IN THE UNITED STATES DISTRICT COURT
FOR THE NORTHERN DISTRICT OF NEW YORK
BINGHAMTON DIVISION

STATE OF NEW YORK and THOMAS C. JORLING as Trustee of the Natural Resources, Plaintiffs,	)	CIVIL ACTION NO. 89-CV-815 Judge McAvoy
v	)	
ALLIED-SIGNAL INC., Defendant.	)	**STIPULATION AND ORDER**

The parties, by their counsel, stipulate and agree as follows:

WHEREAS pursuant to the Stipulation and Order Amending Consent Decree, so ordered January 22, 1998 ("Consent Decree Amendment"), defendant Allied-Signal Inc. ("AlliedSignal") submitted a revised work plan for the remedial investigation/feasibility study ("RI/FS") of Geddes Brook and Nine Mile Creek ("Revised Work Plan") to plaintiffs ("the State") for the State's review;

WHEREAS after reviewing portions of the Revised Work Plan, the State on June 30, 1998, issued the "State of New York's Determination to Disapprove and Revise the Sampling and Analysis Part of the Geddes Brook/Ninemile Creek Remedial Investigation Work Plan" and AlliedSignal has accepted this determination as final and binding;

WHEREAS the State has reviewed the remaining portions of the Revised Work Plan, has determined that substantial revisions are necessary and, in consultation with AlliedSignal, has revised this submittal in a document entitled "Geddes Brook/Ninemile Creek Remedial

Investigation and Feasibliity Study Work Plan (May 12, 2000)" (hereinafter "GB/NMC RI Work Plan"), a copy of which is attached hereto as Exhibit A;

NOW THEREFORE, IT IS HEREBY STIPULATED AND ORDERED:

1 AlliedSignal accepts the GB/NMC RI Work Plan as final and binding and waives any rights it would otherwise have under the Consent Decree Amendment, the interim Consent Decree entered March 16, 1992 ("Interim Order"), or any provision of law, to dispute the State's revision of the Revised Work Plan.

2. Nothing in this stipulation and order is intended to affect the parties' rights or obligations under the Consent Decree Amendment and Interim Order concerning disputes which may arise in the future involving the implementation of work described in the GB/NMC RI Work Plan.

SO AGREED:

For Allied-Signal Inc

06.13.00

MANNING GASCH, JR. Date
Hunton & Williams

Attorney for Defendant

For the State of New York

6/26/00

NORMAN SPIEGEL (102652) Date
PHILIP BEIN (302224)
Assistant Attorneys General
of Counsel to
ELIOT SPITZER
Attorney General of the
State of New York

Attorney for Plaintiffs

SO ORDERED this day of , 2000

U.S.D.J.

Geddes Brook/Ninemile Creek Remedial Investigation and Feasibility Study

Work Plan

Original Version (April 1998) Prepared for

Honeywell (formerly AlliedSignal, Inc.)
1700 Milton Avenue
Solvay, New York 13209

Original Version (April 1998) Prepared by

Exponent
15375 SE 30th Place, Suite 250
Bellevue, Washington 98008

Revised Version (May 12, 2000) Prepared by:

New York State Department of
Environmental Conservation
Division of Environmental Remediation
50 Wolf Road
Albany, New York 12233

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ACRONYMS AND ABBREVIATIONS

ARARs	Applicable or Relevant and Appropriate Requirements
ATSDR	Agency for Toxic Substances and Disease Registry
CDI	chronic daily intake
COC	contaminant of concern
CSF	carcinogenic slope factor
EPA	U.S. Environmental Protection Agency
FWIA	fish and wildlife impact analysis
HSL	hazardous substance list
ICF	ICF Kaiser International
NOAEL	no-observed-adverse-effect level
NYSDEC	New York State Department of Environmental Conservation
PCB	polychlorinated biphenyl
QAPP	quality assurance project plan
RBC	risk-based concentration
RfD	reference dose
RME	reasonable maximum exposure
RI/FS	remedial investigation and feasibility study
PCDD	polychlorinated dibenzo-p-dioxin
PCDF	polychlorinated dibenzofuran
TAL	target analyte list
TBC	to be considered (advisories, criteria or guidance)
TCDD	tetrachlorodibenzo-p-dioxin
TCL	target compound list
TDS	total dissolved solids
TIC	total inorganic carbon
TOC	total organic carbon
TSS	total suspended solids
USGS	U.S. Geological Survey

1. INTRODUCTION

This Work Plan provides background information on Geddes Brook/Ninemile Creek and discusses how the data collected to date will be evaluated in the Geddes Brook/Ninemile Creek Human Health Risk Assessment (HHRA), Ecological Risk Assessment (ERA) and Remedial Investigation (RI) Reports. A Sampling and Analysis Plan, contained in the 1st Geddes Brook/Ninemile Creek Determination, provided the basis for sampling conducted during the summer of 1998 in Geddes Brook and Ninemile Creek. The Geddes Brook/Ninemile Creek Site Remedial Investigation and Feasibility Study (RI/FS) will proceed separately from the Onondaga Lake Remedial Investigation and Feasibility Study. However, the influence of the Geddes Brook/Ninemile Creek Site on Onondaga Lake, as defined by the data collected as part of the Geddes Brook/Ninemile Creek Remedial Investigation, will be discussed in the Onondaga Lake Human Health Risk Assessment, Ecological Risk Assessment and Remedial Investigation Reports. Data from the Geddes Brook and Ninemile Creek investigation are part of the larger Onondaga Lake database and will be considered in the Onondaga Lake Human Health Risk Assessment, Ecological Risk Assessment and Remedial Investigation Reports. Although these Onondaga Lake reports will focus on Onondaga Lake, the effects of contaminants from tributaries such as Geddes Brook and Ninemile Creek will be discussed in these reports, so as not to underestimate potential risks to people, fish, and wildlife using the lake.

The principal objectives of the Geddes Brook/Ninemile Creek RI/FS work are to:

- Determine the concentration and distribution of contaminants in Geddes Brook and Ninemile Creek
- Determine the ecological and human health significance of contaminants in the Geddes Brook/Ninemile Creek system
- Evaluate potential remedial alternatives to determine their engineering feasibility and relative effectiveness in addressing Honeywell-related contamination in the Geddes Brook/Ninemile Creek system.

Figure 1-1 indicates the location of Geddes Brook and Ninemile Creek with respect to Onondaga Lake and known sources of Honeywell contamination (e.g., Bridge Street/West Flume, Waste Beds 1-15). The bounds of the site currently consist of the length of Geddes Brook from approximately 2,500 feet south (upstream) of its intersection with Gerelock Road down to Ninemile Creek, the length of Ninemile Creek from the Amboy Dam down to Onondaga Lake, and state and federal wetlands and floodplains adjacent to these creeks. As the data collected as part of the Geddes Brook/Ninemile Creek Remedial Investigation are evaluated, the bounds of the site may be redefined.

3.1.3 Potential Receptors

Potential ecological receptors are those that may be exposed directly, or indirectly, to COCs through direct contact with chemicals or through trophic transfer via ingestion of contaminated prey. Based on historical ecological investigations (CDR 1991) and observations made during the site visit in December 1997, there are a number of potential receptors in the Geddes Brook/Ninemile Creek area. These receptors include benthic macroinvertebrates; fishes; amphibians; reptiles; birds; and mammals; inclusive of rare, threatened, and endangered species.

Benthic macroinvertebrates may be directly exposed to COCs in sediment and water. Semi-aquatic animals (i.e., amphibians and reptiles) and fishes may be directly exposed to COCs in water and in sediment (by direct contact and incidental ingestion while feeding). Semi-aquatic animals and fishes may be indirectly exposed to COCs in prey. Similarly, birds and mammals may be directly exposed to COCs in sediment and water (by direct contact and incidental ingestion while feeding). Birds and mammals may also be indirectly exposed to COCs in prey such as benthic macroinvertebrates and fishes.

3.1.4 Complete Exposure Pathways

One of the primary tasks of screening-level problem formulation is the evaluation of potential exposure pathways through evaluating source/media and contact/entry routes (U.S. EPA 1997a). A complete ecological exposure pathway includes the following components:

- A source and mechanism of chemical release to the environment
- An environmental transport medium (e.g., water, sediment, biota)
- An ecological exposure route at the contact point (e.g., ingestion, dermal contact).

As discussed in Section 3.1.2, COCs enter Geddes Brook and Ninemile Creek and may become distributed in water, sediment, floodplain soil, and biota. This section focuses on the ecological exposure route at the contact point.

For aquatic, semi-aquatic, and terrestrial biota, primary exposure to COCs is through direct contact with water and sediment, and ingestion of sediment and food sources. The contributions of COCs from each of these media vary between species and are dependent on the functional attributes and feeding ecology of an organism, as well as the physicochemical properties of both the environmental media and the COCs. A summary of potential exposure routes to various groups of receptors identified in Section 3.1.3 is provided below.

3.1.4.1 Direct Contact/Ingestion

For aquatic and some semi-aquatic organisms, uptake of COCs can occur from direct contact with water and sediment, and ingestion of sediment and food sources. For example, the primary exposure pathway for benthic macroinvertebrates living in or on sediments is generally through direct contact and ingestion of sediments. A complete exposure pathway exists for benthic macroinvertebrates in Geddes Brook and Ninemile Creek through direct contact and/or ingestion of sediment and water.

Fish are in contact with surface water and are also likely to have some contact and incidental ingestion of sediments while feeding (primarily bottom feeding fish). However, for many species the dominant route of exposure for piscivorous fish is anticipated to be ingestion of prey due to the bioaccumulation potential of some COCs (e.g., mercury, PCBs). Complete exposure pathways exist for fish in Geddes Brook and Ninemile Creek through ingestion of sediment, water, and prey, and direct contact with water and sediment.

Similarly, direct contact and incidental ingestion of COCs through surface water, and floodplain soils may also constitute a complete exposure pathway for terrestrial mammals. For example, small mammals burrowing in the soil for prey or for shelter have increased opportunity for exposure to contaminated soils. Small mammals generally have small home ranges, and they often live in and on the soil. Larger mammals (e.g., deer, raccoon) and small mammals may use surface waters of the site for drinking water purposes.

Animals feeding on aquatic organisms or organisms with a partial aquatic life history (e.g., insects, amphibians) may be exposed to COCs originating in Geddes Brook or Ninemile Creek with increased opportunity for dietary exposure. Complete exposure pathways exist for terrestrial animals through direct contact and/or ingestion of surface water, floodplain soil and aquatic organisms.

3.1.4.2 Bioaccumulation

For fish and wildlife receptors, potential exposure to COCs is likely to be greatest via ingestion of contaminated prey. Bioaccumulation at each level of the food chain may increase the chemical exposure concentration to many times the original concentration found in water and sediments. Therefore, upper trophic level species are usually exposed to higher concentrations of bioaccumulative contaminants than lower trophic level species. The extent of exposure potential is based on species life history requirements and feeding habits as well as the bioavailability of the COCs. Piscivores and insectivorous animals feeding on fish and insects at the site may have higher exposures to bioaccumulative COCs (e.g., mercury, PCBs) than herbivorous animals

3.1.5 Ecological Endpoints

3.1.5.1 Assessment Endpoints

As defined by Warren-Hicks et al. (1989), assessment endpoints are formal expressions of the actual environmental values that are to be protected (e.g., protection of local piscivorous bird populations; reproductive success of higher-trophic level species). Specific assessment endpoints define the ecological value in sufficient detail to identify the measures needed to answer specific questions or to test specific hypotheses (USEPA, 1997a). Potential assessment endpoints for the screening-level assessment include 1) the protection of the health (i.e., survival, growth, and reproduction) of local benthic macroinvertebrate communities; 2) the protection of the health (i.e., survival, growth, and reproduction) of local fish populations; and 3) the protection of the health (i.e., survival, growth, and reproduction) of local wildlife (including piscivorous and insectivorous birds and mammals). For the screening-level assessment, however, the primary assessment endpoint selected is the protection of the health (i.e., survival, growth, and reproduction) of local aquatic, semi-aquatic, and terrestrial wildlife populations based on comparisons of contaminant concentrations in surface water and sediment to applicable criteria and guidelines and development of hazard quotients using conservative assumptions.

3.1.5.2 Measurement Endpoints

Measures of exposures and effects, which will be used in this risk assessment, are quantifiable environmental characteristics (e.g., organism mortality in sediment toxicity tests) that are related to assessment endpoints. All measures of exposures and effects correspond directly to assessment endpoints or can be related to assessment endpoints using predictive models. The measures of exposure and effects in this assessment generally represent three basic types of data: 1) results of biological surveys (e.g., species abundance, taxa biomass), 2) toxicity tests performed on site media (e.g., percent mortality and biomass in sediment toxicity tests), and 3) chemical data (e.g., concentrations of contaminants in water, sediment, and biota).

Limited information is currently available to address these measurement endpoints. The CDR (1991) study assessed species richness and abundance for benthic communities and fishes in Geddes Brook and Ninemile Creek but did not assess piscivorous wildlife populations.

Single chemical concentration data (when compared to ecotoxicity values in the following section) serve as the primary measurement endpoint for the screening-level assessment. Existing chemical concentration data (prior to that collected in 1998) are far from complete in terms of sampling location, media, and analytes. Because of the deficiencies in the historic data for the measurement endpoints, tasks pertaining to biological surveys, toxicity tests, and chemical concentration data will be included in the work discussed in Section 6 of this Work Plan (these data were collected in 1998).

3.1.6 Screening Ecotoxicity Values

Selection of screening values (and applicable fish and wildlife regulatory criteria as required in Step 1 of a FWIA) was based on availability and applicability to the site and to the freshwater environment. The primary screening values were those identified by New York State (NYSDEC 1998 (water), 1999 (sediment), Newell et al. 1987 (fish)). When state screening values were not available for a substance, secondary screening values were based on those identified by U.S. EPA (1986 (water), 1996a (ecotox thresholds for water and sediment)). Finally, when neither state nor federal screening values were available for a substance, tertiary values were taken from other available peer-reviewed sources such as IJC (1989). The sources of screening values used for this assessment are listed below:

- Surface Water
  - New York State surface water standards (NYSDEC 1998)
  - EPA ambient water quality values (U.S. EPA 1986)
  - EPA ecological toxicity thresholds (U.S. EPA 1996a)

- Sediments

  New York State sediment screening values (NYSDEC 1999)
  EPA ecological toxicity thresholds (U.S. EPA 1996a)
  For parameters without NYSDEC or U.S. EPA screening values, use other thresholds as per NOAA (Long and Macdonald et al. 1995) and Ontario Ministry of the Environment (Persaud, et al. 1993). Note: these thresholds were not used in the screening of historic data in this work plan but will be used, if necessary, in the updated screening document.

- Fish Tissue

  New York State fish flesh criteria for piscivorous wildlife (Newell et al. 1987)
  International Joint Commission objectives (IJC 1989).

The most conservative screening values are presented and compared to maximum detected concentrations of substances in the following section.

For ecological risk assessment purposes, floodplain soil results will be compared with sediment criteria and soil criteria for terrestrial plants and invertebrates, not human health based soil criteria.

3.2 SCREENING-LEVEL EXPOSURE ESTIMATE AND RISK CALCULATION

At the screening level, ecological risk estimation is limited to a simplified quantitative evaluation of the relative potential risks of COCs to potential receptors at the site. Screening-level exposure estimates are used to provide a level of inherent conservatism to ensure that potential ecological hazards are identified early in the problem formulation process. The screening-level estimates ensure that the appropriate and relevant COCs are selected for further evaluation, or if necessary, identify data gaps to be addressed in the baseline ecological risk assessment.

This section presents the results of screening evaluations conducted to identify COCs for the baseline ecological risk assessment. Screening values were selected based on availability and applicability as discussed in Section 3.1.6. The data used in the screening evaluations are the analytical results of previous studies conducted on water, sediment, and fish collected from Geddes Brook and Ninemile Creek. In general, the existing historic data, collected prior to 1998, are inadequate to assess the nature and extent of substances and the potential ecological risk that the substances may pose. The data are limited in the number of sampling locations, the number of samples, and the suite of analytes. In addition, complete data validation was not performed for all referenced studies (see Section 1). Nevertheless, screening of existing data is required by U.S. EPA (1997a) and the exercise is a "first step" for quantitative identification of COCs. Water, sediment and biota screening will be updated with the 1998 data which will include full TAL, TCL, PCDDs/PCDFs and methylmercury.

The premise for evaluating screening-level exposure at the site was through derivation of ecotoxicological or hazard quotients. Hazard quotients are calculated by taking the ratio of the exposure point concentration (EPC) over that of an ecotoxicological effects concentration (EEC) or toxicity-based benchmark, as follows:

HQ = EPC/EEC

where:

HQ = hazard quotient
EPC = exposure point concentration (maximum media concentration)
EEC = ecotoxicological effects concentration (e.g., toxicity-based benchmarks)

In this equation, a hazard quotient value ≤ 1.0 derived from surface water criteria and sediment benchmarks would indicate no significant hazard to an aquatic receptor. Similarly, a hazard quotient value ≤ 1.0 derived from a wildlife no-observed-adverse-effect level ($NOAEL_w$) indicates that the substance presents no significant hazard to the wildlife receptor. Hazard quotient values greater than 1.0 indicate that the substance poses a potential hazard.

3.2.1 Surface Water

Table 3-6 presents the results of the screening evaluation for surface water using data collected prior to 1998. Substances for which hazard quotients exceed 1.0 are designated as COCs and are retained for further evaluation. Based on the available data, 21 substances (12 inorganic and 9 organic) were screened in surface water.

Maximum concentrations of most organic substances in surface water at the site are below water quality screening values. Only one organic substance (chlordane) was detected above its screening value.

Ten of the 12 inorganic substances tested in surface water had maximum concentrations that exceeded water quality screening values. For select metals, water quality criteria are dependent on water hardness. Based on data provided in CDR 1991, the minimum hardness in Geddes Brook/Ninemile Creek was approximately 200 mg/L. Using the minimum hardness value results in conservative criteria (i.e., lower standards). Substances retained for further evaluation were aluminum, barium, cadmium, chloride, copper, iron, lead, mercury, manganese, and zinc.

The surface water screening will be updated using data collected during this Remedial Investigation (1998).

3.2.2 Sediment

Tables 3-7 and 3-8 present the results of the sediment screening evaluation using the data collected prior to 1998. Similar to the procedure used for surface water, substances for which hazard quotients exceeded 1.0 were designated as COCs. A total of 23 substances (10 inorganic and 13 organic) were subjected to the sediment screening evaluation.

One organic substance (chlordane) exceeded the sediment screening value (Table 3-7). For those organic parameters with NYSDEC (1999) benthic chronic toxicity or wildlife bioaccumulation standards (see Table 3-7), the maximum concentrations were standardized to organic carbon with a conservative assumption of 1% total organic carbon (TOC data are not available for these NYSDEC sediment samples). For those parameters without NYSDEC ecological sediment screening criteria, USEPA ecotoxicity thresholds (USEPA 1996a) were used as the screening values. These thresholds are reported on a dry-weight basis.

Nine of 10 inorganic substances exceeded the sediment screening values (Table 3-8). Inorganic substances for which maximum concentrations exceeded screening values were arsenic, cadmium, copper, iron, lead, manganese, mercury, nickel, and zinc. Maximum concentrations of eight of the nine inorganic substances exceeded the Lowest Effect Level (LEL) but not the Severe Effect Level (SEL). The maximum concentration of mercury (21.1 mg/kg) also exceeds the SEL (1.3 mg/kg).

The sediment screening will be updated using data collected during this Remedial Investigation (1998).

3.2.3 Wildlife Communities

To evaluate the potential risk of exposure for wildlife communities, the maximum tissue concentration of fish tissue samples collected in previous field studies (CDR 1991) was compared to fish tissue screening values for piscivorous birds and mammals. Tissue screening values for birds and mammals were obtained from Newell et al. (1987). Prior to the Geddes Brook/Ninemile Creek RI/FS, only six fish species (20 samples) were collected from the Geddes Brook/Ninemile Creek system and subjected to tissue analysis. In CDR (1991), brown trout, northern pike, white sucker, bluegill, largemouth bass, and smallmouth bass were collected and analyzed for total mercury, methylmercury and Aroclor® 1254 (smallmouth bass only). Because only a limited number of contaminants were analyzed in fish tissue, the CDR study results provide a limited estimate of risk. Table 3-9 provides the maximum concentration of Aroclor® 1254 and methylmercury in fish tissue (one smallmouth bass) compared to total mercury and total PCBs tissue screening values for birds and mammals.

The results indicate that the maximum methylmercury and Aroclor® 1254 concentrations detected in smallmouth bass may pose risks to piscivorous birds and mammals consuming these fish at the site.

The wildlife screening will be updated using data collected during this Remedial Investigation (1998). The hazard quotient calculations for wildlife can be a comparison of EPCs in biota to conservative NOAELs to represent potential food chain effects. Fish tissue concentrations will be used as prey concentrations in food chain exposure calculations for piscivorous wildlife. Calculations will be prepared for piscivorous fish, piscivorous mammals and birds, and insectivorous birds.

3.2.4 Summary of Screening Assessment

Substances for which maximum site concentrations in surface water, sediment, and tissue exceeded the lowest available screening value are considered as COCs for further evaluation in the baseline ecological risk assessment. Thirteen inorganic (aluminum, arsenic, barium, cadmium, calcium, chloride, copper, iron, lead, manganese, mercury [including methylmercury], nickel, and zinc) and two organic (chlordane and PCBs) substances warrant further evaluation.

This list will be updated based on a screening (water, sediment, wildlife) using the data collected during the RI (1998).

BASELINE RISK ASSESSMENT PROBLEM FORMULATION

3.3.1 Refinement of Preliminary Contaminants of Concern

The screening-level exposure estimate and risk calculation discussed in Section 3.2 identified 13 inorganic and two organic substances as COCs for the site. However, these COCs should not be considered final or comprehensive because monitoring data lack an extensive evaluation of water, sediment, floodplain soil, and biota. For example, the data do not include analysis of DDT, hexachlorobenzene, and most polycyclic aromatic hydrocarbons, which were identified as COCs for the Bridge Street facility. Therefore, the field investigation discussed in Sections 5 and 6 of this work plan includes comprehensive chemical analysis of water, sediment, floodplain soil and biota. The list of COCs will be re-evaluated during the ecological risk assessment when the data from the remedial investigation are available.

3.3.2 Further Characterization of Ecological Effects

When the list of COCs is finalized during the ecological risk assessment, additional characterization of the ecological effects of COCs will be performed. This characterization may include identification of no-observed-adverse-effect-levels (NOAELs), lowest-observed-adverse-effect levels (LOAELs), exposure-functions, and the mechanisms of toxic responses.

Transport and Fate of Contaminants of Concern, Ecosystems Potentially at Risk, and Complete Exposure Pathways

Transport and fate of COCs, ecosystems potentially at risk, and complete exposure pathways were discussed in Section 3.1 and are summarized in Figure 3-4. The ecosystems potentially at risk are the sediment and aquatic habitat of Geddes Brook and Ninemile Creek and the terrestrial habitat adjacent to these areas. These ecosystems will be evaluated in the work discussed in Section 6 of this Work Plan. Analysis of complete exposure pathways indicates that aquatic, semi-aquatic, and terrestrial biota are potential receptors of COCs from primary and secondary sources in Geddes Brook and Ninemile Creek. Onondaga Lake, which is being evaluated in a separate ecological risk assessment, is the receiving water body of surface water and suspended sediments from Geddes Brook and Ninemile Creek. Data from the Geddes Brook and Ninemile Creek investigation are part of the larger Onondaga Lake database and will be considered in the Onondaga Lake Human Health Risk Assessment, Ecological Risk Assessment and Remedial Investigation Reports. Although these Onondaga Lake reports will focus on Onondaga Lake, the effects of contaminants from tributaries such as Geddes Brook and Ninemile Creek will be discussed in these reports, so as not to underestimate potential risks to people, fish, and wildlife using the lake.

3.3.4 Selection of Assessment Endpoints

Assessment endpoints and measures of exposure and effects were discussed in Section 3.1.5 and are summarized in Table 3-10. The assessment endpoints defined for this study include population abundance and production, assemblage structure, organism health (i.e., survival, growth, and reproduction), and risk to various aquatic, semi-aquatic, and terrestrial biota (including birds and mammals). These endpoints were selected based on their biological significance, their susceptibility to potential contact through indirect or direct exposure to COCs, and the availability of pertinent assessment models and toxicological information in the literature.

The benthic macroinvertebrate community is considered an appropriate receptor community because of its exposure to COCs through direct contact with sediments and water. Furthermore, benthic macroinvertebrates are relatively sedentary, or localized in their movement.

The fish community is considered an appropriate receptor community because it is ecologically and societally important, susceptible to COCs, and of a scale appropriate to habitat and distribution of COCs at the site. The fish community structure is important for this assessment in that much of the energy flow in these small brooks and creeks is through fish, which provide a major nutrient reserve to wildlife systems. Risks to piscivorous fish and forage fish will be individually evaluated in the risk assessment.

Piscivorous wildlife are considered appropriate receptors because they are susceptible to COCs through fish consumption. COCs may bioaccumulate in aquatic food webs, leading to high levels of exposure to piscivorous fish and wildlife. For terrestrial mammals, mink have been shown to be highly sensitive to toxic effects of mercury (and PCBs) through reproductive impairment. Kingfishers, great blue heron, and osprey are examples of piscivorous birds that may use habitat and resources at the site.

The measures of exposures and effects selected for the ecological risk assessment are summarized in Table 3-10 with the assessment endpoints. Information pertaining to measurement endpoints will be obtained from the field investigation discussed in Section 6 and from previous studies.

3.3.5 Conceptual Model and Risk Questions

The conceptual site model is presented in Figure 3-4. Primary sources of substances are tributaries (the West Flume, the unnamed creek to Geddes Brook, and Beaver Meadow Brook), surface water runoff, and groundwater from Waste Beds 1-15 to

Ninemile Creek. From these primary sources, substances enter water through inflow and enter sediments and floodplain soils through precipitation and deposition. Substances enter biota through dermal contact, respiration, and ingestion. Secondary sources are, therefore, water, sediments, floodplain soils, and biota. The major stressors are potentially toxic chemicals in secondary sources that can reach aquatic and semi-aquatic ecological receptors through dermal contact, respiration, and ingestion. Chemicals can also reach terrestrial receptors through dermal contact and ingestion. The major potential effects of chemicals are toxicity and bioaccumulation. Calcite is also considered a stressor that may affect aquatic and semi-aquatic receptors through alteration of sediment characteristics.

The assessment endpoints are: 1) the protection of the health (i.e., survival, growth, and reproduction) of local benthic macroinvertebrate communities, as determined by sediment toxicity tests, community evaluations, and comparison to surface water and sediment criteria and guidelines; 2) the protection of the health (i.e., survival, growth, and reproduction) of local fish populations, as determined by comparison of body burdens to toxicity reference values, comparison to surface water and sediment criteria and guidelines, community evaluations, and observations of gross abnormalities; and 3) the protection of the health (i.e., survival, growth, and reproduction) of local wildlife (including birds and mammals), as determined by comparison of body burdens based on food web models to toxicity reference values and comparison to surface water and sediment criteria and guidelines. Whole-body fish data will be used in all ecological assessments and characterizations.

Ecological risk questions provide a basis for examining relationships among assessment endpoints and their predicted responses when exposed to contaminants (U.S. EPA 1997a). The risk question of whether COCs present at Geddes Brook and Ninemile Creek cause adverse effects on assessment endpoints will be refined during the site investigation evaluation and risk characterization.

3.4 ECOLOGICAL RISK CHARACTERIZATION

The primary objectives of risk characterization are to summarize risk-related information, evaluate exposure concentrations (including comparison to reference conditions, available standards, and available guidelines), determine the potential for various ecological effects, and describe uncertainties associated with the overall risk assessment. Risk-related information will include the results of the field investigation discussed in Section 6 of this work plan, data collected prior to 1998, and data from ongoing studies in the area. Risk characterization may include refinement of the COCs, receptors of concern, and assessment and measurement endpoints described in this work plan based on results of the remedial investigation.

Through risk estimation, the likelihood of adverse effects to assessment endpoints will be determined by integrating exposure and effects data and evaluating the weight-of-evidence and associated uncertainties. Several lines of evidence (e.g., toxicity testing, benthic and fish community evaluation, food web model) will be evaluated for several of the assessment endpoints in an effort to increase confidence in the conclusions of the risk assessment. A summary of the receptors, endpoints, and the risk estimates will be provided in the ecological risk assessment.

The risk characterization will include an uncertainty analysis that identifies and, to the extent possible, quantifies the uncertainty associated with each risk estimate and with the overall conclusions of the ecological risk assessment. The most significant sources of uncertainty will be identified, and the relative significance of each will be discussed. The uncertainty analysis will provide an evaluation of the impact of the uncertainties on the overall assessment.

The ecological risk assessment report will be prepared in accordance with applicable state (FWIA) and federal (ERAGS) requirements.

4. HUMAN HEALTH RISK ASSESSMENT

4.1 INTRODUCTION

The tasks described in this section address the approach to be used in the baseline risk assessment for human populations that might be exposed to contaminants of concern (COCs) in Geddes Brook or Ninemile Creek media. The baseline risk assessment will analyze potential adverse health effects that could result from current or future exposure to potentially hazardous substances in the absence of any remedial action (i.e., under the no-action alternative). The baseline risk assessment will consist of four components: identification of COCs, exposure assessment, toxicity assessment, and risk characterization (Figure 4-1). Assessments will be conducted consistent with the following guidance documents:

- *Risk Assessment Guidance for Superfund (U.S. EPA 1989a, 1991a,b)*
- *Exposure Factors Handbook (U.S. EPA 1997b)*
- *USEPA Region III: Risk Based Concentrations (USEPA 1999a)*
- *Dermal Exposure Assessment: Principles and Applications (U.S. EPA 1992a)*
- *Risk Assessment Guidance for Superfund - Supplemental Guidance: Dermal Risk Assessment - Interim Guidance (Internal Draft; U.S. EPA March 1999b)*
- *Technical Guidance for Screening Contaminated Sediments (NYSDEC, January 1999)*
- *USEPA Region 9 Preliminary Remediation Goals (USEPA 1999c)*
- *Guidance for Data Usability in Risk Assessment (U.S. EPA 1990)*
- *Assessing Dermal Exposure from Soil (U.S. EPA 1995)*
- *USEPA Office of Solid Waste and Emergency Response directives (U.S. EPA 1991c, 1992b) on characterizing risks and uncertainties in quantitative risk assessments.*

Table 4-a indicates additional Human Health Risk Assessment guidance documents which should be considered while developing the Human Health Risk Assessment.

4.2 IDENTIFICATION OF CONTAMINANTS OF CONCERN

This section of the baseline risk assessment will present the rationale for the selection of COCs. The risk assessment will rely on historical data and on data collected during the remedial investigation and will focus on exposure to COCs in the following media:

- Fishes collected from Geddes Brook and Ninemile Creek
- Sediments and surface water in Geddes Brook and Ninemile Creek
- Soils in floodplain areas of Geddes Brook and Ninemile Creek
- Sediments, surface water, and soil samples from reference stations representing uncontaminated areas that will not bias the selection of COCs.

Analytical results of samples from these areas will be evaluated to identify COCs. Consistent with guidance in U.S. EPA (1989a), site data will be reviewed to evaluate frequency of detection and the presence of essential nutrients. Any exclusions of chemicals on this basis will be clearly described in the risk assessment. In addition, substances detected in site media will also be screened based on comparisons with background concentrations of inorganic chemicals and risk-based concentrations (RBCs) for all chemicals. Specifically, substances will be identified as COCs for human health where any of the following criteria are met:

- Mean concentrations of inorganic substances in site soil, water, or sediments exceed the mean concentration identified for that chemical in appropriate (similar) background samples by a factor of two or more.
- Maximum detected concentrations of substances in site soil, water, sediments, or fishes exceed applicable RBCs derived by EPA (USEPA, 1999a) using conservative methods.
- Mercury and methylmercury were generally considered to be COCs in all media, regardless of whether or not location-specific or matrix-specific concentrations exceeded applicable screening criteria. Mercury was not screened out due to its significance for the overall Onondaga Lake HHRA and its pervasiveness in the Onondaga Lake basin.

Sediment concentrations (inorganic contaminants only) in Geddes Brook and Ninemile Creek will be compared with appropriate reference stations in order to screen out possible inorganic contaminants. In the screening presented herein, in instances where the maximum detected concentration exceeded the RBC but was less than the concentration of the background sample, the parameter was retained as a COC.

The RBCs proposed for use in identifying COCs in site media were derived by EPA Region III (U.S. EPA 1999a) and represent a concentration of a chemical that is assumed to pose an acceptable level of human health risk based on specified exposure conditions. The RBCs provide a conservative means to identify potential risks because they incorporate the lower end of the acceptable risk range identified by EPA and are derived assuming a higher level of exposure than is likely to take place during recreational visits to the tributaries. The EPA Region III RBCs are based on a 1×10^{-6} cancer risk for carcinogenic effects or a hazard index (HI) of 1 for noncarcinogenic effects. For the preliminary screening conducted in this chapter, the screening level for non-carcinogenic contaminants has been adjusted to a HI of 0.1, by dividing the published residential soil or tap water screening concentration by 10. Use of these risk levels provides a margin of safety for identifying COCs because it is the lower end of the risk range often identified as acceptable at Superfund sites.

Site data for soil and sediments will be compared with EPA Region III RBCs for residential soil. These residential RBCs are derived assuming that residents are exposed to chemicals in soil 350 days per year, that an adult ingests 100 mg/day of soil for 24 years, and that a child ingests 200 mg/day of soil for 6 years. Thus, these values provide a conservative means to identify COCs for recreational visitors exposed to limited areas of tributary sediments or floodplain soils. Similarly, residential RBCs for consumption of drinking water will be compared with tributary data for water. These RBCs are derived based on ingestion of 2 L of drinking water per day for 30 years and thus provide a conservative means to evaluate exposure to water while visiting the tributaries. RBCs for fish tissue were derived using a fish consumption rate of 54 g/day.

A preliminary list of COCs has been identified based on the comparisons described above. Specifically, mercury, arsenic, aluminum, manganese, and benzo(a)pyrene were identified as COCs in sediments of Geddes Brook and Ninemile Creek (Tables 4-1 and 4-2, respectively). No other COCs were identified exceeding RBCs in sediments. In fish tissue, mercury and PCBs were identified as COCs (Table 4-3). In surface water, manganese and mercury exceeded the RBC in both Geddes Brook and Ninemile Creek, and lead exceeded the drinking water standard of 15 μg/L at two locations in Ninemile Creek (Table 4-4) and two locations in Geddes Brook (Table 4-5); therefore, these metals were identified as COCs. Chloroform, cadmium, and chromium were each detected at a concentration exceeding the surface water RBC in one Ninemile Creek surface water sample (Table 4-4), bromo-dichloro-methane, a-chlordane, chloroform and trichloroethene exceeded the RBC in one water sample from Geddes Brook (Table 4-5).

This preliminary identification of COCs will be updated using results of samples to be collected during this investigation. The updated screening will utilize both EPA Region 3 RBCs and EPA Region 9 preliminary remediation goals (non-cancer PRGs should be divided by 10 for use in contaminant screening). The dermal exposure pathway for soil and sediment will be evaluated in the updated screening for all parameters that have EPA Region 2 dermal absorption factors.

4.3 EXPOSURE ASSESSMENT

Exposure assessment is the process of identifying human populations that could potentially come into contact with site-related substances and estimating the magnitude, frequency, duration, and route(s) of potential exposures. First, the exposure setting is characterized and potentially exposed populations (i.e., recreational visitors) are identified. Next, potential exposure pathways are identified and a summary of exposure assumptions proposed for use in the risk assessment is provided.

4.3.1 Exposure Setting and Receptor Populations

At the present time, the lower reaches of Geddes Brook are generally inaccessible because of fencing and dense stands of reed vegetation (*Phragmites*). Geddes Brook is about 18- to 20-ft wide and about 1- to 2.5-ft deep. The lower reaches of Geddes Brook are classified as Class C water (i.e., suitable for fishing and all other uses except as a source of water supply for drinking, culinary, or food processing purposes and primary contact recreation).

The lower reaches of Ninemile Creek are also generally inaccessible except by boat. The mouth of Ninemile Creek itself has either thick phragmites vegetation or heavy woods along the sides, limiting access to the creek. However, trails from the top of the cliffs to the lakeshore are evident. Between the cliffs and Interstate 690 is a parking area, thereby allowing some access to the lakefront and Creek. However, lower reaches of Ninemile Creek are generally inaccessible because of the predominance of highway structures in the area. West of Interstate 690, an access road along

Ninemile Creek allows for general access to the creek. The water depth of the creek is estimated to be generally about 3 ft. New York state currently classifies Ninemile Creek's lower reaches as Class C waters.

Although the relative inaccessibility of most of the lower reaches of Geddes Brook and Ninemile Creek would result in limited exposure, it is conceivable that recreational visitors might come into contact with COCs in the tributaries or in floodplain soils. Thus, a recreational scenario was selected as a conservative means of estimating future exposures and risks. Residential and industrial or construction scenarios will not be evaluated.

Data collected prior to 1998 and data collected during the remedial investigation will be used to further characterize the exposure setting, including aspects of the physical setting, such as climate, vegetation, soil type, and surface water hydrology, that are relevant to the baseline risk assessment.

4.3.2 Potential Exposure Pathways

An exposure pathway is defined as the path a substance takes from the exposure medium to contact and absorption by an individual (i.e., a receptor). For actual or potential exposures to be present, the exposure pathway must be complete. Exposure pathways are considered to be complete when they have COCs in an exposure medium (e.g., soil), a contact point, and a route of exposure (e.g., soil ingestion). COCs in site media are not expected to pose hazards to receptors at the site unless the pathways for those media are complete.

The affected media to be considered in this evaluation are water, sediments, floodplain soils, and fishes in Geddes Brook and Ninemile Creek. People may come into contact with affected sediments, floodplain soil, and water via ingestion and dermal contact. People may also consume fishes caught in Geddes Brook and Ninemile Creek. Data from the remedial investigation will be used to clarify pathways and to evaluate the relative contributions of various pathways to total exposures. Data available to date indicate that mercury and methylmercury are COCs in sediments, surface water and fish. PCBs are also COCs in fish (no historic fish data for other parameters were available). Thus, the following sections describe methods proposed to quantify exposure to COCs in sediments, floodplain soils, surface water, and fishes. If COCs are identified in additional media, the means to evaluate exposure will be discussed with NYSDEC.

4.3.3 Quantify Exposure

In this section, substance intake rates will be estimated for the exposure pathways identified in the previous section. Substance intakes are based on estimates of exposure concentrations at the exposure point (i.e., exposure point concentrations) and on the estimated magnitude of exposure to chemical-containing media. Exposure estimates for ingestion, termed chronic daily intakes (CDIs), are defined as the mass of a substance taken into the body, per unit of body weight, per unit of time. For dermal contact, exposures are expressed as absorbed dose rather than administered dose. CDIs will be calculated using methods described in U.S. EPA (1989a) to derive estimates for the typical case (U.S. EPA 1992b) and for the reasonable maximum exposure (RME) case, which is described by EPA as the highest exposure that is reasonably expected to occur at a site (U.S. EPA 1989a). The following sections and Tables 4-6 through 4-8 provide proposed exposure algorithms and assumptions to be used to calculate CDIs for fish consumption (Table 4-6), sediment ingestion (Table 4-7) and sediment dermal absorption (Table 4-8). Risks from exposure to water and floodplain soils will similarly be quantified in the HHRA using appropriate algorithms and exposure parameters.

4.3.3.1 General Exposure Factors

The averaging time used to determine a CDI is used in all exposure algorithms and depends on the type of toxic effect being assessed. For assessing carcinogenic effects, CDIs are calculated by averaging the total cumulative dose over a lifetime. The estimate of the average lifespan is assumed to be 70 years, based on U.S. EPA (1991a) guidance. More recent USEPA guidance recommends use of 75 years for the average value for life expectancy (USEPA, 1997b). The 70 year value will be used, however, since some of the cancer slope factors and unit risks are derived based on a 70 year lifetime; the difference (error) between the two values is low; and for consistency among risk assessments. For assessing noncancer effects, CDIs are calculated by averaging intakes only over the period of exposure. The distinction between these two approaches is based on EPA's currently held opinion that the toxicological mechanisms of action are different for carcinogenic and noncarcinogenic processes.

The exposure point concentration, or the concentration term in the exposure equation, is meant to reflect a representative concentration at the exposure point or points over the exposure period (U.S. EPA 1989a). Consistent with EPA guidance, the exposure point concentration for the RME exposure scenario, will be either the 95th percentile upper confidence limit on the arithmetic mean concentration or the maximum detected concentration (whichever is lower), while average concentrations will be used to quantify the typical scenario. In accordance with RAGS guidance, non-detected values of COCs which are being quantitatively evaluated will be set to one-half the sample-specific quantitation limit for the purpose of establishing data distribution type (i.e., normal *vs* lognormal) and exposure point concentrations.

4.3.3.2 Exposure Frequency and Duration

Exposure frequency is an estimate of the number of times or days per year that an exposure takes place. The specific exposure frequencies for each of the exposure pathways are discussed with the specific pathways. Exposure duration is the number of years that exposure may take place. In the absence of site-specific data, U.S. EPA (1989a, 1991a) directs risk assessors to use the 95th percentile value as a reasonable and conservative estimate of exposure duration. Typical default values for mean and upper-bound exposure duration used in risk assessments are 9 years (50th percentile) and 30 years (90th percentile), respectively (U.S. EPA 1989b, 1991a).

U.S. EPA risk assessment guidance (1989a, 1991a) defines exposure duration as a reasonably conservative estimate of the time during which the receptor is potentially exposed to a contaminant. In this risk assessment, the exposure duration of concern is the length of time that a potential receptor resides near Onondaga Lake and engages in recreational activities at the lake (i.e., fishing or otherwise visiting the lake and tributaries). The USEPA default 95th percentile value of 30 years will be used for the RME value, since there is insufficient site-specific data to support use of a site-specific value. For the average exposure duration, the EPA standard default value of 9 years is proposed.

4.3.3.3 Fish Consumption

The total daily fish consumption rates used in the assessment for the lake are proposed for use here, but are combined with a lower fractional intake to account for the amount of time individuals might catch fish from the limited affected areas within the tributaries. For the risk assessment for Onondaga Lake (Exponent 1998b, in prep.), NYSDEC recommended a value of 25 g/day for the RME scenario based on the 95th percentile recreational angler consumption (USEPA, 1997b); this value will also be used for Geddes Brook/Ninemile Creek, but with the lower fractional intake as discussed below. The "typical" or central tendency consumption rate will be 6.6 g/day, based on the average consumption of freshwater/estuarine fish for the general population (USEPA, 1997b). In addition, the possibility of subsistence fishing will be considered in the risk assessment for Geddes Brook/Ninemile Creek, as well as for the ongoing Onondaga Lake HHRA.

A second major component of fish consumption rates is the fractional intake, or the percentage of consumption rate that may originate from the affected area. Studies of New York anglers indicate that 63 percent of anglers fish in more than two locations and at least 39 percent of anglers fish in three or more locations (Connelly et al. 1990, 1992; Connelly 1995, pers. comm.). In addition, fractional intakes of 10 percent and 25 percent were used in a recent risk assessment conducted on the Buffalo River (U.S. EPA 1993). In consideration of these data, the risk assessment for Onondaga Lake used a fractional intake of 0.30 for the typical scenario. This fractional intake is based on the Connelly (1995, pers. comm.) data that indicated that at least 39 percent of the anglers in the New York survey fished in at least three water bodies. A RME fractional intake value of 1 was selected as a conservative assumption for the Lake, reflecting the possibility that some Syracuse residents may consume sport-caught fishes only from Onondaga Lake. The Connelly et al. (1990, 1992) data showed that about 30 percent of New York anglers responded that they fish in only one location.

Consumption of fish from Geddes Brook and Ninemile Creek would be substantially lower than those from Onondaga Lake because the streams are much smaller than Onondaga Lake, support less fish, and are less accessible than the lake. For these reasons, in this risk assessment, fish consumption rates used in the Onondaga Lake risk assessment will be used but will be combined with lower fractional intake estimates. Specifically, for the typical scenario, a fractional intake of 0.1 is proposed. For the RME scenario, a fractional intake of 0.3 is proposed. A summary of the exposure assumptions for fish consumption for both the typical and RME scenarios is provided in Table 4-6.

4.3.3.4 Incidental Ingestion of Surface Sediment

The most likely receptor populations for the tributaries are adults and older children (>6 years). Only older children or adults are likely to frequent the tributaries for walking along the banks, wading, and fishing. Young children are not expected to visit the tributaries because of limited access in these areas. There are no public beaches along the tributaries, and access is restricted in the various tributaries by freeways, industrial sites, and heavy undergrowth. People visiting the tributaries may ingest surface sediment as a result of direct contact with sediment on the hands, followed by hand-to-mouth activity (either inadvertent or associated with eating or smoking).

Incidential soil ingestion is more appropriately viewed by event rather than on a daily basis. Therefore, a fractional intake estimate of 1.0 should be used. This fractional intake rate would then be applied to soil ingestion rates identified by EPA. Consistent with EPA guidance, the mean value for adults, of 50 mg/day, is proposed for use in the typical scenario (U.S. EPA 1997b). U.S. EPA (1997b) does not provide an upper-bound value for adults. However, U.S. EPA (1991a) has identified 100 mg/day as an upper-bound intake rate. Therefore this value was used as the intake rate for older children and adults for the typical and RME scenarios.

The human health risk assessment assumes that contact with surface sediments can occur year-round, although cold weather will likely limit visits to the area to the months of May through September. Older children are assumed to consume as much sediment as adults, yet have a shorter exposure duration (i.e., 15 years from the ages of 6–21 in comparison with the assumption that adults might visit the area over 30-year period of living nearby). Thus, exposure estimates for the tributaries for the RME scenario are calculated for adults only. The typical exposure scenario is evaluated based on an older child with a body weight of 49 kg who might visit the lower tributaries for a period of 9 years. Use of these exposure assumptions would provide maximum exposure estimates for adults and children. Table 4-7 presents the exposure algorithm for ingestion of nearshore and tributary surface sediments.

Visits to the tributaries are expected to be infrequent because of limited access (e.g., due to phragmites vegetation), heavy industrial and commercial development, and cold weather. The proposed exposure frequency is for the typical scenario is one visit per month for the months of May through September, or a total of five visits per year. For an upper-bound value, the proposed frequency is 1 visit per week for the three summer months and 1 visit per month for 2 additional months in spring and fall, for a total of about 14 visits per year.

4.3.3.5 Dermal Contact with Surface Sediment

Dermal exposure is expressed as an absorbed dose by incorporating a chemical-specific absorption factor into the exposure equation. Absorption factors reflect the desorption of the chemical from soil and the absorption of the chemical across the skin and into the bloodstream (U.S. EPA 1989b). Dermal absorption values for any COCs identified will be consistent with current USEPA Region II recommendations, as listed below:

- Arsenic - 3%
- Cadmium - 0.1%
- Generic default for other inorganics - 1%
- VOCs - no recommended factors; address qualitatively only.
- PAHs (benzo(a)pyrene) - 13%
- Pentachlorophenol - 25%
- Generic default for other SVOCs - 10%
- Chlordane - 4%
- DDT - 3%

- Generic default for other pesticides - none; address qualitatively only
- PCBs (Aroclors 1242 and 1254) - 14%
- 2,3,7,8-TCDD (dioxin) - 3% for soil $<10\%$ TOC; 0.1% for soil $\geq 10\%$ TOC

Dermal exposures result in an estimate of absorbed dose, not the amount of substance that comes in contact with the skin (i.e., intake). Because oral toxicity values (i.e., carcinogenic slope factors [CSFs] and reference doses [RfDs]) are usually expressed as intakes, they must be adjusted with oral adjustment factors to obtain reference toxicity values expressed as absorbed dose. Any adjustments needed to account for oral exposure will be described in the risk assessment.

Surface area reflects the amount of skin exposed to a contaminant in the exposure scenario. For an adult contact with outdoor soil exposure, U.S. EPA (1997b) recommends using 5,000 cm^2 as a central tendency estimate and 5,800 cm^2 for an upper-bound estimate. These values represent 25 percent of the total body surface area for adults. Further, they recommend deriving similar estimates for children by multiplying the 50th and 95th percentiles total body surface areas from Tables 6-6 and 6-7 (of U.S. EPA 1997b) by 0.25 for the ages of interest. Thus, it is proposed that risk estimates will be based on an the assumption that 25 percent of the receptors total body surface area might potentially come into contact with COCs in sediment. This results in typical and upper-bound surface area estimates of 3,600 cm^2 and 4,400 cm^2 for children aged 9<18.

The soil-to-skin adherence factor refers to the amount of soil that remains deposited on the skin after contact. Adherence factors vary by soil type, (e.g., moisture content, particle size), by the body part coming in contact with the soil, and by the activity being conducted while in contact with the soil. U.S. EPA (1989b) reports that adherence factors for sandy sediments are likely to be less than for soils because contact with water may wash the sediment off the skin. Based on U.S. EPA's latest guidance, adherence factors for adults were assumed to be 0.15 mg/cm^2 (typical) and 0.3 mg/cm^2 (RME). The adherence factors for children were assumed to be 0.2 mg/cm^2 (typical) and 2.7 mg/cm^2 (RME). The typical adherence factors reflect the average adherence factor reported by U.S. EPA (1997b) for soccer players, groundskeepers, landscapers/rockery installers, irrigation installers, gardeners, rugby players, archeologists, and reed gatherers. When multiple values were reported for the same activity (i.e., three values were provided for soccer players and five for groundskeepers), the values for each activity were averaged first before being averaged across activities. The adult RME adherence factor is based on a 50th percentile for reed gatherers. The children typical and RME adherence factors reflect children playing in wet soil, which is relevant for children for this study (younger than 18 years). Dermal adherence factors used in the quantitative risk assessment will be modified as necessary to reflect documentable USEPA policy at the time the HHRA is performed. The receptors, exposure duration, and frequency are the same as stated for the sediment ingestion scenario. Table 4-8 presents the exposure algorithm for dermal contact with surface sediment.

4.4 TOXICITY ASSESSMENT

The purpose of a toxicity assessment is to evaluate the potential for COCs to cause adverse health effects in exposed persons and to define, as thoroughly as possible, the relationship between the extent of exposure to a hazardous substance and the likelihood and severity of any adverse health effects. The standard procedure for a toxicity assessment is to identify toxicity values for carcinogenic and noncarcinogenic effects and to summarize other relevant toxicity information.

EPA-derived toxicity values used in risk assessments are termed CSFs and RfDs. CSFs are used to estimate the incremental lifetime risk of developing cancer corresponding to CDIs calculated in the exposure assessment. The potential for noncarcinogenic health effects is typically evaluated by comparing estimated daily intakes with RfDs, which represent daily intakes at which no adverse effects are expected to occur over a lifetime of exposure. Both CSFs and RfDs are specific to the route of exposure (e.g., ingestion [oral] exposure). Currently, there are no CSFs or RfDs for dermal exposure; therefore, oral absorption factors were used to adjust CSFs and RfDs to assess dermal exposure.

As indicated in *Risk Assessment Guidance for Superfund* (U.S. EPA 1989a), the primary source for EPA-derived toxicity values is EPA's Integrated Risk Information System (IRIS) (U.S. EPA 1998). This computerized database contains verified toxicity values in addition to up-to-date health risk and EPA regulatory information for many substances commonly detected at hazardous waste sites. EPA's health effects assessment summary tables (HEAST) (U.S. EPA 1997c), which are updated quarterly, also provide EPA-derived toxicity values that may or may not be verified at the time of publication. The most current sources of toxicity information including IRIS, HEAST and the National Center for Environmental Assessment (NCEA) will be used when the HHRA is performed.

Substances identified as COCs to date, based on data collected prior to 1998 (see Tables 4-1 through 4-5), include arsenic and manganese (Geddes Brook and Ninemile Creek sediment); mercury (including methylmercury) (fish tissue; and sediment and surface water in Geddes Brook and Ninemile Creek); aluminum and benzo(a)pyrene (Ninemile Creek sediment); PCBs (fish tissue); chloroform, cadmium and chromium (surface water in Ninemile Creek); bromo-dichloro-methane, a-chlordane, chloroform and trichloroethene (surface water in Geddes Brook); and lead and manganese (Geddes Brook and Ninemile Creek surface water). Toxicity values for all COCs identified in the review of data will be provided in tables. Toxicity profiles, which summarize toxicity information and EPA's derivation of oral toxicity values for the COCs, will be prepared for COCs contributing substantially to risk estimates. The human health screening and associated list of COCs will be updated using data collected during this Remedial Investigation (1998).

Risk estimates for methylmercury will be based on EPA's RfD of 0.0001 mg/kg-day, which was derived based on data from a Iraqi population consuming mercury treated grain.

EPA has not developed any toxicity values for dermal exposure. EPA suggests, however, that dermal toxicity values may be derived from oral toxicity values for substances with systemic effects that are not dependent on route of administration (U.S. EPA 1989a). In deriving such values, consistency is required between the type of dose that forms the basis of the oral toxicity value and the type of dose that will be calculated by the dermal exposure models. Specifically, a distinction must be made between an administered dose or intake (i.e., the amount of chemical taken into the body) and the absorbed dose (i.e., the amount of chemical that crosses body membranes and enters the blood stream).

Typically, oral toxicity values and CDIs for oral exposure are based on administered doses (or intakes); therefore, usually no adjustments are necessary to calculate risk estimates for oral exposures. However, because dermal exposures are usually expressed in terms of absorbed doses, dermal toxicity values must also be based on absorbed, rather than administered, doses (U.S. EPA 1989a). To derive a dermal toxicity value for absorbed dose from an oral toxicity value based on administered dose, the oral toxicity value is adjusted by an estimate of the fractional oral absorption (i.e., the CSF is divided by the oral absorption factor or the RfD is multiplied by the oral absorption factor). The oral absorption values assumed in the human health risk assessment will be described for any COCs that may be dermally absorbed.

As per the recommendation of USEPA Region II, benzo(a)pyrene will be included in the quantitative assessment for dermal absorption.

4.5 HUMAN HEALTH RISK CHARACTERIZATION

The objective of risk characterization is to calculate numerical expressions of risk and to present explanatory text that interprets and qualifies risk estimates. Risk characterization methods provided by U.S. EPA (1989a) will be used to derive risk estimates. For carcinogenic health effects, estimated risks are expressed as the additional (incremental) chance of developing cancer following a lifetime of exposure to the COCs at the levels assumed in the risk calculations (e.g., an example of a carcinogenic risk estimate might be a one-in-one-million chance of developing cancer). For noncarcinogenic health effects and ecological effects, risk estimates are expressed as the ratio between the estimated average daily exposure level and the reference toxicity value, which has been set to reflect a safe intake rate with a margin of protection. Where this ratio (also known as the hazard quotient) is less than 1, the estimated exposure is less than the toxicity value.

Risk estimates will be presented in tables and in text and will be compared with acceptable risk levels identified in the National Contingency Plan (i.e., a risk range from 1×10^{-6} to 1×10^{-4} for carcinogens and a hazard index of below 1 for noncarcinogenic effects).

4.5.1 Uncertainty Assessment

Because risk characterization serves as a bridge between risk assessment and risk management, it is important that major assumptions, scientific judgments, and estimates of uncertainties be described in the assessment. The baseline risk assessment will, given knowledge of the models used, qualitatively evaluate the potential influence of uncertainties on the final risk estimates. These evaluations will be presented in tables and, where applicable, in graphs. In this review, the magnitude of the uncertainty associated with assumptions used in the exposure assessment will be evaluated and a determination will be made as to whether uncertainties are likely to overestimate or underestimate risks predicted by the baseline risk assessment. The risk assessment will provide a complete discussion of uncertainties related to risk assessment methods required by EPA as well as site-specific uncertainties.

5. **WORK PLAN RATIONALE** (contained in 1st Determination)

6. **SAMPLING AND ANALYSIS PLAN** (contained in 1st Determination)

7. PREPARATION OF REMEDIAL INVESTIGATION, HUMAN HEALTH RISK ASSESSEMENT AND ECOLOGICAL RISK ASSESSMENT REPORTS

As part of the remedial investigation portion of the remedial program for this site, three separate reports will be prepared. The three reports will consist of a remedial investigation report, human health risk assessment report and ecological risk assessment report. The analytical data for water, sediment, floodplain soil, and fish samples will be included in the Remedial Investigation Report. Results of the sediment toxicity tests, benthic macroinvertebrate survey, and fish assemblage determination will be included in the Ecological Risk Assessment Report.

In addition, Honeywell will generate, in consultation with the NYSDEC, a document which details the completion of FWIA Step 1 and Steps 1 through 4 of ERAGS. The FWIA/ERAGS document will include information contained in this Work Plan, as well as additional information as necessary, and will be submitted to the NYSDEC prior to the submission of the draft Geddes Brook/Ninemile Creek Remedial Investigation or Ecological Risk Assessment Reports. After receipt and review of the interim FWIA/ERAGS report, which will include an update of the screening using the 1998 data, among other items required in ERAGS Steps 1 through 4 and FWIA Step 1, NYSDEC will meet with Honeywell to discuss any comments that the NYSDEC may have. The meeting will represent a scientific management decision point (SMDP) in the Ecological Risk Assessment process.

8. FEASIBILITY STUDY

8.1 REMEDIAL ALTERNATIVES DEVELOPMENT AND SCREENING (TASK 1)

The primary objective of this phase of the feasibility study is to develop a range of remedial action alternatives that will be analyzed more fully in the detailed analysis phase of the feasibility study. The development and preliminary screening of remedial action alternatives in Task 1 will be followed, if appropriate, by treatability studies in Task 2 and detailed analysis of alternatives in Task 3. The specific scope of the analyses in Tasks 2 and 3 will be determined after the site characterization and human health and ecological baseline risk assessments are completed.

The development and screening of remedial alternatives will include the following tasks:

- Develop remedial action objectives (RAOs)
- Develop general response actions
- Determine areas and volumes subject to remediation
- Identify and screen remedial technologies and process options
- Assemble and screen alternatives.

These tasks are described in the following sections

8.1.1 Development of Remedial Action Objectives

According to U.S. EPA (1988b), RAOs "consist of medium-specific or operable unit-specific goals for protecting human health and the environment." Often, the discussion of goals, objectives, and cleanup levels is confused by a lack of clear definition of terms. The following terms have been found useful in other studies of contaminated aquatic sediments (e.g., Tetra Tech 1988) and are therefore defined for this feasibility study:

- **Study Goal** - A goal is a conceptual target condition. The primary goal of the Geddes Brook/Ninemile Creek RI/FS is to develop a remedy that is protective of human health and the environment (e.g., absence of significant health risk and adverse effects on biological resources).
- **Remedial Action Objective** - An RAO is a discrete and measurable target condition for the project, measurable in terms of a specific human health risk

and/or environmental effects level (e.g., mercury concentrations in fish < 1 mg/kg or absence of sediment toxicity to benthic macroinvertebrates).

- **Cleanup Level** - A cleanup level is a negotiated or estimated trigger level for active cleanup. Cleanup levels are designed to meet RAOs in a reasonable time frame and are based primarily on an assessment of net environmental benefits.

RAOs will be developed for all media of primary interest (i.e., water, sediments, and biota). Where appropriate, media may be divided into subunits. Media subunits may be defined by physical, chemical, or resource-related differences, or by their function as sources or receptors. Lake and tributary sediments are of central interest because these sediments can be an important source of substances to the water column and biota.

To develop RAOs for a site, EPA requires that the following factors be considered for each medium (U.S. EPA 1988b):

- Exposure analyses conducted in the baseline human health risk assessment should address all possible routes of exposure.

- Human health and environmental effects should be considered.

- Any identified carcinogenic compound and their sum should not exceed a human health risk of 10^{-4} to 10^{-6}.

- All identified noncarcinogenic compounds and their sum should not exceed a hazard index of 1 or a compound-specific ARAR action level.

The development of RAOs for media of primary concern will be based on available ARARs. The RAOs may be modified using the results of the human health and ecological risk assessments.

Source control, natural recovery, and sensitive resources will be considered in the development of appropriate cleanup levels.

8.1.2 Development of General Response Actions

General response actions describe those actions that will satisfy the RAOs. Response actions, technologies, and remedial alternatives will be developed for media of concern (i.e., tributary water, sediments, floodplain soils and biota).
General response actions may include some combination of treatment, containment, excavation, extraction, disposal, and institutional actions. For all media, any removal technology will be accompanied by a subsequent containment, treatment, and/or disposal technology for the removed material. In addition, the no-action alternative will

be retained for all media under evaluation. Some general response actions for media of primary interest include the following:

- **Tributary Sediments/Floodplain Soils** - For this medium, possible technologies include complete or partial containment, in situ treatment, and removal. There are several secondary technologies for the remediation of the removed sediments/soils. These technologies include containment, treatment, and/or disposal. Thus, the preliminary screening of remedial alternatives will be critical in reducing the number of technologies to be retained for further evaluation. For example, if a sediment removal technology is retained as a possible alternative, treatability studies may be required to evaluate treatment technologies for the removed material. However, if the sediment removal alternative is "screened out," treatability studies may not be required.

- **Tributary Water** - Water contamination is likely due primarily to continuing substance loadings from tributaries and sources, groundwater infiltration, and sediments. However, it is unlikely that there will be an extensive development of remedial alternatives for remediation of water. The remediation of water would be accomplished indirectly through remediation of the sediments, if appropriate, and through the satisfactory reduction or elimination of continuing sources of substances. If necessary, appropriate technologies for the direct remediation of the water column will be evaluated.

8.1.3 Determination of Areas or Volumes Subject to Remediation

The area or volume of material that could be subjected to remediation will be determined for each medium of interest and will be based on RAOs. This determination will be performed relatively early in the development of alternatives because, for many technology types and process options, the feasibility of implementing these options (termed "implementability") is highly dependent on the volume of material to which they are applied. The concentrations of substances will be assessed concurrently because they can also influence the assessment of implementability.

The determination of areas and volumes that could be subject to remediation will include considering exposure concentrations, exposure routes, site conditions (e.g., physical constraints or obstacles and water depth), concentration gradients (e.g., presence of hot spots), and cross-media effects. Estimates of the areas or volumes subject to remediation may be refined during the process of developing and evaluating alternatives as new information becomes available. For example, to account for interactions among media, response actions for areas or volumes are often refined after sitewide alternatives have been assembled.

For areas containing a variety of different substances, the determination of areas and volumes subject to remedial action may be developed from indicator chemicals only after the State agrees that using indicator chemicals is appropriate. Indicator chemicals are defined as those chemicals that are present at concentrations that 1) pose the greatest threat to human health and the environment, 2) are the most persistent, and 3) are uniquely associated with a source or source type. More than one indicator chemical may be used to delineate cleanup volumes and areas.

8.1.4 Identification and Screening of Remedial Technologies and Process Options

In this step, the list of potentially applicable technology types and process options will be reduced by evaluating the options with respect to technical implementability.

"Technology types" refer to general categories of technologies such as chemical treatment and thermal destruction. "Process options" refer to specific processes within each technology type. For example, a chemical treatment technology type would include such process options as precipitation and ion exchange. This procedure is designed to be as comprehensive as practicable to ensure that every available potentially applicable treatment technology and process option is identified for evaluation in the feasibility study.

The identification of applicable remedial technologies and process options will consist of a broad evaluation of the applicable remedial technologies that are available.

Process options and entire technology types will be eliminated from further consideration on the basis of technical implementability. This screening step will rely on information obtained during site characterization and will consider the following information:

- Substance types-the co-occurrence of inorganic and organic substances may limit applicable technologies

- Substance concentrations-large volumes of low-level contamination are not amenable to treatment

- Sediment characteristics-the characteristics of sediments may affect their ability to be dredged or capped.

Subsequent to this initial screening, process options will be evaluated on the basis of the following criteria:

- Effectiveness-in terms of 1) handling estimated volumes and meeting remedial goals, 2) reducing potential human health and environmental impacts, and 3) reliability

- Implementability-in terms of technical and administrative feasibility, which at this stage is primarily institutional (i.e., ability to obtain permits for offsite actions and availability of treatment, storage, and disposal facilities)

- Cost-differences among process options within particular technology types will be evaluated.

This screening step is intended to reduce the number of process options to be used with each remedial technology. Ideally, a single representative process, or combination of processes, will accompany each remedial technology to provide a basis with which to develop performance specifications for each remedial alternative. These criteria will also be used in the preliminary screening of alternatives (Section 8.1.5).

8.1.5 Assembly and Screening of Alternatives

In assembling alternatives, general response actions and the process options chosen to represent various technology types for each medium (or operable unit) will be combined to form alternatives for the site as a whole. Each remedial alternative will include compatible remedial technologies that will be evaluated as a "system" to ensure that the overall response is protective of human health and the environment and that the technologies, are complementary when implemented in combination.

As part of the development of remedial alternatives, media and process options will be defined in greater detail. The following information will be developed for the various process options used in an alternative:

- Size and configuration of onsite extraction and treatment systems or containment structures
- Time frame in which treatment, containment, or removal goals can be achieved
- Rates of flow or treatment
- Spatial requirements for constructing treatment or containment technologies, or for staging construction material or excavated sediments
- Materials transportation distances
- Required permits for offsite actions and imposed limitations.

The preliminary screening of remedial alternatives will be based on the long- and short term aspects of three criteria: effectiveness, implementability, and cost. A detailed description of the evaluation process is described in U. S. EPA (1989c). Only those alternatives judged to be the most appropriate will be retained for further consideration and detailed analysis. The alternatives that are screened out will receive no further consideration unless additional information is obtained that warrants such action.

The no-action alternative will be retained throughout the feasibility study for all media under evaluation.

8.2 TREATABILITY STUDIES AND PILOT TESTING (TASK 2)

Treatability studies, when needed, are conducted primarily to achieve the following objectives:

- Provide sufficient data to 1) allow remedial alternatives to be fully developed and evaluated prior to performing Task 3 and 2) support the selection of a final remedial alternative
- Eliminate cost and performance uncertainties prior to performing the comparative analysis of remedial alternatives.

Treatability studies to collect data on treatment technologies identified during the alternative development process will be conducted, as appropriate, to provide additional information for evaluating technologies.

8.2.1 Determination of the Need for Treatability Studies

This task may not be performed if the initial evaluation and screening of treatment technologies indicate that treatment is not a viable process option, or if sufficient information about the proposed treatment technologies is available. The decision to conduct treatability studies will also be based on the need for data to assess the feasibility of technologies still under consideration. For example, if sediment removal or in situ treatment were deleted during preliminary alternatives screening, then further consideration of sediment treatment would not be necessary. To the extent possible, data required to assess the feasibility of technologies will be gathered during site characterization. The decision to conduct treatability studies will also weigh the time and cost to perform the investigation against the potential value of the information in resolving uncertainties associated with selection of remedial action. If appropriate, treatability studies for the Geddes Brook/Ninemile Creek feasibility study will focus on areas where substances are highly concentrated.

8.2.2 Performance of Treatability Studies

The implementation of any treatability studies will follow the general guidelines set forth by USEPA Guidance (U.S. EPA 1988b). The studies will consist of the following steps:

- Identification of DQOs for the treatability studies
- Design of treatability tests and determination of data requirements
- Review of existing technical process data for potentially applicable technologies
- Collection of representative samples for each treatability test
- Performance of treatability tests to determine appropriate parameters, sizing, and cost
- Evaluation of treatability test results to ensure that the previously identified DQOs were achieved.

8.2.2.1 Treatability Study Work Plan

Prior to the implementation of any treatability study tests, a treatability study work plan will be prepared. This work plan will outline the treatability testing planned for each medium and will describe the type of testing to be performed (i.e., laboratory, benchscale, and/or pilot-scale). This will enable each treatability test to be conducted in a complete, well-organized, timely, and cost-effective manner.

8.2.2.2 Laboratory Screening

Any laboratory screening will consist of simple laboratory experiments, such as batch reactions, compatibility analyses, and catalyst enhancements.

8.2.2.3 Bench-Scale Testing

Any bench-scale testing will either be performed in a laboratory or onsite to collect performance data for the treatment technologies under evaluation. These tests will mainly consist of batch processes for which the treatment parameters are varied sequentially to evaluate a range of treatment scenarios. In accordance with the USEPA Guidance (U.S. EPA 1988b), any bench-scale testing will consist of an analysis of the following:

- Effectiveness of the treatment technology on the particular medium under evaluation

1.1 OVERVIEW OF APPROACH

The Geddes Brook/Ninemile Creek Work Plan responds to the need for: 1) data on the concentration and distribution of contaminants as defined by the U.S. Environmental Protection Agency's (EPA's) Comprehensive Environmental Response, Compensation and Liability Act of 1980 guidance (U.S. EPA 1988b), 2) an ecological risk assessment that reflects both the New York State Department of Environmental Conservation's (NYSDEC's) guidelines for conducting fish and wildlife impact analyses (FWIAs) for inactive hazardous waste sites (NYSDEC 1994a) and EPA's guidelines for conducting ecological risk assessments at Superfund sites (U.S. EPA 1997a), and 3) a human health risk assessment. The risk assessments performed for the Geddes Brook/Ninemile Creek system will be consistent with those being performed for the Onondaga Lake Remedial Investigation.

This Work Plan addresses scoping of the remedial investigation (i.e., collection and analysis of data collected prior to 1998 and identification of data needs) (U.S. EPA 1988b), Step 1 (partially) of a FWIA (NYSDEC 1994a), and Steps 1 through 4 (partially) of a Superfund ecological risk assessment (U.S. EPA 1997a, ERAGS). In an effort to expedite the Geddes Brook/Ninemile Creek RI/FS process, and since the sampling program discussed in the 1st determination has been completed, this Work Plan does not provide an exhaustive discussion relating to the completion of FWIA Step 1 and Steps 1 through 4 of ERAGS. Honeywell will generate, in consultation with the NYSDEC, a document which details the completion of FWIA Step 1 and Steps 1 through 4 of ERAGS. The FWIA/ERAGS document will include information contained in this Work Plan, as well as additional information as necessary, and will be submitted to the NYSDEC prior to the submission of the draft Geddes Brook/Ninemile Creek Remedial Investigation or Ecological Risk Assessment Reports. After receipt and review of the interim FWIA/ERAGS report, which will include an update of the screening using the 1998 data, among other items required in ERAGS Steps 1 through 4 and FWIA Step 1, NYSDEC will meet with Honeywell as proposed in its letter to NYSDEC dated February 10, 2000. The meeting will represent a scientific management decision point (SMDP) in the Ecological Risk Assessment process. Data acquired through the field investigation conducted as part of the site characterization effort may be used to refine various aspects of the ecological risk assessment problem formulation process (U.S. EPA 1997a).

Should Honeywell want to develop sediment quality values (SQVs) for the Geddes Brook/Ninemile Creek site for use in the RI/FS process, a separate interim report on this subject should be submitted for review and discussion prior to submittal of the draft RI and ERA reports.

1.2 Work Plan Overview

The remainder of this work plan consists of five sections:

- *Site Characterization* (Section 2) discusses the environmental setting of the site, including history and physical characteristics. The description of site background and setting is suggested for a remedial investigation and feasibility study (RI/FS) work plan (U.S. EPA 1988b).
- *Ecological Risk Assessment* (Section 3) discusses screening-level problem formulation and ecological effects evaluation, screening-level exposure estimate and risk calculation, baseline risk assessment problem formulation, methodology for ecological risk characterization and Step 1 of FWIA. The section on risk characterization describes how the results of the field investigation and review of data collected prior to 1998 (i.e., measures of effects and measures of exposures) will be integrated to determine whether the potential for a significant risk is present for each assessment endpoint.
- *Human Health Risk Assessment* (Section 4) addresses the approach to be used in the baseline human health risk assessment. The section discusses identification of contaminants of concern (COCs), exposure assessment, toxicity assessment, and methodology for human health risk characterization.
- *Work Plan Rational and Sampling and Analysis Plan* (Sections 5 & 6) was finalized and is contained in the 1st Determination.
- *Remedial Investigation Report Preparation* (Section 7) describes the report that will be prepared to present the results of the field investigation and risk assessments.
- *Feasibility Study* (Section 8) describes the process by which remedial alternatives will be identified and evaluated.
- *References* (Section 9) provides a list of all references cited in this Work Plan.

Appendix A contains the results of an initial site assessment conducted during development of this work plan. Appendix B contains a checklist for ecological assessment of the site.

2. SITE CHARACTERIZATION

This section describes the history of the Geddes Brook/Ninemile Creek system, including observations from an initial site assessment conducted on December 15–16, 1997.

2.1 SITE IDENTIFICATION AND HISTORY

Geddes Brook and Ninemile Creek are located in Onondaga County, New York, on the southern end of Onondaga Lake (Figure 2-1). Geddes Brook originates in the town of Camillus and flows approximately 5 km to its confluence with the West Flume and an additional 0.5 km to Ninemile Creek on the perimeter of the New York State Fairgrounds in Solvay, New York. Geddes Brook receives surface inflow from the West Flume and from an unnamed creek that carries surface flow from the vicinity of the Onondaga County holding ponds. The West Flume flows through the former Bridge Street facility before joining Geddes Brook. The West Flume, down to Geddes Brook, is part of the Bridge Street Site. The Bridge Street facility produced chlor-alkali products and is the subject of a separate RI/FS. Geddes Brook also receives surface discharge from many areas, including residential areas and road runoff. Numerous municipal and industrial/construction and debris landfills are located east of Geddes Brook between Milton Avenue and Gerelock Road. One of these landfills (Mathews Avenue) was operated by Honeywell.

Ninemile Creek originates at Otisco Lake and flows approximately 26 km to Onondaga Lake. Ninemile Creek receives surface inflow from Beaver Meadow Brook and Geddes Brook at approximately 4.5 km and 2.1 km, respectively, upstream from Onondaga Lake. Ninemile Creek currently flows past Honeywell Waste Beds 1-8, 9-10, 11, and 12-15 (Figure 2-2). Ninemile Creek was rerouted in 1944 to facilitate construction of Waste Beds 9-10 and 11. The creek receives groundwater discharge from Waste Beds 1-8, 9-10, 11, and 12-15.

The history of Honeywell operations and the waste beds is discussed in the *Onondaga Lake RI/FS Work Plan* (PTI 1991), the *Onondaga Lake RI/FS Site History Report* (PTI 1992), and by Blasland & Bouck (1989). In brief, Waste Beds 1–6 and 7–8 were used to dispose of wastes from the manufacture of soda ash via the Solvay process from the 1920s to 1944. These waste beds were subsequently sold to New York State. Other uses were as a landfill for slag and wastewater treatment sludges from Crucible Steel and for Onondaga County Metropolitan Sewage Treatment Plant sewage sludge disposal (Waste Beds B and 5), sites for construction of parking lots for the state fair (Waste Beds 5 and 7–8), and construction of Interstate 690 (Waste Bed 7–8). From 1944 to 1986, wastes from the soda ash and related operations were disposed in Waste Beds 9–10 and 11 through 15 as described by Blasland & Bouck (1989) and BB&L (1997).

This Work Plan references the results of an initial site assessment (included as Appendix A) conducted by Exponent scientists in December 1997.

Information on land use, demographics, climate, geology, and hydrology in the Geddes Brook/Ninemile Creek area has been summarized in the *Onondaga Lake RI/FS Work Plan* (PTI 1991) and will be summarized in the Geddes Brook/Ninemile Creek RI Report.

Work items associated with FWIA Step 1, including, but not limited to, tabulation and discussion of Applicable or Relevant and Appropriate Requirements (ARARs) and to be considered (advisories, criteria or guidance)(TBCs) , preparation of wetland and drainage maps, will be submitted as part of interim FWIA/ERAGS report.

2.2 PHYSICAL CHARACTERISTICS OF THE SITE

2.2.1 Geddes Brook

Geddes Brook originates in the town of Camillus and flows north to Ninemile Creek. Downstream of West Genesee Street, Geddes Brook flows through residential areas, passes through culverts under Route 695 and Horan Road, and flows through residential and semi-rural areas, occasionally through culverts, before receiving discharge from the West Flume (approximately 550 m upstream of the confluence with Ninemile Creek). Downstream of the West Flume discharge (approximately 100 m), Geddes Brook receives discharge from an unnamed creek, which flows by the area of Waste Beds 12–15, flows through double culverts under a field adjacent to the New York State Fairgrounds, and then surfaces to flow approximately 350 m to Ninemile Creek.

The section of Geddes Brook downstream of West Genesee Street varies in width from 1 to 6 m and in depth from several centimeters in upstream reaches to almost 1 m near the confluence with Ninemile Creek. The substrate of Geddes Brook upstream of where the brook enters double culverts to flow under the field adjacent to the New York State Fairgrounds is primarily cobble and sand on a hard-packed bed, with the exception of occasional areas of sandy deposition. Just before flowing into the double culvert, large rocks are present in the stream bed and water flow is rapid. Approximately 50 m downstream of where the brook surfaces, sediment becomes fine-grained and silty, with a 2–5 cm, light-colored crust (presumably calcite) at the surface. In this downstream reach of Geddes Brook, sediment depth varies from 0.5 to 1.5 m (see Appendix A for details of sediment probing conducted in December 1997).

The State of New York has designated the lower reach of Geddes Brook as Class C water (best usage is fishing; water is suitable for fish survival and propagation) and the upper reach of Geddes Brook, above the abandoned Erie Canal (6 NYCRR Part 895), as Class C(T) (best usage is fishing; water is suitable for cold water fish species survival and propagation).

2.2.2 Ninemile Creek

Ninemile Creek flows from Otisco Lake north to Onondaga Lake. Between the Three Aqueduct Park and the dam at Amboy (just upstream of Warners Road), Ninemile Creek is approximately 6–8 m wide and flows through a rural area. The creek bed in this section has areas of hard-packed cobble and areas of silty deposition (observed on the left bank, facing downstream). A riffle area is present downstream of where the Erie Canal crosses Ninemile Creek at Aqueduct Park. The dam at Amboy presents a 1-m barrier to fish migration upstream.

Ninemile Creek is joined by Beaver Meadow Brook approximately 1.7 km downstream of the Amboy dam. A large island is located at the confluence. Sediment just downstream of the confluence appeared fine-grained along the banks. Ninemile Creek flows to the north of Waste Beds 12–15 and to the south of Waste Beds 9–10 and 11. A narrow (3–6 m wide) floodplain exists on the northern bank of much of the section adjacent to Waste Beds 9–10 and 11 and upstream of the Geddes Brook confluence. At various points, the surface sediment along the northern bank consists of a calcite crust covered with a thin layer of darker fine sediment.

Just downstream of the Geddes Brook confluence, water flow is rapid for a 50-m stretch of riffles, with large rocks and branches impeding flow. The sediment bed is mainly stone and cobbles with the exception of calcite shelves covered with greenish-brown algae located along the northern bank. The main flow is to the north of a large island and then south of two smaller islands. A riffle area exists between the two islands. On the northern side of the second and third islands, small hummocks of dry land (1 m or less in diameter) protrude out of the water to a height of about 0.5 m. Along this northern bank, a small floodplain exists and then the bank is deeply cut (to a depth of 1.5 m), presumably by the effects of high velocity storm flow.

Downstream of the islands, Ninemile Creek increases in width and decreases in velocity. The creek passes under several highway and railroad overpasses, flows alongside Waste Bed 1–6, and then discharges to Onondaga Lake. In this section, water and sediment depth increase and channeling of flow occurs within the stream bed. Near the mouth of Ninemile Creek, water depth exceeded 2.5 m and sediment depth exceeded 1.5 m in December 1997. Appendix A presents additional details on results of sediment probing in this section. The longitudinal profile of Ninemile Creek downstream of the Amboy dam is shown in Figure 2-3.

Stream flow in lower Ninemile Creek (measured at the U.S. Geological Survey [USGS] gauging station) averaged 9.32 m^3/sec in 1990 (USGS 1991). The largest contributor of flow to lower Ninemile Creek is upper Ninemile Creek, followed by Geddes Brook, Beaver Meadow Brook, and groundwater. Ninemile Creek is a "gaining stream" downstream of Beaver Meadow Brook as a result of groundwater inflow in this region (Blasland & Bouck 1989).

The State of New York has designated Beaver Meadow Brook and Ninemile Creek from Otisco Lake to Onondaga Lake as Class C water (best usage is fishing; water is suitable for fish survival and propagation). Ninemile Creek upstream of the former AlliedSignal [now Honeywell] water intake location, 0.6 miles upstream of Airport Road (6 NYCRR Part 895), is designated as class C(T) water (best usage is fishing; water is suitable for cold water fish species survival and propagation).

3. ECOLOGICAL RISK ASSESSMENT

SCREENING-LEVEL PROBLEM FORMULATION AND ECOLOGICAL EFFECTS EVALUATION

This section provides, to the extent possible with data collected prior to 1998, information required in Step 1 of a Superfund ecological risk assessment (U.S. EPA 1997a) and Step 1 of a FWIA (NYSDEC 1994a). These steps have been combined to avoid redundancy in the document. The purpose of this section is to describe the screening-level problem formulation and ecological effects evaluation based on information gathered from previous investigations and on observations made during the site visit in December 1997.

The screening-level problem formulation is based on five components: 1) the environmental setting and contaminants of concern (COCs), 2) possible transport and fate mechanisms of COCs, 3) potential receptors, 4) potential exposure routes and receptors, and 5) identification of screening ecotoxicity values used for conservative assessment of potential risk. In accordance with U.S. EPA (1997a), the screening-level problem formulation is used to identify factors related to site releases that may need to be evaluated in greater detail.

Environmental Setting and Preliminary Contaminants of Concern

Physical characteristics of the site were discussed in Section 2 of this work plan. Additional information specific to ecological risk assessment (including site maps, description of fish and wildlife resources, and description of fish and wildlife resource value as required by Step 1 of a FWIA [NYSDEC 1994a]) is discussed in this section. Data gaps are identified for areas where information is not currently available. Appendix B contains a completed checklist for ecological assessment/sampling, as required in Step 1 of a Superfund ecological risk assessment (U.S. EPA 1997a).

3.1.1.1 Site Maps

Topographical, drainage, covertype, and wetlands maps are required for Step 1 of a FWIA (NYSDEC 1994a). The topographical map for the site is shown in Figure 3-1. The limits of the site will be shown on a topographic map in the Interim FWIA/ERAGS submittal as well as in the draft BERA and will show that the site consists of the length of Geddes Brook from approximately 2,500 feet south (upstream) of its intersection with Gerelock Road down to Ninemile Creek, the length of Ninemile Creek from the Amboy

Dam down to Onondaga Lake, state and federal wetlands and floodplains adjacent to these creeks. As the data collected as part of the Geddes Brook/Ninemile Creek Remedial Investigation are evaluated, the bounds of the site may be redefined. Drainage, covertype, and wetlands maps for the site are discussed in Section 6 of this Work Plan. Maps will be prepared as required by FWIA/ERAGS guidance and will be included in the interim FWIA/ERAGS report. A covertype map for adjacent and overlapping areas is presented and discussed below.

3.1.1.2 Terrestrial Covertypes

Existing covertype for the Onondaga Lake area is presented in Figure 3-2. This map was prepared for the draft Onondaga Lake RI/FS baseline ecological risk assessment (Exponent 1998a). Areas of the site not covered by this map include Ninemile Creek upstream of Waste Bed 11 and Geddes Brook upstream of the intersection with Horan Road. Covertype determination for these areas and preparation of a covertype map for the site is included in the work discussed in Section 6 of this Work Plan. A brief description of covertype based on existing maps and the December 1997 site assessment is presented below.

Vegetation around Geddes Brook between West Genesee Street and the confluence with the West Flume primarily consists of small and large trees with some shrubby undergrowth. Stands of *Phragmites australis* (common reed) are abundant just upstream of the West Flume discharge where Geddes Brook widens and forms a pool. Emergent aquatic vegetation occurs along the banks in this area. From the confluence of the West Flume to the mouth of Geddes Brook at Ninemile Creek, the banks of Geddes Brook are overgrown with *Phragmites*.

From Three Aqueduct Park to the Amboy dam, vegetation near Ninemile Creek consists of large trees and some open fields. *Phragmites* is the dominant facultative wetland plant observed along most of the banks of Ninemile Creek downstream of the Amboy dam and on the Ninemile Creek floodplains (Appendix A). On Waste Beds 9–10 and 11, which are adjacent to Ninemile Creek in this area, pioneer grasses have become established. Cottonwood, aspen, birch, black alder, wild carrot, and *Phragmites* are also found on the waste beds.

The covertype adjacent to Ninemile Creek downstream of Waste Beds 9 -10 and 11 is palustrine with *Phragmites* along the banks. Downstream of where Interstate 690 bridges pass over the creek, the land use is undeveloped urban/industrial. Farther downstream the creek borders Waste Beds 1–6, which are also known as Lakeview Point. Lakeview Point mainly comprises calcareous waste derived from soda-ash production, although several of the waste beds here were also used as landfills for steel mill waste and sewage sludge disposal (PTI 1991). Some vegetation has colonized these waste beds, despite the poor nutrient content of the calcareous substrate (Richards 1982), forming openland communities in the early stages of succession (Van Druff and Pike 1992).

A large section of Lakeview Point serves as a parking area for the state fairgrounds and is typical of unmown roadside habitat. South of Lakeview Point are the fairgrounds themselves, surrounded by unmaintained lawn, pavement, mowed roadside, and urban structures. Several successional old fields and a stand of successional northern hardwoods lie beyond the railroad tracks south of the fairgrounds. East of this area, the terrain is covered with a mixture of urban structures, urban vacant lots, successional shrubland, and pavement.

The terminus of Ninemile Creek forms the northern edge of Lakeview Point along the shoreline of Onondaga Lake. A reedgrass/purple loosestrife community is located in this area. An inland salt marsh, considerably larger than those remaining on the east side of Onondaga Lake, lies just west of the north end of Lakeview Point to the west of Interstate 690 (Figure 3-2 Saline Lacustrine/Peatland Systems). As discussed below, this area is a NYS regulated wetland (SYW10) and also a NYS "Natural Heritage Sensitive Element."

3.1.1.3 Wetlands

Four state-regulated wetlands (SYW10, SYW14, SYW15, and SYW18) are located adjacent to the lower reaches of Geddes Brook and Ninemile Creek and additional state-regulated wetlands (CAM-21, 24, 25, 26, 29, 32, and 33) are located along Ninemile Creek. SYW10 is located on the western shore of Onondaga Lake, with the eastern portion of the wetland bordering Ninemile Creek (PTI 1991). The wetland supports emergent aquatic vegetation and deciduous trees and shrubs, and habitat diversity is moderately high (Rhodes and Alexander 1980). SYW18 lies on both sides of Geddes Brook, extending approximately 500 m upstream and downstream of the Geddes Brook confluence with Ninemile Creek. Narrow strips of floodplain were visible along reaches of both Geddes Brook and Ninemile Creek during the initial site assessment (Appendix A). The wetland (a wide expanse of *Phragmites*) extends southward, roughly covering the triangle formed by Geddes Brook and Ninemile Creek. SYW15 is located along Geddes Brook, parallel to Horan Road and SYW14, is located near the West Flume. CAM-21 is located adjacent to Waste Beds 13 and 14 between Van Buren Road (Rt. 106) and Warners Road (Rt. 63). Additional state wetlands are located farther upstream along Ninemile Creek.

As shown on US Department of the Interior National Wetland Inventory (NWI) maps, numerous federal-regulated wetlands are found near Geddes Brook, Ninemile Creek, and the waste beds. A map will be prepared showing the location and extent of all wetlands, including but not limited to, state and federal wetlands in the project areas. A federal wetland delineation will be performed, in accordance with the US Army Corps of Engineers 1987 manual for identification of wetlands, in wetland areas determined to have been impacted by Honeywell's contamination as per CERCLA guidance (USEPA, 1994).

3.1.1.4 Fish and Wildlife Resources

Fish and wildlife resources are summarized in this section based on information compiled for the Bridge Street facility remedial investigation (Gradient and Parsons 1997), the draft Onondaga Lake RI/FS baseline ecological risk assessment (Exponent 1998a), and the initial site assessment. Species identified at the Bridge Street facility and in the vicinity of Onondaga Lake are not necessarily present in the Geddes Brook/Ninemile Creek system and species that have not been identified at other sites may be present at Geddes Brook and Ninemile Creek. A comprehensive habitat evaluation (as required by Step 1 of a FWIA) is included in the work discussed in Section 6 of this Work Plan.

Birds - A list of 66 bird species observed near Onondaga Lake in the summer of 1993 is presented in Table 3-1. These species were documented by Tango (1993). Some of the more common species include cormorants, herons, ducks, swallows, blue jays, crows, robins, starlings, and sparrows. General information presented in OLEMC (1976) indicates that the waste beds near the mouth of Ninemile Creek (Waste Beds 1–6) provide nesting areas and foraging habitat for waterfowl, pheasants, owls, and hawks.

A list of 13 species of waterfowl that overwintered near Onondaga Lake between 1990 and 1994 is presented in Table 3-2. The winter surveys are conducted annually in Christmas counts (by county), and waterfowl surveys (by water body) are conducted by the New York Audubon Society. These lists will be updated as part of the work discussed in Section 6 of this Work Plan.

During the initial site assessment in December 1997, two great blue herons were identified in Ninemile Creek upstream of the confluence with Geddes Brook and another was seen at the mouth of Ninemile Creek near Onondaga Lake. Two pairs of mallard ducks were observed in Ninemile Creek downstream of the confluence with Geddes Brook.

Mammals - A list of 28 mammalian species observed near Onondaga Lake is presented in Table 3-3. The list was developed from the results of systematic live-trapping (Van Druff and Rowse 1986) and personal communications from NYSDEC staff, private contractors, and Exponent staff. The more common species include opossums, shrews, rabbits, chipmunks, woodchucks, squirrels, mice, rats, voles, muskrats, raccoons, and skunks. OLEMC (1976) indicates that the waste beds near the mouth of Ninemile Creek (Waste Bed 1–6) provide habitat for mice, moles, rabbits, raccoons, muskrats, foxes, and deer.

Signs of mammals were observed during the initial site assessment in December 1997. Numerous muskrat burrows were found in the lower reaches of Geddes Brook, and animal tracks in the snow included those of deer, squirrels, and rabbits.

Benthic Macroinvertebrates - In July of 1990, benthic macroinvertebrate communities were sampled at 24 stations in Ninemile Creek, Geddes Brook, and Beaver Meadow Brook (CDR 1991). The stations were located in Ninemile Creek (both upstream and downstream of the confluence with Geddes Brook) and in Geddes Brook (both upstream and downstream of the West Flume discharge). Soft-substrate macroinvertebrates were sampled at 9 stations using a Ponar grab sampler and included midges, amphipods, and non-tubificid and tubificid oligochaete worms.

Hard-substrate macroinvertebrates were sampled at 15 stations using a Surber sampler and included midges, amphipods, caddisflies, mayflies, and non-tubificid oligochaete worms. Nocturnally drifting invertebrates were sampled in September of 1990; midges, amphipods, caddisflies, mayflies, and non-tubificid oligochaete worms were observed. Complete taxonomic species lists are contained in the appendices of CDR (1991). A summary of these data, if used to supplement the 1998 data, will be included in the draft BERA.

Fishes - The fish assemblages in Geddes Brook and Ninemile Creek have been evaluated in two historical studies. In 1973, Finger (1982) collected fishes by electroshocking at a 100-m stretch of Ninemile Creek located 9 km downstream from the outlet of Otisco Lake, well upstream from potential influences of the Honeywell facilities. In 1990, CDR (1991), collected fishes by electroshocking and seining at multiple sites in upstream and downstream reaches of Geddes Brook and Ninemile Creek. Table 3-4 lists the fish species identified in Geddes Brook and Ninemile Creek during these studies.

Finger (1982) collected 16 fish species from the single site evaluated in Ninemile Creek. The five most abundant species (in descending order) were longnose dace, creek chub, white sucker, blacknose dace, and tessellated darter. Fish species characteristic of pool, riffle, and transition habitats were identified.

Twenty-six fish species were collected by CDR (1991). The increased spatial coverage and fishing effort used by CDR (1991) was probably partly responsible for the increased number of species collected in 1990, relative to the number collected in 1973. The five most abundant species collected by CDR (1991) (in descending order of abundance) were alewife, tessellated darter, white sucker, pumpkinseed, and bluegill. Only two of the species (central stoneroller and emerald shiner) collected by Finger (1982) were not collected by CDR (1991). Both of these species were rare in 1973. By contrast, 12 species (alewife, gizzard shad, northern pike, spotfin shiner, fathead minnow, golden redhorse, brown bullhead, banded killifish, brook stickleback, white perch, bluegill, and logperch) were collected by CDR (1991) but not by Finger (1982).

Rare, Threatened, and Endangered Species - New York State listed rare, threatened, and endangered species identified in the Onondaga Lake baseline ecological risk assessment (Exponent 1998a), may be pertinent to the Geddes Brook/Ninemile Creek area. No federally listed species were identified in the area. Among the birds observed at Onondaga Lake, the common tern (*Sterna hirundo*) and the osprey (*Pandion haliaetus*) are NYS threatened species (i.e., any native species likely to become an endangered species within the foreseeable future in New York State), and the common loon (*Gavia immer*) is a NYS species of special concern (i.e., any native species for which a welfare concern or risk of endangerment has been documented in New York State) according to Environmental Conservation Law of New York, Section 11-0535 and 6 NYCRR Part 182.

The one State-listed rare plant species found in the Geddes Brook/Ninemile Creek area is Hart's-tongue fern (*Asplenium scolopendrium* var *americanum*). Hart's tongue fern has a rank of S2, which means typically there are 6 to 20 occurrences within New York making it very vulnerable within the State (NYSDEC 1992a). Hart's-tongue fern occurs southwest of Lakeview Point.

An ecologist will consult the New York Natural Heritage Program and US Fish and Wildlife Service as discussed in Section 6 of this Work Plan to determine the current status and distribution of rare, threatened, or endangered species or significant habitats within 3.23 km (2 miles) of the site.

3.1.1.5 Fish and Wildlife Resource Values

The value of habitat to fish and wildlife and the value of fish and wildlife resources to humans in lower Geddes Brook and lower Ninemile Creek were discussed in the Bridge Street facility remedial investigation report. In summary, Geddes Brook and Ninemile Creek are suitable habitats for both warmwater and coldwater fishes. The terrestrial portion of the site is capable of supporting various species of wildlife and is close to habitat of similar value. Confirmation of habitat value to fish and wildlife is included in work discussed in Section 6 of this Work Plan. The current and/or potential value of these streams as spawning areas for the forage base in Onondaga Lake will be evaluated as part of the ecological risk assessment.

The fish resources of Geddes Brook and Ninemile Creek can potentially support a small sport fishery. Other recreational uses of the site (e.g., hiking and wildlife observation) are limited to areas that are accessible. The reach of Geddes Brook that parallels Horan Road is fairly undeveloped and is somewhat accessible by roads. Farther upstream, Geddes Brook runs through a residential/commercial area and is unlikely to be considered as a recreational area. The terminus of Ninemile Creek at Onondaga Lake is a possible area for viewing wildlife but access is limited by dense vegetation. Confirmation of fish and wildlife resource value to humans is included in the work discussed in Section 6 of this Work Plan.

3.1.1.6 Preliminary Contaminants of Concern

The preliminary COCs for Geddes Brook and Ninemile Creek were taken from the ecological risk assessment for the Bridge Street facility (NY State Revision 1998, based on Gradient and Parsons 1997). These COCs are shown in Table 3-5. Calcium and chloride are also COCs because they can enter Geddes Brook and Ninemile Creek from the waste beds. Most of the substances are of concern because of the potential for direct toxicity to aquatic organisms. Four of the substances (mercury, hexachlorobenzene, DDT, and PCBs) are of particular concern because of the potential for bioaccumulation by aquatic organisms and potential transfer to higher trophic levels of the food web (i.e., birds and mammals). These four contaminants were the only contaminants analyzed by Honeywell in biota at the Bridge Street facility due to the limited quantity of biota tissue available for analysis. Therefore, other contaminants may be of concern from a risk assessment standpoint. Calcium (calcite) is of concern because of its potential to alter sediment characteristics.

3.1.2 Transport and Fate Mechanisms of Contaminants of Concern

Primary sources of COCs to Geddes Brook are the Bridge Street facility and the West Flume. The ecological risk assessment for the Bridge Street facility (NY State Revision 1998, based on Gradient and Parsons 1997) identified the original source of substances to the West Flume as various industrial operations that historically existed at the site. Substances entered the West Flume by direct discharge, shallow groundwater, and surface runoff. Substances may continue to enter the West Flume by shallow groundwater and surface runoff. Other potential sources of COCs to Geddes Brook include the unnamed creek and numerous municipal and industrial/construction and debris landfills located east of Geddes Brook between Milton Avenue and Gerelock Road. A large portion of this area was, and still may be, owned by Honeywell. Geddes Brook is also subject to impacts associated with urbanization (e.g., channelization, runoff).

Sources of COCs to Ninemile Creek include Geddes Brook and groundwater discharges from Waste Beds 1-8, 9-10, 11, and 12-15. Like Geddes Brook, lower Ninemile Creek is subject to impacts such as channelization and runoff from Interstate 690 that are associated with urbanization.

After COCs enter Geddes Brook and Ninemile Creek, they are distributed among water, sediments, and floodplain soils of the system based on their physical and chemical characteristics. Volatile substances will partition to air while water-soluble substances will remain in water and be eventually transported to Onondaga Lake. Particle-active substances, such as mercury, will partition to suspended particles that settle to the sediment. Substances associated with particles may become resuspended during periods of high flow and move downstream or onto floodplains before settling out. Resuspension of sediments from the creek bed and, to some extent, from floodplain soils may occur during high flow events, and sediment will be transported to Onondaga Lake.

Water, sediments, and floodplain soils may become secondary sources by releasing these substances to aquatic, terrestrial, and human receptors. Substances enter biota by being adsorbed from water or sediment through the dermal layers or respiratory apparatus (this pathway applies primarily to fishes) or by being ingested with food, sediment, or water. Bioaccumulation occurs when the uptake of a chemical by an organism exceeds the depuration rate. Biomagnification of chemicals may occur as the chemical passes up two or more trophic levels and increases in the tissue concentration at each level.

- Differences in performance among competing manufacturers
- Differences in performance among alternative treatment chemicals
- Sizing requirements for future pilot-scale tests
- Screening of technologies for future pilot-scale tests
- Sizing of treatment units that may significantly affect the feasibility of implementing future pilot-scale tests or implementing the full-scale technology
- Compatibility of technical process materials with the substances under evaluation.

8.2.2.4 Pilot-Scale Testing

Any pilot-scale testing is used to simulate the physical and chemical parameters of full-scale processes. This step refines the information obtained in the bench-scale testing to more accurately reflect the actual performance of full-scale processes. Because it is likely that any pilot-scale testing would occur onsite, appropriate permits would be obtained, as necessary, prior to implementation.

Because the time and cost associated with designing, assembling, and installing pilot-scale tests may be significant, pilot-scale tests will only be performed for alternatives that have a high probability of being selected. To determine the necessity of performing a pilotscale test, the potential for enhanced performance and reduced amount of time and cost associated with the implementation of a full-scale process will be compared with the additional amount of time and cost associated with the implementation of a pilot-scale test during the RI/FS.

8.3 Detailed Analysis Of Remedial Alternatives (Task 3)

The detailed analysis of alternatives will consist of the analysis and presentation of the relevant information needed to allow decision-makers to select a site remedy. During the detailed analysis, each alternative that passed preliminary screening will be assessed against specific evaluation criteria. The results of this assessment will be arrayed to compare the alternatives and identify the key tradeoffs among them.

This detailed evaluation will rely on data collected during the remedial investigation phase of the RI/FS and on the results of any treatability studies. The results of this evaluation may serve as the basis for the preparation of a proposed plan and a record of decision.

The detailed analysis of remedial alternatives will include the following tasks:

- Define and refine alternatives
- Assemble and characterize evaluation criteria
- Conduct detailed analysis of alternatives
- Compare alternatives
- Recommend an alternative.

These tasks are described in greater detail in the following sections.

8.3.1 Definition and Refinement of Alternatives

Alternatives retained from the preliminary screening phase of the feasibility study will be further defined as necessary to allow a more accurate final evaluation. Factors such as process sizing can be refined based on the results of treatability studies. In addition, a more accurate definition of the quantities of each medium requiring treatment will be calculated based on the site characterization data collected during the remedial investigation phase of the project.

8.3.2 Assembly and Definition of Evaluation Criteria

Candidate remedial alternatives will be further refined, analyzed, and evaluated based on nine evaluation criteria (U.S. EPA 1988b). These criteria can be grouped, in order of decreasing importance, as threshold, balancing, and modifying criteria. The nine evaluation criteria are:

- Threshold criteria
    - Overall protection of human health and the environment
    - Compliance with ARARs
- Balancing criteria
    - Long-term effectiveness and permanence
    - Reduction of toxicity, mobility, and volume through treatment
    - Short-term effectiveness
    - Implementability
    - Cost
- Modifying criteria
    - Support Agency acceptance

Community acceptance.

These criteria are based upon the statutory requirements of Section 121 of CERCLA, the promulgated initiatives of the National Contingency Plan, and technical and institutional considerations that EPA has determined appropriate for a thorough remedial alternative evaluation. All candidate alternatives must satisfy threshold criteria. Balancing criteria represent the primary criteria on which the evaluation of candidate remedial alternatives is based. Modifying criteria are evaluated following public comment on the RI/FS and the Proposed Plan.

All alternatives must provide overall protection of human health and the environment and comply, to the extent feasible, with applicable regulations. The evaluation of long-term effectiveness and permanence addresses both the magnitude of residual risk embodied in the remedy and the adequacy and reliability of controls. Assessment of the potential of a remedy to reduce waste toxicity, mobility, or volume through treatment addresses the statutory preference for a permanent remedy that immobilizes or destroys problem chemicals. Short-term effectiveness measures the ability of a remedy to protect the community, workers, and the environment during remedy implementation, or until remedial objectives are met. Implementability is a measure of both the technical and administrative feasibility of constructing, operating, and maintaining a remedial action alternative. Costs include direct and indirect capital costs and operating and maintenance costs.

Prior to the detailed evaluation, criteria will be characterized in terms of the actions integral to the remedy, the physical characteristics and exposure pathways associated with hot spots, and other location-specific considerations. For example, chemical-, action-, and location-specific ARARs will be identified and assembled. Information on exposure pathways, cross-media effects, technological constraints, and physical considerations will also be assembled and described in terms of the evaluation criteria.

8.3.3 Conduct Detailed Analysis of Alternatives

The nine evaluation criteria previously listed will be used to evaluate each remedial alternative in detail. The assessment of overall protectiveness of human health and the environment will describe how each alternative achieves this goal. The evaluation of compliance with ARARs will describe how each alternative complies with chemical-, action-, and location-specific ARARs or other criteria, advisories, and guidelines.

The evaluation of candidate alternatives against the five balancing criteria is the primary basis for remedy selection. Each alternative will be analyzed individually against these criteria in a detailed narrative fashion.

Support Agency and community acceptance will be addressed during the proposed plan development and during the public comment period, respectively.

8.3.4 Comparison of Alternatives

Once the individual alternatives have been described and individually assessed, a comparative analysis will be conducted to evaluate the relative performance of each of the different alternatives against each evaluation criterion. This comparison will also be presented in narrative form, but will be summarized in simplified terms in a summary matrix. This procedure will allow an independent analysis for each criterion to aid in the selection of a final remedial action.

8.4 FEASIBILITY STUDY REPORT (TASK 4)

The feasibility study report will be submitted at the completion of the detailed analysis of remedial alternatives as part of Task 3. The feasibility study report will present the results of the Task 1 evaluations, including a review of the scientific literature of potentially applicable response actions and technologies and case history data from other sites, all of the remedial alternatives considered in the detailed analysis, the results of the preliminary screening of those alternatives, and the results of the detailed analysis of remedial alternatives. This report will follow the outline presented in *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (U.S. EPA 1988b).

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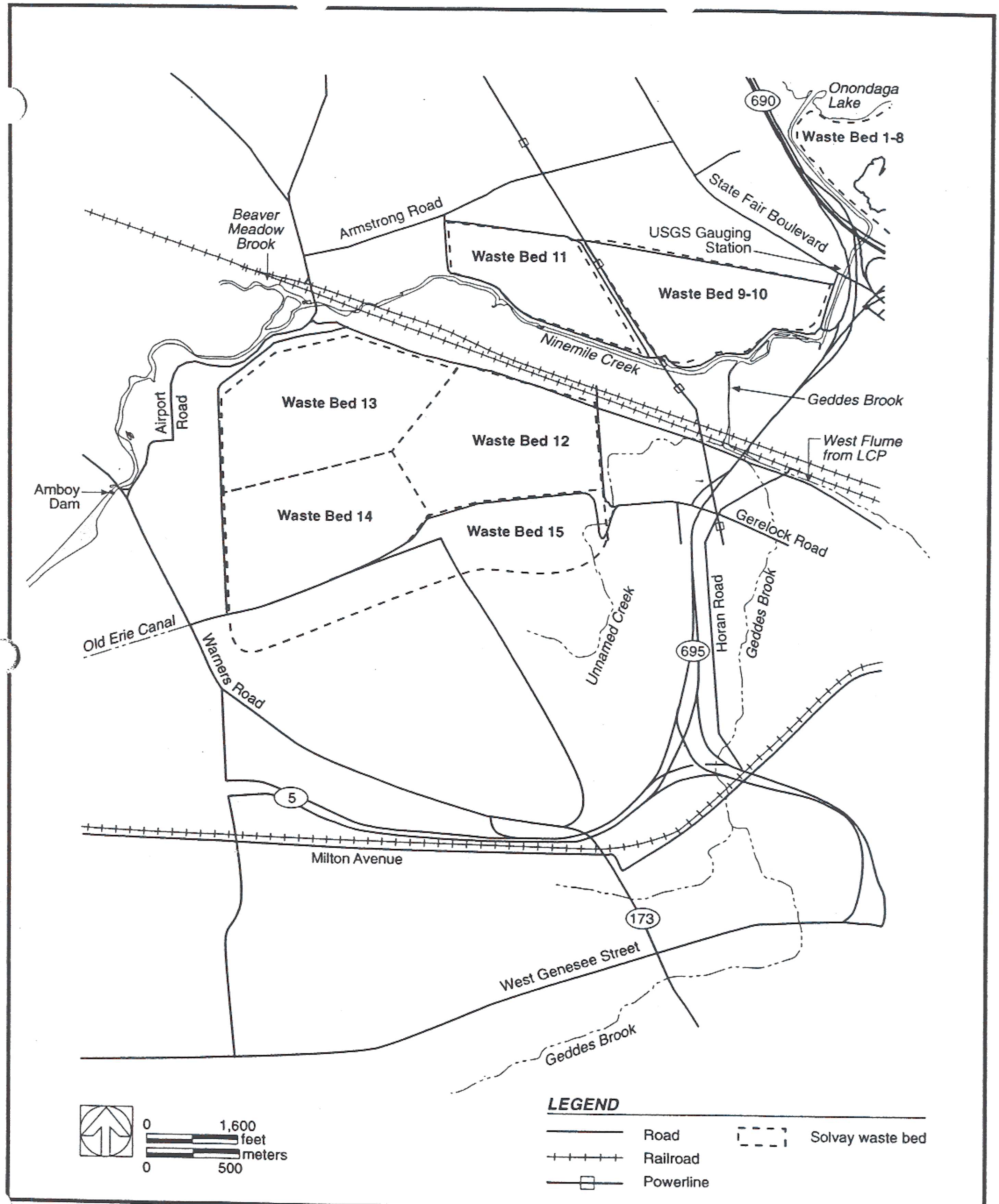

Figure 1-1. Geddes Brook and Ninemile Creek

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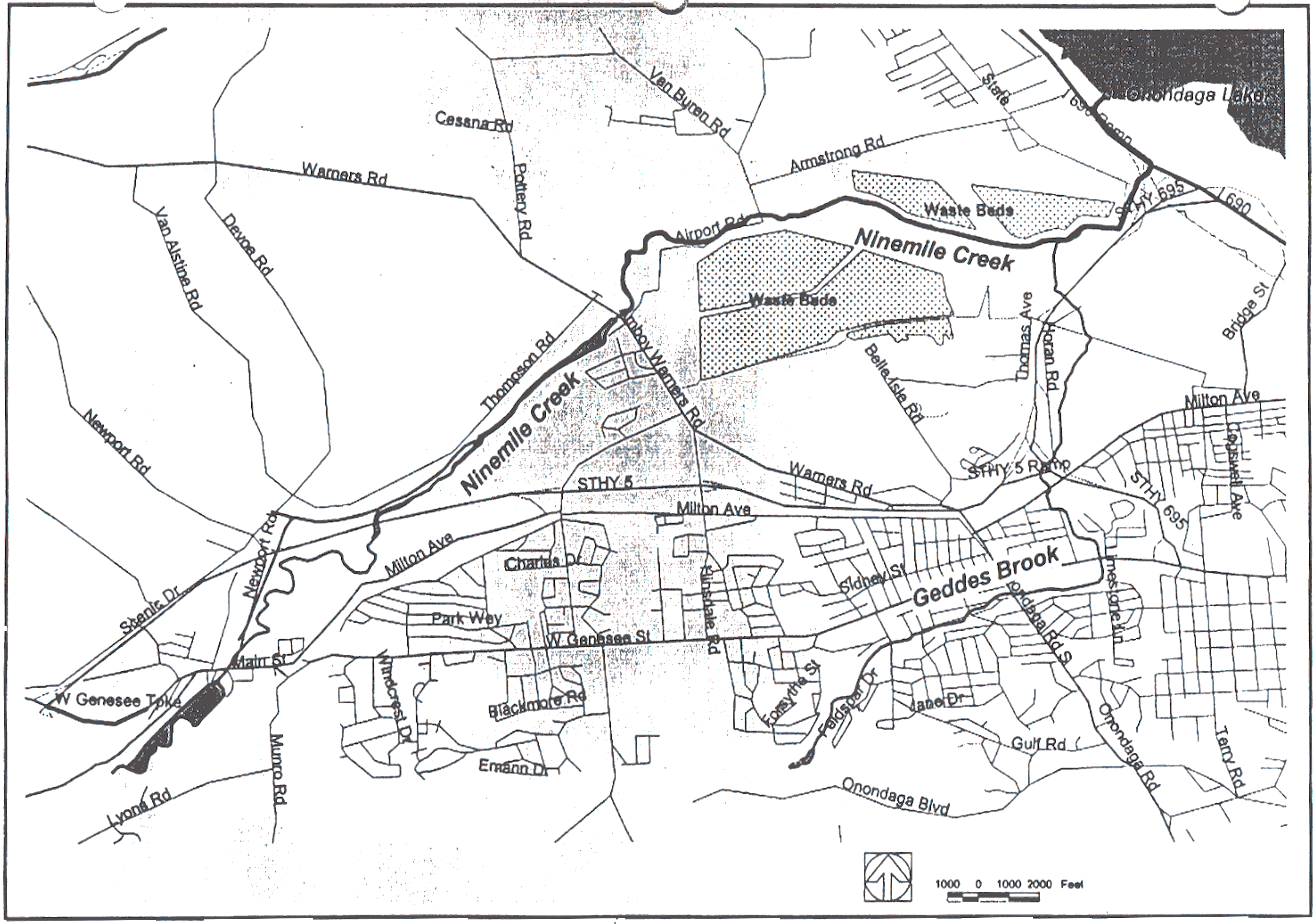


Figure 2-1. Location of Geddes Brook and Ninemile Creek.

CBCP-0301 04/09/98 GIS

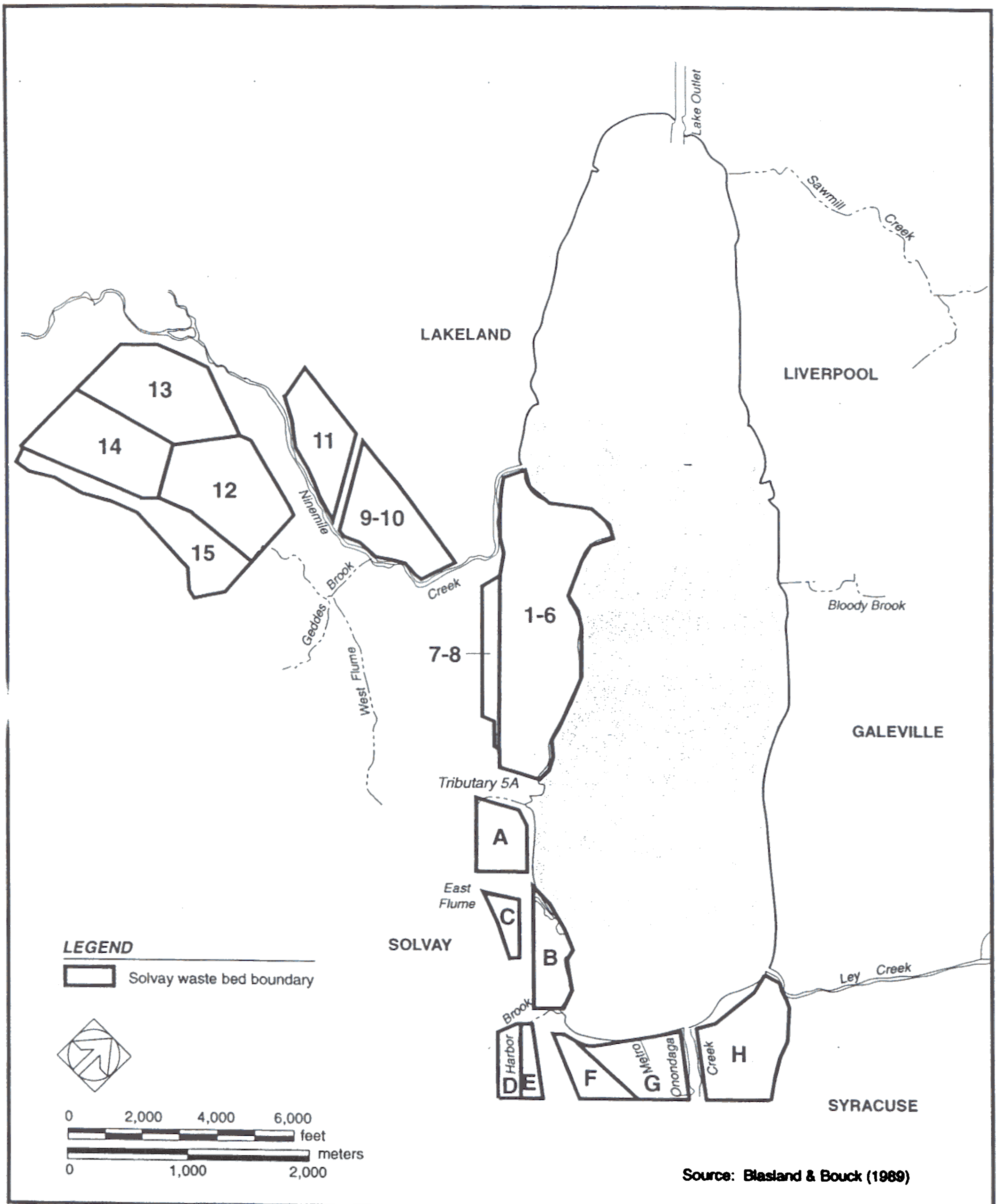
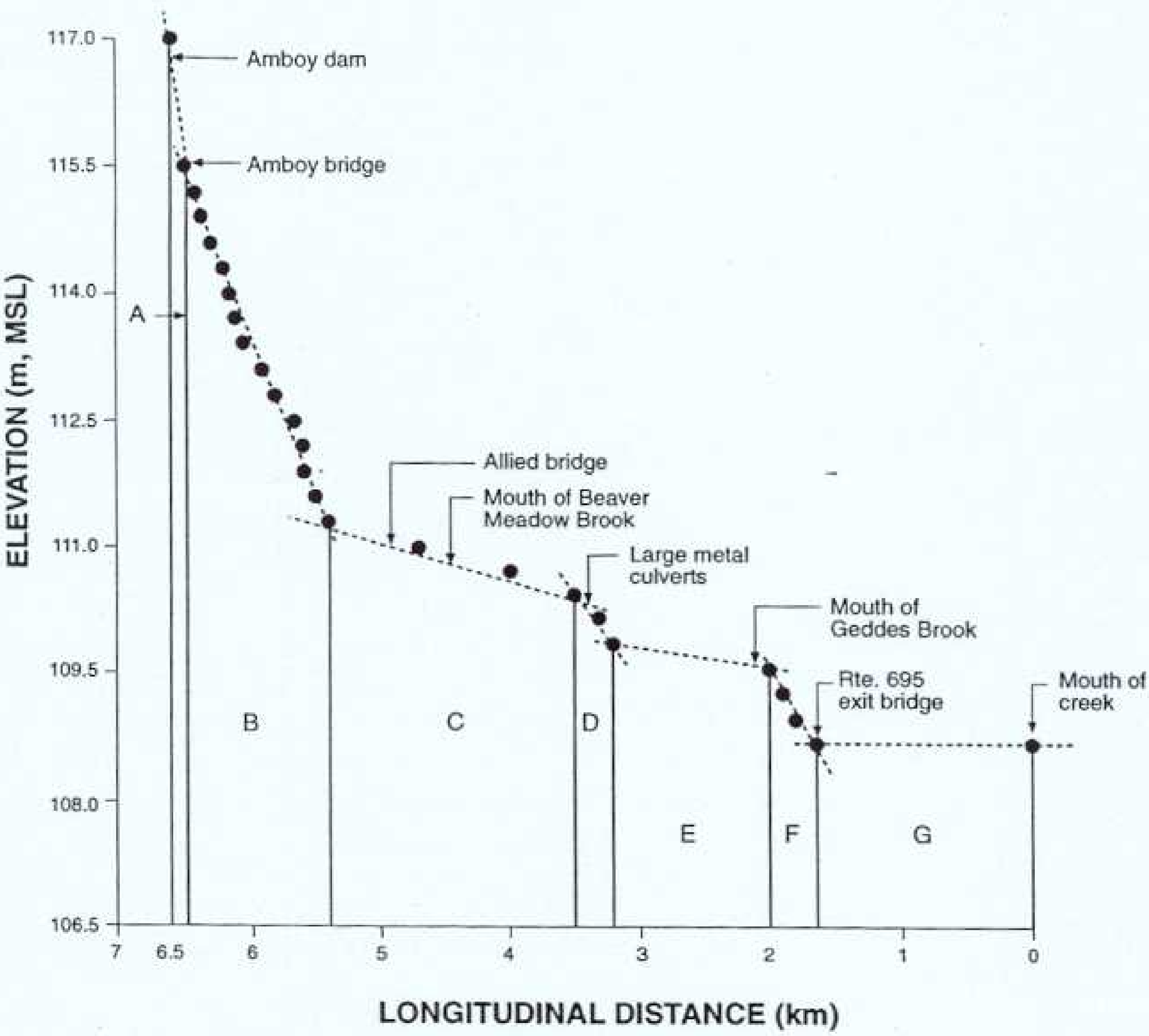


Figure 2-2. Locations of Solvay waste beds.

CBCP 05-01 04/08/96 WA



LEGEND

Stream segment	Descriptor	Slope (m/km)
A	Amboy dam—Amboy bridge	27.8
B	Upstream pools and riffles	3.8
C	Straight, deep, slow-velocity canal	0.5
D	Mid-stretch pools—riffle	2.3
E	Straight, deep, slow-velocity canal	0.2
F	Downstream pools and riffles (by islands)	2.1
G	Straight, deep, slow-velocity canal	<0.2

Boundaries of stream segments are indicated by solid vertical lines. Plotted points generally correspond with 0.3 m (1 ft) contour lines for creek.

Source: (CDR 1991)

Figure 2-3. Longitudinal profile of lower reach of Ninemile Creek.

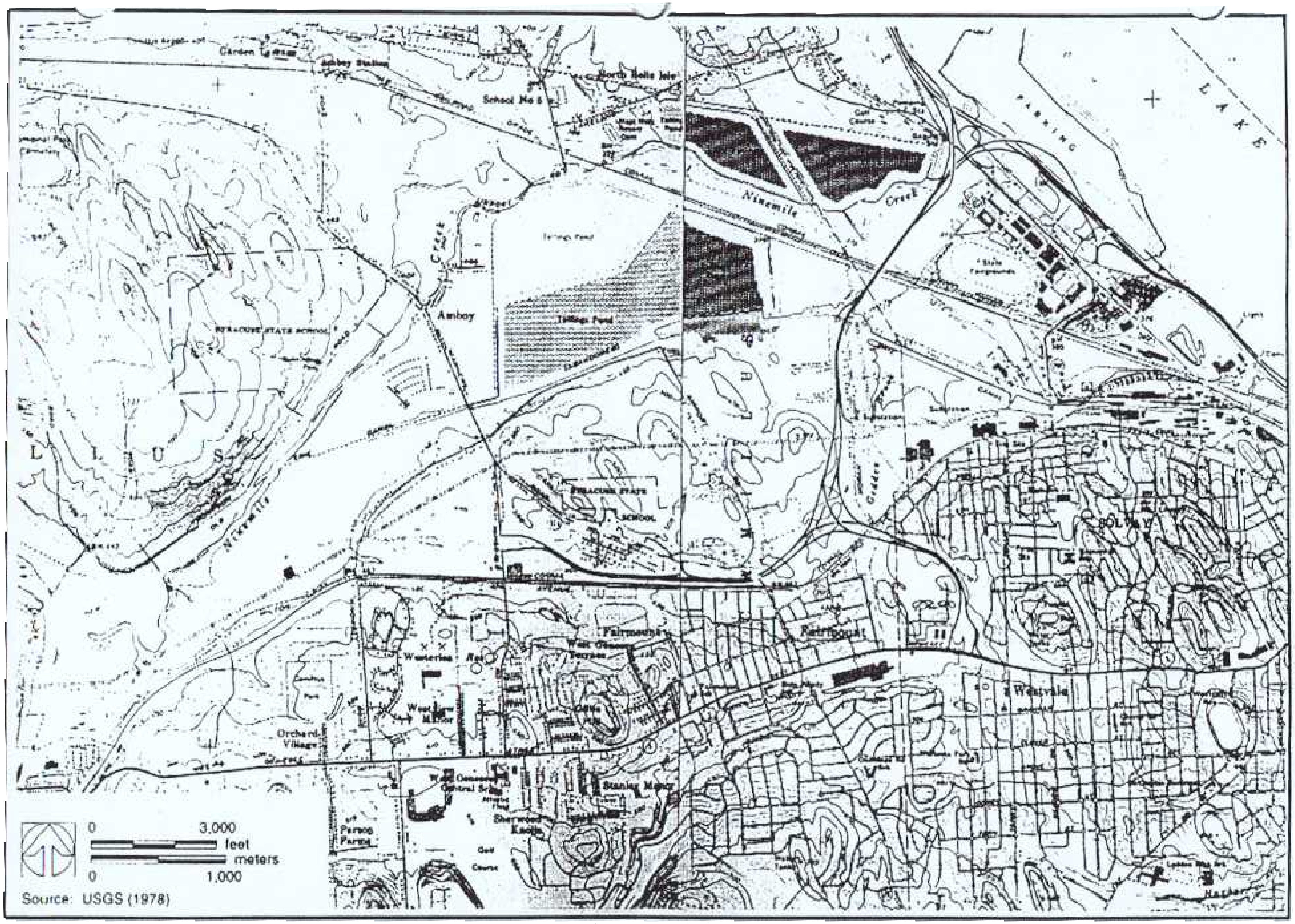


Figure 3-1. Topographical map of Geddes Brook and Ninemile Creek and proximal environment.

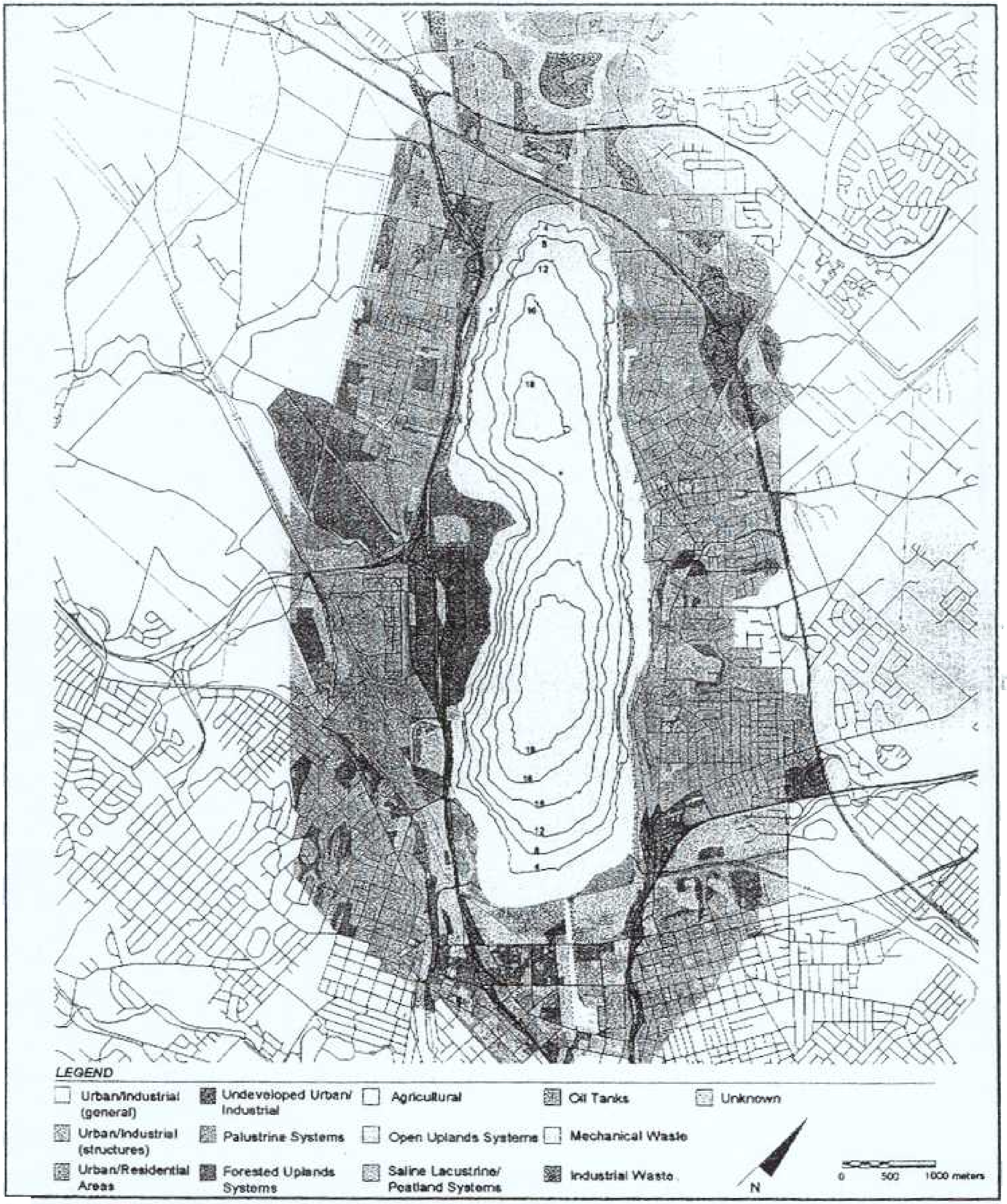


Figure 3-2. Terrestrial covertypes within 0.5 miles of Onondaga Lake.

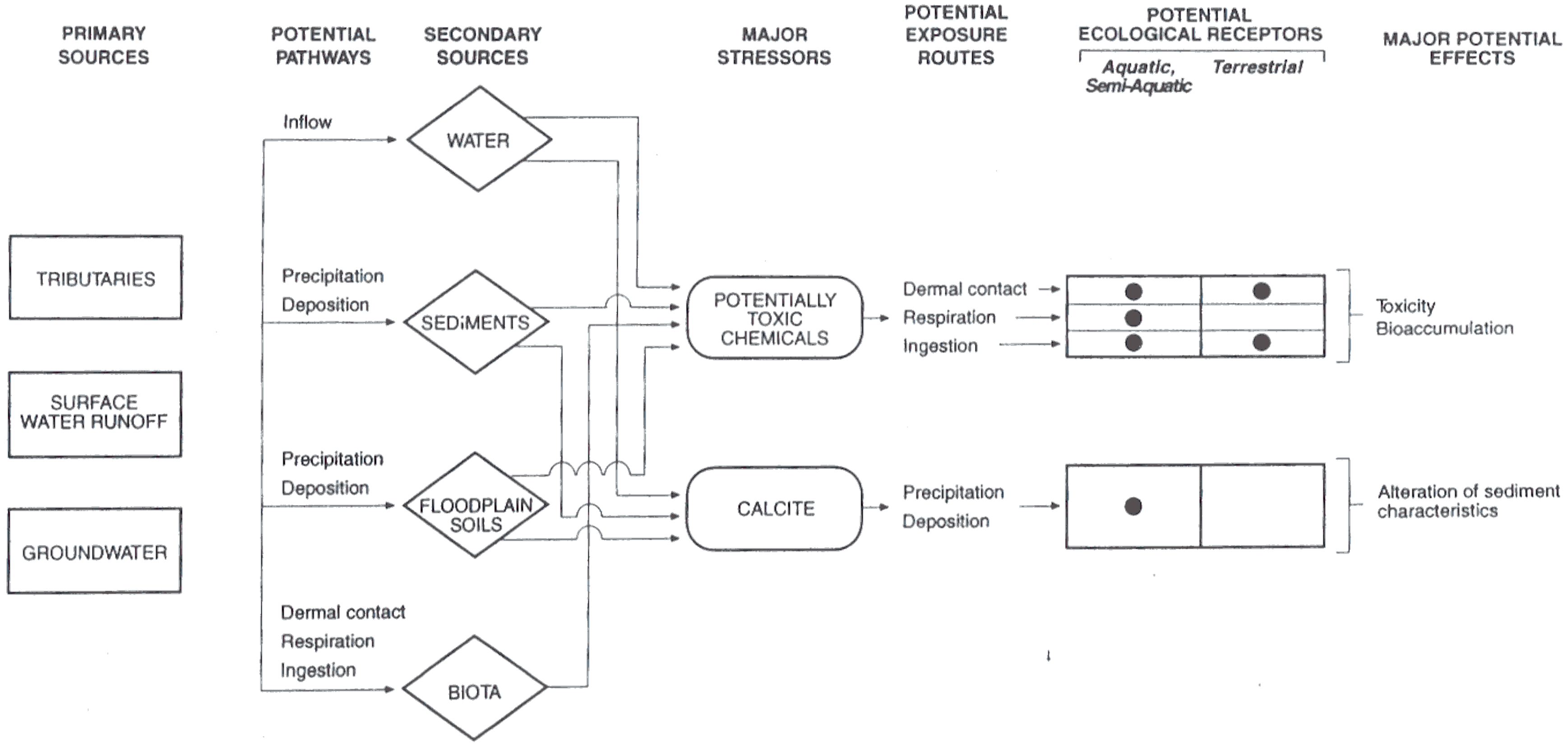
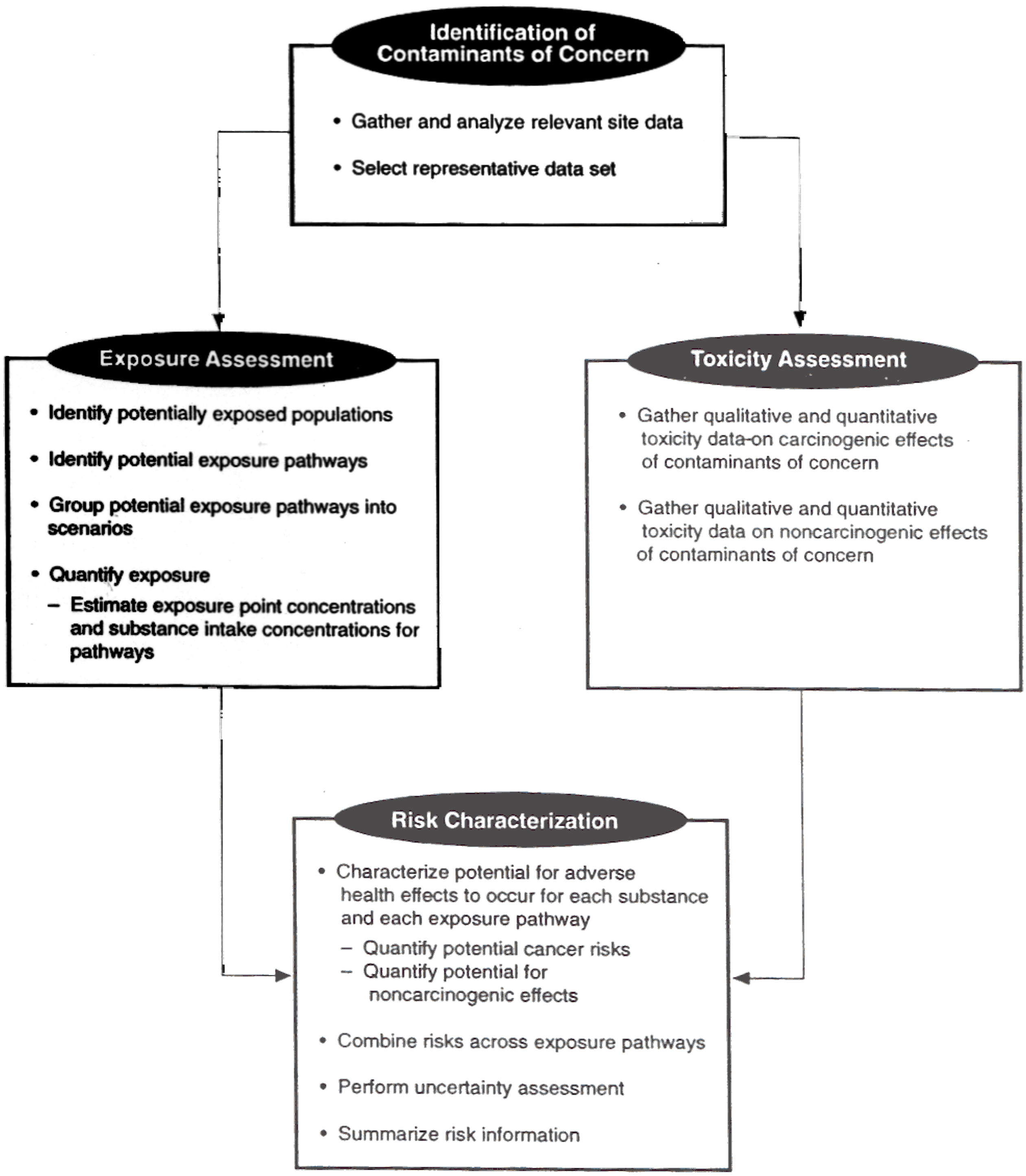


Figure 3-3. Conceptual site model for Geddes Brook and Ninemile Creek.

CBCP 05-01 04/28/98 WA



Source: U.S. EPA (1989a, 1991b)

Figure 4-1. Major components of the baseline human health risk assessment for Geddes Brook and Ninemile Creek.

CBCP-05-01 04/09/98 WA

TABLE 3-1 SPECIES OF BIRDS OBSERVED ON ONONDAGA LAKE AND ITS SHORELINE DURING THE SUMMER OF 1993

Family (Subfamily)	Common Name	Scientific Name
Gaviidae	Common loon[a]	*Gavia immer*
Phalacrocoracidae	Double-crested cormorant	*Phalacrocorax auritus*
Ardeidae	Great blue heron	*Ardea herodias*
	Green heron	*Butorides virescens*
Anatidae		
(Anatinae)	Mallard	*Anas platyrhynchos*
	Black duck	*Anas rubripes*
	Gadwall	*Anas strepera*
	Blue-winged teal	*Anas discors*
	American wigeon	*Anas americana*
	Northern shoveler	*Anas elypeata*
	Wood duck	*Aix sponsa*
(Anserinae)	Canada goose	*Branta canadensis*
	Brant	*Branta bernicla*
(Aythyinae)	Greater scaup	*Aythya marila*
	Lesser scaup	*Aythya affinis*
(Cygninae)	Mute swan	*Cygnus olor*
(Merginae)	Common merganser	*Mergus merganser*
Pandionidae	Osprey[b]	*Pandion haliaetus*
Phasianidae	Ring-necked pheasant	*Phasianus colchicus*
Charadriidae	Semipalmated plover	*Charadrius semipalmatus*
	Killdeer	*Charadrius vociferus*
Scolopacidae	Greater yellowlegs	*Tringa melanoleuca*
	Spotted sandpiper	*Actitis macularia*
	Ruddy turnstone	*Arenaria interpres*
	Semipalmated sandpiper	*Calidris pusillus*
Laridae		
(Larinae)	Great black-backed gull	*Larus marinus*
	Ring-billed gull	*Larus delawarensis*
(Sterninae)	Common tern[b]	*Sterna hirundo*
	Caspian tern	*Sterna caspia*
Columbidae	Rock dove	*Columba livia*
Apodidae	Chimney swift	*Chaetura pelagica*
Alcedinidae	Belted kingfisher	*Ceryle alcyon*
Picidae	Common flicker	*Colaptes auratus*
	Downy woodpecker	*Picoides pubescens*

TABLE 3-1 (cont.)

Family (Subfamily)	Common Name	Scientific Name
Tyrannidae	Great crested flycatcher	*Myiarchus crinitus*
	Eastern phoebe	*Sayornis phoebe*
	Willow flycatcher	*Empidonax traillii*
	Alder flycatcher	*Empidonax alnorum*
	Least flycatcher	*Empidonax minimus*
	Eastern wood-pewee	*Contopus virens*
Hirundinidae	Tree swallow	*Tachycineta bicolor*
	Bank swallow	*Riparia riparia*
	Barn swallow	*Hirundo rustica*
	Purple martin	*Progne subis*
Corvidae	Blue jay	*Cyanocitta cristata*
	American crow	*Corvus brachyrhynchos*
Paridae	Black-capped chickadee	*Parus atricapillus*
	Tufted titmouse	*Parus bicolor*
Troglodytidae	House wren	*Troglodytes aedon*
Mimidae	Mockingbird	*Mimus polyglottos*
	Gray catbird	*Dumetella carolinensis*
Turdidae	American robin	*Turdus migratorius*
Bombycillidae	Cedar waxwing	*Bombycilla cedrorum*
Sturnidae	European starling	*Sturnus vulgaris*
Vireonidae	Red-eyed vireo	*Vireo olivaceus*
	Warbling vireo	*Vireo gilvus*
Parulidae	Yellow warbler	*Dendroica petechia*
	Common yellowthroat	*Geothlypis trichas*
	American redstart	*Setophaga ruticilla*
Icteridae	Red-winged blackbird	*Agelaius phoeniceus*
	Common grackle	*Quiscalus quiscula*
	Brown-headed cowbird	*Molothrus ater*
Fringillidae	House finch	*Carpodacus mexicanus*
	American goldfinch	*Carduelis tristis*
	Chipping sparrow	*Spizella passerina*
	Song sparrow	*Melospiza melodia*

Source: Tango (1993)

Note: All species except the rock dove and European starling are New York State Protected Species.

[a] New York State Protected Species of Special Concern.

[b] New York State Threatened Species.

TABLE 3-2. SPECIES OF WATERFOWL OBSERVED WINTERING ON ONONDAGA LAKE FROM 1990 TO 1994

Common Name	Scientific Name	Recorded Observations				
		1990	1991	1992	1993	1994
	Podiceps auritus					
	Anas platyrhynchos					
Black duck	*Anas rubripes*					
Gadwall	*Anas strepera*					
Green-winged teal	*Anas crecca*					
Ring-necked duck	*Aythya collaris*					
Greater scaup	*Aythya marila*					
Lesser scaup	*Aythya affinis*					
Common goldeneye	*Bucephala clangula*					
Common merganser	*Mergus merganser*					
Red-breasted merganser	*Mergus serrator*					
American coot	*Fulica americana*					
Mute swan	*Cygnus olor*					

Onondaga Audubon Society (1990, 1991, 1992, 1993); Rusk (1994)

TABLE 3-3. SPECIES OF MAMMALS POTENTIALLY PRESENT NEAR ONONDAGA LAKE

Family	Common Name	Scientific Name
Didelphidae	Virginia opossum [a]	*Didelphis virginiana*
Soricidae	Shorttail shrew	*Blarina brevicauda*
Vespertilionidae [b]	Little brown bat	*Myotis lucifugus*
	Northern long-eared bat	*Myotis septentrionalis*
	Big brown bat	*Eptesicus fuscus*
	Red bat	*Lasiurus borealis*
	Hoary bat	*Lasiurus cinereus*
	Silver-haired bat	*Lasionycteris noctivagans*
	Eastern pipistrel	*Pipistrellus subflavus*
Leporidae	Eastern cottontail [a]	*Sylvilagus floridanus*
Sciuridae	Eastern chipmunk	*Tamias striatus*
	Woodchuck	*Marmota monax*
	Gray squirrel [a]	*Sciurus carolinensis*
	Red squirrel	*Tamiasciurus hudsonicus*
Castoridae	Beaver [a]	*Castor canadensis*
Cricetidae	Deer mouse	*Peromyscus maniculatus*
	White-footed mouse	*Peromyscus leucopus*
	Meadow vole	*Microtus pennsylvanicus*
	Muskrat [a]	*Ondatra zibethicus*
Muridae	Norway rat	*Rattus norvegicus*
	House mouse	*Mus musculus*
Canidae	Coyote [a]	*Canis latrans*
	Red fox [a]	*Vulpes fulva*
	Gray fox [a]	*Urocyon cinereoargenteus*
Procyonidae	Raccoon [a]	*Procyon lotor*
Mustelidae	Mink [a]	*Mustela vison*
	Striped skunk [a]	*Mephitis mephitis*
Cervidae	White-tailed deer [a]	*Odocoileus virginianus*

Sources: Van Druff and Rowse (1986)
Van Druff and Pike (1992)
Proud (1994, pers. comm.)
Hicks (1994, pers. comm.)
Richards (1982)
Klein (1995, pers. comm.)

[a] New York State Protected Species.

[b] Bat species are known to occur in Onondaga County and may inhabit the Onondaga Lake area.

TABLE 3-4. FISH SPECIES COLLECTED IN GEDDES BROOK AND NINEMILE CREEK IN 1973 AND 1990

Family	Species	Common Name	Geddes Brook	Ninemile Creek	
			1990[a]	1973[b]	1990[a]
Clupeidae	*Alosa pseudoharengus*	Alewife			X
	Dorosoma cepedianum	Gizzard shad			X
Salmonidae	*Salmo trutta*	Brown trout	X	X	X
Esocidae	*Esox lucius*	Northern pike			X
Cyprinidae	*Campostoma anomalum*	Central stoneroller		X	
	Cyprinus carpio	Carp	X	X	X
	Exoglossum maxillingua	Cutlips minnow		X	X
	Notropis atherinoides	Emerald shiner		X	
	Notropis spilopterus	Spotfin shiner	X		X
	Pimephales promelas	Fathead minnow	X		
	Rhinichthys atratulus	Blacknose dace	X	X	X
	Rhinichthys cataractae	Longnose dace	X	X	X
	Semotilus atromaculatus	Creek chub	X	X	X
Catastomidae	*Catastomus commersoni*	White sucker	X	X	X
	Hypentelium nigricans	Northern hog sucker		X	X
	Moxostoma erythrurum	Golden redhorse			X
Ictaluridae	*Ictalurus nebulosus*	Brown bullhead			X
Cyprinodontidae	*Fundulus diaphanus*	Banded killifish	X		
Gasterosteidae	*Culaea inconstans*	Brook stickleback	X		X

TABLE 3-4. (Cont.)

Family	Species	Common Name	Geddes Brook 1990[a]	Ninemile Creek 1973[b]	Ninemile Creek 1990[a]
Percichthyidae	*Morone americana*	White perch			X
Centrarchidae	*Ambloplites rupestris*	Rock bass		X	X
	Lepomus gibbosus	Pumpkinseed	X	X	X
	Lepomus macrochirus	Bluegill	X		X
	Micropterus dolomieui	Smallmouth bass	X	X	X
	Micropterus salmoides	Largemouth bass		X	X
Percidae	*Perca flavescens*	Yellow perch		X	X
	Etheostoma olmstedi	Tessellated darter	X	X	X
	Percina caprodes	Logperch			X

[a] Fishes were collected in July 1990 throughout Ninemile Creek and Geddes Brook (CDR 1991).

[b] Fishes were collected in July and August 1973 in Ninemile Creek, 9 km downstream from the Otisco Lake outlet (Finger 1982).

TABLE 3-5. CONTAMINANTS OF CONCERN FOR THE BRIDGE STREET FACILITY[a]

Metals
Aluminum
Antimony
Arsenic
Cadmium
Chromium
Copper
Iron
Lead
Manganese
Mercury
Methylmercury
Nickel
Silver
Zinc
Semivolatile Organic Compounds
Benz[a]anthracene
Benzo[a]pyrene
Benzo[b]fluoranthene
Benzo[k]fluoranthene
Chrysene
Fluoranthene
Hexachlorobenzene
Indeno[1,2,3-cd]pyrene
Phenanthrene
Pyrene
Total polycyclic aromatic hydrocarbons
Pesticides and Polychlorinated Biphenyls
DDT
Endosulfan I
Aroclors® 1016/1248; 1254 and 1260

[a] Identified in surficial soil, surface water, sediment, or biota (NYS revision 1998 based on Gradient and Parsons 1997 and in a NYSDEC fish collection conducted on November 30, 1994).

TABLE 3-6. COMPARISON OF MAXIMUM CONCENTRATIONS OF METALS AND ORGANIC COMPOUNDS IN SURFACE WATER OF GEDDES BROOK AND NINEMILE CREEK FROM 1987 TO 1995 WITH STATE AND FEDERAL WATER QUALITY VALUES

	Screening Value[a]		Observed Value			
Chemical	Value	Source[a]	Max	Location	Source	COC?
Metals (µg/L)						
Aluminum	100	NYSDEC (1998)	3,700	NMC	NYSDEC (1992b)	Yes
Barium	3.9	U.S. EPA (1996a)	130	NMC	NYSDEC (1989)	Yes
Cadmium[b]	3.61	NYSDEC (1998)	5 *U*	NMC	NYSDEC (1989)	Yes
Chloride	230,000	U.S. EPA (1988a)	1,700,000	GB	CDR (1991)	Yes
Chromium[b]	130.75	NYSDEC (1998)	12.1	NMC	PTI (1993)	No
Copper[b]	16.19	NYSDEC (1998)	44	NMC	NYSDEC (1992b)	Yes
Iron	300	NYSDEC (1998)	5,400	NMC	NYSDEC (1992b)	Yes
Lead[b]	7.98	NYSDEC (1998)	58	NMC	NYSDEC (1992b)	Yes
Manganese	80	U.S. EPA (1996a)	380	NMC	NYSDEC (1992b)	Yes
Mercury[c]	0.0026	NYSDEC (1998)	1.0	GB	NYSDEC (1992b)	Yes
Nickel[b]	93.48	NYSDEC (1998)	20 *U*	NMC	NYSDEC (1989)	No
Zinc[b]	148.94	NYSDEC (1998)	228	NMC	NYSDEC (1989)	Yes
Organic Compounds (µg/L)						
Aromatic Hydrocarbons						
Benzene	6	NYSDEC (1993)	1 *UJ*	GB, NMC	PTI (1993)	No
Toluene	130	U.S. EPA (1996a)	5	GB	PTI (1993)	No
Xylenes	1.8	U.S. EPA (1996a)	0.8	GB	NYSDEC (1989)	No
Chlorinated Aromatic Hydrocarbons						
Chlorobenzene	5	NYSDEC (1998)	1	NMC	NYSDEC (1989)	No
Dichlorobenzenes	5	NYSDEC (1998)	1.2 *U*	NMC	PTI (1993)	No
Halogenated Alkanes/Alkenes						
Chloroform	1,240	U.S. EPA (1986)	1	GB	NYSDEC (1989)	No
Trichloroethene	21,900	U.S. EPA (1986)	2	GB	NYSDEC (1989)	No
Phthalates						
Di-*n*-butyl phthalate	33	U.S. EPA (1996a)	0.6	GB	NYSDEC (1989)	No
Pesticides						
Chlordane	0.0043	U.S. EPA (1986)	0.6	GB	NYSDEC (1989)	Yes

Note:
COC - contaminant of concern
GB - Geddes Brook
Max. - maximum observed concentration in Geddes Brook and Ninemile Creek
NMC - Ninemile Creek
NYSDEC - New York State Department of Environmental Conservation
U - chemical was not detected in any sample, value presented is the detection limit
UJ - chemical was not detected; the sample quantitation limit is an estimated quantity
U.S. EPA - U.S. Environmental Protection Agency

[a] Screening values are New York State standards (NYSDEC 1993), New York State water quality standards (NYSDEC 1998), EPA ambient water quality criteria (U.S. EPA 1986), EPA ecological toxicity thresholds (U.S. EPA 1996a).

[b] Screening values were calculated based on water hardness of 200 mg/L.

[c] Mercury value is based on dissolved form and is protective of wildlife.

TABLE 3-7. COMPARISON OF MAXIMUM CONCENTRATIONS OF ORGANIC COMPOUNDS IN SEDIMENT FROM GEDDES BROOK AND NINEMILE CREEK (1987-1995) WITH SEDIMENT SCREENING VALUES

Organic Compound (mg/kg or mg/kg organic carbon)	Units	Screening Value[a]		Observed Value			COC?
		Value	Source	Max.[b]	Location	Source	
Aromatic Hydrocarbons							
Ethylbenzene	mg/kg OC	24	NYSDEC (1999)	0.03	GB	NYSDEC (1989)	No
Xylenes	mg/kg OC	92	NYSDEC (1999)	0.200	GB	NYSDEC (1989)	No
Chlorinated Aromatic Hydrocarbons							
Chlorobenzenes	mg/kg OC	3.5	NYSDEC (1999)	0.02	GB	NYSDEC (1989)	No
Halogenated Alkanes/Alkenes							
1,1,2,2-Tetrachloroethane	mg/kg	0.94	U.S. EPA (1996a)	0.001	GB	NYSDEC (1989)	No
Trichloroethene	mg/kg	1.6	U.S. EPA (1996a)	0.002	GB	NYSDEC (1989)	No
Polycyclic Aromatic Hydrocarbons							
Benzo[a]pyrene	mg/kg	0.43	U.S. EPA (1996a)[d]	0.098	NMC	NYSDEC (1989)	No
Fluoranthene	mg/kg OC	1,020	NYSDEC (1999)	23	NMC	NYSDEC (1989)	No
Pyrene	mg/kg OC	961.00	NYSDEC (1999)	19.00	NMC	NYSDEC (1989)	No
Phenanthrene	mg/kg OC	120	NYSDEC (1999)	9.9	NMC	NYSDEC (1989)	No
Phthalates							
Bis(2-ethylhexyl)phthalate	mg/kg OC	199.5	NYSDEC (1999)	6	GB	NYSDEC (1989)	No
Miscellaneous Oxygenated Compounds							
Dibenzofuran	mg/kg	2.0	U.S. EPA (1996a)	0.001	GB	NYSDEC (1989)	No
Pesticides and PCBs							
Chlordane	mg/kg OC	0.006	NYSDEC (1999)	2.4	GB	NYSDEC (1989)	Yes
Total PCBs	[illegible]	1.4	NYSDEC (1999)	0.65[c]	NMC	NYSDEC (1992b)	No

Note:

COC	-	contaminant of concern
GB	-	Geddes Brook
Max.	-	maximum observed concentration in Geddes Brook and Ninemile Creek
NMC	-	Ninemile Creek
NYSDEC	-	New York State Department of Environmental Conservation
PCB	-	polychlorinated biphenyl
U.S. EPA	-	U.S. Environmental Protection Agency

[a] Screening values are U.S. EPA (1996a) ecotoxicity thresholds (mg/kg dry wt.) based on sediment quality benchmarks by equilibrium partitioning assuming 1% organic carbon; or NYSDEC (1999) screening values (mg/kg OC) for lower of benthic aquatic life chronic toxicity or wildlife bioaccumulation

[b] Maximum concentrations were standardized to 1 percent organic carbon for those parameters with NYSDEC (1999) screening values.

[c] Sum of PCB Aroclors® 1254 and 1260.

[d] ERL = Effects Range -- Low, dry-weight basis (Long et al., 1995)

TABLE 3-8. COMPARISON OF MAXIMUM CONCENTRATIONS OF METALS IN SEDIMENT FROM GEDDES BROOK AND NINEMILE CREEK (1987–1995) WITH NEW YORK STATE SEDIMENT SCREENING VALUES

Metal	Screening Value[a]		Observed Value			
(mg/kg dry weight)	LEL	SEL	Max.	Location	Source	COC?
Arsenic	6.0	33	6.3	NMC	NYSDEC (1989)	Yes
Cadmium	0.6	9.0	2	NMC	NYSDEC (1992b)	Yes
Chromium	26	110	18	NMC	NYSDEC (1989)	No
Copper	16	110	37	NMC	NYSDEC (1989)	Yes
Iron[b]	2.0	4.0	2.6	NMC	NYSDEC (1992b)	Yes
Lead	31	110	43	GB	NYSDEC (1989)	Yes
Manganese	460	1,100	600	NMC	NYSDEC (1989)	Yes
Mercury	0.15	1.3	21.1	GB	NYSDEC (1989)	Yes
Nickel	16	50	40	NMC	NYSDEC (1992b)	Yes
Zinc	120	270	172	GB	NYSDEC (1989)	Yes

Note:
- COC — contaminant of concern
- GB — Geddes Brook
- LEL — lowest effect level
- Max. — maximum observed concentration
- NMC — Ninemile Creek
- SEL — severe effect level

[a] Screening values are those identified by NYSDEC (1999).

[b] Iron concentrations are percent dry weight.

TABLE 3-9. COMPARISON OF MAXIMUM CONCENTRATIONS OF METHYLMERCURY AND PCBs DETECTED IN FISH FROM GEDDES BROOK AND NINEMILE CREEK WITH TISSUE SCREENING VALUES FOR WILDLIFE

Substance (mg/kg wet weight)	Tissue Screening Value[a]		Max	COC?
	Newell et al. (1987)	IJC (1989)		
Methylmercury	--	0.5 [b]	2.816	Yes
Aroclor® 1254	0.11 [c]	0.1 [c]	0.14	Yes

Note: - no screening value available

COC - contaminant of concern

IJC - International Joint Commission

[a] Tissue screening values are for fish-consuming birds and animals

[b] Screening value is for total mercury.

[c] Screening value is for total PCBs.

TABLE 3-10. SUMMARY OF ASSESSMENT AND MEASUREMENT ENDPOINTS FOR THE EVALUATION OF ECOLOGICAL RECEPTORS IN AND AROUND GEDDES BROOK AND NINEMILE CREEK

	Endpoints	
Analysis	Assessment	Measurement
Sediment Toxicity Evaluations		
Chironomid test	Population abundance	Percent mortality
	Population production	Biomass
Amphipod test	Population abundance	Percent mortality
	Reproduction (sustainability of population)	Fecundity
Assemblage Evaluations		
Benthic macroinvertebrates	Population abundance Assemblage structure	Species abundance; Benthic Community Metrics: - Total species richness; - Dominance index (e.g., Swartz); - Abundance of indicator species or taxa (e.g., NCO); - Community composition (comparison to predetermined model); and - Species diversity (e.g., Shannon-Wiener).
	Taxa production	Taxa biomass
Fishes	Population abundance Assemblage structure	Contaminant body burdens; Species abundance
	Population production Organism health	Contaminant body burdens; Individual biomass
	Population size structure Organism health	Contaminant body burdens; Individual length
	Organism health	Contaminant body burdens; Individual abnormalities
Bioaccumulation Evaluations		
Fishes	Organism health Risk to aquatic biota	Measured contaminant concentrations in tissue of each of forage and piscivorous fishes
Wildlife (e.g., birds and mammals)	Organism health Risk to terrestrial biota	Modeled contaminant concentrations

Table 4-a. HUMAN HEALTH RISK ASSESSMENT GUIDANCE DOCUMENTS (not the definitive list)

1. USEPA, 1991 Risk Assessment Guidance for Superfund (RAGS); Volume I, Human Health Evaluation Manual (Part C, Risk Evaluation of Remedial Alternatives), OSWER Directive 9285.7-01C, December 1991.

2. USEPA, 1998. Risk Assessment Guidance for Superfund (RAGS);Volume I, Human Health Evaluation Manual, Part D., OERR, Interim Publication No. 9285.7-01D

3. USEPA, 1992. Supplemental Guidance to RAGS: Calculating the Concentration Term OSWER 9285.7-081. May 1992.

4. USEPA, 1997 Human Health Evaluation Manual: Supplemental Guidance: Interim Dermal Risk Assessment Guidance, OSWER Directive 9285.7-10. (Can only provide DAFs and references)

5. USEPA, current version. Integrated Risk Information System (IRIS);On-line Service (WWW.EPA.GOV/IRIS)

6. USEPA. Health Effects Assessment Summary Tables (HEAST), Use most current version.

7. USEPA, 1996. PCBs: Cancer dose-response assessment and application to environmental mixtures. EPA/600/P-96/001A.

8. USEPA, 1993. Provisional Guidance for Quantitative RiskAssessment of PolycyclicAromatic Hydrocarbons. EPA/600/R-93/C89. July 1993.

9. U.S. EPA 1995, Memorandum from Carole Browner on Risk Characterization, U.S. EPA, February 22, 1995.

10. USEPA (1995) EPA Risk Characterization Program Memo from Administrator Carol Browner dated March 21, 1995.

11. USEPA, 1996. Revised Policy on Performance of Risk Assessments During Remedial Investigation/Feasibility Studies (RI/FS) Conducted by Potentially Responsible Parties, OSWER Directive No. 9340.1-02 mistakenly numbered 9835.15c.

12. USEPA, 1986. Risk Assessment Guidelines for Mutagenicity Risk Assessment. 51 Federal Register 34006, September 24, 1986.

13. USEPA, 1986. Risk Assessment Guidelines for Chemical Mixtures 51 Federal Register 34014, September 24, 1986.

Table 4-a. HUMAN HEALTH RISK ASSESSMENT GUIDANCE DOCUMENTS (cont.)

14. USEPA, 1990. Risk Assessment Guidelines for Male and Female Reproductive Health Effects.

15. USEPA, 1995. Risk Assessment Guidelines for Carcinogen Risk Assessment Proposed, Federal Register.

16. USEPA, 1992. Risk Assessment Guidelines for Exposure Assessment. Federal Register

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TABLE 4-1. GEDDES BROOK SURFACE SEDIMENT DATA

Sample ID	Site Station	Date	Aluminum (mg/kg dry weight)	Arsenic (mg/kg dry weight)	Barium (mg/kg dry weight)	Chromium (mg/kg dry weight)	Copper (mg/kg dry weight)	Lead (mg/kg dry weight)	Manganese (mg/kg dry weight)	Total Mercury (mg/kg dry weight)	Nickel (mg/kg dry weight)	Vanadium (mg/kg dry weight)	Zinc (mg/kg dry weight)
CDRI-SD	CDR-I	09/18/90								2.5			
NYS48-SD	NY-S48	11/10/87	4,380	5.2	99.7	9	30.4	43	317	21.1	18.6	9.8	172

TABLE 4-1. (cont.)

Sample ID	Site Station	Date	Acetone (µg/kg dry weight)	Benzyl alcohol (µg/kg dry weight)	Bis[2-ethylhexyl]-phthalate (µg/kg dry weight)	Carbon-disulfide (µg/kg dry weight)	g-Chlor-dane (µg/kg dry weight)	Chloro-benzene (µg/kg dry weight)	2-Chloro-phenol (µg/kg dry weight)	Dibenzo-furan (µg/kg dry weight)	Ethylbenzene (µg/kg dry weight)	Benz[a]-anthracene (µg/kg dry weight)
CDRI-SD	CDR-I	09/18/90										
NYS48-SD	NY-S48	11/10/87	730	7	60	5	24	0.2	6		0.3	17
Total number of samples			1	1	1			1	1	1		
Number of detected values				1	1		1	1	1	1		
Minimum detected value			--	--	--	--	--	--	--	--	--	
Maximum detected value			730	7	60	5	24	0.2	6	1	0.3	
Number of undetected values			0	0	0	0	0	0	0	0	0	
Minimum detection limit			--	--		--	--	--	--	--	--	
Maximum detection limit			--			--		--	--	--	--	
Site-specific background [f]			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
RBC			780,000	2,300,000	46,000	780,000	1800 [g]	160,000	390,000	310,000	7,800,000	870
COC?			NO-r	NO-r	NO-r	NO-r	NO-r	NO-r	NO-r	NO-r	NO-r	NO-r

TABLE 4-1. (cont.)

Sample ID	Site Station	Date	Benzo[b]-fluoranthene (µg/kg dry weight)	Chrysene (µg/kg dry weight)	Fluoranthene (µg/kg dry weight)	Phen-anthrene (µg/kg dry weight)	Pyrene (µg/kg dry weight)	1,1,2,2-Tetrachloro-ethane [b] (µg/kg dry weight)	Trichloro-ethene [b] (µg/kg dry weight)	Xylene isomers (total) (µg/kg dry weight)
CDRI-SD	CDR-I	09/18/90								
NYS48-SD	NY-S48	11/10/87	45	21	32	18	27	1	2	2
Total number of samples			1	1	1	1	1	1	1	1
Number of detected values			1	1	1	1	1	1	1	1
Minimum detected value			--	--	--	--	--	--	--	--
Maximum detected value			45	21	32	18	27	1	2	2
Number of undetected values			0	0	0	0	0	0	0	0
Minimum detection limit			--	--	--	--	--	--	--	--
Maximum detection limit			--	--	--	--	--	--	--	--
Site-specific background [f]			NA	NA	NA	NA	NA	NA	NA	NA
RBC			870	87,000	310,000	230,000 [a]	230,000	3,200	< 5,800	16,000,000
COC?			NO-r	NO-r	NO-r	NO-r	NO-r	NO-r	NO-r	NO-r

Source: CDR (1991), NYSDEC (1989).

Notes:
-- - not applicable
NO-r - not a COC because maximum observed concentration is less than risk-based concentration
COC - Contaminant of concern
RBC - risk-based concentration, residential soil; adjusted to HI = 0.1 for non-carcinogens. USEPA Region III, 10/27/99.

[a] RBC cited for phenanthrene is for pyrene.

[b] Review of database file indicates typo in contaminant ID previously reported by Exponent; contaminant name corrected.

[c] RBC cited for chromium is conservative value for residential Cr(VI), adjusted to HI = 0.1.

[d] RBC cited for lead is USEPA residential soil screening criterion (400 mg/kg).

[e] RBC cited for mercury is conservative value for residential methylmercury, adjsuted to HI = 0.1.

[f] In accordance with USEPA Region II policy, screening against background conducted for inorganics only.

[g] RBC cited for gamma-chlordane is that for "chlordane" (isomer not specified).

TABLE 4-2. NINEMILE CREEK SEDIMENT DATA

Sample ID	Site Station	Date	Aluminum (mg/kg dry weight)	Arsenic (mg/kg dry weight)	Barium (mg/kg dry weight)	Cadmium (mg/kg dry weight)	Chromium (mg/kg dry weight)	Cobalt (mg/kg dry weight)	Copper (mg/kg dry weight)	Lead (mg/kg dry weight)	Manganese (mg/kg dry weight)	Total Mercury (mg/kg dry weight)
NYS44-SD	NY-S44	11/10/87	10,100	6.3	84	0.95 *U*	18	3.8	37	40	600	13
NMCLL-SD	NY-92	07/24/90	9,200			1 *U*			34	20	530	1
NMCLL-SD	NY-92	07/25/90	4,300			2			27	30	370	2
CDRF-SD	CDR-F	09/18/90										0.46
CDRG-SD	CDR-G	09/18/90										1
CDRK-SD	CDR-K	09/18/90										0.91
CDRL-SD	CDR-L	09/18/90										6
CDRM-SD	CDR-M	09/18/90										1.5
CDRO-SD	CDR-O	09/18/90										4
CDRP-SD	CDR-P	09/18/90										2.9
Total number of samples			3	1	1	3	1	1	3	3	3	10
Number of detected values			3	1	1	1	1	1	3	3	3	10
Minimum detected value			4,300	--	--	--	--		27	20	370	0.46
Maximum detected value			10,100	6.3	84	2	18	3.8	37	40	600	13
Number of undetected values			0	0	0	2	0	0	0	0	0	0
Minimum detection limit			--			0.95			--	--	--	--
Maximum detection limit			--			1	--					
Site-specific background			7,750	5.7	120	0.74	12.7	8.9	158	32.1	1,040	0.22
RBC			7,800	0.43	550	3.9	23 [c]	470	310	400 [d]	160	0.78 [e]
COC?			COC	COC	NO-r	NO-r	NO-r	NO-r	NO-r	NO-r	COC	COC

TABLE 4-2. (cont.

Sample ID	Site Station	Date	Nickel (mg/kg dry weight)	Vanadium (mg/kg dry weight)	Zinc (mg/kg dry weight)	Bromo-dichloro-methane (µg/kg dry weight)	Dibromo-chloro-methane (µg/kg dry weight)	Benz[a]-anthracene (µg/kg dry weight)	Benzo[a]-pyrene (µg/kg dry weight)	Benzo[b]-fluoranthene (µg/kg dry weight)	Chrysene (µg/kg dry weight)
NYS44-SD	NY-S44	11/10/87	19	15	103	3	1	160	98	250	150
NMCLL-SD	NY-92	07/24/90	40		68						
NMCLL-SD	NY-92	07/25/90	20		100						
CDRF-SD	CDR-F	09/18/90									
CDRG-SD	CDR-G	09/18/90									
CDRK-SD	CDR-K	09/18/90									
CDRL-SD	CDR-L	09/18/90									
CDRM-SD	CDR-M	09/18/90									
CDRO-SD	CDR-O	09/18/90									
CDRP-SD	CDR-P	09/18/90									
Total number of samples			3	1	3	1	1	1	1	1	1
Number of detected values			3	1	3	1	1	1	1	1	1
Minimum detected value			19	--	68	--	--	--	--	--	--
Maximum detected value			40	15	103	3	1	160	98	250	150
Number of undetected values			0	0	0	0	0	0	0	0	0
Minimum detection limit			--	--	--	--	--	--	--	--	--
Maximum detection limit			--	--	--	--	--	--	--	--	--
Site-specific background [f]			21.7	12.7	72.5	NA	NA	NA	NA	NA	NA
RBC			160	55	2,300	10,000	7600	870	87	870	87,000
COC?			NO-r	NO-r	NO-r	NO-r	NO-r	NO-r	COC	NO-r	NO-r

TABLE 4-2. (cont.

Sample ID	Site Station	Date	Fluoranthene (µg/kg dry weight)	Phenanthrene (µg/kg dry weight)	Pyrene (µg/kg dry weight)	PCBs-Aroclor 1248 (µg/kg dry weight)	PCBs-Aroclor 1254 (µg/kg dry weight)	PCBs-Aroclor 1260 (µg/kg dry weight)	PCBs-Aroclor 1254/1260 (µg/kg dry weight)	Unres. Mix Aroclors 1016/1242[h] (µg/kg dry weight)
NYS44-SD	NY-S44	11/10/87	230	99	190	5,900 *U*	5,900 *U*	5,900 *U*	5,900 *U*	
NMCLL-SD	NY-92	07/24/90				1 *U*	6	1 *U*	6.5	5
NMCLL-SD	NY-92	07/25/90				1 *U*	1 *U*	4	4.5	1 *U*
CDRF-SD	CDR-F	09/18/90								
CDRG-SD	CDR-G	09/18/90								
CDRK-SD	CDR-K	09/18/90								
CDRL-SD	CDR-L	09/18/90								
CDRM-SD	CDR-M	09/18/90								
CDRO-SD	CDR-O	09/18/90								
CDRP-SD	CDR-P	09/18/90								
Total number of samples						3	3	3	3	2
Number of detected values						0	1	1	2	1
Minimum detected value									4.5	
Maximum detected value			230	99	190		6	4	6.5	
Number of undetected values			0	0	0	3	2	2		
Minimum detection limit						1	1			
Maximum detection limit						5,900	5,900	5,900	5,900	
Site-specific background[f]			NA	NA	NA	NA	NA	NA	NA	NA
RBC			310,000	230,000[b]	230,000	320	< 320	320	320[g]	320[g]
COC?			NO-r	NO-r	NO-r	No-ND	NO-r	NO-r	NO-r	NO-r

Source: CDR (1991); NYSDEC (1989, 1992b)

Notes:
NA - not applicable
NO-r - not a COC because maximum observed concentration is less than risk-based concentration
NO-ND - not a COC because compound was not detected in onsite samples
RBC - risk-based concentration, residential soil; adjusted to HI = 0.1 for non-carcinogens. USEPA Region III, 10/27/99.
COC- Contaminant of concern
U - substance undetected at concentration limit reported

a (NOT USED)

[b] RBC cited for phenanthrene is for pyrene.

[c] RBC cited for chromium is conservative value for residential Cr(VI), adjusted to HI = 0.1.

[d] RBC cited for lead is USEPA residential soil screening criterion (400 mg/kg).

[e] RBC cited for mercury is conservative value for residential methylmercury, adjsuted to HI = 0.1.

[f] In accordance with USEPA Region II policy, screening against background conducted for inorganics only.

[g] Used generic value of 320 for unresolved Aroclor mixtures.

[h] Apparent typo ("Aroclors 1016/1042") corrected to 1016/1242.

TABLE 4-3. FISH TISSUE DATA AND COMPARISON WITH RISK-BASED CONCENTRATIONS

Survey	Sample Number	Station	Fish Number	Species	Length (mm)	Length (in)	Legal size?[a]	Total Mercury (mg/kg, wet wt)	Methylmercury (mg/kg, wet wt)	PCBs[b] (ug/kg, wet wt)
CDR-91	19	Ninemile Creek, upstream of Riffle Is.	1	Brown trout	61	2	No	0.055	0.051	
CDR-91	17	Ninemile Creek, upstream of Riffle Is.	2	Brown trout	64	3	No	0.061	0.050	
CDR-91	18	Ninemile Creek, upstream of Riffle Is.	3	Brown trout	72	3	No	0.060	0.053	
CDR-91	1	Ninemile Creek, upstream of Riffle Is.	4	Brown trout	184	7	Yes	0.141	0.155	
CDR-91	3	Ninemile Creek, upstream of Riffle Is.	5	Brown trout	194	8	Yes	0.143	0.130	
CDR-91	2	Ninemile Creek, upstream of Riffle Is.	6	Brown trout	214	8	Yes	0.399	0.423	
CDR-91	4	Ninemile Creek, upstream of Riffle Is.	7	Brown trout	254	10	Yes	0.243	0.212	
CDR-91	15	Ninemile Creek, upstream of canal	1	Northern pike	517	20	Yes	0.635	0.601	
CDR-91	13	Ninemile Creek, upstream of Riffle Is.	1	White sucker	222	9	Yes	0.315	0.316	
CDR-91	14	Ninemile Creek, upstream of Riffle Is.	2	White sucker	243	10	Yes	0.412	0.442	
CDR-91	12	Ninemile Creek, upstream of Riffle Is.	3	White sucker	254	10	Yes	0.265	0.229	
CDR-91	11	Ninemile Creek, upstream of Riffle Is.	4	White sucker	256	10	Yes	0.273	0.304	
CDR-91	6	Ninemile Creek, upstream of Riffle Is.	1	Bluegill	114	4	No	0.334	0.324	
CDR-91	5	Ninemile Creek, upstream of Riffle Is.	2	Bluegill	132	5	No	0.131	0.099	
CDR-91	7	Ninemile Creek, southern channel	1	Bluegill	107	4	No	0.445	0.450	
CDR-91	8	Ninemile Creek, southern channel	2	Bluegill	134	5	No	0.126	0.112	
CDR-91	16	Ninemile Creek, upstream of canal	1	Largemouth bass	114	4	No	0.204	0.177	200 *U*
CDR-91	20	Geddes Brook, near mouth	1	Smallmouth bass	211	8	No	1.432	1.240	60 *U*
CDR-91	9	Ninemile Creek, southern channel	1	Smallmouth bass	163	6	No	0.616	0.639	60 *U*
CDR-91	10	Ninemile Creek, southern channel	2	Smallmouth bass	321	13	Yes	2.512	2.816	140
Total number of fish samples								20	20	4
Number of fish of legal size[a]								10	10	1
Minimum detected value among fish of legal size								0.141	0.130	140
Maximum detected value among fish of legal size								2.512	2.816	140
Risk-based concentration (fish consumption) [c]								0.014 [d]	0.014	1.6
COC?								COC	COC	COC

Source: CDR (1991). Fishes were collected on July 18–24, 1990. Data pertain to skin-free fillets.

COC = Contaminant of Concern

[a] Minimum length for fish used in the risk assessment is 6 in. for all species except smallouth bass, which is 12 in. based on New York fishing regulations (NYSDEC 1996) mandate.

[b] Aroclors 1016, 1221, 1232, 1242, 1248, 1254, and 1260 were analyzed for in 4 fish samples. All were not detected in the fishes with the single exception of Aroclor 1254, which was detected in the large (321 mm) smallmouth bass. PCB concentrations shown represent Aroclor 1254.

[c] Risk-based concentration ("fish") from U.S. EPA Region III risk-based concentration table (10/27/99); adjusted to HI = 0.1 for non-carcinogens (i.e., mercury).

[d] Risk-based concentration for methylmercury used for total mercury.

TABLE 4-4. NINEMILE [illegible]K SURFACE WATER DATA

Sample #	Site Station	Date	Aluminum (µg/L whole)	Barium (µg/L whole)	Cadmium (µg/L whole)	Chromium (µg/L whole)	Copper (µg/L whole)	Lead (µg/L whole)	Manganese (µg/L whole)	Total Mercury (µg/L whole)
		07/26/90								0.0078
		10/04/90								0.0047
		07/26/90								0.0095
		10/04/90								0.0051
		07/26/90								0.0070
		10/04/90								0.0042
		07/26/90								0.0082
		10/04/90								0.0060
		07/26/90								0.0540
		10/04/90								0.0210
		07/26/90								0.0470
		10/04/90								0.0600
		07/26/90								0.0340
		10/04/90								0.0510
		11/10/87	350	130	5 *U*	5 *U*	5	15	101	0.20 *U*
		03/28/89	300		1		7	5 *U*	120	0.70
		04/11/89	1,900		1		44	58	380	0.20
		05/01/89	250		1 *U*		7	1	140	0.30
		05/22/89	780		1 *U*		24	9	110	0.10
		06/12/89	690		1		8	4	340	0.20
		07/10/89	380		1 *U*		15	1 *U*	120	0.10 *U*
		07/25/89	250		1 *U*		7	1	140	0.30
		09/18/89	720		1 *U*		7	2	120	0.10 *U*
		10/18/89	750		1 *U*		6	4	100	0.10 *U*
		11/06/89	210		1 *U*		3	2	80	0.20
		03/26/90	130		1 *U*		3	1	90	0.10 *U*
		04/11/90	3,700		1 *U*		9	7	180	0.10
		04/30/90	220		1 *U*		5	2	120	0.10 *U*
		05/23/90	500		1 *U*		9	4	100	0.10
		06/25/90	620		1 *U*		6	1	160	0.10
		07/24/90	1,700		1 *U*		9	6	200	0.10 *U*
		08/13/90	650		1 *U*		4	2	210	0.10
		09/17/90	360		1 *U*		12	1	230	0.10 *U*
		10/15/90	410		1 *U*		5		130	0.10 *U*
		10/31/90	180		1 *U*		4	1	80	0.10
		11/13/90	340		1 *U*		4	3	70	0.10 *U*
		04/24/92			2 *U*	4 *U*	1.5	1		0.0133
		05/26/92			2 *U*	4 *U*	1 *UJ*	1 *UJ*	110 *J*	0.0086
		06/17/92			2 *U*	4 *U*	1 *U*	1 *U*		0.0087
		07/27/92			2.1 *J*	3	5.2	7.4		0.0674
		08/15/92			2 *U*	2 *U*	5.1	3.1 *U*		0.0184
		08/28/92			2 *U*	7.2	16.6	19.5		0.0338
		09/02/92								0.0183

TABLE 4-4. (cont.)

Sample #	Site Station	Date	Aluminum (µg/L whole)	Barium (µg/L whole)	Cadmium (µg/L whole)	Chromium (µg/L whole)	Copper (µg/L whole)	Lead (µg/L whole)	Manganese (µg/L whole)	Total Mercury (µg/L whole)
L00232	W10	09/16/92			2 *U*	2 *U*	2 *U*	1 *U*		0.0208
L10072	W10	09/27/92			2 *U*	2 *UJ*	4.2	3.4 *UJ*		0.0734
L00284	W10	10/06/92			2 *U*	12.1	3 *U*	1 *U*		0.0881
L10155	W10	10/24/92			2 *U*	4 *U*	5.1	5.6 *J*		0.0708
L00355	W10	11/10/92			2 *U*	4 *U*	7.3 *U*	1 *U*		0.0083
L00357	W10	12/08/92			2 *U*	4 *U*	3 *U*	1.2		0.0089 *J*
L10202	W10	12/17/92			2 *U*	4 *U*	1.5	9		0.0176
PTI-101	NMSW-01	09/09/95								0.00386
PTI-132	NMSW-01	09/09/95								0.0111
PTI-138	NMSW-01	09/09/95								0.00356
PTI-619	NMSW-01	09/22/95								0.00134
PTI-184	NMSW-01	09/22/95								0.00424
PTI-155	NMSW-01	09/22/95								0.00274
NMSW-0495	NMSW-01	10/05/95								0.00371
NMSW-0501	NMSW-01	10/05/95								0.00476
NMSW-0507	NMSW-01	10/06/95								0.00613
NMSW-0549	NMSW-01	10/14/95								0.00725
NMSW-0555	NMSW-01	10/15/95								0.00507
NMSW-0561	NMSW-01	10/15/95								0.00796
NMSW-0603	NMSW-01	10/21/95								0.00565
NMSW-0609	NMSW-01	10/21/95								0.00502
NMSW-0615	NMSW-01	10/21/95								0.00724
PTI-170	NMSW-03	09/09/95								0.0306
PTI-145	NMSW-03	09/09/95								0.0844
PTI-174	NMSW-03	09/09/95								0.0522
PTI-168	NMSW-03	09/22/95								0.0276
PTI-603	NMSW-03	09/22/95								0.0448
PTI-192	NMSW-03	09/22/95								0.0822
NMSW-0513	NMSW-03	10/05/95								0.0625
NMSW-0519	NMSW-03	10/05/95								0.0395
NMSW-0525	NMSW-03	10/06/95								0.107
NMSW-0567	NMSW-03	10/14/95								0.455
NMSW-0573	NMSW-03	10/15/95								0.073
NMSW-0579	NMSW-03	10/15/95								0.104
NMSW-0621	NMSW-03	10/21/95								0.121
NMSW-0627	NMSW-03	10/21/95								0.117
NMSW-0633	NMSW-03	10/21/95								0.404
Total number of samples			22		35	14	35	35	23	80
Number of detected values			22		4	3	29	26	23	70
Minimum detected value			130	--	1	3	2	1	70	0.0013
Maximum detected value			3,700	130	2.1	12.1	44	58	380	0.70
Number of undetected values			0	0	31	11	6	9	0	10

TABLE 4-4. (cont.)

Sample #	Site Station	Date	Aluminum (µg/L whole)	Barium (µg/L whole)	Cadmium (µg/L whole)	Chromium (µg/L whole)	Copper (µg/L whole)	Lead (µg/L whole)	Manganese (µg/L whole)	Total Mercury (µg/L whole)
Minimum undetected value			--	--	1	2	1	1	--	0.1
Maximum undetected value			--	--	5	5	7.3	5	--	0.2
Background			NA	NA	***19*** [x]	***15.9*** [x]	19	2.3	NA	0.0171
Risk-Based Concentration (Tap water)			3,700	260	1.8	11 [c]	150	15 [d]	73	0.37 [f]
COC?			NO-r	NO-r	**COC**	**COC**	NO-r	**COC**	**COC**	**COC** [e]

Background concentrations greater than the RBC.

TABLE 4-4. (cont.)

	Site Station	Date	Methylmercury (µg/L whole)	Nickel (µg/L whole)	Zinc (µg/L whole)	Chlorobenzene (µg/L whole)	Chloroform (µg/L whole)	Di-*n*-butylphthalate (µg/L whole)	Trichloroethene (µg/L whole)
CDR91-07a	CDR-07	07/26/90							
CDR91-07b	CDR-07	10/04/90	0.00003						
CDR91-08a	CDR-08	07/26/90							
CDR91-08b	CDR-08	10/04/90	0.00007						
CDR91-09a	CDR-09	07/26/90							
CDR91-09b	CDR-09	10/04/90	0.00008						
CDR91-10a	CDR-10	07/26/90							
CDR91-10b	CDR-10	10/04/90	0.00009						
CDR91-12a	CDR-12	07/26/90							
CDR91-12b	CDR-12	10/04/90	0.00011						
CDR91-13a	CDR-13	07/26/90							
CDR91-13b	CDR-13	10/04/90	0.00017						
CDR91-14a	CDR-14	07/26/90	0.00015						
CDR91-14b	CDR-14	10/04/90	0.00020						
NY89-015	W7	11/10/87		20 *U*	228		0.2	0.2	0.2
7024301	NMC	03/28/89		3	20		0.1 *U*		0.1 *U*
7024301	NMC	04/11/89		12	80				
7024301	NMC	05/01/89		5	30		0.1 *U*		0.1
7024301	NMC	05/22/89		5	30		0.1 *U*		0.1
7024301	NMC	06/12/89		6	30		0.1 *U*		0.1
7024301	NMC	07/10/89		8	20		0.1 *U*		0.2
7024301	NMC	07/25/89		5	30		0.1		0.2
7024301	NMC	09/18/89		3	20		0.1 *U*		0.1
7024301	NMC	10/18/89		2	30		0.1 *U*		0.1
7024301	NMC	11/06/89		2	30		0.1 *U*		0.1
7024301	NMC	03/26/90		2	20		0.1 *U*		0.1
7024301	NMC	04/11/90		7	30		0.1 *U*		0.1 *U*
7024301	NMC	04/30/90		2	20		0.1 *U*		0.1
7024301	NMC	05/23/90		2	20		0.1 *U*		0.1 *U*
7024301	NMC	06/25/90		3	10 *U*		0.1 *U*		0.1
7024301	NMC	07/24/90		6	30		0.1 *U*		0.1 *U*
7024301	NMC	08/13/90		3	20				0.2
7024301	NMC	09/17/90		6	20		0.1 *U*		0.2
7024301	NMC	10/15/90		2	10 *U*		0.1 *U*		0.2
7024301	NMC	10/31/90		2	10 *U*		0.1 *U*		0.1
7024301	NMC	11/13/90		2	10		0.1 *U*		0.1 *U*
L00024/6/8	W10	04/24/92	0.00015	8 *U*	38.7	1.0 *U*			
L00048	W10	05/26/92	0.00011 *J*	8 *U*	8.5	1 *U*			
L00070	W10	06/17/92	0.00020 *J*	8 *U*	3.3	1 *U*			
L00094	W10	07/27/92		5 *U*	17.4 *J*	1 *U*			
L00167	W10	08/15/92		5 *U*	30.3	1 *U*			
L10020	W10	08/28/92	0.00140	9	71	1 *U*			
L00207	W10	09/02/92	0.00007						

TABLE 4-4. (cont.

Sample #	Site Station	Date	Methylmercury (µg/L whole)	Nickel (µg/L whole)	Zinc (µg/L whole)	Chlorobenzene (µg/L whole)	Chloroform (µg/L whole)	Di-*n*-butylphthalate (µg/L whole)	Trichloroethene (µg/L whole)
L00232	W10	09/16/92	0.00014	5 *U*	5.6	1 *U*			
L10072	W10	09/27/92	0.00034	5 *U*	19.6 *U*	1 *U*			
L00284	W10	10/06/92	0.000094	8.4	5.4 *U*				
L10155	W10	10/24/92	0.00042	7 *U*	21.3	1 *U*			
L00355	W10	11/10/92	0.000091	9	2 *U*				
L00357	W10	12/08/92	0.000074	7 *U*.	2 *U*				
L10202	W10	12/17/92	0.00014	4 *U*	13.9	1 *UJ*			
PTI-101	NMSW-01	09/09/95	0.000113						
PTI-132	NMSW-01	09/09/95	0.00010						
PTI-138	NMSW-01	09/09/95	0.000112						
PTI-619	NMSW-01	09/22/95	0.000051						
PTI-184	NMSW-01	09/22/95	0.000062						
PTI-155	NMSW-01	09/22/95	0.000085						
NMSW-0495	NMSW-01	10/05/95	0.000085						
NMSW-0501	NMSW-01	10/05/95	0.000102						
NMSW-0507	NMSW-01	10/06/95	0.000156						
NMSW-0549	NMSW-01	10/14/95	0.000164						
NMSW-0555	NMSW-01	10/15/95	0.000095						
NMSW-0561	NMSW-01	10/15/95	0.000105						
NMSW-0603	NMSW-01	10/21/95	0.000146						
NMSW-0609	NMSW-01	10/21/95	0.000107						
NMSW-0615	NMSW-01	10/21/95	0.000090						
PTI-170	NMSW-03	09/09/95	0.000252						
PTI-145	NMSW-03	09/09/95	0.00051						
PTI-174	NMSW-03	09/09/95	0.00024						
PTI-168	NMSW-03	09/22/95	0.00012						
PTI-603	NMSW-03	09/22/95	0.000169						
PTI-192	NMSW-03	09/22/95	0.00023						
NMSW-0513	NMSW-03	10/05/95	0.000318						
NMSW-0519	NMSW-03	10/05/95	0.000164						
NMSW-0525	NMSW-03	10/06/95	0.000379						
NMSW-0567	NMSW-03	10/14/95	0.000482						
NMSW-0573	NMSW-03	10/15/95	0.000168						
NMSW-0579	NMSW-03	10/15/95	0.000344						
NMSW-0621	NMSW-03	10/21/95	0.000431						
NMSW-0627	NMSW-03	10/21/95	0.000473						
NMSW-0633	NMSW-03	10/21/95	0.00165						
Total number of samples			50	35	35	11	20	1	21
Number of detected values			50	24	28	1	2	1	16
Minimum detected value			0.000062	2	3	–	0.1		0.1
Maximum detected value			0.0017	12	228	1	0.2	0.2	0.2
Number of undetected values			0	11	7	10	18	0	5

TABLE 4-4. (cont.)

Sample #	Site Station	Date	Methylmercury (µg/L whole)	Nickel (µg/L whole)	Zinc (µg/L whole)	Chlorobenzene (µg/L whole)	Chloroform (µg/L whole)	Di-*n*-butylphthalate (µg/L whole)	Trichloroethene (µg/L whole)
Minimum undetected value			--	4	2	1	0.1	--	0.1
Maximum undetected value			--	20	19.6	1.0	0.1	--	0.1
Background [g]			0.003	14.9	61.4	NA	NA	NA	NA
Risk-Based Concentration			0.37	73	1,100	11	< 0.15	370	1.6
COC?			COC [e]	NO-r	NO-r	NO-r	COC	NO-r	NO-r

Source: PTI (1993, 1996); CDR (1991); NYSDEC (1989, 1992b)

Notes:
J - substance detected above instrumentation detection limit but less than quantitation limit.
NA - not analyzed
NO-r - not a COC because maximum observed concentration is less than risk-based concentration
COC - Contaminant of concern

[a] [NOT USED]

[b] [NOT USED]

[c] Chromium VI RBC at HI = 0.1 used as conservative screening criterion for total chromium.

[d] RBC for lead is the USEPA Drinking Water Action Level (15 ug/L) (40 CFR 141.80)

[e] Total mercury concentration is greater than the RBC at HI = 0.1; methylmercury is also included as a COC due to its significance as an Onondaga Lake contaminant and presence in other media.
Maximum detected value also exceeds NYSDEC surface water criteria (for dissolved mercury) for protection of human health for fish consumption.

[f] Value for methylmercury used as RBC for total mercury.

[g] In accordance with USEPA Region II policy, screening against background conducted for inorganics only.

TABLE 4-5. GEDDES BROOK SURFACE WATER DATA

#	Site Station	Date Sampled	Aluminum (µg/L whole)	Barium (µg/L whole)	Chromium (µg/L whole)	Copper (µg/L whole)	Lead (µg/L whole)	Manganese (µg/L whole)	Total Mercury (µg/L whole)	Methyl-mercury (µg/L whole)	Nickel (µg/L whole)	Zinc (µg/L whole)
11a	CDR-11	07/26/90							0.23	0.00069		
11b	CDR-11	10/04/90							0.23	0.00068		
21a	CDR-21	07/26/90							0.22			
21b	CDR-21	10/04/90							0.37	0.0014		
22a	CDR-22	07/26/90							0.00087			
22b	CDR-22	10/04/90							0.0011	0.00011		
NY89-016	W9	11/10/87	380	70			20	69	1.0			89
L00020	W13	04/23/92			4 U	2.4	1.3 J		0.0464	0.00023 J	8 U	10.1
L00050	W13	05/26/92			4 U	1 UJ	1 UJ	121 J	0.0714	0.00053	8 U	8.7
L00074/5/6	W13	06/17/92			4 U	1 U	1 U		0.0313	0.00046	8 U	8.7
L00096	W13	07/27/92			2 U	2 U	1 U		0.0178	0.00027	5 U	15.7 J
L00171	W13	08/16/92			2 U	2.1	1.2 U		0.211		5 U	23.3
L00209	W13	09/02/92							0.188	0.00067		
L00234/5/6	W13	09/16/92			2 U	1.8	0.7		0.133	0.00045	5 U	10.1
L00285	W13	10/06/92			4 U	3 U	1 U		0.0718	0.00033	7 U	17 U
L00336	W13	11/10/92			4 U	3 U	1 U		0.130	0.00041	7 U	6.4
L00358	W13	12/08/92			4 U	3.8	1.2		0.041 J	0.00037	7 U	11.5
L10024	W13	08/28/92			8.2	19.8	22		0.0856	0.0015	11.8	101
L10043	W13	09/26/92			2 U	5.6	4 UJ		0.183	0.00067	5 U	29.7 U
L10106	W13	10/17/92			4 U	6	1		0.0846	0.00071	7 U	33.2
L10200	W13	12/17/92			4 U	5.7	5.5 J		0.100	0.000077	4 U	36.1
WF0001	GBSW-7	08/29/94							0.0035			
PTI-625	GBSW-02	09/09/95							0.307	0.00217		
PTI-160	GBSW-02	09/09/95							0.207	0.000509		
PTI-123	GBSW-02	09/09/95							0.169	0.000499		
PTI-130	GBSW-02	09/22/95							0.220	0.000806		
PTI-146	GBSW-02	09/22/95							0.269	0.000558		
PTI-149	GBSW-02	09/22/95							0.379	0.000697		
GBSW-0477	GBSW-02	10/05/95							0.615	0.0030		
GBSW-0483	GBSW-02	10/06/95							0.217	0.000496		
GBSW-0489	GBSW-02	10/06/95							0.302	0.000607		
GBSW-0531	GBSW-02	10/14/95							0.349	0.00065		
GBSW-0537	GBSW-02	10/15/95							0.361	0.0011		
GBSW-0543	GBSW-02	10/15/95							0.289	0.000471		
GBSW-0585	GBSW-02	10/21/95							0.441	0.00123		
GBSW-0591	GBSW-02	10/21/95							0.186	0.00043		
GBSW-0597	GBSW-02	10/21/95							0.344	0.000325		

TABLE 4-5. (cont.)

Sample #	Site Station	Date Sa	Aluminum (μg/L whole)	Barium (μg/L whole)	Chromium (μg/L whole)	Copper (μg/L whole)	Lead (μg/L whole)	Manganese (μg/L whole)	Total Mercury (μg/L whole)	Methyl-mercury (μg/L whole)	Nickel (μg/L whole)	Zinc (μg/L whole)
Total number of samples			1	1	13		14	2	37	32	13	14
Number of detected values			1		1		7	2	37	32	1	12
Minimum detected value			--				0.7	69	0.00087	0.000077		6.4
Maximum detected value			380	70	8.2		22	121	1.0	0.00300	11.8	101
Number of undetected values			0	0	12		7	0	0	0	12	2
Minimum undetected value					2		1	--			4	17
Maximum undetected value					4		4	--			8	29.7
Background			NA	NA			2.3	NA	0.0171	0.003		61.4
RBC			3,700	260			15 [d]	73	0.37 [e]	0.37		1,100
COC?			NO-r	NO-r			COC	COC	COC	COC [h]		NO-r

TABLE 4-5. (cont.)

#	Site Station	Date Sampled	Bromo-dichloro-methane (µg/L whole)	a-Chlordane (µg/L whole)	Chloroform (µg/L whole)	Di-n-butyl-phthalate (µg/L whole)	Toluene (µg/L whole)	Trichloro-ethene (µg/L whole)	Xylene isomers (total) (µg/L whole)
11a	CDR-11	07/26/90							
11b	CDR-11	10/04/90							
21a	CDR-21	07/26/90							
21b	CDR-21	10/04/90							
22a	CDR-22	07/26/90							
22b	CDR-22	10/04/90							
NY89-016	W9	11/10/87	0.2	0.6		0.6		2	0.8
L00020	W13	04/23/92					1 *U*		1 *U*
L00050	W13	05/26/92					1 *U*		1 *U*
L00074/5/6	W13	06/17/92					1 *U*		1 *U*
L00096	W13	07/27/92					1 *U*		3 *U*
L00171	W13	08/16/92					1 *U*		3 *U*
L00209	W13	09/02/92							
L00234/5/6	W13	09/16/92					2		3 *U*
L00285	W13	10/06/92							
L00336	W13	11/10/92							
L00358	W13	12/08/92							
L10024	W13	08/28/92					1 *UJ*		1 *U*
L10043	W13	09/26/92					1 *U*		1 *U*
L10106	W13	10/17/92					1 *U*		1 *U*
L10200	W13	12/17/92					1 *UJ*		1 *UJ*
WF0001	GBSW-7	08/29/94							
PTI-625	GBSW-02	09/09/95							
PTI-160	GBSW-02	09/09/95							
PTI-123	GBSW-02	09/09/95							
PTI-130	GBSW-02	09/22/95							
PTI-146	GBSW-02	09/22/95							
PTI-149	GBSW-02	09/22/95							
GBSW-0477	GBSW-02	10/05/95							
GBSW-0483	GBSW-02	10/06/95							
GBSW-0489	GBSW-02	10/06/95							
GBSW-0531	GBSW-02	10/14/95							
GBSW-0537	GBSW-02	10/15/95							
GBSW-0543	GBSW-02	10/15/95							
GBSW-0585	GBSW-02	10/21/95							
GBSW-0591	GBSW-02	10/21/95							
GBSW-0597	GBSW-02	10/21/95							

TABLE 4-5. (cont.)

Sample #	Site Station	Date Sampled	Bromo-dichloro-methane (µg/L whole)	a-Chlordane (µg/L whole)	Chloroform (µg/L whole)	Di-n-butyl-phthalate (µg/L whole)	Toluene (µg/L whole)	Trichloro-ethene (µg/L whole)	Xylenes (total) (µg/L whole)
Total number of samples			1	1	1	1	10	1	11
Number of detected values			1	1	1	1	1	1	1
Minimum detected value			--	--	--	--	--	--	--
Maximum detected value			0.2	0.6	1	0.6	2	2	0.8
Number of undetected values			0	0	0	0	9	0	10
Minimum undetected value			--	--	--	--	1	--	1
Maximum undetected value			--	--	--	--	1	--	3
Background [g]			NA	NA	NA	NA	NA	NA	NA
RBC			0.17	0.19 [f]	0.15	370	75	1.6	1,200
COC?			**COC**	**COC**	**COC**	NO-r	NO-r	**COC**	NO-r

Source: PTI (1993, 1996); CDR (1991); NYSDEC (1989).

Notes:
- -- - not applicable
- *J* - substance detected above instrumentation detection limit but less than quantitation limit
- NA - not analyzed
- NO-r - not a COC because maximum observed concentration is less than risk-based concentration
- RBC - risk-based concentration from U.S. EPA Region III risk-based concentration table (10/27/99); adjusted to HI = 0.1 for non-carcinogens.
- COC - Contaminant of concern
- *U* - substance undetected at concentration limit reported

[a] [NOT USED]

[b] [NOT USED]

[c] Chromium VI tap water RBC at HI = 0.1 used as conservative screening criterion for total chromium.

[d] RBC for lead is the USEPA Drinking Water Action Level (15 ug/L) (40 CFR 141.80)

[e] Value for methylmercury used as RBC for total mercury.

[f] RBC cited for *alpha*-chlordane is that for "chlordane" (isomer not specified).

[g] In accordance with USEPA Region II policy, screening against background conducted for inorganics only.

[h] Methylmercury does not exceed screening criteria; but carried through as COC due to its significance as an Onondaga Lake contamimant and presence in other media.

TABLE 4-6. FISH CONSUMPTION EXPOSURE ALGORITHM

$$\text{Chronic Daily Intake (mg/kg - day)} = \frac{C_{fish} \times IR \times CF \times FI \times EF \times ED}{BW \times AT}$$

where:

C_{fish}	=	substance concentration in fish (mg/kg wet [uncooked] weight)
IR	=	fish ingestion rate (g/day wet [uncooked] weight)
CF	=	conversion factor (10^{-3} kg/g)
FI	=	fractional intake from contaminated source (unitless)
EF	=	exposure frequency (days/year)
ED	=	exposure duration (years)
BW	=	body weight (kg)
AT	=	averaging time (period over which exposure is averaged [days]) – carcinogenic effects: 70-year lifetime × 365 days/year – noncarcinogenic effects: ED × 365 days/year

Exposure Assumptions[a]

	Future Recreational Scenario	
Parameter	Typical	RME
Receptor	Adults	
C_{fish}	Substance-Specific	
IR	6.6[a]	25[a]
FI	0.1[b]	0.3[b]
EF	365	365
ED	9	30[c]
BW	70	70

Sample Calculation

Chronic daily intake (for carcinogenic effects) for RME scenario where the substance concentration is 1 mg/kg:

$$\frac{1\text{ mg/kg} \times 25\text{ g/day} \times 10^{-3}\text{ kg/g} \times 0.3 \times 365\text{ days/year} \times 30\text{ years}}{70\text{ kg} \times (70\text{ years} \times 365\text{ days/year})}$$

$$= 4.6 \times 10^{-5}\text{ mg/kg-day}$$

Note: EPA U.S. Environmental Protection Agency
RME reasonable maximum exposure

Footnotes on following page.

TABLE 4-6. (cont.)

[a] Fish ingestion rates (typical and RME) are the recommended values for the general population consumption of freshwater/estuarine fish; and the 95th percentile for recreational freshwater anglers (U.S. EPA 1997b).

[b] Fractional intake based on data from Connelly (1995, pers. comm.) and best professional judgement regarding use of tributaries.

[c] Based on exposure durations as recommended in RAGS.

TABLE 4-7. SEDIMENT INGESTION EXPOSURE ALGORITHM

$$\text{Chronic Daily Intake (mg/kg - day)} = \frac{CS \times IR \times CF \times FI \times EF \times ED}{BW \times AT}$$

where:

CS	=	substance concentration in sediment (mg/kg)
IR	=	ingestion rate (mg soil/day)
CF	=	conversion factor (10^{-6} kg/mg)
FI	=	fraction ingested from contaminated source (unitless)
EF	=	exposure frequency (days/year)
ED	=	exposure duration (years)
BW	=	body weight (kg)
AT	=	averaging time (period over which exposure is averaged [days])
		– carcinogenic effects: 70-year lifetime x 365 days/year
		– noncarcinogenic effects: ED x 365 days/year

Exposure Assumptions[a]

Parameter	Future Recreational Scenario	
	Typical	RME
CS	Substance-Specific	Substance-Specific
IR[b]	50	100
FI[c]	0.1	1.0
EF[c]	5	14
ED	9 (adults)	30 (adults)[d]
BW	70 (adults)	70 (adults)
	49 (older children)	49 (older children)

Sample Calculation

Chronic daily intake (for carcinogenic effects) for average (central tendency) scenario in the southern part of the lake (adults) where the substance concentration is 1 mg/kg:

$$= \frac{1\ mg/kg \times 50\ mg/day \times 10^{-6}\ kg/mg \times 0.1 \times 5\ days/year \times 9\ years}{70\ kg\ (70\ years \times 365\ days/year}$$

$$= 1.3 \times 10^{-10}\ mg/kg - day$$

Note: EPA - U.S. Environmental Protection Agency
RME - reasonable maximum exposure

[a] All exposure assumptions from U.S. EPA (1991a) unless otherwise noted.

[b] Ingestion rates from U.S. EPA (1997b).

Footnotes continued on following page.

TABLE 4-7. (cont.)

[c] Based on best professional judgment about site use (see text).

[d] Based on exposure duration as recommended in RAGS.

[e] Based on body weights for older children (ages 9–18) from U.S. EPA (1989b).

[f] Children under the age of 6 were not expected to visit the tributaries because of lack of access. Calculations were made for older children only in the average scenario with an exposure duration of 9 years and for adults only in the RME scenario with an exposure duration of 30 years. This approach provides maximum exposure estimates for adults and children.

TABLE 4-8. SEDIMENT DERMAL EXPOSURE ALGORITHM

$$\text{Absorbed dose (mg/kg - day)} = \frac{CS \times CF \times SA \times AF \times ABS \times EF \times ED}{BW \times AT}$$

where:

CS	=	chemical concentration in sediment (mg/kg)
CF	=	conversion factor (10^{-6} kg/mg)
SA	=	skin surface area available for contact (cm^2/event)
AF	=	soil-to-skin adherence factor (mg/cm^2)
ABS	=	absorption factor (unitless)
EF	=	exposure frequency (events/year)
ED	=	exposure duration (years)
BW	=	body weight (kg)
AT	=	averaging time (period over which exposure is averaged [days])
		– carcinogenic effects: 70-year lifetime × 365 days/year
		– noncarcinogenic effects: ED × 365 days/year

Exposure Assumptions[a]

Parameter	Future Recreational Scenario: Typical	Future Recreational Scenario: RME
—	Chemical-specific	Chemical-specific
	5,000-adults, 3,600-older children	5,800-adults, 4,400-older children
	0.15[c] (adult)	0.3[d] (adult)
	0.2[c] (older children)[g]	2.7[d] (older children)[g]
ABS	chemical-specific (see text [section 4.3.3.5])	
EF[e]	5	14
ED	9-adults/older children	30-adults[f], 9-older children
BW	70-adults	70-adults;
	49-older children	49 - older children

Sample Calculation

Central tendency absorbed dose (for carcinogenic effects for hexachlorobenzene[h] with a dermal absorption factor of 0.1[USEPA default recommendation for SVOCs]) for average scenario for southern portion of the lake (adults) where the substance concentration is 1 mg/kg:

$$= \frac{1 \text{ mg/kg} \times 10^{-6} \text{ kg/mg} \times 5{,}000 \text{ cm}^2\text{/event} \times 0.15 \text{mg/cm}^2 \times 0.1^{h} \times 5 \text{ events/year} \times 9 \text{ years}}{70 \text{ kg} \times (70 \text{ years} \times 365 \text{ days/year})}$$

$$= 1.9 \times 10^{-9} \text{ mg/kg-day}$$

Note: EPA U.S. Environmental Protection Agency
RME reasonable maximum exposure

Footnotes continued on following page.

Table 4-8 (cont'd)

[a] Exposure assumptions from U.S. EPA (1991a) unless otherwise noted.

[b] Surface areas represent the 50th and 95th percentile estimates of 25 percent of total body surface for adult and older child 9<18 years (U.S. EPA 1997b).

[c] Central tendency soil-to-skin adherence factor for adults and older children reflects U.S EPA's latest guidance.

[d] RME soil-to-skin adherence factor for adults and older children reflects U.S EPA's latest guidance.

[e] Based on best professional judgment about future site use.

[f] Based on 30 year exposure duration as recommended in RAGS.

[g] Children under the age of 6 were not expected to visit the tributaries because of lack of access.

[h] 10% (0.1) absorption for hexachlorobenzene, based on USEPA Region II generic default recommendation for semivolatile organics.

APPENDIX A

RESULTS OF INITIAL SITE ASSESSMENT

The purpose of the initial site assessment on December 15–16, 1997, was to determine appropriate water, sediment, floodplain, benthic invertebrate, and fish sampling locations and to make general observations related to fish and wildlife resources, vegetative covertypes, and habitat quality. The site assessment was pertinent to both Step 1 of a fish and wildlife impact analysis (NYSDEC 1994) and Step 5 of a Superfund ecological risk assessment (U.S. EPA 1997). Information obtained during the site assessment was used to develop the work plan. Dr. Betsy Henry and Mr. Steve Truchon of PTI Environmental Services conducted the initial site assessment with the assistance of Mr. Bob Halbritter of O'Brien & Gere.

The assessment entailed examining the downstream reaches of Geddes Brook and Ninemile Creek (downstream of the confluence with Geddes Brook) by boat and viewing various points of the upstream reaches of Geddes Brook (downstream of West Genesee Street) and Ninemile Creek (downstream of the Three Arches Aqueduct) from the stream bank or with waders, when feasible. In the downstream reaches of Geddes Brook and Ninemile Creek, sediment probing was conducted. Video tape was taken of representative areas of the downstream reaches of both streams, of Ninemile Creek upstream between the Geddes Brook confluence and adjacent to Waste Bed 11, and of Geddes Brook from the unnamed creek upstream to Gerelock Road. Photographs were taken of all areas visited. Locations of tributaries, point sources, and access points for locating sampling stations were documented in a notebook and by camera and video. The general nature of the stream, banks, floodplain, riparian vegetation, and aquatic and terrestrial organisms were recorded on a sketch map of the area.

The downstream reaches of Geddes Brook and Ninemile Creek were traveled by boat from the point where Geddes Brook surfaces from the double culverts under the State Fair Grounds property to the confluence with Ninemile Creek and then down Ninemile Creek to the outlet at Onondaga Lake. The stream bottom was probed with a metal rod at transects located approximately every 100 yd along the stream. Each transect contained as few as a single sediment probe point in upper Geddes Brook to as many as five points in Ninemile Creek. The transect locations and results of sediment probing are shown in Figure A-1 and Table A-1. Field personnel also prepared a sketch map of stream sediment characteristics including penetration depth, and areas of cementation (calcitic crust) and deposition. Floodplains were included on the map.

Upper Geddes Brook and Ninemile Creek were also assessed by walking along the banks and on the stream bed with waders, if possible, and by probing sediments from the bank. Upper Geddes Brook was examined by walking upstream from the area of the unnamed creek discharge to where the brook flows under Horan Road. The reach of Geddes Brook upstream of Horan Road was examined from various access points (i.e., Gerelock Road, private driveway approximately midway between Gerelock Road and Milton Avenue, southern end of Horan Road, Milton Avenue, and residential area between Milton Avenue and West Genesee Street). Various reaches of upper Ninemile Creek were also examined. These areas included the Three Aqueduct Park (access from Thompson Road), the Amboy dam (access from Warners Road), the confluence of Beaver Meadow Brook with Ninemile Creek (access from Airport Road). Photographs and notes were taken of all areas visited in upper Geddes Brook and Ninemile Creek.

REFERENCES

NYSDEC. 1994. Fish and wildlife impact analysis for inactive hazardous waste sites (FWIA). New York State Department of Environmental Conservation, Division of Fish and Wildlife, Albany, NY.

U.S. EPA. 1997. Ecological risk assessment guidance for Superfund: process for designing and conducting ecological risk assessments. U.S. Environmental Protection Agency, Environmental Response Team, Edison, NJ.

TABLE A-1. RESULTS OF SEDIMEN... ING IN GEDDES BROOK AND NINEMILE CREEK

	Creek Location	Transect Point	Surface Water Depth (in.)	Total Pole Depth (in.)	Approximate Sediment Depth (in.)	$CaCO_3$ Crust Observation (in.)
Geddes Brook						
Transect 1	175 yd down	LB	15	51	36	
	from pipes	C	22	48	26	thin crust
		RB	12	42	30	(1–2 in.)
Transect 2	75 yd up from	LB	18	78	60	
	bend	C	27	90	63	thin crust
		RB	14	72	58	(1–2 in.)
Transect 3	100 yd up from	LB	30	72	42	
	confluence	C	51	86	35	thin crust
		RB	36	75	39	(1–2 in.)
Transect 4	Confluence of	LB	26	50	24	
	Geddes/Ninemile	C	26	48	22	NR
		RB	24	42	18	
Ninemile Creek						
Transect 1	100 yd downstream	LB	18	26	8	
	from Geddes	C	30	36	6	medium crust
		RB	6	36	30	(2–3 in.)
Transect 2	50 yd downstream	LB	NR	NR	NR	
	from second island	C	NR	NR	NR	medium crust
		RB	48	54	6	(2–3 in.)
Transect 3	Rip Rap corner	LB	60	66	6	
	near bend	LB2	84	84	0	
		C	84	84	0	medium crust
		RB2	60	72	12	(2–3 in.)
		RB	48	66	18	

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TABLE A-1. (cont.)

	Creek Location	Transect Point	Surface Water Depth (in.)	Total Pole Depth (in.)	Approximate Sediment Depth (in.)	$CaCO_3$ Crust Observation (in.)
Transect 4	75 yd up from I-695 off ramp	LB	48	60	12	medium crust (2–3 in.)
		LB2	48	72	24	
		C	42	60	18	
		RB2	18	24	6	
		RB	12	18	6	
Transect 5	100 yd downstream from bend and 75 yd downstream from I-695 offramp	LB	48	60	12	
		LB2	60	84	24	
		C	66	88	22	medium crust (2–3 in.)
		RB2	60	84	24	
		RB	24	42	18	
Transect 6	10 yd upstream of pipeline overpass	LB	48	66	18	
		LB2	54	66	12	
		C	66	78	12	medium crust (2–3 in.)
		RB2	30	48	18	
		RB	6	60	54	
Transect 7	In between I-690 east and west ramps	LB	24	42	18	
		LB2	66	90	24	
		C	84	108+	24+	thin crust (1–2 in.)
		RB2	72	108+	36+	
		RB	30	108+	78+	
Transect 8	Just before bend in creek	LB	36	36	0	
		LB2	72	72	0	extremely thick crust (5+ in.)
		C	24	108+	84+	
		RB2	18	21	3	
		RB	24	24	0	

TABLE A-1. (cont.)

	Creek Location	Transect Point	Surface Water Depth (in.)	Total Pole Depth (in.)	Approximate Sediment Depth (in.)	$CaCO_3$ Crust Observation (in.)
Transect 9	150 yd from	LB	6	96+	90+	
	bend down creek	LB2	24	96+	72+	
	adjacent to I-690 on	C	60	96+	36+	thick crust
	left and waste beds	RB2	66	96+	30+	(3+ in.)
	on right	RB	30	96+	66+	
Transect 10	100 yd upstream from	LB	24	96+	72+	thick crust
	bend that goes to	LB2	60	96+	36+	(3+ in.)
	lake	C	84	96+	12+	
		RB2	72	96+	24+	
		RB	30	96+	66+	
Transect 11	50 yd US	LB	18	84+	66+	
	from Onondage	LB2	42	108+	66+	
	Lake	C	84	108+	24+	thin crust
		RB2	96	108+	12+	(1–2 in.)
		RB	54	108+	54+	

Notes:
- LB observation at 36 in. off left bank; looking upstream
- RB observation at 36 in. off right bank; looking upstream
- C mid channel
- LB2 observation at 120 in. off left bank; looking upstream
- RB2 observation at 120 in. off right bank; looking upstream
- NR not recorded

APPENDIX B

Figure 1 Location of Geddes Brook and Ninemile Creek.

Checklist for Ecological Assessment/Sampling

I. SITE DESCRIPTION

1. Site Name: Geddes Brook / Ninemile Creek
   Location: Oswego watershed, south of Onondaga Lake
   County: Onondaga City: Solvay State: NY

2. Latitude: approx: 43° 06' 54" Longitude: approx: 76° 14' 34"

3 What is the approximate area of the site? 10 - 14 km^2

4 Is this the first site visit? ☒ yes ☐ no If no, attach trip report of previous site visit(s), if available.
   Date(s) of previous site visit(s): NA.

Please attach to the checklist USGS topographic map(s) of the site, if available.
see Figure 3-1 from Geddes Brook/Ninemile workplan, attached.

6. Are aerial or other site photographs available? ☐ yes ☒ no If yes, please attach any available photo(s) to the site map at the conclusion of this section.

7. The land use on the site is:

_% Urban	_% Rural
_% Residential	_% Industrial (☐ light ☐ heavy)

_% Urban

____% Rural

_% Residential

_% Industrial (☐ light ☐ heavy)

_% Agricultural

(Crops:______________________)

_% Recreational

(Describe; note if it is a park, etc.)

____

____

____% Undisturbed

100 % Other Site consists of brook/creek and associated flood plain

The area surrounding the site is:
NA mile radius (riparian zone)

25 % Urban

30 % Rural approximate

30 % Residential

_% Industrial (☐ light ☐ heavy)

_% Agricultural

(Crops:______________________)

2 % Recreational upstream Ninemile Creek

(Describe; note if it is a park, etc.)

Three Aqueduct Park, where old Erie Canal intersects Ninemile Creek

3 % Undisturbed

10 % Other highway easement, railroad tracks

8. Has any movement of soil taken place at the site? ☒ yes ☐ no. If yes, please identify the most likely cause of this disturbance:

____ Agricultural Use　　Heavy Equipment　　____ Mining

X Natural Events　　____ Erosion　　____ Other

Please describe: High flow in Ninemile Creek can erode the stream bank in some areas. Adjacent to Geddes Brook and Ninemile Creek, soil has not been disturbed in over 10 years. The site (waste beds included) is currently inactive and soils are stabilized by grasses and successional shrub/scrub vegetation.

9. Do any potentially sensitive environmental areas exist adjacent to or in proximity to the site, e.g., Federal and State parks, National and State monuments, wetlands, prairie potholes? *Remember, flood plains and wetlands are not always obvious; do not answer "no" without confirming information.*

state regulated wetlands

Please provide the source(s) of information used to identify these sensitive areas, and indicate their general location on the site map. wetlands map for Onondaga Lake. Preparation of a wetlands map specific to the site is proposed in the work plan.

10. What type of facility is located at the site?

☐ Chemical ☐ Manufacturing ☐ Mixing ☐ Waste disposal

☒ Other (specify) historical waste beds

11. What are the suspected contaminants of concern at the site? If known, what are the maximum concentration levels?
Based on screening level risk assessment described in work plan, the substances of potential concern are aluminum, arsenic, barium, cadmium, chloride, copper, iron, lead, manganese, mercury, nickel, zinc, benzo[a]pyrene, chlordane, PCBs, and pyrene. Maximum concentrations vary with medium tested and are presented in work plan.

12. Check any potential routes of off-site migration of contaminants observed at the site:

☐ Swales ☐ Depressions ☐ Drainage ditches

☐ Runoff ☐ Windblown particulates ☐ Vehicular traffic

☒ Other (specify) brook/creek transport to Onondaga lake

13. If known, what is the approximate depth to the water table? NA

14. Is the direction of surface runoff apparent from site observations? ☒ yes ☐ no If yes, to which of the following does the surface runoff discharge? Indicate all that apply.

☒ Surface water ☐ Groundwater ☐ Sewer ☐ Collection impoundment

15. Is there a navigable waterbody or tributary to a navigable waterbody? ☒ yes ☐ no

16. Is there a waterbody anywhere on or in the vicinity of the site? If yes, also complete Section III: Aquatic Habitat Checklist – Non-Flowing Systems and/or Section IV: Aquatic Habitat Checklist – Flowing Systems.

☒ yes (approx. distance ____________) ☐ no
the site consists of waterbodies

17. Is there evidence of flooding? ☒ yes ☐ no *Wetlands and flood plains are not always obvious; do not answer "no" without confirming information.* If yes, complete Section V: Wetland Habitat Checklist.

18. If a field guide was used to aid any of the identifications, please provide a reference. Also, estimate the time spent identifying fauna. [Use a blank sheet if additional space is needed for text.]

NA. A habitat assessment will be conducted at the time of sampling for the remedial investigation (summer 1998). Visual observations made during the December 1997 site visit are described in other sections of this checklist.

19. Are any threatened and/or endangered species (plant or animal) known to inhabit the area of the site? ☒ yes ☐ no *If yes, you are required to verify this information with the U.S. Fish and Wildlife Service.* If species' identities are known, please list them next.

Five state-listed rare species which may inhabit the area were identified during the Onondaga Lake baseline ecological risk assessment. These species are:
Hart's-tongue fern (Asplenium scolopendrium var. americanum)
great blue heron (Ardea herodias)
osprey (Pandion haliaetus)
Common tern (Sterna hirundo)
Caspian tern (Sterna caspia)

20. Record weather conditions at the time this checklist was prepared:

DATE 12/16/97

30° Temperature (°C/°F) | 32° Normal daily high temperature
calm Wind (direction/speed) | NA Precipitation (rain, snow)
5% Cloud cover

IA. SUMMARY OF OBSERVATIONS AND SITE SETTING

Geddes Brook originates in the town of Camillus and flows approximately 5 km to its confluence with the West Flume (which discharges from the LCP Bridge Street facility). Flow continues north to Ninemile Creek on the border of the New York State fairgrounds. Geddes Brook flows through a mixture of residential, rural, and urban areas. Depth is shallow (usually <0.5m) and occasionally restricted by culverts. Substrate is predominantly a mixture of sand and cobble except in the lower reaches which are silty. Ninemile Creek flows from Otisco Lake north to Onondaga Lake. Upstream flow is through rural areas while downstream flow is past waste beds, under highways and railroad tracks. Surface waters are a mix of riffles and pools, and sediments are cobbly with moderate to large areas of silty deposition. Surface water flow over Amboy dam presents a one meter barrier to fish migration. The confluence of Ninemile Creek with Beaver Meadow Brook and Geddes Brook occurs approximately 1.7 km and 2.3 km downstream of the Amboy dam. Downstream of the confluence with Geddes Brook, water flow is rapid for a 50 meter stretch of riffles. Several islands channelize flow. Downstream of the islands, Ninemile Creek increases in width and decreases in velocity while passing under numerous overpasses, before discharging to Onondaga Lake. Additional description is available in the work plan.

Completed by Betsy Henry and Steve Truchon Affiliation Exponent

Additional Preparers NA

Site Manager Al Labuz, Allied Signal

Date 12/16/98

II. TERRESTRIAL HABITAT CHECKLIST

IIA. WOODED

Are there any wooded areas at the site? ☒ yes ☐ no If no, go to Section IIB: Shrub/Scrub.

2. What percentage or area of the site is wooded? (≤5 % 5-10 acres). Indicate the wooded area on the site map which is attached to a copy of this checklist. Please identify what information was used to determine the wooded area of the site. Visual survey identified silver maple / green ash swamp near confluence of Ninemile Creek to Onondaga Lake

3. What is the dominant type of vegetation in the wooded area? (Circle one: Evergreen/**Deciduous**/ Mixed) Provide a photograph, if available.

   Dominant plant, if known: silver maple/green ash

4. What is the predominant size of the trees at the site? Use diameter at breast height.

   ☐ 0-6 in. ☒ 6-12 in. ☐ > 12 in.

5. Specify type of understory present, if known. Provide a photograph, if available. NA

   Wooded areas also exist along the upper reaches of Geddes Brook and Ninemile Creek. Stands consist of a mixture of maple, oak, hemlock, and pine.

IIB. SHRUB/SCRUB

1. Is shrub/scrub vegetation present at the site? ☒ yes ☐ no If no, go to Section IIC: Open Field.

   Successional shrub land on/around wastebeds

2. What percentage of the site is covered by scrub/shrub vegetation? (20-30% 100 acres). Indicate the areas of shrub/scrub on the site map. Please identify what information was used to determine this area.

   Visual survey

What is the dominant type of scrub/shrub vegetation, if known? Provide a photograph, if available.

boxelder, birch, sumac, willow, American elm, poplar, wild carrot

4. What is the approximate average height of the scrub/shrub vegetation?

   ☐ 0-2 ft. ☒ 2-5 ft. ☐ > 5 ft.

5. **Based on site observations, how dense is the scrub/shrub vegetation?**

☐ Dense ☒ Patchy ☐ Sparse

IIC. OPEN FIELD

1. **Are there open (bare, barren) field areas present at the site?** ☒ yes ☐ no **If yes, please indicate the type below:** New York State fairgrounds

☐ Prairie/plains ☐ Savannah ☐ Old field ☒ Other (specify) maintained fields

2. **What percentage of the site is open field? (≤ 5 % 5-10 acres). Indicate the open fields on the site map.**

3. **What is/are the dominant plant(s)? Provide a photograph, if available.**

grasses

4. What is the approximate average height of the dominant plant? NA

Describe the vegetation cover: ☐ Dense ☐ Sparse ☐ Patchy NA

IID. MISCELLANEOUS

Are other types of terrestrial habitats present at the site, other than woods, scrub/shrub, and open field? ☐ yes ☐ no
If yes, identify and describe them below.

Describe the terrestrial miscellaneous habitat(s) and identify these area(s) on the site map.

NA

3. **What observations, if any, were made at the site regarding the presence and/or absence of insects, fish, birds, mammals, etc.?**

–muskrat burrows, rabbit tracks, great blue heron, redwing black bird, whitetail deer.

4. **Review the questions in Section I to determine if any additional habitat checklists should be completed for this site.**

NA

III. AQUATIC HABITAT CHECKLIST – NON-FLOWING SYSTEMS

Note: *Aquatic systems are often associated with wetland habitats. Please refer to Section V, Wetland Habitat Checklist.*

1. What type of open-water, non-flowing system is present at the site?

☒ Natural (pond, lake)
☐ Artificially created (lagoon, reservoir, canal, impoundment)

2. If known, what is the name(s) of the waterbody(ies) on or adjacent to the site?

Onondaga Lake

3. If a waterbody is present, what are its known uses (e.g.: recreation, navigation, etc.)? recreation

4. What is the approximate size of the waterbody(ies)? 12 Km^2 acre(s).

5. Is any aquatic vegetation present? ☒ yes ☐ no If yes, please identify the type of vegetation present if known.

☐ Emergent ☒ Submergent ☒ Floating Potamogeton sp.

Ceratophyllum sp. Elodea sp. Heteranthora sp. Myriophyllum sp.

6. If known, what is the depth of the water? Mean 12 m, maximum 19m

7. What is the general composition of the substrate? Check all that apply.

☐ Bedrock	☒ Sand (coarse)	☒ Muck (fine/black)
☐ Boulder (>10 in.)	☒ Silt (fine)	☐ Debris
☐ Cobble (2.5-10 in.)	☐ Marl (shells)	☐ Detritus
☐ Gravel (0.1-2.5 in.	☐ Clay (slick)	☐ Concrete

Other (specify)________

8. What is the source of water in the waterbody?

☒ River/Stream/Creek	☒ Groundwater	☒ Other (specify) municipal sewage treatment plant discharge
☐ Industrial discharge	☒ Surface runoff	

9. Is there a discharge from the site to the waterbody? ☒ yes ☐ no If yes, please describe this discharge and its path.

The site consists of the following tributaries: Geddes Brook (including discharge from the West Flume and an unnamed creek) and Ninemile Creek (including discharge from Beaver Meadow Brook and Geddes Brook)

10. Is there a discharge from the waterbody? ☒ yes ☐ no If yes, and the information is available, identify from the list below the environment into which the waterbody discharges.

☒ River/Stream/Creek	☐ onsite	☒ offsite	outlet to Seneca River Distance NA
☐ Groundwater	☐ onsite	☐ offsite	
☐ Wetland	☐ onsite	☐ offsite	Distance ______
☐ Impoundment	☐ onsite	☐ offsite	

11. Identify any field measurements and observations of water quality that were made. For those parameters for which data were collected provide the measurement and the units of measure below:

NA	Area
↓	Depth (average)
↓	Temperature (depth of the water at which the reading was taken)
↓	pH
↓	Dissolved oxygen
↓	Salinity
↓	Turbidity (clear, slightly turbid, turbid, opaque) (Secchi disk depth ______)
↓	Other (specify)

12. Describe observed color and area of coloration.

No abnormal coloration observed.

13. Mark the open-water, non-flowing system on the site map attached to this checklist.

14. What observations, if any, were made at the waterbody regarding the presence and/or absence of benthic macroinvertebrates, fish, birds, mammals, etc.?

redwing blackbirds, ducks, human fishing activity

IV. AQUATIC HABITAT CHECKLIST – FLOWING SYSTEMS

Note: *Aquatic systems are often associated with wetland habitats. Please refer to Section V, Wetland Habitat Checklist.*

What type(s) of flowing water system(s) is (are) present at the site?

☐ River	☐ Stream	☒ Creek
☐ Dry wash	☐ Arroyo	☒ Brook
☐ Artificially created (ditch, etc.)	☐ Intermittent Stream	☐ Channeling
	☐ Other (specify)________	

2. If known, what is the name of the waterbody? Geddes Brook/Ninemile Creek

3. For natural systems, are there any indicators of physical alteration (e.g., channeling, debris, etc.)?
☒ yes ☐ no If yes, please describe indicators that were observed.
extensive culverts on Geddes Brook, as well as channeling. Amboy dam on Ninemile Creek, culverts, alteration of stream bed location to accomodate waste beds during the 1940s.

4. What is the general composition of the substrate? Check all that apply.

☐ Bedrock	☒ Sand (coarse)	☐ Muck (fine/black)
☐ Boulder (>10 in.)	☒ Silt (fine)	☐ Debris
☒ Cobble (2.5-10 in.)	☐ Marl (shells)	☐ Detritus
☒ Gravel (0.1-2.5 in.)	☐ Clay (slick)	☐ Concrete

☒ Other (specify) Calcite

5. What is the condition of the bank (e.g., height, slope, extent of vegetative cover)? highly variable
Geddes Brook - in lower reaches, banks are steep cut (90°+) with extensive phragmites. Height of banks are approximately 1-2 meters.
Ninemile Creek - bank varies in slope (25-80°) and is generally stabilized by vegetative cover. Height varies from <0.5 m to 2m.

6. Is the system influenced by tides? ☐ yes ☒ no What information was used to make this determination?
Lack of connection to ocean.

7. Is the flow intermittent? ☐ yes ☒ no If yes, please note the information that was used in making this determination.

8. Is there a discharge from the site to the waterbody? ☒ yes ☐ no If yes, please describe the discharge and its path.
The West Flume and an unnamed creek discharge to Geddes Brook. Beaver Meadow Brook and Geddes Brook discharge to Ninemile Creek.

9. Is there a discharge from the waterbody? ☒ yes ☐ no If yes, and the information is available, please identify what the waterbody discharges to and whether the discharge is on site or off site.
Ninemile Creek discharges to Onondaga Lake.

10. Identify any field measurements and observations of water quality that were made. For those parameters for which data were collected, provide the measurement and the units of measure in the appropriate space below:

variable	Width (ft.)	see Table A-1 of work plan
variable	Depth (ft.)	see Table A-1 of work plan
NA	Velocity (specify units): ______	
↓	Temperature (depth of the water at which the reading was taken ______)	
↓	pH	
↓	Dissolved oxygen	
↓	Salinity	
↓	Turbidity (clear, slightly turbid, turbid, opaque) (Secchi disk depth ______)	
↓	Other (specify) ______	

11. **Describe observed color and area of coloration.**

– no discoloration

12. **Is any aquatic vegetation present? ☒ yes ☐ no If yes, please identify the type of vegetation present, if known.**

☒ **Emergent** Phragmites ☒ **Submergent** ☐ **Floating**

watercress in Geddes Brook south of railroad tracks

13. **Mark the flowing water system on the attached site map.**

14. **What observations were made at the waterbody regarding the presence and/or absence of benthic macroinvertebrates, fish, birds, mammals, etc.?**

white tail deer, great blue heron

V. WETLAND HABITAT CHECKLIST

1. Based on observations and/or available information, are designated or known wetlands definitely present at the site?
☒ yes ☐ no

Please note the sources of observations and information used (e.g., USGS Topographic Maps, National Wetland Inventory, Federal or State Agency, etc.) to make this determination.
National Wetland Inventory & NYSDEC maps for vicinity of Onondaga Lake. A wetlands map for the site will be prepared during the remedial investigation.

2. Based on the location of the site (e.g., along a waterbody, in a floodplain) and site conditions (e.g., standing water; dark, wet soils; mud cracks; debris line; water marks), are wetland habitats suspected?
☒ yes ☐ no If yes, proceed with the remainder of the wetland habitat identification checklist.

3. What type(s) of vegetation are present in the wetland?

☐ Submergent
☐ Scrub/Shrub
☒ Emergent
☐ Wooded
mostly monotypic stand of Phragmites / Loosestrife

☐ Other (specify)________________

4 Provide a general description of the vegetation present in and around the wetland (height, color, etc.). Provide a photograph of the known or suspected wetlands, if available.
Phragmite stands are 2+ meters high and border much of Geddes Brook and Ninemile Creek

5. Is standing water present? ☒ yes ☐ no If yes, is this water: ☒ Fresh ☐ Brackish
What is the approximate area of the water (sq. ft.)? 12 km^2 = Onondaga Lake
Please complete questions 4, 11, 12 in Checklist III - Aquatic Habitat -- Non-Flowing Systems.

6 Is there evidence of flooding at the site? What observations were noted?

☐ Buttressing ☐ Water marks ☐ Mud cracks

☐ Debris line ☒ Other (describe below)

- Low relief floodplain areas and back channels near riffle area/islands in Nine Mile Creek just downstream of Geddes Brook confluence.
- Sedge ground cover with[45] intermittent stands of small maple, boxelder/alder

7. If known, what is the source of the water in the wetland?

☒ Stream/River/Creek/Lake/Pond ☐ Groundwater

☒ Flooding ☒ Surface Runoff

8. Is there a discharge from the site to a known or suspected wetland? ☒ yes ☒ no If yes, please describe.

~~Primary discharge from site is to Onondaga Lake via Ninemile Creek~~. CONNECTED WETLANDS INCLUDE SYW18 (GEDDES BROOK), SYW10 (NINEMILE CREEK) AND ONONDAGA LAKE.

9. Is there a discharge from the wetland? ☒ yes ☐ no. If yes, to what waterbody is discharge released?

☒ Surface Stream/River ☐ Groundwater ☐ Lake/Pond ☐ Marine

10. If a soil sample was collected, describe the appearance of the soil in the wetland area. Circle or write in the best response. not collected

Color (blue/gray, brown, black, mottled) NA

Water content (dry, wet, saturated/unsaturated) NA

11. Mark the observed wetland area(s) on the attached site map.

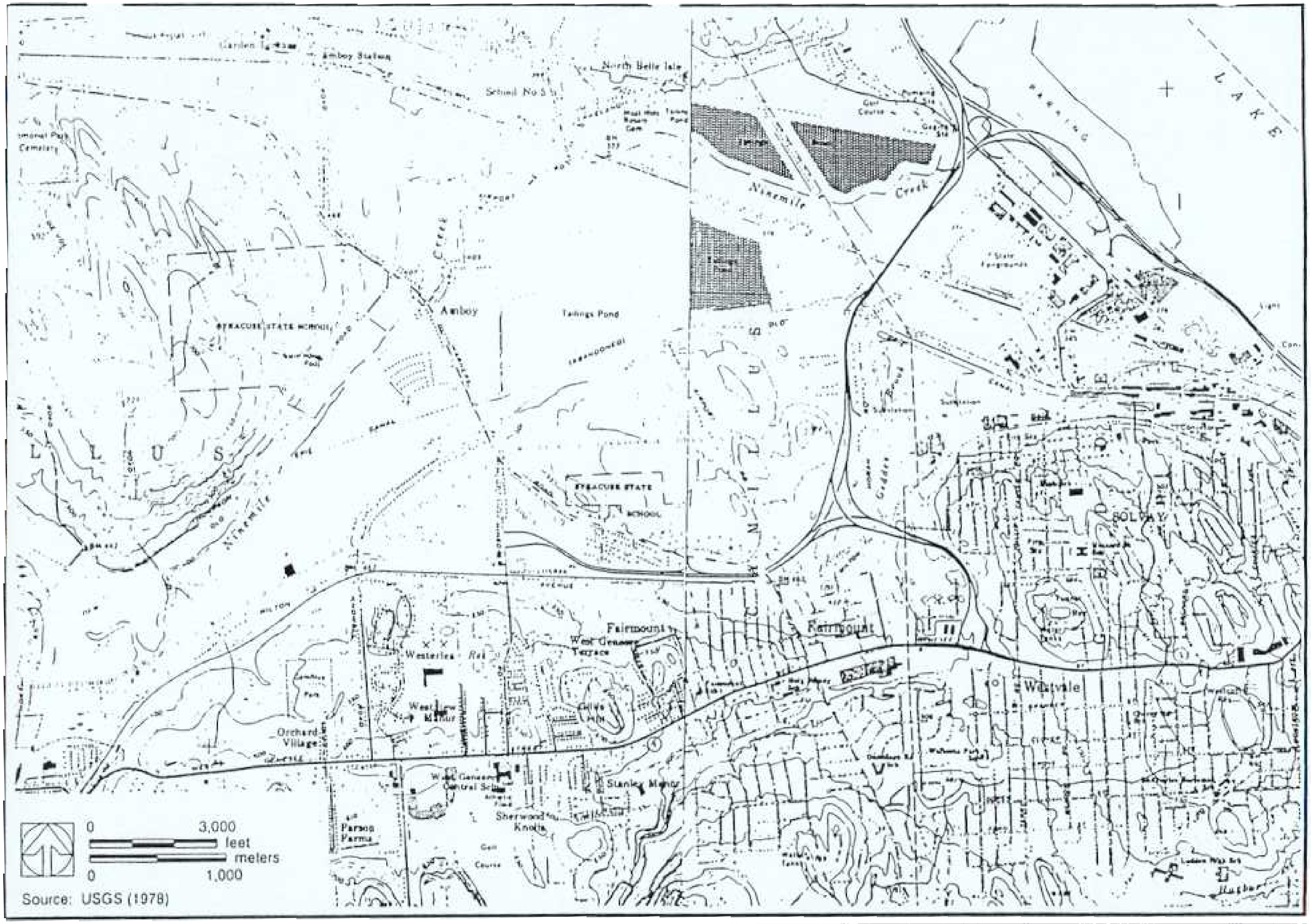

Figure 3-1. Topographical map of Geddes Brook and Ninemile Creek and proximal environment.

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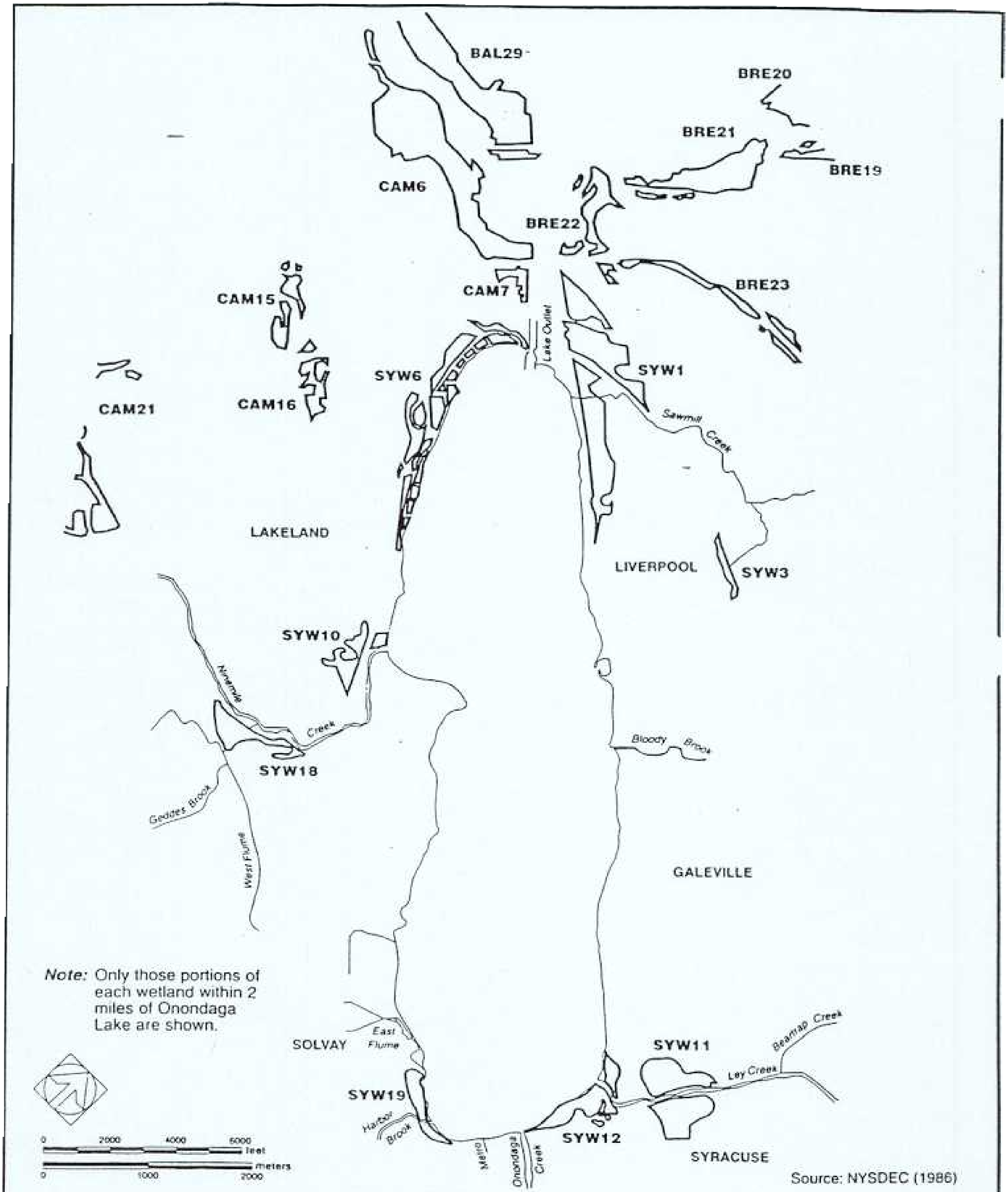

Regulated wetlands within 2 miles of the shoreline of Onondaga Lake.

CBCP-02-01 03/18/98 WA