



**PICKERING CREEK STUDY
MAY 2008**

**Prepared For:
Homebuilders Association of
Chester and Delaware Counties**

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EXECUTIVE SUMMARY

On behalf of The Homebuilders Association of Chester and Delaware Counties, Conestoga-Rovers & Associates (CRA) conducted a stream assessment of the Pickering Creek watershed located in northeastern Chester County, Pennsylvania. The purpose of the assessment was to determine if Pickering Creek meets the biological criteria of an Exceptional Value (EV) watershed. The assessment was conducted on May 6 and 7, 2008 and included sampling benthic macroinvertebrates, measuring water quality field parameters and assessing habitat at eight locations (stations). Four of the stations were established on the main branch of Pickering Creek from upstream of the Pickering Creek Reservoir to the headwaters at Route 401. Four stations were located on major tributaries, Pigeon Creek, North Branch, Pine Creek and Middle Branch. In addition, one station was located on Rock Run (an EV reference station, tributary to French Creek).

Pennsylvania Department of Environmental Protection (PADEP) regulations Chapter 93 sets forth six criteria of which one or more must be achieved to classify a stream as EV. Based on CRA's desktop review of agency information, the Pickering Creek does not meet five of the six criteria. The sixth criterion requires an assessment of the benthic macroinvertebrate community of the stream. This assessment was the focus of CRA's investigation. CRA conducted its assessment of the stream by using PADEP's sampling and data analysis protocols.

CRA conducted its data analyses with both PADEP's current 2007 method and their former 2003 method. The 2007 method defines reference conditions based on data from a number of streams across the state that was used to calculate an Index of Biotic Integrity (IBI). PADEP's 2003 former method compared data directly from the Candidate streams to data collected from a local EV reference stream.

Based on the data collected by CRA and using the 2007 methodology based on IBI scores, Pickering Creek's and its tributaries' IBI scores range from 25 to 68. To qualify as an EV stream the IBI score needs to be greater than or equal to 80. Therefore, Pickering Creek does not meet the 2007 biological criteria for EV.

Based on the 2003 method, a Candidate stream must be 92% similar to the EV Reference stream. Percent similarity to the reference for seven of the eight Pickering Creek main branch and tributary stations ranged from 8% to 70%. One Pickering Creek station, located in Charlestown, scored 93%. However, an upstream station that scored 48% and a downstream station that scored 60% bracketed this station. The average score for four main branch Pickering Creek stations was 69% and the four tributary stations was 44%.

The average percent similarity for the watershed (main branch and tributaries) is 56.5%, well below the required 92% similarity.

Based on the results of this survey, it can be concluded that the Pickering Creek watershed does not qualify as an EV watershed.

1.0 INTRODUCTION

On behalf of The Homebuilders Association of Chester and Delaware Counties (HBA), Conestoga-Rovers & Associates (CRA) conducted a stream assessment of the Pickering Creek watershed located in northeastern Chester County, Pennsylvania (see Figure 1.1). The purpose of the stream assessment was to determine if Pickering Creek meets the biological criteria of an Exceptional Value (EV) watershed. The stream assessment or survey was conducted by CRA on May 6 and 7, 2008.

The assessment was conducted in accordance with protocols published by the Pennsylvania Department of Environmental Protection (PADEP). This stream assessment included sampling benthic macroinvertebrates, measuring water quality field parameters and assessing aquatic habitats at eight locations (stations). Four stations were located along the length of the main branch of the Pickering Creek and one station was located on each of the four major tributaries. An additional station was located on Rock Run, an EV reference station and tributary to French Creek.

Chapter 93 entitled Water Quality Standards, of the PADEP rules and regulations sets forth the criteria that must be achieved for a stream to qualify as EV. To qualify for EV status a stream must qualify as high quality (HQ) and meet one or more of the following attributes:

1. it flows in a national wildlife refuge or a state game propagation and protection area;
2. it flows in a designated state park natural area, state forest natural area, national natural landmark, federal or state wild river, federal wilderness area or national recreation area;
3. it is an *outstanding national, state, regional or local resource water* as defined in Section 93.1 of the regulation¹;
4. it is a *surface water of exceptional recreational significance* as defined in Section 93.1²;
5. the water achieves a biological score of 92 percent or greater using the rapid bioassessment protocols (RBP)³ when compared to a reference stream; or

¹ *Outstanding National, State, regional or local resource water* – A surface water for which a National or State government agency has adopted water quality protective measures in a resource management plan, or regional or local governments have adopted coordinated water quality protective measures along a watershed corridor.

² *Surface water of exceptional recreational significance* – A surface water which provides a water-based, water quality-dependent recreational opportunity (such as fishing for species with limited distribution) because there are only a limited number of naturally occurring areas and waterbodies across the State where the activity is available or feasible.

6. the water is designated a *wilderness trout stream*⁴ by the Pennsylvania Fish and Boat Commission (PFBC).

Alternatively, if the surface water is deemed of *exceptional ecological significance*⁵ it could then be assessed as EV (Commonwealth of PA 2002).

Based on CRA's review of PADEP and PFBC information the Pickering Creek does not meet conditions 1 through 4 nor has it been deemed of *exceptional ecological significance*. This report focuses on assessing the benthic macroinvertebrate community to determine if the item 5 criterion is achieved.

The assessment of the benthic macroinvertebrate community is an established method for evaluating water quality, aquatic habitat, and ecological integrity. Benthic macroinvertebrate communities are indicators of localized conditions and respond to short and long term changes in environmental conditions. Benthic macroinvertebrates are closely associated with surface water and sediments and are exposed to contaminants dissolved in the water and the physical forces of the watershed that influence aquatic habitat.

Analysis of the benthic macroinvertebrate community at various locations along the stream allows comparisons to be made between the sampling locations. Analysis of the structural and functional components of the benthic macroinvertebrate community allows conclusions to be drawn regarding the potential cause of observed differences between the sampling locations and the overall condition of the stream. Habitat assessment is used to determine the quality of habitat in and adjacent to the stream. Altered habitat around a stream can induce stress within the stream.

This report documents the methods, analyses, results, and conclusions based on data CRA collected during its May 2008 Pickering Creek stream survey.

³ *Rapid Bioassessment Protocols for Use in Streams and Rivers: Benthic Macroinvertebrates and Fish*, Plafkin, et al., (EPA/444/4-89-001), as updated and amended.

⁴ *Wilderness trout stream*—A surface water designated by the Fish and Boat Commission to protect and promote native trout fisheries and maintain and enhance wilderness aesthetics and ecological requirements necessary for the natural reproduction of trout.

⁵ *Surface water of exceptional ecological significance*—A surface water which is important, unique or sensitive ecologically, but whose water quality as measured by traditional parameters (for example, chemical, physical or biological) may not be particularly high, or whose character cannot be adequately described by these parameters. These waters include:

(i) Thermal springs. (ii) Wetlands which are exceptional value wetlands under § 105.17(1) (relating to wetlands).

2.0 STUDY AREA AND STATION LOCATIONS

2.1 WATERSHED DESCRIPTION

The Pickering Creek watershed area is approximately 39 square miles and located entirely in northern Chester County. Land use in the watershed is a mix of forest (36%), developed (22%) and agricultural (39%) (Chester County Water Resources Authority, 2002). The watershed extends from the Village of Eagle west to a water supply reservoir above its confluence with the Schuylkill River, east of Phoenixville. PADEP's Chapter 93 classifies the use of the stream upstream of the reservoir as high quality, trout stocked fishery (HQ-TSF). Pickering Creek is a freestone stream stocked with trout by the PFBC and local sportsman groups. The stream, except for its Pine Creek tributary, is currently listed by PADEP as attaining its surface water goals.

Rock Run, the reference site, is located in the French Creek watershed, north of the Pickering Creek watershed. Rock Run, with a drainage area of 3.3 square miles, is designated by PADEP as an EV stream. This stream was also used as a reference site by PADEP in their recent assessment of Pickering Creek.

2.2 PROJECT AREA

Eight locations were selected for sampling in the Pickering Creek watershed, along with one reference station on Rock Run (see Figures 2.1 to 2.4). The location of each station is described below.

- Station 1: Pickering Creek (most downstream station) downstream of bridge on Creek Road, off of State Road (PA Route 29), Charlestown Township, approximately 11,000 feet upstream of the Pickering Creek Reservoir Dam, 40°06'40.80"N, 75°31'21.30" W
- Station 2: Pickering Creek upstream of the bridge on Charlestown Road, across from Charlestown United Methodist Church on Church Road, Charlestown Township, approximately 24,000 feet upstream of the Pickering Creek Reservoir Dam, 40°06'05.84"N, 75°33' 02.10"W
- Station 3: Pigeon Run upstream of bridge on Merlin Road, East Pikeland Township, approximately 1,000 feet upstream of its confluence with Pickering Creek, 40°05'58.96"N, 75°34' 51.91"W

- Station 4: North Branch Pickering Creek downstream of bridge (just north of Old Kimberton Road), on Kimberton Road (PA Route 113), East Pikeland Township, approximately 900 feet upstream of its confluence with Pickering Creek, 40°06'28.03"N, 75°36'04.55"W
- Station 5: Pickering Creek at West Pikeland Township Park (off of PA Route 113), West Pikeland Township, approximately 42,000 feet upstream of the Pickering Creek Reservoir Dam, 40°05'52.14"N, 75°36'38.79"W
- Station 6: Pine Creek upstream of bridge on south Yellow Springs Road, West Pikeland Township, approximately 800 feet upstream of its confluence with Pickering Creek, 40°05'31.36"N, 75°36'52.43"W
- Station 7: Middle Branch Pickering Creek downstream of bridge on Art School Road, West Pikeland Township, approximately 2,500 feet upstream of its confluence with Pickering Creek, 40°06'00.45"N, 75°37'26.23"W
- Station 8: Pickering Creek (most upstream station) upstream of bridge on Conestoga Road (PA Route 401), West Pikeland Township, approximately 58,000 feet upstream of the Pickering Creek Reservoir Dam, 40° 05'00.64"N, 75°38'37.31"W
- Stations 9 and 10: Rock Run upstream of bridge on Old Ridge Road; South Coventry Township, approximately 1,000 feet upstream of its confluence with French Creek, 40°10'29.61"N, 75°41'39.10"W (this station served as the reference station, and was a duplicate sample).

Appendix A contains photographs of each sampling location. Figure 2.5 is a stick diagram showing the relative location of the stations. Each of the nine stations was sampled for benthic macroinvertebrates. Water quality parameters were measured, and a habitat assessment was conducted at each station.

3.0 METHODS

This survey was conducted using the following technical protocols issued by PADEP: *Instream Comprehensive Evaluation Surveys* (PADEP 2007a) and *A Benthic Index of Biotic Integrity for Wadeable Freestone Streams in Pennsylvania* (PADEP 2007b). PADEP's methods are based on the RBPs.

Stations were selected in accordance with the DEP protocols and the availability of access to the stream. Stream reaches were first selected on topographic maps and distributed throughout the length of the stream. Stations were also placed on major tributaries. At each reach of the stream, the best riffle/run habitats that extended for at least 100 meters were selected as the sample station. Habitat variability between stations was reduced using this method.

3.1 WATER QUALITY PARAMETERS

Water temperature (degree Celsius), pH (standard units), dissolved oxygen (mg/L), turbidity (NTU), redox (ORP, mV), and specific conductivity ($\mu\text{S}/\text{cm}$) were measured with a calibrated Horiba multi-parameter electronic meter at each station.

3.2 BENTHIC MACROINVERTEBRATE SAMPLING

The semi-quantitative assessment of the benthic macroinvertebrate community was conducted in accordance with the anti-degradation survey methodologies of the PADEP *Instream Comprehensive Evaluation Surveys* (PADEP 2007a) and *A Benthic Index of Biotic Integrity for Wadeable Freestone Streams in Pennsylvania* (PADEP 2007b). Benthic macroinvertebrates were collected from nine stations (two samples were collected at the reference station). Samples were collected from the most downstream to the most upstream station, to eliminate contamination and disturbance from upstream stations. Two samples were taken at Rock Run, one upstream of the other.

At each station, a 100 meter long survey reach was delineated, to ensure that more than one riffle and variable habitat features were characterized. A D-frame kick net (with 500-micron mesh) was used to collect samples. The kick net was held on the stream bottom with the opening facing upstream while the sampler vigorously kicked a one square meter of stream bottom for a timed one-minute period. Each sample was a composite consisting of six D-frame net kicks, spaced along the 100 meter reach. Benthic

macroinvertebrates were sampled from fast and slow riffle/run areas of the stream because riffles and runs have the greatest variety of microhabitats and support the most diverse and abundant benthic macroinvertebrate species.

The net contents from each sample were transferred to a labeled sample container and preserved with 70% ethanol. Organisms were gleaned from large rocks and other debris while still in the net. Each sample bottle was labeled internally and externally with an individual sample number, location, date and sampler name.

All organisms were delivered to Normandeau Associates' taxonomic laboratory in Stowe, Pennsylvania following standard chain-of-custody procedures. In-lab processing followed the methods specified in PADEP's 2007 protocols. Organisms from a 200-organism subsample (± 40 organisms) were identified and enumerated to the lowest practical level, usually Genus for insects.

3.3 DATA ANALYSIS METHODS

3.3.1 2007 BIOTIC ASSESSMENT METHODOLOGY

Macroinvertebrate data was analyzed in accordance with the PADEP Protocol (PADEP 2007). This method is based on the RBP assessment (Barbour et al., 1999), which used an approach for an integrated assessment of a benthic community by comparing a potentially impacted station to a reference station. Aquatic earthworms and tubifex worms (tubificids) are identified to Class; midges are identified to Family (Chironomidae) and other insects are identified to Genus for the calculation of the metrics. For the 2007 methodology, a suite of indices (such as abundance, diversity, and tolerance metrics) were compiled and assessed by statistical analyses. From this analysis, PADEP selected six metrics that best discriminated between reference and stressed sites. These metrics were:

- Taxa Richness;
- EPT richness;
- Modified Beck's Index;
- Modified Hilsenhoff Biotic Index (HBI);
- Shannon Diversity Index; and
- Percent intolerant individuals.

Taxa richness was calculated to determine the balance of the communities at each station. Taxa richness is the sum of the total number of taxa in the sample. EPT richness was calculated for each station to quantitatively assess water quality. EPT richness is the sum of the total number of taxa within the aquatic insect Orders Ephemeroptera, Plecoptera, and Trichoptera. Percent intolerant taxa measures the number of taxa with a tolerance level of five or less. While tolerant taxa can live in a variety of streams, intolerant taxa are typically restricted to healthy streams; therefore, as the percent tolerant taxa increases, it is likely that there are stressors affecting the stream.

A Modified Hilsenhoff Biotic Index (HBI) was calculated at each station to determine the pollution tolerance of the benthic macroinvertebrate community based on PADEP guidance. A HBI pollution tolerance value of 10 indicates a taxon has a high tolerance for pollution while a 0 indicates a taxon that is pollution intolerant. HBI was calculated as the sum of:

$$\frac{\text{Number of Individuals within a Species} \times \text{Tolerance Value of the Species}}{\text{Total Number of Individuals in the Sample}}$$

The lower the score, the more pollution sensitive the community is.

Modified Beck's Index is a weighted count of taxa with pollution tolerance values of 0, 1, or 2. As pollution sensitive taxa are lost, the metric is expected to decrease in value.

$$\text{Modified Beck's index} = 3(n_{\text{taxaPTL}=0}) + 2(n_{\text{taxaPTL}=1}) + 1(n_{\text{taxaPTL}=2}),$$

where n_{taxaPTL} = the number of taxa in a sample with a pollution tolerance level of 0, 1, or 2.

Shannon Diversity index measures taxonomic richness and evenness of individuals across taxa. The value of the metric is expected to decrease as pollution sensitive taxa are lost.

$$\text{Shannon Diversity index} = - \sum (n_i / N) \ln (n_i / N),$$

where n_i = the number of individuals in each taxa (relative abundance) and N = the total number of individuals in a sub-sample.

To calculate a score for each station, metrics that increase in value with increasing stress (i.e., HBI) were standardized to the 5th percentile of metric scores for all samples (i.e.,

reference, non-reference, stressed, and test from the 2007 methodology). Metrics that decrease in value with increasing stress (i.e., EPT richness, Shannon Diversity index, total richness, Beck's Index, and percent intolerant) were standardized to the 95th percentile of metrics scores for all samples. The resulting standardized values for the six metrics were averaged and multiplied by 100 to represent the index of biological integrity (IBI) score for a sample.

The 2007 methodology does not require sampling at a local reference site. PADEP defined reference conditions based on a number of sites across Pennsylvania.

IBI values derived from these sites were used to provide the basis of comparison of candidate streams. Low IBI scores correspond to increasing deviation from the expected reference condition and progressively higher values corresponding more closely to the biological reference condition (Barbour et al. 1995).

An IBI score of less than 63 indicates that the stream is degraded. A score of greater than or equal to 80 is required to designate a stream HQ or EV. However, other factors (see discussion in Section 1.0) may be used to determine special protection status, and this score is not to be used as an impairment threshold for special status streams. A stream that is already designated HQ or EV prior to the new assessment protocol will keep their special status even if their score is below 80. However, IBI scores calculated for future assessments will not be allowed to drop more than 10 points (or below 63, depending on the original score) in order to retain their HQ or EV status (PADEP 2007).

3.3.2 2003 BIOTIC ASSESSMENT METHODOLOGY

The previous PADEP methodology is described in *Water Quality Antidegradation Implementation Guidance* (PADEP 2003). This method was used by PADEP until the 2007 method was implemented. The method compared various metrics at Candidate streams to those at Reference streams. For a stream to be classified EV, its percent similarity to a reference EV station had to be 92% or greater.

There were some differences in macroinvertebrate sampling methods in the 2003 methodology compared to the 2007 methodology but both methods require a collection of several samples from a 100 meter reach. As in the 2007 methods, the aquatic earthworms and tubifex worms (tubificids) were identified to Class; midges were identified to Family (Chironomidae) while other insects are identified to Genus.

Five metrics are used in applying the 2003 methodology and were calculated using data from each station (candidate and reference). These metrics were:

- taxa richness,
- modified EPT index,
- modified Hilsenhoff index,
- percent dominant taxa, and
- percent modified mayflies.

For the modified EPT index, mayflies (Ephemeroptera; except Families Baetidae, Caenidae, and Siphonuridae), stoneflies (Plecoptera), and caddisflies (Trichoptera; except Families Hydropsychidae and Polycentropodiae) were included. For percent modified mayfly, all mayfly Genera were included except those in the Families Baetidae, Caenidae, and Siphonuridae.

Each metric for the candidate streams was normalized to the same scale (using the reference stream results) and given a score from 0-8, with higher scores indicating similarity to the reference station. The scores were then added together to give a candidate stream score. The greatest score of 40 (five metric scores times eight) indicated excellent, or reference conditions. The candidate score was divided by the reference score and multiplied by 100 to obtain a percentage. If the percentage was 92% or greater, the candidate stream was suitable for an EV stream classification, and if the percentage was 83-92%, the candidate stream was suitable for the HQ classification.

3.4 HABITAT ASSESSMENT

An assessment of physical stream parameters was made to complete a habitat evaluation. Habitat assessment forms (included in the PADEP *Instream Comprehensive Evaluation Surveys* (PADEP 2007a)) were utilized to collect data on 12 habitat parameters, which were rated excellent, good, fair or poor. The scores were summed to obtain a habitat score. The PADEP protocol describes “optimal” category scores from 240 to 192; “sub-optimal” from 180 to 132; “marginal” from 120 to 72; and “poor” as 60 or less. The gaps between these categories are left to the discretion of the investigator’s best professional judgment.

4.0 RESULTS

Weather conditions on May 6 were sunny and warm, and were cloudy and warm on May 7. A light rain began falling on May 7 during sampling at the last station. Previous to that it had rained lightly three nights before the sampling. At the time of the survey, stream flows were low but sufficient for D-frame kick net sampling. Field data sheets are included as Appendix B.

The results of the May 6 and 7, 2008 stream survey including water quality field measurements, benthic macroinvertebrate sampling data, and habitat assessments are presented in the following sections.

4.1 WATER PARAMETER MEASUREMENTS

The field parameters measured by CRA on May 6 between 9:30 AM and 5:00 PM and May 7 between 10:00 AM and 12:10 PM are shown in Table 4.1.

The high air temperature was between 27.7^o C and 29.4^o C (82^o-85^o F). Water temperature ranged from 14.47 °C at Station 1, furthest downstream, to 18.78 °C at the most upstream station on Pickering Creek (Station 8). The upstream increase was most likely due to solar warming of stream as the day progressed. The reference station (Rock Run) was 18.26°C. All stations except Stations 5 and 8 on Pickering Creek and the reference station had temperatures below the maximum high (17.7 °C) permissible for a TSF waterbody as designated by PADEP (Chapter 93).

Specific conductivity ranged from 138 µS/cm at Station 4 (North Branch) to 298 µS/cm at Station 6 (Pine Creek). The slightly higher readings may be due to geologic conditions or anthropogenic influences in the watershed. Specific conductivity at Rock Run was low at 98 µS/cm.

Field pH readings were similar and slightly acidic, ranging from 6.12 at Station 4 to 7.24 at Station 5. Field pH at the reference station was 6.47.

Dissolved oxygen concentrations ranged from nearly saturated (98% at Station 4) to super-saturated, (125% at Station 5). All concentrations were above the minimum of 6 mg/L required for HQ-TFS streams.

Turbidity values were below water quality criteria and ORP readings were within a normal range.

4.2 BENTHIC MACROINVERTEBRATES

Benthic macroinvertebrate sampling results are presented as Table 4-2 and are discussed in this section of the report. Samples were collected from Stations 1, 2, 5, 8, 9, and 10 on May 6, 2008 and from Stations 3, 4, 6, and 7 on May 7, 2008. Ninety-five (95) different taxa (usually Genera, combined from all Pickering Creek stations and reference station) were identified. Appendix C lists taxa collected at each station.

All the stations supported an assemblage of species, including aquatic worms and insects such as mayflies, stoneflies, beetles, caddisflies, and chironomids. Except for Station 2 and the reference stations all the remaining stations were dominated by aquatic worms and midge larvae (Chironomidae). Figure 4.1 illustrates this dominance of worms and midges. Station 6 (Pine Creek) had the greatest percentage of aquatic earthworms and chironomids, with these organisms comprising 76.5% of the identified organisms. This dominance of generally pollution tolerant organisms accounts in large measure for the bioassessments results described in the following two sections of this report.

Station 2 (lower Pickering Creek) had the fewest worm taxa, probably due to lack of fine sediments at this station. Station 6 had the lowest taxa richness and Station 2 had the greatest number of taxa when individual Chironomidae taxa are included. The blind duplicate samples labeled Stations 9 and 10 were relatively equivalent, indicating good field and laboratory procedures.

The benthic macroinvertebrate results were evaluated in accordance with PADEP's 2007 and 2003 anti-degradation guidance documents. These evaluations are discussed in the following two sections.

4.2.1 BIOTIC ASSESSMENT USING 2007 PROTOCOL

The evaluation of the macroinvertebrate data based on PADEP protocol (2007a and 2007b) included the calculation of the following metrics:

- Taxa Richness;
- EPT richness;
- Modified Beck's Index;
- Modified Hilsenhoff Biotic Index (HBI);
- Shannon Diversity Index; and
- Percent intolerant individuals.

Table 4.3 presents the calculated metrics. For each station, the average of the adjusted standardized metric scores was calculated, which determined the IBI score for that station. IBI scores ranged from 25 at Station 6 to 68 at Station 2. Only one Pickering Creek station, Station 2, had an IBI score above 63, above the threshold for which sites are considered degraded. The average IBI for the main branch Pickering Creek stations was 53 and average value for the four tributaries was 43. The average IBI of the reference stations 9 and 10 was 64.

Table 4.4 summarizes and Figure 4.2 illustrates the metric scores and provides PADEP rating criteria. A station needs an IBI score equal to or greater than 80 to qualify for HQ or EV status. All eight Pickering Creek and tributary stations scored less than 80. The reference stations also scored less than 80; however, the reference site was already designated EV. In addition, all but one of the eight stations scored less than 63, indicating impaired stream conditions.

4.2.2 BIOTIC ASSESSMENT USING 2003 PROTOCOL

Table 4.5 and Figure 4.3 summarize the weighing of the stations based on the 2003 methodology that uses five metrics and a comparison to the reference stations. For this assessment, average values of Stations 9 and 10 were used. Pickering Creek Stations were compared to the Reference average values and scored. Percent similarity to the reference station values ranged from 8% at Station 6 (Pine Creek) to 93% at Station 2.

The main branch Pickering Creek stations averaged 69% and the tributary stations averaged 44%. All the stations except for Station 2 scored very high on the HBI metric indicating a dominance of pollution tolerant organisms at the stations.

Candidate Stations must be 92% similar or greater to the reference station to be suitable for an EV stream classification. If the percent similarity is within 83-92%, the candidate stream meets the HQ classification. Only Station 2 exceeded the EV and by only one percentage point. Stations 1 and 5 that bracket Station 2 did not meet the EV criteria;

therefore, based on this data there is not a defined stream reach where the EV criteria was achieved.

4.3 HABITAT ASSESSMENT

Habitat features of each station and their habitat scores are summarized in Table 4.6 and shown on Figure 4.4. Data sheets are in Appendix D. Habitat features are described in the following paragraphs.

Station 1: Habitat features at Station 1 scored 178 out of 240 possible points. This is in the suboptimal range. Station 1 was the most downstream station on Pickering Creek. The station was located about 3,000 feet upstream of the water supply reservoir at the confluence with the Schuylkill River. The creek here was wide (30-40 feet) with islands containing mature trees and other vegetation in the middle of the channel. The stream was well shaded but the riparian zone was limited, particularly on the right bank, which was recently mowed to about 3 feet of the bank due to the presence of athletic fields. There is a roadway beyond the steep but well vegetated left bank. Vegetation included tulip poplars, American beech, and saplings. The riffles were well developed with limited embeddedness, a mix of cobble and gravel substrate, and a variety of habitats. Flow was low and water did not completely fill the channel. There were some areas of limited erosion but the bank is approximately 80% covered with vegetation, some of it overhanging the stream channel.

Station 2: Habitat features at Station 2 scored 212 out of 240 possible points. This is in the optimal range. Station 2 on the Pickering Creek was located off of Church Road, upstream of the bridge on Charlestown Road. The stream was less shaded than Station 1 due to a lack of mature trees on the left bank. The stream channel is narrow due to high and steep banks and this restriction resulted in greater water velocities than were observed at other stations. Fine sediments were lacking probably due to high velocities that transported finer sediments to downstream areas. The left bank was still well vegetated with herbaceous plants and a small palustrine emergent wetland between the stream and the road. The right bank of the stream had a narrow strip of shrubs, saplings, and mature trees such as red maple and sycamore. Beyond this vegetated zone were agricultural fields. The substrate was covered by a slippery film of algae. The riffle areas were well developed with a mix of cobble and gravel, a variety of habitats, and low embeddedness. Water reached the bases of both banks in most areas.

Station 3: Habitat features at Station 3 scored 214 out of 240 possible points. This is in the optimal range. Station 3 was located on Pigeon Run, a tributary of Pickering Creek. Pigeon Run is a small third order tributary that is well shaded in the sampling location. Both banks were vegetated with herbaceous plants, shrubs, saplings, and mature trees. Two large trees had fallen into the stream; vines and vegetation also overhung the channel in several places. There was some channelization where the bridge was constructed. The banks were stable with little erosion, and water reached the base of the banks in most areas. Two riffle areas were sampled, which were separated by a deep pool. The riffles were well developed, consisting of cobble, gravel and sand with a variety of habitats and little embeddedness.

Station 4: Habitat features at Station 4 scored 178 out of 240 possible points. This is in the suboptimal range. The North Branch Pickering Creek converges with Pickering Creek upstream of the Church Road Bridge. The tributary was sampled downstream of the bridge on Route 113. There were no riffle areas just downstream of the bridge; the stream consisted mainly of deep pools with some rocky substrate and vegetation growing in some areas of the channel. Further downstream the tributary was narrow but flowing swiftly in several riffle areas. The tributary was mostly open due to lack of mature trees on the banks, particularly on the left bank. Vegetation on the left bank consisted of grasses; it appeared that the tributary had overflowed its banks and flattened much of the grass that was growing on the steep left bank. Other areas of erosion were also observed. Pooled areas along the right bank were supporting blue flag and duckweed. The riffle areas were well developed with a mix of cobble, gravel and sand.

Station 5: Habitat features at Station 5 scored 173 out of 240 possible points. This is in the suboptimal range. Station 5 was on the main branch of Pickering Creek, within Pikeland Township Park off Route 113. The park appeared to be an abandoned children's day camp; there were buildings and small shacks built along the right bank of the stream, and several footbridges crossed the stream. The stream was wide and only partly shaded due mainly to mature trees growing on the left bank and a few mature trees on the right bank. While the right bank was steep, formerly mowed and currently covered with herbaceous plants, the left bank was forested with saplings and mature trees such as box elders, silver maples, and sycamores. However, further downstream, there was undisturbed forest on the right bank. The banks were eroded and undercut in many areas and there was some woody debris and concrete blocks and slabs in the channel. Flow was very low and there was a large area of exposed gravel along the left bank. At the downstream end of the riffle were rocks placed like a small

dam, with a shallow pool area downstream of the rocks. The riffles contained a mixture of boulders, cobble and gravel. There was some sedimentation around the rocks but it did not appear that the exposed streambed was being enlarged by sediment deposition. Riffle areas were interspersed with shallow runs. Habitat variety was not as great here as other stations on Pickering Creek.

Station 6: Habitat features at Station 6 scored 186 out of 240 possible points. This is in the optimal/suboptimal range. Pine Creek was sampled upstream of the bridge on South Yellow Springs Road. This tributary originates in the Lionville area and flows north to its convergence with Pickering Creek north of South Yellow Springs Road. The left bank of the stream was well vegetated with mature trees, shrubs, and herbaceous plants, and partially shades the stream. Braefield Road, leading into a housing development, is located approximately 30 feet from the right bank. The roadside was mowed grass, but there was a narrow riparian area consisting of mature trees and shrubs left along the bank. Adjacent to the bridge on the right bank the terrain was steep and several large boulders were piled up on the bank and in the tributary. The banks were moderately stable in the sampling area, but severely eroded in areas upstream and downstream. Herbaceous plants covered most of the banks along the sampling reach. Flow was low during the time of sampling and water did not completely fill the channel, leaving some areas of islands and exposed riffles along the banks. However, the riffle areas were well developed with a mixture of boulders, cobble and gravel, and little sedimentation.

Station 7: Habitat features at Station 7 scored 213 out of 240 possible points. This is in the optimal range. Station 7, on the tributary referred to as the Middle Branch Pickering Creek, was located upstream of the bridge on Art School Road. The sampling reach was mostly shaded due to a wide riparian zone on either side of the stream, vegetated with mature trees, shrubs, and herbaceous plants. The banks were mostly level and rocky with some herbaceous vegetation. On the right bank and further downstream the banks were steeper. Flow was low and some limited areas of substrate were exposed, including a few sandy areas along the banks. Riffle areas were frequent and had little sediment deposition. Substrate was varied with a mixture of boulders, cobble, gravel and sand, and a variety of habitats were available.

Station 8: Habitat features at Station 8 scored 152 out of 240 possible points. This is in the suboptimal range. Station 8 is the furthest upstream station on the main branch of Pickering Creek, and was located upstream of the bridge on Route 401 (Conestoga Road). The riparian zone was limited due to mowed lawn areas on both banks

(particularly the left bank) but the bank was well vegetated on the right bank with a few small trees, multiflora rose, and herbaceous plants. The stream was mostly unshaded. The banks were steep and rocky with herbaceous vegetation; some areas of erosion were present, mainly by the bridge. Several small gravel bars were exposed at the time of sampling. Riffle were frequent upstream of the bridge, with pools present downstream of the bridge. The riffles consisted of boulders, cobble, and gravel, with sedimentation.

Station 9: Habitat features at Station 9 scored 185 out of 240 possible points. This is in the suboptimal range. Station 9, on Rock Run, was the reference site. Rock Run was sampled upstream of the bridge on Old Ridge Road, off Route 23 (Ridge Road). Land use in the Rock Run watershed is mainly forested with some rural residential areas. The sampling reach had a limited riparian zone due to a residence on the left bank and a pasture on the right bank; however, there were mature trees (sycamore, red maple) shading the stream and an abundance of shrubs, e.g. multiflora rose, and herbaceous plants on the banks, particularly the right bank. Immediately upstream was a dense forested area along both banks of the stream. Water reached the base of both banks and there was little sedimentation or embeddedness in the substrate. The substrate was tightly packed over bedrock in 50% of the channel; boulders, cobble, and gravel was also present. The bedrock created a step like habitat with water flowing over the bedrock as small waterfalls. There was a variety of habitat.

Three stations, 2, 3, and 7, scored optimal in the habitat assessment, while Station 6 scored optimal/suboptimal. These sites scored high on most parameters, particularly instream cover for fish, lack of substrate embeddedness and sediment deposition, variety of flow regimes, and frequency of riffles. Four Pickering Creek Stations, 1, 4, 5, and 8, and the reference station, 9/10, scored suboptimal. While these stations scored similar to the optimal stations on many parameters, they scored lower on the more broad scale parameters such as bank vegetative coverage, grazing and other disruptive pressure, and riparian vegetative zone width. The reference station scored suboptimal because of a limited riparian zone, due encroachment by a house and a grazing pasture.

5.0 DISCUSSION AND CONCLUSIONS

The purpose of this stream assessment was to determine if Pickering Creek meets the biological criteria of an Exceptional Value (EV) watershed as specified in PADEP's Chapter 93 and guidance documents. A total of eight locations on the Pickering Creek watershed were assessed. Four of these stations were on the main branch of Pickering Creek from upstream of the Pickering Creek Reservoir to the headwaters at Route 401. A total of four stations were on the major tributaries, Pigeon Creek, North Branch, Pine Creek and Middle Branch. A reference station was also sampled on Rock Run (an EV tributary to French Creek).

CRA found that the aquatic community at all the stations was relatively diverse with various species of aquatic worms and insects including mayflies, stoneflies, beetles, caddisflies, and chironomids. A total of 95 taxa were identified from all stations. However, the majority of stations were dominated by aquatic worms and midge larvae (Chironomidae). The benthic community at the Pine Creek Station 6 was comprised of 76.5% aquatic earthworms and chironomids. Station 2 (located in the lower Pickering Creek) had the fewest worm taxa, probably due to lack of fine sediments and higher water velocities at this station. The benthic macroinvertebrate community is used as an indicator of the health of aquatic community. Streams that are frequently disturbed lack long-lived species and usually contain small, short-lived species or species with high reproductive rates such as chironomids (Hershey and Lamberti, 2001).

CRA conducted its biological assessment using two methods developed by PADEP: its current 2007 method using IBIs and the former 2003 method that uses percent similarity to a reference station. CRA's May 2008 survey IBI scores ranged from 25 to 68. Only one station had an IBI score above 63. Values of 62 or less are considered to represent degraded stream conditions. The average IBI for the main branch Pickering Creek stations was 53 and average value for the four tributaries was 43. The average IBI value for the entire watershed was 48. An IBI score of 80 or greater is necessary to qualify as an EV stream.

If the 2003 method is used then the percent similarity to the reference for seven of the eight stations ranged from 8% to 70%. One station scored 93%, likely due to localized habitat conditions, because a station immediately upstream and another downstream scored 48% and 60%, respectively. The main branch Pickering Creek stations average was 69% and the average of the four tributary stations was 44%. The average percent

similarity for the watershed was 56.5%, below the required 92% similarity required for EV status.

There was no clear indication of whether water quality or habitat conditions were the cause of the impairment. Specific conductance values generally increased at those stations with the lowest biotic scores. However, no evidence of discharges or spills was observed. Habitat conditions were generally good. The station that scored the highest biologically (Station 2), had the highest water velocities due to a constricted channel. The higher velocities were apparently transporting fine sediment materials downstream. This process would result in maintaining interstitial spaces in the substrate and creating good circulation between overlying water and the substrate. Both of these conditions are optimal to support a diverse community of benthic organisms.

Based on the results of this survey, it can be concluded that the Pickering Creek watershed does not qualify as an EV watershed.

6.0 REFERENCES

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