CENWS-OD-TS-DMMO

MEMORANDUM FOR: RECORD May 30, 2013

SUBJECT: DETERMINATION REGARDING THE NO-TEST STATUS OF DREDGED MATERIAL FROM THE MOUTH OF THE BIRCH BAY VILLAGE MARINA ENTRANCE CHANNEL, WHATCOM COUNTY, WASHINGTON.

1. Introduction. This memorandum reflects the consensus determination of the Dredged Material Management Program (DMMP) agencies (U.S. Army Corps of Engineers, Washington Departments of Ecology and Natural Resources, and the Environmental Protection Agency) regarding the no-test status of dredged material from the mouth of the Birch Bay Village entrance channel.

2. Background. Birch Bay Village Community Club proposes to dredge approximately 2,000 cubic yards of material from the mouth of the entrance channel to its marina in each of four dredging events over the next ten years. The dredged material is to be placed on the upper tidal beach east of the marina entrance, down-drift of the marina, for beach nourishment. The accumulated sediment originates from feeder bluffs west of the marina (ERM, 2013 – Attachment A). Dredging of the mouth of the entrance channel has been conducted numerous times since construction of the rock jetties in 1967.

   The Clean Water Act (CWA) Section 404(b)1 Guidelines for Specification of Disposal Sites for Dredged or Fill Material (CFR 40 Section 230.60, subparagraphs a and b) include exclusionary criteria with regard to testing. The Guidelines state that (1) dredged or fill material is most likely to be free from chemical, biological, or other pollutants where it is composed primarily of sand, gravel, or other naturally occurring inert material. Dredged material so composed is generally found in areas of high current or wave energy such as streams with large bed loads or coastal areas with shifting bars and channels; and (2) the extraction site shall be examined in order to assess whether it is sufficiently removed from sources of pollution to provide reasonable assurance that the proposed discharge material is not a carrier of contaminants (EPA, 1980). Dredged material that meets these two guidelines may be excluded from further testing.

3. No-Test Determination. The DMMP agencies reviewed the information provided in ERM (2013) and determined that testing will not be required for material dredged from the mouth of the entrance channel. The existing information provides convincing evidence that the sediment proposed for dredging meets the exclusionary criteria provided in the Clean Water Act. The sediment is predominantly sand, with only a small fraction of fines. The project is located in a high-energy environment that transports significant quantities of material along the littoral zone in this area. The material at the mouth of the entrance channel is approximately 600 feet away from the marina's gas dock and 1,500 feet from the former boat maintenance facility, thus providing reasonable assurance that the proposed discharge material is not a carrier of contaminants.

   In addition to meeting the exclusionary criteria, it should be noted that the proposed dredging operation simply continues the transport of material from west to east within the drift cell, placing "like on like" within a small geographic area. In the absence of the marina and entrance channel,

this same west-to-east sediment transport would take place as a result of local hydrodynamic forces. The dredging operation simply keeps the material moving within the littoral drift cell.

In summary, the DMMP agencies have determined that dredging of the mouth of the entrance channel to Birch Bay Village Marina involves material that meets the exclusionary criteria under the Clean Water Act and results in "like on like" deposition. Therefore, sediment testing is not required.

4. Geographic Limitation and Reporting.

This determination applies to the mouth of the entrance channel only, and in the absence of significant changed conditions in the project area during the life of the new permit, this determination will remain in effect for the full 10 years covered by the permit.

This determination does not apply to sediment north of latitude 48.9322 (see Attachment B). If dredging is required north of this latitude, additional evaluation may be required. Prior to each dredging event, Birch Bay Village Community Club must provide a map showing the areas of proposed dredging and placement. The permit number must be included on the map.

5. References.

ERM, 2012. *Birch Bay Village Community Club Maintenance Dredging Permit Renewal*. Memorandum (attached) prepared for the Birch Bay Village Community Club, April 2013.

This determination was coordinated by the undersigned with Laura Inouye (Ecology), Justine Barton (EPA) and Celia Barton (DNR).

The signed document is on file in the Dredged Material Management Office.

_____ _____

Date David Fox, P.E. - Seattle District Corps of Engineers

Copies furnished:

Ken Hoffer, BBVCC
Michelle Fisher, ERM
Justine Barton, EPA
Laura Inouye, Ecology
Celia Barton, DNR
Randel Perry, Seattle District Regulatory

Attachment A

Memorandum

Environmental Resources Management

2211 Rimland Dr.
Suite 210
Bellingham, WA 98226
(360) 647-3900
(360) 647-3901 (fax)

To: David Fox, U.S. Army Corps of Engineers and Dredge Material Management Office

From: Michelle Fisher, ERM, prepared for Birch Bay Village Community Club

Date: April 19, 2013, Revision 1 submitted April 25, 2013

Subject: Maintenance Dredging Permit Renewal

ERM, West Inc. (ERM) is providing this memo on behalf of the Birch Bay Village Community Club (BBVCC). BBVCC is preparing permit applications to continue periodic dredging of native materials that accumulate at the entrance to their marina. This memo is a request to the Dredge Material Management Office (DMMO) to exclude the project from the sediment testing requirement.

As requested by Mr. Dave Fox in a phone conversation March 25, 2013, this memo includes a project description, site and dredging history, a sediment description, sediment source, potential contamination sources, and a summary of ERM's reasons for asking that the sediments proposed for dredging be excluded from testing.

PROJECT DESCRIPTION

The BBVCC dredging site is located on the northwest shore of Birch Bay approximately 2 miles east of Birch Point. The site contains an artificial entrance channel for a pleasure boat marina located inland.

BBVCC is seeking new permits to dredge the same area as previously permitted (2001-2-00437) at the mouth of the entrance channel. This area has had periodic maintenance dredging since the marina's construction, and is due for dredging again in fall 2014. The dredging is needed to maintain adequate water depths for boats accessing the marina.

BBVCC is proposing to dredge to -10 MLLW of less than 2,000 cy in each dredging event (four times over the permit period). This larger volume is based on a prediction in the 2001 Coastal Processes Study by Coastal Geologic Services, Inc. (CGS) that a greater volume of sediment will accumulate over time in the decades subsequent to the study.

BBVCC also plans to place the dredged materials for beach nourishment as requested by Washington Department of Fish and Wildlife (WDFW) and Whatcom County. Since 2001, BBVCC has placed these dredged materials on the upper tidal beach east of the marina entrance down-drift of the marina.

DREDGE HISTORY

The entrance channel to the marina was constructed in 1967 with rock jetties on both sides. Sedimentation within the entrance channel occurs through longshore transport of drift material from west of the channel entrance.

The following table contains the dredging history of the channel entrance. Dredging was authorized by the Corps of Engineers most recently with a 10-year individual permit for the period 2001 to 2011.

Dredge History

Year	Dredge Volume	Year	Dredge Volume
1967	Jetties built	1994	1,000 cy
1968-1980	2 times - unknown volume	2002	1,000 cy
1981	938 cy	2005	1,000 cy
1986	938 cy	2008	1,000 cy
1990	1,000 cy	2011	1,000 cy

SEDIMENT SOURCE

In 2001, Coastal Geologic Services (CGS) studied the sediment drift pattern and source. The following information is taken from this study. The Birch Bay Village Marina entrance is exposed to northeasterly winds. A long fetch from the southwest allows such winds to build up relatively high-energy waves. The proposed project area occurs in the middle of a west-to-east drift sector, in which the natural longshore movement of material is from west to east from Birch Point to Cottonwood Beach in northernmost Birch Bay (Schwartz et al. 1991 cited in CGS 2001). The channel entrance, with jetties on either side, interrupts the longshore drift of material from west to east and has reduced the main supply of drift material to the shoreline east of the entrance (CGS 2001).

An extensive feeder bluff that starts approximately one-quarter mile west and continues north along the shoreline provides the fine-grained material to the project area through natural erosion processes (CGS 2001). The entrance channel is a deposition area for sediment transported eastward from these bluffs west of the marina. The beach east of the jetties is in need of more sediment, and benefits from the dredge sediment.

Along the beach to the east of the jetty, up to 4 feet of vertical erosion may have occurred since construction of the channel in 1967. During this time,

substrate along the beach changed from a mixed sand and gravel beach to a cobble beach. The beach to the east of the jetty is comprised primarily of cobble 3 to 6 inches in diameter. Some bulkheads bordering shoreline residences to the east have been scoured out at their base. In an effort to relieve concerns about bulkheads to the east of the marina entrance, WDFW and Whatcom County Planning Department have encouraged the Community Club to use the dredge material for beach nourishment or potentially implement a separate beach nourishment program.

SEDIMENT DESCRIPTION

In 2001, CGS also conducted sediment sampling that characterized the grain size of the sediments in the outer entrance channel. Several sediment samples from the main shoal area (east of the waterward end of the west jetty). Sample collection was from the -1 to -3 feet MLLW elevation. These samples were sub-sampled and combined into one integrated channel sample for grain size analysis. Results of the grain size analysis are presented in the table below. There was a moderate amount of shell fragment in the smaller pebble and very coarse sand fraction, although the weight of shell fragment was estimated at less than 25 percent of these size classes. The sediment in the entrance channel consisted of 73 percent coarse and very coarse sand. The sample contained 7.1 percent gravel and 20.1 percent medium to very fine sand and silt.

Entrance Channel Sediment Characterization[1]

Sediment Grain Size		**Channel Dredge Area Integrated Sample**
Wentworth Scale	**Inches**	% **Frequency**
(-) 6 phi, (>64 mm) cobble	>2.5	0.0%
(-) 5 phi, (32-64 mm) cobble	1.25 - 2.5	0.0%
(-) 4 phi, (16-32mm) pebble	0.6 - 1.25	1.1%
(-) 3 phi, (8-16 mm) pebble	0.3 - 0.6	1.1%
(-) 2 phi, (4-8 mm) pebble	0.16 - 0.3	1.6%
(-) 1 phi, (2-4 mm) granule	0.08 - 0.16	3.3%
0 phi, (1-2 mm) v.cs. sand	0.04 - 0.08	5.0%
(+)1 phi, (0.5-1 mm) cs. Sand	0.02 - 0.08	67.8%
<(+) 2 phi, <0.5 mm) fines	<0.02	20.1%
	Sum	100.0%
	Total l-8 mm	9.9%

Source: CGS 2001

1. Sediments were collected February 7, 2001.

The amount of silt was fairly low and represents a much lesser proportion than nearby bluff deposits contain. Therefore the minor amount of fine sand and silt in the dredge area would pose less potential "harm" in terms of siltation than would a single moderate-large landslide, an occurrence that is fairly common only several thousand feet up-drift of the entrance channel (CGS 2001).

Note that CGS classified the sediments <0.5 mm (500 microns) as fines. If the acceptable threshold for fines in the sediment is less than 20%, and Ecology and other agencies classify fines as silt (<62 microns) and clay (<4 microns), then the percentage of fines would be well below the 20.1% that CGS classified as fines.

POTENTIAL FOR CONTAMINATION

Potential sources of contamination are the fueling dock within the marina, a former boat maintenance facility, and stormwater.

The marina fueling facility is located approximately 650 feet north of the project area (Figure 2). A non-serviceable boat maintenance rack that has not been used for years is located approximately 1,400 feet north of the project area. These potential sources are unlikely to impact the quality of sediment at the channel entrance.

Stormwater runoff is not a likely source or pathway of contamination to sediment at the channel entrance. There are no industrial or commercial facilities upland of Birch Bay Village. The nearest industry, an oil refinery, is at least 4 miles south and not updrift of the project site. Land use within the basin that drains to the marina is predominantly residential, farming, and woodlands. Stormwater that enters the marina from the northeast and northwest corners of the marina drains through a beaver pond, small lakes, and wetlands that provide settling and filtering.

OTHER SUPPORTING INFORMATION

Surface sediment samples from two locations within Birch Bay were collected and analyzed as part of a sediment quality survey that Ecology conducted (Sites 3 and 125; Figure 2) in 2006. The sample locations are proximate to the project site (Ecology 2012). Neither of these samples in the 2006 study had contaminant concentrations exceeding Sediment Quality Standards (including the samples from locations 3 and 125 in Birch Bay). The sediments in the Strait of Georgia region are largely non-toxic to benthic invertebrates in controlled laboratory tests.

ERM also looked at DMMO determinations from nearby Semiahmoo Marina in Drayton Harbor (December 29, 2007) which is about 4.5 miles north, and the Point Roberts Marina (December 8, 2005) which is about 8 miles northwest. In both marina examples, the dredged materials were tested and found suitable for open water disposal and sediment bypass operations, providing additional evidence of the low risk posed by sediments in the project vicinity. The sediment bypass operation at Point Roberts was recently given a no-test determination based, in part, on this low risk (May 10, 2012).

SUMMARY

The source of sediment that needs periodic dredging to maintain access through the marina's entrance channel is native material from feeder bluffs to the west. Accumulations of this native material across the entrance channel require maintenance dredging approximately every 3 years. The cumulative dredging volume over the course of a 10-year permit cycle is estimated to be less than 8,000 cy.

The sediments proposed for dredging are not proximate to potential sources of contamination, the silt and clay fractions of the sediment are less than 20 percent, and the site was described as having high-energy waves. Sediment quality data from other studies have shown Birch Bay sediment to contain very low contaminant concentrations (less than SQS). ERM believes that these circumstances warrant a Low ranking for the project and that the Birch Bay Village Community Club dredging project can be excluded from testing.

REFERENCES

Dredged Material Management Program [DMMP]. 2005. Determination of the Suitability of Sediment Proposed to be Maintenance Dredged from Point Roberts Marina, Point Roberts, Washington for Open-Water Disposal at the Washington State Department of Natural Resources (DNR) Rosario Strait PSDDA Open Water Disposal Site, as Evaluated Under Section 404 of the Clean Water Act. Prepared by the Dredged Material Management Office for the Dredged Material Management Program agencies, December 2005.

_____. 2007. Determination Regarding the Suitability of Proposed Dredged Material from Semiahmoo Marina, Blaine, Washington, for Unconfined Open-Water Disposal at the Rosario Strait Dispersive Site or

Beneficial Use. Prepared by the Dredged Material Management Office for the Dredged Material Management Program agencies, December 2007.

_____. 2012. Determination Regarding the Exclusionary Status of Dredged Material From the Point Roberts Marina Bypass Operation, Whatcom County, Washington. Prepared by the Dredged Material Management Office for the Dredged Material Management Program agencies, May 2012.

_____. 2013. Dredged Material Evaluation and Disposal Procedures (User's Manual). Dredged Material Management Program, July 2008 as revised January 24, 2013.

Ecology. See Washington Department of Ecology.

Johannessen, J. 2001. Birch Bay Village Community Club Marina: Coastal Processes Study and Analysis of Options for Dredge Spoils Disposal/Beach Nourishment. Coastal Geological Services, Inc., prepared for Anvil Corporation February 9, 2001.

Poppe, L.J., A.H. Eliason, J.J. Fredericks, R.R. Rendigs, D. Blackwood, and C.F. Polloni. 2013. USGS East-Coast Sediment Analysis: Procedures, Database, and Georeferenced Displays, Chapter 1: Grain-Size Analysis of Marine Sediments - Methodology and Data Processing. U.S. Geological Survey Open-File Report 00-358. Website: http://pubs.usgs.gov/of/2000/of00-358/text/contents.htm. Accessed March 2013.

U.S. Environmental Protection Agency. 2008. Puget Sound Sediment Sampling Data taken from EPA's Survey Vessel, the Bold. Website: http://www.epa.gov/pugetsound /bold.html. Accessed April 2013.

Washington Department of Ecology [Ecology]. 2012. Sediment Quality Assessment of the Southern Strait of Georgia, 2006. Department of Ecology Publication No. 12-03-001, February 2012. Website: https://fortress.wa.gov/ecy/publications/publications/1203001.pdf. Accessed April 12, 2013.

FIGURES

Figure 1. Vicinity Map

Figure 2. Ecology Sediment Sampling Sites

APPENDICES

Coastal Geologic Services Report

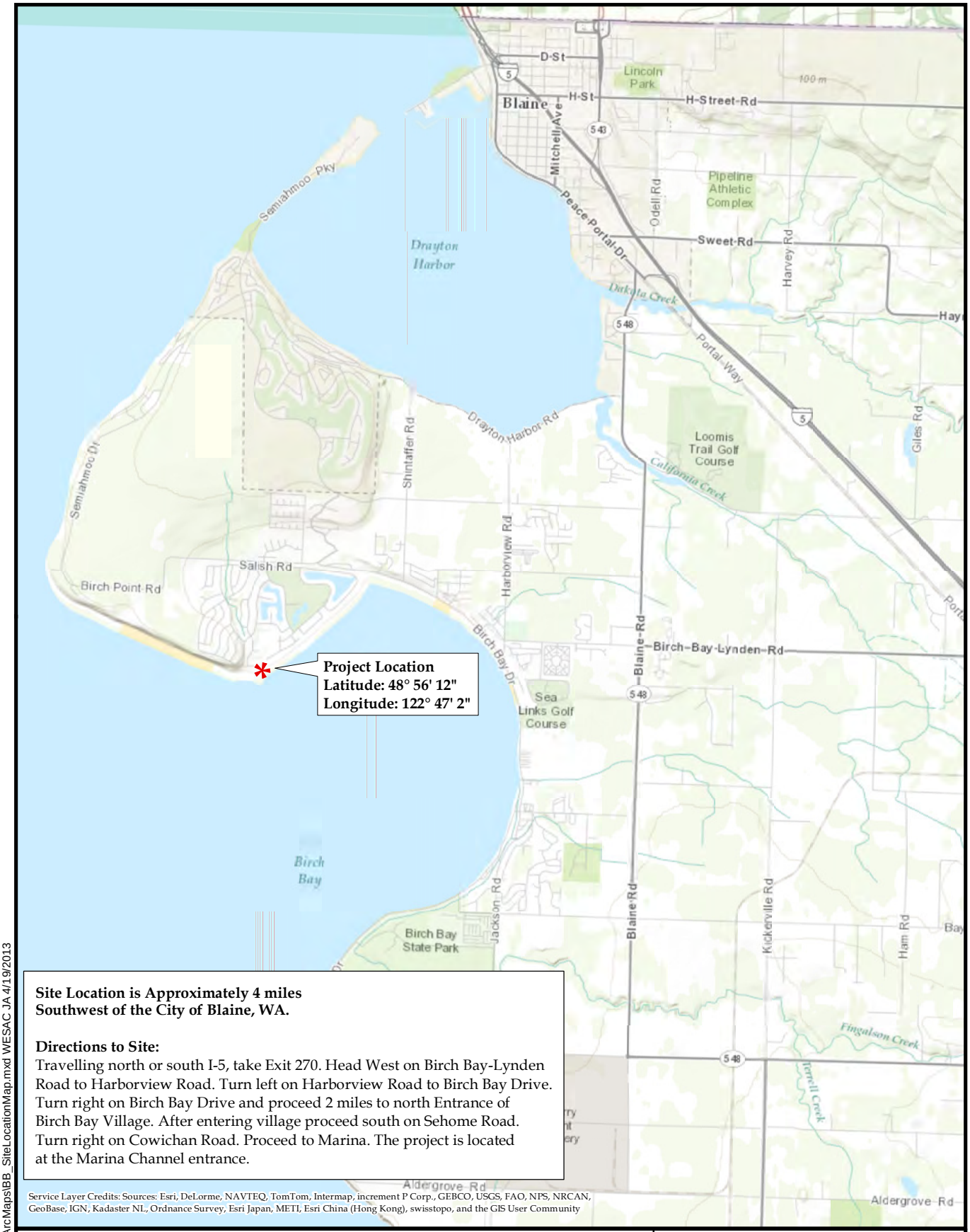

Figure 1
Site Location Map
Birch Bay Village Community Club
Blaine, WA

PREPARED BY: JA (ERM)	Job No.: 105449 File: BB_SiteLocationMap.mxd

F:\GIS\Projects\BirchBay\ArcMaps\BB_SiteLocationMap.mxd WESAC JA 4/19/2013

122°47'24"W 122°47'18"W 122°47'12"W 122°47'6"W 122°47'0"W 122°46'54"W 122°46'48"W 122°46'42"W 122°46'36"W 122°46'30"W 122°46'24"W 122°46'18"W 122°46'12"W

48°56'12"N
48°56'6"N
48°56'0"N
48°55'54"N
48°55'48"N
48°55'42"N
48°55'36"N

Former Boat Maintenance Facility

Gas Dock

Chehalis Rd
Cowichan Rd
Nakat Way
Comox Rd
Tsawwassen Loop

3, Birch Bay
Latitude: 48 55.7973, Longitude: -122 46.8563

125, Birch Bay
Latitude: 48 55.6431, Longitude: -122 46.2477

\\wdsacdc01\data5\AC\GIS\Projects\BirchBay\ArcMaps\BB_2006SamplingLocations.mxd WESAC 4/17/2013

Service Layer Credits: Copyright© 2013 Esri, DeLorme, NAVTEQ, TomTom
Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Legend

- 2006 Dept. of Ecology Sampling Location
- Pre-2014 Dredge Contours March 2013
- 2000-2005 Bathymetry
- Proposed 2014 Dredge Volume Area

Figure 2

N

0 400

Scale in Feet

Birch Bay Village Community Club

2014 Marina Maintenance Dredging Project Nearest Sediment Sampling Sites

ERM

PREPARED BY: (ERM)

JOB NO. 191928
FILE: BB_2006SamplingLocations.mxd

Birch Bay Village Community Club Marina: Coastal Processes Study & Analysis of Options for Dredge Spoils Disposal/ Beach Nourishment

Northern Whatcom County, WA
NW ¼ Section 26, T 40N, R 1W

Prepared by: Jim Johannessen, MS
Coastal Geologic Services, Inc.
Bellingham, WA

Prepared for: Anvil Corporation
Mr. Dan Vekved
Bellingham, WA

February 9, 2001

Purpose and Scope

The purpose of this report was to compile and analyze coastal processes information for the Birch Bay Village Marina channel entrance area and to provide recommendations regarding the possible use of the dredge spoils for beach nourishment at the site. This report follows initial consultation with agency personnel regarding the need for maintenance dredging at the marina channel near the outer end of the jetties. The site is located on the northwest shore of Birch Bay approximately 2 miles east of Birch Point (Figure 1). The site is contains an artificial entrance channel for a pleasure boat marina that is located inland. The outer portion of the entrance channel is proposed for maintenance dredging.

The agreed upon scope of services for this effort included the following items:

- Compilation of relative previous coastal processes work in the area
- Field reconnaissance and assessment
- Aerial photo, map, and document review (including dredging history)
- Analysis of historic air photos to determine shoreline change trends/ rates
- Analysis of options for disposal of dredge spoils to include beach nourishment (suitability and usefulness) and recommended option
- Preparation of a report documenting the above tasks

Work completed included review of historical aerial photos, survey maps, and the recent bathymetric map, performing field assessments, sediment sample collection and grain size analysis, and integration and assessment to provide recommendations.

Coastal Processes

Net-shore Drift

Net shore-drift describes the long-term coastal sediment transport along a stretch of coast. A net shore-drift cell is composed of an origin (erosional bluff acting as a sediment source or "feeder bluff", a transport zone, and a terminus (usually a relatively wide beach or spit). Net shore-drift is generally to the east in the northern Birch Bay area, as documented by Edmund Jacobsen in 1980 in his *Net shore-drift of*

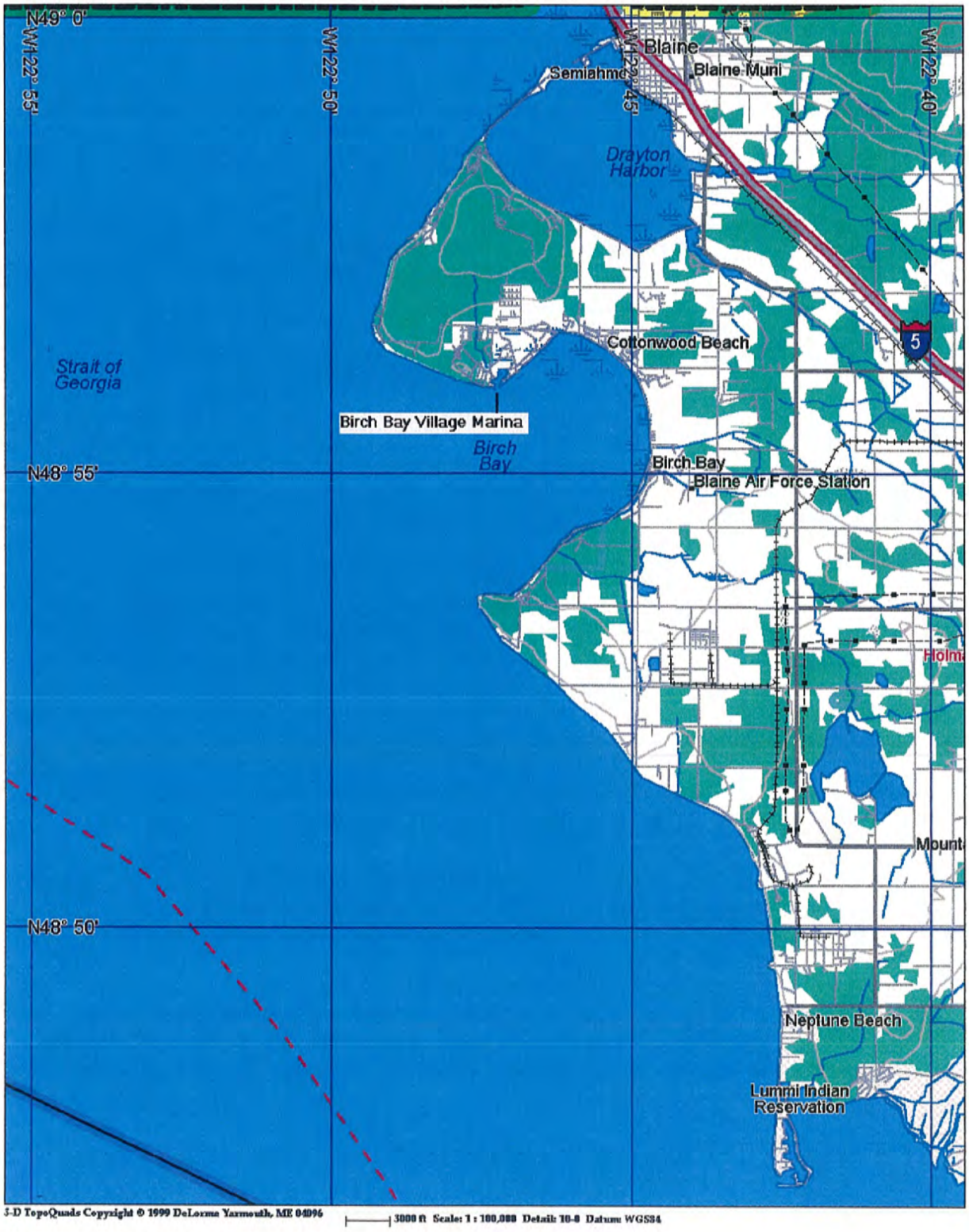

Figure 1. Location map, northwestern Whatcom County.

Whatcom County, Washington report (reprinted in Schwartz, et al., 1991). However, the pre-marina and post-marina net-shore drift patterns are very different. See Appendix 1 for detailed air photos of the area.

The text for the northern bay shore from the Jacobsen report is reprinted here in its entirety. Note that the report was based on field conditions as of 1980.

> **Drift Sector 5**
>
> **Location:** This sector stretches from Birch Point to the Birch Bay Village Marina (See Figure 2).
>
> **Direction:** Drift is to the southeast.
>
> **Evidence:** Coastal bluffs become more vegetated to the southeast. Beach sediment grades from cobbles at Birch Point to sand at the marina. Sediment is accumulating on the northwest side of the marina jetty and eroding on the southeast side. The dredged marina channel and jetty appear to be an absolute barrier to the movement of drift. Predominant waves from the west strike the coast in the area in such a manner so as to move sediment down the coast in a southeast direction.
>
> Greatest fetch is to the west 40 kilometers (25 mi.).
>
> **Drift Sector 6**
>
> **Location:** This sector is located from Birch Bay Village Marina to the most northerly part of Birch Bay (See Figure 2).
>
> **Direction:** Net shore drift is to the northeast.
>
> **Evidence:** Sediment grades finer from the marina to the northeast. The marina jetty shows accumulation on its southwest side and erosion on its northeast side. The erosion is now endangering several homes. This entire sector is an accumulation beach formed by a series of nested spits. These were built by waves generated by predominate northwest winds blowing across the 145 kilometer (91 mi.) fetch along the Strait of Georgia, which refract around Birch Point and the unnamed protuberance of the coast at the marina site, and continue into Birch Bay. Although these nested spits have been somewhat obscured by recent construction, they are still vaguely visible as a series of low, parallel ridges. At the most northerly corner of Birch Bay, at the end of this sector, a northeasterly prograding lobe of sediment nearly closes a small lagoon.
>
> Drift Sectors 5 and 6 comprised one sector prior to the construction of the marina. At the present time there is no evidence of material drifting past the marina jetty.

Net-shore Drift Rate

Information on the rate of net-shore drift (average sediment transport rate) was provided by a report prepared by Schwartz and Wallace (1986) for WA Dept. of Ecology. The information that pertains to the site is reprinted below:

> **Site 24: Birch Bay Village Marina, Birch Bay, Whatcom County, Washington**
>
> **LOCATION**: The marina at Birch Bay Village is located 7.5 km (11 mi.) south of Blaine, Washington, at the northwest corner of Birch Bay.
>
> **OBSERVATIONS**: The Birch Bay Village Marina is the terminus for a drift cell originating 3 km (2 mi.) to the west at Birch Point (Jacobsen, 1980/ Schwartz, et al., 1991). Undefended glacial bluffs supply sediment to the littoral zone west of Birch Bay.
>
> The entrance channel to the marina is protected by rubble mound jetties on its west and east sides. The west jetty is almost a total barrier to the eastward movement of littoral sediment. A large prograding beach has formed west of the channel jetty in response to this obstruction. The beach extends 72 meters (238 ft) seaward from the back of the original beach, and begins to accumulate at a point 105 meters (347 ft) updrift (west) of the west jetty. The thickness is 4.43 meters (14.6 ft) from the top of the beach to the lower foreshore, and the total volume for the prograding beach is

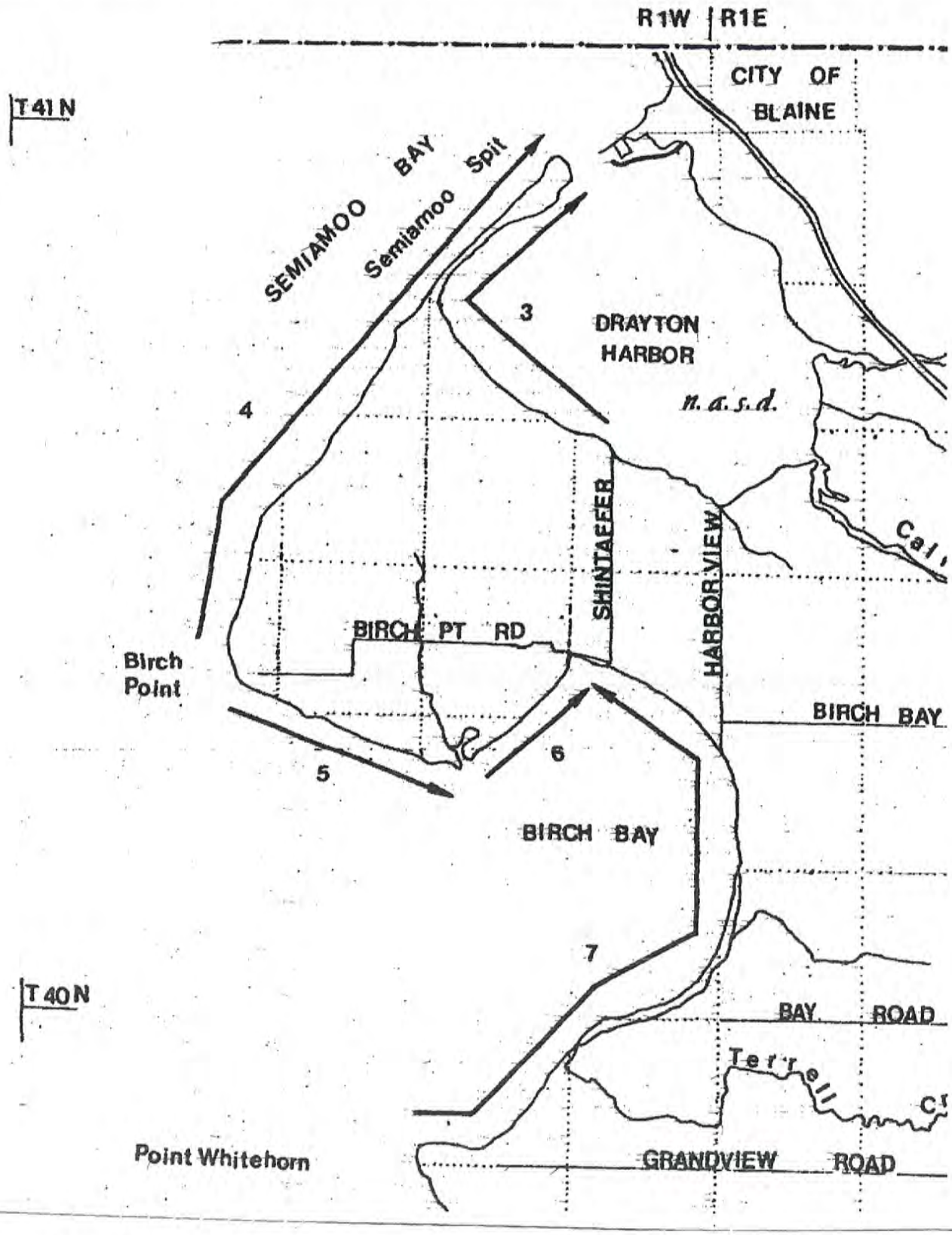

Figure 2. Net-shore drift map of the Birch Bay area, from (Schwartz, et al., 1991).

presently estimated to be 8,370 cubic meters (10,325 cubic yards [cy]). East of the channel the shoreline is offset landward, showing the effect of sediment starvation.

Sediment does bypass the west jetty, and it has been necessary to dredge the channel. Since the construction of the jetties in 1967, the channel has been dredged four times (Elliot Fleming, Birch Bay Village Marina, personal communication, 1986). Approximately 760 cubic meters (938 cy) of material were removed from the channel in 1986 and also in 1981 (Roland Culbertson, Birch Bay Village marina, personal communication, 1986). Records of earlier maintenance dredging volumes and dates were unavailable. Considering the time interval and the number of pre-1981 dredging projects, the assumption was made that a similar volume of material had been removed from the channel during the two previous dredging operations.

The total volume of sediment dredged from the entrance channel is estimated to be 3,050 cubic meters (3,763 cy). This volume, when added to the volume of the prograded beach, is 11,410 cubic meters (14,076 cy) and represents the total volume accumulated at the marina since 1967. Assuming fairly constant accumulation, a first approximation of the annual net shore-drift rate is 600 cubic meters (740 cy) per year.

NET SHORE-DRIFT DIRECTION AND RATE: the net shore-drift at the Birch Bay Village Marina is from west to east, and the drift rate is 600 cubic meters (740 cy) per year.

Beach Conditions

The beach area for approximately 2,000 ft both east and west of the marina entrance channel was examined on 12/7/00, 1/10/01 and 2/5/01. The beach is divided into 3 different portions in this report. The term "backshore" or "backshore area" refers to the drift log band landward to the beginning of upland area such as landscaped yard or a bulkhead, or the bluff toe. The term "high-tide beach" refers to the steeper upper portion of the beach that is generally above the +4 ft MLLW (mean lower low water) elevation, and waterward of the drift log zone. The term "low-tide terrace" refers to the more gently sloping lower beachface that is either dominated by cobble or sand bars.

There are 3 different types of high-tide beach in the study area, as far as sediment composition goes. An accretionary prism (triangular in plan view) is located on the west side of the west jetty. This is caused by the accumulation of net-shore drift sediment that is moving from west to east and that is interrupted by the jetty (this is described in detail in the *Net-shore Drift* and *Net-shore Drift Rate* sections, above). The high-tide beach in the area west of the accretionary prism contains a wide variety of sediment size that includes sand to cobble sized sediment (Figure 3). The lower portion of the high-tide beach there contains mostly pebble and cobble, with less sand. This is contrasted by the high-tide beach in the accretionary prism, which contains relatively more fine gravel (small pebble and granule) and sand (Figure 4). The high-tide beach east of the east jetty is limited to cobble with lesser amount of pebble. This area is the most coarse grained and contains almost no sand at the surface (Figure 6).

The 3 different areas described above also contain very different backshore areas. The area west of the accretionary prism has a narrow backshore area that contains drift logs. The backshore area in the accretionary prism is a very wide area that also contains dunegrass and abundant drift logs (Figure 5). The area east of the east jetty does not have a backshore area. The high-tide beach meets the toe of a row of bulkheads (Figure 6) at elevations that appear to be below MHHW (mean higher high water). The bulkheads in this area show many signs of beach lowering (erosion). The majority of the bulkheads in the 8 houses east of the entrance channel have had a new footing installed one or two times. This must have been in response to dramatic beach lowering and partial bulkhead failure (cracks). There was evidence for significant erosion of at least several feet (vertical) in the damage and changes in the structures, and likely more beach erosion occurred.

Figure 3. High-tide beach in the area west of the accretionary prism. Note mixture of pebble, sand, and cobble, and backshore area with drift logs.

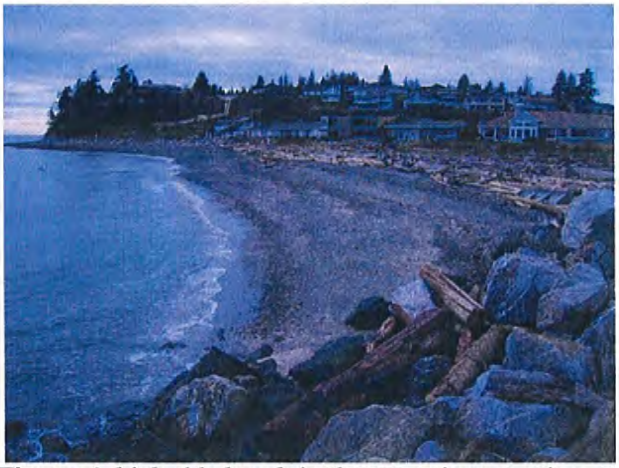

Figure 4. high-tide beach in the accretionary prism. Note sandy beach and very wide backshore area.

Figure 5. Backshore area in accretionary prism looking east. Note wide backshore area and sandy upper high-tide beach.

Figure 6. High-tide (cobble) beach east of east jetty. Note presence of continuous line of bulkheads and expended bulkhead toe protection.

Channel Entrance

The entrance channel and jetties at the Birch Bay Village Community Club were constructed in 1967. The entrance channel was cut into a curvilinear beach that appeared to be relatively consistent prior to construction (as evidenced by historic air photos). On the west side of the entrance channel, a rubble mound/armor rock jetty extends approximately 350 ft from the uplands across the beach to what was subtidal bedlands. A second jetty is present on the east side of the entrance channel that extends roughly 250-275 ft from the uplands (Figure 7). This jetty curves around to the NE near its base and transitions into a riprap revetment (Figure 8), such that its exact length is vague. The west jetty extends approximately 100 ft further waterward that the east jetty. It appears that both jetties were not modified significantly since 1975. There may have been additional armor rock added to the outer portion of the jetties judging by the different types of rock and likely damage/ settling that this type of rock structures would have experienced in this moderate wave energy setting.

Figure 7. Entrance channel and east jetty looking NE. Photo taken at mid-tide from the outer end of the west jetty.

Figure 8. East jetty and entrance channel area, looking SW.

The entrance channel is generally 75-85 ft wide between the 0.0 ft MLLW contours as surveyed in late 2000 (Bluewater Engineering 2000, and Figure 7). The maximum channel depth in the inner channel (landward of the end of the E jetty) is around –8.0 ft MLLW (Bluewater Engineering 2000). The depth in the center of the channel east of the tip of the west jetty is generally –3 to –5 ft MLLW, with the deepest part of the channel a little deeper than –5.0 ft MLLW (Bluewater Engineering 2000). Depth measurements at selected sites were made by CGS through wading the channel area in January 2001. The measurements were correlated to preliminary tidal observations provided on a NOAA Internet site for elevation control. Field measurements and observations by CGS verified the Bluewater Engineering mapping.

Sediment in the entrance channel was inspected in the field and several samples from the main shoal area (east of the waterward end of the west jetty) were collected by CGS. Sample collection was from the –1 to –3 ft MLLW elevation. These samples were sub-sampled and combined into one integrated channel sample for grain size analysis. Results of the grain size analysis are presented in Table 1 below. There was a moderate amount of shell fragment in the smaller pebble and very coarse sand fraction, although the weight of shell fragment was estimated at less than 25 percent of these size classes. The sediment in the entrance channel consisted of 73 percent coarse and very coarse sand. The sample contained 7.1 percent gravel and 20.1 percent medium to very fine sand and silt.

Ripple marks were observed on the shoals in the entrance channel area indicating that active sediment transport was occurring from the SW to NE in the area both south and east of the tip of the west jetty. This supports the net-shore drift information presented in an earlier section of this report.

Table 1. Sediment characterization of entrance channel sediment, collected on 2/7/01.

Sediment Grain Size		**Channel Dredge Area Integrated Sample -1.0 to -3.0 ft MLLW**
Wentworth Scale	**Inches**	**% Frequency**
(-) 6 phi (>64 mm) cobble	>2.5	0.0%
(-) 5 phi (32-64 mm) cobble	1.25 - 2.5	0.0%
(-) 4 phi (16-32mm) pebble	0.6 - 1.25	1.1%
(-) 3 phi (8-16 mm) pebble	0.3 - 0.6	1.1%
(-) 2 phi (4-8 mm) pebble	0.16 - 0.3	1.6%
(-) 1 phi (2-4 mm) granule	0.08 - 0.16	3.3%
0 phi (1-2 mm) v.cs. sand	0.04 - 0.08	5.0%
(+)1 phi (0.5-1 mm) cs. sand	0.02 - 0.08	67.8%
<(+) 2 phi (<0.5 mm) fines	<0.02	20.1%
Sum		100.0%
Total 1-8mm		9.9%

Historical Shoreline Change

The beach both post-channel and pre-channel was examined in a series of historic aerial photos to provide a context in which to examine the modified coastal system near the marina. Available suitable-scale vertical aerial photos were reviewed and an initial quantification of coastal erosion was documented using photos from the Whatcom County Engineering Department archives. Photos were available at generally 1 inch=400 foot scale from 1950, 1961, 1975, 1986, and 1995. Detailed color aerial photos were used at the Whatcom County Planning Department. These photos were from the Dept. of Ecology and included a 1976 vertical set, a 1977 oblique set, as well as a 1994 oblique set (from the Internet).

Shoreline change trends will be discussed in terms used above; in the accretionary prism, the up-drift beach west of the accretionary prism, and at the down-drift area east of the jetties. Copies of the 3 detailed color photo sets (1976, 1977, and 1994) are attached to this report in Appendix 1. Table 2 contains a qualitative history of changes in the coastal system of the study area.

Table 2. Qualitative historical changes evident from aerial photos.

YEAR	SHORELINE CHANGE OR FEATURE
1950	"Natural" shoreline with wide beach and backshore area along entire future marina area (1,500 ft to E and to W). Drift log zone (of backshore) averaged 35 ft wide on both sides of future jetties. Low point (and landward indentation in beach approx. 1,100 ft E of W jetty. Gravel and sand bars present W of W jetty in lower intertidal area.
1961	No discernable beach changes since 1950. Shoreline remained stable with wide beach and backshore area. Gravel and sand bars present W of W jetty slightly enlarged since 1950.
1975-76	Jetties and marina in place (1967). 350 ft long accretionary prism located W of W jetty in 1976. Majority of developed lots first 11 lots E of E jetty bulkheaded. 25-35 ft wide drift log zone present E of E jetty.
1986	Accretionary prism enlarged W of W jetty. Beach narrower E of E jetty with backshore area erosion. Additional houses and bulkheading E of E jetty.
1994-95	Approx. 380 ft long accretionary prism W of W jetty. Gravel and sand bars in intertidal W of W jetty slightly further enlarged. Backshore area absent E of E jetty due to additional beach erosion.
Field 2000-01	Approx. 405 ft long accretionary prism W of W jetty. Evidence of past bulkhead damage and recently installed (and older) extended bulkhead footings E of E jetty.

Several sets of measurements were made on photos that quantify the changes outlined in Table 2. Coastal erosion measurements were made through scaled measurement from aerial photos. Scaled measurements were made with a precision caliper directly from "original" aerial photo enlargements. The feature measured was the waterward line of drift logs, the only beach feature that shows up consistently on the photos. No corrections were made for distortion due to photo enlargement (by the photo contractor), radial lens distortion, or paper shrinkage or stretching, although these errors are not considered large and are randomly distributed.

The rate of loss of the backshore area and the upper high-tide beach east of the entrance channel was quantified from the 1975 and 1995 air photos. Scaled measurements from 3 houses to the waterward extent of the drift log line (or upper beach if drift logs were absent) were made east of the east jetty. The beach erosion was at least 0.7 ft/yr at a point 520 ft east of the east jetty, 1.45 ft/yr at 880ft east, and 0.85 ft/yr at 1,700 ft east.

The accretionary prism become largely filled between 1967 and the mid-1980s. The total cross shore width of the accretionary prism as measured from the base of the west jetty to the waterward extent of drift logs was 75 ft in 1976. The beach in this area accreted to a distance of 123 ft from the base of the jetty by late 2000. The waterward accretion rate was therefore 2.0 ft/yr.

Dredging History

The history of dredging at the site was investigated to determine the frequency and quantity of past dredging efforts. This type of record often provides some insight into the likely future dredging needs to maintain the channel in a similar configuration. Records of dredging at the marina were obtained from the Schwartz and Wallace study and Mr. Dan Vekved of Anvil Corporation. The dredging history at the site is unclear between 1967 and 1981. Schwartz and Wallace (1986) reported that the channel entrance was

dredged 4 times up to 1986, and Mr. Dan Vekved reported 2 dredge events in the 1990s See Table 1 for dredging volumes.

Table 3. Known dredge history at Birch Bay Village Marina.

Year	Dredge Volume
1967	Jetties
1967-1980	2 times - ? Vol.
1981	938 cy
1986	938 cy
1990	1,000 cy
1994	1,000 cy
Average	969 cy

Conclusions and Recommendations

Channel Entrance Impacts on Coastal Processes

Prior to construction of the jetties, wind waves transported sediment (net-shore drift) that was derived from the bluff in the broad area centered at Birch Point eastward through the study area. The older air photos (1950 and 1961) show the old nested spit complex that was mentioned by Jacobson. This demonstrates that the entire low elevation area east and north of the entrance channel was deposited by net-shore drift over the past 2-4 thousand years. The Birch Bay Village Marina jetties and channel entrance have largely interrupted net-shore drift in the Birch Point to the northern Birch Bay shore. This has impacted beaches near the entrance channel and for a substantial distance to the east of the marina.

The beach east of the east jetty was eroded due to a drastic decrease in net-shore drift sediment reaching it. At the same time, wave energy reaching the beach was increased due to wave refraction around the east jetty. High-tide beach erosion there was measured from historic aerial photos at greater than 0.7 ft/yr to 1.45 ft/yr in the area up to 1,700 ft east of the east jetty between 1975 and 1995. At the same time the high-tide beach has changed from a mixed sand and gravel beach to a cobble beach. This area likely contained some amount of potential surf smelt spawning area pre-development. Vertical erosion east of the entrance channel may have been up to 3 or 4 ft on the upper beach since the channel entrance was constructed.

The development of the accretionary prism in the area west of the entrance channel has had several impacts on the beach and nearshore system. The accretionary prism has converted approximately 0.5 acres of shallow nearshore area to a broad drift log and dunegrass covered upland area. At the same time the upper intertidal beach in the accretionary prism contains approximately 350 ft of very good potential sand lance and surf smelt spawning habitat, where habitat was likely marginal to good pre-development.

Net-shore Drift Rate and Entrance Channel Shoaling

Jacobsen (Schwartz, et al., 1991) reported that there was no net-shore drift across the entrance channel in 1980. However, it is thought that some amount of sand was transported (on the low-tide terrace) into the entrance channel. This occurred before the accretionary prism area west of the west jetty became large. The jetties were an absolute barrier to *high-tide* beach littoral drift prior to the mid 1980s. That is when the high-tide beach began encroaching on the tip of the west jetty. Natural sediment transport across the entrance channel was reported in 1986 (Schwartz and Wallace, 1986). Littoral drift of high-tide beach coarse sand and gravel has been occurring at an increasing rate since the mid-1980s. This will cause progressively larger volumes of sediment to be transported into the mouth of the entrance channel over

time. Presently, some amount of the sand entering the mouth of the entrance channel likely naturally bypasses the area at lower tides. Following dredging, very little sediment would bypass the channel.

Schwartz and Wallace (1986) stated that the net-shore drift rate is 740 cy/yr in the study area. When the accretionary prism completely "fills" the area west (up-drift) of the west jetty, which may occur over the next one or two decades, the rate of infilling of the entrance channel will likely increase. The infilling rate may exceed half of the estimated net-shore drift rate, to on the order of 350-500 cy/yr. This would mean that either the frequency of dredging or the volume of material dredged will have to increase over time to maintain the channel in a similar configuration to the past.

Analysis of Bypassing Option

Dredge sediment at the site has always been disposed of at upland locations, as far as the record indicates. The option of using future dredge sediment for a beneficial purpose was one of the main tasks for analysis for this report, and will be discussed here. The term bypassing is used for moving accumulated sediment from the up-drift side of a channel, or from channel shoals, to the down-drift beach. Bypassing is a very common practice in other parts of the country and is not uncommon in the Puget Sound region. Local examples of bypassing mostly occur at artificial marina entrance channels, such as the Point Roberts Marina in northern Whatcom County and the Keystone ferry terminal on Whidbey Island.

Similar to the Birch Bay Village Marina, the Point Roberts Marina is located in the middle of a net-shore drift cell and also contains 2 large jetties. The jetties at Point Roberts do not extend below MLLW due to changes in the Washington hydraulics codes, however a detached breakwater is present immediately waterward of the jetties. These large structures cause net-shore drift sediment to be deposited on the up-drift (east) side of the channel and in the entrance channel. Sediment is annually removed from the Point Roberts Marina entrance channel and the beach immediately up-drift of the channel and bypassed (by truck) around the marina area. Sediment is deposited on the upper beach (above +5.1 ft MLLW) in the area between 300 and 1,200 ft west of the channel. Generally 3,000 to 6,000 cy is bypassed annually in this operation. This bypassing system, although not a perfect solution, has prevented severe erosion on the properties down-drift of the marina. Permits are currently being renewed for the Point Roberts Marina bypassing operation.

The Keystone example also has several things in common with Birch Bay Village Marina. The Keystone harbor contains a channel that is dredged periodically for navigation. There is no jetty up-drift of the Keystone harbor such that net-shore drift sediment directly enters the harbor. The net-shore drift rate was estimated at 5,610 cy/yr (Schwartz and Wallace 1986). Dredge spoils are routinely placed on the upper beach on the east (down-drift) side of the channel. Spoils are placed over the backshore area and it takes a number of years to erode and transport the large volumes of sediment bypassed at Keystone.

A different but related project is in place at Lummi Shore Road beach along western Bellingham Bay at the Lummi Indian Reservation. Sand and fine gravel is brought from upland gravel pits to the upper beach at Lummi Shore Road to mitigate for the construction of a large rock revetment. Mitigation was designed to benefit surf smelt, and has been successful to date.

The sediment in the main dredge area of the entrance channel was dominated by coarse and very coarse sand (73 %, Table 1). The entrance channel sample contained a small amount of gravel (7 %). These sediment sizes are precisely what is missing from the high-tide beach east of the marina jetties. Addition of sand to the down-drift beach would partially mitigate for the upper intertidal beach degradation that has occurred east of the marina.

The entrance channel sample contained 20.1 percent very fine to medium sand and silt. The amount of silt is fairly low and represents a much lesser proportion than nearby bluff deposits contain. Therefore the minor amount of fine sand and silt in the dredge area would pose less potential "harm" in terms of siltation than would a single moderate-large landslide, an occurrence that is fairly common only several thousand ft up-drift of the entrance channel. Additionally, fine sand is a substrate that eelgrass colonizes.

The bypassing of 1,000 cy of sandy sediment would not substantially improve the condition of the beach down-drift, but it would improve conditions to a certain degree. This volume could provide a 1.5 ft thick cover over an area 30 ft wide and 600 ft long. This material would be subjected to waves and eastward transport, but it would continue to benefit the beach further east as it is transported in that direction. The net-shore drift rate decreases to the east and fine sediment would have a progressively longer residence time to the east. Bypassing a larger volume of sediment would provide greater benefit to down-drift beaches. Bypassing sediment each time the channel is dredged in the future would also help improve down-drift beach conditions in the future.

Implementation of a bypassing operation at Birch Bay Village Marina should not require precise placement methods. Waves would quickly redistribute sandy sediment and "naturalize" the beach without the need for extensive design work or site grading.

Limitations of This Report

This report was prepared for the specific conditions present at the subject property to meet the needs of specific individuals. No one other than the client or the Birch Bay Village Community Club should apply this report for any purposes other than that originally contemplated without first conferring with the geologist who prepared this report. The findings and recommendations presented in this report were reached based on several brief field visits and interpretation of aerial photos and maps. The report does not reflect detailed examination of sub-surface conditions present at the site, or coastal hydraulics modeling, which are not known to exist. It is based on examination of surface features, beach and coastal processes, and historical documentation. In addition, conditions may change at the site due to human influences, floods, extreme windstorms, or other factors.

Thank you for engaging the professional services of Coastal Geologic Services, Inc. If we can be of any additional assistance please contact our office.

References

Schwartz, Maurice L. and R. Scott Wallace, 1986, Quantification of net-shore drift rates in Puget Sound and the Strait of Juan de Fuca, Shorelands Program, Washington Department of Ecology, Olympia 41 p.

Schwartz, Maurice L., et al., 1991, *Net shore-drift in Washington State, Volume 5, Northern Bays and Straits*, by, Edmund Jacobsen, 1980, Shorelands Program, Washington Department of Ecology, Olympia.

Coastal Geologic Services, Inc.

2/9/01

Jim Johannessen, MS
Principal Geologist

ATTACHMENT: Appendix 1: Vertical (1976) and oblique air photos (1977, 1994).


1976


1977

Shoreline Aerial Photos

Home Search Zoom Out

WHA0122 • 4/28/94 12:14:00 PM • Mainland • Marina

Next Image

Home - Site Info - Search - Sights - Links

122°47'24"W 122°47'18"W 122°47'12"W 122°47'6"W 122°47'0"W 122°46'54"W 122°46'48"W 122°46'42"W 122°46'36"W 122°46'30"W 122°46'24"W 122°46'18"W 122°46'12"W

48°56'12"N
48°56'6"N
48°56'0"N
48°55'54"N
48°55'48"N
48°55'42"N
48°55'36"N

Former Boat Maintenance Facility

Gas Dock

Cowichan Rd

Chehalis Rd

Comox Rd

Nakat Way

Tsawwassen Loop

latitude = 48.9322

3, Birch Bay
Latitude: 48 55.7973, Longitude: -122 46.8563

125, Birch Bay
Latitude: 48 55.6431, Longitude: -122 46.2477

\\wdsacdc01\data5AC\GIS\Projects\BirchBay\ArcMaps\BB_2006SamplingLocations.mxd WESAC 4/17/2013

Service Layer Credits: Copyright© 2013 Esri, DeLorme, NAVTEQ, TomTom
Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Legend

- 2006 Dept. of Ecology Sampling Location
- Pre-2014 Dredge Contours March 2013
- 2000-2005 Bathymetry
- Proposed 2014 Dredge Volume Area

Attachment B

Figure 2

N

0 400

Scale in Feet

Birch Bay Village Community Club

2014 Marina Maintenance Dredging Project Nearest Sediment Sampling Sites

ERM

PREPARED BY: (ERM)	JOB NO. 191928 FILE: BB_2006SamplingLocations.mxd