

FINAL REMEDIAL ACTION REPORT

Sediment Remediation in Ward Cove Marine Operable Unit, Ketchikan Pulp Company Site, Ketchikan, Alaska

EPA Identification Number AKD009252230

Prepared for

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ACRONYMS AND ABBREVIATIONS

ADEC	Alaska Department of Environmental Conservation
AOC	area of concern
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CWA/CAA	Clean Water Act/Clean Air Act
CoC	chemical of concern
cy	cubic yard
DOJ	U.S. Department of Justice
ENR	enhanced natural recovery
EPA	U.S. Environmental Protection Agency
ESI	expanded site investigation
GFP	Gateway Forest Products, Inc.
KPC	Ketchikan Pulp Company
L-P	Louisiana-Pacific Corporation
MLLW	mean lower low water
MNR	monitored natural recovery
RA	remedial action
RAO	remedial action objective
RD/RA	remedial design/remedial action
RI/FS	remedial investigation and feasibility study
ROD	record of decision
TLP	thin layer placement

FINAL REMEDIAL ACTION REPORT RECORD OF PREPARATION, REVIEW, AND APPROVAL


Sediment Remediation in Ward Cove Marine Operable Unit, Ketchikan Pulp Company Site Ketchikan, Alaska

This Remedial Action (RA) Report has been prepared in accordance with the CERCLA Consent Decree No. A00225 CV (effective date November 20, 2000) for responsible party performance of remedial design/remedial action at the Marine Operable Unit of the Ketchikan Pulp Company Site, Ketchikan, Alaska. Signatories to the Consent Decree are the U.S. Environmental Protection Agency, Gateway Forest Products, Inc., Ketchikan Pulp Company, and Louisiana-Pacific Corporation.

To the best of my knowledge, after thorough investigation, I certify that the information contained in or accompanying this submission is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

RA Report Certified by KPC/L-P
Agent:

Mike Kinney, Director, Business Relations
and Investor Relations
Louisiana-Pacific Corporation




Signature

9/30/09

Date

Approved by EPA Region 10:



Sheila M. Eckman, Manager
Site Cleanup Unit 3

Sheila M Eckman

Signature

10/1/09

Date

1 INTRODUCTION

This Remedial Action (RA) Report for the Marine Operable Unit of the Ketchikan Pulp Company (KPC) site has been prepared for KPC, the prior owner of the KPC sulfite pulp mill and related operations located on the shoreline of Ward Cove, Alaska. The KPC site is located approximately 5 miles north of Ketchikan, Alaska (Figure 1). Pulping activities at the KPC facility were terminated in March 1997.

In September 1995, KPC entered into a Clean Water Act/Clean Air Act (CWA/CAA) Consent Decree with the U.S. Environmental Protection Agency (EPA) to address environmental issues related to KPC's Ketchikan facility. Under the Consent Decree, the KPC site was divided into two operable units: 1) Uplands Operable Unit—the uplands remedial investigation and feasibility study (RI/FS), which includes the former mill areas and other upland areas that may have been affected by past operations, and 2) Marine Operable Unit—the Ward Cove sediment remediation project. As part of the Consent Decree, KPC agreed to conduct the sediment remediation project to address sediment in Ward Cove. EPA Superfund provided oversight of the RI/FS and work performed under the consent decree, and work was deemed to be consistent with the National Contingency Plan. EPA issued two separate records of decision (RODs), under the authority of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), for the two operable units at the site, and negotiated a CERCLA Remedial Design/Remedial Action (RD/RA) consent decree for the responsible parties to perform the work.

The KPC site is not listed on the National Priorities List. The EPA identification number for the KPC site is AKD009252230.

1.1 UPLANDS INVESTIGATION

The Uplands Operable Unit is located on the north shoreline of Ward Cove and covers approximately 85 acres. The former pulp mill was built mainly on steep bedrock.

Parallel with the development of the sediment remediation project for Ward Cove, KPC conducted an RI/FS for the Uplands Operable Unit of the former facility under a Consent Decree providing joint oversight by EPA and the Alaska Department of Environmental Conservation (ADEC). For the Uplands Operable Unit, construction has been completed and institutional controls and restrictive covenants remain in effect. In EPA's five-year review report for the KPC site (U.S. EPA 2005a), it was determined by EPA that the remedial action for the Uplands Operable Unit is complete and that the remedy is protective of human health and the environment and that exposure pathways that could result in unacceptable risks are being controlled by institutional controls and restrictive covenants for the Uplands Operable Unit.

1.2 SEDIMENT INVESTIGATION

The Marine Operable Unit encompasses all of Ward Cove (approximately 250 acres). Of the 250 acres, approximately 80 acres were designated in the ROD (U.S. EPA 2000) as an area of concern (AOC) where remedial action was warranted because sediment contamination impacted by historical releases from the KPC site posed a risk to benthic macroinvertebrates. The chemicals of concern (CoCs) identified in the ROD were ammonia, 4-methylphenol, and sulfide; no bioaccumulative substances were a concern at the site. As documented in the ROD (U.S. EPA 2000), EPA determined that the contaminated sediments were not toxic to human health or to birds and mammals living in Ward Cove. Because the risks were limited to benthic macroinvertebrate communities and the CoCs were nonpersistent, the sediment remedial action relied largely on monitored natural recovery (MNR) and enhanced natural recovery (ENR). ENR using thin layer placement (TLP) of 6–12 in. of clean sand was successfully implemented at approximately 27 acres within the Ward Cove AOC. MNR was the remedial alternative for the remainder of the 80-acre AOC.

For the Marine Operable Unit, KPC initiated response actions pursuant to the CWA/CAA 1995 Consent Decree. The CWA/CAA 1995 Consent Decree was terminated when the CERCLA RD/RA Consent Decree was entered into in November 2000. Remedial action within the AOC was performed between October 2000 and February 2001, and triennial monitoring events were conducted in 2004 and 2007. In 2009, it was determined by EPA (U.S. EPA 2009a) that the remedial action objectives (RAOs) for the site have been achieved. It was also determined by EPA (U.S. EPA 2005a; 2009a) that the remedy at the Marine Operable Unit is protective of human health and the environment.

The remainder of this document addresses the activities that have occurred as part of the sediment remediation project in the Marine Operable Unit.

2 MARINE OPERABLE UNIT BACKGROUND

The Marine Operable Unit at the KPC site comprises submerged sediments and tidelands in Ward Cove. Ward Cove is 1-mile long and has a maximum width of approximately 0.5 mile. Ward Creek, located on the east end of Ward Cove, is the primary source of freshwater to the cove. Sediments in the cove are largely subtidal; intertidal sediments are limited to a very small area near the mouth of Ward Creek. The shoreline of the cove is mostly rocky and relatively steep. More than two-thirds of Ward Cove is deeper than 100 ft.

The facility began operations in 1954 and discharged pulp mill effluent to the cove until March 1997, when pulping operations terminated. The unique physical and chemical characteristics of Ward Cove sediments and related risks were critical considerations in the selection of remedial measures. The natural degradation products of pulp mill by-product (ammonia, 4-methylphenol, and sulfide) were the likely source of sediment toxicity in Ward Cove and were therefore identified as CoCs. These degradation products are themselves nonpersistent and are readily oxidized in the environment. The pulp mill effluent was discharged historically by the facility and associated organic-enriched particles accumulated over time in the adjacent sediments. Affected sediments contain pulp residue and wood debris and have high water and organic content. Concentrations of persistent chemicals that are toxic or that have the potential to bioaccumulate were low and did not pose an unacceptable risk to human health or wildlife (Exponent 1999). However, unacceptable risk to benthic macroinvertebrates was predicted based on sediment toxicity. A benthic community was present, with characteristics consistent with those documented for organic-rich areas (EVS 1992). Remedial action within the AOC was performed between 2000 and 2001 to eliminate or minimize the risk associated with the toxicity of Ward Cove sediments to benthic organisms. The first post-remediation sediment monitoring event occurred in 2004 and the second monitoring event occurred in 2007.

Additional information on site background can be found in the detailed technical studies report (Exponent 1999) and in the long-term monitoring and reporting plan (Exponent 2001).

2.1 REMEDY

The ROD (U.S. EPA 2000) for the Marine Operable Unit at the KPC site was signed on March 29, 2000. EPA identified RAOs for the sediment cleanup in the ROD. Specifically, the response action was intended to achieve the following RAOs:

- Reduce toxicity of surface sediments
- Enhance recolonization of surface sediments to support healthy marine benthic macroinvertebrate communities with multiple taxonomic groups.

The remedy consisted of the following interrelated components (Figure 2):

- ENR by TLP of approximately 6–12 in. of clean, sandy material over approximately 27 acres of the cove within the AOC.
- Dredging of approximately 8,701 cubic yards (cy) of bottom sediments from an area in front of the main dock and an area near the shallow draft barge berth area to accommodate navigational depths, with disposal of the dredged sediments at an upland location. After dredging, a thin-layer of clean, sandy material was placed in the dredged areas where native sediments or bedrock was not reached during dredging. For clarification, a small portion of the AOC, in front of the main dock, was dredged and native sediments/bedrock were reached (thus, thin layer placement was not performed in this area).
- Removal of approximately 680 tons of sunken logs from the bottom of Ward Cove in the dredged areas.
- MNR in the remaining areas of the AOC where TLP was not practicable, as follows:
 - 8-acre area in the center of Ward Cove and a 2-acre area near Boring Station 8 that contained a very high-density of sunken logs (>500 logs/10,000 m²)
 - 13.5-acre area where water depth to the bottom of the cove was greater than –120 ft mean lower low water (MLLW) and the depth of the sediment was considered to be too great to implement the TLP methodology
 - 14.5-acre area where slopes were estimated to be greater than 40 percent and were considered to be too steep for the TLP material to remain in place
 - 11-acre area where the organic-rich sediments did not have the bearing capacity (i.e., strength is less than 6 pounds per square foot) to support the TLP material and were too thick (i.e., sediment thickness is greater than 5 ft) to practicably allow for placement of mounding material
 - 0.2-acre area near the sawmill log lift where maintenance dredging generally occurs on an annual basis.

Deviations from the proposed remedy provided in the ROD (U.S. EPA 2000) were as follows:

- TLP was determined to be preferable over mounding. Also, TLP was found to be successful over a larger area than was estimated in the ROD. Therefore, the originally specified 21 acres for TLP was increased to include an additional 6 acres of the AOC that was originally selected for mounding.
- The ROD allowed for mounding if TLP could not be implemented. No mounding occurred at the site because TLP was effective in all areas.
- The dredging volume was less than expected (ROD planned for 10,050 cy to be dredged rather than the 8,701 cy actually dredged) because native, clean sediments were encountered at a shallower depth than anticipated.

- Submerged creosote-soaked pilings were removed from the area near the east end of the main dock.

The remedy for the Marine Operable Unit of the KPC site was chosen in accordance with CERCLA (to the extent possible) and the National Contingency Plan. ADEC also concurred with the remedy as discussed above.

There are no ROD amendments, explanation of significant differences, or technical impracticability waivers for the Marine Operable Unit.

2.2 CLEANUP GOALS

As specified in the ROD (U.S. EPA 2000), chemical-specific bulk sediment concentrations were not identified as cleanup levels for the CoCs at this site. Rather, it was determined that the success of the remedy would best be measured by biological indicators that are most directly representative of the RAOs (i.e., sediment toxicity and benthic community structure). Biological criteria for sediment toxicity and benthic community analyses were used to evaluate the protectiveness of the remedial action and whether the RAOs were achieved (Exponent 2005; Integral 2009). These criteria included comparisons of various biological parameters at the monitoring stations with reference-area conditions within Ward Cove, and evaluations of the temporal changes in the biological parameters that occurred at the monitoring stations after remediation was completed. As stated in the ROD (U.S. EPA 2000), monitoring data for ENR (i.e., TLP) and MNR areas of the AOC were evaluated using a weight-of-evidence approach to determine whether consistent and acceptable progress was made toward achieving the RAOs. The weight-of-evidence approach is recommended by EPA for sediment quality assessments as part of EPA's national sediment assessment programs, and is consistent with the most current methods of sediment assessment recommended by national experts.

2.3 INSTITUTIONAL CONTROLS

On October 28, 1999, an Environmental Protection Easement and Declaration of Restrictive Covenants was recorded. It was granted by KPC and extends to the Marine Operable Unit. This document designated the holder of the easement and covenants as the State of Alaska Department of Natural Resources, for use by ADEC. The ROD for the Marine Operable Unit (U.S. EPA 2000, Section 11.2) references the October 1999 Easement and Covenants:

An institutional control requires that future post-remediation activities within the AOC that materially damage the thin-layer cap or mounds be required to redress such damage, at the direction of EPA. As such, the following requirement

is included in an “Environmental Protection Easement and Declaration of Restrictive Covenants” recorded on October 28, 1999:

Projects or activities that materially damage the cap or mounds applied to tidelands or submerged lands shall be required, at the direction of EPA, to redress such impacts, e.g., a dredging project that may erode or displace large portions of the cap will be required to repair or replace the cap.

The term “cap” in this requirement is inclusive of any clean material (e.g., cap or mound) placed on the bottom of Ward Cove. As an example, when activities in the AOC, such as dredging projects, expose substantial area(s) of non-native organic-rich sediments and thus adversely affect the continued recovery of the benthic community in the sediments, the current owner will be required, at the direction of EPA, to include replacement of the cap in exposed areas. This requirement is enforceable by the State of Alaska Department of Natural Resources and is binding on the current and future owners of patented tidelands in Ward Cove. This control will remain in place even after RAOs are achieved.

Similarly, under Paragraph (43) of the Consent Decree regarding the Marine Operable Unit, if any future post-remediation activities within the AOC materially damage the thin-layer cap, such impacts shall be redressed at the direction of EPA (see also the *Addendum to the Long-term Monitoring and Reporting Plan for Sediment Remediation in Ward Cove* [Exponent 2002]).

In July 2003, and also in July 2004 with regard to different areas, the Ketchikan Gateway Borough, the new owner of Ward Cove, granted KPC Environmental Easement and Declaration of Covenants which also extend to the Marine Operable Unit. The covenant terms, which run with the land, include agreement by the Borough to comply with all Ward Cove institutional controls under the Consent Decree, including the restriction on damaging the cap. In the event of any such damage to the cap, the Borough (or any future owner) must immediately report the damage to EPA and KPC and then restore the cap.

2.4 REMEDY PLAN

As stated in the ROD (U.S. EPA 2000), monitoring data were collected every third year after remediation was completed (i.e., remediation activities were completed in 2001 and monitoring occurred within the cove in 2004 and 2007). The primary objectives of the Ward Cove sediment monitoring program were identified in the long-term monitoring and reporting plan (Exponent 2001), and included the following:

- Compare sediment toxicity in ENR (i.e., TLP) and MNR areas in the remediated areas with sediment toxicity in reference areas located elsewhere in the cove.
- Compare the characteristics of benthic communities in ENR (i.e., TLP) and MNR areas in the remediated areas with the characteristics of communities in the reference areas located elsewhere in the cove
- Evaluate temporal trends in sediment toxicity in the ENR (i.e., TLP) and MNR areas in the remediated area
- Evaluate temporal trends in the characteristics of benthic communities in the ENR (i.e., TLP) and MNR areas in the remediated area
- Evaluate chemical concentrations and their relationship to sediment toxicity and benthic community structure

The specific indicators of sediment quality used for the monitoring program were as follows:

- Sediment chemistry—Surface sediment samples were analyzed for conventional parameters, ammonia, and 4-methylphenol.
- Sediment toxicity—Surface sediment samples were evaluated using the 10-day amphipod toxicity test with *Eohaustorius estuarius*.
- Benthic communities—Characteristics of benthic communities were evaluated by collection and enumeration of the organisms founding in surface sediment samples.

3 CONSTRUCTION ACTIVITIES

As specified in the remedial action work plan (Foster Wheeler 2000a) and in the project management work plan (Foster Wheeler 200b), Foster Wheeler Environmental Corporation performed the construction and engineering oversight of the remediation activities for the Marine Operable Unit and deposited log wood debris and dredged material in a temporary dewatering area. Remedial activities were conducted from November 1, 2000, to March 6, 2001. Disposal of dredged material was completed by URS Corporation later in 2001 (URS 2001).

The placement of a thin-layer of sand was found to be successful over a larger area than was estimated in the ROD (U.S. EPA 2000). Therefore, the originally specified 21 acres for TLP was increased to include an additional 6 acres of the AOC that was originally selected for mounding; (i.e., a total of 27 acres for ENR using TLP). In addition, 8,701 cy of submerged sediments was dredged and removed from the cove. Furthermore, submerged creosote-soaked pilings were also removed from the cove at the east end of the facility's main loading dock. The location of each of these remedial activities is provided in Figure 2.

Prior to remediation in 2000–2001, no sediment remediation activities had occurred in Ward Cove. Some maintenance dredging operations had been conducted near the main dock and the mill log lift operation in accordance with the U.S. Army Corps of Engineers permits.

A detailed discussion of the Ward Cove sediment remediation construction activities can be found in the final construction report (Foster Wheeler 2001a) and in the Preliminary Close Out Report (U.S. EPA 2005b). As-built drawings of the sediment remediation activities are provided in Appendix A of Foster Wheeler (2001a).

4 CHRONOLOGY OF EVENTS

A general chronology of site events is provided below in Table 1.

Table 1. Chronology of Site Events

Event	Date
KPC operated a dissolving sulfite pulp mill	1954–1997
Preliminary site investigations	1991–1993
EPA Consent Decree (CWA/CAA) – RI/FS work for Marine Operable Unit performed pursuant to this decree	September 19, 1995
Responsible party implements RI/FS (referred to as detailed technical studies report) for the Marine Operable Unit	September 1995–March 2000
Preliminary site investigations continue	1997
EPA performs expanded site investigation for site	1997
Final expanded site investigation report	1998
Final detailed technical studies report	May 1999
Proposed plan issued for Marine Operable Unit	July 12, 1999
Proposed plan and RI/FS for Marine Operable Unit made available to the public	July 1999–August 1999
Sampling and analysis plan for remedial design sampling at the Marine Operable Unit	September 10, 1999
Recording of “Environmental Protection Easement and Declaration of Restrictive Covenants” – Marine Operable Unit	October 28, 1999
Sale of KPC assets to Gateway Forest Products, Inc. (GFP), including Ward Cove real property other than the landfill and the pipeline and dam parcels, USS 3400 and 3401	November 5, 1999
ROD signed for Marine Operable Unit	March 29, 2000
Final water quality monitoring plan for remedial action	2000
Cruise and data report for remedial design sampling at the Marine Operable Unit	February 2000
Construction plans and specifications for the Marine Operable Unit	August 2000
Design analysis report for the Marine Operable Unit	September 2000
Performance standard verification plan for the Marine Operable Unit	September 2000
Project management work plan for the Marine Operable Unit	September 2000
Construction quality assurance plan for the Marine Operable Unit	September 2000
Remedial design work plan for the Marine Operable Unit	September 14, 2000

Table 1. Chronology of Site Events

Event	Date
Final remedial action work plan for the Marine Operable Unit	October 2000
EPA approval of remedial design for Marine Operable Unit	October 24, 2000
EPA/KPC/L-P/GFP Consent Decree (CERCLA) for responsible party performance of RD/RA entered by federal court	November 20, 2000
Start of remedial action in Marine Operable Unit	October 24, 2000
Field construction in Marine Operable Unit	October 2000–February 2001
Completion of in-water work in Marine Operable Unit	February 24, 2001
Pre-final inspection performed of Marine Operable Unit	February 28, 2001
Final water quality monitoring report for the Marine Operable Unit	April 2001
Final inspection performed of Marine Operable Unit	April 4, 2001
EPA approval of final construction report for the Marine Operable Unit	July 10, 2001
KPC submits final construction report addendum for the Marine Operable Unit	July 31, 2001
Final long-term monitoring and reporting plan for sediment remediation in Ward Cove	September 2001
EPA approval of final long-term monitoring and reporting plan for the Marine Operable Unit	September 17, 2001
EPA approval of addendum to the long-term monitoring and reporting plan for the Marine Operable Unit	January 3, 2002
Preliminary close out report signed for the Marine Operable Unit	February 25, 2005
Field sampling for first monitoring event in the Marine Operable Unit	July 2004
KPC submits draft 2004 monitoring report for the Marine Operable Unit	October 2004
EPA comment letter on draft 2004 monitoring report for the Marine Operable Unit	January 14, 2005
KPC submits final 2004 monitoring report for the Marine Operable Unit	June 27, 2005
EPA first five-year review report for Ketchikan Pulp Company site	August 2, 2005
Field sampling for second monitoring event in the Marine Operable Unit	July 2007
KPC submits draft 2007 monitoring report for the Marine Operable Unit	January 31, 2008
EPA comment letter on draft 2007 monitoring report for the Marine Operable Unit	October 28, 2008

Table 1. Chronology of Site Events

Event	Date
KPC submits final 2007 monitoring report for the Marine Operable Unit	April 24, 2009
EPA approval of 2007 monitoring report for sediment remediation in Ward Cove, Alaska	May 7, 2009
EPA Fact sheet mailed indicating RAOs met for Marine Operable Unit	May 2009
Pre-certification inspection/meeting (after attainment of RAOs in Marine Operable Unit)	June 10, 2009
Certification of completion and extension letter for remedial action report	June 11, 2009
Draft remedial action report for the Marine Operable Unit	August 5, 2009
Final remedial action report for the Marine Operable Unit	September 1, 2009

5 PERFORMANCE STANDARDS AND CONSTRUCTION QUALITY CONTROL

A summary of performance standard verification and quality control requirements is provided in the final construction report (Foster Wheeler 2001a) and the Preliminary Close Out Report (U.S. EPA 2005b).

Both method and performance standards were applied to the remedial construction tasks. Method performance standards (i.e., quality assurance standards and checks to ensure that remedial construction methods were performed as planned) are described in the Contractor's Quality Assurance Plan (Foster Wheeler 2000a, Appendix E), the Construction Quality Assurance Plan (PN&D et al. 2000), and the Contractor's Quality Control Plan (Foster Wheeler 2000a, Appendix C). Performance standards (i.e., quality assurance standards and checks to verify that the desired environmental effects were carried out as planned) are described in the performance standard verification plan (Exponent and Hartman 2000). All work was conducted in compliance with the Final Remedial Action Work Plan, Quality Assurance Project Plan, Appendix A (Foster Wheeler 2000a).

Compliance with applicable or relevant and appropriate requirements for the remedial activities (i.e., Alaska water quality standards) are described in the Contractor's Quality Control Plan (Foster Wheeler 2000a, Appendix C), the Quality Assurance Project Plan (Foster Wheeler 2000a, Appendix A), the final Remedial Action Work Plan (see Section 8 in Foster Wheeler 2000a), and the water quality monitoring plan (Exponent 2000). Compliance with these plans was documented in the Water Quality Monitoring Report (Foster Wheeler 2001b), and briefly summarized in Section 7 of the final construction report (Foster Wheeler 2001a).

A quality assurance project plan (Exponent 2001, Appendix B) was also implemented for the long-term monitoring of the remedial action.

Oversight of the remedial actions within Ward Cove was provided by EPA (Region 10) and the U.S. Army Corps of Engineers (Seattle and Alaska Districts) for EPA. Oversight included (but was not limited to) report review and comment and direct oversight of the field monitoring activities in Ward Cove. Issues were resolved satisfactorily to EPA, and there were no significant issues for method or performance standards or analytical data quality.

6 FINAL INSPECTION AND CERTIFICATION

6.1 INSPECTIONS

In-water work was completed on February 24, 2001. A site walkthrough was completed on February 24, 2001, including representatives from Foster Wheeler, KPC/L-P, McAmis and South Coast to develop the punchlist. A subsequent meeting and site walk was performed with GFP representatives, whereby the punchlist items were agreed to and the pre-final inspection was completed on February 28, 2001. Punchlist items primarily referred to equipment or debris to be removed from the site. As documented in an April 4, 2001 letter to EPA, the final inspection was performed on April 4, 2001 and all punchlist items were completed.

On May 7, 2009, EPA (U.S. EPA 2009a, pers. comm.) provided approval of the final monitoring report (Integral 2009a) for the Marine Operable Unit. The final inspection meeting was held on June 10, 2009. EPA, KPC, and Integral Consulting Inc. (KPC's consultant) participated in the meeting. The certification of completion letter was issued by EPA on June 11, 2009 (U.S. EPA 2009b, pers. comm.).

6.2 HEALTH AND SAFETY

Health and safety requirements were met for all activities within the Marine Operable Unit. Site-specific health and safety plans were prepared for each component of the work (i.e., RI/FS data collection, remedial action and construction activities, and subsequent monitoring activities). The health and safety plan included guidance on chemical and physical hazards and measures of protection, emergency procedures, routes to the local hospital in conjunction with a comprehensive list of contact names and phone numbers for key project personnel. All field personnel and visitors were required to participate in daily health and safety briefings that were held prior to each workday. The topics for discussion included the activities to be performed during that day and the associated hazards and levels of protection required to safely complete the work.

6.3 INSTITUTIONAL CONTROLS

Institutional controls are discussed above in Section 2.

7 OPERATION AND MAINTENANCE

Operation and maintenance activities are not applicable to the Marine Operable Unit. Instead, sediment quality was monitored over time to track progress in achieving the RAOs specified in the ROD:

- Reduce toxicity of surface sediments
- Enhance recolonization of surface sediments to support healthy marine benthic macroinvertebrate communities with multiple taxonomic groups.

As stated in the ROD and as mentioned previously, monitoring data were collected every third year after remediation was completed in Ward Cove (i.e., remediation activities were completed in 2001 and monitoring occurred within the cove in 2004 and 2007). Monitoring data were collected in accordance with the long-term monitoring and reporting plan (Exponent 2001).

The monitoring program, as described in Exponent (2001), evaluated three major indicators of sediment quality: 1) sediment chemistry, 2) sediment toxicity, and 3) benthic macroinvertebrate communities. These indicators were evaluated on sediment samples representing the surface (i.e., 0–10 cm horizon) of sediments. Sediment chemistry and toxicity were assessed during the RI/FS (Exponent 1999) and therefore these monitoring components could be compared to pre-remedial conditions as well as to reference areas. Temporal trends in sediment chemistry, sediment toxicity, and benthic infauna were evaluated by comparing pre-remediation data with monitoring data collected in 2004 and 2007. The analytical methods for chemistry and toxicity testing were comparable to those used in the RI/FS (Exponent 1999). Benthic infauna measurements were compared to reference area conditions and qualitative data collected prior to remediation (EVS 1992).

The design of the Ward Cove monitoring program built on different categories of benthic strata, which were based on water depth and on the kind of remedial action taken. Multiple sampling stations were evaluated within each benthic stratum to estimate average (or mean) conditions in the stratum and to provide a measure of within-stratum variability so that statistical analyses could be conducted. A total of 37 AOC stations and 2 reference area stations were sampled during the monitoring program. The characteristics of benthic communities can be influenced by water depth and sediment character. Therefore, the AOC was subdivided into various benthic strata as follows:

- Water depth (four strata): Water depth strata were defined as very shallow areas (<20 ft water depth at MLLW; 5 stations), shallow areas (20–70 ft MLLW; 16 stations), moderately deep areas (70–120 ft MLLW; 11 stations), and deep areas (>120 ft MLLW; 5 stations)

- Remedial action (two strata): Remedial action strata were defined as either ENR (i.e., TLP areas; 15 stations) or MNR areas (22 stations).

The shallow, MNR stratum was further subdivided into an area with thick organic deposits (>5 ft) adjacent to the former pulp mill and an area with more limited organic deposits along the north shore near the mouth of the cove.

The results of the monitoring program are provided in Exponent (2005) and Integral (2009); see Executive Summaries of these documents). The data from the final monitoring event (i.e., 2007) are summarized in the following table and in the text below:

Table 2. Summary of Recovery Status for Various Biological Indicators in Ward Cove Based on 2007 Data^a

Indicator	Stratum					
	Enhanced Natural Recovery (i.e., TLP)			Monitored Natural Recovery		
	1	2a	3a	2b	3b	4
Sediment Toxicity	✓	✓	✓	✓	✓	✓
Benthic Community Metrics ^b	100%	100%	100%	33% ^c	100%	100%
Abundance						
Total abundance	✓	✓	✓	--	✓	✓
Taxa abundance						
Molluscs	✓	✓	✓	--	✓	✓
Polychaetes	✓	✓	✓	✓	✓	✓
Arthropods	✓	✓	✓	✓	✓	✓
Richness						
Total richness	✓	✓	✓	--	✓ ^d	✓
Taxa richness						
Molluscs	✓	✓	✓	--	✓ ^d	✓
Polychaetes	✓	✓	✓	--	✓ ^d	✓
Arthropods	✓	✓	✓	✓	✓	✓
SDI	✓	✓	✓	--	✓ ^d	✓

✓ = For sediment toxicity: Survival is greater than the 75 percent screening value specified in the long-term monitoring and reporting plan.

For benthic metrics: Value is not significantly lower ($P>0.05$) than the respective mean reference value.

-- = Significantly lower ($P\leq 0.05$) than the respective mean reference value.

^a Sediment chemistry was analyzed, but not included in this table because it is not applicable to RAOs. Stratum 2c is not included in this table because results of the 2004 monitoring event showed that this area had achieved the RAOs (see above text for further explanation).

^b Percentages indicate the number of benthic metrics that are not significantly lower ($P>0.05$) than their respective mean reference values (note that for Stratum 3b, uncertainty exists for some benthic metrics due to low statistical power).

^c Recovery of benthic communities is progressing in this stratum (see Integral 2009).

^d Low statistical power for benthic comparisons.

Based on the results of the monitoring program, it was determined that the RAOs have been achieved in Ward Cove. The results of the 2004 and 2007 monitoring events demonstrated that environmental conditions throughout the Ward Cove AOC had improved substantially since the RI/FS was conducted in 1996–1999. In addition, most conditions showed continual improvement between 2004 and 2007. The TLP area was successful in eliminating sediment toxicity and stimulating colonization of benthic macroinvertebrate species such that diverse communities comprising multiple taxa now inhabit most parts of the TLP areas, and exhibit enhanced characteristics beyond those of the reference areas. In addition, recovery is proceeding in the MNR areas, such that all four areas surpassed sediment toxicity screening levels and three of the four areas have achieved healthy benthic communities with multiple taxonomic groups. The weight of evidence for the remaining MNR area (i.e., Stratum 2b; located in the northwest corner of the cove) indicates that, in addition to surpassing sediment toxicity screening levels, substantial and acceptable progress has been made towards diversification of benthic communities in that area, and will continue to proceed, because sediment toxicity in that area has achieved the RAO, concentrations of total organic carbon, ammonia, and 4-methylphenol declined by 20 to 50 percent between 2004 and 2007, and the major source of CoCs to the AOC has been removed.

On May 7, 2009, EPA concluded that the multiple lines of evidence used to evaluate sediment quality in the Ward Cove AOC indicate that the RAOs have been achieved (U.S. EPA 2009a, pers. comm.). The lines of evidence include quantitative and qualitative evaluations of temporal and spatial trends in toxicity responses (amphipod toxicity tests) and benthic macroinvertebrate community characteristics (including statistical analyses comparing benthic metrics between remediated and reference areas), as well as supporting measurements of sediment chemistry (i.e., CoCs and conventional variables).

8 SUMMARY OF PROJECT COSTS

As detailed in the Final Construction Report (Foster Wheeler 2001a), the project construction cost for the Ward Cove Remediation Project was approximately \$3.1 million. The total cost of the Ward Cove Remediation Project, beginning with development of the Remedial Design Work Plan was estimated in Foster Wheeler (2001a) to cost approximately \$4 million.

The estimated cost in Foster Wheeler (2001a) for the dredging component of the project, including preliminary field investigation and reporting, design and plan development, post construction engineering, procurement, construction management, project management, mobilization/demobilization, engineering/QC and science support, construction of dewatering site, surveys, log removal, and dredging was approximately \$1.4 million. Based on the *in situ* volume of material dredged, the unit cost of dredging for the Ward Cove Remediation Project was approximately \$159 per cy. This cost does not include the cost of disposal of the dredged material.

The estimated cost in Foster Wheeler (2001a) for the capping component of the project including preliminary field investigations and reporting, design and plan development, post-construction engineering, procurement, construction management, project management, mobilization/demobilization, engineering/QC and science support, surveys, and capping items was approximately \$2.6 million. Based on the volume of capping material placed, the unit cost of capping for the Ward Cove Remediation Project was \$110 per cy.

The actual capital costs [construction and non-construction costs (design, oversight, construction management)] and periodic monitoring costs for the Marine Operable Unit was \$6.2 million (Benning, P., 2009, pers. comm.). The construction contract award amount, which covered only physical construction activities, was \$2.2 million. Monitoring costs were approximately \$250,000 for each of the 2004 and 2007 monitoring events.

A detailed cost and performance summary is not available.

9 OBSERVATIONS AND LESSONS LEARNED

Observations and lessons learned during the remedial action phase of this project are as follows:

- TLP was found to be preferable over mounding.
- TLP was found to be successful over a larger area than was estimated in the ROD.
- Native, clean sediments were encountered at a shallower depth than anticipated; the dredging volume was therefore less than expected (ROD planned for 10,050 cy to be dredged rather than the 8,701 cy actually dredged).
- All dredged material was successfully placed in the dewatering area.
- No spills occurred.
- There were no fish kills and no observations of distressed fish.
- Water quality monitoring occurred daily. For the entire project (approximately 4 months of in-water work), there were only two instances of exceedances of the turbidity standard of 25 NTU. One exceedance occurred during large tidal variations (stronger than usual ebb currents) and just after a pump-off hose used to pump excess water from the barge into the dewatering area was knocked loose (which discharged some highly turbid water retained in the hose into the surface water).
- Best management practices were successfully implemented.
- The weight-of-evidence approach stipulated in the ROD to evaluate if RAOs had been achieved was found to be appropriate for this site.
- The weight-of-evidence and monitoring approaches used for Ward Cove were found to be forward thinking and consistent with the recommendations of recent EPA guidance for addressing contaminated sediments at hazardous waste sites (U.S. EPA 2005c); this guidance was not available when the scope for this investigation was originally prepared (Exponent 2001).
- The total project costs described in Section 8 are almost equal to the costs estimated in the ROD (U.S. EPA 2000; Table 20). However, when the monies spent on non-construction items (e.g., RI/FS activities) are included, then the total cost of the project exceeded the cost estimate.

10 CONTACT INFORMATION

EPA contacts pursuant to the RD/RA Consent Decree were formally updated on January 28, 2009:

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Note: Gina Belt, DOJ, has retired and a new DOJ attorney has not been assigned.

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FIGURES

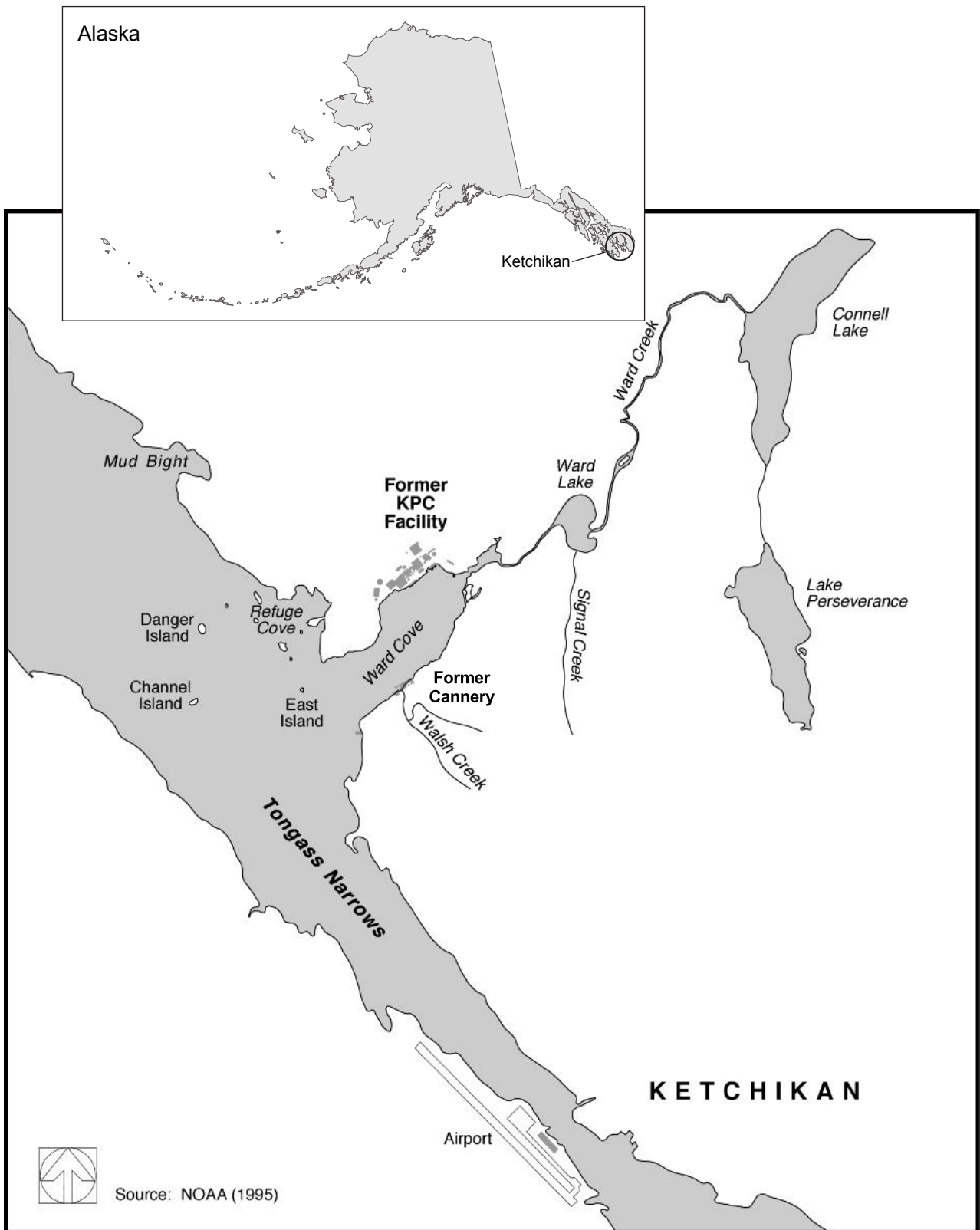
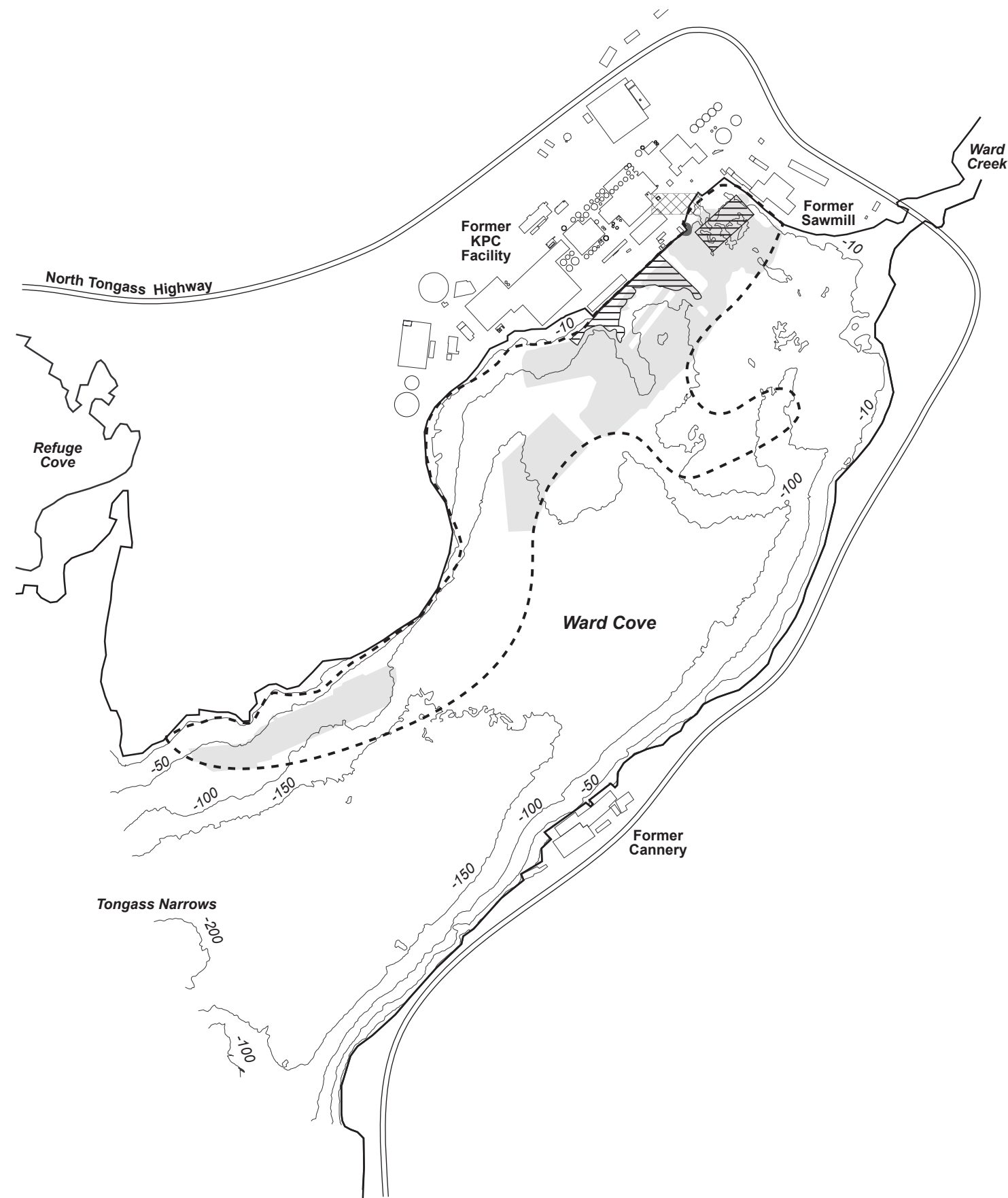


Figure 1. Location of Ward Cove



LEGEND

- - - - Boundary of AOC

Remediation Areas

Dredged areas

Thin layer placement areas

Submerged pilings removed

Notes: Areas within AOC boundary not marked with hatching or shading are subject to natural recovery.

Bathymetry in feet at MLLW

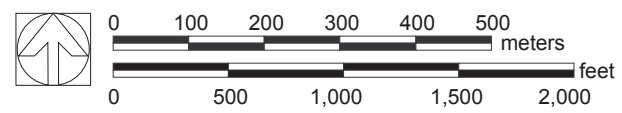


Figure 2. Location of the Ward Cove AOC; areas of thin layer placement, dredging, piling removal, and natural recovery