entrenchment ratio
4.6	low bank height (ft)
3.0	low bank height ratio

Bankfull Flow	
5.1	velocity (ft/s)
148.4	discharge rate (cfs)
0.89	Froude number

Flow Resistance	
0.031	Manning's roughness

Sinuosity
1.7

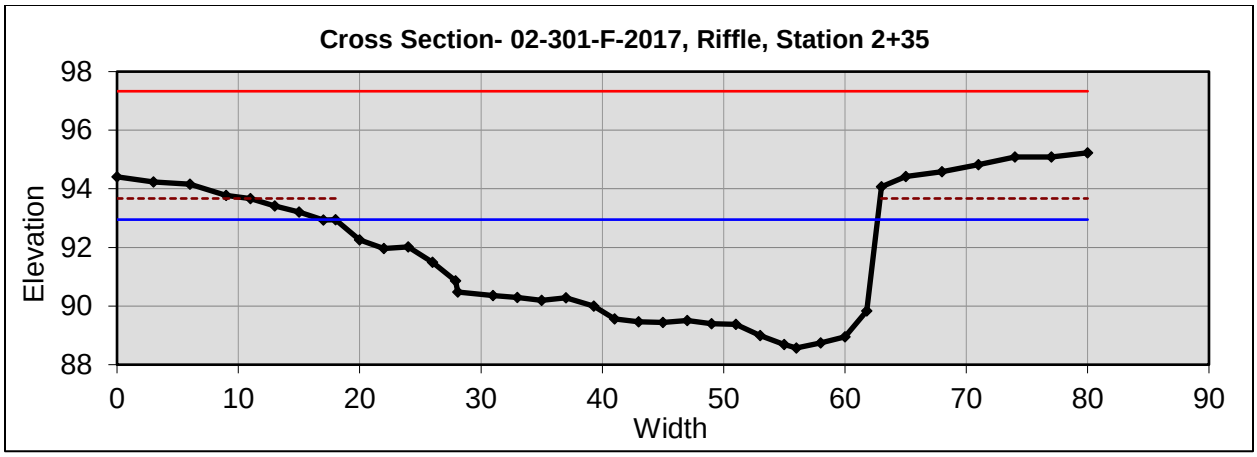
Channel Type
F4



Size (mm)	
D16	1
D35	5.4
D50	10
D65	19
D84	37
D95	130

Size Distribution	
mean	6.1
dispersion	6.9
skewness	-0.17

Type	
silt/clay	2%
sand	21%
gravel	70%
cobble	6%
boulder	1%



Bankfull Dimensions	
114.0	x-section area (ft.sq.)
37.6	width (ft)
3.0	mean depth (ft)
4.4	max depth (ft)
40.6	wetted parimeter (ft)
2.8	hyd radi (ft)
12.4	width-depth ratio

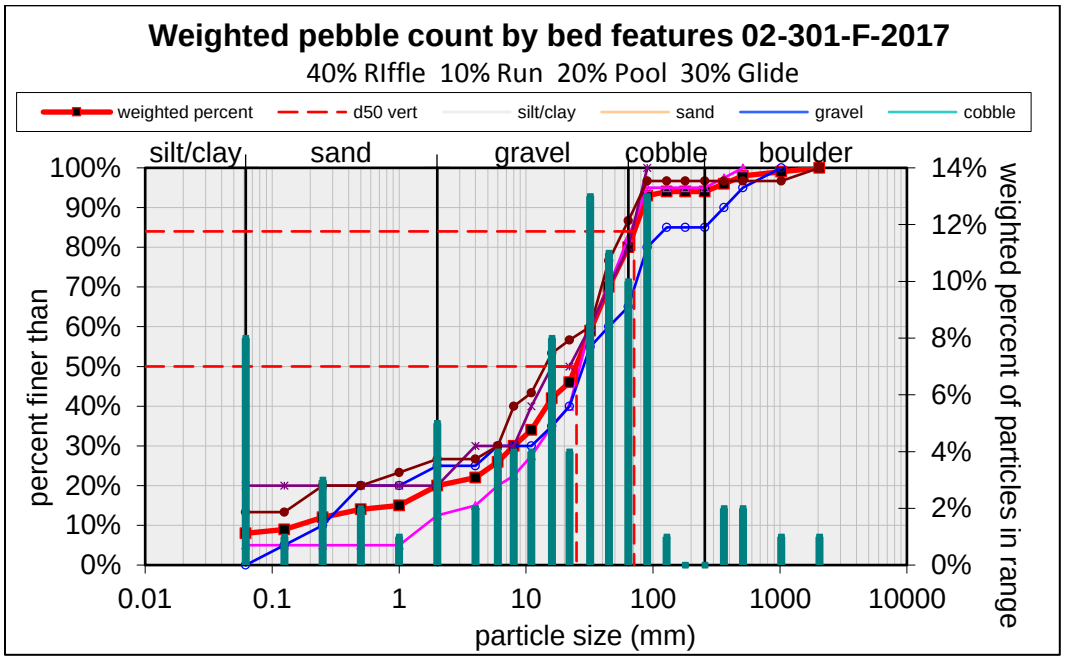
Flood Dimensions	
163.0	W flood prone area (ft)
4.3	entrenchment ratio
5.1	low bank height (ft)
1.2	low bank height ratio

Bankfull Flow	
4.0	velocity (ft/s)
457.6	discharge rate (cfs)
0.42	Froude number

Flow Resistance	
0.033	Manning's roughness

Sinuosity
1.0

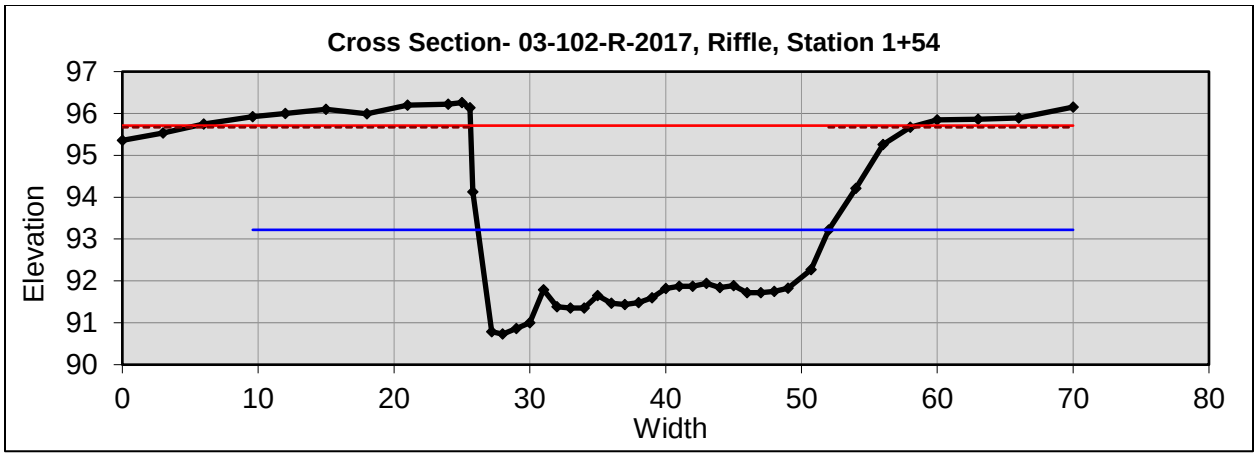
Channel Type
C4



Size (mm)	
D16	1.1
D35	12
D50	25
D65	39
D84	71
D95	300

Size Distribution	
mean	8.8
dispersion	12.8
skewness	-0.34

Type	
silt/clay	8%
sand	12%
gravel	60%
cobble	14%
boulder	6%



Bankfull Dimensions	
40.4	x-section area (ft.sq.)
25.8	width (ft)
1.6	mean depth (ft)
2.5	max depth (ft)
28.3	wetted parimeter (ft)
1.4	hyd radi (ft)
16.5	width-depth ratio

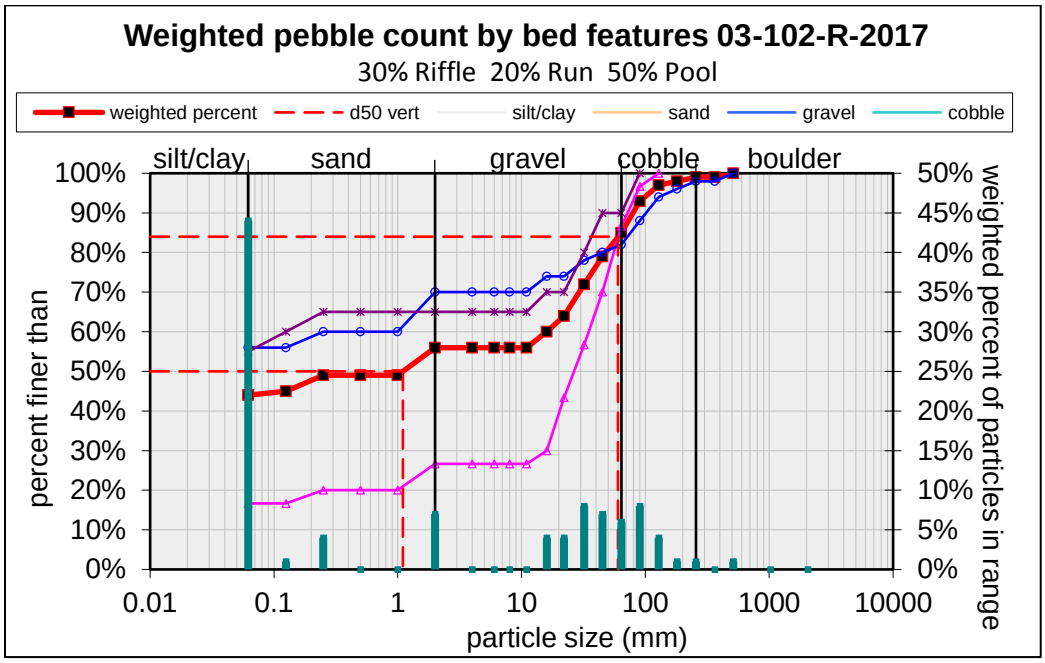
Flood Dimensions	
27.3	W flood prone area (ft)
1.1	entrenchment ratio
4.9	low bank height (ft)
2.0	low bank height ratio

Bankfull Flow	
4.1	velocity (ft/s)
166.1	discharge rate (cfs)
0.61	Froude number

Flow Resistance	
0.034	Manning's roughness

Sinuosity
1.1

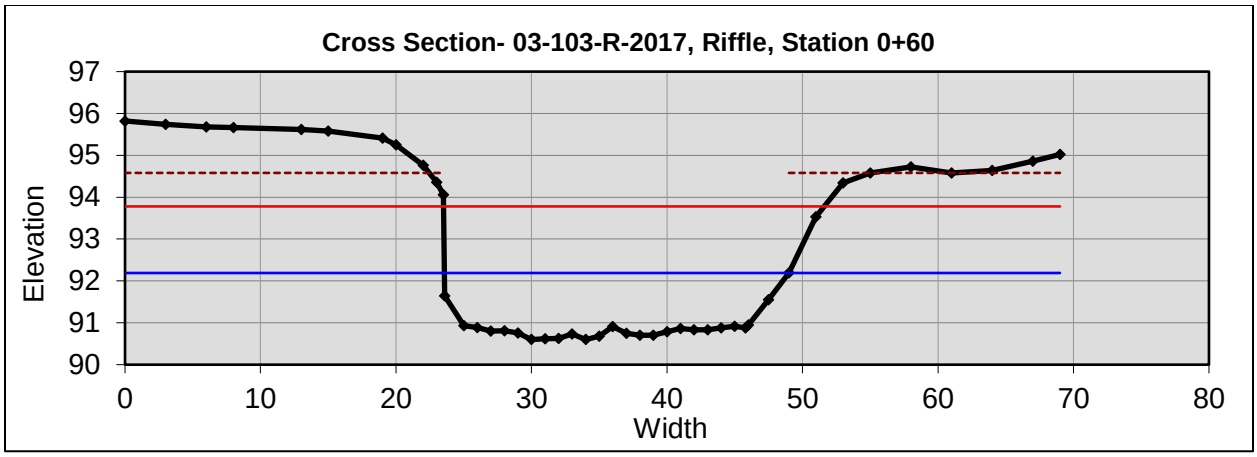
Channel Type
F4/6



Size (mm)	
D16	0.062
D35	0.062
D50	1.1
D65	23
D84	60
D95	110

Size Distribution	
mean	1.9
dispersion	36.1
skewness	0.14

Type	
silt/clay	44%
sand	12%
gravel	29%
cobble	14%
boulder	1%



Bankfull Dimensions	
33.0	x-section area (ft.sq.)
25.4	width (ft)
1.3	mean depth (ft)
1.6	max depth (ft)
26.5	wetted parimeter (ft)
1.2	hyd radi (ft)
19.6	width-depth ratio

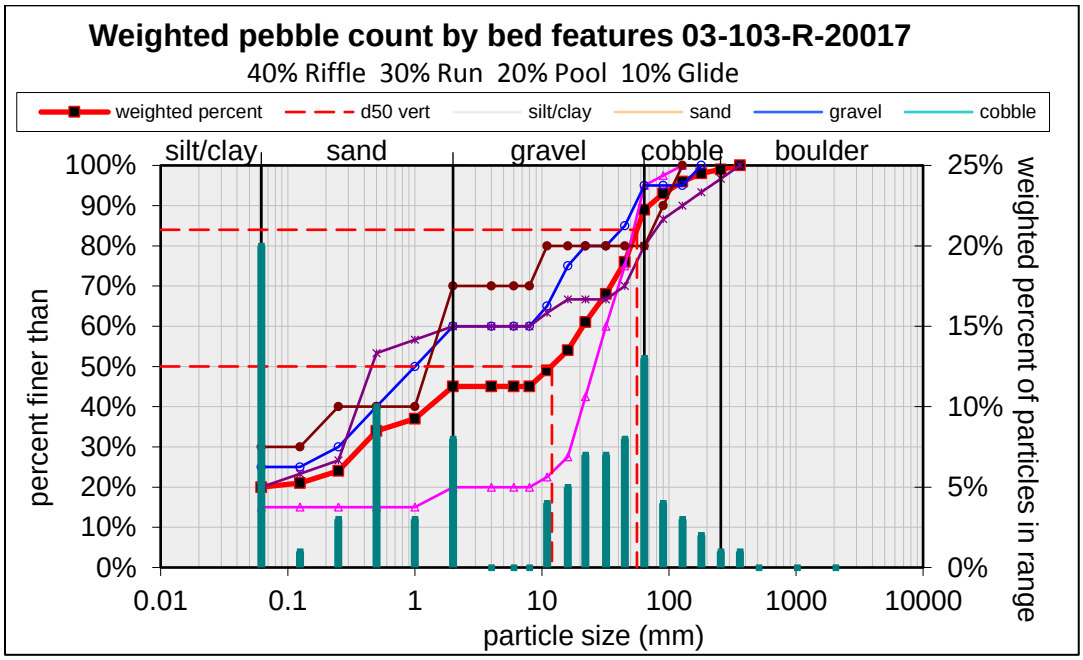
Flood Dimensions	
25.9	W flood prone area (ft)
1.0	entrenchment ratio
4.0	low bank height (ft)
2.5	low bank height ratio

Bankfull Flow	
4.6	velocity (ft/s)
152.0	discharge rate (cfs)
0.73	Froude number

Flow Resistance	
0.035	Manning's roughness

Sinuosity
1.2

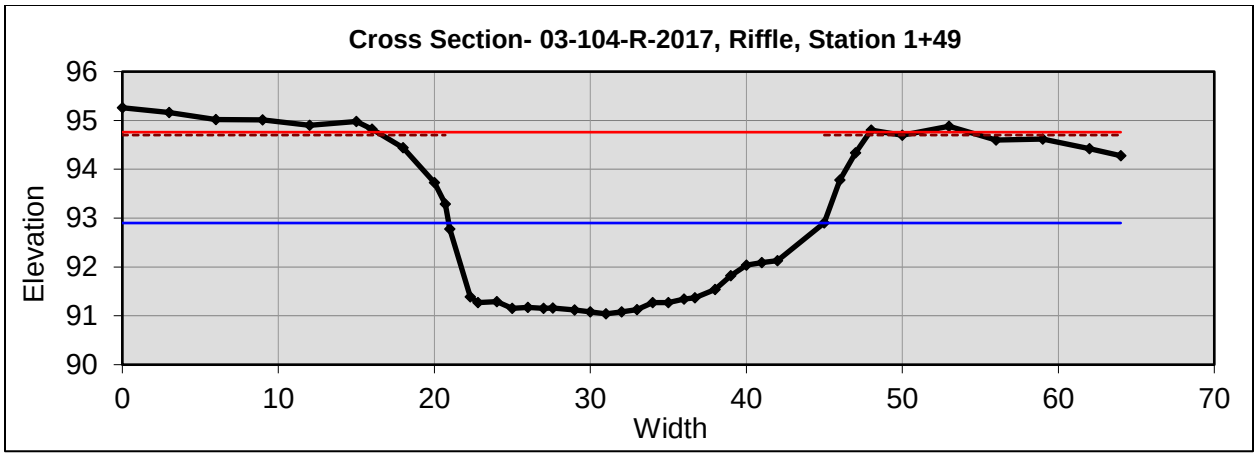
Channel Type
F4/5



Size (mm)	
D16	0.062
D35	0.63
D50	12
D65	27
D84	56
D95	110

Size Distribution	
mean	1.9
dispersion	99.1
skewness	-0.47

Type	
silt/clay	20%
sand	25%
gravel	44%
cobble	10%
boulder	1%



Bankfull Dimensions	
32.6	x-section area (ft.sq.)
24.1	width (ft)
1.4	mean depth (ft)
1.9	max depth (ft)
25.0	wetted parimeter (ft)
1.3	hyd radi (ft)
17.8	width-depth ratio

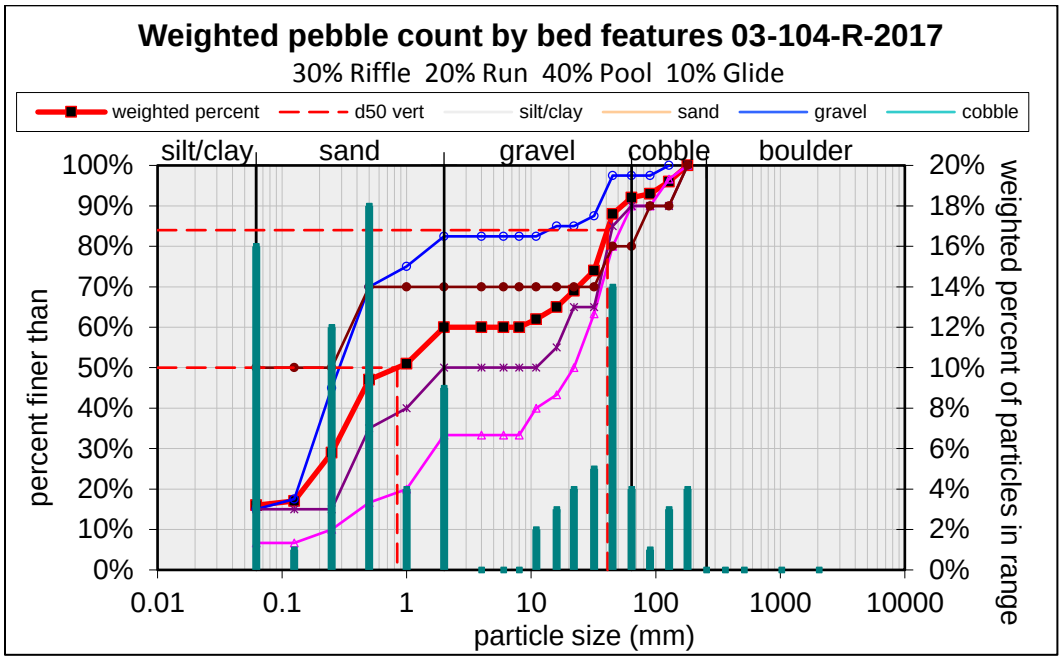
Flood Dimensions	
24.6	W flood prone area (ft)
1.0	entrenchment ratio
3.7	low bank height (ft)
2.0	low bank height ratio

Bankfull Flow	
5.2	velocity (ft/s)
170.1	discharge rate (cfs)
0.80	Froude number

Flow Resistance	
0.031	Manning's roughness

Sinuosity
1.4

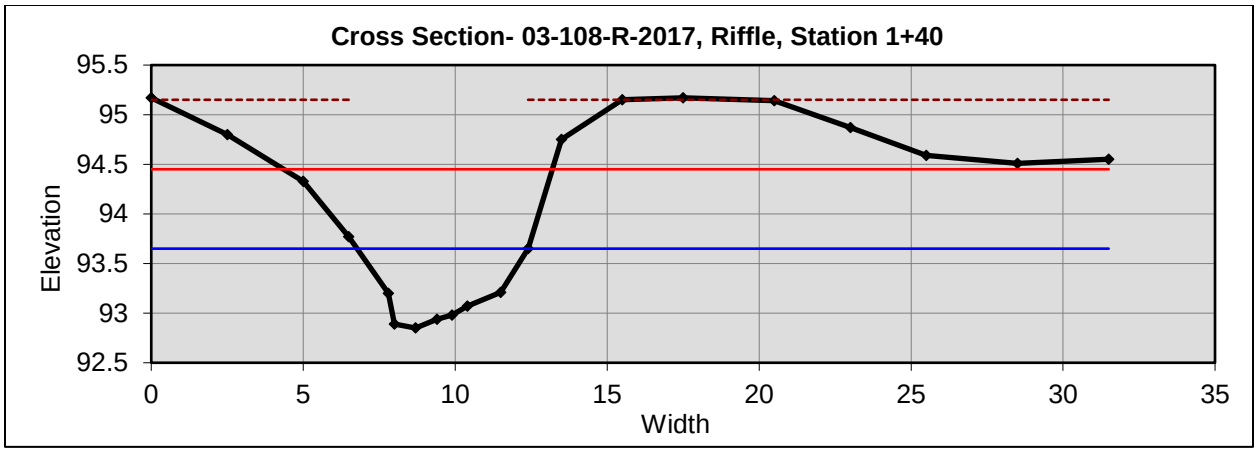
Channel Type
F4/5



Size (mm)	
D16	0.062
D35	0.31
D50	0.84
D65	16
D84	41
D95	110

Size Distribution	
mean	1.6
dispersion	31.2
skewness	0.17

Type	
silt/clay	16%
sand	44%
gravel	32%
cobble	8%
boulder	0%



Bankfull Dimensions	
2.8	x-section area (ft.sq.)
5.6	width (ft)
0.5	mean depth (ft)
0.8	max depth (ft)
6.0	wetted parimeter (ft)
0.5	hyd radi (ft)
11.1	width-depth ratio

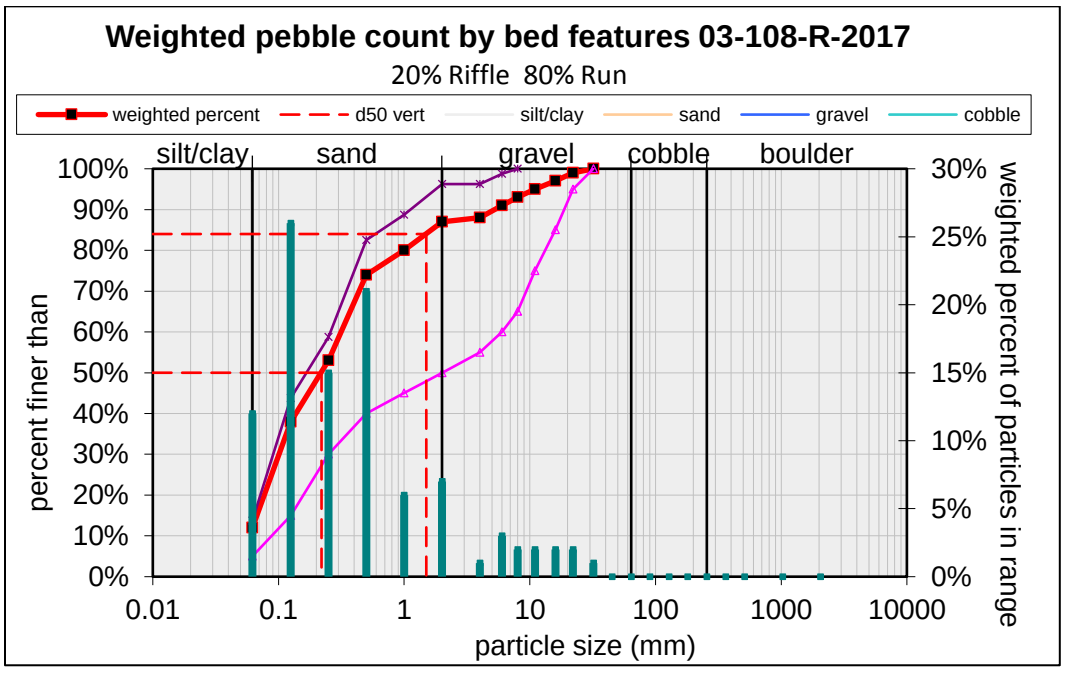
Flood Dimensions	
8.8	W flood prone area (ft)
1.6	entrenchment ratio
2.3	low bank height (ft)
2.9	low bank height ratio

Bankfull Flow	
5.4	velocity (ft/s)
15.5	discharge rate (cfs)
1.39	Froude number

Flow Resistance	
0.016	Manning's roughness

Sinuosity
1.1

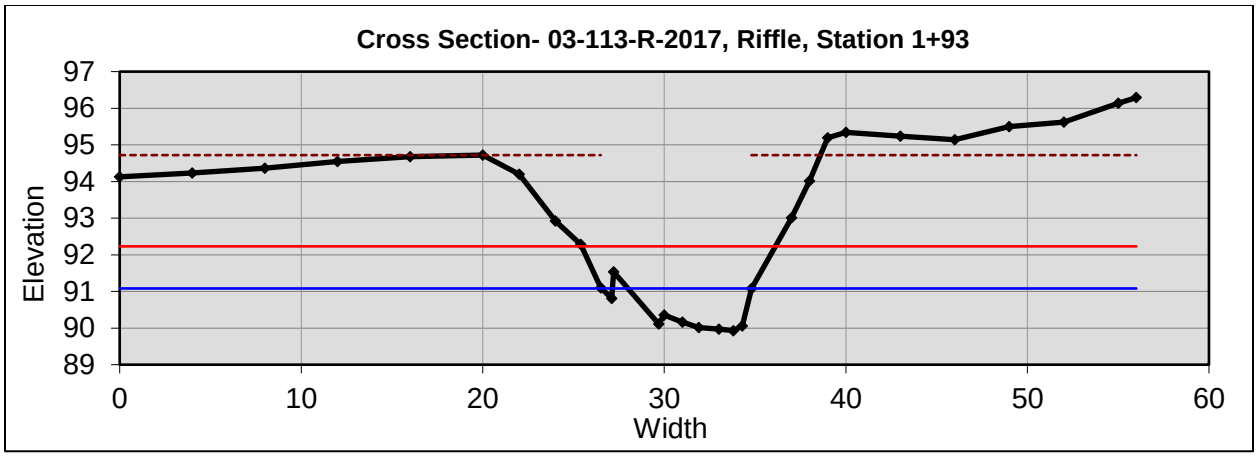
Channel Type
B5c



Size (mm)	
D16	0.069
D35	0.12
D50	0.22
D65	0.37
D84	1.5
D95	11

Size Distribution	
mean	0.3
dispersion	5.0
skewness	0.14

Type	
silt/clay	12%
sand	75%
gravel	13%
cobble	0%
boulder	0%



Bankfull Dimensions	
5.8	x-section area (ft.sq.)
7.4	width (ft)
0.8	mean depth (ft)
1.1	max depth (ft)
8.7	wetted parimeter (ft)
0.7	hyd radi (ft)
9.5	width-depth ratio

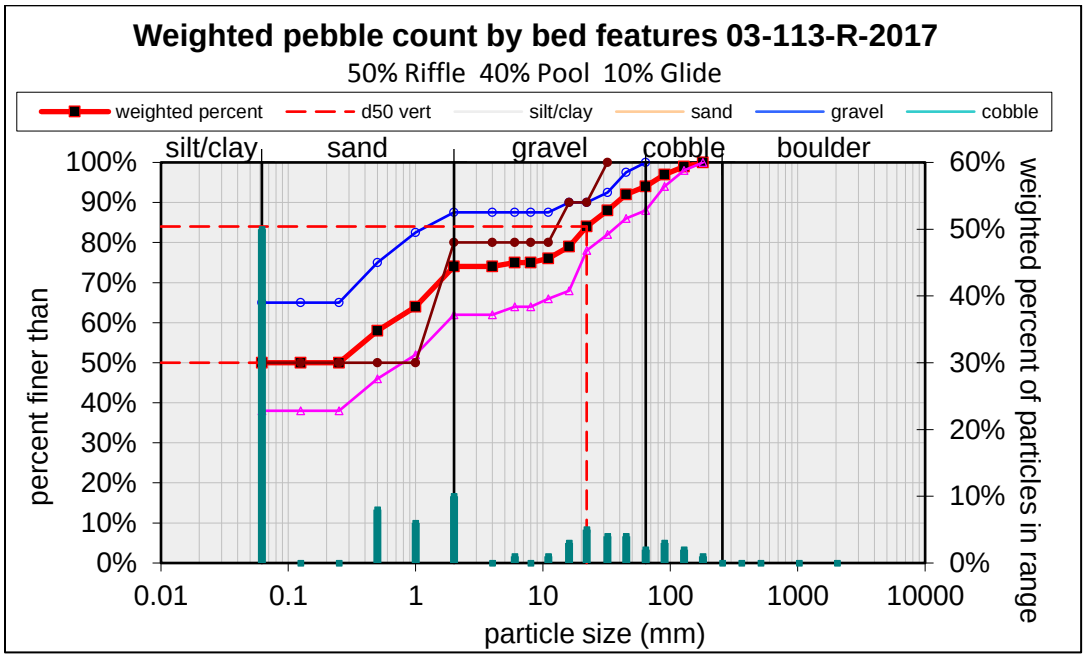
Flood Dimensions	
10.7	W flood prone area (ft)
1.4	entrenchment ratio
4.8	low bank height (ft)
4.2	low bank height ratio

Bankfull Flow	
6.4	velocity (ft/s)
36.9	discharge rate (cfs)
1.38	Froude number

Flow Resistance	
0.028	Manning's roughness

Sinuosity
1.1

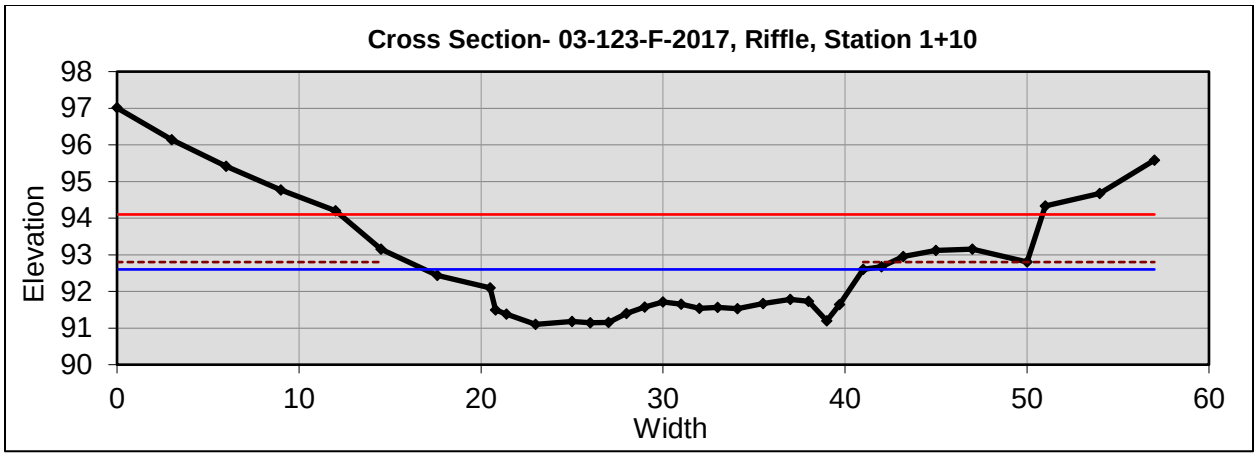
Channel Type
G6



Size (mm)	
D16	0.062
D35	0.062
D50	0.062
D65	1.1
D84	22
D95	72

Size Distribution	
mean	1.2
dispersion	177.9
skewness	0.80

Type	
silt/clay	50%
sand	24%
gravel	20%
cobble	6%
boulder	0%



Bankfull Dimensions	
21.7	x-section area (ft.sq.)
22.1	width (ft)
1.0	mean depth (ft)
1.5	max depth (ft)
23.2	wetted parimeter (ft)
0.9	hyd radi (ft)
22.5	width-depth ratio

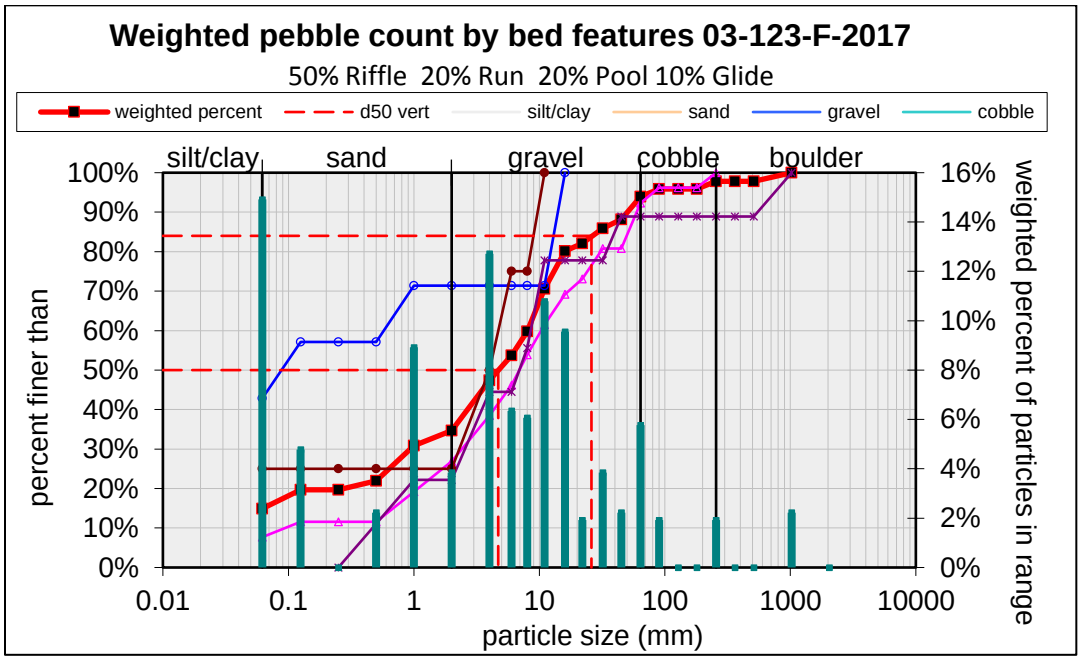
Flood Dimensions	
38.6	W flood prone area (ft)
1.7	entrenchment ratio
1.7	low bank height (ft)
1.1	low bank height ratio

Bankfull Flow	
9.4	velocity (ft/s)
204.1	discharge rate (cfs)
1.71	Froude number

Flow Resistance	
0.029	Manning's roughness

Sinuosity
1.2

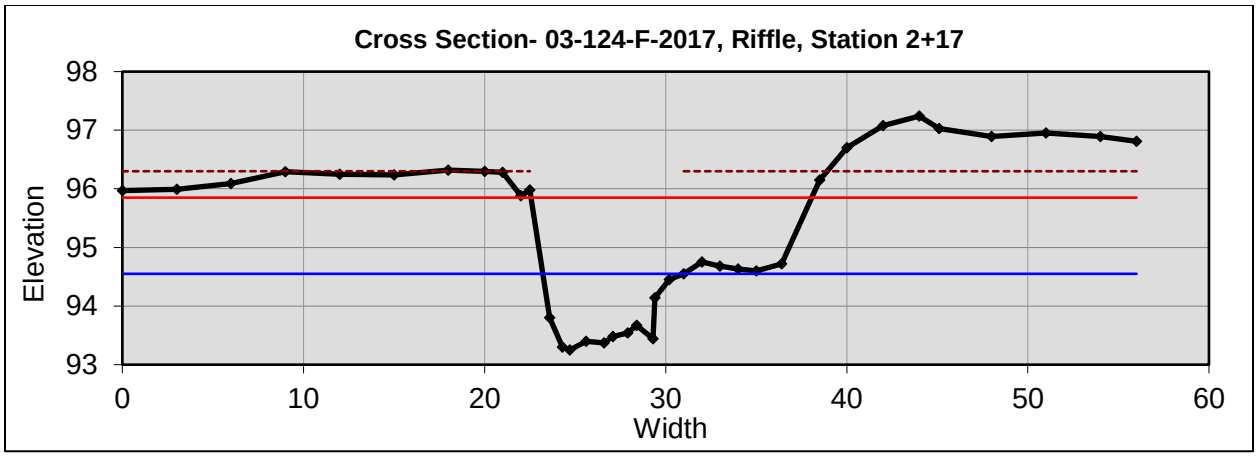
Channel Type
B1



Size (mm)	
D16	0.073
D35	2
D50	4.7
D65	9.3
D84	26
D95	77

Size Distribution	
mean	1.4
dispersion	35.0
skewness	-0.33

Type			
silt/clay	9%	bedrock	38%
sand	12%		
gravel	37%		
cobble	2%		
boulder	1%		



Bankfull Dimensions	
6.7	x-section area (ft.sq.)
7.8	width (ft)
0.9	mean depth (ft)
1.3	max depth (ft)
9.1	wetted parimeter (ft)
0.7	hyd radi (ft)
9.0	width-depth ratio

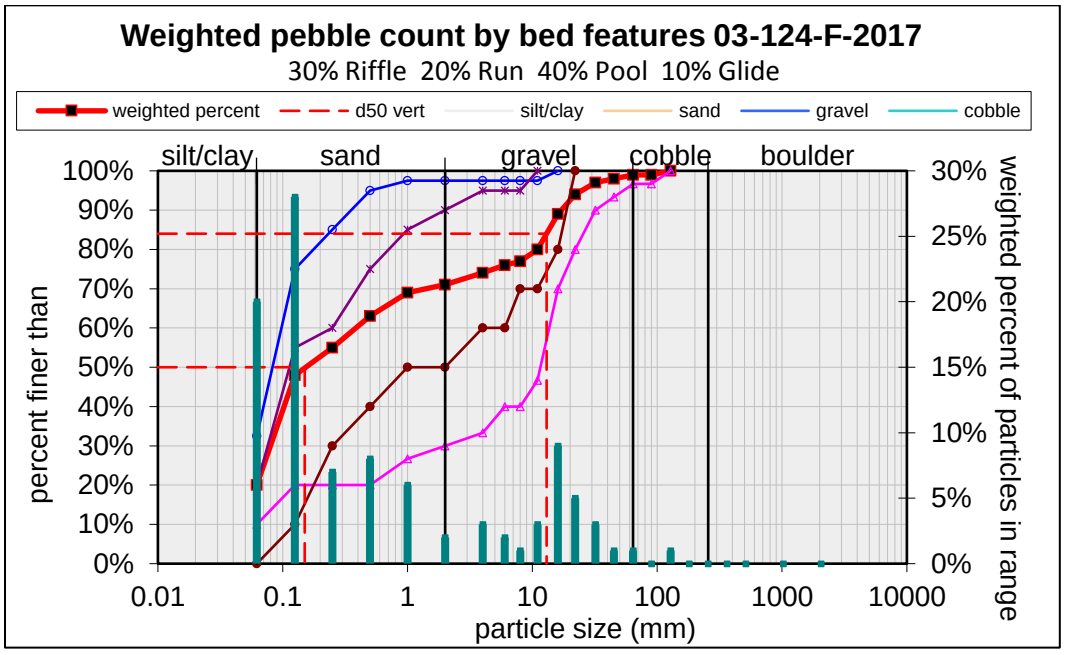
Flood Dimensions	
15.5	W flood prone area (ft)
2.0	entrenchment ratio
3.1	low bank height (ft)
2.3	low bank height ratio

Bankfull Flow	
7.0	velocity (ft/s)
46.8	discharge rate (cfs)
1.44	Froude number

Flow Resistance	
0.024	Manning's roughness

Sinuosity
1.1

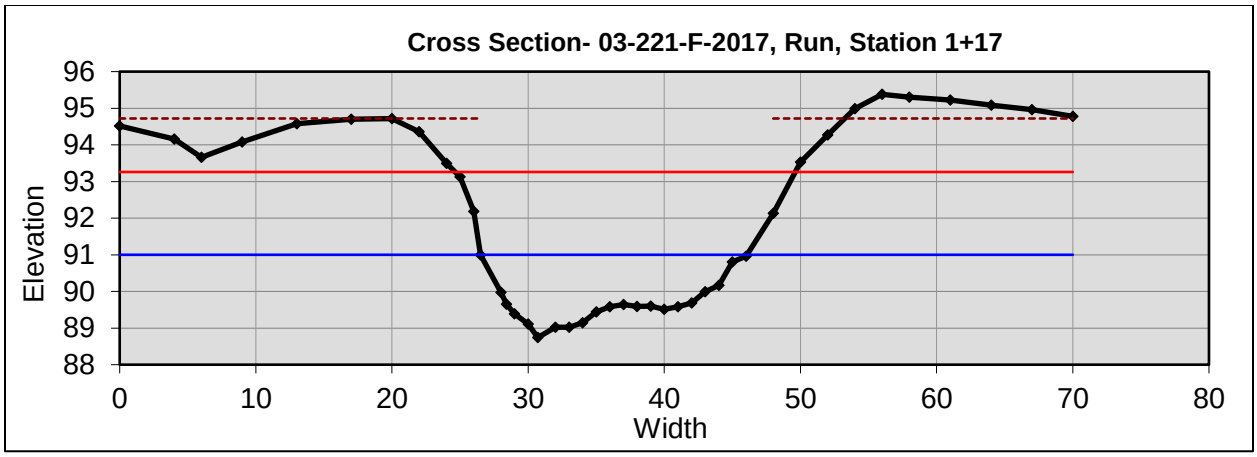
Channel Type
B5/4c



Size (mm)	
D16	0.062
D35	0.09
D50	0.15
D65	0.63
D84	13
D95	25

Size Distribution	
mean	0.9
dispersion	44.5
skewness	0.51

Type	
silt/clay	20%
sand	51%
gravel	28%
cobble	1%
boulder	0%



Bankfull Dimensions	
26.4	x-section area (ft.sq.)
19.6	width (ft)
1.3	mean depth (ft)
2.3	max depth (ft)
20.6	wetted parimeter (ft)
1.3	hyd radi (ft)
14.5	width-depth ratio

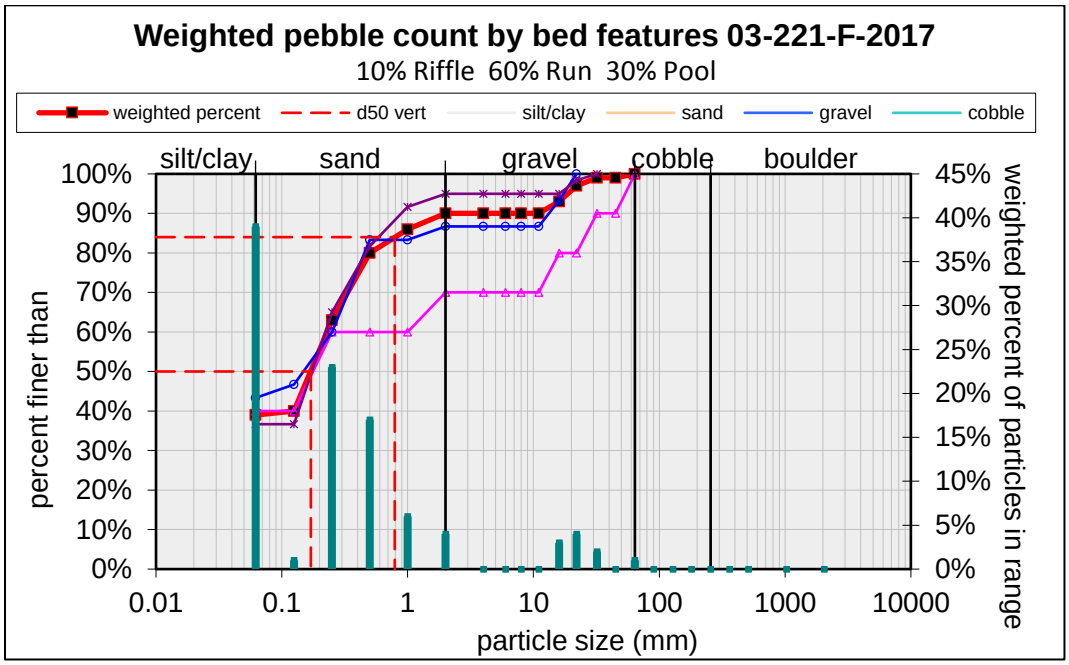
Flood Dimensions	
25.0	W flood prone area (ft)
1.3	entrenchment ratio
6.0	low bank height (ft)
2.6	low bank height ratio

Bankfull Flow	
8.1	velocity (ft/s)
213.8	discharge rate (cfs)
1.26	Froude number

Flow Resistance	
0.015	Manning's roughness

Sinuosity
1.0

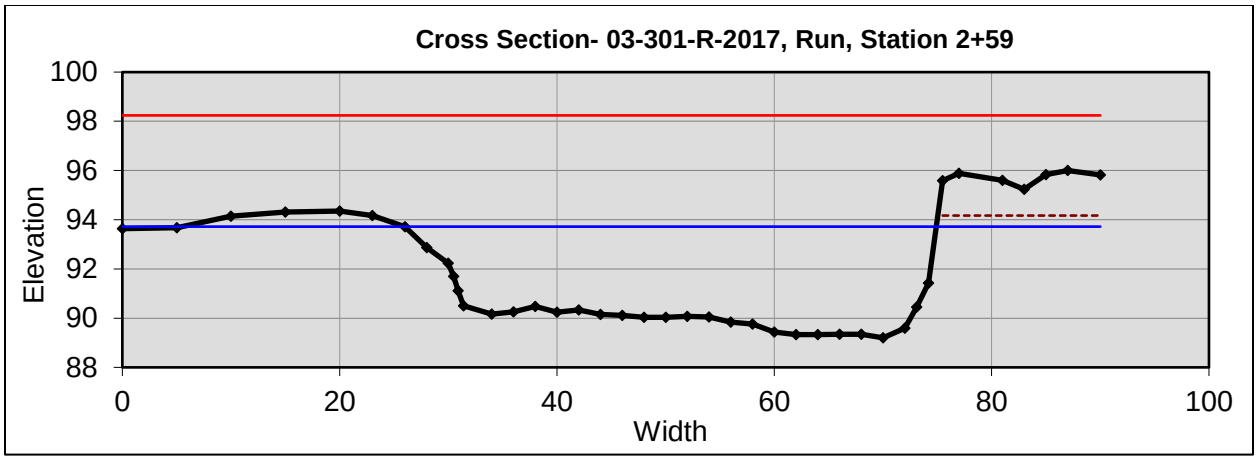
Channel Type
F5/6



Size (mm)	
D16	0.062
D35	0.062
D50	0.17
D65	0.27
D84	0.79
D95	19

Size Distribution	
mean	0.2
dispersion	3.7
skewness	0.11

Type	
silt/clay	39%
sand	51%
gravel	10%
cobble	0%
boulder	0%



Bankfull Dimensions	
170.5	x-section area (ft.sq.)
54.4	width (ft)
3.1	mean depth (ft)
4.5	max depth (ft)
58.0	wetted parimeter (ft)
2.9	hyd radi (ft)
17.4	width-depth ratio

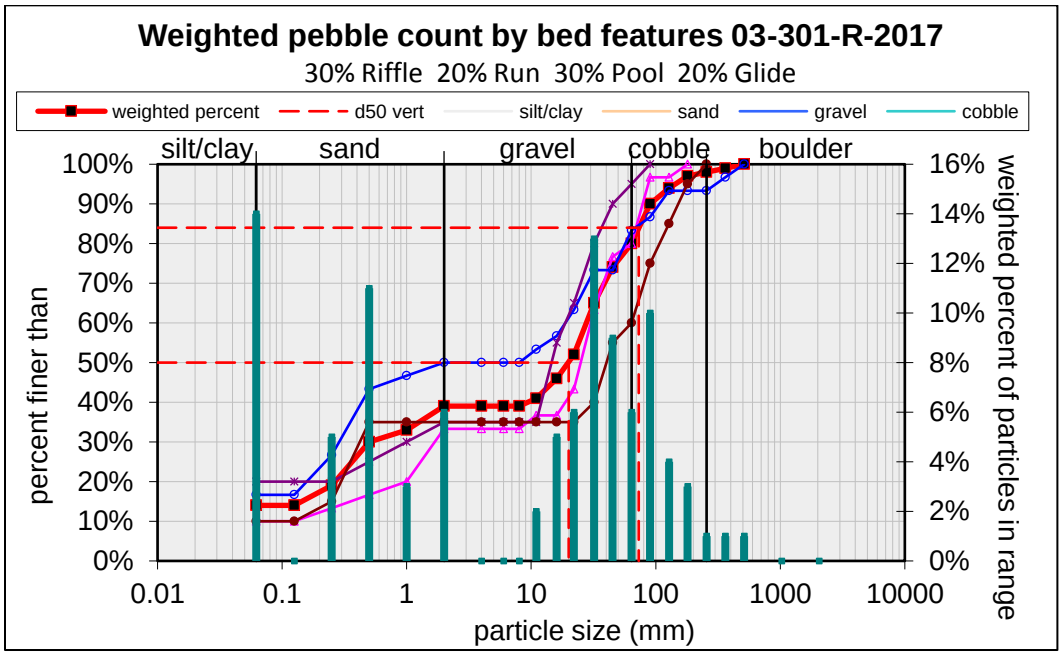
Flood Dimensions	
285.0	W flood prone area (ft)
5.2	entrenchment ratio
5.0	low bank height (ft)
1.1	low bank height ratio

Bankfull Flow	
5.5	velocity (ft/s)
942.5	discharge rate (cfs)
0.57	Froude number

Flow Resistance	
0.033	Manning's roughness

Sinuosity
2.0

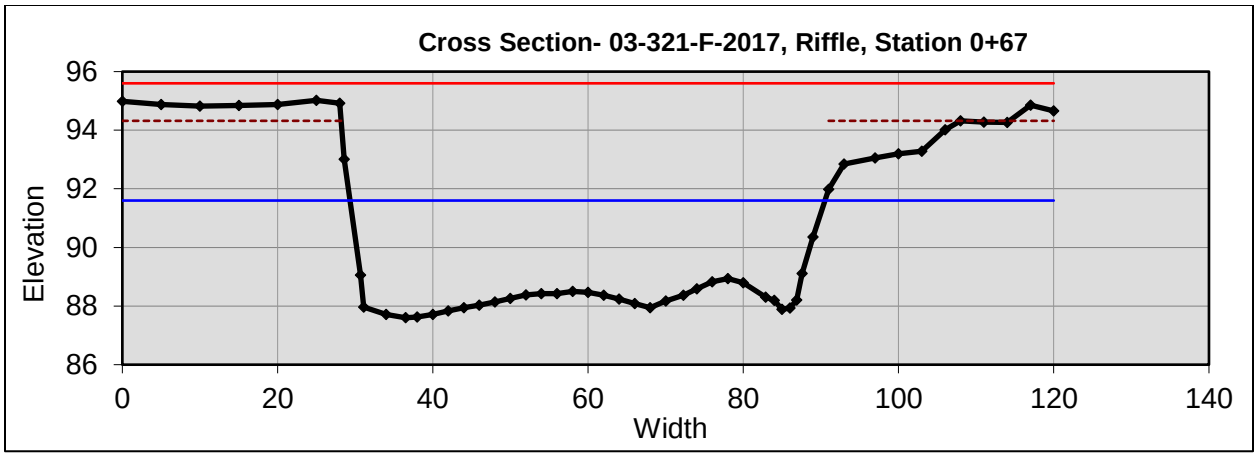
Channel Type
C4



Size (mm)	
D16	0.16
D35	1.3
D50	20
D65	32
D84	73
D95	140

Size Distribution	
mean	3.4
dispersion	64.3
skewness	-0.47

Type	
silt/clay	14%
sand	25%
gravel	41%
cobble	18%
boulder	2%



Bankfull Dimensions	
197.8	x-section area (ft.sq.)
61.2	width (ft)
3.2	mean depth (ft)
4.0	max depth (ft)
65.1	wetted parimeter (ft)
3.0	hyd radi (ft)
18.9	width-depth ratio

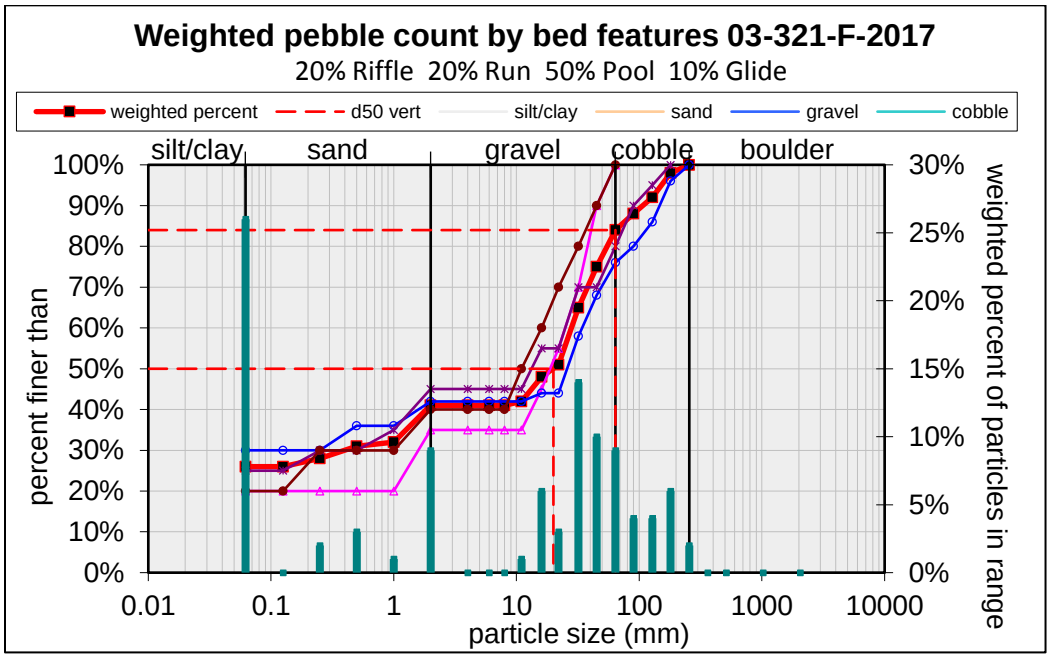
Flood Dimensions	
259.5	W flood prone area (ft)
4.2	entrenchment ratio
6.7	low bank height (ft)
1.7	low bank height ratio

Bankfull Flow	
3.3	velocity (ft/s)
662.2	discharge rate (cfs)
0.34	Froude number

Flow Resistance	
0.032	Manning's roughness

Sinuosity
1.1

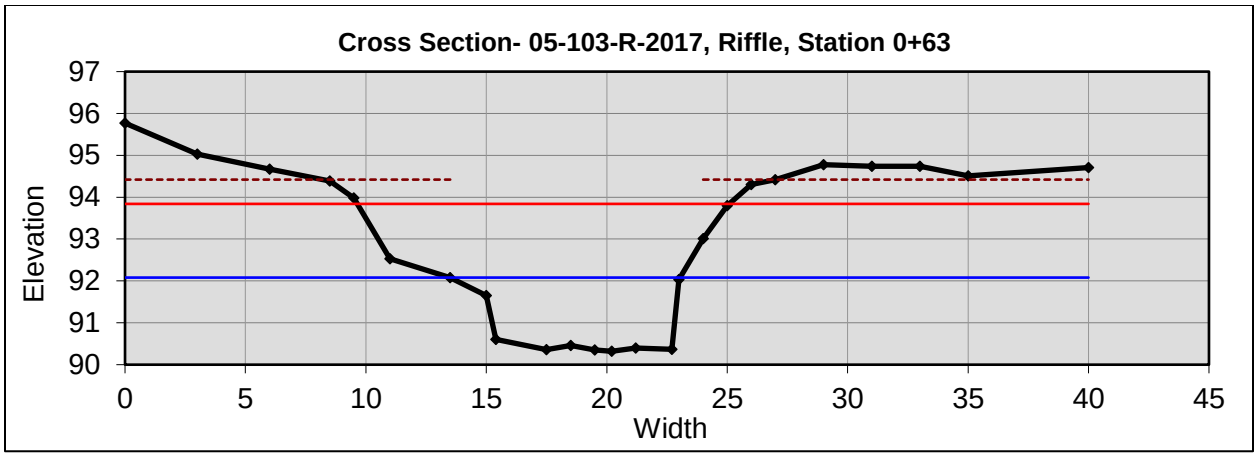
Channel Type
C4



Size (mm)	
D16	0.062
D35	1.3
D50	20
D65	32
D84	64
D95	150

Size Distribution	
mean	2.0
dispersion	162.9
skewness	-0.58

Type	
silt/clay	26%
sand	15%
gravel	43%
cobble	16%
boulder	0%



Bankfull Dimensions	
13.2	x-section area (ft.sq.)
9.6	width (ft)
1.4	mean depth (ft)
1.8	max depth (ft)
11.8	wetted parimeter (ft)
1.1	hyd radi (ft)
6.9	width-depth ratio

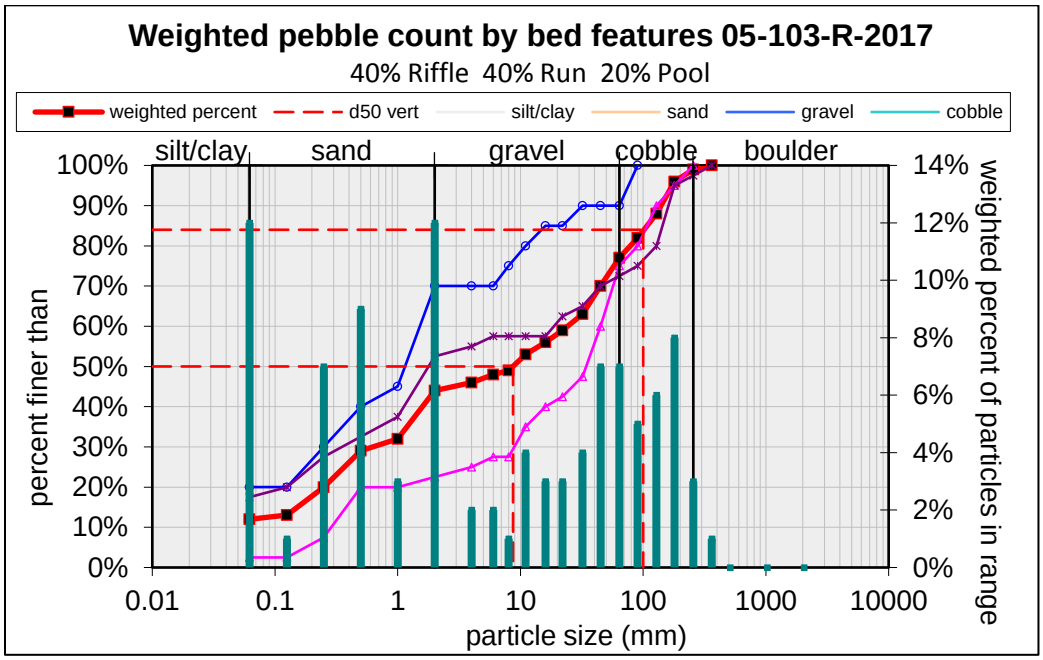
Flood Dimensions	
13.4	W flood prone area (ft)
1.4	entrenchment ratio
4.1	low bank height (ft)
2.3	low bank height ratio

Bankfull Flow	
5.5	velocity (ft/s)
72.1	discharge rate (cfs)
0.91	Froude number

Flow Resistance	
0.042	Manning's roughness

Sinuosity
1.1

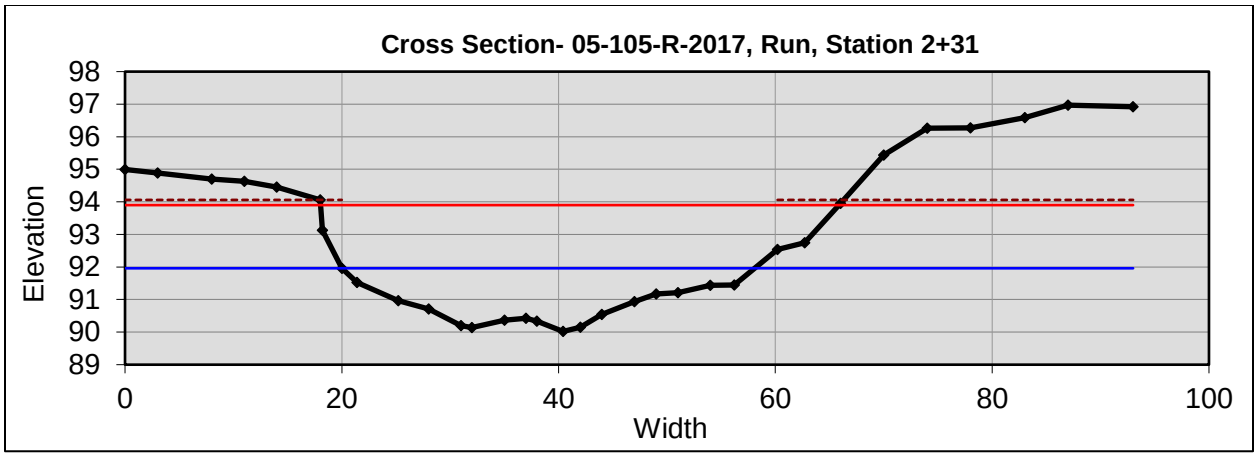
Channel Type
G4/5



Size (mm)	
D16	0.17
D35	1.2
D50	8.7
D65	35
D84	100
D95	170

Size Distribution	
mean	4.1
dispersion	31.3
skewness	-0.19

Type	
silt/clay	12%
sand	32%
gravel	33%
cobble	22%
boulder	1%



Bankfull Dimensions	
43.3	x-section area (ft.sq.)
38.1	width (ft)
1.1	mean depth (ft)
1.9	max depth (ft)
38.4	wetted parimeter (ft)
1.1	hyd radi (ft)
33.5	width-depth ratio

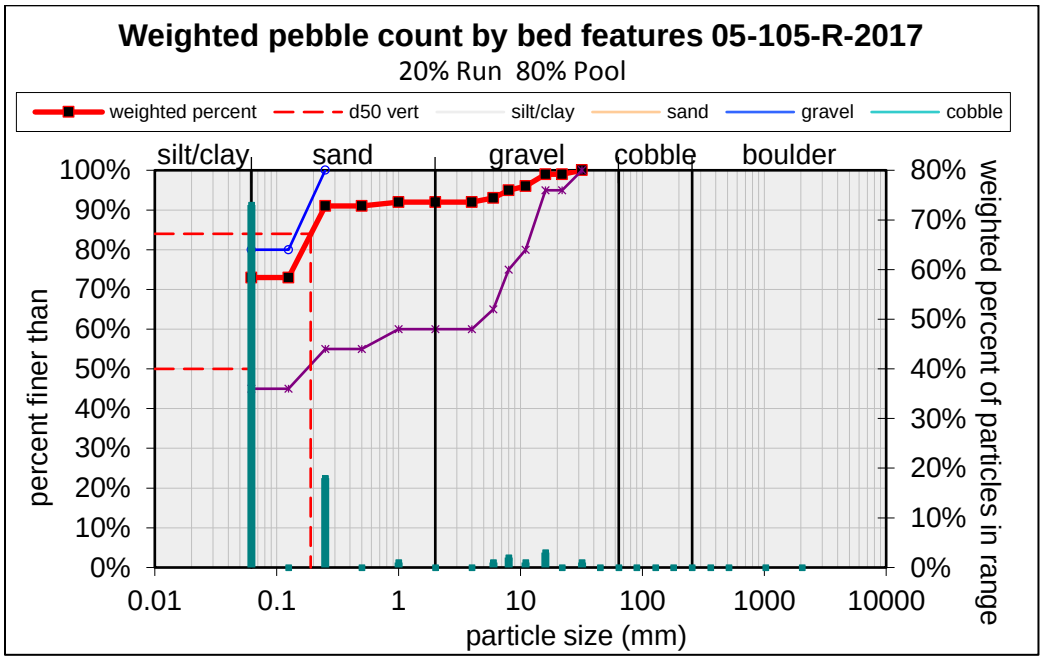
Flood Dimensions	
47.8	W flood prone area (ft)
1.3	entrenchment ratio
4.0	low bank height (ft)
2.1	low bank height ratio

Bankfull Flow	
1.9	velocity (ft/s)
83.3	discharge rate (cfs)
0.32	Froude number

Flow Resistance	
0.012	Manning's roughness

Sinuosity
1.2

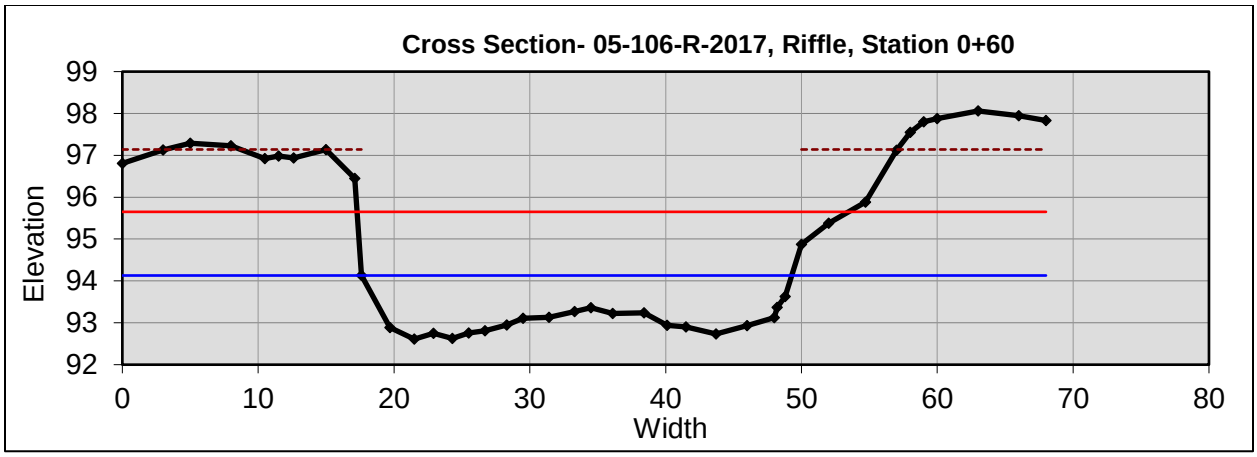
Channel Type
F6



Size (mm)	
D16	0.062
D35	0.062
D50	0.062
D65	0.062
D84	0.19
D95	8

Size Distribution	
mean	0.1
dispersion	2.0
skewness	0.35

Type	
silt/clay	73%
sand	19%
gravel	8%
cobble	0%
boulder	0%



Bankfull Dimensions	
34.8	x-section area (ft.sq.)
31.7	width (ft)
1.1	mean depth (ft)
1.5	max depth (ft)
32.5	wetted parimeter (ft)
1.1	hyd radi (ft)
28.8	width-depth ratio

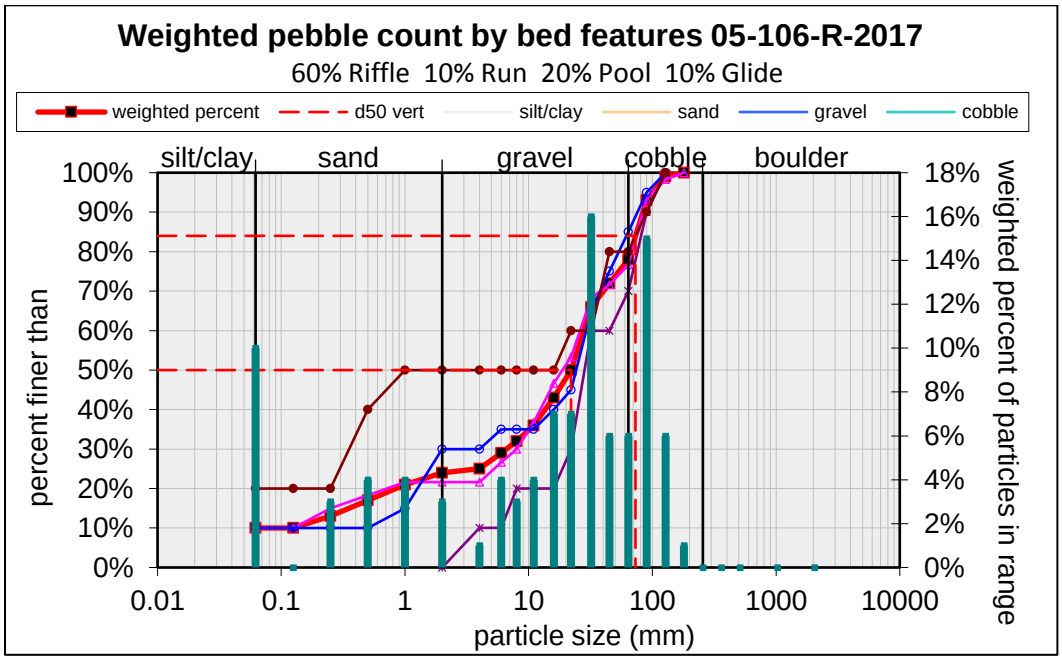
Flood Dimensions	
51.1	W flood prone area (ft)
1.6	entrenchment ratio
4.5	low bank height (ft)
3.0	low bank height ratio

Bankfull Flow	
4.2	velocity (ft/s)
147.7	discharge rate (cfs)
0.72	Froude number

Flow Resistance	
0.039	Manning's roughness

Sinuosity
1.3

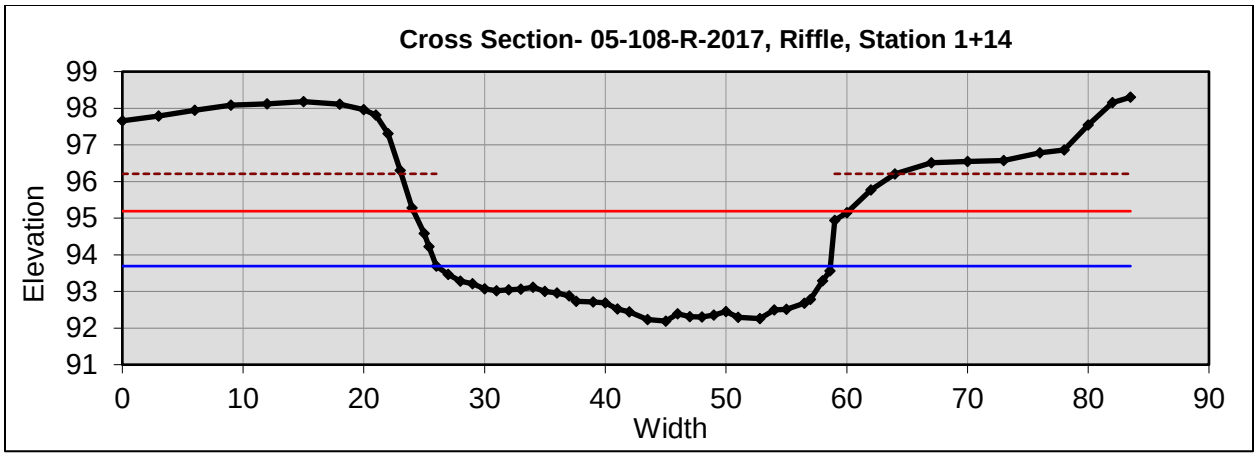
Channel Type
F4



Size (mm)	
D16	0.42
D35	10
D50	22
D65	31
D84	73
D95	100

Size Distribution	
mean	5.5
dispersion	27.8
skewness	-0.40

Type	
silt/clay	10%
sand	14%
gravel	54%
cobble	22%
boulder	0%



Bankfull Dimensions	
31.9	x-section area (ft.sq.)
32.6	width (ft)
1.0	mean depth (ft)
1.5	max depth (ft)
33.1	wetted parimeter (ft)
1.0	hyd radi (ft)
33.4	width-depth ratio

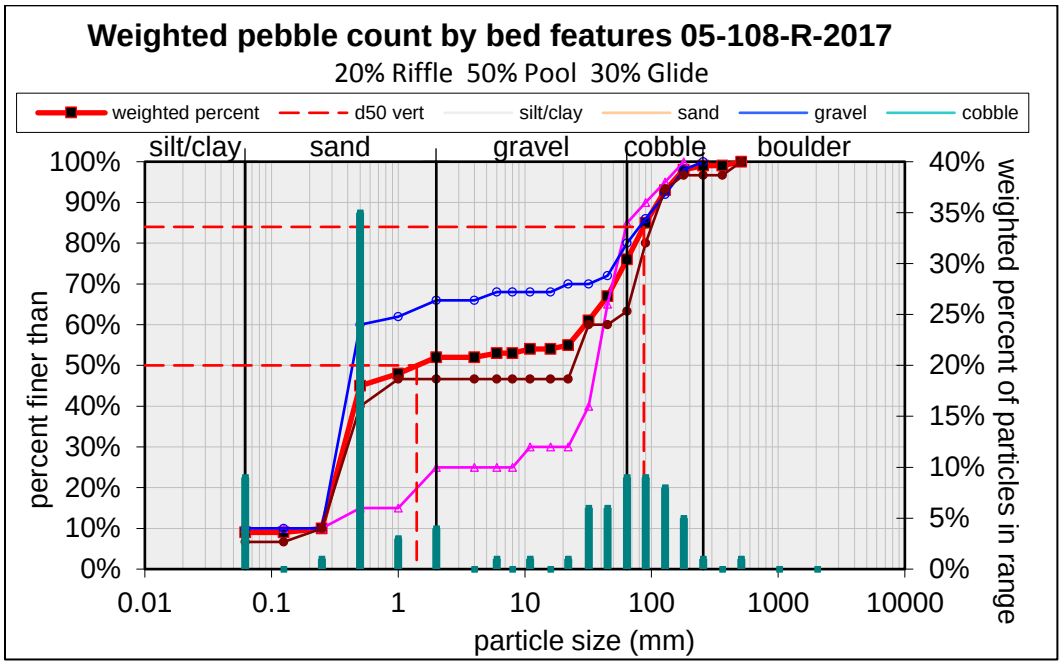
Flood Dimensions	
41.4	W flood prone area (ft)
1.3	entrenchment ratio
4.0	low bank height (ft)
2.7	low bank height ratio

Bankfull Flow	
2.9	velocity (ft/s)
92.4	discharge rate (cfs)
0.52	Froude number

Flow Resistance	
0.042	Manning's roughness

Sinuosity
1.1

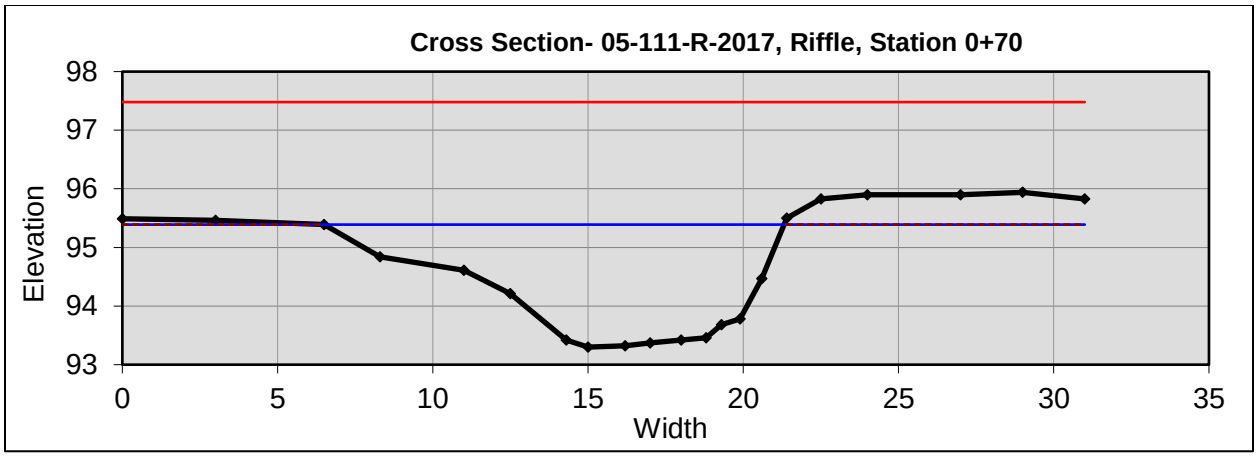
Channel Type
F4/5



Size (mm)	
D16	0.28
D35	0.41
D50	1.4
D65	40
D84	87
D95	150

Size Distribution	
mean	4.9
dispersion	33.6
skewness	0.35

Type	
silt/clay	9%
sand	43%
gravel	24%
cobble	23%
boulder	1%



Bankfull Dimensions	
18.8	x-section area (ft.sq.)
14.8	width (ft)
1.3	mean depth (ft)
2.1	max depth (ft)
15.9	wetted parimeter (ft)
1.2	hyd radi (ft)
11.7	width-depth ratio

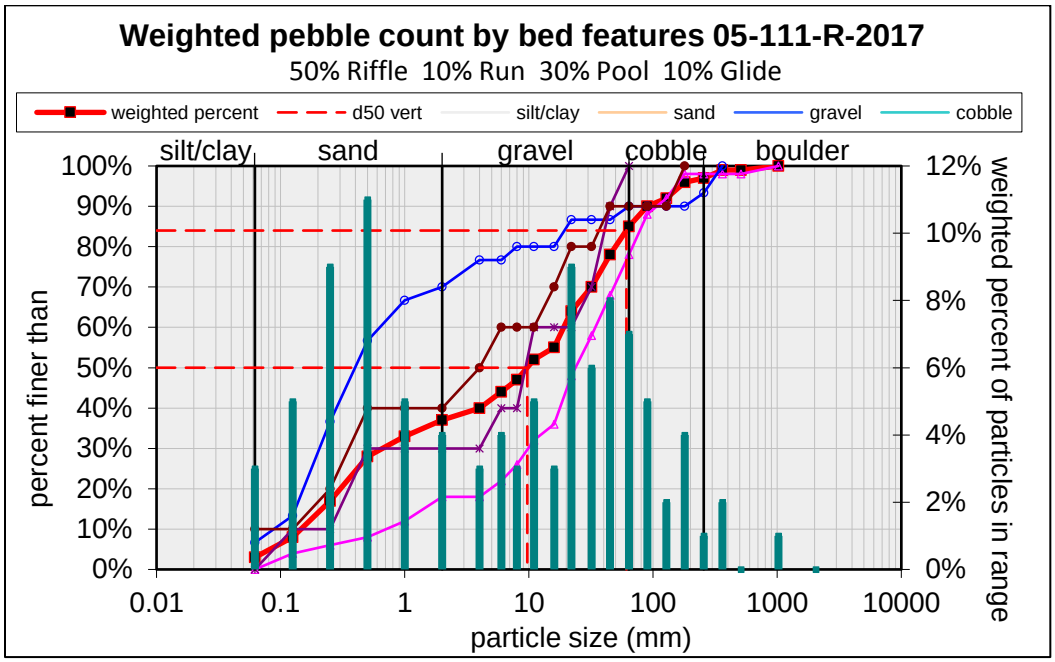
Flood Dimensions	
78.7	W flood prone area (ft)
5.3	entrenchment ratio
2.1	low bank height (ft)
1.0	low bank height ratio

Bankfull Flow	
6.6	velocity (ft/s)
124.3	discharge rate (cfs)
1.07	Froude number

Flow Resistance	
0.035	Manning's roughness

Sinuosity
1.0

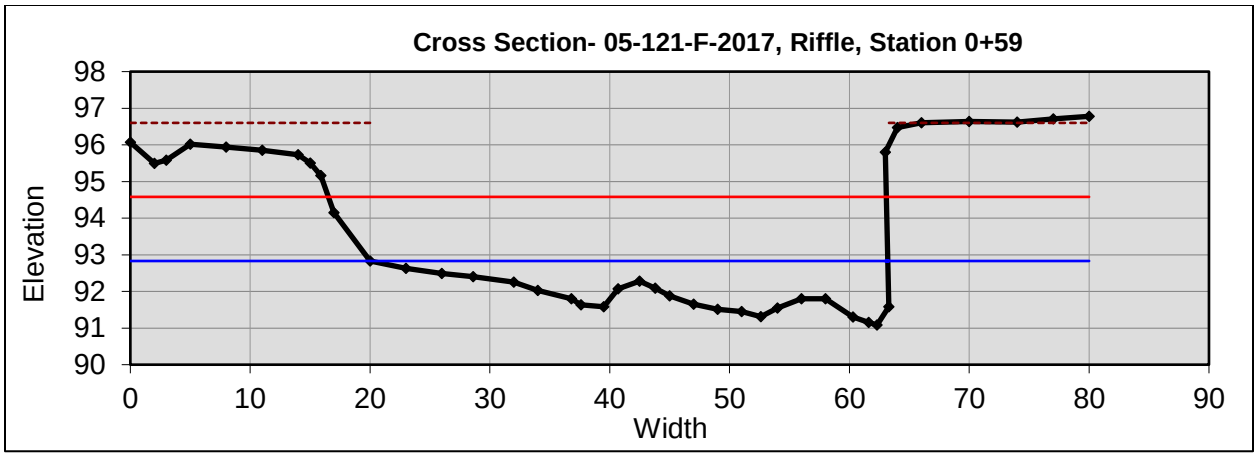
Channel Type
C4/5



Size (mm)	
D16	0.23
D35	1.4
D50	9.7
D65	23
D84	61
D95	170

Size Distribution	
mean	3.7
dispersion	24.2
skewness	-0.27

Type	
silt/clay	3%
sand	34%
gravel	48%
cobble	12%
boulder	3%



Bankfull Dimensions	
38.9	x-section area (ft.sq.)
43.2	width (ft)
0.9	mean depth (ft)
1.8	max depth (ft)
45.0	wetted parimeter (ft)
0.9	hyd radi (ft)
48.0	width-depth ratio

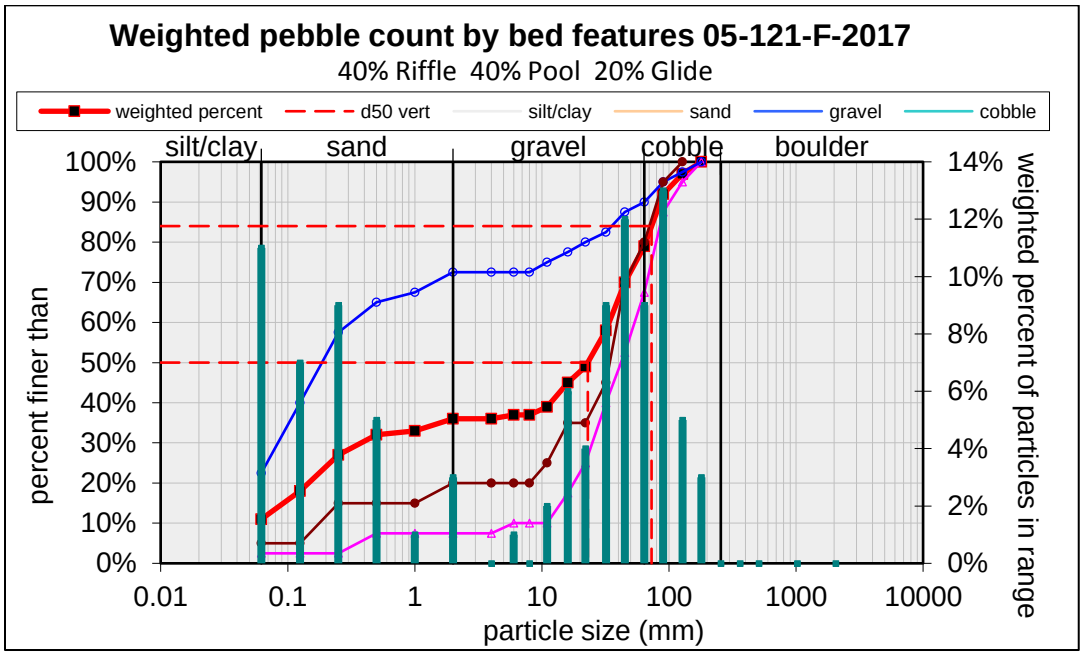
Flood Dimensions	
46.6	W flood prone area (ft)
1.1	entrenchment ratio
5.5	low bank height (ft)
3.2	low bank height ratio

Bankfull Flow	
1.9	velocity (ft/s)
72.1	discharge rate (cfs)
0.35	Froude number

Flow Resistance	
0.039	Manning's roughness

Sinuosity
1.4

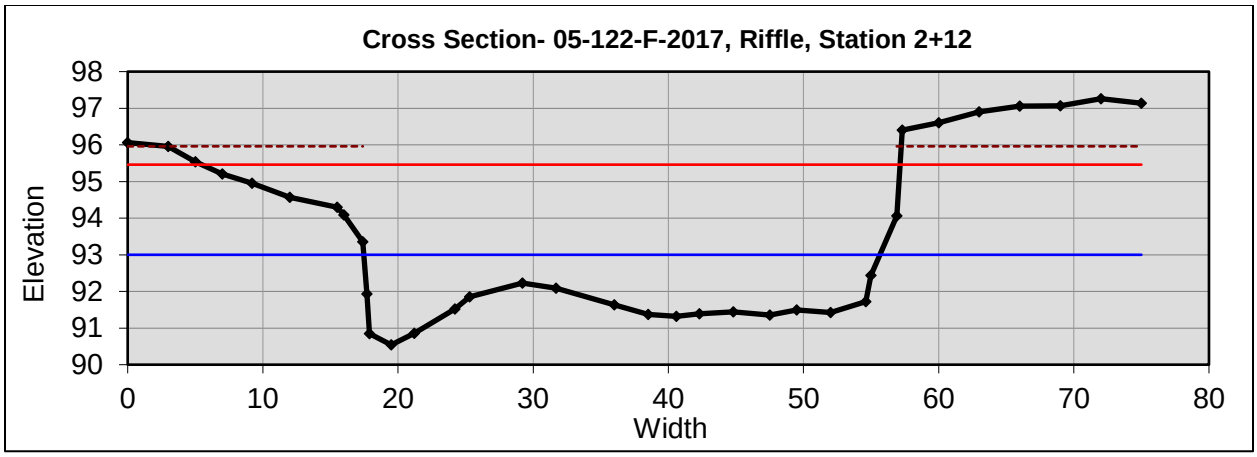
Channel Type
F4



Size (mm)	
D16	0.1
D35	1.6
D50	23
D65	39
D84	73
D95	110

Size Distribution	
mean	2.7
dispersion	116.6
skewness	-0.55

Type	
silt/clay	11%
sand	25%
gravel	43%
cobble	21%
boulder	0%



Bankfull Dimensions	
55.3	x-section area (ft.sq.)
38.2	width (ft)
1.4	mean depth (ft)
2.5	max depth (ft)
40.8	wetted parimeter (ft)
1.4	hyd radi (ft)
26.4	width-depth ratio

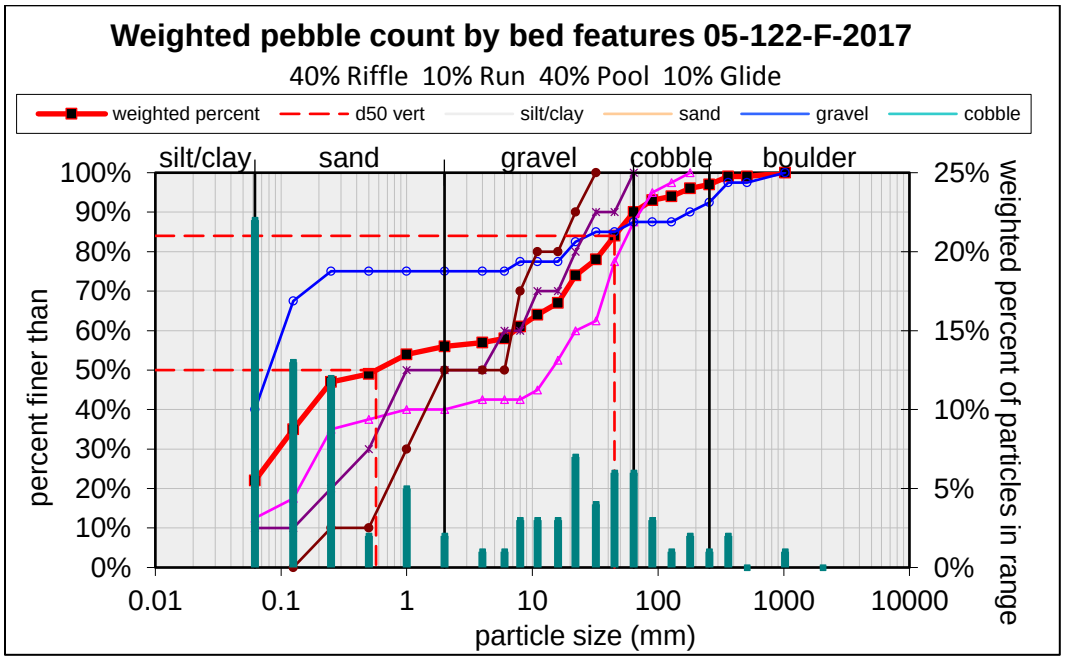
Flood Dimensions	
51.7	W flood prone area (ft)
1.4	entrenchment ratio
5.4	low bank height (ft)
2.2	low bank height ratio

Bankfull Flow	
4.0	velocity (ft/s)
222.6	discharge rate (cfs)
0.61	Froude number

Flow Resistance	
0.033	Manning's roughness

Sinuosity
1.4

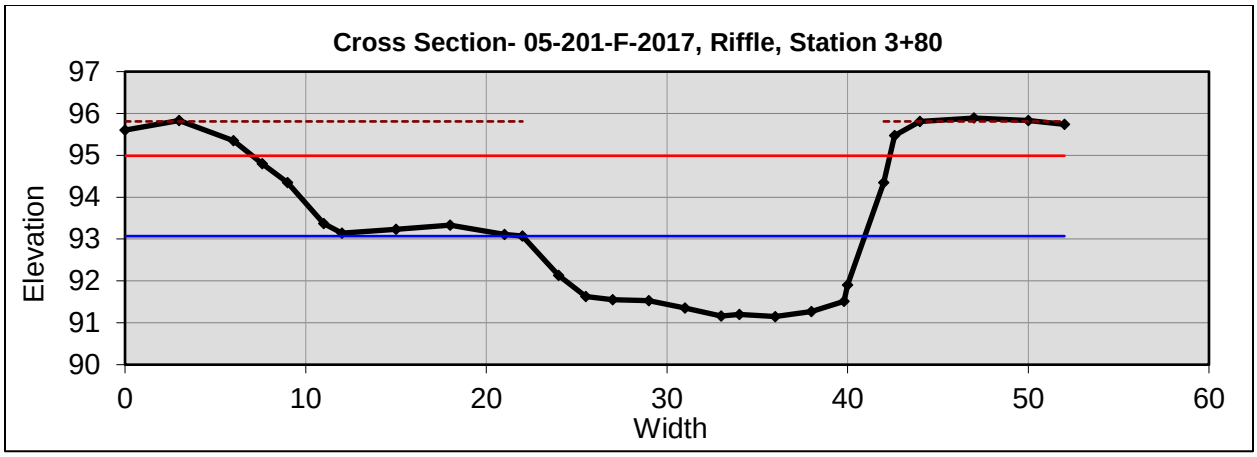
Channel Type
F4/5



Size (mm)	
D16	0.062
D35	0.13
D50	0.57
D65	12
D84	45
D95	150

Size Distribution	
mean	1.7
dispersion	44.1
skewness	0.28

Type	
silt/clay	22%
sand	34%
gravel	34%
cobble	7%
boulder	3%



Bankfull Dimensions	
28.2	x-section area (ft.sq.)
19.0	width (ft)
1.5	mean depth (ft)
1.9	max depth (ft)
20.1	wetted parimeter (ft)
1.4	hyd radi (ft)
12.8	width-depth ratio

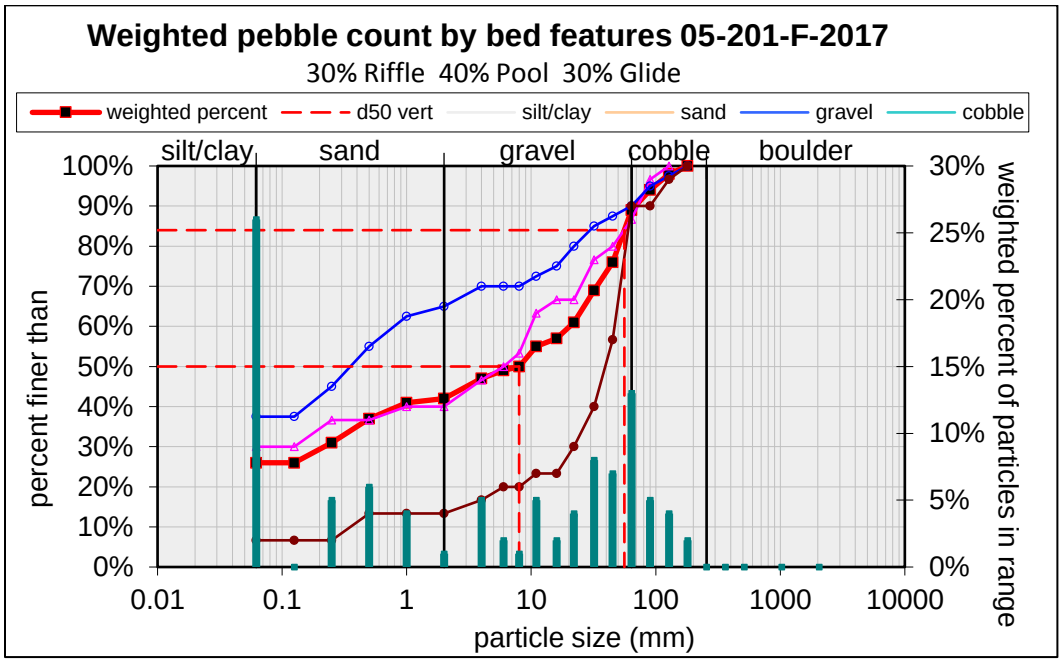
Flood Dimensions	
35.3	W flood prone area (ft)
1.9	entrenchment ratio
4.7	low bank height (ft)
2.4	low bank height ratio

Bankfull Flow	
4.6	velocity (ft/s)
128.9	discharge rate (cfs)
0.68	Froude number

Flow Resistance	
0.034	Manning's roughness

Sinuosity
1.3

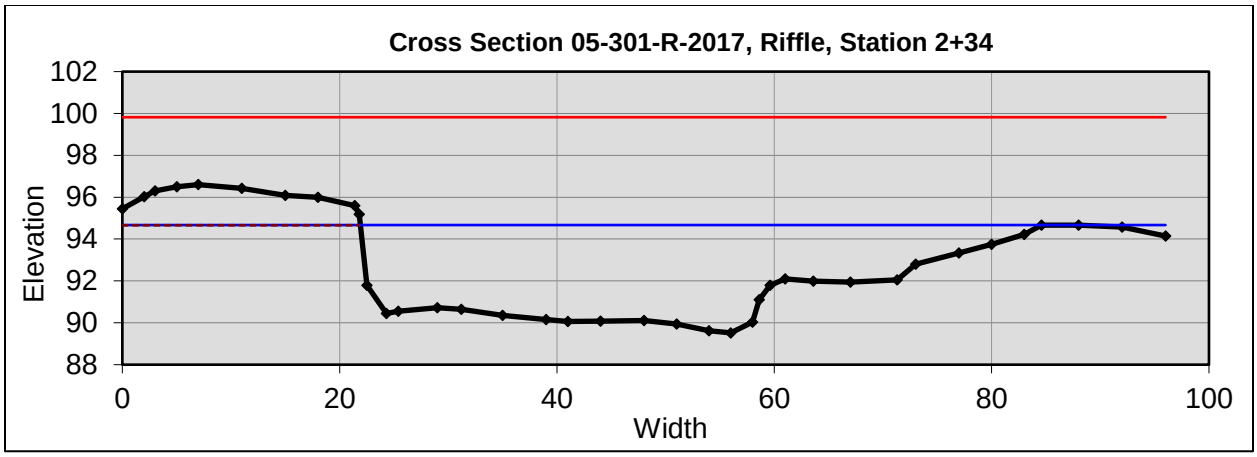
Channel Type
B4c



Size (mm)	
D16	0.062
D35	0.4
D50	8
D65	27
D84	56
D95	98

Size Distribution	
mean	1.9
dispersion	68.0
skewness	-0.37

Type	
silt/clay	26%
sand	16%
gravel	47%
cobble	11%
boulder	0%



Bankfull Dimensions	
212.9	x-section area (ft.sq.)
74.1	width (ft)
2.9	mean depth (ft)
5.2	max depth (ft)
78.2	wetted parimeter (ft)
2.7	hyd radi (ft)
25.8	width-depth ratio

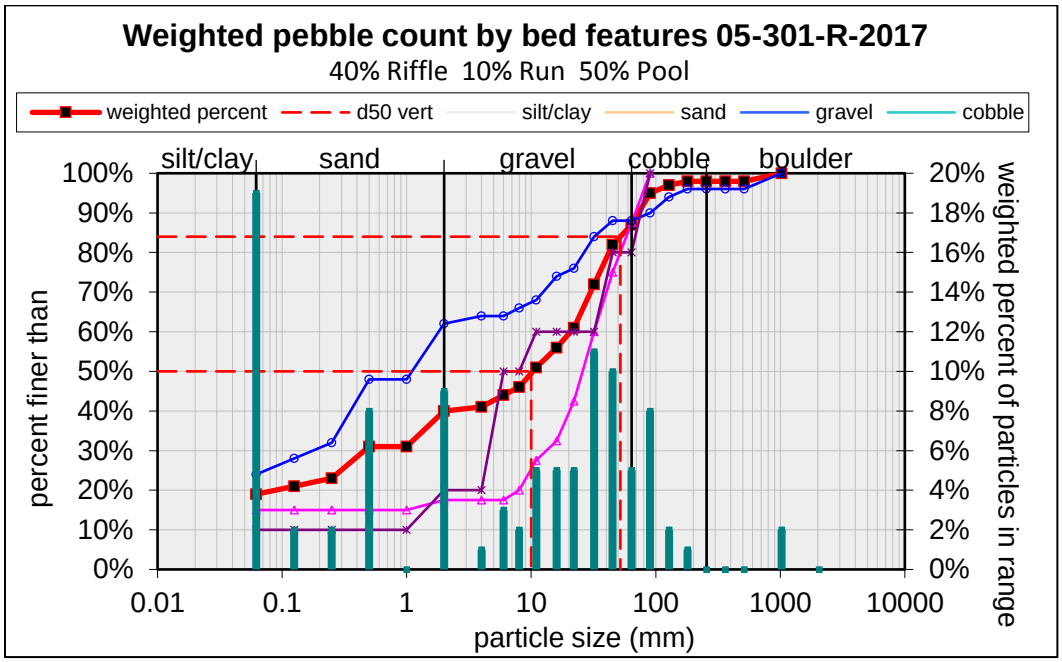
Flood Dimensions	
359.9	W flood prone area (ft)
4.9	entrenchment ratio
5.1	low bank height (ft)
1.0	low bank height ratio

Bankfull Flow	
6.9	velocity (ft/s)
1479.4	discharge rate (cfs)
0.74	Froude number

Flow Resistance	
0.030	Manning's roughness

Sinuosity
1.2

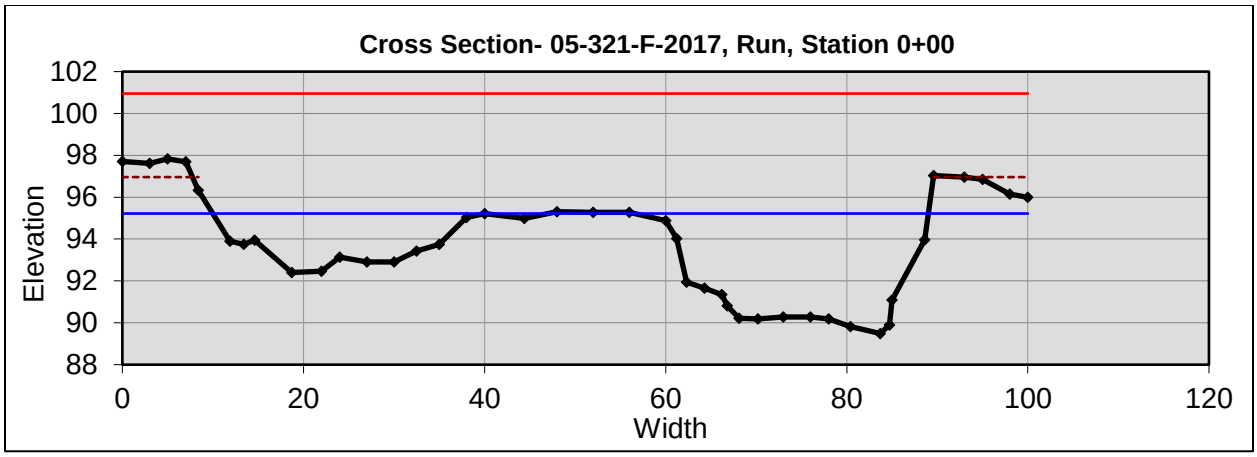
Channel Type
C4



Size (mm)	
D16	0.062
D35	1.4
D50	10
D65	25
D84	52
D95	90

Size Distribution	
mean	1.8
dispersion	83.2
skewness	-0.44

Type	
silt/clay	19%
sand	21%
gravel	47%
cobble	11%
boulder	2%



Bankfull Dimensions	
177.3	x-section area (ft.sq.)
69.5	width (ft)
2.6	mean depth (ft)
5.7	max depth (ft)
75.6	wetted parimeter (ft)
2.3	hyd radi (ft)
27.3	width-depth ratio

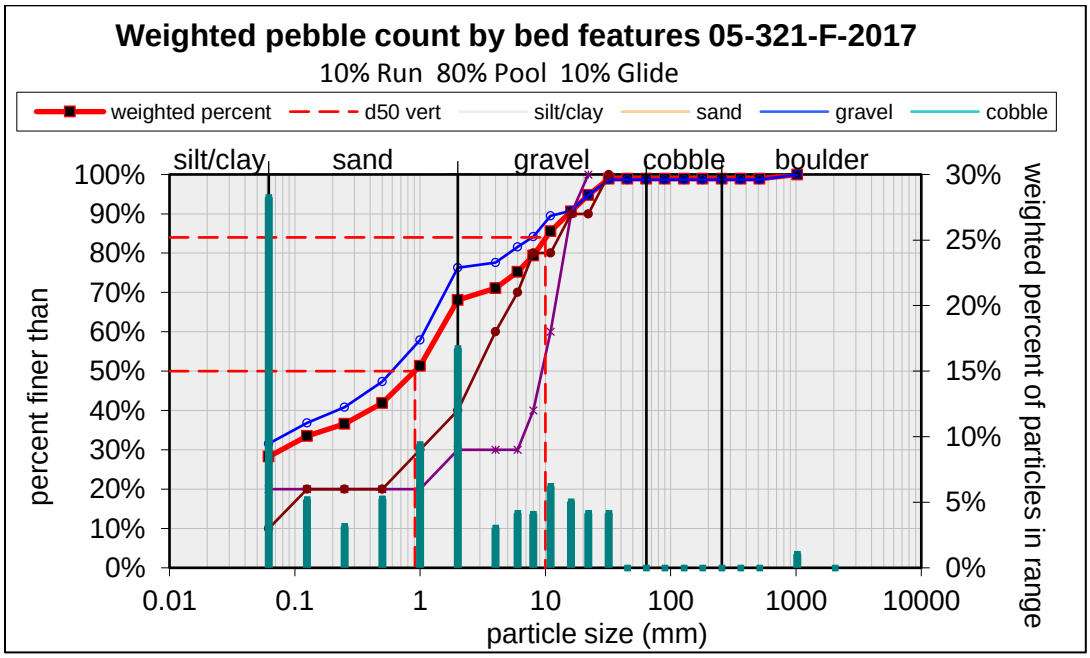
Flood Dimensions	
248.8	W flood prone area (ft)
3.6	entrenchment ratio
7.5	low bank height (ft)
1.3	low bank height ratio

Bankfull Flow	
1.7	velocity (ft/s)
294.3	discharge rate (cfs)
0.19	Froude number

Flow Resistance	
0.021	Manning's roughness

Sinuosity
1.1

Channel Type
C4/5c-



Size (mm)	
D16	0.062
D35	0.17
D50	0.91
D65	1.8
D84	10
D95	22

Size Distribution	
mean	0.8
dispersion	12.8
skewness	-0.04

Type			
silt/clay	27%	bedrock	4%
sand	38%		
gravel	30%		
cobble	0%		
boulder	1%		

Appendix F: Quality Assurance/Quality Control

The biological monitoring program for the Upper Brighton Dam, Cattail Creek, and Lower Brighton Dam subwatersheds includes chemical, physical, and biological assessments conducted throughout the selected PSUs. The sampling methods used are compatible with the Design of the Biological Monitoring and Assessment Program for Howard County Maryland (Tetra Tech, 2001) and the Quality Assurance Project Plan (QAPP) for Howard County Department of Public Works (Tetra Tech, 2001). A summary of the Quality Assurance/Quality Control (QA/QC) procedures and results are presented in this Appendix.

A quality assurance and quality control analysis was completed for the assessment work conducted in the Upper Brighton Dam, Cattail Creek, and Lower Brighton Dam subwatersheds following the methods described by Hill et al. (2005). This analysis included performance characteristics of precision, accuracy, bias and completeness. Performance measures include:

- Precision (consistency) of field sampling and overall site assessments using intra-team site duplication
    - median relative percent difference (mRPD)
    - coefficient of variability (CV)
    - 90% confidence interval (CI)
- Bias of sample sorting and subsampling
    - percent sorting efficiency (PSE)
- Accuracy of data entry
    - number of errors/corrective actions
- Completeness
    - number of valid data points obtained as a proportion of those planned (QAPP, 2001).

Data that does not meet performance or acceptable criteria are re-evaluated to correct any problems or investigated further to determine the cause of any discrepancies.

Field Sampling

All field crew members collecting biological samples were recently trained in MBSS Spring Sampling protocols and certified in benthic macroinvertebrate sample collection procedures by MBSS. All subjective scoring was completed with the input of all team members at the sampling site to reduce individual sampler bias.

Field water quality measurements were collected *in situ* at all monitoring sites including the duplicate sites, according to methods in the County QAPP. All *in situ* parameters were measured with a YSI Pro Plus series multiprobe, except turbidity which was measured using a Hach 2100 Turbidimeter. Water quality equipment was regularly inspected, maintained and calibrated to ensure proper usage and accuracy of the readings. Calibration logs were kept by field crew leaders and checked by the project manager regularly.

Sample buckets contained both internal and external labels. All chain-of-custody procedures were followed for transfer of the samples between the field and the identification lab.

Replicate (duplicate) samples were collected at ten percent of the sites (one site for each PSU, three total for the 2017 sampling year). These QC samples were collected to determine the consistency and precision of the sampling procedures and the intra-team adherence to those protocols. QC sites were field-selected rather than randomly selected to ensure that the QC sites maintained similar habitat conditions to the original site. Data collected from duplicate sites included water quality, benthic macroinvertebrate samples, and completion of the RBP habitat assessment. Photographs were also taken at duplicate sites.

Precision

Measures of precision calculated for the consistency of field sampling using intra-team site duplication were:

- Median relative percent difference (mRPD) and relative percent difference (RPD)
- Coefficient of variability (CV)
- 90% confidence interval (CI)

Acceptable measurement quality objectives (MQO) are listed in the table below. DNR's MBSS protocols were used for the collection and analysis of macroinvertebrate data. In 2005, DNR updated their Benthic Index of Biotic Integrity (BIBI; Southerland et al., 2005). These new metrics were used to calculate the BIBI presented in this report.

Measurement Quality Objectives (QAPP, 2001)

Metric or Index	Precision	Accuracy	Completeness (%)
GPS		± 25m	100
Dissolved Oxygen	RPD ≤ 20%	± 0.2 mg/L	≥ 85
pH	RPD ≤ 20%	± 0.2 units	≥ 85
Temperature	RPD ≤ 20%	± 0.15 ˚C	≥ 85
Conductivity	RPD ≤ 20%	± 1% of value	≥ 85
RBP Physical Habitat Assessment	RPD ≤ 20%	NA	100
Macroinvertebrate taxa			100
Metric Scores	RPD ≤ 5%		
Bioassessment Scores	RPD ≤ 5%		
Sorting Efficiency	SE ≥ 90%		

GPS

All GPS points were collected with a Trimble ProXT GPS unit capable of accuracy of within 2 meters. Multiple readings (approximately 60) were recorded at the reach midpoint and averaged to obtain the location of the final point. Thus, the accuracy requirement of ± 25 meters was met. A GPS point was collected at all 30 sites, therefore the data meets the 100 percent MQO for completeness.

Water Quality

The following table shows the results of the water quality MQO analysis. The field equipment used, with correct maintenance and calibration, are capable of the required accuracy. Since the true accuracy of field measured water quality is not known with confidence, the measure of precision is used instead. Water quality data for all parameters were collected at all 30 sites, therefore the data meets the >85 percent MQO for completeness. One sample pair (02-121-F-2017) had a water quality measurement that exceeded the MQO of ≤20% for turbidity. The calculated RPD for this sample pair was 34.05, above the stated MQO. However, the high RPD value is an artifact of comparing two low values. This automatically results in an inflated RPD value despite a difference of 0.87 NTU between the samples. All other water quality parameters were within the acceptable ranges for precision.

Measurement Quality Objectives Results – Water Quality. Bold records indicate values exceeding stated MQOs.

	Dissolved Oxygen (mg/l)	pH	Water Temperature (°C)	Turbidity (ntu)	Conductivity (µS/cm)
02-121-F-2017	11.24	7.33	12.10	2.1	235.1
02-121-F-2017 QC	10.89	7.01	13.90	3.0	237.1
Absolute Difference	0.35	0.32	1.80	0.87	2.00
RPD	3.16	4.46	13.85	**34.05**	0.85
SD	0.25	0.23	1.27	0.62	1.41
03-301-R-2017	10.39	7.12	12.40	4.4	241.9
03-301-R-2017 QC	10.85	6.98	12.80	5.2	242.3
Absolute Difference	0.46	0.14	0.40	0.87	0.40
RPD	4.33	1.99	3.17	18.14	0.17
SD	0.33	0.10	0.28	0.62	0.28
05-122-F-2017	12.14	8.15	3.90	1.4	253.1
05-122-F-2017 QC	12.26	7.97	3.90	1.2	255.3
Absolute Difference	0.12	0.18	0.00	0.14	2.20
RPD	0.98	2.23	0.00	10.69	0.87
SD	0.08	0.13	0.00	0.10	1.56
Median RPD	3.16	2.23	3.17	18.14	0.85

Habitat Assessment

The following table provides the result of the MQO analysis for the habitat assessment. The RPD was <10 percent for all QC sites, therefore, all data meets the MQO of ≤20 percent.

Measurement Quality Objectives Results – Habitat Assessment (RBP)

	RBP Total Score	RBP Percent Comparability	Narrative Rating
02-121-F-2017	134	67	Partially Supporting
02-121-F-2017 QC	130	65	Partially Supporting
Absolute Difference	4.00	2.00	
RPD	3.03	3.03	
SD	2.83	1.41	
03-301-R-2017	130	65	Partially Supporting
03-301-R-2017 QC	134	67	Partially Supporting
Absolute Difference	4.00	2.00	
RPD	3.03	3.03	
SD	2.83	1.41	
05-122-F-2017	114	57	Not Supporting
05-122-F-2017 QC	124	62	Partially Supporting
Absolute Difference	10.00	5.00	
RPD	8.40	8.40	
SD	7.07	3.54	
Median RPD	3.03	3.03	

Biological Assessment

The following three tables include the results of the QC analysis for the biological metrics and BIBI scores. One metric score and BIBI scores fell outside the acceptable range for precision (shown in bold). In each case, the difference was only one scoring class (i.e, 1, 3, or 5), which resulted in a large RPD. In fact, even the smallest incremental difference in metric scores would result in an exceedance of the RPD MQO. Therefore, additional measures of precision were calculated among the combined QC data set to evaluate the significance of the differences in individual metric values and scores, as well as in the overall BIBI score.

Measurement Quality Objectives Results – Biological Sampling, Sample Pair RPD for Metric and IBI Scores

	BIBI	Total Taxa Score	EPT Taxa Score	Ephem Taxa Score	Percent Intolerant Urban Score	Percent Chironomidae Score	Percent Clinger Score
02-121-F-2017	4.33	5	5	1	5	5	5
02-121-F-2017 QC	4.33	5	5	3	5	5	3
03-301-R-2017	3.33	5	3	3	3	3	3
03-301-R-2017 QC	4.00	5	5	5	3	3	3
05-122-F-2017	3.33	3	3	5	3	3	3
05-122-F-2017 QC	3.67	5	3	5	3	3	3
Median RPD	**9.5**	0.0	0.0	**50.0**	0.0	0.0	0.0

The BIBI is not scored on a continuous scale, but rather each metric is scored on an incremental scale (assigned a value of 1, 3 or 5), and these values are averaged to yield the final BIBI score. Since the piedmont BIBI score is an average of six metric scores, the BIBI scores shift by at least 0.3 or 0.4 with a difference in only metric (e.g., 2.0, 2.3, 2.7, 3.0). Additionally, an individual metric value may differ by only one taxa or one percent for a sample pair, but if it falls on either side of a scoring threshold (i.e, 1, 3, 5), the resulting difference in metric scores will differ by as much as 50 to 100% for RPD. For these reasons, the overall BIBI scores and Ephemeroptera Taxa score mRPDs did not meet the MQOs.

Due to the overall BIBI score consisting of scaled incremental metrics, the RPD does not reflect the precision well. Additional measures of precision (CV, CI, and mRPD) for the combined sample pair results indicate far better precision than does RPD. None of the measures calculated deviated significantly from normal, acceptable levels of precision between duplicate sample pairs observed in similar studies (Hill et. al, 2005; Gallardo et. al, 2006).

All phases of the biological assessment were conducted for every site; therefore the 100 percent completeness MQO is met.

Measurement Quality Objectives Results – Biological Sampling, Combined Precision Measures for Metric Values

	Total Taxa	EPT Taxa	Ephem Taxa	Percent Intolerant Urban	Percent Chironomidae	Percent Clingers
02-121-F-2017	34	13	1	62.0	17.6	77.8
02-121-F-2017 QC	29	12	2	52.9	21.6	71.6
03-301-R-2017	31	8	3	18.3	33.9	43.5
03-301-R-2017 QC	36	11	5	16.5	40.9	51.3
05-122-F-2017	23	10	7	19.3	57.8	53.2
05-122-F-2017 QC	32	9	5	27.1	46.7	32.7
CV	14.7	17.8	58.1	60.5	41.9	30.8
CI	7.4	3.1	3.7	32.4	25.0	27.8
mRPD	15.9	10.5	0.0	10.0	20.3	16.5

Measurement Quality Objectives Results – Biological Sampling, Combined Precision Measures for Metric and IBI Scores

	Total Taxa	EPT Taxa	Ephem Taxa	Percent Intolerant Urban	Percent Chironomidae	Percent Clingers	BIBI
02-121-F-2017	5	5	1	5	5	5	4.33
02-121-F-2017 QC	5	5	3	5	5	3	4.33
03-301-R-2017	5	3	3	3	3	3	3.33
03-301-R-2017 QC	5	5	5	3	3	3	4.00
05-122-F-2017	3	3	5	3	3	3	3.33
05-122-F-2017 QC	5	3	5	3	3	3	3.67
CV	17.5	27.4	44.5	28.2	28.2	24.5	12.0
CI	1.3	1.8	2.7	1.7	1.7	1.3	0.8
mRPD	0.0	0.0	50.0	0.0	0.0	0.0	9.5

Laboratory Sorting and Subsampling

Only one highly qualified sorter was used to sort the 33 countywide samples. After 10 samples were sorted, the laboratory QC officer randomly selected one sample to resort to check the sorting efficiency of the technician. The target sorting efficiency rate for this project was 90%. The sorting technician saved the sample debris that was originally sorted for each sample and stored it in a separate container for QC purposes. The QC officer resorted the sample portion that was originally sorted and removed, counted, and added any organisms originally missed to the sample vials for identification.

Three samples were checked by the QC officer for this project, and all samples passed the QC with an error rate of 7.8 percent, 4.4 percent and 2.1 percent, respectively. Collectively the samples had an average sorting efficiency of 95.2%, which exceeds the sorting efficiency target of 90%.

Taxonomic Identification and Enumeration

Two samples (03-221-F-2017 and 02-123-F-2017) were randomly selected for QC identification and enumeration by an independent lab. Original identification was completed by Aquatic Resources Center[1]. Re-identification of the randomly selected sample was done by Ellen Friedman of Maryland Department of Natural Resources. Each sample was identified to the genus level where possible. Individuals that were not able to be identified to genus level were identified to the lowest possible level, usually family, but in some cases order or subphylum. For Chironomidae, individuals not identifiable to genus may have been identified to subfamily or tribe level.

Precision

Measures of precision were calculated for the identification consistency between the two randomly selected samples. These include percent difference in enumeration (PDE) and percent taxonomic disagreement (PTD).

The PDE compares the final specimen counts between the two taxonomy labs, whereas PTD compares the number of agreements in final specimen identifications between the two taxonomic labs. While MBSS does not specify MQOs for these measures, performance characteristics were compared to recommended standards from Stribling et al. (2003), whereby the PDE for each sample should be equal to or less than 5%, and the PTD should be equal to or less than 15%. Results for the taxonomic comparison and resulting values for PDE and PTD are found in Table 1 and Table 2 for samples 03-221-F-2017 and 02-123-F-2017, respectively.

Both PDE (1.82% and 1.96%) and PTD (5.56 and 12.00%) were below the threshold values for acceptance of 5% and 15%, respectively, indicating good overall taxonomic agreement. All disagreements were minor.

[1] Address: 545 Cathy Jo Circle, Nashville, TN

Table 1. Taxonomic Identification and Enumeration Results for Sample 03-221-F-2017

Subphylum/Class	Order	Family	Tribe	Final ID	Primary Taxonomist	Secondary Taxonomist	# of agreements
Insecta	**Coleoptera**	Elmidae		Oulimnius	Oulimnius	1	1
				Stenelmis	Stenelmis	1	1
	Diptera	Chironomidae		Cricotopus/Orthocladius	Cricotopus/Orthocladius	1	0
				Orthocladinae		0	1
					Orthocladius	0	1
			Chironomini	Cryptochironomus	Cryptochironomus	1	1
				Hydrobaenus	Hydrobaenus	7	7
			Chironomini	Microtendipes	Microtendipes	2	2
			Pentaneurini	Nilotanypus	Nilotanypus	1	1
			Chironomini	not identified	Chironominae	1	3
			Chironomini	Polypedilum	Polypedilum	20	20
			Tanytarsini	Rheotanytarsus	Rheotanytarsus	16	14
			Tanytarsini	Stempellinella	Stempellinella	6	5
			Tanytarsini	Tanytarsus	Tanytarsus	10	10
				Thienemannimyia group	Thienemannimyia group	3	2
					Trissopelopia	0	1
		Empididae	Hemerodromiini	Hemerodromia	Hemerodromia	1	1
		Tipulidae		Antocha	Antocha	1	1
				Hexatoma	Hexatoma	1	1
	Ephemeroptera	Ameletidae		Ameletus	Ameletus	1	1
		Ephemerellidae				0	2
				Ephemerella	Ephemerella	14	12
				Eurylophella	Eurylophella	1	1
				Teloganopsis	Teloganopsis	3	3
		Heptageniidae		not identified	Heptageniidae	1	1
	Plecoptera	Nemouridae		Paranemoura	Paranemoura	1	0
				Prostoia	Prostoia	0	1
		Perlodidae		Isoperla	Isoperla	1	1
	Trichoptera	Hydropsychidae		Cheumatopsyche	Cheumatopsyche	5	5
Oligochaeta	**Haplotaxida**	Naididae		not identified	Naididae	6	11
	Tubificidae					0	1
	Tubificida	Naididae		Chaetogaster	Chaetogaster	2	0
				Total	108	112	102
				PDE			1.82
				PTD			5.56

Table 2. Taxonomic Identification and Enumeration Results for Sample 02-123-R-2017

Subphylum/Class	Order	Family	Tribe	Final ID	Primary Taxonomist	Secondary Taxonomist	# of agreements
Oligochaeta	**Haplotaxida**	Naididae	0	not identified	Naididae	27	29
		Tubificidae				0	3
Insecta	**Coleoptera**	Elmidae	0	Oulimnius	Oulimnius	2	1
					Optioservus	0	1
	Diptera	Chironomidae	0	Corynoneura	Corynoneura	2	1
			0	Cricotopus/Orthocladius	Cricotopus/Orthocladius	1	0
				Orthocladinae		0	2
			0	Diplocladius	Diplocladius	1	1
			Tanytarsini	Micropsectra	Micropsectra	1	0
			Tanytarsini	not identified	Tanytarsini	1	1
			Chironomini			0	1
				Polypedilum	Polypedilum	9	8
			0	Rheocricotopus	Rheocricotopus	1	1
			Tanytarsini	Rheotanytarsus	Rheotanytarsus	1	0
			Tanytarsini	Sublettea	Sublettea	1	1
			Tanytarsini	Tanytarsus	Tanytarsus	5	3
			0	Thienemanniella	Thienemanniella	1	2
			0	Thienemannimyia group	Thienemannimyia group	4	4
					Trissopelopia	0	1
			0	Tvetenia	Tvetenia	3	2
			Pentaneurini	Zavrelimyia	Zavrelimyia	1	0
		Tipulidae	0	Tipula	Tipula	1	0
	Ephemeroptera	Ephemerellidae	0	Ephemerella	Ephemerella	2	1
			0	Eurylophella	Eurylophella	10	16
		Heptageniidae	0	Epeorus	Epeorus	2	2
		Leptophlebiidae	0	not identified	Leptophlebiidae	1	1
	Odonata	Calopterygidae	0	Calopteryx	Calopteryx	2	2
	Plecoptera	Nemouridae	0	Amphinemura	Amphinemura	4	4
		Leuctridae				0	7
		not identified	0	not identified	Plecoptera	7	0
	Trichoptera	Limnephilidae	Stenophylacini	Pycnopsyche	Pycnopsyche	1	1
		Philopotamidae				0	4
			0	Dolophilodes	Dolophilodes	5	0
		Rhyacophilidae	0	Rhyacophila	Rhyacophila	1	1
Malacostraca	**Isopoda**	Asellidae	0	Caecidotea	Caecidotea	1	1
Turbellaria	**not identified**	not identified	0	not identified	Turbellaria	2	0
		Dugesiidae				0	2
				Total	100	104	88
				PDE			1.96
				PTD			12.00