# *Ecological Inventory Report*

## *Aquatic and Terrestrial Animal Communities*

## *Upper Dugway Valley*
## *Forest Hill Park*
## *Cleveland Heights, Ohio*

December, 2003

DAVEY
RESOURCE GROUP
*A Division of The Davey Tree Expert Company*

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## *Cleveland Heights, Ohio*

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# Introduction

Forest Hill Park is located in the cities of Cleveland Heights and East Cleveland, nestled between Monticello Boulevard, Superior Boulevard, Terrace Road, and Lee Boulevard. This 266-acre urban park was once the Rockefeller family's summer estate, but fire took the main house in 1917. John D. Rockefeller, Jr. donated the family lands to the two municipalities. The transfer deed contains an agreement that requires each city be responsible for Forest Hill Park lands within its boundaries and that all development and maintenance follows the intent of the A. D. Taylor[1] master plan.

In 2001, Pressley Associates of Cambridge, Massachusetts, completed an update to the Forest Hill Park Master Plan. The plan identifies twelve zones for park improvements. Two of the zones are within Cleveland Heights—one is Upper Dugway Valley. The plan calls out needs for erosion control, eradication of invasive species, and protection of rare and endangered plants in the valley.

The City of Cleveland Heights contracted Davey Resource Group (Davey) and Kerr + Boron Associates to prepare conceptual plans addressing these three issues (*Environmental Design and Improvement Plan—Upper Dugway Valley, Forest Hill Park, Cleveland Heights, Ohio, 2002*). Following recommendations made in the 2002 report, Davey conducted an ecological survey of aquatic communities and terrestrial wildlife in the Upper Dugway Valley. The findings of that study are contained in this report. The results will provide baseline information that can be used to evaluate the ecological health of these communities in the future.

# Field Surveys

## Aquatic Ecological Survey

Dugway Creek is the dominant aquatic feature within the study area. Forest Hill Park is the only area in which Dugway Brook flows above ground before it enters Lake Erie; the remainder of Dugway Brook is enclosed in culverts below the cities of Cleveland Heights and East Cleveland. Stormwater sewers, combined sanitary sewer overflows, and wastewater treatment effluent all empty into Dugway Brook upstream of Forest Hill Park. Combined with regular scouring during storm events, Dugway Brook, although beautiful, has grave ecological problems that may not easily be remedied. Davey sampled Dugway Brook for aquatic habitat, water chemistry, macroinvertebrates, and fish.

### Ohio EPA Use Designations

Ohio EPA assigns use designations to the streams it samples. Designations describe aquatic life (habitat, fish, aquatic bugs), recreational (physical/external human contact with water), and water supply standards a waterbody should be capable of attaining. Davey contacted Ohio EPA to obtain historical sampling data the agency collected on Dugway Brook and its potential aquatic life habitat use designation. Ohio EPA has not formally sampled Dugway Brook and, therefore, has not assigned any use designation.

[1] Alfred D. Taylor (A.D.) was the original landscape architect hired by John D. Rockefeller, Jr. to craft a master plan that would guide development of the donated land into a park.

The "average/healthy" aquatic life use is Warmwater Habitat. **Warmwater Habitat (WWH)** is defined as "a water capable of supporting and maintaining a balanced, integrated, adaptive community of warmwater aquatic organisms having a species composition, diversity, and functional organization comparable to the 25th percentile for identified reference sites within each of Ohio's ecoregions." This site is located in the Erie Ontario Lake Plains (EOLP) ecoregion of the state. Biological indices used to determine WWH criteria include the Index of Biotic Integrity (IBI), Modified Index of Well Being (MIwB), and the Invertebrate Community Index (ICI). Although not officially part of Ohio's Water Quality Standards (Ohio EPA, 1997), the QHEI is also used to determine the potential of a stream to achieve aquatic life use designation. Streams that score QHEI values of 50 or greater are generally considered potential candidates for WWH designation.

Dugway Brook will be referred to in two segments (or branches): the northern branch and the southern branch. Each segment's results have been analyzed and, when possible, compared to WWH standards.

## Stream Habitat

The Ohio Environmental Protection Agency (EPA) has developed a quantified methodology to evaluate fish habitat in Ohio streams and rivers (Ohio EPA, 1989). The Qualitative Habitat Evaluation Index (QHEI) considers various characteristics of the available habitats based on their ability to support viable, diverse aquatic fauna. The type and quality of substrate, amount of instream cover, channel morphology, extent of riparian canopy, pool and riffle development and quality, and the stream gradient are the metrics used to determine the QHEI score. Scores generally range from 20 to 100 (Ohio EPA, 1987) and are compared to reference sites determined for the various ecoregions in Ohio. This study area is in the Erie Ontario Lake Plain (EOLP) ecoregion. The index was developed primarily to complement the Index of Biotic Integrity (IBI), which analyzes water quality based on fish communities. The QHEI is an accurate measure of fish habitat that was constructed to address the habitat characteristics unique to Ohio.

The habitat of Dugway Brook was assessed on July 14, 2003, within the study area based on the ability to support viable, diverse aquatic fauna. Sampling was in accordance with Ohio EPA procedures. Davey completed two QHEI forms—one for each branch of Dugway Brook (Figure 1). These forms are presented in Appendix A. Both branches scored QHEI values well above the minimum value of 50 required for WWH use designation in the EOLP ecoregion of Ohio (Table 1).

***Table 1. Qualitative Habitat Evaluation Index (QHEI) Scores for Dugway Brook***

| Segment | QHEI Score* |
|---|---|
| North Branch Dugway Brook | 71.5 |
| South Branch Dugway Brook | 73.5 |

*A minimum value of 50 is required for WWH use designation in the EOLP ecoregion of Ohio.

From a fish perspective, potential habitat is good within the park. The benthic substrates are dominated by cobble and bedrock, and supplemented with boulder slabs, large gravel, and coarse sand. There are plenty of interstitial places for fish to lay eggs or hide from predators. Channel morphology is stable—it is incised within bedrock—and the combination of various depths of pools and riffles shows good channel development. Instream cover scored moderate, but the surrounding riparian buffer is largely undisturbed and wide. These combined conditions offer potentially good habitat within the study area for macroinvertebrates, amphibians, and fish.

A limiting factor to the described habitat, not scored by the QHEI, is the regular scouring of these stream channels. The surrounding land use outside of Forest Hill Park is urban. Seemingly, average storm events can bring enormous volumes of water crashing through this valley that can flush out eggs and all "unattached" species. During the aquatics study, Davey scientists flipped over boulders and cobbles in each of the stream branches. Nearly all were clean from algal growth and had only the occasional macroinvertebrate clinging to their undersides. The tremendous amounts and forces of water that have scoured those rocks clean will likely prevent some aquatic communities from successfully inhabiting and reproducing in either of the two Dugway branches.

## Benthic Macroinvertebrates

The natural tendency for any ecosystem, including aquatic ecosystems, is to be in a balanced state, called homeostasis (Odum, 1969). Imbalances can occur when some stream constituents are altered. This is especially true when there are changes in the amount of available nutrients, types of substrates, and dissolved oxygen levels (see Hynes, 1966 and 1970 and Odum, 1975). The levels of these components are reflected in the benthic macroinvertebrate community structure of stream ecosystems. This is because macroinvertebrate communities are sensitive to pollution and other stresses to their environments. Examination of macroinvertebrate structure provides insight about the long-term water quality conditions. For example, when ecosystems undergo stress, organisms intolerant to that stress will be extirpated while the stress-tolerant organisms thrive. The loss and survival of particular species groups (due to environmental stress) results in an unbalanced community structure dominated by tolerant organisms. Such community imbalances are easily detectable through population assessments.

This study analyzed macroinvertebrate community structure by examining species diversity, functional feeding levels, and pollution sensitivity of the taxa collected.

Macroinvertebrate collection involved kick sampling two sites of Dugway Brook in Forest Hill Park. Site 1 is the northern branch and Site 2 is the southern branch (Figure 1). Benthic macroinvertebrates were sampled in a semi-quantitative manner to assess overall water quality and to identify unique and unusual species. The sample was a composite of six kicks, two from a riffled area, two from a run, and two from a pool/undercut bank. The six 0.05-$m^2$ samples were collected using a D-frame ring net. The net was placed facing upstream and the substrate was agitated to dislodge any adhering organisms. Organisms collected in the net were preserved in ethanol and quickly transported to the laboratory.

Every organism visible to the naked eye was placed in a labeled vial filled with 70% ethanol. The organisms were separated into similar groups and identified with taxonomic keys (Peckarsky, et al., 1990 and Merritt and Cummins, 1984). Larvae of Chironomidae were mounted on microscope slides using CMC-9/9AF, a semi-permanent slide-mounting medium.

The sampling resulted in the collection and identification of 73 organisms representing 13 taxa. A list of collected taxa is presented in Table 2. The scores and values of the various biological indices and community metrics are presented in Table 3.

A variety of metrics was used to evaluate the health of the benthic macroinvertebrate communities of Dugway Brook. Collectively, these approaches reveal a community reflective of poor to very poor water quality. Stressors to this environment are evident and may be indicative of recent pollution impacts from within the watershed. A more detailed analysis follows.

### *Taxa Richness*

The total number of taxa (13) is indicative of a heavily impacted stream. Minimums of 30 taxa are expected for unimpacted streams (Hellawell, 1986).

### *EPT Taxa Richness*

Three groups of organisms, Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies) (EPT), are considered sensitive to various environmental stressors, including water quality, habitat diversity, and riparian zone quality. The absence of EPT taxa in Dugway Brook Sites 1 (north branch) and 2 (south branch) indicate very poor benthic macroinvertebrate communities, with possible negative environmental influences affecting the assemblage of this environmentally sensitive group of organisms. Organisms in the Ephemeroptera group are especially sensitive to pollution and are usually the first organisms to decline and eventually disappear with the onset of environmental perturbation.

***Table 2. Benthic Macroinvertebrate Census for Dugway Brook at Forest Hill Park***

| Taxon | Site 1 Count | Site 2 Count | Functional Feeding Group[1] |
|---|---|---|---|
| **Oligochaeta** | 12 | 2 | GC |
| **Crustacea** | | | |
| **Amphipoda** | | | |
| *Crangonyx* spp. | 1 | 0 | GC |
| **Insecta** | | | |
| **Coleoptera** | | | |
| Curculionidae | 0 | 2 | SH |
| **Diptera** | | | |
| **Chironomidae** | | | |
| *Chironomus riparius* | 21 | 6 | GC |
| *Cricotopus sylvestris* | 1 | 0 | SH |
| *Lymnophyes* spp. | 4 | 0 | GC |
| *Rheocricotopus* spp. | 1 | 0 | GC |
| **Psychodidae** | | | |
| *Pericoma* spp. | 0 | 6 | GC |
| *Psychoda* spp. | 4 | 12 | GC |
| **Simuliidae** | | | |
| *Simulium vittatum* | 1 | 0 | FC |
| **TOTAL TAXA: 13** | **TOTAL: 45** | **TOTAL: 28** | **TOTAL COUNT: 73** |

[1] ***FC = Filterer Collector; GC = Gatherer Collector; GS = Grazer Scraper; PR = Predator; SH = Shredder***

***Table 3. Metric and Index Scores for Dugway Brook at Forest Hill Park***

| Index/Metric | Score/Value | |
|---|---|---|
| | Site 1 | Site 2 |
| Total Organisms in Kick Sample | 45 | 28 |
| Taxa Richness | 8 | 5 |
| EPT Taxa Richness | 0 | 0 |
| Total Ephemeroptera (Mayfly) Taxa | 0 | 0 |
| Total Plecoptera (Stonefly) Taxa | 0 | 0 |
| Total Trichoptera (Caddisfly) Taxa | 0 | 0 |
| Percent EPT Composition | 0.00 | 0.00 |
| Shannon Diversity Index | 1.48 | 1.40 |
| Biotic Indices | | |
| Hilsenhoff Biotic Index (HBI) (tolerances adjusted for Ohio) | 8.83 (Very Poor) | 8.50 (Poor) |
| Qualitative Community Tolerance Value (QCTV) | 18 (Poor) | 22 (Fair) |
| Pollution Tolerance Metrics | | |
| Percent Toxic Tolerant Taxa | 2.22 | 0.00 |
| Percent Selected Toxic Tolerant Taxa | 2.22 | 0.00 |
| Percent Organic Tolerant Taxa | 75.56 | 28.57 |

### *Percent EPT Composition*

The percent EPT composition was non-existent (0.00%) at both sites compared to non-impacted streams that tend to have much higher EPT compositions of 65% and more, while moderately impacted streams have concentrations of 55%-65%.

### *Shannon Diversity Index*

A Shannon Diversity Index value of 1.48 and 1.40 was calculated for sites 1 and 2 respectively. These values indicate these are highly disturbed streams. Non-impacted sites generally have minimum diversity index values of 3.

## Biotic Indices

### *Hilsenhoff Biotic Index (HBI)*

The Hilsenhoff Biotic Index (HBI) is frequently used to evaluate levels of organic pollution in streams. This index is semi-quantitative and can be convenient for use in rapid bioassessments. The HBI has been considered one of the most reliable quantitative indices available (Szytko, 1988). Tolerance values from 0-10 are assigned to 359 species used in the calculation of the index (Hilsenhoff, 1987). Tolerance values increase with the ability of an organism to withstand organic pollution. In general, streams with higher HBI scores exhibit higher levels of organic pollutants. Because of its semi-quantitative nature, the HBI is best used in conjunction with other indices when assessing water quality. The weakness of the HBI is its exclusion of species other than arthropods and its restricted ability to detect non-organic pollutants.

The calculation of the HBI (using tolerance values adjusted for Ohio) to detect the level of organic pollution at this location produced scores of 8.83 and 8.50 for sites 1 and 2 respectively. These scores receive respective narrative ratings of *Very Poor* and *Poor*, indicating heavy contamination by organic pollution.

### *Qualitative Community Tolerance Value (QCTV)*

A new Ohio EPA water quality assessment tool is the Qualitative Community Tolerance Value (QCTV) index, an offshoot of the Invertebrate Community Index (ICI). The QCTV is calculated from semi-quantitative kick-net samples from natural substrates to substitute for the installation, retrieval, and processing of Hester-Dendy (HD) Artificial Substrate Samplers (Deshon, 1995). It utilizes Qualitative Community Tolerance Values derived from macroinvertebrate collections in Ohio using Hester-Dendy artificial substrates. The tolerance value is determined from all ICI scores at all locations and weighted by the abundance data for each taxon. The tolerance value is the mean of the weighted ICI scores for that taxon. The tolerance value of a given taxon represents the level of tolerance to environmental stressors in terms of the 0-60 scale of the ICI. The most pollution intolerant taxa, which have the greatest abundance at undisturbed sites and a high ICI score, receive high tolerance values. Conversely, the most pollution tolerant taxa, with the greatest abundance at highly impacted sites and have low ICI scores, receive low tolerance values. This tool can be used in the same fashion as the HBI. The advantage of the QCTV is that all tolerance values are determined from macroinvertebrates collected specifically from Ohio. The tolerance values used were calibrated for the EOLP ecoregion of Ohio. The results can be analyzed using ICI narrative ratings.

A QCTV score of 18 (*Poor*) was calculated for Site 1 and a score of 22 (*Fair*) was calculated for site 2. These scores indicate that these sites have the potential, if sampled using Hester-Dendy artificial substrate samplers, to generate ICI scores of at least 18 and 22 respectively, which, if applied to the Ohio EPA biological criterion for the ICI, would not be in attainment for Warm Water Habitat use designation.[2] The scores indicate a heavily disturbed invertebrate community. Examination of the various community metrics, used in the calculation of the ICI, indicate that the benthic macroinvertebrate community is being impacted by negative environmental influences.

[2] The minimum ICI value for WWH attainment in the Erie/Ontario Lake Plain region is 34.

### *Pollution Tolerance Metrics*

Three pollution tolerance metrics were used to assess the water quality and to determine what type of water quality impacts may be influencing the structure of the benthic macroinvertebrate community: Percent Toxic Tolerant Taxa, Percent Selected Toxic Tolerant Taxa, and Percent Organic Tolerant Taxa (Yoder and Rankin, 1991).

The percent composition of Organic Tolerant Taxa (75.56% and 28.57% for sites 1 and 2 respectively) was significantly higher than Toxic Tolerant Taxa (2.22% and 0.00% respectively) and Selected Toxic Tolerant Taxa (2.22% and 0.00% respectively), indicating that organic pollution is an environmental stressor influencing the benthic macroinvertebrate communities at sites 1 and 2 in Dugway Brook.

### *Functional Feeding Group Distribution*

Functional Feeding Group (FFG) distribution was also examined to measure the macroinvertebrate community structure at sites 1 and 2. Distributions for the following functional feeding groups at Site 1, Collectors (97.8%) (Gatherers [95.6%] + Filterers [2.2%]), Shredders (2.2%), Predators (0.00%%), and Grazers/Scrapers (0.00%), indicate that collectors had a disproportionately high abundance when compared to the other functional feeding groups, which had lower than expected abundances. This is indicative of a severely stressed benthic macroinvertebrate community. Small order headwater streams ($1^{st}$-$3^{rd}$) have benthic macroinvertebrate communities comprised roughly of 45% Collectors, 35% Shredders, 15% Predators, and 5% Grazers (Cummins, 1985). The predominance of a single group of organisms (*i.e.*, Collectors), which have many genera considered tolerant to very extreme environmental conditions, indicates a degraded aquatic environment with extreme fluctuations in hydrological and water quality conditions.

Site 2 functional feeding group distributions, Collectors (92.9%) (Gatherers [92.9%] + Filterers [0.00%]), Shredders (7.14%), Predators (0.00%), and Grazer/Scrapers (0.00%), indicate a disproportionately high abundance of Collectors and a low abundance of Shredders, Scraper/Grazers, and Predators. The predominance of a single group of organisms (*i.e.*, Collectors), which have many genera tolerant to adverse environmental conditions, indicates a degraded aquatic environment with extreme fluctuations in hydrological and water quality conditions.

### *Benthic Macroinvertebrate Findings Summary*

In conclusion, data generated from the kick-net samples collected in August 2003 indicate that Dugway Brook sites 1 (north) and 2 (south) are not capable of supporting diverse benthic macroinvertebrate communities. However, Site 2, which had a QCTV score of 22 (Fair), may have a slight potential to be in attainment of the applicable Ohio EPA Warm Water Habitat biological aquatic life use designation. Nevertheless, there appears to be significant imbalance in the community structure, indicating that negative environmental factors are influencing the benthic macroinvertebrate community at both locations. The various metrics and biological indices indicate that organic enrichment (sewage), riparian quality (watershed land uses), and in-stream habitat quality, and diversity are influencing the structure of the benthic macroinvertebrate community of Dugway Brook and may require further investigation to determine the source of perturbation.

## Fish Communities

Dugway Brook was sampled for fish communities on July 14 and 31, 2003. Electrofishing equipment consisted of a Smith-Root, Inc. Model 12-B Backpack Electrofisher unit (Ohio EPA sampling type F). Electrofishing methods followed those set forth by the Ohio EPA (1989). The sampling distance on each visit was approximately 274 meters for Site 1 (north branch) and 183 meters for Site 2 (south branch) and included all habitats present at the sites. The total time fished was 3,127 seconds over the course of six passes.

No fish were caught or observed in either branch of Dugway Brook on July 14, 2003. Both branches were sampled again on July 31, 2003. This second sampling confirmed the absence of fish in this study area of Dugway Brook.

Fish communities are typically analyzed based on natural history characteristics and pollution tolerance classifications as described by the Ohio EPA (1987 and 1989). These data are then used to calculate an Index of Biotic Integrity (IBI) score. The IBI evaluates water quality based upon pollution tolerance levels and the natural history of fish species.

Since no fish were found in either branch of Dugway Brook, the total IBI score for this site is 0. This score is well below the minimum value (38) for attainment of WWH criteria in the EOLP ecoregion of Ohio and is indicative of severely degraded fish habitat conditions.

The lack of fish communities, in the presence of good physical habitat, suggests there are other limiting factors. As communicated in the aquatic habitat and macroinvertebrate discussions, the surrounding urban land use and inflows into Dugway Brook likely create water forces and pollution levels that exceed those which fish species are able to tolerate. Efforts to improve the water quality of Dugway Brook within Forest Hill Park need to extend out from the park boundaries and into the surrounding watershed.

## Water Chemistry

On August 27, 2003, Davey Resource Group scientists collected temperature, pH, conductivity, and total dissolved solids measurements at the north and south water inlets of Dugway Brook. In addition, surface grab samples were collected in sterilized bottles and labeled with sample number, sample location, date, time, and collector's name. All sample bottles were placed on ice in thermal chests and transported to the laboratory for analysis according to U.S. EPA approved methods. The Analytical Report is in Appendix B and the results of this sampling program are summarized in Table 4.

***Table 4. Water Quality Analytical Laboratory and Field Results: Dugway Brook North and South Branches (August 27, 2003)***

| Parameter | Unit | EPA Method | North Branch Dugway Brook | South Branch Dugway Brook |
|---|---|---|---|---|
| pH | s.u. | Field | 7.85 | 8.31 |
| Temperature | Degrees C | Field | 21.2 | 18.4 |
| Total Dissolved Solids | mg/L | Field | 862 | 766 |
| Conductivity | µS | Field | 1842 | 1512 |
| Fecal Coliform Bacteria | cfu/100ml | SM 9222D | 3,000 | 5,000 |
| Biochemical Oxygen Demand (BOD) | mg/l | 405.1 | 4 | 3 |
| Nitrite as N | mg/L | 300.0A | not detected | not detected |
| Nitrate as N | mg/L | 300.0A | 0.85 | 4.8 |
| Arsenic | mg/L | 6010B | not detected | not detected |
| Barium | mg/L | 6010B | not detected | not detected |
| Lead | mg/L | 6010B | not detected | not detected |
| Chromium | mg/L | 6010B | not detected | not detected |
| Selenium | mg/L | 6010B | not detected | not detected |
| Silver | mg/L | 6010B | not detected | not detected |
| Mercury | mg/L | 7470A | not detected | not detected |

Three items of concern were shown in the water quality report: high numbers of fecal coliform bacteria, elevated nitrate levels, and high biochemical oxygen demand/low dissolved oxygen.

The fecal coliform results for the samples show 5,000-bacteria/100 ml for the South Water Inlet and 3,000-bacteria/100ml for the East Water Inlet (north branch). Both samples are well above the limit for primary contact recreation waters[3] (1,000 bacteria/100 ml) and the South Water Inlet sample was at the uppermost limit for secondary contact recreation waters[4] (5,000 bacteria/100 ml). High fecal coliform numbers indicate sewage contamination. These bacteria are not harmful themselves, but they indicate the possible presence of pathogenic bacteria, viruses, and protozoan that live in the digestive tracts and reduce dissolved oxygen levels in the water (U.S. EPA, 2003).

The nitrate level at the South Water Inlet was found to be elevated at 4.8 mg/l. Currently, there are no criterion for nitrate standards in the Ohio Water Quality Standards pertaining to the protection of aquatic life. However, the natural level of ammonia or nitrate in surface water is typically less than 1 mg/L. Excess nitrates can cause low levels of dissolved oxygen that can become toxic to warm-blooded animals at higher concentrations (≥10 mg/l) (U.S. EPA, 2003). Common sources of excess nitrates are wastewater treatment plants, runoff from fertilized lawns or croplands, failing septic systems, or combined sewer overflows.

[3] Primary contact recreation waters are suitable for full-body contact such as swimming, canoeing, or scuba diving with minimal threat to public health because of water quality.

[4] Secondary contact recreation waters are suitable for partial body contact such as wading, with minimal threat to public health because of water quality.

The third concern is the amount of dissolved oxygen (DO) in the stream. Unfortunately, the field meter malfunctioned, so a proper reading was not attained. However, the biochemical oxygen demand (BOD) was tested at the two water inlets and was found to be 4 mg/l at the East Water Inlet and 3 mg/l at the South Water Inlet. A general rule is that the lower the BOD the better, since it directly affects DO. Less than 2mg/l BOD indicates a clean freshwater stream and greater than 5mg/l is characteristic of streams receiving a large amount of organic pollution. High levels of BOD, fecal coliform, and nitrates, suggest dissolved oxygen levels are very low in Dugway Brook.

It cannot be precluded that the water quality in Dugway Brook is being affected by organic pollution from the combined sewer overflow (CSO) pipes that empty into this stream. Many of the CSO's in Cleveland Heights are currently being replaced due to their age and dilapidated nature. Further water quality investigations would have to be completed in order to determine how much of an affect the CSO's are having on the water quality in Dugway Brook.

## *Terrestrial Vertebrates Survey*

Amphibians, reptiles, and mammals were qualitatively surveyed and were identified by sight or by observation of tracks and other signs. Mammal tracks were observed in soft substrate where present and scats were noted; when possible, mammals were identified to species using these signs. Identification of terrestrial vertebrates was based on Conant (1951, 1975) and Gottschang (1981). A complete list of all terrestrial vertebrate species identified during this study is in Table 6.

### Amphibians and Reptiles

Biologists searched areas that would be considered favorable amphibian or reptile habitat. These areas included shallow streams and riffles, sandbars, drainage ditches, dry streambeds, and any additional areas with standing water or moist soil. Large stones and logs were overturned in these areas to expose damp soil where salamanders are often found. After species had been collected and identified, they were released on site and the stones and logs were returned to their original position to prevent loss of soil moisture.

Four species of amphibians and one reptile species were noted for the study area. Overall, the abundance of this group of animals was good for living in such urban surroundings.

Two salamander species were found in Upper Dugway Valley: northern two-lined salamanders and northern dusky salamanders. Individuals were occasionally discovered under rocks and logs along the Dugway Brook corridor. Both species are common inhabitants in wooded areas adjacent to small, rocky woodland streams. Davey biologists talked with a local young resident who walks the park daily with his grandmother. He energetically demonstrated how he looks for salamanders, each day overturning rocks and logs, and directed the researchers to his "best locations". The two species identified above were the two he was used to seeing. No salamanders were found directly in or along Dugway Brook; all were located in small drainageways in upland woods areas.

American toad and green frog were noted in the study area. Both species are common and tolerant of an urban environment. The recorded sighting of a single garter snake was made in the open canopy, grassy area above the north branch culvert inlet. No other snakes were identified during these surveys.

## Terrestrial Mammals

Terrestrial mammals identified during this study are representative of an urban environment. Seven species were identified by sight, tracks, scat, or in the case of the skunk, smell. All species noted during this survey are considered common residents in suburban and urban landscapes. Eastern gray squirrels and chipmunks were the most commonly encountered inhabitants. Tracks were observed identifying the presence of raccoon and white tailed deer. No rare, threatened, or endangered species were present. A complete list of identified species is included in Table 6.

## Winged Mammals

Although they are the most widely distributed group of mammals, bats are also the most overlooked and understudied group of vertebrates. The study of bats requires extensive time and labor. The nocturnal behavior of these animals, coupled with the time and difficulty required to study these creatures in the wild, has historically discouraged researchers from including these species in park and natural resource inventories. Many species of bats appear to be declining in number from throughout their historic ranges, but lack of data prevents accurate assessments.

*This red bat was an unexpected capture. All bats netted during this study were weighed, measured, identified, and then released on site (July 30, 2003).*

In order to inventory this secretive group of animals, Davey Resource Group conducted mist-netting studies in Forest Hill Park to identify species of bats that are presently utilizing the Upper Dugway Valley.

Mist-netting procedures followed guidelines developed by the Indiana Bat Recovery Team (Brady, et al., 1983) and endorsed by the U.S. Fish and Wildlife Service (USFWS). Sites were selected as described below. At each site, a tier of low-visibility nylon mist nets was erected across likely flyways and other areas where bat activity was anticipated. When possible, nets were erected to sufficient height and width to entirely block off the flight corridor. Nets were secured to a rope-and-pulley system suspended from telescoping poles (Kunz, 1988). Nets were raised each night at 9:00 p.m. (during the twilight hours) and monitored every 15-20 minutes for a five-hour period. All mist nets were constructed of 50-denier/2-ply (1.5-inch mesh) nylon. Six net nights spread over two separate events were established at this site, which is more than the minimum sampling effort recommended by the Indiana Bat Recovery Team.

Basic biological data were collected from all bats netted, including species identification, ear, tragus, forearm length, gender, age (juvenile or adult), weight in grams, and reproductive condition (if discernible). All bats were released at the site of capture. Additional information recorded included the climatalogical conditions, date, time of capture, lunar phase, and percent cloud cover. Species identification was based on Belwood (1998). Field data sheets are included in Appendix C.

Potential flight corridors were identified based upon field reconnaissance conducted during daylight hours on July 31, 2003. Potential flight corridors within this study area exist over both north and south branches of Dugway Brook and along the park hiking trails with closed canopy. A hand-held ultrasound detector (Peterson Model D-100) was used to monitor bat activity within the park to identify additional areas for the placement of mist nets on the second night. A description of each netting station is provided below and shown on the Figure 1 Overview Map.

*Station 1 (July 30, 2003 and July 31, 2003)*

Station 1 was located at a straight portion of the walking trail in successional woods under a closed tree canopy. Three tiers of nets (9 meters long) were stretched across this potential flight corridor and extended to the underside of the tree canopy.

*Station 2 (July 30, 2003)*

Station 2 was located across the north branch of Dugway Brook as it flows through successional woods. Two tiers of nets (9 meters long) were stretched across this potential flight corridor and extended to the underside of the tree canopy. This net was put up late and under heavy canopy. Darkness prevented successful photodocumentation.

*Station 3 (July 30, 2003 and July 31, 2003)*

Station 3 was located over the north branch of Dugway Brook approximately 250 feet upstream of Station 2 and approximately 50 feet from the edge of the successional woods. Two tiers of 6-meter-long nets plus one additional 6 meter net (used to block off the hillside) were stretched across this potential flight corridor and extended to the underside of the tree canopy.

*Station 4 (July 31, 2003)*

Station 4 was located in a small clearing at the top of two ravines. Two walking trails pass through this area affording two intersecting flight corridors. Three tiers of 18-meter-long nets were stretched diagonally across the clearing to intercept both potential flight corridors. The canopy was not completely closed off, but the angle of the flight corridors were such that bats would have difficulty avoiding the nets.

## Mist-Netting Survey Results

### July 30, 2003

Overcast skies and no moonlight characterized this evening. Some faint light shone down from the adjacent ball diamonds and parking lots. Nets were raised at 9:00 p.m. and monitored every 15-20 minutes for five hours. Air temperature ranged between 70 degrees Fahrenheit at the beginning of the evening to 65 degrees at the time nets were lowered. Four bats were captured on this evening: two at Station 1 and two and Station 3. Two eastern red bats *(Lasiurus cinereus)* and two big brown bats *(Eptesicus fuscus)* were captured. Data for these individuals are presented in Table 5.

The entire site was monitored continuously throughout the night with a hand-held bat echolocation detector. Moderate activity was detected over the entire study area. All bats detected in this manner were echolocating calls at a dominant frequency of 30-40 kiloHertz (kHz).

### July 31, 2003

The night skies were again overcast with no moonlight. Nets were raised at 9:00 p.m. and monitored every 15-20 minutes for five hours. Air temperatures ranged between 68 degrees Fahrenheit at the beginning of the evening to a low of 60 degrees at the time nets were lowered. A cold front was blowing in that night and winds averaged approximately 10-15 mph. The echolocation detector began to register bat activity around 8:50 p.m. Activity was steady during the first few hours of netting, but then declined sharply after 11:30 p.m. All bats were noted as calling in the 30-40 kHz range. Lights from the nearby parking lot and ball fields illuminated silhouettes of numerous bats as they flew across the open sky above our base camp.

The locations of all netting stations are shown on the map in Figure 1. The previous night, no bats were caught in the Station 2 net; therefore, that netting locale was abandoned and replaced by Station 4. At the start of the night, Station 4 appeared to be an excellent location. Three bats, one big brown and two red, were netted within the first hour. The two red bats were only slightly tangled and were able to free themselves as the nets were lowered. They have been included in the Table 5 with the other captured bats, as their brilliant red color and rounded, lion-shaped heads made identification possible. Unfortunately, in between net-checks, Station 4 was vandalized. All three 18-meter nets and the guide ropes securing the poles were cut and the metal poles were bent to the ground. It was decided that the study would continue that night with just the two remaining net stations.

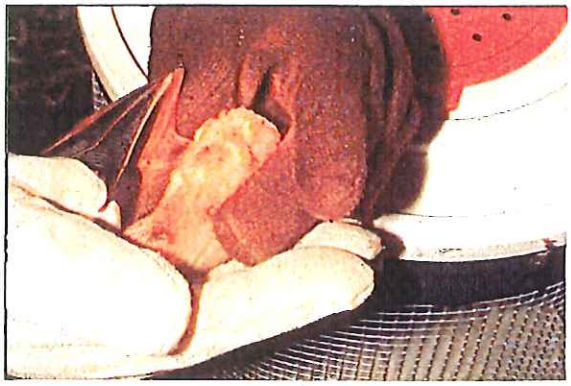
Two last big brown bats were captured over the walking trail at Station 3. No bats were caught this night at Station 1 stretched over the north branch of Dugway Brook. Baseball games were played on the adjacent fields that night, then shortly before midnight numerous loud human voices and booming, bass-heavy music filled the park. It is possible, that because of all the disturbances near that net, the bats chose not to fly that corridor. A total of five bats were captured this night.

***Table 5. Bat Species List and Biological Data***

| Date | Time | Species | Station | Ear | Tragus | Forearm (mm) | Weight (g) | Gender | Age | Breeding Status |
|---|---|---|---|---|---|---|---|---|---|---|
| 7-30 | 9:40 PM | eastern red bat | 1 | short | blunt | 40 | 10 | male | juvenile | non-reproductive |
| 7-30 | 10:00 PM | big brown bat | 1 | short | blunt | 45 | 18 | male | adult | active |
| 7-30 | 10:15 PM | eastern red bat | 3 | short | blunt | 43 | 11 | female | adult | non-reproductive |
| 7-30 | 12:45 AM | big brown bat | 3 | short | blunt | 48 | 17 | male | adult | active |
| 7-31 | 9:40 PM | big brown bat | 4 | short | blunt | 43 | 19 | male | adult | active |
| 7-31 | 9:40 PM | eastern red bat* | 4 | - | - | - | - | - | - | - |
| 7-31 | 9:45 PM | eastern red bat* | 4 | - | - | - | - | - | - | - |
| 7-31 | 10:30 PM | big brown bat | 3 | short | blunt | 41 | 16 | female | adult | lactating |
| 7-31 | 11:45 PM | big brown bat | 3 | short | blunt | 46 | 19 | male | adult | active |

*Bat species identified but escaped from mist nets.

Overall, the netting provided good information about the bat species utilizing Forest Hill Park. A total of nine bats were caught over the course of two nights. Two species were identified as using Forest Hill Park: big brown bats and eastern red bats. Big brown bats (shown to the right) are the most tolerant of urban conditions and are known to roost in man-made structures such as attics, barns, old buildings, under bridges, and even behind shutters. Those colonial "urban" bats were expected.



Red bats, like the one shown to the left, are far less tolerant of human activity. They rarely inhabit urbanized areas, preferring undisturbed woods in sparsely populated areas. These solitary bats typically roost in trees near a water source. Although that description depicts habitat available in the park, the occurrence of this bat in Forest Hill Park was unexpected.

# Summary of Existing Conditions

## Aquatic Communities

Physical habitat within the stream and riparian areas are very good. The stream has the *physical* potential to provide good habitat for fish and bugs, but the results of the Dugway Brook biological surveys reveal stressed aquatic communities. No fish are living in this stream and the only macroinvertebrate species present are highly pollution tolerant. Two limiting factors are preventing the establishment of healthy aquatic communities—torrential water flows during storm events and organic/other pollution. The amount of water entering the system will not likely ever be changed given the stream's urban setting. However, water quality can be improved. Water quality tests revealed potentially hazardous levels of fecal coliform bacteria in Dugway Brook. Nitrate and BOD levels were elevated; both are also indicative of organic pollution. As the City continues to upgrade its sewer systems, it would be useful to periodically test water quality to monitor those improvements.

Summer 2003 has already seen improvements made to reduce the amount of sediment eroding into Dugway Brook. Following recommendations made in the *Environmental Design and Improvement Plan—Upper Dugway Valley, Forest Hill Park, Cleveland Heights, Ohio, 2002,* water that would have normally flowed off adjacent parking lots and ball fields has been slowed down and placed in stable channels. Trails no longer cross through drainageways and water-filtering wetlands have been added to the parks landscape.

## Terrestrial Communities

Forest Hill Park is a wooded oasis in the center of urban development. Upper Dugway Valley provides critical habitat for Cleveland Heights faunal residents. The majority of the park's wildlife are terrestrial mammals commonly found in urban areas, but this particular study sought out the residents that are not so easily evaluated, Forest Hill Park's smaller and more reclusive species—amphibians, reptiles, and winged mammals. During the days, numerous salamanders, dusky and northern two-lined, were found hiding beneath rocks and logs throughout Upper Dugway Valley and on a sunny afternoon a lone garter snake warmed itself in a bright grassy area. By night, the park was alive with bats. Big brown and eastern red bats were caught as they foraged for their nightly meals. Big brown bats are common urban residents, actually preferring man-made structures for shelter. Red bats, however, are solitary creatures and prefer to be away from human disturbances; these bats were a special find.

The trail improvements the City of Cleveland Heights made this past summer within Upper Dugway Valley will aid in preserving sensitive habitats within the park. Human foot traffic has been creatively directed into less sensitive areas around the perimeter of the park and steps towards controlling invasive species will be start in 2004. The City is taking large, positive steps to improve the quality of life for *all* of its residents. This study can serve as a baseline data for future studies that will monitor the continuing improvements of this urban park.

***Table 6. Summary of Terrestrial Vertebrates Observed in Forest Hill Park***

| Common Name | Scientific Name |
|---|---|
| ***Amphibians*** | |
| American toad | *Bufo americanus* |
| dusky salamander | *Desmognathus fuscus* |
| northern two-lined salamander | *Eurycea bislineata bislineata* |
| green frog | *Rana clamitans* |
| ***Reptiles*** | |
| eastern garter snake | *Thamnophis sirtalis sirtalis* |
| ***Mammals*** | |
| opossum | *Didelphus virginiana* |
| big brown bat | *Eptesicus fuscus* |
| eastern red bat | *Lasiurus cinereus* |
| groundhog | *Marmota monax* |
| skunk | *Mephitis mephitis* |
| white-tailed deer | *Odocoileus virginianus* |
| raccoon | *Procyon lotor* |
| eastern grey squirrel | *Sciurus carolinensis* |
| chipmunk | *Tamias striatus* |

# *Appendix A*
# *Qualitative Habitat Evaluation Index (QHEI) Field Sheets*

# Ohio EPA Qualitative Habitat Evaluation Index Field Sheet QHEI Score: 71.5

River Code: _____ RM: _____ Stream: Dugway Brook - Northern branch
Date: July 14, 2003 Location: Forest Hill Park, Cleveland Heights, Ohio
Scorers Full Name: Michelle Malcosky Affiliation: Davey Resource Group

1] SUBSTRATE (Check ONLY Two SubstrateTYPE BOXES; Estimate % present

| TYPE | POOL | RIFFLE |
|---|---|---|
| ☒☐-BLDR /SLBS[10] | 25 | |
| ☐☐-BOULDER [9] | | |
| ☐☐-COBBLE [8] | 20 | |
| ☐☐-HARDPAN [4] | | |
| ☐☐-MUCK [2] | | |
| ☐☐-SILT [2] | | |
| ☐☐-GRAVEL [7] | 10 | |
| ☐☐-SAND [6] | 10 | |
| ☒☐-BEDROCK[5] | 25 | |
| ☐☐-DETRITUS[3] | | |
| ☐☐-ARTIFICIAL[0] | | |

NOTE: Ignore Sludge Originating From Point Sources

SUBSTRATE ORIGIN (Check ONE (OR 2 & AVERAGE)): ☐-LIMESTONE [1] ☐-TILLS [1] ☐-WETLANDS[0] ☐-HARDPAN [0] ☐-SANDSTONE [0] ☐-RIP/RAP [0] ☐-LACUSTRINE [0] ☒-SHALE [-1] ☐-COAL FINES [-2]

SILT: ☐-EXTENSIVE [-2] ☐-MODERATE [-1] ☒-NORMAL [0] ☐-NONE [1]

SUBSTRATE QUALITY (Check ONE (OR 2 & AVERAGE)): ☐- SILT HEAVY [-2] ☐-SILT MODERATE [-1] ☒-SILT NORMAL [0] ☐-SILT FREE [1]

EMBEDDEDNESS: ☐-EXTENSIVE [-2] ☐-MODERATE [-1] ☒-NORMAL [0] ☐-NONE [1]

Substrate: 16 Max 20

NUMBER OF SUBSTRATE TYPES: (High Quality Only, Score 5 or >) ☒4 or More [2] ☐3 or Less [0]

COMMENTS: _____

2] INSTREAM COVER (Give each cover type a score of 0 to 3; see back for instructions)

(Structure): 1 UNDERCUT BANKS [1] ___OVERHANGING VEGETATION [1] 1 SHALLOWS (IN SLOW WATER) [1] ___ROOTMATS [1]

TYPE: Score All That Occur: 2 POOLS> 70 cm [2] ___ROOTWADS [1] 3 BOULDERS [1] ___OXBOWS, BACKWATERS [1] ___AQUATIC MACROPHYTES [1] 1 LOGS OR WOODY DEBRIS [1]

COMMENTS: _____

AMOUNT: (Check ONLY One or check 2 and AVERAGE) ☐ - EXTENSIVE > 75% [11] ☒ - MODERATE 25-75% [7] ☐ - SPARSE 5-25% [3] ☐ - NEARLY ABSENT < 5%[1]

Cover: 13 Max 20

3] CHANNEL MORPHOLOGY: (Check ONLY One PER Category OR check 2 and AVERAGE )

SINUOSITY: ☐ - HIGH [4] ☒ - MODERATE [3] ☐ - LOW [2] ☐ - NONE [1]

DEVELOPMENT: ☐ - EXCELLENT [7] ☒ - GOOD [5] ☐ - FAIR [3] ☐ - POOR [1]

CHANNELIZATION: ☒ - NONE [6] ☐ - RECOVERED [4] ☐ - RECOVERING [3] ☐ - RECENT OR NO RECOVERY [1]

STABILITY: ☒ - HIGH [3] ☐ - MODERATE [2] ☐ - LOW [1]

MODIFICATIONS/OTHER: ☐ - SNAGGING ☒ - IMPOUND. ☐ - RELOCATION ☐ - ISLANDS ☐ - CANOPY REMOVAL ☐ - LEVEED ☐ - DREDGING ☐ - BANK SHAPING ☐ - ONE SIDE CHANNEL MODIFICATIONS

Channel: 17 Max 20

COMMENTS: _____

4]. RIPARIAN ZONE AND BANK EROSION (check ONE box per bank or check 2 and AVERAGE per bank) River Right Looking Downstream

RIPARIAN WIDTH (L R (Per Bank)): ☒☒- WIDE > 50m [4] ☐☐- MODERATE 10-50m [3] ☐☐- NARROW 5-10 m [2] ☐☐- VERY NARROW <5 m[1] ☐☐- NONE [0]

FLOOD PLAIN QUALITY (PAST 100 Meter RIPARIAN) (L R (Most Predominant Per Bank)): ☐☐-FOREST, SWAMP [3] ☐☐-SHRUB OR OLD FIELD [2] ☒☐-RESIDENTIAL,PARK,NEW FIELD [1] ☐☐-FENCED PASTURE [1] ☐☐-CONSERVATION TILLAGE [1] ☒☐-URBAN OR INDUSTRIAL [0] ☐☐-OPEN PASTURE,ROWCROP [0] ☐☐-MINING/CONSTRUCTION [0]

BANK EROSION (L R (Per Bank)): ☒☒-NONE/LITTLE [3] ☐☐-MODERATE [2] ☐☐-HEAVY/SEVERE[1]

Riparian: 8.5 Max 10

COMMENTS: _____

5.]POOL/GLIDE AND RIFFLE/RUN QUALITY

MAX. DEPTH (Check 1 ONLY!): ☐ - >1m [6] ☐ - 0.7-1m [4] ☐ - 0.4-0.7m [2] ☒ - 0.2- 0.4m [1] ☐ - < 0.2m [POOL=0]

MORPHOLOGY (Check 1 or 2 & AVERAGE): ☐-POOL WIDTH > RIFFLE WIDTH [2] ☐-POOL WIDTH = RIFFLE WIDTH [1] ☒-POOL WIDTH < RIFFLE W. [0]

CURRENT VELOCITY [ POOLS & RIFFLES!] (Check All That Apply): ☐-EDDIES[1] ☐-FAST[1] ☒-MODERATE [1] ☒-SLOW [1] ☐-TORRENTIAL[-1] ☐-INTERSTITIAL[-1] ☐-INTERMITTENT[-2] ☐-VERY FAST[1]

Pool/ Current: 3 Max 12

COMMENTS: _____

CHECK ONE OR CHECK 2 AND AVERAGE

RIFFLE DEPTH: ☒ Best Areas >10 cm [2] ☐ - Best Areas 5-10 cm[1] ☐ - Best Areas < 5 cm [RIFFLE=0]

RUN DEPTH: ☐ - MAX > 50 [2] ☒ - MAX < 50[1]

RIFFLE/RUN SUBSTRATE: ☒STABLE (e.g.,Cobble, Boulder) [2] ☐-MOD. STABLE (e.g.,Large Gravel) [1] ☐-UNSTABLE (Fine Gravel,Sand) [0]

RIFFLE/RUN EMBEDDEDNESS: ☐ - NONE [2] ☒ - LOW [1] ☐ - MODERATE [0] ☐ - EXTENSIVE [-1]

Riffle/Run: 6 Max 8

COMMENTS: drainage area is estimate - all of Dugway Brook is culverted outside of Forest Hill Park ☐ - NO RIFFLE [Metric=0]

Gradient: 8 Max 10

6] GRADIENT (ft/mi): 112.15 DRAINAGE AREA (sq.mi.) : ~1 mi.²

%POOL: 25 %GLIDE: 10 %RIFFLE: 65 %RUN: _____

** Best areas must be large enough to support a population of riffle-obligate species

Is Sampling Reach Representative of the Stream (Y/N) Y If Not, Explain:

It is representative of the stream within the park. Outside of Forest Hill Park, the remainder of Dugway Brook is in culverts.

Major Suspected Sources of Impacts (Check All That Apply):
- None ☐
- Industrial ☐
- WWTP ☒
- Ag ☐
- Livestock ☐
- Silviculture ☐
- Construction ☐
- Urban Runoff ☒
- CSOs ☒
- Suburban Impacts ☐
- Mining ☐
- Channelization ☐
- Riparian Removal ☐
- Landfills ☐
- Natural ☐
- Dams ☐
- Other Flow Alteration ☒
- Other: culverting

| Subjective Rating (1-10) | Aesthetic Rating (1-10) |
|---|---|
| 6 | 9 |

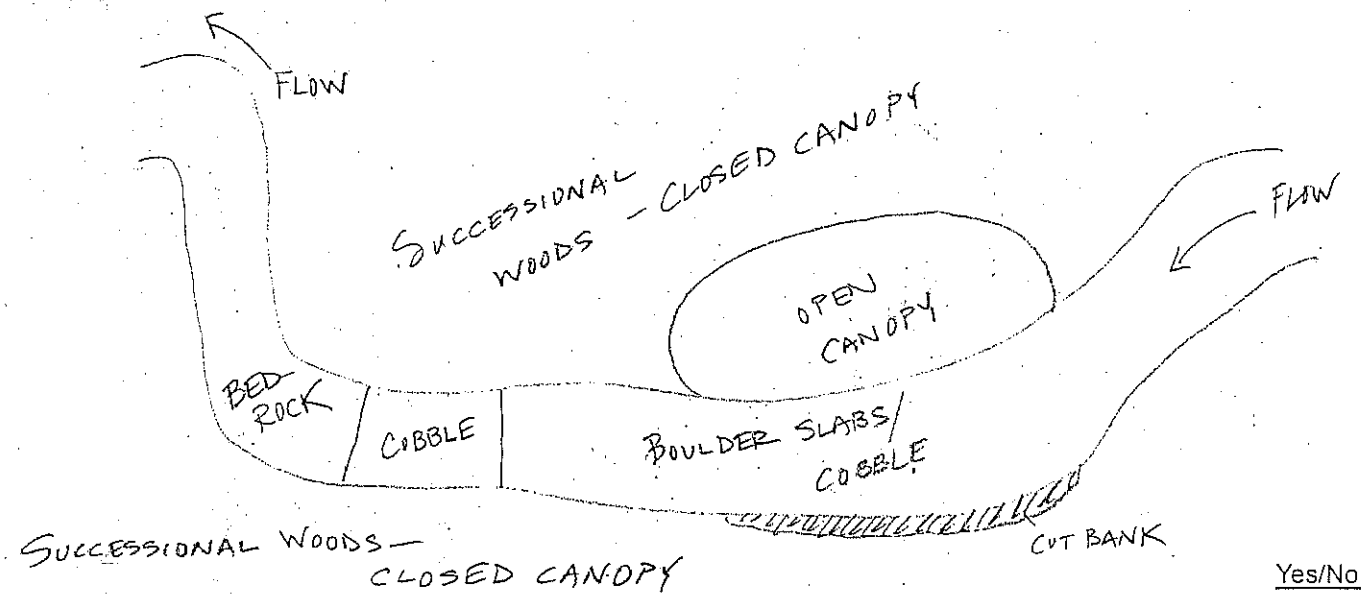
Gradient: ☐ - Low, ☐ - Moderate, ☒ - High

| | Gear: | Distance: | Water Clarity: | Water Stage: | Canopy -% Open |
|---|---|---|---|---|---|
| First Sampling Pass | | | | | |

Stream Measurements:

| Average Width | Average Depth | Maximum Depth | Av. Bankfull Width | Bankfull Mean Depth | W/D Ratio | Bankfull Max Depth | Floodprone Area Width | Entrench. Ratio |
|---|---|---|---|---|---|---|---|---|
| 15' | 6" | 12" | 20' | – | – | – | – | – |

## Stream Drawing:




Instructions for scoring the alternate cover metric: Each cover type should receive a score of between 0 and 3, Where: 0 - Cover type absent; 1 - Cover type present in very small amounts or if more common of marginal quality; 2 - Cover type present in moderate amounts, but not of highest quality or in small amounts of highest quality; 3 - Cover type of highest quality in moderate or greater amounts. Examples of highest quality include very large boulders in deep or fast water, large diameter logs that are stable, well developed rootwads in deep/fast water, or deep, well-defined, functional pools.

| Yes/No | |
|---|---|
| ☐ ☒ | Is Stream Ephemeral (no pools, totally dry or only damp spots)? |
| ☐ ☐ | Is there water upstream? How Far:_____ |
| ☐ ☐ | Is There Water Close Downstream? How Far:_____ |
| ☐ ☐ | Is Dry Channel Mostly Natural? |

# Ohio EPA Qualitative Habitat Evaluation Index Field Sheet QHEI Score: 73.5

River Code: _____ RM: _____ Stream: Dugway Brook – southern branch

Date: July 14, 2003 Location: Forest Hill Park, Cleveland Heights, Ohio

Scorers Full Name: Michelle Malasky Affiliation: Davey Resource Group

1] SUBSTRATE (Check ONLY Two SubstrateTYPE BOXES; Estimate % present

| TYPE | POOL | RIFFLE |
|---|---|---|
| ☐☐-BLDR /SLBS[10] | 5 | |
| ☐☐-BOULDER [9] | | |
| ☒☐-COBBLE [8] | 40 | |
| ☐☐-HARDPAN [4] | | |
| ☐☐-MUCK [2] | | |
| ☐☐-SILT [2] | 5 | |
| ☐☐-GRAVEL [7] | 10 | |
| ☐☐-SAND [6] | 10 | |
| ☒☐-BEDROCK[5] | 30 | |
| ☐☐-DETRITUS[3] | | |
| ☐☐-ARTIFICIAL[0] | | |

NOTE: Ignore Sludge Originating From Point Sources

SUBSTRATE ORIGIN Check ONE (OR 2 & AVERAGE)
☐ -LIMESTONE [1 ]
☐ -TILLS [1]
☐ -WETLANDS[0]
☐ -HARDPAN [0]
☐ -SANDSTONE [0]
☐ -RIP/RAP [0]
☐ -LACUSTRINE [0]
☒ -SHALE [-1]
☐ -COAL FINES [-2]

SUBSTRATE QUALITY Check ONE (OR 2 & AVERAGE)
SILT:
☐ - SILT HEAVY [-2]
☐ -SILT MODERATE [-1]
☒ -SILT NORMAL [0]
☐ -SILT FREE [1]
EMBEDDEDNESS:
☐ -EXTENSIVE [-2]
☒ -MODERATE [-1]
☐ -NORMAL [0]
☐ -NONE [1]

Substrate: 13 Max 20

NUMBER OF SUBSTRATE TYPES: (High Quality Only, Score 5 or >)
☒ 4 or More [2]
☐ 3 or Less [0]

COMMENTS: _____

2] INSTREAM COVER (Give each cover type a score of 0 to 3; see back for instructions)

(Structure)
3 UNDERCUT BANKS [1]
___ OVERHANGING VEGETATION [1]
2 SHALLOWS (IN SLOW WATER) [1]
___ ROOTMATS [1]

TYPE: Score All That Occur
3 POOLS> 70 cm [2]
___ ROOTWADS [1]
2 BOULDERS [1]
___ OXBOWS, BACKWATERS [1]
___ AQUATIC MACROPHYTES [1]
___ LOGS OR WOODY DEBRIS [1]

COMMENTS: _____

AMOUNT: (Check ONLY One or check 2 and AVERAGE)
☐ - EXTENSIVE > 75% [11]
☒ - MODERATE 25-75% [7]
☐ - SPARSE 5-25% [3]
☐ - NEARLY ABSENT < 5%[1]

Cover: 12 Max 20

3] CHANNEL MORPHOLOGY: (Check ONLY One PER Category OR check 2 and AVERAGE )

SINUOSITY
☐ - HIGH [4]
☒ - MODERATE [3]
☐ - LOW [2]
☐ - NONE [1]

DEVELOPMENT
☐ - EXCELLENT [7]
☒ - GOOD [5]
☐ - FAIR [3]
☐ - POOR [1]

CHANNELIZATION
☒ - NONE [6]
☐ - RECOVERED [4]
☐ - RECOVERING [3]
☐ - RECENT OR NO RECOVERY [1]

STABILITY
☒ - HIGH [3]
☐ - MODERATE [2]
☐ - LOW [1]

MODIFICATIONS/OTHER
☐ - SNAGGING
☐ - RELOCATION
☐ - CANOPY REMOVAL
☐ - DREDGING
☐ - ONE SIDE CHANNEL MODIFICATIONS
☒ - IMPOUND.
☐ - ISLANDS
☐ - LEVEED
☐ - BANK SHAPING

Channel: 17 Max 20

COMMENTS: _____

4]. RIPARIAN ZONE AND BANK EROSION (check ONE box per bank or check 2 and AVERAGE per bank) ← River Right Looking Downstream →

RIPARIAN WIDTH (L R Per Bank)
☒☒ - WIDE > 50m [4]
☐☐ - MODERATE 10-50m [3]
☐☐ - NARROW 5-10 m [2]
☐☐ - VERY NARROW <5 m[1]
☐☐ - NONE [0]

FLOOD PLAIN QUALITY (PAST 100 Meter RIPARIAN) (L R Most Predominant Per Bank)
☐☐-FOREST, SWAMP [3]
☐☐-SHRUB OR OLD FIELD [2]
☒☐-RESIDENTIAL,PARK,NEW FIELD [1]
☐☐-FENCED PASTURE [1]
☐☐-CONSERVATION TILLAGE [1]
☒☐-URBAN OR INDUSTRIAL [0]
☐☐-OPEN PASTURE,ROWCROP [0]
☐☐-MINING/CONSTRUCTION [0]

BANK EROSION (L R Per Bank)
☒☒-NONE/LITTLE [3]
☐☐-MODERATE [2]
☐☐-HEAVY/SEVERE[1]

Riparian: 8 Max 10

COMMENTS: _____

5.]POOL/GLIDE AND RIFFLE/RUN QUALITY

MAX. DEPTH (Check 1 ONLY!)
☒ - >1m [6]
☐ - 0.7-1m [4]
☐ - 0.4-0.7m [2]
☐ - 0.2- 0.4m [1]
☐ - < 0.2m [POOL=0]

MORPHOLOGY (Check 1 or 2 & AVERAGE)
☒-POOL WIDTH > RIFFLE WIDTH [2]
☐-POOL WIDTH = RIFFLE WIDTH [1]
☐-POOL WIDTH < RIFFLE W. [0]

CURRENT VELOCITY [POOLS & RIFFLES!] (Check All That Apply)
☐-EDDIES[1]
☒-FAST[1]
☒-MODERATE [1]
☒-SLOW [1]
☐-TORRENTIAL[-1]
☐-INTERSTITIAL[-1]
☐-INTERMITTENT[-2]
☐-VERY FAST[1]

Pool/ Current: 11 Max 12

COMMENTS: _____

CHECK ONE OR CHECK 2 AND AVERAGE

RIFFLE DEPTH
☐ - Best Areas >10 cm [2]
☒ - Best Areas 5-10 cm[1]
☐ - Best Areas < 5 cm [RIFFLE=0]

RUN DEPTH
☐ - MAX > 50 [2]
☒ - MAX < 50[1]

RIFFLE/RUN SUBSTRATE
☒ STABLE (e.g.,Cobble, Boulder) [2]
☒ MOD. STABLE (e.g.,Large Gravel) [1]
☐ UNSTABLE (Fine Gravel,Sand) [0]

RIFFLE/RUN EMBEDDEDNESS
☐ - NONE [2]
☒ - LOW [1]
☐ - MODERATE [0]
☐ - EXTENSIVE [-1]
☐ - NO RIFFLE [Metric=0]

Riffle/Run: 4.5 Max 8

Gradient: 8 Max 10

COMMENTS: drainage area is estimate – all of Dugway Brook outside Forest Hill Park is culverted

6] GRADIENT (ft/mi): 64 DRAINAGE AREA (sq.mi.) ~1.5

%POOL: 35 %GLIDE: 20
%RIFFLE: 45 %RUN: _____

** Best areas must be large enough to support a population of riffle-obligate species

Is Sampling Reach Representative of the Stream (Y/N) Y If Not, Explain:

The sampling reach is representative of the stream within Forest Hill Park. The remainder of the stream is culverted.

Major Suspected Sources of Impacts (Check All That Apply):
- None ☐
- Industrial ☐
- WWTP ☒
- Ag ☐
- Livestock ☐
- Silviculture ☐
- Construction ☐
- Urban Runoff ☒
- CSOs ☒
- Suburban Impacts ☐
- Mining ☐
- Channelization ☐
- Riparian Removal ☐
- Landfills ☐
- Natural ☐
- Dams ☐
- Other Flow Alteration ☒
- Other: culverts

| Subjective Rating (1-10) | Aesthetic Rating (1-10) |
|---|---|
| 5 | 7 |

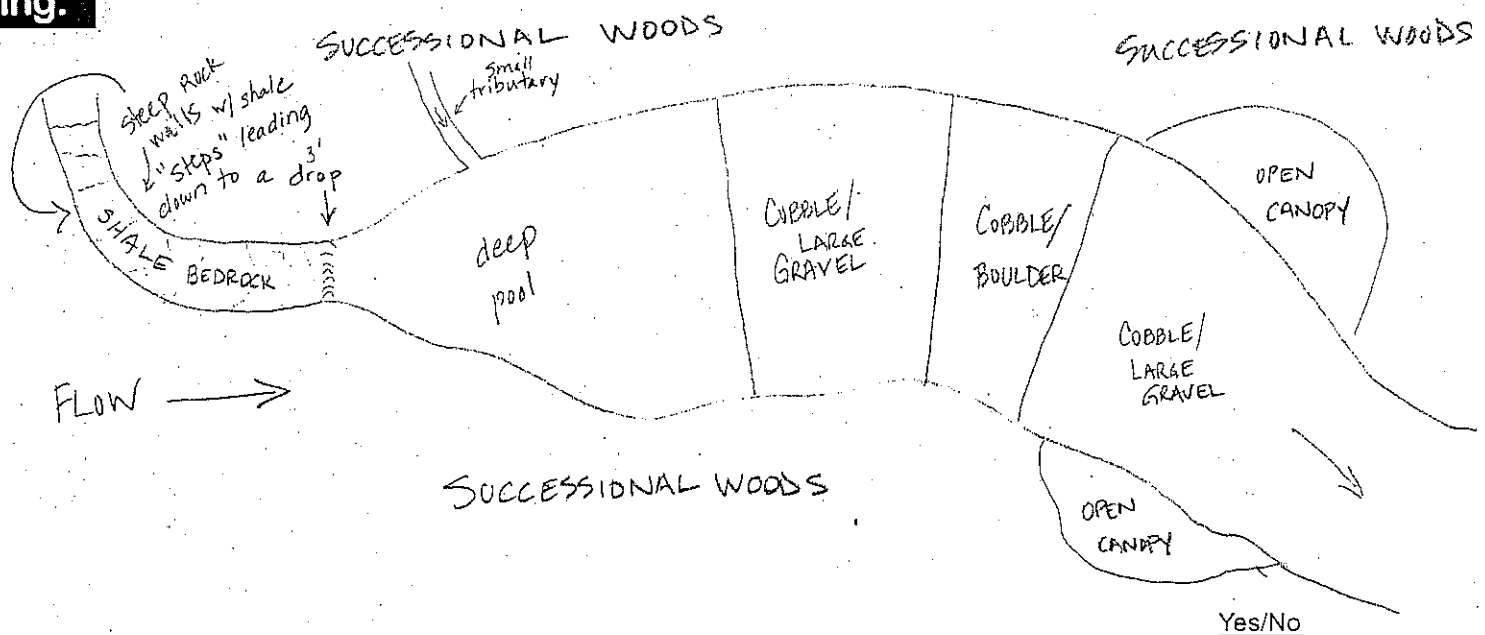
Gradient: ☐ - Low, ☐ - Moderate, ☒ - High

| | Gear: | Distance: | Water Clarity: | Water Stage: | Canopy -% Open |
|---|---|---|---|---|---|
| First Sampling Pass | | | | | |

Stream Measurements:

| Average Width | Average Depth | Maximum Depth | Av. Bankfull Width | Bankfull Mean Depth | W/D Ratio | Bankfull Max Depth | Floodprone Area Width | Entrench. Ratio |
|---|---|---|---|---|---|---|---|---|
| 12' | 18" | 7' | 25' | – | – | – | – | – |

## Stream Drawing:




Instructions for scoring the alternate cover metric: Each cover type should receive a score of between 0 and 3, Where: 0 - Cover type absent; 1 - Cover type present in very small amounts or if more common of marginal quality; 2 - Cover type present in moderate amounts, but not of highest quality or in small amounts of highest quality; 3 - Cover type of highest quality in moderate or greater amounts. Examples of highest quality include very large boulders in deep or fast water, large diameter logs that are stable, well developed rootwads in deep/fast water, or deep, well-defined, functional pools.

| Yes/No | |
|---|---|
| ☐ ☒ | Is Stream Ephemeral (no pools, totally dry or only damp spots)? |
| ☐ ☐ | Is there water upstream? How Far:_____ |
| ☐ ☐ | Is There Water Close Downstream? How Far:_____ |
| ☐ ☐ | Is Dry Channel Mostly Natural? |

# *Appendix B*
# *Severn Trent Laboratories Analytical Report*

SEVERN TRENT STL

# ANALYTICAL REPORT

CLEVELAND HEIGHTS PARK STREAM

Lot #: A3H270232

Jim Jenkins

Davey Resource Group
3728 Fishcreek Road
Stow, OH 44224

SEVERN TRENT LABORATORIES, INC.

Kris M Brooks

Kris M. Brooks
Project Manager

September 16, 2003

Severn Trent Laboratories, Inc.
STL North Canton • 4101 Shuffel Drive NW, North Canton, OH 44720
Tel 330 497 9396 Fax 330 497 0772 • www.stl-inc.com

# CASE NARRATIVE

A3H270232

The following report contains the analytical results for two water samples submitted to STL North Canton by Davey Resource Group from the Cleveland Heights Park Stream Site. The samples were received August 27, 2003, according to documented sample acceptance procedures.

The Fecal Coliform analysis was subcontracted to Adams Water Laboratory, Inc. A copy of their data is provided in this report.

STL utilizes USEPA approved methods in all analytical work. The samples presented in this report were analyzed for the parameter(s) listed on the analytical methods summary page in accordance with the method(s) indicated. Preliminary results were provided to Jim Jenkins on September 05, 2003. A summary of QC data for this analysis is included at the rear of the report.

The results included in this report have been reviewed for compliance with the laboratory QA/QC plan. All data have been found to compliant with laboratory protocol.

## SUPPLEMENTAL QC INFORMATION

### SAMPLE RECEIVING

The temperature of the cooler upon sample receipt was 3.8°C.

See STL's Cooler Receipt Form for additional information.

### METALS

The analytical results met the requirements of the laboratory's QA/QC program.

### GENERAL CHEMISTRY

The analytical results met the requirements of the laboratory's QA/QC program.

# STL Cooler Receipt Form/Narrative
## North Canton Facility

Lot Number: A3H270235

Client: Davey Resource Group  Project: Cleveland Heights Park Stream  Quote#: _____

Cooler Received on: 8-27-03  Opened on: 8-27-03  by: Dale Ehlen (Signature)

Fedx ☐ Client Drop Off ☒ UPS ☐ Airborne ☐ Other: _____

Cooler ☒ Safe ☐ Foam Box ☐ Client Cooler ☐ Other: _____

STL Shipper No#: 854405

1. Were custody seals on the outside of the cooler? Yes ☐ No ☒ Intact? Yes ☐ No ☐ NA ☒
   If YES, Quantity _____ Location _____
   Were the custody seals signed and dated? Yes ☐ No ☐ NA ☒
2. Shipper's packing slip attached to this form? Yes ☐ No ☒
3. Were custody papers included inside the cooler and relinquished? Yes ☒ No ☐
4. Did you sign the custody papers in the appropriate place? Yes ☒ No ☐
5. Packing material used:

Peanuts ☐ Bubble Wrap ☒ Vermiculite ☐ Foam ☐ None ☐ Other : _____

6. Cooler temperature upon receipt 3.8 °C (see back of form for multiple coolers/temp)

METHOD: Temp Vial ☐ Coolant & Sample ☒ Against Bottles ☐ IR ☐ ICE/$H_2O$ Slurry ☐

COOLANT: Wet Ice ☒ Blue Ice ☐ Dry Ice ☐ Water ☐ None ☐

7. Did all bottles arrive in good condition (Unbroken)? Yes ☒ No ☐
8. Did all bottle labels and tags agree with the custody papers? Yes ☒ No ☒
9. Were samples at the correct pH? (record on back) Yes ☒ No ☐ NA ☐
10. Were correct bottles used for the tests indicated? Yes ☒ No ☐
11. Were air bubbles >6 mm in any VOA vials? Yes ☐ No ☐ NA ☒
12. Was a sufficient amount of sample sent in each bottle? Yes ☒ No ☐

Contacted PM _____ Date: _____ by: _____ via Voice Mail ☐ Verbal ☐ Other ☐

Concerning: _____

| √ | MACRO | MACRO |
|---|---|---|
| | *1. CHAIN OF CUSTODY* | |
| ✓ | SR1A | The chain of custody and sample bottles did not agree. The following discrepancies occurred Sample times and dates not on COC - logged from bottles. East water = 8-27-03 @ 11:00 ; South water = 8-27-03 @ 11:40. |
| | *2. SAMPLE CONDITION* | |
| | SR2A | Sample(s) _____ were received or requested after the recommended holding time had expired. |
| | SR2B | Sample(s) were received with insufficient volume. |
| | SR2C | Sample(s) were received in a broken container. |
| | *3. SAMPLE PRESERVATION* | |
| | SR3A | Sample(s) _____ were further preserved in sample receiving to meet recommended pH level(s). *Nitric Acid Lot # 061603-HNO3; Sulfuric Acid Lot # 112801-H2SO4; Sodium Hydroxide Lot # 011102-NaOH; Hydrochloric Acid Lot # 100902-HCl; Sodium Hydroxide and Zinc Acetate Lot # 112801-CH3COO2ZN/NaOH* |
| | SR3B | Sample(s) _____ were received with bubble > 6 mm in diameter (cc: PM) |
| | *4. Other (see below or back)* | |

# STL Cooler Receipt Form/Narrative
## North Canton Facility

| Client ID | pH | Date | Initials |
|---|---|---|---|
| East Water | <2 | 8-27-07 | DE |
| South Water | <2 | 8-27-07 | DE |
| | | | |
| | | | |
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| Cooler | Temp | Method | Coolant |
|---|---|---|---|
| | | | |
| | | | |
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| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

**Discrepancies Cont.**

*Macro Name:*

*Macro Name:*

*Macro Name:*

*Other Anomalies:*

# QUALITY CONTROL ELEMENTS OF SW-846 METHODS

STL North Canton conducts a quality assurance/quality control (QA/QC) program designed to provide scientifically valid and legally defensible data. Toward this end, several types of quality control indicators are incorporated into the QA/QC program, which is described in detail in QA Policy, QA-003. These indicators are introduced into the sample testing process to provide a mechanism for the assessment of the analytical data.

## QC BATCH

Environmental samples are taken through the testing process in groups called QUALITY CONTROL BATCHES (QC batches). A QC batch contains up to twenty environmental samples of a similar matrix (water, soil) that are processed using the same reagents and standards. STL North Canton requires that each environmental sample be associated with a QC batch.

Several quality control samples are included in each QC batch and are processed identically to the twenty environmental samples. These QC samples include a METHOD BLANK (MB), a LABORATORY CONTROL SAMPLE (LCS) and, where appropriate, a MATRIX SPIKE/MATRIX SPIKE DUPLICATE (MS/MSD) pair or a MATRIX SPIKE/SAMPLE DUPLICATE (MS/DU) pair. If there is insufficient sample to perform an MS/MSD or an MS/DU, then a LABORATORY CONTROL SAMPLE DUPLICATE (LCSD) is included in the QC batch.

## LABORATORY CONTROL SAMPLE

The Laboratory Control Sample is a QC sample that is created by adding known concentrations of a full or partial set of target analytes to a matrix similar to that of the environmental samples in the QC batch. The LCS analyte recovery results are used to monitor the analytical process and provide evidence that the laboratory is performing the method within acceptable guidelines. All control analytes indicated by a bold type in the LCS must meet acceptance criteria. Failure to meet the established recovery guidelines requires the repreparation and reanalysis of all samples in the QC batch. The only exception is that if the LCS recoveries are biased high and the associated sample is ND (non-detected) for the parameter(s) of interest, the batch is acceptable.

At times, a Laboratory Control Sample Duplicate (LCSD) is also included in the QC batch. An LCSD is a QC sample that is created and handled identically to the LCS. Analyte recovery data from the LCSD is assessed in the same way as that of the LCS. The LCSD recoveries, together with the LCS recoveries, are used to determine the reproducibility (precision) of the analytical system. Precision data are expressed as relative percent differences (RPDs). If the RPD fails for an LCS/LCSD and yet the recoveries are within acceptance criteria, the batch is still acceptable.

## METHOD BLANK

The Method Blank is a QC sample consisting of all the reagents used in analyzing the environmental samples contained in the QC batch. Method Blank results are used to determine if interference or contamination in the analytical system could lead to the reporting of false positive data or elevated analyte concentrations. All target analytes must be below the reporting limits (RL) or the associated sample(s) must be ND except under the following circumstances:

- Common organic contaminants may be present at concentrations up to 5 times the reporting limits. Common metals contaminants may be present at concentrations up to 2 times the reporting limit, or the reported blank concentration must be twenty fold less than the concentration reported in the associated environmental samples. (See common laboratory contaminants listed below.)

| Volatile (GC or GC/MS) | Semivolatile (GC/MS) | Metals |
|---|---|---|
| Methylene chloride | Phthalate Esters | Copper |
| Acetone | | Iron |
| 2-Butanone | | Zinc |
| | | Lead* |

- *for analyses run on TJA Trace ICP, ICPMS or GFAA only*

- Organic blanks will be accepted if compounds detected in the blank are present in the associated samples at levels 10 times the blank level. Inorganic blanks will be accepted if elements detected in the blank are present in the associated samples at 20 times the blank level.

- Blanks will be accepted if the compounds/elements detected are not present in any of the associated environmental samples.

Failure to meet these Method Blank criteria requires the repreparation and reanalysis of all samples in the QC batch.

MATRIX SPIKE/MATRIX SPIKE DUPLICATE

A Matrix Spike and a Matrix Spike Duplicate are a pair of environmental samples to which known concentrations of a full or partial set of target analytes are added. The MS/MSD results are determined in the same manner as the results of the environmental sample used to prepare the MS/MSD. The analyte recoveries and the relative percent differences (RPDs) of the recoveries are calculated and used to evaluate the effect of the sample matrix on the analytical results. Due to the potential variability of the matrix of each sample, the MS/MSD results may not have an immediate bearing on any samples except the one spiked; therefore, the associated batch MS/MSD may not reflect the same compounds as the samples contained in the analytical report. When these MS/MSD results fail to meet acceptance criteria, the data is evaluated. If the LCS is within acceptance criteria, the batch is considered acceptable. The acceptance criteria do not apply to samples that are diluted for organics if the native sample amount is 4x the concentration of the spike.

For certain methods, a Matrix Spike/Sample Duplicate (MS/DU) may be included in the QC batch in place of the MS/MSD. For the parameters (i.e. pH, ignitability) where it is not possible to prepare a spiked sample, a Sample Duplicate may be included in the QC batch. However, a Sample Duplicate is less likely to provide usable precision statistics depending on the likelihood of finding concentrations below the standard reporting limit. When the Sample Duplicate result fails to meet acceptance criteria, the data is evaluated.

SURROGATE COMPOUNDS

In addition to these batch-related QC indicators, each organic environmental and QC sample is spiked with surrogate compounds. Surrogates are organic chemicals that behave similarly to the analytes of interest and that are rarely present in the environment. Surrogate recoveries are used to monitor the individual performance of a sample in the analytical system.

If surrogate recoveries are biased high in the LCS, LCSD, or the Method Blank, and the associated sample(s) are ND, the batch is acceptable. Otherwise, if the LCS, LCSD, or Method Blank surrogate(s) fail to meet recovery criteria, the entire sample batch is reprepped and reanalyzed. If the surrogate recoveries are outside criteria for environmental samples, the samples will be reprepped and reanalyzed unless there is objective evidence of matrix interference or if the sample dilution is greater than the threshold outlined in the associated method SOP.

For the GC/MS BNA methods, the surrogate criterion is that two of the three surrogates for each fraction must meet acceptance criteria. The third surrogate must have a recovery of ten percent or greater.

For the Pesticide, PCB, PAH, and Herbicide methods, the surrogate criterion is that one of two surrogate compounds must meet acceptance criteria.

# EXECUTIVE SUMMARY - Detection Highlights

A3H270232

| PARAMETER | RESULT | REPORTING LIMIT | UNITS | ANALYTICAL METHOD |
|---|---|---|---|---|
| EAST WATER INLET 08/27/03 11:00 001 | | | | |
| Biochemical Oxygen Demand (BOD) | 4 | 2 | mg/L | MCAWW 405.1 |
| Nitrate as N | 0.85 | 0.10 | mg/L | MCAWW 300.0A |
| SOUTH WATER INLET 08/27/03 11:40 002 | | | | |
| Biochemical Oxygen Demand (BOD) | 3 | 2 | mg/L | MCAWW 405.1 |
| Nitrate as N | 4.8 | 0.10 | mg/L | MCAWW 300.0A |

# ANALYTICAL METHODS SUMMARY

A3H270232

| PARAMETER | ANALYTICAL METHOD |
|---|---|
| Biochemical Oxygen Demand | MCAWW 405.1 |
| Inductively Coupled Plasma (ICP) Metals | SW846 6010B |
| Mercury in Liquid Waste (Manual Cold-Vapor) | SW846 7470A |
| Nitrate as N | MCAWW 300.0A |
| Nitrite as N | MCAWW 300.0A |
| Trace Inductively Coupled Plasma (ICP) Metals | SW846 6010B |

References:

MCAWW "Methods for Chemical Analysis of Water and Wastes", EPA-600/4-79-020, March 1983 and subsequent revisions.

SW846 "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods", Third Edition, November 1986 and its updates.

# SAMPLE SUMMARY

A3H270232

| WO # | SAMPLE# | CLIENT SAMPLE ID | SAMPLED DATE | SAMP TIME |
|---|---|---|---|---|
| FW44H | 001 | EAST WATER INLET | 08/27/03 | 11:00 |
| FW44P | 002 | SOUTH WATER INLET | 08/27/03 | 11:40 |

NOTE(S):

- The analytical results of the samples listed above are presented on the following pages.
- All calculations are performed before rounding to avoid round-off errors in calculated results.
- Results noted as "ND" were not detected at or above the stated limit.
- This report must not be reproduced, except in full, without the written approval of the laboratory.
- Results for the following parameters are never reported on a dry weight basis: color, corrosivity, density, flashpoint, ignitability, layers, odor, paint filter test, pH, porosity pressure, reactivity, redox potential, specific gravity, spot tests, solids, solubility, temperature, viscosity, and weight.

DAVEY RESOURCE GROUP

Client Sample ID: EAST WATER INLET

TOTAL Metals

Lot-Sample #...: A3H270232-001 Matrix.....: WG
Date Sampled...: 08/27/03 11:00 Date Received..: 08/27/03

| PARAMETER | RESULT | REPORTING LIMIT | UNITS | METHOD | PREPARATION-ANALYSIS DATE | WORK ORDER # |
|---|---|---|---|---|---|---|
| Prep Batch #...: 3240136 | | | | | | |
| Arsenic | ND | 0.010 | mg/L | SW846 6010B | 08/28-09/04/03 | FW44H1AE |
| | | Dilution Factor: 1 | | | | |
| Barium | ND | 0.20 | mg/L | SW846 6010B | 08/28-09/04/03 | FW44H1AH |
| | | Dilution Factor: 1 | | | | |
| Cadmium | ND | 0.0050 | mg/L | SW846 6010B | 08/28-09/04/03 | FW44H1AJ |
| | | Dilution Factor: 1 | | | | |
| Lead | ND | 0.0030 | mg/L | SW846 6010B | 08/28-09/04/03 | FW44H1AF |
| | | Dilution Factor: 1 | | | | |
| Chromium | ND | 0.010 | mg/L | SW846 6010B | 08/28-09/04/03 | FW44H1AK |
| | | Dilution Factor: 1 | | | | |
| Selenium | ND | 0.0050 | mg/L | SW846 6010B | 08/28-09/04/03 | FW44H1AG |
| | | Dilution Factor: 1 | | | | |
| Silver | ND | 0.010 | mg/L | SW846 6010B | 08/28-09/04/03 | FW44H1AL |
| | | Dilution Factor: 1 | | | | |
| Mercury | ND | 0.00020 | mg/L | SW846 7470A | 08/28-09/03/03 | FW44H1AM |
| | | Dilution Factor: 1 | | | | |

DAVEY RESOURCE GROUP

Client Sample ID: EAST WATER INLET

General Chemistry

Lot-Sample #...: A3H270232-001 Work Order #...: FW44H Matrix.....: WG
Date Sampled...: 08/27/03 11:00 Date Received..: 08/27/03

| PARAMETER | RESULT | RL | UNITS | METHOD | PREPARATION-ANALYSIS DATE | PREP BATCH # |
|---|---|---|---|---|---|---|
| Biochemical Oxygen Demand (BOD) | 4 | 2 | mg/L | MCAWW 405.1 | 08/27-09/01/03 | 3239641 |
| | | Dilution Factor: 1 | | | | |
| Nitrate as N | 0.85 | 0.10 | mg/L | MCAWW 300.0A | 08/29/03 | 3241387 |
| | | Dilution Factor: 1 | | | | |
| Nitrite as N | ND | 0.10 | mg/L | MCAWW 300.0A | 08/29/03 | 3241388 |
| | | Dilution Factor: 1 | | | | |

DAVEY RESOURCE GROUP

Client Sample ID: SOUTH WATER INLET

TOTAL Metals

Lot-Sample #...: A3H270232-002 Matrix.....: WG
Date Sampled...: 08/27/03 11:40 Date Received..: 08/27/03

| PARAMETER | RESULT | REPORTING LIMIT | UNITS | METHOD | PREPARATION-ANALYSIS DATE | WORK ORDER # |
|---|---|---|---|---|---|---|
| Prep Batch #...: 3240136 | | | | | | |
| Arsenic | ND | 0.010 | mg/L | SW846 6010B | 08/28-09/04/03 | FW44P1AE |
| | | Dilution Factor: 1 | | | | |
| Barium | ND | 0.20 | mg/L | SW846 6010B | 08/28-09/04/03 | FW44P1AH |
| | | Dilution Factor: 1 | | | | |
| Cadmium | ND | 0.0050 | mg/L | SW846 6010B | 08/28-09/04/03 | FW44P1AJ |
| | | Dilution Factor: 1 | | | | |
| Lead | ND | 0.0030 | mg/L | SW846 6010B | 08/28-09/04/03 | FW44P1AF |
| | | Dilution Factor: 1 | | | | |
| Chromium | ND | 0.010 | mg/L | SW846 6010B | 08/28-09/04/03 | FW44P1AK |
| | | Dilution Factor: 1 | | | | |
| Selenium | ND | 0.0050 | mg/L | SW846 6010B | 08/28-09/04/03 | FW44P1AG |
| | | Dilution Factor: 1 | | | | |
| Silver | ND | 0.010 | mg/L | SW846 6010B | 08/28-09/04/03 | FW44P1AL |
| | | Dilution Factor: 1 | | | | |
| Mercury | ND | 0.00020 | mg/L | SW846 7470A | 08/28-09/03/03 | FW44P1AM |
| | | Dilution Factor: 1 | | | | |

DAVEY RESOURCE GROUP

Client Sample ID: SOUTH WATER INLET

General Chemistry

Lot-Sample #...: A3H270232-002 Work Order #...: FW44P Matrix.....: WG
Date Sampled...: 08/27/03 11:40 Date Received..: 08/27/03

| PARAMETER | RESULT | RL | UNITS | METHOD | PREPARATION-ANALYSIS DATE | PREP BATCH # |
|---|---|---|---|---|---|---|
| Biochemical Oxygen Demand (BOD) | 3 | 2 | mg/L | MCAWW 405.1 | 08/27-09/01/03 | 3239641 |
| | | Dilution Factor: 1 | | | | |
| Nitrate as N | 4.8 | 0.10 | mg/L | MCAWW 300.0A | 08/29/03 | 3241387 |
| | | Dilution Factor: 1 | | | | |
| Nitrite as N | ND | 0.10 | mg/L | MCAWW 300.0A | 08/29/03 | 3241388 |
| | | Dilution Factor: 1 | | | | |

# QUALITY CONTROL SECTION

METHOD BLANK REPORT

TOTAL Metals

Client Lot #...: A3H270232 Matrix.....: WATER

| PARAMETER | RESULT | REPORTING LIMIT | UNITS | METHOD | PREPARATION-ANALYSIS DATE | WORK ORDER # |
|---|---|---|---|---|---|---|
| MB Lot-Sample #: A3H280000-136 Prep Batch #...: 3240136 | | | | | | |
| Arsenic | ND | 0.010 | mg/L | SW846 6010B | 08/28-09/04/03 | FW6DD1CM |
| | | Dilution Factor: 1 | | | | |
| Barium | ND | 0.20 | mg/L | SW846 6010B | 08/28-09/04/03 | FW6DD1CU |
| | | Dilution Factor: 1 | | | | |
| Cadmium | ND | 0.0050 | mg/L | SW846 6010B | 08/28-09/04/03 | FW6DD1CW |
| | | Dilution Factor: 1 | | | | |
| Lead | ND | 0.0030 | mg/L | SW846 6010B | 08/28-09/04/03 | FW6DD1CN |
| | | Dilution Factor: 1 | | | | |
| Chromium | ND | 0.010 | mg/L | SW846 6010B | 08/28-09/04/03 | FW6DD1C0 |
| | | Dilution Factor: 1 | | | | |
| Selenium | ND | 0.0050 | mg/L | SW846 6010B | 08/28-09/04/03 | FW6DD1CP |
| | | Dilution Factor: 1 | | | | |
| Silver | ND | 0.010 | mg/L | SW846 6010B | 08/28-09/04/03 | FW6DD1C8 |
| | | Dilution Factor: 1 | | | | |
| Mercury | ND | 0.00020 | mg/L | SW846 7470A | 08/28-09/03/03 | FW6DD1AW |
| | | Dilution Factor: 1 | | | | |

NOTE(S):

Calculations are performed before rounding to avoid round-off errors in calculated results.

# METHOD BLANK REPORT

## General Chemistry

Client Lot #...: A3H270232 Matrix.....: WATER

| PARAMETER | RESULT | REPORTING LIMIT | UNITS | METHOD | PREPARATION-ANALYSIS DATE | PREP BATCH # |
|---|---|---|---|---|---|---|
| Biochemical Oxygen Demand (BOD) | | Work Order #: FXE1L1AA | | MB Lot-Sample #: | A3H270000-641 | |
| | ND | 2 | mg/L | MCAWW 405.1 | 08/27-09/01/03 | 3239641 |
| | | Dilution Factor: 1 | | | | |
| Nitrate as N | | Work Order #: FXAG21AA | | MB Lot-Sample #: | A3H290000-387 | |
| | ND | 0.10 | mg/L | MCAWW 300.0A | 08/28/03 | 3241387 |
| | | Dilution Factor: 1 | | | | |
| Nitrite as N | | Work Order #: FXAG51AA | | MB Lot-Sample #: | A3H290000-388 | |
| | ND | 0.10 | mg/L | MCAWW 300.0A | 08/28/03 | 3241388 |
| | | Dilution Factor: 1 | | | | |

NOTE(S):

Calculations are performed before rounding to avoid round-off errors in calculated results.

LABORATORY CONTROL SAMPLE EVALUATION REPORT

TOTAL Metals

Client Lot #...: A3H270232 Matrix.....: WATER

| PARAMETER | PERCENT RECOVERY | RECOVERY LIMITS | METHOD | PREPARATION-ANALYSIS DATE | WORK ORDER # |
|---|---|---|---|---|---|
| LCS Lot-Sample#: A3H280000-136 Prep Batch #...: 3240136 | | | | | |
| Arsenic | 108 | (80 - 120) | SW846 6010B<br>Dilution Factor: 1 | 08/28-09/04/03 | FW6DD1DW |
| Barium | 108 | (80 - 120) | SW846 6010B<br>Dilution Factor: 1 | 08/28-09/04/03 | FW6DD1D4 |
| Lead | 106 | (80 - 120) | SW846 6010B<br>Dilution Factor: 1 | 08/28-09/04/03 | FW6DD1DX |
| Cadmium | 107 | (80 - 120) | SW846 6010B<br>Dilution Factor: 1 | 08/28-09/04/03 | FW6DD1D6 |
| Selenium | 114 | (80 - 120) | SW846 6010B<br>Dilution Factor: 1 | 08/28-09/04/03 | FW6DD1D0 |
| Chromium | 111 | (80 - 120) | SW846 6010B<br>Dilution Factor: 1 | 08/28-09/04/03 | FW6DD1D8 |
| Silver | 118 | (80 - 120) | SW846 6010B<br>Dilution Factor: 1 | 08/28-09/04/03 | FW6DD1EH |
| Mercury | 113 | (70 - 118) | SW846 7470A<br>Dilution Factor: 1 | 08/28-09/03/03 | FW6DD1CK |

NOTE(S):

Calculations are performed before rounding to avoid round-off errors in calculated results.

LABORATORY CONTROL SAMPLE EVALUATION REPORT

General Chemistry

Lot-Sample #...: A3H270232 Matrix.....: WATER

| PARAMETER | PERCENT RECOVERY | RECOVERY LIMITS | RPD | RPD LIMITS | METHOD | PREPARATION-ANALYSIS DATE | PREP BATCH # |
|---|---|---|---|---|---|---|---|
| Biochemical Oxygen Demand (BOD) | | WO#:FXE1L1AC-LCS/FXE1L1AD-LCSD | | | | LCS Lot-Sample#: A3H270000-641 | |
| | 88 | (85 - 115) | | | MCAWW 405.1 | 08/27-09/01/03 | 3239641 |
| | 88 | (85 - 115) | 0.57 | (0-20) | MCAWW 405.1 | 08/27-09/01/03 | 3239641 |
| | | Dilution Factor: 1 | | | | | |
| Nitrite as N | | WO#:FXAG51AC-LCS/FXAG51AD-LCSD | | | | LCS Lot-Sample#: A3H290000-388 | |
| | 97 | (88 - 110) | | | MCAWW 300.0A | 08/28/03 | 3241388 |
| | 96 | (88 - 110) | 0.41 | (0-20) | MCAWW 300.0A | 08/28/03 | 3241388 |
| | | Dilution Factor: 1 | | | | | |

NOTE(S):

Calculations are performed before rounding to avoid round-off errors in calculated results.

LABORATORY CONTROL SAMPLE EVALUATION REPORT

General Chemistry

Client Lot #...: A3H270232 Matrix.....: WATER

| PARAMETER | PERCENT RECOVERY | RECOVERY LIMITS | METHOD | PREPARATION-ANALYSIS DATE | PREP BATCH # |
|---|---|---|---|---|---|
| Nitrate as N | | Work Order #: FXAG21AC LCS Lot-Sample#: A3H290000-387 | | | |
| | 99 | (90 - 110) | MCAWW 300.0A | 08/28/03 | 3241387 |
| | | Dilution Factor: 1 | | | |

NOTE(S):

Calculations are performed before rounding to avoid round-off errors in calculated results.

# MATRIX SPIKE SAMPLE EVALUATION REPORT

## TOTAL Metals

Client Lot #...: A3H270232 Matrix.....: WATER
Date Sampled...: 08/26/03 10:30 Date Received..: 08/27/03

| PARAMETER | PERCENT RECOVERY | RECOVERY LIMITS | RPD | RPD LIMITS | METHOD | PREPARATION-ANALYSIS DATE | WORK ORDER # |
|---|---|---|---|---|---|---|---|
| MS Lot-Sample #: A3H270166-012 Prep Batch #...: 3240136 | | | | | | | |
| Arsenic | 108 | (75 - 125) | | | SW846 6010B | 08/28-09/04/03 | FW4DL1E7 |
| | 108 | (75 - 125) | 0.04 | (0-20) | SW846 6010B | 08/28-09/04/03 | FW4DL1E8 |
| | | Dilution Factor: 1 | | | | | |
| Barium | 107 | (75 - 125) | | | SW846 6010B | 08/28-09/04/03 | FW4DL1FT |
| | 107 | (75 - 125) | 0.03 | (0-20) | SW846 6010B | 08/28-09/04/03 | FW4DL1FU |
| | | Dilution Factor: 1 | | | | | |
| Cadmium | 106 | (75 - 125) | | | SW846 6010B | 08/28-09/04/03 | FW4DL1EA |
| | 106 | (75 - 125) | 0.13 | (0-20) | SW846 6010B | 08/28-09/04/03 | FW4DL1EC |
| | | Dilution Factor: 1 | | | | | |
| Lead | 105 | (75 - 125) | | | SW846 6010B | 08/28-09/04/03 | FW4DL1FA |
| | 105 | (75 - 125) | 0.01 | (0-20) | SW846 6010B | 08/28-09/04/03 | FW4DL1FC |
| | | Dilution Factor: 1 | | | | | |
| Chromium | 108 | (75 - 125) | | | SW846 6010B | 08/28-09/04/03 | FW4DL1EH |
| | 108 | (75 - 125) | 0.12 | (0-20) | SW846 6010B | 08/28-09/04/03 | FW4DL1EJ |
| | | Dilution Factor: 1 | | | | | |
| Selenium | 112 | (75 - 125) | | | SW846 6010B | 08/28-09/04/03 | FW4DL1FE |
| | 113 | (75 - 125) | 0.27 | (0-20) | SW846 6010B | 08/28-09/04/03 | FW4DL1FF |
| | | Dilution Factor: 1 | | | | | |
| Silver | 121 | (75 - 125) | | | SW846 6010B | 08/28-09/04/03 | FW4DL1F1 |
| | 121 | (75 - 125) | 0.10 | (0-20) | SW846 6010B | 08/28-09/04/03 | FW4DL1F2 |
| | | Dilution Factor: 1 | | | | | |
| Mercury | 111 | (53 - 135) | | | SW846 7470A | 08/28-09/03/03 | FW4DL1D0 |
| | 118 | (53 - 135) | 5.9 | (0-20) | SW846 7470A | 08/28-09/03/03 | FW4DL1D1 |
| | | Dilution Factor: 1 | | | | | |

NOTE(S):

Calculations are performed before rounding to avoid round-off errors in calculated results.

# MATRIX SPIKE SAMPLE EVALUATION REPORT

## General Chemistry

Client Lot #...: A3H270232 Matrix.....: WATER
Date Sampled...: 08/26/03 09:55 Date Received..: 08/27/03

| PARAMETER | PERCENT RECOVERY | RECOVERY LIMITS | RPD | RPD LIMITS | METHOD | PREPARATION-ANALYSIS DATE | PREP BATCH # |
|---|---|---|---|---|---|---|---|
| Nitrate as N | | WO#: FW48J1AF-MS/FW48J1AG-MSD | | | | MS Lot-Sample #: A3H270250-007 | |
| | 96 | (90 - 110) | | | MCAWW 300.0A | 08/28/03 | 3241387 |
| | 98 | (90 - 110) | 1.2 | (0-20) | MCAWW 300.0A | 08/28/03 | 3241387 |

Dilution Factor: 1

NOTE(S):

Calculations are performed before rounding to avoid round-off errors in calculated results.

# Chain of Custody Record

SEVERN TRENT STL

Severn Trent Laboratories, Inc.

STL-4124 (0901)

| Client | Project Manager | Date | Chain of Custody Number |
|---|---|---|---|
| Davey Resource Group | James E. Jenkins | 8/27/03 | 115842 |
| **Address** | **Telephone Number (Area Code)/Fax Number** | **Lab Number** | **Page ____ of ____** |
| 3728 Fishcreek Rd. | 330 673-5685 ext 15 | | |
| **City** | **State** / **Zip Code** | **Site Contact** | **Lab Contact** |
| Stow | OH / 44224 | | |
| **Project Name and Location (State)** | **Carrier/Waybill Number** | | |
| Cleveland Heights Park Stream | | | |
| **Contract/Purchase Order/Quote No.** | | | |

| Sample I.D. No. and Description (Containers for each sample may be combined on one line) | Date | Time | Matrix: Air | Aqueous | Sed. | Soil | Containers & Preservatives: Unpres. | H2SO4 | HNO3 | HCl | NaOH | ZnAc/NaOH | Analysis: RCRA Metals* | Nitrate/Nitrite | BOD | Total Coliform | Special Instructions/ Conditions of Receipt |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| East Water Inlet #1 | | | | X | | | | | X | | | | X | | | | |
| East Water Inlet #2 | | | | X | | | | | | | | | | X | | | |
| East Water Inlet #3 | | | | X | | | | | | | | | | | X | | |
| East Water Inlet #4 | | | | X | | | | | | | | | | | | X | |
| South Water Inlet #1 | | | | X | | | | | X | | | | X | | | | |
| South Water Inlet #2 | | | | X | | | | | | | | | | X | | | |
| South Water Inlet #3 | | | | X | | | | | | | | | | | X | | |
| South Water Inlet #4 | | | | X | | | | | | | | | | | | X | |

**Possible Hazard Identification**

☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

**Sample Disposal**

☐ Return To Client ☐ Disposal By Lab ☐ Archive For ____ Months (A fee may be assessed if samples are retained longer than 1 month)

**Turn Around Time Required**

☐ 24 Hours ☐ 48 Hours ☐ 7 Days ☐ 14 Days ☐ 21 Days ☐ Other ____

**QC Requirements (Specify)**

| | Date | Time | | Date | Time |
|---|---|---|---|---|---|
| 1. Relinquished By | 8/27/03 | 3:00 pm | 1. Received By | 8-27-03 | 3:00 pm |
| 2. Relinquished By | | | 2. Received By | | |
| 3. Relinquished By | | | 3. Received By | | |

Comments

*Metals= As Ba Cd Cr Pb Hg Se Ag

DISTRIBUTION: WHITE - Returned to Client with Report; CANARY - Stays with the Sample; PINK - Field Copy

# *ADAMS WATER LABORATORY, INC. DATA*

**Adams Water Laboratory, Inc.**
**Non-Potable Bacterial Sample Report**

STL-A3H270232-2 FW44P

Water Supply Name

south water inlet

County

Sample Tap ☐ AM ☐ PM

8-27-03

Date Collected

Time Collected

Street Address

City

will cordell

Person Collecting Sample

330 497-9396

Telephone Number

AGENCY COLLECTING SAMPLE: Severn Trent Laboratories, Inc.

SAMPLE CLASSIFICATION

___Wastewater ___Roadside Ditch ___River, Stream ___Lake ___Drinking Water

**LABORATORY FINDINGS**

Check box for each test required.

☐ 5,000 Fecal Coliform / 100 mL

☐ _____ Fecal Strep / 100 mL

☐ _____ E. Coli / 100 mL

☐ _____ Total Coliform/ 100 mL

☐ _____ CFU/ 1 mL Heterotrophic Plate

SAMPLE NOT ANALYZED

___Laboratory Accident

___Broken In Transit

___Sample Too Old

Adams Water Laboratory, Inc. 912 East Tallmadge Ave., Akron, OH 44310-3514 (330) 633-3991

**FOR LAB USE ONLY**

Sample Number 00302

Date Received AUG 27 2003

Time Received 16:05

Time Analyzed

Date Reported AUG 31 2003

Analyst: ___K. Smith ☒ S. Adams ___J. Moritz

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**Adams Water Laboratory, Inc.**
**Non-Potable Bacterial Sample Report**

STL-A3H270232-1 FW44H

Water Supply Name

east water Inlet

County

Sample Tap ☐ AM ☐ PM

8-27-03

Date Collected

Time Collected

Street Address

City

Will Cordell

Person Collecting Sample

330 497-9396

Telephone Number

AGENCY COLLECTING SAMPLE: Severn Trent Laboratories, Inc.

SAMPLE CLASSIFICATION

___Wastewater ___Roadside Ditch ___River, Stream ___Lake ___Drinking Water

**LABORATORY FINDINGS**

Check box for each test required.

☐ 3,000 Fecal Coliform / 100 mL

☐ _____ Fecal Strep / 100 mL

☐ _____ E. Coli / 100 mL

☐ _____ Total Coliform/ 100 mL

☐ _____ CFU/ 1 mL Heterotrophic Plate

SAMPLE NOT ANALYZED

___Laboratory Accident

___Broken In Transit

___Sample Too Old

Adams Water Laboratory, Inc. 912 East Tallmadge Ave., Akron, OH 44310-3514 (330) 633-3991

**FOR LAB USE ONLY**

Sample Number 00301

Date Received AUG 27 2003

Time Received

Time Analyzed 1605

Date Reported AUG 31 2003

Analyst: ___K. Smith ☒ S. Adams ___J. Moritz

## *Appendix C*
## *Bat Capture Data Forms*

# BAT CAPTURE DATA FORM

Location (state, nearest town, area): Forest Hill Park, Cleveland Hts, Ohio  Netting Station: #1

Date: July 30, 2003  Start Time: 9:00 pm  End Time: 2:00 am  Recorder(s): Michelle Malcosky, Ken Christensen, Tony Virgilitte, Matt Adams

Moon Phase: 1 day after New Moon  Start Temp.: 70° F  End Temp: 65° F  % Cloud Cover: overcast, no detectable wind

Habitat Description: Successional woods - over hiking trail  Capture Technique (# and size of nets/traps): 3 tiers of 9m nets

| Time | Species | Sex | Age | Reproductive Status | Forearm Length (mm) | Weight (g) (less bag) | Additional Notes |
|---|---|---|---|---|---|---|---|
| 9:40 pm | Red bat | M | J | NR | 40 | 10 | short ears, blunt tragus |
| 10:00 pm | big brown | M | A | ED | 45 | 18 | short ears, short rounded tragus |
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SEX: **M**(ale) or **F**(emale)  AGE: **A**(dult) or **J**(uvenile)  **Bag Weight**: 9 grams

REPRODUCTIVE STATUS: **P**(regnant), **L**(actating), **E**(pydidymides)-**D**(escended), or **N**(on)-**R**(eproductive)

## BAT CAPTURE DATA FORM

Location (state, nearest town, area): Forest Hill Park, Cleveland Heights, Ohio Netting Station: #1

Date: July 31, 2003 Start Time: 9:00 pm End Time: 2:00 am Recorder(s): Michelle Malcosky, Ken Christensen Shawn Brueda, Tony Virgalitte, Jim Jenkins

Moon Phase: 2days after new moon Start Temp.: 68° F End Temp: 60° F % Cloud Cover: overcast, wind 10-15mph

Habitat Description: successional woods-overhiking trail Capture Technique (# and size of nets/traps): 3 tiers of 9 meter nets

| Time | Species | Sex | Age | Reproductive Status | Forearm Length (mm) | Weight (g) | Additional Notes |
|---|---|---|---|---|---|---|---|
| | | | | | | | No bats caught at this station. |
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SEX: M(ale) or F(emale) AGE: A(dult) or J(uvenile) **Bag Weight**: 9 grams

REPRODUCTIVE STATUS: **P**(regnant), **L**(actating), **E**(pydidymides)-**D**(escended), or **N**(on)-**R**(eproductive)

# BAT CAPTURE DATA FORM

Location (state, nearest town, area): Forest Hill Park, Cleveland Hts., Ohio  Netting Station: #2

Date: July 30, 2003  Start Time: 9:00 PM  End Time: 2:00 am  Recorder(s): Michelle Maicosky, Ken Christensen, Tony Virgalitte, Matt Adams

Moon Phase: New moon (1 day after)  Start Temp.: 70° F  End Temp: 65° F  % Cloud Cover: overcast, no detectable wind

Habitat Description: over Dugway Brook in successional woods  Capture Technique (# and size of nets/traps): 2 tiers of 9 meter nets

| Time | Species | Sex | Age | Reproductive Status | Forearm Length (mm) | Weight (g) | Additional Notes |
|---|---|---|---|---|---|---|---|
| | | | | | | | No bats caught at this station. |
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SEX: **M**(ale) or **F**(emale)  AGE: **A**(dult) or **J**(uvenile)  **Bag Weight**: 9 grams

REPRODUCTIVE STATUS: **P**(regnant), **L**(actating), **E**(pydidymides)-**D**(escended), or **N**(on)-**R**(eproductive)

# BAT CAPTURE DATA FORM

Location (state, nearest town, area): Forest Hill Park, Cleveland Heights, Ohio  Netting Station: # 3

Date: July 30, 2003  Start Time: 9:00 pm  End Time: 2:00 am  Recorder(s): Michelle Malcosky, Ken Christensen, Tony Virgalitte, Matt Adams

Moon Phase: 1 day after new moon  Start Temp.: 70° F  End Temp: 65° F  % Cloud Cover: overcast, no detectable wind

Habitat Description: over Dugway Brook in successional woods  Capture Technique (# and size of nets/traps): 2 tiers – 6 meter nets w/ 6 meter net off to side to block off hillside

| Time | Species | Sex | Age | Reproductive Status | Forearm Length (mm) | Weight (g) | Additional Notes |
|---|---|---|---|---|---|---|---|
| 10:15 pm | Red bat | F | A | NR | 43 | 11 | short round ears w/ blunt tragus |
| 12:45 am | Big brown | M | A | ED | 48 | 17 | short ears, rounded tragus |
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SEX: **M**(ale) or **F**(emale)  AGE: **A**(dult) or **J**(uvenile)  **Bag Weight**: 9 grams

REPRODUCTIVE STATUS: **P**(regnant), **L**(actating), **E**(pydidymides)-**D**(escended), or **N**(on)-**R**(eproductive)

# BAT CAPTURE DATA FORM

Location (state, nearest town, area): Forest Hill Park, Cleveland Heights, Ohio  Netting Station: #3

Date: July 31, 2003  Start Time: 9:00 pm  End Time: 2:00 am  Recorder(s): Michelle Malcosky, Ken Christensen, Shawn Brueda, Tony Virgalitte, Jim Jenkins

Moon Phase: 2 days after new moon  Start Temp.: 68° F  End Temp: 60° F  % Cloud Cover: overcast, wind ~10-15 mph

Habitat Description: over Dugway Brook in successional woods  Capture Technique (# and size of nets/traps): 2 tiers of 6 meter nets w/ 6 meter net off to side to block off hillside

| Time | Species | Sex | Age | Reproductive Status | Forearm Length (mm) | Weight (g) | Additional Notes |
|---|---|---|---|---|---|---|---|
| 10:30 pm | big brown | F | A | L | 24 | 16 | short ears w/ rounded tragus |
| 11:45 pm | big brown | M | A | ED | 27 | 19 | " " |
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SEX: **M**(ale) or **F**(emale)  AGE: **A**(dult) or **J**(uvenile)  **Bag Weight**: 9 grams

REPRODUCTIVE STATUS: **P**(regnant), **L**(actating), **E**(pydidymides)-**D**(escended), or **N**(on)-**R**(eproductive)

## BAT CAPTURE DATA FORM

Location (state, nearest town, area): Forest Hill Park, Cleveland Heights, Ohio  Netting Station: #4

Date: July 31, 2003  Start Time: 9:00 pm  End Time: 2:00 am  Recorder(s): Michelle Malcosky, Ken Christensen, Shawn Bruzda, Tony Virgalitte, Jim Jenkins

Moon Phase: 1 day after new moon  Start Temp.: 68° F  End Temp: 60° F  % Cloud Cover: overcast, wind: 10-15 mph

Habitat Description: small clearing in successional weeds at top of ravines - over trail  Capture Technique (# and size of nets/traps): 3 tiers — 18 meter nets

| Time | Species | Sex | Age | Reproductive Status | Forearm Length (mm) | Weight (g) | Additional Notes |
|---|---|---|---|---|---|---|---|
| 9:40 | big brown | M | A | ED | 43 | 19 | short ears w/ rounded tragus |
| 9:40 | red bat | — | — | — | — | — | loose in net & escaped |
| 9:45 | red bat | — | — | — | — | — | loose in net & escaped |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | Netting station was vandalized. |
| | | | | | | | All nets destroyed, as well as |
| | | | | | | | 2 bottom poles. ~ 10:30 pm |
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SEX: **M**(ale) or **F**(emale)  AGE: **A**(dult) or **J**(uvenile)  **Bag Weight:** 9 grams

REPRODUCTIVE STATUS: **P**(regnant), **L**(actating), **E**(pydidymides)-**D**(escended), or **N**(on)-**R**(eproductive)

# Appendix D
# References


Belwood, J.J. 1988. In Ohio's Backyard: Bats. *Ohio Biological Survey Backyard Series 1*:I-x, 1-196.

Brady, J.T., R.K. LaVal, T.H. Kunz, M.D. Tuttle, D.E. Wilson, and R.L. Clawson. 1983. *Recovery plan for the Indiana bat*. U.S. Fish and Wildlife Service, Washington, DC. 94 pp.

Conant, R. 1951 (2nd edition). *The Reptiles of Ohio*. University of Notre Dame Press, Notre Dame. 283 pp.

———. 1975 (2nd edition). *A Field Guide to Reptiles and Amphibians of Eastern and Central North America*. Houghton Mifflin Co., Boston. xviii + 429 pp., 48 plates.

Cummins, K.W. 1985. *Field Procedures for the Analysis of Functional Feeding Groups of Stream Macroinvertebrates*. Pymatuming Laboratory of Ecology, University of Pittsburgh, Linesville.

Davey Resource Group and Kerr + Boron Associates. 2002. *Environmental Design and Improvement Plan—Upper Dugway Valley, Forest Hill Park, Cleveland Heights, Ohio.* Kent, Ohio

Deshon, J.E. 1995. *Development and Application of the Invertebrate Community Index (ICI)* PP.217-243. In W.S. Davis and T. Simon (eds.) Biological Assessment and Criteria: Tools for Water Resource Planning and Decision Making. Lewis Publishers, Boca Raton.

Gottschang, J.L. 1981. *A Guide to the Mammals of Ohio*. The Ohio State University Press, Columbus. xi + 176 pp., 13 plates.

Hellawell, J.M. 1986. *Biological Indicators of Freshwater Pollution and Environmental Management*. Elsevier Applied Science Publishers, London.

Hilsenhoff, W. L. 1987. *An Improved Biotic Index of Organic Stream Pollution*. The Great Lakes Entomologist 20: 31-39.

Hynes, H.B.N. 1966. *The Biology of Polluted Waters*. Liverpool University Press.

Hynes, H.B.N. 1970. *The Ecology of Running Waters*. Univ. of Toronto Press, Toronto.

Kunz, T.H. 1988. Ecological and Behavioral Methods for the Study of Bats. Smithsonian Institution Press. 533 pp.

Kurta, A., D. King, J.A. Teramino, J.M. Stribley, and K.J. Williams. 1993. Summer Roosts of the Endangered Indiana Bat *(Myotis sodalis)* on the Northern Edge of its Range. *Am. Midl. Nat.* 129:132-138.

Merrit, R.W. and K.W. Cummins, eds. 1995 (3rd edition). *An Introduction to the Aquatic Insects of North America*. Kendall / Hunt Publishing Company, Dubuque.

Odum, E.P. 1969. The Strategy of Ecosystem Development. *Sci.* 164:262-270.

———. 1975 (2nd ed.). *Ecology: the Link Between the Natural and Social Sciences.* Holt, Rinehart and Winston, New York City.

———. 1999. *Ecological Guidelines.* Ohio Department of Transportation, Office of Environmental Services, Columbus.

Ohio Environmental Protection Agency. 1987. *Biological Criteria for the Protection of Aquatic Life. Volume II. Users Manual for Biological Field Assessment of Ohio Surface Waters.* Ohio Environmental Protection Agency Division of Water Quality Monitoring and Assessment, Columbus.

———. 1989. *Biological Criteria for the Protection of Aquatic Life. Volume III. Standardized Biological Field Sampling and Laboratory Methods for Assessing Fish and Macroinvertebrate Communities.* Ohio Environmental Protection Agency Division of Water Quality Planning and Assessment, Columbus.

———. 1997. State of Ohio Water Quality Standards. Chapter 3745-1 of the Administrative Code. Ohio Environmental Protection Agency Division of Water Quality Planning and Assessment, Columbus.

Peckarsky, B.L., P.R. Fraissinet, M.A. Penton, and D.J. Concklin, Jr. 1990. *Freshwater Macroinvertebrates of Northeastern North America.* Cornell University Press, Ithica.

Pressley Associates, Inc. 1999. *Forest Hill Park Updated Master Plan (Revised and Reprinted 2001) Volumes 1 and 2.* Cambridge, Massachusetts.

Szcytko, S.W. 1988. *Investigation of new interpretative techniques for assessing biomonitoring data and stream water quality in Wisconsin streams.* Report to the Surface Water Monitoring Committee, Wisconsin Department of Natural Resources.

United States Environmental Protection Agency. 2003. Retrieved from the World Wide Web: http://www.epa.gov/volunteer/stream/vms57.html

Yoder, C.O. and E.T. Rankin. 1995. Biological response signatures and the area of degradation value: new tools for interpreting multimetric data PP. 263 – 286 In W.S. Davis and T. Simon (eds.). *Biological Assessment and Criteria Tools: for Water Resource Planning and Decision Making.* Lewis Publishers, Boca Raton

# Appendix E
# Davey Resource Group Personnel Profiles

**Shawn W. Bruzda** is a biologist and senior urban forester with Davey Resource Group. Mr. Bruzda serves as an inventory arborist for all types of tree inventory projects including cemeteries, golf courses, military bases, municipalities, parks, and university campuses. Mr. Bruzda is also responsible for the creation and dissemination of tree inventory management plans. He has extensive experience with both GPS and hand-held and pen-based data collection units. He has served as project manager on numerous large-scale municipal tree inventory projects throughout the eastern United States. As a biologist for Davey, Mr. Bruzda is responsible for ecological surveys, fish and macroinvertebrate identification and data analysis, and report writing. He also assists in various other areas such as wetlands delineation surveys, endangered species surveys, tree appraisals and tree preservation planning, habitat analysis, and secondary source reviews. Mr. Bruzda, a graduate of Kent State University, received a bachelor of science degree in biological sciences with an emphasis in aquatic ecology. He is a certified arborist through the International Society of Arboriculture.

**Ana Burns, M.S.E.S.,** is a biologist responsible for project management, data analysis, and report writing for ecological surveys, watershed studies, park inventories, and other large-scale projects. She has experience in wetlands delineations, lake and watershed management, and forestry. In addition, Ms. Burns has extensive knowledge of aerial photograph interpretation and geographic information systems (GIS). She joined Davey Resource Group after working as an environmental planner for a county planning department. In this position, she gained valuable experience in facilitating public participation meetings, developing educational outreach materials, and assisting the Planning Commission and their subcommittees in implementing and enforcing comprehensive plans and zoning ordinances. Ms. Burns graduated from Indiana University, Bloomington, with a bachelor of science degree in biology, and holds a master of science degree in environmental science from IU's School of Public and Environmental Affairs.

**Kenneth John Christensen** assists in plant identification and wetlands delineation surveys, and in field analysis of vertebrate populations, especially amphibians, reptiles, and mammals. He currently holds a permit from the State of Ohio to conduct mist-netting surveys for the federally endangered Indiana bat (*Myotis sodalis*). Proficient with AutoCAD software, Mr. Christensen is responsible for managing the GPS data collection and AutoCAD mapping operations for all natural resource studies. An arborist certified by the International Society of Arboriculture, he performs tree appraisals and inventories. He has 22 years of experience and holds a bachelor of science degree in conservation from Kent State University.

**Todd A. Crandall, M.En.,** is a wetlands scientist that routinely performs wetlands assessments and delineations, and prepares restoration and mitigation plans. He also performs vegetation cover mapping and plant identification, and assists with Section 401 and 404 permits. He is certified for wetlands studies by the U.S. Army Wetlands Delineator Certification Program, and is a certified Professional Wetlands Scientist (PWS) through the Society of Wetland Scientists. He has completed the 40-hour OSHA health and safety training (OSHA Standard 29 CFR 1910.120). He has 10 years of experience and holds a bachelor of science degree from Hiram College in biology and a master of environmental science degree from Miami University.

**Michelle Malcosky,** a biologist, oversees ecological projects for Davey. She manages ecological and wetlands permitting projects, writes technical reports, and assists in wetlands investigations, ecological surveys, mitigation monitoring, endangered species surveys, and watershed studies. Ms. Malcosky conducts plant surveys with an emphasis on rare, threatened, and endangered species identification. In addition, Ms. Malcosky has extensive experience conducting habitat surveys and mist-netting studies for rare bats throughout Ohio. She currently holds a permit from the State of Ohio to conduct mist-netting surveys for the federally endangered Indiana bat (*Myotis sodalis*). Ms. Malcosky has been with Davey for four years and graduated from The University of Akron with a bachelor of science degree in biology with an emphasis on botany.

**Karen M. Wise, M.S.,** manages Davey's natural resource consulting group. A wetlands biologist with ten years of consulting experience, Ms. Wise is an expert in the 401 and 404 wetland/stream regulatory process. She has obtained permits for roadway and bridge projects, correctional facilities, schools, residential subdivisions, and industrial parks throughout the Midwest region. Ms. Wise specializes in preparing creative compensatory mitigation packages to streamline the permitting process, and has directed numerous wetlands and stream restoration design projects. In addition to advising on wetlands projects, Ms. Wise is responsible for administration and business development within the natural resource consulting group. She holds a bachelor of science degree in biology from Wheeling Jesuit College and a master of science degree in natural resources from The Ohio State University.