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October 1997

EPA Superfund Record of Decision:

Eielson Air Force Base, Fairbanks-North Star Borough, AK 9/30/1996

United States Air Force

Environmental Restoration Program

Eielson Air Force Base, Alaska

Sitewide Record of Decision

FINAL

September 1996

Eielson Air Force Base
Final Sitewide

Declaration of the Record of Decision

Site Name and Location

Eielson Air Force Base, Alaska

Statement of Basis and Purpose

This decision document presents the final remedial action selected for Eielson Air Force Base (AFB), Alaska, chosen in accordance with the *Comprehensive Environmental Response, Compensation, and Liability Act* (CERCLA), as amended by the *Superfund Amendments and Reauthorization Act* (SARA), the May 1991 Federal Facility Agreement (FFA) entered into by the U.S. Air Force, the U.S. Environmental Protection Agency (EPA), and the state of Alaska, and to the extent practicable, the National Contingency Plan. This decision is based on the administrative record file for this site.

The state of Alaska concurs with the selected remedy.

Assessment of Areas Evaluated in the Sitewide Investigation

The sitewide investigation at Eielson AFB evaluated basewide contamination that is not confined or attributable to specific source areas identified and addressed in the FFA as well as cumulative risks to human health and the environment posed by contamination on a sitewide basis. No previously unidentified groundwater contamination was found in the sitewide investigation. The following surface water bodies were evaluated to determine whether they were affected by contamination from one or more source areas: Garrison Slough, French Creek, Moose Creek, Piledriver Slough, Flightline Pond, and Lily Lake. Of these surface water bodies, Garrison Slough is the only one that poses an unacceptable risk to human health and the environment. Polycholorinated biphenyls (PCBs) were found in the fish tissue and sediments of Garrison Slough. Soils in a trench adjacent to Garrison Slough were contaminated with PCBs and appear to be the source of contamination to slough sediments via surface water runoff.

Actual or threatened releases and exposure of people to hazardous substances in Garrison Slough and in adjacent soils, if not addressed by implementing the response action selected in this Record of Decision (ROD), may present an imminent and substantial endangerment to public health, welfare, or the environment.

Description of the Selected Remedy

The sediments in Garrision Slough and a limited area of soil contamination in a trench adjacent to the slough require remediation for protection of human health.

Five remedial alternatives were analyzed for contaminated soil and sediments, as follows:

Alternative 1--No Action with Monitoring
Alternative 2--Limited Action
Alternative 3--*In Situ* Capping
Alternative 4--Dredging/Excavation and Disposal
Alternative 5--Dredging/Excavation and Treatment.

A combination of Alternatives 2 and 4 is the selected remedy. The selected remedy addresses the threats posed to human health and the environment by reducing contaminant concentrations in soil and the source of contaminants to fish. This remedy is intended to reduce exposure to contamination through source removal, a physical fish control barrier, and institutional controls.

The major components of the selected remedy include the following:

- Institutional controls: Fishing restrictions in Garrision Slough;

- Engineering controls: Fish control device near the downstream edge of Eielson AFB;

- Excavation of contaminated soils and sediments with concentrations greater than 10 mg/kg PCBs;

- Onsite disposal of material with PCB concentrations less than 50 mg/kg;

  Offsite disposal or treatment of materials with PCB concentrations greater than 50 mg/kg in accordance with the Toxic Substances Control Act (TSCA), 40 CFR part 761; and

- Environmental monitoring of soils, sediments, surface water, fish, and groundwater.

This combination entails the removal and disposal/treatment of the contaminated sediment and soils posing an unacceptable risk, the use of an engineering control to prevent fish from coming into contact with contaminated sediment during removal, and the use of institutional controls to prevent fishing in Garrison Slough until it is confirmed that levels in fish tissue are protective. Soil and sediments containing contaminant concentrations greater than 10 mg/kg will be removed and those with a PCB concentration of less than 50 mg/kg will be disposed of in an on-base landfill. Soil and sediment containing PCB concentrations greater that 50 mg/kg will be disposed or treated offsite in accordance with substantive requirements of TSCA. In addition, a physical fish control device (e.g., fish screen, rock dam) will be constructed in Garrison Slough near the northern base boundary to limit the movement of fish into and out of the slough.

Base fishing directives will restrict the consumption of fish from Garrison Slough until contaminant concentrations in fish are confirmed to be at a level that does not pose an unacceptable risk to human health. The Air Force will continue to monitor contaminant concentrations in fish tissue, surface water and sediment to evaluate the effectiveness of the cleanup.

In conjuction with the CERCLA response action, a Total Maximum Daily Load (TMDL) was developed under Section 303(d) of the Federal Clean Water Act to address nonpoint source loading of PCBs into Garrison Slough. The TMDL will be incorporated into the water quality management plan for the state of Alaska.

Statutory Determination

The selected remedy protects human health and the environment, complies with federal and state requirements that are legally applicable or relevant and appropriate to the remedial actions, and is cost effective. The remedy utilizes permanent solutions and alternative treatment technologies to the maximum extent practicable. However, the statutory preference for remedies that employ treatment as a principal element will not be met. Removal and treatment of contaminated soils and sediments is not considered a cost-effective means of reducing the risks to human health. The identifed risks will be reduced to acceptable levels through onsite disposal and implementation of institutional controls.

Reviews will be conducted at a minimum of every 5 years after commencement of remedial action, in accordance with Section 121(c) of CERCLA, to ensure that the remedy continues to provide adequate protection of human health and the environment.

Signature sheet for the foregoing Record of Decision for the final Sitewide remedial action at Eielson Air Force Base, Alaska between the United States Air Force and the United States Environmental Protection Agency, with concurrence by the state of Alaska.

Eugene D. Santarelli

EUGENE D. SANTARELLI
Lieutenant General, U.S.A.F.
Chairman, HQ PACAF Environmental Protection Committee

2 MAR 97
Date

Signature sheet for the foregoing Record of Decision for the final Sitewide remedial action at Eielson Air Force Base, Alaska between the United States Air Force and the United States Environmental Protection Agency, with concurrence by the state of Alaska.

for Lynn L. Tomich Kent
KURT FREDRIKSSON
Director of the Division of Spill Prevention and Response
Alaska Department of Environmental Conservation

3/27/97
Date

Signature sheet for the foregoing Record of Decision for the final Sitewide remedial action at Eielson Air Force Base, Alaska between the United States Air Force and the United States Environmental Protection Agency, with concurrence by the state of Alaska.

for CHUCK CLARKE
Regional Administrator
Region 10
U.S. Environmental Protection Agency

9/30/96
Date

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LIST OF ACRONYMS

ADEC	Alaska Department of Environmental Conservation
AFB	Air Force Base
ARAR	applicable or relevant and appropriate requirement
BLRA	Baseline Risk Assessment
BTEX	benzene, toluene, ethylbenzene, and xylene
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
EHQ	environmental hazard quotient
EPA	U. S. Environmental Protection Agency
FFA	Federal Facility Agreement
FNSB	Fairbanks North Star Borough
FS	feasibility study
HI	hazard index
HLA	Harding Lawson Associates
HQ	hazard quotient
IRIS	Integrated Risk Information System
IRP	(U.S. Air Force) Installation Restoration Program
LOEC	lowest observable effects concentration
LOED	lowest observable effects dose
LOEL	lowest observable effects level
MCL	maximum contaminant level
NCP	National Contingency Plan
NPL	National Priorities List
OU	operable unit
PAH	polynuclear aromatic hydrocarbon
PCB	polychlorinated biphenyl
POL	petroleum, oil, and lubricant
ppm	parts per million
RAO	remedial action objective
RCRA	Resource Conservation and Recovery Act
RfD	reference dose
RI	remedial investigation
RME	reasonable maximum exposure
ROD	Record of Decision
SARA	Superfund Amendments and Reauthorization Act
SER	Source Evaluation Report
SF	slope factor
SQC	sediment quality criteria
TBC	to be considered
TEF	toxic equivalency factor
TPH	total petroleum hydrocarbons
TSCA	Toxic Substances Control Act
WTP	water treatment plant

Eielson Air Force Base Sitewide Record of Decision

Decision Summary

1.0 Site Name, Location, and Description

Eielson Air Force Base (AFB) is located in the Fairbanks North Star Borough (FNSB) of central Alaska, approximately 40 km (24 mi) southeast of Fairbanks and 16 km (10 mi) southeast of the city of North Pole along the Richardson Highway (Figure 1.1). The base covers an area of approximately 8000 hectares (19,700 acres). Approximately 1500 hectares (3650 acres) are fully or partially developed, with the remaining land comprising forest, wetlands, lakes, and ponds. The base is bounded on the east and south by Fort Wainwright, a U.S. Army installation, and on the west and north by private and public land. Other base facilities that are not contiguous with the main part of Eielson AFB are the Blair Lakes Target Facility, about 72 km (45 mi) southeast of Fairbanks, and the Birch Lake Recreation Area, about 48 km (30 mi) south of the base. The base is isolated from major urban areas, with the adjacent public and private land zoned for general use.

The FNSB, Fairbanks, and North Pole have populations of approximately 82,000, 32,000, and 1600, respectively. Other communities near Eielson AFB include Moose Creek, near the northern boundary of the base, and the Salcha area, near the southern boundary.

Eielson AFB is a major employer in the Fairbanks area. The base employs approximately 3400 military personnel and 500 civilians. The total residential population of Eielson AFB is 5132. The total population (living and working on the base) is approximately 10,000. Residential and occupational populations are concentrated in the developed portion of the base. The area is active with ongoing base functions, work, school, and recreational activities. The base has three elementary schools and one junior-senior high school. There is one child care center and one medical and dental clinic.

The base is located in the Tanana River Valley. Most of the base has been constructed on sand and gravel fill. The topography in the developed portion of the base is generally flat and featureless with elevations averaging about 168 m (550 ft) above mean sea level. The undeveloped east and northeast sides of the base are as high as 343 m (1125 ft) above mean sea level. Two-thirds of the base (mostly the undeveloped areas) is underlain by soils containing discontinuous permafrost. Half of the potential agricultural soil is currently being used for recreation facilities, ammunition storage areas, Arctic Survival Training School, and other Air Force operations. Wildlife inhabits many areas of Eielson AFB, and the base supports a variety of recreation and hunting opportunities. There are no resident threatened or endangered species on the base.

Surface water bodies near Eielson AFB include rivers, creeks, sloughs, lakes, ponds, and wetlands. Surface drainage at Eielson AFB is generally north-northwest, parallel to the Tanana River (Figure 1.2). Several small sloughs and creeks pass through the base and discharge to the Tanana River. Moose Creek is the main receiving stream for small local drainages around the base. Both French Creek, along the eastern edge of the base, and Piledriver Slough, along the western edge, discharge to Moose Creek just above its confluence with the Tanana River. Garrison Slough also discharges to Moose Creek. Garrison Slough passes directly through the developed portion of the base and is primarily an engineered drainage channel. Portions of Garrison Slough are enclosed in culverts.

Eielson AFB contains 13 lakes totaling 1.3 sq km (0.5 sq mi), 54 ponds totaling 1 sq km (0.4 sq mi), and 10 designated wetlands totaling about 1 sq km (0.4 sq mi). One lake and six ponds are natural; the remaining are old borrow pits or gravel pits.

The developed portion of the base is underlain by a shallow, unconfined aquifer comprising up to 91 m (300 ft) of alluvial sands and gravel with minor clay and silt overlying crystalline bedrock. Groundwater is the only source of potable water at the base and in the communities near the base. Potable water in the main base system is treated to remove iron and sulfate. Groundwater is the principal source for various other industrial, domestic, agricultural, and fire-fighting purposes.

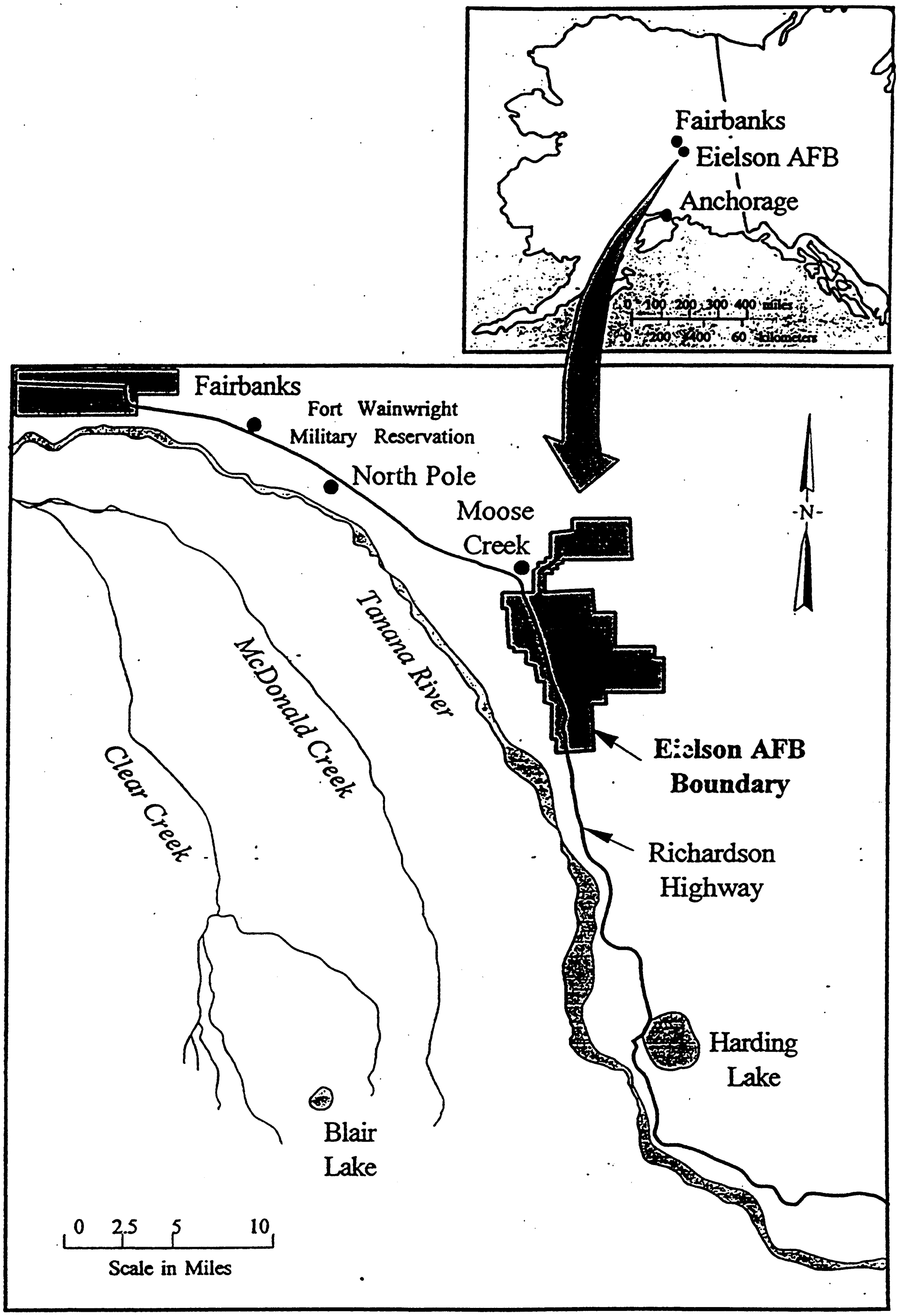

FIGURE 1.1. Map of Eielson AFB

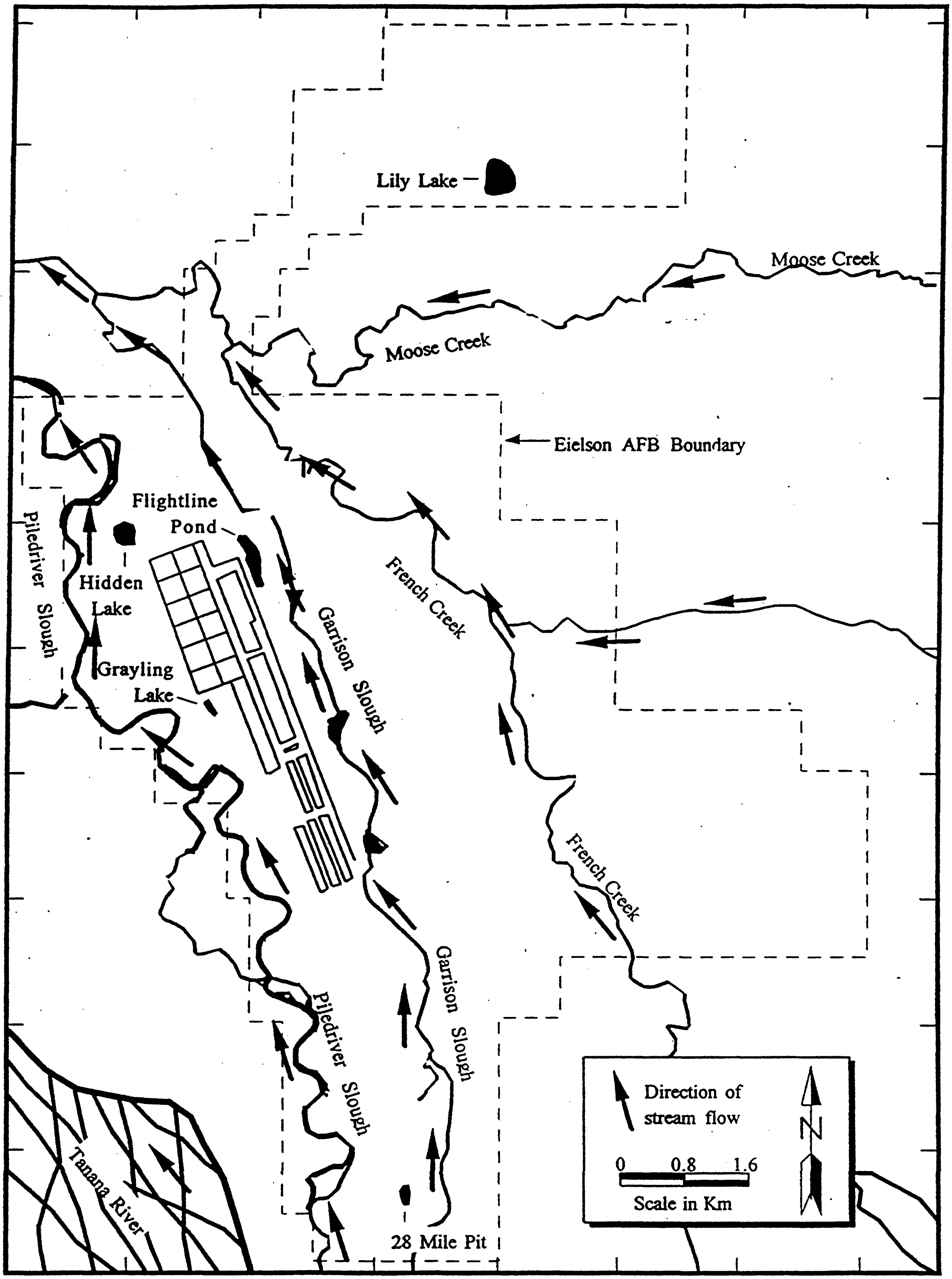

FIGURE 1.2. Surface Drainage Map

2.0 Site History and Enforcement Activities

Eielson AFB was established in 1944, and military operations have continued to the present. The mission of Eielson AFB is to train and equip personnel for close air support of ground troops in an arctic environment. Eielson AFB operations include aircraft maintenance and operations, an active runway and associated facilities, munitions storage, and administrative offices, as well as residential and recreation facilities.

Contamination of soil, groundwater, surface water, and sediment at the base has resulted from the storage and handling of fuels and solvents and the operation of landfills. This contamination was initially evaluated under the U.S. Air Force Installation Restoration Program (IRP). The four-phase IRP was implemented in 1982 with a Phase 1 records search to identify past disposal sites containing contaminants that may pose a hazard to human health or the environment (CH2M Hill 1982). Under the IRP, the U.S. Air Force identified 64 potential areas of contamination at Eielson AFB. Potential source areas include old landfills, storage and disposal areas, fueling system leaks, and spill areas.

Eielson AFB was listed on the National Priorities List (NPL) (54 FR 48184) by the U.S. Environmental Protection Agency (EPA) on November 21, 1989. This listing designated the facility a federal Superfund site subject to the remedial response requirements of the *Comprehensive Environmental Response, Compensation, and Liability Act* (CERCLA), as amended by the *Superfund Amendments and Reauthorization Act* (SARA).

In May 1991, the U.S. Air Force, the state of Alaska, and EPA entered into a Federal Facility Agreement (FFA) (EPA et al. 1991) which established the procedural framework and schedule for developing, implementing, and monitoring CERCLA response actions. Under the FFA, 60 of the 64 potential source areas identified in the IRP were placed in one of six operable units (OU) based on similar contaminant source characteristics, or were included for evaluation in a source evaluation report (SER) for investigation and possible cleanup. Source area locations are shown in Figure 2.1. The FFA also required a final overall sitewide investigation to incorporate all contaminant sources on the base.

An additional goal of the FFA was to integrate the U.S. Air Force's CERCLA response obligations and *Resource Conservation and Recovery Act* (RCRA) corrective action obligations. Thus, any remedial action implemented should be protective of human health and the environment such that remediation of releases shall obviate the need for further corrective action under RCRA (i.e., no further corrective action shall be required).

In conjunction with the CERCLA response action, a Total Maximum Daily Load (TMDL) was developed under Section 303(d) of the Federal Clean Water Act to address nonpoint source loading of PCBs into Garrison Slough. The TMDL will be incorporated into the water quality management plan for the state of Alaska under the Clean Water Act.

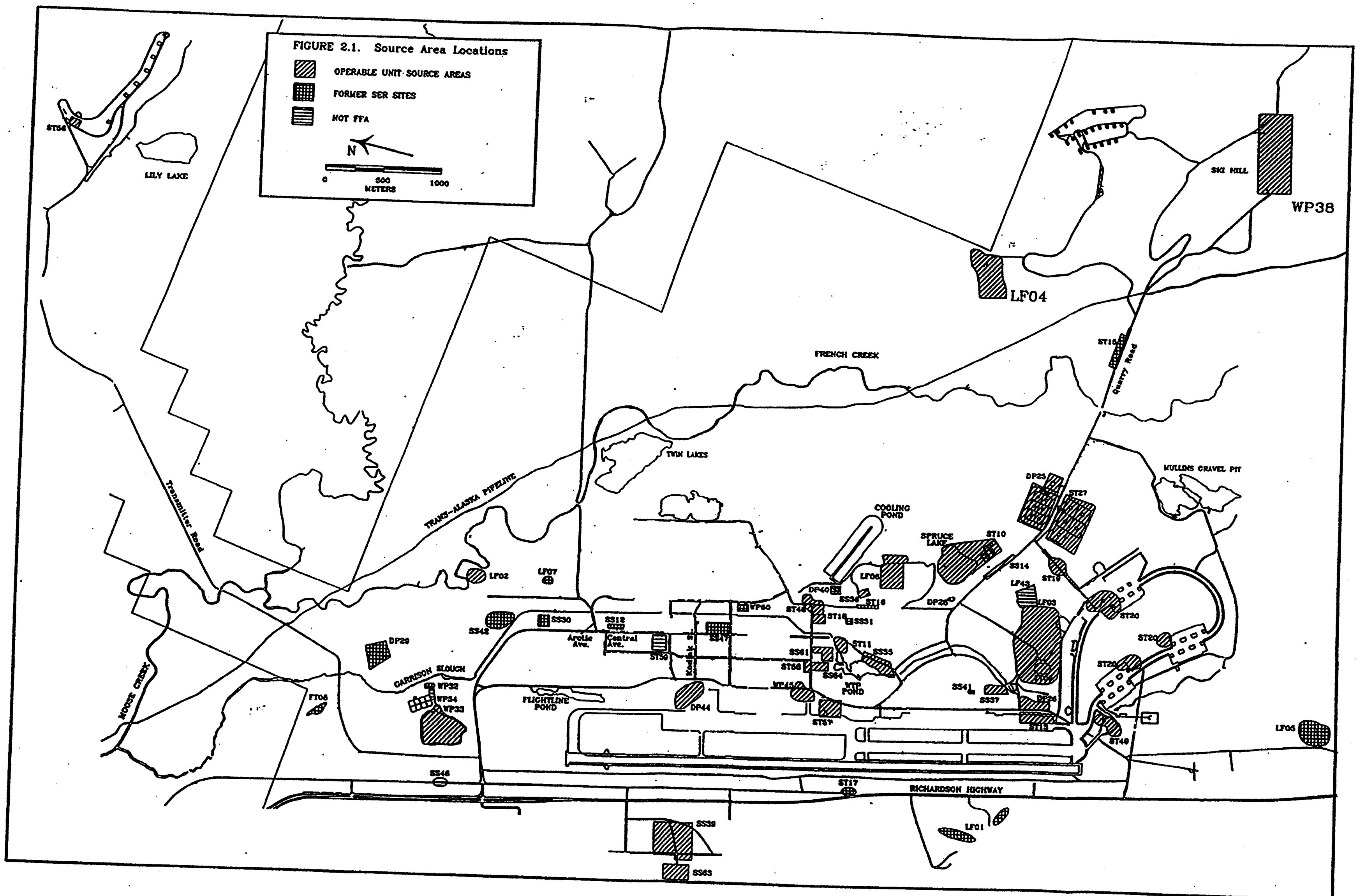

FIGURE 2.1. Source Area Locations

3.0 Highlights of Community Participation

After signing the FFA with the state of Alaska and EPA, the U.S. Air Force began its Superfund cleanup program. As part of this program, in accordance with CERCLA Sections 113(k)(2)(B)(i-v) and 117, a community relations program was initiated to involve the community in the decision-making process.

The community relations staff interviewed 40 local residents and community leaders to develop plans to keep residents informed about the cleanup activity at Eielson AFB. The results of questionnaires and interviews of more than 100 residents were used to revise the Community Relations Plan. An environmental cleanup newsletter was created and mailed to anyone who wished to be on the mailing list. Fact sheets were prepared on various topics related to the cleanup operations. Several times a year, articles that describe significant cleanup events are released to the base newspaper *Goldpanner*, as well as to the *Fairbanks Daily News Miner*. All of these efforts are designed to involve the community in the cleanup process.

The sitewide remedial investigation/feasibility study (RI/FS) and sitewide Proposed Plan for Eielson AFB were released to the public in August 1995. These documents were made available to the public in both the administrative record and an information repository maintained at the Elmer E. Rasmusen Library at the University of Alaska, Fairbanks.

The public comment period on the sitewide Proposed Plan was held from September 1, 1995, through September 30, 1995. Comments received during that period are summarized in the Responsiveness Summary of this ROD.

The sitewide Proposed Plan was advertised in three newspapers. The public comment period and public meeting were advertised on August 31, 1995 in the *Fairbanks Daily News Miner*, and on September 1, 1995, in the *North Pole Independent*. An advertisement also appeared on September 1, 1995 in the *Goldpanner* base paper. In addition, more than 3,500 copies of the sitewide Proposed Plan were added as an insert in the base newspaper and delivered to every home in the Eielson AFB housing area.

A public meeting held on September 21, 1995, was attended by approximately 21 people. At this meeting, representatives from the U.S. Air Force, Alaska Department of Environmental Conservation (ADEC), and EPA answered questions about problems at the site and the remedial alternatives under consideration.

No public comments were received in response to the Sitewide Proposed Plan. A summary of community participation and the public meeting are included in the Responsiveness Summary in this ROD.

4.0 Scope and Role of Sitewide Investigation

The FFA for Eielson AFB divided 29 source areas into 6 OUs based on common characteristics or contaminants, and specified 31 additional sites for source evaluations. The site cleanup strategy was to address contamination at each individual source area through the RI/FS or SER process, and to evaluate cumulative environmental impacts through a sitewide investigation. The OUs are as follows:

OU 1 Petroleum, Oil, and Lubricant (POL) Contamination, some with evidence of floating petroleum product
OU 2 POL Contamination, no current evidence of floating petroleum product
OU 3 Solvent Contamination
OU 4 Land Disposal of Fuel Tank Sludge, Drums, and Asphalt
OU 5 Landfills
OU 6 Ski Lodge Well Contamination.

An interim action at OU 1 (called OU 1B) was initiated in June 1992 to remove petroleum product floating on top of the water table. The RODs for OUs 1 through 6 have been signed (U.S. Air Force 1994c, 1994d, 1994e, 1995b), and remedial actions for source areas that pose an unacceptable risk to human health and the environment are in the design or implementation phase of the Superfund response. Limited action is required at some source areas. No further action under CERCLA is required at source areas that do not pose an unacceptable risk to human health or the environment.

The SER sites were believed to have a low probability of posing a significant risk to human health and the environment. These sites were divided into two groups for Phase 1 or Phase 2 source evaluations. Phase 1 activities were limited to "desk-top" evaluations of historical data. Phase 2 activities required limited field investigations to collect additional data needed for evaluation. After Phase 1 or Phase 2 evaluations, one of the following recommendations for each SER site was made: no further action, referral to another state or federal program, or assignment to an OU for further investigation. Table 4.1 summarizes the CERCLA decisions for the 60 source areas identified in the FFA for Eielson AFB.

The purpose of the sitewide investigation was two-fold: to collect information about site characteristics needed to support all environmental characterization and restoration efforts on the base, and to identify and characterize cumulative environmental impacts not addressed in the OU or SER investigations. The scope of the sitewide investigation was determined by identifying data gaps not addressed by source area investigations. These data gaps included insufficient information about site hydrogeology, background soil and groundwater quality, and surface water and sediment quality. In addition, sitewide groundwater monitoring was needed to ensure that contaminant plumes were not spreading to previously uncontaminated areas and that releases were not occurring in areas designated or recommended for no further action. A sitewide program was also needed to capture the miscellaneous groundwater monitoring requirements across the base. The sitewide investigation also included evaluations of cumulative risks to human health and the environment from contaminants from multiple source areas through multiple pathways. Additional information about soil and air quality was not needed on a sitewide basis because soil contamination was adequately characterized in the OU RIs (U.S. Air Force 1993b, 1994f, 1994g, 1995c), and the OU baseline risk assessments indicated that the risk from airborne contaminants is within acceptable levels (U.S. Air Force 1994c, 1994d, 1994e, 1995b). Based on the data needs identified above, the following objectives for the sitewide investigation were formulated:

1. Provide information about site hydrogeology and background soil and groundwater characteristics to support OU RI/FS efforts and the sitewide RI/FS.

2. Identify and characterize contamination that is not confined or attributable to specific source areas through sitewide monitoring of groundwater and surface water.

3. Provide a mechanism for continued cohesive sitewide monitoring.

4. Evaluate cumulative risks to human health and the environment from contamination from multiple source areas through multiple pathways.

These objectives were addressed in sitewide studies carried out from 1991 to 1994. These studies were outlined in the *Site Management Plan for Eielson Air Force Base* (U.S. Air Force 1993c). The results of the sitewide investigation are provided in the following reports:

- Sitewide RI/FS Volume 1: Remedial Investigation (U.S. Air Force 1995e)
- Sitewide RI/FS Volume 2: Feasibility Study (U.S. Air Force 1995f)
- Sitewide RI/FS Volume 3: Baseline Risk Assessment (U.S. Air Force 1995g)
- Sitewide RI/FS Volume 4: Biological Risk Assessment (U.S. Air Force 1995h).

The identification of PCB contamination in fish and sediments in lower Garrison Slough was unexpected; no potential source of contamination had been identified in this area from previous phases of the Air Force IRP program or under the RI/FS process. Additional soil sampling activities were conducted concurrently with the preparation and finalization of the Sitewide RI/FS documents. This additional information regarding the location and extent of soil contamination, along with the risk evaluation, is included in the Administrative Record. The alternatives for addressing the soils were analogous to those for addressing the contaminated sediments; therefore, the Feasibility Study was not revised.

The purpose of this ROD is to summarize the selection of the final remedial action under CERCLA for the Sitewide investigation of Eielson AFB and the information considered when selecting that action.

TABLE 4.1. Summary of Source Area Decisions

Source Area Number	Source Area Name	FFA Category	Disposition
LF01	Original base landfill	SER	No further action
LF02	Old base landfill	SER	Assigned to OU-5, no further action
LF03	Current base landfill (inactive)	OU 5	Remedial action required
LF04	Old Army landfill and EOD area	OU 5	No further action (deferred to RCRA)
LF05	Old Army landfill	SER	No further action
LF06	Old landfill	SER	Assigned to OU-5, no further action
LF07	Test landfill	SER	No further action
FT08	Fire training area (past)	SER	No further action
FT09	Fire training area (present)	OU 5	Remedial action required
ST10	E-2 POL storage	OU 2	Remedial action required
ST11	Fuel-saturated area	OU 2	No further action
SS12	JP-4 spill, Building 2351	SER	No further action
ST13	E-4 diesel fuel spill	OU 2	Remedial action required
SS14	E-2, RR JP-4 spill area	OU 2	Remedial action required
ST15	Multiproduct fuel line	SER	No further action
ST16	MOGAS fuel line spill	SER	No further action
ST17	Canol pipeline spill	SER	No further action
ST18	Oil boiler fuel-saturated area	OU 2	No further action
ST19	JP-4 fuel line spill area	OU 2	No further action
ST20	Refueling loop fuel-saturated area	OU 1	Remedial action required
SD21	Road oiling, Quarry Road	SER	No further action
SD22	Road oiling, Industrial Drive	SER	No further action
SD23	Road oiling, Manchu Road	SER	No further action
SD24	Road oiling, Gravel Haul Road	SER	No further action
DP25	E-6 fuel tank sludge burial site	OU 4	Limited action required
DP26	E-10 fuel tank sludge burial pit	OU 2	Remedial action required
ST27	E-11 fuel storage tank area	OU 4	No further action
DP28	Fly ash disposal	SER	No further action
DP29	Drum burial site	SER	No further action
SS30	PCB storage area, Building 2339	SER	No further action
SS31	PCB storage area, Building 3424	SER	No further action
WP32	Sewage treatment plant spill	SER	No further action
WP33	Treated effluent infiltration pond	SER	Assigned to OU-4, no further action
WP34	Sewage sludge drying beds	not FFA	NA
SS35	Asphalt mixing area	OU 4	Remedial action required

TABLE 4.1. Summary of Source Area Decisions (cont.)

Source Area Number	Source Area Name	FFA Category	Disposition
SS36	Drum storage site	OU 4	No further action
SS37	Drum storage, asphalt mixing area	OU 4	No further action
WP38	Ski lodge well contamination	OU 6	Limited action required
SS39	Asphalt lake	OU 4	No further action
DP40	Powerplant sludge pit	SER	No further action
SS41	Old auto hobby shop	SER	No further action
SS42	Miscellaneous storage and disposal area	SER	No further action
LF43	Asbestos landfill	not FFA	NA
DP44	Battery shop leach field, building	OU 3	Remedial action required
WP45	Photo lab, Building 1183	OU 3	Limited action required
SS46	KC-135 crash site, Gate 2	not FFA	NA
SS47	Commissary parking lot fuel spill	SER	No further action
ST48	Powerplant fuel spill	OU 1	Remedial action required
ST49	Building 1300 LUST spill site	OU 1	No further action
SS50	Blair Lakes vehicle maintenance	OU 1	Remedial action required
SS51	Blair Lakes ditch	OU 1	Remedial action required
SS52	Blair Lakes diesel spill	OU 1	Remedial action required
SS53	Blair Lakes fuel spill	OU 1	No further action
DP54	Blair Lakes drum disposal site	OU 1	No further action
DP55	Birch Lakes burial site	SER	No further action
ST56	Engineer Hill fuel spill	SER	Assigned to OU-3, limited action
SS57	Fire station parking lot	OU 3	Limited action required
ST58	Old QM service station	SER	Assigned to OU-4, remedial action required
ST59	Dining hall	not FFA	NA
WP60	New auto hobby shop	SER	No further action
SS61	Vehicle maintenance, Building 3213	SER	Assigned to OU-4, limited action required
SS62	Garrison Slough	SER	Assigned to sitewide, remedial action required
SS63	Asphalt Lake spill site	OU 4	No further action
SS64	Trans maintenance spill site	SER	Assigned to OU-4, no further action

5.0 Site Characteristics

Contamination at Eielson AFB has been investigated in detail since the early 1980s under the IRP and CERCLA programs. The following sources of data were used in the sitewide investigation: surface water and sediment data collected during the IRP program (HLA 1989, 1991), surface water and sediment data collected in 1992 by Bioenvironmental Engineering Services at Eielson AFB, data collected by Pacific Northwest Laboratory during the sitewide RI and biological risk assessment (U.S. Air Force 1995e and 1995h), and sediment and soil data collected by the U.S. Air Force in 1995. Table 5.1 lists the analytes and media sampled in the sitewide investigation. These data are summarized in Appendix A.

Brief descriptions of site characteristics, including hydrogeology and the nature and extent of groundwater, soil, surface water, sediment, and biota contamination are provided in the following sections.

The developed portion of Eielson AFB is underlain by a shallow, unconfined aquifer comprising up to 91 m (300 ft) of alluvial sands and gravel with minor clay and silt overlying crystalline bedrock. The aquifer is characterized by high transmissivities and relatively flat (between 0.001 and 0.002) horizontal gradients. Vertical head differences in the upper 30 m (98 ft) of the aquifer are very small, ranging from less than measurable to 0.15 m (0.5 ft), generally in a downward direction. Groundwater is generally found less than 3 m (10 ft) below the ground surface. The water table is lowest during the winter months, and highest after the spring snowmelt, when it is 0.3 to 0.6 m (1 to 2 ft) higher. The infiltration of snowmelt and runoff during the spring is the major recharge event of the year. The groundwater generally flows to the north-northwest with the direction of flow locally influenced by surface water bodies (e.g., Garrison Slough and Spruce [formerly Hardfill] Lake) and groundwater extraction from the base supply wells.

The water level in Garrison Slough is lower than the water table throughout the year over most of the its length. The slough has no other natural source, and it acts as a drain to the shallow aquifer except near the water treatment plant (WTP) pond and a short distance downstream (see Figure 2.1). The level of the WTP pond is higher than the water table except during the spring recharge event.

5.1 Groundwater

Contamination of groundwater with fuel-related compounds, chlorinated solvents, or lead has been identified at various source areas, and a layer of free petroleum product is present on the water table at several locations. In three areas, plumes of contamination from different source areas have coalesced (source areas ST10/ST14, ST13/DP26, and WP45/ST57). The nature and extent of these groundwater plumes have been delineated in the OU RI reports (U.S. Air Force 1993b, 1994f, 1994g, 1995c). The plumes have either remained the same size or diminished since IRP investigations began in the late 1980s; the contaminants are apparently degrading and dispersing faster than the plumes can expand. Consequently, no contamination is currently migrating off of the base in groundwater, and none is projected to migrate off of the base in the future. Previous RODs for Eielson AFB require the cleanup of groundwater contamination that poses a potential threat to human health (U.S. Air Force 1994c, 1994d, 1994e, 1995b).

Sitewide groundwater monitoring from 1992 to 1994 focused on measuring background concentrations of metals, monitoring shallow groundwater quality at the downgradient edge of the base, collecting additional information for OU or SER investigations, and monitoring areas recommended for no further action to confirm the absence of contamination. Mean background concentrations of iron and manganese typically exceed the secondary maximum contaminant levels (MCLs) of 300 and 50 micrograms per liter (μg/L), respectively, for drinking water. Background arsenic concentrations exceed the primary MCL of 50 μg/L in some areas. No previously unidentified groundwater contamination was detected (U.S. Air Force 1995e). Sitewide groundwater monitoring well locations are shown in Figures 5.1 through 5.5. Groundwater monitoring data are summarized in Appendix A.

5.2 Soil

Surface and subsurface soil contamination, which was caused primarily by fuel and solvent spills or leaks in fuel supply lines or tanks, has also been found at various source areas at Eielson AFB. Soil contamination is typically found at or near the source of contamination. Much of the subsurface soil contamination occurs in the smear zone just above the water table, which is inundated during seasonal fluctuations of the water table. Contaminated soils in the smear zone and floating petroleum product are believed to be continuing sources of contamination to groundwater. Although contaminated soils generally do not directly pose an unacceptable risk to human health or the environment, they are being cleaned up in some areas to remove an ongoing source of contaminants to groundwater. Soil cleanup action decisions at Eielson AFB are documented in the previous RODs. Background concentrations of constituents in soil were characterized in the sitewide investigation. Background soil sampling locations are shown in Figure 5.5, and analytical data are summarized in Appendix A.

Soils contaminated with polychlorinated biphenyls (PCBs) were sampled by the U.S. Air Force in 1995 after PCB contamination was found in sediments from Garrison Slough (see Section 5.3). The extent of PCB-contaminated soil is discussed in the following section because it is associated with sediment contamination.

5.3 Surface Water and Sediment

Surface water bodies at Eielson AFB include Moose Creek, French Creek, Garrison Slough, Piledriver Slough, and various lakes and ponds. Some of these surface water bodies cross OU boundaries and can receive contaminants from multiple source areas. Harding Lawson Associates (HLA) collected and analyzed surface water and sediment samples at various locations across the base as part of the IRP in 1988 and 1990 (HLA 1989, 1991). In the sitewide RI, these data were used to determine the probable condition of surface water bodies, and additional surface water and sediment samples were collected in 1993 and 1994 to complete the characterization and provide information for use in the sitewide human health and ecological risk assessments (U.S. Air Force 1995g and 1995h). Sample locations are shown in Figures 5.5 and 5.6. Sampling results are summarized in Appendix A.

Surface water and sediment contamination appears to be largely confined to Garrison Slough; only traces of contamination were found in other surface water bodies (French Creek, Moose Creek, Piledriver Slough, Flightline Pond, and Lily Lake). Garrison Slough receives most of the surface runoff from the developed part of the base. Low levels of fuel-related chemicals (benzene and ethylbenzene), solvents (trichloroethene and dichloroethene), and pesticides (DDT, DDD, and DDE) were found along the entire length of the slough. Metals were detected at concentrations that did not exceed background levels for groundwater and soil (background samples could not be collected from Garrison Slough because it originates in the developed part of the base). The fuel-related chemicals and solvents probably originate from contaminated groundwater discharging into the slough from adjacent source areas. The pesticides were probably derived from the former widespread application of pesticides across the base.

PCBs were detected in some of the 1994 sediment samples from Garrison Slough. PCBs (Aroclor 1260) were measured in samples from the area just upstream of Arctic Avenue to Transmitter Road (the most downstream station sampled). The maximum concentration of Aroclor 1260 in sediment was 55 milligrams per kilogram (mg/kg) dry weight at Station GS12. The PCB concentration dropped by an order of magnitude approximately 200 m (656 ft) downstream (Station GS07), and by another order of magnitude approximately 700 m (2300 ft) downstream (Station GS09) (Figure 5.7). Additional sampling conducted by the U.S. Air Force in 1995 confirmed that the highest PCB concentrations were found in sediment upstream of Arctic Avenue, with a maximum concentration of 66 mg/kg dry weight Aroclor 1260 found in a sample collected 15 m (50 ft) downstream of Station GS12. The upstream extent of contamination was found in a sample collected 15 m (50 ft) upstream of Station GS12, with an Aroclor 1260 concentration of 52 mg/kg dry weight. A sample collected 15 m (50 ft) upstream from this point had no detectable PCBs.

A shallow trench enters Garrison Slough from its west bank at the point of highest sediment PCB concentrations (Figure 5.8). The PCBs could have been contained in a waste discharge or spill that entered the slough from the trench. Elevated PCB concentrations in sediment downstream of this point indicate that downstream migration of the PCBs has occurred, most likely by the erosion and transport of contaminated sediments. The PCBs might have originated from transformers stored in an area where a masonry shop was previously located adjacent to the slough.

The U.S. Air Force sampled surface soils in the trench and upland area adjacent to the slough. The PCB contamination was largely limited to the trench with the highest concentration (620 mg/kg) found at the far west end of the trench. Levels decreased significantly from the west end of the trench to the slough, indicating a possible location of an historic release of PCBs. The location, concentrations, and extent of PCB contamination is illustrated on Figures 5.8a and 5.8b.

This area was also sampled for DDT and its breakdown products. Low levels of DDT were also found in this area with concentrations ranging from nondetect to 190 mg/kg. The concentrations and extent of DDT found in this area is illustrated on Figure 5.8c.

5.4 Biota

Samples of tissue from terrestrial and aquatic organisms were collected in 1993 to provide data for the sitewide ecological risk assessment (U.S. Air Force 1995h). These data are summarized in Appendix A. Additional aquatic biota samples were collected in 1994 to characterize the sitewide distribution of polynuclear aromatic hydrocarbons (PAHs), pesticides (DDT, DDD, and DDE), and PCBs in fish tissue and to compare contaminant levels in fish on Eielson AFB with background and offsite samples. Aquatic invertebrate and macrophyte samples were also collected at on-base locations to identify any correlation between ecosystem components. The 1994 sample locations are shown in Figures 5.5 and 5.6. Sampling results are summarized in Appendix A and in Figure 5.9.

PAHs, pesticides, and PCBs were detected primarily in the 1994 aquatic biota samples collected from Garrison Slough. PCBs were detected in fish caught in Garrison Slough, French Creek, Moose Creek, and Piledriver Slough at concentrations ranging from an average of 7.23 micrograms per kilogram (μg/kg) wet weight (French Creek at Quarry Road) to 1980 μg/kg wet weight (lower Garrison Slough). PCBs were detected in aquatic invertebrates and vegetation at only one location (lower Garrison Slough). A strong spatial relationship exists between PCB concentrations in sediment and fish, that is, the highest concentrations in sediment were measured in Garrison Slough near Arctic Avenue, and the highest concentrations in fish tissue were measured in fish caught in lower Garrison Slough. Additionally, PCBs were only detected in other ecosystem components (invertebrates and vegetation) in lower Garrison Slough. PCB concentrations in fish tissue decreased at points downstream of Arctic Avenue and were approaching background in tributary streams upstream of the Garrison Slough-Moose Creek confluence. Concentrations in both sediment and tissue were orders of magnitude lower at other sampling locations.

Based on these data, it appears that a complete exposure pathway exists from the sediment to fish in lower Garrison Slough, and that the high concentrations in fish tissues are a direct result of exposure to the contaminated sediment. The uptake of PCBs by fish may occur through incidental ingestion of contaminated sediment while feeding, gill exchange with surface water, and ingestion of contaminated water and prey. Although PCBs were not detected in surface water, they may be present at concentrations below detection limits. PCBs are not readily broken down or excreted by organisms, and tend to concentrate in lipids (fat). Consequently, a fish that has bioaccumulated PCBs is expected to remain contaminated throughout its life. Fish that remain in the area of lower Garrison Slough are likely to continue to bioaccumulate PCBs.

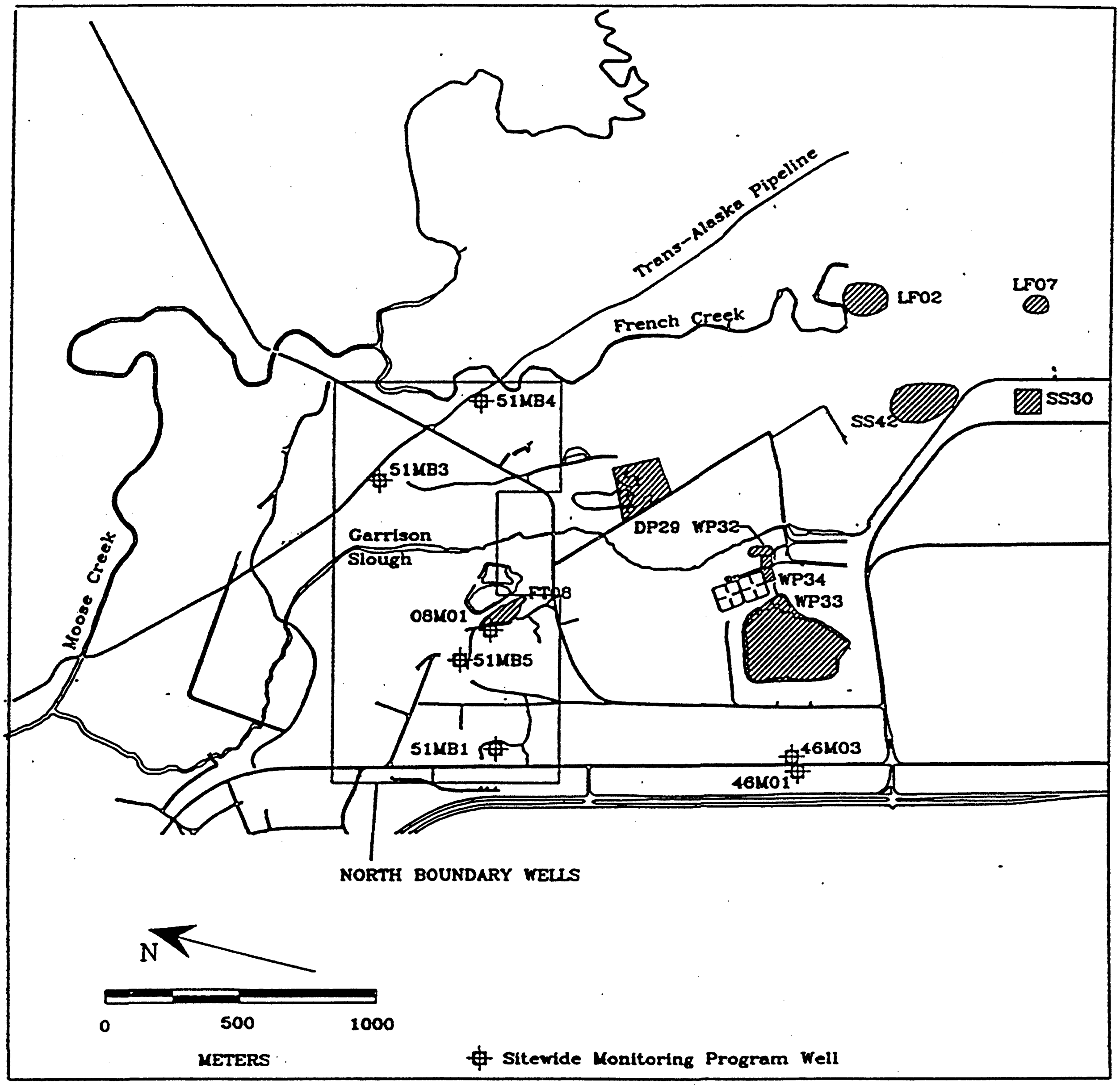

FIGURE 5.1. Sitewide Monitoring Wells in the Lowland Area (North)

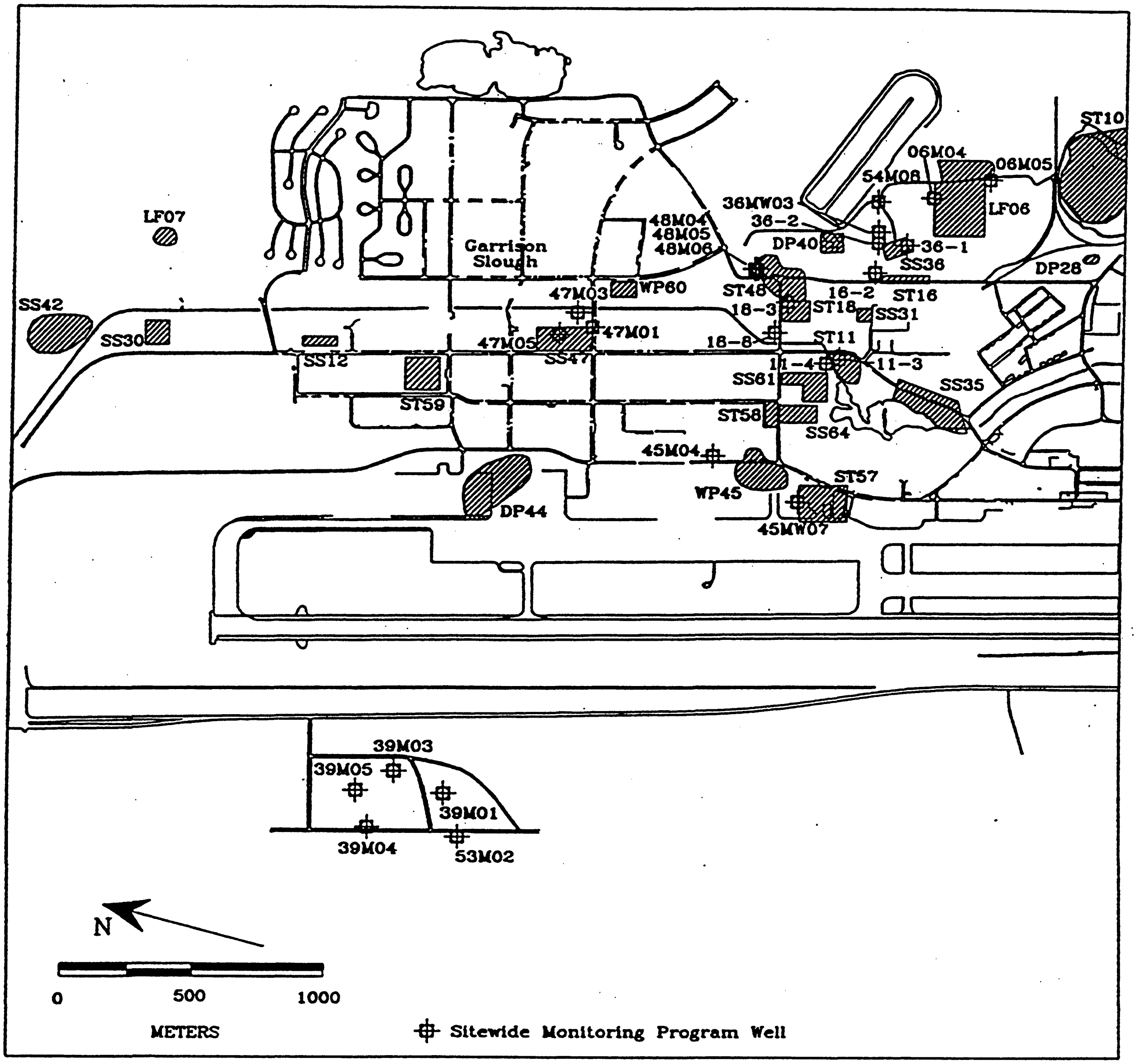

FIGURE 5.2. Sitewide Monitoring Wells in the Lowland Area (Middle)

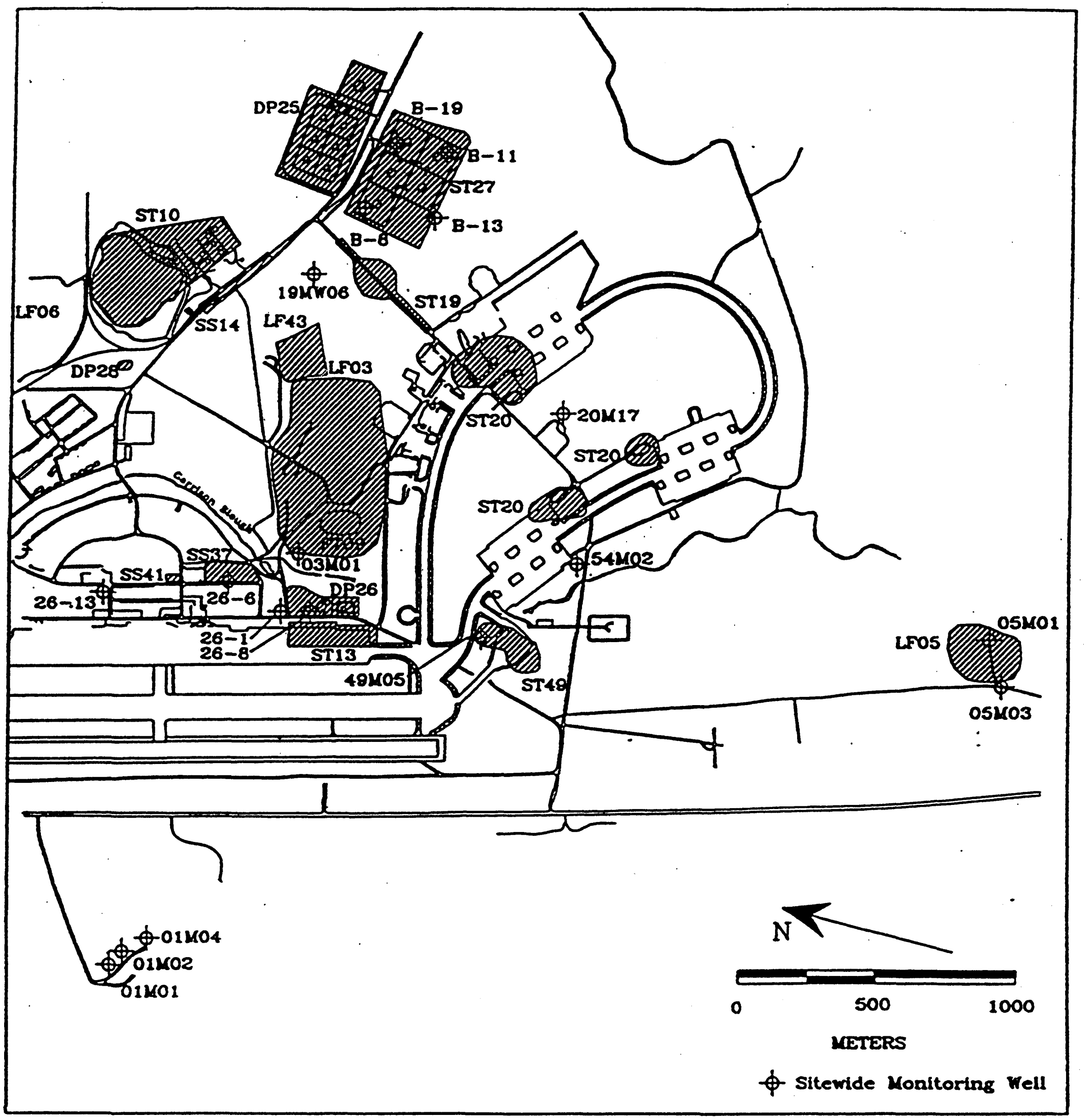

FIGURE 5.3. Sitewide Monitoring Wells in the Lowland Area (South)

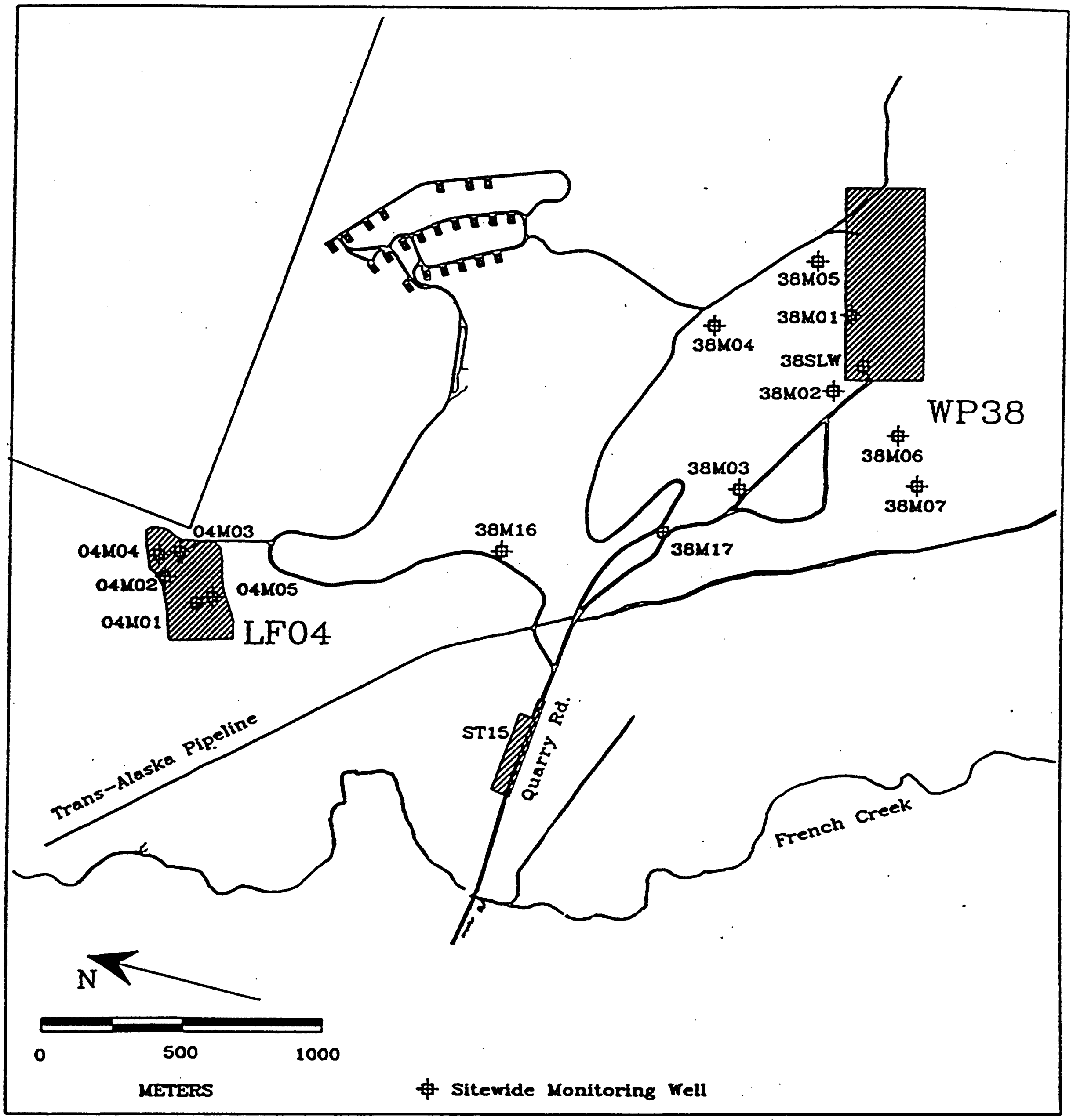

FIGURE 5.4. Sitewide Monitoring Wells in the Upland Area

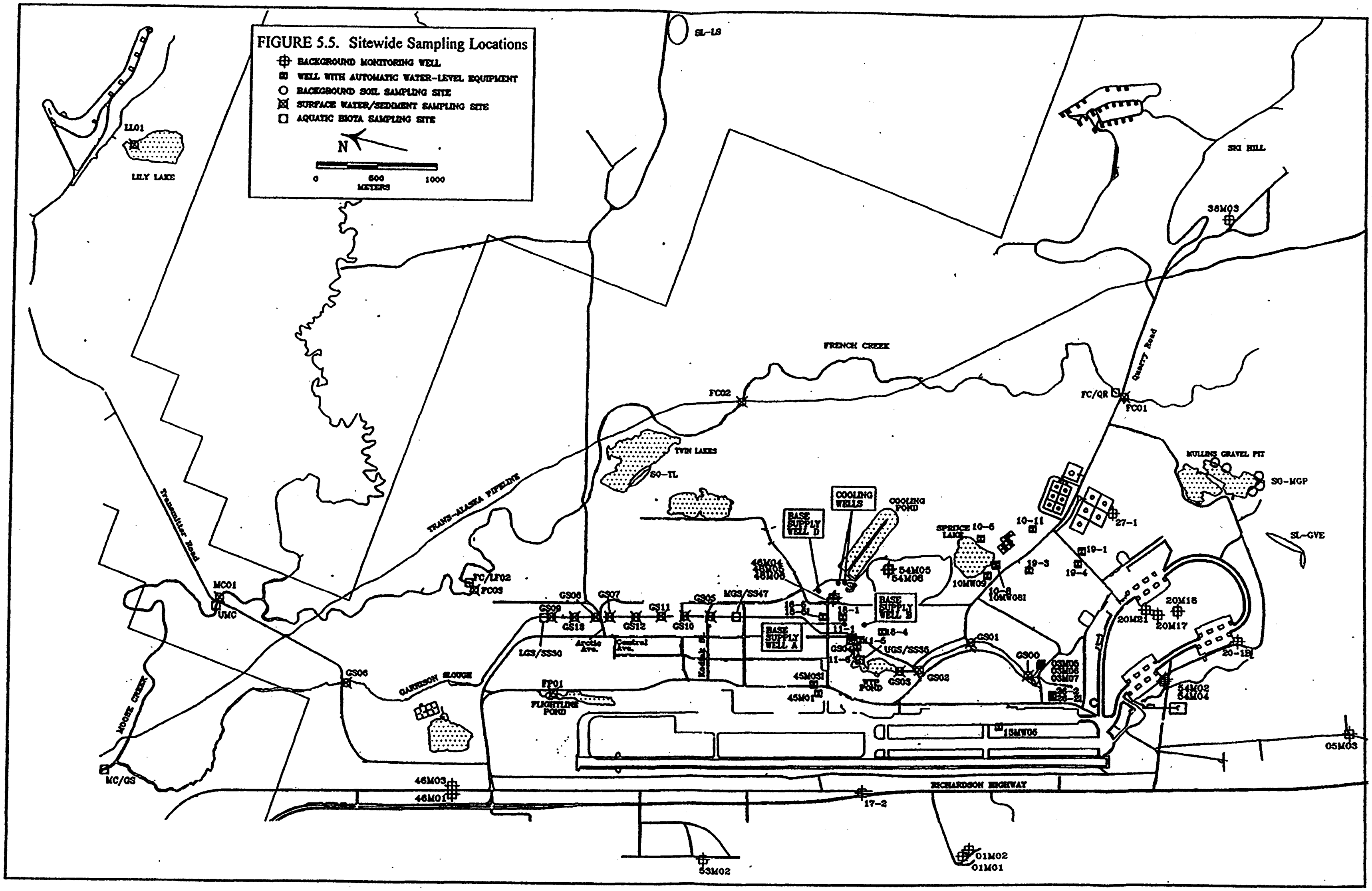

FIGURE 5.5. Sitewide Sampling Locations

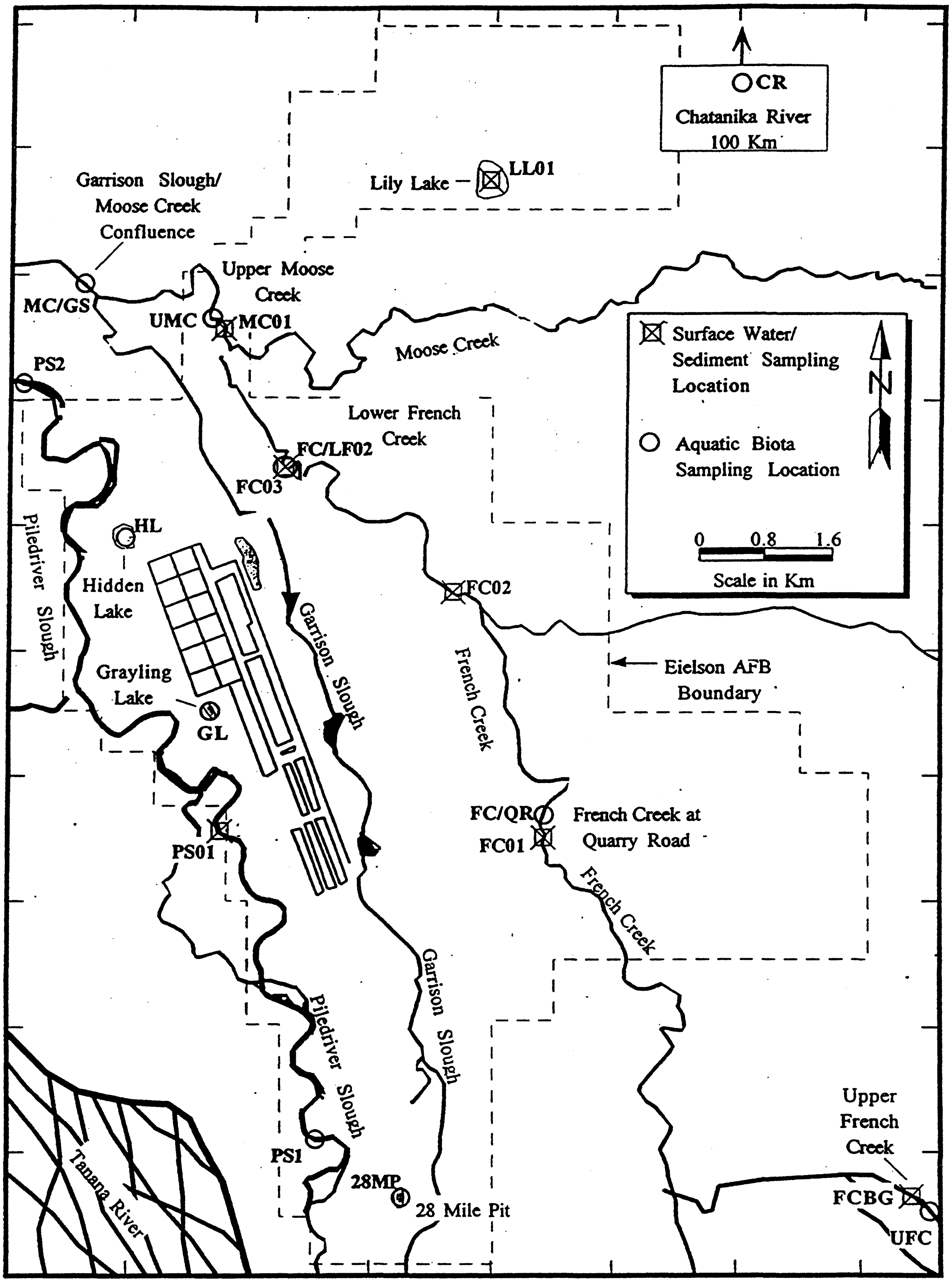

FIGURE 5.6. Sample Locations in Outlying Areas

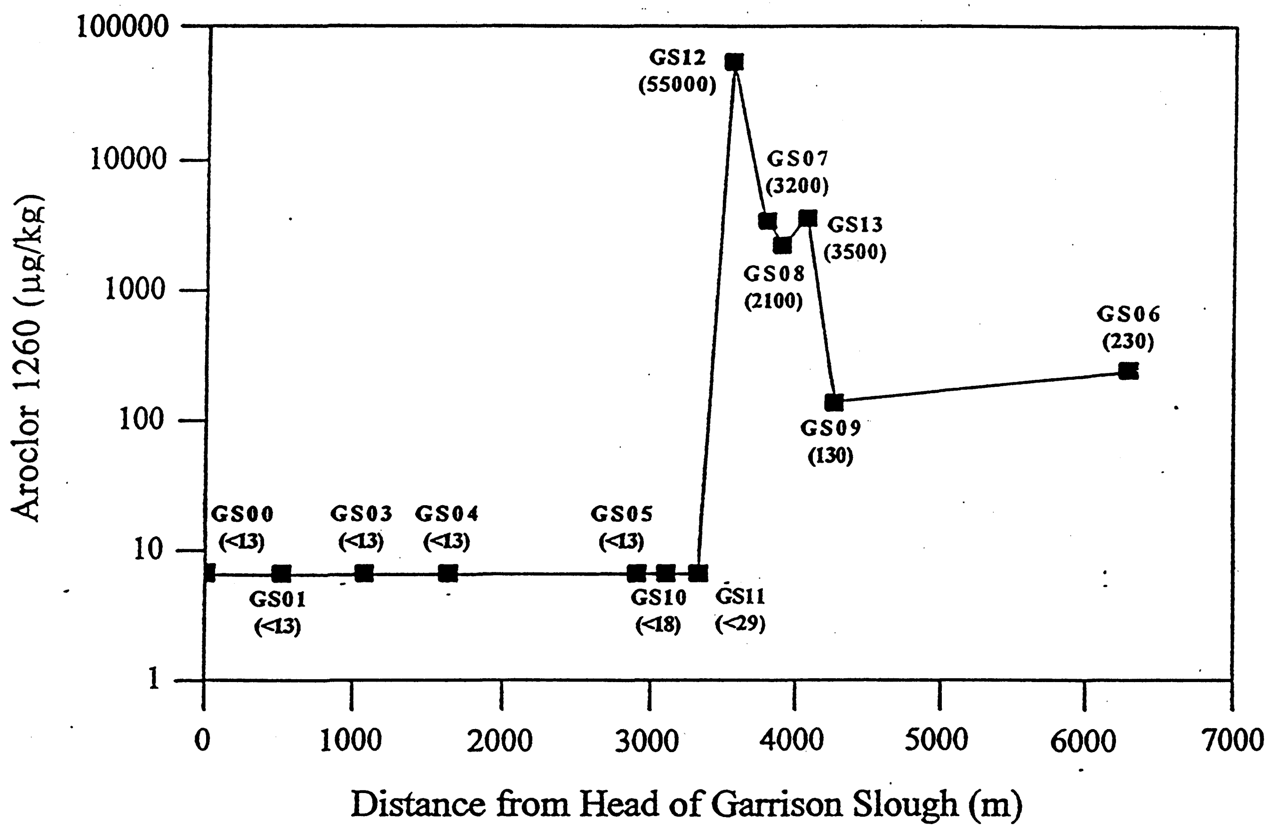

FIGURE 5.7. PCBs in Sediment Samples From Garrison Slough

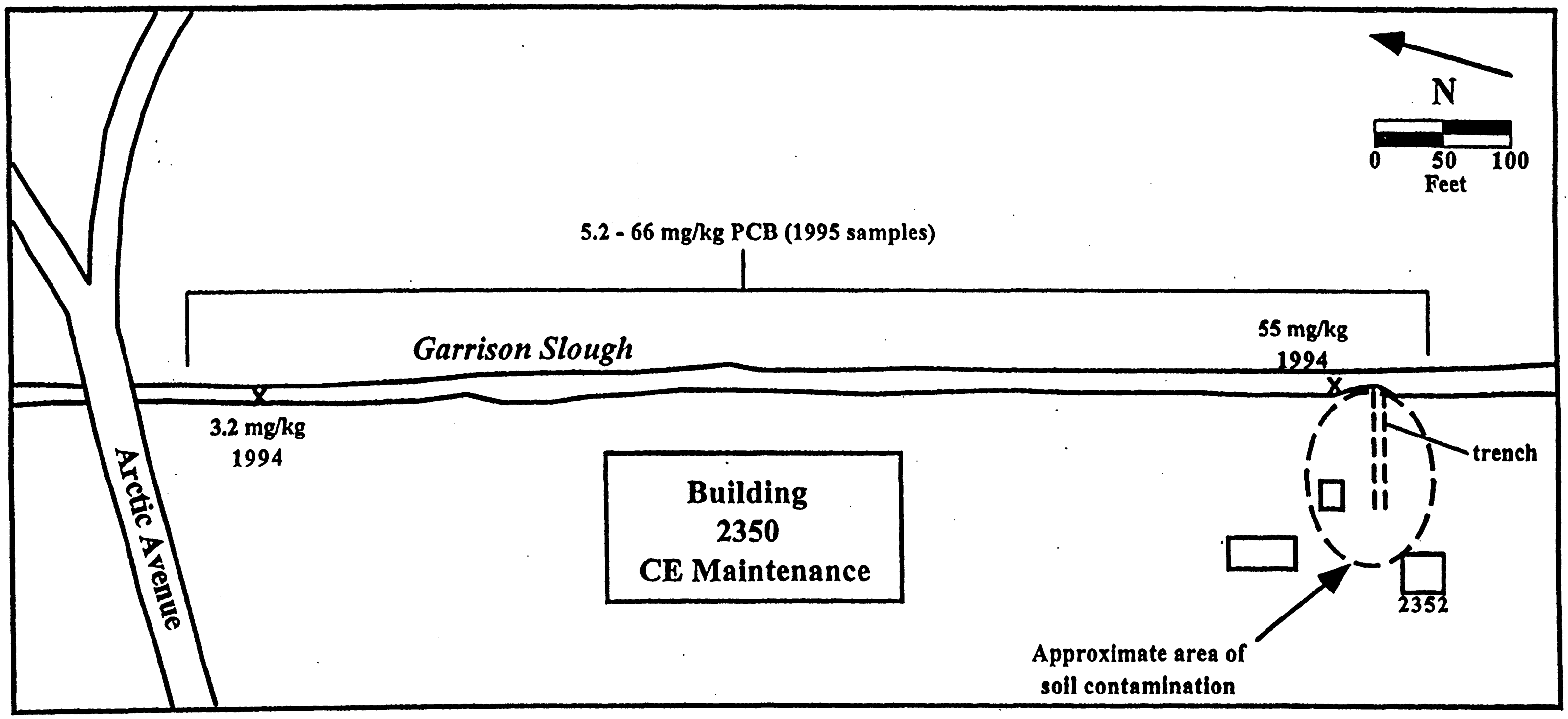

FIGURE 5.8. PCB Contamination South of Arctic Avenue

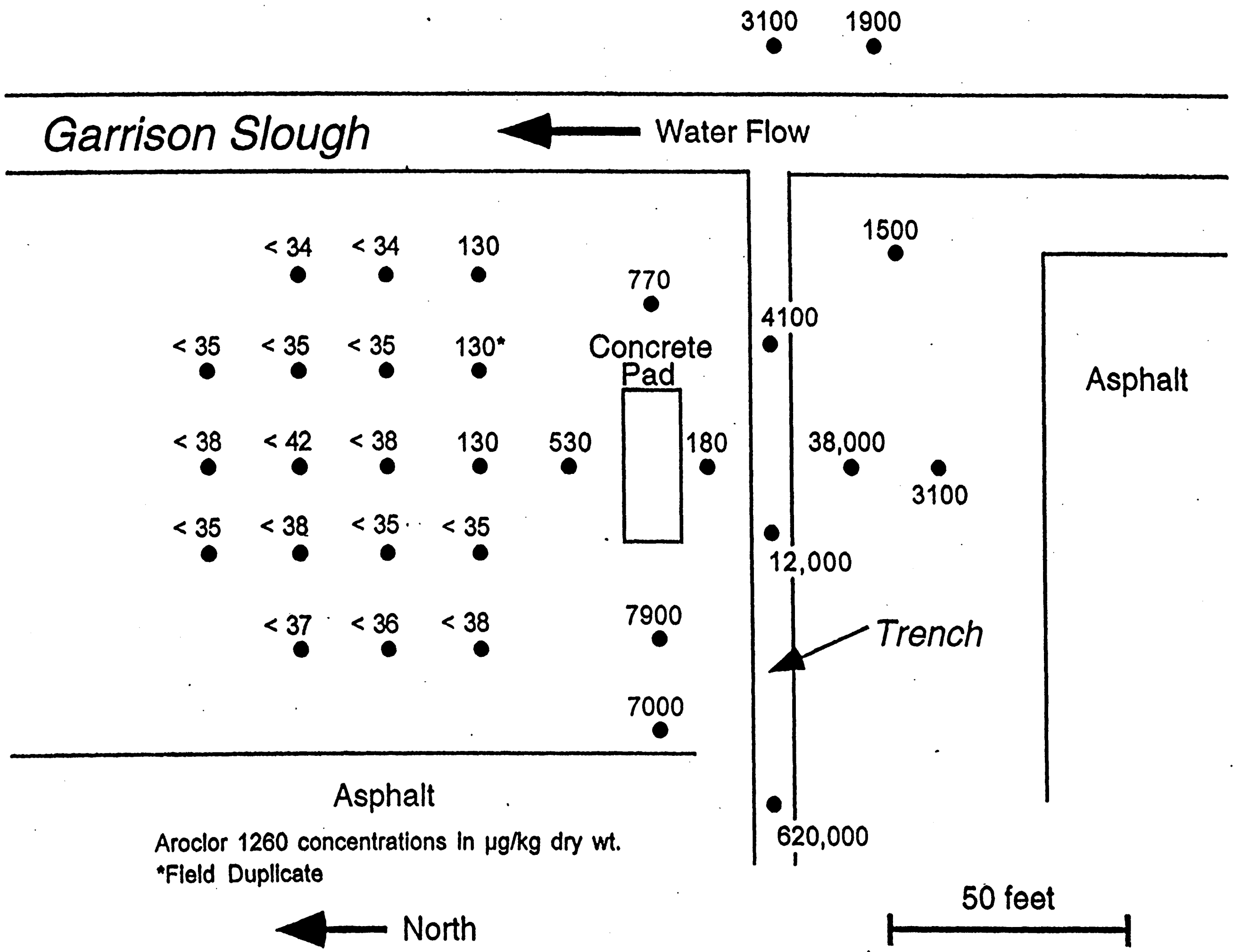

Figure 2. PCB Concentrations in Soil

Risk-Based Concentrations for soil ingestion (in µg/kg)	Industrial	Residential
10^{-6} risk	1,300	160
10^{-4} risk	130,000	16,000

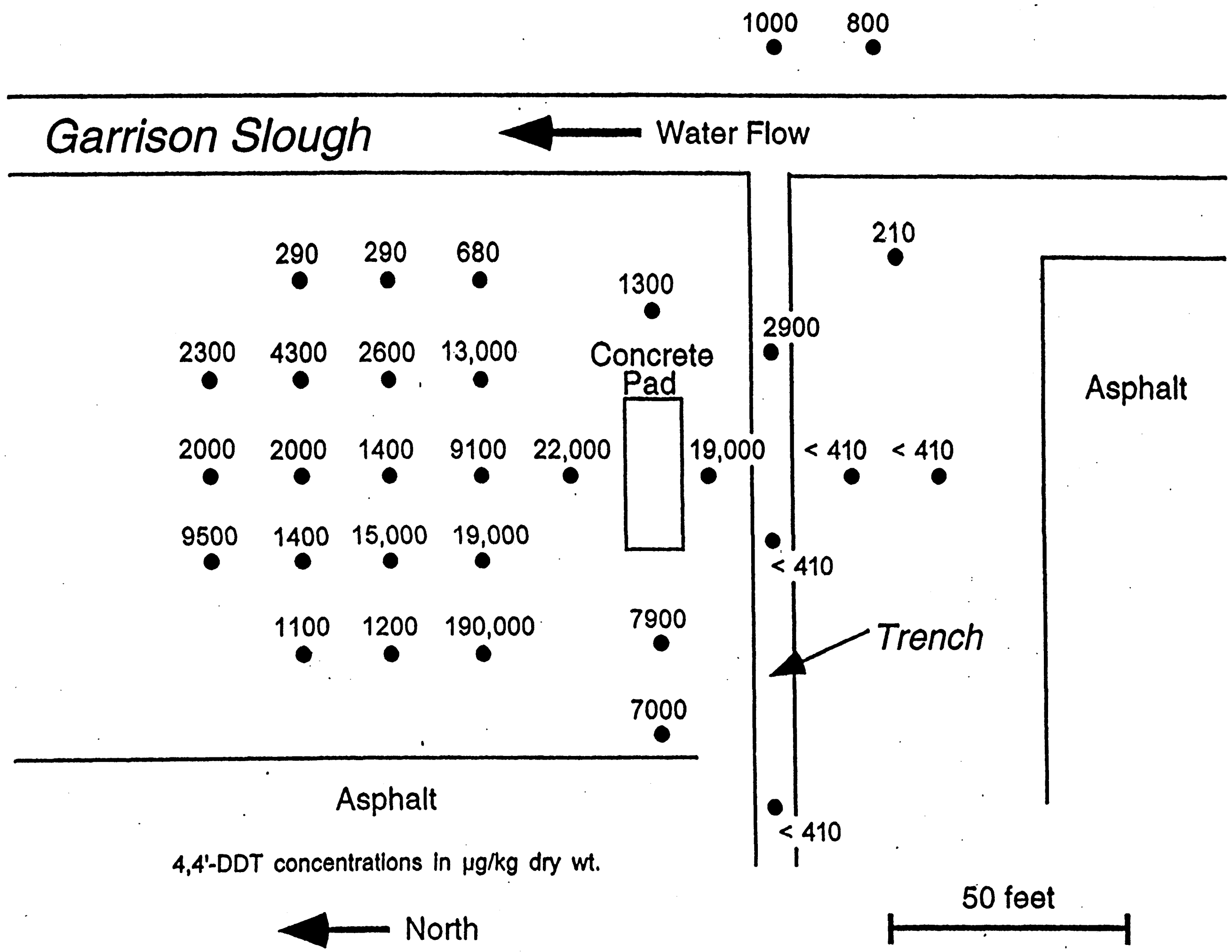

Figure 3. 4,4'-DDT Concentrations in Soil

Risk-Based Concentrations for soil ingestion (in µg/kg)	Industrial	Residential
10^{-6} risk	2,900	370
10^{-4} risk	290,000	37,000

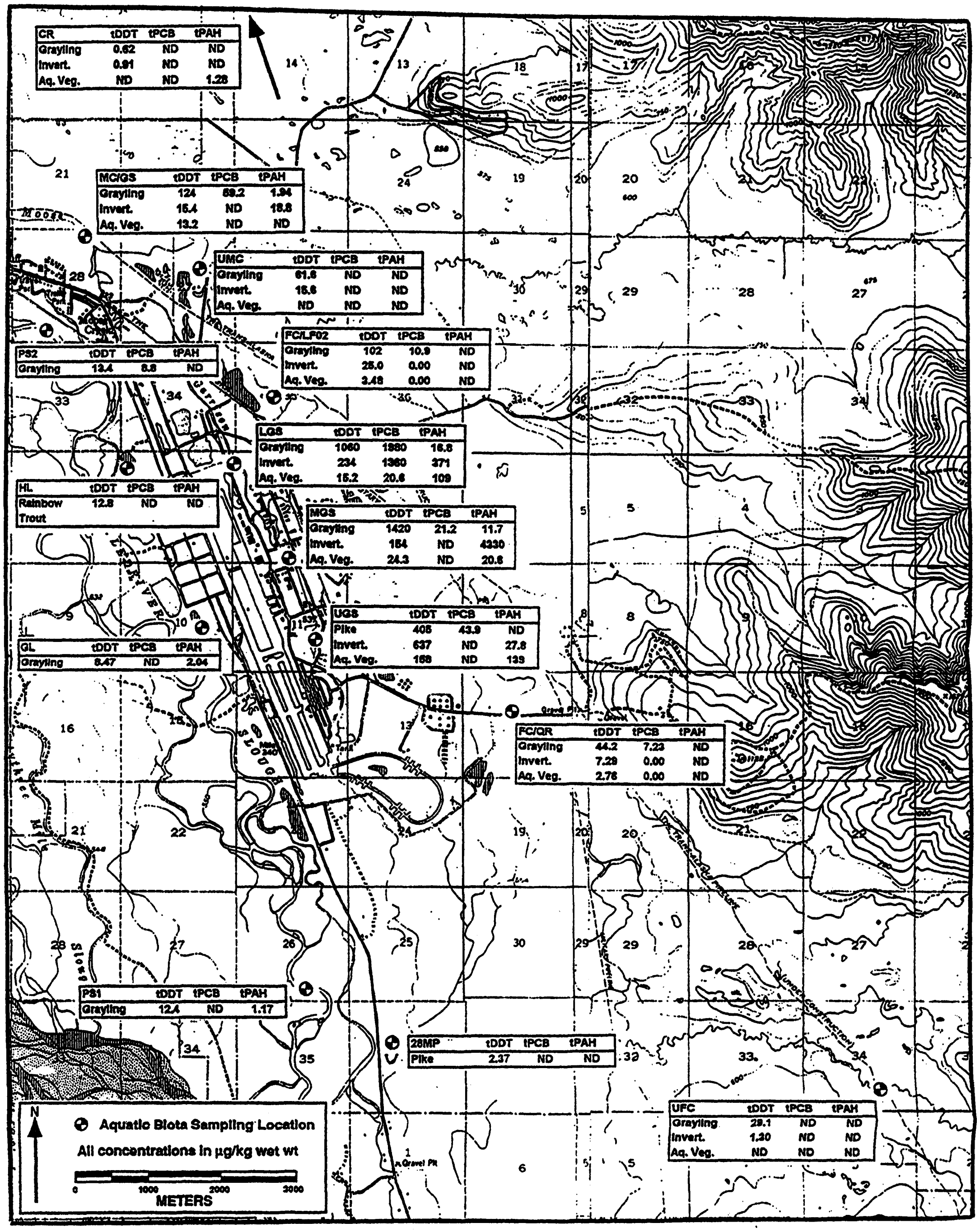

FIGURE 5.9. Total DDT, PCBs, and PAHs in 1994 Aquatic Biota Samples

TABLE 5.1. Analytical Data, Sitewide Investigation

Parameter	Analytical Method	Soil		Groundwater			Surface Water					Sediment						Biota	
		1991 (a)	1995 (b)	1992 (a)	1993 (a)	1994 (a)	1988 (c)	1990 (d)	1992 (e)	1993 (a)	1994 (a)	1988 (c)	1990 (d)	1992 (e)	1993 (a)	1994 (a)	1995 (b)	1993 (f)	1994 (a)
Metals	CLP	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Metals	6010	-	-	X	X	X	X	X	-	X	-	X	X	-	X	-	-	-	-
Metals	6020	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-
Arsenic	7060	-	-	X	X	-	X	-	-	X	-	-	-	-	X	-	-	-	-
Lead	7421	-	-	X	X	-	X	X	-	X	-	X	X	-	X	-	-	-	-
Lead	200.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-
Mercury	7470	-	-	-	-	-	X	-	-	-	-	X	-	-	-	-	-	-	-
TCLP Metals	40 CFR 268	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-
Halogenated Volatile Organics	8010	-	-	X	X	X	X	X	-	X	X	-	-	-	-	-	-	-	-
Aromatic Volatile Organics	8020	-	-	X	X	X	X	X	-	X	X	-	-	-	-	-	-	-	-
1,2-Dibromoethane	504	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-
Volatile Organics	8240	-	-	-	-	-	-	-	-	-	-	X	X	-	-	-	-	-	-
Volatile Organics	502.2	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-
Volatile Organics	524.2	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-
Semivolatile Organics	8270	-	-	-	X	X	X	X	-	X	-	X	X	X	X	-	-	-	-
Semivolatile Organics	625.0	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-
Organochlorine Pesticides/PCBs	8080	X	X[g]	-	X	-	-	X	-	X	X	X	X	X	X	X	X[g]	X	X
Organophosphorus Pesticides	8140	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-
Total Petroleum Hydrocarbons	418.1	X	-	X	-	-	X	X	-	-	-	X	X	-	-	-	-	-	-

TABLE 5.1. Analytical Data, Sitewide Investigation (cont.)

Parameter	Analytical Method	Soil		Groundwater			Surface Water					Sediment						Biota	
		1991 (a)	1995 (b)	1992 (a)	1993 (a)	1994 (a)	1988 (c)	1990 (d)	1992 (e)	1993 (a)	1994 (a)	1988 (c)	1990 (d)	1992 (e)	1993 (a)	1994 (a)	1995 (b)	1993 (f)	1994 (a)
Diesel Range Organics	AK102	-	-	-	X	X	-	-	-	X	-	-	-	-	X	-	-	-	-
Gasoline Range Organics	AK101	-	-	-	-	X	-	-	-	X	-	-	-	-	-	-	-	-	-
PAHs	8270	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X
Anions	300.0	-	-	X	-	-	X	X	-	-	-	-	-	-	-	-	-	-	-
Nitrate	353.2	-	-	-	-	-	X	X	X	-	-	-	-	-	-	-	-	-	-
Total Organic Carbon	9060	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Alkalinity	ASTM 1067 A&B	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Dissolved Solids	209B	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Dissolved Solids	160.1	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-
Cyanide	9010	-	-	-	-	-	X	-	-	-	-	X	-	-	-	-	-	-	-

X Analyzed.
\- Not analyzed.
(a) U.S. Air Force 1995e.
(b) U.S. Air Force 1995 sampling.
(c) HLA 1989.
(d) HLA 1991.
(e) Bioenvironmental Engineering Services, Eielson AFB.
(f) U.S. Air Force 1995h.
(g). PCBs only.

6.0 Summary of Site Risks

6.1 Human Health Risks

The objective of the sitewide baseline risk assessment (BLRA) was to evaluate risks to human health from contamination on Eielson AFB as a whole (U.S. Air Force 1995g). The results of the BLRA provide the basis for taking action and identify the exposure pathways that need to be addressed by remedial action. This section of the ROD reports the results of the sitewide BLRA.

BLRAs were performed for the source areas within the six OUs as part of the RI/FS process (U.S. Air Force 1993a, 1994a, 1994b, 1995a). The potential risks associated with contamination at SER sites were analyzed by conservative screening risk assessments that compared the maximum concentration of each contaminant detected at the site with a risk-based concentration calculated using EPA default exposure factors assuming a residential scenario. The purpose of the sitewide BLRA was to evaluate the cumulative risks to human health from exposure to contamination from multiple source areas through multiple pathways, and to evaluate the human health risk presented by sources that had not yet been evaluated (i.e., surface water contamination).

The nature and extent of groundwater contamination, including areas where plumes from different source areas commingle, and potential for plume migration were evaluated in the individual OU RI/FS documents (U.S. Air Force 1993b, 1994f, 1994g, 1995c). No additional areas of overlapping groundwater contamination were identified in the Sitewide groundwater monitoring program; therefore human health risks posed by contaminated groundwater at Eielson AFB were not further addressed in the sitewide BLRA.

There is potential for cumulative exposures from multiple source areas through multiple pathways at Eielson AFB. Because many source areas are close together, a receptor can be exposed directly (e.g., by surface soil contact) to contaminants from one source area, and indirectly (e.g., by inhalation of volatile organic compounds) to another source area. However, no significant risks were calculated for the inhalation of resuspended particulates or inhalation of volatiles from soils in any of the Eielson AFB source areas (definitions of significant risk are provided in Section 6.1.4). Therefore, indirect exposures will not increase the potential risk at a given source area above levels of concern.

Because the previous BLRAs adequately characterized potential cumulative human health risks associated with groundwater, soil, and air contamination at other OUs at Eielson AFB, the sitewide BLRA evaluated the risks presented by surface water and sediment and soils adjacent to Garrison Slough, which are the media that had not yet been evaluated for cumulative risk. Onsite water bodies evaluated in the sitewide assessment include the following:

- Garrison Slough (upper Garrison Slough, middle Garrison Slough, lower Garrison Slough, and Transmitter Road);
- Moose Creek/Garrison Slough confluence;

- French Creek (upper French Creek [background], Quarry Road, middle French Creek [FC02], and lower French Creek);
- Flightline Pond;
- Lily Lake; and
- Moose Creek (at Transmitter Road).

The following water bodies were also evaluated to determine background risks: Chatanika River, Piledriver Slough, Grayling Lake, Hidden Lake, and 28-Mile Pit. The locations of the surface water locales and associated sample locations evaluated in the risk assessment are shown in Figures 6.1 and 6.2 (except the Chatanika River location, which is along the Steese Highway northeast of Fairbanks).

6.1.1 Identification of Contaminants of Concern

Data collected during the sitewide RI were used to identify contaminants of concern (U.S. Air Force 1995g). The contaminants of concern were identified based on the screening method suggested in the supplemental guidance for Superfund risk assessments in EPA Region 10 (EPA 1991). This method, called the "risk-based screening approach," is conducted as follows:

(1) List maximum concentration of each chemical detected in each medium for each site.

(2) Compare to risk-based screening concentrations.

(3) Eliminate chemicals that meet the following criteria:

- maximum concentration detected in water is $\leq 10^{-6}$ excess cancer risk and 0.1 Hazard Quotient (HQ) screening values, or
- maximum concentration detected in sediment is $\leq 10^{-7}$ excess cancer risk and 0.1 HQ screening values.

(4) Carry the remaining chemicals through the BLRA calculations.

The screening concentrations were calculated using a future residential exposure scenario for the ingestion of soils and sediments, and the ingestion of water and inhalation of its vapors during showering. Although these land-use scenarios and exposure pathways were not appropriate for exposure to surface water and sediment contamination, they yielded more conservative screening values (i.e., the ingestion rates and exposure duration were greater than those associated with exposure to surface water and sediment contamination).

There is no EPA guidance for risk-based screening of fish tissue contaminant data; therefore, all chemical concentrations detected in fish tissue samples passed the screen and were used as input in the risk calculations. No background data for metals in surface water and sediment in Garrison Slough exist because the head of the stream is in a developed (and potentially contaminated) part of the base. Consequently, metals were screened in the same manner as the organic compounds, and those with maximum concentrations exceeding the screening values were input into the risk calculations. However, concentrations of these metals (arsenic, beryllium, and manganese) are believed to occur at site background levels (U.S. Air Force 1995g). Some areas near Fairbanks are noted for elevated concentrations of metals; particularly iron, manganese, and arsenic in the groundwater (U.S. Air Force 1995e). Concentrations of arsenic and manganese correlated well with iron, suggesting that elevated concentrations of these metals reflected natural variations in iron concentration. Beryllium did not correlate well with iron; however, there were only two detections of this metal at concentrations just above the detection limit. Because there are no known sources of beryllium contamination at Eielson AFB, it was not considered a contaminant of concern.

No EPA toxicity data are available for lead, which is a contaminant of concern at several of the source areas at Eielson AFB (e.g., U.S. Air Force 1993b). Lead was analyzed in surface water and sediment samples as part of the sitewide investigation. Screening concentrations for lead at Eielson AFB were calculated using the Uptake Biokinetic model for lead (EPA 1994b). Concentrations of lead in surface water and sediment did not exceed the screening values calculated from the model; therefore, lead was not included in the quantitative risk calculations.

Essential human nutrients that were detected in water and sediment samples (aluminum, calcium, iron, magnesium, potassium, and sodium) were not included in the screening process or in the risk assessment because they are not associated with toxicity under normal circumstances (EPA 1989).

The analytical data used for all locales were collected during the 1993 and 1994 field seasons. These data are listed in Appendixes H and I of the RI (U.S. Air Force 1995e) and summarized in Appendix A of this ROD. The results of the screening process for analytes detected in sediment, water and fish tissue are listed in Tables 6.1 through 6.17. Chemicals of concern input into the risk calculations are those that were not removed in the screening process. The concentrations listed for each contaminant of concern are either the maximum value or the 95-percent upper confidence level on the mean concentration, whichever is smaller. The reasons for screening out chemicals detected in surface water or sediment samples are provided in the tables. No chemicals were screened out for the soils adjacent to the slough; all contaminants detected were evaluated for risk.

6.1.2 Exposure Assessment

The residential area at Eielson AFB currently houses 2730 military personnel and 4230 dependents. In addition, 690 civilians and Air National Guard personnel are employed on the base. Because of the changing nature of military activities, military personnel and dependents typically reside at Eielson AFB for less time than do civilian workers.

Specific base populations were selected to evaluate potential risk from exposure to soil, surface water and sediment contamination in a manner consistent with EPA guidance. Children exposed to soil and playing and fishing in surface water bodies, particularly in and near Garrison Slough, is a primary concern. This scenario requires the evaluation of exposures to soil, surface water, sediments, and fish.

Table 6.18a lists both EPA default and Eielson AFB site-specific exposure factors used in the assessment.

Surface Water and Sediment

Surface water bodies at Eielson AFB are currently used for recreation, and future land use is anticipated to be the same. Children at play are the most likely population to be exposed to surface water and sediment contaminants, both currently and in the future. A site-specific recreational exposure scenario was developed to evaluate exposure of a child playing in surface water, and catching and eating fish. These exposures are expected to occur over shorter periods than would be expected for workers or residents. Under the current recreational land use scenario, the child lives on the base for 3 years, which is consistent with the movement of dependents at a military facility. Under the future recreational land use scenario, the child will play in the stream for 12 years (from age 3 to age 15).

The recreational land use scenario excluded three inhalation exposure pathways: (1) inhalation of volatiles from water, (2) inhalation of volatiles from soil, and (3) inhalation of resuspended sediments. The first pathway was excluded because no volatiles were detected in sediments at sitewide surface water locations. The second pathway was excluded because only one data point for a volatile compound in water exceeded the risk based screening level, and the excess cancer risk calculated from this concentration (1.08 μg/L benzene in upper Garrison Slough) using the recreational land use scenario was less than 1×10^{-6}. Inhalation of resuspended sediments was not included because the riparian habitat prevents the generation of dust.

For each surface water locale and each exposure scenario, the following exposure pathways were considered:

- dermal contact with sediments
- dermal contact with surface water
- ingestion of fish
- incidental ingestion of sediments
- incidental ingestion of surface water.

All of these exposure pathways were considered complete at each locale and for the current and future land use scenarios.

Site-specific exposure factors were developed to reflect the recreational land use scenario and the subarctic climate at the base. Detailed descriptions of the exposure factors are provided in Appendix B of the sitewide BLRA (U.S. Air Force 1995g).

The exposure frequency of 60 days or events per year comprises 30 days of fishing and 30 days of playing in the sediments at a given water body. The adherence factor of 1.5 mg/cm^2 for dermal contact with sediments is at the conservative end of the recommended EPA range (EPA 1991). The exposed skin areas for contact with surface water and sediments by children at play were obtained from EPA's human health risk assessment guidance (EPA 1989). It is assumed that children will be exposed to surface water and sediments on their hands, arms, feet, and lower legs, comprising surface areas averaging 2756 cm^2 for a 6-year-old child, and 4800 cm^2 for a 12-year-old child. The current and future exposure scenarios assume that while at the surface water body, the child ingests 0.5 L of surface water and 200 mg of sediment per day.

There is no known subsistence fishing at Eielson AFB, and none is anticipated in the future because of the limited size and depth of the surface water bodies, and, because of the subarctic climate. The exposure scenario for fishing assumes that fish are caught, taken home, and eaten by a child at a rate of 300 g/day (skin and fillet). The consumption rate 300 g/day for 30 days corresponds to an average of 25 g/day annually, which is about half of the 54 g/day (90th percentile) reported for seafood consumption in Puget Sound (Pierce et al. 1981).

Soil

The exposure cases or scenarios evaluated for a given source area depend on the populations potentially exposed and on the current and potential land use at Eielson. A residential scenario is evaluated to consider potentially exposed future users who could spend 30 years on site. This scenario, which include children who may be the most sensitive subpopulation, is generally considered to be the most conservative. The residential exposure is evaluated to determine the potential risks in the unexpected event of base closure. The current land use as a military base is not expected to change in the foreseeable future.

The potential current- and future-use exposures assume above-average intake of contaminants that are used to calculate chemical (contaminant) intake by humans. The upper 95th confidence limit on mean RME concentrations represents conservative exposures expected for a site under current or future conditions. Non-detect values were assigned a concentration of one-half the detection limit.

6.1.3 Toxicity Assessment

The values and references for all toxicity data used in the risk assessment are listed in Table 6.18b. Toxicity data are divided into carcinogenic (slope factor [SF]) and noncarcinogenic (reference dose [RfD]) categories.

SFs have been developed by EPA's Carcinogenic Assessment Group for estimating excess lifetime cancer risks associated with exposure to potentially carcinogenic contaminants of concern. SFs, which are expressed in units of $(mg/kg\text{-}day)^{-1}$, are multiplied by the estimated intake of a potential carcinogen, in mg/kg-day, to provide an upper-bound estimate of the excess lifetime cancer risk associated with exposure at that intake level. The term "upper bound" reflects the conservative estimate of the risks calculated from the SF. Use of this approach makes underestimation of the actual cancer risk highly unlikely. SFs are derived from the results of human epidemiological studies or chronic animal bioassays to which animal-to-human extrapolation and uncertainty factors have been applied (e.g., to account for the use of animal data to predict effects on humans).

RfDs have been developed by EPA to indicate the potential for adverse health effects from exposure to contaminants of concern exhibiting noncarcinogenic effects. RfDs, which are expressed in units of mg/kg-day, are estimates of lifetime daily exposure levels for humans, including sensitive individuals. Estimated intakes of contaminants of concern from environmental media (e.g., the amount of a contaminant of concern ingested from contaminated surface water) can be compared with the RfD. RfDs are derived from human epidemiological studies or animal studies to which uncertainty factors have been applied (e.g., to account for the use of animal data to predict effects on humans).

No EPA toxicity data exist for the following sitewide contaminants that were not screened out: the PAHs, benzo(a)anthracene, benzo(a)pyrene, and benzo(b)fluoranthene; and the pesticides, 2,4'-DDD and 2,4'-DDT. Benzo(a)pyrene is the only carcinogenic PAH that has a toxicity value in Integrated Risk Information System (IRIS) (EPA 1992b, 1992c). EPA guidance adopts a toxic equivalency factor (TEF) method for carcinogenic PAHs based on the relative potency of each PAH compound relative to benzo(a)pyrene. The toxicity values for the carcinogenic PAHs in Table 6.18 are the products of these TEFs and the toxicity of benzo(a)pyrene. There are no toxicity values in IRIS for 2,4'-DDT and 2,4'-DDD. The toxicity values for 4,4'-DDT and its metabolites were used for the 2,4'-DDT family.

6.1.4 Risk Characterization

The exposure point concentrations listed in Tables 6.1 through 6.17 were used with the toxicity data in Table 6.18 to calculate the risks for carcinogens and noncarcinogens.

For carcinogens, risks were estimated as the incremental probability of an individual developing cancer over a lifetime as a result of exposure to the carcinogen. Excess lifetime cancer risk was calculated from the following equation:

$$\text{Risk} = \text{CDI} \times \text{SF}$$

where:

Risk = a unitless probability (e.g., 2×10^{-5}) of an individual developing cancer
CDI = chronic daily intake average over 70 years (mg/kg-day)
SF = slope factor $(\text{mg/kg-day})^{-1}$.

These risks are probabilities that are generally expressed in scientific notation (e.g., 1×10^{-6} or 1E-06). An excess lifetime cancer risk of 1×10^{-6} indicates that as a reasonable maximum estimate, an individual has a 1 in 1,000,000 chance of developing cancer as a result of site-related exposure to a carcinogen over a 70-year lifetime under the specific exposure conditions at a site.

For noncarcinogens, the potential effects were evaluated by comparing an exposure level over a specified time period with a reference dose derived for a similar exposure period. The ratio of exposure to toxicity is called a hazard quotient (HQ). By adding the HQs for all contaminants of concern within a medium or across all media to which a given population may reasonably be exposed, the Hazard Index (HI) is generated.

The HQ is calculated as follows:

$$\text{Noncancer HQ} = \text{CDI/RfD}$$

where:

CDI = chronic daily intake
RfD = reference dose

CDI and RfD are expressed in the same units and represent the same exposure period (i.e., chronic, subchronic, or short term).

Generally, hazard indices greater than 1 indicate that the potential exists for noncarcinogenic effects to be seen in exposed individuals. Although the incidence or severity of those effects is likely to increase as the HQ increases, the dose-response rates can differ among contaminants and health effects. Thus, an HQ value of 1.0 does not define a sharp distinction between no effects and adverse effects, but rather a transition to the potential for adverse effects.

Risk calculations were performed for the current and future land-use scenarios and all associated exposure pathways. Table 6.19 summarizes by surface water locale the cancer risk and the HI for each exposure pathway individually, the sum of the risks for all exposure pathways, and the sum minus the risk attributable to the background metals. As discussed in Section 6.1.1, metals in sitewide surface water and sediment samples were found at background levels and are not the result of base activities.

Because risk assessments were performed on 17 sitewide surface water locales, this ROD does not present quantified carcinogenic risks and HQs for each contaminant of concern in each exposure medium for each exposure pathway. These data are provided in Appendix I of the sitewide BLRA (U.S. Air Force 1995g).

Table 6.20a summarizes the total pathway cancer risk and HI for each locale using the future recreational land-use scenario. The contributions from the site background metals are subtracted from these totals. Surface water locales can be divided into two groups based on potential risk: 1) those within the developed part of the base with carcinogenic risks greater than 10^{-5} and HIs greater than 1, and 2) offsite locales with lower risks and HIs, typically less than 10^{-6} and 0.1, respectively. At all locales, almost all of the risk is contributed by the fish ingestion pathway. At the lower risk sites, the potential risk is attributable to pesticides in fish tissue (however, this risk is within acceptable levels). At the higher risk sites, almost all of the potential risk is attributable to PCBs in fish tissue.

Table 6.20b summarizes the cancer risk and HIs for the soils adjacent to Garrison Slough based on the 1995 soil data.

Based on these estimates, the primary exposure pathway of concern is exposure to soils in the trench adjacent to the slough and the ingestion of fish. The primary contaminants of concern are PCBs for both the current and future land-use scenarios.

6.1.5 Uncertainty

Health risk assessment methods have inherent uncertainty associated with how accurately the calculated risk estimates represent the actual risk. The effects of the assumptions and the uncertainty factors is not known. Usually, the effect is difficult to quantify numerically (i.e., in terms of an error bar). As a result, the effects are discussed qualitatively. Some of the assumptions and uncertainty factors associated with the sitewide BLRA include the following:

Exposure Point Concentrations

- The risks quantified (based on EPA cancer potency factors) are statistically at the 95 percent upperbound estimate of the risk using a linear, low-dose extrapolation (may overestimate risk).
- Existing concentrations are assumed to be the concentrations or exposure source terms in the future. No reduction from natural degradation and attenuation over time is taken into account. No increase from additional contamination is assumed, and potential degradation products of existing organic contaminants are not taken into account (may overestimate or underestimate risk).
- Fish tissue data were not available for several of the surface water bodies (may underestimate risk).
- Bioconcentration factors for estimating fish ingestion risk were not used at the sites lacking fish tissue data (may underestimate risk).
- Different species of fish, with potentially different contaminant uptake rates, were used for tissue samples (may overestimate or underestimate risk).
- No modeling was performed to predict VOC concentrations in fish tissue (may underestimate risk).
- Only used skin and fillet for fish tissue analyses. Some subpopulations may ingest other tissues (may underestimate risk).
- The surface water detection limits for some organic and inorganic contaminants (e.g., PCBs, PAHs, and dieldrin) are greater than risk-based screening concentrations (may underestimate risk).
- The default dermal adherence factor was used. Actual adherence may be higher or lower because of soil moisture content and other characteristics of soil (may overestimate or underestimate risk).

Exposure Factors

- Use of 300 g/day fish ingestion rate for a child. The Exposure Factors Handbook (EPA 1988) projects a reasonable maximum exposure (RME) consumption rate of 140 g/day (90th percentile). The 300 g/day value, which was calculated for the Puget Sound area of the state of Washington, was used to provide a conservative estimate for this rate of contact (may overestimate risk).
- Surface water bodies (e.g., Garrison Slough) may not support a large enough fish population to provide 30 meals per year (may overestimate risk).
- A site-specific recreational land-use scenario was developed (may overestimate or underestimate risk).

- The exposure calculations performed did not include relative bioavailability factors, so did not account for differences among substance matrices (may overestimate risk).

- The factor of 1.5 mg/cm^2 used for contact with sediments in the recreational land-use scenario is at the conservative end of the range (0.5 to 1.5) recommended in Region 10 supplemental guidance (EPA 1991) (may overestimate risk).

Toxicity Parameters

- The toxicities of 2,4'-DDT and its metabolites are not known. The toxicities of 4,4'-DDT and its metabolites were used as surrogates (may overestimate risk).

- Unknown congener profile of PCBs detected (may underestimate or overestimate risk).

6.2 Environmental Risks

As part of the sitewide RI/FS, a biological risk assessment was performed to evaluate the hazards posed to plants and wildlife from environmental contamination at Eielson AFB (U.S. Air Force 1995h). The biological risk assessment evaluated cumulative risks to ecological receptors posed by all sources of contamination at the site. The risk assessment process approximately followed the modification to the National Academy of Sciences risk assessment paradigm proposed by Lipton et al. (1993). This process includes the following stages:

- Hazard identification - identification of the sources and types of environmental contamination at Eielson AFB.

- Biological characterization - identification of habitats and biological resources that could be affected by contaminants of concern.

- Receptor and source area identification - screen of source areas on the basis of completed biota exposure pathways and identification of receptors to be evaluated in the risk assessment.

- Risk assessment screen - screen of source areas and contaminants based on toxicological benchmarks. Sites and contaminants passing the screen were fully evaluated in the ecological risk assessment.

- Ecological risk assessment - quantitative estimate of exposure hazards to receptors based on toxicological benchmarks.

- Uncertainty analysis - analysis of uncertainties and their effects on the risks identified in the risk assessments.

The first three bulleted elements correspond to the "Problem Formulation" phase identified in EPA's Framework for Ecological Risk Assessment (EPA 1992a). The risk assessment screen comprises a screening-level Analysis Phase as defined by the EPA framework. The ecological risk assessment includes elements of the Analysis Phase and Risk Characterization Phases of the framework, and the uncertainty analysis is the final portion of the Risk Characterization Phase.

6.2.1 Hazard Identification

Potential ecological hazards at Eielson AFB were identified by reviewing base operations that resulted in releases of hazardous materials, summarizing abiotic transport information pertaining to the movement of contaminants to areas potentially accessible by biological receptors (i.e., surface water and groundwater hydrology), and identifying contaminants of concern and contaminated media at each source area by reviewing RI/FS and SER reports (U.S. Air Force 1993b, 1993d, 1994f, 1994g, 1994h, 1995c, 1995e).

Contaminants of concern identified through this process were primarily fuels (diesel/kerosene), fuel constituents (benzene, toluene, ethylbenzene, toluene [BTEX] and lead), PAHs, chlorinated solvents and solvent breakdown products, pesticides (DDT and its breakdown products), and PCBs. All metals except lead were determined to be attributable to site background conditions rather than base activities, and were not included in the list of contaminants of concern. Contaminant concentrations, the media in which they were detected, and the estimated affected area for each OU source area are listed in Appendix B of the biological risk assessment (U.S. Air Force 1995h). Surface water and sediment contaminant concentrations were obtained from sampling conducted in 1993 (U.S. Air Force 1995e). These data were used to evaluate risk to aquatic organisms.

6.2.2 Biological Characterization

In the biological characterization, biological systems and species present at Eielson AFB were identified and analyzed. For key species, information on diets (food webs), residence times, and site usage was reviewed. A complete list of fish and wildlife species known to occur on Eielson AFB is provided in Appendix A of the biological risk assessment (U.S. Air Force 1995h).

Land cover at the base was subdivided for the purpose of the biological risk assessment into areas suitable for foraging by wildlife (i.e., mown vegetation, forests, water and wetlands) and those unsuitable for wildlife foraging (i.e., small lawns, pavement, buildings). The terrestrial biota on Eielson AFB are typical of the boreal forests and extensive wetlands in the central Alaska basin. The primary migratory terrestrial species include numerous waterfowl and a few large raptors. Great horned owls are year-round residents. A few year-round resident mammals are present. Seventeen species of fish are found on Eielson AFB, including resident species such as northern pike and grayling. Anadromous species entering a few streams include chum salmon and king salmon. Many of the water bodies on the base have few or no fish due to winter kill and lack of a connection to areas containing fish, or to unsuitable habitat. Aquatic invertebrates, principally insect larvae and snails, are present in most streams and lakes on the base. These organisms are a primary food source for fish, when they are present.

No endangered or threatened species are resident to Eielson AFB. The American peregrine falcon (federal endangered) breeds within 50 miles of the base. Bald and golden eagles (federally protected) are occasionally sighted on Eielson AFB.

6.2.3 Source Area, Receptor, and Endpoint Identification

In this stage of the biological risk assessment, contaminants and source areas were screened to identify those where pathways to biota were complete. Receptors that were evaluated in the full risk assessment were selected by identifying those likely to be most heavily exposed to contaminants. Bioaccumulating and nonbioaccumulating exposures are addressed separately. Additional consideration was given to species protected by the state of Alaska and/or federal laws and regulations, and on species or components that provide key functions within the Eielson ecosystems.

Contaminants of concern were subdivided into volatiles (BTEX, fuels, solvents), semivolatiles (PAHs), and those compounds that are environmentally persistent and bioaccumulate (PCBs, DDTs, and lead). Volatiles will not partition strongly to biota and will evaporate from soil and surface water. Compounds with a high octanol-water partition coefficient (K_{ow}) (PCBs and DDTs) will partition to soils and sediments, and have a high potential to bioaccumulate. Lead and PAHs may also bioaccumulate in some cases. Total petroleum hydrocarbons (TPH) were not specifically evaluated because of the lack of toxicity data; however, the most toxic components (BTEX) were quantified and included in the risk assessment.

Source areas were screened to eliminate from consideration those where contamination is presently limited to areas unused by wildlife for food. Source areas where contaminants have not been found above background levels were eliminated prior to the screen. For non-bioaccumulating contaminants, the contaminated area was estimated from data in the RI reports. For bioaccumulating contaminants, the contaminated area was assumed to be twice the known area for the purposes of the screen. These contaminated areas were compared to land cover classes using field and aerial photographic data. Source areas where the contaminated area did not extend into foraging habitat where the contaminants could be taken up by vegetation were eliminated from further evaluation. Because of its importance as the primary receiving water body from both groundwater and surface water drainage from Eielson AFB, Garrison Slough was included as warranting further examination of ecological risk from sitewide contaminants. Flightline Pond was also included as a potential pond also potentially receiving persistent and bioaccumulating contaminants.

Receptors were screened to select those most likely to receive the greatest exposure and those most sensitive to contaminant exposure. Aquatic receptors likely to receive the highest exposures were carnivores: grayling and northern pike. Terrestrial receptors were selected on the basis of maximum inhalation exposure (animals living within or within a few centimeters of the ground) and maximum ingestion exposure (herbivores for volatile contaminants; carnivores for the remaining contaminants). Animals with smaller home ranges were selected over those with larger home ranges because a greater portion of their diet could come from any single contaminated area. Animals were combined into feeding guilds with weighting factors given according to bioaccumulation potential.

The measurement endpoints used were the lowest adverse effects levels for screening purposes. For ingestion, this corresponds to the lowest observable effects dose (LOED); for inhalation exposures or aquatic species, this corresponds to the lowest observable effects concentration (LOEC). These are referred to interchangeably as lowest observable effects levels (LOELs). Higher-order effects were evaluated at the lowest lethal dose concentration or the median lethal dose, as appropriate to the exposure level.

6.2.4 Risk Assessment Screen

In this stage of the biological risk assessment, a screening process was used to screen source areas based on potential risk to aquatic organisms from chemical contaminants in surface waters, and to screen source areas and contaminants based on inhalation by terrestrial organisms. The objectives of the screen were to evaluate exposure for aquatic receptors based on the latest surface water concentration data, compare exposure to risk-based toxicological benchmarks, and eliminate from further consideration those aquatic sites and chemicals below hazard levels. For terrestrial receptors, screening was performed against LOELs.

Sites where potential surface water contamination existed were screened for hazard to aquatic organisms. Screening compared water concentration data obtained in 1993 against risk-based water quality LOELs from EPA's Ambient Water Quality Criteria (EPA 1986a), which were set to protect 95 percent of aquatic organisms for acute or chronic exposure. The maximum detected concentration for each contaminant at each site or source area was divided by the relevant acute and chronic LOEL to obtain an Environmental Hazard Quotient (EHQ). The contaminants with an EHQ > 1 were total DDTs and dieldrin. All surface water sampling sites on Garrison Slough had water concentrations of total DDTs that were above levels posing a risk to aquatic organisms. The surface water sampling location on French Creek near source area LF02 also had concentrations of total DDTs and dieldrin that were above minimum risk levels.

Sites were also screened on the basis of inhalation of contaminated soils by terrestrial receptors. Source terms used were RME levels from soil sampling at any depth conducted in 1992 and 1993, which were used to estimate air concentrations of vapors and particulates at a height of 1 cm above ground level. LOECs for inhalation were obtained either from the toxicological literature or were estimated from ingestion LOELs on a per-weight basis. EHQs were totaled across contaminants to give a composite risk quotient. Sites where inhalation EHQs were less than 0.1 were dropped from consideration of inhalation exposure. Inhalation was added to ingestion exposure for the one site (source area WP38) with a summary EHQ above 0.1.

6.2.5 Ecological Risk Assessment

A quantitative risk assessment was performed for the sites, source areas, contaminant groups, and receptors identified in the previous stages. Exposures of aquatic and terrestrial organisms were estimated for sites where exposure pathways were complete. Exposures of fish to DDTs were evaluated for both gill uptake and ingestion of contaminated prey using the Food and Gill Exchange of Toxic Substances model (Ambrose and Barnwell 1989).

Exposures of terrestrial organisms were evaluated on the basis of the ingestion pathway; the inhalation pathway was evaluated in risk assessment screen and found to be potentially significant only for BTEX at WP38. Ingestion exposures were estimated using two methods:

(1) Exposures of herbivores to volatiles were estimated using plant stem concentration factors and daily vegetation intake rates for herbivores obtained from the literature.

(2) Exposures of maximally-exposed receptors to PAHs, DDTs, PCBs, and lead were estimated using prey composition and intake rates obtained from the literature, and prey tissue concentration data for these contaminants that were measured in prey organisms at each site

(tissue data are summarized in Appendix A). Where tissue data were not available, they were estimated from Biological Transfer Factors derived from Eielson tissue samples or biological accumulation factors obtained from the literature.

Exposures were compared with toxic concentrations for ingestion using data from published laboratory studies. LOELs were obtained from the literature or were estimated as fractions of the median lethal dose following EPA-suggested methods. The median LOEL was used as the reference value for volatiles and semivolatiles; the lowest LOEL was used for the remaining contaminants, the potential reproductive effects of which can be severe at low exposures in some species. The ratio of exposure to LOEL (the EHQ) was used to indicate hazard. EHQs for receptors were summed across contaminants and pathways to develop a composite risk quotient (Table 6.21).

The EHQ exceeded a value of 1 in only one case: for a shrike at lower Garrison Slough (EHQ = 1.6). PCBs were the primary contaminants contributing to risk at this site.

6.2.6 Uncertainty

This section identifies some of the major sources of uncertainty in the screening-level and quantitative biological risk assessments. A full discussion of the uncertainties, their possible range of influence on the risk assessments, and an analysis of significant unresolved issues are provided in Section 7.0 of the biological risk assessment report (U.S. Air Force 1995h).

The primary uncertainty in the screen and the full risk assessment concerns the temporal and spatial scales of variability in the contaminant concentrations in abiotic and biological media. No information on the extent of spatial variability of surface water concentrations is available on a scale appropriate to aquatic invertebrates. Also, no information on temporal variability is available for an annual scale. Because of uncertainties in temporal and spatial variation in the occurrence and transport of contaminants with the potential to bioaccumulate, actual concentrations were obtained from biological samples collected at the source areas rather than using concentrations estimated from transport models. These concentrations were obtained for composited material from samples of plants, voles, macrophytes, and invertebrates. Compositing produces a reasonable estimate of mean concentration within the composited area; however, all information on local variability is lost. As a result, the ingestion estimates based on these values are averages rather than maximal exposures.

Tissue samples for fish and squirrels reflect concentrations in samples of one or two animals. Again, because these values are the best estimate of the mean concentration, there is no information about variability within these groups at any site. Furthermore, the estimates of mean concentrations are uncertain because they were based on few individuals. Consequently, there is at least a moderate uncertainty associated with estimated ingestion dose for organisms feeding heavily on fish and squirrels (e.g., bald eagles, kingfisher, grebes, and owls).

Uncertainty associated with PCB exposure to terrestrial receptors that consume fish is probably underestimated for some species, because the data were based on measured concentrations in skinless fillets and liver. Bufflehead consume prey whole; osprey and eagles may not consume much skin. PCB concentrations in skin-on fillets have been found to be 3.5 to 4 times that in skinless fillets. Similarly, concentrations in the high-lipid eggs will be much higher than in muscle.

There is a moderate amount of uncertainty associated with the ingestion exposure estimations because of use of average diet fractions for receptors of interest. Daily intake rates were estimated from body weight/intake regression data, which does not take into consideration the metabolic demands of the cool Eielson environment. Maintenance of thermal equilibrium will require mammals and birds to increase their food intake rates, and will also require more consumption of water. Direct water consumption was ignored in these analyses. Consequently, ingestion exposures are potentially underestimates. Because mass scales to ingestion at a rate less than 1 (Calder 1984), the uncertainty associated with dietary exposure (μg/kg body weight) will be less for large animals than for small animals.

Uncertainties associated with toxicological benchmarks (LOELs) and their relevance to field exposures produce a moderate to high degree of uncertainty in the risk assessment. Potential considerations include the following:

- extrapolations from one taxonomic group to another, especially from mammals to birds;
- relevance of response of laboratory animals to wildlife;
- relevance of laboratory presentation of the chemical to wildlife dietary exposures;
- relationship between chronic wildlife exposures and 96-hour laboratory animal exposures;
- toxic responses at different life stages;
- extrapolation of toxic effects between exposure modes (i.e, ingestion to inhalation LOEL);
- effects of environmental conditions; and
- effects of animals' nourishment status.

EPA has recommended an uncertainty factor of 10 be applied to taxonomic extrapolations for aquatic receptors where data are available for fish and microcrustacea (OWRS 1985). No such factors have been defined for terrestrial species; however, all sites with an EHQ $\leq$ 1 and $\geq$ 0.1 would be elevated into the significant risk category (EHQ$>$1) by application of a 10X LOEL.

Finally, there is a large amount of uncertainty associated with estimation of ingestion exposure for volatile organics. The uncertainty arises from using RME groundwater data, using maximal root exposures, and using bioaccumulation estimates derived for barley but applied to trees and shrubs. Because there has been no work published on tree and shrub uptake of BTEX, it is not possible to determine whether the use of this estimate is conservative or not. The other sources of uncertainty produced a conservative estimate of exposure (i.e., actual exposures are likely to be less than those estimated).

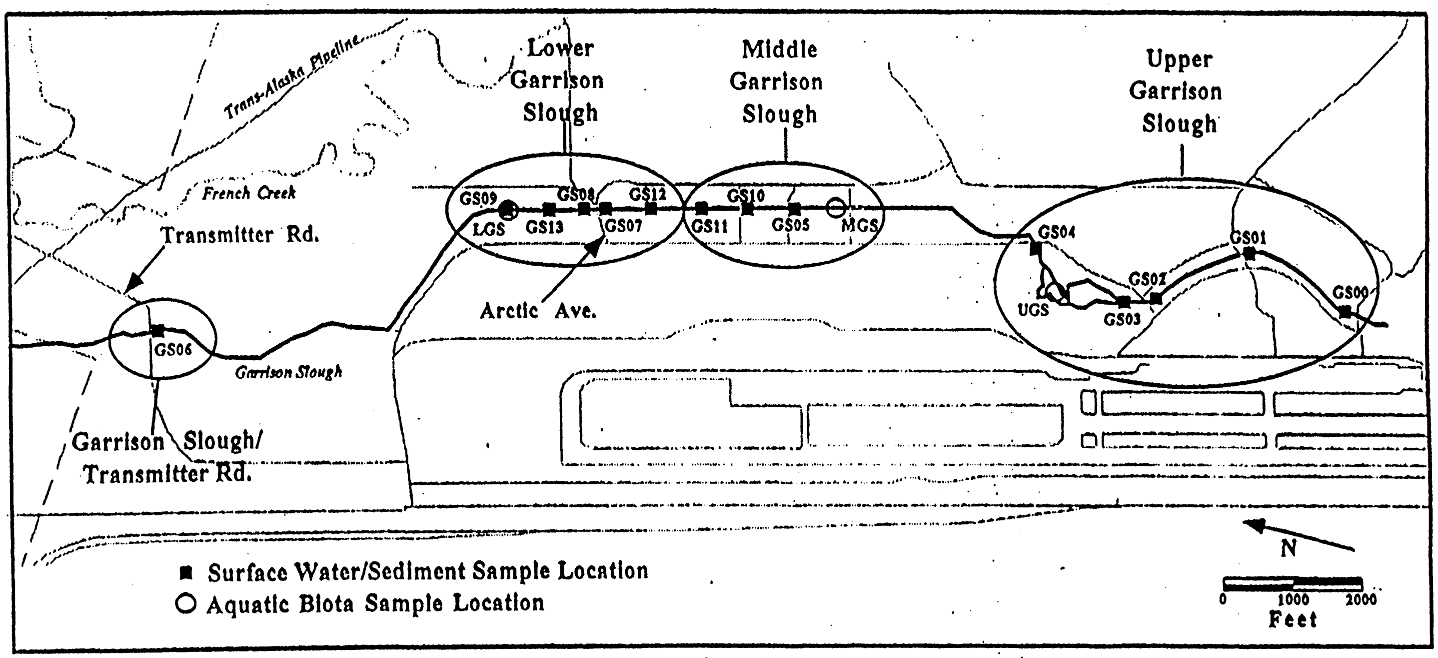

FIGURE 6.1. Garrison Slough Locales for Risk Assessment

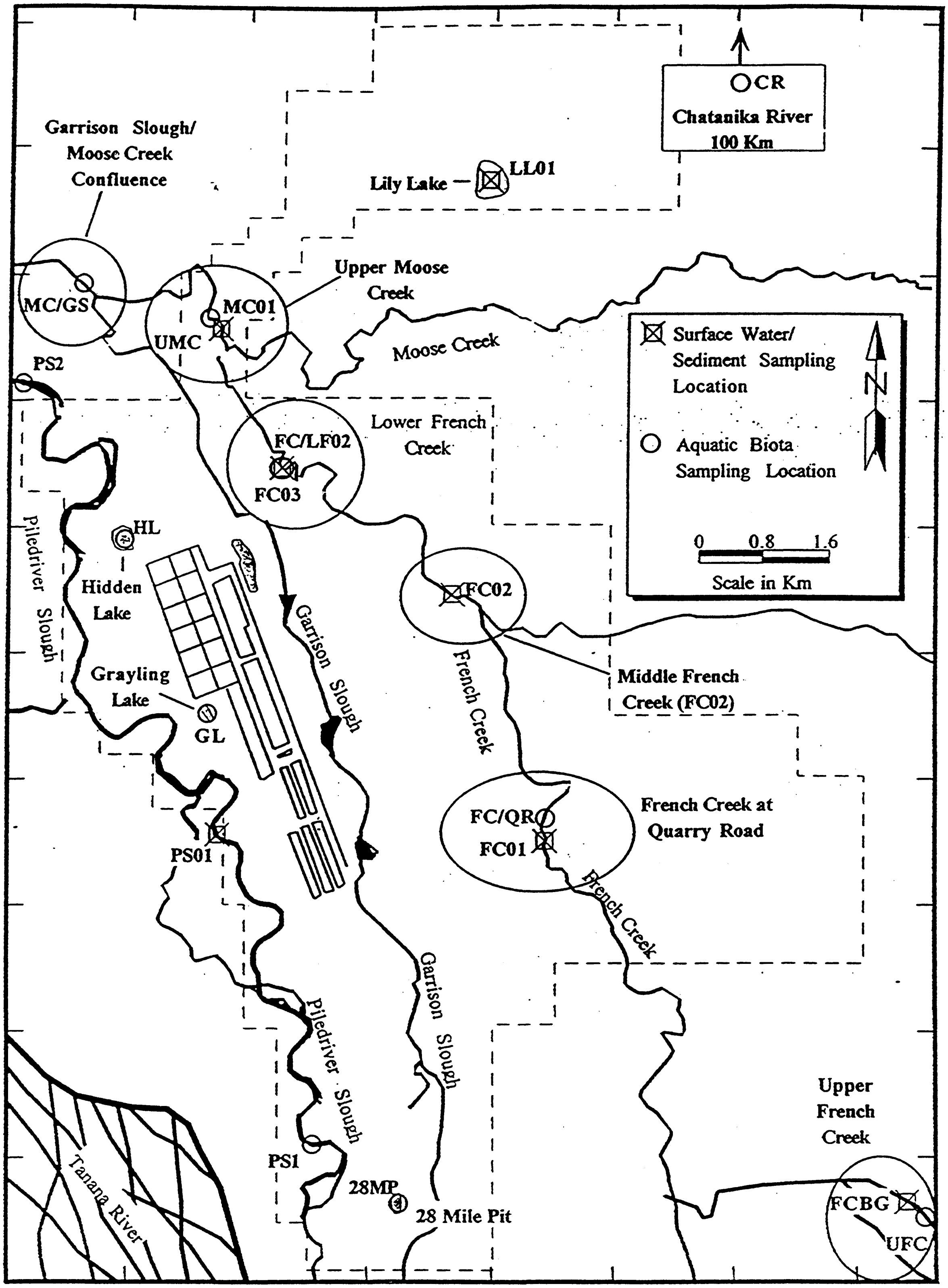

FIGURE 6.2. Surface Water Locales for Risk Assessment (Excluding Garrison Slough)

TABLE 6.1. Identification of Chemicals of Concern at Upper Garrison Slough

Analyte Detected	CAS Number	Matrix	Units	Maximum	Average	95% UCL	Risk Evaluation Status
Diesel range organics		Sediment	µg/kg dw	38,000	19,000	33,000	Removed: maximum value below screening level
4,4-DDD	72-54-8	Sediment	µg/kg dw	11,000	4,950	11,639	
4,4-DDE	72-55-9	Sediment	µg/kg dw	270	113	266	
4,4-DDT	50-29-3	Sediment	µg/kg dw	4,200	1,963	4,610	
Beta-BHC	319-85-7	Sediment	µg/kg dw	4.10	1.47	3.18	Removed: maximum value below screening level
Delta-BHC	319-86-8	Sediment	µg/kg dw	5.60	1.28	3.58	Removed: maximum value below screening level
Endosulfan sulfate		Sediment	µg/kg dw	47.0	10.1	29.8	Removed: maximum value below screening level
Antimony	7440-36-0	Sediment	µg/kg dw	8,700	4,474	7,040	Removed: maximum value below screening level
Arsenic	7440-38-2	Sediment	µg/kg dw	33,000	20,280	30,780	
Barium	7440-39-3	Sediment	µg/kg dw	400,000	148,400	284,736	Removed: maximum value below screening level
Beryllium	7440-41-7	Sediment	µg/kg dw	210	127	200	
Chromium	18540-29-9	Sediment	µg/kg dw	8,000	5,800	7,307	Removed: maximum value below screening level
Cobalt	7440-48-4	Sediment	µg/kg dw	2,800	1,560	2,517	Removed: no screening value
Copper	7440-50-8	Sediment	µg/kg dw	11,000	6,600	9,573	Removed: maximum value below screening level
Lead	7439-92-1	Sediment	µg/kg dw	9,100	5,260	7,896	Removed: maximum value below screening level
Manganese	7439-96-5	Sediment	µg/kg dw	2,800,000	736,200	1,841,312	
Nickel	7440-02-0	Sediment	µg/kg dw	7,600	3,934	6,418	Removed: maximum value below screening level
Silver	7440-72-4	Sediment	µg/kg dw	510	381	506	Removed: maximum value below screening level
Vanadium	7440-62-2	Sediment	µg/kg dw	18,000	12,540	16,603	Removed: no screening value
Zinc	7440-66-6	Sediment	µg/kg dw	45000	27200	37,433	Removed: maximum value below screening level
Benzene	71-43-2	Water	µg/L	1.8	0.94	1.78	
cis-1,2-Dichloroethylene	159-59-2	Water	µg/L	1.4	0.76	1.41	Removed: maximum value below screening level
Trichloroethylene	79-01-6	Water	µg/L	0.61	0.26	0.55	Removed: maximum value below screening level
4,4'-DDD	72-54-8	Water	µg/L	0.0520	0.0325	0.0522	Removed: maximum value below screening level
4,4'-DDE	72-55-9	Water	µg/L	0.0035	0.0017	0.0033	Removed: maximum value below screening level
Delta-BHC	319-86-8	Water	µg/L	0.0057	0.0031	0.0063	Removed: maximum value below screening level
Arsenic	7440-38-2	Water	µg/L	17	13.06	16	
Barium	7440-39-3	Water	µg/L	210	180	214	Removed: maximum value below screening level
Lead	7439-92-1	Water	µg/L	0.91	0.58	0.84	Removed: maximum value below screening level
Manganese	7439-96-5	Water	µg/L	1,900	1,422	1,951	
Hexachlorobenzene		Fish Tissue	µg/L	0.65	0.21	0.56	
Aroclor-1260	11096-82-5	Fish Tissue	µg/L	104.00	48.85	103.91	
2,4-DDD		Fish Tissue	µg/L	118.00	76.83	115.58	
4,4-DDD	72-54-8	Fish Tissue	µg/L	345.00	239	328.70	
4,4-DDE	72-55-9	Fish Tissue	µg/L	82.20	67.2	84.82	
4,4-DDT	50-29-3	Fish Tissue	µg/L	26.80	22.18	27.27	
Aldrin	309-00-2	Fish Tissue	µg/L	0.46	0.23	0.47	
Dieldrin	60-57-1	Fish Tissue	µg/L	1.83	1.2	1.74	
Endrin	72-20-8	Fish Tissue	µg/L	0.58	0.31	0.62	
Methoxyclor	72-43-5	Fish Tissue	µg/L	4.73	1.25	3.98	

TABLE 6.2. Identification of Chemicals of Concern at Middle Garrison Slough

Analyte Detected	CAS Number	Matrix	Units	Maximum	Average	95% UCL	Risk Evaluation Status
4,4-DDD	72-54-8	Sediment	µg/kg dw	120	59	149	Removed: maximum value below screening level
4,4-DDE	72-55-9	Sediment	µg/kg dw	14.0	8.5	17.5	Removed: maximum value below screening level
4,4-DDT	50-29-3	Sediment	µg/kg dw	26.0	18.4	33.9	Removed: maximum value below screening level
Antimony	7440-36-0	Sediment	µg/kg dw	9,300			Removed: maximum value below screening level
Arsenic	7440-38-2	Sediment	µg/kg dw	9,800			
Barium	7440-39-3	Sediment	µg/kg dw	1,500,000			Removed: maximum value below screening level
Beryllium	7440-41-7	Sediment	µg/kg dw	730			
Chromium	18540-29-9	Sediment	µg/kg dw	41,000			Removed: maximum value below screening level
Cobalt	7440-48-4	Sediment	µg/kg dw	10,000			Removed: no screening value
Copper	7440-50-8	Sediment	µg/kg dw	30,000			Removed: maximum value below screening level
Lead	7439-92-1	Sediment	µg/kg dw	64,000			Removed: maximum value below screening level
Manganese	7439-96-5	Sediment	µg/kg dw	440,000			
Nickel	7440-02-0	Sediment	µg/kg dw	29,000			Removed: maximum value below screening level
Silver	7440-72-4	Sediment	µg/kg dw	420			Removed: maximum value below screening level
Vanadium	7440-62-2	Sediment	µg/kg dw	54,000			Removed: no screening value
Zinc	7440-66-6	Sediment	µg/kg dw	17,000			Removed: maximum value below screening level
cis-1,2-Dichloroethylene	159-59-2	Water	µg/L	0.2			Removed: maximum value below screening level
Ethylbenzene	100-41-4	Water	µg/L	0.086			Removed: maximum value below screening level
Trichloroethylene	79-01-6	Water	µg/L	0.75			Removed: maximum value below screening level
4,4'-DDD	72-54-8	Water	µg/L	0.0071			Removed: maximum value below screening level
4,4'-DDE	72-55-9	Water	µg/L	0.00098			Removed: maximum value below screening level
Arsenic	7440-38-2	Water	µg/L	14			
Barium	7440-39-3	Water	µg/L	120			Removed: maximum value below screening level
Manganese	7439-96-5	Water	µg/L	11,000			
Zinc	7440-66-6	Water	µg/L	8.7			Removed: maximum value below screening level
Acenaphthene	83-32-9	Fish Tissue	µg/kg ww	8.52	6.96	8.58	
Benzo(a)pyrene	50-32-8	Fish Tissue	µg/kg ww	2.23	1.12	1.99	
Fluorene	86-73-7	Fish Tissue	µg/kg ww	5.09	1.74	4.37	
Naphthalene	91-20-3	Fish Tissue	µg/kg ww	6.69	2.37	5.76	
Phenanthrene	85-01-8	Fish Tissue	µg/kg ww	5.08	2.23	4.47	
Aroclor-1260	11096-82-5	Fish Tissue	µg/kg ww	32.80	23.7	35.78	
2,4-DDD		Fish Tissue	µg/kg ww	361.00	224.5	334.37	
4,4-DDD	72-54-8	Fish Tissue	µg/kg ww	1450.00	1015.25	1387.62	
4,4-DDE	72-55-9	Fish Tissue	µg/kg ww	179.00	139.1	190.33	
4,4-DDT	50-29-3	Fish Tissue	µg/kg ww	52.60	39.3	56.12	
Aldrin	309-00-2	Fish Tissue	µg/kg ww	1.49	0.93	1.40	
Dieldrin	60-57-1	Fish Tissue	µg/kg ww	1.65	1.13	1.87	

TABLE 6.3. Identification of Chemicals of Concern at Lower Garrison Slough

Analyte Detected	CAS Number	Matrix	Units	Maximum	Average	95% UCL	Risk Evaluation Status
Aroclor-1260	11096-82-5	Sediment	µg/kg dw	55,000	12,786	35,319	
Acenaphthene	83-32-9	Fish Tissue	µg/kg ww	11.10	9.55	10.84	
Fluorene	86-73-7	Fish Tissue	µg/kg ww	5.46	4.02	6.72	
Hexachlorobenzene		Fish Tissue	µg/kg ww	2.87	1.93	2.80	
Phenanthrene	85-01-8	Fish Tissue	µg/kg ww	4.73	3.74	5.71	
Aroclor-1260	11096-82-5	Fish Tissue	µg/kg ww	3000.00	1980	2935.50	
2,4-DDD		Fish Tissue	µg/kg ww	174.00	136.75	169.34	
4,4-DDD	72-54-8	Fish Tissue	µg/kg ww	989.00	786	993.21	
4,4-DDE	72-55-9	Fish Tissue	µg/kg ww	234.00	141.1	220.24	
Aldrin	309-00-2	Fish Tissue	µg/kg ww	1.80	1.36	1.71	

TABLE 6.4. Identification of Chemicals of Concern at Garrison Slough, Transmitter Road

Analyte Detected	CAS Number	Matrix	Units	Maximum	Average	95% UCL	Risk Evaluation Status
Aroclor-1260	11096-82-5	Sediment	µg/kg dw	230			
4,4-DDD	72-54-8	Sediment	µg/kg dw	22			Removed: maximum value below screening level
4,4-DDT	50-29-3	Sediment	µg/kg dw	8.2			Removed: maximum value below screening level
Arsenic	7440-38-2	Sediment	µg/kg dw	70,000			
Barium	7440-39-3	Sediment	µg/kg dw	180,000			Removed: maximum value below screening level
Chromium	18540-29-9	Sediment	µg/kg dw	5,100			Removed: maximum value below screening level
Cobalt	7440-48-4	Sediment	µg/kg dw	1,500			Removed: no screening value
Copper	7440-50-8	Sediment	µg/kg dw	4,600			Removed: maximum value below screening level
Lead	7439-92-1	Sediment	µg/kg dw	4,700			Removed: maximum value below screening level
Manganese	7439-96-5	Sediment	µg/kg dw	990,000			
Nickel	7440-02-0	Sediment	µg/kg dw	2,500			Removed: maximum value below screening level
Silver	7440-72-4	Sediment	µg/kg dw	450			Removed: maximum value below screening level
Vanadium	7440-62-2	Sediment	µg/kg dw	9,700			Removed: no screening value
Zinc	7440-66-6	Sediment	µg/kg dw	24,000			Removed: maximum value below screening level
Ethylbenzene	100-41-4	Water	µg/L	0.063			Removed: maximum value below screening level
Trichloroethylene	79-01-6	Water	µg/L	0.075			Removed: maximum value below screening level
4,4'-DDD	72-54-8	Water	µg/L	0.0075			
Arsenic	7440-38-2	Water	µg/L	5.4			
Barium	7440-39-3	Water	µg/L	100			Removed: maximum value below screening level
Manganese	7439-96-5	Water	µg/L	220			
Zinc	7440-66-6	Water	µg/L	7			Removed: maximum value below screening level

TABLE 6.5. Identification of Chemicals of Concern at French Creek, Quarry Road

Analyte Detected	CAS Number	Matrix	Units	Maximum	Average	95% UCL	Risk Evaluation Status
4,4-DDD	72-54-8	Sediment	µg/kg dw	19			Removed: maximum value below screening level
4,4-DDE	72-55-9	Sediment	µg/kg dw	7.2			Removed: maximum value below screening level
4,4-DDT	50-29-3	Sediment	µg/kg dw	3.6			Removed: maximum value below screening level
Arsenic	7440-38-2	Sediment	µg/kg dw	7,900			Removed: maximum value below screening level
Barium	7440-39-3	Sediment	µg/kg dw	62,000			Removed: maximum value below screening level
Beryllium	7440-41-7	Sediment	µg/kg dw	130			
Chromium	18540-29-9	Sediment	µg/kg dw	10,000			Removed: maximum value below screening level
Cobalt	7440-48-4	Sediment	µg/kg dw	3,000			Removed: no screening value
Copper	7440-50-8	Sediment	µg/kg dw	10,000			Removed: maximum value below screening level
Lead	7439-92-1	Sediment	µg/kg dw	3,200			Removed: maximum value below screening level
Manganese	7439-96-5	Sediment	µg/kg dw	190,000			
Nickel	7440-02-0	Sediment	µg/kg dw	8,800			Removed: maximum value below screening level
Silver	7440-72-4	Sediment	µg/kg dw	460			Removed: maximum value below screening level
Vanadium	7440-62-2	Sediment	µg/kg dw	20,000			Removed: no screening value
Zinc	7440-66-6	Sediment	µg/kg dw	25,000			Removed: maximum value below screening level
Delta-BHC	319-86-8	Water	µg/L	0.0027			Removed: maximum value below screening level
Arsenic	7440-38-2	Water	µg/L	4.7			
Barium	7440-39-3	Water	µg/L	47			Removed: maximum value below screening level
Manganese	7439-96-5	Water	µg/L	220			
Aroclor-1260	11096-82-5	Fish Tissue	µg/kg ww	28.90	14.73	25.84	
2,4-DDD		Fish Tissue	µg/kg ww	15.60	5.73	13.81	
4,4-DDD	72-54-8	Fish Tissue	µg/kg ww	32.50	19.68	30.87	
4,4-DDE	72-55-9	Fish Tissue	µg/kg ww	17.90	15.53	18.13	
4,4-DDT	50-29-3	Fish Tissue	µg/kg ww	6.26	3.28	6.35	
Endosulfan sulfate		Fish Tissue	µg/kg ww	0.24	0.13	0.22	

TABLE 6.6. Identification of Chemicals of Concern at Middle French Creek (FC02)

Analyte Detected	CAS Number	Matrix	Unit	Maximum	Average	95% UCL	Risk Evaluation Status
4,4-DDD	72-54-8	Sediment	µg/kg dw	32			Removed: maximum value below screening level
4,4-DDE	72-55-9	Sediment	µg/kg dw	7			Removed: maximum value below screening level
4,4-DDT	50-29-3	Sediment	µg/kg dw	58			Removed: maximum value below screening level
Antimony	7440-36-0	Sediment	µg/kg dw	7,400			Removed: maximum value below screening level
Arsenic	7440-38-2	Sediment	µg/kg dw	29,000			
Barium	7440-39-3	Sediment	µg/kg dw	120,000			Removed: maximum value below screening level
Chromium	18540-29-9	Sediment	µg/kg dw	13,000			Removed: maximum value below screening level
Cobalt	7440-48-4	Sediment	µg/kg dw	4,200			Removed: no screening value
Copper	7440-50-8	Sediment	µg/kg dw	9,700			Removed: maximum value below screening level
Lead	7439-92-1	Sediment	µg/kg dw	3,000			Removed: maximum value below screening level
Manganese	7439-96-5	Sediment	µg/kg dw	350,000			
Nickel	7440-02-0	Sediment	µg/kg dw	9,700			Removed: maximum value below screening level
Vanadium	7440-62-2	Sediment	µg/kg dw	24,000			Removed: no screening value
Zinc	7440-66-6	Sediment	µg/kg dw	30,000			Removed: maximum value below screening level
Methylene chloride	75-09-2	Water	µg/L	0.94			
4,4'-DDD	72-54-8	Water	µg/L	0.0013			
Delta-BHC	319-86-8	Water	µg/L	0.0020			
Dieldrin	60-57-1	Water	µg/L	0.026			
Arsenic	7440-38-2	Water	µg/L	4.9			
Barium	7440-39-3	Water	µg/L	37			Removed: maximum value below screening level
Lead	7439-92-1	Water	µg/L	0.69			Removed: maximum value below screening level
Manganese	7439-96-5	Water	µg/L	180			
Zinc	7440-66-6	Water	µg/L	8.1			Removed: maximum value below screening level

TABLE 6.7. Identification of Chemicals of Concern at Lower French Creek

Analyte Detected	CAS Number	Matrix	Units	Maximum	Average	95% UCL	Risk Evaluation Status
Diesel range organics		Sediment	µg/kg dw	11,000			Removed: maximum value below screening level
4,4-DDD	72-54-8	Sediment	µg/kg dw	7.7			Removed: maximum value below screening level
Antimony	7440-36-0	Sediment	µg/kg dw	6,900			Removed: maximum value below screening level
Arsenic	7440-38-2	Sediment	µg/kg dw	18,000			
Barium	7440-39-3	Sediment	µg/kg dw	110,000			Removed: maximum value below screening level
Beryllium	7440-41-7	Sediment	µg/kg dw	280			Removed: maximum value below screening level
Chromium	18540-29-9	Sediment	µg/kg dw	13,000			Removed: maximum value below screening level
Cobalt	7440-48-4	Sediment	µg/kg dw	4,000			Removed: no screening value
Copper	7440-50-8	Sediment	µg/kg dw	12,000			Removed: maximum value below screening level
Lead	7439-92-1	Sediment	µg/kg dw	4,300			Removed: maximum value below screening level
Manganese	7439-96-5	Sediment	µg/kg dw	280,000			
Nickel	7440-02-0	Sediment	µg/kg dw	10,000			Removed: maximum value below screening level
Silver	7440-72-4	Sediment	µg/kg dw	610			Removed: maximum value below screening level
Vanadium	7440-62-2	Sediment	µg/kg dw	27,000			Removed: no screening value
Zinc	7440-66-6	Sediment	µg/kg dw	30,000			Removed: maximum value below screening level
4,4'-DDD	72-54-8	Water	µg/L	0.00085			Removed: maximum value below screening level
Delta-BHC	319-86-8	Water	µg/L	0.0028			Removed: maximum value below screening level
Arsenic	7440-38-2	Water	µg/L	5.9			
Barium	7440-39-3	Water	µg/L	44			Removed: maximum value below screening level
Lead	7439-92-1	Water	µg/L	1			Removed: maximum value below screening level
Manganese	7439-96-5	Water	µg/L	160			
Silver	7440-72-4	Water	µg/L	3			Removed: maximum value below screening level
Aroclor-1260	11096-82-5	Fish Tissue	µg/kg ww	24.60	15.85	24.27	
2,4-DDD		Fish Tissue	µg/kg ww	13.30	8.11	14.52	
2,4-DDT		Fish Tissue	µg/kg ww	37.00	11.85	32.01	
4,4-DDD	72-54-8	Fish Tissue	µg/kg ww	68.40	33.25	66.37	
4,4-DDE	72-55-9	Fish Tissue	µg/kg ww	50.60	22.97	45.40	
4,4-DDT	50-29-3	Fish Tissue	µg/kg ww	78.60	25.46	67.58	
Methoxyclor	72-43-5	Fish Tissue	µg/kg ww	0.57	0.21	0.49	

TABLE 6.8. Identification of Chemicals of Concern at Flightline Pond

Analyte Detected	CAS Number	Matrix	Units	Maximum	Average	95% UCL	Risk Evaluation Status
Anthracene		Sediment	µg/kg dw	370			Removed: maximum value below screening level
Benzo[a]anthracene		Sediment	µg/kg dw	650			
Benzo[a]pyrene		Sediment	µg/kg dw	670			
Benzo[b]fluoranthene		Sediment	µg/kg dw	680			
Benzo[g,h,i]perylene		Sediment	µg/kg dw	400			Removed: maximum value below screening level
Benzo[k]fluoranthene		Sediment	µg/kg dw	730			Removed: maximum value below screening level
Chrysene		Sediment	µg/kg dw	960			Removed: maximum value below screening level
Fluoranthene		Sediment	µg/kg dw	2300			Removed: maximum value below screening level
Phenanthrene		Sediment	µg/kg dw	1300			Removed: maximum value below screening level
Pyrene		Sediment	µg/kg dw	2600			Removed: maximum value below screening level
Diesel range organics		Sediment	µg/kg dw	41,000			Removed: maximum value below screening level
Arsenic	7440-38-2	Sediment	µg/kg dw	18,000			Removed: maximum value below screening level
Barium	7440-39-3	Sediment	µg/kg dw	20,000			Removed: maximum value below screening level
Chromium	18540-29-9	Sediment	µg/kg dw	2,500			Removed: maximum value below screening level
Cobalt	7440-48-4	Sediment	µg/kg dw	2,200			Removed: no screening value
Copper	7440-50-8	Sediment	µg/kg dw	4,400			Removed: maximum value below screening level
Lead	7439-92-1	Sediment	µg/kg dw	3,100			Removed: maximum value below screening level
Manganese	7439-96-5	Sediment	µg/kg dw	500,000			Removed: maximum value below screening level
Nickel	7440-02-0	Sediment	µg/kg dw	3,500			Removed: maximum value below screening level
Vanadium	7440-62-2	Sediment	µg/kg dw	4,400			Removed: no screening value
Zinc	7440-66-6	Sediment	µg/kg dw	8,700			Removed: maximum value below screening level
Delta-BHC	319-86-8	Water	µg/L	0.0051			
Arsenic	7440-38-2	Water	µg/L	6.2			
Barium	7440-39-3	Water	µg/L	76			Removed: maximum value below screening level
Manganese	7439-96-5	Water	µg/L	160			

TABLE 6.9. Identification of Chemicals of Concern at Lily Lake

Analyte Detected	CAS Number	Matrix	Units	Maximum	Average	95% UCL	Risk Evaluation Status
Anthracene		Sediment	µg/kg dw	210			Removed: maximum value below screening level
Chrysene		Sediment	µg/kg dw	240			Removed: maximum value below screening level
Fluoranthene		Sediment	µg/kg dw	1300			Removed: maximum value below screening level
Phenanthrene		Sediment	µg/kg dw	980			Removed: maximum value below screening level
Pyrene		Sediment	µg/kg dw	1400			Removed: maximum value below screening level
4,4-DDD	72-54-8	Sediment	µg/kg dw	16			Removed: maximum value below screening level
Arsenic	7440-38-2	Sediment	µg/kg dw	3,700			Removed: maximum value below screening level
Barium	7440-39-3	Sediment	µg/kg dw	76,000			Removed: maximum value below screening level
Chromium	18540-29-9	Sediment	µg/kg dw	13,000			Removed: maximum value below screening level
Cobalt	7440-48-4	Sediment	µg/kg dw	3,200			Removed: no screening value
Copper	7440-50-8	Sediment	µg/kg dw	14,000			Removed: maximum value below screening level
Lead	7439-92-1	Sediment	µg/kg dw	4,600			Removed: maximum value below screening level
Manganese	7439-96-5	Sediment	µg/kg dw	84,000			Removed: maximum value below screening level
Nickel	7440-02-0	Sediment	µg/kg dw	12,000			Removed: maximum value below screening level
Vanadium	7440-62-2	Sediment	µg/kg dw	21,000			Removed: no screening value
Zinc	7440-66-6	Sediment	µg/kg dw	33,000			Removed: maximum value below screening level
Manganese	7439-96-5	Water	µg/L	33			
Zinc	7440-66-6	Water	µg/L	7			Removed: maximum value below screening level

TABLE 6.10. Identification of Chemicals of Concern at Upper Moose Creek

Analyte Detected	CAS Number	Matrix	Units	Maximum	Average	95% UCL	Risk Evaluation Status
Diethylphthalate		Sediment	µg/kg dw	460			Removed: maximum value below screening level
Diesel range organics		Sediment	µg/kg dw	12,000			Removed: maximum value below screening level
Antimony	7440-36-0	Sediment	µg/kg dw	7,400			Removed: maximum value below screening level
Arsenic	7440-38-2	Sediment	µg/kg dw	23,000			
Barium	7440-39-3	Sediment	µg/kg dw	84,000			Removed: maximum value below screening level
Beryllium	7440-41-7	Sediment	µg/kg dw	210			Removed: maximum value below screening level
Chromium	18540-29-9	Sediment	µg/kg dw	13,000			Removed: maximum value below screening level
Cobalt	7440-48-4	Sediment	µg/kg dw	3,700			Removed: no screening value
Copper	7440-50-8	Sediment	µg/kg dw	8,900			Removed: maximum value below screening level
Lead	7439-92-1	Sediment	µg/kg dw	3,600			Removed: maximum value below screening level
Manganese	7439-96-5	Sediment	µg/kg dw	270,000			
Nickel	7440-02-0	Sediment	µg/kg dw	10,000			Removed: maximum value below screening level
Vanadium	7440-62-2	Sediment	µg/kg dw	21,000			Removed: no screening value
Arsenic	7440-38-2	Water	µg/L	5.8			
Barium	7440-39-3	Water	µg/L	42			Removed: maximum value below screening level
Beryllium	7440-41-7	Water	µg/L	1.4			Removed: maximum value below screening level
Manganese	7439-96-5	Water	µg/L	260			
Vanadium	7440-62-2	Water	µg/L	7.5			Removed: no screening value
Zinc	7440-66-6	Water	µg/L	7.4			Removed: maximum value below screening level
2,4-DDD		Fish Tissue	µg/kg ww	13.30	3.87	11.29	
2,4-DDT		Fish Tissue	µg/kg ww	2.37	0.79	2.06	
4,4-DDD	72-54-8	Fish Tissue	µg/kg ww	73.50	24.97	63.94	
4,4-DDE	72-55-9	Fish Tissue	µg/kg ww	33.80	14.36	30.66	
4,4-DDT	50-29-3	Fish Tissue	µg/kg ww	34.20	17.72	39.30	
Methoxyclor	72-43-5	Fish Tissue	µg/kg ww	0.76	0.28	0.66	

TABLE 6.11. Identification of Chemicals of Concern at the Moose Creek/Garrison Slough Confluence

Analyte Detected	CAS Number	Matrix	Units	Maximum	Average	95% UCL	Risk Evaluation Status
Acenaphthene	83-32-9	Fish Tissue	µg/kg ww	4.12	1.51	3.56	
Fluorene	86-73-7	Fish Tissue	µg/kg ww	3.63	1.36	3.14	
Hexachlorobenzene		Fish Tissue	µg/kg ww	0.59	0.29	0.55	
Aroclor-1260	11096-82-5	Fish Tissue	µg/kg ww	216.00	64.15	183.41	
2,4-DDD		Fish Tissue	µg/kg ww	20.00	9.87	19.33	
4,4-DDD	72-54-8	Fish Tissue	µg/kg ww	196.00	71.65	169.48	
4,4-DDE	72-55-9	Fish Tissue	µg/kg ww	71.00	34.68	66.52	
4,4-DDT	50-29-3	Fish Tissue	µg/kg ww	28.30	7.96	23.96	
Dieldrin	60-57-1	Fish Tissue	µg/kg ww	0.71	0.43	0.69	
Methoxyclor	72-43-5	Fish Tissue	µg/kg ww	0.24	0.13	0.22	

TABLE 6.12. Identification of Chemicals of Concern at Upper French Creek (Background)

Analyte Detected	CAS Number	Matrix	Units	Maximum	Average	95% UCL	Risk Evaluation Status
Arsenic	7440-38-2	Sediment	µg/kg dw	3,400			Removed: maximum value below screening level
Barium	7440-39-3	Sediment	µg/kg dw	94,000			Removed: maximum value below screening level
Chromium	18540-29-9	Sediment	µg/kg dw	17,000			Removed: maximum value below screening level
Cobalt	7440-48-4	Sediment	µg/kg dw	6,100			Removed: maximum value below screening level
Copper	7440-50-8	Sediment	µg/kg dw	13,000			Removed: maximum value below screening level
Lead	7439-92-1	Sediment	µg/kg dw	4,700			Removed: maximum value below screening level
Manganese	7439-96-5	Sediment	µg/kg dw	140,000			
Nickel	7440-02-0	Sediment	µg/kg dw	14,000			Removed: maximum value below screening level
Vanadium	7440-62-2	Sediment	µg/kg dw	28,000			Removed: no screening value
Zinc	7440-66-6	Sediment	µg/kg dw	35,000			Removed: maximum value below screening level
Arsenic	7440-38-2	Water	µg/L	2.1			
Barium	7440-39-3	Water	µg/L	30			Removed: maximum value below screening level
Cobalt	7440-48-4	Water	µg/L	6.1			Removed: no screening value
Copper	7440-50-8	Water	µg/L	3.8			Removed: maximum value below screening level
Lead	7439-92-1	Water	µg/L	0.75			Removed: maximum value below screening level
Manganese	7439-96-5	Water	µg/L	110			
Vanadium	7440-62-2	Water	µg/L	7.8			Removed: no screening value
Zinc	7440-66-6	Water	µg/L	3.6			Removed: maximum value below screening level
Hexachlorobenzene	118-74-1	Fish Tissue	µg/kg ww	0.20	0.1	0.18	
2,4-DDD		Fish Tissue	µg/kg ww	9.91	2.61	8.34	
2,4-DDT		Fish Tissue	µg/kg ww	0.51	0.2	0.44	
4,4-DDD	72-54-8	Fish Tissue	µg/kg ww	46.10	14.21	39.32	
4,4-DDE	72-55-9	Fish Tissue	µg/kg ww	12.70	8.97	12.12	
4,4-DDT	50-29-3	Fish Tissue	µg/kg ww	6.65	3.3	6.16	

TABLE 6.13. Identification of Chemicals of Concern at Piledriver Slough (Background)

Analyte Detected	CAS Number	Matrix	Units	Maximum	Average	95% UCL	Risk Evaluation Status
Antimony	7440-36-0	Sediment	µg/kg dw	5,600			Removed: maximum value below screening level
Arsenic	7440-38-2	Sediment	µg/kg dw	3,900			Removed: maximum value below screening level
Barium	7440-39-3	Sediment	µg/kg dw	61,000			Removed: maximum value below screening level
Beryllium	7440-41-7	Sediment	µg/kg dw	120			
Chromium	18540-29-9	Sediment	µg/kg dw	14,000			Removed: maximum value below screening level
Cobalt	7440-48-4	Sediment	µg/kg dw	5,400			Removed: no screening value
Copper	7440-50-8	Sediment	µg/kg dw	17,000			Removed: maximum value below screening level
Lead	7439-92-1	Sediment	µg/kg dw	4,700			Removed: maximum value below screening level
Manganese	7439-96-5	Sediment	µg/kg dw	180,000			
Nickel	7440-02-0	Sediment	µg/kg dw	14,000			Removed: maximum value below screening level
Vanadium	7440-62-2	Sediment	µg/kg dw	24,000			Removed: no screening value
Zinc	7440-66-6	Sediment	µg/kg dw	36,000			Removed: maximum value below screening level
Tetrachloroethylene	127-18-4	Water	µg/L	0.071			Removed: maximum value below screening level
Barium	7440-39-3	Water	µg/L	46			Removed: maximum value below screening level
Beryllium	7440-41-7	Water	µg/L	1.2			
Manganese	7439-96-5	Water	µg/L	21			
Benzo(a)pyrene	50-32-8	Fish Tissue	µg/kg ww	2.33	1.14	2.07	
Hexachlorobenzene	118-74-1	Fish Tissue	µg/kg ww	0.49	0.17	0.42	
Aroclor-1260	11096-82-5	Fish Tissue	µg/kg ww	17.60	11.9	16.37	
2,4-DDD		Fish Tissue	µg/kg ww	0.30	0.17	0.27	
2,4-DDT		Fish Tissue	µg/kg ww	0.70	0.29	0.63	
4,4-DDD	72-54-8	Fish Tissue	µg/kg ww	5.72	3.34	5.25	
4,4-DDE	72-55-9	Fish Tissue	µg/kg ww	11.00	7.84	10.92	
4,4-DDT	50-29-3	Fish Tissue	µg/kg ww	1.98	1.4	2.00	
Methoxyclor	72-43-5	Fish Tissue	µg/kg ww	0.20	0.12	0.18	

TABLE 6.14. Identification of Chemicals of Concern at Chatanika River (Background)

Analyte Detected	CAS Number	Matrix	Units	Maximum	Average	95% UCL	Risk Evaluation Status
4,4-DDD	72-54-8	Fish tissue	µg/kg ww	0.33	0.18	0.30	
4,4-DDE	72-55-9	Fish tissue	µg/kg ww	0.60	0.54	0.59	

TABLE 6.15. Identification of Chemicals of Concern at Grayling Lake (Background)

Analyte Detected	CAS Number	Matrix	Units	Maximum	Average	95% UCL	Risk Evaluation Status
Fluorene	86-73-7	Fish Tissue	µg/kg ww	4.08	2.35	13.27	
2,4-DDE		Fish Tissue	µg/kg ww	0.70	0.65	0.97	
4,4-DDD	72-54-8	Fish Tissue	µg/kg ww	1.95	1.63	3.65	
4,4-DDE	72-55-9	Fish Tissue	µg/kg ww	6.24	6.01	7.49	
4,4-DDT	50-29-3	Fish Tissue	µg/kg ww	0.36	0.18	1.12	
Endosulfan sulfate		Fish Tissue	µg/kg ww	0.21	0.15	0.53	

TABLE 6.16. Identification of Chemicals of Concern at Hidden Lake (Background)

Analyte Detected	CAS Number	Matrix	Units	Maximum	Average	95% UCL	Risk Evaluation Status
Hexachlorobenzene	118-74-1	Fish Tissue	µg/kg ww	0.17	0.16	0.22	
4,4-DDD	72-54-8	Fish Tissue	µg/kg ww	1.56	1.48	2.01	
4,4-DDE	72-55-9	Fish Tissue	µg/kg ww	12.10	10.6	19.99	
4,4-DDT	50-29-3	Fish Tissue	µg/kg ww	1.05	0.75	2.64	

TABLE 6.17. Identification of Chemicals of Concern at 28-Mile Pit (Background)

Analyte Detected	CAS Number	Matrix	Units	Maximum	Average	95% UCL	Risk Evaluation Status
4,4-DDE	72-54-8	Fish Tissue	µg/kg ww	2.37			

TABLE 6.18. Toxicity Data for Contaminants of Concern in Sitewide BLRA

		Cancer Potency Factor				RfD		RfC	
Analyte	CAS	(mg/kg•d)-1 Oral	Reference	(mg/kg•d)-1 Inhalation	Reference	(mg/kg•d) Oral	Reference	(mg/kg•d) Inhalation	Reference
Volatiles									
Benzene	71-43-2	2.90E-02		2.90E-02	[1]	[4]		[4]	
Methylene chloride	75-09-2	7.50E-03		1.60E-03	[1]	6.00E-02		[4]	
Semivolatiles									
Acenaphthene	83-32-9	[4]				6.00E-02		[3]	
Anthracene	120-12-7	[2]				3.00E-01		[4]	
Benzo(a)anthracene	56-55-3	7.30E-01	[6]	[3]		[3]		[4]	
Benzo(a)pyrene	50-32-8	7.30E+00	[5]	[3]		[3]		[3]	
Benzo(b)fluoranthene	205-99-2	7.30E-01	[6]	[3]		[3]		[3]	
Fluorene	86-73-7	[3]				4.00E-02		[3]	
Hexachlorobenzene	118-74-1	1.60E+00		1.60E+00		[2]		[2]	
Naphthalene	91-20-3					4.00E-02	[7]	4.00E-03	[7]
Phenanthrene	85-01-8	[2]				4.00E-02	[8]	[4]	
PCB									
Aroclor-1260	11096-82-5	7.70E+00	[10]	7.70E+00	[10]	2.00E-05		[3]	
Pesticides									
4,4'-DDD	72-54-8	2.40E-01		[3]		[3]		[3]	
4,4'-DDE	72-55-9	3.40E-01		[3]		[3]		[3]	
4,4'-DDT	50-29-3	3.40E-01		3.40E-01		5.00E-04		[3]	
Aldrin	309-00-2	1.70E+01		1.70E+01		3.00E-05		[3]	
Delta-BHC	319-86-8	[3]		[3]		2.00E-03	[9]	[3]	
Dieldrin	60-57-1	1.60E+01		1.60E+01		5.00E-05		[3]	
Endosulfan sulfate	115-29-7	[4]				6.00E-03		[3]	
Endrin	72-20-8					3.00E-04		[3]	
Methoxychlor	72-43-5	[3]				5.00E-03		[2]	
Metals									
Arsenic	7440-38-2	[3]		1.50E+01		3.00E-04		[3]	
Beryllium	7440-41-7	4.30E+00		8.40E+00		5.00E-03		[3]	
Manganese	7439-96-5	[2]		[2]		5.00E-03		5.00E-05	

Unless referenced otherwise, the toxicity factors are IRIS2 (EPA 1995).
[1] EPA 1994a.
[2] "Inadequate" - database is not adequate to assess risk.
[3] "Empty" -- an IRIS term that suggests that scientific data are lacking for determination of animal or human risk.
[4] Under review or to be reviewed.
[5] EPA 1992c.
[6] "Risk Assessment for PAH Mixtures." Letter from Carol Sweeney to Sally Thomas, EPA Health and Environmental Assessment Section, November 16, 1993.
[7] EPA 1992.
[8] RfD set equal to value for fluoranthene.
[9] EPA 1986b.
[10] Cancer Potency Factors set equal to values for PCBs, general.

TABLE 6.19. Summary of Cancer Risk and Hazard Index at Surface Water Bodies

Surface Water Body	Exposure Pathway	Current		Future	
		Cancer Risk	Hazard Index	Cancer Risk	Hazard Index
Chatanika River	Ingestion of fish	<	<	<	<
	Ingestion of surface water	NS	NS	NS	NS
	Dermal contact with surface water	NS	NS	NS	NS
	Ingestion of sediments	NS	NS	NS	NS
	Dermal contact with sediments	NS	NS	NS	NS
	Summation for all pathways	<	<	<	<
	Sum minus background metals	<	<	<	<
Upper French Creek (background)	Ingestion of fish	1E-06	2E-02	3E-06	1E-02
	Ingestion of surface water	<	1E-01	<	1E-01
	Dermal contact with surface water	<	<	<	<
	Ingestion of sediments	<	3E-02	<	2E-02
	Dermal contact with sediments	<	<	<	<
	Summation for all pathways	1E-06	2E-01	3E-06	1E-01
	Sum minus background metals	1E-06	2E-02	3E-06	1E-02
Piledriver Slough	Ingestion of fish	9E-06	1E+00	3E-05	9E-01
	Ingestion of surface water	1E-06	2E-02	3E-06	2E-02
	Dermal contact with surface water	<	<	<	<
	Ingestion of sediments	<	3E-02	<	3E-02
	Dermal contact with sediments	<	<	<	<
	Summation for all pathways	1E-05	1E+00	3E-05	9E-01
	Sum minus background metals	9E-06	1E+00	3E-05	9E-01
Grayling Lake	Ingestion of fish	2E-07	<	6E-07	<
	Ingestion of surface water	NS	NS	NS	NS
	Dermal contact with surface water	NS	NS	NS	NS
	Ingestion of sediments	NS	NS	NS	NS
	Dermal contact with sediments	NS	NS	NS	NS
	Summation for all pathways	2E-07	<	6E-07	<
	Sum minus background metals	2E-07	<	6E-07	<
Hidden Lake	Ingestion of fish	3E-07	<	1E-06	<
	Ingestion of surface water	NS	NS	NS	NS
	Dermal contact with surface water	NS	NS	NS	NS
	Ingestion of sediments	NS	NS	NS	NS
	Dermal contact with sediments	NS	NS	NS	NS
	Summation for all pathways	3E-07	<	1E-06	<
	Sum minus background metals	3E-07	<	1E-06	<

TABLE 6.19. Summary of Cancer Risk and Hazard Index at Surface Water Bodies (cont.)

Surface Water Body	Exposure Pathway	Current		Future	
		Cancer Risk	Hazard Index	Cancer Risk	Hazard Index
28-Mile Pit	Ingestion of fish	<	<	2E-07	<
	Ingestion of surface water	NS	NS	NS	NS
	Dermal contact with surface water	NS	NS	NS	NS
	Ingestion of sediments	NS	NS	NS	NS
	Dermal contact with sediments	NS	NS	NS	NS
	Summation of all exposure pathways	<	<	2E-07	<
	Sum minus background metals	<	<	2E-07	<
Upper Garrison Slough	Ingestion of fish	6E-05	7E+00	2E-04	6E+00
	Ingestion of surface water	<	2E+00	<	2E+00
	Dermal contact with surface water	<	<	<	<
	Ingestion of sediments	2E-07	4E-01	6E-07	3E-01
	Dermal contact with sediments	<	2E-02	2E-07	1E-02
	Summation of all exposure pathways	6E-05	1E+01	2E-04	8E+00
	Sum minus background metals	6E-05	7E+00	2E-04	6E+00
Middle Garrison Slough	Ingestion of fish	5E-05	3E+00	2E-04	2E+00
	Ingestion of surface water	<	8E-01	<	6E-01
	Dermal contact with surface water	<	<	<	<
	Ingestion of sediments	1E-07	1E-01	4E-07	9E-02
	Dermal contact with sediments	<	<	<	<
	Summation of all exposure pathways	5E-05	3E+00	2E-04	3E+00
	Sum minus background metals	5E-05	3E+00	2E-04	2E+00
Lower Garrison Slough	Ingestion of fish	1E-03	2E+02	4E-03	2E+02
	Ingestion of surface water	<	<	<	<
	Dermal contact with surface water	<	<	<	<
	Ingestion of sediments	1E-05	2E+00	3E-05	1E+00
	Dermal contact with sediments	4E-06	6E-01	1E-05	5E-01
	Summation for all exposure pathways	1E-03	2E+02	4E-03	2E-02
	Sum minus background metals	1E-03	2E+02	4E-03	2E-02
Garrison Slough at Transmitter Road	Ingestion of fish	NS	NS	NS	NS
	Ingestion of surface water	<	3E-01	<	2E-01
	Dermal contact with surface water	<	<	<	<
	Ingestion of sediments	<	4E-01	2E-07	3E-01
	Dermal contact with sediments	<	2E-02	<	1E-02
	Summation for all exposure pathways	<	7E-01	3E-07	6E-01
	Sum minus background metals	<	1E-02	3E-07	1E-02

TABLE 6.19. Summary of Cancer Risk and Hazard Index at Surface Water Bodies (cont.)					
Surface Water Body	Exposure Pathway	Current		Future	
		Cancer Risk	Hazard Index	Cancer Risk	Hazard Index
Moose Creek/Garrison Slough Confluence	Ingestion of fish	9E-05	1E+01	3E-04	1E+01
	Ingestion of surface water	NS	NS	NS	NS
	Dermal contact with surface water	NS	NS	NS	NS
	Ingestion of sediments	NS	NS	NS	NS
	Dermal contact with sediments	NS	NS	NS	NS
	Summation for all exposure pathways	9E-05	1E+01	3E-04	1E+01
	Sum minus background metals	9E-05	1E+01	3E-04	1E+01
French Creek at Quarry Road	Ingestion of fish	1E-05	2E+00	4E-05	1E+00
	Ingestion of surface water	<	3E-01	<	2E-01
	Dermal contact with surface water	<	<	<	<
	Ingestion of sediments	<	4E-02		3E-02
	Dermal contact with sediments	<	<	<	<
	Summation for all exposure pathways	1E-05	2E+00	4E-05	2E+00
	Sum minus background metals	1E-05	2E+00	4E-05	1E+00
Middle French Creek (FC02)	Ingestion of fish	NS	NS	NS	NS
	Ingestion of surface water	<	2E-01	3E-07	2E-01
	Dermal contact with surface water	<	<	2E-07	<
	Ingestion of sediments	<	2E-01	<	1E-01
	Dermal contact with sediments	<	<	<	<
	Summation for all exposure pathways	2E-07	4E-01	5E-07	3E-01
	Sum minus background metals	2E-07	<	5E-07	<
Lower French Creek	Ingestion of fish	2E-05	2E+00	5E-05	2E+00
	Ingestion of surface water	<	2E-01	<	2E-01
	Dermal contact with surface water	<	<	<	<
	Ingestion of sediments	<	2E-01	<	1E-01
	Dermal contact with sediments	<	<	<	<
	Summation for all exposure pathways	2E-05	2E+00	5E-05	2E+00
	Sum minus background metals	2E-05	2E+00	5E-05	2E+00
Flightline Pond	Ingestion of fish	NS	NS	NS	NS
	Ingestion of surface water	<	2E-01	<	2E-01
	Dermal contact with surface water	<	<	<	<
	Ingestion of sediments	2E-07	1E-01	7E-07	1E-01
	Dermal contact with sediments	<	<	3E-07	<
	Summation for all exposure pathways	3E-07	4E-01	1E-06	3E-01
	Sum minus background metals	3E-07	<	1E-06	<

TABLE 6.19. Summary of Cancer Risk and Hazard Index at Surface Water Bodies (cont.)

Surface Water Body	Exposure Pathway	Current		Future	
		Cancer Risk	Hazard Index	Cancer Risk	Hazard Index
Lily Lake	Ingestion of fish	<	<	<	<
	Ingestion of surface water	<	3E-02	<	2E-02
	Dermal contact with surface water	<	<	<	<
	Ingestion of sediments	<	<	<	<
	Dermal contact with sediments	<	<	<	<
	Summation for all exposure pathways	<	3E-02	<	2E-02
	Sum minus background metals	<	<	<	<
Upper Moose Creek	Ingestion of fish	2E-06	1E-01	8E-06	8E-02
	Ingestion of surface water	1E-06	3E-01	4E-06	3E-01
	Dermal contact with surface water	<	<	<	<
	Ingestion of sediments	<	1E-01	1E-07	1E-01
	Dermal contact with sediments	<	<	<	<
	Summation of all exposure pathways	4E-06	6E-01	1E-05	4E-01
	Sum minus background metals	2E-06	1E-01	8E-06	8E-02

NS Chemical data for this medium were not available.
< Excess cancer risk < 1E-06 or Hazard Index < 1E-02

Table 2. Risk Estimates for Exposure to Soil Collected Near Garrison Slough

Case	Scenario	Exposure Concentrations	Carcinogenic Risk	Hazard Index	% of Carcinogenic Risk Due to PCBs
1. All samples	Current Industrial	RME	2.1E-04	3.8	>99%
	Future Residential	RME	1.1E-03	16	99%
	Future Residential	Mean	3.7E-04	5.6	98%
2. Excluding three trench samples	Future Residential	RME	1.0E-04	1.5	87%
	Future Residential	Mean	4.3E-05	0.6	84%
3. Excluding three trench samples and GSTR-3	Future Residential	RME	3.4E-05	0.5	59%

TABLE 6.20. Total Pathway Risks for Surface Water Locales						
Site	Future Recreational		Samples Collected		PCB Contribution	
	Total Cancer Risk	Total Hazard Index	Fish	Sediment/ Water	Cancer Risk	Hazard Index
Background						
Chatanika River	<	<	X		0%	0%
Upper French Creek	3E-06	1E-02	X	X	0%	0%
Offsite Monitoring						
Piledriver Slough	3E-05	9E-01	X	X	85%	99%
Grayling Lake	6E-07	<	X		0%	0%
Hidden Lake	1E-06	<	X		0%	0%
28-Mile Pit	2E-07	<	X		0%	0%
Garrison Slough						
Upper	2E-04	6E+00	X	X	81%	98%
Middle	2E-04	2E+00	X	X	31%	90%
Lower	4E-03	2E+02	X	X	98%	100%
Transmitter Rd.	3E-07	1E-02		X	0%	0%
Moose Creek Confluence	3E-04	1E+01	X		94%	99%
French Creek						
Quarry Rd.	4E-05	1E+00	X	X	91%	99%
Middle (FC02)	5E-07	<		X	0%	0%
Lower	5E-05	2E+00	X	X	73%	86%
Other onsite						
Flightline Pond	1E-06	<		X	0%	0%
Lily Lake	<	<		X	0%	0%
Upper Moose Creek	8E-06	8E-02	X	X	0%	0%

< Excess cancer risk < 1E-07 or Hazard Index < 1E-02.

TABLE 6.21. Summary EHQs for Key Receptors by Site							
Receptor	Site	Inhalation	Ingestion				Summary EHQ
			Volatile	Semi-volatile	Pesticide/ PCB	Lead	
Shrew	WP38	0.24	0		0.002	0.004	0.246
	LF02	0.02	0	0.001	0.02	0.01	0.051
	LF03	0.07	0	0.003	0.00001	0.004	0.077
	ST20	0.0001	0	0.0006	0.0003		0.001
	SS35	0.08	0	0.02	0.004	0.01	0.114
	SS56	0.0001	0		0.0002	5E-04	0.0008
	ST19	0.04	0		0.00001		0.040
	G-lower	0	0	0.02	0.7	0.06	0.78
	G-middle	0	0	0.003	0.005	0.1	0.108
	ST10	0	0	0.002	0.004	0.01	0.016
Grouse	WP38	0.02	0.034				0.054
	LF02		2E-05				0.00002
	LF03		5E-05				0.00005
	ST20		6E-04				0.0006
	SS35						0
	SS56						0
	ST19		0.04				0.04
	G-lower						0
	G-middle						0
	ST10		0.021				0.021
Shrike	WP38				0.001	0.008	0.009
	LF02				0.01	0.04	0.05
	LF03				0.00003	0.007	0.00703
	ST20				0.0001		0.0001
	SS35				0.002	0.04	0.042
	SS56				0.0001	0.003	0.0031
	ST19				0.00004		0.00004
	G-lower				1.5	0.1	1.6
	G-middle				0.003	0.4	0.403
	ST10				0.002	0.01	0.012

7.0 Description of Alternatives

An FS was performed as part of the sitewide RI/FS process. This section of the ROD describes the remedial alternatives proposed and evaluated in the FS. For more details, see the FS (U.S. Air Force 1995f).

7.1 Remedial Action Objectives

Remedial action objectives (RAOs) are developed to specify actions and contaminant levels necessary to provide protection of human health and the environment. RAOs define the contaminants of concern, exposure routes and receptors, and remediation goals, which are acceptable contaminant levels for each exposure route. The results of the sitewide BLRA (U.S. Air Force 1995g) were used to identify the contaminants and pathways that pose an unacceptable risk, and to determine acceptable contaminant levels for each exposure pathway. The BLRA indicated that unacceptable potential risks (i.e., excess cancer risk $> 10^{-4}$ and/or HI > 1) exist in or adjacent to Garrison Slough and French Creek. Exposure to PCBs through soil and fish ingestion accounts for almost all of the potential risk.

Soil

There are two RAOs associated for the soils located adjacent to Garrison Slough. The first RAO is to prevent ingestion of soils in excess of the acceptable carcinogenic risk range as defined by CERCLA. The second RAO is to prevent additional loading to the slough via surface water runoff.

The concentration of concern for PCBs depends primarily on the type of exposure that will occur based on projected land use. Land use in this area is currently industrial and is projected to remain industrial for the foreseeable future. EPA guidance suggests action levels for PCBs within the range of 10 to 25 mg/kg for industrial areas. Using Eielson site-specific exposure factors, an action level of 10 mg/kg is also within the acceptable risk range assuming a future residential scenario. An action level of 10 mg/kg is also consistent with the RAO to reduce contaminant loading to Garrison Slough and is consistent with the action level for slough sediments.

Surface Water and Sediments

As discussed in Section 5.4, the PCBs found in fish are believed to be the direct result of their exposure to PCB-contaminated sediment. The uptake of PCBs by fish may occur through incidental ingestion of contaminated sediment while feeding, gill exchange with surface waters, and ingestion of contaminated water and prey. Although PCBs were not detected in surface water samples, they may be present at concentrations below the detection limit and contribute to their bioaccumulation in fish. PCB-contaminated sediment was found in lower Garrison Slough, with the highest concentrations found immediately upstream of Arctic Avenue. Because fish inhabiting Garrison Slough will presumably continue to accumulate PCBs from sediment either directly or indirectly, RAOs were developed for both fish and sediments.

State of Alaska or federal freshwater sediment cleanup criteria for PCBs do not currently exist. In its guidance for PCB-contaminated sites, EPA uses the equilibrium partitioning approach to derive sediment quality criteria (SQC) that will achieve the chronic ambient water quality criteria of 0.014 μg/L in interstitial water (EPA 1990). EPA recommends that if the sediment concentration at a site exceeds the SQC value, water column species should be monitored to determine whether prey contain unacceptable contaminant levels. The Air Force sampled water column species in lower Garrison Slough, and it appears that the PCB levels in fish tissue pose an unacceptable potential risk to human health. EPA guidance, however, does not suggest a method for determining a cleanup criterion if unacceptable contaminant levels in water column species are found. In addition, EPA points out that an established cleanup concentration, based on total PCB, may show little relationship to biological phenomena because not all PCB congeners have the same toxicological effects.

Consequently, a mass-removal approach is the basis for the sediment remediation goal. This approach assumes that removing or isolating the sediment with the highest PCB concentrations and reducing the mass available for uptake by water column organisms will, over time, lead to a reduction in the average PCB concentration in the fish population. Because of the long half-life of PCBs in aquatic organisms (approximately 8 years [DeBoer et al. 1994]), a reduction in average fish tissue concentrations for the general population may not be evident until fish with high body burdens either die or migrate out of the system.

The primary remediation goal for slough sediment is to reduce the potential risk to human health from the consumption of PCB-contaminated fish. This goal can be achieved through the following measures:

- Preventing ingestion of contaminated fish from lower Garrison Slough, and
- Reducing the mass of PCBs available for uptake by water column organisms, including fish, so that concentrations of PCBs in fish tissue will eventually achieve acceptable levels.

To achieve the remediation goal and meet the general goals of the CERCLA program, RAOs were developed to define media-specific contaminant concentrations or mass reduction goals. Table 7.1 presents these RAOs.

The remediation goal for fish is based on a back calculation for the fish tissue PCB concentration that would produce a total excess cancer risk of less than 10^{-6}. This calculation assumed a recreational exposure scenario (exposure parameters are specified in Section 6.1.2).

A plot of the cumulative PCB mass vs. downstream distance from the point where contamination starts indicates that approximately 80 percent of the PCB mass lies in a 300-m (984-ft) stretch upstream from Arctic Avenue (Figure 7.1). Downstream of Arctic Avenue, the cumulative mass curve flattens out, indicating that the remainder of the PCBs are disseminated throughout a much larger volume of sediment. Remediation in this area would be less cost-effective because of the large volume of sediment containing relatively low (maximum concentration <5 milligrams per kilogram [mg/kg] PCBs).

It is believed that the RAO will be achieved by remediating the 300-m (984-ft) stretch of Garrison Slough just upstream of Arctic Avenue (Figure 7.2). Assuming a stream channel 3.3 m (10 ft) wide and filled with 0.6 m (2 ft) of contaminated sediment, the volume of sediment requiring remediation is approximately 600 m^3 (730 cy). The effectiveness of remediating the target area upstream of Arctic Avenue in reducing PCB concentrations in fish to acceptable levels will require verification, and further remediation may be necessary. Residual PCBs in sediment downstream of Arctic Avenue will eventually degrade and disperse through natural processes.

7.2 Remedial Alternatives

Five remedial alternatives for lower Garrison Slough were developed and analyzed in detail in the sitewide FS (U.S. Air Force 1995f). The alternatives evaluated under the FS are also applicable to contaminated soils adjacent to Garrison Slough. These alternatives are listed below.

7.2.1 Alternative 1: No Action with Monitoring

The *No Action* alternative requires that no action be taken to reduce contaminant concentrations in either soil, fish or sediment. This alternative relies on natural degradation and dispersion to reduce contaminant concentrations. Ongoing environmental monitoring of soil, fish, sediment, and surface water would be performed.

Based this alternative would result in hazardous substances remaining on-site above health based levels, a review would be required no less often than each 5 years in accordance with Section 121(c) of CERCLA.

7.2.2 Alternative 2: Limited Action

The *Limited Action* alternative uses institutional controls to restrict use of areas with unacceptable soil contamination and to restrict fishing, along with engineering controls to restrict the migration of fish into the contaminated portion of Garrison Slough. It would result in an almost immediate reduction in human exposure to PCBs by interrupting the fish ingestion pathway. These controls are described below.

Fishing Advisory/Restrictions. Air Force restrictions at Eielson AFB are currently in place to prevent fishing in Garrison Slough. The restrictions stste that the ingestion of fish from Garrison Slough may pose a health risk and should be avoided. Fishing permits are required to fish at Eielson AFB. The briefing that is required to obtain a permit identifies areas where fishing is prohibited and explains the potential risks associated with ingestion of fish from lower Garrison Slough. This area would also be designated as a restricted use area in the base Management Action Plan. The Air Force would be responsible for posting any signs necessary to advise the public of the fishing restrictions. In addition, the Alaska State Department of Fish and Game has designate Garrison Slough a catch-and-release-only area. This classification would further reduce the potential for ingestion of contaminated fish.

Physical Fish Control. A physical barrier (e.g., a rock dam, a fish screen) would be installed in Garrison Slough near the northern base boundary to prevent the migration of fish into and out of the contaminated reach of the slough. This control would also prevent further bioaccumulation of PCBs by fish that have migrated out of the slough. The FS assumed construction of a rock dam that would be approximately 1 m (0.3 ft) high, and would be constructed with a vertical to very steep downstream face to prevent the upstream migration of fish (Figure 7.2).

Ongoing environmental monitoring of fish, sediment, and surface water would also be performed as part of this alternative.

Based this alternative would result in hazardous substances remaining on-site above health based levels, a review would be required no less often than each 5 years in accordance with Section 121(c) of CERCLA.

7.2.3 Alternative 3: *In Situ* Capping

Under the *In Situ Capping* alternative, PCB-contaminated soils adjacent to the slough would be capped in place using native soils. Sediment in the 300-m (984-ft) stretch upstream of Arctic Avenue would be left in place but covered with a multilayer cap to isolate it from the ecosystem. Isolating the contaminated sediment would, over time, lead to a reduction in PCB concentrations in the fish population. After temporary diversion of the slough and preparation of the stream bed (devegetation and contouring), a permeable geotextile liner would be installed, and covered by successive 10-15 cm (4-6 in.) thick layers of pea gravel, coarse pebble, and cobble. The permeable liner would permit any gases formed during decomposition of organic mater to escape without lifting the liner. The complete liner is estimated to raise the bed of the slough approximately 30 to 45 cm (12 to 18 in.).

Institutional controls (described in Alternative 2) would also be implemented with this alternative to provide a near-immediate reduction in the amount of fish ingested from Garrison Slough. Ongoing environmental monitoring of fish, sediment, and surface water would also be performed.

7.2.4 Alternative 4: Dredge/Excavate and On-site Disposal

This alternative requires removal of PCB-contaminated soil and sediment with with concentrations greater than 10 mg/kg followed by onsite disposal of the material with concentrations less than 50 mg/kg. Mechanical dredging of sediment would produce an estimated 600 m^3 (730 cy) of contaminated sediment. Onsite disposal would require hauling the dredged material directly to the inactive base landfill at source area LF03 (Figure 7.2). The soil and sediments would be placed in an unlined trench above the water table, covered with clean soil, and revegetated. Under the CERCLA OU 5 ROD, LF03 was closed in accordance with relevant and appropriate requirements of RCRA Subtitle C (40 CFR 264). Actions included capping and implementation of institutional controls of the landfill. Therefore, disposal of the PCB-contaminated material less than 50 mg/kg would be protective of human health and the environment.

Soil and sediments with $\geq$50 mg/kg PCBs would be handled and shipped offsite in accordance with TSCA 40 CCFR 761. Under the existing rule, PCBs of 50 mg/kg or greater are typically incinerated or TSCA landfilled.

Institutional controls (described in Alternative 2) would also be implemented with this alternative to provide a nearly immediate reduction in the amount of fish ingested from Garrison Slough. Ongoing environmental monitoring of fish, sediment, and surface water would also be performed.

7.2.5 Alternative 5: Dredge/Excavate and Treat

The *Dredge/Excavate and Treat* alternative is similar to the *Dredge/Excavate and Dispose* Alternative, except that the dredged material would be treated to permanently destroy the PCBs. Land farming would degrade the PCBs over several months to years. A biological agent, such as white rot fungus (*Phanerocheate chrysosporium*), can be used with a cellulose/lignin base food source and nutrients to degrade PCBs. Sawdust is the most likely food source, although straw could also be used. The degradation might normally be completed in a season; however, due to the short growing season in the Fairbanks area, it is expected that up to three seasons would be required, with new inoculations and aeration performed at the beginning of each growing season.

Institutional controls (described in Alternative 2) would also be implemented with this alternative to provide a nearly immediate reduction in the amount of fish ingested from Garrison Slough. Ongoing environmental monitoring of fish, sediment, and surface water would also be performed.

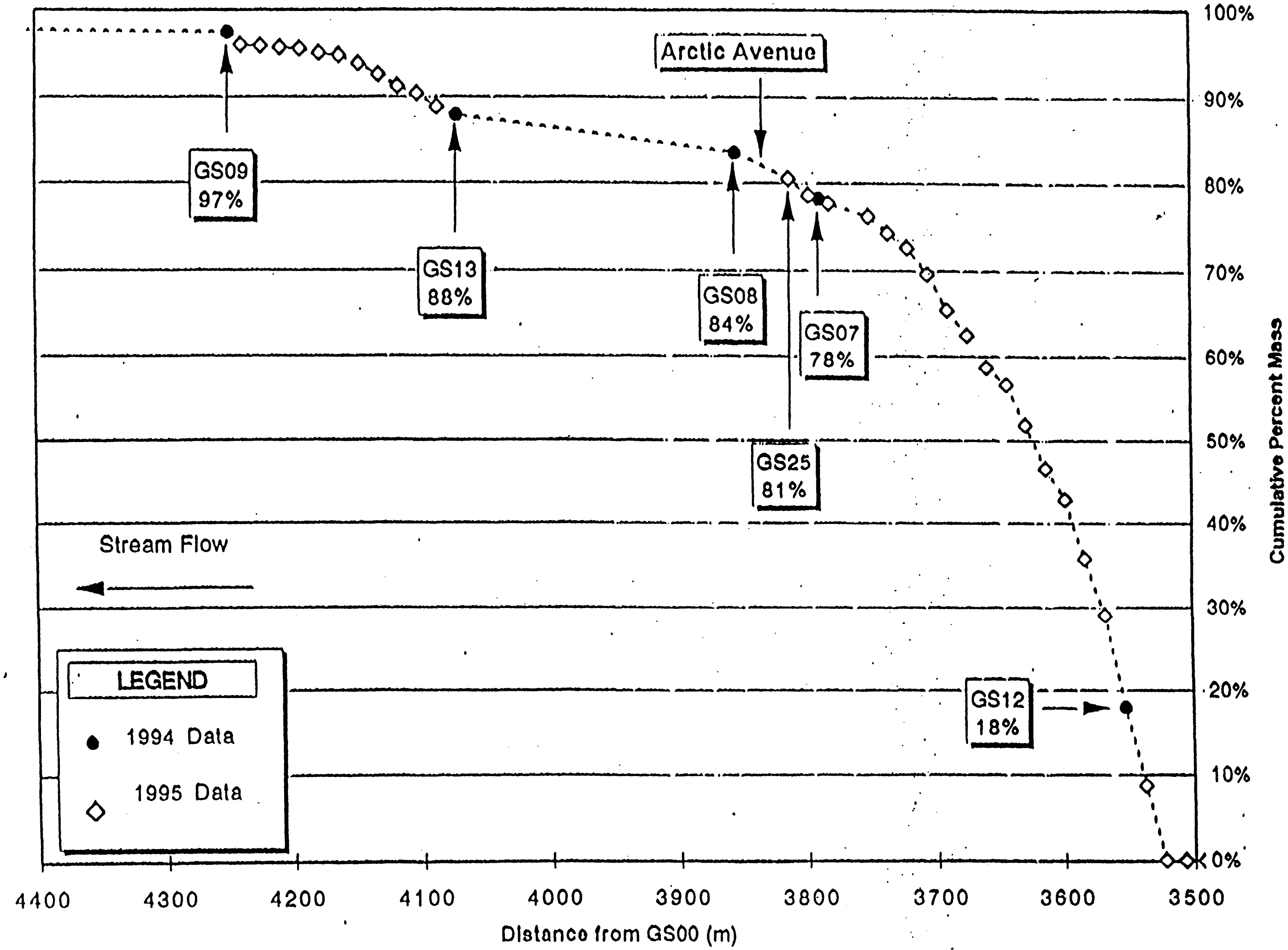

FIGURE 7.1. Cumulative Percent of PCB Mass with Increasing Distance from Contamination Source in Garrison Slough

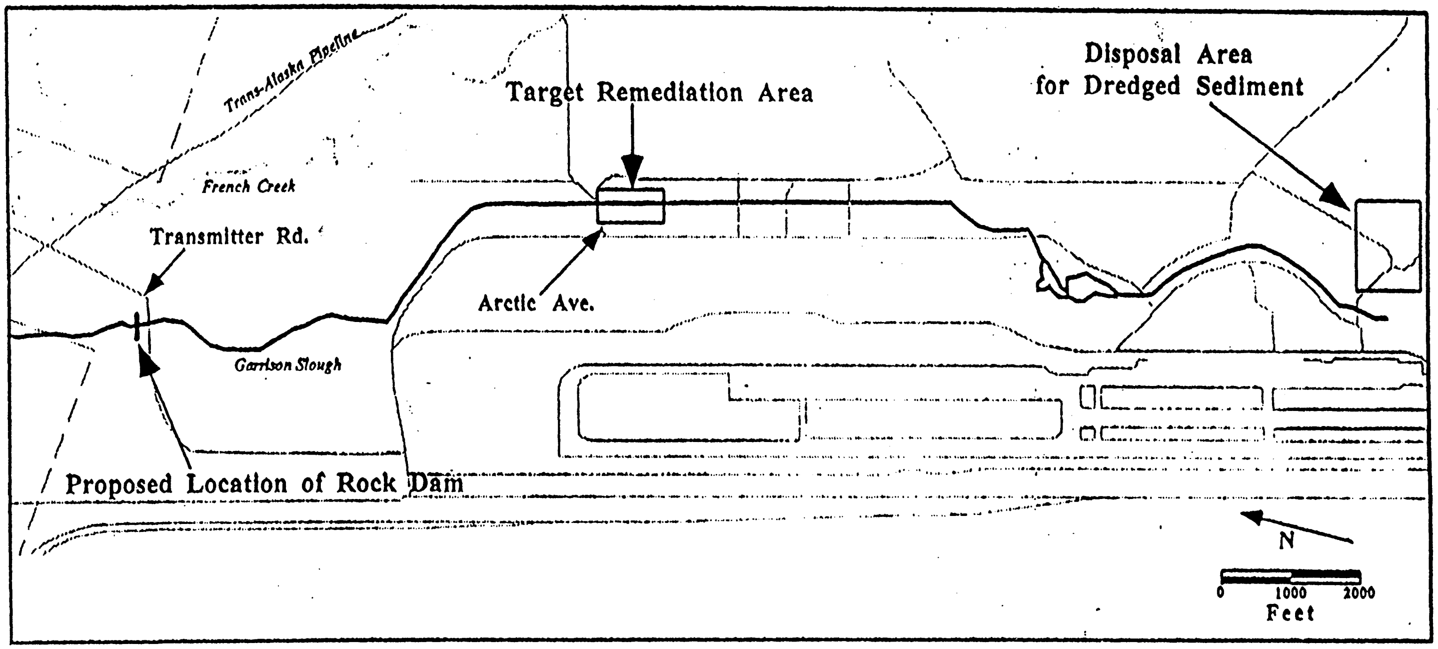

FIGURE 7.2. Elements of Remedial Action for Garrison Slough

TABLE 7.1. Remedial Action Objectives for Garrison Slough

Medium	Contaminant of Concern	Exposure Route	Receptor	Remediation Goal
Fish	PCBs (Aroclor 1260)	Ingestion	Human	0.69 μg/ kg (wet weight)
Sediment	PCBs (Aroclor 1260)	Ingestion	Human (through fish ingestion)	Remove PCBs > 10 mg/kg
Soils	PCBs (Aroclor 1260)	Ingestion	Human	Remove PCBs > 10 mg/kg

8.0 Summary of the Comparative Analysis of Alternatives

In accordance with federal regulations, the five cleanup alternatives were evaluated based on the nine criteria presented in the National Contingency Plan (NCP). The nine criteria are divided into three groups as follows:

Threshold Criteria - Must be met by all alternatives.

(1) Overall protection of human health and the environment. How well does the alternative protect human health and the environment, both during and after construction?

(2) Compliance with Applicable or Relevant and Appropriate Requirements (ARARs). Does the alternative meet all applicable or relevant and appropriate state and federal laws?

Balancing Criteria - Used to compare the alternatives.

(3) Long-Term Effectiveness and Permanence. How well does the alternative protect human health and the environment after cleanup? What, if any, risks will remain at the area?

(4) Reduction of Toxicity, Mobility, or Volume Through Treatment. Does the alternative effectively treat the contamination to significantly reduce the toxicity, mobility, and volume of the hazardous substance?

(5) Short-Term Effectiveness. Are there potential adverse effects to either human health or the environment during construction or implementation of the alternative? How fast does the alternative reach the cleanup goals?

(6) Implementability. Is the alternative both technically and administratively feasible? Has the technology been used successfully at similar areas?

(7) Cost. What are the relative costs of the alternatives?

Modifying Criteria - Evaluated as a result of public comments.

(8) State Acceptance. What are the state's comments or concerns about the alternatives considered and about the preferred alternative? Does the state support or oppose the preferred alternative?

(9) Community Acceptance. What are the community's comments or concerns about the alternatives considered and about the preferred alternative? Does the community generally support or oppose the preferred alternative?

This section contains the results of the comparative analyses of remedial alternatives for Garrison Slough.

8.1 Threshold Criteria

8.1.1 Overall Protection of Human Health and the Environment

All of the alternatives, except *No Action*, would implement institutional controls to reduce the short-term risk to human health by preventing or limiting the ingestion of PCB-contaminated soils or fish. The *Limited Action* alternative would reduce the long-terms risks by preventing the migration of fish into the most highly-contaminated reach of Garrison Slough by using a fish migration control device. The *In-Situ Capping* alternative would achieve protection by isolating the soils and sediment, thereby reducing the degree of PCB bioaccumulation in fish.

The *Dredge/Excavate and Dispose* and *Dredge/Excavate and Treat* alternatives would achieve long-term protection by permanently removing soils and sediments that are the source of PCBs to fish. The residual PCBs in sediment downstream of Arctic Avenue would naturally degrade and disperse with time. Institutional controls would be maintained under these alternatives to restrict fishing until concentrations were below acceptable levels.

8.1.2 Compliance with ARARs

All of the alternatives, except *No Action*, would meet all applicable or relevant and appropriate requirements as outlined in Section 10.2.

8.2. Modifying Criteria

A comparative analysis of the five alternatives using the modifying criteria is provided in Table 8.1.

8.3. Balancing Criteria

8.3.1 State Acceptance

The State of Alaska concurs with the selected remedy for Garrison Slough. Interested Natural Resource Trustees, specifically Alaska State Department of Fish and Game, US Fish and Wildlife Service, and State of Alaska Department of Natural Resources, have also been involved in determining the selected remedy.

8.3.2 Community Acceptance

There were no public comments received during the public comment period. The Eielson AFB Restoration Advisory Board (RAB) was briefed on the proposed remedy and expressed support of the proposed remedy. One of the co-chairs of the RAB was specifically interested in continued monitoring of fish, surface water, and sediments off-base in Moose Creek.

A summary of community participation activities is included in Section 3 and in the Responsiveness Summary.

TABLE 8.1. Comparison of Alternatives for Garrison Slough					
Cleanup Alternatives					Balancing Criteria
1	2	3	4	5	
W	W	P	G	B	Long-term effectiveness and permanence The no action, limited action, and capping alternatives leave all of the contamination in place. However, the capping alternative isolates almost all (about 80 percent of the PCBs by weight) of the contamination from contact with fish. Both removal alternatives (dredging and disposal or treatment) leave a small amount (about 20 percent by weight) of the PCB contamination in place. The residual contamination should eventually degrade through natural processes. The no action alternative does not prevent people from eating contaminated fish. All of the other alternatives provide controls for preventing or limiting the ingestion of potentially-contaminated fish through fishing restrictions. The no action alternative does not prevent exposure to contaminated soils or fish. The limited action alternative will prevent fish from migrating upstream into the contaminated reach of the slough; however, it will not protect fish and other aquatic life that are already upstream of the dam. The capping alternative isolates most of the PCBs, although long-term reliability will require monitoring and maintenance to preserve the integrity of the liner. The two dredging alternatives will reliably remove soil and sediment contamination that are the source of contamination to the fish in the slough.
W	W	W	W	G	Reduction of toxicity, mobility, or volume through treatment Only the dredge/excavate and treat alternative uses a treatment process. Treatment would be accomplished through land farming. An estimate 870 cubic yards of dredged material, containing about 80 percent of the PCBs by weight, would be treated. Depending on the effectiveness of this technology in an arctic environment, PCBs might be broken down into nonhazardous materials (carbon dioxide) during this process. None of the other alternatives use treatment to reduce the toxicity, mobility, or volume of the PCB contamination.
W	P	G	B	B	Short-term effectiveness The capping and dredging alternatives present the potential for some movement of the contaminated sediment, which could be controlled by isolating the area and diverting the surface water. The dredging alternatives present some potential for direct contact exposure during excavation and land farming or landfilling, although the risks from this pathway are very low. Engineering and institutional controls would reduce this potential. It is estimated that under the no action and limited action alternatives, PCB contamination in fish would be reduced to acceptable levels in tens of years. Under the capping and dredging alternatives, the majority of the sediment contamination would be isolated via capping or removed within a few weeks. Contamination levels in fish would decrease to acceptable levels after all of the currently contaminated fish die.

TABLE 8.1. Comparison of Alternatives for Garrison Slough					
Cleanup Alternatives					Balancing Criteria
1	2	3	4	5	
					Short-term effectiveness (cont.) The no action and limited action alternatives would not prevent environmental impacts from PCB contamination. The limited action alternative would raise the base level of the slough behind the rock dam, and prevent fish from migrating to areas above the dam. The remaining alternatives will completely change about 900 feet of the existing channel and temporarily affect the ecology of this part of the slough. Capping will also rase the stream bed by 1 to 2 feet, and maintenance of the liner may also adversely affect the slough. The dredging alternatives will lower the bed of the slough 1 to 2 feet, and some short-term degradation of the surface water (turbidity) may occur. However, impacts to the slough from all of the alternatives are expected to be only temporary.
NA	B	P	B	G	Implementability Implementation of fishing restrictions and installation of a fish control device can be easily implemented. Temporary damming and rerouting of the surface water during remediation is relatively straightforward. Capping might be problematic if the cap must be installed through standing water and/or over soft sediment. Dredging and disposal is easy to implement. Dredging and treatment is also easily implemented, although land farming of PCB-contaminated material has not been successfully demonstrated at Eielson AFB. The reliability of land farming to treat PCBs, particularly in an arctic environment, is not well established. Base fishing restrictions are reliable for preventing the ingestion of fish. The reliability of the capping alternative is high as long as the integrity of the liner is not disrupted through bioturbation or changing stream flow conditions. Dredging and disposal of PCB contaminated sediment is easy to implement, and is a proven technology.
98	140	290	191	217	Cost ($K) The estimated total present worth costs (assuming 30 years at a 5% interest rate) for each of the cleanup alternatives are presented in thousands of dollars.

Cleanup Alternatives
1 No Action.
2 Limited Action.
3 Capping.
4 Dredge and Dispose.
5 Dredge and Treat.

Key
B Best.
G Good.
P Poor.
W Worst.
NA Not applicable.

9.0 The Selected Remedy

This section describes the selected remedy for Garrison Slough. Based upon consideration of the requirements of CERCLA, the detailed analysis of the remedial alternatives using the nine criteria, and public comments, the U.S. Air Force, ADEC, and EPA have determined that a combination of Alternatives 2 (*Limited Action*) and 4 (*Dredge/Excavate and Dispose*) is the most appropriate remedy for Garrison Slough and adjacent soils. Major components of the selected remedy include:

- Institutional controls: Fishing restrictions in Garrison Slough
- Engineering controls: Fish control device near the downstream edge of Eielson AFB
- Excavation of contaminated soils and sediments with concentrations greater than 10 mg/kg PCBs
- Onsite disposal of material with PCB concentrations less than 50 mg/kg
- Offsite disposal or treatment of materials with PCB concentrations greater than 50 mg/kg in accordance with the Toxic Substances Control Act (TSCA) 40 CFR 761.
- Environmental monitoring of soils, sediments, surface water, fish, and groundwater.

This combination entails the active removal and disposal of PCB-contaminated soils and sediment with concentrations greater than 10 mg/kg, and the use of an engineering control to prevent fish from migrating during the remediation. These soils and sediments will be disposed of in an on-site landfill designated LF03. Under the CERCLA OU 5 ROD, LF03 was closed in accordance with relevant and appropriate requirements of RCRA Subtitle C (40 CFR 264). Actions included capping and implementation of institutional controls of the landfill. Therefore, disposal of the PCB-contaminated material less than 50 mg/kg would be protective of human health and the environment.

Excavated soil or sediments containing greater than 50 ppm PCBs would be disposed of or treated in a manner that complies with TSCA (40 CFR 761).

Institutional controls will restrict fishing and the consumption of fish from Garrison Slough until PCB concentrations in fish have been reduced to a level that does not pose an unacceptable risk to human health. This alternative will permanently remove approximately 80 percent of the PCB-contaminated sediment from Garrison Slough to prevent exposure and ingestion by fish. Air Force restrictions at Eielson AFB are currently in place to prevent fishing in Garrison Slough. The restrictions state that the ingestion of fish from Garrison Slough may pose a health risk and should be avoided. Fishing permits are required to fish at Eielson AFB. The briefing that is required to obtain a permit identifies areas where fishing is prohibited and explains the potential risks associated with ingestion of fish from lower Garrison Slough. This area would also be designated as a restricted use area in the base Management Action Plan. The Air Force would be responsible for posting any signs necessary to advise the public of the fishing restrictions. In addition, the Alaska State Department of Fish and Game has designate Garrison Slough a catch-and-release-only area. This classification would further reduce the potential for ingestion of contaminated fish.

The Air Force will continue to monitor PCB concentrations in fish tissue and sediment to evaluate the effectiveness of the cleanup. The estimated cost of $233,000 for the combined preferred alternative includes 8 years of fish tissue monitoring (the estimated lifespan of a grayling) and 3 years of sediment monitoring. Additional monitoring may be required if concentrations have not decreased below acceptable levels in these timeframes.

The selected remedy of fishing restrictions and excavation of soils and sediments with concentrations greater that 10 mg/kg with on-site disposal will reduce the carcinogenic risks to an acceptable level as defined by CERCLA for both industrial and residential scenarios. The HD for noncarcinogenic effects will be reduced to less than 1 by the remedial action.

After all of the currently-contaminated fish have died, PCB levels in fish are expected to be low enough that they no longer pose an unacceptable risk to human health. This alternative is easy to implement and has the greatest likelihood of success.

In the event that it becomes apparent during or after implementation of the selected remedy that the remediation goals will not be met, additional measures could be required to protect human health and the environment (i.e., removal or isolation of PCB-contaminated sediment downstream of Arctic Avenue or ongoing institutional controls).

10.0 Statutory Determinations

The selected remedy meets statutory requirements of Section 121 of CERCLA, as amended by SARA, and to the extent practicable, the NCP. The evaluation criteria are discussed below.

10.1 Protection of Human Health and the Environment

The selected remedies protect human health and the environment through the removal and on-site disposal of PCB-contaminated soils and sediments that are the source of contamination to humans and fish. Soils and sediments with PCB concentrations greater than 50 mg/kg will be disposed or treated in accordance with TSCA. Most of the PCB-contaminated sediments, which are believed to be the source of PCBs to fish, will be removed by mechanical dredging and disposed in an on-base landfill. This action will remove approximately 80 percent of the PCBs by weight, and will interrupt the exposure pathway from sediments to fish. Implementation of institutional control to restrict fishing in Garrison Slough will be designed to eliminate the risk from humans ingesting fish until levels decrease to below acceptable levels.

The selected remedy is designed will reduce the excess cancer risk to within the 10^{-4} to 10^{-6} range, and the HI to less than 1. No unacceptable short-term risks or cross-media impacts resulting from implementation of the remedy are anticipated that cannot be readily controlled.

10.2 Attainment of ARARs

CERCLA specifies that remedial actions must attain standards that are defined by EPA and ADEC as applicable or relevant and appropriate for Eielson AFB, unless a waiver is obtained. The selection process for remedial actions may also take into account the *to be considered* (TBC) criteria. These criteria may include nonenforceable criteria, advisories, or guidance issued by federal or state agencies that are not legally binding but are considered, if appropriate, in developing remedial action objectives and goals. The selected remedies will comply with ARARs of federal and Alaska State environmental and public health laws.

The remedy chosen for Garrison Slough will comply with all action- and location-specific ARARs, as described in the following sections. Potential ARARs for surface water and sediment were identified in the sitewide FS (U.S. Air Force 1995e).

10.2.1 Chemical-Specific ARARs

The State of Alaska has promulgated water quality criteria for specific classes of protected water use and has adopted a nondegradation policy for waters of higher quality than the criteria (18 AAC 70). Surface waters at Eielson AFB are protected for Classes (1)(A) Water Supply, (1)(B) Water Recreation, and (1)(C) Growth and Propagation of Fish, Shellfish, Other Aquatic Life, and Wildlife.

No chemical-specific ARARs for PCBs in freshwater sediment or fish tissue currently exist. The Food and Drug Administration (FDA) has established a temporary tolerance level for PCB residues in food for human consumption until these contaminants are eliminated from the environment

(21 CFR 109.30). The tolerance level of 2 mg/kg PCBs in the edible portion of fish and shellfish is a *TBC* criterion for Eielson AFB.

EPA Guidance of Remedial Actions for Superfund Sites with PCB Contamination, August 1990, EPA/540/G-90/007 is a TBC for this action and provides a general framework for determining cleanup levels, identifying treatment options, and assessing necessary management controls for residuals. This guidance recommends preliminary remediation goals for PCBs in soil as follows: 1) 1 mg/kg for residential areas, and 2) 10 to 25 mg/kg for industrial areas. Principal threats are identified as: 1) soils with concentrations greater than 100 mg/kg for residential areas, and 2) soils with concentrations greater than 500 mg/kg for industrial areas.

TSCA's PCB Spill Cleanup Policy is also a TBC criterion for Superfund response actions. The spill policy provides cleanup targets as follows: 1) for non-restricted areas, cleanup levels of 1 mg/kg (or 10 mg/kg if covered with 10 inches of clean soil), and 2) for restricted areas, 25 ppm (50 ppm if the area is secured by a fence and a warning sign posted.

10.2.2 Location-Specific ARARs

The location-specific ARARs identified for the remediation of contaminated sediments and fish are the following:

- Floodplain restrictions. For activities on a floodplain, action must be taken to avoid adverse effects, minimize potential harm, and restore and preserve natural and beneficial values (40 CFR 6, Appendix A). Eielson AFB is located on the floodplain of the Tanana River.

- Stream restrictions. Under the Fish and Wildlife Coordination Act, if any activity requires diversion, channeling, or other modification of a stream or river and affects fish or wildlife, action must be taken to protect the fish or wildlife (40 CFR 6.302).

- Wetlands. Designated wetlands are protected under the Clean Water Act. Any remedial activities conducted in wetland areas must be implemented in a manner that avoids adverse effects, minimizes potential harm, and preserves and enhances the wetlands to extent possible. Although permit requirements are waived under CERCLA, excavation or fill would require special planning and could require wetland replacement if a significant area was affected. The part of Garrison Slough where remedial actions will be taken is not in a designated wetland protected under the Clean Water Act.

10.2.3 Action-Specific ARARs

Action-specific requirements for the treatment, storage and disposal of PCB-contaminated material are derived from two sets of regulations: TSCA PCB regulations (40 CFR 761), and RCRA land disposal restrictions (40 CFR 268).

TSCA requirements do not apply to PCBs at concentrations less than 50 ppm; however, PCBs cannot be diluted to escape TSCA requirements. Response actions must evaluate the form and concentration of PCB contamination "as found" at the site (EPA 1990). Soils and sediments with concentrations greater than 50 mg/kg are subject to the substantive requirements of 40 CFR 761.

Disposal of Non-Liquid PCB Waste With Concentrations Greater Than or Equal to 50 ppm. Non-liquid PCB waste in the form of soil, rags, or other debris, with concentrations of 50 ppm or greater are to be disposed of in one of the following manners:

- in an incinerator (40 CFR 761.70)
- treated by an equivalent method (40 CFR 761.60(e))
- in a chemical waste landfill (40 CFR 761.75).

Land Disposal Restriction Consideration

PCB- contaminated RCRA hazardous waste (as defined by 40 CFR 261) may be subject to land disposal restrictions if:

- the concentration of PCBs in liquid hazardous waste is greater than or equal to 50 ppm; or
- the total concentration of Halogenated Organic Compounds (HOCs) in non-liquid hazardous waste exceeds 1000 ppm.

The total concentration of HOCs in sediment from Garrison Slough do not exceed 1000 ppm; therefore, land disposal restriction will not apply.

10.3 Cost Effectiveness

The selected remedy is cost effective for the remediation of the contaminated sediments because it has been determined to provide overall effectiveness proportionate to its costs and duration.

10.4 Utilization of Permanent Solutions and Alternative Treatment Technologies

The selected remedy does not employ alternative treatment or resource recovery technologies. The use of alternative treatment technologies was determined to be impracticable due to the large volume of low concentration of PCBs, the remoteness of the site, the unavailability of technologies, and the availability of a protective landfill.

The remedy selected for Garrison Slough is a permanent solution because contaminated soil and sediment will be removed from the Garrison Slough, thereby interrupting the exposure pathway from sediment to fish. The remedy provides protection of human health and the environment, complies with ARARs, is cost-effective and utilizes permanent solutions to the extent practicable. The selected remedy provides the best balance of tradeoffs among the alternatives with respect to the evaluation criteria, specifically long-term permanence, implementability, and cost-effectiveness.

10.5 Preference for Treatment as a Principal Element

The statutory preference for remedies that employ treatment as a principal element will not be met.

Treatment of contaminated soils and sediments is not considered to be a cost-effective means of reducing risks to human health. The identified risks will be reduced to acceptable levels by implementing institutional controls and removal with on-site disposal of contaminated soils and sediments.

The selected remedy satisfies the statutory preference for remedies that employ treatment as a principal element. The selected remedy reduces the principal threat by reducing the total mass of PCBs that are available to biological receptors, and reduces contaminant mobility through isolation of the PCB-contaminated sediment in a landfill.

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APPENDIX

Sitewide Investigation Sampling Results

TABLE A.1. Background Soil Study

Analyte	Year	Highest Detection Limit	Units	No. of Samples	No. of Detects	Minimum Detect	Maximum Detect	Maximum Location
Aluminum	1991	4.5	mg/kg dw	91	90	2950	30400	GVE11
Antimony	1991	3.8	mg/kg dw	91	53	2.5	1400	LS07
Arsenic	1991	2.4	mg/kg dw	91	85	2.1	2310	LS07
Barium	1991	-	mg/kg dw	91	91	39.2	44400	LS07
Beryllium	1991	0.1	mg/kg dw	91	64	0.048	40.2	LS07
Cadmium	1991	0.3	mg/kg dw	91	87	0.32	162	LS07
Calcium	1991	9.1	mg/kg dw	91	90	1360	14100	GVE13
Chromium	1991	-	mg/kg dw	91	91	6.3	7360	LS07
Cobalt	1991	-	mg/kg dw	91	91	2.5	2900	LS07
Copper	1991	-	mg/kg dw	91	91	8.3	9010	LS07
Iron	1991	1.6	mg/kg dw	91	90	5660	54100	GVE11
Lead	1991	-	mg/kg dw	91	91	2.3	23.3	GVE11
Magnesium	1991	3.0	mg/kg dw	91	90	1880	16100	GVE11
Manganese	1991	-	mg/kg dw	91	91	89.3	69800	LS07
Mercury	1991	0.2	mg/kg dw	91	41	0.03	0.24	GVE30
Nickel	1991	-	mg/kg dw	91	91	8.4	7000	LS07
Potassium	1991	-	mg/kg dw	91	91	307	13400	LS07
Selenium	1991	0.1	mg/kg dw	91	75	0.08	0.86	GVE04
Silver	1991	0.6	mg/kg dw	91	37	0.44	89	LS07
Sodium	1991	-	mg/kg dw	91	91	153	63000	LS07
Thallium	1991	0.2	mg/kg dw	91	33	0.1	0.65	GVE06
Vanadium	1991	-	mg/kg dw	91	91	11.1	12400	LS07
Zinc	1991	-	mg/kg dw	91	91	14.5	13400	LS07
TPH	1991	2.6	mg/kg dw	91	19	2.7	39.2	GVE09
4,4'-DDD	1991	12.0	µg/kg dw	91	2	4.7	9.3	TL01
4,4'-DDE	1991	4.5	µg/kg dw	91	2	1.5	1.9	TL01
4,4'-DDT	1991	14.0	µg/kg dw	91	2	5.1	14.0	TL01
Aldrin	1991	4.5	µg/kg dw	91	0	-	-	-
Alpha-BHC	1991	3.3	µg/kg dw	91	0	-	-	-
Alpha-Chlordane	1991	5.5	µg/kg dw	91	0	-	-	-
Beta-BHC	1991	6.7	µg/kg dw	91	0	-	-	-
Delta-BHC	1991	6.7	µg/kg dw	91	0	-	-	-
Dieldrin	1991	2.2	µg/kg dw	91	0	-	-	-
Endosulfan I	1991	6.7	µg/kg dw	91	0	-	-	-
Endosulfan II	1991	4.5	µg/kg dw	91	0	-	-	-
Endosulfan Sulfate	1991	13.0	µg/kg dw	91	0	-	-	-
Endrin	1991	6.7	µg/kg dw	91	0	-	-	-
Endrin Ketone	1991	13.0	µg/kg dw	91	0	-	-	-
Gamma-BHC	1991	4.5	µg/kg dw	91	0	-	-	-
Gamma-Chlordane	1991	5.5	µg/kg dw	91	0	-	-	-
Heptachlor	1991	3.3	µg/kg dw	91	0	-	-	-
Heptachlor Epoxide	1991	6.7	µg/kg dw	91	0	-	-	-
Methoxychlor	1991	27.0	µg/kg dw	91	0	-	-	-
Toxaphene	1991	110.0	µg/kg dw	91	0	-	-	-
Aroclor 1016	1991	53.0	µg/kg dw	91	0	-	-	-
Aroclor 1221	1991	130.0	µg/kg dw	91	0	-	-	-
Aroclor 1232	1991	130.0	µg/kg dw	91	0	-	-	-
Aroclor 1242	1991	53.0	µg/kg dw	91	0	-	-	-
Aroclor 1248	1991	53.0	µg/kg dw	91	0	-	-	-
Aroclor 1254	1991	27.0	µg/kg dw	91	0	-	-	-
Aroclor 1260	1991	27.0	µg/kg dw	91	0	-	-	-

TABLE A.2. Background Groundwater Study

Analyte	Year	Detection Limit	Units	No. of Samples	No. of Detects	Minimum Detect	Maximum Detect	Maximum Location
Antimony	1992	200	µg/L	17	0	-	-	-
Arsenic	1992	5	µg/L	17	5	8.1	56	54MO5
Barium	1992	-	µg/L	17	17	35	200	20M17
Beryllium	1992	3	µg/L	17	0	-	-	-
Cadmium	1992	10	µg/L	17	0	-	-	-
Calcium	1992	-	µg/L	17	17	8000	71000	53M02
Chromium	1992	20	µg/L	17	0	-	-	-
Cobalt	1992	20	µg/L	17	0	-	-	-
Copper	1992	20	µg/L	17	0	-	-	-
Iron	1992	20	µg/L	17	16	100	15000	20M17
Lead	1992	5	µg/L	17	2	5.2	8.3	05M03
Magnesium	1992	-	µg/L	17	17	1500	16000	05M03
Manganese	1992	10	µg/L	17	16	32	3300	46M01
Nickel	1992	30	µg/L	17	0	-	-	-
Potassium	1992	-	µg/L	17	17	2200	4600	20-1B
Silver	1992	20	µg/L	17	0	-	-	-
Sodium	1992	-	µg/L	17	17	1200	9700	20M18
Vanadium	1992	30	µg/L	17	0	-	-	-
Zinc	1992	10	µg/L	17	2	14	18	53M02
Chloride	1992	200	µg/L	17	16	500	3700	46M01/46M03
Fluoride	1992	100	µg/L	17	16	100	500	05M03
Nitrate	1992	200	µg/L	17	8	200	11000	38M03
Sulfate	1992	500	µg/L	17	16	1900	45000	38M03
Phosphate	1992	400	µg/L	17	0	-	-	-
Alkalinity	1992	50	µg/L	17	16	70	5230	53M02
TOC	1992	9000	µg/L	17	0	-	-	-
TDS	1992	-	µg/L	17	17	20	250	05M03/46M01/53M02
TPH	1992	0.5	µg/L	17	0	-	-	-
Aluminum	1993	32.5	µg/L	32	26	37	680	01M01
Antimony	1993	69.4	µg/L	32	0	-	-	-
Arsenic	1993	1.0	µg/L	32	24	2.0	22	20M17
Barium	1993	-	µg/L	32	32	46	180	20M17
Beryllium	1993	0.814	µg/L	32	3	0.85	1.5	27-1
Cadmium	1993	4.70	µg/L	32	0	-	-	-
Calcium	1993	-	µg/L	32	32	2000	75000	53M02
Chromium	1993	5.42	µg/L	32	8	5.6	9.7	01M01
Cobalt	1993	6.9	µg/L	32	6	4.2	5.8	54M08
Copper	1993	2.65	µg/L	32	7	2.9	6.1	54M02
Iron	1993	-	µg/L	32	32	150	14000	20M17
Lead	1993	1	µg/L	32	6	0.71	48	20-1B
Magnesium	1993	-	µg/L	32	32	3600	15000	53M02
Manganese	1993	-	µg/L	32	32	20	3400	54M02
Nickel	1993	17.9	µg/L	32	0	-	-	-
Potassium	1993	-	µg/L	32	32	1200	5100	53M02
Silver	1993	2.87	µg/L	32	3	3.00	3.00	20M17/54M05/54M02
Sodium	1993	-	µg/L	32	32	1500	5400	54M05
Vanadium	1993	7.8	µg/L	32	11	64	6.9	20M17
Zinc	1993	8.1	µg/L	32	7	4.3	25	20-1B
Benzene	1993	0.105	µg/L	16	0	-	-	-
Carbon Tetrachloride	1993	0.121	µg/L	16	0	-	-	-
Chloroform	1993	0.043	µg/L	16	0	-	-	-
p-Dichlorobenzene	1993	0.107	µg/L	16	0	-	-	-
1,1-Dichloroethane	1993	0.337	µg/L	16	0	-	-	-
1,2-Dichloroethane	1993	0.139	µg/L	16	0	-	-	-
cis-1,2-Dichloroethylene	1993	0.127	µg/L	16	0	-	-	-
trans-1,2-Dichloroethylene	1993	0.149	µg/L	16	0	-	-	-
Ethylbenzene	1993	0.046	µg/L	16	0	-	-	-
Methylene Chloride	1993	0.44	µg/L	16	0	-	-	-
Tetrachloroethylene	1993	0.049	µg/L	16	0	-	-	-

TABLE A.2. Background Groundwater Study

Analyte	Year	Detection Limit	Units	No. of Samples	No. of Detects	Minimum Detect	Maximum Detect	Maximum Location
Toluene	1993	0.056	µg/L	16	0	-	-	-
1,1,1-Trichloroethane	1993	0.072	µg/L	16	0	-	-	-
1,1,2-Trichloroethane	1993	0.043	µg/L	16	0	-	-	-
Trichloroethylene	1993	0.065	µg/L	16	0	-	-	-
Vinyl Chloride	1993	0.266	µg/L	16	0	-	-	-
Xylene	1993	0.202	µg/L	16	0	-	-	-
Aluminum	1994	-	µg/L	8	8	1600	18000	01M02
Antimony	1994	1.0	µg/L	8	3	1	2	01M01/01M02
Arsenic	1994	-	µg/L	8	8	8	63	54M08
Barium	1994	-	µg/L	8	8	160	420	01M01
Beryllium	1994	1.0	µg/L	8	0	-	-	-
Cadmium	1994	1.0	µg/L	8	3	1	3	01M01
Calcium	1994	-	µg/L	8	8	38000	66000	05M03
Chromium	1994	-	µg/L	8	8	3	46	01M02
Cobalt	1994	-	µg/L	8	8	2	31	01M02
Copper	1994	-	µg/L	8	8	18	140	01M01
Iron	1994	-	µg/L	8	8	7600	33000	01M01/01M02
Lead	1994	-	µg/L	8	8	4	48	01M02
Magnesium	1994	-	µg/L	8	0	10000	26000	01M02
Manganese	1994	-	µg/L	8	8	1400	6500	01M01
Nickel	1994	-	µg/L	8	8	5	77	01M01
Potassium	1994	-	µg/L	8	8	4400	7900	01M02
Silver	1994	1.0	µg/L	8	0	-	-	-
Sodium	1994	-	µg/L	8	8	6000	9700	01M01
Vanadium	1994	-	µg/L	8	8	8	52	01M02
Zinc	1994	-	µg/L	8	8	20	120	01M01/01M02

TABLE A.3. Sitewide Monitoring Program

Analyte	Year	Detection Limit	Units	No. of Samples	No. of Detects	Minimum Detect	Maximum Detect	Maximum Location
Antimony	1992	200	µg/L	5	0	-	-	-
Arsenic	1992	5.0	µg/L	5	4	11	31	51MB4
Barium	1992	-	µg/L	5	5	60	290	08M01
Beryllium	1992	3.0	µg/L	5	0	-	-	-
Cadmium	1992	10	µg/L	5	0	-	-	-
Calcium	1992	-	µg/L	5	5	46000	55000	68M01
Chromium	1992	20	µg/L	5	1	31	31	51MB4
Cobalt	1992	20	µg/L	5	0	-	-	-
Copper	1992	20	µg/L	5	0	-	-	-
Iron	1992	30	µg/L	5	4	1100	15000	51MB4
Lead	1992	5.0	µg/L	5	1	7.6	7.6	51MB4
Magnesium	1992	-	µg/L	5	5	9500	13000	08M01/51MB4
Manganese	1992	-	µg/L	5	5	1100	11000	51MB5
Nickel	1992	30	µg/L	5	1	32	32	51MB4
Potassium	1992	-	µg/L	5	5	3700	5900	51MB5
Silver	1992	20	µg/L	5	0	-	-	-
Sodium	1992	-	µg/L	5	5	5100	26000	51MB5
Tin	1992	100	µg/L	5	0	-	-	-
Vanadium	1992	30	µg/L	5	0	-	-	-
Zinc	1992	43	µg/L	5	0	-	-	-
Benzene	1992	2.0	µg/L	5	0	-	-	-
Carbon Tetrachloride	1992	1.0	µg/L	5	0	-	-	-
Chloroform	1992	0.5	µg/L	5	0	-	-	-
p-Dichlorobenzene	1992	2.0	µg/L	5	0	-	-	-
1,1-Dichloroethane	1992	1.0	µg/L	5	0	-	-	-
1,2-Dichloroethane	1992	0.5	µg/L	5	0	-	-	-
cis-1,2-Dichloroethylene	1992	1.0	µg/L	5	0	-	-	-
trans-1,2-Dichloroethylene	1992	1.0	µg/L	5	0	-	-	-
Ethylbenzene	1992	2.0	µg/L	5	0	-	-	-
Methylene Chloride	1992	5.0	µg/L	5	0	-	-	-
Tetrachloroethylene	1992	0.5	µg/L	5	0	-	-	-
Toluene	1992	2.0	µg/L	5	0	-	-	-
1,1,1-Trichloroethane	1992	0.5	µg/L	5	0	-	-	-
1,1,2-Trichloroethane	1992	0.5	µg/L	5	0	-	-	-
Trichloroethylene	1992	1.0	µg/L	5	0	-	-	-
Vinyl Chloride	1992	2.0	µg/L	5	0	-	-	-
Xylene	1992	5.0	µg/L	5	0	-	-	-
p-Chlorofluorobenzene	1992	1.0	µg/L	5	0	-	-	-
m-Chlorofluorobenzene	1992	1.0	µg/L	5	0	-	-	-
TPH	1992	500	µg/L	5	0	-	-	-
Aluminum	1993	32.5	µg/L	14	12	58	5800	03M01
Antimony	1993	69.4	µg/L	14	0			
Arsenic	1993	-	µg/L	14	14	3.0	37	03M01
Barium	1993	-	µg/L	14	14	5.8	1200	03M01
Beryllium	1993	0.814	µg/L	14	7	0.83	1.91	05M01
Cadmium	1993	6.6	µg/L	14	0	-	-	-
Calcium	1993	-	µg/L	14	14	43000	12000	03M01
Chromium	1993	5.42	µg/L	14	3	8	9.2	03M01
Cobalt	1993	4.05	µg/L	14	1	4.4	4.4	06M05
Copper	1993	2.65	µg/L	14	3	4.0	9.7	03M01
Iron	1993	-	µg/L	14	14	84	46000	03M01
Lead	1993	1.4	µg/L	14	5	2.0	690	03M01
Magnesium	1993	-	µg/L	14	14	8800	75000	03M01
Manganese	1993	-	µg/L	14	14	870	12000	51MB5
Nickel	1993	17.9	µg/L	14	2	18	20	03M01
Potassium	1993	-	µg/L	14	14	2300	18000	03M01
Silver	1993	2.87	µg/L	14	1	4.3	4.3	03M01
Sodium	1993	-	µg/L	14	14	3800	68000	03M01
Tin	1993	51.1	µg/L	14	0	-	-	-

TABLE A.3. Sitewide Monitoring Program

Analyte	Year	Detection Limit	Units	No. of Samples	No. of Detects	Minimum Detect	Maximum Detect	Maximum Location
Vanadium	1993	3.84	µg/L	14	7	3.9	14	03M01
Zinc	1993	3.44	µg/L	14	8	3.6	170	03M01
Benzene	1993	0.105	µg/L	16	4	0.17	2700	26-8
Carbon Tetrachloride	1993	0.121	µg/L	16	0	-	-	-
Chloroform	1993	0.043	µg/L	16	1	0.96	0.96	18-3
p-Dichlorobenzene	1993	0.107	µg/L	16	1	0.12	0.12	18-3
1,1-Dichloroethane	1993	0.337	µg/L	16	0	-	-	-
1,2-Dichloroethane	1993	0.139	µg/L	16	0	-	-	-
cis-1,2-Dichloroethylene	1993	0.127	µg/L	16	1	1.1	1.1	18-3
trans-1,2-Dichloroethylene	1993	0.149	µg/L	16	1	1.9	1.9	47M05
Ethylbenzene	1993	0.046	µg/L	16	5	0.14	1200	26-1
Methylene Chloride	1993	0.056	µg/L	16	1	1.3	1.3	18-3
Tetrachloroethylene	1993	0.049	µg/L	16	1	0.076	0.076	18-3
Toluene	1993	0.13	µg/L	16	4	0.26	8500	26-8
1,1,1-Trichloroethane	1993	0.072	µg/L	16	0	-	-	-
1,1,2-Trichloroethane	1993	0.043	µg/L	16	0	-	-	-
Trichloroethylene	1993	0.065	µg/L	16	2	0.089	0.9	18-3
Vinyl Chloride	1993	0.266	µg/L	16	0	-	-	-
Xylene	1993	0.202	µg/L	16	5	0.56	9800	26-1
Diesel Range Organics	1993	0.1	µg/L	5	0	-	-	-
o-Cresol	1993	1.80	µg/L	4	0	-	-	-
m-Cresol	1993	1.44	µg/L	4	0	-	-	-
p-Cresol	1993	3.54	µg/L	4	0	-	-	-
Kerosene	1993	4.03	µg/L	4	0	-	-	-
Naphthalene	1993	6.50	µg/L	4	0	-	-	-
Pentachlorophenol	1993	8.07	µg/L	4	0	-	-	-
Phenol	1993	0.833	µg/L	4	0	-	-	-
Tributylphosphate	1993	4.42	µg/L	4	0	-	-	-
Tri-2-chloroethylphosphate	1993	2.88	µg/L	4	0	-	-	-
Benzothiazole	1993	2.55	µg/L	4	0	-	-	-
Bis(2-ethylhexyl)phthalate	1993	4.07	µg/L	4	0	-	-	-
2,4-Dichlorophenol	1993	2.80	µg/L	4	0	-	-	-
2-Nitrophenol	1993	3.96	µg/L	4	0	-	-	-
p-Dichlorobenzene	1993	4.64	µg/L	4	0	-	-	-
2-Methylpyridine	1993	5.83	µg/L	4	0	-	-	-
Acenaphthene	1993	2.88	µg/L	4	0	-	-	-
Acenaphthylene	1993	3.96	µg/L	4	0	-	-	-
Acetophenone	1993	2.38	µg/L	4	0	-	-	-
2-Acetylaminofluorene	1993	2.83	µg/L	4	0	-	-	-
4-Aminobiphenyl	1993	3.83	µg/L	4	0	-	-	-
Aniline	1993	3.53	µg/L	4	0	-	-	-
Anthracene	1993	2.95	µg/L	4	0	-	-	-
Aramite	1993	8.60	µg/L	4	0	-	-	-
Benzo[a]anthracene	1993	2.34	µg/L	4	0	-	-	-
Benzo[b]fluoranthene	1993	4.41	µg/L	4	0	-	-	-
Benzo[k]fluoranthene	1993	2.21	µg/L	4	0	-	-	-
benzo[g,h,i]perylene	1993	3.65	µg/L	4	0	-	-	-
Benzo[a]pyrene	1993	1.70	µg/L	4	0	-	-	-
Benzyl alcohol	1993	5.16	µg/L	4	0	-	-	-
Bis(2-chloroethoxy)methane	1993	7.13	µg/L	4	0	-	-	-
Bis(2-chloroethyl)ether	1993	2.90	µg/L	4	0	-	-	-
Bis(2-chloro-1-methylethyl)ether	1993	3.35	µg/L	4	0	-	-	-
4-Bromophenylphenylether	1993	2.34	µg/L	4	0	-	-	-
Butylbenzylphthalate	1993	5.94	µg/L	4	0	-	-	-
p-Chloroaniline	1993	13.2	µg/L	4	0	-	-	-
Chlorobenzilate	1993	8.69	µg/L	4	0	-	-	-
p-Chloro-m-cresol	1993	7.41	µg/L	4	0	-	-	-
2-Chloronaphthalene	1993	3.02	µg/L	4	0	-	-	-
2-Chlorophenol	1993	1.91	µg/L	4	0	-	-	-

TABLE A.3. Sitewide Monitoring Program

Analyte	Year	Detection Limit	Units	No. of Samples	No. of Detects	Minimum Detect	Maximum Detect	Maximum Location
4-Chlorophenylphenylether	1993	3.04	µg/L	4	0	-	-	-
Chrysene	1993	1.70	µg/L	4	0	-	-	-
Diallate	1993	3.15	µg/L	4	0	-	-	-
Dibenz[a,h]anthracene	1993	1.92	µg/L	4	0	-	-	-
Dibenzofuran	1993	2.54	µg/L	4	0	-	-	-
Di-n-butylphthalate	1993	4.34	µg/L	4	0		-	-
o-Dichlorobenzene	1993	3.77	µg/L	4	0	-	-	-
m-Dichlorobenzene	1993	7.85	µg/L	4	0	-	-	-
3,3'-Dichlorobenzidine	1993	3.88	µg/L	4	0	-	-	-
2,6-Dichlorophenol	1993	3.47	µg/L	4	0	-	-	-
Diethylphthalate	1993	8.94	µg/L	4	0	-	-	-
Thionazin	1993	3.04	µg/L	4	0	-	-	-
Dimethoate	1993	10.0	µg/L	4	0	-	-	-
p-(Dimethylamino)azobenzene	1993	3.36	µg/L	4	0	-	-	-
7,12-Dimethylbenz[a]anthracene	1993	1.82	µg/L	4	0	-	-	-
Pyridine	1993	4.57	µg/L	4	0	-	-	-
3,3'-Dimethylbenzidine	1993	10.4	µg/L	4	0	-	-	-
a,a-Dimethylphenethylamine	1993	37.8	µg/L	4	0	-	-	-
2,4-Dimethylphenol	1993	5.88	µg/L	4	0	-	-	-
Dimethylphthalate	1993	5.55	µg/L	4	0	-	-	-
M-Dinitrobenzene	1993	9.35	µg/L	4	0	-	-	-
4,6-Dinitro-o-cresol	1993	5.55	µg/L	4	0	-	-	-
2,4-Dinitrophenol	1993	4.46	µg/L	4	0	-	-	-
2,4-Dinitrotoluene	1993	2.59	µg/L	4	0	-	-	-
2,6-Dinitrotoluene	1993	2.85	µg/L	4	0	-	-	-
Di-n-octylphthalate	1993	2.98	µg/L	4	0	-	-	-
Diphenylamine	1993	2.86	µg/L	4	0	-	-	-
Ethylmethanesulfonate	1993	2.07	µg/L	4	0	-	-	-
Famphur	1993	12.8	µg/L	4	0	-	-	-
Fluoranthene	1993	4.62	µg/L	4	0	-	-	-
Fluorene	1993	2.56	µg/L	4	0	-	-	-
Hexachlorobenzene	1993	2.38	µg/L	4	0	-	-	-
Hexachlorobutadiene	1993	4.29	µg/L	4	0	-	-	-
Hexachlorocyclopentadiene	1993	2.62	µg/L	4	0	-	-	-
Hexachloroethane	1993	4.73	µg/L	4	0	-	-	-
Hexachlorophene	1993	19.6	µg/L	4	0	-	-	-
Hexachloropropene	1993	3.68	µg/L	4	0	-	-	-
Indeno[1,2,3-cd]pyrene	1993	3.21	µg/L	4	0	-	-	-
Isodrin	1993	1.44	µg/L	4	0	-	-	-
Isophorone	1993	3.29	µg/L	4	0	-	-	-
Isosafrole	1993	2.25	µg/L	4	0	-	-	-
Kepone	1993	9.59	µg/L	4	0	-	-	-
Methapyrilene	1993	8.45	µg/L	4	0	-	-	-
3-Methlcholanthrene	1993	2.63	µg/L	4	0	-	-	-
Methylmethanesulfonate	1993	1.61	µg/L	4	0	-	-	-
2-Methylnaphthalene	1993	2.76	µg/L	4	0	-	-	-
1,4-Naphthoquinone	1993	10.0	µg/L	4	0	-	-	-
1-Naphthylamine	1993	25.3	µg/L	4	0	-	-	-
2-Naphthylamine	1993	15.6	µg/L	4	0	-	-	-
o-Nitroaniline	1993	7.82	µg/L	4	0	-	-	-
m-Nitroaniline	1993	9.52	µg/L	4	0	-	-	-
p-Nitroaniline	1993	21.4	µg/L	4	0	-	-	-
Nitrobenzene	1993	3.16	µg/L	4	0	-	-	-
p-Nitrophenol	1993	1.52	µg/L	4	0	-	-	-
4-Nitroquinoline-1-oxide	1993	6.00	µg/L	4	0	-	-	-
N-nitrosodi-n-butylamine	1993	3.22	µg/L	4	0	-	-	-
N-nitrosodiethylamine	1993	2.90	µg/L	4	0	-	-	-
N-nitrosodimethylamine	1993	3.81	µg/L	4	0	-	-	-
N-nitrosodiphenylamine	1993	2.11	µg/L	4	0	-	-	-

TABLE A.3. Sitewide Monitoring Program

Analyte	Year	Detection Limit	Units	No. of Samples	No. of Detects	Minimum Detect	Maximum Detect	Maximum Location
N-nitrosodipropylamine	1993	3.67	µg/L	4	0	-	-	-
N-nitrosomethylethylamine	1993	2.83	µg/L	4	0	-	-	-
N-nitrosomorpholine	1993	3.27	µg/L	4	0	-	-	-
N-nitrosopiperidene	1993	4.35	µg/L	4	0	-	-	-
N-nitrosopyrrolidine	1993	2.78	µg/L	4	0	-	-	-
5-Nitro-o-toluidine	1993	5.25	µg/L	4	0	-	-	-
Parathion	1993	3.90	µg/L	4	0	-	-	-
Pentachlorbenzene	1993	3.99	µg/L	4	0	-	-	-
Pentachloronitrobenzene	1993	2.49	µg/L	4	0	-	-	-
Phenacetin	1993	4.78	µg/L	4	0	-	-	-
Phenanthrene	1993	5.27	µg/L	4	0	-	-	-
p-Phenylenediamine	1993	3.09	µg/L	4	0	-	-	-
Pronamide	1993	3.42	µg/L	4	0	-	-	-
Pyrene	1993	3.69	µg/L	4	0	-	-	-
Safrole	1993	3.22	µg/L	4	0	-	-	-
1,2,4,5-Tetrachlorobenzene	1993	4.39	µg/L	4	0	-	-	-
2,3,4,6-Tetrachlorophenol	1993	4.77	µg/L	4	0	-	-	-
Tetraethyldithiopyrophosphate	1993	2.81	µg/L	4	0	-	-	-
o-Toluidine	1993	2.27	µg/L	4	0	-	-	-
1,2,4-Trichlorobenzene	1993	4.14	µg/L	4	0	-	-	-
2,4,5-Trichlorophenol	1993	4.01	µg/L	4	0	-	-	-
2,4,6-Trichlorphenol	1993	2.54	µg/L	4	0	-	-	-
o,o,o-Triethylphosphorothioate	1993	5.19	µg/L	4	0	-	-	-
sym-Trinitrobenzene	1993	3.74	µg/L	4	0	-	-	-
Aldrin	1993	0.05	µg/L	3	0	-	-	-
Alpha-BHC	1993	0.012	µg/L	3	0	-	-	-
Beta-BHC	1993	0.0026	µg/L	3	1	0.0032	0.0032	06M04
Delta-BHC	1993	0.0014	µg/L	3	1	0.0048	0.0048	06M04
Lindane	1993	0.0012	µg/L	3	0	-	-	-
Chlordane	1993	0.0057	µg/L	3	0	-	-	-
4,4'-DDD	1993	0.0005	µg/L	3	1	0.00075	0.00075	05M01
4,4'-DDE	1993	0.0009	µg/L	3	0	-	-	-
4,4'-DDT	1993	0.011	µg/L	3	0	-	-	-
Dieldrin	1993	0.019	µg/L	3	0	-	-	-
Endosulfan I	1993	0.0029	µg/L	3	0	-	-	-
Endosulfan II	1993	0.004	µg/L	3	0	-	-	-
Endosulfan Sulfate	1993	0.0072	µg/L	3	0	-	-	-
Endrin	1993	0.008	µg/L	3	0	-	-	-
Endrin Aldehyde	1993	0.011	µg/L	3	0	-	-	-
Heptachlor	1993	0.0019	µg/L	3	0	-	-	-
Heptachlor Epoxide	1993	0.0008	µg/L	3	0	-	-	-
Methoxychlor	1993	0.1	µg/L	3	0	-	-	-
Toxaphene	1993	0.89	µg/L	3	0	-	-	-
Aroclor 1016	1993	0.19	µg/L	3	0	-	-	-
Aroclor 1221	1993	0.14	µg/L	3	0	-	-	-
Aroclor 1232	1993	0.11	µg/L	3	0	-	-	-
Aroclor 1242	1993	0.11	µg/L	3	0	-	-	-
Aroclor 1248	1993	0.04	µg/L	3	0	-	-	-
Aroclor 1254	1993	0.1	µg/L	3	0	-	-	-
Aroclor 1260	1993	0.11	µg/L	3	0	-	-	-
Aluminum	1994	57	µg/L	33	31	27	130000	38M06
Antimony	1994	1.0	µg/L	33	4	1.3	11	38M06
Arsenic	1994	3.0	µg/L	33	27	4.5	200	04M03
Barium	1994	-	µg/L	33	33	9.6	2400	38M06
Beryllium	1994	2.0	µg/L	33	2	2.0	4.8	38M06
Cadmium	1994	1.0	µg/L	33	6	1.3	2.8	B-8
Calcium	1994	-	µg/L	33	33	2800	350000	38M02
Chromium	1994	1.0	µg/L	33	32	1.2	670	38M06
Cobalt	1994	1.0	µg/L	33	28	1.1	220	38M06

TABLE A.3. Sitewide Monitoring Program

Analyte	Year	Detection Limit	Units	No. of Samples	No. of Detects	Minimum Detect	Maximum Detect	Maximum Location
Copper	1994	1.0	µg/L	33	32	1.5	650	38M06
Iron	1994		µg/L	33	33	58	330000	38M06
Lead	1994	1.0	µg/L	33	26	1.4	210	38M06
Magnesium	1994	-	µg/L	33	33	7800	130000	38M02
Manganese	1994	-	µg/L	33	33	6.3	9600	B-8
Nickel	1994	-	µg/L	33	33	1.1	970	38M06
Potassium	1994	4050	µg/L	33	32	2100	13000	38M02
Silver	1994	1.0	µg/L	33	3	1.2	2.9	38M06
Sodium	1994	-	µg/L	33	33	5600	63000	04M02
Vanadium	1994	1.0	µg/L	33	25	1.4	400	38M06
Zinc	1994	14	µg/L	33	31	9.3	980	38M06
Dichlorodifluoromethane	1994	100	µg/L	35	0	-	-	-
Chloromethane	1994	1.0	µg/L	35	2	1.0	1.2	36M03
Vinyl Chloride	1994	50	µg/L	35	0	-	-	-
Bromomethane	1994	200	µg/L	35	0	-	-	-
Chloroethane	1994	100	µg/L	35	0	-	-	-
Trichlorofluoromethane	1994	100	µg/L	35	0	-	-	-
1,1-Dichloroethene	1994	50	µg/L	35	0	-	-	-
Methylene chloride	1994	100	µg/L	35	0	-	-	-
Trans-1,1-Dichloroether	1994	100	µg/L	35	2	1.4	1.8	47M01
1,1-Dichloroethane	1994	100	µg/L	35	0	-	-	-
Chloroform	1994	100	µg/L	35	1	17	17	Birch Lake
1,1,1-Trichloroethane	1994	100	µg/L	35	5	2.3	3.1	36-1
Carbon Tetrachloride	1994	50	µg/L	35	0	-	-	-
1,2-Dichloroethane	1994	50	µg/L	35	2	0.65	1.2	45MW07
Trichloroethene	1994	50	µg/L	35	6	0.65	5.8	49M05
1,2-Dichloropropane	1994	50	µg/L	35	0	-	-	-
Bromodichloromethane	1994	100	µg/L	35	1	5.8	5.8	Birch Lake
2-Chloroethylvinylether	1994	200	µg/L	35	0	-	-	-
cis-1,3-Dichloropropene	1994	50	µg/L	35	0	-	-	-
Trans-1,3-Dichloropropene	1994	50	µg/L	35	0	-	-	-
1,1,2-Trichloroethane	1994	50	µg/L	35	0	-	-	-
Tetrachloroethene	1994	50	µg/L	35	2	0.7	0.84	45MW07
Dibromochloromethane	1994	100	µg/L	35	1	1.2	1.2	Birch Lake
Chlorobenzene	1994	50	µg/L	35	0	-	-	-
Bromoform	1994	100	µg/L	35	0	-	-	-
1,1,2,2-Tetrachloroethane	1994	100	µg/L	35	0	-	-	-
1,3-Dichlorobenzene	1994	100	µg/L	35	0	-	-	-
1,4-Dichlorobenzene	1994	100	µg/L	35	0	-	-	-
1,2-Dichlorobenzene	1994	100	µg/L	35	0	-	-	-
Benzene	1994	1.0	µg/L	35	3	3.8	400	38M01
Toluene	1994	100	µg/L	35	4	1.1	290	04M07
Chlorobenzene	1994	100	µg/L	35	0	-	-	-
Ethylbenzene	1994	100	µg/L	35	0	-	-	-
m,p-Xylene	1994	100	µg/L	35	0	-	-	-
o-Xylene	1994	100	µg/L	35	0	-	-	-
Gasoline Range Organics	1994	0.25	mg/L	12	1	1.9	1.9	04M07
Diesel Range Organics	1994	0.25	mg/L	17	5	0.3	1.3	04M04
Phenol	1994	10	µg/L	4	0	-	-	-
2-Chlorophenol	1994	10	µg/L	4	0	-	-	-
2-Methylphenol	1994	10	µg/L	4	1	10	10	04M07
3/4-Methylphenol (total)	1994	-	µg/L	4	4	1.0	42	04M07
2-Nitrophenol	1994	10	µg/L	4	0	-	-	-
2,4-Dimethylphenol	1994	10	µg/L	4	0	-	-	-
2,4-Dichlorophenol	1994	10	µg/L	4	0	-	-	-
4-Chloro-3-methylphenol	1994	20	µg/L	4	0	-	-	-
2,4,6-Trichlorphenol	1994	10	µg/L	4	0	-	-	-
2,4,5-Trichlorophenol	1994	10	µg/L	4	0	-	-	-
2,4-Dinitrophenol	1994	50	µg/L	4	0	-	-	-

TABLE A.3. Sitewide Monitoring Program

Analyte	Year	Detection Limit	Units	No. of Samples	No. of Detects	Minimum Detect	Maximum Detect	Maximum Location
4-Nitrophenol	1994	50	µg/L	4	0	-	-	-
4,6-Dinitro-2-methylphenol	1994	50	µg/L	4	0	-	-	-
Pentachlorophenol	1994	50	µg/L	4	0	-	-	-

TABLE A.4. Surface Water and Sediment Investigation (Water)

Analyte	Year	Detection Limit	Units	No. of Samples	No. of Detects	Minimum Detect	Maximum Detect	Maximum Location
Aluminum	1993	120	µg/L	15	7	40	1000	MC01
Antimony	1993	69.4	µg/L	15	0	-	-	-
Arsenic	1993	2.0	µg/L	15	13	2.1	17	GS02
Barium	1993	13	µg/L	15	14	30	210	GS00
Beryllium	1993	0.814	µg/L	15	2	1.2	1.4	MC01
Cadmium	1993	7.8	µg/L	15	0	-	-	-
Calcium	1993	-	µg/L	15	15	2800	55000	GS01/GS03
Chromium	1993	5.42	µg/L	15	1	6.1	6.1	FCBG
Cobalt	1993	4.05	µg/L	15	0	-	-	-
Copper	1993	2.65	µg/L	15	1	3.8	3.8	FCBG
Iron	1993	-	µg/L	15	15	67	8200	GS02
Lead	1993	1.2	µg/L	15	6	0.62	0.91	GS00
Magnesium	1993	-	µg/L	15	15	1500	13000	GS00
Manganese	1993	-	µg/L	15	15	21	1900	GS00
Nickel	1993	17.9	µg/L	15	0	-	-	-
Potassium	1993	-	µg/L	15	15	860	3700	GS00/GS02
Silver	1993	2.87	µg/L	15	1	2.9	2.9	FC03
Sodium	1993	-	µg/L	15	15	440	5700	GS01
Tin	1993	51.1	µg/L	15	0	-	-	-
Vanadium	1993	3.84	µg/L	15	2	7.5	7.8	FCBG
Zinc	1993	14	µg/L	15	6	3.6	8.7	GS05
Benzene	1993	0.105	µg/L	14	0	-	-	-
Carbon Tetrachloride	1993	0.121	µg/L	14	0	-	-	-
Chloroform	1993	0.043	µg/L	14	0	-	-	-
p-Dichlorobenzene	1993	0.107	µg/L	14	0	-	-	-
1,1-Dichloroethane	1993	0.337	µg/L	14	0	-	-	-
1,2-Dichloroethane	1993	0.139	µg/L	14	0	-	-	-
cis-1,2-Dichloroethylene	1993	0.127	µg/L	14	5	0.20	1.4	GS01
trans-1,2-Dichloroethylene	1993	0.149	µg/L	14	0	-	-	-
Ethylbenzene	1993	0.046	µg/L	14	2	0.063	0.086	GS05
Methylene Chloride	1993	0.94	µg/L	14	0	-	-	-
Tetrachloroethylene	1993	0.049	µg/L	14	1	0.071	0.071	PS01
Toluene	1993	0.1	µg/L	14	0	-	-	-
1,1,1-Trichloroethane	1993	0.072	µg/L	14	0	-	-	-
1,1,2-Trichloroethane	1993	0.043	µg/L	14	0	-	-	-
Trichloroethylene	1993	0.065	µg/L	14	5	0.075	0.38	GS01
Vinyl Chloride	1993	0.266	µg/L	14	0	-	-	-
Xylene	1993	0.202	µg/L	14	0	-	-	-
Gasoline Range Organics	1993	0.10	mg/L	15	0	-	-	-
Diesel Range Organics	1993	0.10	mg/L	15	0	-	-	-
Aldrin	1993	0.05	µg/L	15	0	-	-	-
Alpha-BHC	1993	0.012	µg/L	15	0	-	-	-
Beta-BHC	1993	0.0026	µg/L	15	0	-	-	-
Delta-BHC	1993	0.0014	µg/L	15	7	0.0020	0.0057	GS01
Lindane	1993	0.0021	µg/L	15	0	-	-	-
Chlordane	1993	0.0057	µg/L	15	0	-	-	-
4,4'-DDD	1993	0.0005	µg/L	15	9	0.00085	0.052	GS01
4,4'-DDE	1993	0.0009	µg/L	15	4	0.00098	0.0035	GS03
4,4'-DDT	1993	0.011	µg/L	15	0	-	-	-
Dieldrin	1993	0.019	µg/L	15	1	0.026	0.026	FC02
Endosulfan I	1993	0.0029	µg/L	15	0	-	-	-
Endosulfan II	1993	0.004	µg/L	15	0	-	-	-
Endosulfan Sulfate	1993	0.0072	µg/L	15	0	-	-	-
Endrin	1993	0.008	µg/L	15	0	-	-	-
Endrin Aldehyde	1993	0.011	µg/L	15	0	-	-	-
Heptachlor	1993	0.0019	µg/L	15	0	-	-	-
Heptachlor Epoxide	1993	0.0008	µg/L	15	0	-	-	-
Methoxychlor	1993	0.1000	µg/L	15	0	-	-	-
Toxaphene	1993	0.89	µg/L	15	0	-	-	-

TABLE A.4. Surface Water and Sediment Investigation (Water)

Analyte	Year	Detection Limit	Units	No. of Samples	No. of Detects	Minimum Detect	Maximum Detect	Maximum Location
Aroclor 1016	1993	0.19	µg/L	15	0	-	-	-
Aroclor 1221	1993	0.14	µg/L	15	0	-	-	-
Aroclor 1232	1993	0.11	µg/L	15	0	-	-	-
Aroclor 1242	1993	0.11	µg/L	15	0	-	-	-
Aroclor 1248	1993	0.04	µg/L	15	0	-	-	-
Aroclor 1254	1993	0.10	µg/L	15	0	-	-	-
Aroclor 1260	1993	0.11	µg/L	15	0	-	-	-
o-Cresol	1993	1.80	µg/L	3	0	-	-	-
m-Cresol	1993	1.44	µg/L	3	0	-	-	-
p-Cresol	1993	3.54	µg/L	3	0	-	-	-
Kerosene	1993	4.03	µg/L	3	0	-	-	-
Naphthalene	1993	6.50	µg/L	3	0	-	-	-
Pentachlorophenol	1993	8.07	µg/L	3	0	-	-	-
Phenol	1993	0.833	µg/L	3	0	-	-	-
Tributylphosphate	1993	4.42	µg/L	3	0	-	-	-
Tri-2-chloroethylphosphate	1993	2.88	µg/L	3	0	-	-	-
Benzothiazole	1993	2.55	µg/L	3	0	-	-	-
Bis(2-ethylhexyl)phthalate	1993	4.07	µg/L	3	0	-	-	-
2,4-Dichlorophenol	1993	2.80	µg/L	3	0	-	-	-
2-Nitrophenol	1993	3.96	µg/L	3	0	-	-	-
p-Dichlorobenzene	1993	4.64	µg/L	3	0	-	-	-
2-Methylpyridine	1993	5.83	µg/L	3	0	-	-	-
Acenaphthene	1993	2.88	µg/L	3	0	-	-	-
Acenaphthylene	1993	3.96	µg/L	3	0	-	-	-
Acetophenone	1993	2.38	µg/L	3	0	-	-	-
2-Acetylaminofluorene	1993	2.83	µg/L	3	0	-	-	-
4-Aminobiphenyl	1993	3.83	µg/L	3	0	-	-	-
Aniline	1993	3.53	µg/L	3	0	-	-	-
Anthracene	1993	2.95	µg/L	3	0	-	-	-
Aramite	1993	8.60	µg/L	3	0	-	-	-
Benzo[a]anthracene	1993	2.34	µg/L	3	0	-	-	-
Benzo[b]fluoranthene	1993	4.41	µg/L	3	0	-	-	-
Benzo[k]fluoranthene	1993	2.21	µg/L	3	0	-	-	-
benzo[g,h,i]perylene	1993	3.65	µg/L	3	0	-	-	-
Benzo[a]pyrene	1993	1.70	µg/L	3	0	-	-	-
Benzyl alcohol	1993	5.16	µg/L	3	0	-	-	-
Bis(2-chloroethoxy)methane	1993	7.13	µg/L	3	0	-	-	-
Bis(2-chloroethyl)ether	1993	2.90	µg/L	3	0	-	-	-
Bis(2-chloro-1-methylethyl)ether	1993	3.35	µg/L	3	0	-	-	-
4-Bromophenylphenylether	1993	2.34	µg/L	3	0	-	-	-
Butylbenzylphthalate	1993	5.94	µg/L	3	0	-	-	-
p-Chloroaniline	1993	13.2	µg/L	3	0	-	-	-
Chlorobenzilate	1993	8.69	µg/L	3	0	-	-	-
p-Chloro-m-cresol	1993	7.41	µg/L	3	0	-	-	-
2-Chloronaphthalene	1993	3.02	µg/L	3	0	-	-	-
2-Chlorophenol	1993	1.91	µg/L	3	0	-	-	-
4-Chlorophenylphenylether	1993	3.04	µg/L	3	0	-	-	-
Chrysene	1993	1.70	µg/L	3	0	-	-	-
Diallate	1993	3.15	µg/L	3	0	-	-	-
Dibenz[a,h]anthracene	1993	1.92	µg/L	3	0	-	-	-
Dibenzofuran	1993	2.54	µg/L	3	0	-	-	-
Di-n-butylphthalate	1993	4.34	µg/L	3	0	-	-	-
o-Dichlorobenzene	1993	3.77	µg/L	3	0	-	-	-
m-Dichlorobenzene	1993	7.85	µg/L	3	0	-	-	-
3,3'-Dichlorobenzidine	1993	3.88	µg/L	3	0	-	-	-
2,6-Dichlorophenol	1993	3.47	µg/L	3	0	-	-	-
Diethylphthalate	1993	8.94	µg/L	3	0	-	-	-
Thionazin	1993	3.04	µg/L	3	0	-	-	-
Dimethoate	1993	10.0	µg/L	3	0	-	-	-

TABLE A.4. Surface Water and Sediment Investigation (Water)

Analyte	Year	Detection Limit	Units	No. of Samples	No. of Detects	Minimum Detect	Maximum Detect	Maximum Location
p-(Dimethylamino)azobenzene	1993	3.36	µg/L	3	0	-	-	-
7,12-Dimethylbenz[a]anthracen	1993	1.82	µg/L	3	0	-	-	-
Pyridine	1993	4.57	µg/L	3	0	-	-	-
3,3'-Dimethylbenzidine	1993	10.4	µg/L	3	0	-	-	-
a,a-Dimethylphenethylamine	1993	37.8	µg/L	3	0	-	-	-
2,4-Dimethylphenol	1993	5.88	µg/L	3	0	-	-	-
Dimethylphthalate	1993	5.55	µg/L	3	0	-	-	-
M-Dinitrobenzene	1993	9.35	µg/L	3	0	-	-	-
4,6-Dinitro-o-cresol	1993	5.55	µg/L	3	0	-	-	-
2,4-Dinitrophenol	1993	4.46	µg/L	3	0	-	-	-
2,4-Dinitrotoluene	1993	2.59	µg/L	3	0	-	-	-
2,6-Dinitrotoluene	1993	2.85	µg/L	3	0	-	-	-
Di-n-octylphthalate	1993	2.98	µg/L	3	0	-	-	-
Diphenylamine	1993	2.86	µg/L	3	0	-	-	-
Ethylmethanesulfonate	1993	2.07	µg/L	3	0	-	-	-
Famphur	1993	12.8	µg/L	3	0	-	-	-
Fluoranthene	1993	4.62	µg/L	3	0	-	-	-
Fluorene	1993	2.56	µg/L	3	0	-	-	-
Hexachlorobenzene	1993	2.38	µg/L	3	0	-	-	-
Hexachlorobutadiene	1993	4.29	µg/L	3	0	-	-	-
Hexachlorocyclopentadiene	1993	2.62	µg/L	3	0	-	-	-
Hexachloroethane	1993	4.73	µg/L	3	0	-	-	-
Hexachlorophene	1993	19.6	µg/L	3	0	-	-	-
Hexachloropropene	1993	3.68	µg/L	3	0	-	-	-
Indeno[1,2,3-cd]pyrene	1993	3.21	µg/L	3	0	-	-	-
Isodrin	1993	1.44	µg/L	3	0	-	-	-
Isophorone	1993	3.29	µg/L	3	0	-	-	-
Isosafrole	1993	2.25	µg/L	3	0	-	-	-
Kepone	1993	9.59	µg/L	3	0	-	-	-
Methapyrilene	1993	8.45	µg/L	3	0	-	-	-
3-Methlcholanthrene	1993	2.63	µg/L	3	0	-	-	-
Methylmethanesulfonate	1993	1.61	µg/L	3	0	-	-	-
2-Methylnaphthalene	1993	2.76	µg/L	3	0	-	-	-
1,4-Naphthoquinone	1993	10.0	µg/L	3	0	-	-	-
1-Naphthylamine	1993	25.3	µg/L	3	0	-	-	-
2-Naphthylamine	1993	15.6	µg/L	3	0	-	-	-
o-Nitroaniline	1993	7.82	µg/L	3	0	-	-	-
m-Nitroaniline	1993	9.52	µg/L	3	0	-	-	-
p-Nitroaniline	1993	21.4	µg/L	3	0	-	-	-
Nitrobenzene	1993	3.16	µg/L	3	0	-	-	-
p-Nitrophenol	1993	1.52	µg/L	3	0	-	-	-
4-Nitroquinoline-1-oxide	1993	6.00	µg/L	3	0	-	-	-
N-nitrosodi-n-butylamine	1993	3.22	µg/L	3	0	-	-	-
N-nitrosodiethylamine	1993	2.90	µg/L	3	0	-	-	-
N-nitrosodimethylamine	1993	3.81	µg/L	3	0	-	-	-
N-nitrosodiphenylamine	1993	2.11	µg/L	3	0	-	-	-
N-nitrosodipropylamine	1993	3.67	µg/L	3	0	-	-	-
N-nitrosomethylethylamine	1993	2.83	µg/L	3	0	-	-	-
N-nitrosomorpholine	1993	3.27	µg/L	3	0	-	-	-
N-nitrosopiperidene	1993	4.35	µg/L	3	0	-	-	-
N-nitrosopyrrolidine	1993	2.78	µg/L	3	0	-	-	-
5-Nitro-o-toluidine	1993	5.25	µg/L	3	0	-	-	-
Parathion	1993	3.90	µg/L	3	0	-	-	-
Pentachlorbenzene	1993	3.99	µg/L	3	0	-	-	-
Pentachloronitrobenzene	1993	2.49	µg/L	3	0	-	-	-
Phenacetin	1993	4.78	µg/L	3	0	-	-	-
Phenanthrene	1993	5.27	µg/L	3	0	-	-	-
p-Phenylenediamine	1993	3.09	µg/L	3	0	-	-	-
Pronamide	1993	3.42	µg/L	3	0	-	-	-

TABLE A.4. Surface Water and Sediment Investigation (Water)

Analyte	Year	Detection Limit	Units	No. of Samples	No. of Detects	Minimum Detect	Maximum Detect	Maximum Location
Pyrene	1993	3.69	µg/L	3	0	-	-	-
Safrole	1993	3.22	µg/L	3	0	-	-	-
1,2,4,5-Tetrachlorobenzene	1993	4.39	µg/L	3	0	-	-	-
2,3,4,6-Tetrachlorophenol	1993	4.77	µg/L	3	0	-	-	-
Tetraethyldithiopyrophosphate	1993	2.81	µg/L	3	0	-	-	-
o-Toluidine	1993	2.27	µg/L	3	0	-	-	-
1,2,4-Trichlorobenzene	1993	4.14	µg/L	3	0	-	-	-
2,4,5-Trichlorophenol	1993	4.01	µg/L	3	0	-	-	-
2,4,6-Trichlorphenol	1993	2.54	µg/L	3	0	-	-	-
o,o,o-Triethylphosphorothioate	1993	5.19	µg/L	3	0	-	-	-
sym-Trinitrobenzene	1993	3.74	µg/L	3	0	-	-	-
Dichlorodifluoromethane	1994	1.0	µg/L	9	1	2.5	2.5	GS00
Chloromethane	1994	1.0	µg/L	9	0	-	-	-
Vinyl Chloride	1994	0.50	µg/L	9	0	-	-	-
Bromomethane	1994	2.0	µg/L	9	0	-	-	-
Chloroethane	1994	1.0	µg/L	9	0	-	-	-
Trichlorofluoromethane	1994	1.0	µg/L	9	0	-	-	-
1,1-Dichloroethene	1994	0.50	µg/L	9	0	-	-	-
Methylene chloride	1994	1.0	µg/L	9	0	-	-	-
Trans-1,1-Dichloroether	1994	1.0	µg/L	9	0	-	-	-
1,1-Dichloroethane	1994	1.0	µg/L	9	0	-	-	-
Chloroform	1994	1.0	µg/L	9	0	-	-	-
1,1,1-Trichloroethane	1994	1.0	µg/L	9	0	-	-	-
Carbon Tetrachloride	1994	0.50	µg/L	9	0	-	-	-
1,2-Dichloroethane	1994	0.50	µg/L	9	0	-	-	-
Trichloroethene	1994	0.50	µg/L	9	2	0.61	0.75	GS05
1,2-Dichloropropane	1994	0.50	µg/L	9	0	-	-	-
Bromodichloromethane	1994	1.0	µg/L	9	0	-	-	-
2-Chloroethylvinylether	1994	2.0	µg/L	9	0	-	-	-
cis-1,3-Dichloropropene	1994	0.50	µg/L	9	0	-	-	-
Trans-1,3-Dichloropropene	1994	0.50	µg/L	9	0	-	-	-
1,1,2-Trichloroethane	1994	0.50	µg/L	9	0	-	-	-
Tetrachloroethene	1994	0.50	µg/L	9	0	-	-	-
Dibromochloromethane	1994	1.0	µg/L	9	0	-	-	-
Chlorobenzene	1994	0.50	µg/L	9	0	-	-	-
Bromoform	1994	1.0	µg/L	9	0	-	-	-
1,1,2,2-Tetrachloroethane	1994	1.0	µg/L	9	0	-	-	-
1,3-Dichlorobenzene	1994	1.0	µg/L	9	0	-	-	-
1,4-Dichlorobenzene	1994	1.0	µg/L	9	0	-	-	-
1,2-Dichlorobenzene	1994	1.0	µg/L	9	0	-	-	-
Benzene	1994	1.0	µg/L	9	0	-	-	-
Toluene	1994	1.0	µg/L	9	0	-	-	-
Chlorobenzene	1994	1.0	µg/L	9	0	-	-	-
Ethylbenzene	1994	1.0	µg/L	9	0	-	-	-
m,p-Xylene	1994	1.0	µg/L	9	0	-	-	-
o-Xylene	1994	1.0	µg/L	9	0	-	-	-
Alpha-BHC	1994	0.05	µg/L	11	0	-	-	-
Beta-BHC	1994	0.05	µg/L	11	0	-	-	-
Gamma-BHC	1994	0.05	µg/L	11	0	-	-	-
Delta-BHC	1994	0.05	µg/L	11	0	-	-	-
Heptachlor	1994	0.05	µg/L	11	0	-	-	-
Aldrin	1994	0.05	µg/L	11	0	-	-	-
Heptachlor Epoxide	1994	0.05	µg/L	11	0	-	-	-
Gamma-Chlordane	1994	0.05	µg/L	11	0	-	-	-
Endosulfan I	1994	0.05	µg/L	11	0	-	-	-
Alpha-Chlordane	1994	0.05	µg/L	11	0	-	-	-
4,4'-DDE	1994	0.1	µg/L	11	0	-	-	-
4,4'-DDT	1994	0.1	µg/L	11	0	-	-	-
Dieldrin	1994	0.1	µg/L	11	0	-	-	-

TABLE A.4. Surface Water and Sediment Investigation (Water)

Analyte	Year	Detection Limit	Units	No. of Samples	No. of Detects	Minimum Detect	Maximum Detect	Maximum Location
Endrin	1994	0.1	µg/L	11	0	-	-	-
Endosulfan II	1994	0.1	µg/L	11	0	-	-	-
4,4'-DDD	1994	0.1	µg/L	11	0	-	-	-
Endrin Aldehyde	1994	0.1	µg/L	11	0	-	-	-
Endosulfan Sulfate	1994	0.1	µg/L	11	0	-	-	-
Methoxychlor	1994	0.5	µg/L	11	0	-	-	-
Toxaphene	1994	5	µg/L	11	0	-	-	-
Aroclor 1016	1994	1	µg/L	11	0	-	-	-
Aroclor 1221	1994	2	µg/L	11	0	-	-	-
Aroclor 1232	1994	1	µg/L	11	0	-	-	-
Aroclor 1242	1994	1	µg/L	11	0	-	-	-
Aroclor 1248	1994	1	µg/L	11	0	-	-	-
Aroclor 1254	1994	1	µg/L	11	0	-	-	-
Aroclor 1260	1994	1	µg/L	11	0	-	-	-

TABLE A.5. Surface Water and Sediment Investigation (Sediment)

Analyte	Year	Maximum Detection Limit	Units	No. of Samples	No. of Detects	Minimum Detect	Maximum Detect	Maximum Location
Aluminum	1993	-	µg/kg dw	15	15	1100000	18000000	GS05
Antimony	1993	4270	µg/kg dw	15	8	4500	9300	GS05
Arsenic	1993	-	µg/kg dw	15	15	3400	70000	GS06
Barium	1993	96.7	µg/kg dw	15	15	20000	1500000	GS05
Beryllium	1993	330	µg/kg dw	15	9	120	730	GS05
Cadmium	1993	-	µg/kg dw	15	0	-	-	-
Calcium	1993	-	µg/kg dw	15	15	1700000	39000000	GS05
Chromium	1993	-	µg/kg dw	15	15	2500	41000	GS05
Cobalt	1993	-	µg/kg dw	15	15	750	10000	GS05
Copper	1993	-	µg/kg dw	15	15	2900	30000	GS05
Iron	1993	-	µg/kg dw	15	15	4700000	31000000	FC02
Lead	1993	-	µg/kg dw	15	15	2200	64000	GS05
Magnesium	1993	-	µg/kg dw	15	15	560000	5500000	GS05
Manganese	1993	-	µg/kg dw	15	15	81000	2800000	GS04
Nickel	1993	2340	µg/kg dw	15	14	2500	29000	GS05
Potassium	1993	-	µg/kg dw	15	15	120000	1100000	GS05
Silver	1993	326	µg/kg dw	15	8	370	610	FC03
Sodium	1993	98000	µg/kg dw	15	12	100000	690000	GS05
Tin	1993	5120	µg/kg dw	15	0	-	-	-
Vanadium	1993	-	µg/kg dw	15	15	4400	54000	GS05
Zinc	1993	-	µg/kg dw	15	15	8700	45000	GS01
Diesel Range Organics	1993	7.4	mg/kg dw	15	8	11	38	GS02
Aldrin	1993	0.63	µg/kg dw	15	0	-	-	-
Alpha-BHC	1993	0.26	µg/kg dw	15	0	-	-	-
Beta-BHC	1993	0.44	µg/kg dw	15	2	2.6	4.1	GS03
Delta-BHC	1993	0.39	µg/kg dw	15	1	5.6	5.6	GS03
Lindane	1993	0.41	µg/kg dw	15	0	-	-	-
Chlordane	1993	7.40	µg/kg dw	15	0	-	-	-
4,4'-DDD	1993	0.65	µg/kg dw	15	6	9.8	170	GS03
4,4'-DDE	1993	6.70	µg/kg dw	15	1	13	13	GS03
4,4'-DDT	1993	1.20	µg/kg dw	15	4	3.4	170	GS00
Dieldrin	1993	5.10	µg/kg dw	15	0	-	-	-
Endosulfan I	1993	4.30	µg/kg dw	15	0	-	-	-
Endosulfan II	1993	0.28	µg/kg dw	15	0	-	-	-
Endosulfan Sulfate	1993	1.70	µg/kg dw	15	1	47	47	GS02
Endrin	1993	0.51	µg/kg dw	15	0	-	-	-
Endrin Aldehyde	1993	2.50	µg/kg dw	15	0	-	-	-
Heptachlor	1993	0.40	µg/kg dw	15	0	-	-	-
Heptachlor Epoxide	1993	5.70	µg/kg dw	15	0	-	-	-
Methoxychlor	1993	13.0	µg/kg dw	15	0	-	-	-
Toxaphene	1993	26.0	µg/kg dw	15	0	-	-	-
Aroclor 1016	1993	3.50	µg/kg dw	15	0	-	-	-
Aroclor 1221	1993	7.30	µg/kg dw	15	0	-	-	-
Aroclor 1232	1993	3.00	µg/kg dw	15	0	-	-	-
Aroclor 1242	1993	1.60	µg/kg dw	15	0	-	-	-
Aroclor 1248	1993	2.40	µg/kg dw	15	0	-	-	-
Aroclor 1254	1993	2.40	µg/kg dw	15	0	-	-	-
Aroclor 1260	1993	3.00	µg/kg dw	15	0	-	-	-
o-Cresol	1993	94.8	µg/kg dw	3	0	-	-	-
m-Cresol	1993	92.1	µg/kg dw	3	0	-	-	-
p-Cresol	1993	188	µg/kg dw	3	0	-	-	-
Kerosene	1993	46.8	µg/kg dw	3	0	-	-	-
Naphthalene	1993	168	µg/kg dw	3	0	-	-	-
Pentachlorophenol	1993	254	µg/kg dw	3	0	-	-	-
Phenol	1993	127	µg/kg dw	3	0	-	-	-
Tributylphosphate	1993	223	µg/kg dw	3	0	-	-	-
Tri-2-chloroethylphosphate	1993	94.7	µg/kg dw	3	0	-	-	-
Benzothiazole	1993	144	µg/kg dw	3	0	-	-	-

TABLE A.5. Surface Water and Sediment Investigation (Sediment)

Analyte	Year	Maximum Detection Limit	Units	No. of Samples	No. of Detects	Minimum Detect	Maximum Detect	Maximum Location
Bis(2-ethylhexyl)phthalate	1993	68.9	µg/kg dw	3	0	-	-	-
2,4-Dichlorophenol	1993	160	µg/kg dw	3	0	-	-	-
2-Nitrophenol	1993	195	µg/kg dw	3	0	-	-	-
p-Dichlorobenzene	1993	161	µg/kg dw	3	0	-	-	-
2-Methylpyridine	1993	339	µg/kg dw	3	0	-	-	-
Acenaphthene	1993	168	µg/kg dw	3	0	-	-	-
Acenaphthylene	1993	157	µg/kg dw	3	0	-	-	-
Acetophenone	1993	169	µg/kg dw	3	0	-	-	-
2-Acetylaminofluorene	1993	203	µg/kg dw	3	0	-	-	-
4-Aminobiphenyl	1993	430	µg/kg dw	3	0	-	-	-
Aniline	1993	202	µg/kg dw	3	0	-	-	-
Anthracene	1993	177	µg/kg dw	3	2	210	370	FP01
Aramite	1993	267	µg/kg dw	3	0	-	-	-
Benzo[a]anthracene	1993	170	µg/kg dw	3	1	650	650	FP01
Benzo[b]fluoranthene	1993	176	µg/kg dw	3	1	680	680	FP01
Benzo[k]fluoranthene	1993	248	µg/kg dw	3	1	730	730	FP01
benzo[g,h,i]perylene	1993	216	µg/kg dw	3	1	400	400	FP01
Benzo[a]pyrene	1993	164	µg/kg dw	3	1	670	670	FP01
Benzyl alcohol	1993	226	µg/kg dw	3	0	-	-	-
Bis(2-chloroethoxy)methane	1993	36.2	µg/kg dw	3	0	-	-	-
Bis(2-chloroethyl)ether	1993	134	µg/kg dw	3	0	-	-	-
Bis(2-chloro-1-methylethyl)ether	1993	83.5	µg/kg dw	3	0	-	-	-
4-Bromophenylphenylether	1993	45.4	µg/kg dw	3	0	-	-	-
Butylbenzylphthalate	1993	107	µg/kg dw	3	0	-	-	-
p-Chloroaniline	1993	112	µg/kg dw	3	0	-	-	-
Chlorobenzilate	1993	244	µg/kg dw	3	0	-	-	-
p-Chloro-m-cresol	1993	159	µg/kg dw	3	0	-	-	-
2-Chloronaphthalene	1993	170	µg/kg dw	3	0	-	-	-
2-Chlorophenol	1993	144	µg/kg dw	3	0	-	-	-
4-Chlorophenylphenylether	1993	32.2	µg/kg dw	3	0	-	-	-
Chrysene	1993	184	µg/kg dw	3	2	240	960	FP01
Diallate	1993	143	µg/kg dw	3	0	-	-	-
Dibenz[a,h]anthracene	1993	190	µg/kg dw	3	0	-	-	-
Dibenzofuran	1993	39.5	µg/kg dw	3	0	-	-	-
Di-n-butylphthalate	1993	97.8	µg/kg dw	3	0	-	-	-
o-Dichlorobenzene	1993	140	µg/kg dw	3	0	-	-	-
m-Dichlorobenzene	1993	156	µg/kg dw	3	0	-	-	-
3,3'-Dichlorobenzidine	1993	45.4	µg/kg dw	3	0	-	-	-
2,6-Dichlorophenol	1993	145	µg/kg dw	3	0	-	-	-
Diethylphthalate	1993	133	µg/kg dw	3	0	-	-	-
Thionazin	1993	180	µg/kg dw	3	0	-	-	-
Dimethoate	1993	184	µg/kg dw	3	0	-	-	-
p-(Dimethylamino)azobenzene	1993	66.0	µg/kg dw	3	0	-	-	-
7,12-Dimethylbenz[a]anthracene	1993	227	µg/kg dw	3	0	-	-	-
Pyridine	1993	205	µg/kg dw	3	0	-	-	-
a,a-Dimethylphenethylamine	1993	358	µg/kg dw	3	0	-	-	-
2,4-Dimethylphenol	1993	357	µg/kg dw	3	0	-	-	-
Dimethylphthalate	1993	57.0	µg/kg dw	3	0	-	-	-
M-Dinitrobenzene	1993	74.5	µg/kg dw	3	0	-	-	-
4,6-Dinitro-o-cresol	1993	201	µg/kg dw	3	0	-	-	-
2,4-Dinitrophenol	1993	157	µg/kg dw	3	0	-	-	-
2,4-Dinitrotoluene	1993	169	µg/kg dw	3	0	-	-	-
2,6-Dinitrotoluene	1993	168	µg/kg dw	3	0	-	-	-
Di-n-octylphthalate	1993	225	µg/kg dw	3	0	-	-	-
Diphenylamine	1993	497	µg/kg dw	3	0	-	-	-
Ethylmethanesulfonate	1993	118	µg/kg dw	3	0	-	-	-
Famphur	1993	317	µg/kg dw	3	0	-	-	-
Fluoranthene	1993	212	µg/kg dw	3	2	1300	2300	FP01

TABLE A.5. Surface Water and Sediment Investigation (Sediment)

Analyte	Year	Maximum Detection Limit	Units	No. of Samples	No. of Detects	Minimum Detect	Maximum Detect	Maximum Location
Fluorene	1993	166	µg/kg dw	3	0	-	-	-
Hexachlorobenzene	1993	241	µg/kg dw	3	0	-	-	-
Hexachlorobutadiene	1993	182	µg/kg dw	3	0	-	-	-
Hexachlorocyclopentadiene	1993	168	µg/kg dw	3	0	-	-	-
Hexachloroethane	1993	146	µg/kg dw	3	0	-	-	-
Hexachlorophene	1993	1190	µg/kg dw	3	0	-	-	-
Hexachloropropene	1993	135	µg/kg dw	3	0	-	-	-
Indeno[1,2,3-cd]pyrene	1993	152	µg/kg dw	3	0	-	-	-
Isodrin	1993	94	µg/kg dw	3	0	-	-	-
Isophorone	1993	163	µg/kg dw	3	0	-	-	-
Isosafrole	1993	155	µg/kg dw	3	0	-	-	-
Kepone	1993	1404	µg/kg dw	3	0	-	-	-
Methapyrilene	1993	120	µg/kg dw	3	0	-	-	-
3-Methlcholanthrene	1993	170	µg/kg dw	3	0	-	-	-
Methylmethanesulfonate	1993	132	µg/kg dw	3	0	-	-	-
2-Methylnaphthalene	1993	30.6	µg/kg dw	3	0	-	-	-
1,4-Naphthoquinone	1993	263	µg/kg dw	3	0	-	-	-
1-Naphthylamine	1993	119	µg/kg dw	3	0	-	-	-
2-Naphthylamine	1993	720	µg/kg dw	3	0	-	-	-
o-Nitroaniline	1993	121	µg/kg dw	3	0	-	-	-
m-Nitroaniline	1993	253	µg/kg dw	3	0	-	-	-
p-Nitroaniline	1993	1119	µg/kg dw	3	0	-	-	-
Nitrobenzene	1993	161	µg/kg dw	3	0	-	-	-
p-Nitrophenol	1993	195	µg/kg dw	3	0	-	-	-
4-Nitroquinoline-1-oxide	1993	362	µg/kg dw	3	0	-	-	-
N-nitrosodi-n-butylamine	1993	82.0	µg/kg dw	3	0	-	-	-
N-nitrosodiethylamine	1993	134	µg/kg dw	3	0	-	-	-
N-nitrosodimethylamine	1993	178	µg/kg dw	3	0	-	-	-
N-nitrosodiphenylamine	1993	143	µg/kg dw	3	0	-	-	-
N-nitrosodipropylamine	1993	164	µg/kg dw	3	0	-	-	-
N-nitrosomethylethylamine	1993	124	µg/kg dw	3	0	-	-	-
N-nitrosomorpholine	1993	135	µg/kg dw	3	0	-	-	-
N-nitrosopiperidene	1993	27.9	µg/kg dw	3	0	-	-	-
N-nitrosopyrrolidine	1993	171	µg/kg dw	3	0	-	-	-
5-Nitro-o-toluidine	1993	186	µg/kg dw	3	0	-	-	-
Parathion	1993	257	µg/kg dw	3	0	-	-	-
Pentachlorbenzene	1993	186	µg/kg dw	3	0	-	-	-
Pentachloronitrobenzene	1993	211	µg/kg dw	3	0	-	-	-
Phenacetin	1993	200	µg/kg dw	3	0	-	-	-
Phenanthrene	1993	185	µg/kg dw	3	2	980	1300	FP01
p-Phenylenediamine	1993	311	µg/kg dw	3	0	-	-	-
Pronamide	1993	209	µg/kg dw	3	0	-	-	-
Pyrene	1993	177	µg/kg dw	3	2	1400	2600	FP01
Safrole	1993	165	µg/kg dw	3	0	-	-	-
1,2,4,5-Tetrachlorobenzene	1993	190	µg/kg dw	3	0	-	-	-
2,3,4,6-Tetrachlorophenol	1993	173	µg/kg dw	3	0	-	-	-
Tetraethyldithiopyrophosphate	1993	149	µg/kg dw	3	0	-	-	-
o-Toluidine	1993	169	µg/kg dw	3	0	-	-	-
1,2,4-Trichlorobenzene	1993	179	µg/kg dw	3	0	-	-	-
2,4,5-Trichlorophenol	1993	176	µg/kg dw	3	0	-	-	-
2,4,6-Trichlorphenol	1993	138	µg/kg dw	3	0	-	-	-
o,o,o-Triethylphosphorothioate	1993	156	µg/kg dw	3	0	-	-	-
sym-Trinitrobenzene	1993	152	µg/kg dw	3	0	-	-	-
Alpha-BHC	1994	7.6	µg/kg dw	15	0	-	-	-
Beta-BHC	1994	7.6	µg/kg dw	15	0	-	-	-
Gamma-BHC	1994	7.6	µg/kg dw	15	0	-	-	-
Delta-BHC	1994	7.6	µg/kg dw	15	0	-	-	-
Heptachlor	1994	7.6	µg/kg dw	15	0	-	-	-

TABLE A.5. Surface Water and Sediment Investigation (Sediment)

Analyte	Year	Maximum Detection Limit	Units	No. of Samples	No. of Detects	Minimum Detect	Maximum Detect	Maximum Location
Aldrin	1994	7.6	µg/kg dw	15	0	-	-	-
Heptachlor Epoxide	1994	7.6	µg/kg dw	15	0	-	-	-
Gamma-Chlordane	1994	7.6	µg/kg dw	15	0	-	-	-
Endosulfan I	1994	7.6	µg/kg dw	15	0	-	-	-
Alpha-Chlordane	1994	7.6	µg/kg dw	15	0	-	-	-
4,4'-DDE	1994	15.0	µg/kg dw	15	7	7.2	540	GS03
4,4'-DDT	1994	15.0	µg/kg dw	15	9	3.6	4200	GS03
Dieldrin	1994	15.0	µg/kg dw	15	0	-	-	-
Endrin	1994	15.0	µg/kg dw	15	0	-	-	-
Endosulfan II	1994	15.0	µg/kg dw	15	0	-	-	-
4,4'-DDD	1994	15.0	µg/kg dw	15	9	19	11000	GS01
Endrin Aldehyde	1994	15.0	µg/kg dw	15	0	-	-	-
Endosulfan Sulfate	1994	15.0	µg/kg dw	15	0	-	-	-
Methoxychlor	1994	76	µg/kg dw	15	0	-	-	-
Toxaphene	1994	760	µg/kg dw	15	0	-	-	-
Aroclor 1016	1994	58	µg/kg dw	15	0	-	-	-
Aroclor 1221	1994	58	µg/kg dw	15	0	-	-	-
Aroclor 1232	1994	58	µg/kg dw	15	0	-	-	-
Aroclor 1242	1994	58	µg/kg dw	15	0	-	-	-
Aroclor 1248	1994	58	µg/kg dw	15	0	-	-	-
Aroclor 1254	1994	58	µg/kg dw	15	0	-	-	-
Aroclor 1260	1994	29	µg/kg dw	15	6	130	55000	GS12

TABLE A.6. 1993 Biota Samples (Biological Risk Assessment)

Analyte	Year	Detection Limit	Units	No. of Samples	No. of Detects	Minimum Detect	Maximum Detect	Maximum Location
Lead	1993	0.081	µg/g dw	70	59	0.83	20.2	MGS
Naphthalene	1993	-	µg/g ww	70	70	1.14	28.4	LF03
Acenapthylene	1993	1.64	µg/g ww	70	1	2.36	2.36	LGS
Acenaphthene	1993	1.56	µg/g ww	70	11	1.48	42.1	DP44
Fluorene	1993	2.75	µg/g ww	70	17	2.54	37.8	DP44
Pheneanthrene	1993	1.30	µg/g ww	70	53	1.44	83.8	LGS
Anthracene	1993	4.46	µg/g ww	70	2	8.05	12.8	LGS
Fluoranthene	1993	3.29	µg/g ww	70	39	2.88	372	LGS
Pyrene	1993	2.36	µg/g ww	70	26	2.39	311	LGS
Benzo(a)anthracene	1993	1.11	µg/g ww	70	48	1.63	119	LGS
Chrysene	1993	1.31	µg/g ww	70	19	1.31	136	LGS
Benzo(b)fluoranthene	1993	0.56	µg/g ww	70	38	0.96	117	LGS
Benzo(k)fluoranthene	1993	1.65	µg/g ww	70	10	2.06	40.2	LGS
Benzo(a)pyrene	1993	1.58	µg/g ww	70	7	1.59	64.9	LGS
Indeno(1,2,3-cd)pyrene	1993	5.43	µg/g ww	70	1	33.6	33.6	LGS
Dibenzo(a,h)anthracene	1993	5.85	µg/g ww	70	1	8.80	8.80	LGS
Benzo(g,h,i)perylene	1993	4.84	µg/g ww	70	1	29.5	29.5	LGS
Alpha-BHC	1993	0.50	µg/kg ww	70	3	0.58	4.25	LF02
Gamma-BHC	1993	0.24	µg/kg ww	70	5	0.75	6.57	LF02
Heptachlor	1993	0.15	µg/kg ww	70	2	0.35	2.15	LF02
Aldrin	1993	0.18	µg/kg ww	70	1	1.00	1.00	LGS
Beta-BHC	1993	0.50	µg/kg ww	70	2	0.26	0.88	LF02
Delta-BHC	1993	0.50	µg/kg ww	70	4	0.62	0.77	LGS
Heptachlor Epoxide	1993	0.49	µg/kg ww	70	15	0.51	1.46	LF02
Endosulfan I	1993	0.50	µg/kg ww	70	2	0.30	0.36	ST10
g-Chlordane	1993	0.50	µg/kg ww	70	10	0.25	6.40	UGS
a-Chlordane	1993	0.13	µg/kg ww	70	12	0.23	3.33	UGS
Trans Nonachlor	1993	0.12	µg/kg ww	70	11	0.14	3.89	UGS
4,4'-DDE	1993	0.14	µg/kg ww	70	53	0.72	547	UGS
Dieldrin	1993	0.32	µg/kg ww	70	28	0.60	1.51	LF02
Endrin	1993	0.50	µg/kg ww	70	7	0.30	4.45	UGS
4,4'-DDD	1993	0.47	µg/kg ww	70	45	0.71	671	UGS
Endosulfan II	1993	0.50	µg/kg ww	70	0	-		
4,4'-DDT	1993	0.36	µg/kg ww	70	38	1.02	102	UGS
Aroclor 1242	1993	5.00	µg/kg ww	70	0	-	-	-
Aroclor 1248	1993	5.00	µg/kg ww	70	0	-	-	-
Aroclor 1254	1993	5.00	µg/kg ww	70	0	-	-	-
Aroclor 1260	1993	5.00	µg/kg ww	70	9	9.58	995	LGS

TABLE A.7. 1994 Aquatic Biota Samples

Analyte	Year	Highest Detection Limit	Units	No. of Samples	No. of Detects	Minimum Detect	Maximum Detect	Maximum Location
Naphthalene	1994	24.6	µg/kg ww	63	2	6.69	34.5	MGS
Acenapthylene	1994	9.57	µg/kg ww	63	1	9.77	9.77	MGS
Acenaphthene	1994	17.2	µg/kg ww	63	15	1.28	63.7	MGS
Fluorene	1994	16.3	µg/kg ww	63	14	3.20	111	MGS
Pheneanthrene	1994	33.8	µg/kg ww	63	13	3.90	1050	MGS
Anthracene	1994	29.5	µg/kg ww	63	1	132	132	MGS
Fluoranthene	1994	70.1	µg/kg ww	63	7	7.27	742	MGS
Pyrene	1994	60.3	µg/kg ww	63	5	6.58	540	MGS
Benzo(a)anthracene	1994	14.4	µg/kg ww	63	4	5.39	247	MGS
Chrysene	1994	29.9	µg/kg ww	63	5	4.20	296	MGS
Benzo(b)fluoranthene	1994	21.7	µg/kg ww	63	4	6.10	345	MGS
Benzo(k)fluoranthene	1994	22.1	µg/kg ww	63	3	8.21	141	MGS
Benzo(a)pyrene	1994	19.7	µg/kg ww	63	5	3.22	241	MGS
Indeno(1,2,3-cd)pyrene	1994	23.3	µg/kg ww	63	5	3.88	187	MGS
Dibenzo(a,h)anthracene	1994	16.6	µg/kg ww	63	3	3.21	39.0	MGS
Benzo(g,h,i)perylene	1994	18.5	µg/kg ww	63	4	3.70	150	MGS
Hexachlorobenzene	1994	1.76	µg/kg ww	63	13	0.20	2.87	MGS
Alpha-BHC	1994	2.37	µg/kg ww	63	0	-	-	-
Gamma-BHC	1994	1.65	µg/kg ww	63	1	0.85	0.85	UMC
Heptachlor	1994	2.43	µg/kg ww	63	0	-	-	-
Aldrin	1994	1.67	µg/kg ww	63	12	0.22	1.8	LGS
Beta-BHC	1994	2.37	µg/kg ww	63	0	-	-	-
Delta-BHC	1994	2.37	µg/kg ww	63	1	0.69	0.69	UGS
Heptachlor Epoxide	1994	1.75	µg/kg ww	63	0	-	-	-
2,4'-DDE	1994	3.43	µg/kg ww	63	2	0.60	0.70	GL
Endosulfan I	1994	2.37	µg/kg ww	63	1	0.32	0.32	FC/LF02
4,4'-DDE	1994	0.26	µg/kg ww	63	59	0.31	234	LGS
Dieldrin	1994	6.78	µg/kg ww	63	9	0.51	1.83	UGS
2,4'-DDD	1994	3.34	µg/kg ww	63	37	0.28	361	MGS
Endrin	1994	2.37	µg/kg ww	63	3	0.33	0.58	UGS
2,4'-DDT	1994	2.36	µg/kg ww	63	10	0.27	37.0	FC/LF02
4,4'-DDD	1994	0.26	µg/kg ww	63	55	0.33	1450	MGS
Endosulfan II	1994	2.37	µg/kg ww	63	0	-	-	-
4,4'-DDT	1994	1.99	µg/kg ww	63	42	0.36	78.6	FC/LF02
Mirex	1994	3.33	µg/kg ww	63	0	-	-	-
Endosulfan Sulfate	1994	2.37	µg/kg ww	63	3	0.21	2.58	LGS
Methoxychlor	1994	2.37	µg/kg ww	63	9	0.19	9.25	MGS
Endrin Ketone	1994	2.37	µg/kg ww	63	0	-	-	-
Technical Chlordane	1994	30.0	µg/kg ww	63	0	-	-	-
Toxaphene	1994	30.0	µg/kg ww	63	0	-	-	-
Aroclor 1242	1994	20.0	µg/kg ww	63	0	-	-	-
Aroclor 1248	1994	20.0	µg/kg ww	63	0	-	-	-
Aroclor 1254	1994	20.0	µg/kg ww	63	1	926	926	LGS
Aroclor 1260	1994	20.0	µg/kg ww	63	17	17.6	3000	LGS

TABLE A.8. 1995 Sediment Samples (U.S. Air Force)

Analyte	Year	Highest Detection Limit	Units	No. of Samples	No. of Detects	Minimum Detect	Maximum Detect	Maximum Location
Aroclor 1016	1995	62	µg/kg dw	40	0	-	-	-
Aroclor 1221	1995	62	µg/kg dw	40	0	-	-	-
Aroclor 1232	1995	62	µg/kg dw	40	0	-	-	-
Aroclor 1242	1995	62	µg/kg dw	40	0	-	-	-
Aroclor 1248	1995	62	µg/kg dw	40	0	-	-	-
Aroclor 1254	1995	62	µg/kg dw	40	0	-	-	-
Aroclor 1260	1995	62	µg/kg dw	40	28	658	65600	GS41