BAINBRIDGE ISLAND LANDFILL

SEPA Checklist

prepared by

Kitsap County Department of Public Works
Solid Waste Division

March 2001

PART ELEVEN - FORMS

WAC 197-11-960 Environmental checklist.

ENVIRONMENTAL CHECKLIST

Purpose of checklist:

The State Environmental Policy Act (SEPA), chapter 43.21C RCW, requires all governmental agencies to consider the environmental impacts of a proposal before making decisions. An environmental impact statement (EIS) must be prepared for all proposals with probable significant adverse impacts on the quality of the environment. The purpose of this checklist is to provide information to help you and the agency identify impacts from your proposal (and to reduce or avoid impacts from the proposal, if it can be done) and to help the agency decide whether an EIS is required.

Instructions for applicants:

This environmental checklist asks you to describe some basic information about your proposal. Governmental agencies use this checklist to determine whether the environmental impacts of your proposal are significant, requiring preparation of an EIS. Answer the questions briefly, with the most precise information known, or give the best description you can.

You must answer each question accurately and carefully, to the best of your knowledge. In most cases, you should be able to answer the questions from your own observations or project plans without the need to hire experts. If you really do not know the answer, or if a question does not apply to your proposal, write "do not know" or "does not apply." Complete answers to the questions now may avoid unnecessary delays later.

Some questions ask about governmental regulations, such as zoning, shoreline, and landmark designations. Answer these questions if you can. If you have problems, the governmental agencies can assist you.

The checklist questions apply to all parts of your proposal, even if you plan to do them over a period of time or on different parcels of land. Attach any additional information that will help describe your proposal or its environmental effects. The agency to which you submit this checklist may ask you to explain your answers or provide additional information reasonably related to determining if there may be significant adverse impact.

Use of checklist for nonproject proposals:

Complete this checklist for nonproject proposals, even though questions may be answered "does not apply." IN ADDITION, complete the SUPPLEMENTAL SHEET FOR NONPROJECT ACTIONS (part D).

For nonproject actions, the references in the checklist to the words "project," "applicant," and "property or site" should be read as "proposal," "proposer," and "affected geographic area," respectively.

A. BACKGROUND

1. Name of proposed project, if applicable:

   Bainbridge Island Landfill Model Toxics Control Act (MTCA) Remediation Project

2. Name of applicant: Kitsap County

3. Address and phone number of applicant and contact person:
   614 Division St., MS-27
   Port Orchard, WA 98366
   Contact: Michelle Miller 360-337-4485
   or Gretchen Olsen 360-337-4626

4. Date checklist prepared: 1/31/01

5. Agency requesting checklist:

   Kitsap County

6. Proposed timing or schedule (including phasing, if applicable):

Project activities will be conducted during the 2001 construction season (approximately May through September).

7. Do you have any plans for future additions, expansion, or further activity related to or connected with this proposal? If yes, explain.

   No. Kitsap County intends to fulfill the remediation requirements set forth by the Department of Ecology. When the requirements have been met other uses for the property may be considered. Appropriate permit applications would be submitted for each proposed project.

8. List any environmental information you know about that has been prepared, or will be prepared, directly related to this proposal.

   Documents that have been prepared on behalf of Kitsap County are required under the State Model Toxics Control Act (MTCA) (Chapter 70.105D RCW,) and include: the Remedial Investigation Work Plan, Health and Safety Plan, Technical Memorandum, Remedial Investigation (RI) Report and 2 supplements, Feasibility Study (FS), and RI/FS Executive Summary. All of these documents have been reviewed and approved by the State Department of Ecology, and have gone through a public review process. The Washington State Department of Ecology has prepared the Cleanup Action Plan (CAP). As required under the CAP the following documents will be prepared: Engineering Report, Construction Plans and Specifications, Operation and Maintenance Plans, and Compliance Monitoring Plan. Bid documents will also be prepared to conduct the remediation activities.

9. Do you know whether applications are pending for governmental approvals of other proposals directly affecting the property covered by your proposal? If yes, explain.

   Yes. A private water system purveyor has requested an easement along the northwestern portion of the property for a water system storage tank. This purveyor is currently in the process of negotiating the easement from Kitsap County, obtaining permits from the City of Bainbridge Island, and the State Health Department. The location of the tank will not be affected by the reclamation project.

10. List any government approvals or permits that will be needed for your proposal, if known.

    The proposed activities are exempt from the City of Bainbridge Island's grading permit requirements. While this project is exempt from the administrative requirements of obtaining permits for other activities under the Cleanup Action Plan, all activities will be conducted in accordance with the substantive requirements of all applicable or relevant and appropriate (ARARs) federal, state or local standards, requirements, criteria, or limitations. These ARARs are identified in the RI/FS.

11. Give brief, complete description of your proposal, including the proposed uses and the size of the project and site. There are several questions later in this checklist that ask you to describe certain aspects of your proposal. You do not need to repeat those answers on this page. (Lead agencies may modify this form to include additional specific information on project description.)

The Bainbridge Island Landfill is situated on a 40-acre parcel and approximately 7 acres were used for disposing waste from 1948 through 1976. The cleanup action will include the following:

- Excavate all waste, screen main landfill and west end area waste, and re-grade the site with the inert waste fraction (i.e. constituents less than 1½ inches in diameter)
- Dispose of the bulky waste fraction (i.e. constituents greater than 3 inches in diameter) off site at a permitted landfill
- Dispose of the garbage waste fraction (i.e. constituents greater than 1½ inch but less than 3 inches in diameter) off site at a permitted landfill
- Dispose of the septage pit wastes and any cover soil requiring off site disposal at a permitted landfill.
- Construct a minimum 2-foot thick soil cover on top of the inert waste
- Restore site drainage and reestablish site vegetation
- Monitor groundwater quality and natural attenuation of contaminants
- Monitor surface water for compliance with cleanup levels
- Establish institutional controls, that may include installation of fencing to control access, zoning restrictions, and deed restrictions to prevent access to groundwater and protect the final cover system

12. Location of the proposal. Give sufficient information for a person to understand the precise location of your proposed project, including a street address, if any, and section, township, and range, if known. If a proposal would occur over a range of area, provide the range or boundaries of the site(s). Provide a legal description, site plan, vicinity map, and topographic map, if reasonably available. While you should submit any plans required by the agency, you are not required to duplicate maps or detailed plans submitted with any permit applications related to this checklist.

    The landfill is located off Vincent Road on Bainbridge Island, WA. The site comprises the northeast quarter of the northwest quarter of Section 33, Township 25 North, Range 2 East. The latitude is 47°37'02" North and longitude 122°33'02" West. See attached site map.

B. ENVIRONMENTAL ELEMENTS

1. Earth

a. General description of the site (circle one): Flat, rolling, hilly, steep slopes, mountainous, other . . . . . .

b. What is the steepest slope on the site (approximate percent slope)? 30%

c. What general types of soils are found on the site (for example, clay, sand, gravel, peat, muck)? If you know the classification of agricultural soils, specify them and note any prime farmland.

Sand. Unconsolidated glacial deposits.

d. Are there surface indications or history of unstable soils in the immediate vicinity? If so, describe.

No.

e. Describe the purpose, type, and approximate quantities of any filling or grading proposed. Indicate source of fill.

Approximately 120,000 cubic yards of material will be excavated, screened, and the fraction less than 1.5" will remain on site. Based on earlier studies, approximately 66% by volume of the excavated refuse will be placed back into the landfill excavation. The remaining 24% will be disposed of at a permitted landfill. This material will occupy a slightly smaller area than the original landfill and will be graded to allow drainage to flow in an easterly direction. Site grading outside of the landfill area will include temporary roads, processing area for equipment, staging area, and stockpiles. The material remaining onsite will be covered with a minimum two-foot thickness of soil that will all be derived from onsite.

f. Could erosion occur as a result of clearing, construction, or use? If so, generally describe.

Possibly, but best management practices for the prevention of erosion will be instituted.

g. About what percent of the site will be covered with impervious surfaces after project construction (for example, asphalt or buildings)?

Temporary roads will be constructed from compacted gravel and stockpile pads may be placed on asphalt. These surfaces may be left after the remediation project is completed. This will comprise less than 5 % of the 40-acre parcel.

h. Proposed measures to reduce or control erosion, or other impacts to the earth, if any:

Standard best management practices including scheduling major earthwork during the dry season, use of hay bales and silt fences, minimizing disturbance of natural vegetation and soil during construction, minimizing the extent to and duration for which an area is exposed, and instituting practices to keep runoff velocities low.

2. **Air**

a. What types of emissions to the air would result from the proposal (i.e., dust, automobile, odors, industrial wood smoke) during construction and when the project is completed? If any, generally describe and give approximate quantities if known.

Some dust may be generated from truck traffic during the construction phase. The potential for odors has been investigated and has been determined not to be a problem.

b. Are there any off-site sources of emissions or odor that may affect your proposal? If so, generally describe.

No.

c. Proposed measures to reduce or control emissions or other impacts to air, if any.

If dust control measures are needed, the temporary gravel roads will be watered, as necessary.

3. **Water**

a. Surface:

1) Is there any surface water body on or in the immediate vicinity of the site (including year-round and seasonal streams, saltwater, lakes, ponds, wetlands)? If yes, describe type and provide names. If appropriate, state what stream or river it flows into.

The only surface water body is a small seasonal drainage ditch that intermittently flows only during the wettest times of the year. Flow is directly related to a storm event.

There are two wetlands delineated on the 40-acre parcel and these are located on either side of an old road that divides the coniferous forest on the western edge of the property from the historic landfill on the eastern side of the road.

2) Will the project require any work over, in, or adjacent to (within 200 feet) the described waters? If yes, please describe and attach available plans.

Since the work will occur during the dry season, no impact will occur to the water in this intermittent drainage ditch.

The wetland to the east of the old road, referred to as Wetland A, is less than 5000 square feet. Removal of waste will occur within 50 feet of Wetland A. The wetland to the west of the old road, referred to as Wetland B, is a Category III wetland that lies within a coniferous forest. No remediation activities are planned in this area and thus Wetland B will not be impacted at all by the project.

3) Estimate the amount of fill and dredge material that would be placed in or removed from surface water or wetlands and indicate the area of the site that would be affected. Indicate the source of fill material.

Wetland A is near the northwest end of the landfill that contains approximately 2500 cubic yards of waste. Any waste located near or in Wetland A will be removed. Once the underlying soil has been confirmed as having met MTCA cleanup standards, the area will be graded such that water will continue to flow in the historic drainage.

4) Will the proposal require surface water withdrawals or diversions? Give general description, purpose, and approximate quantities if known.

No. Surface water only flows after a storm event. There will be no withdrawal or diversions of surface water.

5) Does the proposal lie within a 100-year floodplain? If so, note location on the site plan.

No.

6) Does the proposal involve any discharges of waste materials to surface waters? If so, describe the type of waste and anticipated volume of discharge.

Currently landfill leachate emanates from a surface seep at the toe of the main landfill and joins the surface water drainage after a storm event. The current system includes storm water ponds at the toe of the landfill. During the remediation activities, potentially contaminated vehicle wash down water, and any surface water will continue to flow through the existing surface water drainage system, which will be dry during the time period that the proposed activities will take place. The leachate seep will be remediated as part of the project and any waste discharge will be eliminated by the remediation project.

b. Ground:

1) Will ground water be withdrawn, or will water be discharged to ground water? Give general description, purpose, and approximate quantities if known.

No.

2) Describe waste material that will be discharged into the ground from septic tanks or other sources, if any (for example: Domestic sewage; industrial, containing the following chemicals. . . ; agricultural; etc.). Describe the general size of the system, the number of such systems, the number of houses to be served (if applicable), or the number of animals or humans the system(s) are expected to serve.

None.

c. Water runoff (including stormwater):

1) Describe the source of runoff (including storm water) and method of collection and disposal, if any (include quantities, if known). Where will this water flow? Will this water flow into other waters? If so, describe.

There are established storm water detention ponds at the site. These will be functioning until the waste is removed and the ponds are decommissioned. A new stormwater detention pond will be installed at the conclusion of the remediation project.

2) Could waste materials enter ground or surface waters? If so, generally describe.

No. Groundwater has already been impacted by the historic landfill. The purpose of the reclamation activity is to remove decomposable waste to control potential groundwater contamination from leachate and landfill gas migration. Best management practices will be in place to prevent sediment from entering the surface water system.

d. Proposed measures to reduce or control surface, ground, and runoff water impacts, if any:

Best management practices will be applied to the stormwater runoff area (such as straw bales to prevent sediment runoff).

4. **Plants**

a. Check or circle types of vegetation found on the site:

✓ deciduous tree: alder, maple, aspen, other

✓ evergreen tree: fir, cedar, pine, other

✓ shrubs

✓ grass

—— pasture

—— crop or grain

✓ wet soil plants: cattail, buttercup, bullrush, skunk cabbage, other: pacific willow, water parsley, manna grass, salmonberry, hardhack, lady fern.

—— water plants: water lily, eelgrass, milfoil, other

✓ other types of vegetation

b. What kind and amount of vegetation will be removed or altered?

Some alder, fir and pine, and blackberry bushes.

c. List threatened or endangered species known to be on or near the site.

No known endangered plant species are on or near the site.

d. Proposed landscaping, use of native plants, or other measures to preserve or enhance vegetation on the site, if any:

Naturally occurring native grasses will be used to revegetate the land surface after the remediation is complete.

5. **Animals**

a. Circle any birds and animals which have been observed on or near the site or are known to be on or near the site:

birds: hawk, heron, eagle, songbirds, other:

mammals: deer, bear, elk, beaver, other: mountain beaver

fish: bass, salmon, trout, herring, shellfish, other:

b. List any threatened or endangered species known to be on or near the site.

The U.S. Fish and Wildlife Service was contacted regarding potential threatened or endangered species in the vicinity of the site. The only one identified was a bald eagle nest located over one-half mile west of the proposed remediation project.

c. Is the site part of a migration route? If so, explain.

None known.

d. Proposed measures to preserve or enhance wildlife, if any:

No structures are being erected. The site will still be open space after the project is completed. Existing drainage patterns will be maintained and an effort will be made to minimize the number of trees removed and the amount of landscape disturbed. Overall, wildlife habitat will be preserved or enhanced by the remediation activity.

6. **Energy and natural resources**

a. What kinds of energy (electric, natural gas, oil, wood stove, solar) will be used to meet the completed project's energy needs? Describe whether it will be used for heating, manufacturing, etc.

Diesel-powered construction equipment.

b. Would your project affect the potential use of solar energy by adjacent properties? If so, generally describe.

No

c. What kinds of energy conservation features are included in the plans of this proposal? List other proposed measures to reduce or control energy impacts, if any:

None.

7. **Environmental health**

a. Are there any environmental health hazards, including exposure to toxic chemicals, risk of fire and explosion, spill, or hazardous waste that could occur as a result of this proposal? If so, describe.

The removal of municipal solid waste has the potential to encounter household hazardous waste. A Health and Safety Plan and Contingency Plan, approved by Ecology, sets forth the appropriate actions needed to respond to such an event, if it occurs. The project manager will be certified in Hazardous Waste Handling, site personnel will have proper training and there will be daily safety meetings conducted.

1) Describe special emergency services that might be required.

All emergency services will be listed in the Health and Safety Plan as well as the Contingency Plan. Fire and emergency medical services will be notified prior to project initiation.

2) Proposed measures to reduce or control environmental health hazards, if any:

If environmental hazards are encountered, trained personnel will be onsite and will implement best management practices for handling hazardous waste as described in the approved Health and Safety and Contingency Plans. Site access will be controlled and restricted to prevent hazard exposure to untrained persons.

b. **Noise**

1) What types of noise exist in the area which may affect your project (for example: traffic, equipment, operation, other)?

There is existing truck traffic noise associated with the Drop Box and Recycling Facility. Noise will be generated by construction and screening equipment and the temporary increase in truck traffic hauling the waste to an off site disposal facility.

2) What types and levels of noise would be created by or associated with the project on a short-term or a long-term basis (for example: traffic, construction, operation, other)? Indicate what hours noise would come from the site.

For the short-term, noise levels will be typical of construction sites: heavy equipment, backup horns, shaker screens, and others equipment. The increase in traffic will also be on a short-term basis. It is anticipated that the hours of operation will be 7 a.m. to 7 p.m. Monday through Saturday. This is in accordance with the City of Bainbridge Island's noise ordinance Chapter 16.16.

3) Proposed measures to reduce or control noise impacts, if any:

Noise will be controlled by operating in accordance with the local noise ordinance.

8. **Land and shoreline use**

a. What is the current use of the site and adjacent properties?

A portion of this site is currently used as a Solid Waste Transfer Facility and Recycling Facility. The closed landfill is located on approximately 7 acres of the 40 acre parcel. Adjacent properties are residential, tree farm, outdoor recreation area.

b. Has the site been used for agriculture? If so, describe.

No

c. Describe any structures on the site.

A small toll booth for the transfer station. There is also a concrete, z-wall structure where the public can park and place recycled materials in open box containers located below the structure.

d. Will any structures be demolished? If so, what?

No

e. What is the current zoning classification of the site?

ROH 1 unit/2.5 acres.

f. What is the current comprehensive plan designation of the site?

Open space, residential (OS R-0.4)

g. If applicable, what is the current shoreline master program designation of the site?

N/A

h. Has any part of the site been classified as an "environmentally sensitive" area? If so, specify.

Wetlands, Class 5, seasonal drainage.

i. Approximately how many people would reside or work in the completed project?

None, other than the existing personnel employed by Bainbridge Disposal at the Solid Waste Transfer Facility.

j. Approximately how many people would the completed project displace?

None.

k. Proposed measures to avoid or reduce displacement impacts, if any:

N/A.

l. Proposed measures to ensure the proposal is compatible with existing and projected land uses and plans, if any:

There are currently no definite plans to change the existing land use. However, Kitsap County is working closely with the City of Bainbridge Island and area residents regarding future uses for the site. The City of Bainbridge Island will ensure compatibility with its land use ordinances through this process.

9. **Housing**

a. Approximately how many units would be provided, if any? Indicate whether high, middle, or low-income housing.

N/A

b. Approximately how many units, if any, would be eliminated? Indicate whether high, middle, or low-income housing.

N/A

c. Proposed measures to reduce or control housing impacts, if any:

N/A

10. **Aesthetics**

a. What is the tallest height of any proposed structure(s), not including antennas; what is the principal exterior building material(s) proposed?

No structures are proposed, thus this question in not applicable.

b. What views in the immediate vicinity would be altered or obstructed?

None.

c. Proposed measures to reduce or control aesthetic impacts, if any:

There will be no aesthetic impacts, thus this question is not applicable.

11. **Light and glare**

a. What type of light or glare will the proposal produce? What time of day would it mainly occur?

None. All activities will occur during daylight hours.

b. Could light or glare from the finished project be a safety hazard or interfere with views?

N/A

c. What existing off-site sources of light or glare may affect your proposal?

None.

d. Proposed measures to reduce or control light and glare impacts, if any:

N/A

12. **Recreation**

a. What designated and informal recreational opportunities are in the immediate vicinity?

Gazzam Lake is located to the west of the site. This is owned by the City of Bainbridge Island's Parks and Recreation District.

b. Would the proposed project displace any existing recreational uses? If so, describe.

No.

c. Proposed measures to reduce or control impacts on recreation, including recreation opportunities to be provided by the project or applicant, if any:

There are no anticipated impacts on recreation. However, an effort will be made to minimize the number of trees cut on the western property boundary.

13. **Historic and cultural preservation**

a. Are there any places or objects listed on, or proposed for, national, state, or local preservation registers known to be on or next to the site? If so, generally describe.

No.

b. Generally describe any landmarks or evidence of historic, archaeological, scientific, or cultural importance known to be on or next to the site.

None.

c. Proposed measures to reduce or control impacts, if any:

N/A

14. **Transportation**

a. Identify public streets and highways serving the site, and describe proposed access to the existing street system. Show on site plans, if any.

Vincent Road serves the site. See attached map for other nearby streets.

b. Is site currently served by public transit? If not, what is the approximate distance to the nearest transit stop?

No

c. How many parking spaces would the completed project have? How many would the project eliminate?

N/A

d. Will the proposal require any new roads or streets, or improvements to existing roads or streets, not including driveways? If so, generally describe (indicate whether public or private).

Temporary gravel roads will be constructed onsite to facilitate the loading and hauling of excavated waste.

e. Will the project use (or occur in the immediate vicinity of) water, rail, or air transportation? If so, generally describe.

No

f. How many vehicular trips per day would be generated by the completed project? If known, indicate when peak volumes would occur.

In order to complete the project during the 2001 construction season, approximately 1000 cubic yards of waste will be moved off-site daily to be disposed at permitted landfill. This will require an average of 30 trips per day. Peak volumes from the project would occur in the late morning, and will not coincide with the existing peak traffic volumes off-site.

g. Proposed measures to reduce or control transportation impacts, if any:

The materials to be hauled will be staged to reduce the number of trucks running daily and to reduce the total number of days the trucks are hauling waste off-site.

15. **Public services**

a. Would the project result in an increased need for public services (for example: fire protection, police protection, health care, schools, other)? If so, generally describe.

No

b. Proposed measures to reduce or control direct impacts on public services, if any.

There will be no impacts on public services, so this question is not applicable.

16. **Utilities**

a. Circle utilities currently available at the site: electricity, natural gas, water, refuse service, telephone, sanitary sewer, septic system, other: portable toilets

b. Describe the utilities that are proposed for the project, the utility providing the service, and the general construction activities on the site or in the immediate vicinity which might be needed.

None.

C. SIGNATURE

The above answers are true and complete to the best of my knowledge. I understand that the lead agency is relying on them to make its decision.

Signature:

Date Submitted:

NOTICE
DETERMINATION OF NONSIGNIFICANCE

Description of Proposal: Bainbridge Island Landfill Model Toxics Control Act (MTCA) Remediation Project. The proposal involves the Bainbridge Island landfill situated on a 40-acre parcel, approximately 7 acres of which were used for disposing waste from 1948 through 1976. The cleanup action will include the following:

- Excavate all waste, screen main landfill and west end area waste, and re-grade the site with the inert waste fraction (i.e. constituents less than 1½ inches in diameter).
- Dispose of the bulky waste fraction (i.e. constituents greater than 3 inches in diameter) off site at a permitted landfill.
- Dispose of the garbage waste fraction (i.e. constituents greater than 1½ inches but less than 3 inches in diameter) off site at a permitted landfill.
- Dispose of the seepage pit wastes and any cover soil requiring off site disposal at a permitted landfill.
- Construct a minimum 2-foot thick soil cover on top of the inert waste.
- Restore site drainage and reestablish site vegetation.
- Monitor groundwater quality and natural attenuation of contaminants.
- Monitor surface water for compliance with cleanup levels.
- Establish institutional controls, that may include installation of fencing to control access, zoning restrictions, and deed restrictions to prevent access to groundwater and protect the final cover system.

Proponent: Kitsap County
Lead Agency: KITSAP COUNTY

Location of proposal, including street address, if any: The landfill is located off Vincent Road on Bainbridge Island, Washington. The site comprises the Northeast Quarter of the Northwest Quarter of Section 33, Township 25 North, Range 2 East. The latitude is 47º 37' 02" North and Longitude 122º 33' 02" West.

The lead agency for this proposal has determined that it does not have a probable significant adverse impact on the environment. An environmental impact statement (EIS) is not required under RCW 43.21C.030(2)(c). This decision was made after review of a completed environmental checklist and other information on file with the lead agency. This information is available to the public on request.

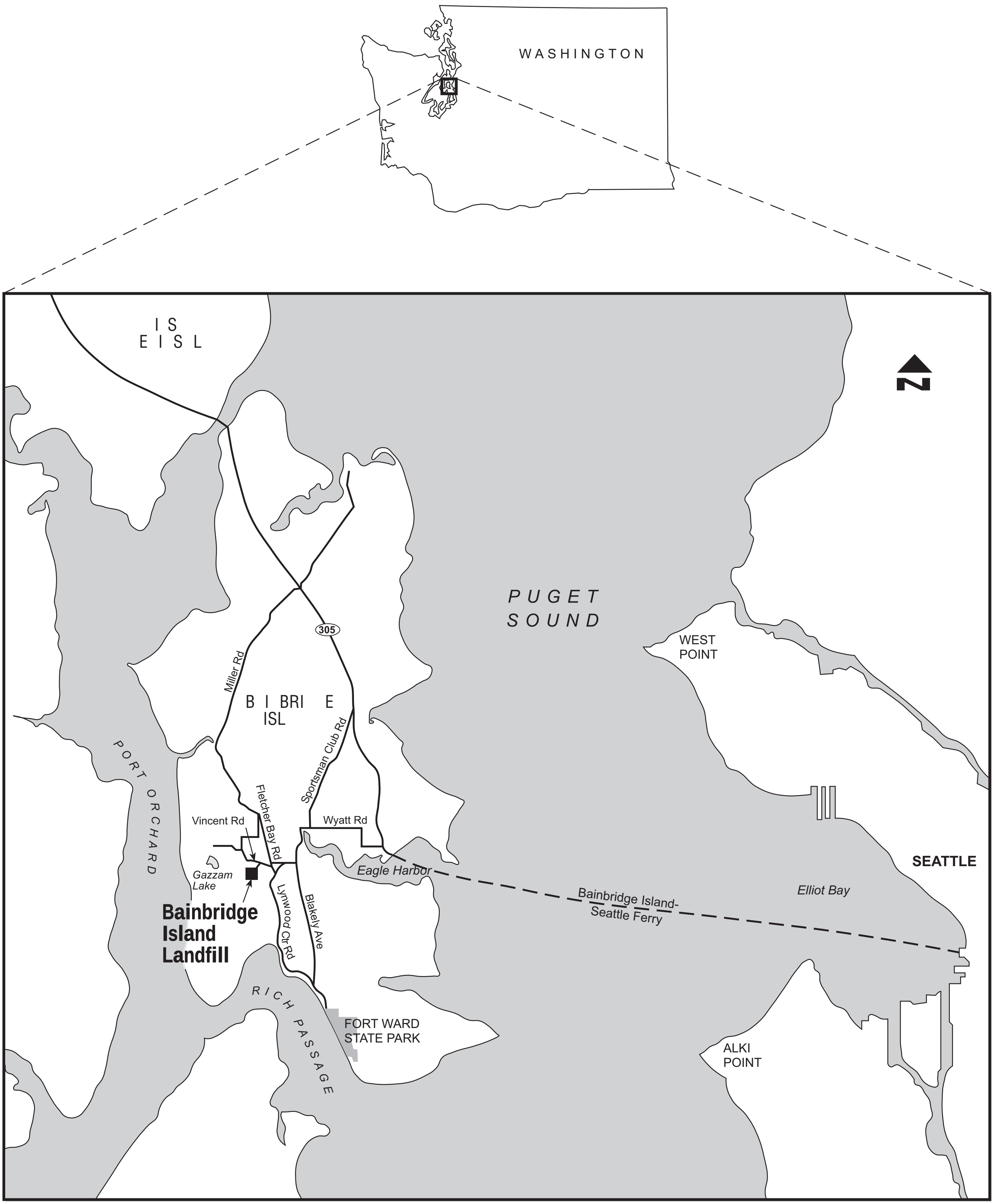
This DNS is issued under 197-11-340(2); the lead agency will not act on this proposal for 30 days from the date of public notice. Comments must be submitted by: April 6, 2001.

Responsible Official: Bruce Freeland
Position/Title: Director, Dept. of Community Development Phone: (360) 337-7181
Contact Person: Rick Kimball
Position/Title: SEPA Administrator, Dept. of Community Dev. Phone: (360) 337-4966
Address: 614 Division Street, Port Orchard, WA 98366

DATE: March 1, 2001 Signature:

You may appeal this determination to the Dept. of Community Development, at 614 Division Street, Port Orchard WA 98366, no later than (date) April 6, 2001 in writing, with a $125.00 appeal fee.

You should be prepared to make specific factual objections. Contact **Rick Kimball** to read or ask about the procedures for SEPA appeals.



Scale in Miles

0 1 2 3

Figure 1

Site Location Map

Bainbridge Island Landfill SEPA Checklist

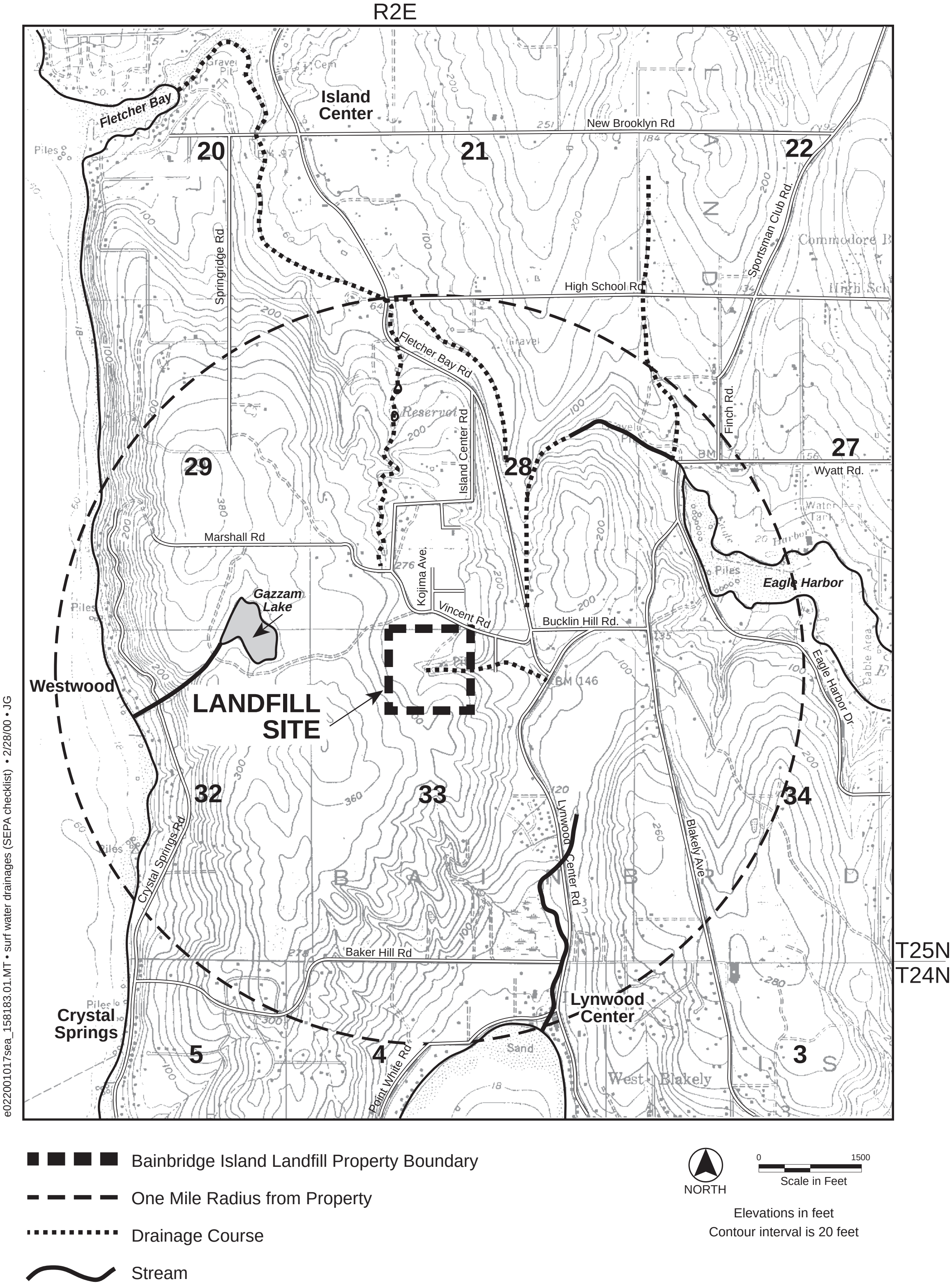
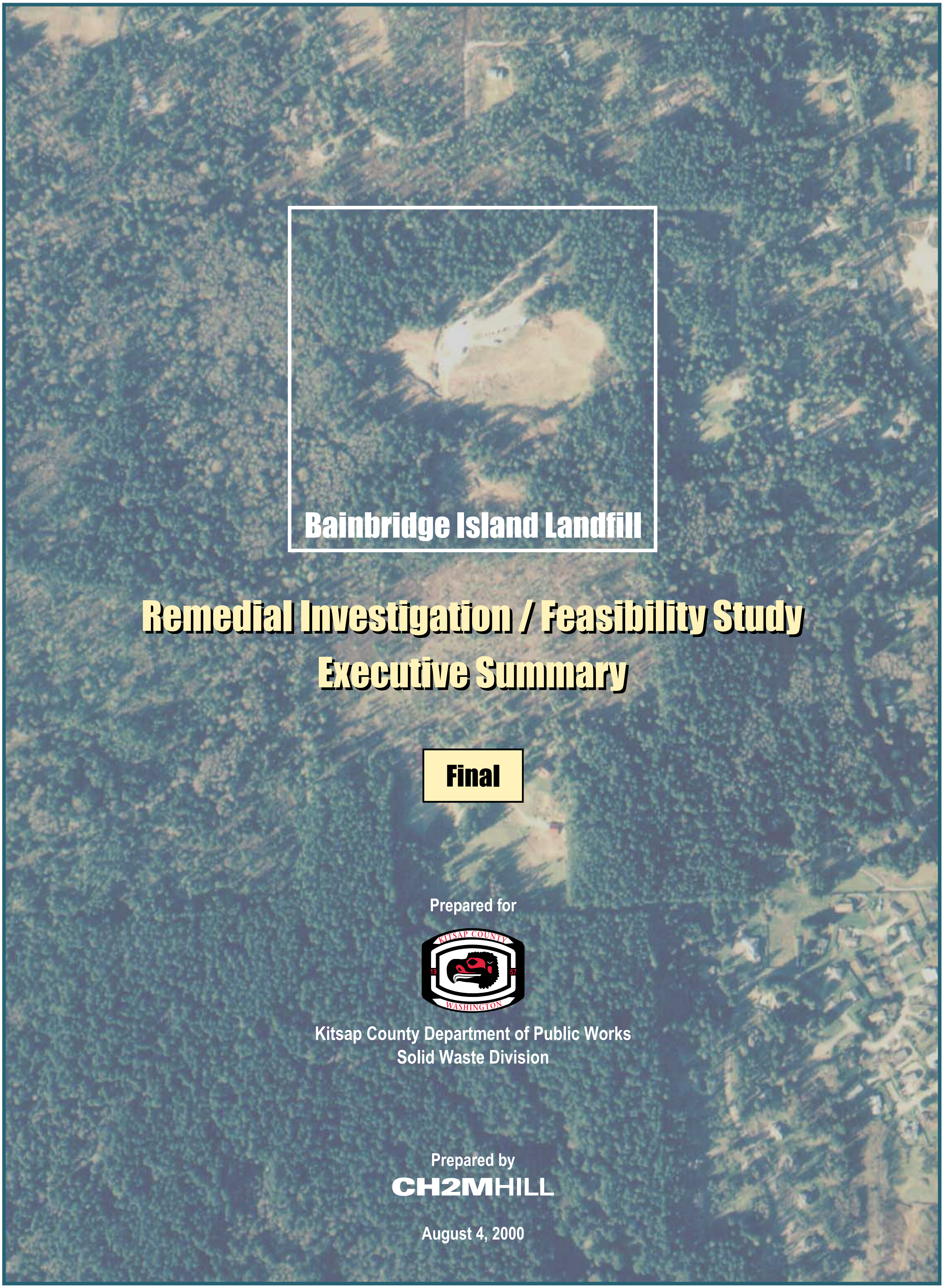


Figure 2

Regional Topography and Surface Water Drainages

Bainbridge Island Landfill SEPA Checklist



Bainbridge Island Landfill

Remedial Investigation / Feasibility Study Executive Summary

Final

Prepared for

Kitsap County Department of Public Works
Solid Waste Division

Prepared by

CH2MHILL

August 4, 2000

Bainbridge Island Landfill RI/FS Executive Summary

Introduction

Kitsap County has completed a remedial investigation and feasibility study (RI/FS) at the Bainbridge Island Landfill site under the Model Toxics Control Act (MTCA; Chapter 173-340 WAC). As a result of the RI/FS process, Kitsap County is proposing to remediate the site by reclaiming the landfill and monitoring natural attenuation processes in groundwater. This Executive Summary presents a synopsis of the findings of the remedial investigation, the feasibility study, and the selection of the preferred remedial alternative. Details of information presented in the Executive Summary may be found in the following four documents:

- Bainbridge Island Landfill Remedial Investigation Report
- Remedial Investigation Report Supplement 1
- Remedial Investigation Report Supplement 2
- Bainbridge Island Landfill Feasibility Study Report

The Bainbridge Island Landfill is a closed municipal solid waste landfill located in the City of Bainbridge Island, Kitsap County, Washington. The site stopped accepting waste in 1975 and was closed by 1977.

The Washington State Department of Ecology (Ecology) issued an Enforcement Order in 1994 that required Kitsap County to complete an RI/FS for the site, to follow a scope of work for the RI/FS included in the order, and to conduct interim actions at the site, if necessary, to reduce threats to human health or the environment. RI/FS reports were prepared in accordance with the Washington State Model Toxics Control Act (MTCA, WAC 173-340) and pursuant to Exhibit A, Task IV of the Enforcement Order for an RI/FS at the Bainbridge Island Landfill.

The purpose of the RI/FS was to collect, develop, and evaluate sufficient information to enable a cleanup action to be selected. The RI phase of the process determined the nature and extent of site-derived contaminants. The FS phase determined what actions are feasible to clean up the site to an acceptable level.

The remedial investigation obtained and analyzed data to characterize the nature and extent of contaminants that pose potential risks to human health and the environment, and to support selection of appropriate cleanup actions. The RI began in March 1996 and was completed in August 1999. The RI/FS Work Plan (CH2M HILL, 1996) specifies the work to be completed for the RI and FS. The RI is presented in three reports that document information obtained during the investigation, analyze site conditions, and determine the characteristics of environmental media. The first RI report (RI Report; CH2M HILL, 1999a) covers site activities, including initial sampling in all media, for the period March 1996 through May 1997. Two supplements to the RI Report were prepared to cover follow-up sampling that defined the nature and extent of contamination: RI Supplement 1 (CH2M HILL, 1999b) covers May-December 1997, and RI Supplement 2 (CH2M HILL, 2000a) documents work done between March 1998 and August 1999. These three reports are referred to collectively as the RI Reports.

The feasibility study was completed in May 2000. It is documented in the *Bainbridge Island Landfill Feasibility Study Report,* prepared by CH2M HILL for Kitsap County (FS Report; CH2M HILL, 2000b). The FS Report identifies contaminants of concern in site media, identifies and evaluates feasible actions for site cleanup, and selects a preferred remedial alternative.

Remedial Investigation

Site Description

The Bainbridge Island Landfill is located west of Eagle Harbor on Bainbridge Island, near Seattle, Washington (Figure 1). The site covers 40 acres, approximately 7 of which were used for disposing various types of waste between 1948 and 1975. The main landfill is located on an east-facing slope at an elevation of approximately 200 to 260 feet above sea level (NAVD-88). The site was originally a steep, narrow, east-sloping ravine, which was reshaped and largely filled in by landfill activities. The only structures onsite are refuse transfer and recycling stations. Access is restricted by a gated northern entrance off Vincent Road.

The Bainbridge Island Landfill site consists of the following waste disposal areas:

- Main landfill
- West end area (northern and southern)
- Five septage pits and Trench 1-2
- Trench 3

The locations of these disposal areas are shown in Figure 1. The main landfill and west end area accepted primarily domestic refuse and a small amount of commercial waste. The five septage pits received liquid-solid sludge from domestic septic system haulers. The largest of the pits is the south septage pit, located southwest of the main landfill. Trench 3, located just north of the south septage pit, was an excavation in native soil where liquid wood-preserving waste from the Wyckoff Company was disposed.

Site History

Kitsap County acquired the property that was later to become the Bainbridge Island Landfill as part of a tax foreclosure process in 1942. It was operated as a landfill by several parties over 29 years, during which time it accepted typical domestic waste, tank bottoms from the nearby Wyckoff wood treatment facility (in Trench 3), and petroleum products such as oil. Until 1968, refuse was burned at the site. The landfill ceased accepting waste in 1975 and was closed in 1977. Also in 1977, the Bainbridge Disposal Company opened a refuse transfer station at the site, a facility that is still operating.

In 1975 the first of several government agencies became involved with the site's investigation and cleanup. The Washington State Department of Ecology sampled surface water and leachate between 1975

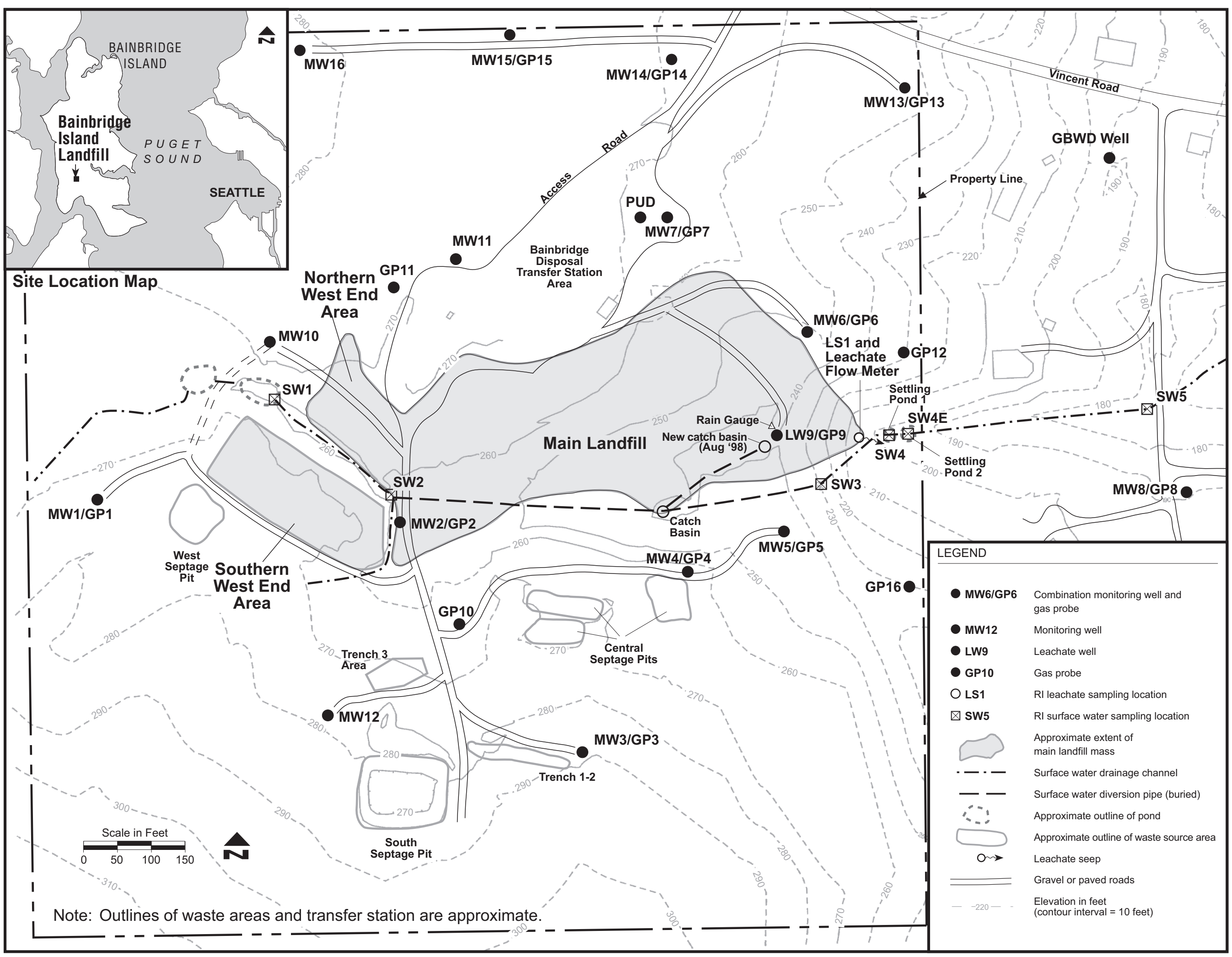


Figure 1. Site Plan

and 1978. In 1986, the U.S. Environmental Protection Agency (EPA) conducted a Site Investigation, sampling several waste sources and environmental media, including domestic water wells, surface water, surface and subsurface soil, and sediment (E&E, 1997). The investigation identified organic contaminants in surface water and leachate, and organic and inorganic contaminants in the septage pits, Trench 3, and the main landfill. Domestic water samples showed no evidence of contamination (E&E, 1987). The Site Investigation report recommended that the material be removed from Trench 3, a groundwater monitoring program implemented, and a leachate collection system installed. Interim measures, such as fencing, were recommended to prevent contact with hazardous materials in Trench 3. In 1989, EPA discontinued its investigation and deferred to Ecology for further action. Based on the report's recommendations, Kitsap County fenced and covered Trench 3, posted warning signs, and implemented a testing program for nearby domestic wells.

Between 1988 and 1994, the Bremerton-Kitsap County Health District collected samples from domestic wells near the landfill and sampled surface water, leachate, and septage pit sludge from the site (Bremerton-Kitsap County Health District, 1988 and 1992). The samples from the drinking water wells, surface water, and leachate were in compliance with state primary drinking water standards. The metal content of the sludge was found to be similar to typical septage, and viral assays were negative.

In 1990 Ecology became the lead regulatory agency for managing the site, and in 1992 ranked the site as a level one waste site under MTCA. Also in 1992, Kitsap County performed an independent remedial action under MTCA on Trench 3 by removing approximately 475 tons of sludge. The waste was stabilized and removed from the site, as was an additional 930 tons of contaminated soil (Golder Associates, 1993).

Kitsap County began the remedial investigation / feasibility study to clean up the landfill in 1996. The remedial investigation was completed in August 1999. The FS was completed in May 2000.

Environmental Setting

The region surrounding the landfill site is of moderate topography and slopes generally to the northeast from a 400-foot-high hill southwest of the site. The site occupies an east-trending ravine, a natural depression into which refuse was placed, surrounded by rolling uplands. Above the banks of the ravine, septage disposal pits were dug in the gentler upland slopes. The north, southeast and southwest portions of the site remain relatively undisturbed and are covered with second-growth forest.

Stormwater drainage from the site flows east to a large lowland about ½ mile east of the site. Rainfall data and surface water monitoring indicate that surface water only flows after major storms, and that it drains quickly. Sediment in the stormwater drainage consists dominantly of fine to coarse sand and fine gravel derived from local soils.

Bainbridge Island has a marine climate dominated by cool, moist winds that move east to northeast off the Pacific Ocean. This pattern results in typically warm, dry summers and cool, wet winters. The average total annual precipitation is 50 inches, of which 80 percent falls between October and March. A year of rainfall monitoring at the leachate monitoring well LW9 (Figure 1) from November 1998 through November 1999 recorded 52 inches of rain at the site (CH2M HILL, 2000a).

Land use in the vicinity consists primarily of single-family residential homes, with a small number of commercial and industrial operations within a 3-mile radius. The site is surrounded by low-density residential property, an undeveloped park, undeveloped and recently logged private property, rural residential land, and a tree farm.

Geology and Hydrogeology

The majority of Bainbridge Island is covered by up to 1,600 feet of glacial drift and interglacial sediments deposited beginning approximately 13,000 years ago (USGS, 1988). The unconsolidated glacial deposits consist of recessional outwash, glacial till, and advance outwash of the Vashon glaciation, underlain by older Quaternary glacial and interglacial sediments (see RI Report Figure 4-1). Groundwater occurs in aquifers in the unconsolidated glacial deposits. These water-bearing units consist of permeable, granular materials deposited by glacial processes. The aquifers are separated by aquitards of low-permeability lacustrine silt and clay deposited between glacial periods (USGS, 1988; Kitsap County, 1989).

Groundwater conditions and aquifer characteristics at the site and vicinity were investigated by constructing, monitoring, and hydraulically testing 18 monitoring wells. Two nearby pre-existing water wells also were monitored: the Public Utilities District (PUD) well and the Gamble Bay Water District (GBWD) well. Additional information was obtained by reviewing available logs of water supply wells in the area. Three aquifers were delineated beneath the site and surrounding vicinity: the upper, lower, and perched aquifers. These aquifers are separated by two low-permeability geologic units that act as aquitards and limit flow between the aquifers.

Upper Aquifer

The upper aquifer is the primary aquifer beneath the site and is the first aquifer encountered directly beneath the main landfill and all of the other waste sources on the site (Figure 2). The upper aquifer occurs in Unit 1, an advance outwash sand, which consists of a uniform brownish gray fine sand with minor silt, extending from the surface to a maximum depth of about 185 feet. The GBWD well and all of the monitoring wells installed during the RI were used to monitor this aquifer. Groundwater in the upper aquifer is unconfined, and the water table is between 120 and 155 feet below the ground surface of the site. The depth to groundwater is at least 60 feet below the base of the main landfill and over 119 feet below the base of Trench 3.

Groundwater elevations in the upper aquifer range from about 128 to 138 feet above sea level. Groundwater generally flows from south to north across the site, as shown in Figure 3, a recent groundwater elevation contour map (March 1999). The groundwater flow velocity in the upper aquifer is about 0.5 foot per day.

Lower Aquifer and Aquitards

The lower aquifer is confined and occurs in a thin pre-Vashon sand unit, Unit 3. The potentiometric surface of the lower aquifer is about 60 feet above sea level. The direction and velocity of groundwater flow are unknown. The lower aquifer is separated from the upper aquifer by the aquitard Unit 2, which is a stiff bluish to dark gray silt with variable amounts of sand and clay. This unit is an interglacial lacustrine deposit about 145 feet thick with very low vertical hydraulic conductivities, ranging from $2x10^{-6}$ to $2x10^{-8}$ centimeters per second. Another interglacial lacustrine silt / clay aquitard, Unit 4, underlies the lower aquifer.

The vertical gradient between the upper and lower aquifers was calculated to be 0.47, down. Although groundwater from the upper aquifer may be a minor source of recharge for the lower aquifer because the vertical gradient between the two is down, it would take the water over 875 years to travel the 150 feet between the two aquifers.

Perched Aquifer

The perched aquifer, extending west and north from the northwest corner of the site, is contained in a highly permeable sand and gravel of Unit 1a,

Mechanisms of Groundwater Contaminant Transport

1. Leachate generated by precipitation and surface water percolating through landfill during rainy season. Leachate migrates down to water table.
2. Landfill gas migrates in vadose zone. VOCs from landfill gas enter groundwater and/or percolating leachate.
3. Leachate-enriched groundwater flows generally north at 0.5 ft per day.
4. Contaminant concentrations reduced by dispersion, sorption, degradation, and dilution.
5. Potential receptors use groundwater (upper aquifer domestic water supply).

Note: For cross-sections and descriptions of geologic units, refer to the RI Report.

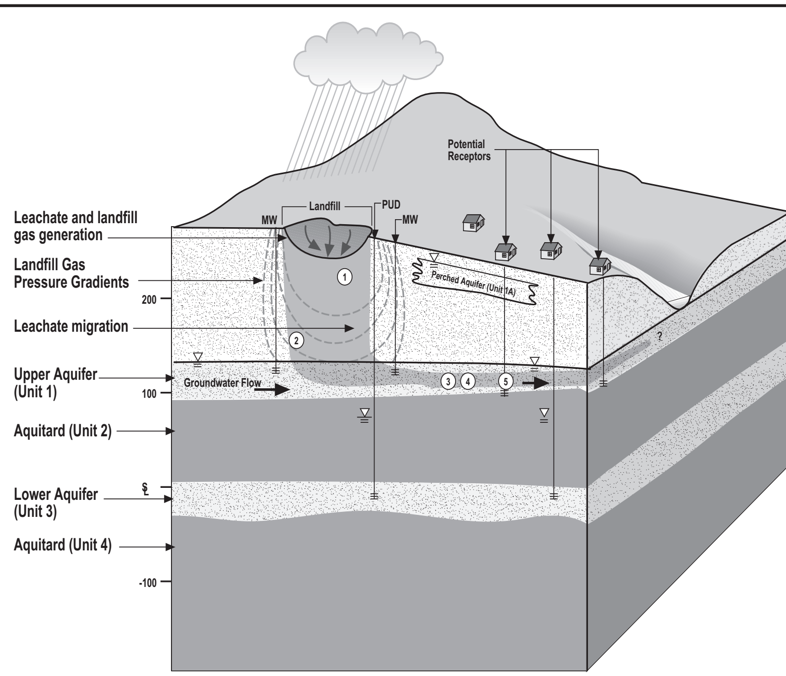


Figure 2. Conceptual Site Model: Groundwater Contamination

a 10- to 50-foot-thick layer of dense silty sand with gravel that overlies the outwash sand of Unit 1. The permeability contrast between this aquifer and the relatively less-permeable Unit 1 inhibits downward flow of water, creating the perched aquifer approximately 100 feet above and hydraulically isolated from the upper aquifer (Figure 2). For this reason, the perched aquifer was not monitored. The extent of this aquifer is unknown, and it may actually consist of two or more discrete permeable lenses within a lower-permeability surrounding matrix. Several domestic wells located northwest of the landfill are installed in the perched aquifer.

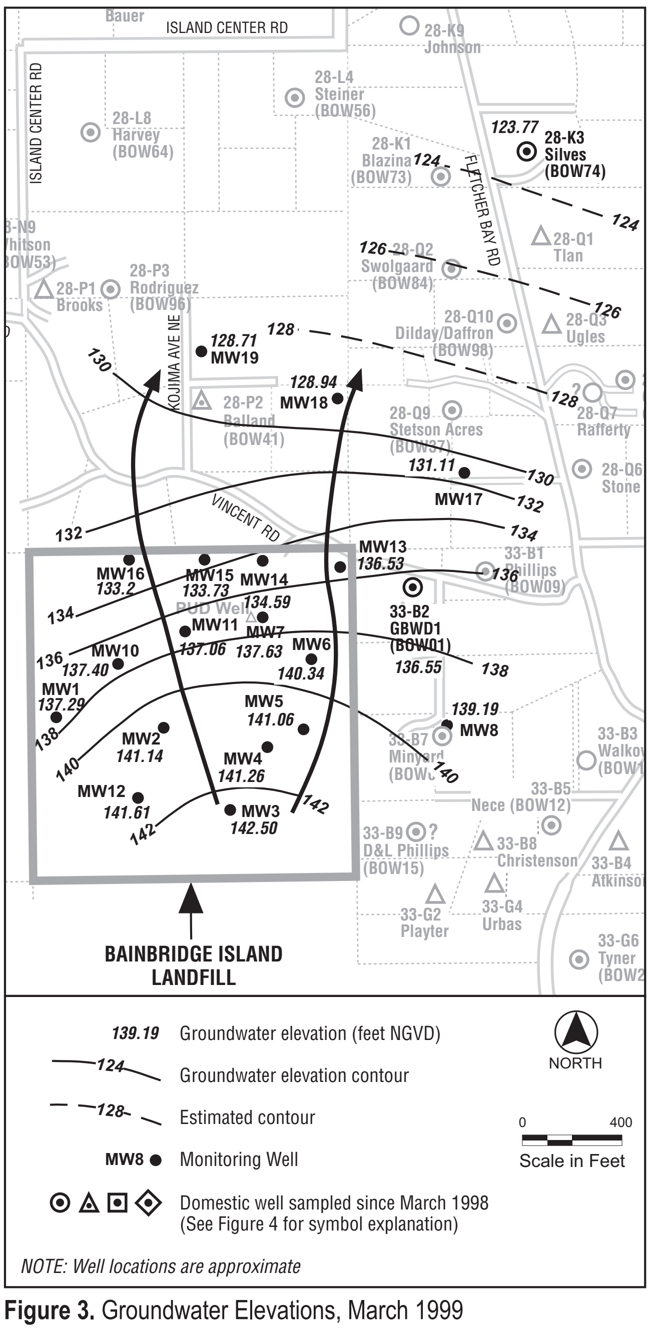


Figure 3. Groundwater Elevations, March 1999

Remedial Investigation Summary

The remedial investigation at the Bainbridge Island Landfill was conducted between March 1996 and August 1999, and focused on gathering data that would support a conceptual model for the site and the feasibility study of remedial options. The nature and extent of the chemical contamination and the physical properties of the contaminated media were determined for the landfill waste sources, including landfill gas and leachate, and all environmental media: soil, sediment, air, surface water, and groundwater. A domestic well inventory was performed, and water from nearby domestic water-supply wells was sampled.

A summary of sampling events and numbers of samples taken during the RI is presented in Table 1. Contaminant screening levels were developed for soil, sediment, surface water, and groundwater for comparison to concentrations detected in RI samples. Screening levels included the most stringent applicable, relevant, and appropriate regulations (ARARs) developed in the Work Plan, and were updated for revised regulations and additional requirements from Ecology. These screening levels were used to identify contaminants of potential concern at the site, and were developed into cleanup levels for the remedial action (see discussion of the FS, below). The actions and findings of the RI are summarized below. Table 2 compiles the contaminants of concern at the site and their cleanup levels.

Waste Sources

Three principal waste sources were investigated: 1) the main landfill and west end area, 2) the septage pits and Trench 1-2, and 3) Trench 3. These have been evaluated by test pits and soil borings, by surveying their boundaries, and by sampling and analysis. Secondary waste sources investigated include landfill gas and leachate. The results of each waste source investigation are summarized below.

Main Landfill and West End Area

The main landfill and west end area cover roughly 4 acres in the center of the landfill property and received most of the waste disposed at the landfill (Figure 1). The extent of the main landfill and west end area was defined by test pit explorations. Based on the test pit results, the west end area was divided into northern and southern subareas distinguished

Table 1. Remedial Investigation Sampling Schedule – All Samples Taken, March 1996 through August 1999

	1996										1997												1998												1999							
	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A
Waste Sources																																										
MLF/WEA waste		6																																								
MLF cover soil																														1												11
MLF/WEA inert fraction[a]																																										10
MLF/WEA refuse fraction[b]																																										8
Septage Pits, Trench 1-2		19																												16[c]												
Soil																																										
MLF base soil																																										10
Trench 3 base soil	8	8																																								
Sediment																																										
		8																																								
Landfill Gas																																										
Monitoring				10	10	22[d]		11	11	11	11	11	11	14	14	14				14	20	20						20			20			20			20					
VOC sampling					2	1																																				
Gas Probe Installation Dates																																										
GP01-07, 09-11	✓																																									
GP08					✓																																					
GP13-15													✓																													
GP12, 16[e]																						✓																				
Leachate																																										
Seep		1								1												1			1									1			1					
Well											1																															
Surface Water																																										
		4									5		4									5			3									5								
Groundwater																																										
Monitoring Wells				8	1	3	11	1		12			12	4		16			16			16			16			16			19			18			9			9		
Domestic Wells		6					15	4	1	1			1	17		18			17			19		6	21			22			13			12			13			13		
Monitoring Well Installation Dates																																										
MW01-07	✓																																									
MW08, 10-12					✓																																					
MW13-16													✓																													
MW17-19																															✓											
Report Periods																																										
RI Report	■	■	■	■	■	■	■	■	■	■	■	■	■	■																												
Supplement 1															■	■	■	■	■	■	■	■	■	■																		
Supplement 2																									■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■

Notes:

MLF/WEA = main landfill and west end area

✓ = Installation date of gas probe or monitoring well

[a] Inert fraction also referred to in Supplement 2 as "inert soil"

[b] Refuse fraction referred to in Supplement 2 as "garbage fraction" and "garbage soil"

[c] TCLP and fish bioassay analyses

[d] Gas probes monitored on August 3 and 29, 1996

[e] GP12 and 16 are multi-level probes with shallow, intermediate, and deep monitoring levels

by different physical and chemical characteristics. Beneath the main landfill, the native soil is outwash sand and silt of Unit 1, and native soil under the northern west end area is sand and gravel till of Unit 1a.

Waste in the main landfill and west end area was characterized physically and chemically in the EPA Site Investigation, the RI Report, and RI Supplement 2 (Table 1). Landfill waste generally consists of domestic and construction waste mixed with soil and ash. The waste fills an east-trending ravine up to approximately 45 feet deep that comprises an estimated total volume of approximately 102,000 cubic yards (cy), including about 3,900 cy in the northern west end area and about 3,100 cy in the southern west end area.

No clear spatial trend was noted in the composition of the main landfill waste that would indicate distinct cells or waste disposal areas. Contamination in the refuse includes low levels of SVOCs, pesticides, PCBs, and metals.

During sampling in August 1999, landfill waste was screened to evaluate the proportions and physical and chemical characteristics of three waste size fractions: the inert fraction (less than 1½ inches), the garbage fraction (1½ to 3 inches), and the bulky fraction (greater than 3 inches). The inert fraction comprises an average of 67 percent by weight of the waste, and consists mainly of soil, gravel, and ash, with small pieces of glass and plastic. SVOCs, pesticides, PCBs, and metals all exceeded the RI soil screening levels

Table 2. Contaminants of Concern and Proposed Cleanup Levels

		Soil					
Parameter Group	**Contaminant**	**Trench 3 Base Soil**	**MLF & WEA (Inert & Cover soil)**	**Septage Pits**	**Sediment**	**Surface Water**	**Groundwater**
VOCs							
	1,4-dichlorobenzene			182 µg/kg			
	1,1-dichloroethene						0.073 µg/L
	vinyl chloride						0.023 µg/L
SVOC							
	benzo(a)anthracene		137 µg/kg	137 µg/kg	137 µg/kg		
	benzo(a)pyrene	137 µg/kg	137 µg/kg	137 µg/kg	137 µg/kg		
	benzo(b)fluoranthene	137 µg/kg	137 µg/kg	137 µg/kg	137 µg/kg		
	benzo(k)fluoranthene		137 µg/kg	137 µg/kg			
	carbazole		50,000 µg/kg				
	chrysene		137 µg/kg	137 µg/kg	137 µg/kg		
	dibenzo(a,h)anthracene		137 µg/kg		137 µg/kg		
	indeno(1,2,3-cd)pyrene	137 µg/kg	137 µg/kg		137 µg/kg		
	naphthalene		32,000 µg/kg				
	pentachlorophenol		8,333 µg/kg				
TPH							
	diesel-range			200,000 µg/kg			
	heavy oil-range			200,000 µg/kg	200,000 µg/kg		
Metals							
	arsenic		7,300 µg/kg	7,300 µg/kg	7,300 µg/kg		
	beryllium				610 µg/kg		
	cadmium			40,000 µg/kg			
	chromium		100,000 µg/kg				
	copper		2.96E+6 µg/kg	2.96E+6 µg/kg		1.8 µg/L dissolved	
	iron		5.87E+7 µg/kg		5.87E+7 µg/k	1.0 mg/L total 1.0 µg/L dissolved	
	lead		250,000 µg/kg	250,000 µg/kg		0.3 µg/L dissolved	
	manganese						50 µg/L
	mercury		24,000 µg/kg	24,000 µg/kg			
	selenium		400,000 µg/kg	400,000 µg/kg			
	zinc		2.40E+7 µg/kg	2.40E+7 µg/kg		21 µg/L dissolved	
Pesticides/PCBs							
	4,4'-DDD			4,167 µg/kg			
	Aldrin		59 µg/kg				
	Dieldrin			63 µg/kg			
	Aroclor 1254		1,600 µg/kg	1,600 µg/kg			
	Total PCBs		130 µg/kg	130 µg/kg			
Conventionals							
	alkalinity					20 mg/L	
	conductivity (indicator)						indicator [a]
	dissolved oxygen					> 9.5 mg/L	
	fecal coliform					< 50 CFU/100 mL	
	nitrate (and nitrite + nitrate)						
	pH (indicator)						indicator [a]
	total coliform					< 50 CFU/100 mL	
	turbidity					5.0 NTU	

[a] Secondary drinking water standard for conductivity is 700 umhos/cm; for pH, 6.5-8.5

MLF = main landfill

WEA = west end area

For source of cleanup level, see associated ARARs tables in FS Report Appendix B.

in the inert fraction. The garbage fraction comprises an average of 7 percent by weight, consisting of soil mixed with various debris, including paper, glass, plastic, wood, styrofoam, metal, and unidentifiable materials. Analyses showed that SVOCs, pesticides, PCBs, and metals exceeded the RI soil screening levels. Additional analyses (TCLP metals and TCLP SVOCs) showed no exceedances of state dangerous waste maximum contaminant concentrations. The bulky waste fraction is an average of 26 percent of the waste, comprising concrete, lumber, wood, appliances, scrap metal, construction debris, and other large waste. This waste fraction was not chemically analyzed.

Septage Pits and Trench 1-2

Five septage pits were disposal sites for septic tank waste consisting of liquid-solid sludge (Figure 1). Trench 1-2 is an indistinct feature just northeast of the south septage pit that was excavated but did not receive waste (R. Hanson, 1995). Two previous investigations, by Ecology between 1975 and 1978, and the 1986 EPA Site Investigation, sampled the south septage pit. Remedial investigation work investigated the south septage pit, four other septage pits, and Trench 1-2, which had not been sampled previously. The septage pit and Trench 1-2 sampling events are shown in Table 1.

The waste material in the septage pits consists of homogeneous dark brown soft moist organic silt with fine sand and small amounts of plastic and glass. The estimated volume of the five septage pits is about 1,500 cy. No physical or chemical evidence of contamination was found in Trench 1-2, so no waste volume was calculated.

Chemical analyses of septage pit samples taken in April 1996 showed that VOCs, SVOCs, pesticides, total PCBs, TPH, and metals exceeded RI soil screening levels. Additional samples were taken in April 1998 for state dangerous waste designation including TCLP metals analyses and fish toxicity analysis. No metals exceeded TCLP maximum concentration of contaminants values, and the samples did not exhibit fish toxicity; therefore, the sludge would not be designated hazardous or state dangerous waste.

Trench 3

Trench 3 was located between the south septage pit and the main landfill (Figure 1) and was the disposal site for liquid wood-preserving waste from the Wyckoff Company. It was located and sampled during the 1986 EPA Site Investigation and was remediated by Kitsap County in 1992. All of the waste and contaminated soil to a depth of 15 feet below ground surface (bgs) was removed in 1992 and disposed at a hazardous waste landfill in Arlington, Oregon. Soil below the Trench 3 area was further investigated during the RI (see below).

Soil

Soils investigated during the RI included landfill cover soil and the base soil beneath the landfill and below Trench 3 (Table 1). One sample of background soil was taken during the EPA Site Investigation.

Landfill Cover Soil

The waste in the main landfill and west end area is overlain by a layer of site-derived sandy soil. It ranges from less than 1 foot to about 15 feet thick, and is generally thicker over the east end of the main landfill. Its total volume over all landfill areas is estimated to be 16,410 cy. Landfill cover soil at the site generally has little or no contamination: RI and historical samples revealed that only SVOCs and metals exceeded the RI soil screening levels, and no PCBs were detected. One pesticide, Aldrin, was detected in samples from the 1986 EPA Site Investigation, but no pesticides were detected in the RI samples. One area of cover soil at the east end of the main landfill has a discrete layer of creosote-like contamination and is referred to as the cover soil “hotspot” area. The hotspot area soil has relatively high concentrations of petroleum hydrocarbons, PAHs, pentachlorophenol, and metals. Results of TCLP testing showed that the soil is not a federal hazardous waste. The soil is a state-only dangerous waste (based on persistence criteria, designation WP02). The hotspot area comprises about 1,125 cubic yards of the total landfill cover volume.

Base Soil

Soil below the main landfill, west end area, and Trench 3 was investigated. Historical and RI data show that low concentrations of VOCs, SVOCs, and metals (arsenic, beryllium, iron, lead, manganese, nickel, and vanadium) exceeded RI soil screening levels in base soil below the main landfill and west end area. Soil at 15 feet bgs in the Trench 3 area exceeded screening levels for PAHs and metals, but deeper samples (down to 90 feet bgs) showed only metals exceeding screening levels. As discussed in a fate and transport analysis in the RI Report (Section 8.1.1), this indicates that natural site background soil concentrations for some metals exceed RI screening levels.

Sediment

The sediment in the surface water drainage system was sampled during both the RI and the EPA Site Investigation (Table 1). SVOCs, heavy-oil-range hydrocarbons, and the metals arsenic, beryllium, and zinc were detected above RI sediment screening levels. (Note that RI sediment screening levels were the same as RI soil screening levels.)

Landfill Gas and Air Quality

The RI data showed that although the landfill is still producing landfill gas, it does not migrate far into the surrounding sandy soil before it dissipates into the atmosphere. Landfill gas was monitored at 15 gas probes installed in the soil surrounding the landfill and one probe installed in the waste (Table 1). Monitoring measured pressure and the relative amounts of methane, carbon dioxide, oxygen, hydrogen sulfide, and nitrogen. Methane was consistently high in the gas probe installed in the waste, reaching up to 80 percent by volume, which is above the typical landfill value of 55 percent. At times, low levels of methane were detected in probes directly adjacent to the landfill; however, methane and other gases measured in probes outside the landfill generally indicated the presence of air at atmospheric conditions, with very little or no impact from landfill gas. Methane was never detected at probes located on the property boundaries. Gas samples obtained from three probes were analyzed for VOCs. Sixteen VOCs were detected in the sample from the probe installed in the waste, typical for landfill gas. Lower levels of the same VOCs were detected in two probes outside the waste.

Air quality was evaluated by using USEPA's model of methane and non-methane organic compound (NMOC) emissions to determine whether emissions from landfill gas would exceed federal air quality standards. The model incorporated the results of a Tier 1 decay analysis to estimate potential emissions, and used measured concentrations of onsite landfill gas. Modeling results showed that the maximum total NMOC emissions would be about 20 tons per year, occurring in 1976, well below the threshold of 162 tons per year requiring a NMOC investigation. The potential for specific toxic air contaminants (TACs) to migrate offsite was also modeled, using measured VOC concentrations in landfill gas as input. According to the modeling results, no TACs were expected to exceed their respective acceptable source impact levels (ASILs) or MTCA Method B cleanup standards at the property boundaries.

Leachate

Landfill leachate, produced by rainwater percolating through refuse, emanates from a surface seep at the toe of the main landfill (Figure 1) and joins the surface water drainage. Leachate was observed to flow intermittently during the RI, and flow was directly linked to rainfall events. Six leachate samples were taken during the RI, and one sample was obtained from the leachate well installed in the main landfill (Table 1). Sample results indicated that VOCs, TPH, and metals in leachate exceeded the RI surface water screening levels. In the 1996 and January 1997 samples, SVOCs exceeded RI screening levels, but had dropped far below RI screening levels in the 1998 and 1999 samples. The conventional parameters alkalinity, fecal coliform, turbidity, dissolved oxygen, and pH either exceeded RI surface water screening levels or did not meet Washington State Class A surface water criteria.

Surface Water

Surface water was monitored each quarter during the RI and sampled at stations upstream and downstream of the main landfill (Figure 1, Table 1). Two surface water sample stations were downstream of the leachate seep. Apart from one SVOC (bis(2-ethylhexyl)phthalate) detected in one sample, the only parameters that exceeded RI surface water screening levels were metals, including arsenic, iron, manganese, copper, zinc, and lead. The conventional parameters alkalinity, pH, dissolved oxygen, total coliform, and turbidity either exceeded or were outside the range specified by the RI surface water screening levels.

Groundwater

Groundwater Monitoring

Groundwater was characterized beneath the site and downgradient offsite. Fifteen monitoring wells were installed in the upper aquifer in 1996 and 1997, and three were installed in 1998 (Figure 1). These 18 wells were monitored for groundwater elevations and were sampled during 16 quarterly monitoring events between 1996 and 1999 (Table 1). One existing well completed in the lower aquifer was also monitored, the Public Utilities District (PUD) well.

All monitoring wells were sampled for a comprehensive list of contaminants for the first four quarters after installation. Subsequent groundwater monitoring focused on the constituents that exceeded RI screening levels: VOCs and landfill indicator parameters. Groundwater elevation measurements showed that the gradient and flow direction were consistent throughout the 3-year monitoring period, flowing generally north and with a slightly radial pattern away from the main landfill (Figure 3).

Domestic Well Inventory and Sampling

A domestic well inventory was performed in order to identify water-supply wells within a 1-mile radius of the site that may have been affected by the landfill. Well records on file with Ecology and the Bremerton-Kitsap County Health District were examined, and a door-to-door survey was conducted in April and July 1996. To characterize the quality of drinking water from these domestic wells, between 17 and 23 wells were sampled between April 1996 and June 1999 (see Figure 4 and Table 1; for further details see monitoring and analytical schedules in the RI Report and RI Supplements 1 and 2.) Monitoring at one domestic well and the GBWD well continued after June 1999.

Vinyl chloride and bis(2-ethylhexyl)phthalate were consistently above RI screening levels in one or more domestic wells. The metals arsenic, iron, lead, manganese, copper, and zinc were above RI screening levels in one or more domestic wells, as were the conventional parameters alkalinity, conductivity, pH, total coliform, and turbidity. The RI data evaluation showed that only vinyl chloride, alkalinity, conductivity, and pH in domestic wells may result from landfill impacts to groundwater. Although some parameters detected in the domestic wells were above RI screening levels, they were all below federal and state drinking water standards (MCLs).

Extent of Groundwater Contamination

A set of indicator parameters was found to define an area of landfill-affected groundwater that extends downgradient from the main landfill. These parameters included Freon 12, alkalinity, pH, chloride, total dissolved solids, dissolved oxygen, and conductivity. A series of maps presented in RI Supplements 1 and 2 clearly shows the affected area, although its exact shape varies with time and / or parameter. Domestic wells in the affected area show some evidence of groundwater contamination, including one well, BOW37, that has vinyl chloride concentrations consistently exceeding the MTCA Method B cleanup level of 0.023 micrograms per liter (µg / L), but well below the state drinking water standard of 2 µg / L.

Nature and Extent of Contamination

The only waste source on site that was found to contain hazardous waste, Trench 3, was completely removed from the site in 1992. The RI data show that Trench 3 did not affect soil greater than about 15 feet below the ground surface. Other waste sources have been shown to contain low levels of contaminants typical of domestic waste, including SVOCs, pesticides, PCBs, total petroleum hydrocarbons, and metals.

Landfill gas and leachate generated by the landfill contain very low levels of contaminants such as VOCs and metals, but less than is typical for domestic waste landfills. Surface water, sediment, and soil beneath waste sources show low-level contamination, including VOCs, SVOCs, heavy oil-range hydrocarbons, and metals.

The primary medium of concern at the site is groundwater, which is used as an offsite domestic drinking water source. Low levels of VOCs in the groundwater probably originate from the landfill, as shown by distribution of the indicator parameters. A specific VOC source has not been identified in the main landfill or west end area. Therefore, the feasibility study focused on controlling all the waste sources to enable remediation of the groundwater.

Feasibility Study

Following completion of the remedial investigation, a feasibility study was undertaken to develop a remedial action for the Bainbridge Island Landfill site. The first step in the feasibility study was to identify regulations that apply to the site and use them to develop cleanup levels. Next, general remedial approaches and specific technologies were identified and screened to eliminate those that were not appropriate. The technologies that remained were then evaluated in terms of effectiveness, implementability, and cost. Technologies that were found to be most appropriate for the site were combined into remedial alternatives, which were in turn evaluated and compared with each other to arrive at a preferred alternative. The feasibility study is summarized below.

Cleanup Levels, Points of Compliance, and Remedial Action Objectives

Development of MTCA Cleanup Levels

Cleanup levels for the Bainbridge Island Landfill were developed in accordance with MTCA requirements by identifying which contaminants must be remediated (contaminants of concern, or COCs), their remediation or cleanup levels, and their points of compliance (onsite locations where cleanup levels must be met).

The first step in developing cleanup levels was to conduct a comprehensive analysis of all applicable, relevant, and appropriate requirements (ARARs) by researching all regulations that might apply to the site. An ARAR is either chemical-specific, action-specific, or location-specific. Chemical-specific ARARs identify health or risk-based cleanup limits for specific hazardous substances. Location-specific ARARs depend on the location of hazardous substances, and action-specific ARARs depend on the specific activities involved in the remedial action. In general, chemical- and location-specific ARARs are used to establish remedial action objectives (RAOs) and action-specific ARARs help to determine how the remedial action will be performed. A summary of the chemical-, action-, and location-specific ARARs for the Bainbridge Island Landfill site is presented in Table 3. The result of the ARARs analysis was the selection of the most

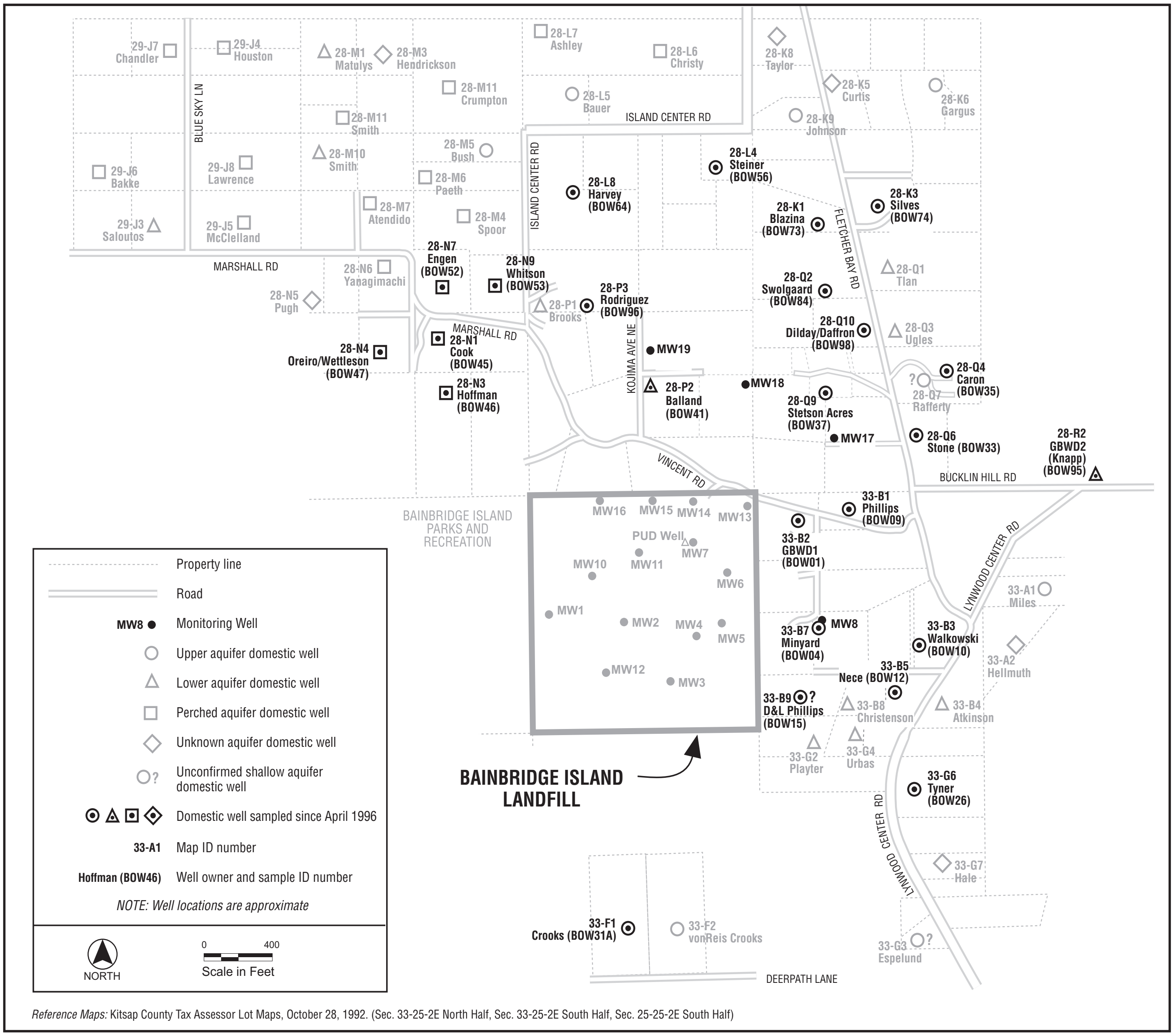


Figure 4. Offsite Wells Sampled During RI

stringent ARAR, or MSA, for each parameter in each environmental medium: soil, sediment, air, surface water, and groundwater.

Contaminants of potential concern (COPCs) were identified during the RI, and a final list of COPCs was developed by comparing the concentration of each detected parameter to the most stringent ARAR (MSA) for each parameter in each environmental medium. Each COPC was then evaluated, taking into account the site-specific physical characteristics of each environmental medium that would affect the fate and transport of contaminants from sources to potential receptors. This evaluation produced the final list of COCs, and cleanup levels were identified for these parameters. Generally, the most stringent ARAR (MSA) for each parameter in each medium became the cleanup level. In certain cases, the cleanup level was not the MSA. For example, Ecology has determined that certain metals in Washington State soils (e.g., arsenic, beryllium, iron) have natural background concentrations that are higher than the MSAs. For these metals the cleanup level is the natural background concentration. Cleanup levels for the COCs in each medium are presented in Table 2.

Points of Compliance

Points of compliance are the physical locations where cleanup levels must be achieved. Like COCs and cleanup levels, points of compliance are media-specific. Points of compliance for the Bainbridge Island Landfill site are as follows.

Soil and Sediment

- From 0 to 15 feet below the ground surface for protection of human health and the environment (WAC 173-340-740(6)(c))
- At any depth on the site for volatile organic constituents for protection of groundwater (WAC 173-340-740-(6)(b))

Surface Water

The point of compliance for surface water is the point at which hazardous substances are released to waters of the state. After the remedial action is complete, hazardous substance discharges to surface water will be eliminated. The point of compliance will be at the east end of the site, east of the main landfill mass near the property boundary, in the vicinity of surface water monitoring station SW4 (Figure 1). If an engineered surface water collection system is constructed for the remedial action, then surface water will be monitored at the point where the discharge enters the natural stormwater flow.

Groundwater

The point of compliance for upper aquifer groundwater is the northern property boundary. Monitoring wells MW13, MW14, and MW15, located on the northern property boundary (Figure 1), are downgradient of the landfill and would be used to monitor the point of compliance for groundwater.

Remedial Action Objectives

Remedial action objectives (RAOs) are specific goals for protecting human health and the environment that also define a framework for developing and evaluating remedial actions. The primary remedial action objective is to meet the MTCA cleanup requirements, which are partly defined by the cleanup levels and points of compliance. The following RAOs have been identified based on the nature and extent of contamination defined by the remedial investigation:

- Protect the use of the upper aquifer as a drinking water source
- Prevent or minimize future releases of COCs from the waste sources to surface water and direct contact with humans or wildlife
- Reduce concentrations of COCs in soil, surface water, sediment, and groundwater to acceptable and appropriate cleanup levels
- Maximize permanence of the remedial action

Development of Remedial Action Alternatives

Screening and Evaluation of Technologies

In order to focus the FS, general remedial approaches and technologies were screened to identify those that are most appropriate for the site. The general approaches that were determined as potentially feasible and were analyzed as alternative technologies in the FS were waste consolidation and containment, waste reclamation, and onsite groundwater remediation, including natural attenuation. A No Action alternative was not evaluated. Table 4 summarizes the technologies that were evaluated, and lists the technologies that were retained. These retained technologies were combined into the three remedial action alternatives described below.

Remedial Action Alternatives

The technologies that were retained for further consideration were combined into the following three cleanup action alternatives and carried forward for more detailed evaluation.

Alternative 1—Waste Consolidation and Containment with Monitoring, Institutional Controls, and Monitored Natural Attenuation of Groundwater

- Excavate waste, sediment, septage pit residue, and soil, and consolidate them on the main landfill
- Fill excavated areas, regrade and reseed the site
- Install a five-layer cap with a 40-mil linear low density polyethylene barrier layer
- Install a passive landfill gas venting system
- Install a surface water diversion and detention system
- Monitor natural attenuation in groundwater
- Monitor surface water and landfill gas for compliance with cleanup levels
- Establish institutional controls including installation of fencing to control access to the site, zoning, and deed restrictions to protect the final cover system

Surface water control facilities would include ditches upstream from the landfill and around the final cover area; a lined ditch along the south side of the main landfill; a detention pond on the southeast side of the main landfill; a controlled outlet and discharge

Table 3. Summary of Applicable, Relevant, and Appropriate Requirements (ARARs)

ARARs	Comments
Chemical-Specific ARARs	
WAC 173-340 Washington Model Toxics Control Act	
WAC 173-304-460 Washington State Minimal Functional Standards for Landfills	
Natural Background Soil Metals in the Puget Sound	Ecology Pub. #94-115
Puget Sound Clean Air Agency Regulations I and III	
WAC 173-201A Washington Water Quality Standards for Fresh Water, Chronic (FWC ST) and Acute (FWA ST)	
40 CFR 131 Federal Water Quality Criteria for Surface Water, Fresh Water, Chronic (FWC FED) and Acute (FWA ST)	
40 CFR 141 and 142 Federal Maximum and Secondary Contaminant Level (MCL)	
WAC 246-290 Washington State Primary and Secondary MCLs	
Location-Specific ARARs	
40 CFR 6.302 (g) Fish and Wildlife Coordination Act	Applicable, but not likely to be triggered
Bainbridge Island Municipal Code Ordinance 98-20 City of Bainbridge Island Critical Areas Ordinance	Applicable, but not likely to be triggered
Action-Specific ARARs	
40 CFR 6.302 (g) Fish and Wildlife Coordination Act (16 USC 661 et seq.)	Applicable, but not likely to be triggered
WAC 173-303 State Dangerous Waste Regulations	
WAC 173-304 Minimal Functional Standards for Landfills	
WAC 197-11 SEPA	Ecology Policy 130A addresses coordination of MTCA and SEPA
WAC 173-160-171(a)(iii) Minimum Standards for Well Construction	Application for permit to install a water supply well within 1,000 feet of landfill; monitoring well construction and abandonment requirements
WAC 296-62 Occupational Health Standards for Workers on Hazardous Waste Sites	
WAC 173-340-410 Compliance Monitoring Plan Requirements	
WAC 173-226 State Waste Discharge General Permit Program	
WAC 173-304-460 State Minimal Functional Standards for Landfill	
Bremerton-Kitsap County Health District Ordinance 1996-11	Landfill gas monitoring in nearby structures
WAC 173-240 Submittal of plans and reports for construction of wastewater treatment facilities	Only required if active groundwater remediation is constructed

pipe from the detention pond; and a riprap / energy dissipater at the outlet of the discharge pipe. Monitoring of groundwater, surface water, subsurface landfill gas, and landfill gas vent emissions would include contingencies for conversion to active landfill gas extraction and active groundwater remediation if cleanup levels are not met.

Alternative 2—Waste Reclamation with a Soil Cap, Monitoring, Institutional Controls, and Monitored Natural Attenuation of Groundwater

- Excavate all waste, screen main landfill and west end area waste, and regrade the site with the inert waste fraction (including landfill cover soil outside hotspot area)
- Dispose the bulky waste fraction offsite
- Dispose the garbage fraction offsite
- Dispose offsite the septage pit waste, sediment, and main landfill cover soil hotspot
- Construct a minimum 2-foot-thick, site-derived soil cap on the inert fraction
- Restore the site drainage and reestablish site vegetation
- Monitor natural attenuation in groundwater
- Monitor surface water for compliance with cleanup levels
- Establish institutional controls, including installation of fencing to control access, zoning, and deed restrictions to protect the final cover system

Included in the compliance monitoring plan would be a contingency to install active groundwater remediation if cleanup levels are not met with monitored natural attenuation.

Alternative 3—Waste Reclamation with an Impermeable Cap, Monitoring, Institutional Controls, and Monitored Natural Attenuation of Groundwater

This alternative was the same as Alternative 2 except that the cap over the inert materials would consist of a combination soil and impermeable geomembrane layer.

Selection of the Preferred Remedial Alternative

Evaluation of Remedial Action Alternatives

The goal of the feasibility study was to identify a preferred remedial action alternative that meets MTCA requirements and site-specific remedial action objectives. The preferred remedial action was chosen in two steps: first, all three alternatives were evaluated relative to a set of nine evaluation criteria, which included criteria required by MTCA. The three alternatives all scored similarly relative to these criteria, so a second evaluation step was added, decision analysis, which incorporated additional evaluation criteria. The evaluation process and results are described below.

MTCA Evaluation of Alternatives

A set of nine objective evaluation criteria was developed from RAOs and MTCA requirements to comparatively evaluate the three alternatives. MTCA requirements include threshold criteria (WAC 173-340-360) and other criteria (WAC 173-340-360(3)(c)). These criteria were:

1. Overall protectiveness of human health and the environment
2. Attainment of cleanup levels and compliance with ARARs
3. Short-term effectiveness
4. Long-term effectiveness
5. Reduction in toxicity / mobility / volume through treatment
6. Implementability
7. Cost
8. Community concerns
9. Degree to which recycling / reuse / waste minimization are used

With the exception of community concerns (which will be addressed during the RI / FS public review and comment period), each of the proposed cleanup alternatives is evaluated below in terms of these criteria.

All three of the alternatives met the first two MTCA threshold criteria: protectiveness of human health and the environment, and attainment of cleanup levels (compliance with ARARs). Alternatives were assessed either qualitatively or quantitatively against the six remaining criteria, and compared to each other by scoring each alternative on a scale of 1 to 5 for each criterion. A high score corresponded to the preferred outcome for each criterion, and a low score corresponded to the least preferred outcome. The higher an alternative's aggregate score, the closer that alternative is to meeting all criteria. Table 5 compares the scores of the alternatives for the six other MTCA criteria.

As shown in Table 5, all three of the alternatives met most of the MTCA criteria. The scores are similar, and no single alternative emerged as the clear choice. If all of the criteria had equal importance, then these total scores indicate that the alternatives were very close to one another at meeting the criteria. However, in order to select the preferred remedial alternative, the rela-

Table 4. Summary of Technologies Considered in the FS

	Accepted	Rejected	Reason for Rejection
Institutional Controls			
Access restriction	●		
Site use restriction	●		
Controls on development (restrictive deed covenants)	●		
Alternative water supplies		●	Possible future action
Monitoring			
Groundwater	●		
Surface water	●		
Landfill gas (capping only)	●		
Engineered systems	●		
Waste Source Control			
Capping	●		
Excavation and grading	●		
Final cover system	●		
Reclamation	●		
Excavation, grading, and size screening	●		
Offsite disposal (bulky and garbage fractions)	●		
Composting (garbage fraction)		●	Unknown effectiveness for metals, VOCs, and SVOCs; cost
Soil washing (inert fraction)		●	High cost, extensive testing, disposal of contaminated residuals
Bioremediation (inert fraction)		●	Low effectiveness, erratic implementability, high cost
Impermeable cap (inert fraction)	●		
Permeable soil cap (inert fraction)	●		
Landfill Gas			
Passive venting system (capping only)			
Active venting system		●	Cost, same effectiveness as passive venting
Soil			
Excavation and consolidation (capping)	●		
Excavation and combining with inert fraction (reclamation)	●		
Offsite disposal (reclamation)	●		
Sediment			
Same technologies as soil			
Leachate			
All technologies		●	Both capping and reclamation will remove source of leachate
Surface Water			
Diversion and detention (capping)	●		
Restore surface drainage (reclamation)	●		
Erosion control (reclamation)	●		
Groundwater			
Onsite Groundwater			
Monitored natural attenuation	●		
Institutional controls	●		
Trench technologies		●	Unsuitable geology, deep groundwater levels
Pump and air strip with discharge to atmosphere		●	High cost, uncertain effectiveness
Aerobic biological stimulation		●	Moderate to high cost, uncertain effectiveness
Air sparging		●	Uncertain effectiveness
In-well stripping		●	Uncertain effectiveness
Other ex situ treatment technologies		●	Low effectiveness, difficult implementability
Offsite Groundwater			
Monitored natural attenuation	●		
Engineered remediation (offsite pump and treat)		●	Difficult to implement, high cost

Table 5. Comparitive Evaluation of Alternatives — Scores from MTCA Criteria

Criteria	Alternative 1: Consolidation and Containment	Alternative 2: Reclamation with Permeable Soil Cover	Alternative 3: Reclamation with Impermeable Cover
Short-Term Effectiveness (Score 1-5)	High (5)	Medium-High (4)	Medium-High (4)
Long-Term Effectiveness (1-5)	Medium-High (4)	High (5)	High (5)
Reduce Toxicity/ Mobility/ Volume of Contaminants (1-5)	Low (1)	Medium-High (4)	Medium-High (4)
Implementability (1-5)	High (5)	Medium-High (4)	Medium-High (4)
Cost (5-1)	Medium-Low (4)	Medium-High (2)	High (1)
Recycling/ Reuse/ Waste Minimization (1-5)	Low (1)	Medium-Low (2)	Medium-Low (2)
Community Concerns	To Be Addressed Later	To Be Addressed Later	To Be Addressed Later
Total "Score" (sum of numbers in parentheses)	**20**	**21**	**20**

tive importance of criteria must be determined. For example, if cost is the most important criterion and all others were equal, Alternative 1 would be selected. Because all three alternatives met these MTCA threshold criteria as well as most or all other MTCA criteria, Kitsap County developed an additional set of criteria and used a decision analysis process to distinguish the preferred alternative.

Decision Analysis Evaluation of Alternatives

Kitsap County selected the preferred remedial alternative by applying an analytic decision process. A set of seven new criteria was developed:

1. Net remediation cost to Kitsap County
2. Land value
3. Land use potential
4. Liability
5. Permanence of remedial action
6. Reasonable time frame
7. Additional public concerns

Three of the criteria, cost, permanence, and additional public concerns, are carried over from the other MTCA criteria already evaluated. The cost and permanence criteria were included because of their high importance to Kitsap County and other stakeholders. These criteria were also believed to be good at distinguishing the alternatives. Additional public concerns were partly addressed by anticipating public concerns based on public feedback received on the project over the past several years. In addition, Kitsap County elected to incorporate public input in the decision-making prior to the official RI / FS public comment period. Informal input was solicited from local residents, the City of Bainbridge Island, and the Associated Bainbridge Communities on the decision analysis process, criteria, and weighting during the feasibility study. Respondents ranked permanence and land value, respectively, as their greatest concerns.

The criteria were weighted to reflect their relative importance. In assigning weights, Kitsap County incorporated input from stakeholders, including Kitsap County Public Works staff and managers, the Kitsap County Prosecuting Attorney's and Risk Management offices, the Bremerton-Kitsap County Health District, Ecology, and public interest groups. After the criteria were defined and weights assigned, Alternatives 1 and 2 were again scored against the criteria. (Alternative 3 was not included in the final process because it was the most expensive alternative.) The scores were then "adjusted" based on the weight assigned to each criterion and the aggregate score was compiled. The alternative with the highest aggregate score is preferred.

The decision analysis results were developed using a computer model. Figure 5 shows the final scores for the two alternatives. Model results show that the reclamation alternative, with an aggregate score of 0.65, is preferred over consolidation and containment, which scored a total of 0.45. Results indicate that consolidation and containment (Alternative 1) outperformed reclamation (Alternative 2) on cost, but performed less well on every other criterion. This indicates that Kitsap County is willing to trade off the lower cost of consolidation and containment for the higher performance of reclamation in terms of liability, public concerns, permanence, land use potential, land value, and a reasonable restoration time frame. Kitsap County is willing to invest more of its limited budget in the remedy in order to get more value out of the other criteria. A sensitivity analysis was performed to see if changes in weights would change the preferred alternative. This showed that the model was robust with regard to the assigned weights—only substantial changes in weights would alter the outcome.

Uncertainty in scores also was evaluated, and showed that there is more confidence in the score for consolidation and containment than the score for reclamation. This is because a narrower range of scores was assigned to consolidation and containment, reflecting the fact that it is a more widely used technology for landfill cleanup and there is much more data from capped landfill sites than from reclaimed landfills. However, despite reclamation's higher degree of uncertainty, even the worst expected performance by the reclamation alternative is expected to be better than the best performance by consolidation and containment—the aggregate score for reclamation was always better than consolidation and containment, even after the risk of uncertain outcomes was considered.

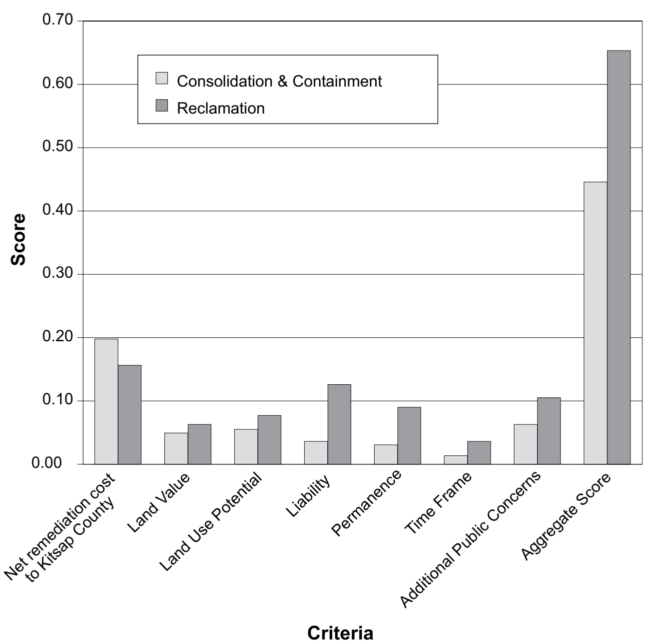


Figure 5. Comparitive Evaluation of Alternatives — Scores from Decision Analysis

Preferred Remedial Alternative

Based on the results of the decision analysis, Alternative 2, reclamation with a permeable soil cover, is the preferred remedial alternative. Construction of the remedial action is planned to begin in the summer of 2001.

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