Screening-Level Ecological Risk Assessment

Peter Cooper Landfill Site

Gowanda
New York

Prepared for **Benchmark Environmental Engineering & Science, PLLC**
Larkin Building, Suite 624
726 Exchange Street
Buffalo, NY 14210

Prepared by ***VHB*/Vanasse Hangen Brustlin, Inc.**
54 Tuttle Place
Middletown, CT 06457

April 2004

Table of Contents

List of Tables

List of Figures

List of Attachments

1

Objectives and Overview

This document presents an assessment of potential ecological risks associated with chemicals detected at and adjacent to the Peter Cooper Landfill Site (site). The purpose of this screening-level ecological risk assessment (SLERA) was to identify and characterize potential risks to ecological receptors posed by chemical releases using worst-case methods as defined by United States Environmental Protection Agency (USEPA) guidance. The objective of the assessment was to fulfill Steps 1 and 2 outlined in the *Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments* (ERAGS), Interim Final (USEPA, 1997b). Based on the results of a SLERA, a determination can be made as to whether site contaminants pose a negligible threat or whether additional work and/or remediation is required.

This SLERA was prepared pursuant to a Unilateral Administrative Order with the USEPA (CERCLA-02-2000-2014), and the Respondents' Notices of Intent to Comply.

According to current USEPA guidance, the first step in the process of ecological risk assessment is problem formulation and ecological effects evaluation. The problem formulation establishes the goals and focus of the ERA. It establishes the assessment endpoints based on potentially complete exposure pathways and toxicological effects. Problem formulation results in the definition of the risk system, using the Conceptual Risk System Model (CRSM) as a vehicle. The CRSM describes a site and its environment and presents information regarding the fate and transport of chemicals released from the site through the environment to an exposed plant or animal.

Step 2 of the SLERA includes the exposure estimate and risk calculation. This step includes estimating exposure levels and screening for ecological risks as the last two phases of the SLERA. This process concludes with a Scientific Management Decision Point meeting (SMDP) at which it is determined that: (1) ecological threats are negligible; (2) the ecological risk assessment should continue to determine whether a risk exists; or (3) there is a potential for adverse ecological effects, and a more detailed ecological risk assessment is needed.

Site History

The Peter Cooper Site was previously used to manufacture animal glue and industrial adhesives. Peter Cooper Corporation (PCCI) and/or its predecessors, Eastern Tanners Glue Company and successors (Rousselot Gelatin Corporation (PCCII)), manufactured animal glue at the site from 1904 to 1971 and adhesives from the 1950s until the plant closed in 1985. Animal glue manufacturing operations were reportedly closed by the early 1970s. The northwest portion of the Inactive Landfill Area was reportedly used to dispose of residuals from the animal glue manufacturing process, commonly referred to as cookhouse sludge. The cookhouse sludge was derived from animal hides, some of which were chrome-tanned, used as a feedstock in the process. Based on observations of the landfill sludge material made during the RI, the cookhouse sludge appears to be mixed with cinders, ash, and construction and demolition debris. This sludge mixture is referred to in this report as sludge fill.

Review of historic (1924 and 1948) fire insurance (Sanborn) maps and aerial photos from 1939, 1956, 1966, 1973, 1980, 1983 and 1990 indicates that the Former Manufacturing Plant Area was substantially covered by buildings and support structures throughout its operational history. The 1980 aerial photo for the Site indicates that animal glue manufacturing facilities were decommissioned/ demolished at that time.

In June 1971, the New York State Supreme Court ordered PCCI to remove all or part of the waste pile and terminate discharges into Cattaraugus Creek. In response, PCCI reportedly removed approximately 38,600 tons of waste pile material to its Markhams, New York site in early 1972. Between 1972 and 1975, the remaining waste pile at the site was graded, covered with a 6" clay barrier layer and 18-30 inches of barrier protection soil, and vegetated with grass. Stone rip-rap and concrete blocks were placed along the bank of Cattaraugus Creek to protect the fill material from scouring.

In July 1976, the assets of original PCCI, including the manufacturing plant and property located in Gowanda, were purchased by Rousselot Gelatin Corporation and its parent, Rousselot, S.A., of France. Rousselot Gelatin was renamed Peter Cooper Corporation (PCCII) and this newly-formed PCCII sold the Gowanda site to the current owner, JimCar Development, Inc., in April 1988.

Previous Investigations and Remedial Measures

NYSDEC performed Phase I and Phase II Site Investigations at the Peter Cooper Gowanda Site in 1981 and 1983, respectively (RCRA Research, Inc. 1983 and 1984). The Phase I included limited soil and seep sampling performed in November 1981.

The Phase II investigation was performed in May 1983 and included the investigation of soil, groundwater, surface water and sediment. Samples were analyzed for total halogenated organics and total volatile halogenated organics, as well as priority pollutant metals. Analytical results indicated the presence of arsenic, chromium and zinc in soil and sediment samples. Surface water and groundwater inorganic analyses were non-detect with the exception of low levels of chromium in groundwater.

The current PCCII subsequently agreed with the New York State Department of Environmental Conservation (NYSDEC) to perform a Remedial Investigation and Feasibility Study (RI/FS) at the site. The RI was performed by O'Brien & Gere Engineers under a NYSDEC-approved work plan. Activities performed during the RI included collection of soil, surface water, sediment, waste material, seep, and groundwater samples. Most of the O'Brien & Gere investigation targeted the Inactive Landfill Area. The RI Report was issued in January 1989. The RI concluded that there were no significant health risks associated with the site.

The FS Report was issued in March 1991. In June of 1991, NYSDEC and PCCII reportedly agreed upon a remedial alternative for the site that included containment of source materials, leachate collection and access restrictions through fencing and deed restrictions.

In 1991 NYSDEC removed the site from its Registry of Inactive Hazardous Waste Sites because it did not meet the statutory definition of an inactive hazardous waste disposal site. As a consequence of this designation, NYSDEC could not use State resources to implement a remedial program. NYSDEC and the Village of Gowanda reportedly requested that EPA evaluate the site for NPL listing.

In 1996, United States Environmental Protection Agency (USEPA) Region II activated the Response Engineering and Analytical Contract (REAC) and the Superfund Technical and Assessment Response Team (START) to collect and analyze soil, groundwater, surface water, and sediment samples from the Peter Cooper Site.

In 1997, New York State Electric & Gas Corporation (NYSEG), under an order on consent with U.S. EPA, placed an approximately 150-foot long rip-rap revetment adjacent to Cattaraugus Creek on the portion of the site owned by NYSEG (*i.e.*, northwest portion of the site).

In 1998, USEPA Region II prepared a Hazard Ranking System Model score for the site and listed the Peter Cooper Site on the NPL. USEPA subsequently notified several potentially responsible parties (PRPs) of their possible involvement in the site investigation and remediation, and proceeded to develop a Remedial Investigation/Feasibility Study (RI/FS) Work Plan for the site. The Revised Final RI/FS Work Plan was issued by USEPA on June 15, 1999. Representatives of certain PRPs subsequently met with USEPA and volunteered to prepare a modified RI/FS Work Plan addressing the Inactive Landfill Area of the site. The final RI/FS work plan for the Inactive Landfill Area was submitted to USEPA in March 2000. In April 2000 USEPA issued a Unilateral Administrative Order to certain PRPs directing completion of the RI/FS for the Inactive Landfill Area as well as the Former Manufacturing Plant Area. Representatives of the cooperating PRPs subsequently submitted an Addendum to the March 2000 RI/FS Work Plan that extended RI/FS activities to the Former Manufacturing Plant Area. The Addendum was approved in August 2000.

A Remedial Investigation Report was submitted to the EPA in December, 2002. Soil and water sampling relevant to the SLERA was conducted (see Attachment 1 for sampling results and locations). Surface soil sampling at the Former Manufacturing Plant Area was conducted to assess potential chemical presence in soil/fill located near historic operational areas of the former glue factory (see map in Appendix A). These areas include: a former unloading house, downgradient of ponds formerly in the northwest portion of the Former Manufacturing Plant Area, the former Fertilizer Plant, downgradient of the former Machine Shop and storage area, the former Vat House, historic storage tanks adjacent to the former Cook House, the former Cook House, the former Acid Room, the former Dry House, the former Finished Product Warehouse, downgradient of storage buildings formerly adjacent to the Finished Product Warehouse, and general areas the southeastern property boundary.

Surface soil samples were collected across the Inactive Landfill Area to evaluate the physical characteristics of the soil and fill including the presence of odors or staining of soil related to potential chemical impact and assess the nature, magnitude and extent of chemical concentrations in soil and fill. Surface soil sampling was conducted in a grid-like pattern to provide complete characterization of the approximately 8-acre portion of the non-elevated area of the Inactive Landfill Area.

A total of four surface water sample locations were selected in Cattaraugus Creek. Sample location SW-1 was selected upstream of the Peter Cooper Site to represent the background water quality of the Creek. Sample location SW-2 was upstream of the approximate division between the Inactive Landfill Area and the Former Manufacturing Plant Area. Sample location SW-3 was selected immediately downstream from the sludge fill disposal area of the Inactive Landfill Area. Sample location SW-4 was selected at a location approximately 400-feet downstream of the Inactive Landfill Area.

Four sediment samples (and one duplicate) were collected from the Cattaraugus Creek at the same locations as the surface water samples. Sample SED-1 represents the background sediment sample. A total of ten sediment samples (and one duplicate) were collected from the adjacent wetland to the Inactive Landfill Area. The samples were collected in a grid-like pattern to achieve a uniform characterization of sediment quality data.

Current Conditions

Benchmark Environmental Engineering & Science, PLLC (Benchmark) and Geomatrix Consultants, Inc. (Geomatrix) performed Remedial Investigation field activities at the Site on several occasions beginning in August 2000 and continuing through April 2001. A brief description of site conditions as observed during these investigations is provided below.

Inactive Landfill Area

The cover on the surface of the landfill is generally well vegetated and is preventing direct contact with waste materials, but appears to be thin in a few places where stressed vegetation is visible. Cover soil thickness across the elevated fill portion of the landfill was investigated during the RI. A total of 24 test holes were excavated to determine existing landfill cover system thickness and characteristics (see Figure 2-1 in Attachment 1). Each test hole was extended into waste material to allow measurement of approximate cover thickness. The soil cover ranged in thickness from approximately 10 inches to over 45 inches. However, a localized area near GMW-2 shows vegetative stress and cover soils are very thin to absent. The thickness of the soil cover is illustrated on Figure 3-11 in Attachment 1. Several test holes encountered a geotextile fabric below the soil cover. Descriptions of top soil and cover soil thickness at each of the 24 test hole locations are summarized in Table 3-8 in Attachment 1. Odors have been detected where stressed vegetation is visible within the elevated fill area and near certain seeps which are present along the northeast side of the Inactive Landfill Area.

The remains of a concrete and cemented boulder dam are present on the western edge of the elevated fill area that separates the fill area from the adjacent wetland area. The dam was reportedly part of a hydroelectric generating station. The dam is constructed of a large concrete monolith that at one time extended into the Creek, and cemented boulders that extend toward Palmer Street. The top of the dam sits approximately 8-feet above the adjacent wetland area. Riprap revetment is present on the creek bank in the northwest corner of the site. The revetment runs from the water to the top of the bank, and extends approximately 150 feet east from the former dam.

A sluiceway was present on a portion of the northern border of the Area. According to the O'Brien & Gere Remedial Investigation Report, the sluiceway served as a Creek water source for the plant, possibly for fire protection system and/or process water feed. The sluiceway no longer exists as an open channel. It appears that fill has been placed up to the outer wall of the sluiceway.

Former Manufacturing Plant Area

In general, all former buildings and support structures have been demolished to grade. Wood, masonry demolition debris, the remnants of former foundations and various other salvage materials reportedly brought to the Site by the current property owner, JimCar Development, substantially cover the eastern side of the area. The debris exists in mounds several feet high, and limits site access on the southeastern side of the Area. Scrub vegetation and deciduous trees of various sizes are present outside and around the debris piles and foundation slabs, and along the northwestern side of the Former Manufacturing Plant Area. No visible evidence of production waste or vegetative stress was encountered.

Future Use

The site is currently zoned industrial. The Village of Gowanda has expressed a strong desire to redevelop the site. The Village was awarded a Superfund Redevelopment Pilot Program grant from USEPA, and recently completed a Reuse Assessment and Conceptual Plan designed to determine the highest and best final use of the property. The Reuse Assessment and Conceptual Plan envisions a mixed recreational use for the site.

2

Problem Formulation

Environmental Setting

Terrestrial

The site and surrounding area are found in a community that is mostly vegetated and can support a diversity of wildlife species. The site is comprised of an inactive landfill area and former animal-glue and adhesives manufacturing facility (*i.e.*, former manufacturing plant area) located on approximately 26-acres of property between Palmer Street and Cattaraugus Creek in Gowanda, New York.

A site reconnaissance was conducted on September 26 and 27, 2000 and ten distinct habitat (*i.e.*, cover) types were identified in the vicinity of the site (Figure 1). Plant species identified by cover type are presented in Table 1.

Each plant cover type is described below as to the plant species composition, vegetation structure, and land use. Whenever possible, these areas were classified according to the New York State Natural Heritage Program's *Ecological Communities of New York State* (Reschke, 1990).

Cover Type 1: Successional Old Field

This cover type is characterized as a weedy field dominated by grasses and forbs that occur on sites that have been cleared for development. Dominant plant species include crown vetch (*Coronilla varia*), early goldenrod (*Solidago juncea*), gray goldenrod (*Solidago nemoralis*), and late goldenrod (*Solidago gigantea*). In some areas, especially near the forested areas, woody vegetation such as staghorn sumac (*Rhus typhina*), tartarian honeysuckle (*Lonicera tatarica*) and summer grape (*Vitis aestivalis*) has begun to invade these fields. A steep (>10% grade) slope is located along the southern border to this cover type near an outfall pipe. The remainder of this cover type is adjacent to the floodplain of Cattaraugus Creek.

Cover Type 2: Successional Northern Hardwood Woodlot

This small (less than 0.5 acre) woodlot is bordered by the remains of a former concrete hydroelectric dam, Cattaraugus Creek, and an emergent/scrub-shrub wetland. It is dominated by red oak (*Quercus rubra*) and cottonwood (*Populus*

deltoides). The understory and ground cover was sparse and consisted of box elder (*Acer negundo*), white snakeroot (*Eupatorium rugosum*) and black raspberry (*Rubus allegheniensis*).

Cover Type 3: Successional Northern Hardwood Woodlot

This cover type is found adjacent to the western boundary of the site, and extends well west of the site. This cover type is a successional northern hardwood forest dominated by red oak, box elder, black cherry (*Prunus serotina*) and sugar maple (*Acer saccharium*). The understory is sparse except along the edges where sunlight penetrates. It is comprised of dewberry (*Rubus flagellaris*), maple-leaf viburnum (*Viburnum acerifolium*), and tartarian honeysuckle. The ground layer is also sparse except along the forest edge and consists of white snakeroot and garlic mustard (*Alliaria officinalis*).

Cover Type 4: Early Successional Field

This cover type is found at the southwest corner of the property along Palmer Street. This cover type is a successional field dominated by crown vetch, Queen Anne's lace (*Daucus carota*) and spotted knapweed (*Centaurea maculosa*). A portion of this cover type is graveled and used as a parking area.

Cover Type 5: Successional Old Field

This cover type is the dominant cover type on the Site. This cover type is characterized as a weedy field dominated by grasses and forbs. The dominant forb species are spotted knapweed, gray goldenrod, early goldenrod, and white sweet clover (*Melilotus alba*). The dominant grass species are switch grass (*Panicum virgatum*), and Kentucky blue grass (*Poa pratensis*). Woody vegetation, such as staghorn sumac, quaking aspen (*Populus tremuliodes*) and box elder, has begun to invade the field. This cover type also contains three pockets of phragmites (*Phragmites communis*). Debris piles consisting of trash, tires, bricks and ash were observed in the eastern portion of this area.

Cover Type 6: Successional Northern Hardwood Forest

This cover type was dominated by 4- to 6-inch diameter black walnut (*Juglans nigra*), quaking aspen and box elder trees. The understory was dense and consisted of black locust (*Robinia pseudo-acacia*), box elder, and tartarian honeysuckle. The ground cover was dense and consisted of goldenrods and garlic mustard.

Cover Type 7: Former Industrial Area

This cover type is located within the former manufacturing plant area. Demolition work was being performed in the area at the time of the field reconnaissance. Most of this area is covered with gravel, concrete, asphalt, rubble piles or a gravel and dirt mixture. This area is essentially devoid of vegetation, with the exception of a few small weedy patches of grass, due to disturbances from on-site demolition

equipment. Therefore currently, there is little area for free growth of vegetation or development of wildlife habitats.

Wetlands

The New York State Freshwater Wetlands Map, Gowanda, New York topographic map was reviewed for the presence of state wetlands within two miles of the Peter Cooper Landfill Site. No state wetlands are present. The NYSDEC classifies and regulates wetlands in New York State pursuant to 6 NYCRR Parts 663 and 664. Regulated wetlands must be at least 12.4 acres (5.02 hectares) in area and must be dominated by hydrophytic vegetation. Smaller wetlands having "unusual local importance as determined by the Commissioner" may also be regulated by the state.

The U.S. Fish and Wildlife Service (USFWS) National Wetlands Inventory (NWI) Map, Gowanda, New York topographic map identifies the presence of several federal wetlands along Cattaraugus Creek (Figure 2). The creek itself is classified as riverine, upper perennial, unconsolidated bottom, permanently flooded (R3UBH) wetland.

Three federal wetland plant communities were delineated within the boundary of the site. One of these is located on the NWI map. The boundaries between these wetland cover types are depicted in Figure 1 as cover types 8, 9 and 10. Plant species identified by cover type are presented in Table 1.

Each wetland is described below as to the plant species composition, vegetation structure, and land use. Whenever possible, these areas were classified according to the New York State Natural Heritage Program's *Ecological Communities of New York State* (Reschke, 1990). In addition, the soil color and chroma as defined on a Munsell color chart is provided in parenthesis after the soil description.

Cover Type 8: Forested/Scrub-Shrub Wetland

This wetland is located at the northern end of the property near Cattaraugus Creek. A Village storm sewer outfall pipe discharges to the western portion of this wetland. A portion of the wetland is shown on the NWI map as riverine, upper perennial, unconsolidated shore, temporarily flooded (R3USA) and palustrine, forested, broad leaved deciduous, temporarily flooded (PFO1A). The forested portion of the wetland is dominated by cottonwood and black willow (*Salix nigra*) trees. The scrub-shrub portion of the wetland is dominated by black willow saplings, elderberry (*Sambucus candensis*), Joe-pye weed (*Eupatorium maculatum*), jewelweed (*Impatiens capensis*), and poison ivy (*Rhus radcans*). The soil varied from sand (10YR 4/2) near the river to sandy clay (5Y 2.5/0) closer to the outfall. At the time of the survey, 2- to 4-inches of standing water was observed in the southern portion of the wetland. In addition, a three-foot wide flowing stream originating at the outfall and emptying into the Cattaraugus Creek was observed along the northern edge of the wetland.

Cover Type 9: Emergent Wetland

This wetland is located along the south/southwestern edge of the elevated fill area. It is not indicated on the NWI map. This small wetland (less than 1 acre) is dominated by boneset (*Eupatorium perfoliatum*), soft rush (*Juncus effusus*), and Canada rush (*Juncus canadensis*). The wetland contained 4- to 6-inches of standing water at the time of the field survey. Auger refusal occurred at 6 inches. The soil in this layer was sandy clay (5Y2.5/2).

Cover Type 10: Scrub-Shrub Wetland

This wetland is located in the central portion of the site. It originates at a drainage outfall from Palmer Street. It is dominated by jewelweed, black willow saplings, and Joe-pye weed. At the time of the survey, the drainage channel contained 2 inches of standing water. The soil was a sandy clay loam (2.5/0).

Cattaraugus Creek (South Branch)

The Cattaraugus Creek is a surface water body suitable for fishing and secondary recreation (not primary contact recreation such as swimming) but not as a drinking water supply (NYSDEC designated Class C(T)). The New York State water classification of C(T) indicates that Cattaraugus Creek waters support a trout population. The Cattaraugus Creek watershed predominantly drains a rural environment that varies in topographic nature from hilly terrain, steep slopes and narrow valleys upstream of the Village to a generally flat slope and wide valley downstream of Gowanda (Wendell-Duchscherer, *Flood and Hazard Mitigation Plan for the Village of Gowanda*, April 2001). The drainage area of the Creek is approximately 436 square miles and its length is approximately 70 miles. In the vicinity of the Site, the Creek meanders through an incised bedrock valley cut by thousands of years of stream flow. The Creek channel width is 130 feet and of variable depth in the area forming the northern Site property boundary. Cattaraugus Creek flows in a westerly direction eventually discharging into Lake Erie at Irving.

A USGS Gauging Station (#04213500) is located on Cattaraugus Creek west of the Route 62 bridge after the confluence of the east and west branches of Cattaraugus Creek. Stream flow data collected from the USGS gauging station indicates a mean annual stream flow of 1,030 cubic feet/second (USGS, 2001). No significant discharges occur to the Creek within a few miles of the Site from upstream sources. Presently, the Village of Gowanda sewage treatment plant outfall discharges to Cattaraugus Creek approximately 2 miles downstream of the Peter Cooper Gowanda site. A mean annual stream flow near the Peter Cooper Site of

approximately 600 cubic feet/second is reported by O'Brien & Gere in the 1989 RI Report. However, this flow rate is unconfirmed.

Fish and Wildlife Resources

Wildlife uses in the area were evaluated using literature sources and field observations; wildlife sightings, including direct observations and identification based on vocalizations, tracks, browse, and scat; and observed general wildlife values (*e.g.*, food and cover availability).

Federally listed endangered, threatened or species of concern are not known to occur within 2 miles of the site (Clough, 2000). Several state-listed endangered, threatened or special concern species were identified as occurring within 2 miles of the site (Ketcham, 2000) (see Figure 2) and are summarized in Table 2. In addition, the NYSDEC identified one unprotected community of significance – shale cliff and talus community. This community occurs along both banks of the Cattaraugus Creek especially in the Zoar Valley, Deer Lick and Forty Road seep areas (Ketcham, 2000) all upstream of the Site.

Per USEPA request, follow up fish and wildlife resource requests were submitted to the NYSDEC and the U.S. Fish and Wildlife Service in March 2004 (see Attachment 4). Any significant findings will be forwarded to USEPA upon receipt.

In the vicinity of the site, the land use is a mixture of residential, commercial and industrial. Areas adjacent to Cattaraugus Creek are zoned for industrial land use. This area appears to support a diversity of wildlife due to the limited amount of development and proximity to undeveloped natural habitat.

Tables 3 through 6 identify species of fish, herptiles (amphibians and reptiles), birds, and mammals that may potentially occur within and adjacent to the site based on the cover types identified during the field reconnaissance. The species observed during the field reconnaissance (which are representative of early Fall conditions at the time of the reconnaissance) are also identified in the tables. No signs of animal distress were observed during the field reconnaissance.

The successional old fields on the site serve as wildlife openings that provide edge, cover and food. These areas typically harbor songbirds and mammalian species such as goldfinches (*Carduelis tristis*), song sparrows (*Melospiza melodia*), white-footed mice (*Peromyscus leucopus*), and meadow voles (*Microtus pennsylvanicus*), which consume the seeds of grass and forbs. With an abundant prey base, carnivores, such as red fox (*Vulpes vulpes*), red-tailed hawks (*Buteo jamaicensis*), and barn owls (*Tyto alba*) may reside in the area.

The wildlife value of forest stands is determined in large part by the composition of tree species. The variability of each individual stand will slightly alter the wildlife

present, and the greater the diversity of tree species, the greater the wildlife value. Although there is considerable overlap between food sources that wildlife may use in each stand, in general, the greater the diversity within the stand, and the larger the tract size, the more significant the value of the habitat.

The successional northern hardwood woodlots on the Site are dominated by a variety of species including cottonwoods, red oak, maple, black walnut and black cherry. Black cherry is one of the most important wildlife food sources. Wild cherries comprise most of the diet of songbirds such as rose-breasted grosbeaks (*Pheucticus ludovicianus*), American robin (*Turdus migratorius*), cedar waxwing (*Bombycilla cedrorum*) and small mammals such as chipmunks (*Tamias striatus*) (Martin *et al.*, 1951). The presence of sugar maples, cottonwoods and oak increase the value of the area by providing additional sources of food and cover. Because acorns are a preferred food item and are abundantly available, oak trees are of major importance to wildlife (Martin *et al.*, 1951). They are a staple in the diets of wild turkey (*Meleagris gallopavo*), blue jays (*Cyanocitta cristata*), raccoon (*Procyon lotor*) and gray squirrel (*Sciurus carolinensis*). With an abundant prey base of birds and small mammals, predators such as great horned owls (*Bubo virginianus*) and skunks (*Mephitis mephitis*) may reside in the area.

The wetland communities on or adjacent to the site provide habitat for many animals because of the seasonal or perennial presence of water. This water is likely used directly for drinking by animals in the general area. In addition, pooled water is essential for breeding of amphibians.

Contaminants Known or Suspected to Exist at the Site

Historical data collected before the RI characterization activities were not used in this risk assessment because of uncertainties regarding data quality. The RI data also more accurately reflect current conditions at the site. Attachment 1 provides sampling locations and analytical data tables of data used in the SLERA.

The potential ecological risk of all detected chemicals was evaluated. Maximum concentrations were evaluated for surface soils, defined in this assessment to be soils in the 0 to 2-foot interval. Essential nutrients (calcium, potassium, sodium and magnesium) were not considered and will not be considered further in this evaluation. Chemicals detected in subsurface soil (*i.e.*, generally greater than 2 feet below ground surface) and groundwater were not considered applicable for the ecological risk assessment because of the lack of wildlife exposure to these media. Potential fate and transport of these contaminants was considered in the evaluation of seep and surface water contaminants.

Soil

Chemicals detected in shallow soil (0-2' below grade) from the inactive landfill and former manufacturing plant areas were evaluated. A summary of the soil data are presented in Table 7. Attachment 1 provides summary tables from the RI of the analytical data for the sampling locations used in the SLERA.

A total of 20 (including one duplicate) and 11 (including one duplicate) shallow soil samples were collected from the inactive landfill area and former manufacturing plant area, respectively. The inactive landfill area samples were analyzed for select volatile organic compounds including: BTEX (benzene, toluene, ethylbenzene, and xylene), chlorobenzene, 1,2- dichlorobenzene and 1,4-dichlorobenzene, chromium, hexavalent chromium, arsenic and zinc. The Former Manufacturing Plant Area samples were analyzed for TCL volatile organic compounds, TCL semi-volatile organic compounds, TAL metals, and hexavalent chromium. The following chemicals were detected and all detected constituents were evaluated for potential ecological risk:

Inactive Landfill Area

- Benzene, ethylbenzene, toluene, M&P-xylene, O-xylene, and several metals were detected in one or more inactive landfill area samples and all detected constituents were evaluated for potential ecological risk as shown in Table 7.

Former Manufacturing Plant Area

- Twenty-seven volatile organic compounds, 21 semivolatile organic compounds, and several metals were detected and all detected constituents were evaluated for ecological risk are shown in Table 7.

Surface Water/Seeps

Groundwater seeps discharging north of the Inactive Landfill area and Cattaraugus Creek were sampled to characterize a potential chemical constituent migration pathway from groundwater to surface water. Five (including one duplicate) creek surface water samples and three seep samples were collected from the Site on each of two events. Surface water and seep sample locations are identified on Figure 2-6 in Attachment 1. Creek sediment samples were also collected from the same locations as the surface water during the first sampling event. As indicated on Figure 2-6, surface water and sediment samples SW/SED 3 and SW/SED 4 were collected from the southern side of the creek downgradient of the seeps.

The seeps are frequently associated with white, calcium-rich precipitates visible at the contact between the overburden and bedrock and along bedrock outcrops in Cattaraugus Creek along the elevated fill portion (referred to in the RI Report as the Elevated Fill Subarea) of the Inactive Landfill Area. The seeps are the result of

overburden and shallow fractured bedrock groundwater discharging from the Elevated Fill Subarea to the creek. Groundwater elevation data recorded during the RI indicates that overburden groundwater within the Elevated Fill Subarea produces water table elevations approximately 8 feet higher than the Cattaraugus Creek surface water level within a distance of 20 feet from the creek bank. This translates to a high hydraulic gradient (approximately 0.4 ft/ft) near the creek bank. Groundwater discharge calculations presented in the RI estimate combined average overburden and bedrock flows from the Inactive Landfill Area to the creek of 1434 cubic feet (10,700 gallons) per day. The length of the Inactive Landfill Area along the creek is approximately 1150 linear feet. Test pit investigations and topographic mapping performed during the RI established that the length of the Elevated Fill Subarea along Cattaraugus Creek is approximately 480 linear feet, or 42 % of the Inactive Landfill Area creek boundary. The estimated average rate of groundwater discharge from the Elevated Fill Subarea to the creek therefore can be conservatively estimated by multiplying the combined overburden and bedrock groundwater discharge rates for the Inactive Landfill Area by 42%, yielding a value of 602 cubic feet (4,500 gallons) per day. It is important to note that this estimated value represents an average of the total overburden and bedrock groundwater flow from the Elevated Fill Subarea to the creek. As the seeps represent primarily overburden flow, actual seep discharge rates are expected to be significantly lower on average. Seep flow/contribution is minor in comparison to the mean annual stream flow for Cattaraugus Creek, which is reported in the RI at 1,030 cubic feet per second, or approximately 89 million cubic feet per day.

Seep and surface water sample locations are shown in Figure 2-6 of the RI (please see Attachment 1 of this report).

These samples were analyzed for volatile organic compounds, semi-volatile organic compounds, hexavalent chromium, and TAL metals. The maximum detected concentration of each contaminant was screened against the NYSDEC surface water screening criteria (NYSDEC 1998a). A summary of the surface water data are presented in Table 8. Attachment 1 provides the complete summary tables from the RI of the analytical data for the sampling locations used in the SLERA. Please note that the upstream/background sample for the creek is Creekwater #1 and Creek Sediment #1 (RI tables 4-13 and 4-15, and Figure 2-6 as shown in Attachment 1).

Cattaraugus Creek

- Acetone, ammonia, barium, manganese, cis-1,2-dichloroethene and iron were detected in some or all of the samples. Contaminants with maximum concentrations above the NYSDEC surface water criteria were evaluated for potential ecological risk.

Seeps

- Ammonia, toluene, phenol, and arsenic, zinc, chromium and iron were detected in some or all of the samples. Contaminants with maximum concentrations above the NYSDEC surface water criteria were evaluated for potential ecological risk.

Sediment

A total of 11 (including one duplicate) and 5 (including one duplicate sample) sediment samples were collected from the wetland area and Cattaraugus Creek, respectively. The wetland samples were analyzed for volatile organic compounds, chromium, hexavalent chromium, arsenic and zinc. Cattaraugus Creek samples were analyzed for volatile organic compounds, semi-volatile organic compounds, hexavalent chromium and TAL metals. The maximum detected concentration of each metal was screened against the NYSDEC sediment screening criteria (NYSDEC 1998b). A summary of the sediment data are presented in Table 9. Attachment 1 provides the complete summary tables from the RI of the analytical data for the sampling locations used in the SLERA. The following chemicals were detected:

Cattaraugus Creek

- Acetone, benzene, 2-butanone, carbon disulfide, cis-1,2-dichloroethene, cyclohexane, methylcyclohexane, 4-methyl-2-pentanone, toluene, M&P-xylene, and the detected metals were screened. Metals with maximum concentrations below the NYSDEC sediment criteria were not evaluated for ecological risk.

Wetland Area

- Benzene, ethylbenzene, toluene, M&P-xylene, O-xylene, arsenic, chromium and zinc were detected in one or more samples and evaluated for ecological risk. Metals with maximum concentrations below the NYSDEC sediment criteria were not evaluated for ecological risk.

Fate and Transport

The fate and transport of chemicals in the environment are influenced by a variety of physicochemical- and site- specific factors. The chemical constituents detected at Site include volatile organic compounds and semi-volatile organic compounds (primarily PAHs in soils) as well as some inorganic constituents (predominately chromium and arsenic). Environmental fate and transport processes for these types of chemicals are briefly discussed in the following subsections.

Physicochemical Properties

The fate and transport of chemicals in the environment depend on the properties of both the chemicals and the environmental media in which they occur. Table 10 lists several principal organic constituents along with some of their respective physical and chemical properties (*e.g.*, water solubility, Henry's Law Constant, octanol-water partition coefficient, organic-carbon partition coefficient).

Water solubility is the maximum concentration of a compound that dissolves in water at a specific temperature. Highly soluble compounds can be rapidly leached from soils and water and are generally mobile in groundwater and surface water. Chemicals of low water solubility are relatively immobile in aquifers but may be transported rapidly in turbulent surface waters as suspended particles. Some water-insoluble compounds become readily mobile when in contact with organic solvents.

Vapor pressure is a measure of the volatility of a chemical in its pure state and is a determinant of vaporization from waste sites. A compound's tendency to volatilize from water depends upon its Henry's Law Constant. Henry's Law Constant is the ratio, at equilibrium, of a compound's vapor pressure (atmospheres) to its water solubility (moles/m^3). Compounds with Henry's Law Constants greater than 10^{-3} atm-m^3/mol readily volatilize from water. Those with Henry's Law Constants from 10^{-3} to 10^{-5} atm-m^3/mol volatile less readily, while those with Henry's Law Constant less than 10^{-5} atm-m^3/mol volatilize slowly.

The octanol-water partition coefficient (K_{ow}) expresses the equilibrium distribution of an organic compound between octanol and water. K_{ow} is often used to estimate the extent to which a chemical will partition from water into fatty tissues of animals. Log K_{ow} values range from –2.5 to 10.5. Organic chemicals with log K_{ow} values less than 3 are generally considered not to concentrate in animal tissues: that is, they do not bioaccumulate.

The organic carbon partition coefficient (K_{oc}) is a measure of the tendency of organic compounds to sorb to soil and sediment and is expressed by this equation:

$$K_{oc} = \frac{(\text{mg chemical sorbed / kg organic carbon})}{(\text{mg chemical dissolved/ L of solution})}$$

K_{oc} reflects the tendency of organic compounds to sorb to organic matter in soil and sediment. K_{oc} values for organic compounds range from 1 to 10^7; higher values indicate greater sorption potential. Chemicals with K_{oc} values less than 10^3 generally do not sorb strongly enough to soil to affect overall leachability.

Fate and Transport Mechanisms

Volatile Organic Compounds

The volatile organic compounds detected in the inactive landfill area of the site are primarily aromatic petroleum hydrocarbons (i.e., benzene, ethylbenzene, toluene, and xylene, or BTEX). These also represent the most frequently detected VOCs in the former manufacturing plant area of the Site. These compounds have high vapor pressures and, therefore, would be expected to volatilize readily from surface soil and surface water to the atmosphere. Once released to the atmosphere, these compounds are rapidly photodegraded.

In deeper soils, these compounds degrade slowly, are water soluble and may leach into groundwater. These compounds have low octanol/water coefficients (log K_{ow}) and, therefore, do not adsorb to sediment or particulate matter present in the water column.

Bioconcentration factors (BCFs), which relate the concentration of the chemical in the organism at equilibrium to the concentration of the chemical in water, are used to assess the potential for chemical bioconcentration. BCFs correlate with the octanol/water partition coefficient and solubility of a chemical. Since BETX compounds have low octanol/water coefficients and high water solubilities, these chemicals have a low potential to bioconcentrate in organisms (Howard, 1990).

PAHs

PAHs contain only carbon and hydrogen and consist of two or more fused benzene rings in linear, angular or cluster arrangements. The number of rings in a PAH molecule affects its biological activity, and fate and transport in the environment. In general, most PAHs can be characterized as having low vapor pressure, low to very low water solubility, low Henry's Law constant, high log K_{ow}, and high organic carbon partition coefficient (K_{oc}).

High partition coefficients and low solubilities suggest that PAHs are likely to be adsorbed onto sediment particles (Fetter 1993). Conversely, these properties indicate that most PAHs will not readily volatilize into the atmosphere. Accordingly, PAHs are not considered mobile in the environment.

Although PAHs are regarded as persistent in the environment, they are degradable by microorganisms. Environmental factors, microbial flora and physicochemical properties of the PAHs themselves influence degradation rates and degree of degradation. Important environmental factors influencing degradation include temperature, pH, and redox potential and microbial species. Physicochemical properties, which influence degradation, include chemical structure, concentration and lipophilicity.

In general, PAHs show little tendency to biomagnify in food chains, despite their high lipid solubility, probably because most PAHs are rapidly metabolized (Eisler, 1987).

Metals

In a terrestrial setting, trace elements released to the environment accumulate in the soil (Sposito and Page, 1984). Mobility of these trace elements in soil is low and accumulated metals are depleted slowly by leaching, plant uptake, erosion, or chelation. The half-life of trace elements in temperate climate ranges from 75 years for cadmium to more than 3,000 for zinc.

The transport of trace elements in soil may occur via the dissolution of metals into pore water and leaching to groundwater, or colloidal or bulk movement (i.e., wind or surface water erosion). The rate of trace element migration in soil is affected by the chemical, physical and biological characteristics of the soil. The most important characteristics include:

- Eh-pH system
- Cation exchange capacity and salt content
- Quantity of organic matter
- Plant species
- Water content and temperature
- Microbial activity

Metals that do mobilize from the soil into the water column are most mobile under acid conditions and increasing pH usually reduces their bioavailability. Generally, metals do not exist in soluble forms for long and generally accumulate in bottom sediment. Once in the sediment, most metals sorb onto hydrous iron and manganese oxides, clayey minerals and organic materials and are eventually partitioned into the sediments. Metal bioavailability from the sediment is enhanced under conditions of low pH, high dissolved oxygen, high temperature, and oxidation state. During these conditions, metals become soluble and freely move in the interstitial pore water and the water column (McIntosh, 1992).

Arsenic

Although certain arsenic minerals and compounds are soluble, arsenic migration is greatly limited due to the strong sorption by clays, hydroxides, and organic matter. The reactions of arsenic in soil are governed by its oxidation state. However, arsenate ions are known to be readily fixed by such soil components in order of retention as iron oxide, aluminum oxide, clay, humus, and calcium. Strongly adsorbed arsenic is unlikely to be desorbed and the retention of arsenic by soil increases with time (Kabata-Pendias and Pendias, 1992).

The chemistry of arsenic in water is complex and the form present in solution is dependent on such environmental conditions as Eh, pH, organic content, suspended solids and sediment. Arsenic is generally quite mobile in the environment. Sorption by the sediment is an important fate for the chemical. Arsenic is metabolized to organic arsenicals by a number of organisms (Clement Associates, 1985)

Chromium

Chromium (III) tends to be adsorbed strongly on clay particles and organic particulate matter, and tends to exist in the environment in the form of insoluble Cr_2O_3. As such it is generally stable and not bioavailable. Hexavalent compounds are not strongly adsorbed by soil components and chromium (VI) is mobile in groundwater. Chromium (VI) is quickly reduced to chromium (III) in poorly drained soils having a high content of organic matter. Chromium (VI) of natural origin is rarely found in soils (Clement Associates, 1985).

Zinc

Zinc in the environmental occurs mainly in the (+2) oxidation state (Lindsay 1979). Sorption is the dominant reaction for zinc and leads to its enrichment in sediments from aerobic waters (USEPA 1979). The mobility of zinc in soil and water is determined by the pH, concentration of zinc, salinity, ion exchange, redox potential, cation exchange capacity, and complexing ligands present in the medium (ATSDR 2003).

The ecological migration pathways for potential contaminants are illustrated on Figure 3-3.

Fate and Transport On-Site

Potential migration pathways involving airborne transport include:

- Wind erosion and transport of soil particles and sorbed chemical constituents in fugitive dust emissions.
- Volatilization of chemical constituents from soils localized in the area of MWFP-3S/D in the Former Manufacturing Plant Area and from the sludge fill in the Inactive Landfill Area and subsequent atmospheric dispersion.

Fugitive Dust

Although the Site is well vegetated and a layer of top soil generally covers the Site, a small amount of fugitive dust emission could occur.

Volatilization

Volatile chemical constituents present in Site media could volatilize to the atmosphere and be transported off-site. For surface soils, volatilization of chemicals (if present) would be more or less direct into the atmosphere.

Volatilization of chemicals from groundwater is not a significant contributor to volatilization and off-site transport since volatile organic compound concentrations in the groundwater are very low. Volatilization of chemicals from groundwater is therefore not a significant pathway for off-site migration.

Waterborne Pathways

Chemicals in surface soils could be potentially transported off-site via storm water runoff. Chemicals in Site soil could also leach and migrate via groundwater to groundwater discharge areas.

Surface Water Runoff

Erosion and transport of surface soils and associated sorbed chemicals in surface water runoff is a potential migration pathway for the Site. However, the site's low topographic relief, vegetated nature of the Site, and lack of visible evidence of significant erosion minimize off-site transport via storm water runoff. The generally low chemical concentrations in Site surface soils would not result in significant concentrations in storm water and would not substantially affect off-site surface soil or Cattaraugus Creek. Off-site transport in surface water is therefore not considered to be a significant migration pathway.

Groundwater Migration

According to the Remedial Investigation, groundwater in overburden and bedrock ultimately discharges to Cattaraugus Creek. The Remedial Investigation estimates the total groundwater flow rate from the Site (overburden and bedrock) to Cattaraugus Creek to be approximately 3,050 cubic feet/day. This rate is less than 0.006 percent of the mean annual stream flow in Cattaraugus Creek, indicating that chemical concentrations in discharging groundwater would have to be quite high to result in significant degradation of water quality in Cattaraugus Creek.

High concentrations of chemicals were generally not detected in Site overburden and bedrock groundwater. In the few instances where organic chemicals were detected, concentrations were relatively low. Besides phenol and chlorobenzene, no other organic chemical exceeded the guidance value for groundwater by a factor of more than two and none exceeded guidance values by any amount in more than three monitoring wells. Based on the limited distribution and low concentrations present,

organic chemicals in groundwater have limited potential for impacting water quality in Cattaraugus Creek. This is evidenced by the results of water samples obtained from Cattaraugus Creek in which no organic chemicals were measured definitively above detection limits.

Several metals exceeded guidance values in overburden and bedrock groundwater. As with organic chemicals, metals concentrations were generally low and of limited distribution. In Site overburden and bedrock groundwater, concentrations of metals in excess of 1 mg/L were limited to iron, calcium, magnesium and sodium. Based on the limited distribution and low concentrations present, metals in groundwater have limited potential for impacting water quality in Cattaraugus Creek. The only metal measured in Cattaraugus Creek above its surface water guidance value was iron. Iron is naturally occurring and was present in the water sample collected upstream of the Site at a concentration of 0.39 mg/L.

Ecotoxicity and Potential Receptors

Ecological Effects

The ecological effect of a chemical constituent depends on many factors, such as the chemical's bioavailability, its concentration in the environment and/or receptor organism, synergistic interactions among chemicals, the duration and frequency of receptor biota exposure to that constituent, the species of the receptor, the metabolic rate of the species, and the characteristics of the metabolic processes of the species (USEPA, 1988). Chemicals in the environment can affect receptor biota and ecosystems in both lethal and sublethal ways, such as the following:

- Altered developmental rates, metabolic and physiologic processes and functions, or behavior.
- Increased susceptibility to disease, parasitism, or predation.
- Disrupted reproductive functions.
- Mutations or other reduction in the viability of offspring (USEPA, 1989).

When potential effects of an environmental chemical on biotic receptors are being evaluated, the toxicity of the chemical must be determined. The determination should be based on field data, monitoring data, and the results of toxicity testing of contaminated media (USEPA, 1989).

Attachment 2 of this report summarizes toxicological information from the scientific literature for all of the potential contaminants selected for the site. The summaries present information on chemical toxicity, likely mechanisms of toxicity, and potential effects on receptor biota, populations, and ecosystems.

Former Manufacturing Facility Area

For organic chemicals, the hazard quotients are less than 1.0 indicating no significant potential risk. A potential risk (HQ≥1) was identified for aluminum, barium, lead, mercury, and zinc. TRV values were unavailable for the remaining volatile organic compounds identified as contaminants, the PAHs or iron.

Risk to Fish

Potential risks to fish are shown in Table 23. TRV values were unavailable for the remaining volatile organic compounds identified as contaminants, barium and manganese so potential risk could not be calculated. A potential risk (HQ≥1) was identified for iron.

Risk to Birds

Potential risks to avian endpoint species through the terrestrial food chain are shown in Table 23.

- For the volatile organic chemicals, the hazard quotients were <1.0, indicating no significant potential risk to American robin.
- A potential risk (HQ≥1) was identified for the American Robin from exposure to arsenic, total chromium, and zinc in the **Landfill Area**.
- A potential risk (HQ≥1) was identified for the American Robin from exposure to dibenzofuran, aluminum, arsenic, barium, total chromium, lead, mercury, selenium, and zinc in the **Manufacturing Facility Area**.
- For the organic chemicals, the hazard quotients are less than 1.0 indicating no significant potential risk to the Red-Tailed Hawk from the entire site.
- A potential risk (HQ≥1) was identified for the Red-Tailed Hawk from exposure to aluminum, arsenic, total chromium, lead, and zinc across the entire site.

Risk to Mammals

Potential risks to mammalian receptors through the food chain are shown in Table 23.

Mink

A potential risk (HQ≥1) was identified for the mink from exposure to aluminum, arsenic, and vanadium from an assumed diet consisting of 100% benthos from the creek and wetland areas.

Raccoon

The Raccoon was assumed to have a diet consisting of 100% American Robin, the most contaminated food item at the site. For volatile organic chemicals, the hazard quotients are less than 1.0 indicating no significant potential risk. A potential risk (HQ≥1) was identified for various PAHs (benzo(a)anthracene, benzo(a)pyrene, benzo(g,h,i)perylene, chrysene, dibenzo(a,h)anthracene, dibenzofuran, phenanthrene, and pyrene), and inorganics (aluminum, arsenic, barium, copper, lead, manganese, selenium, vanadium, and zinc).

Red Fox

The Red Fox receptor was assumed to have a diet consisting of 100% American robin, the most contaminated food item at the site. For volatile organic chemicals, the hazard quotients were <1.0 indicating no significant potential risk. A potential risk (HQ≥1) was identified for PAHs (benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, indeno(cd-1,2,3)pyrene, chrysene, dibenzo(a,h)anthracene, fluoranthene, phenanthrene, and pyrene), and inorganics (aluminum, arsenic, barium, copper, lead, selenium, and vanadium).

Deer Mouse

For organic chemicals, the hazard quotients are less than 1.0 indicating no significant potential risk in the Landfill Area. A potential risk (HQ≥1) was identified for arsenic only in the Landfill Area.

In the Manufacturing Facility Area, a potential risk (HQ≥1) was identified for acetone, various PAHs (benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, indeno(cd-1,2,3)pyrene, chrysene, dibenzo(a,h)anthracene, bis(2-ethylhexyl)phthalate, fluoranthene, phenanthrene, and pyrene), and inorganics (aluminum, arsenic, copper, lead, and mercury).

White-Tailed Deer

A potential risk (HQ≥1) to the White-Tailed Deer was identified for

- Volatiles (acetone, methyl acetate)
- PAHs (benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, indeno(cd-1,2,3)pyrene, chrysene, dibenzo(a,h)anthracene, bis(2-ethylhexyl)phthalate, fluoranthene, phenanthrene, and pyrene).
- Inorganics (aluminum, arsenic, copper, lead, mercury, and zinc).

Ecological Significance

This screening-level assessment suggests that the Gowanda- Peter Cooper site does pose a potential ecological risks from two volatile organic chemicals, several semi-volatile organic chemicals (primarily PAHs), and several inorganic chemicals to endpoint species representing various biota (see the summary in Table 24). With limited exception, benthic organisms and fish in Cattaraugus Creek show no potential ecological risks from inorganic potential contaminants in creek sediment and surface water, and where hazard quotient exceedances were modeled the potential contaminants were present in upstream samples at similar concentration as downstream samples.

An elevated hazard quotient (*i.e.*, ≥1) indicates that there is a potential for toxicological effects to a certain organism resulting from prolonged exposure. It does not necessarily imply a significant risk to the local ecosystem.

The food web exposure model used in this assessment suggests that potential ecological risks (*i.e.*, HQ≥1) may result from exposure to organic potential contaminants (primarily PAHs) for terrestrial mammalian species. The model also suggests potential risks to several measurement endpoint terrestrial biota from one or more of the inorganic chemicals. Yet these modeled effects are considered to have minimal site-specific ecological significance for reasons discussed below and in the following section (#6) dealing with uncertainty within this assessment.

For a chemical in soil to pose a risk, it must first be made available to a receptor through mobilization, transport, and exposure; and then that chemical must cause an adverse response from the ecological receptor due to that exposure.

Inorganic chemicals (metals) readily adsorb to settling particles (Sigg 1985), high concentrations of these metals are frequently found in sediment from lakes and streams near former industrial areas. The toxicity of metals in sediments is influenced to the extent that metals bind to the sediment and are converted to insoluble salts or organo-metallic complexes. Metals that are strongly bound have very low pore water concentrations and thus pose little or no potential for uptake by biota. The fate of PAHs is similar to metals. High partition coefficients and low solubilities result in PAHs remaining adsorbed to soil particles decreasing bioavailability and therefore exposure.

The availability of a chemical in the soil is affected by existing site conditions. These conditions may include "fresh" chemicals or "weathered" chemicals (Page and Sposito, 1984). Fresh conditions refer to sites where a recent spill or chemical release has occurred. Weathered or aged chemicals are chemicals that have been in soils for many years, even decades. Chemical availability differs for fresh and weathered chemicals: chemicals recently released to soils will be more available for leaching, degradation, and bio-uptake than will weathered chemicals. At the Peter Cooper Site,

potential contaminants have weathered for decades are held tightly by the soil and are unavailable for transport.

From the moment that a chemical comes into contact with a soil, a series of natural physical and chemical processes occur. These processes result in the diffusion and distribution of the chemical onto the surfaces and into the pores of the individual soil particles. As the time of contact increases, the "aging" process results in movement of some of the chemical to the interior of the soil particle surfaces. In addition to the physical interaction, there can be chemical reactions that cause the chemicals in the soil to be more complex and less available for leaching and degradation. This "sequestration" and "complexation" of the chemical over time has an impact on the availability of the chemicals to living organisms. Environmental laboratory analytical methods use aggressive extraction techniques in order to obtain total chemical levels within a tested medium. Thus, the analytical data indicates total concentrations versus what is really bioavailable to receptors. Thus, elevated hazard quotients for this class of chemicals may not be indicative of site-specific ecological concerns.

While final redevelopment plans have not been established, any construction activity at the site, whether for the purpose of demolition, cleanup, or redevelopment will have a substantial impact on site ecology. Wildlife and plant species will be displaced as a result of construction equipment use, disruption of site topography and vegetative cover during clearing and regrading, and ongoing human activities. Buildings and parking facilities will prevent re-establishment of vegetative cover for foraging, nesting and burrow. Human use of the site following redevelopment will mitigate re-population by wildlife. As such, redevelopment itself will cause an impact to the wildlife community present at the site perhaps equal to or greater than the risks from chemical contaminant exposure predicted by this SLERA.

6 Uncertainties

The following section discusses uncertainties associated with the ERA. The relative significance of the uncertainties has been discussed within the text whenever possible.

Selection of Endpoint Species

Uncertainty is associated with the selection of endpoint species because it is impossible to evaluate all species potentially impacted by the site. However, the site characterization limits the range of species that would reasonably be expected to be impacted by site-related chemicals. While other species may visit the site, the red-tailed hawk, American robin, and white-tailed deer were consistently observed foraging on site and seem to spend a significant time in the area. Although not seen on-site, raccoon, deer mouse, red fox and mink are common wildlife species present in the habitat types described for the site and could possibly use the site.

Selection of Surface Soil Stratum

Environmental data for surface soil at the site is within the EPA defined 0-2 ft bgs strata. Some additional data points lie just beneath this surface soil, such as SB-3 (3-5 ft bgs) and TP-7 (3-4 ft bgs). Although these soils are considered below the available strata for most ecological receptors, the inclusion of this data would only serve to enhance the conservative nature of the assessment, considering that the maximum concentrations were used as EPCs. Exclusion of these samples, particularly in areas where these is little vegetation to prevent soil mixing, presents a minor source of uncertainty.

Modeling of Chemical Uptake

The uptake and accumulation of organic substances in the benthic organisms is viewed as the result of equilibrium partitioning of the chemicals between the lipids of the organism, the organic fraction of sediments and the interstitial pore water (Gobas *et al.* 1993). This assumes the system is in steady state. The steady-state assumption may not be appropriate for soluble and/or mobile metals or organic compounds in sediment. In

addition, certain organic compounds can degrade over time. For example, the half-life of PAHs varies from months to several years (Mackay *et al.* 1992). The concentration of chemicals in surface water could also decrease over the next 30 years depending on many creek-specific factors such as changes in groundwater discharge, CSO inputs, and physical or biotic degradation. Nevertheless, the conservative steady-state assumption was used because it provides the best understanding of conditions in the absence of change.

The model used a simple food chain model scenario. Uncertainty arises from assuming 100% of the diet was one species. If the lipid content of other food items is significantly higher or lower than assumed for benthic invertebrates, fathead minnow or small mouth bass, the model may over- or under- estimate the chemical concentration.

Fish tissue concentrations for inorganics were modeled from sediment concentrations rather than directly measured. Published BCFs (bioconcentration factors) and BAF (bioaccumulation factor) values were used to estimate concentrations of chemicals in fathead minnow, benthic invertebrates, and small mouth bass from sediment pore water through the food chain. In some instances, BCF and BAF values were unavailable from the literature, so surrogate values were developed from related metals. For example, the BAF for arsenic was used for selenium (no published BAF) because arsenic and selenium are in the same group in the periodic table of elements. This may have introduced uncertainty to the assessment, but this approach was deemed superior to using a BCF or BAF value of 1.0 as a default, for instance, where BCF or BAF values were unavailable.

Furthermore, the terrestrial food chain exposure models assumed 100% uptake from areas with the highest chemical concentrations, and 100% exposure to the most contaminated food items, and maximum food intake, and minimum body weight. This type of exposure modeling (required by guidance) heavily biases this SLERA towards unrealistic exposure; nevertheless, it is highly protective of the ecological resources of concern in the analysis.

Extrapolation from Literature Toxicity Data to TRVs

Principal uncertainties associated with the extrapolation process are identified and discussed in Section 3. A sensitivity analysis was conducted to determine the most important factors in deriving hazard quotients. The range of published TRV values were such that, in almost every case in which worst-case TRVs showed HQs greater than one, the middle or high range of the TRV published values could be used to show no impact. In fact, the TRVs for aluminum, manganese, and iron are generally greater than the normal background concentrations.

Interactive Effects of Chemicals

Uncertainty in toxic effects of a chemical can arise from its interaction with other chemicals in the environment. Chemicals can act synergistically, antagonistically, or additively. Because the effects of the interaction on toxicity of various chemicals are not known, it is not clear whether accounting for these interactions would increase or decrease the risk estimations.

Uncertainties in the sub-assessments result in uncertainties in the overall risk characterization. Uncertainty is associated with the extrapolation of risks to populations and ecological communities based upon risk estimates to an individual animal. Although bias in these extrapolations could either overestimate or underestimate actual risk to biota at higher levels of the biological organization, worst-case assumptions were used to make overestimated risks more likely. The potential for significant ecological risks where the analysis indicates a hazard quotient less than one is very low.

7

Conclusions

The results of the ecological risk assessment for the Peter Cooper Landfill Site indicate the potential ecological risks from organic contaminants to fish, terrestrial plants, wetland plants, benthic invertebrates, terrestrial invertebrates, birds, and mink. With limited exception, benthic organisms and fish in Cattaraugus Creek also show no potential ecological risks from inorganic chemicals in creek sediment and surface water, and where potential risks were modeled the associated chemical was present in upstream samples at concentrations similar to that found in downstream samples.

The assessment food web exposure model predicted that potential ecological risks (*i.e.*, hazard quotient ≥1, see Tables 23 and 24) may result from exposure to organic contaminants (particularly polyaromatic hydrocarbons or PAHs) for terrestrial mammalian species. The model similarly predicts potential risks to several measurement endpoint terrestrial biota from one or more of the inorganic chemicals. However, the predicted effects are considered to have minimal ecological significance for several reasons:

- The physical properties of the PAHs and several of the inorganic contaminants likely limit mobilization and bioavailability. Weathering and aging of the contaminants also results in lower bioavailability as sorptive bonds become stronger with age. Naturally occurring phenomena such as sequestration and complexation of the chemical over time may further limit leachability and its availability to biological processes.
- The PAHs and inorganic contaminants tend to be common in urban and historically industrial areas. As such, TRV exceedances for PAH and metal constituents may not be indicative of site-specific ecological concerns. In fact, because all soils have metal concentrations exceeding one or more of the screening TRVs, few natural or unaffected environments could be shown to be "unimpacted" using the worst-case exposure assumptions of the SLERA process.
- Although the worst-case modeling approach used in this assessment suggests that there is a potential for individual organisms to be affected (that is, there is a potential for adverse effects to certain organisms), it does not necessarily follow that a significant risk exists for the local population, biological community, or ecosystem in the area of the site. This is evidenced by the fact that the site-

specific ecological field investigation and fish and wildlife resources investigation indicate that the site wildlife community as a whole is thriving.

In addition, as described in Section 6.0 there are several uncertainties associated with the assessments that could either overestimate or underestimate actual risk to the ecosystem.

The Village of Gowanda has expressed a desire to redevelop the site. While final site redevelopment plans have not been established, any construction activity at the site, whether for the purpose of demolition, cleanup, or redevelopment will have an impact on site ecology. Wildlife and plant species will be displaced as a result of construction equipment use, disruption of site topography and vegetative cover during clearing and regrading, and ongoing human activities. Buildings and parking facilities will prevent re-establishment of vegetative cover for foraging, nesting and burrow. Continued human use of the site following redevelopment will further mitigate repopulation by terrestrial biota. As such, redevelopment can reasonably be expected to cause substantial impact to the wildlife community at the site, perhaps as much and likely even more than exposure to chemical contaminants detected on the property.

Conclusions concerning the need for additional investigation will be made at the scientific/management decision point (SMDP) in accordance with Step 2 of USEPA's Ecological Risk Assessment process. However, it is the opinion of VHB that it is highly unlikely that further ecological studies will change the conclusions of the ecological risk assessment. At sites where there is a potential for only marginal ecological impact, the uncertainty of the TRVs is the most important factor in the ecological risk assessment. Field studies or biological tests will not serve to provide more specific information that would aid in remedy selection. Given the extensive soil, sediment, and water sampling that has occurred on this site, it is clear that potential localized impact caused by contaminants can be mitigated effectively by simply eliminating potential exposure pathways. In the final analysis, the most environmentally protective solution is to use the results of the SLERA to limit any potential ecological exposure pathways during the development of the final reuse plan.

8

References

Agency for Toxics Substances and Disease Registry (ATSDR). 1990-1998. Toxicological Profiles. U.S. Department of Health and Human Services. Atlanta, GA.

ATSDR. 2003. Draft Toxicological Profile for Zinc. U.S. Department of Health and Human Services. Atlanta, GA.

Aquatic Toxicity Information Retrieval. 1997-2000. USEPA database.

Baes, G.F., R.D. Sharp, A.L. Sjoreen and R.W. Shor. 1984. *A Review and Analysis of Parameters for Assessing Transport of Environmentally Released Radionuclides trough Agriculture.* ORNL-5786. Ok Ridge National Laboratory. Oak Ridge, TN.

Bechtel Jacobs Company, LLC. 1998 *Biota Sediment Accumulation Factors for Invertebrates: Review and Recommendations for the Oak Ridge Reservation.* Prepared for the U.S. Department of Energy, Oak Ridge, TN.

Beyer, W.E., E. Connor, and S. Gerould. 1994. *Estimates of Soil Ingestion by Wildlife.* J. Wildlife Management 58(2): 375-382.

Bruggeman, W.A., J.M. Matron, D. Kooiman and O. Hutzinger. 1981. *Accumulation and Elimination Kinetics of di-, tri-, and tetra- Chlorobiphenyls by Goldfish After Dietary and Aqueous Exposure.* Chemosphere 10: 811-832.

Clark, K.E., F.A.P.C Gobas and D. Mackay. 1990. *Model of Organic Chemical Uptake and Clearance by Fish from Food and Water.* Environ. Sci. Technol. 22: 99-103.

Clement Associates, Inc. 1985. *Chemical, Physical, and Biological Properties of Compounds Present at Hazardous Waste Sites.* Final Report. Prepared for USEPA. Arlington, VA.

Clough, M.W. 2000. Personal Communication. United States Department of the Interior, Fish and Wildlife Service, Cortland, New York.

Conat, R. and J.T. Collins. 1975. *A Field Guide to Reptiles and Amphibians of Eastern and Central North America.*. Houghton Mifflin Company. Boston, MA.

DeGraaf, R.M. and D.D., Rudis. 1983. *New England Wildlife: Habitat, Natural History, and Distribution.* General Technical Report NE-108. Northeast Forest Experiment Station. Amherst, MA.

Efroymson, R.A., M.E. Will, G.W. Suter III and A.C. Wooten.. 1997a. *Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Terrestrial Plants: 1997 Revision.* ES/ER/TM-126/R2. Oak Ridge National Laboratory, Oak Ridge, TN.

Efroymson, R.A., M.E. Will, and G.W. Suter III. 1997b. *Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Soil and Litter Invertebrates and Heterotrophic Process: 1997 Revision.* ES/ER/TM-126/R2. Oak Ridge National Laboratory, Oak Ridge, TN.

Eisler, R. 1987. *Polycyclic Aromatic Hydrocarbon Hazards to Fish, Wildlife, and Invertebrates: A Synoptic Review.* Biological Report 85(1.11) U.S. Fish and Wildlife Service, Laurel, MD.

Fetter, C.W. 1993. Contaminant Hydrogeology. Prentice-Hall. Upper Saddle River, NJ.

Gilbert, R.O. 1987. *Statistical Methods for Environmental Pollution Monitoring*, New York: John Wiley & Sons, Inc.

Gobas, F.A.P.C. D.C. Bedard, J.J.H. Ciborowski, and G.D. Haffner. 1989 . *Bioaccumulation of Chlorinated Hydrocarbons by Mayfly Hexegenia limbata in Lake S. Clair.* J. Great Lakes Res. 15: 581-588.

Gobas, F.A.P.C. 1993. *A Model for Predicting the Bioaccumulation of Hydrophobic Organic chemicals in Aquatic Food-Webs: Application to Lake Ontario.* Ecological Modeling 69: 1-17.

Hill, E.F., and M.B. Camardese. 1986. Lethal dietary toxicities of environmental contaminants and pesticides to Coturnix. U.S. Fish and Wildlife Services, Technical Report 2.

Howard, P.H. 1990. *Handbook of Environmental Fate and Exposure Data for Organic Chemicals.* Lewis Publishers, Chelsea, MI.

Jones, D.S., G.W. Suter and R.N. Hall. 1997. *Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Sediment-Associated Biota: 1997 Revision.* ES/ER/TM-95/R4. Oak Ridge National Laboratory, Oak Ridge, TN.

Kabata-Pendias, A. and H. Pendias. 1992. Trace Elements in Soils and Plants. P.T. Kostecki, E.J. Calabrese, eds. Lewis Publishers, Inc. Chelsea, Michigan.

Ketcham, B. 2000. Personal Communication. New York State Department of Environmental Conservation, Division of Fish, Wildlife & Marine Resources. NYS Natural Heritage Program. Latham, NY.

Linday, W.L. 1979. Chemical equilibria in soils. John Wiley & Sons. New York. p. 210-220.

Malcolm Pirnie. 1998. *Remedial Investigation for Eustis Lake, Fort Eustis, Virginia.* Newport News, Virginia.

Markwell, R.D., D.W. Connell and A.J. Gabric. 1989. *Bioaccumulation of Lipophilic Compounds from Sediments to Oligochaetes.* Water Res. 23:1443-1450

Martin, A.C., H.S. Zim, and A.L. Nelson. 1951. *American Wildlife and Plants. A Guide to Wildlife Food Habits.* Dover Publications, Inc. New York, New York.

McIntosh, A. 1992. Trace Metals in Freshwater Sediments: A Review of the Literature and an Assessment of Research Needs. In: Metal Ecotoxicology Concepts & Applications. Edited by M.C. Newman and A.W. McIntosh, Lewis Publishers, Inc. Chelsea, MI.

Nagy, K.A.. 1987. *Field Metabolic Rate and Food Requirement Scaling in Mammals and Birds.* Ecol. Monogr. 57: 111-128.

National Toxicology Program's Chemical Health and Safety Data Website: http://ntp-server.niehs.nih.gov/Main_Pages/Chem-HS.html

New York State Department of Environmental Conservation. 1994. Fish and Wildlife Impact Analysis for Hazardous Waste Sites. Division of fish and Wildlife, Albany, New York.

New York State Department of Environmental Conservation (NYSDEC), 1998a. *Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations.* Division of Water Technical and Operational Guidance Series (TOGS) 1.1.1, Albany, NY.

New York State Department of Environmental Conservation (NYSDEC), 1998b, Technical Guidance for Screening Contaminated Sediments, Division of Fish and Wildlife, Albany, New York.

New York State Department of Environmental Conservation (NYSDEC), 2000. New York Breeding Bird Atlas 2000 Project.

Oak Ridge National Laboratory (ORNL), 1999, (http://risk.lsd.ornl.gov/homepage/rap_tool.htm): INTERNET.

Registry of Toxic Effects of Chemical Substances (RTECS). 1994. on-line database, CIS Inc. National Institute of Occupational Safety and Health (NIOSH). Bethesda, MD.

Reschke, C., 1990. *Ecological Communities of New York State*, New York Natural Heritage Program, Latham, NY.

Ridgon, R.H. and J. Neal. 1963. *Absorption and excretion of benzpyrene observation in the duck, chicken, mouse, and dog.* Texas Rep Biol and Med 21(2):247-261.

Sample, B.E., D.M. Opresko and G.W. Suter. 1996. *Toxicological Benchmarks for Wildlife: 1996 Revision.* ES/ER/TM-86/R3. Prepared for the U.S. Department of Energy, Office of Environmental Management, Oak Ridge National Laboratory, Oak Ridge, TN.

Schafer, P., Bowles, Jr., W., and J. Hurlbut. 1983. *The acute oral toxicity, repellency, and hazard potential of 998 chemicals to one or more species of wild and domestic birds.* Arch Environ Contam Toxicol 12:355-382.

Sigg, L., 1985, "Metal Transfer Mechanisms in Lakes: The Roles of Settling Particles," pp. 283-310 In: W. Stumm (ed.) *Chemical Processes in Lakes*, John Wiley and Sons, Inc., New York.

Sposito, G. and A.L. Page. 1984. "Cycling of Metal Ions in the Soil Environment." Chapter 9 *Metal Ions in Biological Systems. Volume 18*, in: H. Sigal (ed.) Circulation of Metals in the Environment. Marcel Dekker, Inc. New York, NY.

Stafford, E.A., and A.G. Tacon. 1988. *Use of earthworms as a food for rainbow Trout.* In C.A. Edwards and E.F. Neuhauser, eds., *Earthworms in Waste and Environmental Management.* S.P.B. Acedemic Publishing, The Hague, The Netherlands, pp. 193-208.

Suter, G.W. and C.L. Tsao. 1996. *Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota: 1996 Revision.* ES/ER/TM-96/R2. Oak Ridge National Laboratory, Oak Ridge, TN.

Travis, C. and H.A. Hattemer-Frey. 1988. *Uptake of Organics by Aerial Plant Parts: A Call for Research.* Risk Analysis Ofice, Health and Safety Research Division, Oak Ridge National Laboratory. Oak Ridge, TN. Chemosphere, Vol. 17, No. 2, pp 277-283.

Complete Exposure Pathways

Figure 3 presents the conceptual risk system model illustrating complete exposure pathways evaluated during this assessment. An exposure pathway is a course that a contaminant may take from a source to an individual receptor and includes a source, a release mechanism, an exposure point, and exposure route. The exposure point is the location of potential contact between individual and a contaminant; while the exposure route is the way that a chemical comes in contact with an individual.

Ecological resources in the vicinity of the site may be exposed to chemicals through various exposure routes (see Figure 3). Surface soil, sediment and surface water are the environmental media most likely to be encountered by biota.

Upon their release, some of the site chemicals are persistent and may be transformed to more bioavailable forms and mobilized in the food chain. Mobilization of chemicals in the aquatic food chain could occur through the following pathways:

- Root uptake by aquatic and terrestrial macrophytes.
- Contact and absorption of chemicals in surface soil, surface water and sediments, incidental ingestion; and feeding on contaminated food by aquatic and terrestrial invertebrates.
- Drinking of chemicals in surface water, incidental ingestion and contact with surface soil and sediment by fish and wildlife.

Because of the relative concentrations of the contaminants and the vegetative covering at the site, air exposure pathways such as inhalation and dermal absorption of contaminants and dusts were considered *de minimis* exposure pathways for this assessment.

Assessment and Measurement Endpoints

Assessment Endpoints

Although many ecological resources occur at the site, it is beyond the scope of this assessment to evaluate risks to every resource. Rather, assessment endpoints were developed from the conceptual risk system model to evaluate whether chemicals are affecting or could affect ecological resources at the site. Assessment endpoints are explicit expressions of the actual environmental values that are to be protected, operationally defined by an ecological entity together with some particular attribute (USEPA, 1997b). The assessment endpoints identified for the site targeted ecological resources that, because of their ecological characteristics, represent components of

the local ecosystem and that are in direct contact with constituents detected in environmental media.

For terrestrial resources, three general assessment endpoints were identified:

- Protection of plant communities from ecological changes related to chemical exposure and, in particular, the maintenance of plant species survival and production at levels similar to those at areas not exposed to potential contaminants. This endpoint was selected on the basis of the ecological value associated with terrestrial vegetation, namely food production and habitat. Terrestrial vegetation is ecologically important because of its role as the base of the food chain and in providing nesting, foraging, and shelter for vertebrate and invertebrate biota. Also, plants are immobile and rooted directly in soil, thus they represent a receptor category that may be expected to incur maximum exposure to soil-related potential contaminants.
- Protection of terrestrial vertebrate communities from ecological changes related to chemical exposure. This assessment endpoint targeted the small mammal herbivore community because of its important role as the principal food source for higher trophic level predators. Also due to the size of the site, a large mammal herbivore community is also targeted because of its importance for human recreation. This assessment endpoint also targeted insectivorous birds and top-level predators. The former are ecologically relevant because of their roles in maintaining invertebrate populations and their high potential for exposure to site chemicals, while the latter are ecologically relevant because of their function in population control of lower trophic-level biota. In general, top-level predators are especially susceptible and sensitive to bioaccumulating potential contaminants, and thus may be at particular risk at those locations where bioaccumulating chemicals are present.
- Protection of the soil biota community and associated soil nutrient processes from ecological changes related to constituent exposure. This endpoint was selected based on the ecological roles of soil biota in food production for vertebrate biota and because of the importance of soil biota as scavengers and decomposers, and in nutrient cycling.

For aquatic resources, the general assessment endpoint was the protection of aquatic communities from ecological changes related to chemical exposure. Components of the aquatic community addressed by this assessment endpoint include benthic macroinvertebrates because of their ecological relevance as food for higher trophic-level organisms. Fish were addressed because they represent the dominant fully aquatic vertebrate component of the aquatic ecosystem. This assessment endpoint also targeted semi-aquatic mammals because they represent high-level predators.

Measurement Endpoints

Measurement endpoints are the actual measurements or estimates used to evaluate each of the assessment endpoints and are the basis for evaluating risk. This SLERA relies primarily on evaluating exposure to fish and wildlife using the measured concentrations in environmental media and modeling concentrations of chemicals in food items. The measured concentrations in environmental media were based on maximum detected concentrations. To assess the first assessment endpoint that concerns protection of vegetative communities, the following measurement endpoints were considered:

- **Terrestrial plant community**—Maximum detected concentrations in soil compared to available screening benchmark values derived by the Oak Ridge National Laboratory (ORNL) (Efroymson *et al.*, 1997a).

To assess the first assessment endpoint that concerns protection of terrestrial vertebrate communities from ecological changes related to chemical exposure, the following measurement endpoints were considered:

- **Herbivorous mammals**—Maximum chemical concentrations in soil and modeled chemical dietary doses to the deer mouse and white-tailed deer to determine exceedance of effect-level thresholds based on Toxicity Reference Values (TRVs).
- **Predatory mammals**—Maximum detected chemical concentrations in soil and modeled chemical dietary doses to the red fox to determine exceedance of effect-level thresholds based on TRVs.
- **Local insectivorous birds**—Maximum detected chemical concentration in soil and modeled chemical dietary doses to the American robin to determine exceedance of effect-level thresholds based on TRVs.
- **Predatory birds**—Maximum detected chemical concentrations in soil and modeled chemical dietary doses to the red-tailed hawk to determine exceedance of effect-level thresholds based on TRVs.

To assess protection of the soil biota community and associated soil nutrient processes from ecological changes related to soil constituent exposure, the following measurement endpoints were considered:

- **Soil invertebrate community**—Maximum detected chemical concentrations in soil compared to available screening benchmark values derived by the ORNL (Efroymson *et al.*, 1997b).

To assess the protection of aquatic communities from ecological changes related to chemical exposure, the following measurement endpoints were considered:

- **Benthic invertebrate community**—Maximum concentrations in sediment compared to sediment benchmarks such as NYSDEC Technical Guidance for Screening Contaminated Sediments (1998b), and toxicological benchmarks for sediment presented in the Oak Ridge National Laboratory guidance (Jones *et al.*, 1997).
- **Local fish populations**—Modeled chemical body burdens in fish to determine exceedance of effect-level thresholds based on toxicity reference values (TRVs). A steady-state model developed by Gobas *et al.* (1993) and Clarke *et al.* (1990) for estimating concentrations of hydrophobic organic substances in various organisms of the aquatic food-web, including fish and benthos was used in this evaluation. The model combines the toxicokinetics of chemical uptake, elimination and bioaccumulation in individual organisms and the trophodynamics of food webs to estimate chemical concentrations in different organisms of food webs.
- **Obligate semi-aquatic mammal**—Maximum chemical concentrations in water and sediment and modeled chemical dietary doses to the mink to determine exceedance of effect-level thresholds based on TRVs.
- **Omnivorous mammal**—Maximum detected concentrations in soil, water and sediment and modeled chemical dietary doses to the raccoon to determine exceedance of effect-level thresholds based on TRVs.

3

Screening-Level Ecological Effects Evaluation

The toxicity assessment describes the toxicological characteristics of contaminants and establishes Toxicity Reference Values (TRVs) for each endpoint species identified at the site. These TRVs represent "no observed adverse effect levels" (NOAEL) for each chemical for each endpoint species.

Derivation of TRVs

TRVs for benthic invertebrates were sediment quality criteria.

For fish, the TRVs were ambient water quality criteria.

TRVs for plants, earthworms, mammalian and avian endpoint receptors were derived from published toxicity studies. Literature toxicity values judged most relevant for the ecological assessment were used to derive the TRVs used in this assessment. The species and conditions in a laboratory study often differ from those found in the field; therefore, some uncertainty is involved in extrapolating from the laboratory toxicity data to the TRVs. Because of this uncertainty, a conservative approach is used to calculate TRVs and the most sensitive, ecologically significant toxicological effect is used. When studies involve several species, the test species that is most closely related to the endpoint species is usually selected. The lowest available toxicity NOAEL or LOAEL for this species is used to calculate the TRV. If only a LOAEL is available, the LOAEL was multiplied by an uncertainty factor ranging from 0.01 to 1 to approximate an equivalent NOAEL

The chemical applied in a laboratory study is often expressed as a concentration in food (*e.g.*, ppm). This concentration must be converted to a dose (as mg chemical/kg BW-day) to allow for a comparison among species of various body sizes. This conversion is performed by multiplying the concentration by the food ingestion rate (which is either from the toxicity study or can be estimated from published values for the test species), and dividing by the test organism's body weight (also taken from the study or estimated from the scientific literature). Differences in body size between the test species and the receptor species can also be a source of uncertainty. Therefore, the test species NOAEL is modified by a body-scaling factor to calculate

the receptor species NOAEL (Sample *et al.*, 1996). Receptor species NOAELS were calculated using the following equation:

$$TRV = NOAEL_R = NOAEL_T \times (BW_T / BW_R)^{1/3}$$

Where:

$NOAEL_R$	=	No observed adverse effect level for receptor species (mg/kg/day)
$NOAEL_T$	=	No observed adverse effect level for test species (mg/kg/day)
BW_T	=	Body weight of test species (kg)
BW_R	=	Body weight of receptor species (kg)
$(BW_T/BW_R)^{1/3}$	=	Body scaling factor

For mammalian and avian endpoint species, if a test species was listed in Sample *et al.* (1996), it was selected as the TRV and adjusted accordingly. If a value was not present, other published sources were used.

The NYSDEC ambient water quality standards and guidance values (NYSDEC, 1998a) for the protection of freshwater aquatic life were used to evaluate chemical concentrations in surface water collected from the seeps associated with the inactive landfill area and Cattaraugus Creek. The values are generally based on acute toxicity endpoints from laboratory studies of aquatic species, or endpoints related to bioaccumulation. Class C water standards (secondary contact recreation and fish propagation) were used because Cattaraugus Creek, the receiving water body for site run-off is classified as Class C(T). All surface water standards and guidance values were obtained from either 6 NYCRR 703.5 or TOGS 1.1.1. NYSDEC surface water quality standards are not available for several of the organic chemicals detected in the seep samples and Cattaraugus creek. The New York State water classification of C(T) indicates that Cattaraugus Creek waters support a trout population.

The NYSDEC technical guidance for screening contaminated sediments (NYSDEC, 1998b) was used to evaluate chemical concentrations in sediment; the results are provided in Table 9. The NYSDEC has derived sediment criteria for non-polar organic compounds using the equilibrium partitioning methodology recommended by the USEPA. This methodology contends that sediment toxicity is attributable to the concentration of chemicals in the interstitial pore water, which is considered to be biologically available to benthic organisms. To derive an organic carbon-normalized sediment criterion, the following information is needed:

- An ambient water quality criterion (WQC) for a particular chemical.
- The octanol/water partition coefficient (K_{ow}) for the chemical.

The organic carbon-normalized sediment criterion (SC_{oc}) is defined as:

$$SC_{oc} = WQC * K_{ow}$$

The NYSDEC has established two levels of criteria for inorganic chemicals in sediments. These are the lowest effect level (LEL) and the severe effect level (SEL). The LEL indicates a level of sediment chemical that can be tolerated by the majority of benthic organisms, but still causes toxicity to a few species. The SEL indicates the concentration where effects to the sediment-dwelling community indicate highly contaminated sediments. The LEL was used for screening purposes.

The calculated TRVs are presented in Table 22.

Toxicological Profiles

A toxicological profile summarizing the potential adverse ecological effects of each potential contaminant was derived from literature sources. The profiles include effects of potential contaminants on growth, reproduction, and survival of endpoint species or their surrogates. These profiles are presented in Attachment 2.

4

Screening-Level Exposure Estimates

This section includes site-specific information pertinent to the assessment of potential ecological exposures to chemicals at the site. The general approach involves deriving exposure estimates for the endpoint species identified in the problem formulation step. To derive these estimates, assumptions were made regarding the ecological receptor's co-occurrence, contact with, and uptake of, potential contaminants. These assumptions were derived from published or readily available information.

Exposure Point Concentration

Soil, Surface Water, and Sediment

The exposure point concentration represents the environmental concentration of a chemical in a particular medium to which an ecological receptor at that site would be exposed.

In this SLERA however, only maximum concentrations were used in order to represent worst-case potential exposure.

Vegetation

Surface soil and sediment chemicals may also be available to endpoint species through uptake by plants in their diet. No data on concentrations of chemicals in vegetation at the site were collected, so concentrations for organic compounds were estimated using the vegetative uptake model of Travis and Hattemer-Frey (1988). The model uses a regression equation derived from empirical data for several organic compounds to predict a vegetation bioconcentration factor (BCF). The regression equation predicts the BCF from the log of the octanol-water partition coefficient (K_{ow}) of the contaminants using the following equation:

$$Log\ BCF_v = 1.588 - (0.578\ Log\ (K_{ow}))$$

For inorganic compounds, the values presented in Baes, *et al.* (1984) were used to derive plant EPCs. The predicted BCFs for vegetative uptake are shown in Table 11 with corresponding EPCs for each chemical.

Benthic Macroinvertebrates and Fish

A steady-state model for estimating concentrations of organic substances in various organisms of the aquatic food web, including fish and benthos was used in this evaluation. The model combines the toxicokinetics of chemical uptake, elimination and bioaccumulation in individual organisms and the trophodynamics of food webs to estimate chemical concentrations in different organisms of food webs.

The model is generic in the sense that it can make predictions for any aquatic food chain. However, it requires site-specific input information to make realistic estimates of concentration in actual food webs. The input parameters and values are provided in Table 12.

For modeling Cattaraugus Creek, a simple food chain model of sediment to benthic organisms to permanent resident forage fish (fathead minnow) to small mouth bass was used. For the wetland area, which lacks sufficient water to support fish, a simple food chain model of sediment to benthic organisms was used. Uptake and accumulation of organic substances in benthic invertebrates are considered as the result of an equilibrium partitioning of the chemical between the lipids of the organism, the organic fraction (OC) of the sediment, and the interstitial (or pore) water (Gobas, *et al.* 1989). This model used the following equation to determine uptake and accumulation in benthos:

$$\frac{CBdL}{OC} = \frac{CSdOC}{LB}$$

Where:

CB = Chemical concentrations in the benthic invertebrate (µg/kg wet weight)
CS = Chemical concentrations in sediments (µg/kg dry weight)
LB = Lipid fraction of the benthos
dL = Density of lipids of the benthos (kg/L)
OC = Organic carbon fraction of the sediments (kg/kg)
dOC = Density of the organic carbon fraction of the sediments (kg/L)

Fish absorb chemicals directly from the water (*i.e.*, via the gills), and through the consumption of food (*i.e.*, via the GI-tract, Bruggeman *et al.* 1981). Other uptake routes such as chemical absorption via the skin are usually insignificant. Chemical loss or elimination can occur via the gills to the water, via egestion of fecal matter, or

as a result of metabolic transformation. Fish growth can have a considerable effect on bioaccumulation factors and concentrations in fish, in particular for chemicals with high K_{ow}s (Clark *et al* 1990). To incorporate fish growth into the model and allow for a simple steady-state solution, the effect of growth was introduced in terms of a rate constant.

The food chain model was used only for organic compounds. For inorganic compounds, the concentration in pore water was determined because BCFs for invertebrates are for uptake from water.

The derivation of BCFs for inorganic compounds was accomplished by multiplying the sediment concentration (mg chemical/kg sediment) by a sediment-water partition coefficient (Kd expressed in Kg sediment/L water). The result is the concentration in pore water expressed as mg chemical/L water. The BCF, expressed as L water/Kg organism, was then multiplied by the pore water concentration to determine benthic invertebrate tissue concentration. Benthic tissue concentrations were multiplied by a bioaccumulation factor (BAF) to determine tissue concentrations in fathead minnows. This same BAF was then multiplied by fathead minnow concentrations to derive small mouth bass tissue concentrations. BCFs and BAFs were obtained from literature sources, or assumed based on periodic table relationships. Table 13 presents modeling results for organic compounds as well as BCFs and BAFs for inorganic compounds and the resulting EPC concentration for benthos and fish.

Soil Invertebrates

An earthworm bioaccumulation model based on Markwell *et al.* (1989) was used to determine the body burdens of chemicals in earthworms. This model considers the lipid content of soil invertebrates (YL) and organic carbon content (foc) of soils as the important components in calculating the BAF. This model uses the following equation to determine accumulation in earthworms:

$$BAF = Y_L / 0.66 f_{oc}$$

A lipid content of 2% was assumed for earthworms based on the work of Stafford and Tacon (1988). The average total organic carbon concentration of soils on the site was calculated to be 3.24%.

Exposure Estimates

The total exposure for the ecological receptors is the sum of exposures from various components of the diet and from incidental soil and/or sediment ingestion, and ingestion of surface water. The cumulative dietary exposure is calculated by multiplying the tissue concentration in each prey item by the proportion that prey

item represents in the diet and adding these values. The total is then multiplied by the exposure duration (ED), and ingestion rate (IR); and divided by the receptor's body weight (BW). The process is represented by the following equation:

$$EE_{diet} = \frac{\sum_{1-n}[(P_1 \times T_1) + (P_2 \times T_2) + \ldots (P_n \times T_n)] \times SUF \times ED \times IR}{BW}$$

Where:

EE_{diet}	=	Estimated Exposure from diet (mg/kg/day)
P_n	=	Percentage of diet by prey item ingested (designed to maximum exposure)
T_n	=	Tissue concentration in prey item n (mg/kg dry weight)
SUF	=	Site use factor (in this represented case equals 1.0)
ED	=	Exposure duration (unitless), equal to the fraction of the year spent in the region
IR	=	Ingestion rate of receptor (kg/kg-day in dry weight; maximum)
BW	=	Body weight of receptor (kg in fresh weight; minimum)

Exposure parameters for endpoint species, including dietary breakdown, home range and body weight information, are presented in Table 14.

The tissue concentrations of chemicals in prey items are the EPCs for soil, sediment, surface water, benthic invertebrates, and fish listed in Tables 11. The calculations used to derive the EPCs were discussed in the previous section. The EPC calculated for fish endpoint species also represent the total exposure for these species.

The SUF indicates that portion of an animal's home range comprised by the Site. The SUF was set at 1.0 to reflect a worst-case assumption, and allocated to that site area where a maximum exposure would occur.

The ED is the percentage of the year spent in the site area by the receptor species. Avian receptors may be considered either year round residents or migratory (the avian endpoint species [American robin] is a migratory bird). Regardless, all ED's were set at 1. The EDs are shown in Table 14.

The estimation of receptor exposure to chemicals through incidental soil and/or sediment ingestion was similar to the dietary exposure estimate. The soil or sediment EPC was multiplied by soil/sediment ingestion (as a percentage of total diet). This number was then multiplied by the SUF, ED and IR, and then divided by BW. Soil/sediment ingestion data for receptors is based on data in Beyer *et al.* (1994).

Maximum food ingestion rates for endpoint species were either taken from Chapter 2 of USEPA (1993) or estimated based on maximum body weight using the following equations:

Passerine Bird:	$Food\ intake\ (g/day) = 0.398(BW_{max})^{0.850}$
Nonpasserine Bird:	$Food\ intake\ (g/day) = 0.301(BW_{max})^{0.751}$
Mammal:	$Food\ intake\ (g/day) = 0.235(BW_{max})^{0.822}$
Rodent:	$Food\ intake\ (g/day) = 0.621(BW_{max})^{0.564}$
Herbivores:	$Food\ intake\ (g/day) = 0.577(BW_{max})^{0.727}$

Similarly, to estimate maximum drinking water intake for endpoint species values from Chapter 2 of USEPA (1993) were used or the following formula from USEPA were used:

Bird:	$Water\ intake\ (kg/kg\text{-}day) = 0.059(BW_{max})^{0.67}$
Mammal:	$Water\ intake\ (kg/kg\text{-}day) = 0.099(BW_{max})^{0.9}$

The total exposure for a receptor is the sum of exposure from diet, soil/sediment ingestion and surface water ingestion, as represented by the following equation:

$$EE_{total} = EE_{diet} + EE_{sediment} + EE_{soil} + EE_{water}$$

Tables 15 through 21 provide exposure estimates for the endpoint receptors within each area of concern. This table also presents the relative contributions of dietary, soil, sediment and surface water exposure as a percentage of total exposure. The significance of these estimated exposures for wildlife receptors is discussed in the following sections.

Bioaccumulation in Secondary Trophic Species

The deer mouse and the American robin are considered prey species for the following tertiary trophic level species; raccoon, red fox, and the red-tailed hawk. For these species, a bioaccumulation factor is applied to exposure inputs to estimate a whole body tissue concentration of each COPEC. The following formula for the deer mouse, an herbivorous mammal, was taken from Table F-1-2 in the SLERA guidance from USEPA (1999).

$$C_{HM} = (C_{TP} \cdot BCF_{TP-HM} \cdot P_{TP} \cdot F_{TP}) + (C_S \cdot BCF_{S-HM} \cdot P_S) + (C_{WCTOT} \cdot BCF_{W-HM} \cdot P_W)$$

Where:

C_{HM} = Concentration in deer mouse (herbivorous mammal)
C_{TP} = Concentration of COPEC in terrestrial plant
BCF_{TP-HM} = Bioconcentration factor for terrestrial plants to deer mouse

P_{TP} = Proportion of terrestrial plant in diet that is contaminated (assume 100%)
F_{TP} = Fraction of diet comprised of terrestrial plant (assume 100%)
C_S = Concentration of COPEC in soil
BCF_{S-HM} = Bioconcentration factor for soil to deer mouse
P_S = Proportion of soil in diet that is contaminated (assume 100%)
C_{WCTOT} = Concentration of COPEC in water
BCF_{W-HM} = Bioconcentration factor for water to deer mouse
P_W = Proportion of water in diet that is contaminated (assume 100%)

BCF values for the deer mouse, herbivorous mammal, were taken from Tables D-1 through D-3 of the SLERA guidance (USEPA 1999). For most of the volatile organic compounds and some of the PAHs and inorganics, BCF values were unavailable. While soil and water contributions to the deer mouse are not calculated, a value of 1.0 was used for COPEC contribution from plant material in the diet. This is an overly conservative estimate of the potential tissue concentration expected to be present in a deer mouse at the site.

For the American robin, the following equation for an omnivorous bird was adapted from Table F-1-6 in the SLERA guidance (USEPA 1999). Because the American robin in this evaluation is assumed to be exposed to the maximally contaminated food item (i.e., the earthworm from the manufacturing area) the plant ingestion portion of the equation was not performed.

$$C_{OB} = \left(C_{INV} \cdot \frac{FCM_{TL3}}{FCM_{TL2}} \cdot P_{INV} \cdot F_{INV} \right) + \left(C_S \cdot BCF_{S-OB} \cdot P_S \right) + \left(C_{WCTOT} \cdot BCF_{W-OB} \cdot P_W \right)$$

Where:

C_{OB} = Concentration of COPEC in American robin (omnivorous bird)
C_{INV} = Concentration of COPEC in terrestrial invertebrate (earthworm)
FCM_{TL3} = Food Chain Multiplier for tertiary level consumer (robin)
FCM_{TL2} = Food Chain Multiplier for secondary level consumer (earthworm)
P_{INV} = Proportion of terrestrial invertebrate contaminated (assume 100%)
F_{INV} = Fraction of diet composed of terrestrial invertebrate (assume 100%)
C_S = Concentration of COPEC in soil
BCF_{S-OB} = Bioconcentration factor for soil to omnivorous bird
P_S = Proportion of soil in diet that is contaminated (assume 100%)
C_{WCTOT} = Concentration of COPEC in water
BCF_{W-OB} = Bioconcentration factor for water to omnivorous bird
P_W = Proportion of water in diet that is contaminated (assume 100%)

FCM values for the secondary and tertiary consumers were taken from Table 5-2 of the SLERA guidance (1999). Table 10 of this document provides the log K_{ow} values used for determining the FCM value. BCF values for the American robin were taken from Tables D-2 and D-3 of the SLERA guidance (USEPA 1999). For most of the

volatile organic compounds and some of the PAHs and inorganics, BCF values were unavailable.

BCFs, FCM_{TL3}/FCM_{TL2}, and estimated concentrations of COPECs in the deer mouse and the American robin are provided in Tables 18 and 20, respectively.

5

Screening-Level Risk Characterization

Risk Estimation

Potential risks posed by contaminants were evaluated by calculating a hazard quotient (HQ) for each chemical and for each endpoint species in each area of concern. The HQ_{total} for all pathways was determined by dividing the total exposure through all pathways (EE_{total}) by the appropriate TRV for the endpoint species and contaminant:

$$HQ_{total} = EE_{total} / TRV$$

A resulting HQ_{total} greater than 1.0 suggests that a risk for adverse ecological effects from exposure to contaminants exists. The magnitude of the HQs generally indicates the relative risk posed to endpoint species. By referring to the percentages of exposure resulting from different pathways (*e.g.*, food ingestion, sediment ingestion and surface water ingestion), the relative contribution to total potential risk for each exposure pathway can be identified.

Risk to Benthic Invertebrates

Potential risks to benthic invertebrates are shown in Table 23.

Wetland Areas

For organic chemicals, the hazard quotients are less than 1.0 indicating no significant potential risk. A potential risk (HQ≥1) was identified for arsenic, total chromium, and zinc, with the greatest being for arsenic.

Cattaraugus Creek

For most organic chemicals, the hazard quotients are less than 1.0 indicating no significant potential risk. A potential risk (HQ≥1) was identified for acetone, arsenic and nickel, with the greatest being for acetone.

TRV values were not available for cyclohexane, cis-1,2-dichloroethane, methylcyclohexane, 4-methyl-2-pentanone, barium, and cobalt, so potential risk could not be calculated.

Risk to Terrestrial Invertebrates

Potential risks to terrestrial invertebrates are shown in Table 23.

Landfill Area

Many TRV values were unavailable for the volatile organic compounds contaminants identified for the landfill area or arsenic. However, a potential risk (HQ≥1) was identified for total chromium.

Former Manufacturing Facility Area

For 1,4-dichlorobenzene and 1,2,4-trichlorobenzene, the hazard quotients are less than 1.0 indicating no significant potential risk. TRV values were unavailable for the remaining volatile organic compounds identified as contaminants, the PAHs (except for fluorine), and seven inorganic compounds including arsenic. However, a potential risk (HQ≥1) was identified for total chromium, copper, mercury, and zinc with the greatest being for total chromium.

Risk to Wetland Plants

Potential risks to wetland plants are shown in Table 23. For toluene, the hazard quotients are less than 1.0 indicating no significant potential risk. TRV values were unavailable for the remaining volatile organic compounds identified as contaminants. A potential risk (HQ≥1) was identified for zinc.

Risk to Terrestrial Plants

Potential risks to terrestrial plants are shown in Table 23.

Landfill Area

For toluene, the hazard quotients are less than 1.0 indicating no significant potential risk. A potential risk (HQ≥1) was identified for chromium and zinc.

United States Environmental Protection Agency (USEPA). 1979. Water-related environmental fate of 129 priority pollutants. Office of Water Planning and Standards. Washington, D.C. EPA 440/4-79/029a.

USEPA. 1988. *Superfund Exposure Assessment Manual.* EPA/540/1-88/001. OWSER Directive 9285.5-1. USEPA Office of Remedial Response. Washington, D.C.

USEPA. 1989. *Risk Assessment Guidance for Superfund, Volume II: Environmental Evaluation Manual.* Interim Final. EPA/540/1-89/001. USEAP Office of Emergency and Remedial Response. Washington, D.C.

USEPA. 1991. *Proposed Sediment Quality Criteria for the Protection of Benthic Organisms.* Office of Water, Research and Development and Science and Technology; Health and Ecological Criteria Division, Washington, D.C.

USEPA. 1992. *Supplemental Guidance to RAGS: Calculating the Concentration Term,* Office of Emergency and Remedial Response, Hazardous Site Evaluation Division, NTIS Publication No. PB92-963373.

USEPA. 1993. *Wildlife Exposure Factors Handbook.* Washington, D.C.: Office of Research and Development. EPA/600/R-93/187a.

USEPA. 1996. Soil Screening Guidance: Fact Sheet, Office of Solid Waste and Emergency Response, EPA/540/F-95/128, Washington, D.C.

USEPA. 1997a. Health Assessment Effects Summary Tables, FY 1997 update, Washington, D.C.

USEPA. 1997b. *Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments. Interim Final.* U.S. EPA Environmental Response Team. Edison, NJ.

USEPA. 1999. *Screening Level Ecological Risk Assessment Protocol for Hazardous Waste Combustion Facilities.* Office of Solid Waste and Emergency Response. EPA/530/D-99/001A.

USEPA. 2000. *Draft Ecological Screening Level Guidance,* Office of Emergency and Remedial Response, Washington, D.C.

USEPA. 2001. Integrated Risk Information System on-line database, http://www.epa.gov/ngispgm3/iris/index.html; INTERNET.

Werner, R.G. 1980. *Freshwater Fishes of New York State.* Syracuse University Press. Syracuse, New York.

Wisconsin Department of Natural Resources (WDNR). 1986. *The White-Tailed Deer.* Bureau of Wildlife Management, Madison, WI.

www.chemfinder.com

http://esc_plaza.syrres.com/efdb/Chemfate.htm

http://www.dec.state.ny.us/website/dfwmr/corm01sec3.pdf

http://biology.nebrwesleyan.edu/empiricist/research/Ecology/Christchurch/AyscueP_388.html

http://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?HSDB

302645

Tables

TABLE 1

PLANT SPECIES IDENTIFIED DURING FIELD RECONNAISSANCE

Peter Cooper Site
Gowanda, New York

Common Name	Scientific Name	Cover Type	Common Name	Scientific Name	Cover Type
Avens	*Geum sp.*	3	Kentucky bluegrass	*Poa pratensis*	4,7
Big-toothed aspen	*Populus grandidentata*	5	Late goldenrod	*Solidago gigantea*	1, 7, 5, 10
Birds-foot trefoil	*Lotus orniculatus*	6, 7, 11	Many flowered aster	*Aster ericoides*	1, 7
Bittersweet nightshade	*Solanum dulcamara*	1, 6, 11	Maple-leaved viburnum	*Viburnum acreifolium*	6
Black cherry	*Prunus serotina*	5	Mouse-eared chickweed	*Cerastium vulgatum*	5
Black locust	*Robinia pseudo-acacia*	6, 7	Mugwort	*Artemisia vulgaris*	5
Black raspberry	*Rubus occidentalis*	1, 4, 5, 6, 7	Multi-flora rose	*Rosa multiflore*	1, 6
Black walnut	*Juglans nigra*	6	New England aster	*Aster novae-angliae*	1, 5, 10
Black willow	*Salix nigra*	8, 9, 10	Orchard grass	*Dactylis glomerata*	5, 8
Blue flag iris	*Iris versicolor*	10	Phragmites	*Phragmites communis*	10
Boneset	*Eupatorium perfoliatum*	8, 9, 10	Poison ivy	*Rhus radicans*	3, 8, 9, 10
Box elder	*Acer negundo*	2, 4, 6, 8	Pokeweed	*Phytolacca americana*	1
Bouncing bet	*Saponaria officinalis*	1, 10	Purple loosestrife	*Lythrum salicaria*	8, 9
Bristly foxtail	*Setaria viridis*	5, 7	Quaking aspen	*Populus tremuloides*	2, 3, 6
Broad-leaved cattail	*Typhia latifolia*	8, 10	Queen Anne's lace	*Daucus carota*	1, 5, 7
Bull thistle	*Cirsium vulgare*	7	Ragweed	*Ambrosia artemsiifolia*	5, 7
Burdock	*Arctium minus*	1, 5, 7	Red clover	*Trifolium pratense*	4, 5, 7
Butter-n-eggs	*Linaria vulgaris*	5, 7	Red fescue	*Festuca rubra*	7
Canada goldenrod	*Solidago canadesis*	1, 5	Red maple	*Acer rubrum*	8, 2, 11,3
Catalpa	*Catalpa bignonioides*	6	Red oak	*Quercus rubra*	3, 6
Chicory	*Cichorium intybus*	4, 5, 7	Reed canary grass	*Phalaris arundinacea*	8, 9
Choke cherry	*Prunus virginiana*	6	Sedge	*Carex lurida*	9
Cinnamon fern	*Osmunda cinnamomea*	8	Silky dogwood	*Cornus amomum*	10
Cocklebur	*Xanthium chinense*	1	Slippery elm	*Ulmus rubra*	2, 8, 10
Common cinquefoil	*Potentilla simplex*	1, 4, 5, 7	Small white aster	*Aster vimineus*	4, 5, 7
Common milkweed	*Asclepias syriaca*	1, 5, 7	Soft-stemmed bulrush	*Juncus effusus*	9
Common mullein	*Verbascum thapsus*	1, 5, 7	Spearmint	*Mentha spicata*	8
Common plantain	*Plantago major*	4, 7	Spotted jewelweed	*Impatiens capensis*	8, 9, 10
Cottonwood	*Populus deltoides*	2, 3, 8, 10	Spotted knapweed	*Centarea maculosa*	1,4. 5, 6, 7
Crab apple	*Pyrus prunifolia*	6	Spreading dogbane	*Apocynum androsaemifolium*	1, 7
Crab grass	*Digitaria sanguinalis*	4, 7	Squirrel tail grass	*Hordeum jubatum*	1, 4, 5
Crown vetch	*Coronilla varia*	1, 6, 7, 11	Staghorn sumac	*Rhus typhina*	1, 5, 6, 7, 10

TABLE 1

PLANT SPECIES IDENTIFIED DURING FIELD RECONNAISSANCE

Common Name	Scientific Name	Cover Type	Common Name	Scientific Name	Cover Type
Curled dock	*Rumex crispus*	4, 5	Sugar maple	*Acer Saccharum*	3
Dandelion	*Taraxacum officinale*	4, 7	Summer grape	*Vitis aestivalis*	1, 2, 3, 6
Deer-tongue grass	*Panicum clandestinum*	1	Switch grass	*Panicum virgatum*	1, 4, 5, 6
Dewberry	*Rubus flagellaris*	5	Sycamore	*Platanus occidentalis*	6, 10
Early goldenrod	*Solidago juncea*	1, 4, 5, 6	Tartarian honeysuckle	*Lonicera tatarica*	1, 4, 5, 6,7
Elderberry	*Sambucus canadensis*	8	Tear thumb	*Polygonum sagittatum*	8
English plantain	*Plantago lanceolata*	4, 5	Teasel	*Dipsacus sylvestris*	1, 5, 7
Evening primrose	*Oenothera biennis*	1, 5, 7	Timothy grass	*Phleum pratense*	5, 7
Everlasting pea	*Lathyrus latifolius*	5, 7	Virginia creeper	*Parthenocissus quinquefolia*	2, 3, 6
Garlic mustard	*Alliaria officinalis*	3, 6, 7	White ash	*Fraxinus americana*	3
Gray goldenrod	*Solidago nemoralis*	1, 4, 5, 7	White clover	*Trifolium repens*	7
Green ash	*Fraxinus pennsylvanica*	3	White snake root	*Eupatorium rugosum*	2, 3, 6, 8, 10
Groud ivy	*Glechoma hederacea*	4, 5	White sweet clover	*Melilotus alba*	1, 4, 5, 7
Horsetail	*Equisetum arvense*	9	White wood aster	*Aster divaricatus*	6, 7
Japanese knotweed	*Polygonum cuspidatum*	1, 4	Wild strawberry	*Fragaria virginiana*	1, 4, 5, 7
Jerusalem artichoke	*Helianthus tuberosus*	1, 8	Wool grass	*Scirpus cyperinus*	8, 9
Joe-pye weed	*Eupatorium dubium*	8, 10	Wood sorrel	*Oxalis europaea*	6

TABLE 2

ENDANGERED AND THREATENED SPECIES IN THE VICINITY OF THE PETER COOPER SITE

Peter Cooper Site
Gowanda, New York

Common Name	Scientific Name	NYS Legal Status	Last Seen	Location
Giant pine-Drops	Pterospora andromedea	Endangered	1977	Deer Lick Sanctuary
Schweintz' Sedge	Carex schweinitzii	Threatened	1930	Cattaraugus Indian Reservation
Yellow Giant-Hyssop	Agastache neptoides	Threatened	1930	Cattaraugus Indian Reservation
Bear's Foot	Polymnia uvedalia	Endangered	1931	Cattaraugus Indian Reservation – near creek
Downy Lettuce	Lactuca hirsuta	Endangered	1921	Cattaraugus Indian Reservation
Golden Seal	Hydrastis canadensis	Threatened	1986, 1928	Sand Hill, Cattaragus Creek
Hooker's Orchid	Platanthera hookeri	Endangered	1927	Cattaraugus Indian Reservation
Woodland Bluegrass	Poa sylvestris	Endangered	1921	Gowanda
Blunt-Lobe Grape Fern	Botrychium oneidense	Endangered	1930	Collins
Rough-Leaf Dogwood	Cornus drummondii	Endangered	1992	Cattaraugus Creek Canyon – Vail Road
St. Andrew's Cross	Hypericum hypericoides	Endangered	1992	Cattaraugus Creek Canyon – Vail Road
Eastern Sand Darter	Etheostoma pellucidum	Threatened	1893	Cattaraugus Creek
Channel Darter	Percina copelandi	Unprotected	1893	Cattaraugus Creek

Source: Ketcham, 2000

TABLE 3

FISH SPECIES THAT MAY BE PRESENT IN CATTARAUGUS CREEK

Peter Cooper Site
Gowanda, New York

Common Name	Scientific Name	Common Name	Scientific Name
Northern brook lamprey	*Ichthyomyzon fossor*	Silver lamprey	*Ichthyomyzon unicuspis*
American brook lamprey	*Lampetra lamottei*	Sea lamprey	*Petromyzon marinus*
Lake sturgeon	*Acipenser fulvescens*	Longnose gar	*Lepisosteus osseus*
Bowfin	*Amia calva*	American eel	*Anguilla rostrata*
Alewife	*Alosa pseudoharengus*	Gizzard shad	*Dorosoma cepedianum*
Mooneye	*Hiodon tergisus*	Cisco	*Coregonus artedii*
Lake whitefish	*Coregonus clupeaformis*	Coho salmon	*Oncorhynchus kisutch*
Chinook salmon	*Oncorhynchus tshawytscha*	Rainbow trout	*Oncorhynchus mykiss*
Brown trout	*Salmo trutta*	Brook trout	*Salvelinus fontinalis*
Chain pickerel	*Esocx niger*	Grass pickerel	*Esox americanus*
Northern pike	*Esox lucius*	Muskellunge	*Esox masquinongy*
Central mudminnow	*Unbra limi*	Carp	*Cyprinus carpio*
Goldfish	*Carassius auratus*	Stoneroller	*Campostoma anomalum*
Golden shiner	*Notemigonus crysoleucas*	River chub	*Nocomis micropogon*
Bigeye chub	*Hybopsis amblops*	Silver chub	*Hybopsis storeriana*
Cutslip minnow	*Exoglossum maxillingua*	Redside dace	*Clinosomus elongatus*
Brassy minnow	*Hybognathus hankinsoni*	Sand shiner	*Notropis stramineus*
Pugnose minnow	*Notropis emiliae*	Blacknose shiner	*Notropis heterolepis*
Spottail shiner	*Notropis hudsonius*	Spotfin shiner	*Notropis spilopterus*
Blackchin shiner	*Notropis heterodon*	Mimic shiner	*Notropis volucellus*
Bigmouth shiner	*Notropis dorsalis*	Common shiner	*Notropis cornutus*
Striped shiner	*Notropis chrysocephalus*	Redfin shiner	*Notropis umbratilis*
Emerald shiner	*Notropis atherinoides*	Rosyface shiner	*Notropis rubellus*
Southern redbelly dace	*Phoxinus erthrogaster*	Bluntnose minnow	*Pimephales notatus*
Fathead minnow	*Pimephales promelas*	Blacknose dace	*Rhinichthys atratulus*
Longnose dace	*Rhinichthys cataractae*	Creek chub	*Semotilus atromaculatus*
Pearl dace	*Semotilus margarita*	Quillback	*Carpoides cyprinus*
White sucker	*Catostomus commersoni*	Northern hog sucker	*Hypentelium migricans*
Spotted sucker	*Minytrema melanops*	Silver redhorse	*Moxostoma anisurum*
River redhorse	*Moxostoma carinatum*	Golden redhorse	*Moxostoma erythrurum*
Shorthead redhorse	*Moxostoma macrolepidotum*	Greater redhorse	*Moxostoma valenciennesi*
Black redhorse	*Moxostoma duquesnei*	Channel catfish	*Ictalurus puctatus*
Yellow bullhead	*Ictalurus natalis*	Brown bullhead	*Ictalurus nebulosus*
Black bullhead	*Ictalurus melas*	Stonecat	*Noturus flavus*
Banded killifish	*Fundulus diaphanus*	Brook silverside	*Lavidesthes sicculus*

TABLE 3

FISH SPECIES THAT MAY BE PRESENT IN CATTARAUGUS CREEK

Common Name	Scientific Name	Common Name	Scientific Name
Brook stickleback	*Culaea inconstans*	Threespine stickleback	*Culaea aculeatus*
Mottled sculpin	*Cottus bairdi*	Slimy sculpin	*Cottus cognatus*
White bass	*Morone chrysops*	Rock bass	*Ambloplites rupestris*
Pumpkinseed	*Lepomis gibbosus*	Bluegill	*Lepomis macrochirus*
Longear sunfish	*Lepomis megalotis*	Small mouth bass	*Micropterus dolomieui*
Large mouth bass	*Micropterus salmoides*	White crappie	*Pomoxis ammularis*
Black crappie	*Pomoxis migromaculatus*	Eastern sand darter	*Ammocrypta pellucida*
Greenside darter	*Etheostoma blennioides*	Rainbow darter	*Etheostoma caeruleum*
Fantail darter	*Etheostoma flavellare*	Johnny darter	*Etheostoma nigrum*
Logperch	*Percina caprodes*	Channel darter	*Percina copelandii*
Blackside darter	*Percina maculata*	Yellow perch	*Perca flavescens*
Walleye	*Stizosedion vitreum*	Freshwater drum	*Aplodimotus grummiens*

Source: Werner, 1980

TABLE 4

HERPTILE SPECIES THAT MAY BE PRESENT BASED ON COVER TYPES

Peter Cooper Site
Gowanda, New York

Common Name	Scientific Name	Habitat Requirements
Eastern toad	*Bufo americanus*	Found in almost any habitat.
Northern spring peeper	*Hyla crucifer*	Second growth woodlots.
Gray treefrog	*Hyla veriscolor*	Forested regions with small trees, shrubs and bushes near or in shallow water. Will breed in roadside ditches.
Green frog[a]	*Rana clamitans*	Margins of shallow permanent water.
Northern leopard frog	*Rana pipiens*	Commonly ofund in wet open fields and woods.
Marbled salamander	*Ambystoma opacum*	Sandy and gravelly areas of mixed deciduous woodlands, especially oak-maple and oak-hickory.
Spotted salamander	*Ambystoma maculatum*	Found in moist woods, streambanks, beneath stones, logs and boards.
Red-spotted newt	*Notophthalmus viridescens*	Adults found in water with abundant submerged vegetation including lakes marshes, ditches, backwaters. Terrestrial juveniles live in moist areas on land.
Redback salamander	*Plethodon cinerus*	Entirely terrestrial. Mixed deciduous or coniferous woods, inhabiting interiors of decaying logs and stumps.
Northern two-lined salamander	*Euryce bislineata*	Along brooks and streams. Found under objects at water's edge in moist soil.
Northern dusky salamander	*Desognathus fuscus*	Woodlands at the margins of running wter.
Common snapping turtle	*Chelydra serpentina*	Bottom dweller in any permanent body of fresh o brackish water.
Eastern painted turtle	*Chrysemys picta*	Quiet, shallow ponds and marshes. Sometimes in brackish tidal waters and salt marshes.
Spotted turtle	*Clemmys guttata*	Small shallow bodies of water including roadside ditches and brackish tidal creeks.
Eastern box turtle	*Terrapene carolina*	Typically found in well-drained forest bottomlands.
Red-eared slider	*Pseudemys scripta*	Ponds, shallow areas of lakes, creeks and drainage ditches.
Eastern painted turtle	*Chrysemys picta*	Quiet shallow ponds.
Northern water snake	*Nerodia sipedon*	Inhabits salt or fresh water. Common around spillways and bridges.
Northern brown snake	*Storeria dekayi*	Ubiquitous.
Northern ringneck snake	*Diadophis punctatus*	Secretive. Found hiding in stony woodland pastures, rocks, stone walls, junk piles, logs, debris, stumps and logs.
Northern black racer	*Coluber constrictor*	Moist or dry areas, forests and wooded areas, fields, roadsides, near old buildings.
Eastern smooth green snake	*Opheodrys vernalis*	Upland areas, grassy fields.
Eastern worm snake	*Carpophis amoenus*	Dry to moist forests, often near streams, in the loose soil of gardens or weedy pastures. Sandy areas are favored.

TABLE 4

HERPTILE SPECIES THAT MAY BE PRESENT BASED ON COVER TYPES

Common Name	Scientific Name	Habitat Requirements
Black rat snake	*Elape obsoleta*	Thickets, woodland edges, farmlands.
Eastern ribbon snake	*Thamnophis sauritus*	Semiaquatic, inhabiting stream edges and ditches.
Eastern garter snake	*Thamnophis srtalis*	Ubiquitous.
Eastern hognose snake	*Heterodon platyrhinos*	Where sandy soils predominate, such as beaches, open fields, dry open woods.
Eastern milk snake	*Lampropeltis triangulum*	Various habitats, usually with brushy or woody cover.

Source: Degraf and Rudis, 1983; Conat and Collins, 1975

TABLE 5

BIRD SPECIES THAT MAY BE PRESENT BASED ON COVER TYPES

Peter Cooper Site
Gowanda, New York

Common Name	Scientific Name	Habitat Requirements
Great blue heron	*Ardea herodias*	Shallow shores of ponds, lakes, streams, fresh marshes
Green heron	*Butorides virescens*	Makes use of nearly all fresh and salt water habitats.
Sharp-shined hawk	*Accipter striatus*	Open woodlands, edges and clearings
Red-tailed hawk	*Buteo jamaicensis*	Deciduous and mixed woodlands interspersed with meadows
Turkey vulture[a]	*Cathartes aura*	Various habitats including wet, dry, open, and wooded
Killdeer[a]	*Charadrius vociferus*	Fields, roadsides lawns.
American kestrel	*Falco sparverius*	Open areas, forest edges, cities.
Spotted sandpiper	*Actitis macularia*	Breeding in the vicintiy of fresh water in dry pastures or fields.
Ruffed grouse	*Bonasa umbellus*	Areas wih dense woody cover.
Rock dove	*Columbia livia*	Near human habitation.
Mourning dove	*Zenaida macroura*	Suburbs, cities, open woodlands.
Eastern screech owl	*Otus asio*	Shade trees in suburbs.
Great horned owl	*Bubo virginianus*	Woodlands near large streams
Barred owl	*Strix varia*	Low, wet woodlands
Common nighthawk	*Chordeiles minor*	Cites, open areas.
Chiney swift	*Chaetura pelagica*	Buildings, cities.
Ruby-throated hummingbird	*Archilochus colubris*	Shade trees in residential landscapes.
Belted kingfisher[a]	*Ceryle alcyon*	Near water containing fish.
Pileated woodpecker	*Dryocopus pileatus*	Extensive second growth woodlands.
Downy woodpecker[a]	*Picoides pubescens*	Shade trees in towns and suburbs.
Hairy woodpecker	*Picoides villosus*	Open coniferous, deciduous and mixed woodlots
Northern flicker	*Colaptes auratus*	Suburbs, woodland edges.
Eastern wood peewee	*Contopus virens*	Roadsides, parks. Closely associated with oaks.
Eastern phoebe[a]	*Sayornis phoebe*	Suburban areas.
Great crested flycatcher	*Myiarchus crinitus*	Edges of deciduous woodlands
Eastern kingbird	*Tyrannus tyrannus*	Forest edges, fields, pastures.
Purple martin	*Progne subis*	Suburban areas near water.
Blue jay[a]	*Cyanocitta cristata*	Suburbs, cities, parks and gardens.
American crow[a]	*Corvus brachyrhynchos*	Edges of woodlots, coastal areas.
Black-capped chickadee[a]	*Parus atricapilus*	Residential areas, woodlands.
Tufted titmouse	*Parus bicolor*	Residential areas in shade trees.
White-breasted nuthatch	*Sitta carolinensis*	Shade trees in villages.

TABLE 5

BIRD SPECIES THAT MAY BE PRESENT BASED ON COVER TYPES

Common Name	Scientific Name	Habitat Requirements
House wren	*Troglodytes aedon*	Near human dwellings.
American robin	*Turdus migratorius*	Shade trees in residnetial areas.
Gray catbird[a]	*Dumetella carolinensis*	Shrubbery around buildings.
Cedar waxing	*Bombycilla cedrorum*	Shade trees in residential areas.
Red-winged blackbird	*Agelaius phoeniceus*	Swamps and marshes.
Common grackle	*Quiscalus quiscula*	Suburbs.
Northern oriole	*Icterus galbula*	Shade trees in residential areas.
Purple finch	*Carpodacus purpureus*	Residential areas.
House finch	*Carpodacus mexicanus*	Suburban and urban yards.
American goldfinch	*Cardeulis tristis*	Suburban gardens, shade trees.
Starling	*Sturnus vulgaris*	Cities, gardens, parks.
Yellow warbler	*Dendroica petechia*	Farmlands and roadsides.
American redstart	*Mniotilta varia*	Shade trees near dwellings.
Common yellowthroat	*Geothlypis trichas*	Fresh or salt water marshes.
Blue-winged warbler	*Vermivora pinus*	Edges of woods, brushy overgrown fields.
Nashville warbler	*Vermivora ruficapilla*	Moist open deciduous woods.
Chestnut-sided warbler	*Dendroica pensylvanica*	Second growth woodland edges.
Ovenbird	*Seiurus aurocapillus*	Mature deciduous woodlands.
Mourning warbler	*Oporornis philadelphia*	Dense underbrush.
Hooded warbler	*Wilsonia citrina*	Brushy, swampy lowlands.
Northern cardinal	*Cardinalis cardinalis*	Suburban gardens.
Rose-breasted grosbeak	*Pheucticus ludovicianus*	Shade trees in suburban areas.
House sparrow	*Passer domesticus*	Cities, parks.
Chipping sparrow	*Spizella paserina*	Suburban residential areas.
Field sparrow	*Spizella pusilla*	Briar thickets, old fields.
Song sparrow[a]	*Melospiza melodia*	Suburbs, cities.
Swamp sparrow	*Melospiza georgiana*	Marshes, swamps, bogs.
Brown-headed cowbird	*Molothrus ater*	Open coniferous and deciduous woodlands.
Eastern towhee	*Pipilo erythrophthalmus*	Woodland edges.
Scarlet tanager	*Piranga olivacea*	Roadside shade trees, mixed woodlands.
Indigo bunting	*Passerina cyanea*	Edges of woods.
Bobolink	*Dolichonyx oryzivorus*	Hayfields, meadows, marshes.
Brown thrasher	*Toxostoma rufum*	Woodland edges. Often in cities.
Veery	*Catharus fuscescens*	Low moist deciduous woods.
Hermit thrush	*Catharus fuscescens*	Lowlands in wooded swamps.
Wood thrush	*Hylocichla mustelina*	Mature lowland forest.
Barn swallow	*Hirundo rustica*	Man-made structures for nesting.
Northern rough-winged	*Stelgidopteryx serripennis*	Nearly any open area with nest sites.

TABLE 5

BIRD SPECIES THAT MAY BE PRESENT BASED ON COVER TYPES

Common Name	Scientific Name	Habitat Requirements
swallow		
Tree swallow	*Tachycineta bicolor*	Farmlands, river bottomlands.
Bank swallow	*Riparia riparia*	Riverbnks, gravel pits.
Cliff swallow	*Petrochelidon pyrrhonota*	Farmlands, villages, cliffs, bridges.
Red-eyed vireo	*Vireo olivaceus*	Open deciduous and second-growth woodlands.
Eastern kingbird	*Tyrannus tyrannus*	Shrubby borders, forest edges.
Great-crested flycatcher	*Myiarchus crinitus*	Forest edges.
Willow flycatcher	*Empidonax traillii*	Open, newly clear cut areas.
Acadian flycatcher	*Empidonax virescens*	Deciduous woodlands.
Black-billed cuckoo	*Coccyzus erythropthalmis*	Shrubby hedgerows.
Yellow-billed cuckoo	*Coccyzus americnus*	Open woods, overgrown weedy fields.
Northern bobwhite	*Colinus virginianus*	Open fields of grass.
Ring-necked pheasant	*Phasianus colchicus*	Meadows with abundant weedy growth.

Source: Degraf and Rudis, 1983; NYSDEC, 2000.

[a]Species observed during field reconnaissance.

TABLE 6

MAMMALS THAT MAY POTENTIALLY BE PRESENT BASED ON COVER TYPES

Peter Cooper Site
Gowanda, New York

Common Name	Scientific Name	Habitat Requirements
Virginia opossum	*Didlphis virginiana*	Near human habitation.
Masked shrew	*Sorex cinereus*	Damp deciduous woodlands with grass.
Least shrew	*Cryptosis parva*	Salt marshes, woodland edges.
Northern short-tailed shrew	*Blarina brevicauda*	Both timbered and fairly open habitats
Eastern moles	*Scalopus aquaticus*	Lawns, sandy soils.
Star-nosed moles	*Condylura cristata*	Prefers low wet ground.
Keen's myotis	*Myotis keenii*	Barns, attics, tree cavities.
Little brown myotis	*Myotis lucifugus*	Dark warm sites for materinity colonies.
Big brown bat	*Eptesicus fuscus*	Buildings, bridges, tunnels.
Eastern cottontail[a]	*Sylvilagus floridanus*	Suburban areas wit adequate food and cover.
Eastern chipmunk[a]	*Tamias striatus*	Tree or shrub cover with elevated perches.
Woodchuck	*Marmota monax*	Edges of woodlands, open cultivated land, meadows, open brushy hillsides.
Gray squirrel	*Sciurus carolinensis*	Suburban parks, shade trees especially oaks.
Red squirrel	*Tamiascuirus hudsonicus*	Rural woodlands.
Deer mouse	*Peromyscus maniculatus*	Near out-buildings in shrubs.
White-footed mouse	*Peromyscus leucopus*	Edges of woodlands.
Meadow vole	*Microtus pennsylvanicus*	Freshwater and salt water marshes.
Norway rat	*Rattus morevegicus*	Buildings, dumps, cities.
House mouse	*Mus musculus*	Buildings.
Meadow jumping mouse	*Zapus hudsonius*	Moist, open grassy and brushy marshes and meadows.
Woodland jumping mouse	*Mapaeozapus insignis*	Areas with herbaceous groundcover and low woody plants.
Coyote	*Canis latrans*	Edges of second growth forests.
Red fox	*Vulpes vulpes*	Found in a variety of habitats. A mixure of forest and open areas is preferred.
Mink	*Mustela vison*	Streambanks.
Long-tailed weasel	*Mustela frenata*	Open woods and woodland edges.
Ermine	*Mustela erminea*	Open country with thickets, rock piles or other heavy cover.
White-tailed deer[a]	*Odocoileus virginianus*	Forest edges, swamp borders, areas interspersed with fields and woodlands.
Raccoon[a]	*Procyon lotor*	Found in wetlands near human habitation.
Striped skunk	*Mephitis mephitis*	Suburban areas.

Source: Degraf and Rudis, 1983

[a]Species observed during field reconnaissance

TABLE 7
SURFACE SOIL DATA
Peter Cooper Site
Gowanda, New York

		Inactive Landfill Area Soil		Former Manufacturing Plant Area Soil	
Parameter	**USEPA Soil Screening Values**	**Frequency of Detection**	**Range of Detected Concentrations**	**Frequency of Detection**	**Range of Detected Concentrations**
Volatile Organic Compounds (µg/kg)					
Acetone		0/20	—	10/11	45-1400
Benzene		13/20	1.6-5.1	9/11	1.6-9.5
2-Butanone		0/20	—	9/11	5.7-280
Carbon disulfide		0/20	—	9/11	2.3-72
Carbon tetrachloride		0/20	—	1/11	10000
Chloroform		0/20	—	1/11	5700
Cyclohexane		0/20	—	9/11	3-470
1,2-Dichlorobenzene		0/20	—	1/11	4.9
1,4-Dichlorobenzene		0/20	—	2/11	1.7-4.6
1,3-Dichlorobenzene		0/20	—	1/11	4.3
1,1-Dichloroethane		0/20	—	1/11	160
1,2-Dichloroethane		0/20	—	1/11	240
cis-1,2-Dichloroethene		0/20	—	1/11	260
Ethylbenzene		4/20	1.2-1.8	1/11	5.7
2-Hexanone		0/20	—	2/11	25-64
Isopropylbenzene		0/20	—	1/11	1.7
Methyl Acetate		0/20	—	2/11	4.8-210
Methylcyclohexane		0/20	—	10/11	2.1-1600
4-Methyl-2-pentanone		0/20	—	2/11	5-39
Styrene		0/20	—	1/11	2.9
Tetrachloroethene		0/20	—	5/11	2.3-54000
Toluene		14/20	1.6-10	10/11	2.3-380
1,2,4-Trichlorobenzene		0/20	—	2/11	9.3-360
1,1,1-Trichloroethane		0/20	—	2/11	6.4-5500
Trichloroethene		0/20	—	2/11	3.6-510
M&P-Xylene		12/20	1.6-6	8/11	3-520
O-Xylene		6/20	1.5-2.8	7/11	0.98-420
Semivolatile Organic Compounds (µg/kg)					
Acenaphthane		NA	—	3/11	160-2600
Acenaphthylene		NA	—	2/11	290-400
Anthracene		NA	—	9/11	40-14000
Benzo(a)anthracene		NA	—	9/11	110-24000
Benzo(a)pyrene		NA	—	9/11	87-20000
Benzo(b)fluoranthene		NA	—	9/11	79-15000
Benzo(g,h,i)perylene		NA	—	8/11	110-14000
Benzo(k)fluoranthene		NA	—	9/11	90-18000
Carbazole		NA	—	3/11	44-3500
Indeno(cd-1,2,3)pyrene		NA	—	9/11	43-13000
Chrysene		NA	—	9/11	140-22000
Dibenzo(a,h)anthracene		NA	—	7/11	51-5200
Dibenzofuran		NA	—	4/11	55-2200
bis(2-Ethylhexyl)phthalate		NA	—	2/11	68-69
Flouranthene		NA	—	9/11	260-60000
Fluorene		NA	—	3/11	170-4200
2-Methylnaphthalene		NA	—	5/11	79-180
4-Methylphenol		NA	—	1/11	59
Naphthalene		NA	—	6/11	44-110
Phenanthrene		NA	—	9/11	140-45000
Pyrene		NA	—	9/11	220-44000

TABLE 7
SURFACE SOIL DATA
Peter Cooper Site
Gowanda, New York

		Inactive Landfill Area Soil		Former Manufacturing Plant Area Soil	
Parameter	**USEPA Soil Screening Values**	**Frequency of Detection**	**Range of Detected Concentrations**	**Frequency of Detection**	**Range of Detected Concentrations**
Inorganic Compounds (mg/kg)					
Aluminum		NA	—	11/11	2010-8280
Arsenic	37	20/20	4-919	11/11	6.6-168
Barium		NA	—	11/11	58.4-117
Beryllium		NA	—	3/11	0.64-1.2
Cadmium	29	NA	—	1/11	1.6
Chromium	5	20/20	10.6-550	11/11	9-198
Cobalt	32	NA	—	10/11	6.1-8.2
Copper	61	NA	—	11/11	20.2-171
Iron		NA	—	11/11	12600-31300
Lead		NA	—	11/11	8.2-269
Manganese		NA	—	11/11	64.7-489
Mercury		NA	—	8/11	0.08-3.1
Nickel		NA	—	11/11	13.1-27.2
Selenium		NA	—	11/11	0.95-2.7
Vandium		NA	—	11/11	12.8-20.2
Zinc	120	20/20	46.9-165	11/11	45.6-728

Notes:
NA = Not Analyzed
Source: USEPA 2000, Draft Ecological Screening Level Guidance
All detected contaminants are evaluated for ecological risk.

TABLE 8
COMPARISON OF SURFACE WATER DATA TO SCREENING CRITERIA
Peter Cooper Site
Gowanda, New York

		Creek Surface Water					Seeps			
Parameter	NYSDEC Surface Water Criteria	Frequency of Detection	Range of Detected Concentrations	Upstream Concentration [a]	Below Criteria?	EPC	Frequency of Detection	Range of Detected Concentrations	Below Criteria?	EPC
Volatile Organic Compounds (µg/l)										
Acetone		3/5	3.2-4	3.5	no	4	0/6	---	yes	---
cis-1,2-Dichloroethene		1/5	2.7	2.7	no	2.7	0/6	---	yes	---
Toluene	100	0/5	---	---	yes	---	4/6	2-3.5	yes	---
Semi-Volatile Organic Compounds (µg/l)										
Phenol	5	0/5	---	---	yes	---	2/6	1.8-1.8	yes	
Inorganic compounds (µg/l)										
Arsenic	150	0/10	---	---	yes	---	6/6	31.4-71	yes	
Barium		5/5	61.8-69.3	64.1	no	69.3	0/6	---	yes	---
Chromium*	128/422	0/10	---	---	yes	---	6/6	94.9-423	no	423
Iron	300	10/10	126-470	390	no	470	5/6	123-28600	no	28,600
Manganese		10/10	11.5-21.6	16.1	no	21.6	0/6	---	yes	---
Zinc*	146/502	0/10	---	---	yes	---	1/6	74.7	yes	---

Notes:
Source: NYSDEC 1998a, Technical and Operational Guidance Series 1.1.1
a - Upsteam concentration used as location for local background conditions of surface water
* Hardness dependant criteria; hardness values of 195 and 836 used for the creek and seeps, respectively. The first value in column represent criteria for the creek. The second value represents criteria for the seeps.

302660

TABLE 9
SEDIMENT DATA
Peter Cooper Site
Gowanda, New York

	NYSDEC Sediment Criteria	Wetland Sediment		Creek Sediment		Upstream Conc.[a]
		Freq. of Detection	Range of Detected Concentrations	Frequency of Detection	Range of Detected Concentrations	
Volatile Organic Compounds (µg/kg)						
Acetone		0/11	---	5/5	19-78	24
Benzene		11/11	2.6-8.5	4/5	1.4-2.5	---
2-Butanone		0/11	---	1/5	9.5	---
Carbon Disulfide		0/11	---	5/5	10-25	10
Cyclohexane		0/11	---	4/5	2.2-4.5	---
cis-1,2-Dichlorethene		0/11	---	1/5	3.5	---
Ethylbenzene		6/11	0.94-3.4	0/5	---	---
Methylcyclohexane		0/11	---	4/5	3.3-7.2	---
4-Methyl-2-pentanone		0/11	---	1/5	2.5	---
Toluene		11/11	4.1-18	5/5	4.1-6.8	5.9
M&P-Xylene		9/11	4.4-15	4/5	1.5-2.7	---
O-Xylene		8/11	1.3-4.4	0/5	---	---
Inorganic Compounds (mg/kg)						
Aluminum		NA	---	5/5	4820-6160	4820
Arsenic	6	11/11	5.2-16.3	5/5	6.3-9.6	7.2
Barium		NA	---	5/5	31.5-41.4	31.5
Chromium	26	11/11	6.5-55.3	5/5	6.3-8.6	6.3
Cobalt		NA	---	3/5	6.1-7.5	0
Copper	16	NA	---	5/5	11.3-15.3	13.7
Iron	20000	NA	---	5/5	14400-18400	14400
Lead	31	NA	---	5/5	7.3-9.8	7.9
Manganese	460	NA	---	5/5	246-401	250
Nickel	16	NA	---	5/5	12.6-18.2	12.6
Selenium		NA	---	3/5	0.71-1.1	1.1
Vanadium		NA	---	5/5	10.9-123	10.9
Zinc	120	11/11	45.7-290	5/5	39.2-52.8	39.2

Notes:
a - Upsteam concentration used as location for local background conditions of sediment
NA = Not Analyzed
Source: NYSDEC 1998b, Technical Guidance for Screening Contaminated Sediments, lowest effect level used.

TABLE 10
PHYSICAL-CHEMICAL PROPERTIES OF PRINCIPAL CHEMICAL CONSTITUENTS
Peter Cooper Site
Gowanda, New York

Chemical Name	CAS Number	Molecular Weight (g/mole)	Physical State at 20° C	Water Solubility (mg/l)	Ref.	Henry's Law Constant (atm-m^3/mol)	Ref.	K_{oc} (L/kg)	Ref.	Log K_{ow}	Ref.
Volatile Organic Compounds											
Acetone	67-64-1	58.1	Liquid	4.24E+00	A	3.88E-05	A	5.75E-01	A	-0.24	A
Benzene	71-43-2	78.1	Liquid	1.75E+03	A	5.55E-03	A	5.89E+01	A	2.13	A
2-Butanone	78-93-3	72.1	Liquid	2.56E+05	B	5.59E-05	C			0.29	C
Carbon Disulfide	75-15-0	76.1	Liquid	1.19E+03	A	3.03E-02	A	4.57E+01	A	2.00	A
Carbon tetrachloride	56-23-5	153.8	Liquid	7.93E+02	A	3.04E-02	A	1.74E-02	A	2.73	A
Chloroform	67-66-3	119.4	Liquid	7.92E+03	A	3.67E-03	A	3.98E+01	A	1.92	A
Cyclohexane	100-82-7	84.2	Liquid	5.50E+02	C	1.95E-01	C			3.44	C
1,2-Dichlorobenzene	95-50-1	147.0	Liquid	1.56E+02	A	1.90E-03	A	6.17E+02	A	3.43	A
1,3-Dichlorobenzene	541-73-1	147.0	Liquid	1.32E+02	C	3.10E-03	C			3.60	C
1,4-Dichlorobenzene	106-46-7	147.0	Solid	7.38E+01	A	2.43E-03	A	6.17E+02	A	3.42	A
1,1-Dichloroethane	75-34-3	98.9	Liquid	5.06E+03	A	5.62E-03	A	3.16E+01	A	1.79	A
1,2-Dichloroethane	107-06-2	98.9	Liquid	8.52E+03	A	9.79E-04	A	1.74E+01	A	1.47	A
cis-1,2-dichloroethene	156-59-2	96.9	Liquid	3.50E+03	A	4.08E-03	A	3.55E+01	A	1.86	A
Ethylbenzene	100-41-4	106.2	Liquid	1.69E+02	A	7.88E-03	A	3.63E+02	A	3.14	A
2-Hexanone	591-78-6	100.2	Liquid	1.40E+00	B					1.38	C
Isopropylbenzene	98-82-8	120.2	Liquid	4.99E+01	C	1.16E+00	C			3.66	C
Methyl acetate	79-20-9	74.1	Liquid	2.44E+05	C	1.15E-04	C			0.18	C
Methylcyclohexane	108-87-2	98.2	Liquid								
4-Methyl-2-penanone	108-10-1	100.2	Liquid	1.90E+04	B	1.38$-04	C			1.19	C
Styrene	100-42-5	104.2	Liquid	3.10E+02	A	2.75E-03	A	7.76E+02	A	2.94	A
Tetrachloroethene	127-18-4	165.8	Liquid	2.00E+02	A	1.84E-02	A	1.55E-02	A	2.67	A
Toluene	108-88-3	92.1	Liquid	5.26E+02	A	6.64E-03	A	1.82E+02	A	2.75	A
1,2,4-Trichlorobenzene	120-82-1	181.4	Liquid	3.00E+02	A	1.42E-03	A	1.78E+03	A	4.01	A
1,1,1-Trichloroethane	71-55-6	133.4	Liquid	1.33E+03	A	1.72E-02	A	1.10E+02	A	2.48	A
Trichloroethene	79-01-6	131.4	Liquid	1.10E+03	A	1.03E-02	A	1.66E+02	A	2.71	A
o-Xylene	95-47-6	106.2	Liquid	1.78E+02	A	5.19E-03	A	3.63E+02	A	3.13	A
m-Xylene	108-42-3	106.2	Liquid	1.61E+02	A	7.34E-03	A	4.07E+02	A	3.20	A
p-Xylene	106-42-3	106.2	Liquid	1.85E+02	A	7.66E-03	A	3.89E+02	A	3.17	A
Semi-Volatile Organic Compounds											
2-Methylnaphthalene	91-57-6	142.2	Solid	2.46E+01	B	5.18E-04	C			3.86	C
4-Methylphenol	106-44-5	108.1	Solid	2.15E+05	C	7.92E-07	C			1.94	C
Acenaphthene	83-32-9	154.2	Solid	4.24E+00	A	1.55E-04	A	7.08E+03	A	3.92	A

TABLE 10
PHYSICAL-CHEMICAL PROPERTIES OF PRINCIPAL CHEMICAL CONSTITUENTS

Chemical Name	CAS Number	Molecular Weight (g/mole)	Physical State at 20° C	Water Solubility (mg/l)	Ref.	Henry's Law Constant (atm-m^3/mol)	Ref.	K_{oc} (L/kg)	Ref.	Log K_{ow}	Ref.
Acenaphthylene	208-96-8	152.2	Solid	3.93E+00	B	1.13E-04	C			4.07	C
Anthracene	120-12-7	178.2	Solid	4.34E-02	A	6.50E-05	A	2.95E+04	A	4.55	A
Benzo(a)anthracene	56-55-3	228	Solid	9.40E-03	A	3.35E-06	A	3.98E+05	A	5.70	A
Benzo(a)pyrene	50-32-8	252.3	Solid	1.62E-03	A	1.13E-06	A	1.02E+06	A	6.11	A
Benzo(b)fluoranthene	205-99-2	252	Solid	1.50E-03	A	1.11E-04	A	1.23E+06	A	6.20	A
Benzo(k)fluoranthene	207-08-9	252	Solid	8.00E-04	A	8.29E-07	A	1.23E+06	A	6.20	A
Benzo (ghi)perylene	191-24-2	276	Solid	2.6E-04	B	1.41E-07	C			6.58	C
bis(2-ethylhexyl)phthalate	117-81-7	390.6	Liquid	3.40E-01	A	1.02E-07	A	1.51E+07	A	7.30	A
Carbazole	86-74-8	167.2	Solid	7.48E+00	A	1.53E-08	A	3.39E+03	A	3.59	A
Chrysene	218-01-9	228.2	Solid	1.60E-03	A	9.46E-05	A	3.98E+05	A	5.70	A
Dibenzo(a,h)anthracene	53-70-3	278.4	Solid	2.49E-03	A	1.47E-08	A	3.80E+06	A	6.69	A
Dibenzofuran	132-64-9	168.2	Solid	3.10E+00	C	1.26E-05	C			4.12	C
Fluoranthene	206-44-0	202	Solid	2.06E-01	A	1.61E-05	A	1.07E+05	A	5.12	A
Fluorene	86-73-7	116	Solid	1.98E+00	A	6.36E-05	A	1.38E+04	A	4.21	A
Indeno(1,2,3-cd)pyrene	193-39-5	276.3	Solid	2.20E-05	A	1.60E-06	A	3.47E+06	A	6.65	A
Naphthalene	91-20-3	128.2	Solid	3.10E+01	A	4.83E-04	A	2.00E+03	A	3.36	A
Phenanthrene	85-01-8	178.2	Solid	1.15E+00	C	2.28E-05	C			4.57	C
Pyrene	129-00-0	202.3	Solid	1.35E-01	A	1.10E-05	A	1.05E+05	A	5.11	A

Notes:

A – USEPA, 1996, Soil Screening Guidance: Fact Sheet, Office of Solid Waste and Emergency Response, EPA/540/F-95/041, Washington, D.C.
B – www.chemfinder.com
C - http://esc_plaza.syrres.com/efdb/Chemfate.htm

TABLE 11
PLANT AND INVERTEBRATE EXPOSURE POINT CONCENTRATIONS
Peter Cooper Site
Gowanda, New York

Parameter	Plant Uptake Factors	Earthworm BAF	Landfill Area			Manufacturing Area			Combined Soil			Wetland Area		Creek	
			Soil EPC (mg/kg)	Plant EPC (mg/kg)	Earthworm EPC (mg/kg)	Soil EPC (mg/kg)	Plant EPC (mg/kg)	Earthworm EPC (mg/kg)	Soil EPC (mg/kg)	Plant EPC (mg/kg)	Earthworm EPC (mg/kg)	Sediment EPC (mg/kg)	Plant EPC (mg/kg)	Sediment EPC (mg/kg)	Plant EPC (mg/kg)
Volatile Organic Compounds															
Acetone	2.36E+02	9.35E-01				1.40E+00	3.30E+02	1.31E+00	1.40E+00	3.30E+02	1.31E+00			7.80E-02	1.84E+01
Benzene	3.35E-05	9.35E-01	5.10E-03	1.71E-07	4.77E-03	9.50E-03	3.18E-07	8.89E-03	9.50E-03	3.18E-07	8.89E-03	8.50E-03	2.85E-07	2.50E-03	8.37E-08
2-Butanone	3.34E+01	9.35E-01				2.80E-01	9.36E+00	2.62E-01	2.80E-01	9.36E+00	2.62E-01			9.50E-03	3.18E-01
Carbon disulfide	2.26E-04	9.35E-01				7.20E-02	1.63E-05	6.73E-02	7.20E-02	1.63E-05	6.73E-02			2.50E-02	5.66E-06
Carbon tetrachloride	1.06E-20	9.35E-01				1.00E+01	1.06E-19	9.35E+00	1.00E+01	1.06E-19	9.35E+00				
Chloroform	6.26E-04	9.35E-01				1.56E+00	9.78E-04	1.46E+00	1.56E+00	9.78E-04	1.46E+00				
Cyclohexane	1.06E-04	9.35E-01				4.71E+00	4.98E-04	4.40E+00	4.71E+00	4.98E-04	4.40E+00			4.50E-03	4.76E-07
1,2-Dichlorobenzene	9.14E-05	9.35E-01				4.90E-03	4.48E-07	4.58E-03	4.90E-03	4.48E-07	4.58E-03				
1,4-Dichlorobenzene	7.89E-05	9.35E-01				4.60E-03	3.63E-07	4.30E-03	4.60E-03	3.63E-07	4.30E-03				
1,3-Dichlorobenzene	8.45E-04	9.35E-01				4.30E-03	3.63E-06	4.02E-03	4.30E-03	3.63E-06	4.02E-03				
1,1-Dichloroethane	2.69E-03	9.35E-01				1.60E-03	4.31E-06	1.50E-03	1.60E-03	4.31E-06	1.50E-03				
1,2-Dichloroethane	4.81E-02	9.35E-01				2.40E-01	1.16E-02	2.24E-01	2.40E-01	1.16E-02	2.24E-01				
cis-1,2-Dichloroethene	1.26E-03	9.35E-01				2.60E-01	3.28E-04	2.43E-01	2.60E-01	3.28E-04	2.43E-01			3.50E-03	4.41E-06
Ethylbenzene	3.62E-07	9.35E-01	1.80E-03	6.52E-10	1.68E-03	5.70E-03	2.06E-09	5.33E-03	5.70E-03	2.06E-09	5.33E-03	3.40E-03	1.23E-09		
2-Hexanone	9.51E-02	9.35E-01				6.40E-02	6.09E-03	5.99E-02	6.40E-02	6.09E-03	5.99E-02				
Isopropylbenzene (cumene)	1.67E-03	9.35E-01				1.70E-03	2.83E-06	1.59E-03	1.70E-03	2.83E-06	1.59E-03				
Methyl Acetate	5.18E+01	9.35E-01				2.10E-01	1.09E+01	1.96E-01	2.10E-01	1.09E+01	1.96E-01				
Methylcyclohexane	1.00E+00	9.35E-01				1.60E+00	1.60E+00	1.50E+00	1.60E+00	1.60E+00	1.50E+00			7.20E-03	7.20E-03
4-Methyl-2-pentanone	3.49E-01	9.35E-01				3.90E-02	1.36E-02	3.65E-02	3.90E-02	1.36E-02	3.65E-02			2.50E-03	8.73E-04
Styrene	2.92E-10	9.35E-01				2.90E-03	8.47E-13	2.71E-03	2.90E-03	8.47E-13	2.71E-03				
Tetrachloroethene	3.21E-14	9.35E-01				5.40E+01	1.74E-12	5.05E+01	5.40E+01	1.74E-12	5.05E+01				
Toluene	5.77E-29	9.35E-01	1.00E-02	5.77E-31	9.35E-03	2.30E-03	1.33E-31	2.15E-03	1.00E-02	5.77E-31	9.35E-03	1.80E-02	1.04E-30	6.80E-03	3.92E-31
1,2,4-Trichlorobenzene	4.28E-02	9.35E-01				3.60E-01	1.54E-02	3.37E-01	3.60E-01	1.54E-02	3.37E-01				
1,1,1-Trichloroethane	7.78E-09	9.35E-01				5.50E+00	4.28E-08	5.14E+00	5.50E+00	4.28E-08	5.14E+00				
Trichloroethene	2.23E-17	9.35E-01				5.10E-01	1.14E-17	4.77E-01	5.10E-01	1.14E-17	4.77E-01				
M&P-Xylene	1.50E-06	9.35E-01	6.00E-03	9.01E-09	5.61E-03	5.20E-01	7.81E-07	4.86E-01	5.20E-01	7.81E-07	4.86E-01	1.50E-02	2.25E-08	2.70E-03	4.05E-09
O-Xylene	2.80E-07	9.35E-01	2.80E-03	7.83E-10	2.62E-03	4.20E-01	1.17E-07	3.93E-01	4.20E-01	1.17E-07	3.93E-01	4.40E-03	1.23E-09		
Semivolatile Organic Compounds															
Acenaphthene	2.05E-02	9.35E-01				2.60E+00	5.32E-02	2.43E+00	2.60E+00	5.32E-02	2.43E+00				
Acenaphthylene	6.82E-02	9.35E-01				4.00E-01	2.73E-02	3.74E-01	4.00E-01	2.73E-02	3.74E-01				
Anthracene	1.51E+00	9.35E-01				1.40E+01	2.11E+01	1.31E+01	1.40E+01	2.11E+01	1.31E+01				
Benzo(a)anthracene	2.10E+02	9.35E-01				2.40E+01	5.03E+03	2.24E+01	2.40E+01	5.03E+03	2.24E+01				
Benzo(a)pyrene	7.69E+02	9.35E-01				2.00E+01	1.54E+04	1.87E+01	2.00E+01	1.54E+04	1.87E+01				
Benzo(b)fluoranthene	1.00E+03	9.35E-01				1.50E+01	1.50E+04	1.40E+01	1.50E+01	1.50E+04	1.40E+01				
Benzo(g,h,i)perylene	2.85E+03	9.35E-01				1.40E+01	3.98E+04	1.31E+01	1.40E+01	3.98E+04	1.31E+01				
Benzo(k)fluoranthene	1.00E+03	9.35E-01				1.80E+01	1.80E+04	1.68E+01	1.80E+01	1.80E+04	1.68E+01				
Carbazole	7.51E-04	9.35E-01				3.50E+00	2.63E-03	3.27E+00	3.50E+00	2.63E-03	3.27E+00				
Indeno(cd-1,2,3)pyrene	3.41E+03	9.35E-01				1.30E+01	4.43E+04	1.22E+01	1.30E+01	4.43E+04	1.22E+01				
Chrysene	2.10E+02	9.35E-01				2.20E+01	4.61E+03	2.06E+01	2.20E+01	4.61E+03	2.06E+01				
Dibenzo(a,h)anthracene	3.78E+03	9.35E-01				5.20E+00	1.96E+04	4.86E+00	5.20E+00	1.96E+04	4.86E+00				
Dibenzofuran	9.88E-02	9.35E-01				2.20E+00	2.17E-01	2.06E+00	2.20E+00	2.17E-01	2.06E+00				
bis(2-Ethylhexyl)phthalate	1.59E+04	9.35E-01				6.90E-02	1.10E+03	6.45E-02	6.90E-02	1.10E+03	6.45E-02				
Flouranthene	2.35E+01	9.35E-01				6.00E+01	1.41E+03	5.61E+01	6.00E+01	1.41E+03	5.61E+01				
Fluorene	1.86E-01	9.35E-01				4.20E+00	7.83E-01	3.93E+00	4.20E+00	7.83E-01	3.93E+00				
2-Methylnaphthalene	1.21E-02	9.35E-01				1.80E-01	2.18E-03	1.68E-01	1.80E-01	2.18E-03	1.68E-01				
4-Methylphenol	4.90E-04	9.35E-01				5.90E-02	2.89E-05	5.52E-02	5.90E-02	2.89E-05	5.52E-02				
Naphthalene	3.10E-05	9.35E-01				1.10E-01	3.41E-06	1.03E-01	1.10E-01	3.41E-06	1.03E-01				
Phenanthrene	1.68E+00	9.35E-01				4.50E+01	7.58E+01	4.21E+01	4.50E+01	7.58E+01	4.21E+01				
Pyrene	2.26E+01	9.35E-01				4.40E+01	9.92E+02	4.12E+01	4.40E+01	9.92E+02	4.12E+01				
Inorganic Compounds															
Aluminum	4.00E-03	9.35E-01				8.20E+03	3.28E+01	7.67E+03	8.20E+03	3.28E+01	7.67E+03			6.16E+03	2.46E+01
Arsenic	4.80E-02	9.35E-01	9.19E+02	4.41E+01	8.60E+02	1.68E+02	8.06E+00	1.57E+02	9.19E+02	4.41E+01	8.60E+02	1.63E+01	7.82E-01	9.60E+00	4.61E-01
Barium	1.50E-01	9.35E-01				1.17E+02	1.76E+01	1.09E+02	1.17E+02	1.76E+01	1.09E+02			4.14E+01	6.21E+00
Beryllium	1.00E-02	9.35E-01				1.20E+00	1.20E-02	1.12E+00	1.20E+00	1.20E-02	1.12E+00				
Chromium	7.50E-03	9.35E-01	5.50E+02	4.13E+00	5.14E+02	1.98E+02	1.49E+00	1.85E+02	5.50E+02	4.13E+00	5.14E+02	5.53E+01	4.15E-01		
Cobalt	3.00E-02	9.35E-01												7.50E+00	2.25E-01
Copper	4.00E-01	9.35E-01				1.71E+02	6.84E+01	1.60E+02	1.71E+02	6.84E+01	1.60E+02				
Iron	1.00E+00	9.35E-01				3.13E+04	3.13E+04	2.93E+04	3.13E+04	3.13E+04	2.93E+04				

TABLE 11
PLANT AND INVERTEBRATE EXPOSURE POINT CONCENTRATIONS
Peter Cooper Site
Gowanda, New York

Parameter	Plant Uptake Factors	Earthworm BAF	Landfill Area			Manufacturing Area			Combined Soil			Wetland Area		Creek	
			Soil EPC (mg/kg)	Plant EPC (mg/kg)	Earthworm EPC (mg/kg)	Soil EPC (mg/kg)	Plant EPC (mg/kg)	Earthworm EPC (mg/kg)	Soil EPC (mg/kg)	Plant EPC (mg/kg)	Earthworm EPC (mg/kg)	Sediment EPC (mg/kg)	Plant EPC (mg/kg)	Sediment EPC (mg/kg)	Plant EPC (mg/kg)
Lead	4.50E-01	9.35E-01				2.69E+02	1.21E+02	2.52E+02	2.69E+02	1.21E+02	2.52E+02				
Manganese	2.50E-01	9.35E-01				4.89E+02	1.22E+02	4.57E+02	4.89E+02	1.22E+02	4.57E+02				
Mercury	9.00E-01	9.35E-01				3.10E+00	2.79E+00	2.90E+00	3.10E+00	2.79E+00	2.90E+00				
Nickel	6.00E-02	9.35E-01				2.72E+01	1.63E+00	2.54E+01	2.72E+01	1.63E+00	2.54E+01			1.82E+01	1.09E+00
Selenium	2.50E-02	9.35E-01				2.70E+00	6.75E-02	2.53E+00	2.70E+00	6.75E-02	2.53E+00			1.10E+00	2.75E-02
Vandium	5.50E-03	9.35E-01				2.02E+01	1.11E-01	1.89E+01	2.02E+01	1.11E-01	1.89E+01			1.23E+02	6.77E-01
Zinc	1.50E+00	9.35E-01	1.65E+02	2.48E+02	1.54E+02	7.28E+02	1.09E+03	6.81E+02	7.28E+02	1.09E+03	6.81E+02	2.90E+02	4.35E+02		

TABLE 12
FOOD CHAIN MODELING PARAMETERS
Peter Cooper Site
Gowanda, New York

Parameter Name	Units	Value
Molecular Weight	g/mole	Chemical Specific, see Table G7-1
Log octanol-water partition coefficient	unitless	Chemical Specific, see Table G7-1
Henry's law constant	$P.m^3/mol$	Chemical Specific, see Table G7-1
Concentration suspended solids in water	kg/L	1.77E-06 average of anlayzed samples
Concentration of organic carbon in wetland sediments	g/g	0.022 average of anlayzed samples
Concentration of organic carbon in creek sediments	g/g	average of anlayzed samples
Chemical concentration in sediment	g/kg	Chemical Specific, see Table G9-1
Chemical concentration in surface water	g/L	Chemical Specific, see Table G9-1
Body weight		
- fathead minnow	kg	0.00081 median weight value[c]
- smallmouth bass	kg	0.0729 average weight of fish collected[b]
Water temperature	°C	19.97 averaged measured temperature
Water pH	unitless	7.09 average measured pH
Percent Lipid		
- benthos	%	3 used value for polychaetes[a]
- fathead minnow	%	19 used value for fathead minnow[a]
- smallmouth bass	%	3.4 used value for smallmouth bass[a]
Feeding Preferences		
- fathead minnow	%	assumed 100% benthos
- smallmouth bass	%	assumed 100% fathead minnow

[a]source: Gobas, 1993

[b] http://www.dec.state.ny.us/website/dfwmr/corm01sec3.pdf

[c] http://biology.nebrwesleyan.edu/empiricist/research/Ecology/Christchurch/AyscueP_388.html

TABLE 13
BENTHOS AND FISH EXPOSURE POINT CONCENTRATIONS
Peter Cooper Site
Gowanda, New York

	Creek Sediment	Surface Water	Wetland Sediment	Inorganic				Pore Water Concentration (mg/L)		Benthos EPC (mg/kg)		Creek Fish EPC (mg/kg)			
Parameter	EPC (mg/kg)	EPC (mg/L)	EPC (mg/kg)	Kd	Ref	Inorganic BCF	Ref	Creek	Wetland	Creek	Wetland	BAF	Ref	Fathead Minnow	Smallmouth Bass
Volatile Organic Compounds															
Acetone	7.80E-02	4.00E-03		NA		NA		NA	NA	1.06E-01		NA		5.25E-04	7.85E-05
Benzene	2.50E-03		8.50E-03	NA		NA		NA	NA	3.41E-03	8.75E-03	NA		6.59E-06	7.04E-09
2-Butanone	9.50E-03			NA		NA		NA	NA	1.30E-02		NA		1.09E-05	5.04E-09
Carbon disulfide	2.50E-02			NA		NA		NA	NA	3.41E-02		NA		5.61E-05	5.11E-08
Cyclohexane	4.50E-03			NA		NA		NA	NA	6.14E-03		NA		1.43E-04	1.85E-06
cis-1,2-Dichloroethene	3.50E-03	2.70E-03		NA		NA		NA	NA	4.77E-03		NA		3.71E-02	6.68E-03
Ethylbenzene			3.40E-03	NA		NA		NA	NA		9.42E-03	NA			
Methylcyclohexane	7.20E-03			NA		NA		NA	NA	9.82E-03		NA		7.20E-03	7.20E-03
4-Methyl-2-pentanone	2.50E-03			NA		NA		NA	NA	3.41E-03		NA		3.24E-06	1.70E-09
Toluene	6.80E-03		1.80E-02	NA		NA		NA	NA	9.27E-03	1.79E-02	NA		5.05E-05	1.52E-07
M&P-Xylene	2.70E-03		1.50E-02	NA		NA		NA	NA	3.68E-03	1.35E-02	NA		5.61E-05	4.29E-07
O-Xylene			4.40E-03	NA		NA		NA	NA		1.11E-02	NA			
Inorganic Compounds															
Aluminum	6.16E+03			6.67E-04	a	1.90E+01	a	4.11E+00		7.81E+01		1.00E-03	f	7.81E-02	7.81E-05
Arsenic	9.60E+00		1.63E+01	3.45E-02	b	1.43E-01	d	3.31E-01	5.62E-01	4.74E-02	8.04E-02	8.30E-01	f	3.93E-02	3.26E-02
Barium	4.14E+01	6.93E-02		2.44E-02	b	4.00E+00	a	1.01E+00		4.04E+00		2.00E-03	f	8.08E-03	1.62E-05
Chromium		4.23E-01	5.53E+01	5.56E-07	b	1.00E-01	d		3.07E-05		3.07E-06	1.00E-02	g		
Cobalt	7.50E+00			3.33E-03	a	3.00E+02	a	2.50E-02		7.49E+00		2.90E-01	f	2.17E+00	6.30E-01
Iron		2.86E+01		2.50E-02	a	2.00E+02	a	2.86E+01		5.72E+03		1.00E-02	j	5.72E+01	5.72E-01
Manganese		2.16E-02		1.54E-02	a	4.00E+02	a	2.16E-02		8.64E+00		1.00E-02	f	8.64E-02	8.64E-04
Nickel	1.82E+01			1.54E-02	b	4.86E-01	d	2.80E-01		1.36E-01		2.00E-02	h	2.72E-03	5.45E-05
Selenium	1.10E+00			2.00E-01	b	1.43E-01	e	2.20E-01		3.15E-02		8.30E-01	i	2.61E-02	2.17E-02
Vandium	1.23E+02			1.00E-03	b	1.00E+01	a	1.23E-01		1.23E+00		1.00E-02	j	1.23E-02	1.23E-04
Zinc			2.90E+02	1.61E-02	b	1.94E+00	d		4.67E+00		9.06E+00	8.00E-02	f		

a ORNL RAIS data page (http://risk.lsd.ornl.gov/homepage/rap_tool.shtml)
b USEPA, 1996
c Literature value not available, assumed 1
d Bechtel, 1998
e Assumed BCF for arsenic
f Malcolm Pirnie, 1998
g Assumed BAF for barium
h Assumed BAF for lead.
i Assumed BAF for arsenic
j Assumed BAF for manganese

TABLE 14
EXPOSURE PARAMETERS USED IN THE ECOLOGICAL RISK ASSESSMENT
Peter Cooper Site
Gowanda, New York

Assessment Endpoint Species/Functional Group	Measurement Endpoint Species	Percent of Diet[a]							Home Range[a] (acres)	Minimum Body Weight[b] (kg)
		Benthic Invertebrates	Terrestrial Invertebrates	Aquatic Plant Material	Terrestrial Plant Material	Fish	Small Mammals	Birds		
Obligate semi-aquatic mammal	Mink	100%	--	0.0%	--	0.0%	--	--	1903	0.53
Omnivorous mammal	Raccoon	0.0%	0.0%	0.0%	0.0%	--	0.0%	100%	504	4.0
Predatory mammal	Red Fox	--	0.0%	--	0.0%	--	0.0%	100%	1772	4.0
Herbivorous small mammal	Deer Mouse	--	0.0%	--	100%	--	--	--	0.10	0.015
Herbivorous large mammal	White-tailed Deer	--	--	--	100%	--	--	--	300	56
Insectivorous birds	American Robin	--	100%	--	0.0%	--	--	--	0.52	0.06
Predatory bird	Red-tailed hawk	--	--	--	--	--	0.0%	100%	1722	0.9

Assessment Endpoint Species/Functional Group	Measurement Endpoint Species	Site Use Factor (maximum assumed)					Sediment[d] (% of Food Intake)	Soil[c] (% of Food Intake)	Maximum Food Ingestion Rate[a] (kg/day)	Maximum Water Ingestion Rate[d] (L/day)
		Wetland Area	Creek	Landfill Area	Manufacturing area	Combined				
Obligate semi-aquatic mammal	Mink	--	1	--	--	--	10.0%	10.0%	1.36E-01	1.1E-01
Omnivorous mammal	Raccoon	--	--	--	--	1	10.0%	10.0%	3.91E-01	3.3E-01
Predatory mammal	Red Fox	--	--	--	--	1	--	3.0%	3.00E-01	2.3E-01
Herbivorous small mammal	Deer Mouse	--	--	1	1	--	--	2.0%	4.85E-03	2.2E-03
Herbivorous large mammal	White-tailed Deer	--	--	--	--	1	--	2.0%	4.12E+00	5.8E+00
Insectivorous birds	American Robin	--	--	1	1	--	--	10.0%	1.82E-02	1.2E-03
Predatory bird	Red-tailed hawk	--	--	--	--	1	--	0.0%	6.94E-02	7.2E-03

Notes:
a USEPA (1993); white-tailed deer Degraaf and Rudis (1983)
b USEPA (1993); white-tailed deer WDNR 1986.
c Beyer et al. 1994; based on feeding habit value of turkey used for the American robin
d USEPA (1993); white-tailed deer estimated using allometric scaling
-- - Not Applicable

Animal	BWmax (g)
Mink	2300
Raccoon	8300
Red Fox	5500
Deer Mouse	32
White Tailed Deer	200000
American Robin	90
Red Tailed Hawk	1300

TABLE 15
ESTIMATED EXPOSURE OF MINK TO CONSTITUENTS
Peter Cooper Site
Gowanda, New York

Parameter	EE in Diet (mg/kg/day)	Diet Percent of Total Exposure	EE from Sediment (mg/kg/day)	Sediment Percent of Total Exposure	EE from Drinking Water (mg/kg/day)	Drinking Water Percent of Total Exposure	EE Total (mg/kg/day)
Volatile Organic Compounds							
Acetone	4.72E+00	99.9%	2.01E-03	0.0%	7.92E-04	0.0%	4.73E+00
Benzene	8.76E-04	93.2%	6.43E-05	6.8%			9.41E-04
2-Butanone	8.16E-02	99.7%	2.44E-04	0.3%			8.19E-02
Carbon Disulfide	8.76E-03	93.2%	6.43E-04	6.8%			9.41E-03
Cyclohexane	1.58E-03	93.2%	1.16E-04	6.8%			1.69E-03
cis-1,2-Dichlorethene	9.55E-03	93.9%	9.00E-05	0.9%	5.35E-04	5.3%	1.02E-02
Methylcyclohexane	2.52E-03	93.2%	1.85E-04	6.8%			2.71E-03
4-Methyl-2-pentanone	8.76E-04	93.2%	6.43E-05	6.8%			9.41E-04
Toluene	2.38E-03	93.2%	1.75E-04	6.8%			2.56E-03
M&P-Xylene	9.46E-04	93.2%	6.94E-05	6.8%			1.02E-03
Inorganic Compounds							
Aluminum	2.01E+01	11.2%	1.58E+02	88.8%			1.78E+02
Arsenic	1.18E-01	32.4%	2.47E-01	67.6%			3.65E-01
Barium	1.60E+00	59.7%	1.06E+00	39.8%	1.37E-02	0.5%	2.67E+00
Cobalt	1.93E+00	90.9%	1.93E-01	9.1%			2.12E+00
Chromium					8.38E-02	100.0%	8.38E-02
Iron	1.47E+03	99.6%			5.67E+00	0.4%	1.48E+03
Manganese	2.22E+00	99.8%			4.28E-03	0.2%	2.23E+00
Nickel	2.81E-01	37.5%	4.68E-01	62.5%			7.49E-01
Selenium	8.09E-03	22.2%	2.83E-02	77.8%			3.64E-02
Vanadium	3.16E-01	9.1%	3.16E+00	90.9%			3.48E+00

Exposure Assumptions:

1. The mink lives around and feeds 100% of the time in Cattaraugus Creek

TABLE 16
ESTIMATED EXPOSURE OF RACCOON TO CONSTITUENTS
Peter Cooper Site
Gowanda, New York

Parameter	EE in Diet (mg/kg/day)	Diet Percent of Total Exposure	EE from Soil (mg/kg/day)	Soil Percent of Total Exposure	EE from Sediment (mg/kg/day)	Sediment Percent of Total Exposure	EE from Drinking Water (mg/kg/day)	Drinking Water Percent of Total Exposure	EE Total (mg/kg/day)
Volatile Organic Compounds									
Acetone	1.28E-01	89.6%	1.37E-02	9.6%	7.63E-04	0.5%	3.33E-04	0.233%	1.43E-01
Benzene	8.69E-04	83.2%	9.29E-05	8.9%	8.31E-05	8.0%			1.05E-03
2-Butanone	2.56E-02	90.0%	2.74E-03	9.6%	9.29E-05	0.3%			2.84E-02
Carbon disulfide	6.59E-03	87.4%	7.04E-04	9.3%	2.45E-04	3.2%			7.54E-03
Carbon tetrachloride	9.15E-01	90.3%	9.78E-02	9.7%					1.01E+00
Chloroform	1.43E-01	90.3%	1.53E-02	9.7%					1.58E-01
Cyclohexane	4.74E-01	91.1%	4.60E-02	8.9%	4.40E-05	0.0%			5.20E-01
1,2-Dichlorobenzene	4.93E-04	91.1%	4.79E-05	8.9%					5.41E-04
1,4-Dichlorobenzene	4.63E-04	91.1%	4.50E-05	8.9%					5.08E-04
1,3-Dichlorobenzene	4.33E-04	91.1%	4.21E-05	8.9%					4.75E-04
1,1-Dichloroethane	1.46E-04	90.3%	1.56E-05	9.7%					1.62E-04
1,2-Dichloroethane	2.20E-02	90.3%	2.35E-03	9.7%					2.43E-02
cis-1,2-Dichloroethene	2.38E-02	89.5%	2.54E-03	9.6%	3.42E-05	0.1%	2.25E-04	0.8%	2.66E-02
Ethylbenzene	5.21E-04	85.4%	5.58E-05	9.1%	3.33E-05	5.4%			6.10E-04
2-Hexanone	5.85E-03	90.3%	6.26E-04	9.7%					6.48E-03
Isopropylbenzene	1.71E-04	91.1%	1.66E-05	8.9%					1.88E-04
Methyl Acetate	1.92E-02	90.3%	2.05E-03	9.7%					2.13E-02
Methylcyclohexane	1.46E-01	90.3%	1.56E-02	9.7%	7.04E-05	0.0%			1.62E-01
4-Methyl-2-pentanone	3.57E-03	89.8%	3.81E-04	9.6%	2.45E-05	0.6%			3.97E-03
Styrene	2.65E-04	90.3%	2.84E-05	9.7%					2.94E-04
Tetrachloroethene	4.94E+00	90.3%	5.28E-01	9.7%					5.47E+00
Toluene	2.10E-04	43.4%	9.78E-05	20.2%	1.76E-04	36.4%			4.84E-04
1,2,4-Trichlorobenzene	4.28E-02	92.4%	3.52E-03	7.6%					4.63E-02
1,1,1-Trichloroethane	5.03E-01	90.3%	5.38E-02	9.7%					5.57E-01
Trichloroethene	4.67E-02	90.3%	4.99E-03	9.7%					5.16E-02
M&P-Xylene	4.76E-02	90.1%	5.09E-03	9.6%	1.47E-04	0.3%			5.28E-02
O-Xylene	3.84E-02	90.2%	4.11E-03	9.6%	4.30E-05	0.1%			4.26E-02
Semivolatile Organic Compounds									
Acenaphthane	2.85E-01	91.8%	2.54E-02	8.2%					3.11E-01
Acenaphthylene	4.76E-02	92.4%	3.91E-03	7.6%					5.15E-02
Anthracene	2.56E+00	94.9%	1.37E-01	5.1%					2.70E+00
Benzo(a)anthracene	1.76E+01	98.7%	2.35E-01	1.3%					1.78E+01
Benzo(a)pyrene	2.01E+01	99.0%	1.96E-01	1.0%					2.03E+01
Benzo(b)fluoranthene	1.65E+01	99.1%	1.47E-01	0.9%					1.66E+01

TABLE 16
ESTIMATED EXPOSURE OF RACCOON TO CONSTITUENTS
Peter Cooper Site
Gowanda, New York

Parameter	EE in Diet (mg/kg/day)	Diet Percent of Total Exposure	EE from Soil (mg/kg/day)	Soil Percent of Total Exposure	EE from Sediment (mg/kg/day)	Sediment Percent of Total Exposure	EE from Drinking Water (mg/kg/day)	Drinking Water Percent of Total Exposure	EE Total (mg/kg/day)
Benzo(g,h,i)perylene	1.79E+01	99.2%	1.37E-01	0.8%					1.81E+01
Benzo(k)fluoranthene	1.98E+01	99.1%	1.76E-01	0.9%					1.99E+01
Carbazole	3.52E-01	91.1%	3.42E-02	8.9%					3.86E-01
Indeno(cd-1,2,3)pyrene	1.66E+01	99.2%	1.27E-01	0.8%					1.68E+01
Chrysene	1.61E+01	98.7%	2.15E-01	1.3%					1.63E+01
Dibenzo(a,h)anthracene	6.66E+00	99.2%	5.09E-02	0.8%					6.71E+00
Dibenzofuran	2.62E-01	92.4%	2.15E-02	7.6%					2.83E-01
bis(2-Ethylhexyl)phthalate	8.21E-02	99.2%	6.75E-04	0.8%					8.27E-02
Flouranthene	1.98E+01	97.1%	5.87E-01	2.9%					2.03E+01
Fluorene	5.38E-01	92.9%	4.11E-02	7.1%					5.79E-01
2-Methylnaphthalene	1.98E-02	91.8%	1.76E-03	8.2%					2.15E-02
4-Methylphenol	5.40E-03	90.3%	5.77E-04	9.7%					5.97E-03
Naphthalene	1.11E-02	91.1%	1.08E-03	8.9%					1.21E-02
Phenanthrene	8.23E+00	94.9%	4.40E-01	5.1%					8.67E+00
Pyrene	1.45E+01	97.1%	4.30E-01	2.9%					1.49E+01
Inorganic Compounds									
Aluminum	7.50E+02	84.2%	8.02E+01	9.01%	6.03E+01	6.8%			8.91E+02
Arsenic	1.54E+01	62.7%	8.99E+00	36.66%	1.59E-01	0.7%			2.45E+01
Barium	1.07E+01	87.3%	1.14E+00	9.34%	4.05E-01	3.3%	5.77E-03	0.047%	1.23E+01
Beryllium	1.10E-01	90.3%	1.17E-02	9.66%					1.22E-01
Chromium	1.81E+01	75.3%	5.38E+00	22.35%	5.41E-01	2.2%	3.52E-02	0.146%	2.41E+01
Copper	1.56E+01	90.3%	1.67E+00	9.66%					1.73E+01
Iron	2.86E+03	90.3%	3.06E+02	9.65%			2.38E+00	0.075%	3.17E+03
Lead	2.46E+01	90.3%	2.63E+00	9.66%					2.72E+01
Manganese	4.47E+01	90.3%	4.78E+00	9.66%			1.80E-03	0.004%	4.95E+01
Mercury	2.84E-01	90.3%	3.03E-02	9.66%					3.14E-01
Nickel	2.49E+00	84.9%	2.66E-01	9.07%	1.78E-01	6.1%			2.93E+00
Selenium	2.47E-01	86.9%	2.64E-02	9.29%	1.08E-02	3.8%			2.84E-01
Vandium	1.85E+00	56.9%	1.98E-01	6.08%	1.20E+00	37.0%			3.25E+00
Zinc	6.66E+01	87.0%	7.12E+00	9.30%	2.84E+00	3.7%			7.66E+01

Exposure Assumptions:

1. Used combined soil data set because a raccoon has large home range and can use entire site.
2. Combined area use.
3. Water intake use assumed maximal (highest) exposure concentration.

TABLE 17
ESTIMATED EXPOSURE OF RED FOX TO CONSTITUENTS
Peter Cooper Site
Gowanda, New York

Parameter	EE in Diet (mg/kg/day)	Diet Percent of Total Exposure	EE from Soil (mg/kg/day)	Soil Percent of Total Exposure	EE from Drinking Water (mg/kg/day)	Drinking Water Percent of Total Exposure	EE Total (mg/kg/day)
Volatile Organic Compounds							
Acetone	9.81E-02	96.7%	3.15E-03	3.1%	2.30E-04	0.2%	1.01E-01
Benzene	6.66E-04	96.9%	2.13E-05	3.1%			6.87E-04
2-Butanone	1.96E-02	96.9%	6.29E-04	3.1%			2.02E-02
Carbon disulfide	5.04E-03	96.9%	1.62E-04	3.1%			5.21E-03
Carbon tetrachloride	7.01E-01	96.9%	2.25E-02	3.1%			7.23E-01
Chloroform	1.10E-01	96.9%	3.51E-03	3.1%			1.13E-01
Cyclohexane	3.63E-01	97.2%	1.06E-02	2.8%			3.73E-01
1,2-Dichlorobenzene	3.78E-04	97.2%	1.10E-05	2.8%			3.89E-04
1,4-Dichlorobenzene	3.55E-04	97.2%	1.03E-05	2.8%			3.65E-04
1,3-Dichlorobenzene	3.31E-04	97.2%	9.66E-06	2.8%			3.41E-04
1,1-Dichloroethane	1.12E-04	96.9%	3.60E-06	3.1%			1.16E-04
1,2-Dichloroethane	1.68E-02	96.9%	5.39E-04	3.1%			1.74E-02
cis-1,2-Dichloroethene	1.82E-02	96.1%	5.84E-04	3.1%	1.55E-04	0.8%	1.90E-02
Ethylbenzene	3.99E-04	96.9%	1.28E-05	3.1%			4.12E-04
2-Hexanone	4.48E-03	96.9%	1.44E-04	3.1%			4.63E-03
Isopropylbenzene	1.31E-04	97.2%	3.82E-06	2.8%			1.35E-04
Methyl Acetate	1.47E-02	96.9%	4.72E-04	3.1%			1.52E-02
Methylcyclohexane	1.12E-01	96.9%	3.60E-03	3.1%			1.16E-01
4-Methyl-2-pentanone	2.73E-03	96.9%	8.76E-05	3.1%			2.82E-03
Styrene	2.03E-04	96.9%	6.52E-06	3.1%			2.10E-04
Tetrachloroethene	3.78E+00	96.9%	1.21E-01	3.1%			3.90E+00
Toluene	1.61E-04	87.8%	2.25E-05	12.2%			1.84E-04
1,2,4-Trichlorobenzene	3.28E-02	97.6%	8.09E-04	2.4%			3.36E-02
1,1,1-Trichloroethane	3.85E-01	96.9%	1.24E-02	3.1%			3.98E-01
Trichloroethene	3.57E-02	96.9%	1.15E-03	3.1%			3.69E-02
M&P-Xylene	3.64E-02	96.9%	1.17E-03	3.1%			3.76E-02
O-Xylene	2.94E-02	96.9%	9.44E-04	3.1%			3.04E-02
Semivolatile Organic Compounds							
Acenaphthane	2.19E-01	97.4%	5.84E-03	2.6%			2.24E-01
Acenaphthylene	3.64E-02	97.6%	8.99E-04	2.4%			3.73E-02
Anthracene	1.96E+00	98.4%	3.15E-02	1.6%			1.99E+00
Benzo(a)anthracene	1.35E+01	99.6%	5.39E-02	0.4%			1.35E+01
Benzo(a)pyrene	1.54E+01	99.7%	4.49E-02	0.3%			1.55E+01
Benzo(b)fluoranthene	1.26E+01	99.7%	3.37E-02	0.3%			1.26E+01
Benzo(g,h,i)perylene	1.37E+01	99.8%	3.15E-02	0.2%			1.38E+01

TABLE 17
ESTIMATED EXPOSURE OF RED FOX TO CONSTITUENTS
Peter Cooper Site
Gowanda, New York

Parameter	EE in Diet (mg/kg/day)	Diet Percent of Total Exposure	EE from Soil (mg/kg/day)	Soil Percent of Total Exposure	EE from Drinking Water (mg/kg/day)	Drinking Water Percent of Total Exposure	EE Total (mg/kg/day)
Benzo(k)fluoranthene	1.51E+01	99.7%	4.05E-02	0.3%			1.52E+01
Carbazole	2.70E-01	97.2%	7.87E-03	2.8%			2.78E-01
Indeno(cd-1,2,3)pyrene	1.28E+01	99.8%	2.92E-02	0.2%			1.28E+01
Chrysene	1.23E+01	99.6%	4.94E-02	0.4%			1.24E+01
Dibenzo(a,h)anthracene	5.10E+00	99.8%	1.17E-02	0.2%			5.11E+00
Dibenzofuran	2.00E-01	97.6%	4.94E-03	2.4%			2.05E-01
bis(2-Ethylhexyl)phthalat	6.28E-02	99.8%	1.55E-04	0.2%			6.30E-02
Flouranthene	1.51E+01	99.1%	1.35E-01	0.9%			1.53E+01
Fluorene	4.12E-01	97.8%	9.44E-03	2.2%			4.21E-01
2-Methylnaphthalene	1.51E-02	97.4%	4.05E-04	2.6%			1.55E-02
4-Methylphenol	4.13E-03	96.9%	1.33E-04	3.1%			4.27E-03
Naphthalene	8.48E-03	97.2%	2.47E-04	2.8%			8.72E-03
Phenanthrene	6.31E+00	98.4%	1.01E-01	1.6%			6.41E+00
Pyrene	1.11E+01	99.1%	9.89E-02	0.9%			1.12E+01
Inorganic Compounds							
Aluminum	5.75E+02	96.9%	1.84E+01	3.1%			5.93E+02
Arsenic	1.18E+01	85.1%	2.07E+00	14.9%			1.38E+01
Barium	8.20E+00	96.8%	2.63E-01	3.1%	3.99E-03	0.0%	8.46E+00
Beryllium	8.41E-02	96.9%	2.70E-03	3.1%			8.68E-02
Chromium	1.39E+01	91.7%	1.24E+00	8.2%	2.43E-02	0.2%	1.51E+01
Copper	1.20E+01	96.9%	3.84E-01	3.1%			1.24E+01
Iron	2.19E+03	96.8%	7.03E+01	3.1%	1.65E+00	0.1%	2.26E+03
Lead	1.88E+01	96.9%	6.05E-01	3.1%			1.95E+01
Manganese	3.43E+01	96.9%	1.10E+00	3.1%	1.24E-03	0.0%	3.54E+01
Mercury	2.17E-01	96.9%	6.97E-03	3.1%			2.24E-01
Nickel	1.91E+00	96.9%	6.11E-02	3.1%			1.97E+00
Selenium	1.89E-01	96.9%	6.07E-03	3.1%			1.95E-01
Vandium	1.42E+00	96.9%	4.54E-02	3.1%			1.46E+00
Zinc	5.10E+01	96.9%	1.64E+00	3.1%			5.26E+01

Exposure Assumptions:

1. Use combined soils data set since red fox has large home range and can utilizes the entire site
2. Combined area use.
3. Water intake use assumed maximal (highest) exposure concentration.

TABLE 18

ESTIMATED EXPOSURE OF DEER MOUSE TO CONSTITUENTS

Peter Cooper Site

Gowanda, New York

	Landfill Area				Manufacturing Area					EE Total (mg/kg/day)		Bioaccumulation/Bioconcentration Factors			
Parameter	EE in Diet (mg/kg/day)	Diet Percent of Total Exposure	EE from Soil (mg/kg/day)	Soil Percent of Total Exposure	EE in Diet (mg/kg/day)	Diet Percent of Total Exposure	EE from Soil (mg/kg/day)	Soil Percent of Total Exposure	EE from Drinking Water (mg/kg/day)	Landfill Area	Manufacturing Area	Plant to Deer Mouse	Soil To Deer Mouse[3]	Water to Deer Mouse[4]	Deer Mouse EPC for Manufacturing Area (mg/kg)
Volatile Organic Compounds															
Acetone					1.07E+02	100.0%	9.06E-03	0.0%	5.97E-04	5.97E-04	1.07E+02	9.05E-09 1	2.17E-11	2.28E-09	9.66E-07
Benzene	5.52E-08	0.2%	3.30E-05	99.8%	1.03E-07	0.2%	6.15E-05	99.8%		3.30E-05	6.16E-05	1.00E+00 2	NA	--	3.18E-07
2-Butanone					3.03E+00	99.9%	1.81E-03	0.1%			3.03E+00	1.00E+00 2	NA	--	9.36E+00
Carbon disulfide					5.27E-06	1.1%	4.66E-04	98.9%			4.71E-04	1.00E+00 2	NA	--	1.63E-05
Carbon tetrachloride					3.43E-20	0.0%	6.47E-02	100.0%			6.47E-02	1.00E+00 2	NA	--	1.06E-19
Chloroform					3.16E-04	3.0%	1.01E-02	97.0%			1.04E-02	1.34E-06 1	3.22E-09	--	4.57E-10
Cyclohexane					1.61E-04	0.5%	3.04E-02	99.5%			3.06E-02	1.00E+00 2	NA	--	4.98E-04
1,2-Dichlorobenzene					1.45E-07	0.5%	3.17E-05	99.5%			3.18E-05	1.00E+00 2	NA	--	4.48E-07
1,4-Dichlorobenzene					1.17E-07	0.4%	2.98E-05	99.6%			2.99E-05	1.00E+00 2	NA	--	3.63E-07
1,3-Dichlorobenzene					1.17E-06	4.1%	2.78E-05	95.9%			2.90E-05	1.00E+00 2	NA	--	3.63E-06
1,1-Dichloroethane					1.39E-06	11.9%	1.03E-05	88.1%			1.17E-05	1.00E+00 2	NA	--	4.31E-06
1,2-Dichloroethane					3.74E-03	70.7%	1.55E-03	29.3%			5.29E-03	1.00E+00 2	NA	--	1.16E-02
cis-1,2-Dichloroethene					1.06E-04	4.8%	1.68E-03	76.8%	4.03E-04	4.03E-04	2.19E-03	1.00E+00 2	NA	NA	3.28E-04
Ethylbenzene	2.11E-10	0.0%	1.16E-05	100.0%	6.67E-10	0.0%	3.69E-05	100.0%		1.16E-05	3.69E-05	1.00E+00 2	NA	--	2.06E-09
2-Hexanone					1.97E-03	82.6%	4.14E-04	17.4%			2.38E-03	1.00E+00 2	NA	--	6.09E-03
Isopropylbenzene					9.17E-07	7.7%	1.10E-05	92.3%			1.19E-05	1.00E+00 2	NA	--	2.83E-06
Methyl Acetate					3.52E+00	100.0%	1.36E-03	0.0%			3.52E+00	1.00E+00 2	NA	--	1.09E+01
Methylcyclohexane					5.17E-01	98.0%	1.03E-02	2.0%			5.28E-01	1.00E+00 2	NA	--	1.60E+00
4-Methyl-2-pentanone					4.41E-03	94.6%	2.52E-04	5.4%			4.66E-03	1.00E+00 2	NA	--	1.36E-02
Styrene					2.74E-13	0.0%	1.88E-05	100.0%			1.88E-05	1.00E+00 2	NA	--	8.47E-13
Tetrachloroethene					5.61E-13	0.0%	3.49E-01	100.0%			3.49E-01	1.00E+00 2	NA	--	1.74E-12
Toluene	1.87E-31	0.0%	6.47E-05	100.0%	4.29E-32	0.0%	1.49E-05	100.0%		6.47E-05	1.49E-05	1.00E+00 2	NA	--	1.33E-31
1,2,4-Trichlorobenzene					4.99E-03	68.2%	2.33E-03	31.8%			7.32E-03	1.00E+00 2	NA	--	1.54E-02
1,1,1-Trichloroethane					1.38E-08	0.0%	3.56E-02	100.0%			3.56E-02	1.00E+00 2	NA	--	4.28E-08
Trichloroethene					3.68E-18	0.0%	3.30E-03	100.0%			3.30E-03	1.00E+00 2	NA	--	1.14E-17
M&P-Xylene	2.91E-09	0.0%	3.88E-05	100.0%	2.52E-07	0.0%	3.36E-03	100.0%		3.88E-05	3.36E-03	1.00E+00 2	NA	--	7.81E-07
O-Xylene	2.53E-10	0.0%	1.81E-05	100.0%	3.80E-08	0.0%	2.72E-03	100.0%		1.81E-05	2.72E-03	1.00E+00 2	NA	--	1.17E-07
Semivolatile Organic Compounds															
Acenaphthene					7.86E-01	97.9%	1.68E-02	2.1%			8.03E-01	1.00E+00 2	NA	--	5.32E-02
Acenaphthylene					8.82E-03	77.3%	2.59E-03	22.7%			1.14E-02	1.00E+00 2	NA	--	2.73E-02
Anthracene					6.83E+00	98.7%	9.06E-02	1.3%			6.92E+00	1.00E+00 2	NA	--	2.11E+01
Benzo(a)anthracene					1.63E+03	100.0%	1.55E-01	0.0%			1.63E+03	7.19E-03 1	1.73E-05	--	1.17E+01
Benzo(a)pyrene					4.98E+03	100.0%	1.29E-01	0.0%			4.98E+03	5.32E-03 1	4.86E-05	--	2.65E+01
Benzo(b)fluoranthene					4.86E+03	100.0%	9.70E-02	0.0%			4.86E+03	2.40E-02 1	5.75E-05	--	1.17E+02
Benzo(g,h,i)perylene					1.29E+04	100.0%	9.06E-02	0.0%			1.29E+04	1.00E+00 2	NA	--	3.98E+04
Benzo(k)fluoranthene					5.83E+03	100.0%	1.16E-01	0.0%			5.83E+03	2.39E-02 1	5.73E-05	--	1.39E+02
Carbazole					8.50E-04	3.6%	2.26E-02	96.4%			2.35E-02	1.00E+00 2	NA	--	2.63E-03
Indeno(cd-1,2,3)pyrene					1.43E+04	100.0%	8.41E-02	0.0%			1.43E+04	1.24E-01 1	2.98E-04	--	1.78E+03
Chrysene					1.49E+03	100.0%	1.42E-01	0.0%			1.49E+03	8.27E-03 1	1.99E-05	--	1.23E+01
Dibenzo(a,h)anthracene					6.35E+03	100.0%	3.36E-02	0.0%			6.35E+03	5.31E-02 1	1.27E-04	--	3.37E+02
Dibenzofuran					7.03E-02	83.2%	1.42E-02	16.8%			8.45E-02	1.00E+00 2	NA	--	2.17E-01
bis(2-Ethylhexyl)phthalate					3.55E+02	100.0%	4.46E-04	0.0%			3.55E+02	2.42E-03 1	5.80E-06	--	8.60E-01
Flouranthene					4.56E+02	99.9%	3.88E-01	0.1%			4.57E+02	1.00E+00 2	NA	--	1.41E+03
Fluorene					2.53E-01	90.3%	2.72E-02	9.7%			2.80E-01	1.00E+00 2	NA	--	7.83E-01
2-Methylnaphthalene					7.04E-04	37.7%	1.16E-03	62.3%			1.87E-03	1.00E+00 2	NA	--	2.18E-03
4-Methylphenol					9.35E-06	2.4%	3.82E-04	97.6%			3.91E-04	1.00E+00 2	NA	--	2.89E-05
Naphthalene					1.10E-06	0.2%	7.12E-04	99.8%			7.13E-04	1.00E+00 2	NA	--	3.41E-06
Phenanthrene					2.45E+01	98.8%	2.91E-01	1.2%			2.48E+01	1.00E+00 2	NA	--	7.58E+01
Pyrene					3.21E+02	99.9%	2.85E-01	0.1%			3.21E+02	1.00E+00 2	NA	--	9.92E+02
Inorganic Compounds															
Aluminum					1.06E+01	16.7%	5.30E+01	83.3%			6.36E+01	1.00E+00 2	NA	--	3.28E+01
Arsenic	1.43E+01	70.6%	5.94E+00	29.4%	2.61E+00	70.6%	1.09E+00	29.4%		2.02E+01	3.69E+00	1.20E-03 1	2.88E-06	--	3.13E-03
Barium					5.68E+00	88.1%	7.57E-01	11.7%	1.03E-02	1.03E-02	6.44E+00	8.99E-05 1	2.16E-07	2.26E-05	5.11E-04
Beryllium					3.88E-03	33.3%	7.76E-03	66.7%			1.16E-02	5.99E-04 1	1.44E-06	--	2.34E-06
Chromium	1.33E+00	26.9%	3.56E+00	71.8%	4.80E-01	26.3%	1.28E+00	70.2%	6.32E-02	4.95E+00	1.82E+00	3.30E-03 1	7.91E-06	8.30E-04	1.65E-03
Copper					2.21E+01	95.2%	1.11E+00	4.8%			2.32E+01	1.00E+00 2	NA	--	6.84E+01
Iron					1.01E+04	98.0%	2.02E+02	2.0%	4.27E+00	4.27E+00	1.03E+04	1.00E+00 2	NA	NA	3.13E+04
Lead					3.92E+01	95.7%	1.74E+00	4.3%			4.09E+01	1.80E-04 1	4.12E-07	--	7.05E-03

302674

TABLE 18

ESTIMATED EXPOSURE OF DEER MOUSE TO CONSTITUENTS

Peter Cooper Site

Gowanda, New York

Parameter	Landfill Area				Manufacturing Area				EE from Drinking Water (mg/kg/day)	EE Total (mg/kg/day)		Bioaccumulation/Bioconcentration Factors			Deer Mouse EPC for Manufacturing Area (mg/kg)
	EE in Diet (mg/kg/day)	Diet Percent of Total Exposure	EE from Soil (mg/kg/day)	Soil Percent of Total Exposure	EE in Diet (mg/kg/day)	Diet Percent of Total Exposure	EE from Soil (mg/kg/day)	Soil Percent of Total Exposure		Landfill Area	Manufacturing Area	Plant to Deer Mouse	Soil To Deer Mouse[3]	Water to Deer Mouse[4]	
Manganese					3.95E+01	92.6%	3.16E+00	7.4%	3.23E-03	3.23E-03	4.27E+01	1.00E+00 2	NA	NA	1.22E+02
Mercury					9.02E-01	97.8%	2.01E-02	2.2%			9.22E-01	3.13E-03 1	7.52E-06	--	2.82E-03
Nickel					5.28E-01	75.0%	1.76E-01	25.0%			7.04E-01	3.60E-03 1	8.63E-06	--	1.90E-03
Selenium					2.18E-02	55.6%	1.75E-02	44.4%			3.93E-02	1.36E-03 1	3.27E-06	--	2.97E-05
Vanadium					3.59E-02	21.6%	1.31E-01	78.4%			1.67E-01	1.00E+00 2	NA	--	1.11E-01
Zinc	8.00E+01	98.7%	1.07E+00	1.3%	3.53E+02	98.7%	4.71E+00	1.3%		8.11E+01	3.58E+02	5.39E-05 1	1.29E-07	--	1.90E-02

1 - Table D-1, USEPA (1999)
2 - Table 5-2, USEPA (1999)
3 - Table D-2, USEPA (1999)
4 - Table D-3, USEPA (1999)
NA - Not Available

302675

TABLE 19
ESTIMATED EXPOSURE OF WHITE-TAILED DEER TO CONSTITUENTS
Peter Cooper Site
Gowanda, New York

Parameter	EE in Diet (mg/kg/day)	Diet Percent of Total Exposure	EE from Soil (mg/kg/day)	Soil Percent of Total Exposure	EE from Drinking Water (mg/kg/day)	Drinking Water Percent of Total Exposure	EE Total (mg/kg/day)
Volatile Organic Compounds							
Acetone	2.43E+01	100.0%	2.06E-03	0.0%	4.17E-04	0.0%	2.43E+01
Benzene	2.34E-08	0.2%	1.40E-05	99.8%			1.40E-05
2-Butanone	6.89E-01	99.9%	4.12E-04	0.1%			6.89E-01
Carbon disulfide	1.20E-06	1.1%	1.06E-04	98.9%			1.07E-04
Carbon tetrachloride	7.81E-21	0.0%	1.47E-02	100.0%			1.47E-02
Chloroform	7.20E-05	3.0%	2.30E-03	97.0%			2.37E-03
Cyclohexane	3.66E-05	0.5%	6.93E-03	99.5%			6.96E-03
1,2-Dichlorobenzene	3.30E-08	0.5%	7.21E-06	99.5%			7.25E-06
1,4-Dichlorobenzene	2.67E-08	0.4%	6.77E-06	99.6%			6.80E-06
1,3-Dichlorobenzene	2.67E-07	4.1%	6.33E-06	95.9%			6.60E-06
1,1-Dichloroethane	3.17E-07	11.9%	2.35E-06	88.1%			2.67E-06
1,2-Dichloroethane	8.50E-04	70.7%	3.53E-04	29.3%			1.20E-03
cis-1,2-Dichloroethene	2.41E-05	3.5%	3.83E-04	55.6%	2.82E-04	40.9%	6.88E-04
Ethylbenzene	1.52E-10	0.0%	8.39E-06	100.0%			8.39E-06
2-Hexanone	4.48E-04	82.6%	9.42E-05	17.4%			5.42E-04
Isopropylbenzene	2.09E-07	7.7%	2.50E-06	92.3%			2.71E-06
Methyl Acetate	8.00E-01	100.0%	3.09E-04	0.0%			8.01E-01
Methylcyclohexane	1.18E-01	98.0%	2.35E-03	2.0%			1.20E-01
4-Methyl-2-pentanone	1.00E-03	94.6%	5.74E-05	5.4%			1.06E-03
Styrene	6.24E-14	0.0%	4.27E-06	100.0%			4.27E-06
Tetrachloroethene	1.28E-13	0.0%	7.95E-02	100.0%			7.95E-02
Toluene	4.24E-32	0.0%	1.47E-05	100.0%			1.47E-05
1,2,4-Trichlorobenzene	1.14E-03	68.2%	5.30E-04	31.8%			1.67E-03
1,1,1-Trichloroethane	3.15E-09	0.0%	8.10E-03	100.0%			8.10E-03
Trichloroethene	8.37E-19	0.0%	7.51E-04	100.0%			7.51E-04
M&P-Xylene	5.74E-08	0.0%	7.65E-04	100.0%			7.65E-04
O-Xylene	8.64E-09	0.0%	6.18E-04	100.0%			6.18E-04
Semivolatile Organic Compounds							
Acenaphthene	3.91E-03	50.6%	3.83E-03	49.4%			7.74E-03
Acenaphthylene	2.01E-03	77.3%	5.89E-04	22.7%			2.60E-03
Anthracene	1.55E+00	98.7%	2.06E-02	1.3%			1.57E+00
Benzo(a)anthracene	3.70E+02	100.0%	3.53E-02	0.0%			3.70E+02
Benzo(a)pyrene	1.13E+03	100.0%	2.94E-02	0.0%			1.13E+03
Benzo(b)fluoranthene	1.11E+03	100.0%	2.21E-02	0.0%			1.11E+03
Benzo(g,h,i)perylene	2.93E+03	100.0%	2.06E-02	0.0%			2.93E+03
Benzo(k)fluoranthene	1.33E+03	100.0%	2.65E-02	0.0%			1.33E+03
Carbazole	1.93E-04	3.6%	5.15E-03	96.4%			5.34E-03

TABLE 19
ESTIMATED EXPOSURE OF WHITE-TAILED DEER TO CONSTITUENTS
Peter Cooper Site
Gowanda, New York

Parameter	EE in Diet (mg/kg/day)	Diet Percent of Total Exposure	EE from Soil (mg/kg/day)	Soil Percent of Total Exposure	EE from Drinking Water (mg/kg/day)	Drinking Water Percent of Total Exposure	EE Total (mg/kg/day)
Indeno(cd-1,2,3)pyrene	3.26E+03	100.0%	1.91E-02	0.0%			3.26E+03
Chrysene	3.39E+02	100.0%	3.24E-02	0.0%			3.39E+02
Dibenzo(a,h)anthracene	1.45E+03	100.0%	7.65E-03	0.0%			1.45E+03
Dibenzofuran	1.60E-02	83.2%	3.24E-03	16.8%			1.92E-02
bis(2-Ethylhexyl)phthalate	8.08E+01	100.0%	1.02E-04	0.0%			8.08E+01
Flouranthene	1.04E+02	99.9%	8.83E-02	0.1%			1.04E+02
Fluorene	5.76E-02	90.3%	6.18E-03	9.7%			6.38E-02
2-Methylnaphthalene	1.60E-04	37.7%	2.65E-04	62.3%			4.25E-04
4-Methylphenol	2.13E-06	2.4%	8.68E-05	97.6%			8.90E-05
Naphthalene	2.51E-07	0.2%	1.62E-04	99.8%			1.62E-04
Phenanthrene	5.57E+00	98.8%	6.62E-02	1.2%			5.64E+00
Pyrene	7.30E+01	99.9%	6.48E-02	0.1%			7.31E+01
Inorganic Compounds							
Aluminum	2.41E+00	16.7%	1.21E+01	83.3%			1.45E+01
Arsenic	3.25E+00	70.6%	1.35E+00	29.4%			4.60E+00
Barium	1.29E+00	87.8%	1.72E-01	11.7%	7.23E-03	0.5%	1.47E+00
Beryllium	8.83E-04	33.3%	1.77E-03	66.7%			2.65E-03
Chromium	3.04E-01	26.2%	8.10E-01	70.0%	4.41E-02	3.8%	1.16E+00
Copper	5.03E+00	100.0%	0.00E+00	0.0%			5.03E+00
Iron	2.30E+03	99.9%	2.52E-01	0.0%	2.98E+00	0.1%	2.31E+03
Lead	8.91E+00	16.2%	4.61E+01	83.8%			5.50E+01
Manganese	9.00E+00	95.8%	3.96E-01	4.2%	2.25E-03	0.0%	9.39E+00
Mercury	2.05E-01	22.2%	7.20E-01	77.8%			9.25E-01
Nickel	1.20E-01	96.3%	4.56E-03	3.7%			1.25E-01
Selenium	4.97E-03	11.0%	4.00E-02	89.0%			4.50E-02
Vandium	8.18E-03	67.3%	3.97E-03	32.7%			1.22E-02
Zinc	8.04E+01	100.0%	2.97E-02	0.0%			8.04E+01

TABLE 20

ESTIMATED EXPOSURE OF AMERICAN ROBIN TO CONSTITUENTS

Peter Cooper Site

Gowanda, New York

	Landfill Area				Manufacturing Area					EE Total (mg/kg/day)		Bioaccumulation/Bioconcentration Factors			
Parameter	EE in Diet (mg/kg/day)	Diet Percent of Total Exposure	EE from Soil (mg/kg/day)	Soil Percent of Total Exposure	EE in Diet (mg/kg/day)	Diet Percent of Total Exposure	EE from Soil (mg/kg/day)	Soil Percent of Total Exposure	EE from Drinking Water (mg/kg/day)	Landfill Area	Manufacturing Area	Earthworm to American Robin[1]	Soil To American Robin[1]	Water to American Robin[1]	American Robin EPC for Manufacturing Area (mg/kg)
Volatile Organic Compounds															
Acetone					3.98E-01	90.3%	4.26E-02	9.7%	8.02E-05	8.02E-05	4.41E-01	1.00E+00	1.70E-10	1.63E-09	1.31E+00
Benzene	1.45E-03	90.3%	1.55E-04	9.7%	2.70E-03	90.3%	2.89E-04	9.7%		1.60E-03	2.99E-03	1.00E+00	NA	NA	8.89E-03
2-Butanone					7.96E-02	90.3%	8.51E-03	9.7%			8.81E-02	1.00E+00	NA	NA	2.62E-01
Carbon disulfide					2.05E-02	90.3%	2.19E-03	9.7%			2.27E-02	1.00E+00	NA	NA	6.73E-02
Carbon tetrachloride					2.84E+00	90.3%	3.04E-01	9.7%			3.15E+00	1.00E+00	NA	NA	9.35E+00
Chloroform					4.44E-01	90.3%	4.75E-02	9.7%			4.92E-01	1.00E+00	2.51E-08	NA	1.46E+00
Cyclohexane					1.34E+00	90.3%	1.43E-01	9.7%			1.48E+00	1.10E+00	NA	NA	4.84E+00
1,2-Dichlorobenzene					1.39E-03	90.3%	1.49E-04	9.7%			1.54E-03	1.10E+00	NA	NA	5.04E-03
1,4-Dichlorobenzene					1.31E-03	90.3%	1.40E-04	9.7%			1.45E-03	1.10E+00	NA	NA	4.73E-03
1,3-Dichlorobenzene					1.22E-03	90.3%	1.31E-04	9.7%			1.35E-03	1.10E+00	NA	NA	4.42E-03
1,1-Dichloroethane					4.55E-04	90.3%	4.86E-05	9.7%			5.04E-04	1.00E+00	NA	NA	1.50E-03
1,2-Dichloroethane					6.82E-02	90.3%	7.30E-03	9.7%			7.55E-02	1.00E+00	NA	NA	2.24E-01
cis-1,2-Dichloroethene					7.39E-02	90.3%	7.90E-03	9.7%	5.41E-05	5.41E-05	8.19E-02	1.00E+00	NA	NA	2.43E-01
Ethylbenzene	5.12E-04	90.3%	5.47E-05	9.7%	1.62E-03	90.3%	1.73E-04	9.7%		5.66E-04	1.79E-03	1.00E+00	NA	NA	5.33E-03
2-Hexanone					1.82E-02	90.3%	1.95E-03	9.7%			2.01E-02	1.00E+00	NA	NA	5.99E-02
Isopropylbenzene					4.83E-04	90.3%	5.17E-05	9.7%			5.35E-04	1.10E+00	NA	NA	1.75E-03
Methyl Acetate					5.97E-02	90.3%	6.38E-03	9.7%			6.61E-02	1.00E+00	NA	NA	1.96E-01
Methylcyclohexane					4.55E-01	90.3%	4.86E-02	9.7%			5.04E-01	1.00E+00	NA	NA	1.50E+00
4-Methyl-2-pentanone					1.11E-02	90.3%	1.19E-03	9.7%			1.23E-02	1.00E+00	NA	NA	3.65E-02
Styrene					8.24E-04	90.3%	8.82E-05	9.7%			9.13E-04	1.00E+00	NA	NA	2.71E-03
Tetrachloroethene					1.54E+01	90.3%	1.64E+00	9.7%			1.70E+01	1.00E+00	NA	NA	5.05E+01
Toluene	2.84E-03	90.3%	3.04E-04	9.7%	6.54E-04	90.3%	6.99E-05	9.7%		3.15E-03	7.24E-04	1.00E+00	NA	NA	2.15E-03
1,2,4-Trichlorobenzene					1.02E-01	90.3%	1.09E-02	9.7%			1.13E-01	1.30E+00	NA	NA	4.38E-01
1,1,1-Trichloroethane					1.56E+00	90.3%	1.67E-01	9.7%			1.73E+00	1.00E+00	NA	NA	5.14E+00
Trichloroethene					1.45E-01	90.3%	1.55E-02	9.7%			1.60E-01	1.00E+00	NA	NA	4.77E-01
M&P-Xylene	1.71E-03	90.3%	1.82E-04	9.7%	1.48E-01	90.3%	1.58E-02	9.7%		1.89E-03	1.64E-01	1.00E+00	NA	NA	4.86E-01
O-Xylene	7.96E-04	90.3%	8.51E-05	9.7%	1.19E-01	90.3%	1.28E-02	9.7%		8.81E-04	1.32E-01	1.00E+00	NA	NA	3.93E-01
Semivolatile Organic Compounds															
Acenaphthene					7.39E-01	90.3%	7.90E-02	9.7%			8.18E-01	1.20E+00	NA	NA	2.92E+00
Acenaphthylene					1.14E-01	90.3%	1.22E-02	9.7%			1.26E-01	1.30E+00	NA	NA	4.86E-01
Anthracene					3.98E+00	90.3%	4.26E-01	9.7%			4.41E+00	2.00E+00	NA	NA	2.62E+01
Benzo(a)anthracene					6.82E+00	90.3%	7.30E-01	9.7%			7.55E+00	8.00E+00	1.35E-04	NA	1.80E+02
Benzo(a)pyrene					5.69E+00	90.3%	6.08E-01	9.7%			6.29E+00	1.10E+01	3.81E-04	NA	2.06E+02
Benzo(b)fluoranthene					4.26E+00	90.3%	4.56E-01	9.7%			4.72E+00	1.20E+01	4.50E-04	NA	1.68E+02
Benzo(g,h,i)perylene					3.98E+00	90.3%	4.26E-01	9.7%			4.41E+00	1.40E+01	NA	NA	1.83E+02
Benzo(k)fluoranthene					5.12E+00	90.3%	5.47E-01	9.7%			5.66E+00	1.20E+01	4.48E-04	NA	2.02E+02
Carbazole					9.95E-01	90.3%	1.06E-01	9.7%			1.10E+00	1.10E+00	NA	NA	3.60E+00
Indeno(cd-1,2,3)pyrene					3.70E+00	90.3%	3.95E-01	9.7%			4.09E+00	1.40E+01	2.32E-03	NA	1.70E+02
Chrysene					6.25E+00	90.3%	6.69E-01	9.7%			6.92E+00	8.00E+00	1.55E-04	NA	1.65E+02
Dibenzo(a,h)anthracene					1.48E+00	90.3%	1.58E-01	9.7%			1.64E+00	1.40E+01	9.98E-04	NA	6.81E+01
Dibenzofuran					6.25E-01	90.3%	6.69E-02	9.7%			6.92E-01	1.30E+00	NA	NA	2.67E+00
bis(2-Ethylhexyl)phthalate					1.96E-02	90.3%	2.10E-03	9.7%			2.17E-02	1.30E+01	4.53E-05	NA	8.39E-01
Flouranthene					1.71E+01	90.3%	1.82E+00	9.7%			1.89E+01	3.60E+00	NA	NA	2.02E+02
Fluorene					1.19E+00	90.3%	1.28E-01	9.7%			1.32E+00	1.40E+00	NA	NA	5.50E+00
2-Methylnaphthalene					5.12E-02	90.3%	5.47E-03	9.7%			5.66E-02	1.20E+00	NA	NA	2.02E-01
4-Methylphenol					1.68E-02	90.3%	1.79E-03	9.7%			1.86E-02	1.00E+00	NA	NA	5.52E-02
Naphthalene					3.13E-02	90.3%	3.34E-03	9.7%			3.46E-02	1.10E+00	NA	NA	1.13E-01
Phenanthrene					1.28E+01	90.3%	1.37E+00	9.7%			1.42E+01	2.00E+00	NA	NA	8.42E+01
Pyrene					1.25E+01	90.3%	1.34E+00	9.7%			1.38E+01	3.60E+00	NA	NA	1.48E+02
Inorganic Compounds															
Aluminum					2.33E+03	90.3%	2.49E+02	9.7%			2.58E+03	1.00E+00	NA	NA	7.67E+03
Arsenic	2.61E+02	90.3%	2.79E+01	9.7%	4.78E+01	90.3%	5.11E+00	9.7%		2.89E+02	5.29E+01	1.00E+00	NA	NA	1.57E+02
Barium					3.31E+01	90.3%	3.56E+00	9.7%	1.39E-03	1.39E-03	3.68E+01	1.00E+00	NA	NA	1.09E+02
Beryllium					3.41E-01	90.3%	3.65E-02	9.7%			3.78E-01	1.00E+00	NA	NA	1.12E+00
Chromium	1.56E+02	90.1%	1.67E+01	9.6%	5.63E+01	89.7%	6.02E+00	9.6%	4.23E-01	1.74E+02	6.27E+01	1.00E+00	NA	NA	1.85E+02
Copper					4.86E+01	90.3%	5.20E+00	9.7%			5.38E+01	1.00E+00	NA	NA	1.60E+02
Iron					8.90E+03	90.3%	9.51E+02	9.7%	5.73E-01	5.73E-01	9.85E+03	1.00E+00	NA	NA	2.93E+04
Lead					7.65E+01	90.3%	8.18E+00	9.7%			8.47E+01	1.00E+00	NA	NA	2.52E+02
Manganese					1.39E+02	90.3%	1.49E+01	9.7%	4.33E-04	4.33E-04	1.54E+02	1.00E+00	NA	NA	4.57E+02

TABLE 20

ESTIMATED EXPOSURE OF AMERICAN ROBIN TO CONSTITUENTS

Peter Cooper Site

Gowanda, New York

	Landfill Area				Manufacturing Area					EE Total (mg/kg/day)		Bioaccumulation/Bioconcentration Factors			
Parameter	EE in Diet (mg/kg/day)	Diet Percent of Total Exposure	EE from Soil (mg/kg/day)	Soil Percent of Total Exposure	EE in Diet (mg/kg/day)	Diet Percent of Total Exposure	EE from Soil (mg/kg/day)	Soil Percent of Total Exposure	EE from Drinking Water (mg/kg/day)	Landfill Area	Manufacturing Area	Earthworm to American Robin[1]	Soil To American Robin[2]	Water to American Robin[3]	American Robin EPC for Manufacturing Area (mg/kg)
Mercury[4]					8.81E-01	90.3%	9.42E-02	9.7%			9.76E-01	1.00E+00	5.12E-05	NA	2.90E+00
Nickel					7.73E+00	90.3%	8.27E-01	9.7%			8.56E+00	1.00E+00	NA	NA	2.54E+01
Selenium					7.68E-01	90.3%	8.21E-02	9.7%			8.50E-01	1.00E+00	1.61E-02	NA	2.53E+00
Vandium					5.74E+00	90.3%	6.14E-01	9.7%			6.36E+00	1.00E+00	NA	NA	1.89E+01
Zinc	4.69E+01	90.3%	5.02E+00	9.7%	2.07E+02	90.3%	2.21E+01	9.7%		5.19E+01	2.29E+02	1.00E+00	1.25E-04	NA	6.81E+02

1 - Table 5-2, USEPA (1999)
2 - Table D-2, USEPA (1999)
3- Table D-3, USEPA (1999)
4 - Bioconcentration factors for methylmercury used
NA - Not Available

TABLE 21
ESTIMATED EXPOSURE OF RED-TAILED HAWK TO CONSTITUENTS
Peter Cooper Site
Gowanda, New York

Parameter	EE in Diet (mg/kg/day)	Diet Percent of Total Exposure	EE from Drinking Water (mg/kg/day)	Drinking Water Percent of Total Exposure	EE Total (mg/kg/day)
Volatile Organic Compounds					
Acetone	1.01E-01	100.0%	3.20E-05	0.0%	1.01E-01
Benzene	6.85E-04	100.0%			6.85E-04
2-Butanone	2.02E-02	100.0%			2.02E-02
Carbon disulfide	5.19E-03	100.0%			5.19E-03
Carbon tetrachloride	7.21E-01	100.0%			7.21E-01
Chloroform	1.13E-01	100.0%			1.13E-01
Cyclohexane	3.73E-01	100.0%			3.73E-01
1,2-Dichlorobenzene	3.89E-04	100.0%			3.89E-04
1,4-Dichlorobenzene	3.65E-04	100.0%			3.65E-04
1,3-Dichlorobenzene	3.41E-04	100.0%			3.41E-04
1,1-Dichloroethane	1.15E-04	100.0%			1.15E-04
1,2-Dichloroethane	1.73E-02	100.0%			1.73E-02
cis-1,2-Dichloroethene	1.87E-02	99.9%	2.16E-05	0.1%	1.88E-02
Ethylbenzene	4.11E-04	100.0%			4.11E-04
2-Hexanone	4.62E-03	100.0%			4.62E-03
Isopropylbenzene	1.35E-04	100.0%			1.35E-04
Methyl Acetate	1.51E-02	100.0%			1.51E-02
Methylcyclohexane	1.15E-01	100.0%			1.15E-01
4-Methyl-2-pentanone	2.81E-03	100.0%			2.81E-03
Styrene	2.09E-04	100.0%			2.09E-04
Tetrachloroethene	3.89E+00	100.0%			3.89E+00
Toluene	1.66E-04	100.0%			1.66E-04
1,2,4-Trichlorobenzene	3.37E-02	100.0%			3.37E-02
1,1,1-Trichloroethane	3.97E-01	100.0%			3.97E-01
Trichloroethene	3.68E-02	100.0%			3.68E-02
M&P-Xylene	3.75E-02	100.0%			3.75E-02
O-Xylene	3.03E-02	100.0%			3.03E-02
Semivolatile Organic Compounds					
Acenaphthene	2.25E-01	100.0%			2.25E-01
Acenaphthylene	3.75E-02	100.0%			3.75E-02
Anthracene	2.02E+00	100.0%			2.02E+00
Benzo(a)anthracene	1.38E+01	100.0%			1.38E+01
Benzo(a)pyrene	1.59E+01	100.0%			1.59E+01
Benzo(b)fluoranthene	1.30E+01	100.0%			1.30E+01

TABLE 21
ESTIMATED EXPOSURE OF RED-TAILED HAWK TO CONSTITUENTS
Peter Cooper Site
Gowanda, New York

Parameter	EE in Diet (mg/kg/day)	Diet Percent of Total Exposure	EE from Drinking Water (mg/kg/day)	Drinking Water Percent of Total Exposure	EE Total (mg/kg/day)
Benzo(g,h,i)perylene	1.41E+01	100.0%			1.41E+01
Benzo(k)fluoranthene	1.56E+01	100.0%			1.56E+01
Carbazole	2.78E-01	100.0%			2.78E-01
Indeno(cd-1,2,3)pyrene	1.31E+01	100.0%			1.31E+01
Chrysene	1.27E+01	100.0%			1.27E+01
Dibenzo(a,h)anthracene	5.25E+00	100.0%			5.25E+00
Dibenzofuran	2.06E-01	100.0%			2.06E-01
bis(2-Ethylhexyl)phthalate	6.47E-02	100.0%			6.47E-02
Flouranthene	1.56E+01	100.0%			1.56E+01
Fluorene	4.24E-01	100.0%			4.24E-01
2-Methylnaphthalene	1.56E-02	100.0%			1.56E-02
4-Methylphenol	4.25E-03	100.0%			4.25E-03
Naphthalene	8.73E-03	100.0%			8.73E-03
Phenanthrene	6.49E+00	100.0%			6.49E+00
Pyrene	1.14E+01	100.0%			1.14E+01
Inorganic Compounds					
Aluminum	5.91E+02	100.0%			5.91E+02
Arsenic	1.21E+01	100.0%			1.21E+01
Barium	8.44E+00	100.0%	5.54E-04	0.0%	8.44E+00
Beryllium	8.65E-02	100.0%			8.65E-02
Chromium	1.43E+01	100.0%	3.38E-03	0.0%	1.43E+01
Copper	1.23E+01	100.0%			1.23E+01
Iron	2.26E+03	100.0%	2.29E-01	0.0%	2.26E+03
Lead	1.94E+01	100.0%			1.94E+01
Manganese	3.53E+01	100.0%	1.73E-04	0.0%	3.53E+01
Mercury	2.24E-01	100.0%			2.24E-01
Nickel	1.96E+00	100.0%			1.96E+00
Selenium	1.95E-01	100.0%			1.95E-01
Vandium	1.46E+00	100.0%			1.46E+00
Zinc	5.25E+01	100.0%			5.25E+01

Exposure Assumptions:

1. Use combined soils data set since red-tailed hawk has large home range and can utilizes the entire site
2. Combined area use.
3. Water intake use assumed maximal (highest) exposure concentration.

TABLE 22A
TOXICITY REFERENCE VALUES USED IN THE ECOLOGICAL RISK ASSESSMENT
Peter Cooper Site
Gowanda, New York

Parameter	Avian Test Species (mg/kg/day)		American Robin (mg/kg/day)	Red-Tailed Hawk (mg/kg/day)	Mammalian Test Species (mg/kg/day)		Mink (mg/kg/day)	Raccoon (mg/kg/day)	Red Fox (mg/kg/day)	Deer Mouse (mg/kg/day)	White-tailed Deer (mg/kg/day)	Benthic Invertebrates[4,16,17] (mg/kg)	Terrestrial Invertebrates[7] (mg/kg)	Wetland Plants[8] (mg/kg)	Terrestrial Plants[8] (mg/kg)	Fish[9,14,18,19] (mg/l)
Volatile Organic Compounds																
Acetone	6.22E+03	14-ch[10]	6.22E+03	6.22E+03	1.00E+01	rat[1]	7.70E+00	4.44E+00	5.30E+00	2.86E+01	2.80E+00	8.70E-03				
Benzene					2.64E+01	mu[1]	1.10E+01	5.16E+00	7.50E+00	1.32E+01	4.00E+00	1.60E-01				1.90E-01
2-Butanone					1.77E+03	rat[1]	1.36E+03	7.86E+02	9.35E+02	3.06E+03	4.97E+02	2.70E-01				
Carbon disulfide					1.10E+01	rb[1]	2.12E+01	1.08E+01	2.09E+01	6.96E+01	8.50E+00					
Carbon tetrachloride					1.60E+01	rat[1]	1.23E+01	7.10E+00	8.40E+00	4.57E+01	4.50E+00					
Chloroform					1.50E+01	rat[1]	1.15E+01	6.66E+00	7.90E+00	4.29E+01	7.20E+00					
Cyclohexane					NA		NA	NA	NA	NA	NA					
1,2-Dichlorobenzene					8.57E+01	rat[2]	7.46E+01	3.80E+01	3.31E+01	2.45E+02	6.10E+00	3.40E-01				5.00E-01
1,4-Dichlorobenzene					8.00E-01	rat[1]	6.97E-01	3.55E-01	3.09E-01	2.29E+00	5.70E-02	3.50E-01	2.00E+01			5.00E-01
1,3-Dichlorobenzene*					8.00E-01	rat[1]	6.97E-01	3.55E-01	3.09E-01	2.29E+00	5.70E-02	1.70E+00				5.00E-01
1,1-Dichloroethene					2.26E+01	rat[1]	1.96E+01	1.00E+01	8.72E+00	6.45E+01	1.61E+00					
1,2-Dichloroethene	1.72E+01	1-ch[1]	1.72E+01	1.72E+01	5.00E+01	mu[1]	2.16E+01	9.79E+00	1.48E+01	6.30E+01	7.90E+00					
cis-1,2-Dichloroethene					4.52E+01	mu[1]	1.88E+01	8.85E+00	1.29E+01	5.69E+01	6.90E+00					
Ethylbenzene					9.71E+01	rat[1]	8.46E+01	4.31E+01	3.75E+01	2.77E+02	6.91E+00	3.60E+00				1.50E-01
2-Hexanone*					4.14E+00	rat[1]	3.61E+00	1.84E+00	1.60E+00	1.18E+01	2.95E-01					4.30E+01
Isopropylbenzene (cumene)					1.54E+02	rat[1]	1.34E+02	6.84E+01	5.95E+01	4.40E+02	1.10E+01					2.60E-01
Methyl Acetate					2.63E+00	rb[1]	2.29E+00	1.17E+00	1.02E+00	7.51E+00	1.87E-01					
Methylcyclohexane					NA		NA	NA	NA	NA	NA					
4-Methyl-2-pentanone*					3.33E+00	rat[1]	2.90E+00	1.48E+00	1.29E+00	9.51E+00	2.37E-01	3.90E+01				5.70E+01
Styrene					2.00E+02	dog[1]	5.77E+02	2.94E+02	8.47E+02	1.89E+03	5.17E+02			3.00E+02	3.00E+02	
Tetrachloroethene					1.40E+01	mu[1]	1.22E+01	6.22E+00	5.41E+00	4.00E+01	9.97E-01	5.30E-01				
Toluene					2.60E+01	mu[1]	1.08E+01	5.09E+00	7.40E+00	3.28E+01	3.90E+00	6.70E-01		2.00E+02	2.00E+02	1.00E-01
1,2,4-Trichlorobenzene					1.48E+01	rat[1]	1.29E+01	6.57E+00	5.72E+00	4.23E+01	1.05E+00	2.00E+00	2.00E+01			5.00E-01
1,1,1-Trichloroethane					1.00E+03	mu[1]	4.33E+02	1.96E+02	2.97E+02	1.26E+03	1.58E+02	1.70E-01				
Trichloroethene					7.00E-01	mu[1]	2.91E-01	1.37E-01	2.00E-01	8.82E-01	1.06E-01	1.60E+00				
M&P-Xylene					2.10E+00	mu[1]	8.74E-01	4.11E-01	6.00E-01	2.65E+00	3.19E-01	2.50E-02				6.50E-03
O-Xylene	8.54E+02	14-ch[10]	8.54E+02	8.54E+02	2.10E+00	mu[1]	8.74E-01	4.11E-01	6.00E-01	2.65E+00	3.19E-01	2.50E-02				6.50E-03
Semivolatile Organic Compounds																
Acenaphthene*	1.00E+03	md[11]	1.00E+03	1.00E+03	1.75E+02	mu[1]	6.72E+01	3.43E+01	1.32E+01	2.20E+02	1.07E+00	3.00E+00				4.80E-03
Acenaphthylene*	1.00E+03	md[11]	1.00E+03	1.00E+03	1.75E+02	mu[1]	6.72E+01	3.43E+01	1.32E+01	2.20E+02	1.07E+00	3.30E-01				5.00E-03
Anthracene	1.80E+03	md[11]	1.00E+03	1.00E+03	1.00E+03	mu[1]	3.84E+02	1.96E+02	7.52E+01	1.26E+03	6.10E+00	2.20E-01				3.80E-03
Benzo(a)anthracene**	4.00E+01	ck mdch[12]	4.00E+01	4.00E+01	1.00E+00	mu[1]	4.20E-01	1.96E-01	2.90E-01	1.26E+00	1.50E-01	2.60E-01				3.00E-03
Benzo(a)pyrene*	4.00E+01	ck mdch[12]	4.00E+01	4.00E+01	1.00E+00	mu[1]	4.20E-01	1.96E-01	2.90E-01	1.26E+00	1.50E-01	3.50E-01				1.00E-01
Benzo(b)fluoranthene**	4.00E+01	ck mdch[12]	4.00E+01	4.00E+01	1.25E+02	mu[1]	4.80E+01	2.45E+01	9.39E+00	1.57E+02	7.63E-01	2.72E-02				1.00E-01
Benzo(g,h,i)perylene**	4.00E+01	ck mdch[12]	4.00E+01	4.00E+01	7.50E+01	mu[1]	2.88E+01	1.47E+01	5.64E+00	9.45E+01	4.58E-01	2.90E-01				1.00E-01
Benzo(k)fluoranthene**	4.00E+01	ck mdch[12]	4.00E+01	4.00E+01	1.25E+02	mu[1]	4.80E+01	2.45E+01	9.39E+00	1.57E+02	7.63E-01	2.72E-02				1.00E-01
Carbazole					8.00E+00	rat[1]	6.97E+00	3.55E+00	3.09E+00	2.29E+01	5.70E-01	2.06E+01				
Indeno(1,2,3-cd)pyrene**	4.00E+01	ck mdch[12]	4.00E+01	4.00E+01	1.25E+02	mu[1]	4.80E+01	2.45E+01	9.39E+00	1.57E+02	7.63E-01	7.80E-02				1.00E-01
Chrysene*	4.00E+01	ck mdch[12]	4.00E+01	4.00E+01	1.00E+00	mu[1]	4.20E-01	1.96E-01	2.90E-01	1.26E+00	1.50E-01	5.00E-01				5.00E-03
Dibenzo(a,h)anthracene**	4.00E+01	ck mdch[12]	4.00E+01	4.00E+01	1.00E+00	mu[1]	4.20E-01	1.96E-01	2.90E-01	1.26E+00	1.50E-01	3.30E-01				1.00E-01
Dibenzofuran*	2.18E-01	rwb[13]	2.18E-01	2.18E-01	1.00E+00	mu[1]	4.20E-01	1.96E-01	2.90E-01	1.26E+00	1.50E-01	2.00E+00				
bis(2-Ethylhexyl)phthalate	1.10E+00	rd[11]	1.10E+00	1.10E+00	1.30E+01	mu[14]	1.13E+01	5.77E+00	5.03E+00	3.71E+01	9.26E-01	4.39E+00				6.00E-01
Fluoranthene*	4.00E+01	ck mdch[12]	4.00E+01	4.00E+01	1.25E+02	mu[1]	4.80E+01	2.45E+01	9.39E+00	1.57E+02	7.63E-01	2.24E+01				1.30E-01
Fluorene	1.00E+03	md[11]	1.00E+03	1.00E+03	1.25E+02	mu[1]	4.80E+01	2.45E+01	9.39E+00	1.57E+02	7.63E-01	3.46E-02	3.00E+01			5.40E-01
2-Methylnaphthalene*	1.00E+03	md[11]			7.00E-01	rat[1]	6.10E-01	3.11E-01	2.71E-01	2.00E+00	4.98E-02	3.30E-01				4.70E-01
4-Methylphenol*	2.06E-01	rwb[13]	2.06E-01	2.06E-01	5.00E+00	rat[1]	4.35E+00	2.22E+00	1.93E+00	1.43E+01	3.56E-01	6.70E-01				2.60E-01
Naphthalene*	1.00E+03	md[11]	1.00E+03	1.00E+03	7.10E+00	rat[1]	6.18E+00	3.15E+00	2.74E+00	2.03E+01	5.06E-01	3.30E-01				1.30E-02
Phenanthrene	1.00E+03	md[11]	1.00E+03	1.00E+03	2.60E+00	mu[1]	9.98E-01	5.09E-01	1.95E-01	3.28E+00	1.59E-02	3.30E-01				5.00E-03
Pyrene	4.00E+01	ck mdch[12]	4.00E+01	4.00E+01	7.50E+01	mu[1]	2.88E+01	1.47E+01	5.64E+00	9.45E+01	4.58E-01	5.70E-01				4.60E-03

TABLE 22A
TOXICITY REFERENCE VALUES USED IN THE ECOLOGICAL RISK ASSESSMENT
Peter Cooper Site
Gowanda, New York

Parameter	Avian Test Species (mg/kg/day)		American Robin (mg/kg/day)	Red-Tailed Hawk (mg/kg/day)	Mammalian Test Species (mg/kg/day)		Mink (mg/kg/day)	Raccoon (mg/kg/day)	Red Fox (mg/kg/day)	Deer Mouse (mg/kg/day)	White-tailed Deer (mg/kg/day)	Benthic Invertebrates[a,16,17] (mg/kg)	Terrestrial Invertebrates[5] (mg/kg)	Wetland Plants[5] (mg/kg)	Terrestrial Plants[5] (mg/kg)	Plants[4,14,15,19] (mg/l)
Inorganic Compounds																
Aluminum	1.10E+02	rd[1]	1.10E+02	1.10E+02	1.93E+00	mu[1]	8.03E-01	3.78E-01	5.51E-01	2.43E+00	2.93E-01	5.80E+04		5.00E+01	5.00E+01	3.28E+00
Arsenic	5.14E+00	md[1]	5.14E+00	5.14E+00	1.26E-01	mu[1]	5.20E-02	2.47E-02	3.60E-02	1.59E-01	1.90E-02	6.00E+00	6.80E+00	1.00E+01	1.00E+01	1.50E-01
Barium	2.08E+01	ck[1]	2.08E+01	2.08E+01	5.10E+00	rat[1]	4.10E+00	2.26E+00	2.80E+00	1.46E+01	1.50E+00			5.00E+02	5.00E+02	
Beryllium					6.60E-01	rat[1]	5.10E-01	2.93E-01	3.50E-01	1.89E+00	1.90E-01	3.80E-03		1.00E+01	1.00E+01	1.10E+00
Chromium	1.00E+00	bd[1]	1.00E+00	1.00E+00	2.74E+03	rat[1]	2.11E+03	1.22E+03	1.45E+03	7.82E+03	7.68E+02	2.60E+01	4.00E-01	1.00E+00	1.00E+00	1.28E-01
Cobalt					5.00E+00	rat[1,2]	4.35E+00	2.22E+00	1.93E+00	1.43E+01	3.56E-01			2.00E+01	1.00E+01	3.00E-01
Copper	6.17E+01	l-ck[1]	6.17E+01	6.17E+01	1.17E+01	mink[1]	1.17E+01	7.65E+00	8.00E+00	7.65E+00	4.30E+00	1.60E+01	3.20E+00	1.00E+02	1.00E+02	1.58E-02
Iron[6]					2.60E+01	rat[13]						2.00E+04				3.00E-01
Lead	3.85E+00	ks[1]	3.85E+00	3.85E+00	8.00E+00	rat[1]	6.15E+00	3.55E+00	4.22E+00	2.29E+01	2.24E+00	3.10E+01	5.00E+02	5.00E+01	5.00E+01	7.77E-01
Manganese	9.91E+02	pf[1]	9.91E+02	9.91E+02	8.80E+01	rat[1]	6.80E+01	3.91E+01	4.60E+01	2.51E+02	2.50E+01	4.60E+02		5.00E+02	5.00E+02	
Mercury	4.50E-01	pf[1]	4.50E-01	4.50E-01	1.00E+00	mink[1]	1.00E+00	6.54E-01	6.90E-01	6.54E-01	3.60E-01	1.30E-01	1.00E-01	3.00E-01	3.00E-01	7.70E-01
Nickel	7.74E+01	md[1]	7.74E+01	7.74E+01	4.00E+01	rat[1]	3.08E+01	1.78E+01	2.11E+01	1.14E+02	1.12E+01	1.60E+01	2.00E+02	3.00E+01	3.00E+01	9.15E-02
Selenium	5.00E-01	md[1]	5.00E-01	5.00E-01	2.00E-01	rat[1]	1.54E-01	8.88E-02	1.06E-01	5.72E-01	5.60E-02		7.00E+01	1.00E+00	1.00E+00	4.60E-02
Vanadium	1.14E+01	md[1]	1.14E+01	1.14E+01	2.10E-01	rat[1]	1.50E-01	9.32E-02	1.03E-01	6.00E-01	5.50E-02			2.00E+00	2.00E+00	1.40E-02
Zinc	1.45E+01	wh[1]	1.45E+00	1.45E+00	1.60E+02	rat[1]	1.23E+02	7.10E+01	8.45E+01	4.57E+02	4.49E+01	1.20E+02	2.00E+02	5.00E+01	5.00E+01	9.31E-02

***All values based on NOAEL or NOEC concentrations unless otherwise indicated.

Notes:
1. Sample et al 1996
2. IRIS 2004
3. Hener 1997
4. NTP: National Toxicology Program's Chemical Health and Safety Data Website: http://ntp-server.niehs.nih.gov/Main_Pages/Chem-HS.html
5. http://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?HSDB
6. Jones et al 1997 and NYSDEC, 1994
7. Efroymson et al 1997a
8. Efroymson et al 1997b
9. NYSDEC 1994
10. Hill and Camardese. 1986
11. Eisler 1985
12. Ridgon and Neal. 1985
13. Schafer et al 1983
14. ATSDR 1993 - 1998. Toxicological Profile
15. RTECS. 1994
16. AQUIRE Database 1997-2001
17. USEPA Region IV. Surface Water Screening Value
18. USEPA. 1991
a Value for 1,4-dichlorobenzene used
b Value for acenaphthene used
c Value for benzo(a)pyrene used
d Value for fluoranthene used
e Value for pyrene used
*See Tables 22B and 22C for derivation of TRV

Test Species and Body Weights[1]

mallard duck (md) 1.17E+00	mink 1.12E+00	ringed dove (rd) 1.55E-01	chicken (ck) 1.60E+00
meadow vole (mu) 3.00E-02	dog 1.27E+01	rabbit (rb) 3.80E+00	Japanese quail (jq) 1.50E-01
1 day old chick (l-ck); 5.43E-01	rat 3.50E-01	black duck (bd) 1.25E+00	kestrel (ke) 1.30E-01
14 day old chick (14-ck		red winged blackbird (rwb)	white leghorn (wh) 1.94E+00

***All values based on NOAEL or NOEC concentrations unless otherwise indicated.

Notes:
1. Sample et al 1996
2. IRIS 2004
3. Hener 1997
4. NTP: National Toxicology Program's Chemical Health and Safety Data Website: http://ntp-server.niehs.nih.gov/Main_Pages/Chem-HS.html
5. http://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?HSDB
6. Jones et al 1997 and NYSDEC, 1994
7. Efroymson et al 1997a
8. Efroymson et al 1997b
9. NYSDEC 1994
10. Hill and Camardese. 1986
11. Eisler 1985
12. Ridgon and Neal. 1985
13. Schafer et al 1983
14. ATSDR 1993 - 1998. Toxicological Profile
15. RTECS. 1994
16. AQUIRE Database 1997-2001
17. USEPA Region IV. Surface Water Screening Value
18. USEPA. 1991
a Value for 1,4-dichlorobenzene used
b Value for acenaphthene used
c Value for benzo(a)pyrene used
d Value for fluoranthene used
e Value for pyrene used
*See Tables 22B and 22C for derivation of TRV

Test Species and Body Weights[1]

mallard duck (md) 1.17E+00 | mink 1.12E+00 | ringed dove (rd) 1.55E-01 | chicken (ck) 1.60E+00
meadow vole (mu) 3.00E-02 | dog 1.27E+01 | rabbit (rb) 3.80E+00 | Japanese quail (jq) 1.50E-01
1 day old chick (1-ck); 5.43E-01 | rat 3.50E-01 | black duck (bd) 1.25E+00 | kestrel (ke) 1.30E-01
14 day old chick (14-ck | | red winged blackbird (rwb) | white leghorn (wh) 1.94E+00

Table 22B. Terrestrial Animals TRV Derivation for Values Used in the Ecological Risk Assessment
Peter Cooper Site
Gowanda, New York

COPEC	Concentration/Dose	Units	Endpoint CF	Study Duration CF	Total CF	TRV	Applicable Species
Arsenic	6.80E+01	mg/kg	10 (EC_{56}; 5 weeks LOEC)	1	10	6.80E+00	Terrestrial Invertebrate
Copper	3.20E+01	mg/kg	10 (21-dy; NOEC)	1	10	3.20E+00	Terrestrial Invertebrate
Dibenzofuran	2.18E+01	mg/kg/day	10 (LC_{50})	10 (18-hr)	100	2.18E-01	Avian
4-Methylphenol	2.06E+01	mg/kg/day	10 (LC_{50})	10 (18-hr)	100	2.06E-01	Avian
Naphthalene	7.10E+01	mg/kg/day	10 (subchronic)	1	10	7.10E+00	Mammal
2-Methylnaphthalene	3.50E+00	mg/kg/day	5 ($BMDL_{05}$)	1	5	7.00E-01	Mammal
Iron	2.60E+03	mg/kg/day	10 (LC_{50})	10	100	2.60E+01	Mammal

Table 22C. Fish TRV Derivation for Values Used in the Ecological Risk Assessment
Peter Cooper Site
Gowanda, New York

COPEC	EC (mg/l)		Endpoint CF	Study Duration CF	Total CF	Fish TRV
2-Hexanone	4.28E+02	(LC_{50} mortality; 4-dy flow)	10	10	100	4.28E+00
4-Methyl-2-pentanone	5.70E+01	(Reproductive; 5-dy NOEC)	1	10	10	5.70E+00
4-Methylphenol	2.57E+00	(Growth; 32-dy LOEC)	10	1	10	2.57E-01
Fluoranthene	1.30E-02	(Mortality; 96-hr LC_{50})	10	10	100	1.30E-04
Benzo(a)pyrene Benzo(b)fluoranthene Benzo(ghi)perylene Benzo(k)fluoranthene Dibenz(ah)anthracene Indeno(123-cd)pyrene	1.00E+00	(Mortality bluegill; 6-month LC_{87}, benzo(a)anthracene surrogate)	10	1	10	1.00E-01
Acenaphthylene	5.00E-01	(Mortality; 30-dy LC_{12}; fluoranthene surrogate)	10	1	10	5.00E-02

TABLE 23
HAZARD QUOTIENTS FOR ENDPOINT SPECIES
Peter Cooper Site
Gowanda, New York

	American Robin		Red-Tailed Hawk	Mink	Raccoon	Red Fox	Deer Mouse		White-tailed Deer	Benthic Invertebrates	
Parameter	Landfill	Manufact. Area					Landfill	Manuf. Area		Wetland Area	Creek
Volatile Organic Compounds											
Acetone	1.29E-08	7.08E-05	1.62E-05	6.14E-01	3.22E-02	1.91E-02		**3.73E+00**	**8.67E+00**		**8.97E+00**
Benzene				8.55E-05	2.03E-04	9.16E-05	9.95E-07	1.85E-06	3.50E-06	5.31E-02	1.56E-02
2-Butanone				6.01E-05	3.62E-05	2.17E-05		5.98E-04	1.39E-03		3.52E-02
Carbon disulfide				4.43E-04	6.97E-04	2.50E-04		6.77E-06	1.26E-05		
Carbon tetrachloride								1.41E-03			
Chloroform								2.43E-04			
Cyclohexane				NC	NC	NC		NC	NC		NC
1,2-Dichlorobenzene								1.30E-07			
1,4-Dichlorobenzene					1.43E-03	1.18E-03		1.31E-05	1.19E-04		
1,3-Dichlorobenzene											
1,1-Dichloroethane								1.82E-07			
1,2-Dichloroethane	3.15E-06	4.39E-03	1.01E-03					8.40E-05			
cis-1,2-Dichloroethene				5.41E-04				3.85E-05	9.98E-05		NC
Ethylbenzene					1.42E-05	1.10E-05	4.20E-08	1.33E-07	1.21E-06	9.44E-04	
2-Hexanone					3.52E-03	2.89E-03		2.01E-04	1.84E-03		
Isopropylbenzene								2.71E-08			
Methyl Acetate					1.82E-02	1.49E-02		4.68E-01	**4.28E+00**		
Methylcyclohexane											NC
4-Methyl-2-pentanone				3.25E-04	2.69E-03	2.19E-03		4.90E-04	4.47E-03		NC
Styrene								9.91E-09			
Tetrachloroethene					8.80E-01	7.21E-01		8.73E-03	7.97E-02		
Toluene				2.37E-04	9.52E-05	2.48E-05	1.97E-06	4.54E-07	3.77E-06	2.69E-02	1.01E-02
1,2,4-Trichlorobenzene					7.05E-03	5.87E-03		1.73E-04	1.58E-03		
1,1,1-Trichloroethane					2.85E-03	1.34E-03		2.82E-05	5.12E-05		
Trichloroethene					3.77E-01	1.84E-01		3.74E-03	7.08E-03		
M&P-Xylene				1.16E-03	1.28E-01	6.27E-02	1.47E-05	1.27E-03	2.40E-03	6.00E-01	1.08E-01
O-Xylene	1.03E-06	1.55E-04	3.55E-05		1.04E-01	5.06E-02	6.85E-06	1.03E-03	1.94E-03	1.76E-01	

TABLE 23
HAZARD QUOTIENTS FOR ENDPOINT SPECIES
Peter Cooper Site
Gowanda, New York

	American Robin		Red-Tailed Hawk	Mink	Raccoon	Red Fox	Deer Mouse		White-tailed Deer	Benthic Invertebrates	
Parameter	**Landfill**	**Manufact. Area**					**Landfill**	**Manuf. Area**		**Wetland Area**	**Creek**
Semivolatile Organic Compounds											
Acenaphthene		8.18E-04	2.25E-04		9.07E-03	1.71E-02		3.64E-03	7.25E-03		
Acenaphthylene		1.26E-04	3.75E-05		1.50E-03	2.84E-03		5.17E-05	2.43E-03		
Anthracene		4.41E-03	2.02E-03		1.38E-02	2.65E-02		5.49E-03	2.58E-01		
Benzo(a)anthracene		1.89E-01	3.46E-01		**9.09E+01**	**4.66E+01**		**1.29E+03**	**2.47E+03**		
Benzo(a)pyrene		1.57E-01	3.97E-01		**1.04E+02**	**5.33E+01**		**3.95E+03**	**7.55E+03**		
Benzo(b)fluoranthene		1.18E-01	3.25E-01		6.79E-01	**1.35E+00**		**3.09E+01**	**1.45E+03**		
Benzo(g,h,i)perylene		1.10E-01	3.53E-01		**1.23E+00**	**2.44E+00**		**1.36E+02**	**6.40E+03**		
Benzo(k)fluoranthene		1.42E-01	3.89E-01		8.15E-01	**1.62E+00**		**3.70E+01**	**1.74E+03**		
Carbazole		NC	NC		1.09E-01	8.98E-02		1.03E-03	9.38E-03		
Indeno(cd-1,2,3)pyrene		1.02E-01	3.28E-01		6.86E-01	**1.36E+00**		**9.10E+01**	**4.28E+03**		
Chrysene		1.73E-01	3.17E-01		**8.34E+01**	**4.27E+01**		**1.18E+03**	**2.26E+03**		
Dibenzo(a,h)anthracene		4.09E-02	1.31E-01		**3.43E+01**	**1.76E+01**		**5.04E+03**	**9.63E+03**		
Dibenzofuran		**3.18E+00**	9.46E-01		**1.45E+00**	7.08E-01		6.71E-02	1.28E-01		
bis(2-Ethylhexyl)phthalate		1.97E-02	5.88E-02		1.43E-02	1.25E-02		**9.56E+00**	**8.73E+01**		
Fluoranthene		4.72E-01	3.89E-01		8.32E-01	**1.63E+00**		**2.90E+00**	**1.36E+02**		
Fluorene		1.32E-03	4.24E-04		2.37E-02	4.49E-02		1.78E-03	8.36E-02		
2-Methylnaphthalene		NC	NC		6.92E-02	5.74E-02		9.34E-04	8.53E-03		
4-Methylphenol		9.01E-02	2.07E-02		2.69E-03	2.21E-03		2.74E-05	2.50E-04		
Naphthalene		3.46E-05	8.73E-06		3.85E-03	3.18E-03		3.51E-05	3.21E-04		
Phenanthrene		1.42E-02	6.49E-03		**1.70E+01**	**3.28E+01**		**7.57E+00**	**3.55E+02**		
Pyrene		3.46E-01	2.86E-01		**1.02E+00**	**1.99E+00**		**3.40E+00**	**1.60E+02**		
Inorganic Compounds											
Aluminum		**2.35E+01**	**5.39E+00**	**2.22E+02**	**2.36E+03**	**1.08E+03**		**2.62E+01**	**4.94E+01**		1.06E-01
Arsenic	**5.63E+01**	**1.03E+01**	**2.36E+00**	**7.02E+00**	**9.94E+02**	**3.84E+02**	**1.27E+02**	**2.33E+01**	**2.42E+02**	**2.72E+00**	**1.60E+00**
Barium	6.68E-05	**1.77E+00**	4.06E-01	6.52E-01	**5.41E+00**	**3.02E+00**		4.42E-01	9.81E-01		NC
Beryllium	NC	NC	NC		4.15E-01	2.48E-01		6.17E-03	1.39E-02		
Chromium	**1.74E+02**	**6.27E+01**	**1.43E+01**		1.98E-02	1.05E-02	6.34E-04	2.33E-04	1.51E-03	**2.13E+00**	
Cobalt	NC	NC	NC	4.87E-01							NC
Copper		8.72E-01	2.00E-01		**2.26E+00**	**1.55E+00**		**3.03E+00**	**1.17E+00**		
Iron	NC	NC	NC								
Lead		**2.20E+01**	**5.04E+00**		**7.67E+00**	**4.61E+00**		**1.79E+00**	**2.45E+01**		
Manganese	4.37E-07	1.55E-01	3.56E-02	3.27E-02	**1.27E+00**	7.69E-01		1.70E-01	3.76E-01		
Mercury		**2.17E+00**	4.97E-01		4.80E-01	3.25E-01		**1.41E+00**	**2.57E+00**		
Nickel		1.11E-01	2.53E-02	2.43E-02	1.65E-01	9.31E-02		6.16E-03	1.11E-02		**1.14E+00**
Selenium		**1.70E+00**	3.90E-01	2.36E-01	**3.20E+00**	**1.84E+00**		6.88E-02	8.04E-01		NC
Vandium		5.58E-01	1.28E-01	**2.32E+01**	**3.48E+01**	**1.42E+01**		2.78E-01	2.21E-01		NC
Zinc	**3.58E+01**	**1.58E+02**	**3.62E+01**		**1.08E+00**	6.23E-01	1.77E-01	7.83E-01	**1.79E+00**	**2.42E+00**	

NC = Hazard Quotient not calculated

TABLE 23
HAZARD QUOTIENTS FOR ENDPOINT SPECIES
Peter Cooper Site
Gowanda, New York

	Terrestrial Invertebrates		Wetland Plants	Terrestrial Plants		Fish
Parameter	Landfill	Manufact. Area		Landfill	Manufact. Area	
Volatile Organic Compounds						
Acetone		NC			NC	NC
Benzene	NC	NC	NC	NC	NC	
2-Butanone		NC			NC	
Carbon disulfide		NC			NC	
Carbon tetrachloride		NC			NC	
Chloroform		NC			NC	
Cyclohexane		NC			NC	
1,2-Dichlorobenzene		NC			NC	
1,4-Dichlorobenzene		2.15E-04			NC	
1,3-Dichlorobenzene		NC			NC	
1,1-Dichloroethane		NC			NC	
1,2-Dichloroethane		NC			NC	
cis-1,2-Dichloroethene		NC			NC	NC
Ethylbenzene	NC	NC	NC	NC	NC	
2-Hexanone		NC			NC	
Isopropylbenzene		NC			NC	
Methyl Acetate		NC			NC	
Methylcyclohexane		NC			NC	
4-Methyl-2-pentanone		NC			NC	
Styrene		NC			2.82E-15	
Tetrachloroethene		NC			NC	
Toluene	NC	NC	5.19E-33	6.63E-34	6.63E-34	
1,2,4-Trichlorobenzene		1.68E-02			NC	
1,1,1-Trichloroethane		NC			NC	
Trichloroethene		NC			NC	
M&P-Xylene	NC	NC	NC	NC	NC	
O-Xylene	NC	NC	NC	NC	NC	

TABLE 23
HAZARD QUOTIENTS FOR ENDPOINT SPECIES
Peter Cooper Site
Gowanda, New York

	Terrestrial Invertebrates		Wetland Plants	Terrestrial Plants		Fish
Parameter	**Landfill**	**Manufact. Area**		**Landfill**	**Manufact. Area**	
Semivolatile Organic Compou						
Acenaphthene		NC			NC	
Acenaphthylene		NC			NC	
Anthracene		NC			NC	
Benzo(a)anthracene		NC			NC	
Benzo(a)pyrene		NC			NC	
Benzo(b)fluoranthene		NC			NC	
Benzo(g,h,i)perylene		NC			NC	
Benzo(k)fluoranthene		NC			NC	
Carbazole		NC			NC	
Indeno(cd-1,2,3)pyrene		NC			NC	
Chrysene		NC			NC	
Dibenzo(a,h)anthracene		NC			NC	
Dibenzofuran		NC			NC	
bis(2-Ethylhexyl)phthalate		NC			NC	
Fluoranthene		NC			NC	
Fluorene		1.31E-01			NC	
2-Methylnaphthalene		NC			NC	
4-Methylphenol		NC			NC	
Naphthalene		NC			NC	
Phenanthrene		NC			NC	
Pyrene		NC			NC	
Inorganic Compounds						
Aluminum		NC			**3.28E+00**	
Arsenic	NC	NC	7.82E-02	8.06E-01	1.61E-02	
Barium		NC			**1.76E+00**	NC
Beryllium		NC			1.20E-02	
Chromium	**1.29E+03**	**4.63E+02**	4.15E-01	**1.49E+00**	1.49E-01	
Cobalt		NC				
Copper		**5.00E+01**			6.84E-01	
Iron		NC			NC	**9.53E+01**
Lead		5.03E-01			**2.42E+00**	
Manganese		NC			2.45E-01	NC
Mercury		**2.90E+01**			**9.30E+00**	
Nickel		1.27E-01			5.44E-02	
Selenium		3.61E-02			6.75E-02	
Vandium		NC			5.56E-02	
Zinc	7.72E-01	**3.40E+00**	**8.70E+00**	**2.18E+01**	**2.18E+01**	

NC = Hazard Quotient not calculated

TABLE 24
RISK CHARACTERIZATION
Peter Cooper Site
Gowanda, New York

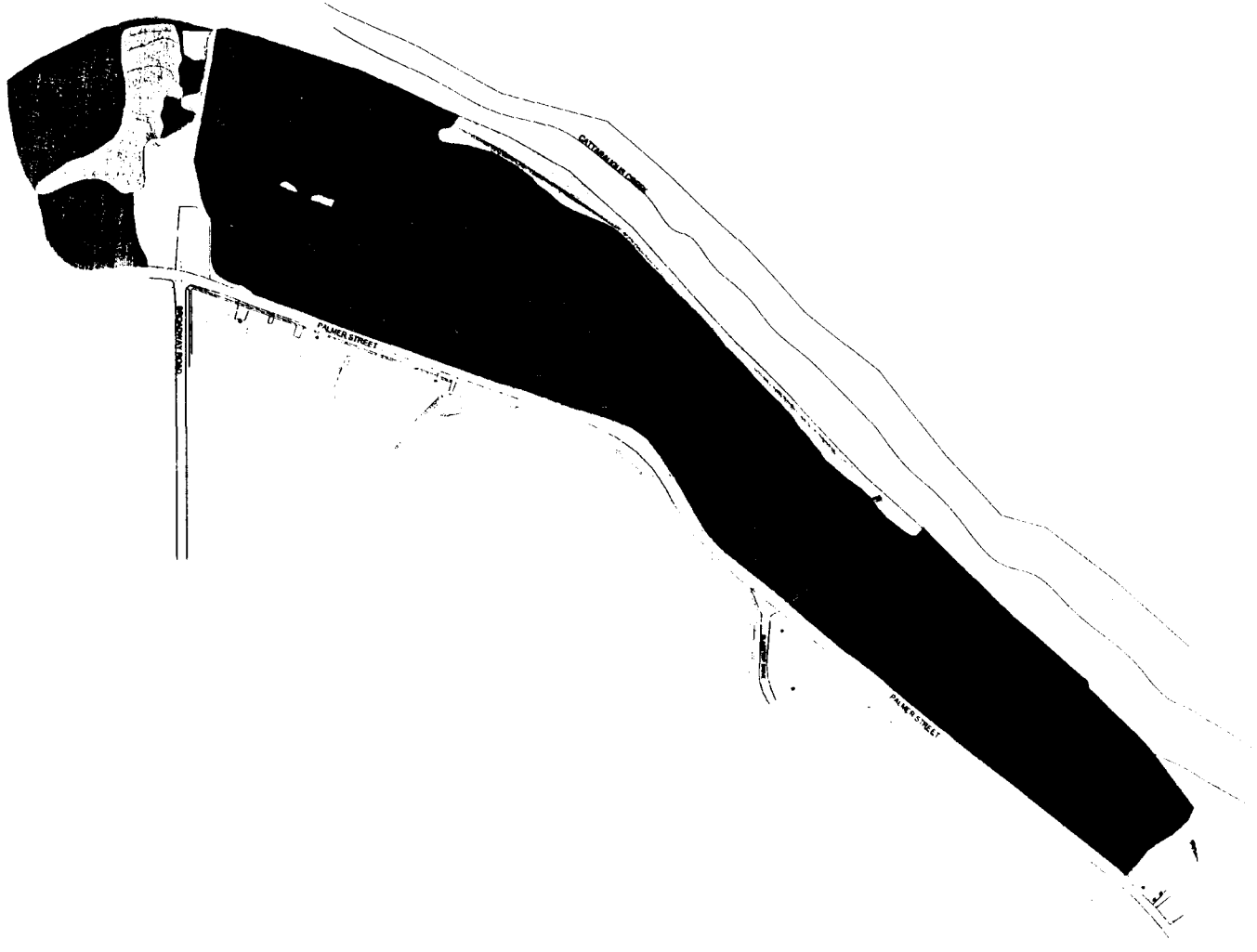
	American Robin		Red-Tailed Hawk	Mink	Raccoon	Red Fox	Deer Mouse		White-tailed Deer	Benthic Invertebrates		Terrestrial Invertebrates		Wetland Plants	Terrestrial Plants		Fish
Parameter	Landfill	Manufact. Area					Landfill	Manuf. Area		Wetland Area	Creek	Landfill	Manuf. Area		Landfill	Manuf. Area	
Volatile Organic Compounds																	
Acetone								3.7	8.7		9.0						
Methyl Acetate									4.3								
Semivolatile Organic Compounds																	
Benzo(a)anthracene					91	47		1,291	2,468								
Benzo(a)pyrene					104	53		3,949	7,548								
Benzo(b)fluoranthene						1.3		31	1,449								
Benzo(g,h,i)perylene					1.2	2.4		136	6,405								
Benzo(k)fluoranthene						1.6		37	1,739								
Indeno(cd-1,2,3)pyrene						1.4		91	4,276								
Chrysene					83	43		1,184	2,262								
Dibenzo(a,h)anthracene					34	18		5,041	9,635								
Dibenzofuran		3.2			1.4												
bis(2-Ethylhexyl)phthalate								9.6	87								
Fluoranthene						1.6		2.9	136								
Phenanthrene					17	33		7.6	355								
Pyrene					1.0	2.0		3.4	160								
Inorganic Compounds																	
Aluminum		24	5.4	222	2,357	1,076		26	49							3.3	
Arsenic	56	10	2.4	7.0	994	384	127	23	242	2.7	1.6						
Barium		1.8			5.4	3.0										1.8	
Chromium	174	63	14							2.1		1,286	463		1.5		
Copper					2.3	1.5		3.0	1.2				50				
Iron																	95
Lead		22	5.0		7.7	4.6		1.8	25							2.4	
Manganese					1.3												
Mercury		2.2						1.4	2.6				29			9.3	
Nickel											1.1						
Selenium		1.7			3.2	1.8											
Vandium				23	35	14											
Zinc	36	158	36		1.1				1.8	2.4			3.4	8.7	22	22	

NC = Hazard Quotient not calculated

NC = Hazard Quotient not calculated

Figures

302692



Land Cover Types
- Cover Type 1: Successional Old Field
- Cover Type 2: Successional Northern Hardwood Woodlot
- Cover Type 3: Successional Northern Hardwood Forest
- Cover Type 4: Early Successional Field
- Residential Area
- Cover Type 5 : Successional Old Field
- Cover Type 6 : Successional Northern Hardwood Forest
- Cover Type 7 : Former Industrial Area
- Cover Type 8 : Forested/Scrub-Shrub Wetland
- Cover Type 9: Emergent Wetland
- Cover Type 10: Scrub-Shrub Wetland

125 0 125 250 Feet

SOURCES:

BASE MAP PREPARED BY BENCHMARK ENVIRONMENTAL ENGINEERING & SCIENCE, PLLC, DECEMBER 2000
LAND COVER TYPES MAPPED FROM FIELD OBSERVATIONS

Vanasse Hangen Brustlin, Inc.

PLAN PREPARED FOR BENCHMARK

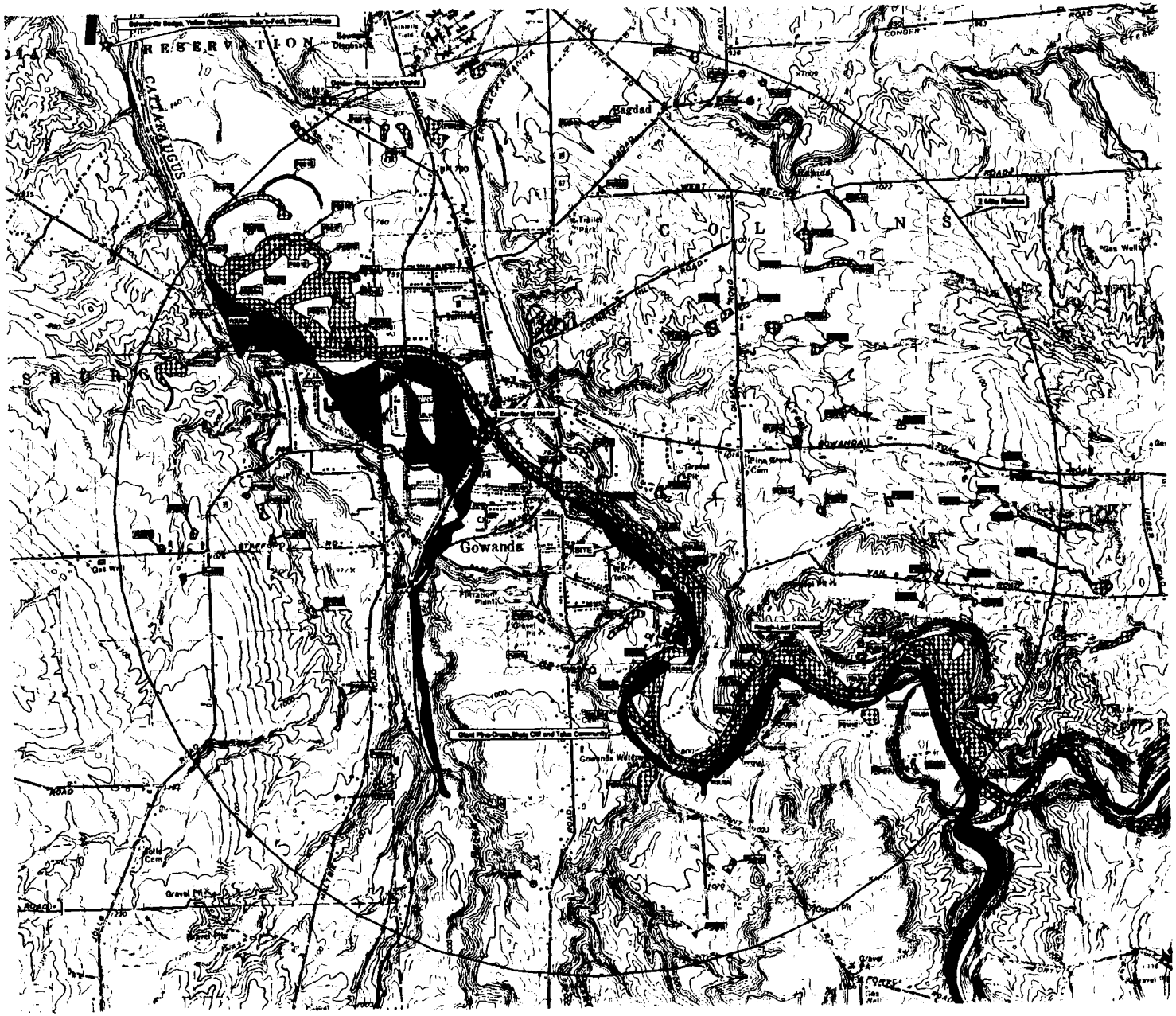
PETER COOPER SITE
GOWANDA, NEW YORK

COVER TYPE MAP

SCALE: 1" = 125'
DATE: FEBRUARY 2001

FIGURE 1

302693



LEGEND

Site

2 Mile Radius

1000 0 1000 2000 Feet

DATA SOURCES:
USGS TOPOGRAPHIC QUADRANGLE, GOWANDA, NY, PHOTOINSPECTED 1979
US FISH AND WILDLIFE SERVICE NATIONAL WETLANDS INVENTORY, 1988
PROTECTED SPECIES - NYSDEC, 2001
FEMA OB FLOODPLAIN DATA, 1988

Vanasse Hangen Brustlin, Inc.

PLAN PREPARED FOR

PETER COOPER SITE
GOWANDA, NEW YORK

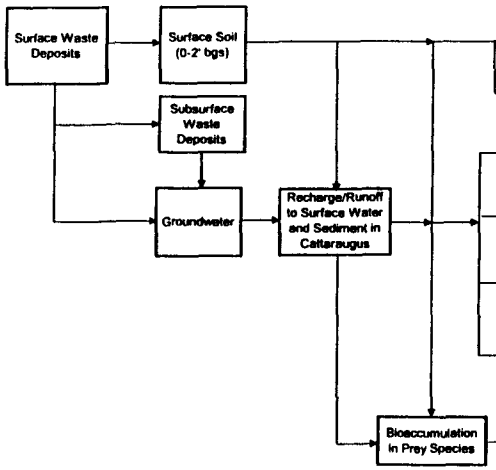
CONCEPTUAL SITE MODEL

SCALE 1" = 1000'

DATE FEBRUARY 2001

FIGURE 2

Figure 3. Conceptual Site Risk Model for Peter Cooper Landfill Site, Gowanda, NY

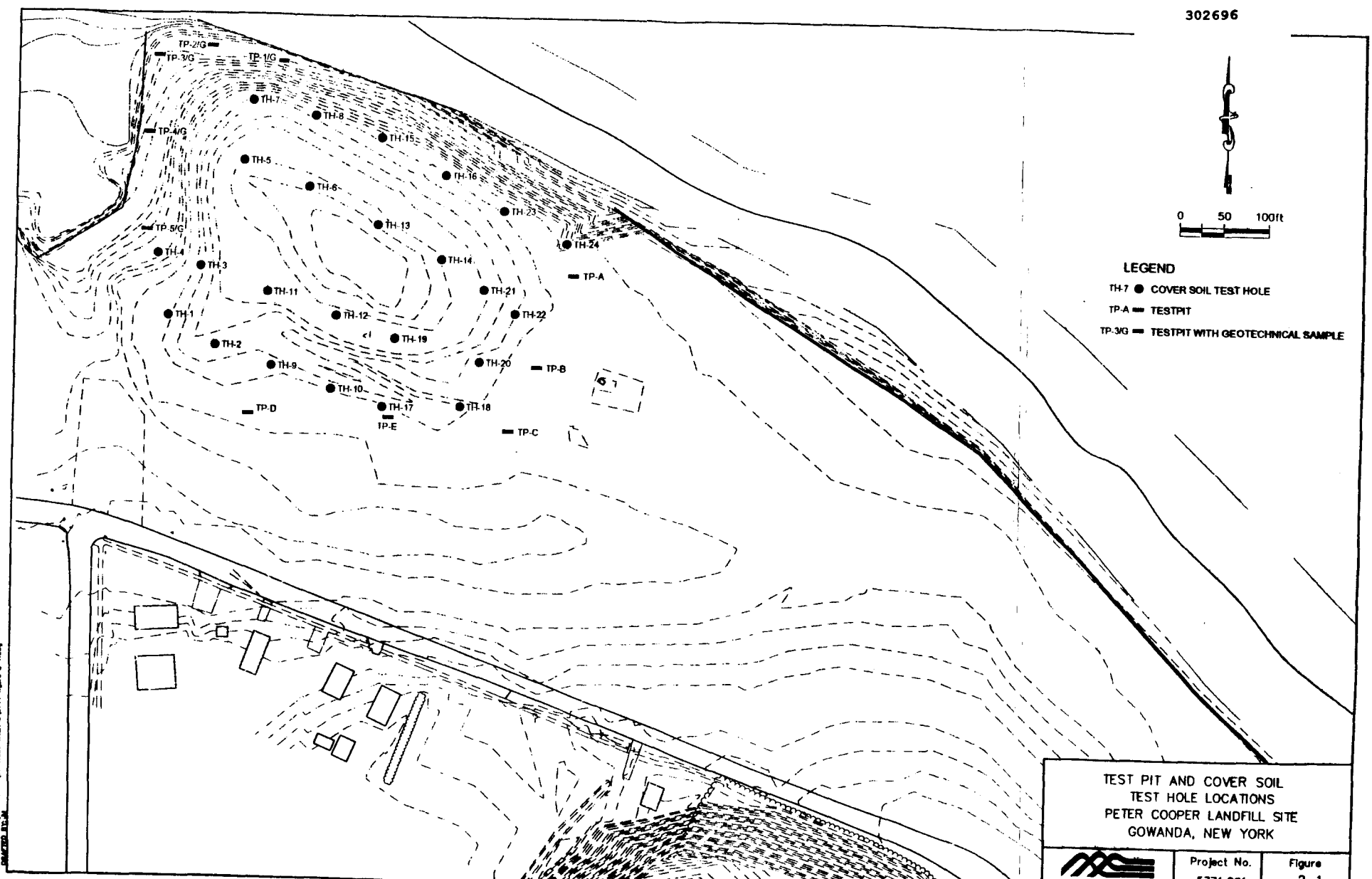


	Ecological Receptors									
	Benthic Macroinvertebrates	Fish	Obligate Aquatic Mammal (Mink)	Facultative Aquatic Mammal (Raccoon)	Terrestrial Invertebrates (Earthworm)	Terrestrial Herbivore (Deer Mouse, White-Tailed Deer)	Terrestrial Carnivore (Red Fox)	Avian Insectivore (American Robin)	Avian Predator (Red-Tailed Hawk)	Terrestrial Plants
Ingestion/Accumulation of Soil Contaminants	O	O	O	X	X	X	X	X	O	X
Dermal Contact with Surface Soil	O	O	X	X	X	X	X	X	O	X
Ingestion/Accumulation of Surface/Seep Water Contaminants	X	X	X	X	O	X	X	X	X	O
Dermal Contact with Surface/Seep Water	X	X	X	X	O	O	O	O	O	O
Ingestion/Accumulation of Sediment Contaminants	X	X	X	X	O	O	O	O	O	O
Dermal Contact with Sediment	X	X	X	X	O	O	O	O	O	O
Ingestion of Prey Species	O	Macroinvertebrates, Benthic organisms, other fish	Fish, Benthic organisms	Benthic Organisms, Fish, Terrestrial Invertebrates, Deer Mouse, Terrestrial Plants, Avian Species	O	Terrestrial Plants	Terrestrial Invertebrates, Deer Mouse	Terrestrial Invertebrates	Deer Mouse	O

Key
X - Complete Exposure Pathway
O - Incomplete Exposure Pathway
→ Exposure Route

Attachments

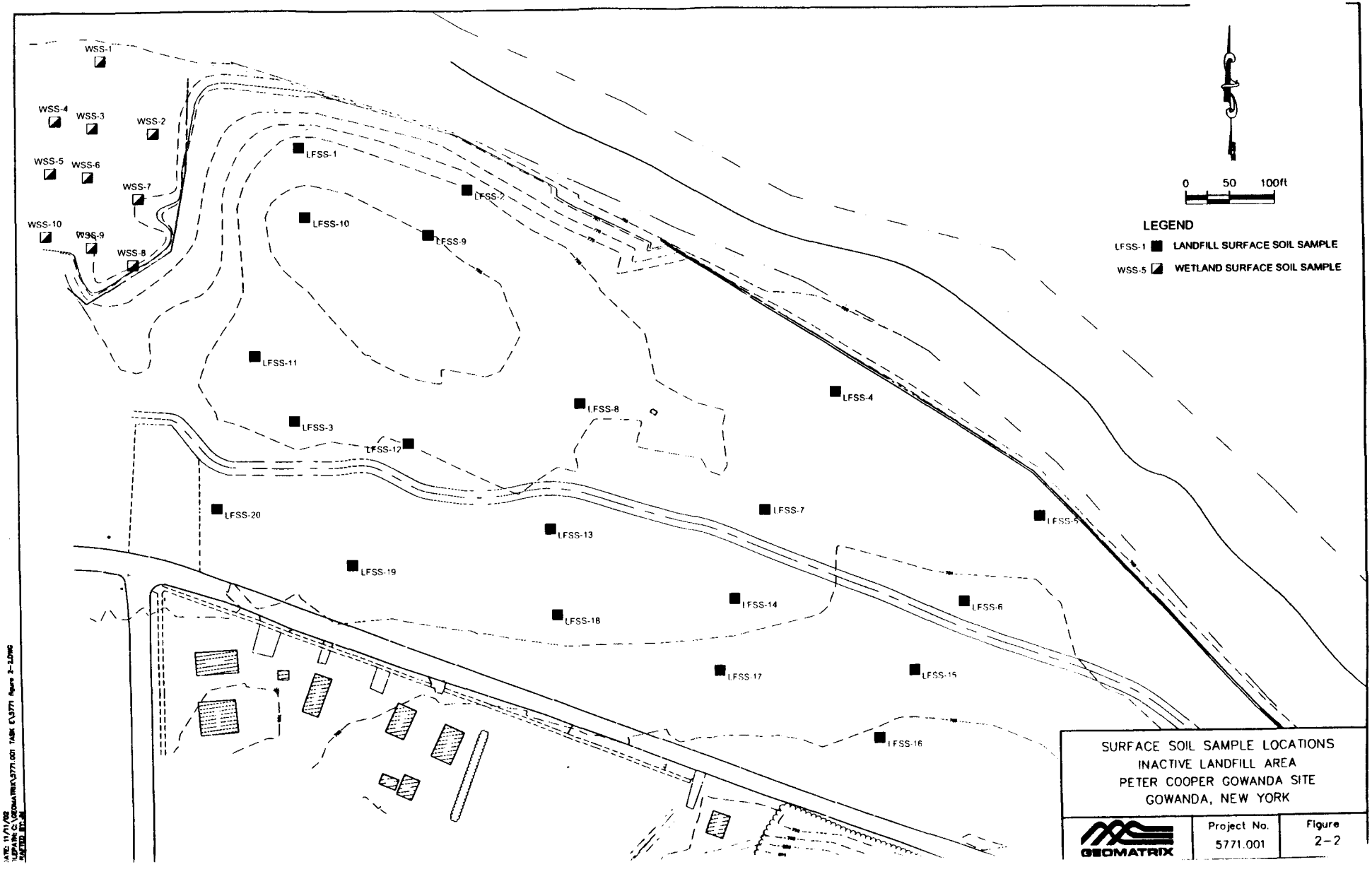
302696



TEST PIT AND COVER SOIL
TEST HOLE LOCATIONS
PETER COOPER LANDFILL SITE
GOWANDA, NEW YORK

GEOMATRIX	Project No. 5771.001	Figure 2-1

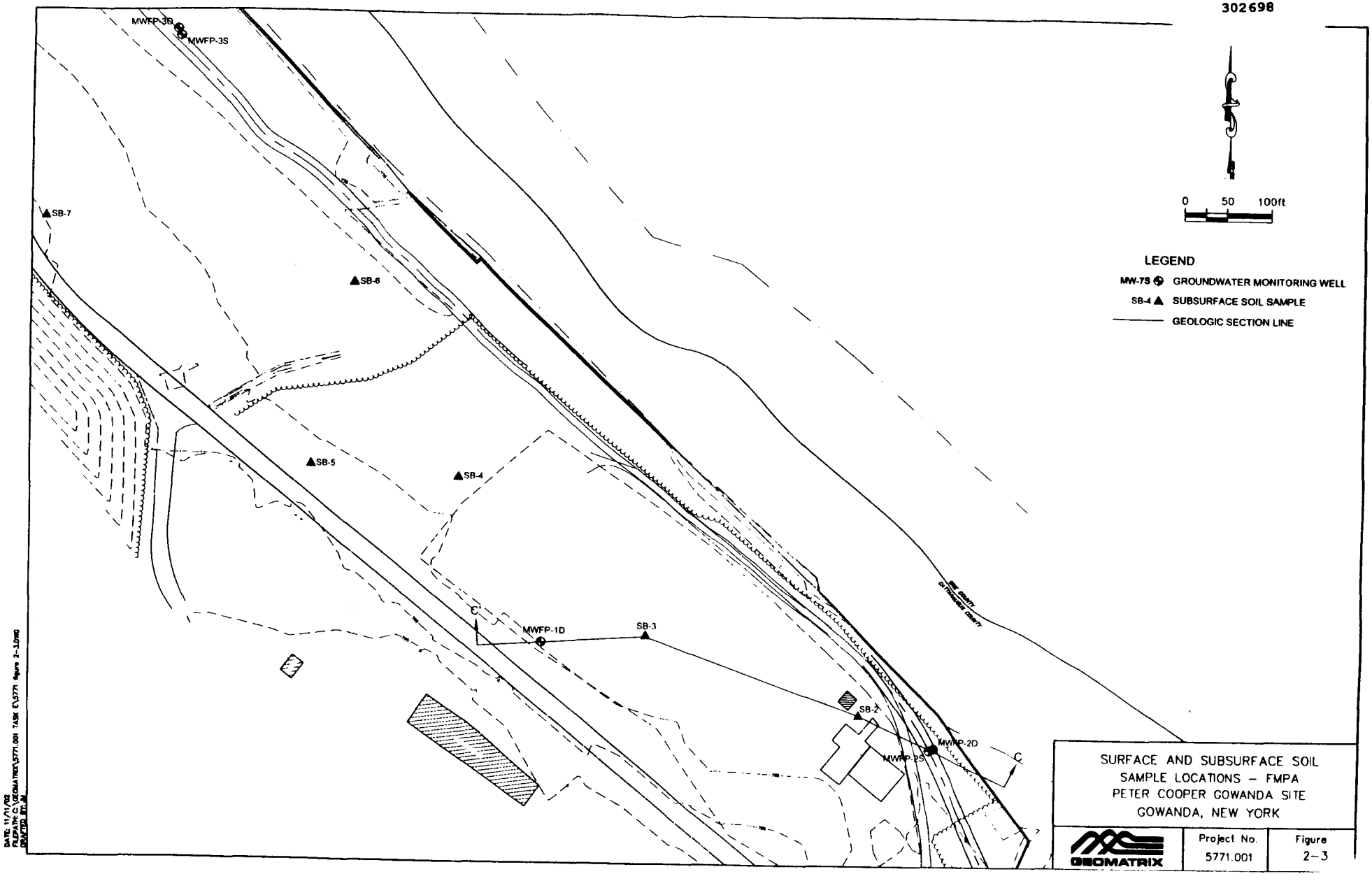
302697



SURFACE SOIL SAMPLE LOCATIONS
INACTIVE LANDFILL AREA
PETER COOPER GOWANDA SITE
GOWANDA, NEW YORK

GEOMATRIX | Project No. 5771.001 | Figure 2-2

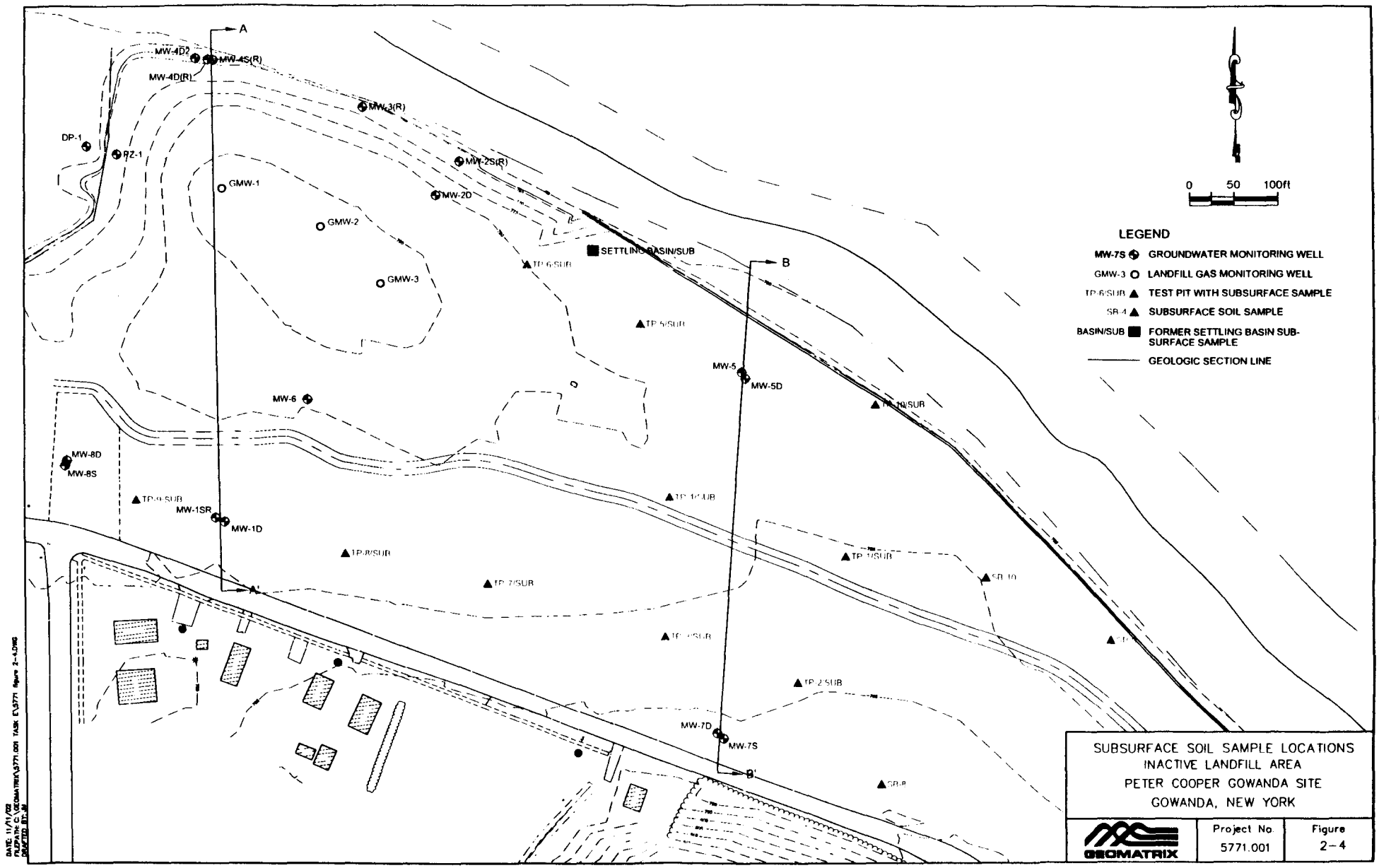
302698



SURFACE AND SUBSURFACE SOIL SAMPLE LOCATIONS – FMPA
PETER COOPER GOWANDA SITE
GOWANDA, NEW YORK

GEOMATRIX | Project No. 5771.001 | Figure 2–3

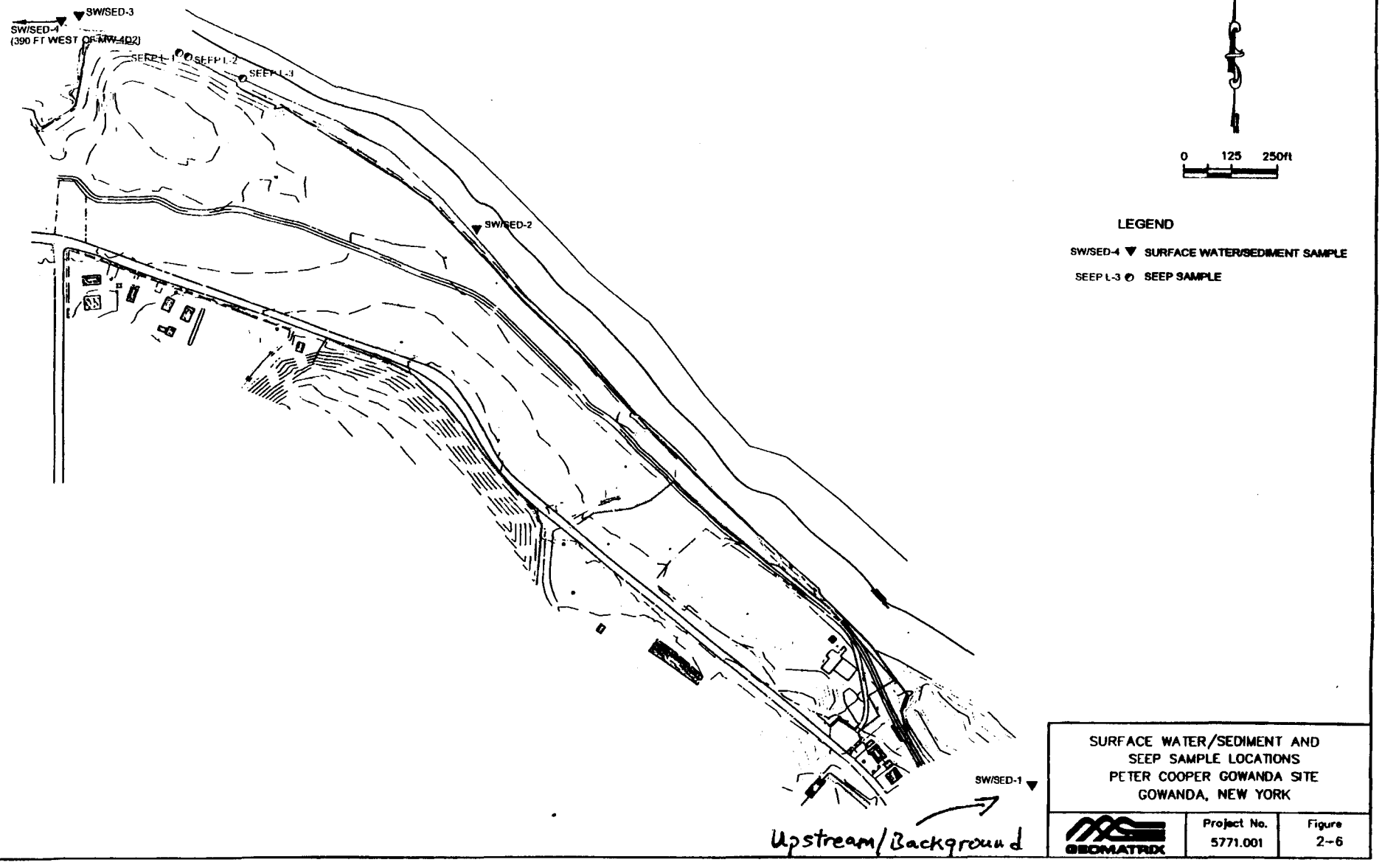
DATE: 11/1/02
FILEPATH: C:\GEOMATRIX\5771.001 TASK 6\5771 figure 2-3.DWG
DRAWN BY: JM



SUBSURFACE SOIL SAMPLE LOCATIONS
INACTIVE LANDFILL AREA
PETER COOPER GOWANDA SITE
GOWANDA, NEW YORK

GEOMATRIX | Project No. 5771.001 | Figure 2-4

302699

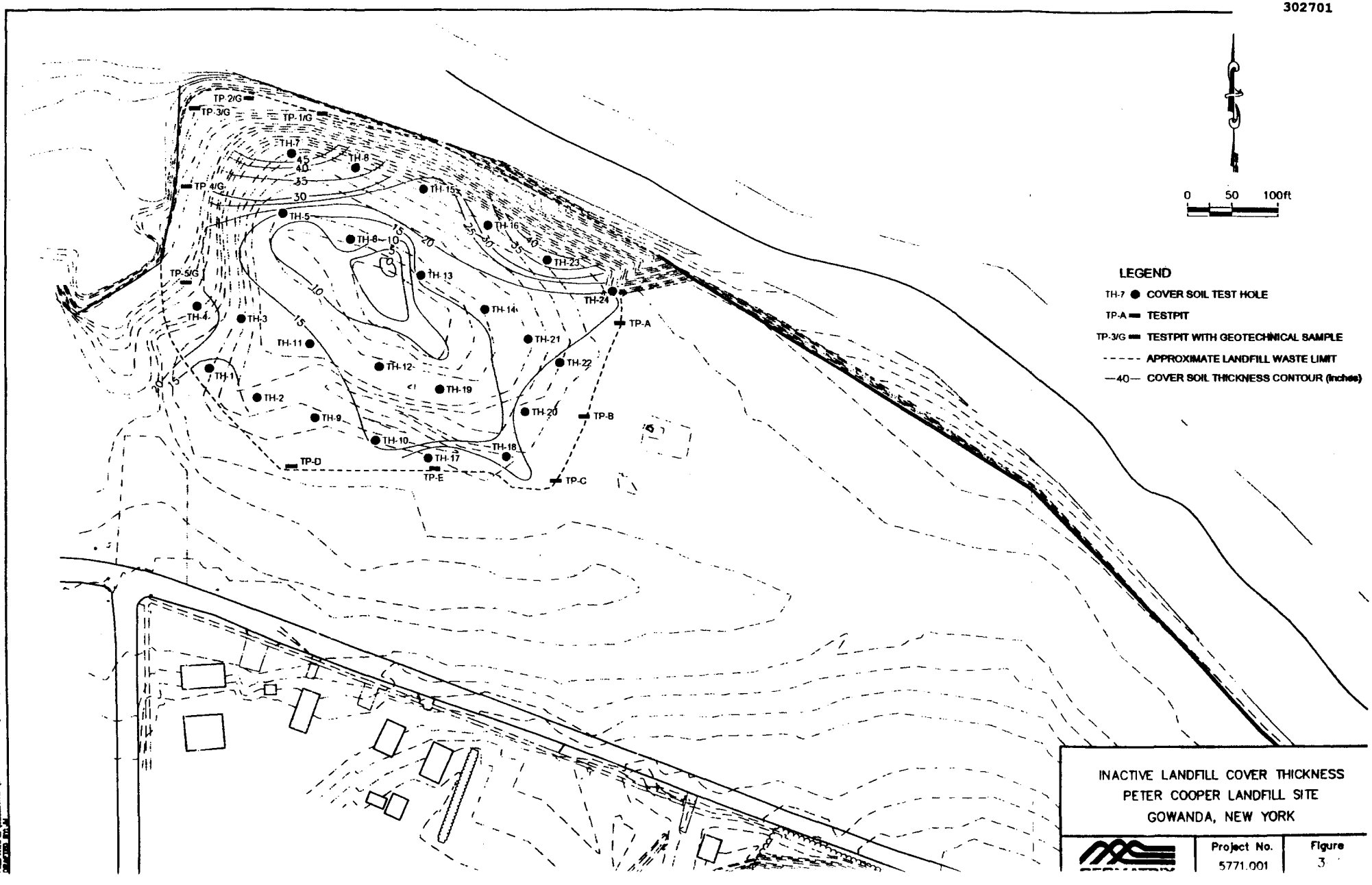


SURFACE WATER/SEDIMENT AND SEEP SAMPLE LOCATIONS
PETER COOPER GOWANDA SITE
GOWANDA, NEW YORK

GEOMATRIX | Project No. 5771.001 | Figure 2-6

302700

302701



INACTIVE LANDFILL COVER THICKNESS
PETER COOPER LANDFILL SITE
GOWANDA, NEW YORK

	Project No.	Figure
	5771.001	3

GEOMATRIX

TABLE 3-8

SUMMARY OF TEST HOLES TO EVALUATE EXISTING COVER SOIL THICKNESS

Peter Cooper Site
Gowanda, New York

Test Hole No.	*Cover Soil Thickness (inches)*	*Test Hole Depth (inches)*	*Depth Range (inches)*	*Description of Lithology*
TH-1	13	> 13	0-13" 13-?"	Grayish Brown silty sand, trace gravel & sand Waste cinders
TH-2	18	30	0-18" 18-30"	Gray sandy silt, trace clay, gravel Dark brown sand & gravel fill with little brick, wood
TH-3	18	44	0-18" 18-32" 32-44"	Gray silt & fine sand Brown sandy waste material Black waste with sand & brick
TH-4	22	32	0-22" 22-32"	Olive gray sandy silt, trace clay & gravel Brown and rust colored fill with wood, glass, gravel
TH-5	7	10	0-7" 7-10"	Gray silt and sand, trace clay and gravel Black sludge, very strong odor
TH-6	12	13	0-12" 12-13"	Gray & dark gray silt and sand, trace clay and gravel Black sludge
TH-7	48	53	0-48" 48-53"	Gray silt and sand, trace clay and gravel Black sludge
TH-8	38	43	0-38" 38-43"	Olive gray sandy silt, trace clay & gravel Black sludge
TH-9	18	21	0-18" 18-21"	Gray silty sand with trace clay and gravel Black sludge
TH-10	14.4	16.8	0-14.4" 14.4-16.8"	Olive brown to gray silt with trace clay, little sand Grayish black sandy material with odor
TH-11	18	> 18	0-18" 18-?"	Gray silt and sand, trace gravel Black waste
TH-12	15	> 15	0-15" 15-?"	Silt and fine sand, trace gravel Black waste
TH-13	18	24	0-18" 18-24"	Gray fine sand and silt with trace gravel Black sludge
TH-14	18	> 18	0-18" 18-?"	Sand and gray silt, trace gravel Black sludge with odor
TH-15	23	26	0-23" 23-26"	Gray silt and sand, trace clay and gravel Black sludge
TH-16	32	34	0-32" 32-34"	Gray silt and sand, trace clay and trace-little gravel Black sludge
TH-17	31.2	31.2	0-31.2" 31.2"	Brownish gray sandy silt with little gravel & silty sand Refusal on metal, likely bottom of 'cover'
TH-18	17	20	0-17" 17-20"	Brownish gray/gray sandy silt w/trace clay & gravel Black waste
TH-19	12	> 12	0-12" 12-?"	Gray/brown fine sand and silt, trace gravel Black waste sludge with odor
TH-20	24	26	0-24" 24-26"	Gray sand and silt Black sludge
TH-21	18	> 18	0-18" 18-?"	Silt and fine sand, trace gravel Black sludge waste
TH-22	22	25	0-22" 22-25"	Gray sandy silt with trace clay and gravel Black sludge
TH-23	41	44	0-41" 41-44"	Gray silt and fine sand, little gravel, trace clay Black sludge
TH-24	20	25	0-20" 20-25"	Gray sandy silt with trace clay and gravel Cinders

TABLE 4-3

ANALYTICAL RESULTS FOR SURFACE SOIL SAMPLES FROM THE INACTIVE LANDFILL AREA

Peter Cooper Site
Gowanda, New York

Constituent[2]	Guidance Values[3] Eastern USA Background	Guidance Values[3] Region 9 PRGs	Sample Location, Identification, Depth, and Date Collected[1] LFSS-1 101100058 0-6 in. bgs 10/11/2000	LFSS-2 101100059 0-6 in. bgs 10/11/2000	LFSS-3 101100060 0-6 in. bgs 10/11/2000	LFSS-4 101100061 0-6 in. bgs 10/11/2000	LFSS-5 101100062 0-6 in. bgs 10/11/2000	LFSS-6 101100063 0-6 in. bgs 10/11/2000	LFSS-7 101100064 0-6 in. bgs 10/11/2000	LFSS-8 101100065 0-6 in. bgs 10/11/2000	LFSS-9 101100066 0-6 in. bgs 10/11/2000	LFSS-10 101100067 0-6 in. bgs 10/11/2000
Volatile Organic Compounds, milligrams per kilogram												
1,2-dichlorobenzene		370	0.013 U J	0.014 U J	0.014 U J	0.012 U	0.01 U	0.015 U J	(0.015 U) R	0.021 U J	0.015 U J	0.014 U J
1,4-dichlorobenzene		8.1	0.013 U J	0.014 U J	0.014 U J	0.012 U	0.01 U	0.015 U J	(0.015 U) R	0.021 U J	0.015 U J	0.014 U J
Benzene		1.5	0.013 U J	0.0016 J	0.0042 J	0.0051 J	0.0032 J	0.0029 J	0.015 U J	0.0022 J	0.015 U	0.014 U J
Chlorobenzene		54	0.013 U J	0.014 U J	0.014 U J	0.012 U	0.01 U	0.015 U J	0.015 U J	0.021 U	0.015 U	0.014 U J
Ethylbenzene		230	0.013 U J	0.014 U J	0.0018 J	0.012 U	0.01 U	0.015 U J	0.015 U J	0.021 U	0.015 U	0.014 U J
m/p-Xylene		--	0.0016 J	0.0023 J	0.006 J	0.0047 J	0.004 J	0.015 U J	0.015 U J	0.0028 J	0.015 U	0.014 U J
o-Xylene		--	0.013 U J	0.014 U J	0.002 J	0.0015 J	0.01 U	0.015 U J	0.015 U J	0.021 U	0.015 U	0.014 U J
Toluene		520	0.002 J	0.0037 J	0.0082 J	0.0086 J	0.0052 J	0.015 U J	0.015 U J	0.0058 J	0.0016 J	0.014 U J
Metals, milligrams per kilogram												
Arsenic	3-12**	2.7	9.3	8.7	10.2	6.6	10.6	919	21.1	7.2	11	8.7
Chromium	1.5-40**	450	18.4	15.4	267	13	32.8	341	208	550	33.8	36.4
Hexavalent Chromium	--	64	5.03 U	5.35 U	5.03 U	5.28 U	5.1 U	5.17 U	5.12 U	5.62 U	5.42 U	5.44 U
Zinc	9-50	100,000	81.8	79.3	163	55	91.4	165	77.5	137	96.6	89.2
Other												
Percent Solids, %			79.5	74.8	79.5	75.8	78.4	77.3	78.1	71.2	73.8	73.5
Total Organic Carbon, %			2.30	2.40	2.80	2.10	2.70	5	5.60	3.40	2.40	3.70
pH			7.42	7.36	7.78	8.07	7.97	6.61	7.53	7.35	7.18	5.76

Notes:

1. Sample locations provided on Plate 1.
2. Data qualifications reflect 100% data validation performed by Data Validation Services.
3. Guidance values from U.S EPA, 2000 Region 9 Preliminary Remediation Goals (PRGs) for Industrial Soil and from range of background metals concentrations measured in soil found in the eastern United States from NYSDEC Division of Technical and Administrative Guidance Memorandum (TAGM) #4046.

** A New York State Background value TAGM 4046

in. bgs =inches below ground surface.

-- = indicates value does not exist.

UJ = indicates compound was not detected above the listed detection limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the compound in the sample.

J = indicates an estimated value.

U = indicates compound was not detected.

R = indicates data rejected by data validator.

(values) = indicates value reported before rejected.

indicates concentration above guidance value.

302703

C:\Documents and Settings\ggarvey\Desktop\Table 4-3 landfill surface soils

TABLE 4-5

ANALYTICAL RESULTS FOR SURFACE SOIL SAMPLES FROM THE FORMER MANUFACTURING PLANT AREA

Peter Cooper Site
Gowanda, New York

Constituent[2]	Guidance Values[3]		Sample Location, Identification, Depth, and Date Collected[1]										Maximum Conc.	Minimum Conc.
	Eastern USA Background	Region 9 PRGs	SB-1 1005000006 0-2' 10/05/00	SB-2 100500008 0-2' 10/05/00	SB-4 100500010 0-2' 10/05/00	SB-5 100600012 0-2' 10/06/00	SB-7 100600018 0-2' 10/06/00	SB-8 100600032 0-2' 10/06/00	SB-9 100600034 0.5-2.5' 10/06/00	SB-10 100600036 0-2' 10/06/00	MWFP-2 100600015 0.5-2.5' 10/06/00	MWFP-3 100900038 0.5-2.5 10/09/00		
Volatile Organic Compounds, milligrams per kilogram														
Acetone		620	0.045 J	0.053 J	0.12	0.056	0.053 J	0.058 J	1.4 EJ	0.21 J	0.056 J	1.4 U	1.4 EJ	0.045 J
Benzene		1.5	0.0027 J	0.0021 J	0.01 UJ	0.0036 J	0.0025 J	0.0016 J	0.0023 J	0.0082 J	0.0076 J	1.4 U	1.4 U	0.0016 J
Bromodichloromethane		--	0.0094 UJ	0.011 UJ	0.01 UJ	0.01 UJ	0.0099 UJ	0.0094 UJ	0.014 UJ	0.016 UJ	0.022 UJ	1.4 U	1.4 U	0.0094 UJ
Bromoform		--	0.0094 UJ	0.011 UJ	0.01 UJ	0.01 UJ	0.0099 UJ	0.0094 UJ	0.014 UJ	0.016 UJ	0.022 UJ	1.4 U	1.4 U	0.0094 UJ
Bromomethane		--	0.0094 UJ	0.011 UJ	0.01 UJ	0.01 UJ	0.0099 UJ	0.0094 UJ	0.014 UJ	0.016 UJ	0.022 UJ	1.4 UJ	1.4 UJ	0.0094 UJ
2-Butanone (MEK)		2800	0.0088 J	0.0094 J	0.018 J	0.011	0.0071 J	0.0057 J	0.28 J	0.017 J	0.022 UJ	1.4 U	1.4 U	0.0057 J
Methyl tert-Butyl Ether		--	0.0094 UJ	0.011 UJ	0.01 UJ	0.01 UJ	0.0099 UJ	0.0094 UJ	0.014 UJ	0.016 UJ	0.022 UJ	1.4 U	1.4 U	0.0094 UJ
Carbon Disulfide		720	0.013 J	0.0023 J	0.0072 J	0.01	0.072 J	0.015 J	0.0031 J	0.016 UJ	0.01 J	1.4 U	1.4 U	0.0023 J
Carbon Tetrachloride		0.53	0.0094 UJ	0.011 UJ	0.01 UJ	0.01 UJ	0.0099 UJ	0.0094 UJ	0.014 UJ	0.016 UJ	0.022 UJ	10	10	0.0094 UJ
Chlorobenzene		54	0.0094 UJ	0.011 UJ	0.01 UJ	0.01 UJ	0.0099 UJ	0.0094 UJ	0.014 UJ	0.016 UJ	0.022 UJ	1.4 U	1.4 U	0.0094 UJ
Chloroethane		--	0.0094 UJ	0.011 UJ	0.01 UJ	0.01 UJ	0.0099 UJ	0.0094 UJ	0.014 UJ	0.016 UJ	0.022 UJ	1.4 U	1.4 U	0.0094 UJ
Chloroform		0.52	0.0094 UJ	0.011 UJ	0.01 UJ	0.01 UJ	0.0099 UJ	0.0094 UJ	0.014 UJ	0.016 UJ	0.022 UJ	5.7	5.7	0.0094 UJ
Chloromethane		--	0.0094 UJ	0.011 UJ	0.01 UJ	0.01 UJ	0.0099 UJ	0.0094 UJ	0.014 UJ	0.016 UJ	0.022 UJ	1.4 U	1.4 U	0.0094 UJ
1,2-Dibromo-3-Chloropropane		--	0.0094 UJ	0.011 UJ	0.01 UJ	0.01 UJ	0.0099 UJ	0.0094 UJ	0.014 UJ	0.016 UJ	0.022 UJ	1.4 U	1.4 U	0.0094 UJ
Cyclohexane		140	0.013 J	0.011 J	0.01 UJ	0.0058 J	0.0065 J	0.003 J	0.0036 J	0.016 UJ	0.0095 J	0.47 J	0.47 J	0.003 J
Dibromochloromethane		--	0.0094 UJ	0.011 UJ	0.01 UJ	0.01 UJ	0.0099 UJ	0.0094 UJ	0.014 UJ	0.016 UJ	0.022 UJ	1.4 U	1.4 U	0.0094 UJ
1,2-Dibromoethane		--	0.0094 UJ	0.011 UJ	0.01 UJ	0.01 UJ	0.0099 UJ	0.0094 UJ	0.014 UJ	0.016 UJ	0.022 UJ	1.4 U	1.4 U	0.0094 UJ
1,2-Dichlorobenzene		370	0.0094 UJ	0.011 UJ	0.01 UJ	0.01 UJ	0.0099 UJ	0.0094 UJ	0.014 UJ	0.016 UJ	0.022 UJ	1.4 U	1.4 U	0.0094 UJ
1,4-Dichlorobenzene		8.1	0.0094 UJ	0.011 UJ	0.01 UJ	0.01 UJ	0.0099 UJ	0.0094 UJ	0.0017 J	0.016 UJ	0.022 UJ	1.4 U	1.4 U	0.0017 J
1,3-Dichlorobenzene		5.2	0.0094 UJ	0.011 UJ	0.01 UJ	0.01 UJ	0.0099 UJ	0.0094 UJ	0.014 UJ	0.016 UJ	0.022 UJ	1.4 U	1.4 U	0.0094 UJ
Dichlorodifluoromethane		--	0.0094 UJ	0.011 UJ	0.01 UJ	0.01 UJ	0.0099 UJ	0.0094 UJ	0.014 UJ	0.016 UJ	0.022 UJ	1.4 U	1.4 U	0.0094 UJ
1,1-Dichloroethane		210	0.0094 UJ	0.011 UJ	0.01 UJ	0.01 UJ	0.0099 UJ	0.0094 UJ	0.014 UJ	0.016 UJ	0.022 UJ	0.16 J	0.16 J	0.0094 UJ
1,2-Dichloroethane		0.76	0.0094 UJ	0.011 UJ	0.01 UJ	0.01 UJ	0.0099 UJ	0.0094 UJ	0.014 UJ	0.016 UJ	0.022 UJ	0.24 J	0.24 J	0.0094 UJ
1,1-Dichloroethene		0.12	0.0094 UJ	0.011 UJ	0.01 UJ	0.01 UJ	0.0099 UJ	0.0094 UJ	0.014 UJ	0.016 UJ	0.022 UJ	1.4 U	1.4 U	0.0094 UJ
trans-1,2-Dichloroethene		--	0.0094 UJ	0.011 UJ	0.01 UJ	0.01 UJ	0.0099 UJ	0.0094 UJ	0.014 UJ	0.016 UJ	0.022 UJ	1.4 U	1.4 U	0.0094 UJ
cis-1,2-Dichloroethene		15	0.0094 UJ	0.011 UJ	0.01 UJ	0.01 UJ	0.0099 UJ	0.0094 UJ	0.014 UJ	0.016 UJ	0.022 UJ	0.26 J	0.26 J	0.0094 UJ
1,2-Dichloropropane		--	0.0094 UJ	0.011 UJ	0.01 UJ	0.01 UJ	0.0099 UJ	0.0094 UJ	0.014 UJ	0.016 UJ	0.022 UJ	1.4 U	1.4 U	0.0094 UJ
trans-1,3-Dichloropropene		--	0.0094 UJ	0.011 UJ	0.01 UJ	0.01 UJ	0.0099 UJ	0.0094 UJ	0.014 UJ	0.016 UJ	0.022 UJ	1.4 U	1.4 U	0.0094 UJ
cis-1,3-Dichloropropene		--	0.0094 UJ	0.011 UJ	0.01 UJ	0.01 UJ	0.0099 UJ	0.0094 UJ	0.014 UJ	0.016 UJ	0.022 UJ	1.4 U	1.4 U	0.0094 UJ
Ethylbenzene		230	0.0094 UJ	0.011 UJ	0.01 UJ	0.01 UJ	0.0099 UJ	0.0094 UJ	0.014 UJ	0.016 UJ	0.022 UJ	1.4 U	1.4 U	0.0094 UJ
2-Hexanone		--	0.0094 UJ	0.011 UJ	0.01 UJ	0.01 UJ	0.0099 UJ	0.064 J	0.025 J	0.016 UJ	0.022 UJ	1.4 U	1.4 U	0.0094 UJ
Isopropylbenzene		52	0.0094 UJ	0.011 UJ	0.01 UJ	0.01 UJ	0.0099 UJ	0.0094 UJ	0.014 UJ	0.016 UJ	0.022 UJ	1.4 U	1.4 U	0.0094 UJ
Methyl Acetate		9600	0.0094 UJ	0.011 UJ	0.01 UJ	0.01 UJ	0.0099 UJ	0.0094 UJ	0.0048 J	0.21 J	0.022 UJ	1.4 U	1.4 U	0.0048 J
Methylcyclohexane		880	0.022 J	0.014 J	0.01 UJ	0.0096 J	0.01 J	0.0042 J	0.0023 J	0.0021 J	0.015 J	1.6	1.6	0.0021 J
Methylene Chloride		--	0.0094 UJ	0.011 UJ	0.01 UJ	0.01 UJ	0.0099 UJ	0.0094 UJ	0.014 UJ	0.016 UJ	0.022 UJ	1.4 U	1.4 U	0.0094 UJ
4-Methyl-2-Pentanone		290	0.0094 UJ	0.011 UJ	0.01 UJ	0.01 UJ	0.0099 UJ	0.0094 UJ	0.005 J	0.039 J	0.022 UJ	1.4 U	1.4 U	0.005 J
Styrene		1700	0.0094 UJ	0.011 UJ	0.01 UJ	0.01 UJ	0.0099 UJ	0.0094 UJ	0.014 UJ	0.016 UJ	0.022 UJ	1.4 U	1.4 U	0.0094 UJ
1,1,2,2-Tetrachloroethane		--	0.0094 UJ	0.011 UJ	0.01 UJ	0.01 UJ	0.0099 UJ	0.0094 UJ	0.014 UJ	0.016 UJ	0.022 UJ	1.4 U	1.4 U	0.0094 UJ
Tetrachloroethene		19	0.0094 UJ	0.011 UJ	0.01 UJ	0.01 UJ	0.0031 J	0.0094 UJ	0.0097 J	0.18 J	0.022 UJ	54	54	0.0031 J
Toluene		520	0.005 J	0.0032 J	0.01 UJ	0.0061 J	0.0046 J	0.0032 J	0.0023 J	0.019 J	0.015 J	0.38 J	0.38 J	0.0023 J
1,2,4-Trichlorobenzene		3000	0.0094 UJ	0.011 UJ	0.01 UJ	0.01 UJ	0.0099 UJ	0.0094 UJ	0.014 UJ	0.016 UJ	0.022 UJ	0.36 J	0.36 J	0.0094 UJ
1,1,1-Trichloroethane		1400	0.0094 UJ	0.011 UJ	0.01 UJ	0.01 UJ	0.0099 UJ	0.0094 UJ	0.014 UJ	0.0064 J	0.022 UJ	5.5	5.5	0.0064 J
1,1,2-Trichloroethane		--	0.0094 UJ	0.011 UJ	0.01 UJ	0.01 UJ	0.0099 UJ	0.0094 UJ	0.014 UJ	0.016 UJ	0.022 UJ	1.4 U	1.4 U	0.0094 UJ

TABLE 4-5

ANALYTICAL RESULTS FOR SURFACE SOIL SAMPLES FROM THE FORMER MANUFACTURING PLANT AREA

Peter Cooper Site
Gowanda, New York

Constituent[2]	Guidance Values[3] Eastern USA Background	Guidance Values[3] Region 9 PRGs	Sample Location, Identification, Depth, and Date Collected[1] SB-1 1005000006 0-2' 10/05/00	SB-2 100500008 0-2' 10/05/00	SB-4 100500010 0-2' 10/05/00	SB-5 100600012 0-2' 10/06/00	SB-7 100600018 0-2' 10/06/00	SB-8 100600032 0-2' 10/06/00	SB-9 100600034 0.5-2.5' 10/06/00	SB-10 100600036 0-2' 10/06/00	MWFP-2 100600015 0.5-2.5' 10/06/00	MWFP-3 100900038 0.5-2.5 10/09/00	Maximum Conc.	Minimum Conc.
Trichloroethene		6.1	0.0094 UJ	0.011 UJ	0.01 UJ	0.01 UJ	0.0099 UJ	0.0094 UJ	0.014 UJ	0.016 UJ	0.022 UJ	0.51 J	0.51 J	0.0094 UJ
Trichlorofluoromethane		--	0.0094 UJ	0.011 UJ	0.01 UJ	0.01 UJ	0.0099 UJ	0.0094 UJ	0.014 UJ	0.016 UJ	0.022 UJ	1.4 U	1.4 U	0.0094 UJ
1,1,2-Trichloro-1,2,2-Trifluoroethane		--	0.0094 UJ	0.011 UJ	0.01 UJ	0.01 UJ	0.0099 UJ	0.0094 UJ	0.014 UJ	0.016 UJ	0.022 UJ	1.4 U	1.4 U	0.0094 UJ
Vinyl Chloride		--	0.0094 UJ	0.011 UJ	0.01 UJ	0.01 UJ	0.0099 UJ	0.0094 UJ	0.014 UJ	0.016 UJ	0.022 UJ	1.4 U	1.4 U	0.0094 UJ
m-/p-Xylene		--	0.0045 UJ	0.0031 UJ	0.01 UJ	0.0036 J	0.0048 J	0.0033 J	0.003 J	0.0044 J	0.0071 J	0.52 J	0.52 J	0.003 J
o-Xylene		--	0.0014 UJ	0.0011 UJ	0.01 UJ	0.0011 J	0.0015 J	0.00098 J	0.014 UJ	0.004 J	0.0039 J	0.42 J	0.42 J	0.00098 J
Semi-Volatile Organic Compounds, milligrams per kilogram														
Acenaphthene		3800	0.37 U	1.8 J	0.16 J	0.36 U	2.6 J	0.38 U	0.41 U	0.39 U	0.42 U	0.38 U	2.6 J	0.16 J
Acenaphthylene		3800	0.37 U	3.9 U	0.4 U	0.36 U	0.4 J	0.38 U	0.41 U	0.39 U	0.29 J	0.38 U	0.41 U	0.29 J
Acetophenone		--	0.37 U	3.9 U	0.4 U	0.36 U	3.9 U	0.38 U	0.41 U	0.39 U	0.42 U	0.38 U	3.9 U	0.36 U
Anthracene		100000	0.04 J	5.9	0.47 J	0.36 U	14	0.38 U	0.044 J	0.055 J	0.24 J	0.049 J	14	0.04 J
Atrazine		--	0.37 U	3.9 U	0.4 U	0.36 U	3.9 U	0.38 U	0.41 U	0.39 U	0.42 U	0.38 U	3.9 U	0.36 U
Benzaldehyde		--	0.37 U	3.9 U	0.4 U	0.36 U	3.9 U	0.38 U	0.41 U	0.39 U	0.42 U	0.38 U	3.9 U	0.36 U
Benzo(a)anthracene		2.9	0.16 J	10	1.6 J	0.36 U	24	0.38 U	0.11 J	0.23 J	0.47	0.26 J	24	0.11 J
Benzo(a)pyrene		0.29	0.16 J	8.3	1.5 J	0.36 U	20	0.38 U	0.087 J	0.25 J	0.46	0.27 J	20	0.087 J
Benzo(b)fluoranthene		2.9	0.14 J	6.4	1.3 J	0.36 U	15	0.38 U	0.079 J	0.24 J	0.3 J	0.23 J	15	0.079 J
Benzo(g,h,i)perylene		3800	0.11 J	4.4	1 J	0.36 U	14	0.38 U	0.41 U	0.24 J	0.33 J	0.21 J	14	0.11 J
Benzo(k)fluoranthene		29	0.14 J	7.2	1.3 J	0.36 U	18	0.38 U	0.09 J	0.25 J	0.38 J	0.23 J	18	0.09 J
1,1-Biphenyl		--	0.37 U	3.9 U	0.4 U	0.36 U	3.9 U	0.38 U	0.41 U	0.39 U	0.42 U	0.38 U	3.9 U	0.36 U
Butyl Benzyl Phthalate		--	0.37 UJ	3.9 U	0.4 U	0.36 U	3.9 U	0.38 U	0.41 U	0.39 U	0.42 U	0.38 U	3.9 U	0.36 U
di-N-Butylphthalate		--	0.37 U	3.9 U	0.4 U	0.36 U	3.9 U	0.38 U	0.41 U	0.39 U	0.42 U	0.38 U	3.9 U	0.36 U
Caprolactam		--	0.37 U	3.9 U	0.4 U	0.36 U	3.9 U	0.38 U	0.41 U	0.39 U	0.42 U	0.38 U	3.9 U	0.36 U
Carbazole		120	0.37 U	2.3 J	0.39 J	0.36 U	3.5 J	0.38 U	0.41 U	0.044 J	0.42 U	0.38 U	3.5 J	0.044 J
Indeno(1,2,3-cd)pyrene		2.9	0.084 J	4	0.92 J	0.36 U	13	0.38 U	0.043 J	0.19 J	0.27 J	0.19 J	13	0.043 J
4-Chloroaniline		--	0.37 U	3.9 U	0.4 U	0.36 U	3.9 U	0.38 U	0.41 U	0.39 U	0.42 U	0.38 U	3.9 U	0.36 U
bis(2-chloroethoxy)methane		--	0.37 U	3.9 U	0.4 U	0.36 U	3.9 U	0.38 U	0.41 U	0.39 U	0.42 U	0.38 U	3.9 U	0.36 U
bis(2-chloroethyl)ether		--	0.37 U	3.9 U	0.4 U	0.36 U	3.9 U	0.38 U	0.41 U	0.39 U	0.42 U	0.38 U	3.9 U	0.36 U
2-Chloronaphthalene		--	0.37 U	3.9 U	0.4 U	0.36 U	3.9 U	0.38 U	0.41 U	0.39 U	0.42 U	0.38 U	3.9 U	0.36 U
2-Chlorophenol		--	0.37 U	3.9 U	0.4 U	0.36 U	3.9 U	0.38 U	0.41 U	0.39 U	0.42 U	0.38 U	3.9 U	0.36 U
2,2-oxybis(1-chloropropane)		--	0.37 U	3.9 U	0.4 U	0.36 U	3.9 U	0.38 U	0.41 U	0.39 U	0.42 U	0.38 U	3.9 U	0.36 U
Chrysene		290	0.17 J	9.3	1.7 J	0.36 U	22	0.38 U	0.14 J	0.36 J	0.6	0.29 J	22	0.14 J
Dibenzo(a,h)anthracene		0.29	0.37 U	1.9 J	0.35 J	0.36 U	5.2	0.38 U	0.41 U	0.076 J	0.13 J	0.078 J	5.2	0.076 J
Dibenzofuran		510	0.37 U	1.1 J	0.12 J	0.36 U	2.2 J	0.38 U	0.41 U	0.055 J	0.42 U	0.38 U	2.2 J	0.055 J
3,3-Dichlorobenzidine		--	0.37 U	3.9 U	0.4 U	0.36 U	3.9 U	0.38 U	0.41 U	0.39 U	0.42 U	R	3.9 U	0.36 U
2,4-Dichlorophenol		--	0.37 U	3.9 U	0.4 U	0.36 U	3.9 U	0.38 U	0.41 U	0.39 U	0.42 U	0.38 U	3.9 U	0.36 U
Diethylphthalate		--	0.37 U	3.9 U	0.4 U	0.36 U	3.9 U	0.38 U	0.41 U	0.39 U	0.42 U	0.38 U	3.9 U	0.36 U
Dimethyl Phthalate		--	0.37 U	3.9 U	0.4 U	0.36 U	3.9 U	0.38 U	0.41 U	0.39 U	0.42 U	0.38 U	3.9 U	0.36 U
2,4-Dimethylphenol		--	0.37 U	3.9 U	0.4 U	0.36 U	3.9 U	0.38 U	0.41 U	0.39 U	0.42 U	0.38 U	3.9 U	0.36 U
2,4-Dinitrophenol		--	0.93 U	9.8 U	1 U	0.92 U	9.8 U	0.95 U	1 U	0.98 U	1.1 U	0.97 U	3.9 U	0.36 U
2,4-Dinitrotoluene		--	0.37 U	3.9 U	0.4 U	0.36 U	3.9 U	0.38 U	0.41 U	0.39 U	0.42 U	0.38 U	3.9 U	0.36 U
2,6-Dinitrotoluene		--	0.37 U	3.9 U	0.4 U	0.36 U	3.9 U	0.38 U	0.41 U	0.39 U	0.42 U	0.38 U	3.9 U	0.36 U
bis(2-Ethylhexyl)phthalate		180	0.068 J	3.9 U	0.069 J	0.36 U	3.9 U	0.38 U	0.41 U	0.39 U	0.42 U	0.38 U	3.9 U	0.068 J
Fluoranthene		3,000	0.31 J	23	3.8 J	0.36 U	60	0.38 U	0.26 J	0.51	0.62	0.41	60	0.26 J

TABLE 4-5

ANALYTICAL RESULTS FOR SURFACE SOIL SAMPLES FROM THE FORMER MANUFACTURING PLANT AREA

Peter Cooper Site
Gowanda, New York

	Guidance Values[1]		Sample Location, Identification, Depth, and Date Collected[1]											
			SB-1	SB-2	SB-4	SB-5	SB-7	SB-8	SB-9	SB-10	MWFP-2	MWFP-3		
			1005000006	100500008	100500010	100600012	100600018	100600032	100600034	100600036	100600015	100900038		
	Eastern USA	Region 9	0-2'	0-2'	0-2'	0-2'	0-2'	0-2'	0.5-2.5'	0-2'	0.5-2.5'	0.5-2.5	Maximum	Minimum
Constituent[2]	Background	PRGs	10/05/00	10/05/00	10/05/00	10/06/00	10/06/00	10/06/00	10/06/00	10/06/00	10/06/00	10/09/00	Conc.	Conc.
Fluorene		3,000	0.37 U	2.3 J	0.17 J	0.36 U	4.2	0.38 U	0.41 U	0.39 U	0.42 U	0.38 U	4.2	0.17 J
Hexachlorobenzene		--	0.37 U	3.9 U	0.4 U	0.36 U	3.9 U	0.38 U	0.41 U	0.39 U	0.42 U	0.38 U	3.9 U	0.36 U
Hexachlorobutadiene		--	0.37 U	3.9 U	0.4 U	0.36 U	3.9 U	0.38 U	0.41 U	0.39 U	0.42 U	0.38 U	3.9 U	0.36 U
Hexachlorocyclopentadiene		--	0.37 U	3.9 U	0.4 U	0.36 U	3.9 U	0.38 U	0.41 U	0.39 U	0.42 U	1.9 U	3.9 U	0.36 U
Hexachloroethane		--	0.37 U	3.9 U	0.4 U	0.36 U	3.9 U	0.38 U	0.41 U	0.39 U	0.42 U	0.38 U	3.9 U	0.36 U
Isophorone		--	0.37 U	3.9 U	0.4 U	0.36 U	3.9 U	0.38 U	0.41 U	0.39 U	0.42 U	0.38 U	3.9 U	0.36 U
2-Methylnaphthalene		19	0.37 U	3.9 U	0.4 U	0.36 U	3.9 U	0.38 U	0.1 J	0.18 J	0.083 J	0.079 J	3.9 U	0.079 J
4,6-Dinitro-2-Methylphenol		--	0.93 U	9.8 U	1 U	0.92 U	9.8 U	0.95 U	1 U	0.98 U	1.1 U	0.97 U	9.8 U	0.92 U
4-Chloro-3-Methylphenol		--	0.37 U	3.9 U	0.4 U	0.36 U	3.9 U	0.38 U	0.41 U	0.39 U	0.42 U	0.38 U	3.9 U	0.36 U
2-Methylphenol		--	0.37 U	3.9 U	0.4 U	0.36 U	3.9 U	0.38 U	0.41 U	0.39 U	0.42 U	0.38 U	3.9 U	0.36 U
4-Methylphenol		440	0.37 U	3.9 U	0.4 U	0.36 U	3.9 U	0.38 U	0.41 U	0.059 J	0.42 U	0.38 U	3.9 U	0.059 J
Naphthalene		19	0.37 U	3.9 U	0.051 J	0.36 U	3.9 U	0.38 U	0.069 J	0.11 J	0.044 J	0.047 J	3.9 U	0.044 J
2-Nitroaniline		--	0.93 U	9.8 U	1 U	0.92 U	9.8 U	0.95 U	1 U	0.98 U	1.1 U	0.97 U	9.8 U	0.92 U
4-Nitroaniline		--	0.93 U	9.8 U	1 U	0.92 U	9.8 U	0.95 U	1 U	0.98 U	1.1 U	0.97 U	9.8 U	0.92 U
Nitrobenzene		--	0.37 U	3.9 U	0.4 U	0.36 U	3.9 U	0.38 U	0.41 U	0.39 U	0.42 U	0.38 U	3.9 U	0.36 U
2-Nitrophenol		--	0.37 U	3.9 U	0.4 U	0.36 U	3.9 U	0.38 U	0.41 U	0.39 U	0.42 U	0.38 U	3.9 U	0.36 U
4-Nitrophenol		--	0.93 U	9.8 U	1 U	0.92 U	9.8 U	0.95 U	1 U	0.98 U	1.1 U	0.97 U	9.8 U	0.92 U
n-Nitrosodiphenylamine		--	0.37 U	3.9 U	0.4 U	0.36 U	3.9 U	0.38 U	0.41 U	0.39 U	0.42 U	0.38 U	3.9 U	0.36 U
di-n-Octyl Phthalate		--	0.37 U	3.9 U	0.4 U	0.36 U	3.9 U	0.38 U	0.41 U	0.39 U	0.42 U	0.38 U	3.9 U	0.36 U
Pentachlorophenol		11	0.93 U	9.8 U	1 U	0.92 U	9.8 U	0.95 U	1 U	0.98 U	1.1 U	0.97 U	9.8 U	0.92 U
Phenanthrene		100,000	0.18 J	21	2.4 J	0.36 U	45	0.38 U	0.23 J	0.34 J	0.3 J	0.24 J	45	0.18 J
Phenol		100,000	0.37 U	3.9 U	0.4 U	0.36 U	3.9 U	0.38 U	0.41 U	0.39 U	0.42 U	0.38 U	3.9 U	0.36 U
4-Bromophenyl-Phenylether		--	0.37 U	3.9 U	0.4 U	0.36 U	3.9 U	0.38 U	0.41 U	0.39 U	0.42 U	0.38 U	3.9 U	0.36 U
4-Chlorophenyl-Phenylether		--	0.37 U	3.9 U	0.4 U	0.36 U	3.9 U	0.38 U	0.41 U	0.39 U	0.42 U	0.38 U	3.9 U	0.36 U
n-Nitroso-di-n-Propylamine		--	0.37 U	3.9 U	0.4 U	0.36 U	3.9 U	0.38 U	0.41 U	0.39 U	0.42 U	0.38 U	3.9 U	0.36 U
Pyrene		5,400	0.32 J	20	3.4 J	0.36 U	44	0.38 U	0.22 J	0.49	0.86	0.43	44	0.22 J
2,4,6-Trichlorophenol		--	0.37 U	3.9 U	0.4 U	0.36 U	3.9 U	0.38 U	0.41 U	0.39 U	0.42 U	0.38 U	3.9 U	0.36 U
2,4,5-Trichlorophenol		--	0.93 U	9.8 U	1 U	0.92 U	9.8 U	0.95 U	1 U	0.98 U	1.1 U	0.97 U	9.8 U	0.92 U
Metals, milligrams per kilogram														
Aluminum	33,000	100,000	6210	5440	7570	8000	8280	6810	2010	4220	6490	5190	8280	2010
Antimony	--	82	6.5 UJ	6.9 UJ	7.2 UJ	6.5 UJ	6.9 UJ	6.8 UJ	7.2 UJ	7 UJ	7.6 UJ	7 UJ	7.6 UJ	6.5 UJ
Arsenic	3-12**	2.7	8.5	168	10.7	8	9.5	6.6	16.2	16.2	29.9	22.7	168	6.6
Barium	15-600	100,000	72.8	65.1	80.2	58.4	92.8	63.9	68.7	59.2	64.2	117	117	58.4
Beryllium	0-1.75	2,200	0.54 U	0.58 U	0.6 U	0.54 U	0.57 U	0.57 U	0.6 U	0.58 U	0.87	0.64	0.87	0.54 U
Cadmium	0.1-1	81	0.54 U	0.58 U	0.6 U	0.54 U	0.57 U	0.57 U	0.6 U	0.58 U	0.64 U	1.6	1.6	0.54 U
Calcium	130-35,000**	--	29000	6880	23800	44200	30200	33600	1050	1870	2490 J	8210	44200	1050
Chromium	1.5-40**	450	34.2	59.7	18.2	10.8	33.3	9	59.3	54.5	198 J	52.5	198	9 J
Cobalt	2.5-60**	100,000	6.4	6.9	8.2	7.7	7.2	6.6	6 U	6.6	7.1	7.6	8.2	6 U
Copper	1-50	7,600	26.6	37	43.6	21	73.3	20.9	56.7	30.7	29.3	171	171	20.9
Hexavalent Chromium	--	64	4.46 UJ	4.74 UJ	4.9 UJ	4.42 UJ	4.71 UJ	4.57 UJ	4.92 UJ	4.74 UJ	5.08 UJ	4.66 U	5.08 UJ	4.42 UJ
Iron	2,000-550,000	100,000	18200	18900	23000	16900	12600	15300	31300	18500	18900	30100 J	31300	12600
Lead	4-61***	750	50.1 J	79.4 J	169 J	8.2 J	74.2 J	8.2 J	193 J	269 J	41 J	202	269 J	8.2 J
Magnesium	100-5,000	--	4470	3130	6260	12600	5740	9300	225	1520	1730	2270	12600	225
Manganese	50-5,000	3,200	332	251	449	489	451	469	64.7	132	160	314	489	64.7

TABLE 4-5

ANALYTICAL RESULTS FOR SURFACE SOIL SAMPLES FROM THE FORMER MANUFACTURING PLANT AREA

Peter Cooper Site
Gowanda, New York

	Guidance Values[3]		Sample Location, Identification, Depth, and Date Collected[1]											
Constituent[2]	Eastern USA Background	Region 9 PRGs	SB-1 100500006 0-2' 10/05/00	SB-2 100500008 0-2' 10/05/00	SB-4 100500010 0-2' 10/05/00	SB-5 100600012 0-2' 10/06/00	SB-7 100600018 0-2' 10/06/00	SB-8 100600032 0-2' 10/06/00	SB-9 100600034 0.5-2.5' 10/06/00	SB-10 100600036 0-2' 10/06/00	MWFP-2 100600015 0.5-2.5' 10/06/00	MWFP-3 100900038 0.5-2.5 10/09/00	Maximum Conc.	Minimum Conc.
Mercury	0.001-0.2	61	0.08	0.13	0.13	0.05 U	0.17	0.06 U	3.1	0.47	0.16 J	0.4	3.1	ND
Nickel	0.5-25	4,100	17.8	17.9	19.4	18	19.1	15.9	13.1	14.7	17.9	27.2	27.2	13.1
Potassium	8,500-43,900**	--	951	527	805	1060	912	755	239 U	399	542	622	1060	239 U
Selenium	0.1-3.9	1,000	1.6	1.8	1.3	1.4	0.95	1.6	1.7	2	2.7	2.1 J	2.7	0.95
Silver	--	--	1.1 U	1.2 U	1.2 U	1.1 U	1.1 U	1.1 U	1.2 U	1.2 U	1.3 U	1.2 U	1.3 U	1.1 U
Sodium	6,000-8,000	--	377	372	439	425	479	389	398	458	411	514	514	372
Thallium	--	--	1.1 U	1.1 U	1.2 U	1.1 U	1.2 U	1.1 U	1.2 U	1.2 U	1.3 U	1.1 U	1.3 U	1.1 U
Vanadium	1-300	1,400	14.8	12.8	16.7	18	17.7	14.6	17.5	17.8	15.3	20.2	20.2	12.8
Zinc	9-50	100,000	152 J	109 J	132 J	45.6 J	124 J	51.6 J	116 J	728 J	84.6 J	246	728	45.6 J
Others														
Percent Solids, %			89.7	84.3	81.7	90.6	84.9	87.6	81.3	84.4	78.7	85.8	90.6	78.7
pH			8.01	8.2	8.34	7.85	8.24	7.81	7.34	7.61	7.7	7.46	8.34	7.34
TOC, %			0.47	0.94	1.8	0.25	1.3	0.35	1.1	1.7	1.7	1.5	1.8	0.25

Notes:

1. Sample locations provided on Plate 1.
2. Data qualifications reflect 100% data validation performed by Data Validation Services. The analytical results for the SVOC, 3-Nitroaniline, was rejected during data validation for each sample.
3. Guidance values from U.S EPA, 2000 Region 9 Preliminary Remediation Goals (PRGs) for Industrial Soil and from range of background metals concentrations measured in soil found in the eastern United States from NYSDEC Division of Technical and Administrative Guidance Memorandum (TAGM) #4046.

** A New York State Background value TAGM 4046

*** Background levels for lead vary widely, average levels in undeveloped, rural areas range from 4-61 ppm while metropolitan/suburban areas range from 200-500 ppm.

J = indicates a laboratory estimated value or estimated as a result of data validation.
U = indicates compound was not detected at or above the listed detection limit.
R= indicates data rejected by data validator.
UJ = indicates compound was not detected above the listed detection limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the compound in the sample.
E = concentration exceeded the calibration range in the first analysis and was non-detect in the dilution analysis. Data validator qualified the first analysis concentration as estimated.

-- = indicates value does not exist.
fbgs = feet below ground surface
indicates concentration above guidance value.

302707

C:\Documents and Settings\jgurney\Desktop\Table 4-5 new plant indoor soil

TABLE 4-12

ANALYTICAL RESULTS FOR SEEP SAMPLES FROM THE INACTIVE LANDFILL AREA

Peter Cooper Site
Gowanda, New York

Constituent[2]	Guidance Value[3]	Sample Location, Identification and Date Collected[1]						Maximum Conc.	Minimum Conc.
		Seep #1		Seep #2		Seep #3			
		110800102 11/8/2000	052001137 5/20/2001	110800103 11/8/2000	052001138 5/20/2001	110800104 11/8/2000	052001139 5/20/2001		
Volatile Organic Compounds, micrograms per liter									
Benzene	210*	10 U	10 U	10 U	10 UJ	10 U	10 UJ	10 UJ	10 UJ
Chlorobenzene	5	10 U	10 U	10 U	10 UJ	10 U	10 UJ	10 UJ	10 UJ
1,2-Dichlorobenzene	5	10 U	10 U	10 U	10 UJ	10 U	10 UJ	10 UJ	10 UJ
1,4-Dichlorobenzene	5	10 U	10 U	10 U	10 UJ	10 U	10 UJ	10 UJ	10 UJ
Ethylbenzene	17*	10 U	10 U	10 U	10 UJ	10 U	10 UJ	10 UJ	10 UJ
Toluene	100*	3.1 J	2.8 J	2 J	3.5 J	10 U	10 UJ	10 UJ	2 J
m/p-Xylene	5	10 U	10 U	10 U	10 UJ	10 U	10 UJ	10 UJ	10 UJ
o-Xylene	5	10 U	10 U	10 U	10 UJ	10 U	10 UJ	10 UJ	10 UJ
Semi-Volatile Organic Compounds, micrograms per liter									
2-Chorophenol	–	10 U	9.4 U	10 U	10 U	10 U	16 U	16 U	9.4 U
2,4-Dichlorophenol	–	10 U	9.4 U	10 U	10 U	10 U	16 U	16 U	9.4 U
2,4-Dimethylphenol	–	10 U	9.4 U	10 U	10 U	10 U	16 U	16 U	9.4 U
2,4-Dinitrophenol	–	50 U	24 U	50 U	25 U	50 U	40 U	50 U	24 U
4,6-Dintiro-2-methylphenol	–	50 U	24 U	50 U	25 U	50 U	40 U	50 U	24 U
4-Chloro-3-Methylphenol	–	10 U	9.4 U	10 U	10 U	10 U	16 U	16 U	9.4 U
2-Methylphenol	–	10 U	9.4 U	10 U	10 U	10 U	16 U	16 U	9.4 U
4-Methylphenol	–	10 U	9.4 U	10 U	10 U	10 U	16 U	16 U	9.4 U
2-Nitrophenol	–	10 U	9.4 U	10 U	10 U	10 U	16 U	16 U	9.4 U
4-Nitrophenol	–	50 U	24 U	50 U	25 U	50 U	40 U	50 U	24 U
Pentachlorophenol[4]	20.2	50 U	24 U	50 U	25 U	50 U	40 U	50 U	24 U
Phenol	–	10 U	9.4 U	1.8 J	10 U	1.8 J	16 U	16 U	1.8 J
2,4,6-Trichlorophenol	–	10 U	9.4 U	10 U	10 U	10 U	16 U	16 U	9.4 U
2,4,5-Trichlorophenol	–	10 U	24 U	10 U	25 U	10 U	40 U	40 U	10 U
Total Metals, milligrams per liter									
Arsenic	0.150	0.071	0.052	0.0520	0.038	0.062	0.0314	0.071	0.0314
Calcium	–	156	171	150	156	116	170	171	116
Chromium	0.422	0.374	0.221	0.423	0.312	0.0949	0.129	0.423	0.0949
Hexavalent Chromium	0.011	0.04 U	(0.01 U) R	0.04 U	(0.01 U) R	0.01 U	(0.01 U) R	0.04 U	0.01 U
Iron	0.300	3.01	1.18	28.6	0.1 U	0.39	0.123	28.6	0.1 U
Magnesium	–	190	102	163	123	82.9	90.5	190	82.9
Potassium	–	10.9	7.71	8.79	6.19	3.56	4.12	10.9	3.56
Sodium	–	26.8	18.1	19.7	18.3	17.5	18	26.8	17.5
Zinc	0.017	0.02 U	0.02 U	0.0747	0.02 U	0.02 U	0.02 U	0.0747	0.02 U
Soluble Metals[5], milligrams per liter									
Arsenic	0.15	0.0665	NA	0.0528	NA	0.0599	NA	0.0665	0.0528
Calcium	–	155	NA	132	NA	113	NA	155	113
Chromium	0.422	0.369	NA	0.325	NA	0.0969	NA	0.369	0.0969
Hexavalent Chromium	0.011	0.04 U	(0.01 U) R	0.04 U	(0.01 U) R	0.04 U	(0.01 U) R	0.04 U	(0.01 U) R
Iron	0.3	4.78	NA	0.914	NA	0.107	NA	4.78	0.107
Magnesium	–	184	NA	144	NA	84.1	NA	184	84.1
Potassium	–	10.5	NA	6.4	NA	3.7	NA	10.5	3.7
Sodium	–	26	NA	19.6	NA	17	NA	26	17
Zinc	0.017	0.02 U	NA	0.02 U	NA	0.02 U	NA	0.02 U	0.02 U

TABLE 4-12

ANALYTICAL RESULTS FOR SEEP SAMPLES FROM THE INACTIVE LANDFILL AREA

Peter Cooper Site
Gowanda, New York

Constituent[2]	Guidance Value[3]	Sample Location, Identification and Date Collected[1]						Maximum Conc.	Minimum Conc.
		Seep #1		Seep #2		Seep #3			
		110800102 11/8/2000	052001137 5/20/2001	110800103 11/8/2000	052001138 5/20/2001	110800104 11/8/2000	052001139 5/20/2001		
Other Geochemical Data, milligrams per liter									
Ammonia	1.1 Nov./1.3 Apr.[6]	891	627	734	678	381	393	891	381
Bicarbonate Alkalinity	–	4000	2800	3150	3100	1340	1550	4000	1340
Carbonate Alkalinity	–	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
Chloride	–	33.9	17.3	29.9	20.6	17.5	20.3	33.9	17.3
Nitrate Nitrogen	–	2.35	0.545	0.746	0.05 U	2.84	1.74	2.84	0.05 U
Soluble Organic Carbon	–	97.875	NA	81.925	NA	31.025	NA	97.875	31.025
Sulfate	–	241	242	157	150	595	632	632	150
Total Alkalinity	–	4000	2800	3150	3100	1340	1550	4000	1340
Total Dissolved Solids	–	1060	NA	1030	NA	855	NA	1060	855
Total Hardness	–	1100	NA	800	NA	608	NA	1100	608
Total Kjeldahl Nitrogen	–	836	602	721	667	380	392	836	380
Total Organic Carbon	–	100.675	55.525	81.425	64.875	NA	38.425	100.675	38.425
Total Sulfide	2	9.00	5.9	3.70	5.2	1 U	2 U	9	1 U
Turbidity, NTU	–	NA	120	NA	137	NA	4.38	137	4.38
Field Measured Parameters[7]	--								
Conductivity (uS/cm)	–	>1990	>1990	>1990	>1990	>1990	>1990	>1990	>1990
Dissolved Oxygen (ppm)	–	7.11	NA	8.48	NA	8.53	NA	8.53	7.11
Oxidation Reduction Potential (mV)	–	<-50 and >1050	<-50 and >1050	<-50 and >1050	<-50 and >1050	75	-40	>1050	<-50
pH (pH units)	–	7.92	7.88	8.21	7.9	8.25	8.2	8.25	7.88
Temperature (°C)	–	11.1	12.8	14.3	20	14.3	18.3	20	11.1
Turbidity (NTU)	–	212	NA	110	NA	5.8	NA	212	5.8

Notes:

1. Sample locations provided on Plate 1.
2. Data qualifications reflect 100% data validation performed by Data Validation Services.
3. Surface water criteria for Class A, A-S, AA, AA-S, B, C fresh water fish propogation as provided in Division of Water Technical and Operational Series (1.1.1), Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations, October 22, 1993, reissued June 1998.
   * Values indicated a guidance value as a standard value does not exist.
4. pH dependent criteria; pH = 8.1 was used to calculate Pentachlorophenol guidance value.
5. Samples collected for soluble metals analysis were field filtered.
6. Total Ammonia calculated with the (T) or (TS) Specifications (most conservative) using an average pH of 8.1 (Nov) and 8.0 (Apr) and average temp of 13.2 °C (Nov) and 17.0°C (Apr).
7. The YSI 600XL was used in the November and May sampling events for temperature, pH, specific electrical conductance, dissolved oxygen,and redox potential measurements.
   Ferrous iron was field measured with the HACH18-R field kit (for QC, 10% were sent to analytical laboratory).
   Turbidity measurements were collected with the TURB2020 meter during the November sampling events.

NA = not analyzed
– = indicates value does not exist.
NTU = Nephelometric Turbidity Unit
uS/cm = microsiemens per centimeter at 25°C.
ppm = parts per million
mV = millivolts

J = indicates an estimated value.
U = indicates compound was not detected.
R= indicates value was rejected by data validator.
UJ = indicates compound was not detected above the listed detection limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the compound in the sample.
indicates exceedance of guidance value.
(values) = laboratory reported value prior to data validation rejection.

TABLE 4-13

ANALYTICAL RESULTS FOR SURFACE WATER SAMPLES FROM CATTARAUGUS CREEK

Peter Cooper Site
Gowanda, New York

Constituent[2]	Guidance Value[3]	Sample Location, Identification, and Date Collected[1]								Maximum Conc	Minimum Conc
		Creek Water #1		Creek Water #2		Creek Water #3		Creek Water #4			
		110700101 11/7/2000	050201134 5/2/2001	110700100 11/7/2000	050201130 5/2/2001	110700098 11/7/2000	050201131 5/2/2001	110700097 11/7/2000	050201132 5/2/2001		
Volatile Organic Compounds, micrograms per liter											
Acetone	--	3.5 J	NA	10 U	NA	10 U	NA	3.2 J	NA	10 U	3.2 J
Benzene	210*	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Bromodichloromethane	--	10 U	NA	10 U	NA	10 U	NA	10 U	NA	10 U	10 U
Bromoform	--	10 U	NA	10 U	NA	10 U	NA	10 U	NA	10 U	10 U
Bromomethane	--	10 U	NA	10 U	NA	10 U	NA	10 U	NA	10 U	10 U
2-Butanone (MEK)	--	10 U	NA	10 U	NA	10 U	NA	10 U	NA	10 U	10 U
Methyl tert-Butyl Ether	--	10 U	NA	10 U	NA	10 U	NA	10 U	NA	10 U	10 U
Carbon Disulfide	--	10 U	NA	10 U	NA	10 U	NA	10 U	NA	10 U	10 U
Carbon Tetrachloride	--	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Chlorobenzene	5	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Chloroethane	--	10 U	NA	10 U	NA	10 U	NA	10 U	NA	10 U	10 U
Chloroform	--	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Chloromethane	--	10 U	NA	10 U	NA	10 U	NA	10 U	NA	10 U	10 U
1,2-Dibromo-3-chloropropane	--	10 U	NA	10 U	NA	10 U	NA	10 U	NA	10 U	10 U
Cyclohexane	--	10 U	NA	10 U	NA	10 U	NA	10 U	NA	10 U	10 U
Dibromochloromethane	--	10 U	NA	10 U	NA	10 U	NA	10 U	NA	10 U	10 U
1,2-Dibromoethane	--	10 U	NA	10 U	NA	10 U	NA	10 U	NA	10 U	10 U
1,2-Dichlorobenzene	5	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
1,4-Dichlorobenzene	5	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
1,3-Dichlorobenzene	5	10 U	NA	10 U	NA	10 U	NA	10 U	NA	10 U	10 U
Dichlorodifluoromethane	--	10 U	NA	10 U	NA	10 U	NA	10 U	NA	10 U	10 U
1,1-Dichloroethane	--	10 U	NA	10 U	NA	10 U	NA	10 U	NA	10 U	10 U
1,2-Dichloroethane	--	10 U	NA	10 U	NA	10 U	NA	10 U	NA	10 U	10 U
1,1-Dichloroethene	--	10 U	NA	10 U	NA	10 U	NA	10 U	NA	10 U	10 U
trans-1,2-Dichloroethene	--	10 U	NA	10 U	NA	10 U	NA	10 U	NA	10 U	10 U
cis-1,2-Dichloroethene	--	2.7 J	NA	10 U	NA	10 U	NA	10 U	NA	10 U	2.7 J
1,2-Dichloropropane	--	10 U	NA	10 U	NA	10 U	NA	10 U	NA	10 U	10 U
trans-1,3-Dichloropropene	--	10 U	NA	10 U	NA	10 U	NA	10 U	NA	10 U	10 U
cis-1,3-Dichloropropene	--	10 U	NA	10 U	NA	10 U	NA	10 U	NA	10 U	10 U
Ethylbenzene	17*	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2-Hexanone	--	10 U	NA	10 U	NA	10 U	NA	10 U	NA	10 U	10 U
Isopropylbenzene	2.6*	10 U	NA	10 U	NA	10 U	NA	10 U	NA	10 U	10 U
Methyl Acetate	--	10 U	NA	10 U	NA	10 U	NA	10 U	NA	10 U	10 U
Methylcyclohexane	--	10 U	NA	10 U	NA	10 U	NA	10 U	NA	10 U	10 U
Methylene Chloride	--	10 U	NA	10 U	NA	10 U	NA	10 U	NA	10 U	10 U
4-Methyl-2-Pentanone	--	10 U	NA	10 U	NA	10 U	NA	10 U	NA	10 U	10 U
Styrene	--	10 U	NA	10 U	NA	10 U	NA	10 U	NA	10 U	10 U
1,1,2,2-Tetrachloroethane	--	10 U	NA	10 U	NA	10 U	NA	10 U	NA	10 U	10 U
Tetrachloroethene	--	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Toluene	100*	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
1,2,4-Trichlorobenzene	5	10 U	NA	10 U	NA	10 U	NA	10 U	NA	10 U	10 U
1,1,1-Trichloroethane	--	10 U	NA	10 U	NA	10 U	NA	10 U	NA	10 U	10 U
1,1,2-Trichloroethane	--	10 U	NA	10 U	NA	10 U	NA	10 U	NA	10 U	10 U
Trichloroethene	--	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Trichlorofluoromethane	--	10 U	NA	10 U	NA	10 U	NA	10 U	NA	10 U	10 U
1,1,2-Trichloro-1,2,2-Trifluoroethane	--	10 U	NA	10 U	NA	10 U	NA	10 U	NA	10 U	10 U
Vinyl Chloride	--	10 U	NA	10 U	NA	10 U	NA	10 U	NA	10 U	10 U
m-/p-Xylene	5	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
o-Xylene	5	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Semi-Volatile Organic Compounds, micrograms per liter											
Acenaphthene	5.3*	10 U	NA	10 U	NA	10 U	NA	10 U	NA	10 U	10 U
Acenaphthylene	--	10 U	NA	10 U	NA	10 U	NA	10 U	NA	10 U	10 U
Acetophenone	--	10 U	NA	10 U	NA	10 U	NA	10 U	NA	10 U	10 U
Anthracene	3.8*	10 U	NA	10 U	NA	10 U	NA	10 U	NA	10 U	10 U
Atrazine	--	10 U	NA	10 U	NA	10 U	NA	10 U	NA	10 U	10 U
Benzaldehyde	--	10 U	NA	10 U	NA	10 U	NA	10 U	NA	10 U	10 U
Benzo(a)anthracene	0.03	10 U	10 U	10 U	10 U	10 U	10 U	10 U	9.5 U	10 U	9.5 U
Benzo(a)pyrene	--	10 U	10 U	10 U	10 U	10 U	10 U	10 U	9.5 U	10 U	9.5 U
Benzo(b)fluoranthene	--	10 U	10 U	10 U	10 U	10 U	10 U	10 U	9.5 U	10 U	9.5 U
Benzo(g,h,i)perylene	--	10 U	NA	10 U	NA	10 U	NA	10 U	NA	10 U	10 U
Benzo(k)fluoranthene	--	10 U	NA	10 U	NA	10 U	NA	10 U	NA	10 U	10 U
1,1-Biphenyl	--	10 U	NA	10 U	NA	10 U	NA	10 U	NA	10 U	10 U
Butyl Benzyl Phthalate	--	10 U	NA	10 U	NA	10 U	NA	10 U	NA	10 U	10 U
di-N-Butylphthalate	--	10 U	NA	10 U	NA	10 U	NA	10 U	NA	10 U	10 U
Caprolactam	--	10 U	NA	10 U	NA	10 U	NA	10 U	NA	10 U	10 U
Carbazole	--	10 U	NA	10 U	NA	10 U	NA	10 U	NA	10 U	10 U
Indeno(1,2,3-cd)pyrene	--	10 U	10 U	10 U	10 U	10 U	10 U	10 U	9.5 U	10 U	9.5 U
4-Chloroaniline	--	10 U	NA	10 U	NA	10 U	NA	10 U	NA	10 U	10 U
bis(2-chloroethoxy)methane	--	10 U	NA	10 U	NA	10 U	NA	10 U	NA	10 U	10 U
bis(2-chloroethyl)ether	--	10 U	NA	10 U	NA	10 U	NA	10 U	NA	10 U	10 U
2-Chloronaphthalene	--	10 U	NA	10 U	NA	10 U	NA	10 U	NA	10 U	10 U

TABLE 4-13

ANALYTICAL RESULTS FOR SURFACE WATER SAMPLES FROM CATTARAUGUS CREEK

Peter Cooper Site
Gowanda, New York

Constituent[2]	Guidance Value[3]	Sample Location, Identification, and Date Collected[1]								Maximum Conc	Minimum Conc.
		Creek Water #1		Creek Water #2		Creek Water #3		Creek Water #4			
		110700101 11/7/2000	050201134 5/2/2001	110700100 11/7/2000	050201130 5/2/2001	110700098 11/7/2000	050201131 5/2/2001	110700097 11/7/2000	050201132 5/2/2001		
2-Chlorophenol	--	10 U	10 U	10 U	10 U	10 U	10 U	10 U	9.5 U	10 U	9.5 U
2,2-oxybis(1-chloropropane)	--	10 U	NA	10 U	NA	10 U	NA	10 U	NA	10 U	10 U
Chrysene	--	10 U	NA	10 U	NA	10 U	NA	10 U	NA	10 U	10 U
Dibenzo(a,h)anthracene	--	10 U	10 U	10 U	10 U	10 U	10 U	10 U	9.5 U	10 U	9.5 U
Dibenzofuran	--	10 U	NA	10 U	NA	10 U	NA	10 U	NA	10 U	10 U
3,3-Dichlorobenzidine	--	10 U	NA	10 U	NA	10 U	NA	10 U	NA	10 U	10 U
2,4-Dichlorophenol	--	10 U	10 U	10 U	10 U	10 U	10 U	10 U	9.5 U	10 U	9.5 U
Diethylphthalate	--	10 U	NA	10 U	NA	10 U	NA	10 U	NA	10 U	10 U
Dimethyl Phthalate	--	10 U	NA	10 U	NA	10 U	NA	10 U	NA	10 U	10 U
2,4-Dimethylphenol	--	10 U	10 U	10 U	10 U	10 U	10 U	10 U	9.5 U	10 U	9.5 U
2,4-Dinitrophenol	--	25 U	26 U	25 U	25 U	25 U	25 U	25 U	24 U	26 U	24 U
2,4-Dinitrotoluene	--	10 U	NA	10 U	NA	10 U	NA	10 U	NA	10 U	10 U
2,6-Dinitrotoluene	--	10 U	NA	10 U	NA	10 U	NA	10 U	NA	10 U	10 U
bis(2-Ethylhexyl)phthalate	--	10 U	NA	10 U	NA	10 U	NA	10 U	NA	10 U	10 U
Fluoranthene	--	10 U	NA	10 U	NA	10 U	NA	10 U	NA	10 U	10 U
Fluorene	0.54*	10 U	NA	10 U	NA	10 U	NA	10 U	NA	10 U	10 U
Hexachlorobenzene	--	10 U	NA	10 U	NA	10 U	NA	10 U	NA	10 U	10 U
Hexachlorobutadiene	1	10 U	NA	10 U	NA	10 U	NA	10 U	NA	10 U	10 U
Hexachlorocyclopentadiene	0.45	10 U	NA	10 U	NA	10 U	NA	10 U	NA	10 U	10 U
Hexachloroethane	--	10 U	NA	10 U	NA	10 U	NA	10 U	NA	10 U	10 U
Isophorone	--	10 U	NA	10 U	NA	10 U	NA	10 U	NA	10 U	10 U
2-Methylnaphthalene	4.7*	10 U	NA	10 U	NA	10 U	NA	10 U	NA	10 U	10 U
4,6-Dinitro-2-Methylphenol	--	25 U	26 U	25 U	25 U	25 U	25 U	25 U	24 U	26 U	24 U
4-Chloro-3-Methylphenol	--	10 U	10 U	10 U	10 U	10 U	10 U	10 U	9.5 U	10 U	9.5 U
2-Methylphenol	--	10 U	10 U	10 U	10 U	10 U	10 U	10 U	9.5 U	10 U	9.5 U
4-Methylphenol	--	10 U	10 U	10 U	10 U	10 U	10 U	10 U	9.5 U	10 U	9.5 U
Naphthalene	13*	10 U	NA	10 U	NA	10 U	NA	10 U	NA	10 U	10 U
2-Nitroaniline	--	25 U	NA	25 U	NA	25 U	NA	25 U	NA	25 U	25 U
3-Nitroaniline	--	25 U	NA	25 U	NA	25 U	NA	25 U	NA	25 U	25 U
4-Nitroaniline	--	25 U	NA	25 U	NA	25 U	NA	25 U	NA	25 U	25 U
Nitrobenzene	--	10 U	NA	10 U	NA	10 U	NA	10 U	NA	10 U	10 U
2-Nitrophenol	--	10 U	10 U	10 U	10 U	10 U	10 U	10 U	9.5 U	10 U	9.5 U
4-Nitrophenol	--	25 U	26 U	25 U	25 U	25 U	25 U	25 U	24 U	26 U	24 U
n-Nitrosodiphenylamine	--	10 U	NA	10 U	NA	10 U	NA	10 U	NA	10 U	10 U
di-n-Octyl Phthalate	--	10 U	NA	10 U	NA	10 U	NA	10 U	NA	10 U	10 U
Pentachlorophenol[4]	24.7	25 U	26 U	25 U	25 U	25 U	25 U	25 U	24 U	26 U	24 U
Phenanthrene	5.0*	10 U	NA	10 U	NA	10 U	NA	10 U	NA	10 U	10 U
Phenol	--	10 U	10 U	10 U	10 U	10 U	10 U	10 U	9.5 U	10 U	9.5 U
4-Bromophenyl-Phenylether	--	10 U	NA	10 U	NA	10 U	NA	10 U	NA	10 U	10 U
4-Chlorophenyl-Phenylether	--	10 U	NA	10 U	NA	10 U	NA	10 U	NA	10 U	10 U
n-Nitroso-di-n-Propylamine	--	10 U	NA	10 U	NA	10 U	NA	10 U	NA	10 U	10 U
Pyrene	4.6*	10 U	NA	10 U	NA	10 U	NA	10 U	NA	10 U	10 U
2,4,6-Trichlorophenol	--	10 U	10 U	10 U	10	10 U	10	10 U	9.5 U	10 U	9.5 U
2,4,5-Trichlorophenol	--	25 U	26 U	25 U	25	25 U	25	25 U	24 U	26 U	24 U
Metals, milligrams per liter											
Aluminum	0.1	0.1 U	NA	0.1 U	NA	0.1 U	NA	0.1 U	NA	0.1 U	0.1 U
Antimony	--	0.06 U	NA	0.06 U	NA	0.06 U	NA	0.06 U	NA	0.06 U	0.06 U
Arsenic	0.15	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Barium	--	0.0641	NA	0.0647	NA	0.0618	NA	0.0693	NA	0.0693	0.0618
Beryllium[5]	1.1	0.005 U	NA	0.005 U	NA	0.005 U	NA	0.005 U	NA	0.005 U	0.005 U
Cadmium[5]	0.0035	0.005 U	NA	0.005 U	NA	0.005 U	NA	0.005 U	NA	0.005 U	0.005 U
Calcium	--	57.8	51.8	59.6	51.9	58.3	53.4	59.1	56.6	59.6	51.8
Chromium[5]	0.1280	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Hexavalent Chromium	0.0110	0.04 U	(0.01 U) R	0.01 U	(0.01 U) R	0.01 U	(0.01 U) R	0.01 U	(0.01 U) R	0.04 U	(0.01 U) R
Cobalt	0.0050	0.05 U	NA	0.05 U	NA	0.05 U	NA	0.05 U	NA	0.05 U	0.05 U
Copper[5]	0.0158	0.02 U	NA	0.02 U	NA	0.02 U	NA	0.02 U	NA	0.02 U	0.02 U
Iron	0.3000	0.129	0.39	0.126	0.403	0.143	0.47	0.151	0.344	0.47	0.126
Lead[5]	0.0078	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U
Magnesium	--	10.3	9.25	10.3	9.45	9.88	9.21	10.8	9.99	10.8	9.21
Manganese	--	0.0115	0.0161	0.0138	0.0149	0.0129	0.0216	0.0184	0.0206	0.0216	0.0115
Mercury	0.0008	0.0003 U	NA	0.0003 U	NA	0.0003 U	NA	0.0003 U	NA	0.0003 U	0.0003 U
Nickel[5]	0.0915	0.04 U	NA	0.04 U	NA	0.04 U	NA	0.04 U	NA	0.04 U	0.04 U
Potassium	--	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
Selenium	0.0046	0.005 U	NA	0.005 U	NA	0.005 U	NA	0.005 U	NA	0.005 U	0.005 U
Silver	0.0001	0.01 U	NA	0.01 U	NA	0.01 U	NA	0.01 U	NA	0.01 U	0.01 U
Sodium	--	13.7	NA	13.9	NA	13.4	NA	16.2	NA	16.2	13.4
Thallium	0.008	0.01 U	NA	0.01 U	NA	0.01 U	NA	0.01 U	NA	0.01 U	0.01 U
Zinc[5]	0.0094	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U
Vanadium	0.0140	0.05 U	NA	0.05 U	NA	0.05 U	NA	0.05 U	NA	0.05 U	0.05 U

TABLE 4-13

ANALYTICAL RESULTS FOR SURFACE WATER SAMPLES FROM CATTARAUGUS CREEK

Peter Cooper Site
Gowanda, New York

Constituent[2]	Guidance Value[3]	Sample Location, Identification, and Date Collected[1]								Maximum Conc	Minimum Conc
		Creek Water 01		Creek Water 02		Creek Water 03		Creek Water 04			
		110700101 11/7/2000	050201134 5/2/2001	110700100 11/7/2000	050201130 5/2/2001	110700098 11/7/2000	050201131 5/2/2001	110700097 11/7/2000	050201132 5/2/2001		
Other Geochemical Data, milligrams per liter											
Ammonia	0.58 Nov./0.44 Apr.	0.05 U	0.05 U	0.05 U	0.05 U	0.234	0.306	0.17	0.442	0.442	0.05 U
Bicarbonate Alkalinity	–	167	270 J	166	133	164	135	169	140	270 J	133
Carbonate Alkalinity	–	2 U	2 U	2 U	2 UJ	2 U	2 U	2 U	2 U	2 UJ	2 UJ
Chloride	–	24	26.4	22.9	27	23.4	27.1	28.7	46.9	46.9	22.9
Ferrous Iron	–	NA	NA	NA	0.1 U	NA	NA	NA	NA	0.1 U	0.1 U
Nitrate Nitrogen		1.78	1.07	1.81	1.11	1.81	1.07	1.9	1.12	1.9	1.07
Sulfate	–	28.8	24.8	27.6	25.9	27.5	24.9	28.5	28	28.8	24.8
Total Alkalinity	–	167	270 J	166	133	164	135	169	140	270 J	133
Total Dissolved Solids	–	254	216	250	221	249	216	255	264	264	216
Total Hardness	–	191	166	198	164	195	161	200	175	200	161
Total Kjeldahl Nitrogen	–	0.308	0.345	0.412	0.2 U	0.417	0.445	0.344	0.648	0.648	0.2
Total Organic Carbon	–	1.975 U	1.665	1.8875	1.6525	2.135	1.675	1.9875	1.7225	2.135	1.6525
Total Sulfide	2	1 U	2 UJ	1 U	2	1 U	2 UJ	1 U	2 UJ	2 UJ	1 U
Total Suspended Solids	–	1.3	6.6	1.6	7.1	1.3 J	8.2	1.9	4.9	8.2	1.3 J
Field Measured Parameters[7]											
Conductivity (uS/cm)	–	440	350	390	340	320	340	340	390	440	320
Dissolved Oxygen (ppm)	–	NA	NA	9.8	NA	8.65	NA	13.6	NA	13.6	8.65
Ferrous Iron (mg/l)	–	NA	NA	NA	0	NA	0	NA	0	0	0
Oxidation Reduction Potential (mV)	–	30	-40	35	-60	35	-60	-5	-45	35	-60
pH (pH units)	–	8.52	8.5	8.3	8.42	8.37	8.4	8.36	8.5	8.52	8.3
Temperature (°C)	–	16.5	14.4	7.9	14.4	7.8	14.4	5.3	14.4	16.5	5.3
Turbidity (NTU)	–	2.43	NA	NA	NA	5.18	NA	4.14	NA	5.18	2.43

Notes:

1. Sample locations provided on Plate 1.
2. Data qualifications reflect 100% data validation performed by Data Validation Services.
3. Surface water criteria for Class A, A-S, AA, AA-S, B, C fresh water fish propagation as provided in Division of Water Technical and Operational Series (1.1.1), Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations, October 22, 1993, reissued June 1998.
   * Values indicated a guidance value as a standard value does not exist.
4. pH dependent criteria; pH = 8.3 was used to calculate Pentachlorophenol guidance value.
5. Hardness dependent criteria; Hardness value of 195 ppm was used.
6. Total Ammonia calculated with the (T) or (TS) Specifications (most conservative) using an average pH of 8.4 (Nov) and 8.5 (Apr) and average temp of 9°C (Nov) and 14.4°C (Apr).
7. The YSI 600XL was used in the November and May sampling events for temperature, pH, specific electrical conductance, dissolved oxygen, and redox potential measurements.
   Ferrous iron was field measured with the HACH18-R field kit (for QC, 10% were sent to analytical laboratory).
   Turbidity measurements were collected with the TURB2020 meter during the November sampling events.

NA = not analyzed
(values) = laboratory reported value prior to data validation.
mg/l = milligrams per liter
NTU = Nephelometric Turbidity Unit
uS/cm = microsiemens per centimeter at 25°C.
– = indicates guidance value does not exist.
ppm = parts per million
mV = millivolts

J = indicates an estimated value.
U = indicates compound was not detected.
R= indicates value was rejected by data validator.
UJ = indicates compound was not detected above the listed detection limit.
However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the compound in the sample.
-- = indicates value does not exist.
indicates exceedance of guidance value.

Creek Water # 1 Sample = upstream/background

C:\Documents and Settings\gregory\Desktop\Table 4-13 surface water

TABLE 4-14

ANALYTICAL RESULTS FOR WETLAND SEDIMENT SAMPLES

Peter Cooper Site
Gowanda, New York

Constituent[2]	Guidance Values[3] Eastern USA Background	Guidance Values[3] Region 9 PRGs	Sample Location, Identification, and Date Collected[1] WSS-1 101000047 10/10/2000	WSS-2 101000048 10/10/2000	WSS-3 101000049 10/10/2000	WSS-4 101000050 10/10/2000	WSS-5 101000051 10/10/2000	WSS-6 101000052 10/10/2000	WSS-7 101000054 10/10/2000	WSS-8 101000055 10/10/2000	WSS-9 101000056 10/10/2000	WSS-10 101000057 10/10/2000	Maximum Conc.	Minimum Conc.
Volatile Organic Compounds, milligrams per kilogram														
Benzene		1.5	0.0065 J	0.0085 J	0.0037 J	0.0058 J	0.005 J	0.004 J	0.0068 J	0.0082 J	0.0035 J	0.0026 J	0.0085 J	0.0026 J
Chlorobenzene		54	0.0120 U	0.023 UJ	0.0063 UJ	0.013 UJ	0.014 UJ	0.018 UJ	0.012 U	0.014 UJ	0.023 UJ	0.017 UJ	0.023 UJ	0.0063 UJ
1,2-dichlorobenzene		370	0.0120 UJ	0.023 UJ	0.0063 UJ	0.013 UJ	0.014 UJ	0.018 UJ	0.012 U	0.014 UJ	0.023 UJ	0.017 UJ	0.023 UJ	0.0063 UJ
1,4-dichlorobenzene		8.1	0.0120 UJ	0.023 UJ	0.0063 UJ	0.013 UJ	0.014 UJ	0.018 UJ	0.012 U	0.014 UJ	0.023 UJ	0.017 UJ	0.023 UJ	0.0063 UJ
Ethylbenzene		230	0.0015 J	0.0034 J	0.0009 J	0.013 UJ	0.014 UJ	0.018 UJ	0.0014 J	0.0021 J	0.023 UJ	0.0033 J	0.023 UJ	0.00094 J
m/p-Xylene		--	0.0082 J	0.015 J	0.0044 J	0.0058 J	0.006 J	0.0053 J	0.0083 J	0.011 J	0.023 UJ	0.017 UJ	0.023 UJ	0.0044 J
o-Xylene		--	0.0027 J	0.0044 J	0.0013 J	0.0017 J	0.0019 J	0.018 U	0.0023 J	0.0033 J	0.023 UJ	0.017 UJ	0.023 UJ	0.0013 J
Toluene		520	0.0120	0.018 J	0.0066 J	0.011 J	0.0082 J	0.0082 J	0.011 J	0.015 J	0.016 J	0.0041 J	0.018 UJ	0.0041 J
Metals, milligrams per kilogram														
Arsenic	3-12**	2.7	7.4	16.3	8.7	8.5	9.4	10.7	5.2	5.6	9.9	8.6	16.3	5.2
Chromium	1.5-40**	450	6.5	44.9	11.8	28.4	30.6	31.2	8.9	13.7	17.2	55.3	55.3	6.5
Hexavalent Chromium	--	64	5.07 U	7.12 U	5.35 U	5.29 U	5.43 U	5.87 U	4.68 U	5.55 U	6.34 U	5.81 U	7.12 U	4.68 U
Zinc	9-50	100,000	45.7	227	69.8	80.5	74.9	92.5	58.8	65.6	290	110	290	45.7
Other														
Percent Solids, %			78.9	56.2	74.8	75.6	73.6	68.2	85.5	72.1	63.1	68.8	85.5	56.2
pH			8.17	7.56	7.68	7.76	7.48	7.74	7.91	7.47	7.30	6.92	8.17	6.92
Total Organic Carbon, %			0.29	3.4	1.50	1.70	1.90	2.70	0.290	1.50	3.80	4.40	4.4	0.29

Notes:

1. Sample locations provided on Plate 1.
2. Data qualifications reflect 100% data validation performed by Data Validation Services.
3. Guidance values from U.S.EPA, 2000 Region 9 Preliminary Remediation Goals (PRGs) for Industrial Soil and from range of background metals concentrations measured in soil found in the eastern United States from NYSDEC Division of Technical and Administrative Guidance Memorandum (TAGM) #4046.

** A New York State Background value TAGM 4046

J = indicates a laboratory estimated value or estimated as a result of data validation.
U = indicates compound was not detected at or above the listed detection limit.
UJ = indicates compound was not detected above the listed detection limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the compound in the sample.
-- = indicates value does not exist.
indicates concentration above guidance value.

302713

C:\Documents and Settings\rgarvey\Desktop\Table 4-14 wetland sediment

TABLE 4-15

ANALYTICAL RESULTS FOR CATTARAUGUS CREEK SEDIMENTS

Peter Cooper Site
Gowanda, New York

Constituents[2]	Guidance Values[3]	Sample Location, Identification, and Date Collected[1]				Maximum Conc.	Minimum Conc.
		Creek Sed. #1 110700096 11/7/2000	Creek Sed. #2 110700095 11/7/2000	Creek Sed. #3 110700093 11/7/2000	Creek Sed. #4 110700092 11/7/2000		
Volatile Organic Compounds, milligrams per kilogram							
Acetone		0.024	0.078	0.019	0.022	0.078	0.019
Benzene		0.017 U	0.0025 J	0.0015 J	0.0014 J	0.017 U	0.0014
Bromodichloromethane		0.017 U	0.012 U	0.011 U	0.011 U	0.017 U	0.011
Bromoform		0.017 U	0.012 U	0.011 U	0.011 U	0.017 U	0.011
Bromomethane		0.017 U	0.012 U	0.011 U	0.011 U	0.017 U	0.011
2-Butanone (MEK)		0.017 U	0.0095 J	0.011 U	0.011 U	0.017 U	0.0095 J
Methyl tert-Butyl Ether		0.017 U	0.012 U	0.011 U	0.011 U	0.017 U	0.011
Carbon Disulfide		0.01 J	0.025	0.019	0.02	0.025	0.01
Carbon Tetrachloride		0.017 U	0.012 U	0.011 U	0.011 U	0.017 U	0.011
Chlorobenzene		0.017 U	0.012 U	0.011 U	0.011 U	0.017 U	0.011
Chloroethane		0.017 U	0.012 U	0.011 U	0.011 U	0.017 U	0.011
Chloroform		0.017 U	0.012 U	0.011 U	0.011 U	0.017 U	0.011
Chloromethane		0.017 U	0.012 U	0.011 U	0.011 U	0.017 U	0.011
1,2-Dibromo-3-Chloropropane		0.017 U	0.012 U	0.011 U	0.011 U	0.017 U	0.011 U
Cyclohexane		0.017 U	0.0045 J	0.0022 J	0.0022 J	0.017 U	0.0022
Dibromochloromethane		0.017 U	0.012 U	0.011 U	0.011 U	0.017 U	0.011
1,2-Dibromoethane		0.017 U	0.012 U	0.011 U	0.011 U	0.017 U	0.011 U
1,2-Dichlorobenzene		0.017 U	0.012 U	0.011 U	0.011 U	0.017 U	0.011 U
1,4-Dichlorobenzene		0.017 U	0.012 U	0.011 U	0.011 U	0.017 U	0.011 U
1,3-Dichlorobenzene		0.017 U	0.012 U	0.011 U	0.011 U	0.017 U	0.011 U
Dichlorodifluoromethane		0.017 U	0.012 U	0.011 U	0.011 U	0.017 U	0.011
1,1-Dichloroethane		0.017 U	0.012 U	0.011 U	0.011 U	0.017 U	0.011 U
1,2-Dichloroethane		0.017 U	0.012 U	0.011 U	0.011 U	0.017 U	0.011 U
1,1-Dichloroethene		0.017 U	0.012 U	0.011 U	0.011 U	0.017 U	0.011 U
trans-1,2-Dichloroethene		0.017 U	0.012 U	0.011 U	0.011 U	0.017 U	0.011
cis-1,2-Dichloroethene		0.017 U	0.0035 J	0.011 U	0.011 U	0.017 U	0.0035
1,2-Dichloropropane		0.017 U	0.012 U	0.011 U	0.011 U	0.017 U	0.011 U
trans-1,3-Dichloropropene		0.017 U	0.012 U	0.011 U	0.011 U	0.017 U	0.011
cis-1,3-Dichloropropene		0.017 U	0.012 U	0.011 U	0.011 U	0.017 U	0.011
Ethylbenzene		0.017 U	0.012 U	0.011 U	0.011 U	0.017 U	0.011
2-Hexanone		0.017 U	0.012 U	0.011 U	0.011 U	0.017 U	0.011
Isopropylbenzene		0.017 U	0.012 U	0.011 U	0.011 U	0.017 U	0.011
Methyl Acetate		0.017 U	0.012 U	0.011 U	0.011 U	0.017 U	0.011
Methylcyclohexane		0.017 U	0.0072 J	0.0033 J	0.0034 J	0.017 U	0.0033
Methylene Chloride		0.017 U	0.012 U	0.011 U	0.011 U	0.017 U	0.011
4-Methyl-2-Pentanone		0.017 U	0.0025 J	0.011 U	0.011 U	0.017 U	0.0025
Styrene		0.017 U	0.012 U	0.011 U	0.011 U	0.017 U	0.011
1,1,2,2-Tetrachloroethane		0.017 U	0.012 U	0.011 U	0.011 U	0.017 U	0.011 U
Tetrachloroethene		0.017 U	0.012 U	0.011 U	0.011 U	0.017 U	0.011
Toluene		0.0059 J	0.0068 J	0.0045 J	0.0041 J	0.0068 J	0.0041
1,2,4-Trichlorobenzene		0.017 U	0.012 U	0.011 U	0.011 U	0.017 U	0.011 U
1,1,1-Trichloroethane		0.017 U	0.012 U	0.011 U	0.011 U	0.017 U	0.011 U
1,1,2-Trichloroethane		0.017 U	0.012 U	0.011 U	0.011 U	0.017 U	0.011 U
Trichloroethene		0.017 U	0.012 U	0.011 U	0.011 U	0.017 U	0.011
Trichlorofluoromethane		0.017 U	0.012 U	0.011 U	0.011 U	0.017 U	0.011
1,1,2-Trichloro-1,2,2-Trifluoroethane		0.017 U	0.012 U	0.011 U	0.011 U	0.017 U	0.011 U
Vinyl Chloride		0.017 U	0.012 U	0.011 U	0.011 U	0.017 U	0.011
m-/p-Xylene		0.017 U	0.0027 J	0.0015 J	0.0015 J	0.017 U	0.0015
o-Xylene		0.017 U	0.012 U	0.011 U	0.011 U	0.017 U	0.011

TABLE 4-15

ANALYTICAL RESULTS FOR CATTARAUGUS CREEK SEDIMENTS

Peter Cooper Site
Gowanda, New York

Constituents[2]	*Guidance Values*[3]	*Sample Location, Identification, and Date Collected*[1]				*Maximum Conc.*	*Minimum Conc.*
		Creek Sed. #1 110700096 11/7/2000	*Creek Sed. #2 110700095 11/7/2000*	*Creek Sed. #3 110700093 11/7/2000*	*Creek Sed. #4 110700092 11/7/2000*		
Semi-Volatile Organic Constituents, milligrams per kilogram							
Acenaphthene		0.4 U	0.42 U	0.4 U	0.41 U	0.42	0.4
Acenaphthylene		0.4 U	0.42 U	0.4 U	0.41 U	0.42	0.4
Acetophenone		0.4 U	0.42 U	0.4 U	0.41 U	0.42	0.4
Anthracene		0.4 U	0.42 U	0.4 U	0.41 U	0.42	0.4
Atrazine		0.4 U	0.42 U	0.4 U	0.41 U	0.42	0.4
Benzaldehyde		0.4 UJ	0.42 UJ	0.4 UJ	0.41 UJ	0.42	0.4
Benzo(a)anthracene		0.4 U	0.42 U	0.4 U	0.41 U	0.42	0.4
Benzo(a)pyrene		0.4 U	0.42 U	0.4 U	0.41 U	0.42	0.4
Benzo(b)fluoranthene		0.4 U	0.42 U	0.4 U	0.41 U	0.42	0.4
Benzo(g,h,i)perylene		0.4 U	0.42 U	0.4 U	0.41 U	0.42	0.4
Benzo(k)fluoranthene		0.4 U	0.42 U	0.4 U	0.41 U	0.42	0.4
1,1-Biphenyl		0.4 U	0.42 U	0.4 U	0.41 U	0.42	0.4
Butyl Benzyl Phthalate		0.4 U	0.42 U	0.4 U	0.41 U	0.42	0.4
di-N-Butylphthalate		0.4 U	0.42 U	0.4 U	0.41 U	0.42	0.4
Caprolactam		0.4 U	0.42 U	0.4 U	0.41 U	0.42	0.4
Carbazole		0.4 U	0.42 U	0.4 U	0.41 U	0.42	0.4
Indeno(1,2,3-cd)pyrene		0.4 U	0.42 U	0.4 U	0.41 U	0.42	0.4
4-Chloroaniline		0.4 U	0.42 U	0.4 U	0.41 U	0.42	0.4
bis(2-chloroethoxy)methane		0.4 U	0.42 U	0.4 U	0.41 U	0.42	0.4
bis(2-chloroethyl)ether		0.4 U	0.42 U	0.4 U	0.41 U	0.42	0.4
2-Chloronaphthalene		0.4 U	0.42 U	0.4 U	0.41 U	0.42	0.4
2-Chlorophenol		0.4 U	0.42 U	0.4 U	0.41 U	0.42	0.4
2,2-oxybis(1-chloropropane)		0.4 U	0.42 U	0.4 U	0.41 U	0.42	0.4
Chrysene		0.4 U	0.42 U	0.4 U	0.41 U	0.42	0.4
Dibenzo(a,h)anthracene		0.4 U	0.42 U	0.4 U	0.41 U	0.42	0.4
Dibenzofuran		0.4 U	0.42 U	0.4 U	0.41 U	0.42	0.4
3,3-Dichlorobenzidine		0.4 U	0.42 U	0.4 U	0.41 U	0.42	0.4
2,4-Dichlorophenol		0.4 U	0.42 U	0.4 U	0.41 U	0.42	0.4
Diethylphthalate		0.4 U	0.42 U	0.4 U	0.41 U	0.42	0.4
Dimethyl Phthalate		0.4 U	0.42 U	0.4 U	0.41 U	0.42	0.4
2,4-Dimethylphenol		0.4 U	0.42 U	0.4 U	0.41 U	0.42	0.4
2,4-Dinitrophenol		1 U	1 U	1 U	1 U	1	1
2,4-Dinitrotoluene		0.4 U	0.42 U	0.4 U	0.41 U	0.42	0.4
2,6-Dinitrotoluene		0.4 U	0.42 U	0.4 U	0.41 U	0.42	0.4
bis(2-Ethylhexyl)phthalate		0.4 U	0.42 U	0.4 U	0.41 U	0.42	0.4
Fluoranthene		0.4 U	0.42 U	0.4 U	0.41 U	0.42	0.4
Fluorene		0.4 U	0.42 U	0.4 U	0.41 U	0.42	0.4
Hexachlorobenzene		0.4 U	0.42 U	0.4 U	0.41 U	0.42	0.4
Hexachlorobutadiene		0.4 U	0.42 U	0.4 U	0.41 U	0.42	0.4
Hexachlorocyclopentadiene		0.4 UJ	0.42 UJ	0.4 UJ	0.41 UJ	0.42	0.4
Hexachloroethane		0.4 U	0.42 U	0.4 U	0.41 U	0.42	0.4
Isophorone		0.4 U	0.42 U	0.4 U	0.41 U	0.42	0.4
2-Methylnaphthalene		0.4 U	0.42 U	0.4 U	0.41 U	0.42	0.4
4,6-Dinitro-2-Methylphenol		1 U	1 U	1 U	1 U	1	1
4-Chloro-3-Methylphenol		0.4 U	0.42 U	0.4 U	0.41 U	0.42	0.4
2-Methylphenol		0.4 U	0.42 U	0.4 U	0.41 U	0.42	0.4
4-Methylphenol		0.4 U	0.42 U	0.4 U	0.41 U	0.42	0.4
Naphthalene		0.4 U	0.42 U	0.4 U	0.41 U	0.42	0.4
2-Nitroaniline		1 U	1 U	1 U	1 U	1	1
3-Nitroaniline		1 U	1 U	1 U	1 U	1	1
4-Nitroaniline		1 U	1 U	1 U	1 U	1	1

TABLE 4-15

ANALYTICAL RESULTS FOR CATTARAUGUS CREEK SEDIMENTS

Peter Cooper Site
Gowanda, New York

Constituents[2]	*Guidance Values*[3]	*Sample Location, Identification, and Date Collected*[1]				*Maximum Conc.*	*Minimum Conc.*
		Creek Sed. #1 110700096 11/7/2000	*Creek Sed. #2 110700095 11/7/2000*	*Creek Sed. #3 110700093 11/7/2000*	*Creek Sed. #4 110700092 11/7/2000*		
Nitrobenzene		0.4 U	0.42 U	0.4 U	0.41 U	0.42	0.4
2-Nitrophenol		0.4 U	0.42 U	0.4 U	0.41 U	0.42	0.4
4-Nitrophenol		1 U	1 U	1 U	1 U	1	1
n-Nitrosodiphenylamine		0.4 U	0.42 U	0.4 U	0.41 U	0.42	0.4
di-n-Octyl Phthalate		0.4 U	0.42 U	0.4 U	0.41 U	0.42	0.4
Pentachlorophenol		1 U	1 U	1 U	1 U	1	1
Phenanthrene		0.4 U	0.42 U	0.4 U	0.41 U	0.42	0.4
Phenol		0.4 U	0.42 U	0.4 U	0.41 U	0.42	0.4
4-Bromophenyl-Phenylether		0.4 U	0.42 U	0.4 U	0.41 U	0.42	0.4
4-Chlorophenyl-Phenylether		0.4 U	0.42 U	0.4 U	0.41 U	0.42	0.4
n-Nitroso-di-n-Propylamine		0.4 U	0.42 U	0.4 U	0.41 U	0.42	0.4
Pyrene		0.4 U	0.42 U	0.4 U	0.41 U	0.42	0.4
2,4,6-Trichlorophenol		0.4 U	0.42 U	0.4 U	0.41 U	0.42	0.4
2,4,5-Trichlorophenol		1 U	1 U	1 U	1 U	1	1
Metals, milligrams per kilogram							
Aluminum		4820	4960	5730	6160	6160	4820
Antimony		6.9 UJ	7.5 UJ	7 UJ	7.04 UJ	7.5	6.9
Arsenic	6	7.2 J	6.7 J	7.1 J	9.6 J	9.6	6.7
Barium		31.5	36.1	38.6	41.4	41.4	31.5
Beryllium		0.57 U	0.63 U	0.58 U	0.59 U	0.63	0.57
Cadmium		0.57 U	0.63 U	0.58 U	0.59 U	0.63	0.57
Calcium		7490	10500	11700	5080	11700	5080
Chromium	26	6.3	6.5	7.1	8.6	8.6	6.3
Cobalt		5.7 U	6.25 U	6.7	7.5	7.5	5.7
Copper	16	13.7	11.3	13.9	14.8	14.8	11.3
Hexavalent Chromium		4.8 U	5.05 U	4.85 U	4.93 U	5.05	4.8
Iron	20000	14400	18100	16900	18400	18400	14400
Lead	31	7.9	9.2	8.8	9.8	9.8	7.9
Magnesium		3290	3240	3160	3350	3350	3160
Manganese	460	250	356	401	246	401	246
Mercury		0.06 U	0.06 U	0.06 U	0.06 U	0.06	0.06
Nickel	16	12.6	13.6	15.5	18.2	18.2	12.6
Potassium		525	591	617	786	786	525
Selenium		1.1	0.71	0.58 U	0.59 U	1.1	0.58
Silver		1.1 UJ	1.3 UJ	1.17 UJ	1.2 UJ	1.3	1.1
Sodium		333	226	240	201	333	201
Thallium		1.1 U	1.3 U	1.2 U	1.17 U	1.3	1.1
Vanadium		10.9	12.3	12.2	13.8	13.8	10.9
Zinc	120	39.2	40.2	47.1	52.8	52.8	39.2
Others							
Percent Solids, %		83.3	79.2	82.5	81.2	83.3	79.2
pH		8.6	8.2	8.21	8.18	8.6	8.18
Total Organic Carbon, %		0.1 U	0.1 U	0.1 U	0.1 U	0.1	0.1

Notes:

1. Sample locations provided on Plate 1.
2. Data qualifications reflect 100% data validation performed by Data Validation Services.
3. Guidance values from NYSDEC Technical Guidance for Screening Contaminated Sediments, Division of Fish and Wildlife

J = indicates an estimated value.

U = compound was not detected at or above the listed detection limit.

UJ = indicates compound was not detected above the listed detection limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the compound in the sample.

Creek Sediment # 1 Sample = upstream/background

Attachment 2

Ecological Effects of Detected Compounds

The ecological effect of a chemical constituent depends on many factors, such as the constituent's bioavailability, its concentration in the environment and/or receptor organism, synergistic interactions among constituents, the duration and frequency of receptor biota exposure to that constituent, the species of the receptor, the metabolic rate of the species, and the characteristics of the metabolic processes of the species (USEPA 1988). Constituents in the environment can affect receptor biota and ecosystems in both lethal and sublethal ways, such as the following:

- Altered developmental rates, metabolic and physiologic processes and functions, or behavior.
- Increased susceptibility to disease, parasitism, or predation.
- Disrupted reproductive functions.
- Mutations or other reduction in the viability of offspring (USEPA, 1989a).

When the potential effects of an environmental chemical on biotic receptors are being evaluated, the toxicity of the constituent must be determined. The determination should be based on field data, monitoring data, and the results of toxicity testing of contaminated media (USEPA, 1989a).

The following sections summarize toxicology information from scientific literature for the Peter Cooper Site. The summaries present information on chemical toxicity; likely mechanisms of toxicity; and potential effects on receptor biota, populations, and ecosystem.

Volatile Organic Compounds

Acetone. Acetone is a chemical that is naturally found in the environment. It is also normally present in animals from the breakdown of fat. It can also be used in normal processes that make sugar and fats for energy. Chronic exposure to acetone can cause liver and nerve damage, birth defects, and impaired reproduction (in males only) in animals. Acetone does not cause skin cancer when applied dermally. It is unknown whether ingesting or inhaling acetone can cause cancer (ATSDR 1994a).

Acute oral LD50 values were calculated only for rats. In general, the lethality of acetone decreases with the age of the rat (Kimura et al., 1971). The LD50 values ranged from 1,726 mg/kg for newborn rats to 6,667 mg/kg for older adults.

No effects were observed in male rats exposed to 1,071 mg/kg/day for 6 weeks in drinking water (Larsen et al., 1991). Mice treated with 3,500 mg/kg/day during gestation had reduced postnatal pup survival, increased gestation duration, and reduced reproduction index (EHRT, 1987)

Acetone is moderately toxic to the liver and kidney of animals. In a 13-week drinking water study, increased liver weights were observed in rats treated with 1,600 mg/kg/day (Dietz et al., 1991). Acetone also induces liver microsomal enzymes. Kidney weights were increased in male and female rats exposed to 3,400 mg/kg and 1,600 mg/kg, respectively for 14-days in drinking water (Dietz et al., 1991).

Benzene. High levels (50,000 times the average levels) of benzene in the air.can cause drowsiness, dizziness, rapid heart rate, headaches, tremors, confusion, and unconsciousness. Chronically breathing lower levels can damage blood cells and bone marrow, causing anemia, excessive bleeding, or leukemia (ATSDR, 1993a). Oral exposure to high levels of benzene can cause vomiting, irritation of the stomach, dizziness, sleepiness, convulsions, rapid heart rate, coma and death (ATSDR, 1993a).

Benzene can produce hematological, neurological, and behavioral effects (Hughes et al., 1994) and adversely affect genes and reproductive capabilities in animals (ATSDR, 1993a). Rats exposed to benzene concentrations of 10 ppm (32 mg/m3) for 6 days developed immunological effects (Hughes et al., 1994).

2-Butanone. Only limited informtion is available on the toxicity of 2-butanone to wildlife. LC50 concnetrations for two freshwater fishes were around 5,600 µg/l. 2-Butanone was toxic to brine shrimp at LC50 levels of 1,950 mg/l (Clement Associates, 1985). In animals, short-term studies suggest that 2-butanone is of low oral toxicity. The LD50 of 2-butanone in the rat has been reported to be between 2,700 and 5,530 mg/kg (Fawell and Hunt, 1988).

Carbon disulfide. No ecological toxicity data were found for carbon disulfide. Carbon disulfide mainly affects the central nervous system. At acutely poisonous levels, carbon disulfide is a narcotic and anesthetic and leads to respiratory failure and death. Chronic doses damage the central and peripheral nervous system. Carbon disulfide also produces developmental and other reproductive effects. The lowest published toxic concentration for humans is 14-mg/kg body weight. In rabbits, 350-mg/kg body weight adversely affected reproduction (Sax and Lewis, 1989).

Carbon tetrachloride. There has been more publicity and attention given to this VOC as a potential hazard to humans than to fish or wildlife; thus there is more literature related to humans and the information found on other species is comparatively sparse compared to
the more detailed human health literature. The imbalance in favor of human effects information, as reflected in the sections below, will hopefully be corrected in the future as more ecological effects information becomes available.

Effects of this volatile solvent to non-human biota would often result from high concentrations immediately after a spill (before the compound has volatilized into the atmosphere) or be the indirect result of contamination of groundwater. For example, if highly polluted groundwater water comes into surface waters from springs or seeps, local effects may occur in the mixing zone where thegroundwater enters surface water.

Poisoning in animals is commonly acute, following administration of the compound as a antihelmintic. Symptoms include a loss of appetite, dullness, staggering gait, evidence of gastrointestinal disturbances with passage of blood stained feces, constipation followed by diarrhea, collapse, and death (Clarke and Clarke, 1975).

Chloroform. Chloroform (trichloromethane) is a colorless liquid which is used primarily to synthesize other chemicals. Chloroform is highly soluble in water and readily evaporates. It is degraded by photochemical reactions. In long-term animal studies, liver and kidney damage are noted. Reproductive effects in mice associated with chloroform inhalation exposure include decreased ability to maintain pregnancy and an increase in birth defects. Liver and kidney tumors are associated with oral exposure in mice and rats.

Beagle dogs given chloroform in a toothpaste base in gelatin capsule for seven and one-half years experienced fatty cyst formation in their livers (Heywood et al.). In rats administered a single dose of chloroform by gavage, a LOAEL of 60 mg/kg-day was identified. This dose was associated with decreased weight gain, plasma cholinesterase and relative liver weight (Palmer et al. 1979).

In a gavage bioassay by the National Cancer Institute, Osborne-Mendel rats and B6C3F1 mice were given chloroform in corn oil 5 times/week for 78 weeks. Fifty male rats received 90 or 125 mg/kg/day; females were treated with 125 or 250

mg/kg/day for 22 weeks and 90 or 180 mg/kg/day thereafter. A significant increase in kidney epithelial tumors occurred in male rats and highly significant increases in hepatocellular carcinomas were observed in both male and female mice. Chloroform administered in drinking water to male Osborne-Mendel rats and female B6C3F1 mice at concentrations of 200, 400, 900, and 1800 mg/L for 104 weeks. These concentrations correspond to 19, 38, 81, and 160 mg/kg/day for rats and 34, 65, 130, and 263 mg/kg/day for mice. A significant increase in renal tumors in rats was observed in the highest dose group. The increase was dose related. The liver tumor incidence in female mice was not significantly increased (Jorgenson et al. 1985).

Cyclohexane. Cyclohexane is used as a solvent and is a constituent of gasoline. It exists solely as a vapor at ambient temperatures and is degraded in the atmosphere by reaction with photochemically-produced hydroxyl radicals. Cyclohexane is moderately mobile in soil and volatilization from moist soil surfaces is likely an important fate process. Cyclohexane is expected to adsorb to suspended solids and sediment in the water column based upon the estimated Koc. It does not biodegrade (HSDB 2001).

In rabbits exposed to 786 ppm of cyclohexane for 50 periods of six hours, microscopic changes in the liver and kidneys were noted (ACGIH 1991). Exposure to 18,000 ppm cyclohexane vapor in air produced trembling effect in mice after five minutes; disturbed equilibrium after 15 minutes and complete recumbency after 25 minutes. Exposure to this concentration produced trembling in rabbits after six minutes, disturbed equilibrium after 15 minutes and complete recumbency after 30 minutes (Clayton et al. 1993-1994). Intermittent daily exposure of rats to cyclohexane vapor for 1 or 2 weeks at concentrations of 300; 1,000; or 20,000 ppm resulted in a dose-dependent solvent concentration in perirenal fat. In the brain, these concentrations were associated with a reduction in the activity of azoreductase (Savolainen and Pfaffli 1980).

1,2-Dichlorobenzene. 1,2-Dichlorobenzene is used as a solvent, as a starting material in the manufacture of 3,4-dichloroaniline, and as an insecticide. It exists as a vapor in the ambient atmosphere. 1,2-dichlorobenzene exhibits low to moderate mobility in soils. It is expected to adsorb to sediment and particulate matter. The potential for bioconcentration in aquatic organisms is considered moderate to high based on BCF values in the range of 90 to 560 measured in fish (HSDB 2001).

In rats who were fed 1,2-dichlorobenzene by gavage, five days per week at a dose of 376 mg/kg of body weight per day, moderate increases in liver weight and slight increases in average kidney weight were noted. There were also slight hisotpathological changes in the liver at 188 mg/kg-day (Clayton and Clayton, eds 1993-1994). The maximum tolerated dose for rats administered 1,2-dichlorobenzene by stomach tube lies between 19 and 190 mg/kg body weight per day. This is based on a study in which the compound was adminstered by gavage five days a week for approximately 28 weeks (IARC 1974). 1,2-dichlorobenzene was evaluated for teratogenic potential in rats and rabbits. Bred rats and inseminated rabbits were

exposed to 0, 100, 200, or 400 ppm of 1,2-dichlorobenzene for 6 hours per day on days 6 through 15 (rats) or days 6 through 18 (rabbits) of gestation. Maternal toxicity, indicated by a significant decrease in body weight gain, was observed in all groups of 1,2-dichlorobenzene exposed rats and liver weight was significantly increased in the 400 ppm 1,2-dichlorobenzene exposed group. Slight maternal toxicity was observed in groups of rabbits exposed to 400 ppm 1,2-dichlorobenzene as evidenced by significantly decreased body weight gain during the first three days of exposure. Inhalation of up to 400 ppm of 1,2-dichlorobenzene was neither teratogenic nor fetotoxic in rats and rabbits (Hayes et al. 1985).

Two year toxicology and carcinogenecity studies were conducted by administering 1,2-dichlorobenzene in corn oil by gavage 5 days per week for 103 weeks to groups of 50 male and 50 female F344/N rats and B6C3F1 mice at doses of 60 and 120 mg/kg. Under the study conditions, there was no evidence of carcinogenicity of 1,2-dichlorobenzene for male or female F344/N rats or B6C3F1 mice (NIH 1985).

1,3-Dichlorobenzene. 1,3-Dichlorobenzene is used as a fumigant and as an insecticide. It exists in the vapor-phase under ambient conditions and is degraded in the atmosphere by reaction with photochemically-produced hydroxyl radicals. It is expected to have low to moderate mobility in soil. Biodegradation is expected to be slow in soil and water. In water, 1,3-dichlorobenzene is expected to adsorb to sediment and particulate matter.

Eight halogenated benzenes including 1,3- dichlorobenzene were tested for acute toxicity (LD50) and clastogenicity in 8 week old NMRI mice. Four doses of each chemical were tested for clastogenic activity. Each compound was administered in two equal doses, 24 hours apart. Increased formation of micronucleated polychromatic erythrocytes, observed in femoral bone marrow, 30 hours after the first injection, was considered to be due to the clastogenic activity of the test compound. The highest clastogenic activities were induced by 1,3-dichlorobenzene. Among three isomers of dichlorobenzeen, 1,3-dichlorobenzene significantly induced more micronuclei than 1,2-dichlorobenzene or 1,4-dichlorobenzene (Mohtashamipur E et al 1987).

For fathead minnows, chronic toxicities were estimated from day 32-33 of the embryonic stage through early juvenile development. The ranges between the highest no observable effect concentration and the lowest observed effect concentration was 1,000-2,300 µg/L for 1,3-dichlorobenzene. The tissue concentrations associated with the no observable effect concentration and lowest observed effect concentration for 1,3-dichlorobenzene was 120-160 µg/g (Carlson and Kosian 1987). A dose with 1,3-dichlorobenzene at 1000 mg/kg was porphyrogenic in rats and at an 800 mg/kg dosage, effects on hepatic metabolic activity were noted (Poland et al. 1971).

1.4-Dichlorobenzene. 1,4-Dichlorobenzene is used as an insecticide, a disinfectant, a metal polishing agent and in industrial odor control. It is also used as a intermediate

in chemical manufacturing. It exists as a vapor in the ambient atmosphere and is degraded by reaction with photochemically-produced hydroxyl radicals. It exhibits low to moderate mobility in soils and volatilization of 1,4-dichlorobenzene from dry soil surfaces is an important fate process. 1,4-Dichlorobenzene is not expected to biodegrade in soils or water. Biodegradation half-lives of approximately a year or longer are reported. In water, 1,4-dichlorobenzene is expected to adsorb to sediment and particulate matter.

Detectable histological changes in lungs of rabbits exposed to 340 ppm 1,4-dichlorobenzene eight hours daily for two months were noted. Ten percent of rabbits exposed to 800 ppm for the same time frame died (Thienes and Haley 1972). Rats, guinea pigs and rabbits exposed to 1,4-dchlorobenzene seven hours daily five days a week at a concentration of 798 ppm in air exhbitited tremors, weakness, loss of weight, and eye irritation. In some, swelling and central necrosis of the liver occurred. Swelling of the tubular epthelium of the kidneys also occurred in some (Clayton and Clayton, eds. 1981). Rats fed 1,4-dichlorobenzene as 20% solution in olive oil survived single doses of 1 g/kg body weight but succumbed to a dose of 4 g/kg body weight (Clayton and Clayton, eds. 1981).

In two year gavage studies, 1,4-dichlorobenzene produced clear evidence of carcinogenicity for male F344/N rats, as indicated by an increased incidence of renal tubular cell adenocarcinomas. There was no evidence of carcinogenicity for female F344/N rats receiving doses of 300 or 600 mg/kg (NIH 1987).

1,1-Dichloroethane. No histopathological lesions occurred in the liver, lungs, or kidneys of male mice that were exposed for 52 weeks to 1,1-dichloroethane in their drinking water at concentrations up to 2500 mg/L (Klaunig et al., 1986). In carcinogenicity studies conducted by the National Cancer Institute (1978), no histopathological lesions were seen in male and female Osborne-Mendel rats and B6C3F1 mice treated by gavage 5 days/week for 78 weeks (3 weeks on, 1 week off) at time-weighted average (TWA) dose levels of 764 and 382 mg/kg/day (male rats), 950 and 475 mg/kg/day (female rats), 2,885 and 1,442 mg/kg/day (male mice), and 3,331 and 1,665 mg/kg/day (female mice). The results of the bioassay were complicated by high early mortality (possibly caused by pneumonia) in both treated and control animals.

Vapors of 1,1-dichloroethane are relatively low in acute toxicity but can cause narcosis at high concentrations. Rats survived an 8-hour vapor exposure to 4,000 ppm but not 16,000 ppm (Clayton and Clayton, 1981). Those exposed to 32,000 ppm survived 30 minutes of exposure but died after 2.5 hours.

1,2-Dichloroethane. 1,2-Dichloroethane is used as a chemical intermediate, solvent, and was used as a lead scavenger in gasoline. Once in the atmosphere, it may be transported long distances and is primarily lost by photooxidation. Releases to water will primarily be removed by evaporation. Releases on land will dissipate by volatilization to air and by percolation into groundwater where it is likely to persist.

1,2-Dichloroethane is not expected to bioconcentrate in the food chain (HSCB 2001). Chronic toxicity of 1,2-dichloroethane was studied by exposing rats, rabbits, guinea pigs, monkeys, dogs, and cats 7 hours per day, 5 days per week to concentrations of 100-1,000 ppm of vapor in air. At a concentration of 1,000 ppm rats, rabbits, and guinea pigs died after a few 7 hour exposures. Dogs and cats were more tolerant, but deaths eventually occurred. Pathological exams of the various animals indicated pulmonary congestion, renal tubular degeneration, fatty degeneration of the liver, and less commonly, necrosis and hemorrhage of the adrenal cortex and fatty infiltration of the myocardium. When concentrations were decreased to 100 ppm, even rats, guinea pigs and mice survived exposures for 4 months and developed no demonstrable lesions. A comparable chronic study was carried out by others. They likewise showed high mortality at 400 ppm in rats and guinea pigs for periods of 14 to 56 days of exposure. The animals exhibited loss of weight and slight increases in weights of the liver and kidneys, but relatively slight histopathological changes. Guinea pigs presented more definite histopathological changes in both the liver and kidneys (Clayton and Clayton, eds. 1981).

A bioassay of technical grade 1,2-dichloroethane for possible carcinogenicity was conducted using Osborne-Mendel rats and B6C3F1 mice. 1,2-Dichloroethane in corn oil was administered by gavage, to groups of 50 male and 50 female animals of each species. The 78 week period of administration was followed by an observation period of 32 weeks for the low dose rats of both sexes. The last high dose male rat died after 23 weeks of observation with the last high dose female rat dying after 15 weeks of observation. All treated groups of mice were observed for an additional 12 or 13 weeks following administration. The time-weighted average high and low doses of 1,2-dichloroethane in the study were 95 and 47 mg/kg/day, respectively, for rats. The high and low time-weighted average doses for the male mice were 195 and 97 mg/kg/day, respectively, and 299 and 149 mg/kg/day, respectively, for the females. A statistically significant correlation between dosage and the incidence of squamous cell carcinomas of the forestomach and hemangiosarcomas of the circulatory system occurred in the male rats, but not in the females. There was also a significantly increased incidence of adenocarcinomas of the mammary gland in female rats, and mammary adenocarcinomas and endometrial tumors in female mice. Alveolar/bronchiolar adenomas occurred in mice of both sexes (NCI 1978).

Ethylbenzene. Ethylbenzene is most commonly found as a vapor in the air, and it moves easily from soil and water to air. Therefore, the most common route of exposure is via inhalation.

The lethality of ethylbenzene in animals following inhalation exposure has been shown to vary among species (ATSDR, 1991). The acute NOAEL for rabbits was 2,400 ppm while the same concentration is the LD50 for rats. Mice have a LD50 of 1,200 ppm (Cragg et al., 1989).

Data is limited on the systemic effects of inhaled ethylbenzene. The principal target organs appear to be the lungs, liver, and kidney. Rats exposed to 1,000 ppm

developed lung lesions and had increased liver and kidney weights (NTP, 1988). Inhalation of ethylbenzene also causes developmental effects. Rats exposed to 138 to 552 ppm during gestation resulted in fetal resorption and retardation of skeletal development in surviving fetuses.

Few studies have been done on the oral route of exposure. The acute LD50 for rats fed ethylbenzene was 4,728 mg/kg (ATSDR, 1990). Acute oral exposure to 500 to 1,000 mg/kg decreased peripheral hormone levels and blocked or delayed the estrus cycle in female rats (Ungvary, 1986).

2-Hexanone. 2-Hexanone (methyl n-butyl ketone) is used as a solvent for materials including lacquers, resins, oils, nitrocellulose, acrylates, vinyl, and alkyd coatings. It exists as a vapor under ambient conditions and exhibits high mobility in soils. This compound is expected to biodegrade under both aerobic and anaerobic conditions. In water, 2-hexanone does not adsorb to suspended solids or sediment. Bioconcentration in aquatic organisms is considered low based upon the estimated BCF value of 7 (HSDB 2001).

Acute inhalation exposure of guinea pigs to 2-hexanone produced decreases in body temperature, respiratory and heart rates, and loss of corneal, auditory, and equilibrium reflexes. It also resulted in central nervous system depression, coma and death (Clayton and Clayton, eds. 1993-1994). Central nervous system effects were noted at high concentrations (20,000 ppm) for 30 minutes. Under exposure for greater than 30 minutes, even given lower concentrations, death occurred in some animals. It is approximately five times more acutely toxic that methyl ethyl ketone but approximately one-fifth as volatile (Browning, E. 1965).

Isopropylbenzene. Isopropylbenzene (cumene) is used in the production of phenol and acetone. It occurs in a variety of natural substances including essential oils from plants and foodstuffs. It exists as a vapor under ambient conditions. If released to soil, isopropylbenzene is expected to have low mobility and is susceptible to biodegradation. It adsorbs to sediment and suspended solids in water. A BCF of 35 indicates moderate bioconcentration in aquatic organisms. Isopropylbenzene is widely detected in the atmosphere mainly due to its presence in gasoline and as a natural component in plants (HSDB 2001).

Exposure to isopropylbenzene has been studied for several effects including gene mutation, chromosomal aberration, and primary DNA damage. Only one test, a micronucleus assay, was mildly positive, and at a dose that resulted in mortality in some animals. Exposure of rats to 500 ppm isopropylbenzene daily for 5 months resulted in hyperemia and congestion in the lungs, liver, and kidneys of exposed animals. When animals were dosed by repeated gastric intubation of 154 mg/kg body weight for 194 days, no evidence of injury was found. At a higher dosage (462 mg/kg), an increase in the weight of kidneys was observed (ACGIH 1991). Exposure of rabbits to isopropylbenzene doses of 0.5 mg/L four hours daily for four months resulted in immunological changes (Samedav, IG et al. 1978). A dose of 0.5 ml/L

resulted in 100% mortality of both crabs Asellus aquaticus L and Gammarus fossarum Koch (Isopoda, Amphipoda) within 24 hours (Erben R, et al. 1983). An LC50 of 10.0 mg/L in mice is based on 7 hour exposure to a "relatively pure" isopropylbenzene (NRC 1981).

Methyl acetate. Methyl acetate is used primarily as a solvent and as a chemical intermediate. It also naturally occurs in certain plants. Under ambient conditions, it exists in the vapor-phase and is degraded in the atmosphere by reaction with photochemically-produced hydroxyl radicals. In soil, methyl acetate exhibits very high mobility. Limited data suggest that methyl acetate is expected to biodegrade in both soil and water under both aerobic and anaerobic conditions. Hydrolysis in soil and water is not expected to be significant except in highly basic soils (pH >9). Methyl acetate does not typically adsorb to suspended solids and sediment in water. An estimated BCF of 0.8 suggests that the potential for bioconcentration in aquatic organisms is low (HSDB 2001).

Cats exposed to high concentrations (53,790 ppm / 163 mg/L) for 14- 18 minutes exhibited irriation, salivation, nad dyspnea. Convulsions occurred in half of the cats. Central nervous system depression and pulmonary edema also occurred. At a lower concentration, 34,980 ppm (106 mg/L), following exposure for 29-30 minutes, irritation, salivation, dyspnea, convulsions, central nervous system depression and lateral emphysema occcurred (Clayton and Clayton, eds. 1993-1994).

Methylcyclohexane. Inhalation of 7,500 to 10,000 ppm methylcylcohexane for two hours caused prostration in white mice. Inhalation of 10,000 to 12,500 ppm was lethal. Results of two studies indicate that acute toxicity of methylcyclohexane is greater than that of heptane but less than octane. Exposure of rabbits to 1,200 ppm resulted in no reportable adverse effects while prolonged exposure to 370 ppm methylcychlohexane appeared to result in no harm to monkeys (ACGIH 1986). In studies of fish exposed to methylcychlohexane, concentrations less than 0.8 mg/L were nonlethal to rainbow trout *(salmo gairdneri)*, however, seven day exposure to concentrations ranging from 0.83 to 1.85 mg/L caused death in flagfish (Klein et al. 1975).

The lowest lethal oral dose of methylcyclohexane was identified in rabbits as 4.0 to 4.5 g/kg. Severe diarrhea occurred at this concentrations though no other adverse effects were noted except an seven-fold increase in glucuronide in urine excreted from the treated animals (Snyder 1987). Inhalation exposure to 11.35 mg/L (2,886 ppm) for 90 hours (6 hours/day, 5 days/week) produced very minor microscopic evidence of cellular injury in the liver and kidneys of rabbits. Death occurred among rabbits exposed repeatedly to 28.75 mg/L (7,308 ppm) or higher for 60 hour (6 hours/day, 5 days/week). Prior to death, conjunctival congestion with mucoid secretion and lacrimation, salivation, coughing, sneezing, labored breathing, and diarrhea were noted (Snyder 1987).

4-Methyl-2-pentanone. 4-Methyl-2-pentanone (methyl isobutyl ketone) is used as a solvent for vinyl, epoxy, acrylic and natural resins; and dyes. It is also used as an extracting agent in the production of antibiotics and the removal of paraffins from mineral oil in the production of lubricating oils. 4-methyl-2-pentanone occurs naturally in grapes and oranges. It exists as a vapor in the ambient atmosphere and demonstrates high mobility in soils. 4-methyl-2-pentanone biodegrades under aerobic and anaerobic conditions and in water, does not adsorb to suspended solids or sediment. Bioconcentration in aquatic organisms is considered low based on an estimated BCF of 6 (HSDB 2001).

Exposure to guinea pigs of concentrations at 1,000 ppm 4-methyl-2-pentanone resulted in little or no irritation of the eyes and nose but the animals did exhibit a decreased respiratory rate during the first six hours of exposure. In guinea pigs exposed to 16,800 ppm 4-methyl-2-pentanone, immediate signs of eye and nose irritation, followed by salivation, lacrimation, ataxia and death were noted. Ninety percent of the animals died within six hours of exposure. Exposure to 28,000 ppm resulted in death after 45 minutes for half of the animals. Fatty livers and congestion of the brain, lungs and spleen occurred (Clayton and Clayton 1993-1994).

When administered orally to mice and rats, the lethal doses of 4-methyl-2-pentanone were 2.85 and 4.6 g/kg, respectively. Exposure of rats to concentrations of 86-127 mg/m^3 4 hours daily for 4.5 months resulted in disturbances of the conditioned reflexes and in the detoxifying function of the liver (Batyrova 1973). Six male and six female Fischer 344 rats and B6C3F1 mice were exposed to 0, 100, 500, and 2,000 ppm of 4-methyl-2-pentanone. The animals were exposed to 4-methyl-2-pentanone vapor for 6 hours per day for 5 consecutive days with 2 days off. No deaths occurred in the animals during this study. A significant increase in liver and kidney weights of male and female rats occurred following exposure to 2,000 ppm. In a subchronic study, rats were exposed to 0, 50, 250, or 1,000 ppm 4-methyl-2-pentanone for 6 hours per day, 5 days per week for 14 weeks. Increased liver weights in male rats were noted following exposure to 1,000 ppm. In female rats absolute, but not relative, kidney weight was increased by exposure to 250 ppm. An increase in liver weight of male mice exposed to 250 or 1,000 ppm was noted. Following exposure to 1,000 ppm of 4-methyl-2-pentanone, male rat platelet numbers increased as did serum cholesterol in rats exposed to 250 or 1000 ppm (Phillips 1987).

Styrene. Styrene is primarily a synthetic chemical. It is used in the production of rubber and plastics and is released into the air from the stacks of manufacturing plants that use or produce styrene.

If released to the atmosphere, styrene will react rapidly with both hydroxyl radicals and ozone with a combined, calculated half-life of about 2.5 hours. If released to environmental bodies of water, styrene will volatilize relatively rapidly and may be subject to biodegradation, but is not expected to hydrolyze. If released to soil it will biodegrade and leach with a low-to-moderate soil mobility (Spectrum Laboratories, 2001).

Styrene was administered/ to beagle hounds by stomach tube at 200, 400, or 600 mg/kg/day for up to 561 days. Erythrocyte Heinz bodies were found in males dosed with 400 and 600 mg/kg/day, and sporadically in females administered 200 mg/kg/day. Other changes found occasionally were decreased packed cell volume, erythrocyte counts, erythrocyte sedimentation rate, and hemoglobin levels; an increased incidence of anisocytosis and hypochromia of erythrocytes, hemosiderin in reticuloendothelial cells of the liver; and an increased number of hepatocellular intranuclear acidophilic crystalline inclusions. Other blood elements examined were not affected by the administration of styrene at these doses. The blood changes were readily reversed after the administration of styrene was stopped (NIOSH, 1983).

Administration of 125-200 ppm in drinking water of rats over a 2 yr period showed no deleterious health or reproductive effects Beliles, 1985). Acute exposure of animals to styrene causes irritation of the skin and respiratory tract, and central nervous system effects. Liquid styrene is a skin irritant which, on direct contact, causes erythema. Long-term contact with styrene results in blistering of the skin and development of dermatitis, which is thought to result from defatting of the skin. Single exposures of rats and guinea pigs to 1300 ppm (5633 mg/cu m) styrene resulted in central nervous system effects, including weakness and unsteadiness. After exposure to 2500 ppm (10.8 g/cu m) styrene for 10 hr, both rats and guinea pigs lost consciousness; exposure to 5,000-10,000 ppm (21.7-43.3 g/cu m) resulted in unconsciousness and death. The principal pathological findings in these animals were severe pulmonary irritation, congestion, oedema, hemorrhage and leukocytic infiltration (ARC, 1994).

Tetrachloroethene. The acute oral LD50 for tetrachloroethene was 3,005 to 3,835 mg/kg in rats and 5,000 mg/kg in mice (Hayes et al., 1986 and Wenzel and Gibson, 1951 as cited in ATSDR, 1993). The liver, kidneys, and blood are targets for acute oral toxicity (ATSDR, 1993b).

The hepatic and renal systems are also targets in chronic exposure to tetrachloroethene. Both increased death and severe renal damage were seen in rats and mice exposed to tetrachloroethene for 78 weeks (NCI 1977). In the study, the rat LOAEL was 471 mg/kg/day, while the mouse LOAEL was 536 mg/kg/day. The mouse NOAEL for hepatic effects over a six-week period was 20 mg/kg/day (Buben and O'Flaherty, 1985). Tetrachloroethene was teratogenic in developing chick embryos at a concentration of 100 micromoles/egg (Elovaara et al.,1979).

Methyl acetate. Methyl acetate is used primarily as a solvent and as a chemical intermediate. It also naturally occurs in certain plants. Under ambient conditions, it exists in the vapor-phase and is degraded in the atmosphere by reaction with photochemically-produced hydroxyl radicals. In soil, methyl acetate exhibits very high mobility. Limited data suggest that methyl acetate is expected to biodegrade in both soil and water under both aerobic and anaerobic conditions. Hydrolysis in soil and water is not expected to be significant except in highly basic soils (pH >9).

Methyl acetate does not typically adsorb to suspended solids and sediment in water. An estimated BCF of 0.8 suggests that the potential for bioconcentration in aquatic organisms is low (HSDB 2001).

Cats exposed to high concentrations (53,790 ppm / 163 mg/L) for 14- 18 minutes exhibited irriation, salivation, nad dyspnea. Convulsions occurred in half of the cats. Central nervous system depression and pulmonary edema also occurred. At a lower concentration, 34,980 ppm (106 mg/L), following exposure for 29-30 minutes, irritation, salivation, dyspnea, convulsions, central nervous system depression and lateral emphysema occcurred (Clayton and Clayton, eds. 1993-1994).

Methylcyclohexane. Inhalation of 7,500 to 10,000 ppm methylcylcohexane for two hours caused prostration in white mice. Inhalation of 10,000 to 12,500 ppm was lethal. Results of two studies indicate that acute toxicity of methylcyclohexane is greater than that of heptane but less than octane. Exposure of rabbits to 1,200 ppm resulted in no reportable adverse effects while prolonged exposure to 370 ppm methylcychlohexane appeared to result in no harm to monkeys (ACGIH 1986). In studies of fish exposed to methylcychlohexane, concentrations less than 0.8 mg/L were nonlethal to rainbow trout *(salmo gairdneri)*, however, seven day exposure to concentrations ranging from 0.83 to 1.85 mg/L caused death in flagfish (Klein et al. 1975).

1,1,1-Trichloroethane. Oral exposure to 1,1,1-trichloroethane can be toxic at relatively high doses. The oral LD50 for rats varied from 10,300 to 12,300 mg/kg, while the mouse oral LD50 was 11,240 mg/kg (Torkelson et al., 1958). The lowest LD50 reported for oral exposure was 5,660 in rabbits (Torkelson et al., 1958). Some hepatic and neurological effects were seen in response to oral 1,1,1-trichloroethane exposure (ATSDR, 1994b).

1,2,4-Trichlorobenzene. 1,2,4-Trichlorobenzene is used as a solvent, organic intermediate, dielectric fluid, insecticide and as a dye carrier. It exists as a vapor under ambient conditions and is degraded in the atmosphere by reaction with photochemically-produced hydroxyl radicals. It exhibits low mobility in soils and biodegrades slowly in soils and water. In water, 1,2,4-trichlorobenzene adsorbs to sediment and particulate. Bioconcentration in aquatic organisms is considered high based on BCF values in the range of 120 to 2,400 as measured in fish (HSDB 2001).

An acute and subacute inhalation toxicity study indicated that target organs of non-lethal exposures of cats, dogs, rabbits and guinea pigs included liver, kidney and ganglion cells of the brain. Local pulmonary irriation and dyspnea were noted in animals that later died. Short-term exposures (six hour exposures to concentrations of 70 and 200 ppm repeated fifteen times resulted in lethargy and retarded weight gain but no organ pathology was noted (ACGIH 1991).

In rats continuously exposed to 0, 25, 100, or 400 ppm 1,2,4-trichlorobenzene in drinking water, beginning with birth of the parental generation and continuing

through weaning of the second filial generation, treatment did not affect fertility, growth, viability, locomotor activity, nor blood chemistry. Adrenal gland enlargement was observed in both the parental and first filial generation animals at 95 days of age (Robinson 1981). Possible maternal & hepatic reproductive effects of 1,2,4-trichlorobenzene were assessed in rats given 0, 36, 120, 360, & 1,200 mg/kg/day on days 9-13 of gestation. Hepatic microsomal cytochrome p450 content was significantly increased by administration of both 120 & 360 mg/kg-day. Although pretreatment with 360 mg/kg-day did not increase resorptions, embryolethality, or teratogenicity, embryonic development was significantly retarded by all four growth criteria used (head length, crown-rump length, somite number, & protein content) following exposure to 1,2,4-trichlorbenzene (Kitchin and Ebron 1983).

In studies of fish exposed to 1,2,4-trichlorobenzene, high levels of biotransformation products were found in rainbow trout *(Salmo gardneri)* bile during and after exposure (USEPA 1980). The cytotoxicity of 12 chemicals to rainbow trout was determined in culture. Of these twelve chemicals (pentachlorophenol; p-methylaminophenol; 2,4-dichlorophenol; p-chlorophenol; p-cyanophenol; p-nitrophenol; benzene; p-methylphenol; aniline; phenol; p-methoxyphenol; and 1,2,4-trichlorobenzene), 1,2,4-trichlorobenzene was the least toxic. The indicator of cytotoxicity was the inability of cells to attach to a growth surface following chemical exposure (Bols et al. 1985).

Trichloroethene. Effects of this volatile solvent to non-human biota would often result from: A) high concentrations immediately after a spill (before the compound has volatilized into the atmosphere) or B) the indirect impacts of contaminated groundwater. For example,
if highly polluted groundwater water comes into surface or cave waters from springs or seeps, local effects may occur in the mixing zone where the groundwater enters surface water.

Fathead minnows impacted by TCE, 31 days old, lost schooling behavior, swam in a corkscrew/spiral pattern near the surface, were hyperactive and hemorrhaging. Equilibrium loss was not observed prior to death (Geiger D. et al, 1985).

The NOAEL for various systemic effects due to 78-week exposure to 1,1,1-trichloroethene was 1,500 mg/kg/day for rats and 5,615 mg/kg/day for mice (NCI, 1977). Included in these studies were hepatic, renal, neurological, and reproductive systems. Neurological effects, including hyperexcitability and narcosis, and weight gain reductions were seen at a dose of 2,500 mg/kg/day (Bruckner, 1983). A dose dependent relationship between 1,1,1-trichloroethane and teratogenesis was seen in developing chick embryos, with an apparent LD50 as low as 5 micromoles/egg (Elovaara et al., 1979).

Xylene. Acute oral LD50 values in male and female mice are 5,627 and 5,251 mg/kg, respectively (NTP 1986). Rat LD50 values vary depending on mode of intake. The oral LD50 value of undiluted xylene is 5,251 mg/kg (Hine and Zuidema 1970) compared with 3,523 mg/kg if administered diluted in corn oil (NTP, 1986). The

LD50 value for m-xylene in rats is 6,661 mg/kg (Smyth et al., 1962). The differences in LD50 values may be due to specific isomer composition of the xylene mixtures, sex, nutritional status, and solvent in which xylene is administered (ATSDR 1993c).

The NOAEL in rats and mice is 1,000 mg/kg above which respiratory, cardiovascular, gastrointestinal, hematopoietic, musculo-skeletal, hepatic, and renal systems are adversely affected (NTP, 1986). Information of toxicity values on avifauna is scarce. The oral LD50 value in Japanese quail is greater than 2,876 mg/kg and evidence of overt toxicity is observed above concentrations of 719 mg/kg (Hill and Camardese, 1986).

Semi-Volatile Organic Compounds

Bis(2-ethylhexyl)phthalate. Oral LD50 values of 30 g/kg, 30.6 g/kg, and 34 g/kg have been listed for mice, rats and rabbits respectively (Sittig, 1985; Sax and Lewis, 1989). Gray et al. (1977) observed a variety of symptoms after feeding groups of 15 male and 15 female Sprague Dawley rats 0, 0.2, 1.0, or 2% bis(2-ethylhexyl)phthalate (0, 150, 750, or 1,500 mg/kg/day, respectively) in their diet for 17 weeks. Increased absolute and relative liver weights were observed in all treated groups. Food consumption and growth rates were reduced in the 1 and 2% treated groups. A dose-related reduction in testicular weight and an increase in testicular damage were observed. Decreased hemoglobin concentration was observed in male rats, and decreased packed red cell volume was also observed in both sexes in the two highest dose groups. An interstitial nephritis, increased SGPT and decreased blood glucose were reported by Nagasaki et al. (1974) in a 48 week rat study (U.S.EPA, 1987a). Animals in this study were fed 500 or 1,000 ppm bis(2-ethylhexyl)phthalate in the diet (25 or 50 mg/kg/day, respectively). Ota et al. (1974) reported degenerative changes in the kidneys and liver of mice given 0.5 to 5 g/kg/day in the diet for 1 to 3 months. Male albino ferrets fed 1% bis(2-ethylhexyl)phthalate in the diet for 14 months exhibited decreased body weight, increased liver weight with morphological and biochemical changes, and testicular damage (Lake et al., 1976; U.S. EPA 1987b).

Carpenter et al. (1953) fed groups of 32 male and 32 female Sherman rats 0, 0.04, 0.13, or 0.4% bis(2-ethylhexyl)phthalate (0, 20, 60, or 200 mg/kg/day, respectively) in the diet for one year during which time they were allowed to breed. After one year, groups of eight males and eight females were continued on the same regimen and groups of 32 male and 32 female offspring were fed 0, and 0.4% (200 mg/kg/day) bis(2-ethylhexyl)phthalate in the diet. Significantly increased liver and kidney weights were observed with the high dose in the male parental group and in both sexes of the F1 groups. No other treatment related effects were reported in the rats. The same study also included guinea pigs and dogs. Groups of 22 to 24 male and 22 to 24 female guinea pigs were fed the equivalent of 0, 19 or 64 mg/kg/day bis(2-ethylhexyl)phthalate for one year. Groups of 4 dogs randomly selected were given the equivalent of 54.7 mg/kg/day for about four weeks and then 0.06 mg/kg/day

for about 48 weeks. One dog was given a TWA dose of 79.3 mg/kg/day for a total of 246 days. Increased relative liver weight was seen in all treated groups of female guinea pigs, however, no histological changes were reported. The dog that received the TWA dose of 79.3 mg/kg/day developed fatty vacuolation and congestion in the liver and cloudy swelling and congestion in the kidneys. No effects were reported for the other groups of dogs (U.S. EPA, 1987a).

Two year dietary studies have been performed on groups of 50 male and 50 female F344 rats and B6C3F1 mice (NTP, 1982; Kluwe et al., 1982). Rats were given 0; 6,000; or 12,000 ppm in the diet (0, 322, 674 mg/kg/day for males; 0, 394, 774 mg/kg/day for females). Mice were given 0; 3,000; or 6,000 ppm in the diet (0; 672; 1,325 mg/kg/day for males; 0; 799; 1,821 mg/kg/day for females). Decreased body weight was observed in all treated male rats, and female rats in the high dose group, and in all treated female mice. An increased incidence of seminiferous tubule degeneration was observed at the highest dose in both rats and mice (U.S. EPA, 1987b). Renal cysts have been reported to appear in rats fed 150 mg/kg three times/week for a year, but not when the chemical is given for six months (Woodward, 1990).

Dibenzofuran.. Dibenzofuran is a component of coal tar and is a product of incomplete combustion. It may also be released from tobacco smoke. Dibenzofuran has very low to no mobility in soil. In water, it adsorbs strongly to sediment and particulate matter in the water column. It biodegrades in soil and groundwater at contaminated sites where populations of adapted microorganisms are present; otherwise biodegradation is slow. Biodegradation is also slow in oxygen starved environments such as anoxic sediment. Ambient air monitoring has shown that dibenzofuran exists primarily in the gas-phase (HSDB 2001). Animal data for exposure to dibenzofuran alone are not available.

4-Methylphenol. 4-Methylphenol (p-cresol) is used as a solvent, a disinfectant, and is a chemical intermediate in the production of synthetic resins. It is also released to the environment via automobile exhaust and tobacco smoke. In ambient air, 4-methylphenol exists in the vapor phase. It exhibits moderate to high mobility in soil and biodegrades rapidly. If released into water, 4-methylphenol may adsorb to suspended solids and sediment in the water column (HSDB 2001).

Animal toxicity data for 4-methylphenol is limited. Adminstration of 4-methylphenol by gavage for six to eighteen days during gestation resulted in hypoactivity of the central nervous system, respiratory distress and maternal death in rabbits (HEAST 1997). Skin application studies of mice indicate that cresols can serve as tumor promoters of a polycyclic aromatic hydrocarbon. In these studies mice were given a single dose of 0.3% dimethylbenzanthracene (DMBA) followed by application of cresols. The mice were subsequently examined for the presence of skin papillomas. In one study, 7/20 mice developed papillomas; in the other study approximately 29% developed skin papillomas (Boutwell and Bosch 1959). In an acute dermal toxicity study, technical grade p-cresol caused severe skin damage on at least a third of shaved, female, albino New Zealand rabbits within 4 hours of

application of 300 mg/kg p-cresol (Vernot et al. 1977). The oral LD_{50} for rats is 207 mg/kg (Sax and Lewis 1989).

Polycyclic Aromatic Hydrocarbons (PAHs). PAHs are ubiquitous in the environment. PAH levels are typically elevated in nonbiological materials in industrial areas because of anthropogenic sources; human activities release approximately 43,000 metric tons of PAHs into the atmosphere and 230,000 metric tons into aquatic environments each year. Most PAHs released to the atmosphere eventually reach surface soils and waters by direct deposition (Eisler , 1987a).

Terrestrial vegetation and invertebrates can accumulate significant levels of PAHs. Plants can assimilate PAHs deposited on leaf surfaces as well as take up PAHs through the roots. Translocation of PAHs occurs, and concentrations are usually greater on plant surfaces than in internal tissues. Aboveground vegetation typically has higher PAH levels than do the roots. Reported plant PAH concentrations range from 20 to 1,000 µg/kg (fresh weight) in vegetation from nonpolluted areas, and up to 25,000 µg/kg (fresh weight) in polluted areas. Phytotoxic effects of PAHs are rare. The biomagnification potential of PAHs in vegetation in terrestrial and aquatic food chains has not been adequately investigated (Eisler, 1987a).

Concentrations of PAHs in fish do not appear to be elevated. Reported values range from 3 µg/kg (fresh weight) for fish muscle from specimens collected in Lake Ontario to >15,000 µg/kg (fresh weight) in fish muscle from specimens collected near a wastewater treatment plant in Michigan. In aquatic systems, the PAH toxicity generally increases with increased molecular weight and increased alkyl substitution on the aromatic ring. Toxicity is most pronounced among crustaceans and least pronounced among fish. Most aquatic organisms appear to bioconcentrate PAHs rapidly, and uptake is highly species-specific. Bioconcentration factors for whole organisms and tissues are affected by biotic and abiotic factors and range from 0.02 to >82,0000. The many carcinogenic, and cytotoxic effects, as well as inhibited reproduction, inhibited respiration, and inhibited photosynthesis, have been reported among various biota (Eisler, 1987a).

Little information is available on the effects of PAHs on terrestrial wildlife, but significant concentrations that could cause adverse effects are unlikely. Reported LD50 acute oral doses for laboratory rodents range from 50 to 2,000 mg/kg body weight. Adverse effects observed in laboratory mammals include carcinomas, testicular damage, oocyte and follicle destruction, and altered blood serum chemistry and nephrotoxicity.

Metals

Aluminum. Most studies of the helath effects of aluminum to animals involved oral and inhalation exposure. Few studies are available regarding respiratory effects in animals. Two studies that involoved exposure of rates, guinea pigs, and hamsters to

aluminum chlorohydrate, reported reactions similar to that of dust expsoure, sometimes accompanied by pneumonia.

According to the Draft Toxiclogicl Profile for Aluminum (ATSDR, 1991a), the effects of aluminum on the development of laboratory animals are controversial. Some studies show decreases in pup growth and neurological development, while others do not. In mice, aluminum lactate in food during gestation produced weight decreases and lowered birth weights in pups, but it was difficult to determine whether these effects were permanent. Studies on pups that were exposed to aluminum after they were born also have mixed results. Aluminum is fatal to laboratory animals (rats, mice) only at very high doses.

Arsenic. Background concentrations of arsenic are generally <10 µg/L in surface water and <15 mg/kg in soil (Eisler 1988a). Commercial use and production of arsenic compounds, such as agricultural insecticides and herbicides, have raised local concentrations above natural background concentrations in some areas. In the United States, arsenic levels >240,000 µg/L in surface water and 2.5 x 106 mg/kg soil (DW) in arsenic-pesticide-treated soils have been reported (Eisler 1988a). Arsenic concentrations of up to 3,500 mg/kg sediment (DW) in contaminated areas (Eisler 1988a), up to 30 mg/kg sediment in Lake Michigan (Eisler 1988a), and 47 to 209 µg/g sediment in Lake Texoma (Hunter et al. 1981) have been reported.

Arsenic toxicity depends strongly on its chemical form and oxidation state. In general, inorganic arsenic compounds are more toxic than organic compounds, and trivalent forms are the most toxic (Eisler 1988a). Biota may take up arsenic via ingestion, inhalation, or absorption through body surfaces, and cells take up arsenic via the active transport system normally used in phosphate transport (Eisler 1988a).

Adverse effects on crops and vegetation, such as poor growth, seedling death, defoliation, and inhibition of photosynthesis, have been reported at concentrations of 1 to 25 mg water soluble arsenic/kg soil (equivalent to approximately 25 to 85 mg total arsenic/kg soil) (Eisler 1988a). Data on effects of arsenic on soil biota and insects are limited. Tolerant soil microbiota can withstand arsenic concentrations as high as 1,600 mg/kg soil (NAS 1977). In contrast, reduced growth and metabolism in sensitive species have been reported at arsenic concentrations of 375 mg/kg soil (NAS 1977), and soils with arsenic levels of 150 to165 mg/kg soil lost their earthworm biota and showed reduced quantities of microfauna (Eisler 1988a).

Mammals and birds are exposed to arsenic primarily by ingestion of contaminated vegetation and water. Arsenic is bioconcentrated by organisms but is not biomagnified in the food chain (Eisler 1988a). In birds, arsenic poisoning produces many effects, including loss of muscular coordination, slowness, loss of righting reflex, seizures, and death. Single oral doses producing 50% fatality in sensitive species (such as the turkey) range from 17 to 33 mg/kg body weight. In mammals, arsenic toxicosis can produce trembling, extreme weakness, vomiting, and death (Eisler 1988a). Because arsenic detoxification and excretion are rapid, poisoning is

generally caused by acute or subacute exposures. Single doses reported to produce 50% fatality in sensitive mammal species ranged in concentration from 2.5 to 33.0 mg/kg body weight. Susceptible species have been adversely affected at chronic arsenic doses of 1 to 10 mg/kg body weight or 50 mg/kg diet (Eisler 1988a).

Adverse effects on aquatic biota have been reported at concentrations of 19 to 85 µg/L (Eisler 1988a). Fish exposed to 1 to 2 mg/L total arsenic for 2-3 days exhibited gill hemorrhages; fatty infiltration of the liver; and necroses of the heart, liver, and ovarian tissues. Developing toad embryos exhibited increased malformity or mortality following a 7-day exposure to 40 µg trivalent arsenic/L, and concentrations of 48 µg pentavalent arsenic/L significantly reduced growth in freshwater algae (EPA 1986). Many organisms accumulate arsenic from water, but there is little evidence of magnification through aquatic food chains (NAS 1977; Eisler 1988a). The AWQC for trivalent arsenic for the protection of aquatic life are 360 and 190µg/L for acute and chronic exposure, respectively (EPA 1986). Although no criteria for the protection of aquatic life have been developed for pentavalent arsenic because of insufficient data, the lowest-observed-effect levels for freshwater acute and chronic exposure are 850 and 48 µg/L.

Barium. Soil barium concentrations in the United States range from 15 to 5,000 mg/kg soil (Peterson and Girling 1981). Sheppard and Evenden (1990) reported a mean barium concentration of 630 µg/g for soils from 64 sites throughout CanadaPlants can bioaccumulate barium and have been reported to contain 4 to 40 mg/kg plant material (DW). Little information is available to indicate that barium is toxic to plants, and no information was found in the literature regarding adverse effects of barium on terrestrial wildlife.

Barium concentrations in American drinking water range from 0.6 to 10 µg/L; upper limits in some midwestem and western states range from 100 to 3,000 µg/L (USEPA 1986). The human health AWQC for barium is 1,000 µg/L. Experimental data indicate that soluble barium concentrations in freshwater would have to exceed 50,000 µg/L before toxicity to aquatic biota would be expected (USEPA 1986). Barium ions rapidly precipitate as barium sulfate or barium carbonate, which are highly insoluble and nontoxic. Soluble barium is also removed from solution by sedimentation and adsorption by clays, hydroxides, and organic matter. Because of the general absence of toxic soluble forms of barium in freshwater systems, AWQC for barium for the protection of aquatic life are considered unnecessary (USEPA 1986).

Beryllium. The toxicity of beryllium varies according to the compound. For beryllium sulfate, the acute exposure LD50 values reported were 82 to 120 mg/kg for rat and 80 to 140 mg/kg for mouse (ATSDR 1993d). Similarly, beryllium chloride LD50 was 86 mg/kg for rat and 92 mg/kg for mouse (ATDSR 1993d). The LD50 for beryllium fluoride was as low as 18.8 mg/kg in rats, but this higher toxicity may be due to toxic effects from the fluoride ion.

Chronic exposure of rats to 31 mg/kg/day beryllium sulfate produced no observed adverse effect over a period of two years (ATSDR, 1993d). None of these systems appears to be a target for beryllium toxicity. Musculo-skeletal damage (in the form of rickets) was reported in rats exposed to 10 mg/kg/day beryllium carbonate (ATSDR, 1993d). Young rats fed 121 mg/kg day beryllium carbonate developed severely weakened bones (ATSDR, 1993d). No reproductive damage is reported as a result of chronic or acute exposure to beryllium compounds.

Plants easily take up beryllium when it occurs in a soluble form in the soil. Some plant species in the Leguminosae and Cruciferae families have a pronounced ability to accumulate beryllium. Beryllium concentrates mainly in the roots. Relatively low beryllium concentrations ranging from 2 to 16 ppm in solution are highly toxic to plants. Common symptoms of toxicity are brown retarded roots and stunted foliage (Kabata-Pendias and Pendias 1992).

Chromium. Chromium concentrations range from 5 to 300 mg/kg in soils and 1 to 10 µg/L in contaminated rivers and lakes (Eisler 1986). Sheppard and Evenden (1990) reported a mean chromium concentration of 38 µg/g for soil collected from 64 sites throughout Canada, and the World Health Organization (WHO 1988) reported an average concentration of 53 mg/kg for 863 samples collected in the United States. Chromium is most frequently encountered in the trivalent (III) or hexavalent (VI) oxidation states; the hexavalent form is more toxic because it has a higher oxidation potential and can easily penetrate biological membranes (Eisler 1986).

A variety of plants take up and accumulate chromium. Adverse effects include decreased growth and leaf necrosis (Peterson and Girling 1981). Treatment of plants with nutrient solutions containing chromium (VI) concentrations of 5 mg/L or less resulted in decreased chlorophyll concentration, inhibition of seed germination and growth, and decreased root uptake of nutrients (WHO 1988). The high chromium concentrations reported in many plants may represent a significant pathway of chromium transport to herbivorous biota. Adverse effects of chromium on sensitive wildlife species have been reported at concentrations of 5.1 and 10.0 mg/kg of diet for chromium (VI) and chromium (III), respectively (Eisler 1986). Documented effects in birds include limb deformities, everted viscera, and stunting. In mammals, chromium exposure has resulted in altered blood chemistry, skin ulcerations, bronchial carcinomas, kidney and liver lesions, and teratogenic effects (Eisler 1986).

In aquatic systems, exposure to 10 µ/L of chromium (VI) inhibited growth in algae; frond growth in common duckweed; and survival and fecundity in Daphnia (Eisler 1986). For chromium (VI), acute toxicity values range from 23.07 µg/1- for a cladoceran to 1,870,000 µg/L for a stonefly; chronic values range from <2.5 µg/L for a daphnid to 1,987 µg/L for fathead minnows (USEPA 1986). Acute values for chromium (VI) range from 2,221 µg/L for a mayfly to 71,060 µg/L for a caddisfly; chronic values range from 66 µg/L for Daphnia to 1,025 µg/L for fathead minnows (USEPA 1986). For fish, chromium (VI) concentrations of 16 to 21 µg/L resulted in reduced growth; altered plasma cortisol metabolism; altered enzyme activities;

chromosomal aberrations; and morphological changes in gill, stomach, and kidney tissues. The AWQC for chromium (VI) for the protection of freshwater biota are 16 and 11 µg/L for acute and chronic exposure, respectively (USEPA 1986). The AWQC for chromium (III) is hardness dependent. At a hardness of 200, the AWQC are 3,100 and 370 µg/L for acute and chronic exposure, respectively.

Copper. Copper causes lethal and sublethal effects in aquatic systems, including reduced primary productivity and decreased growth, increased mortality, inhibited spawning, and altered foraging behavior in fish (Benoit 1975; Harrison 1986; Sandheinrich and Atchison 1989). Copper toxicity in aquatic systems decreases with increased hardness, alkalinity, and total organic carbon (USEPA 1986). At a hardness of 50, acute values for 41 genera of freshwater organisms ranged from 16.74 µg/L for Ptychocheilus to 10,240 µg/L for the stonefly Acroneuria. Chronic toxicity values at a hardness of 50 for 15 freshwater species ranged from 3.873 µg/L for brook trout to 60.36 µg/L for northern pike (USEPA 1986). The AWQC for copper is hardness dependent. At a hardness of 200, the AWQC for copper for the protection of aquatic biota is 34 and 21.4 µg/L for acute and chronic exposures, respectively (USEPA 1986).

Soil copper concentrations range from 9.3 to 159.4 µg/g soil (average 38.3 µg/g) in forests of the northeastern United States (Herrick and Friedland 1990) and from 29.2 to 129.8 µg/g soil in an urban forest in southwestern Ohio (Tong and Farrell 1991). Sheppard and Evenden (1990) reported a mean soil copper concentration of 14 µg/g soil at 64 sites throughout Canada. In terrestrial systems, soil copper concentrations of <500 mg/kg induce a wide range of adverse impacts, such as reduced microbial and fungal abundance and biomass, and decreased species diversity, density, and biomass in invertebrates. Soil concentrations of 50 to 100 µg copper/g soil have been reported to be toxic to nontolerant plants (Tyler et al. 1989).

Iron. A 96-hour LC50 value of 0.32 mg/l (320 µg/l) was obtained for mayflies, stoneflies, and caddisflies (USEPA, 1976). Iron was found to be toxic to carp at concnetrations of 0.9 mg/l (900 µg/l) when the pH of the water was 5.5, and both pike and trout died at iron concentrations of 1 to 2 mg/l (1,000 to 2,000 µg/l) (USEPA, 1986). The USEPA (1986) has established a criterian of 1,000 µg/l for fresh water, based upon laboratory tests. Data obtained under laboratory conditions suggest a greater toxicity for iron than that obtained in natural exosystems, due to variations in alkalinity, pH, hardness, temperature and the presence of ligands which change the valence state and solubility, and therefore, the toxicity of the metal.

Lead. Lead concentrations have been reported as 26 µg/g of soil at 64 sites through Canada (Sheppard and Evenden 1990), 69.4 to 180.8 µg/g of soil (average 115.3 µg/g) in montane forests of the northeastern United States (Herrick and Friedland 1990), and 160.7 to 196.3 µg/g of soil (average 178.5 µg/g) among urban maple and maple-pine forest sites in southeastern Ohio (Tong and Farrel 1991). In the United States, lead concentrations are generally <2 µg/L in lakes, but the average lead

concentration in major rivers has been reported as 23 µg/L (Biddinger and Gloss 1984).

Plants readily take up lead (under certain soil conditions such as low pH and low organic matter levels) via absorption in ionic solution through the roots. Lead can also enter plants across vegetative surfaces following aerosol deposition; little translocation occurs after uptake (Koeppe 1981; Eisler 1988b; Xian and Shokohifard 1989). Elevated lead levels generally cause negligible damage to plants, depending on species. Very high concentrations (several hundred milligrams per kilogram or more), however, have inhibited growth and reduced photosynthesis, water absorption, and mitosis (Demayo et al. 1982). Elevated levels of particulate lead may occur on plant surfaces as a result of aerosol deposition. This topical lead coating typically does not affect the plant but may represent a significant route of lead entry into higher trophic levels via food chain transfer to herbivores (Koeppe 1981; Eisler 1988b).

Soil invertebrate communities exposed to soil lead levels as low as 34 mg/kg soil exhibited a significant decrease in species diversity, while exposure to lead soil levels of 34 to 4,800 mg/kg soil significantly altered biomass, density, species number, and vertical distributions in individual soil groups, such as earthworms, ants, and spiders (Tyler et al. 1989). Terrestrial invertebrates take up and accumulate lead, and some taxa (e.g., woodlice and spiders) have been proposed for use as environmental monitors of lead concentrations in soil and litter.

Elevated levels of lead (up to 270 mg/kg body [DW]) have been reported in amphibians and reptiles collected near lead mines and smelters. Lead in tadpoles may contribute to the lead levels observed in wildlife that prey on tadpoles (Eisler 1988b). Lead poisoning in frogs may result in sloughing of the integument; sluggishness; decreases in red and white blood cells, neutrophils, and monocytes; and death. Death has been reported in frogs at lead concentrations of 25 mg/L and in salamanders at 1.4 mg/L (Eisler 1988b).

Lead concentrations in birds tend to be highest in specimens collected from urban areas and near lead mining and smelting facilities (Eisler 1988b). Lead poisoning in birds has been extensively documented. Its effects include loss of appetite; impaired locomotion, balance, and depth perception; microscopic lesions in brain, kidney, muscle, and bone tissues; and altered blood composition and chemistry and immune system (Eisler 1988b). Birds of prey may be exposed to lead by feeding on dead or dying game animals that contain lead shot or by consuming prey (such as waterfowl and small mammals) that contain high levels of biologically incorporated lead (Eisler 1988b). Ingestion of lead-contaminated prey may represent a significant source of mortality in golden and bald eagles (Frenzel and Anthony 1989; Craig 1990).

The highest body burdens of lead in mammals have been reported for specimens collected from urban areas and near lead mining and smelting facilities (Eisler 1988b). The lead exposure route for mammals is via diet; species high on the food

chain are apparently more susceptible to lead contamination (Scanlon 1987; Eisler 1988b). Reported effects of lead poisoning in mammals include altered structure and function in kidneys, bone, and the hematopoietic and central nervous systems, as well as biochemical, histopathological, teratogenic, and reproductive effects. The effects are species specific; younger developmental stages are the most sensitive; and organolead compounds are more toxic than inorganic ones (Eisler 1988b). Little is known about the toxic and sublethal effects of lead on mammalian wildlife. In laboratory and domestic mammals, adverse effects have been observed with lead doses ranging from 0.05 mg lead/kg body weight (mice) to 5 mg lead/kg body weight (rats and dogs) (Eisler 1988b).

Lead is toxic to all phyla of aquatic organisms. Its effects are determined by species and physical and chemical factors. Dissolved waterborne lead is more toxic than total lead; organic lead forms are more toxic than inorganic ones; toxicity decreases with increasing hardness; and toxic effects generally increase under conditions of rapid growth (EPA 1986; Eisler 1988b). Although lead is concentrated by aquatic biota, little evidence of biomagnification exists (Demayo et al. 1982; Eisler 1988b). In fishes, toxic and sublethal effects of lead include increased mucus production, which interferes with the respiratory and ion-exchange functions of gills; spinal curvature; anemia; destruction of spinal neurons; reduced swimming ability; growth inhibition; altered blood chemistry; and death (Holcombe et al. 1976; Demayo et al. 1982; Eisler 1988b).

Reduced survival, impaired reproduction, and reduced growth have been reported in aquatic organisms at lead concentrations of 1.0 to 5.1 µg/L (Eisler 1988b); lead concentrations of >10 µg/L are expected to cause increasingly severe long-term effects on aquatic biota (Demayo et al. 1982). At a hardness level of 200, the AWQC for lead for the protection of freshwater life is 200 and 7.7 µg/L for acute and chronic exposure, respectively (USEPA 1986).

Manganese. Manganese compounds are required for good health in animals. Manganese deficiency has been linked with impaired growth, skeleltal abnormalities, impaired reproductive function in females, testicular degeneration in males, and altered metabolism of carbohydrates. Excessive manganese can cause adverse effects. However, moste studies have shown that manganese has low acute oral toxicity. Doses as high 2,300 mg/kg/day have been olerated by rats for 6 moths without lethality. Oral administration of highly concentrated manganese solutions (16,000 - 44,000 mg/l) can cause lethality in animals. No effects were seen in mice or rats exposed to average oral doses of 810 or 30 mg/kg/day. In rats fed manganese orally, some minor neurological effects were seen in doses as low as 14 mg/kg for up to 8 months. Decreased litter weights were seen in rats dosed with 1,240 mg/kg during 20 days of gestation. Repeated intramuscular injection of rats and mice with suspensions of metallic manganese did not result in tumors (ATSDR, 1992).

Mercury. Mercury and its compounds have no known normal biological function, and the presence of mercury in living cells is undesirable and potentially hazardous

(NAS 1978). Mercury exists in three oxidation states: elemental mercury, mercurous ion (Hg_2^{+2}), and mercuric ion (Hg^{+2}). All mercury compounds interfere with thiol metabolism. Chemical speciation is probably the most important factor affecting the ecotoxicology of mercury (Boudou and Ribeyre 1983).

In general, organic forms of mercury are more readily absorbed than inorganic forms. Organic mercury compounds are also more soluble in organic solvents and lipids, pass more readily through biological membranes, and are slower to be excreted (Eisler 1987a). In aquatic systems, low toxicity forms of mercury may become methylated by biological or chemical processes. Methylmercury is the most hazardous mercury species owing to its high stability, high lipid solubility, and high ability to penetrate biological membranes (Eisler 1987a; Hobson 1988).

Total mercury concentrations range from about 0.001 to 0.05 µg/L in uncontaminated natural waters and are typically <1.0 mg/kg in uncontaminated sediments (Eisler 1987b). In aquatic systems, sediments act as mercury sinks, while methylation tends to release mercury from sediments into the ecosystem (Hobson 1988). Mercury levels are usually <1 mg/kg (fresh weight) in biota from uncontaminated areas and > 1 mg/kg in biota from areas that have received mercury from anthropogenic sources. Mercury can bioconcentrate in biota and biomagnify through food chains (Eisler 1987b).

Early developmental stages are most sensitive to the effects of mercury, and organomercury compounds are more toxic than inorganic forms. In addition to its lethal effects, mercury is a mutagen, teratogen, and carcinogen. Lethal concentrations of total mercury range from 0.1 to 200 µg/L in aquatic biota; 2.2 to 31 mg/kg body weight (acute oral dose) and 4.0 to 40 mg/kg (dietary) for birds; and 0.1 to 0.5 mg/kg body weight (daily dose) and 1.0 to 5.0 mg/kg (dietary) for mammals (Eisler 1987b). Sublethal effects of mercury have been observed at concentrations of 0.03 to 0.1 µg/L for aquatic species, 604 µg/kg body weight (daily dose) and 50 to 500 µg/kg (dietary) for birds, and 250 µg/kg body weight (daily dose) and 1,100 µg/kg (dietary) for mammals (Eisler 1987b).

No information was found regarding the effects of mercury on terrestrial vegetation. Mercury poisoning in fish can result in increased respiratory movements, loss of equilibrium, emaciation, brain lesions, inability to capture food, abnormal motor coordination, and death. Sublethal effects can include inhibited reproduction; reduced growth; and altered behavior, metabolism, blood chemistry, and osmoregulation (Eisler 1987b). The AWQC for mercury for the protection of freshwater biota is 2.4 and 0.012 µg/L for acute and chronic exposure, respectively. However, the AWQC of 2.4 µg/L for acute exposure is above the mercury concentration of 0.03 to 0.1 µg/L reported to produce sublethal effects and also above the lower limit (0.1 µg/L) reported to be fatal to sensitive aquatic biota. On the basis of these data, the U.S. Fish and Wildlife Service considers the acute mercury AWQC to provide no significant protection for freshwater aquatic biota (Eisler 1987b).

Mercury poisoning produces muscular incoordination, falling, slowness, and death in birds. Sublethal effects in birds include decreased growth, developmental abnormalities, inhibited reproduction, altered blood chemistry and composition, altered metabolism, and behavioral modifications (Eisler 1987b). Mercury bioaccumulation and biomagnification has been observed in birds, and young are more sensitive than older individuals. In mammals, methylmercury affects the central nervous system and the kidneys. Toxic effects include convulsions, widespread brain damage, kidney damage, and increased stillbirths. Sublethal effects include reduced fertility, increased anomalous fetuses, behavioral changes, visual disturbances, tremors, and motor incoordination (Eisler 1987b).

Nickel. Nickel concentrations in soils range from 5 to 500 mg/kg, with an average of about 100 mg/kg (Hutchinson 1981). Reported nickel concentrations in surface waters from the major U.S. river and lake basins range from 3 ug/L in the western gulf to 56 µg/L in Lake Erie (Snodgrass 1980).

Nickel concentrations in plants grown in uncontaminated soils are typically <10 mg/kg. The bioavailability and uptake of nickel by plants depend on the soil type and plant species (Hutchinson 1981). Plants collected near nickel smelters had nickel concentrations ranging from 2 to 40 mg/kg DW (Hutchinson 1981), while concentrations ranged from 0.2 to 4.5 µg/g for nearly 2,000 specimens of field crops and natural vegetation in the United States (Brooks 1980). The effects of nickel toxicity in plants include induced iron-deficiency chlorosis, foliar necrosis, stunted root and shoot growth, deformation, leaf and stem spotting, abnormal starch accumulation, and accumulation of apolar soluble phenolics (Hutchinson 1981).

Nickel accumulation has been reported for only a few wildlife species. Nickel concentrations were <3.67 µg/g (wet weight) in liver, heart, and kidney tissues collected from white-tailed deer, gray and red squirrels, and cottontail rabbit (Jenkins 1980). Scanlon (1989) measured heavy metal concentrations in several species of small mammals living in roadside environments and reported average body burdens of nickel ranging from 0.23 µg/g (DW) in the house mouse to 4.19 µg/g in the masked shrew. Scanlon (1989) suggested that small mammals at higher trophic levels are more vulnerable to heavy metal contamination. Reported nickel levels in kidney tissues collected from the ruffed grouse and the American robin were 4.96 and 1.66 µg/g (wet weight), respectively (Jenkins 1980).

No information was found regarding nickel toxicity in wildlife. In laboratory animals, reported effects of nickel include inhibition of enzyme systems, elevated ATPase levels, inhibition of RNA synthesis, significant increases in serum glucose, loss of ATPase activity in brain capillaries, interference with spermatogenesis, reduced litter size, and enhanced neonatal mortality (Mushak 1980). Oral intake of nickel is associated with the lowest level of toxicological response; dogs and cats that received daily oral doses of 12 mg/kg for more than 6 months exhibited no adverse effects (Mushak 1980).

In freshwater systems, nickel toxicity decreases with increasing hardness (USEPA 1986). Nickel results in a variety of adverse effects in freshwater biota. Adverse effects on algae exposed to nickel concentrations of 1.0 to 45 mg/L included reduced growth, inhibition of flagellar movement, decreased capacity for phototaxis and geotaxis, and changes in community structure and species diversity (Spencer 1980). In aquatic invertebrates, nickel adversely affected locomotion, reproduction, development, and growth. In fish, exposure to nickel reduced fecundity and egg hatchability, increased embryo and larvae mortality, and increased incidence of abnormal larvae (Birge and Black 1980).

Acute toxicity values for 21 freshwater species ranged from 1,101 µg/L for a cladoceran to 43,240 µg/L for fish. Chronic toxicity values for two invertebrates and two fish in freshwaters ranged from 14.77 µg/L for Daphnia magna in soft water to 526.7 µg/L for the fathead minnow in hard water (USEPA 1986). Reported bioconcentration factors range from 0.8 for fish to 193 for a cladoceran. The AWQC for nickel for the protection of freshwater biota is 2,500 and 280 µg/L (hardness of 200) for acute and chronic exposure, respectively (USEPA 1986).

Selenium. In the environment, especially alkaline environments, selenium occurs as selenate, which is the most abundant stable form of selenium. Selenium is an essential micronutrient that may account for organisms' ability to accumulate selenium in their tissues. Selenium accumulation by organisms or plants eaten by fish and wildlife is usually the major pathway leading to toxicity. Organisms can accumulate selenium to concentrations one or more orders of magnitude greater than the concentration of selenium in food or water (Lemly and Smith, 1987). Ingested selenium concentrates in the liver, kidneys, and breast muscle. Symptoms of selenium toxicosis in grasses include snow-white chlorosis of leaves and pink root tissue. In other plants, symptoms of toxicosis include stunted growth, yellow chlorosis and pink leaf veins. Plants are capable of absorbing concentrations of selenium that are toxic to animals. Corn grown in culture solutions containing 5 ppm and 10 ppm of selenite accumulated 200 ppm and 300 ppm selenium, respectively. Resistance to selenium toxicity among plant species widely ranges, therefore a general toxicity level cannot be reliably estimated (Gough et. al. 1979).

Selenium, a metalloid that is released to water from both natural and anthropogenic sources, can be highly toxic to aquatic life at relatively low concentrations. Selenium is also an essential trace nutrient for many aquatic and terrestrial species. Derivation of aquatic life criteria for selenium is complicated by its complex biogeochemistry in the aquatic environment. For example, multiple oxidation states of selenium often exist in ambient surface waters, each displaying different toxicological and chemical properties. Selenium can undergo rapid biotransformation between its inorganic and organic forms that also can affect its bioavailability and toxicity. Bioaccumulation of selenium in aquatic food webs further complicates the derivation of aquatic life criteria because both water and dietary exposures need to be considered.

Symptoms of selenium toxicosis in animals include liver necrosis, muscle atrophy, degeneration and emaciation. However, the greatest effect of selenium is on reproductive success. Selenium concentrates in eggs of birds and fish and is passed to the developing embryos. Selenium concentrations greater than 2 to 5 µg/L in water can bioconcentrate in the food chain and cause reproductive failure in fish (Lemly and Smith 1987). Dietary selenium concentrations of 5 ppm caused reduced hatchability of poultry eggs and 9 ppm decreased egg production (Ohlendorf et., al. 1988, Heinz et. al. 1987). Female mallards fed 10 ppm selenium as sodium selenite exhibited embryotoxicity such as stunted growth, swollen necks, edema, and fewer than normal feathers. In addition, female mallards fed 10 ppm selenium as selenonmethionine exhibited teratogenic effects such as hydrocephaly, bill defects, eye defects twisted legs and missing toes (Heinz et. al. 1987).

Vanadium. Vanadium is a natural element in the earth and occurs naturally in fuel oils and coal (ATSDR, 1991b).

Little is reported on the toxicity of vanadium to animals. The acute oral (by gavage) LD50 for rats was 41 mg/kg as sodium metavanadate and 31.2 mg/kg for mice (Llobet and Domingo, 1984). Chronic exposures of 4.1 mg/kg as vanadyl sulfate in food or water did not affect mortality of rats or mice (Schroeder and Balassa, 1967). No systemic effects were observed in rats or mice chronically exposed to 0.7 mg/kg/day or 4.1 mg/kg/day thallium, respectively, in drinking water (Schroeder et al., 1970; Schroeder and Mitchner, 1975).

Vanadium is known to stimulate photosynthesis in plants, but is not conclusive if this is an essential element. Soluble soil vanadium appears to be easily taken up by the roots and some species show a great ability to accumulate this metal (Kabata-Pendias and Pendias, 1992). Gough et al. reported vanadium concentrations as high as 0.5 ppm in the nutrient solution and 140 ppm in the soil solution may be toxic to plants. Symptoms of phytotoxicity include reduced root length, chlorosis and dwarfing (Kabata-Pendias and Pendias, 1992).

Zinc. Soil levels of zinc typically range from 10 to 300 mg/kg (Collins 1981); Sheppard and Evenden (1990) reported an average zinc concentration of 80 µg/g for 64 Canadian sites, and Herrick and Friedland (1990) reported zinc concentrations of 56.5 to 207.4 µg/g in montane forest soils of the northeastern United States.

In plants, zinc is actively taken up by the roots and can be translocated throughout the plant (Collins 1981). Zinc concentrations of 18 mg/L in soil moisture (as measured in lysimeter solutions) resulted in appreciable damage to coniferous forest understory plants. Nutrient concentrations of 0.02 to 0.1 mg/L caused cytological changes, reduced root elongation, and decreased growth in some plants (Tyler et al. 1989). The symptoms of zinc toxicity include retardation of growth and chlorosis of older leaves; zinc may also inhibit CO2 fixation, inhibit photosynthesis and respiration, disrupt electron transport, and restrict phloem translocation (Collins 1981).

Zinc concentration of >170 mg/kg in soils reduced density, biomass, species diversity, and vertical distributions of soil invertebrates (Tyler et al. 1989). Zinc concentrations in small mammals living in roadside environments ranged from 50.94 to 146.18 µg/g, with higher levels found in species at higher trophic levels (Scanlon 1987).

In aquatic systems, zinc damages gill surfaces in fishes and invertebrates, affecting ion regulation and gas exchange (de March 1988). Zinc is bioaccumulated but does not appear to biomagnify in aquatic food chains (Biddinger and Gloss 1984). Acute toxicity in freshwater varies with hardness. At a hardness of 50, acute sensitivities for eight species ranged from 50.7 µg/L for Ceriodaphnia reticulate to 88,960 µg/L for a damselfly (USEPA 1986). For invertebrates, chronictoxicity values were 46.73 µg/L for Daphnia magna and >5,243 µg/L for a caddisfly. Among seven fish species, chronic toxicity values ranged from 36.41 µg/L for the flagfish to 854.7 µg/L for the brook trout (USEPA 1986). Freshwater plants are more sensitive than are animals; a zinc concentration of 30 µg/L inhibited growth of the alga Selenastrum capriocomutum (USEPA 1986). In freshwater, zinc bioaccumulates in animal tissues 51 to 1,130 times the ambient water concentration. The AWQC for zinc for the protection of aquatic life is 210 and 190 µg/L for acute and chronic exposure, respectively (USEPA 1986).

References

ATSDR. 1991a. *Toxicological Profile for Aluminum.* U.S. Department of Health and Human Services. Atlanta, Georgia.

ATSDR. 1991b. *Toxicological Profile for Vanadium.* U.S. Department of Health and Human Services. Atlanta, Georgia.

ATSDR. 1992. *Toxicological Profile for Manganese.* U.S. Department of Health and Human Services. Atlanta, Georgia.

ATSDR. 1993a. *Toxicological Profile for Benzene.* U.S. Department of Health and Human Services. Atlanta, Georgia.

ATSDR. 1993b. *Toxicological Profile for Tetrachloroethene.* U.S. Department of Health and Human Services. Atlanta, Georgia.

ATSDR. 1993c. *Toxicological Profile for Toluene.* U.S. Department of Health and Human Services. Atlanta, Georgia.

ATSDR. 1993d. *Toxicological Profile for Beryllium.* U.S. Department of Health and Human Services. Atlanta, Georgia.

ATSDR. 1994a. *Toxicological Profile for Acetone.* U.S. Department of Health and Human Services. Atlanta, Georgia.

ATSDR. 1994b. *Toxicological Profile for 1,1,1-Trichloroethane.* U.S. Department of Health and Human Services. Atlanta, Georgia.

American Conference of Governmental Industrial Hygienists, Inc. 1991. Documentation of the Threshold Limit Values and Biological Exposure Indices. 6th ed. Volumes I,II, III. Cincinnati, OH: ACGIH, 355.

Barrows, M.E., S.R. Perocelli, and K.J. Macek. 1980. Bioconcentration and elimination of selected water pollutants by bluegill sunfish (*Lepomis macrocherus*). In: *Dynamic Expsoure, and Hazard Assessment of Toxic Chemicals.* R. Hague (editor). Ann Arbor Science. Ann Arbor, Michigan. pp. 379-390.

Batyrova TF. 1973. Gig Tr Prof Zabol 11: 52-3.

Benoit, D.A. 1975. Chronic effects of copper on survival, growth and reproduction of the bluegill (*Lepomis mavrochirus*). Transactions of the Americn Fisheries Society 104: 353-358.

Biddinger, G.R. and S.P. Gloss. 1984. The importance of trophic transfer in the bioccumualtion of chemical contamination in aquatic systems. Residue Reviews 91: 103-145.

Birge, W.J. and J.A. Black. 1980. Aquatic toxicology of nickel. In: *Nickel in the Environment.* J.O. Nriagu (ed.), John Wiley & Sons, Inc. New York, New York.

Bols NC et al. 1985. Aquat Toxicol 6(2): 147-55.

Boudou,A. and F. Ribeyre. 1983. Contamination of aquatic biocenoes by mercury compounds: an experimental toxicological approach. In: *Aquatic Toxicology,* O. Nriagu (ed.), John Wiley & Sons, Inc. New York, New York.

Boutwell, R.K. and D.K. Bosch. 1959. The tumor-promoting action of phenol and related compounds for mouse skin. Cancer Research 19: 413-424.

Bornmann, G. and A. Loeser. 1967. Zur Frage einer chronisch-toxischen Wirkung von Dichloromethan. Z. Lebensm.-Untersuch. Forsch. 136: 14-18. (Cited in U.S. EPA, 1989b)

Brooks, R.R. 1980. Accumulation of nickel by terrestrial plants. In: *Nickel in the Environment.* J.O. Nriagu (ed.), John Wiley & Sons, Inc. New York, New York.

Browning, E. Toxicity and Metabolism of Industrial Solvents. New York: American Elsevier, 1965. 429

Bruckner, J. 1983. *Findings of Toxicological Studies of 1,1,1-Trichloroethane.* Progress Report. U.S. EPA Cooperative Agreement 807449.

Buben, J. and E. O'Flaherty. 1985. Delineation of the role of metabolism in the hepatotoxicity of trichloroethylene and perchloroethylene: a dose-effect study. Toxicol. Appl. Pharmacol. 78:105-122.

Carlson, AR and Kosian, PA. 1987. Arch Environ Contam Toxicol 16(2): 129

Carpenter, G.P., C.S. Weil and H.F. Smyth, Jr. 1953. Chronic oral toxicity of di(2-ethylhexyl)phthalate for rats, guinea pigs and dogs. J. Ind. Hyg. Occup. Med. 18: 219-226.

Clarke, E.G., and M. L. Clarke. 1975. VeterinaryToxicology. Baltimore, Maryland: The Williams and Wilkins Company, pp. 129.

Clayton, G.D. and F.E. Clayton, eds. 1981. *Patty's Industrial Hygiene and Toxicology*, 3rd rev. ed., Vol. 2A, 2B, Toxicology, John Wiley and Sons, Inc., New York.

Clayton, G.D. and F.E. Clayton (eds.). 1993-1994 *Patty's Industrial Hygiene and Toxicology*. Volumes 2A, 2B, 2C, 2D, 2E, 2F: Toxicology. 4th ed. John Wiley & Sons Inc., New York.

Clement Associates, Inc., 1985. *Chemical, Physical, and Biological Properties of Compounds Present at Hazardous Waste Sites.* Final Report. Prepared for USEPA. Arlington, VA.

Collins, J.C. 1981. Zinc. In *Effects of Heavy Metal Pollution on Plants, Volume 1, Effects of Trace Metals on Plant Function.* N.W. Lepp (ed.). Pollution Monitoring series. Applied Science Publishers Ltd., Englewood, N.J.

Craig, T.H. 1990. Lead concnetrations in golden and bald eagles. Wilson Bulletin 102: 130-133.

Cragg, S.T., E.A., Clark. I.W. Daly *et al.* 1989. Subchronic inhalation toxicity of ethylbenzene in mice, rats, and rabbits. Fundam. Appl. Toxicol. 13: 300-408.

De March, B.G.E. 1988. Acute toxicity of binary mixtures of five cations (Cu^{2+}, Cd^{2+}, Zn^{2+}, Mg^{2}, and K^{+}) to the freshwater amphipod *Gammarus lacustris* (Sars): Alternative descriptive models. Canadian Journal of Fisheries and Aquatic Science 45: 625-633.

Demayo, A. *et al.* 1982. Toxic effects of lead and lead compounds on human health, aquatic life, wildlife plants, and livestock. CRC Crti. Rev. Environ. Contr. 12: 257-305.

Dietz, D.D., J.R. Leininger, and E.J. Rauckman *et al.* 1991. Toxicity studies of acetone administered in the drinking water or rodents. Fundam. Appl. Toxicol. 17: 347-360.

Donald, J., K. Hooper, and C. Hopenhayn-Rich. 1991. Reproductive and developmental toxicity of toluene: a review. Environ. Health Persp. 94: 237-244.

EHRT. 1987. *Screening of Priority Chemicals for Reproductive Hazards: Benzethonium Chloride (CAS No. 121-54-0); 3-Ethoxy-1-propanol (CAS No. 111-35-3); Acetone (CAS No. 67-64-1).* Environmental Health Research and Testing, Inc. Cincinnati, Ohio. NTIS PB89-139083.

Elovaara, E., K. Hemminki, and H. Vainio.1979. Effects of methylene chloride, trichloroethane, trichloroethylene, and toluene on the development of chick embryos. Toxiciology 12: 111-119.

Eisler, R. 1986. *Chromium Hazards to Fish, Wildlife, and Invertebrates: A Synoptic Review.* Biological Report 85(1.6) U.S. Fish and Wildlife Service, Laurel, MD.

Eisler, R. 1987a. *Polycyclic Aromatic Hydrocarbon Hazards to Fish, Wildlife, and Invertebrates: A Synoptic Review.* Biological Report 85(1.11) U.S. Fish and Wildlife Service, Laurel, MD.

Eisler, R. 1987b. *Mercury Hazards to Fish, Wildlife, and Invertebrates: A Synoptic Review.* Biological Report 85(1.10) U.S. Fish and Wildlife Service, Laurel, MD.

Eisler, R. 1988a. *Arsenic Hazards to Fish, Wildlife, and Invertebrates: A Synoptic Review.* Biological Report 85(1.12) U.S. Fish and Wildlife Service, Laurel, MD.

Eisler, R. 1988b. *Lead Hazards to Fish, Wildlife, and Invertebrates: A Synoptic Review.* Biological Report 85(1.14) U.S. Fish and Wildlife Service, Laurel, MD.

Erben R, Beader B; Poljopr Sumar. 1983. 29 (2): 105-14

Fawell, J.K. and S. Hunt. 1988. *Environmental Toxicology: Organic Pollutants.* Ellis Horwood Limited. Chichester, West Sussex, England.

Frenzel, R.W. and R.G. Anthony. 1989. Relationship of diets and environmental contaminants in wintering bald eagles. J. Wild. Manag. 53: 792-802.

Gray, T.J.B, K.R. Butterworth, I.F. Gaunt, P. Grasso and S.D. Gangolli. 1977. Short-term toxicity study of di(2-ethylhexyl)phthalate in rats. Food Cosmet. Toxicol. 15(5): 389-400.

Geiger D.L., Poirier S.H., Brooke L.T., Call D.J., eds, 1985 Acute Toxicities of Organic Chemicals to Fathead Minnows, Pimephales promelas, Vol. II. Superior,Wisconsin: University of Wisconsin-Superior, pp. 33.

Gough, L.P., H.T. Schacklette,and A.A. Case. 1979. *Element Concentrations Toxic to Plants, Animals, and Man. USGS Bulletin 1466*, GPO, Washington, D.C.

Harrison, F.L. 1986. The impact of increased copper concentrations on freshwater ecosystems. In: *Reviews in Environmental Toxicology 2*. E. Hodgson (ed.), Elsevier Science Publishing Company, New York, New York.

Hayes, WC et al. 1985. Fundam Appl Toxicol 1: 190-202.

Hayes, J., L. Condie, and J. Borzelleca. 1986. The subchronic toxicity of tetrachloroethylene (perchloroethylene) administered in the drinking water of rats. Fundam. Appl. Toxicol. 7: 119-125.

Hazardous Substances Data Bank (HSDB). 2001. http://toxnet.nlm.nih.gov.

Heinz, G.H., D.J. Hoffman, A.J. Krynitsky, and D.M.G. Weller. 1987. Reproduction in mallards fed selenium. Environ. Toxicol. Chem. 6: 423-433.

Herrick, G.T. and A.J. Friedland. 1990. Patterns of trace metal concentrations and acidity in montane forest soils of the northeastern United States. Water, Air and Soil Pollution 53: 151-157.

Heywood, R., R.J. Sortwell, P.R.B. Noel, et al. 1979. Safety evaluation of toothpaste containing chloroform. III. Long-term study in beagle dogs. J. Environ. Pathol. Toxicol. 2: 835-851.

Hill, E.F. and M.B. Camardese. 1986. Lethal dietary toxicities of environmental contaminants and pesticides to coturnix. *USFWS Technical Report 2*. Washington, D.C.

Hobson, P.V. 1988. The effect of metal metabolism on uptake, disposition, and toxicity in fish. Aquatic Toxicology 11: 3-18.

Holcombe, G.W. *et al.* 1976. Long term-effects of lead exposure on three generations of brook trout (*Salvelinus fontinalis*). Journal of the Fisheries Research Board of Canada 33: 1731-1741.

Holdgate, M.W. (editor). 1971. *The Seabird Wreck of 1969 in the Irish Sea.* Natural Environmental Research Council. London, England.

Hughes, K. *et al.* 1994. Benzene: Evaluation of risks to health from environmental exposure in Canada. Environ. Varcino. Ecotox. Rev. C12(2): 161-171.

Hunter, R.G., *et al.* 1981. The relationship of trophic level to arsenic burden in fish of a southern great plains lake. Journal of Freshwater Ecology 1: 121-127.

Hutchinson, T.C. 1981. Nickel. In: *Effects of Heavy Metal Pollution on Plants, Volume 1, Effects of Trace Metals on Plant Function.* N.W. Lepp (ed.). Pollution Monitoring Series. Applied Science Publishers Ltd., Englewood, N.J.

IARC. 1994. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer,1972-PRESENT. (Multivolume work).,p. V60 277.

Jenkins, D.W. 1980. Nickel accumulation in terrestrial wildlife. In: *Nickel in the Environment.* J.O. Nriagu (ed.), John Wiley & Sons, Inc. New York, New York.

Jorgenson, T.A., C.J. Rushbrook and D.C.L. Jones. 1982. Dose-response study of chloroform carcinogenesis in the mouse and rat: Status report. Environ. Health Perspect. 46: 141-149.

Kabata-Pendias, A. and H. Pendias. 1992. *Trace Eelments in Soils and Plants.* P.T. Kostecki, E.J. Calabrese, eds. Lewis Publishers, Inc. Chelsea, Michigan.

Kimball, G. undated. The effects of lesser known metals and one organic to fathead minnows (*Pimephales promelas*) and *Daphnia magna* (manuscript), available from Charles E. Stephan, USEPA, Duluth, Minnesota.

Kimura, E.T., D.M. Ebert, and P.W. Dodge. 1971. Acute toxicity and limits of solvent residue for sixteen organic solvents. Toxicol. Appl. Pharmacol. 19: 699-704.

Kirschman, J.C., N.M. Brown, R.H. Coots and K. Morgareigde. 1986. Review of investigations of dichloromethane metabolism and subchronic oral toxicity as the basis for the design of chronic oral studies in rats and mice. Food Chem. Toxicol. 24: 943-949.

Kitchin, K.T. and Ebron, M.T. 1983. Environ Res 31 (2): 362-73

Klaunig, J.E., R.J. Ruch, and M.A. Pereira. 1986. Carcinogenicity of chlorinated methane and ethane compounds administered in drinking water to mice. *Environ. Health Perspect.* 69:89-95.

Klein, SA et al. 1975. Aerosp Med Res Lab Technical Report AMRL-TR-125:429-55.

Kluwe, W.M., J. K. Haseman, J.F. Douglas and J.E. Huff. 1982. The carcinogenicity of dietary di(2-ethylhexyl)phthalate (DEHP) in Fischer 344 rats and B6C3F1 mice. J. Toxicol. Environ. Health. 10(4-5): 797-815.

Koeppe, D.E. 1981. Lead: Understanding the minimal toxicity of lead in plants. In: *Effects of Heavy Metal Pollution on Plants, Volume 1, Effects of Trace Metals on Plant Function.* N.W. Lepp (ed.). Pollution Monitoring Series. Applied Science Publishers Ltd., Englewood, N.J.

Kostas, J. and J. Hotchin. 1981. Behavioral effects of low-level perinatal exposure to toluene in mice. Neurobehav. Toxicol. Teratol. 3: 467-469.

Lake, B.G., P.G. Brantom, S.D. Gangolli, K.R. Butterworth and P. Grasso. 1976. Studies on the effects of orally administered *bis*(2-ethylhexyl)phthalate in the ferret. Toxicology 6(3): 341-356.

Larsen, J.J., M. Lykkegaard, and O. Ladefoged. 1991. Infertility in rats induced by 2,4-hexanedione in combination with acetone. Pharmacol. Toxicol. 69: 43-46.

Lemly, A.D., Smith, G.J., 1987. *Aquatic Cycling of Selenium: Implications for Fish and Wildlife.* U.S. Fish Wildlife Service, Fish Wildlife Leaflet 12.:10p.

Llobet, J.M and D.L. Domingo. 1984. Acute toxicity of vanadium compounds in rats and mice. Toxicol. Lett. 23: 227-231.

Mohtashamipur E. et al. 1987. Mutagenesis 2(2): 111-14.

Mushak, P. 1980. Metabolism and Systemic Toxicity of Nickel. In: *Nickel in the Environment.* J.O. Nriagu (ed.), John Wiley & Sons, Inc. New York, New York.

NAS. 1977. *Arsenic.* National Academy of Sciences. Washington, D.C.

NAS. 1978. *An Assessment of Mercury in the Environment.* National Academy of Sciences. Washington, D.C.

National Cancer Institute (NCI). 1978. Bioassay of 1,2-Dichloroethane for Possible Carcinogenicity (1978) Technical Rpt Series No. 55 DHEW Pub No. (NIH) 78-1361, U.S. Department of Health Education and Welfare, National Cancer Institute, Bethesda, MD 20014.

NCI (National Cancer Institute). 1978. Carcinogenesis Bioassay of 1,1-Dichloroethane. *NCI Carcinogenesis Technical Report Series Number 66, NCI-CG-TR-66, DHEW Publications* No. (NIH) 78-1316.

National Research Council. 1981. The Alkyl Benzenes p.298

NIH 1985. Toxicology & Carcinogenesis Studies of 1,2-Dichlorobenzene (o-Dichlorobenzene) in F344/N Rats and B6C3F1 Mice. Technical Report Series No. 255 (1985) NIH Publication No. 86-2511 U.S. Department of Health and Human Services, National Toxicology Program, National Institute of Environmental Health Sciences, Research Triangle Park, NC

NIH. 1987. Toxicology & Carcinogenesis Studies of 1,4-Dichlorobenzene in F344/N Rats and B6C3F1 Mice (Gavage Studies). Technical Report Series No. 319 (1987) NIH Publication No. 87-2575 U.S. Department of Health and Human Services, National Toxicology Program, National Institute of Environmental Health Sciences, Research Triangle Park, NC 27709

NIOSH. 1983. Criteria Document: Styrene p.95 DHEW Pub. NIOSH 83-119

NTP (National Toxicology Program). 1982. Carcinogenesis bioassay of di(2-ethylhexyl)phthalate (CAS No. 117-81-7) in F344 rats and B6C3F$_1$ mice (feed study). Report NIH/PUB-82-1773, NTP-80-37. NTIS PB82-184011.

NTP. 1988. Draft Subchronic and Chronic Toxicity Study of Ethylbenzene: 90-day Subchronic Study Report on Inhalation Exposure of F344/N Rats and B6C3F1 mice. Prepared for National Toxicology Program of the Nation Institute of Health by IT Reasearch Institute. Chicago, Illinois.

NTP. 1990. National Toxicology Program Technical Report Series Toxicology and Carcinogenesis Studies of Toluene (CAS No. 108-88-3) in F344/N Rats and 86C3F Mice (Inhalation Sudies). Research Triangle Park, N.C.: USEPA, Department of Health and Human Services. No. 371. PB90-256371.

Ohlendorf, H.M., A.W. Kilness, J.L. Simmons, R.K. Stroud, D.J. Hoffman, and J.F. Moore. 1988. Selenium toxicosis in wild aquatic birds. J. Toxicol. Environ. Health 24: 67-92.

Ota, H., H. Onda, H. Kodama and N. Yamada. 1974. Histopathological studies on the effect of phthalic acid esters on the biological system of mice. Nippon Eiseigaku Zasshi. 29(5): 519-524.

Palmer, A.K., A.E. Street, F.J.C. Roe, A.M. Worden and N.J. Van Abbe. 1979. Safety evaluation of toothpaste containing chloroform. II. Long-term studies in rats. J. Environ. Pathol. Toxicol. 2: 821-833.

Peterson, P.J. and C.A. Girling. 1981. Other Trace Metals. In: *Effects of Heavy Metal Pollution on Plants, Volume 1, Effects of Trace Metals on Plant Function.* N.W. Lepp (ed.). Pollution Monitoring series. Applied Science Publishers Ltd., Englewood, N.J.

Phillips RD et al. 1987. Fundam Appl Toxicol 9 (3): 380-8.

NEW YORK STATE STATUS (communities): At this time there are no categories defined for communities.

FEDERAL STATUS (plants and animals): The categories of federal status are defined by the United States Department of the Interior as part of the 1974 Endangered Species Act (see Code of Federal Regulations 50 CFR 17). The species listed under this law are enumerated in the Federal Register vol. 50, no. 188, pp. 39526 - 39527.

(blank) = No Federal Endangered Species Act status.
LE = The element is formally listed as endangered.
LT = The element is formally listed as threatened.
E/SA = The element is treated as endangered because of similarity of appearance to other endangered species or subspecies.
PE = The element is proposed as endangered.
PT = The element is proposed as threatened.
C= The element is a candidate for listing.
(LE) = If the element is a full species, all subspecies or varieties are listed as endangered; if the element is a subspecies, the full species is listed as endangered.
(LE-LT) = The species is formally listed as endangered in part of its range, and as threatened in the other part; or, one or more subspecies or varieties is listed as endangered, and the others are listed as threatened.
(LT-C) = The species is formally listed as threatened in part of its range, and as a candidate for listing in the other part; or, one or more subspecies or varieties is listed as threatened, and the others are candidates for listing.
(LT-(T/SA)) = One or more subspecies or populations of the species is formally listed as threatened, and the others are treated as threatened because of similarity of appearance to the listed threatened subspecies or populations.
(PS) = Partial status: the species is listed in parts of its range and not in others; or, one or more subspecies or varieties is listed, while the others are not listed.

GLOBAL AND STATE RANKS (animals, plants, ecological communities and others): Each element has a global and state rank as determined by the NY Natural Heritage Program. These ranks carry no legal weight. The global rank reflects the rarity of the element throughout the world and the state rank reflects the rarity within New York State. Infraspecific taxa are also assigned a taxon rank to reflect the infraspecific taxon's rank throughout the world. ? = Indicates a question exists about the rank. Range ranks, e.g. S1S2, indicate not enough information is available to distinguish between two ranks.

GLOBAL RANK:

G1 = Critically imperiled globally because of extreme rarity (5 or fewer occurrences), or very few remaining acres, or miles of stream) or especially vulnerable to extinction because of some factor of its biology.
G2 = Imperiled globally because of rarity (6 - 20 occurrences, or few remaining acres, or miles of stream) or very vulnerable to extinction throughout its range because of other factors.
G3 = Either rare and local throughout its range (21 to 100 occurrences), or found locally (even abundantly at some of its locations) in a restricted range (e.g. a physiographic region), or vulnerable to extinction throughout its range because of other factors.
G4 = Apparently secure globally, though it may be quite rare in parts of its range, especially at the periphery.
G5 = Demonstrably secure globally, though it may be quite rare in parts of its range, especially at the periphery.
GH = Historically known, with the expectation that it might be rediscovered.
GX = Species believed to be extinct.

STATE RANK:

S1 = Typically 5 or fewer occurrences, very few remaining individuals, acres, or miles of stream, or some factor of its biology making it especially vulnerable in New York State.
S2 = Typically 6 to 20 occurrences, few remaining individuals, acres, or miles of stream, or factors demonstrably making it very vulnerable in New York State.
S3 = Typically 21 to 100 occurrences, limited acreage, or miles of stream in New York State.
S4 = Apparently secure in New York State.
S5 = Demonstrably secure in New York State.
SH = Historically known from New York State, but not seen in the past 15 years.
SX = Apparently extirpated from New York State.
SZ = Present in New York State only as a transient migrant.

SxB and SxN, where Sx is one of the codes above, are used for migratory animals, and refer to the rarity within New York State of the breeding (B) populations and the non-breeding populations (N), respectively, of the species.

TAXON (T) RANK: The T-ranks (T1 - T5) are defined the same way as the Global ranks (G1 - G5), but the T-rank refers only to the rarity of the subspecific taxon.
T1 through T5 = See Global Rank definitions above.
Q = Indicates a question exists whether or not the taxon is a good taxonomic entity.

OFFICE USE: Information for use by the Natural Heritage Program.

c:\datareq\system\userguid.new

Poland A et al. 1980. Biochem Pharmacol 20: 1281 (1971) as cited in USEPA; Ambient Water Quality Criteria Doc: Dichlorobenzenes p.C-17 EPA 440/5-80-039

Puls, R. 1988. Mineral Levels in Animal Health. Sherpa International Publishers. Clearbrook, British Columbia, Canada.

Robinson, KS et al. 1981. J Toxicol Environ Health 8 (3): 489-500.

Samedav, IG et al. 1978. Azerb Med ZH 55(9): 58-61.

Sax, N.I. 1992. *Dangerous Properties of Industrial Materials*. Van Nostrand Reinhold, New York, New York.

Sax, N.I., and R.J. Lewis, Sr. 1989. *Dangerous Properties of Industrial Materials*. 7th ed. Van Nostrand Reinhold, New York, New York.

Sandheinrich, M.B. and G.J. Atchison. 1989. Sublethal copper effects on bluegill, *Lepomis macrochirus*, foraging behavior. Canadian Journal of Fisheries and Aquatic Science 46: 1977-1985.

Savolainen, H. and Pfaffli, P. 1980. Toxicolo Lett 7 (1): 17-22

Scanlon, P.F. 1987. Heavy metals in small mammals in roadside environments: inplications for food chains. Science for the Total Environment 59: 317-323.

Schroeder, H.A. and J.J. Valassa. 1967. Arsenic, germanium, tin, and vanadium in mice: effects on growth, survival, and tissue levels. J. Nutr. 92: 245-252.

Schroeder, H.A. and M. Mitchner. 1975. Life-time effects of mercury, methyl mercury and nine other trace metals on mice. J. Nutr. 105: 452-458.

Schroeder, H.A., M. Mitchner, and A.P. Nason. 1970. Zirconium, niobium, antimony, vanadium, and lead in rats: life term studies. J. Nutr. 100: 59-68.

Sheppard, S.C. and W.G. Evenden. 1990. Characteristics of plant concentration ratios assessed in a 64-site field survey of 23 elements. Journal of Environmental Radioactivity 11: 15-36.

Sittig, M. 1985. *Handbook of Toxic and Hazardous Chemicals and Carcinogens*. Second Edition. Noyes Publications. Park Ridge, New Jersey.

Smyth, H.F., C.P. Carpenter, C.S. Weil *et al.* 1962. Range-finding toxicity data list IV. Am. Ind. Hyg. Assoc. 23: 95-107.

Smyth, H., C. Weil, J. West *et al.* 1969. An exploration of joint toxic action: twenty-seven industrial chemicals intubated in rats in all possible pairs. Toxicol. Appl. Pharmacol. 14: 340-347.

Snodgrass, W.J. 1980. Distribution and Behavior of Nickel in the Aquatic Environment. In: *Nickel in the Environment.* J.O. Nriagu (ed.), John Wiley & Sons, Inc. New York, New York.

Snyder, R. (ed.). 1987. Ethyl Browning's Toxicity and Metabolism of Industrial Solvents. 2nd ed. Volume 1: Hydrocarbons. Amsterdam - New York - Oxford: Elsevier: 240

Spectrum Laboratories. 1999. http://www.speclab.com/compound/m8021aa.htm

Spencer, D.F. 1980. Nickel and Aquatic Algae. In: *Nickel in the Environment.* J.O. Nriagu (ed.), John Wiley & Sons, Inc. New York, New York.

Thienes, C., and T.J. Haley. 1972. Clinical Toxicology. 5th ed. Lea and Febiger: Philadelphia.

Tong, S.T.Y. and P.M. Farrell. 1991. The concentration profile of heavy metals in an urban forest. Env. Tech. 12: 79-85.

Torkelson, T., F. Oyen, D. McCollister *et al.* 1958. Toxicity of 1,1,1-trichloroethane as determined on laboratory animals and human subjects. Am. Ind. Hyg. Assoc. J. 19: 353-362.

Tucker, A. 1972. *The Toxic Metals.* Earth Island, Ltd. London, England.

Tyler, G. *et al.* 1989. Heavy metal ecology of terrestrial plants, microorganisms, and invertebrates. Water, Air, and Soil Pollution 47: 189-215.

Ungvary, G. and E. Tatrai. 1986. On the embryotoxic effects of benzene and its alkyl derivatives in mice, rats, and rabbits. Arch. Toxicol (Suppl) 8: 425-430.

United States Environmental Protection Agency (USEPA). 1980. Uptake Metabolism and Disposal of Xenobiotic Chemicals in Fish p. 1-157. EPA 600/3-80-082

United States Environmental Protection Agency (USEPA). 1986. *Quality Criteria for Water - 1986.* EPA/440/5-86/001. U.S. Environmental Protection Agency. Office of Water Regualtions and Standards. Washington, D.C., as ited in USATHAMA 1991.

U.S. EPA. 1987a. Health Effects Assessment for Selected Phthalic Acid Esters, Prepared by the Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Cincinnati, OH for the Office of Solid Waste and Emergency Response, Washington, DC.

U.S. EPA. 1987b. Health and Environmental Effects Profile for Phthalic Acid Alkyl, Aryl and Alkyl/Aryl Esters, Prepared by the Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Cincinnati, OH for the Office of Solid Waste and Emergency Response, Washington, DC.

USEPA. 1988. *Superfund Exposure Assessent Manual.* EPA/540/1-88/001. OWSER Directive 9285.5-1. USEPA Office of Remedial Response. Washington, D.C.

USEPA. 1991. *National Primary Drinking Water Regulations*: Final Rule. FR: 563578-3596, 30 January, 1991.

Vernot, E.H., J.D. MacEwen, C.C. Haun and E.R. Kinkead. 1977. Acute Toxicity and Skin Corrosion Data for some Organic and Inorganic Compounds and Aqueous Solutions. Toxicology and Applied Pharmacology 42(2): 417-423.

Wenzel, D. and R. Gibson. 1951. A study of the toxicity and anthelminthic activity of n-butylidene chloride. J. Pharmacol. 3: 169-176.

Wood, J.M. and H.K. Wang. 1985. Strategies for microbial resistence to heavy metals. In *Chemical Processes in Lakes.* Stumn, W. (Ed.). John Wiley and Sons Publishers. New York, New York.

Woodward, K. N. 1990. Phthalate esters, cystic kidney disease in animals and possible effects on human health: a review. Human and Exp. Toxicol. 9(6): 397-401.

World Health Organization (WHO). 1985. *Toluene.* Geneva, Switzerland: Environmental Health Criteria N. 52.

WHO. 1988. *Chromium.* Geneva, Switzerland: Environmental Health Criteria N. 61.

Xian, X., and G.I. Shokohifard. 1989. Effect of pH on chemical forms and plant availability of cadmium, zinc, and lead in polluted soils. Water, Air and Soil Pollution 45: 265-273.

Attachment #3
Peter Cooper Landfill Site Gowanda, NY
Screening Eco-Risk Assessment Report--How Comments Were Addressed

USEPA Comments				How Addressed in April '04 Report? (Page/Table Location of Correction)	
Type	#	Round 1 (June 18, 2003)	Round 2 (March 16, 2004)		
General		Overall, the technical review of the SLERA indicates that EPA's Draft SLERA comments were not adequately addressed and that additional revision of the SLERA is required. Further, the unaddressed comments may significantly impact the conclusions of the Final SLERA and, therefore, the SLERA should not be considered complete until all comments are satisfactorily addressed.	Same	Addressed as indicated below	Changes throughout document
General	1	No background of the chemical contamination at the site was provided. Instead, reference was made to the RI which has not been issued yet.	Although RI sampling results & locations were added as an attachment, background values are not provided. It is unclear as to what samples were collected as background samples. The background soil values (Tables 4-3 through 4-6) and background sediment values (Table 4-14) are missing citations. It is unclear (Tables 4-5 & 4-6) if "SB" designation truly means site background, the notes indicate "soil boring." The header "Upstream Concentration" on Table 9 for wetland sediment suggests that it represents data from a background location. Whether or not it represents data from a background location should be clarified.	Addressed as indicated: Upstream comment defined on page 4 & added to Tables 8 and 9. Also, note that soil background samples were not collected and the previous footnotes "SB=Site Background" were incorrect and eliminated from the RI tables included in Attachment 1 herein. Any New York State values for soil were derived from NYSDEC TAGM 4046, Sediment Criteria or TOGs for surface water.	
General	2	Maximum concentrations, rather than the 95 percent UCLs, should be used as input parameters for all media in a SLERA.	The maximum contaminant values may have been used for the food chain models, but there are some discrepancies in the maximum values on the data summary tables and the exposure point concentrations in the models. For example, for the Landfill Area, maximum detected concentration of benzene in surface soil is shown on Table 7 as 5.1 milligrams per kilogram and the maximum soil exposure point concentration for benzene is 0.051 milligrams per kilogram on Table 11, (thus a discrepancy of an order of three). This discrepancy appears to occur in Tables 7 and 11 for organic compounds detected in surface soil. Discrepancies exist between maximum sediment values in Table 9 and Table 11. In Table 11, the detected organic concentrations for wetland sediment are incorrect and many of the maximum concentrations for creek sediment are missing.	Addressed as indicated: Organic Concentrations on Table 7 are called out as ug/kg while inorganic are in mg/kg. Combined soil EPC (Table 11) is maximum of both areas. Refer to Tables in RI: Tables 4-3, 4-5, 4-12, 4-13, and 4-15.	
General	3	Site area use factors and exposure durations should all be set to one (ERAGS, page 2-2) in contrast to the Peter Cooper ERA site use factors (provided in Table 14), which assumed only partial spatial and temporal exposure for some receptors.	Same	Addressed: page 32 and Table 14; also Site Use Factor footnotes in Tables 16, 17, 19 & 21 were corrected as indicated in General Comment 5 below.	
General	4	Previous Comment: Minimum receptor body weights and maximum food ingestion rates were not used (Table 14), as directed by EPA (ERAGS, page 2-2).	Same	Addressed in Table 14	

Attachment #3
Peter Cooper Landfill Site Gowanda, NY
Screening Eco-Risk Assessment Report--How Comments Were Addressed

USEPA Comments				How Addressed in April '04 Report? (Page/Table Location of Correction)
Type	#	Round 1 (June 18, 2003)	Round 2 (March 16, 2004)	
General	5	Previous Comment: Dietary composition did not consist 100 percent of the most contaminated item, as directed by EPA (ERAGS, page 2-2). Instead a mixed diet was assumed for all receptors Table 14.	There is a discrepancy between the estimated exposure equation (provided on Page 31) and the resulting receptor exposure estimates (provided in Tables 14 through 21). The values that are estimated appear to be up to several orders of magnitude different. It is unclear where the discrepancy is being created because the breakout of the calculations is not provided. Also, it is not clear how the exposure estimates for diet were calculated for raccoon, red fox, and red-tailed hawk, because the small mammal exposure point estimation information (such as bioconcentration factors) was not provided. The incidental ingestion of sediment/soil appear to have been removed since the last submittal. The incidental ingestion of sediment or soil is additive to the dietary exposure and should not have been eliminated from the exposure estimates.	Addressed: text and table corrections on pages 31-33 and Tables 14-21
General	6	Potential risks (*i.e.*, Hazard Quotients >1.0) were calculated indicating the need for a more thorough assessment.	Conclusions concerning the need for additional investigations must be made at the scientific management decision points (SMDP) and in accordance with Step 2 of EPA's 8-step ecological risk assessment process. This next step should have been noted in the conclusions.	Addressed in Section 7, last paragraph
General	7	Air transport pathways (fugitive dusts and volatilization) are discussed for soil-borne contaminants, however, airborne exposure pathways should also be briefly discussed.	An airborne exposure pathway was not broken out into a separate section and discussed.	Addressed in text on pages 19-20
General	8	The New York State water classification of C (T) indicates that Cattaraugus Creek waters support a trout population. This should be indicated where the water classification of Cattaraugus Creek is discussed.	Same	Addressed: made text corrections on pages 10 and 26
General	9	The process for selection of contaminants of potential concern (COPCs) needs to be clearly defined. In remains unclear in the Final SLERA, how COPCs were selected.	Same	While a response is unnecessary (see the first sentence of the second paragraph of the Section titled "Contaminants Known of Suspected to Exist at the Site"), all text on pages 12-14 was checked, as were the tables. Please note that ALL detected chemicals in soil were evaluated and for sediment & surface water ALL detected chemicals were evaluated unless they fell below published NYSDEC screening criteria).
General	10	In several tables (for example Tables 7, 22, and 23), the footnotes appear to have been cut off and cannot be completely read and understood. Please revise the document so that the footnotes are legible.	With the exception of the last page of Table 7, footnotes now appear to have been corrected. However, in various tables, footnotes are not defined at the bottom of the table, different fonts are used on the same table, a footnote definition is located at the bottom of the table but is not referred to anywhere on the actual table.	Fixed all table footnotes
General	11	A figure (or figures) should be included in the SLERA to show the location of all samples used in the SLERA. Background locations should also be identified on this figure. Without clear sample locations, it is not possible to evaluate whether the sampling data used in the SLERA are adequate.	The RI sampling results and locations have been added as an attachment, however, the background locations are still not identified.	Addressed: see pages 12-15 and Attachment #1
General	12	Full tables for all analytical data used in the SLERA must be included (in an appendix/attachment) so that the assessment can be verified. Additional details regarding the samples used in the SLERA (such as sample collection date and depth of samples) should also be provided.	The analytical results have been provided in the latest version of this document. Additional analytical results were unnecessarily provided for matrices not evaluated in the SLERA (subsurface soil, groundwater, test pit, landfill sludge, and landfill gas).	Addressed: see pages 12-15 and Attachment #1

Attachment #3
Peter Cooper Landfill Site Gowanda, NY
Screening Eco-Risk Assessment Report--How Comments Were Addressed

USEPA Comments				How Addressed in April '04 Report? (Page/Table Location of Correction)
Type	#	Round 1 (June 18, 2003)	Round 2 (March 16, 2004)	
Specific	1	The depth of the soil samples used in this screening level risk assessment appear to be up to four feet. Usually, biological receptors will not come into contact with soils greater than one or two feet deep. Ideally, the assessment of soils should be re-evaluated using surface soil data from the zero- to one-foot depths (or zero- to two-foot depths, if necessary). If that is not possible, a discussion of the uncertainty associated with using deep soil data should be included. A discussion of the condition of the cap, especially in relation to soil sample locations used in the assessment, should be provided. Previous information suggests that the cap is eroded and is absent at a number of locations. This condition has implications for receptor exposure and should be discussed.	Same	Addressed: Note cap cover soil description on Page 5 & the depth of soil samples discussion on pages 12-13
Specific	2A	Organization and receptor group terminology are not presented with consistency between assessment and measurement endpoints. The endpoint discussion should also match what is portrayed in the site conceptual model (Figure 3).	Is still missing the predatory bird, red-tailed hawk.	Addressed in Figure 3
Specific	2B	The acronym TRVs is used on page 23 but not defined until page 25. This should be corrected.	Same	Addressed on page 24
Specific	3	Section 3, Screening-Level Ecological Effects Evaluation. Toxicity reference values (TRVs) that are used in screening level risk assessments are to be equivalent to chronic "no observed adverse effects levels" (NOAELs). The text does not specify acute or chronic TRVs and it cannot be assumed that only chronic values have been used in this assessment. The use of chronic values should be discussed and, if necessary, an uncertainty factor for the conversion from acute to chronic values should be provided and carried through the TRV conversion process.	This correction is still required. And, the conversion factors used to extrapolate "lowest observed adverse effects levels" (LOAELs) to NOAELs, discussed on Page 25, are not provided. See also related comments under Comment 14.	Addressed on Table 22
Specific	4	Table 7 and Table 8. The units for the semi-volatile parameters on Table 7 and the semi-volatile organic and inorganic parameters on Table 8 are incorrect. Additionally, Table 7 does not indicate which of the detected compounds will be evaluated for potential ecological risks, as the text states on page 14.	The units have been corrected, but Table 7 does not indicate which of the detected compounds will be evaluated for potential ecological risks.	See General Comment #2 regarding the units issue & General Comment #9 concerning which chemicals were evaluated.
Specific	5A	Minimum body weights have not been used (as directed by EPA). The body weights should be changed to minimum values and the table should be revised to indicate that minimum values were used.	Same	Addressed; see Table 14
Specific	5B	Maximum food ingestion rates have not been used (as directed by EPA). Ingestion rates should be changed to maximum values and the table should be revised to indicate that maximum values were used.	Same	Addressed; see Table 14
Specific	6A	Not all of the chemicals detected in drinking water sources were carried though in the exposure estimates for ecological receptors (for example, the seep exposure estimate in Table 18 is missing values for toluene, arsenic and zinc). Chemicals detected in the surface water should be included in the exposure estimate whether or not they are considered to be surface water COCs.	Same	Column inserted in Table 8 to indicate screening of maximum detected surface water concentration to NYSDEC Surface Water Criteria. Maximum values below screening criteria were not included in risk assessment.
Specific	6B	For some receptors, the drinking water exposure is calculated as a proportion between the two surface water sources. Since the SLERA is conservative, it may be more appropriate in the exposure estimation to use the drinking water source that has the highest concentrations of contaminants (or to use the maximum detected concentrations from both of the drinking water sources).	Same	Maximum concentrations detected above NYSDEC Surface Water Criteria were used in risk assessment, regardless of location (creek surface water or seep). EPCs can be found in Table 13.

Attachment #3
Peter Cooper Landfill Site Gowanda, NY
Screening Eco-Risk Assessment Report--How Comments Were Addressed

Type	#	USEPA Comments: Round 1 (June 18, 2003)	USEPA Comments: Round 2 (March 16, 2004)	How Addressed in April '04 Report? (Page/Table Location of Correction)
Specific	7	Table 22: More information is required for the toxicity reference values (TRVs) presented in this table. The table should include an indication of the type of values that the TRVs represent (NOAELs, LOAELs, acute, chronic, etc.) so that the reader may confirm that conversions to TRVs are equivalent to chronic NOAEL values.	Same	Addressed see Table 22 & 22B
Specific	8	Sec. 2.1.21 Wetlands Para. 1: Please include the following discussion about NYSDEC classified and regulated wetlands. The NYSDEC classifies and regulates wetlands in NYS pursuant to 6 NYCRR Parts 663 and 664. Regulated wetlands must be at least 12.4 acres (5.02 ha) in area and must be dominated by hydrophytic vegetation. Smaller wetlands having "unusual local importance as determined by the Commissioner" may also be state regulated.	The original comment still applies. The wetland should be described in terms of its size and type, relating to the NYSDEC classification.	Addressed on Page 9 of the Problem Formulation Section, Wetlands Subsection before discussion of Cover Type 8.
Specific	9	Section 2, Problem Formulation, under Fish and Wildlife Resources. State and federal threatened and endangered species searches should be less than one year old. The New York Natural Heritage program (NYNHP) Coordination and USFWS letters should be dated within one year of the document and included in an appendix.	The state and federal threatened and endangered species search is not provided in an appendix. These data have not been updated.	See Page 11 & Attachment #4; Updated request made to State in March '04 and any follow-up will be forwarded once received
Specific	10	Sec. 2 Problem Formulation under Surface Water/Seeps Para. 2: Describe how large the seeps (e.g., flow rate) are and where they are located. Also describe where the samples from Cattaraugus Creek were taken. Sampling needs to be described prior to presenting the results. A discussion of the seeps should be included regarding the need for sediment sampling, and the potential contaminant pathway through groundwater, as noted previously.	This information is still lacking and should be included to provide adequate information to make determinations regarding the potential risks to seep water.	Addressed on pages 13-14
Specific	11	Section 2, Problem Formulation, Fate and Transport Mechanisms. Zinc should also be discussed.	Same	Addressed on page 19
Specific	12	Section 5, Screening-Level Risk Calculation, last paragraph. The proposed site redevelopment is not relevant to the SLERA and should be deleted.	Same: Mention of site redevelopment should be curtailed.	Please compare new language in paragraphs 1 and 2 page 40 under Ecological significance and last pararagraph on page 41
Specific	13	Table 7 and Table 9. Contaminants that were not analyzed should not be presented on this table.	Same	See General Comments #2 & #9
Specific	14	Table 22. Original studies on which TRVs are based should be referenced. IRIS, HEAST, NTP, and NIH studies often do not measure the most sensitive endpoints of concern (e.g., reproductive endpoints) for ecological receptors and should only be used when more suitable studies are not available. Both NOAELs and LOAELs should be presented and should be clearly labeled (Table 22 does not specify whether NOAELS or LOAELs are presented). Allometric scaling should not be used.	The previous comment still applies. Allometric scaling should be removed from the text, as well. It is not possible to distinguish with Table 22 where each TRV originated, since the TRVs are not properly referenced. The TRVs should be rechecked for applicability and accuracy. It should be confirmed that no appropriate TRVs exist where there are none currently listed (particularly avian TRVs for organic compounds).	Addressed: see Table 22 and pages 26-27 Also, note that a limited amount of scaling was necessary for the assessment. It was judged in this instance to include such TRVs and keep contaminants in for a more complete assessment rather than loose them from the analysis. We do recognize the importance of the matter, however, no other TRVs have come to our attention as of this date.
Additional Comments for Nov 2003 SLERA				
Other	General 1	Overall, confidence cannot be placed in the values providing the evaluation of ecological risks since the tables have many discrepancies and uncorrected items.		NA
Other	Specific 1	Section 1, Objectives and Overview, under Previous Investigations and Remedial Measures. Sediment sampling is left out of the discussion and should be included.		Addressed on pages 4-5
Other	Specific 2	Section 4, Screening-Level Exposure Estimates. References in the text to Tables 11 and 14 are not correct. These tables do not contain the information that the text states.		Addressed on page 32

NA - Not Applicable

Transportation
Land Development
Environmental
Services

imagination | innovation | energy Creating results for our clients and benefits for our communities

March 29, 2004

Vanasse Hangen Brustlin, Inc.

Ref: 07283.00

Information Services
New York Natural Heritage Program
625 Broadway, Fifth Floor
Albany, New York 12233-4757

Re: Natural Heritage Program Information

To Whom It May Concern:

Vanasse Hangen Brustlin, Inc. (VHB) has been retained to update a Screening Level Ecological Risk Assessment (SLERA) for closure activities occurring at a location in Gowanda, New York. The site is a former manufacturing operation for animal glue and industrial adhesives. Other parts of the site include an inactive landfill and an area of wetlands. This site is adjacent to the Cattaraugus Creek. The purpose of the SLERA is to identify potential impacts to ecological receptors associated with potential migration of constituents from the site. This analysis is being conducted under USEPA and NYSDEC guidance. As a component of the analysis, the guidance requires the identification of any ecologically sensitive species (within a 2 mile radius) such as endangered and threatened species, protected plant communities, and any other ecologically sensitive area that may be present in the vicinity of the site. Enclosed is a copy of the Gowanda, NY 7.5-minute topographic map. The site location is outlined.

Please direct any correspondence concerning this request to me at the following address:
Greg Garvey
VHB, Inc.
54 Tuttle Place
Middletown, CT 06457-1847

We appreciate your assistance in this matter. If you have any questions concerning this request, please do not hesitate to call me at 860-632-1500.

Very truly yours,

VANASSE HANGEN BRUSTLIN, INC.

Greg Garvey, M.S.P.H.
Project Scientist/Risk Analyst

54 Tuttle Place
Middletown, Connecticut 06457-1847
860.632.1500 • FAX 860.632.7879
email: info@vhb.com
www.vhb.com

Transportation
Land Development
Environmental
Services

imagination | innovation | energy Creating results for our clients and benefits for our communities

Vanasse Hangen Brustlin, Inc.

March 29, 2004

Ref: 07283.00

Ms. Sherry Morgan
U.S. Fish and Wildlife Service
3817 Luker Road
Cortland, NY 13045-9349

Re: Request for Information

To Whom It May Concern:

Vanasse Hangen Brustlin, Inc. (VHB) has been retained to update a Screening Level Ecological Risk Assessment (SLERA) for closure activities occurring at a location in Gowanda, New York. The site is a former manufacturing operation for animal glue and industrial adhesives. Other parts of the site include an inactive landfill and an area of wetlands. This site is adjacent to the Cattaraugus Creek. The purpose of the SLERA is to identify potential impacts to ecological receptors associated with potential migration of constituents from the site. This analysis is being conducted under USEPA and NYSDEC guidance. As a component of the analysis, the guidance requires the identification of any ecologically sensitive species (within a 2 mile radius) such as endangered and threatened species, protected plant communities, and any other ecologically sensitive area that may be present in the vicinity of the site. Enclosed is a copy of the Gowanda, NY 7.5-minute topographic map. The site location is outlined.

Please direct any correspondence concerning this request to me at the following address:
Greg Garvey
VHB, Inc.
54 Tuttle Place
Middletown, CT 06457-1847

We appreciate your assistance in this matter. If you have any questions concerning this request, please do not hesitate to call me at 860-632-1500.

Very truly yours,

VANASSE HANGEN BRUSTLIN, INC.

Greg Garvey, M.S.P.H.
Project Scientist/Risk Analyst

54 Tuttle Place
Middletown, Connecticut 06457-1847
860.632.1500 • FAX 860.632.7879
email: info@vhb.com
www.vhb.com

United States Department of the Interior

FISH AND WILDLIFE SERVICE
3817 Luker Road
Cortland, NY 13045

April 26, 2004

Mr. Greg Garvey, M.S.P.H.
Project Scientist/Risk Analyst
Vanasse Hangen Brustlin, Inc.
54 Tuttle Place
Middletown, CT 06457-1847

Dear Mr. Garvey:

This responds to your letter of March 29, 2004, requesting information on the presence of endangered or threatened species in the vicinity of the proposed updating of the Screening Level Ecological Risk Assessment for closure activities at a former manufacturing operation for animal glue and industrial adhesives on the south side of Cattaraugus Creek in the City of Gowanda, Cattaraugus County, New York.

Except for occasional transient individuals, no Federally listed or proposed endangered or threatened species under our jurisdiction are known to exist in the project impact area. In addition, no habitat in the project impact area is currently designated or proposed "critical habitat" in accordance with provisions of the Endangered Species Act (87 Stat. 884, as amended; 16 U.S.C. 1531 et seq.). Therefore, no further Endangered Species Act coordination or consultation with the U.S. Fish and Wildlife Service (Service) is required. Should project plans change, or if additional information on listed or proposed species or critical habitat becomes available, this determination may be reconsidered. The most recent compilation of Federally listed and proposed endangered and threatened species in New York* is available for your information.

The above comments pertaining to endangered species under our jurisdiction are provided pursuant to the Endangered Species Act. This response does not preclude additional Service comments under other legislation.

For additional information on fish and wildlife resources or State-listed species, we suggest you contact the appropriate New York State Department of Environmental Conservation regional office(s),* and:

New York State Department of Environmental Conservation
New York Natural Heritage Program Information Services
625 Broadway
Albany, NY 12233-4757
(518) 402-8935

302760

Since wetlands may be present, you are advised that National Wetlands Inventory (NWI) maps may or may not be available for the project area. However, while the NWI maps are reasonably accurate, they should not be used in lieu of field surveys for determining the presence of wetlands or delineating wetland boundaries for Federal regulatory purposes. Copies of specific NWI maps can be obtained from:

Cornell Institute for Resource Information Systems
302 Rice Hall
Cornell University
Ithaca, NY 14853-5601
(607) 255-6520
web: http://iris.css.cornell.edu
email: cornell-iris@cornell.edu

Work in certain waters of the United States, including wetlands, may require a permit from the U.S. Army Corps of Engineers (Corps). If a permit is required, in reviewing the application pursuant to the Fish and Wildlife Coordination Act, the Service may concur, with or without recommending additional permit conditions, or recommend denial of the permit depending upon potential adverse impacts on fish and wildlife resources associated with project construction or implementation. The need for a Corps permit may be determined by contacting the appropriate Corps office(s).*

If you require additional information or assistance please contact Michael Stoll at (607) 753-9334.

Sincerely,

Mark W. Clough

Acting For

David A. Stilwell
Field Supervisor

*Additional information referred to above may be found on our website at: http://nyfo.fws.gov/es/esdesc.htm.

cc: NYSDEC, Allegany, NY (Environmental Permits)
NYSDEC, Albany, NY (Natural Heritage Program)
COE, Buffalo, NY

302761

U.S. Fish and Wildlife Service
New York Field Office
3817 Luker Road
Cortland, NY 13045

To provide a timely response to future requests for endangered species comments in New York, please include the following in future inquiries:

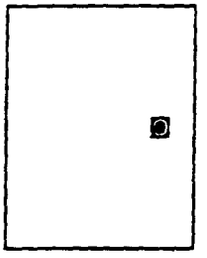
1. A concise brief description of the project/action.

2. Name of the hamlet/village/city/town/county where the project/action occurs.

3. The latitude and longitude of the project/action, i.e.: 42° 13' 28" / 76° 56' 30". If the project/action is linear, you may provide coordinates for both ends or just one near center.

4. A map showing the project/action location. Preferrably the map should be a U.S. Geological Survey quadrangle map (USGS Quad). You need only provide a copy of that portion where the project/action occurs. Please provide the name(s) of the USGS quadrangle.

   If providing only a portion, indicate where the portion would be located on the full quadrangle, i.e.



Providing the information above will assist us in responding to your needs.

If you require additional information please contact Michael Stoll at (607) 753-9334.

New York State Department of Environmental Conservation
Division of Fish, Wildlife & Marine Resources
New York Natural Heritage Program
625 Broadway, 5th floor, Albany, New York 12233-4757
Phone: (518) 402-8935 • **FAX:** (518) 402-8925
Website: www.dec.state.ny.

Erin M. Crotty
Commissioner

May 5, 2004

Greg Garvey
Vanasse Hangen Brustlin, Inc
54 Tuttle Place
Middletown, CT 06457-1847

Dear Mr. Garvey:

In response to your recent request, we have reviewed the New York Natural Heritage Program database with respect to an Environmental Assessment for the Ecological Risk Assessment for Closure Activities at the area indicated on the map you provided, including a 2-mile radius, located in the Town of Gowanda, Cattaraugus and Erie Counties.

Enclosed is a report of rare or state-listed animals and plants, significant natural communities, and other significant habitats, which our databases indicate occur, or may occur, on your site or in the immediate vicinity of your site. The information contained in this report is considered sensitive and may not be released to the public without permission from the New York Natural Heritage Program.
PLEASE NOTE: The Buffer Zone includes portions of the Zoar Valley Wildlife Management Area.

The presence of rare species may result in this project requiring additional permits, permit conditions, or review. For further guidance, and for information regarding other permits that may be required under state law for regulated areas or activities (e.g., regulated wetlands), please contact the appropriate NYS DEC Regional Office, Division of Environmental Permits, at the enclosed address.

For most sites, comprehensive field surveys have not been conducted; the enclosed report only includes records from our databases. We cannot provide a definitive statement on the presence or absence of all rare or state-listed species or significant natural communities. This information should not be substituted for on-site surveys that may be required for environmental impact assessment.

Our databases are continually growing as records are added and updated. If this proposed project is still under development one year from now, we recommend that you contact us again so that we may update this response with the most current information.

Sincerely,

Charlene Houle

Charlene Houle, Information Services
NY Natural Heritage Program

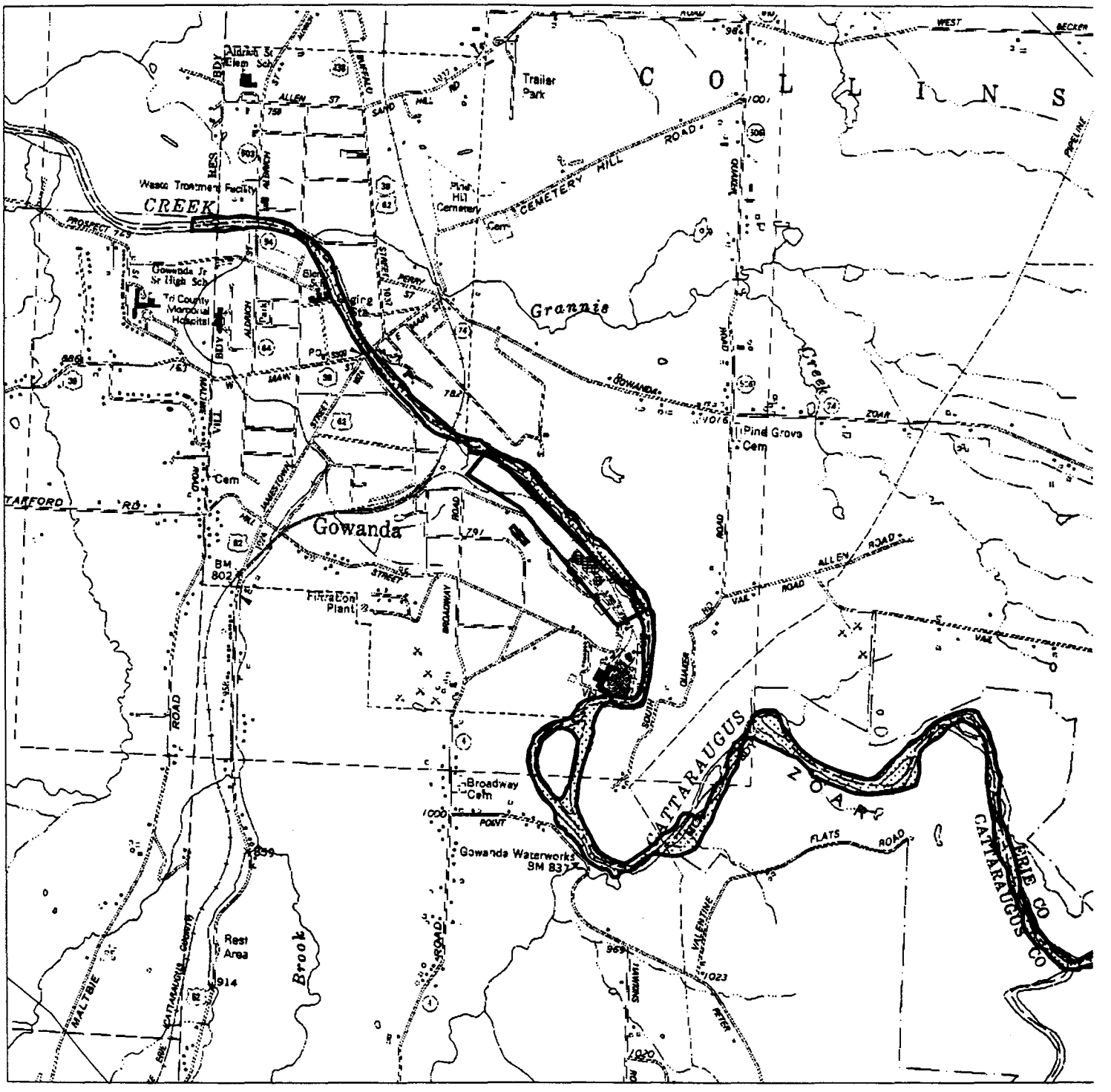
Enc.

Cc: Reg. 9, Wildlife Mgr.
Reg. 9, Fisheries Mgr.
Shaun Keeler, Bureau of Fisheries, Albany

302763

Natural Heritage Map of Rare Species and Ecological Communities

Prepared May 3, 2004 by the NY Natural Heritage Program, NYS DEC, Albany, NY



PROJECT SITE

New York Natural Heritage Program Database Records

Midreach Stream

Scale: 1:24000

N

0.4 0 0.4 Miles

*The locations that are displayed are considered sensitve and cannot be released to the public without permission. We do not provide map locations for all records. Please see report for details.

302764

Site only-detailed records

Natural Heritage Report on Rare Species and Ecological Communities

Prepared 3 May 2004 by NY Natural Heritage Program, NYS DEC, Albany, New York

This report contains SENSITIVE information that should be treated in a sensitive manner -- Please see cover letter. Refer to the Users' Guide for explanations of codes, ranks, and fields.
We do not always provide maps of locations of species most vulnerable to disturbance, nor of some records whose locations and/or extents are not precisely known or are too large to display.

* County
** Town

Scientifc Name, COMMON NAME, & Group Name	NY Legal Status, Heritage Ranks, & Federal Status	EO Rank & Last Seen	Detailed Location	General Habitat and Quality	Office Use
* CATTARAUGUS, ERIE					
** PERSIA, COLLINS					
Cornus drummondii ROUGH-LEAF DOGWOOD Vascular Plant	ENDANGERED G5 S1	H 1921-07-10	GOWANDA Gowanda. Specimens were collected in thickets.	Thickets.	4207848
* ERIE					
** COLLINS					
Hydrastis canadensis GOLDEN-SEAL Vascular Plant	THREATENED G4 S2	H 1928-05-11	CATTARAUGUS CREEK Back road to Cattaraugus Creek.	Bottomland woods.	4207848 M
Cardamine rotundifolia MOUNTAIN WATERCRESS Vascular Plant	ENDANGERED G4 S1	H 1930-09-17	COLLINS Near Gowanda, region of Cattaraugus Creek. Cold Springs near Collins. Bed of dry stream Gowanda. Collins, indian reservation.	Cold springs. Bed of dry stream.	4207848
Poa sylvestris WOODLAND BLUEGRASS Vascular Plant	ENDANGERED G5 S1	H 1921-05-30	GOWANDA Gowanda.		4207848 M
** COLLINS, CATTARAUGUS INDIAN RESERVATION					
Carex garberi ELK SEDGE Vascular Plant	ENDANGERED G5 S1	H 1920-06-03	COLLINS Collins.	Calcareous bogs.	4207847
Cynoglossum virginianum var boreale NORTHERN WILD COMFREY Vascular Plant	ENDANGERED G5T4T5 S1S2	H 1927-07-25	COLLINS Town of Collins.		4207848

302765

Site only-detailed records

Natural Heritage Report on Rare Species and Ecological Communities

Prepared 3 May 2004 by NY Natural Heritage Program, NYS DEC, Albany, New York

This report contains SENSITIVE information that should be treated in a sensitive manner -- Please see cover letter. Refer to the Users' Guide for explanations of codes, ranks, and fields.
We do not always provide maps of locations of species most vulnerable to disturbance, nor of some records whose locations and/or extents are not precisely known or are too large to display.

* County
** Town

Scientifc Name, COMMON NAME, & Group Name	NY Legal Status, Heritage Ranks, & Federal Status	EO Rank & Last Seen	Detailed Location	General Habitat and Quality	Office Use
* ERIE					
** COLLINS, CATTARAUGUS INDIAN RESERVATION					
Polygonum erectum ERECT KNOTWEED Vascular Plant	ENDANGERED G5 SH	H 1931-09-13	COLLINS The plant was collected along a roadside in the Town of Collins.	Roadside.	4207847
Sphenopholis obtusata var obtusata PRAIRIE WEDGEGRASS Vascular Plant	ENDANGERED G5T5 S1	H 1934-PRE	COLLINS Collins.		4207847
* ERIE, CATTARAUGUS					
** COLLINS, PERSIA, PERRYSBURG					
Etheostoma pellucidum EASTERN SAND DARTER Fish	THREATENED G3 S2		CATTARAUGUS CREEK GOWANDA Gowanda; Cattaraugus Creek. [probably near Route 39 bridge crossing].		4207848 M BOF
** COLLINS, PERSIA, PERRYSBURG, CATTARAUGUS INDIAN RESERVATION					
Percina copelandi CHANNEL DARTER Fish	UNPROTECTED G4 S2	H 1893	CATTARAUGUS CREEK GOWANDA Cattaraugus Creek, Towanda [Gowanda?].	Creek.	4207848 M
** PERRYSBURG, OTTO, COLLINS, CATTARAUGUS INDIAN RESERVATION, PERSIA					

302766

Site only-detailed records

Natural Heritage Report on Rare Species and Ecological Communities

Prepared 3 May 2004 by NY Natural Heritage Program, NYS DEC, Albany, New York

This report contains SENSITIVE information that should be treated in a sensitive manner -- Please see cover letter. Refer to the Users' Guide for explanations of codes, ranks, and fields.
We do not always provide maps of locations of species most vulnerable to disturbance, nor of some records whose locations and/or extents are not precisely known or are too large to display.

* County
** Town

Scientifc Name, COMMON NAME, & Group Name	NY Legal Status, Heritage Ranks, & Federal Status	EO Rank & Last Seen	Detailed Location	General Habitat and Quality	Office Use
* ERIE, CATTARAUGUS					
** PERRYSBURG, OTTO, COLLINS, CATTARAUGUS INDIAN RESERVATION, PERSIA					
MIDREACH STREAM Community	UNPROTECTED G4 S4	B 2000-10-13	CATTARAUGUS CREEK-ZOAR VALLEY From Zoar travel southeast on Zoar Valley Road for about 1.9 miles to North Otto Road and turn right (south). The occurrence is Cattaraugus Creek beginning approximately 0.4 miles downstream (southwest) of North Otto Road bridge and extends downstre	A large sixth order stream mostly confined within a long steep gorge representing one of the major tributaries of Lake Erie. Patches of infrequently flooded associated riverside communities include riverside san/gravel bar, cobble shore, and calcareo A moderately large occurrence in fair condition and with fair species diversity. There are some major water quality impacts as a result of being in a moderately intact forested valley and a large watershed that has much agriculture. The rank could be	4207847

11 Records Processed

302767

Site and Buffer Records

Natural Heritage Report on Rare Species and Ecological Communities

Prepared 3 May 2004 by NY Natural Heritage Program, NYS DEC, Albany, New York

This report contains SENSITIVE information that should be treated in a sensitive manner -- Please see cover letter. Refer to the Users' Guide for explanations of codes, ranks, and fields.
We do not always provide maps for locations of species most vulnerable to disturbance, nor of some records whose locations and/or extents are not precisely known or are too large to display.

* County
** Town

Scientifc Name, COMMON NAME, & Group Name	NY Legal Status, Heritage Ranks, & Federal Status	EO Rank & Last Seen	Location	Office Use
* CATTARAUGUS				
** PERSIA				
RICH GRAMINOID FEN Community	UNPROTECTED G3 S1S2	BC 2000-08-23	VALENTINE FLATS	4207848
** PERSIA, OTTO				
CALCAREOUS SHORELINE OUTCROP Community	UNPROTECTED G3G4 S3?	BC 2000-08-28	CATTARAUGUS CREEK-ZOAR VALLEY	4207848
* CATTARAUGUS, ERIE				
** CONCORD, PERSIA, EAST OTTO, OTTO, COLLINS				
RIVERSIDE SAND/GRAVEL BAR Community	UNPROTECTED G5 S5	AB 2000-08-28	CATTARAUGUS CREEK-ZOAR VALLEY	4207847
** OTTO, EAST OTTO, COLLINS, PERSIA				
HEMLOCK-NORTHERN HARDWOOD FOREST Community	UNPROTECTED G4G5 S4	A 2001-09-01	CATTARAUGUS CREEK ZOAR VALLEY	4207847
** PERSIA, COLLINS				
Cornus drummondii ROUGH-LEAF DOGWOOD Vascular Plant	ENDANGERED G5 S1	H 1921-07-10	GOWANDA	4207848
** PERSIA, COLLINS, OTTO				

302768

Site and Buffer Records

Natural Heritage Report on Rare Species and Ecological Communities

Prepared 3 May 2004 by NY Natural Heritage Program, NYS DEC, Albany, New York

This report contains SENSITIVE information that should be treated in a sensitive manner -- Please see cover letter. Refer to the Users' Guide for explanations of codes, ranks, and fields.
We do not always provide maps for locations of species most vulnerable to disturbance, nor of some records whose locations and/or extents are not precisely known or are too large to display.

* County
** Town

Scientifc Name, COMMON NAME, & Group Name	NY Legal Status, Heritage Ranks, & Federal Status	EO Rank & Last Seen	Location	Office Use
* CATTARAUGUS, ERIE				
** PERSIA, COLLINS, OTTO				
SHALE CLIFF AND TALUS COMMUNITY Community	UNPROTECTED G4 S3?	A 2000-09-14	CATTARAUGUS CREEK ZOAR VALLEY	4207848
* ERIE				
** CATTARAUGUS INDIAN RESERVATION				
Castilleja coccinea SCARLET INDIAN-PAINTBRUSH Vascular Plant	ENDANGERED G5 S1	H 1926-06-20	CATTARAGUS INDIAN RESERVATION	4207858
Cornus drummondii ROUGH-LEAF DOGWOOD Vascular Plant	ENDANGERED G5 S1	H 1931-10-13	CATTARAGUS INDIAN RESERVATION	4207858
Monarda clinopodia BASIL-BALM Vascular Plant	ENDANGERED G5 S1S2	H 1927-08-02	CATTARAGUS INDIAN RESERVATION	4207858
Polymnia uvedalia BEAR'S-FOOT Vascular Plant	ENDANGERED G4G5 SH	H 1931-08-23	CATTARAUGUS CREEK COLLINS	4207848
Platanthera hookeri HOOKER'S ORCHID Vascular Plant	ENDANGERED G5 S1	H 1927-06-05	CATTARAUGUS INDIAN RESERVATION	4207858

302769

Site and Buffer Records

Natural Heritage Report on Rare Species and Ecological Communities

Prepared 3 May 2004 by NY Natural Heritage Program, NYS DEC, Albany, New York

This report contains SENSITIVE information that should be treated in a sensitive manner -- Please see cover letter. Refer to the Users' Guide for explanations of codes, ranks, and fields.
We do not always provide maps for locations of species most vulnerable to disturbance, nor of some records whose locations and/or extents are not precisely known or are too large to display.

* County
** Town

Scientific Name, COMMON NAME, & Group Name	NY Legal Status, Heritage Ranks, & Federal Status	EO Rank & Last Seen	Location	Office Use
* ERIE				
** CATTARAUGUS INDIAN RESERVATION				
Agastache nepetoides YELLOW GIANT-HYSSOP Vascular Plant	THREATENED G5 S2S3	H 1930-09-10	COLLINS	4207848 M
Carex schweinitzii SCHWEINITZ' SEDGE Vascular Plant	THREATENED G3 S2S3	H 1930-06-15	COLLINS	4207848 M
Lactuca hirsuta DOWNY LETTUCE Vascular Plant	ENDANGERED G5? S1	H 1921	COLLINS	4207848 M
Chamaelirium luteum BLAZING-STAR Vascular Plant	THREATENED G5 S1S2	D 1986-08-02	SAND HILL	4207848 S
Hydrastis canadensis GOLDEN-SEAL Vascular Plant	THREATENED G4 S2	D 1986-08-02	SAND HILL	4207848 S
** COLLINS				
Hydrastis canadensis GOLDEN-SEAL Vascular Plant	THREATENED G4 S2	H 1928-05-11	CATTARAUGUS CREEK	4207848 M

302770

Site and Buffer Records

Natural Heritage Report on Rare Species and Ecological Communities

Prepared 3 May 2004 by NY Natural Heritage Program, NYS DEC, Albany, New York

This report contains SENSITIVE information that should be treated in a sensitive manner -- Please see cover letter. Refer to the Users' Guide for explanations of codes, ranks, and fields.
We do not always provide maps for locations of species most vulnerable to disturbance, nor of some records whose locations and/or extents are not precisely known or are too large to display.

* County
** Town

Scientifc Name, COMMON NAME, & Group Name	NY Legal Status, Heritage Ranks, & Federal Status	EO Rank & Last Seen	Location	Office Use
* ERIE				
** COLLINS				
Cornus drummondii ROUGH-LEAF DOGWOOD Vascular Plant	ENDANGERED G5 S1	C 1992-09-24	CATTARAUGUS CREEK CANYON	4207848 S
Pterospora andromedea GIANT PINE-DROPS Vascular Plant	ENDANGERED G5 S1	F 1990-11	CATTARAUGUS CREEK CANYON	4207847 M
Botrychium oneidense BLUNT-LOBE GRAPE FERN Vascular Plant	ENDANGERED G4Q S1S3	H 1930-10-11	COLLINS	4207848 M
Cardamine rotundifolia MOUNTAIN WATERCRESS Vascular Plant	ENDANGERED G4 S1	H 1930-09-17	COLLINS	4207848
Poa sylvestris WOODLAND BLUEGRASS Vascular Plant	ENDANGERED G5 S1	H 1921-05-30	GOWANDA	4207848 M
** COLLINS, CATTARAUGUS INDIAN RESERVATION				
Carex garberi ELK SEDGE Vascular Plant	ENDANGERED G5 S1	H 1920-06-03	COLLINS	4207847

302771

Site and Buffer Records

Natural Heritage Report on Rare Species and Ecological Communities

Prepared 3 May 2004 by NY Natural Heritage Program, NYS DEC, Albany, New York

This report contains SENSITIVE information that should be treated in a sensitive manner -- Please see cover letter. Refer to the Users' Guide for explanations of codes, ranks, and fields.
We do not always provide maps for locations of species most vulnerable to disturbance, nor of some records whose locations and/or extents are not precisely known or are too large to display.

* County
** Town

Scientifc Name, COMMON NAME, & Group Name	NY Legal Status, Heritage Ranks, & Federal Status	EO Rank & Last Seen	Location	Office Use
* ERIE				
** COLLINS, CATTARAUGUS INDIAN RESERVATION				
Cynoglossum virginianum var boreale NORTHERN WILD COMFREY Vascular Plant	ENDANGERED G5T4T5 S1S2	H 1927-07-25	COLLINS	4207848
Polygonum erectum ERECT KNOTWEED Vascular Plant	ENDANGERED G5 SH	H 1931-09-13	COLLINS	4207847
Sphenopholis obtusata var obtusata PRAIRIE WEDGEGRASS Vascular Plant	ENDANGERED G5T5 S1	H 1934-PRE	COLLINS	4207847
* ERIE, CATTARAUGUS				
** COLLINS, EAST OTTO, YORKSHIRE, OTTO, PERSIA, SARDINIA, CONCORD, ASHFORD				
Cicindela ancocisconensis A TIGER BEETLE Beetle	UNPROTECTED G3 S1	AB 2000-08-28	CATTARAUGUS CREEK	4207847
** COLLINS, PERSIA, PERRYSBURG				
Etheostoma pellucidum EASTERN SAND DARTER Fish	THREATENED G3 S2	H 1893-08-07	CATTARAUGUS CREEK GOWANDA	4207848 M BOF

302772

Site and Buffer Records

Natural Heritage Report on Rare Species and Ecological Communities

Prepared 3 May 2004 by NY Natural Heritage Program, NYS DEC, Albany, New York

This report contains SENSITIVE information that should be treated in a sensitive manner -- Please see cover letter. Refer to the Users' Guide for explanations of codes, ranks, and fields.
We do not always provide maps for locations of species most vulnerable to disturbance, nor of some records whose locations and/or extents are not precisely known or are too large to display.

* County
** Town

Scientifc Name, COMMON NAME, & Group Name	NY Legal Status, Heritage Ranks, & Federal Status	EO Rank & Last Seen	Location	Office Use
* ERIE, CATTARAUGUS				
** COLLINS, PERSIA, PERRYSBURG, CATTARAUGUS INDIAN RESERVATION				
Percina copelandi CHANNEL DARTER Fish	UNPROTECTED G4 S2	H 1893	CATTARAUGUS CREEK GOWANDA	4207848 M
** EAST OTTO, COLLINS, CONCORD, PERSIA, ASHFORD, DAYTON, OTTO				
HEMLOCK-NORTHERN HARDWOOD FOREST Community	UNPROTECTED G4G5 S4	A 2001-09-01	CATTARAUGUS CREEK ZOAR VALLEY	4207847
** EAST OTTO, OTTO, CONCORD, COLLINS, PERSIA				
COBBLE SHORE Community	UNPROTECTED G4G5 S4	B 2000-08-28	CATTARAUGUS CREEK-ZOAR VALLEY	4207847
** OTTO, PERSIA, COLLINS, CONCORD				
RICH MESOPHYTIC FOREST Community	UNPROTECTED G4 S2S3	AB 2001-09-01	CATTARAUGUS CREEK ZOAR VALLEY	4207847
** PERRYSBURG, OTTO, COLLINS, CATTARAUGUS INDIAN RESERVATION, PERSIA				

Site and Buffer Records

Natural Heritage Report on Rare Species and Ecological Communities

Prepared 3 May 2004 by NY Natural Heritage Program, NYS DEC, Albany, New York

This report contains SENSITIVE information that should be treated in a sensitive manner -- Please see cover letter. Refer to the Users' Guide for explanations of codes, ranks, and fields.
We do not always provide maps for locations of species most vulnerable to disturbance, nor of some records whose locations and/or extents are not precisely known or are too large to display.

* County
** Town

Scientifc Name, COMMON NAME, & Group Name	NY Legal Status, Heritage Ranks, & Federal Status	EO Rank & Last Seen	Location	Office Use
* ERIE, CATTARAUGUS				
** PERRYSBURG, OTTO, COLLINS, CATTARAUGUS INDIAN RESERVATION, PERSIA				
MIDREACH STREAM Community	UNPROTECTED G4 S4	B 2000-10-13	CATTARAUGUS CREEK-ZOAR VALLEY	4207847

33 Records Processed

DIVISION OF ENVIRONMENTAL PERMITS

June 2001

REGION	COUNTIES	REGIONAL PERMIT ADMINISTRATORS
1	Nassau & Suffolk Telephone: (631) 444-0365	John Pavacic NYS-DEC BLDG 40 SUNY at Stony Brook Stony Brook, NY 11790-2356
2	New York City (Boroughs of Manhattan, Brooklyn, Bronx, Queens, & Staten Island Telephone: (718) 482-4997	John Cryan NYS-DEC One Hunters Point Plaza 47-40 21st Street Long Island City, NY 11101-5407
3	Dutchess, Orange, Putnam, Rockland, Sullivan, Ulster & Westchester Telephone: (845) 256-3054	Margaret Duke (Peg) NYS-DEC 21 South Putt Corners Road New Paltz, NY 12561-1696
4	Albany, Columbia, Greene, Montgomery, Rensselaer & Schenectady Telephone: (518) 357-2069	William Clarke NYS-DEC 1150 North Wescott Road Schenectady, NY 12306-2014
4 (sub-office)	Delaware, Otsego & Schoharie Telephone: (607) 652-7741	John Feltman NYS-DEC Route 10 HCR#1, Box 3A Stamford, NY 12167-9503
5	Clinton, Essex, Franklin & Hamilton Telephone: (518) 897-1234	Richard Wild NYS-DEC Route 86, PO Box 296 Ray Brook, NY 12977-0296
5 (sub-office)	Fulton, Saratoga, Warren & Washington Telephone: (518) 623-1281	Thomas Hall* NYS-DEC County Route 40 PO Box 220 Warrensburg, NY 12885-0220
6	Jefferson, Lewis & St. Lawrence Telephone: (315) 785-2245	Brian Fenlon NYS-DEC State Office Building 317 Washington Street Watertown, NY 13601-3787
6 (sub-office)	Herkimer & Oneida Telephone: (315) 793-2555	J. Joseph Homburger* NYS-DEC State Office Building 207 Genesee Street Utica, NY 13501-2885

302775

7	Broome, Cayuga, Chenango, Cortland, Madison, Onondaga, Oswego, Tioga & Tompkins Telephone: (315) 426-7438	Ralph Manna NYS-DEC 615 Erie Blvd. West (Env.Permits Room 206) Syracuse, NY 13204-2400
7 (sub-office)	 Telephone: (607) 753-3095	Michael Barylski* NYS-DEC 1285 Fisher Avenue Cortland, NY 13045-1090
8	Chemung, Genesee, Livingston, Monroe, Ontario, Orleans, Schuyler, Seneca, Steuben, Wayne & Yates Telephone: (716) 226-5390	Peter Lent NYS-DEC 6274 East Avon Lima Road Avon, NY 14414-9519
9	Allegany, Cattaraugus, Chautauqua, Erie, Niagara & Wyoming Telephone: (716) 851-7165	Steve Doleski NYS-DEC 270 Michigan Avenue Buffalo, NY 14203-2999
9 (sub-office)	 Telephone: (716) 372-0645	Ken Taft* NYS-DEC 182 East Union, Suite 3 Allegany, NY 14706-1328

* Deputy Regional Permit Administrator

USERS GUIDE TO NY NATURAL HERITAGE DATA

New York Natural Heritage Program, 625 Broadway, Albany, NY, 12233-4757 (518) 402-8935

NATURAL HERITAGE PROGRAM: The Natural Heritage Program is an ongoing, systematic, scientific inventory whose goal is to compile and maintain data on the rare plants and animals native to New York State, and significant ecological communities. The data provided in the report facilitate sound planning, conservation, and natural resource management and help to conserve the plants, animals and ecological communities that represent New York's natural heritage.

DATA SENSITIVITY: The data provided in the report are ecologically sensitive and should be treated in a sensitive manner. The report is for your in-house use and should not be released, distributed or incorporated in a public document without prior permission from the Natural Heritage Program.

NATURAL HERITAGE REPORTS (may contain any of the following types of data):

COUNTY NAME: County where the occurrence of a rare species or significant ecological community is located.
TOWN NAME: Town where the occurrence of a rare species or significant ecological community is located.
USGS 7 ½' TOPOGRAPHIC MAP: Name of 7.5 minute US Geological Survey (USGS) quadrangle map (scale 1:24,000).

SIZE (acres): Approximate acres occupied by the rare species or significant ecological community at this location. A blank indicates unknown size.
SCIENTIFIC NAME: Scientific name of the occurrence of a rare species or significant ecological community.
COMMON NAME: Common name of the occurrence of a rare species or significant ecological community.
ELEMENT TYPE: Type of element (i.e. plant, animal, significant ecological community, other, etc.)

LAST SEEN: Year rare species or significant ecological community last observed extant at this location.

EO RANK: Comparative evaluation summarizing the quality, condition, viability and defensibility of this occurrence. Use with LAST SEEN.
A-E = Extant: A=excellent, B=good, C=fair, D=poor, E=extant but with insufficient data to assign a rank of A - D.
F = Failed to find. Did not locate species, but habitat is still there and further field work is justified.
H = Historical. Historical occurrence without any recent field information.
X = Extirpated. Field/other data indicates element/habitat is destroyed and the element no longer exists at this location.
? = Unknown.
Blank = Not assigned.

NEW YORK STATE STATUS (animals): Categories of Endangered and Threatened species are defined in New York State Environmental Conservation Law section 11-0535. Endangered, Threatened, and Special Concern species are listed in regulation 6NYCRR 182.5.

E = Endangered Species: any species which meet one of the following criteria:
1) Any native species in imminent danger of extirpation or extinction in New York.
2) Any species listed as endangered by the United States Department of the Interior, as enumerated in the Code of Federal Regulations 50 CFR 17:11.

T = Threatened Species: any species which meet one of the following criteria:
1) Any native species likely to become an endangered species within the foreseeable future in NY.
2) Any species listed as threatened by the U.S. Department of the Interior, as enumerated in the Code of the Federal Regulations 50 CFR 17.11.

SC = Special Concern Species: those species which are not yet recognized as endangered or threatened, but for which documented concern exists for their continued welfare in New York. Unlike the first two categories, species of special concern receive no additional legal protection under Environmental Conservation Law section 11-0535 (Endangered and Threatened Species).

P = Protected Wildlife (defined in Environmental Conservation Law section 11-0103): wild game, protected wild birds, and endangered species of wildlife.

U = Unprotected (defined in Environmental Conservation Law section 11-0103): the species may be taken at any time without limit; however a license to take may be required.

G = Game (defined in Environmental Conservation Law section 11-0103): any of a variety of big game or small game species as stated in the Environmental Conservation Law; many normally have an open season for at least part of the year, and are protected at other times.

NEW YORK STATE STATUS (plants): The following categories are defined in regulation 6NYCRR part 193.3 and apply to NYS Environmental Conservation Law section 9-1503.

E = Endangered Species: listed species are those with:
1) 5 or fewer extant sites, or
2) fewer than 1,000 individuals, or
3) restricted to fewer than 4 U.S.G.S. 7 ½ minute topographical maps, or
4) species listed as endangered by U.S. Department of Interior, as enumerated in Code of Federal Regulations 50 CFR 17.11.

T = Threatened: listed species are those with:
1) 6 to fewer than 20 extant sites, or
2) 1,000 to fewer than 3,000 individuals, or
3) restricted to not less than 4 or more than 7 U.S.G.S. 7 and ½ minute topographical maps, or
4) listed as threatened by U.S. Department of Interior, as enumerated in Code of Federal Regulations 50 CFR 17.11.

R = Rare: listed species have:
1) 20 to 35 extant sites, or
2) 3,000 to 5,000 individuals statewide.

V = Exploitably vulnerable: listed species are likely to become threatened in the near future throughout all or a significant portion of their range within the state if causal factors continue unchecked.

U = Unprotected; no state status.

continued on next page