Bellingham/Lake Whatcom Coal Mines
Bellingham No. 1 Coal Mine
Preliminary Assessment Report
Whatcom County, Washington
TDD: 03-01-0002

Ecology and Environment, Inc.
Contract: 68-S0-01-01
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Region 10

START-2

Superfund Technical Assessment and Response Team

Submitted To:
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Acronym	Definition
AMD	acid mine drainage
bgs	below ground surface
CERCLIS	Comprehensive Environmental Response, Compensation, and Liability Information System
cfs	cubic feet per second
E & E	Ecology and Environment, Inc.
EPA	United States Environmental Protection Agency
PAs	preliminary assessments
PPE	probable point of entry
ppm	parts per million
START	Superfund Technical Assessment and Response Team
TDL	target distance limit
USGS	United States Geological Survey

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1. INTRODUCTION

Ecology and Environment, Inc. (E & E) was tasked by the United States Environmental Protection Agency (EPA) to provide technical support for completion of preliminary assessments (PAs) and pre-Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) screenings at several abandoned coal mines in the Bellingham/Lake Whatcom area, located in Whatcom County, Washington. The EPA is doing this work in response to a citizens' petition filed by two environmental groups in Bellingham, the Environmental Exposure Network and the Clean Water Alliance. These groups believe the mines may contain pollutants, such as mercury and other heavy metals.

E & E completed PA activities under Technical Direction Document Number 03-01-0002, issued under EPA, Region 10, Superfund Technical Assessment and Response Team (START)-2 Contract Number 68-S0-01-01.

The specific goals for the Bellingham No. 1 Coal Mine PA, identified by the EPA, are:

- Determine the potential threat to public health or the environment posed by the site;
- Determine the potential for a release of hazardous constituents into the environment; and
- Determine the potential for placement of the site on the National Priorities List.

Completion of the PA included reviewing existing site information, collecting receptor information within the range of site influence, determining regional characteristics, and conducting a site visit. This document includes a discussion of background site information (Section 2), a discussion of migration/exposure pathways and potential receptors (targets; Section 3), conclusions (Section 4), and a list of pertinent references (Section 5).

2. SITE BACKGROUND

2.1 SITE LOCATION

Site Name:	Bellingham No. 1 Coal Mine
CERCLIS ID Number:	WAN001002480
Location:	Bellingham, Whatcom County, Washington
Latitude:	48° 46’ 35” North
Longitude:	122° 29’ 28” West
Legal Description:	Surface facilities: Sections 13 and 24, Township 38 North, Range 2 East, Willamette Meridian Underground workings: Sections 13, 14, 23, 24, 43, and 44, Township 38 North, Range 2 East, Willamette Meridian
Site Owners/Contacts:	See Appendix A

2.2 SITE DESCRIPTION/OWNERSHIP HISTORY

The Bellingham No. 1 Coal Mine, also referred to as the “Bellingham Coal Mine Company, Mine No. 1" (e.g., Tetra Tech 1984) is an abandoned underground coal mine that operated between 1918 and 1955. The mine is located in the northern portion of Bellingham, Washington (Figure 2-1). During its operation, the Bellingham No. 1 Coal Mine was one of the largest coal producers in Washington state (Vonheeder 1975).

The Bellingham Bay Improvement Company purchased 880 acres of land north of Squalicum Creek between 1888 and 1891, and hired R.B. Symington, a mining engineer, in 1891 to prospect for the northerly extension of the coal seam previously mined at the nearby Sehome Mine (Tetra Tech 1984). The Bellingham No. 1 coal seam was encountered at a depth of 410 feet below ground surface (bgs) in the sixth borehole in 1892 (Jenkins 1923). Preparations to develop the coal were initiated in 1917 by John C. Eden and his associates (Jenkins 1923). The Bellingham Coal Mine Company was formed in 1918, and production at the No. 1 mine commenced in September 1918 (Jenkins 1923). The mine

operated almost continuously until 1951. It reopened in 1952 under the management of the Northwestern Improvement Company, and operated until 1955 (Moen 1969).

The Bellingham No. 1 Coal Mine targets the Bellingham No. 1 coal seam (Jenkins 1923). The Bellingham No. 1 coal seam dips 10° toward the southwest in the upper levels of the mine (Jenkins 1923); further down the slope, the dip flattens to as low as 5° (Vonheeder 1975). The coal seam lies within the Chuckanut Formation or the Huntington Formation (Vonheeder 1975). The Chuckanut Formation is a thick (greater than 10,000 feet thick) sequence of Upper Cretaceous to Lower Tertiary sandstone, conglomerate, shale, and bituminous to sub-bituminous coal seams deposited within alluvial channels and floodplains. The Tertiary Huntington Formation comprises predominantly sandstone and shale deposited unconformably over the Chuckanut Formation following uplift and deformation of the Chuckanut Formation (Easterbrook 1973). In the area of the Bellingham No. 1 Coal Mine, the bedrock of the Chuckanut Formation is overlain by a total thickness of between 200 and 300 feet of marine clay and Pleistocene unconsolidated glacial outwash sediments consisting predominantly of sand and gravels (Jenkins 1923; Tetra Tech 1984).

The surface facilities of the mine, including several mine openings and coal processing, storage, and shipping facilities, appear to have been limited to an area between Squalicum Way and Northwest Avenue on the south, and Bellingham Golf and Country Club on the north (Figure 2-2). Mine openings used over the history of the mine include three slopes and two air shafts. The two primary slopes are referred to as the "30° slope" and the "18° slope." The portals of these slopes were located approximately 1,200 feet northeast of the intersection of Birchwood Avenue and Northwest Avenue at an elevation of approximately 94 feet above sea level (BCM 1939). The 30° slope was driven from the surface at an incline of 30° bearing generally southwest for 550 feet to its intersection with the coal bed, at which point it is driven down the dip of the coal seam on an incline of approximately 10°. At the location where the 30° slope encounters the Bellingham No. 1 coal seam, the coal seam lies 20 feet stratigraphically beneath the sandstone-overburden contact, and the overburden is approximately 265 feet thick (Vonheeder 1975). The 18° slope was driven above and parallel to the 30° slope from the surface at an incline of 18° for 1,800 feet, where it intercepts the coal seam just beyond the third level of the mine (BCM 1939; Tetra Tech 1984). The 18° slope was apparently installed to reduce the power requirements to hoist the coal out of the mine (Tetra Tech 1984). The 18° slope and 30° slope are collectively referred to as the "main slope." The total length of the main slope is 6,800 feet (Moen 1969). The base of the main slope lies at an elevation of 1,166 feet below sea level (Tetra Tech 1984). The portal of a third "abandoned" slope of unknown origin and extent is located approximately 200 feet east of the main portal (BCM 1939). A return airway slope was driven parallel to and approximately 100 feet southeast of the main slope to

provide ventilation (BCM 1939; Jenkins 1923). The return airway slope was connected to the surface by a vertical air shaft driven approximately 179 feet deep at a location approximately 400 feet southwest of the main slope entry (BCM 1939; Jenkins 1923). At some time during mine operations, this vertical air shaft was replaced by an air shaft driven at an incline of 54° for 329 feet to its intersection with the return airflow slope (BCM 1939; Tetra Tech 1984). The portal of the 54° air shaft is located approximately 600 feet southwest of the main slope entry (BCM 1939).

The underground workings of the mine are extensive, covering a total of approximately 1,340 acres (Moen 1969). A total of 11 levels, also referred to as entries or gangways, were driven laterally off the main slope toward the northwest and southeast at intervals of between 500 and 700 feet for distances as great as 5,000 feet (BCM 1939; Moen 1969; Tetra Tech 1984). The entries were driven approximately along the strike of the target coal seam at a 1% grade. The main entries were 8 to 9 feet wide. Coal was mined from the entries using a room and pillar method. Rooms were typically 20 to 21 feet wide on 50-foot centers, leaving pillars approximately 29 to 30 feet wide (Jenkins 1923; Moen 1969; Tetra Tech 1984). Pillar sizes ranged from 15 to 35 feet wide and between 55 and 100 feet long (Batchelor 1982). In several parts of the mine, the pillars were either partially or completely mined out (Batchelor 1982).

The portal of the 18° slope was a rail reinforced concrete bulkhead (Tetra Tech 1984). In order to prevent flowage of the saturated sands and gravels into the slopes, a timber bulkhead was installed within the 18° slope at a depth of approximately 90 feet bgs, and that a similar bulkhead was probably installed at a similar depth within the 30° slope (Tetra Tech 1984). The structures used to support the air shafts are not known; the standard method at the time was to use rail and timber as the primary support, with wood planks as lagging (Tetra Tech 1984).

Surface features that existed at the mine as of 1939 (BCM 1939) are illustrated in Figure 2-2. These features include:

- Portal of the 30° slope;
- Portal of the 18° slope;
- Trestle extending from the main slope;
- Hoisting engine house at the end of the trestle;
- Coal washing plant;

- Coal bunkers adjacent to the washing plant;
- Tipple;
- Portal of the abandoned slope;
- Bunkers and adjacent concrete area located southwest of the main slope portals;
- Portal of vertical air shaft;
- Portal of 54° air shaft;
- Fan house adjacent to 54° air shaft;
- Two transformer stations, located north and northeast of the main slope portals;
- Transformer located south of the of the main slope portals;
- Eight-inch water pipe spanning the distance between Squalicum Creek and the coal washing plant;
- Water tower; and
- Ancillary buildings, including a bunk house, cook house, lamp houses, hose house, wash house, blacksmith shop, hydrant shed, timber platform, and several unlabeled structures.

Equipment used in 1922 included three boilers, a 500 horsepower hoist, an Ingersoll Rand air compressor, air powered jackhammers and drilling equipment, and both electric and pneumatic pumps (Jenkins 1923). Equipment in use at the mine in 1947 included Ingersoll-Rand jackhammers, steam hoist engines, electric lighting, three Forrester jigs and a Foust jig, five Deister-Overstrom concentrating tables, storage and shipping bunkers with a combined capacity of 1,000 tons, and two locomotive-type cranes for yard storage (Green 1947).

There existed at least two coal washing facilities at the mine to separate the coal from rock and other impurities over the course of its operation (BOM 1969). One is reported to have operated until 1951 (BOM 1969); this may be the washing plant shown on the 1939 mine map (BCM 1939). A second washing facility was constructed in 1951, and was used until the mine closed (BOM 1969). The location of the second coal washing plant is not specified (BOM 1969). The construction of the second coal washing facility coincides with the resumption of mine operations by the Northwest Improvement Company and the introduction of continuous mining techniques at the mine; this is noteworthy because continuous mining techniques generated significantly more waste rock than the more selective previous methods (Moen 1969; Tetra Tech 1984).

The Bellingham Coal Mine Company was formed in 1918, and production at the Bellingham No. 1 Coal Mine commenced in September 1918 (Jenkins 1923). The mine operated almost continuously until 1951. It reopened in 1952 under the management of the Northwestern Improvement Company, and

operated until 1955 (Moen 1969). Since that time, the property has been subdivided and redeveloped, as discussed below. The current owners of the properties in the area of the surface facilities of the mine are listed in Appendix A.

2.3 SITE OPERATIONS AND WASTE CHARACTERISTICS

2.3.1 Mine Operations

During its operation, the Bellingham No. 1 Coal Mine was one of the largest coal producers in Washington state; its production over the life of the mine was approximately 5.5 million tons (Vonheeder 1975). Cement plants were reported to be the largest market for the coal (Jenkins 1923; Moen 1969). The mine operated almost continuously between 1918 and 1951. In 1952, it resumed operations under the management of the Northwestern Improvement Company, and operated until 1955 (Moen 1969).

Coal was removed from the mine using the room and pillar method, in which rooms are mined out and pillars of coal are left behind to support the mine roof. Typically, approximately half the coal is removed and the rest left behind as pillars. The pillars were mined upon retreat in only limited areas of the mine (Tetra Tech 1984). At the Bellingham No. 1 Coal Mine, the coal seam is reported to average 12 feet 6 inches (Green 1947) or 14 feet (Moen 1969) thick, of which only 7 to 9.5 feet was mined for most of the production history (Moen 1969). However, with the use of continuous mining techniques beginning in 1952, the full thickness of the seam was mined (Tetra Tech 1984). Previously, the coal was mined using blasting. Horses and mules were used in the early operations for underground haulage in the levels, and a steam hoist was used to hoist the mine cars up the slope to the surface. Electric locomotives replaced the livestock in the 1940s (Moen 1969).

The following is a description of coal processing at the mine as of 1922. The coal was hoisted out of the mine in coal cars, which were emptied by means of a rotary drum into a hopper. From the hopper, the coal was fed onto shaker screens to separate coal by size (3-inch and 7/8-inch screens). The coal that passed over the screens was conveyed to a picking table, and from there it was either loaded directly into a railroad car for delivery to market or loaded into storage bins. The coal that passed through the 3-inch holes (“nut coal”) was transported to a washer, where the coal was separated from rock and dirt, which were loaded into rail cars for transport to a waste dump at an unspecified location. The washed nut coal was further segregated by size by passing it over a 2-inch screen. The nut coal greater than 2 inches in diameter was conveyed to bins. Coal that passed through 7/8-inch screen (“pea coal”) and 1/4-inch screen (“slack coal”) was washed in separate washers. From the washer, the pea coal was

conveyed to bins. The slack coal was conveyed to two Overstrom Universal concentrating tables, where the coal was separated from the rock and dirt by sluicing into a sludge tank, which measured approximately 40 feet long, 10 feet wide, and 8 feet deep. The refuse rock left behind on the concentrating tables was washed into the sluice box, which carried the refuse "down into the creek." In addition to the coal from the concentrating tables, the sludge tank received all the water from the washers and the overflow from the watering elevators. The coal particles settled to the bottom, where they were recovered by dragging the bottom, and were then conveyed to the slack coal bin. Water for the washing plant was drawn from Squalicum Creek. Water from the sludge tank was recycled. (Jenkins 1923)

Coal processing at the mine in 1946 was apparently conducted in a similar manner as in 1922. The process is described as follows. The coal cars were dumped through a rotary dump onto shaking screens, with 4-inch plus size coal passing over the screens to the picking tables. The coal passing through the 4-inch screen was subsequently passed through a revolving screen, segregating nut and smaller size coal, which were sent to separate washers. Pea coal was cleaned using Forrester and Foust jigs, and coal finer than 5/16-inch was cleaned using a battery of Deister-Overstrom concentrating tables. Washed coal was stored on site in storage bunkers or temporarily stored in shipping bunkers. Coal was shipped to market using both truck and rail. (Green 1947)

The coal produced at the Bellingham No. 1 Coal Mine has been sampled for thermal content, sulfur content, and grade. The coal is classified as high volatile "C" category bituminous coal (Vonheeder 1975). Results of proximate analyses of five coal samples collected in 1922 (three in situ, one from the concentrating tables, and one of washed coal) indicate sulfur content ranging from 0.68% to 1.18% (Jenkins 1923). A sulfur content of 0.3% is reported for 15 samples (Beikman et al. 1961).

At the Bellingham No. 1 Coal Mine, an estimated one million tons of coal washer refuse was generated over the history of the mine. The coal washer was located adjacent to a "small creek" (apparently Squalicum Creek), into which several hundred tons of refuse was dumped daily. The refuse was carried to Bellingham Bay, where it was deposited on the tideflat. The refuse soon accumulated into a delta which was subjected to stream, tidal, and wave action. The current extent of the refuse is not known. All of the delta area above extreme high tide line had been converted to industrial usage including storage yards and warehouses. (BOM 1969)

Subsequent to 1951, with the construction of a new coal washery, all coal refuse was hauled offsite for use in landfill operations. However, periodic overflows from the slurry settling pond were reportedly discharged to the stream, which resulted in elevated turbidity. (BOM 1969)

In 1984, a "refuse bank (coal washing spoil pile) along the left branch of Squalicum Creek near Birchwood Avenue" was observed (Tetra Tech 1984). According to unverified eyewitness reports, the

quality of the stream was impaired as a result of refuse washing from the embankment into the stream (Tetra Tech 1984). It was concluded that, with the cessation of mining, the embankment has stabilized, and poses no threat to the public (Tetra Tech 1984). Tetra Tech (1984) recommended that the refuse be used in (mine) backfilling operations, and should be tested for acid potential and combustibility prior to use as fill material.

2.3.2 Mine Closure

The mine was abandoned in 1955. Many of the details of abandonment of the Bellingham No. 1 Coal Mine are not known (Batchelor 1982; Tetra Tech 1984). Available information is summarized below.

The area of the main slope portals is presently occupied by a shopping center, including a grocery store (Albertsons). Prior to construction of the grocery store, the 18° slope, the 30° slope, and the 54° air shaft were reportedly backfilled by the surface owners. No information is available regarding possible backfilling of the "abandoned slope" or the vertical air shaft. (Tetra Tech 1984)

It was reported that a proposal was prepared by Northwest Testing, of Portland, Oregon, to backfill the 54° air shaft and the 18° and 30° slopes with gravel. It was reportedly stated in the proposal that water would be used to sluice the gravel down to the level of a bulkhead within the 18° slope. It was not indicated whether or not a bulkhead existed in either the 30° slope or the 54° air shaft.
(Tetra Tech 1984)

The details of the actual backfilling operation are unclear. It is reported that in 1962, the State of Washington Office of the Chief Coal Mine Inspector brought suit against the surface owners to compel them to properly close and backfill areas of potential hazard to public safety. It is further reported that the mining engineer that supervised the backfilling operations testified that 3,000 cubic yards of washed glacial gravel, 3-inch and under, were poured into the excavated opening of the 18° slope, and that water was pumped in to sluice the gravel down the slope. The mining engineer reportedly stated that he did not think the gravel would be transported past the intersection with the 10° slope (located approximately 550 feet down the 18° slope); however, test borings drilled after the backfilling indicated that it had, and that the slope was not solidly backfilled. The mining engineer reportedly stated that the 30° slope was backfilled in a manner similar to the 18° slope, with 1,600 cubic yards of gravel to fill the slope, and another 1,300 cubic yards of gravel to fill the excavated opening. Apparently, no bulkhead or any form

of plug was installed within either of the slopes prior to backfilling to prevent the washing or sluffing of the gravel further down the slopes. It is reported that, according to court documents, Washington State law required that a concrete bulkhead be placed at the ends of the inclined shafts and that the shafts be backfilled to prevent the collapse of overlying unconsolidated materials, and that these measures were not undertaken at the mine when it closed. The suit was dismissed on the grounds that the owners had met their legal obligations by blocking the shaft openings on the ground. (Batchelor 1982)

As of 1984, the "decline air shaft" was at least partially backfilled, with the opening overgrown and blocked by fill (Tetra Tech 1984). It was concluded that "the slopes and the air shafts have been partially filled where they intersect the unconsolidated clays, sands and gravels" (Tetra Tech 1984). The United States Department of the Interior, Office of Surface Mining abandoned mine land survey project manager stated that no other mine openings were open to the surface at the time of the Tetra Tech (1984) survey (Kaldenbach 2003).

As of the early 1960s, the coal processing and storage facilities, except for a concrete storage bunker, had been removed (Batchelor 1982). All that remained of the mine surface features in 1975 were "a few concrete abutments located several hundred yards northeast of the intersection of Birchwood and Northwest Avenues" (Vonheeder 1975). A parking lot and shopping center covered the area of the main slope as of 1984 (Tetra Tech 1984).

2.4 SITE CHARACTERIZATION

Previous investigations of the Bellingham No. 1 have focused principally on geotechnical considerations, and are summarized in the preceding sections. Other ancillary information gathered during the PA may be pertinent to the mine, as discussed below.

2.4.1 United States Geological Survey Coal Quality Data

The United States Geological Survey (USGS) has collected information on coal sampled from across the United States over the last 25 years (Tewalt et al. 2001). Results are compiled in USGS's COALQUAL database (USGS 2004a). Although most samples represented in the database were collected from major coal producing areas around the country, two coal samples were collected from exposures of the Chuckanut Formation in Whatcom County (near Glacier, Washington) and Skagit County (near Hamilton, Washington) in 1979 and 1975, respectively. The Chuckanut Formation is the geologic unit that contains the coal beds developed in the Bellingham/Lake Whatcom area (Jenkins 1923). These two samples were collected from distances greater than 20 miles from the

Bellingham/Lake Whatcom area coal mines (including the Geneva Mine), and may not be representative of the coal beds targeted in the Bellingham/Lake Whatcom area mines. Nonetheless, it is important to note that the total mercury concentrations in these samples were relatively high, at 0.46 parts per million (ppm) and 1.1 ppm (USGS 2004a). By comparison, for the more than 7,000 samples in the COALQUAL database, the mean mercury concentration is 0.17 ppm, and the median concentration is 0.11 ppm. The maximum mercury database value for coal in the ground is 1.8 ppm, after deleting one higher value as a statistical outlier (Tewalt et al. 2001).

2.4.2 Coal Mine Drainage Studies

One of the principal environmental impacts that can result from coal mining is coal mine drainage. Coal mine drainage can be either acidic or alkaline, and can degrade receiving surface water bodies and groundwater. Acid mine drainage (AMD), in which acidity exceeds alkalinity, results from a complex suite of reactions involving the oxidation of pyrite (iron sulfide) and other sulfide minerals. AMD typically results in elevated concentrations of ferric (Fe^{3+}) and ferrous (Fe^{2+}) iron, manganese (Mn^{2+}), aluminum (Al^{3+}), and sulfate (SO_4^{2-}). Neutral or alkaline mine drainage, in which alkalinity equals or exceeds acidity, can also have relatively high concentrations of iron, manganese, sulfate, and other constituents. Upon aeration of the water or neutralization of the acidity, ferric oxides, hydroxides, and/or oxyhydroxysulfate minerals commonly precipitate, forming a reddish-yellow or yellowish-brown coating (often referred to as yellowboy) on rocks and other surfaces. (PDEP 1999)

Trace metals such as arsenic, selenium, and mercury are locally present in coal and coal waste, and can be released to surface water and groundwater under coal mine drainage conditions (Seal 2004).

The chemical reactions that occur during development of AMD are analogous to those that occur during natural geologic weathering, which takes place over extended periods of time (e.g., hundreds to thousands of years); however, with AMD, the reaction rates are orders of magnitude greater than in natural weathering systems. The exact lengths of time required for initiation, propagation, and termination of acid generation in coal mine AMD scenarios are not well characterized, but appear to be on the order of years to decades. Results of modeling and evaluation of a limited number of case studies indicate that the peak acid load occurs 5 to 10 years after mining, followed by a gradual decline over 20 to 40 years. (OSM 2003)

2.5 START-2 ACTIONS

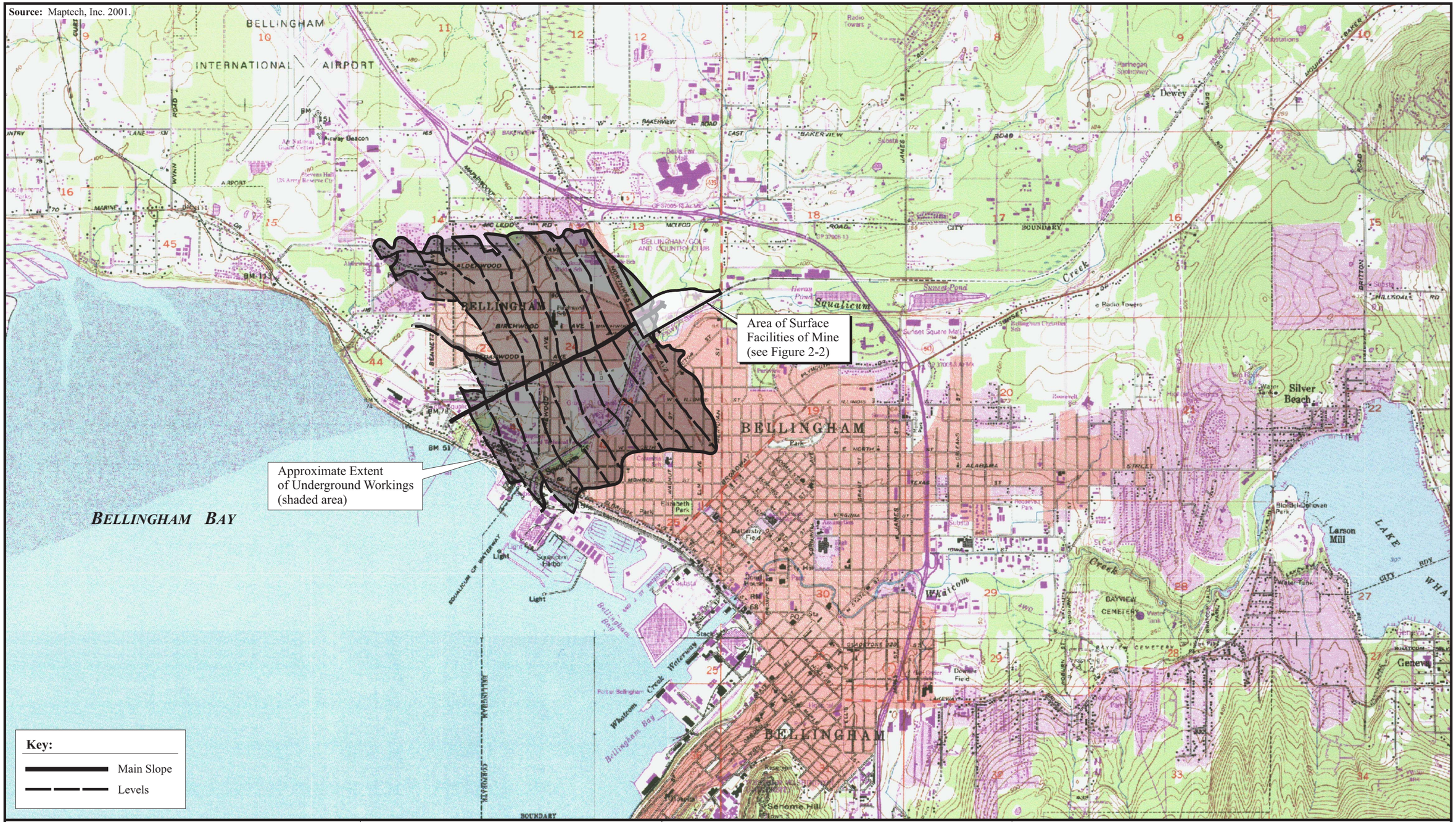
To obtain information about coal mining in the Bellingham/Lake Whatcom area, including the area of the Bellingham No. 1 Coal Mine, START-2 reviewed numerous reports, maps, and other documents. In addition, START-2 conducted interviews with representatives of federal, state, and local agencies; representatives of academic institutions; and owners or representatives of properties in the vicinity of the former coal mining activities. A list of these data sources for the Bellingham/Lake Whatcom Coal Mines PA/pre-CERCLIS screening project is provided in Appendix B.

All pertinent information gathered from the sources listed above has been incorporated into this PA report. The START-2 conducted a site visit on January 29, 2004. Photographic documentation of the site visit is provided as Appendix C. None of the property owners were present during the site visit. The area of the surface facilities of the Bellingham No. 1 Coal Mine currently is developed for commercial and residential use. Current facilities include a shopping center, Salvation Army outlet, car wash, gas station, and apartment buildings. With the exception of the banks of Baker Creek, the area is covered with buildings, pavement, and grass or other landscaping.

An exposed section of the east bank of Baker Creek, approximately 400 feet north of Birchwood Avenue, consisted of black, coaly material ranging up to cobble size (Photograph 1-1, Appendix C). The stream bank at this location inclines steeply from a flat shoulder approximately 20 feet down to Baker Creek. At the location where the coaly material was observed, the bank is devoid of vegetation and undercut by the stream, which was visually estimated to be flowing at 30 cubic feet per second at the time of the site visit. It was not possible to determine the extent or volume of the coaly material because the steep embankment and thick brush limited access, and dense vegetation and landscaping and/or pavement obscure the makeup of the substrate. The START-2 estimates that the coaly material exists over an area of at least 1,000 square feet. Coal fragments were observed along the bed of Baker Creek downstream of the undercut bank (Photograph 1-2, Appendix C). It was not possible to access Squalicum Creek during the site visit. START-2 also observed a concrete pedestal approximately 10 feet by 3 feet by 3 feet high on the east bank of Baker Creek approximately 50 feet north of the undercut coaly bank. Coal fragments were also noted scattered on the surface of soil along the northern property line (fence line) of Whatcom County parcel no. 380213365011 (Whatcom County 2003), as illustrated in Photograph 1-1 (Appendix C).

No other features associated with the former coal mining operations at the site were observed during the site visit.

Source: Maptech, Inc. 2001.



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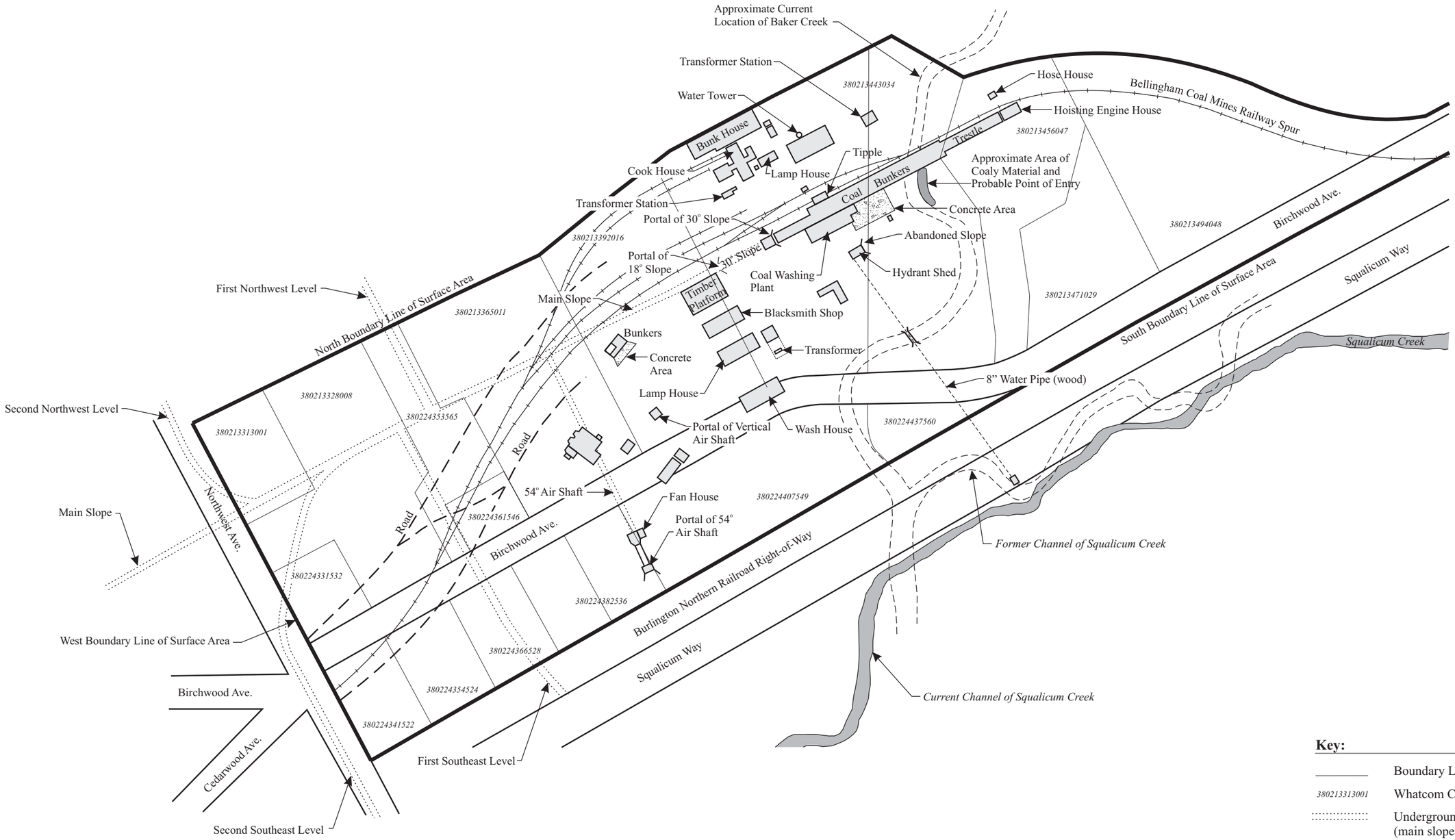
International Specialists in the Environment
Seattle, Washington

BELLINGHAM/LAKE WHATCOM COAL MINES
Bellingham, Washington

Figure 2-1
SITE MAP
BELLINGHAM NO. 1 COAL MINE

Date:	Drawn by:	
10/22/04	AES	10:START-2\03-01-0002\fig 2-1

Source: Whatcom County 2003 and BCM 1939.



Key:

- Boundary Line of Present Parcels
- 380213313001 — Whatcom County Parcel Number
- Underground Workings (main slope or levels)

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0 100 200
Approximate Scale in Feet

BELLINGHAM/LAKE WHATCOM COAL MINES
Bellingham, Washington

Figure 2-2
SURFACE FEATURES AND FACILITIES MAP
BELLINGHAM NO. 1 COAL MINE

Date:	Drawn by:	
10/20/04	AES	10:START-2\03-01-0002\fig 2-2

3. MIGRATION/EXPOSURE PATHWAYS AND TARGETS

This section describes migration/exposure pathways and potential targets (or receptors) within the site's range of influence. This section addresses only the surface water migration pathway and potential targets within the site's range of influence. The groundwater migration, soil exposure, and air migration pathways have been excluded at this time per direction of the EPA Task Monitor.

The surface water migration pathway target distance limit (TDL) begins at the probable point of entry (PPE) of surface water runoff from the site to a surface waterbody and extends downstream for 15 miles. The PPE at the Bellingham No. 1 Coal Mine is located along Baker Creek in the vicinity of the former coal bunkers where coaly material was observed along the stream bank during the January 29, 2004 START-2 site visit (Figures 2-2 and 3-1). From the PPE, Baker Creek flows generally southward approximately 800 feet downstream before merging with Squalicum Creek, which flows approximately 1.38 miles toward the southwest before emptying into Bellingham Bay. The surface water TDL extends radially from the mouth of Squalicum Creek another 13.47 miles into Bellingham Bay. Figure 3-1 depicts the surface water 15-mile TDL for Bellingham No. 1 Coal Mine.

START-2 estimates an average annual flow in Baker Creek to be less than 10 cubic feet per second (cfs). During the January 29, 2004 site visit, Baker Creek was flowing at approximately 30 cfs. It is assumed the flow of the creek would decline in the drier months. START-2 estimates the average annual flow of Squalicum Creek to be more than 10 cfs, but less than 100 cfs.

Potential source areas at the mine have no containment to prevent a release of hazardous substances to the surface water pathway. START-2 estimates the drainage area above and including the potential source areas at approximately 170.77 acres (USGS 1994).

Soils in the vicinity of the site consist of Kickerville-Urban land complex, 0% to 3% slopes. The Kickerville soil is described as very deep and well drained. It is formed in a mixture of loess and volcanic ash over glacial outwash. Permeability is moderate in the upper part of the Kickerville soil and very rapid in the substratum. Available water capacity is high. Runoff is very slow, and there is no hazard of erosion. (USDA 1992).

The two-year, 24-hour probable maximum rainfall for the Bellingham area is 2.5 inches (NOAA 1973). START-2 assumes the potential sources at the Bellingham No. 1 Mine are located within a 100-year floodplain (FEMA 2004).

There are no domestic or municipal drinking water intakes within the 15-mile TDL.

Bellingham Bay is fished for salmon. Bellingham Bay is part of the Washington Department of Fish and Wildlife's statistical Area 7, which comprises the area of the Strait of Georgia. The 1999 harvest for salmon in statistical Area 7 was 99,051.25 pounds (WDFW 2002). START-2 estimates that the portion of the surface water TDL that lies within statistical Area 7 is approximately 25%. Therefore, 25% of the salmon harvest (24,764.75 pounds) from statistical Area 7 is assumed to occur in the surface water TDL. No Tribal or subsistence fisheries were identified in the TDL. Table 3-1 presents the harvest data by waterbody segment and fish type. Bellingham Bay is also used for shellfish harvest. The 1999 harvest of clams including Manila Littleneck, Native Littleneck, Butter, Soft Shell, and Horse, is 1,352 pounds from Bellingham Bay (WDFW 2002). During the 1999 season, 15,109 Dungeness crab were harvested from Bellingham Bay. The average weight of a Dungeness crab is between 2 and 3 pounds (ASMI 2004). Based on an assumed average weight of 2.5 pounds, approximately 37,772.5 pounds of Dungeness crab were harvested from Bellingham Bay.

The following sensitive environments are located within the surface water pathway TDL:

- Portions of Bellingham Bay have habitat known to be used by the bald eagle, *Haliaeetus Leucocephalus*, a Federal-listed threatened species (WDFW 2003);
- Bellingham Bay has habitat known to be used for the Steller sea lion, *Eumetopias jubatus*, a Federal-listed threatened species (WDFW 2003);

It is estimated from National Wetland Inventory maps that a total of 15.165 miles of wetland frontage occur along the 15-mile surface water pathway TDL, all of which occur on Bellingham Bay (USFWS 1988, 1987a, 1987b, 1987c, 1987d, 1987e, 1987f, 1987g, 1987h, 1987i, and 1987j).

Table 3-1

FISH HARVEST WITHIN THE 15-MILE TARGET DISTANCE LIMIT
BELLINGHAM/LAKE WHATCOM COAL MINES
BELLINGHAM NO. 1 MINE
PRELIMINARY ASSESSMENT
WHATCOM COUNTY, WASHINGTON

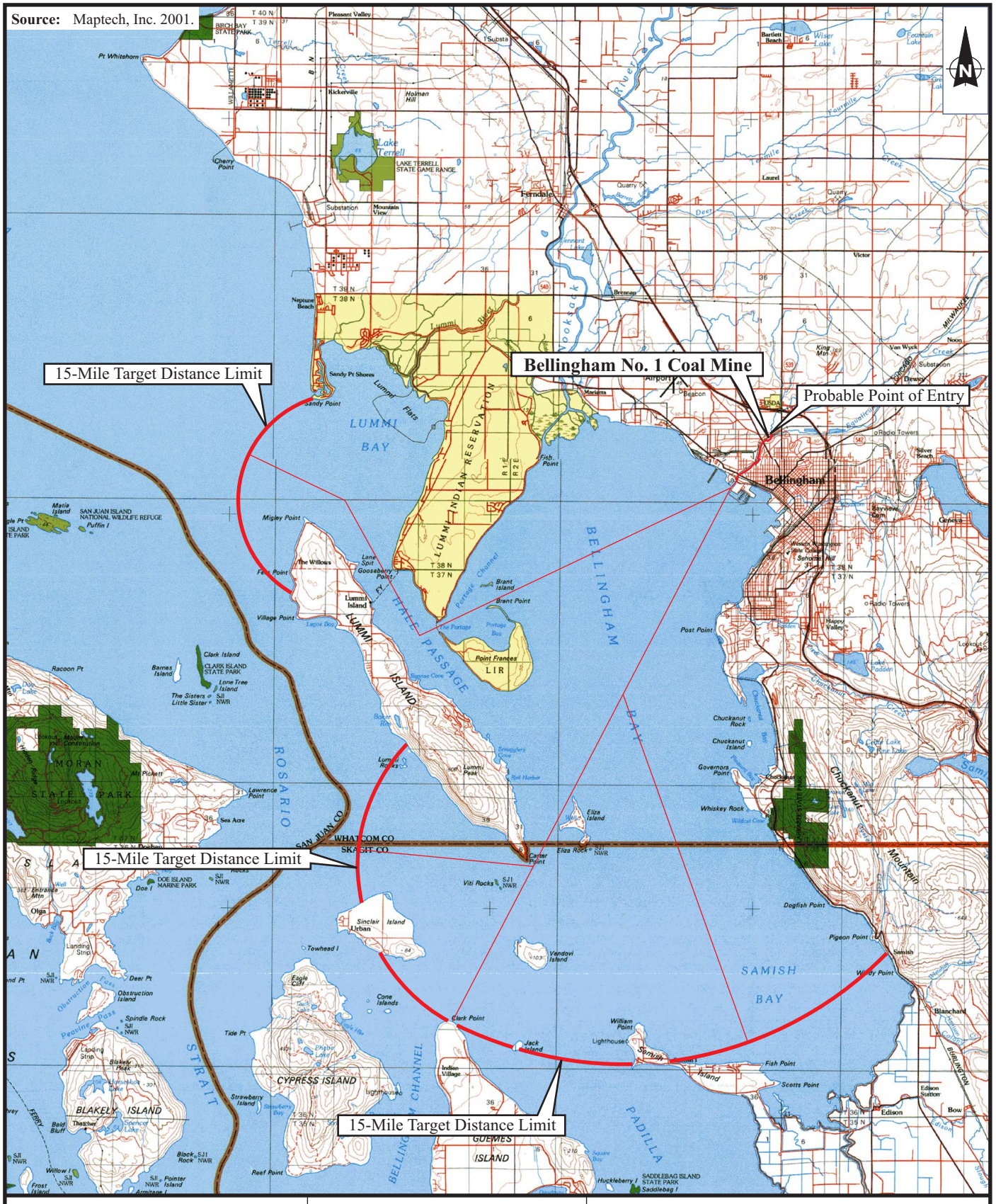
Stream Segment	Fish Species	Number Harvested	Average Pound per Fish[a]	Pounds Harvested
Bellingham Bay	Chinook Salmon	767.25	22	16,879.5
	Coho Salmon	621.75	12	7,461
	Pink Salmon	23	4	92
	Sockeye Salmon	12	8	96
	Chum Salmon	26.25	9	236.25
	Total	**1,450.25**	**NA**	**24,764.75**

Source: WDFW 2002.

[a] Average pound per fish gathered from Wydoski and Whitney 1979.

Key:

NA = Not applicable.



ecology and environment, inc. International Specialists in the Environment Seattle, Washington	BELLINGHAM/ LAKE WHATCOM COAL MINES Whatcom County, Washington	Figure 3-1 15-MILE MAP BELLINGHAM NO. 1 COAL MINE		
	0 1.5 3 Approximate Scale in Miles	Date: 10-22-04	Drawn by: AES	10:START-2\03-01-0002\fig 3-1

4. CONCLUSIONS

The Bellingham No. 1 Coal Mine operated between 1918 and 1955. Over the course of the mine operation, coaly waste rock was generated and deposited on the land surface, and within Baker Creek and Squalicum Creek. During the START-2 site visit on January 29, 2004, coal and/or coaly waste rock were observed at several locations in the vicinity of the former surface facilities of the Bellingham No. 1 Coal Mine, including Baker Creek. It is possible that heavy metals, such as arsenic and mercury, could be associated with this coaly material. However, based on available information, it does not appear likely that these potential sources would significantly impact environmental targets within the site's range of influence. Little evidence currently remains of the former surface facilities. No other indication of former mining activities were apparent during the site visit.

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APPENDIX A

SITE OWNERS

Bellingham No. 1 Coal Mine
Site Owners

Owner:	Dickerson Family LP	Owner:	Kenoyer and Company Inc
Street:	1014 11th Street, #301	Street:	1400 King Street, #D
City:	Bellingham	City:	Bellingham
State:	WA	State:	WA
Zip Code:	98225	Zip Code:	98229-6262
Property Use:	Automobile wash services	Property Use:	Retail
Type of Ownership:	Private	Type of Ownership:	Private
Parcel #:	380224 382535 0000	Parcel #:	380224 366528 0000
Owner:	Hawaii LOA Realty Inc	Owner:	Chet & Lynette Kenoyer; Jess & Mary Kenoyer
Street:	PO Box 5392	Street:	2617 Northshore Road
City:	Bellingham	City:	Bellingham
State:	WA	State:	WA
Zip Code:	98227-5392	Zip Code:	98226-9487
Property Use:	Residential housing	Property Use:	Warehouse/storage
Type of Ownership:	Private	Type of Ownership:	Private
Parcel #:	380213 471029 0000	Parcel #:	380224 354524 0000
Owner:	Kollias Family LLC	Owner:	Gregory and Elizabeth Grant
Street:	10900 NE Fourth Street, #1550	Street:	PO Box 532
City:	Bellevue	City:	Bellingham
State:	WA	State:	WA
Zip Code:	98004-8345	Zip Code:	98227-0532
Property Use:	Retail	Property Use:	Retail
Type of Ownership:	Private	Type of Ownership:	Private
Parcel #:	380213 392016 0000	Parcel #:	380224 341522 0000
Owner:	POB Apollo Park Manor LP	Owner:	Karan Enterprises Inc
Street:	5550 LBJ Highway, #380	Street:	3208 Northwest Ave
City:	Dallas	City:	Bellingham
State:	TX	State:	WA
Zip Code:	75240	Zip Code:	98225
Property Use:	Retail	Property Use:	Gasoline/service station
Type of Ownership:	Private	Type of Ownership:	Private
Parcel #:	380213 365011 0000	Parcel #:	380224 331532 0000

Owner: Street: City: State: Zip Code: Property Use: Type of Ownership: Parcel #:	Whatcom County Council on Aging 315 Halleck Street Bellingham WA 98225-4092 Residential housing Non-profit 380213 456047 0000	Owner: Street: City: State: Zip Code: Property Use: Type of Ownership: Parcel #:	NW Avenue LLC 3236 Northwest Ave Bellingham WA 98225 Commercial Private 380213 316017 0000
Owner: Street: City: State: Zip Code: Property Use: Type of Ownership: Parcel #:	Ventas Realty Ltd Partnership PO Box 81290 Chicago IL 60681-0290 Medical Private 380213 494048 0000	Owner: Street: City: State: Zip Code: Property Use: Type of Ownership: Parcel #:	Stephen-Shannon Rohrbacher; Clyde& Marcia Moller 3236 Northwest Ave Bellingham WA 98225-1318 Restaurant Private 380213 307008 0000
Owner: Street: City: State: Zip Code: Property Use: Type of Ownership: Parcel #:	The Salvation Army 2912 Northwest Ave Bellingham WA 98225 Retail Non-profit 380224 407549 0000	Owner: Street: City: State: Zip Code: Property Use: Type of Ownership: Parcel #:	Albertson’s Inc PO Box 20 Boise ID 83726-0020 Grocery Store Private 380213 328008 0000; 380224 353565 0000
Owner: Street: City: State: Zip Code: Property Use: Type of Ownership: Parcel #:	Mark and Kristen Hollander 359 E Wiser Lake Road Lynden WA 98264 Commercial Private 380224 437560 0000	Owner: Street: City: State: Zip Code: Property Use: Type of Ownership: Parcel #:	Brampton Court Properties LLC PO Box 2129 Bellingham WA 98227-2129 Residential housing Private 380213 443034 0000

Owner:	Whatcom Educational Credit Union		
Street:	PO Box 9750		
City:	Bellingham		
State:	WA		
Zip Code:	98227-9750		
Property Use:	Bank		
Type of Ownership:	Private		
Parcel #:	380224 361546 0000		

APPENDIX B

PROJECT DATA SOURCES

PROJECT DATA SOURCES:

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Hardy, Sheila, 2003, City of Bellingham, Planning and Community Development, personal communication with Mark Longtine, E & E, Seattle, on March 5, 2003, regarding geotechnical investigations in the vicinity of the Sehome Mine.

Hatch, Joe, 2004, United States Geological Survey (USGS), personal communication with Mark Longtine, E & E, Seattle, on February 26, 2004, regarding trace metals in coals.

Hood, Steve, 2004, Project contact, Washington State Department of Ecology (Ecology), personal communication with Mark Longtine, E & E, Seattle, on March 3, 2004, regarding the preliminary result s of the joint Ecology/USGS Lake Whatcom mercury investigation.

Judge, Janice, 2003, Whatcom County Tax Assessor's Office, personal communication with Mark Longtine, E & E, Seattle, on April 21, 2003, regarding records of historic coal mines in Bellingham and Lake Whatcom area.

Kaldenbach, Ginger, June 25, 2003, Washington State Supervisor, United States Department of the Interior, Office of Surface Mining (OSM), personal communication with Mark Longtine, E & E, Seattle, regarding OSM's investigation of abandoned coal mines in Whatcom County, Washington.

Kolker, Alan, 2004, United States Geological Survey (USGS), personal communication with Mark Longtine, E & E, on February 26, 2004, regarding the presence of trace metals in coal.

Maginnis, Christina, 2003 and 2004, City of Bellingham, Public Works, Engineering Department, personal communication with Mark Longtine, E & E, Seattle, on June 18, 2003 and February 5, 2004, regarding Manley' Camp and Geneva mines.

McHenry, Greg, 2003, Port of Bellingham, personal communication with Mark Longtine, E & E, Seattle, on June 30, 2003, regarding Port of Bellingham and other property in the vicinity of the Sehome mine.

McInerney, Lucy, 2004, Washington State Department of Ecology, personal communication with Mark Longtine, E & E, Seattle, on September 13, 2004, regarding Cornwall Avenue Landfill site cleanup.

Morrison, Jean, 2004, United States Geological Survey (USGS), personal communication with Mark Longtine, E & E, Seattle, on February 27, 2004, regarding trace metals in coal.

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Seal, Bob, 2004, United States Geological Survey (USGS), personal communication with Mark Longtine, E & E, Seattle, on March 1, 2004, regarding trace elements in coal.

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Management, personal communication with Mark Longtine, E & E, Seattle, on April 23, 2003, regarding General Land Office, Office of Surface Mining, and cadastral survey records as pertinent to historic coal mines in the Bellingham and Lake Whatcom area.

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Smith, Kathy, 2004, United States Geological Survey (USGS), personal communication with Mark Longtine, E & E, Seattle, on March 2, 2004, regarding trace metals in coal.

Stoner, Mike, 2003, Port of Bellingham, personal communication with Mark Longtine, E & E, Seattle, on June 25, 2003, regarding Port of Bellingham and other property in the vicinity of the Sehome mine.

Stroebel, Erica, Whatcom County Water Resources Division, personal communication with Mark Longtine, E & E, Seattle on April 7, 2003, regarding abandoned coal mines in the Bellingham and Lake Whatcom area.

Vesper, Don, 2003, Environmental Health, Whatcom County Health Department, personal communication with Mark Longtine, E & E, Seattle, on April 2, 2003, regarding coal mines in the Bellingham and Lake Whatcom area.

Wahl, Tim, 2003, Real Estate Specialist, City of Bellingham, Parks and Recreation Department, personal communication with Mark Longtine, E & E, Seattle, on April 15 and 28, 2003, regarding abandoned coal mines in the Bellingham and Lake Whatcom area.

Walsh, Timothy, 2003, Geologist, Washington Department of Natural Resources, Division of Geology and Earth Resources, personal communication with Mark Longtine, E & E, Seattle, on April 25, 2003, regarding historic coal mines in the Bellingham and Lake Whatcom area.

Watten, Barnaby, 2003, United States Geological Survey, Project Chief, Coal Acid Mine Drainage Project, personal communication with Mark Longtine, E & E, on April 15, 2003, regarding trace metals and other constituents of coal mine drainage.

Waugh, Glen, 2003, United States Department of the Interior, Office of Surface Mining (OSM, Olympia Washington, personal communication with Mark Longtine, E & E, Seattle, on June 16, 2003, regarding abandoned coal mines in the Bellingham and Lake Whatcom area.

Wenger, Barry, 2003, Washington State Department of Ecology (Ecology), personal communication with Mark Longtine, E & E, Seattle, on May 9, 2003, regarding historic coal mines in the Bellingham and Lake Whatcom area.

Whitcomb, Tye, 2003, Engineer, Whatcom County, personal communication with Mark Longtine, E & E, Seattle, on April 21, 2003, regarding records of historic coal mines in the Bellingham and Lake Whatcom area.

Zielinski, Robert, 2004, United States Geological Survey (USGS), personal communication with Mark Longtine, E & E, Seattle, on February 26, 2004, regarding coal mine drainage and trace elements in coal.

PROJECT DATA SOURCES:

RESEARCH FACILITY CONTACTS

Bellingham Public Library
210 Central Avenue
Bellingham, Washington 98225
Margaret Ziegler, Reference Librarian

Center for Pacific Northwest Studies/Washington State Archives: Northwest Regional Branch
Goltz-Murray Archives Building
Western Washington University
Bellingham, Washington 98225-9123

Washington State Department of Natural Resources
Division of Geology and Earth Resources
1111 Washington Street SE, Room 148
P.O. Box 47007
Olympia, Washington 98504-7007

APPENDIX C

PHOTOGRAPHIC DOCUMENTATION

PHOTOGRAPH IDENTIFICATION SHEET

Camera: Kodak Max HQ 35 mm Flash **TDD No. 03-01-0002**

Site Name: Bellingham No. 1 Coal Mine

Photo No.	Dir.	By	Date	Time	Description
1-1	S	ML	1/29/04	1210	East bank of Baker Creek. Approximate location of former surface facilities. Steep bank consists of coaly material.
1-2	Down	ML	1/29/04	1230	Coaly gravel-size fragment in sandy stream sediments, Baker Creek. Pen for scale.
1-3	Down	ML	1/29/04	1251	Coal/coaly material at location along northern boundary of Whatcom County Parcel No. 380213365011. Pen for scale.

Key:

ML = Mark Longtine.
S = South.


1-1


1-2


1-3