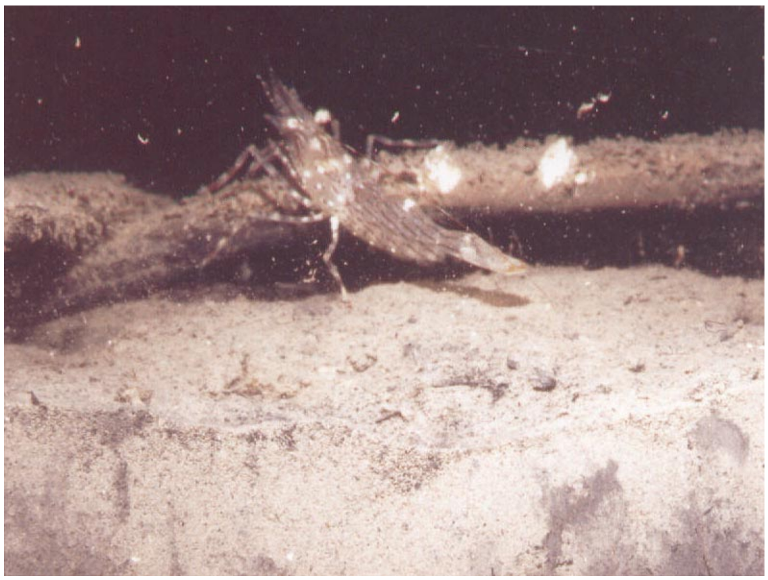
PORT ANGELES HARBOR
WOOD WASTE STUDY
PORT ANGELES, WASHINGTON

FINAL

February 5, 1999



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EXECUTIVE SUMMARY

Port Angeles Harbor, Washington has been listed as an impaired water body under the 1998 Clean Water Act 303(d) for not meeting water quality standards for dissolved oxygen. The Washington State Department of Ecology (Ecology) wants to determine the extent to which water quality problems are due to wood waste accumulation. Science Applications International Corporation (SAIC), under contract to Ecology, conducted a survey to map the extent of wood waste on the harbor bottom and assess the biological impact due to its accumulation. The study was designed to address the following objectives:

1. Map the horizontal extent of wood waste accumulations
2. Measure the thickness of the accumulations
3. Describe the wood waste encountered
4. Measure the depth of the apparent redox potential discontinuity (RPD)
5. Identify areas with potential for high sediment oxygen demand (SOD)
6. Evaluate the health of the benthic macroinvertebrate community

The survey was conducted in subtidal portions of Port Angeles Harbor (west of the end of Ediz Hook; 123° 24’W Longitude) using sediment vertical profile photography, sediment plan-view photography, and towed underwater video. The following is a summary of the major findings of this study:

- Wood waste covers approximately 25 percent (500 acres) of the bottom of Port Angeles Harbor, primarily in nearshore log booming areas.

- Five types of wood waste were identified on the bottom of Port Angeles Harbor:
  - Logs or large wood pieces
  - Small wood and/or bark chips (wood chips)
  - Very fine wood particles and/or fibers (wood pulp)
  - Trace to sparse wood pulp/chips mixed within the sediment column
  - Sparse, scattered wood pieces on top of the sediment surface

- Abundant wood debris including logs and large bark/wood fragments was observed in the active and historical log booming grounds. Large piles of recently deposited logs were observed in the active log booming grounds along the northern portion of the harbor. Size and abundance of wood debris decreased offshore from the booming grounds.

- A layer of wood pulp covering approximately 35 acres is buried under 6 to 8 cm of ambient silt in the western central harbor. The layer represents an estimated volume of 9,500 cubic yards of wood pulp (wet-volume).

- Shallow apparent redox (RPD) depths in Port Angeles Harbor were associated with active and historical log booming grounds and indicate organic overloading. Stations with very shallow to non-existent apparent redox depths were observed close to shore near the Daishowa facility, the public log dump grounds, the booming grounds near K-Ply, and the former ITT Rayonier grounds.

- Accumulation of fine wood waste (pulp) has contributed to apparent high sediment oxygen demand (SOD) conditions in the western harbor near the Daishowa and M&R Timber facilities, the public log dump, the booming grounds near K-Ply, and the former ITT Rayonier grounds. Bacterial mats, which indicate organic loading and low dissolved oxygen conditions, were also observed at four stations in the western harbor.

- Organism-Sediment Index (OSI) values in the central harbor were between +7 and +11 indicating healthy benthic infaunal communities. Stressed or disturbed communities (OSI values less than +6 were generally observed in the log booming grounds. Degraded benthic habitat (OSI less than zero) was observed in near shore areas of the western harbor (stations 8, 12, 40, 43, and 95). Such habitat is of little value to fish.

- The presence of sparse, scattered wood debris on the sediment surface (offshore of the log booming areas) appears to have minimal impact on the health of the benthic community and provides habitat for epibenthic organisms (e.g., shrimp, crabs, fish, etc).

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1.0 INTRODUCTION

Port Angeles Harbor, Washington is located on the northern side of the Olympic Peninsula, along the Strait of Juan de Fuca (Figure 1). The harbor has been listed as an impaired water body under the 1998 Clean Water Act 303(d) for not meeting water quality standards for dissolved oxygen. Some areas of the harbor have been reported to be anoxic in places, lacking shellfish and bottom fish.

Logging and timber have been important industries to Port Angeles since the early 1900's. The Washington State Department of Ecology (Ecology) wants to determine the extent to which water quality problems are due to accumulations of wood debris from a history of log rafting and other sources of wood debris to the harbor (see Figure 1). Under contract to Ecology, Science Applications International Corporation (SAIC) conducted a survey to map the extent of wood waste accumulation in Port Angeles Harbor, and assess the biological impact due to its accumulation. SAIC conducted the survey in subtidal portions of Port Angeles Harbor (west of the end of Ediz Hook; 123° 24' W Longitude) using sediment vertical profile photography, sediment plan-view photography, and towed underwater video. The study was designed to address the following objectives:

1. Map the horizontal extent of wood waste accumulations
2. Measure the thickness of the accumulations
3. Describe the wood waste encountered
4. Measure the depth of the apparent redox potential discontinuity
5. Identify areas with potential for high sediment oxygen demand
6. Evaluate the health of the benthic macroinvertebrate community

This report presents the results of the wood waste study conducted in Port Angeles Harbor in November 1998. This study provides a first step in determining a Total Maximum Daily Load (TMDL) or alternative for dissolved oxygen in Port Angeles Harbor. The results will be used to guide decisions about more in-depth studies, and identify possible corrective actions or best management practices for log rafting in Port Angeles Harbor.

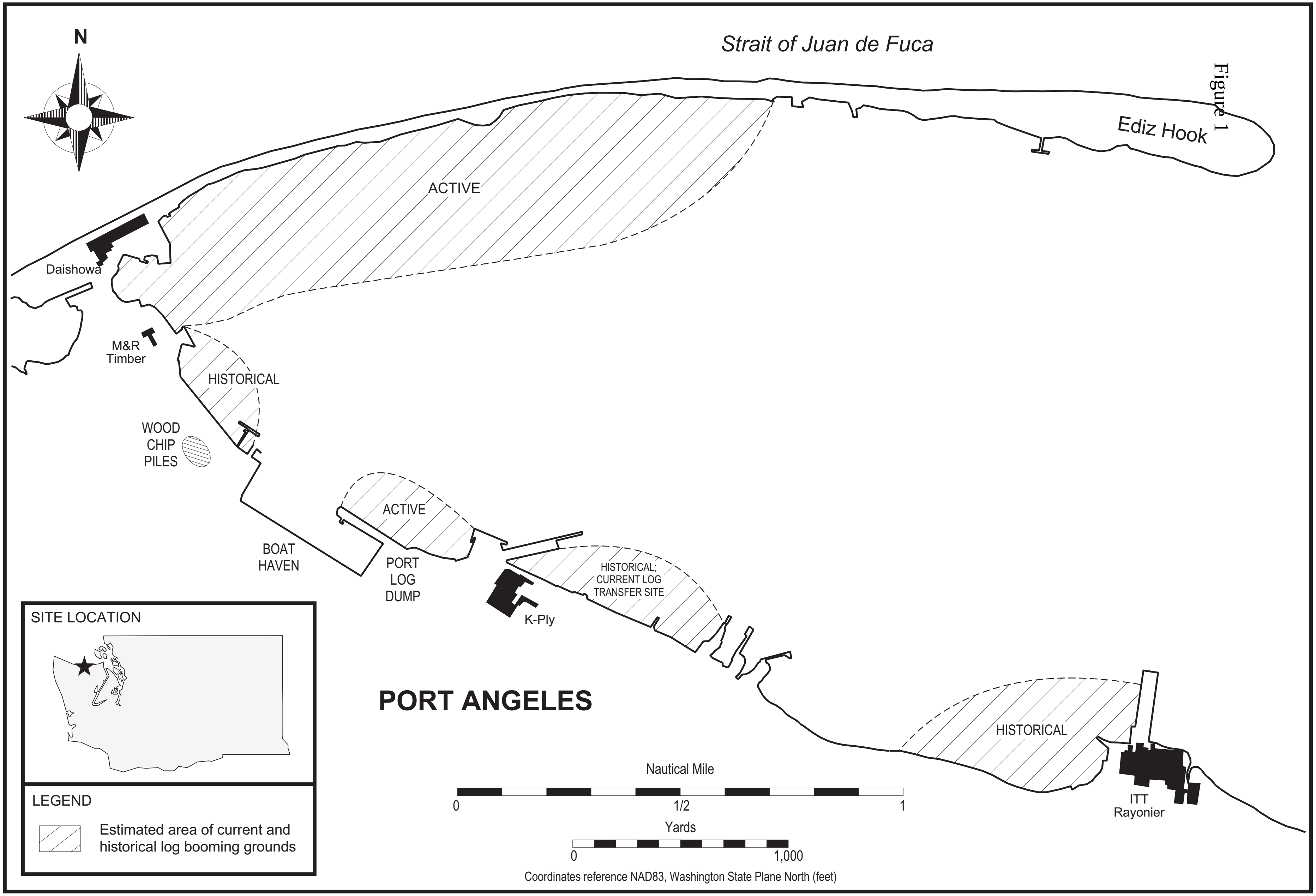


Figure 1. Port Angeles Harbor, Washington, with estimated area of current and historical log booming grounds.

2.0 FIELD METHODS

A field survey of wood waste in Port Angeles Harbor was conducted from November 3 through 6, 1998 using sediment vertical profiling system (SVPS) photography, sediment plan-view photography, and towed underwater video. Survey operations were conducted aboard the R/V BRENDAN D II, owned and operated by Sound Vessels Inc. of Port Townsend, WA. A chronological description of field sampling operations can be found in the field log (Appendix C).

2.1 Towed Underwater Video

During the first day of the study, towed underwater video was used as a reconnaissance tool in Port Angeles Harbor, to determine preliminary boundaries of wood waste accumulation. This information was used as a guide to locate the SVPS and plan-view station locations. The towed underwater video provided a real-time visual inspection of surficial features (physical and biological) on the seafloor. Large wood wastes (e.g., submerged logs) and mobile bottom fauna (e.g., fish and crustaceans) may not be photographed routinely using SVPS or plan-view photography, but can be observed using the towed video system. A total of 12 towed video transects were occupied, providing a good synoptic view of seafloor conditions in Port Angeles Harbor (Figure 2).

The towed underwater video system consisted of a SeaCam 2000 underwater camera (DeepSea Power and Light, San Diego, CA) attached to a towfish in a downward looking orientation. A 250-watt underwater light provided illumination. The video camera was oriented to view a 1-meter wide area of the seafloor. One complete set of VHS tapes containing the towed video record will be submitted to Ecology as part of the final report.

2.2 SVPS Photography

A three-day SVPS photographic survey was conducted in Port Angeles Harbor following the towed underwater video survey. SVPS photography provides a cross-sectional photograph of surface and near-surface sediment. An area 20 centimeters (cm) high by 14 cm wide is captured in this profile and recorded as a 35 millimeter (mm) slide image. SVPS photography allows detailed identification of wood waste in surface sediments and mapping of the horizontal extent

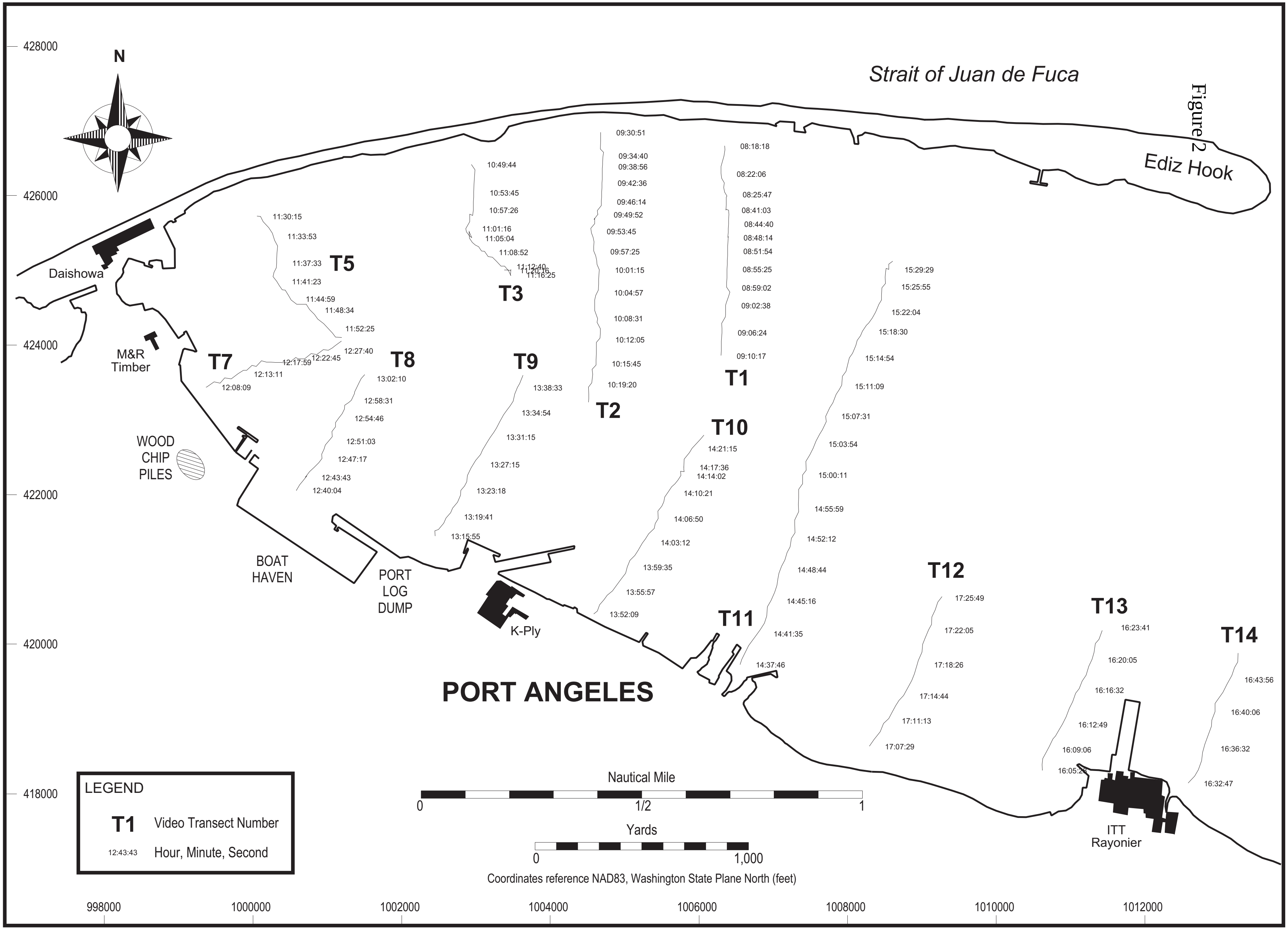


Figure 2. Towed underwater video transect locations. Port Angeles Harbor, November 3, 1998.

of wood waste accumulations at the sediment surface. Biological parameters are also measured from SVPS images to evaluate overall benthic habitat quality. A discussion of SVPS image analysis methods is provided in Section 3.0.

A total of 94 stations (37 baseline and 57 “floating” stations) were occupied during the 3-day SVPS survey (Figure 3). The baseline stations were placed in nearshore historical log storage areas where wood waste was anticipated, and in the central harbor where minimal wood waste was expected. Particular attention was made to characterize the distribution and extent of wood waste deposits. SVPS images were developed at the end of each survey day to verify successful data acquisition. Each image was inspected, and a “quick-look” assessment of environmental conditions at each station was made. Presence of wood debris and other indicators of impacted seafloor conditions were used to direct the location of the “floating” stations.

Up to three SVPS images were collected at each station. Stations 1, 49, 88, and 93 were occupied but useable profile images could not be obtained due to the presence of log debris or rocky bottom. Profile images from stations 38 and 39 were found to be overpenetrated (picture taken below the sediment-water interface) following the second SVPS survey day. These stations were re-occupied on the last survey day using less camera weight. A useable profile image was collected at station 39, but re-collected images at station 38 were also overpenetrated.

Images were collected using a Benthos model 3731 sediment profile camera (Benthos, Inc., North Falmouth, MA). The sediment profile camera consists of a wedge-shaped prism with a Plexiglas faceplate and a back mirror mounted at a 45° angle. Light is provided by an internal strobe. The mirror reflects the image of the profile of the sediment-water interface up to a 35 mm camera that is mounted horizontally on top of the prism. A diagram of SVPS camera operation is included in Appendix A.

2.3 Plan-View Photography

Plan-view underwater still photography was conducted simultaneously with SVPS photography. Plan-view images were taken using a downward looking PhotoSea underwater 35 mm camera and strobe that were mounted on the Benthos sediment profile camera frame. The plan-view camera photographs a 20 cm by 30 cm area near the front of the SVPS camera faceplate that provides a high resolution image of the sediment surface. Visual analysis of the plan-view

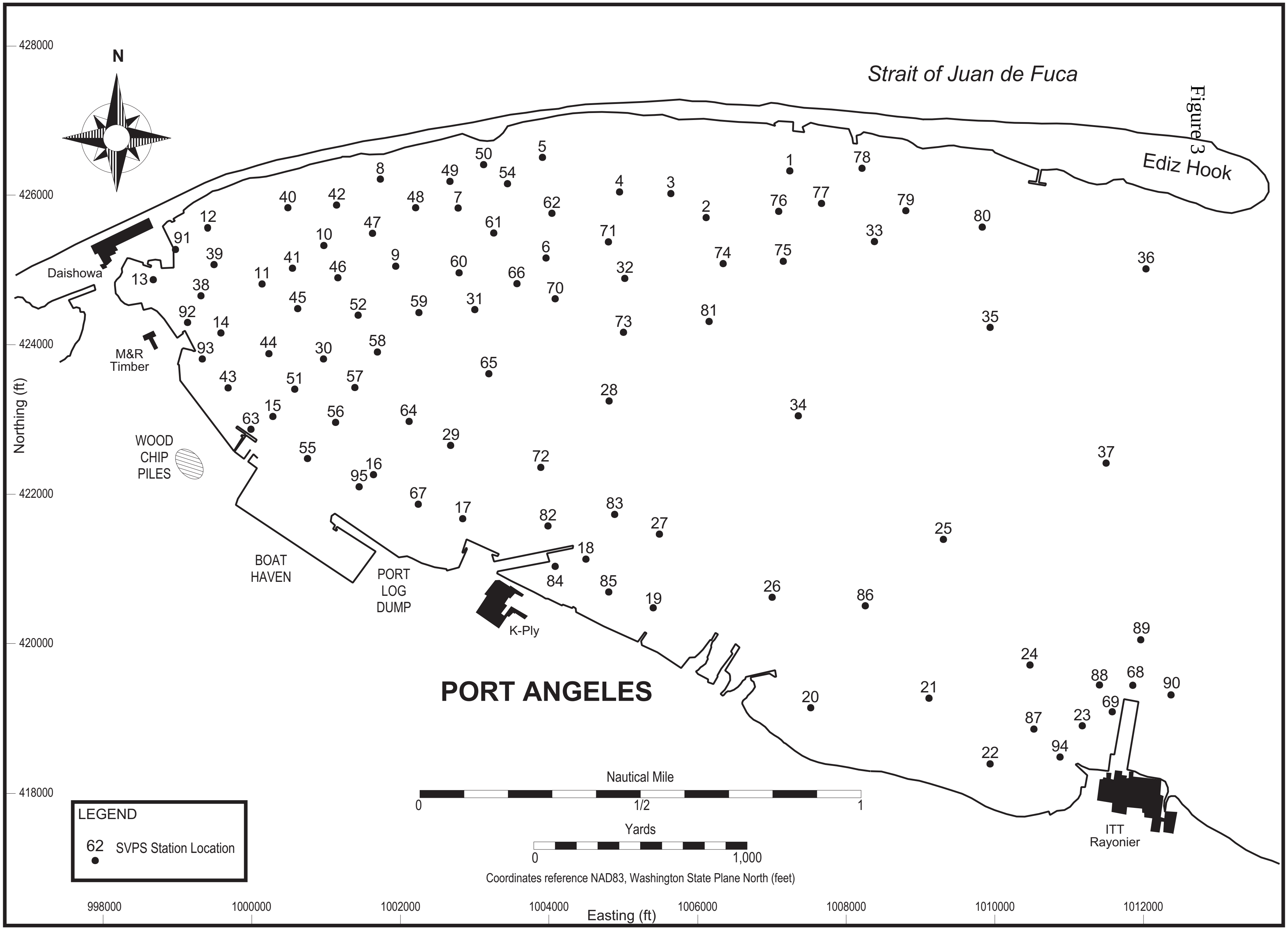


Figure 3. Port Angeles wood waste study SVPS station locations, November 4-6, 1998.

images in conjunction with SVPS images is an effective method for identifying the presence and extent of wood waste, as well as identifying other physical and biological features (e.g., sand ripples, shrimp). Results of the plan-view qualitative analysis are summarized in Appendix B.

Due to a film-advance malfunction of the plan-view camera, some plan-view images were found to overlap each other. These overlapping images were not useable in some instances. Plan-view images were not collected at stations 17, 53, 63, 72, 82, 83, and 85 due to this problem. However, useable SVPS images were collected at these stations.

2.4 Navigation

Navigation and positioning for all survey operations were accomplished using a differential global position system (DGPS) integrated with a computerized navigation system developed by SAIC. The Portable Integrated Navigation and Survey System (PINSS) provided a plan-view display to aid the helmsman and allowed the electronic recording of transect and sampling locations. The 12-channel MX400 DGPS receiver utilized U.S. Coast Guard differential corrections which provided positional accuracy of ± 3 meters in real-time. Geographic coordinates for all sampling locations are provided in Appendix B.

3.0 SVPS IMAGE ANALYSIS

SAIC has developed a standardized and formalized technique called REMOTS® (Remote Ecological Monitoring of the Seafloor) for SVPS image collection, analysis, and interpretation. Physical and biological parameters are measured directly from the SVPS color slides using a video digitizer and computer image analysis system. The image analysis system can measure up to 256 different tonal color scales, so subtle features can be accurately digitized and measured. The image analysis software allows the measurement and storage of data from up to 21 different parameters for each image.

A total of 110 Port Angeles SVPS images underwent full computer image analysis. The images included one image each from 90 stations, plus a second image from 19 (21%) of the stations to characterize small-scale (i.e., within-station) spatial variability in the measured parameters. A summary of image analysis results is provided in Appendix B. Three interactive CD-ROMs containing computer image analysis results and scanned SVPS and plan-view images will be submitted as part of the final report. The primary REMOTS® parameters used to address the Port Angeles wood waste study objectives include presence and thickness of wood waste, the apparent redox potential discontinuity depth, infaunal successional stage, presence of methane, evidence of apparent low dissolved oxygen conditions, and calculation of the organism-sediment index. A description of each parameter is described below.

3.1 Presence and Thickness of Wood Waste

Wood waste identified in SVPS images was digitized using the computer image analysis system, measured to scale, and divided by the prism window width to obtain a mean thickness of wood waste. Stations where wood waste thickness was greater than the length of the prism faceplate (20 cm) were identified as greater than the SVPS penetration limit. Due to the nature of some of the wood waste (e.g., scattered wood particles mixed in the ambient sediments) it was not always possible to distinctly measure the thickness of wood waste accumulation. In these instances, the nature of the wood waste was described, but a thickness measurement of wood waste was not calculated.

3.2 Depth of the Apparent Redox Potential Discontinuity

In fine-grained coastal areas where there is oxygen in the overlying water column, the near-surface sediment will have a higher optical reflectance (i.e., lighter color) than hypoxic or anoxic sediment underlying it. This is because the oxidized surface sediment contains ferric hydroxide (an olive color when associated with organic particles), while the hydrogen sulfide sediments below this oxygenated layer are gray to black. The boundary between the light-colored ferric hydroxide surface sediment and underlying darker-colored (gray to black) sediment is called the apparent Redox Potential Discontinuity (RPD). In general, the depth of the actual RPD is shallower than the depth of the apparent RPD because bioturbating organisms mix ferric hydroxide-coated particles downward in the sediment column. As a result, the apparent RPD depth provides an estimate of the degree of biogenic sediment mixing.

The area of the aerobic sediment was determined from the SVPS images by density slicing its unique reflectance value. Areas of anomalous high reflectance, such as shell/shell fragments and bacterial mats, were taken into account in determining the apparent RPD. The oxidized area was then digitized, measured to scale, and divided by the prism window width to obtain a mean depth for the apparent RPD. The apparent RPD is a sensitive indicator of infaunal succession, sediment bioturbation activity, and sediment oxygen demand. Areas impacted with abundant wood waste generally exhibit shallow or no apparent RPD depths.

3.3 Infaunal Successional Stage

The mapping of infaunal successional stages (the functional types of infaunal organisms) from SVPS images is based on the theory that organism-sediment interactions follow a predictable sequence after a major seafloor disturbance. In shallow water environments, infaunal succession following a major seafloor disturbance initially involves pioneering populations (Primary or Stage I succession) of very small organisms that live at, or near, the sediment-water interface (Pearson and Rosenberg, 1978; Rhoads and Germano, 1986).

In the absence of further disturbance, these early successional assemblages are eventually replaced by infaunal deposit feeders; the start of this “infaunalization” process is designated as Stage II. Large, deep-burrowing infauna, or Stage III taxa, represent a high-order successional stage typically found in areas of low disturbance. The presence of Stage III feeding voids indicate the presence of Stage III organisms. Figure 4 illustrates an idealized infaunal successional sequence following a disturbance.

3.4 High Sediment Oxygen Demand / Presence of Methane

Areas with low sediment oxygen conditions, or high sediment oxygen demand (SOD), can occur when the bottom sediment experiences severe organic loading. For example, deposition of the fine fraction of wood waste (pulp) can form a "fiber blanket" at the sediment-water interface, and dense populations of sulfate-reducing bacteria can populate this fiber blanket. Such a surface has a high SOD and a thin or non-existent apparent RPD within the sediment column. Macrofaunal colonization can range from azoic to dominance by low diversity opportunistic polychaetes (i.e., Stage I infaunal succession). When sulfate is used up, methane gas may then accumulate within the bottom sediments (observed as bubbles in SVPS images).

Areas with shallow or no RPD depths, low diversity or azoic infaunal colonization, highly reduced underlying sediment (dark gray to black in color), and the presence of methane gas bubbles in the sediment are indicative of organic loading and high sediment oxygen demand.

3.5 Organism-Sediment Index

The Organism-Sediment Index (OSI) provides a measure of benthic habitat quality in shallow water environments based on dissolved oxygen conditions, depth of the apparent RPD, infaunal successional stage, and presence or absence of sedimentary methane measured during REMOTS® image analysis (Rhoads and Germano, 1986). The OSI is a numerical index ranging from -10 to +11. The lowest value is given to bottom sediments with low or no dissolved oxygen in the overlying bottom water, no apparent macrofaunal life, and methane gas present in the sediment. High OSI values are given to aerobic bottom sediments with a deep apparent RPD, mature macrofaunal community, and no methane gas. The numerical values and ranges used in calculating the OSI are provided in Table 1. Previous SVPS surveys conducted in various coastal regions by SAIC (e.g. Puget Sound, Long Island Sound, Chesapeake Bay, and the Florida and Louisiana coasts) have shown that OSI values between +7 and +11 are typical of natural, undisturbed sediments. OSI values less than +6 indicate a "stressed" or disturbed benthic environment and values less than 0 indicate degraded benthic habitat.

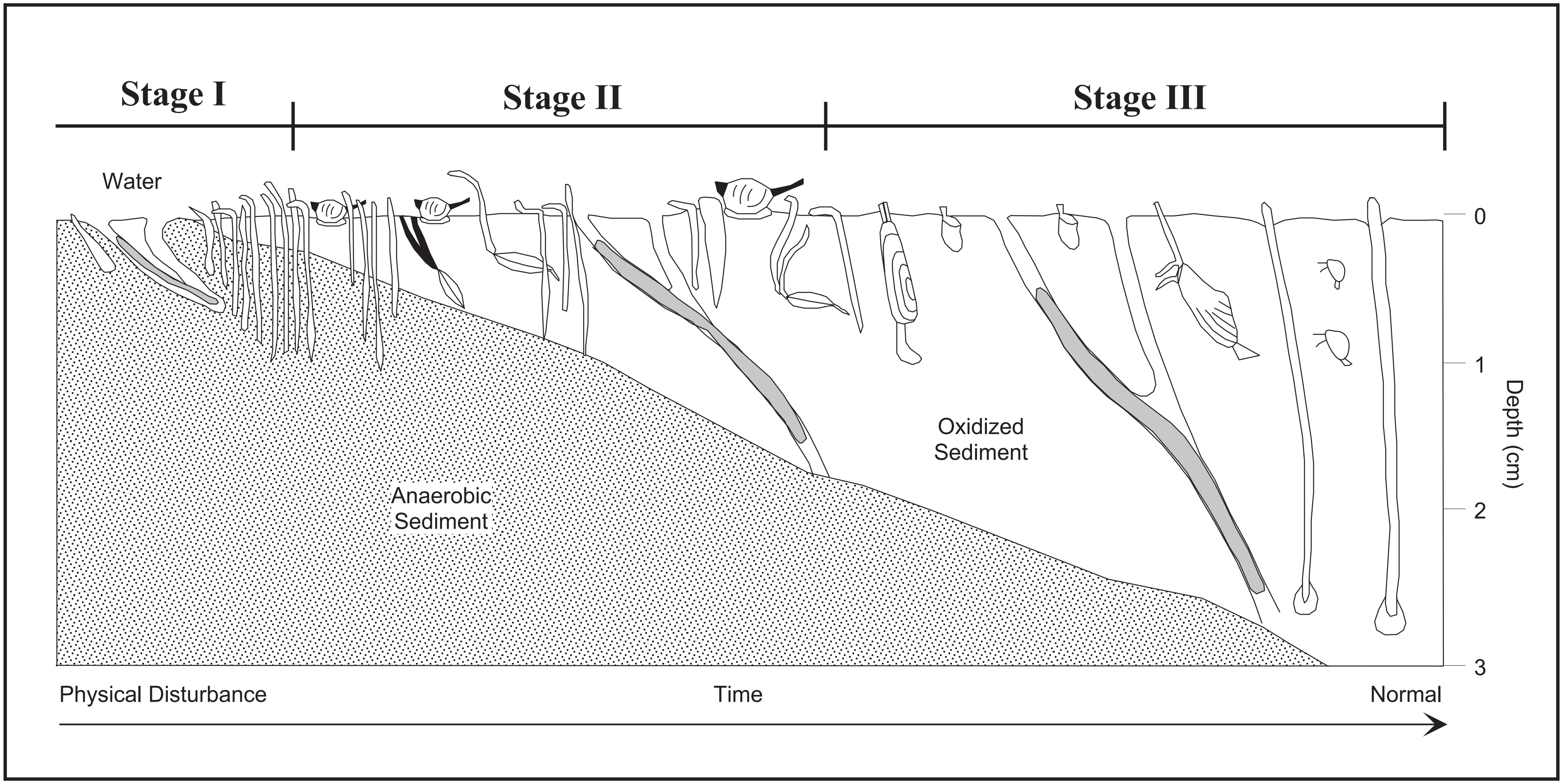


Figure 4. Development of infaunal successional stages over time following a physical disturbance. This figure is taken from Rhodes and Germano (1986) which was modified from Pearson and Rosenberg (1978).

Table 1. Calculation of the Organism-Sediment Index.

Choose One Value:

Mean RPD Depth Classes	Index Value
0.00 cm	0
> 0 - 0.75 cm	1
0.76 - 1.50 cm	2
1.51 - 2.25 cm	3
2.26 - 3.00 cm	4
3.01 - 3.75 cm	5
> 3.75 cm	6

Choose One Value:

Successional Stage	Index Value
Azoic	- 4
Stage I	1
Stage I - II	2
Stage II	3
Stage II - III	4
Stage III	5
Stage I on III	5
Stage II on III	5

Choose One or Both if Appropriate:

Chemical Parameters	Index Value
Methane Present	- 2
No/Low Dissolved Oxygen*	- 4

Organism-Sediment Index = Range: - 10 + 11

* No/low dissolved oxygen is based on the imaged evidence of reduced, low reflectance (i.e., high oxygen demand) sediment at the sediment-water interface. It is not a chemical measurement using Winkler titration or polargraphic electrode.

4.0 RESULTS

Results from the towed underwater video, SVPS photography, and plan-view underwater still photography were used to address the six objectives of the Port Angeles Harbor wood waste study:

1. Map the horizontal extent of wood waste accumulations
2. Measure the thickness of the accumulations
3. Describe the wood waste encountered
4. Measure the depth of the apparent redox potential discontinuity
5. Identify areas with potential for high sediment oxygen demand
6. Evaluate the health of the benthic macroinvertebrate community

4.1 Distribution of Wood Waste

Identification and mapping of wood waste in Port Angeles Harbor (Objectives 1 and 3) were conducted using a combination of towed underwater video, SVPS photography, and plan-view photography. SVPS photography was used to measure the thickness of wood waste accumulations (Objective 2).

4.1.1 Towed Underwater Video

Towed underwater video was used as a reconnaissance tool to determine preliminary boundaries of wood waste accumulation and guide the placement of SVPS and plan-view station locations. Towed video also provided identification of large wood waste (e.g., submerged logs) which may not be photographed using SVPS or plan-view photography.

Visual observations of wood waste made during the Port Angeles Harbor towed underwater video survey are presented in Figure 5. Abundant wood debris including logs and large bark/wood fragments was generally observed in active and historical log booming grounds. Wood debris in the active north harbor log booming grounds appears to be “fresh” (recently deposited) while the older or less active log booming areas (booming grounds near K-Ply, former ITT Rayonier grounds, and log dump grounds) contained generally older, decomposing, or bio-fouled wood deposits. Size and abundance of wood debris decreased offshore from the booming grounds.

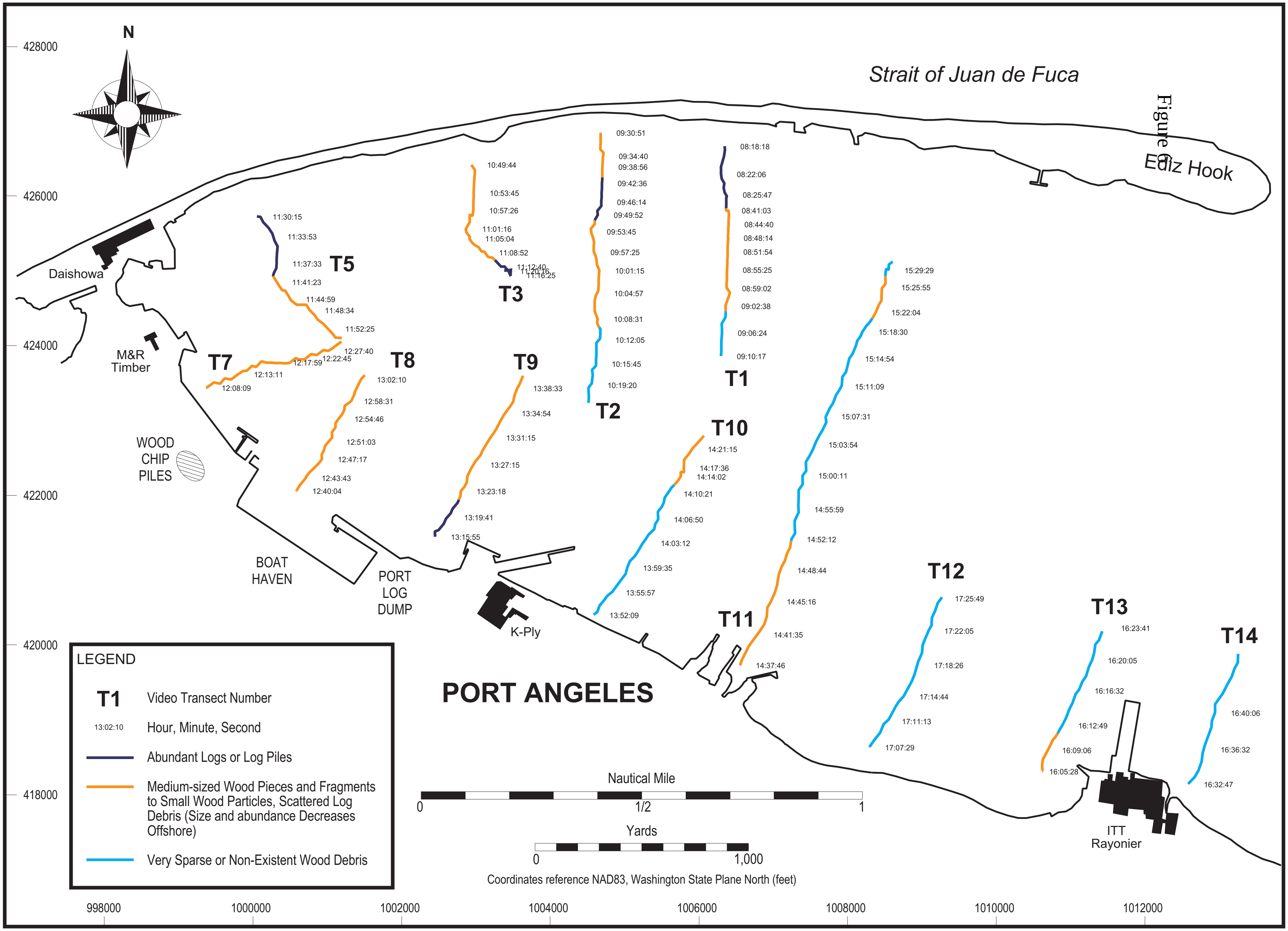


Figure 5. Wood waste identification in Port Angeles Harbor using towed underwater video.

Wood debris ranged from log-sized debris (meters), medium size wood pieces and fragments (10's of centimeters), to small wood particles (millimeters to centimeters). Wood debris was very sparse or non-existent in the central and outer harbor.

Large piles of "fresh" submerged logs were observed in the log booming grounds along the northern portion of the harbor. The logs were seen along transects T1, T2, and T3 at water depths of 100 to 150 feet. It is likely that these logs were lost from barges moored in the booming grounds. It was reported that two barge loads of hemlock were lost when the barges listed during storms earlier this year. Due to the depth of water, divers could not salvage the logs. A bathymetry (depth) map of Port Angeles Harbor is included in Appendix A.

4.1.2 SVPS and Plan-View Photography

SVPS photography provided detailed identification of wood waste types, the horizontal extent of wood waste deposits, and the measured thickness of accumulation. Sediment plan-view photography provided qualitative observations for wood waste identification and distribution. Figure 6 presents estimates of the horizontal distribution and measured accumulations of wood waste in Port Angeles Harbor, based on SVPS and plan-view photography.

Five general categories of wood waste types were identified:

- Logs or large wood pieces
- Small wood and/or bark chips (wood chips)
- Very fine wood particles and/or fibers (wood pulp)
- Trace to sparse wood pulp/chips mixed within the sediment column
- Sparse, scattered wood pieces on top of the sediment surface

Measurement of wood waste accumulations was made when discreet layers of wood chips or wood pulp were present. Areas showing logs or large wood pieces, trace to sparse wood pulp mixed within the sediment column ("MX" designation), and scattered wood pieces on the sediment surface ("SC" designation) were identified, but distinct measurements of wood waste accumulation were not possible under these conditions.

The greatest accumulation of wood waste was observed in the north and west portions of the harbor, in the active log booming grounds and near the Daishowa facility (Figure 6). This area covers approximately 400 acres (0.6 square miles) of harbor bottom. Wood waste consisted of discreet wood/pulp layers, wood pulp mixed within the sediment column (MX), and scattered wood pieces on the sediment surface (SC). The highest measurable amount of wood waste was at station 91 (next to Daishowa), where >21 cm of wood pulp accumulation was measured (Figure 7). Profile and plan-view images showing "MX" and "SC" wood waste conditions are provided in Figures 8 and 9. Wood waste was also identified near the log dumping grounds (approximately 30 acres) and the former ITT Rayonier booming grounds (approximately 55 acres). Abundant wood chip accumulations were measured at stations 23 and 94 near the ITT Rayonier facility (Figure 10).

At stations 30, 45, 51, 52, and 57 in the western central portion of Port Angeles Harbor, a layer of wood pulp was found buried under 6 to 8 cm of ambient silt (Figure 7). The wood pulp layer measures from 5.1 cm thick at station 57 to >10.1 cm at station 45, and covers an area of approximately 35 acres (see Figure 6). Assuming a conservative thickness of 5.1 cm, the wood pulp layer represents approximately 9,500 cubic yards of wood pulp. However, the subsurface layer of wood pulp does not appear to have adverse impacts to the benthic infaunal community. The profile images at these locations show well-developed RPD depths and feeding voids in the overlying ambient silt layer, and the presence of polychaetes within the wood pulp layer (Figure 7, image 52/B).

At stations 9, 12, 38, and 39, where a thin layer of wood pulp was measured at the sediment surface, the presence and growth of sulfur-reducing bacteria has created a membrane or bacterial mat (Figures 11 and 12). Presence of bacterial mats is indicative of high labile organic carbon and low dissolved oxygen conditions (see discussion in Section 5.3).

At three stations (19, 63, and 67) along the southwest shoreline, possible creosote and/or oil was observed in the SVPS images.

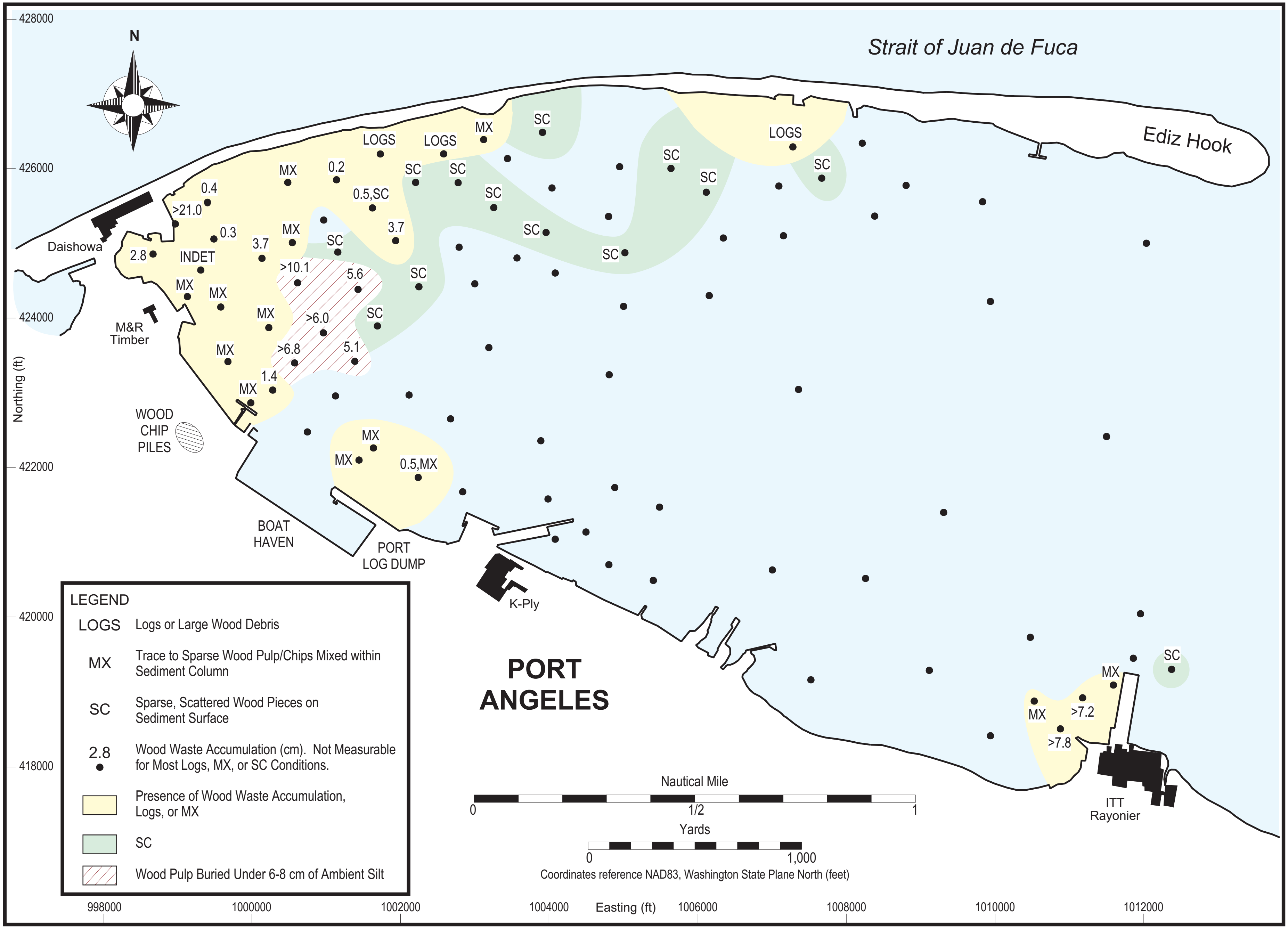


Figure 6. Wood waste distribution and accumulation in Port Angeles Harbor based on SVPS and plan-view photography.

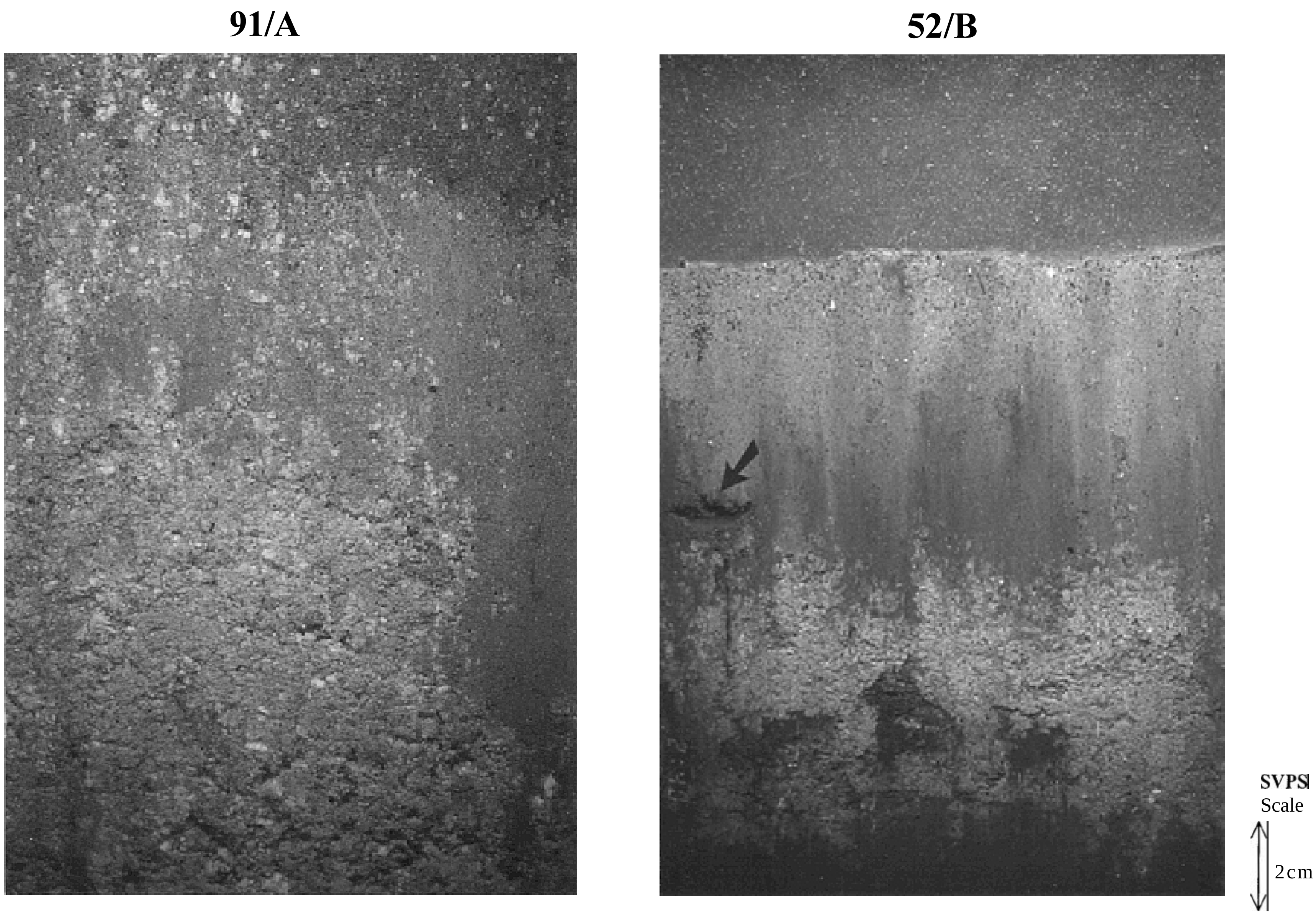


Figure 7. SVPS images from stations 91 (replicate A) and 52/B in Port Angeles Harbor. Station 91 is located near the Daishowa loading dock and shows abundant wood pulp accumulation greater than camera prism penetration. Overpenetration indicates high water content and a high sedimentation rate. Silt is mixed into the upper portions of the wood fabric. Station 52 located in the western central portion of the harbor shows a wood pulp layer (5.2 cm) buried under 7.9 cm of ambient sediment. A feeding void (arrow) is present and a polychaete is feeding within the wood pulp layer.

63/B

69/A

Scale

2cm

Figure 8. SVPS images from stations 63/B and 69/A in Port Angeles Harbor. Station 63 located near the K-Ply wood chip loading dock shows fine wood particles (pulp) mixed within the sediment column. The image shows a well-developed apparent RPD depth (3.56 cm) and a filamentous red/brown algae (bacterial mats'?) is present on the sediment surface. Station 69 located along the western pier-face of the former ITT Rayonier facility also shows wood pulp mixed within the sediment column. Two methane bubbles are present within relic feeding voids (arrows) which indicates degraded sediment conditions and potential for high sediment oxygen demand.

6/B (SVPS)

SVPS Scale

2 cm

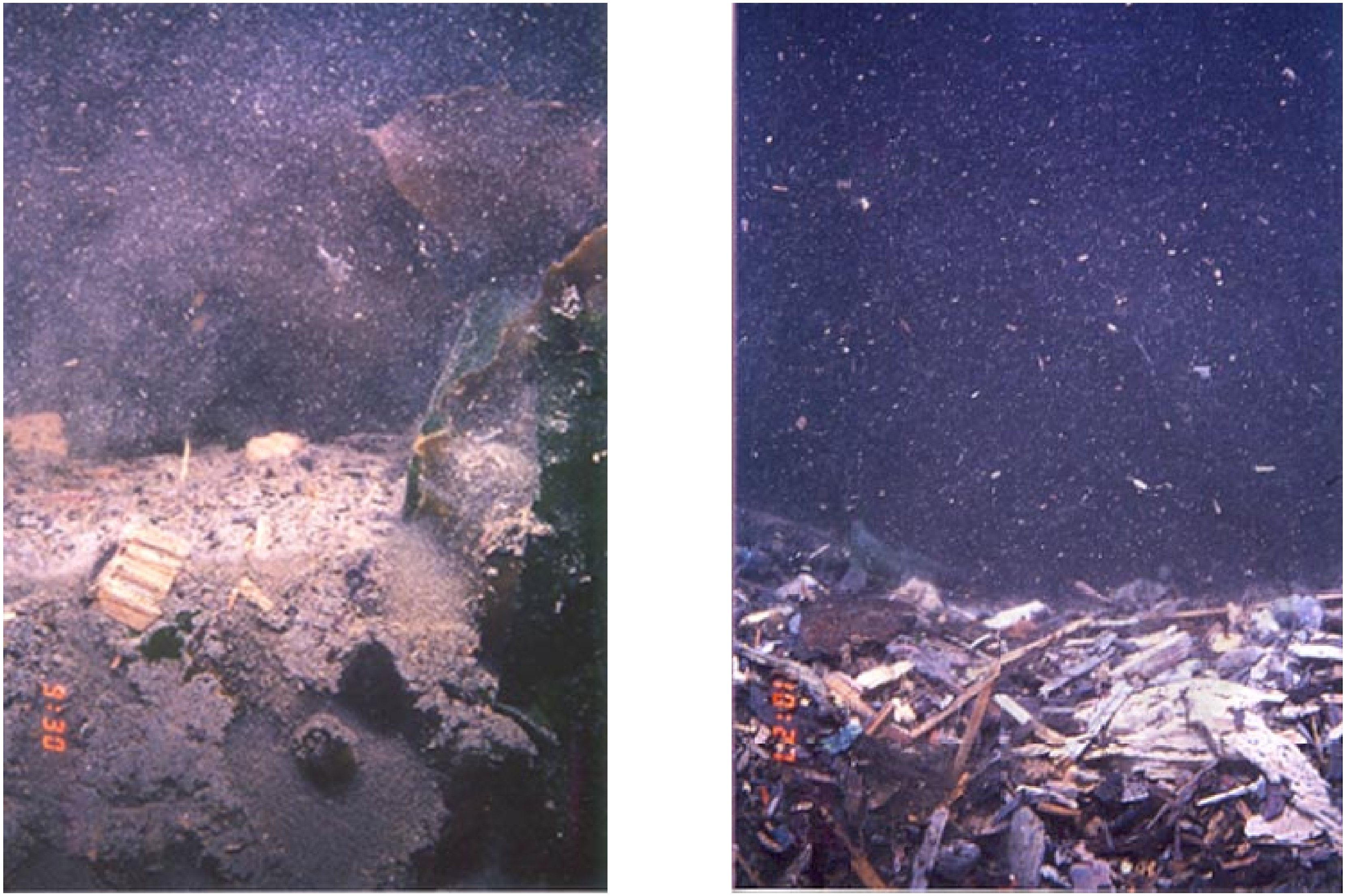
6/C (Plan-View)

Plan-View Scale

3 cm

Figure 9. SVPS and plan-view images from station 6 (north-central part of the harbor) where sparse. scattered wood debris is present on the sediment surface. The SVPS image shows healthy sediment conditions. A well-developed apparent RPD depth. feeding voids (arrows), and a possible anemone burrow are present (dotted line delimits the burrow). The plan-view image shows a piece of wood debris on the sediment surface with a shrimp seeking shelter beneath the wood debris.

23/C 94/C



Scale

2 cm

Figure 10. **SVPS** images from stations 23/C and 94/C in the log booming grounds near the former ITT Rayonier facility. Station 23 shows abundant wood chips and fibers mixed in the surface sediments. Green algae (*Ulva* and/or *Enteromorpha*) on the right side of the image has been dragged down into the sediment by the camera prism. Station 94 shows a pile of wood chips and fragments (>7.8 cm). Underlying sediments are not visible in the image.

9/c (SVPS)

SVPS Scale

2cm

9/A (Plan-View)

Plan-View Scale

3 cm

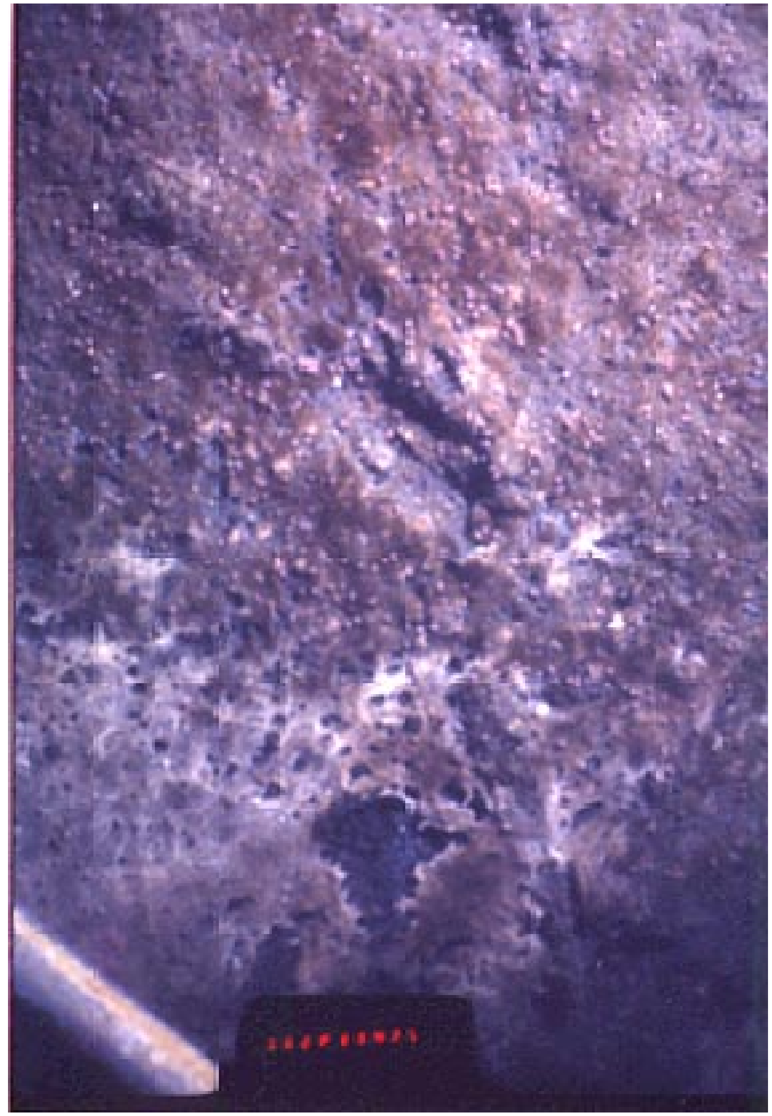
Figure 11. SVPS and plan-view images from station 9 (in log booming grounds in north-central part of the harbor) showing the presence of a wood fiber layer. Dense populations of sulfate-reducing bacteria have created a "bacterial mat" or membrane on the sediment surface (white fibrous material in the SVPS and plan-view images). Formation of these bacterial mats occurs in anaerobic conditions. Sediments underlying the bacterial mat (approximately 3.7 cm thick) are black and sulfidic.

12/A (SVPS)

SVPS Scale

2 cm

12/A (Plan-View)



Plan-View Scale

3 cm

Figure 12. SVPS and plan-view images from station 12 (in log booming grounds just east of Daishowa) showing the presence of a wood fiber layer. Dense populations of sulfate-reducing bacteria have created a thin "bacterial mat" or membrane on the sediment surface (white fibrous material in the SVPS image). Notice the ventral "fringes" of filaments in the bacterial mats (black arrow). A methane bubble is also present at depth in a relic feeding void (white arrow). The bacterial mat surface has high sediment oxygen demand. As the bacteria use up sulfate, sedimentary methane can accumulate. The plan-view image shows the fibrous, membrane-like appearance of the bacterial mat. The bulb-like features on the surface may be fusiform rods related to a different type of bacterial growth.

Based on results of the towed underwater video survey, it is apparent that wood debris is present outside of the wood waste perimeter measured using SVPS and plan-view photography (compare Figures 5 and 6). However, the lack of visual evidence in the SVPS and plan-view images suggests that the amount of wood debris is low in these areas and is having little impact on the benthic habitat. The distribution of wood debris is patchy, so that it appears in the wider-ranging video survey, but not in all of the very localized SVPS and plan-view photographs.

4.2 Depth of the Apparent RPD

SVPS photography was used to measure the depth of the apparent RPD (Objective 4). The depth of the apparent RPD provides an estimate of the degree of oxygenation in the sediment column as well as the degree of biogenic sediment mixing.

Mean apparent RPD depths in Port Angeles Harbor had a major mode around 2.25 cm (Figure 13 inset). Greater apparent RPD depths were found in open-water areas of the central harbor (Figures 13 and 14), where wood waste accumulation generally was low or minimal and where there is assumed to be a higher rate of tidal exchange compared to nearshore shallow areas. Although scattered wood pieces were observed at the sediment surface at Station 2, this station in the northern central portion of the harbor had the greatest apparent RPD depth of 5.59 cm. The shallowest RPD depths generally were found at stations located in both active and historical log booming grounds; areas with apparent RPD depths less than 1.00 cm are highlighted in Figure 13. Note that indeterminate RPD values were recorded at several stations near the ITT Rayonier facility due to poor camera prism penetration. Water depths are shallow in this region (10 to 15 feet deep) and the bottom consists of a hard, rocky substrate.

Stations with non-existent apparent RPD depths were observed near the Daishowa facility, the log dump grounds, the booming grounds near K-Ply, and the former ITT Rayonier grounds. While there is an association between areas of active/historical log booming and shallow/non-existent RPD depths, it is important to note such RPD depths were not always associated with actual accumulations of wood waste observed on or within the sediment. For example, no wood waste was observed at the stations around K-Ply (Figure 6), but apparent RPD depths in this area were very shallow. Likewise, Station 55 near the port log dump had a non-existent RPD but no observed wood waste. In general, the areas along the shoreline having shallow RPD depths, particularly in the western harbor, are also areas where water circulation within the harbor may be

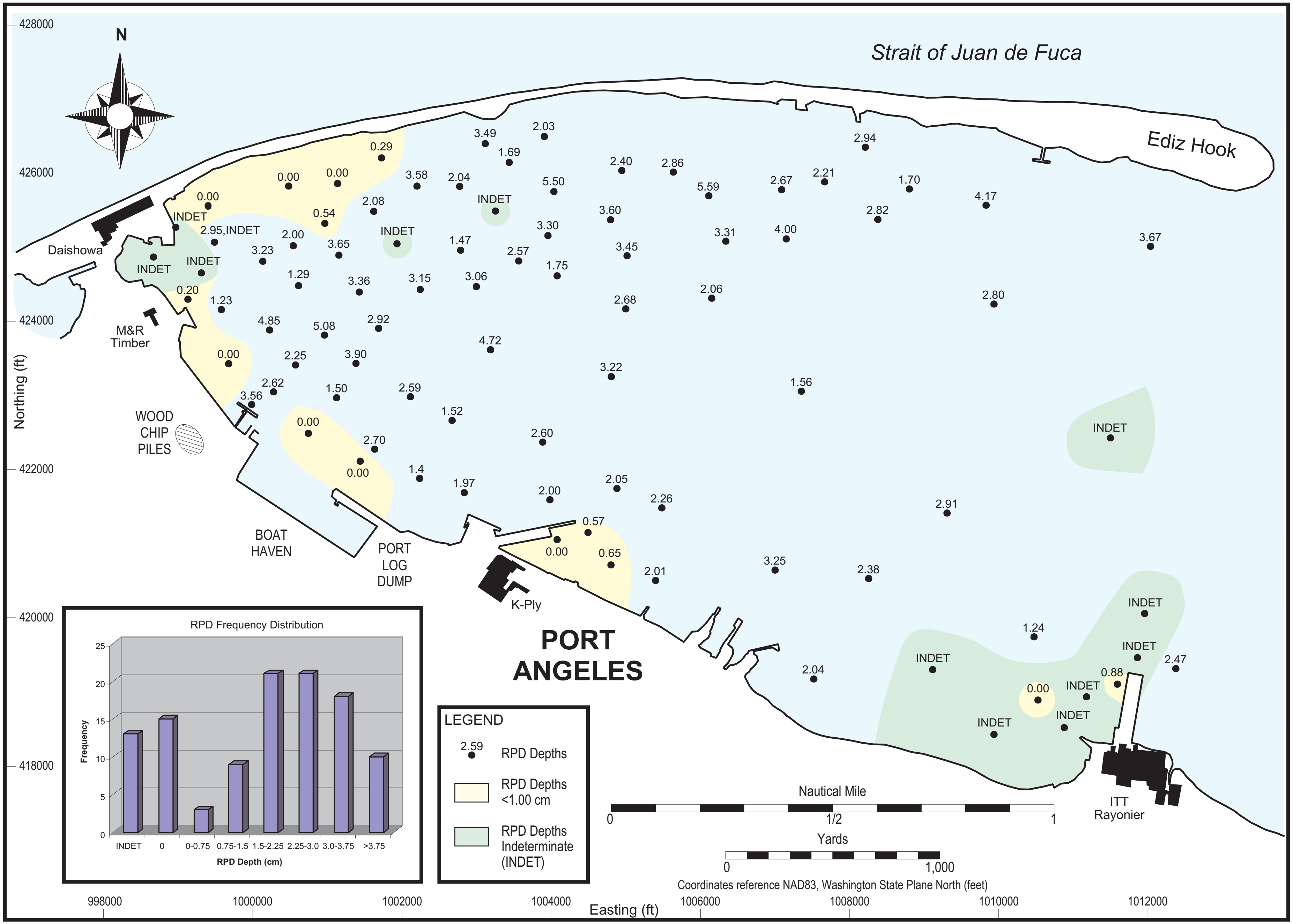


Figure 13. Distribution of the redox potential discontinuity (RPD) depth in Port Angeles Harbor.

28/A

64/A

Scale

2 cm

Figure 14. SVPS images from stations 28/A and 64/A in the central harbor showing minimal pulp impact. Station 28 shows Stage I tube worms on the sediment surface and a polychaete worm at depth (large arrow). Stage III feeding voids and a possible burrow (small arrows) are present as well as a deep apparent RPD (3.22 cm). Station 64 provides a good reference for undisturbed bottom conditions in Port Angeles Harbor. The image shows a well-developed apparent *RPD* depth and the presence of a Stage III feeding void and polychaete (arrows) at depth.

minimal. Accumulation of wood waste within or on the sediment, poor water circulation, and other potential sources of organic enrichment (e.g., surface runoff) may all contribute in varying degrees and combinations to the low sediment oxygen levels observed at the nearshore REMOTS® stations.

4.3 High Sediment Oxygen Demand

SVPS and plan-view photography are used to identify areas with potential for high sediment oxygen demand (Objective 5). Areas with apparent high sediment oxygen demand (SOD) or with potential for high SOD in Port Angeles Harbor are identified in Figure 15. Apparent high SOD designations were given to stations with shallow or no RPD depths, low diversity or azoic infaunal colonization, highly reduced sulfidic sediment (dark gray to black in color), and the presence of methane gas bubbles in the sediment. Sedimentary methane bubbles were photographed at stations 69 and 12 (Figures 8 and 12, respectively). Presence of bacterial mats on the sediment surface also indicates low dissolved oxygen conditions (see Section 5.3).

Areas with shallow or no RPD depths indicate poor oxygenation in the sediment column, and could lead to low dissolved oxygen conditions. Therefore, areas with apparent RPD depths less than 1.00 cm were identified as areas with potential for high SOD. Station 39 showed an RPD of 2.95 cm in one SVPS image, and an indeterminate RPD and apparently anoxic mud in another. Therefore, this station is considered to have a potentially high SOD.

4.4 Benthic Community

The health of the benthic macroinvertebrate community (Objective 6) is evaluated using SVPS and plan-view photography. Depth of the apparent RPD (discussed in Section 4.2) is an important parameter in assessing the health of the benthic infaunal community. Also important are the determination of infaunal successional stage, and the calculation of the Organism-Sediment Index (OSI).

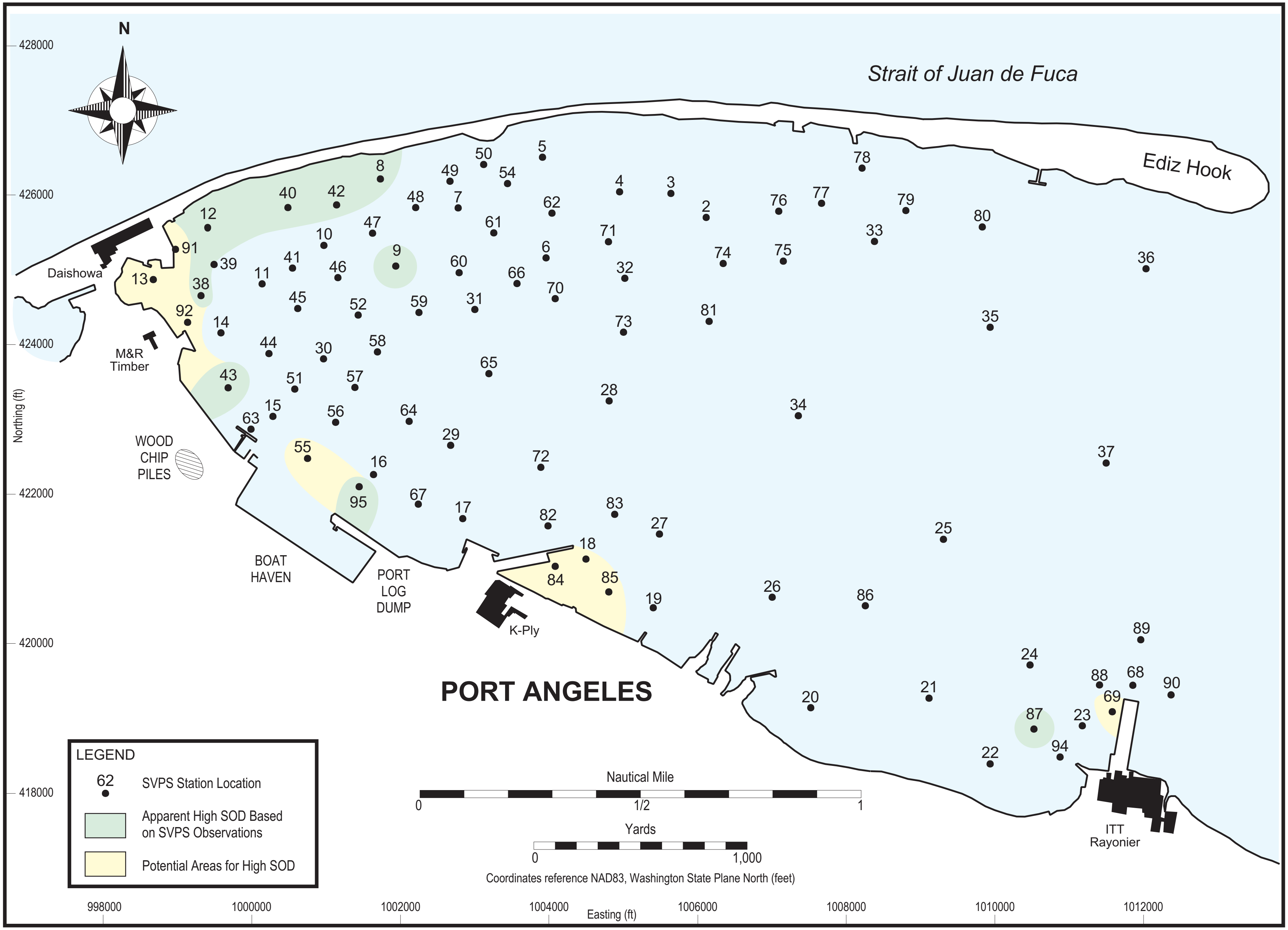


Figure 15. Stations with apparent or with potential high sediment oxygen demand (SOD) in Port Angeles Harbor.

4.4.1 Infaunal Successional Stage

The mapping of infaunal successional stages (the functional types of infaunal organisms) in Port Angeles Harbor is presented in Figure 16. The infaunal community in most areas of Port Angeles Harbor consists of small surface feeding or filtering Stage I organisms and larger head-down deposit feeders (Stage III). Stage III assemblages were present in most offshore areas of the central harbor (Figure 16). Areas with only pioneering or Stage I succession are generally associated with the log booming grounds. In addition, some nearshore stations within the western log booming areas (stations 8, 12, 13, 43, and 95) showed no evidence of benthic infaunal colonization (AZOIC). Infaunal successional stage could not be determined at several stations near the ITT Rayonier facility due to the hard, rocky substrate and poor camera prism penetration. For some of the stations where two SVPS images were analyzed, different stages were identified in the two images, indicating small-scale patchiness in benthic conditions.

4.4.2 Organism-Sediment Index

The Organism-Sediment Index (OSI) is a sensitive metric for measuring benthic habitat quality and assessing stages of organic enrichment in shallow water environments. The OSI is calculated based on dissolved oxygen conditions, depth of the apparent RPD, infaunal successional stage, and presence or absence of sedimentary methane.

OSI values in Port Angeles Harbor had a major mode of +9 (Figure 17 inset). The majority of OSI values in the central harbor were between +7 and +11, indicating healthy and undisturbed benthic conditions. Areas with OSI values less than +6 (stressed or disturbed conditions) were generally found in the log booming grounds. Degraded benthic habitat (OSI less than zero) was observed at stations 8, 12, 40, 43, and 95. Because the OSI is calculated using apparent RPD depths and successional stages, indeterminate apparent RPD depths and/or successional stages lead to indeterminate OSI values. Several OSI values near the ITT Rayonier facility were indeterminate because either the RPD depth or successional stage, or both, were indeterminate. At two stations near the ITT Rayonier facility where apparent RPD depths could be measured, they were shallow (less than 1.0 cm; Figure 13). At station 13 next to the Daishowa facility, the OSI value was indeterminate due to an indeterminate RPD, but an “azoic” successional designation suggested a degraded benthic habitat quality.

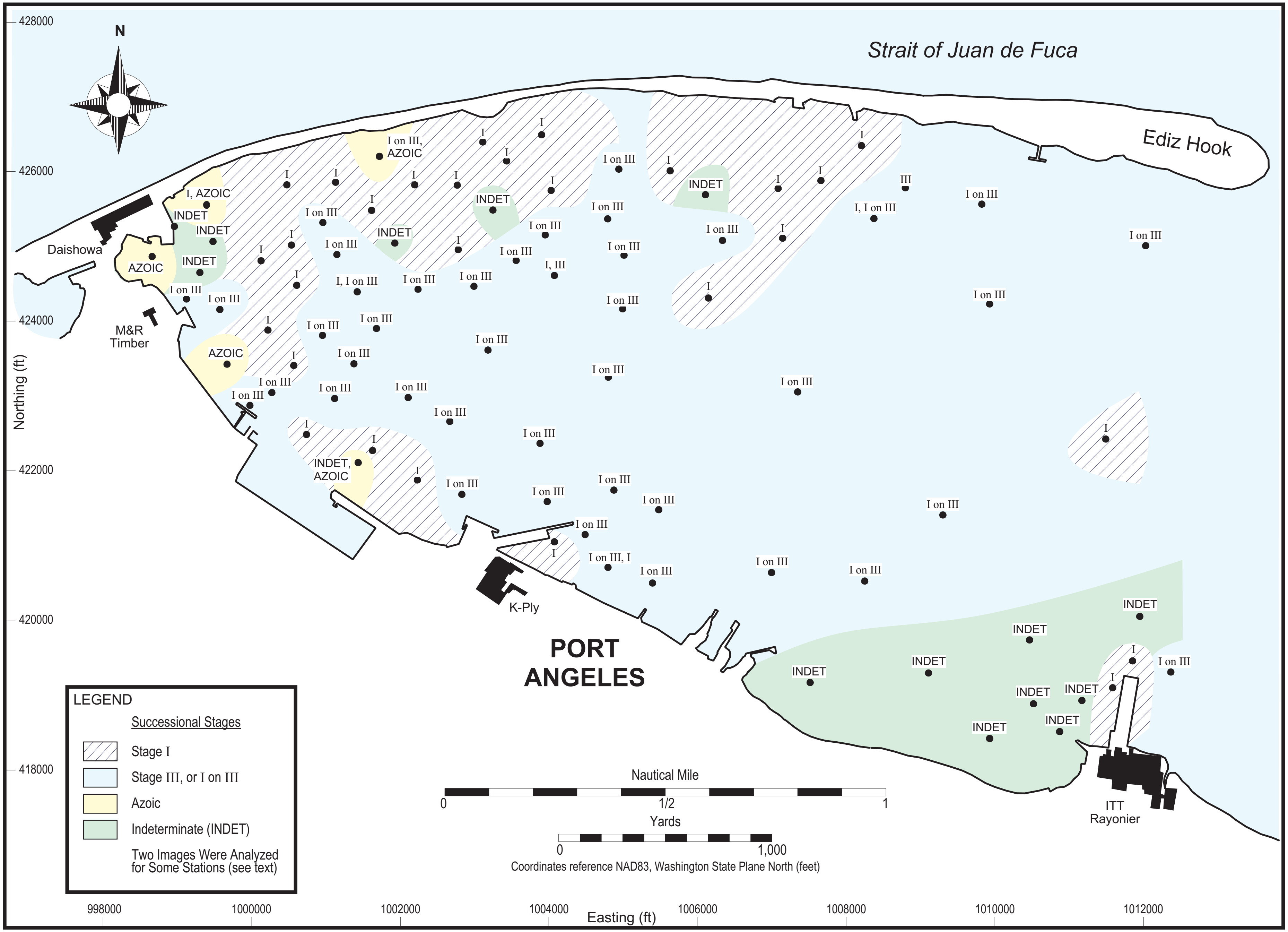


Figure 16. Distribution of infaunal successional stage in Port Angeles Harbor.

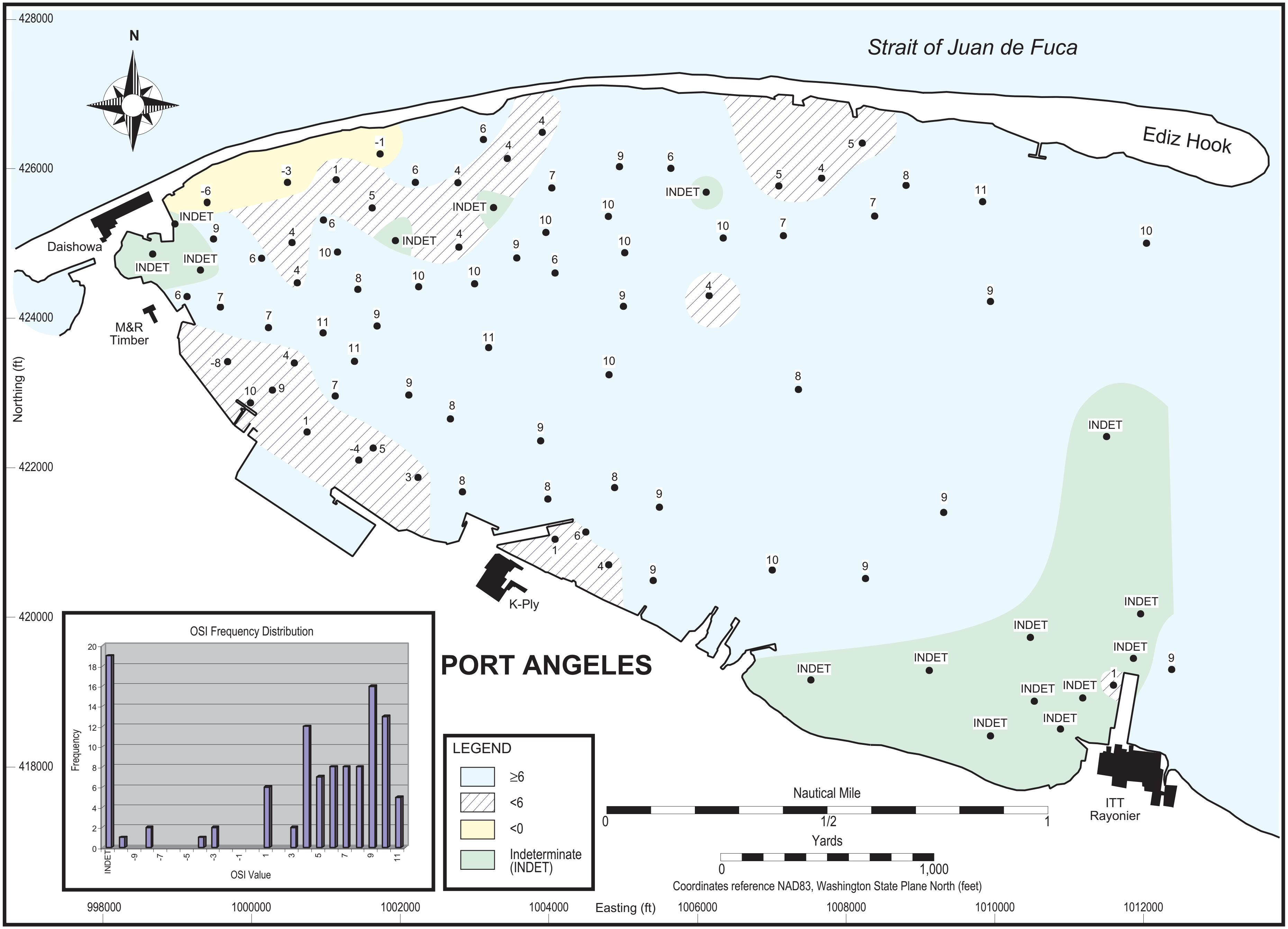


Figure 17. Distribution of organism-sediment indices (OSI) in Port Angeles Harbor.

5.0 DISCUSSION

5.1 Wood Waste Distribution

Abundant wood debris including logs and large bark/wood fragments was generally observed in the log booming grounds. These areas included the log booming areas in the northern harbor, near the Daishowa and M&R Timber facilities, near the public log dump, and near the former ITT Rayonier facility. Measurable wood pulp or wood chip deposits were generally confined to these nearshore areas (Figure 6). Wood waste was observed over approximately 500 acres of the harbor bottom, with about 400 acres covered near the north and west portions of the harbor (Figure 6). The horizontal distribution of wood waste covers approximately 25 percent of the bottom of Port Angeles Harbor. Size and abundance of wood debris generally decreased offshore from the booming grounds.

A layer of wood pulp was found buried under 6 to 8 cm of ambient silt in the western central harbor (Figures 6 and 7). The subsurface wood pulp deposit covers an area of approximately 35 acres. Very little sediment is mixed within the pulp layer, suggesting that the wood pulp was deposited very rapidly on the harbor bottom. One possible explanation could be that barges loaded with wood pulp may have listed during a storm and lost their loads. Assuming a conservative thickness of 5.1 cm, the buried wood pulp layer represents approximately 9,500 cubic yards of wood pulp.

5.2 Wood Waste Impacts

Areas of the harbor bottom with no apparent wood debris have healthy sediment conditions with epibenthic organisms present on the sediment surface (Figures 14 and 18). Figure 18 shows a small flat fish present at the sediment surface at station 35 (central outer harbor). The underlying sediments have well-developed apparent RPD depths, and Stage III infaunal communities are present.

The presence of sparse, scattered wood debris on the sediment surface ("SC" designation in Figure 6) appears to have minimal impact on the health of the benthic community. At many locations with scattered wood debris, apparent RPD depths are well developed, Stage III infaunal communities are present, and epibenthic organisms are observed on the sediment surface. Figure

35/A (Plan-View)

77/A (Plan-View)

Plan-View Scale

3 cm

Figure 18. Plan-view images from stations 35/A and 77/A in northern Port Angeles Harbor. Station 35 shows the presence of a small flat fish (approximately 5 cm long) on the sediment surface along with a piece of algae debris. Wood **waste** is absent at this location. Station 77 shows the presence of a small Cancer crab (approximately 6 cm) and small fish (goby?). Sparse, scattered wood debris is present on the sediment surface in this part of the harbor.

18 shows a crab (*Cancer*) and small fish (goby?) at station 77, where sparse wood debris was observed on the sediment surface. Figure 9 shows a plan-view image at station 6 with a shrimp seeking shelter below a piece of wood debris. Similarly, a coon-striped shrimp (*Pandalus danae*) is sitting on a stick on the harbor bottom at station 47 (report cover). As long as overlying water quality is not impacted, wood debris can provide habitat for epibenthic organisms.

The value of wood debris as epibenthic habitat is also supported by towed underwater video observations (Figure 19). Rockfish (Yellowtail?) were observed in log piles in the nearshore areas of transect T1. Abundant anemones (*Metridium*) were often seen attached to submerged logs and wood debris. Abundant populations of shrimp were seen inhabiting wood debris in the deep northern portion of the harbor, in water depths of 100 to 150 feet. Crabs (*Cancer*), sea cucumbers, and seastars were also observed in association with wood debris during the towed video survey.

However, the benefits of wood debris to the epibenthic organisms can come at the expense of the benthic infaunal community. Accumulations of log piles or wood debris piles on the harbor bottom can smother the underlying sediments, eliminating the infaunal community and creating anaerobic sediment conditions. For example, stations 2, 12, 13, 43, and 95 in log booming areas in the western harbor were azoic, showing no evidence of benthic infaunal colonization.

5.3 Bacterial Mats

Accumulations of fine wood particles (i.e., pulp, wood chips) in low energy environments causes organic enrichment, leading to degradation of benthic habitat and potentially to a decline in the overlying water quality. This process appears to be occurring at some stations along the western shoreline of the harbor (see Figure 15). Bacterial mats were observed at stations 9, 12, 38 and 39, which indicate high labile organic loading and low dissolved oxygen conditions (Figure 11 and 12). Dense populations of sulfate-reducing bacteria can populate wood pulp deposits. This "fiber blanket" surface has a high SOD and a thin or non-existent apparent RPD depth within the sediment column. When sulfate is used up, methane gas may then accumulate within the bottom sediments (observed as bubbles in SVPS images). A methane bubble is present in a relict feeding void at station 12 (see Figure 12).

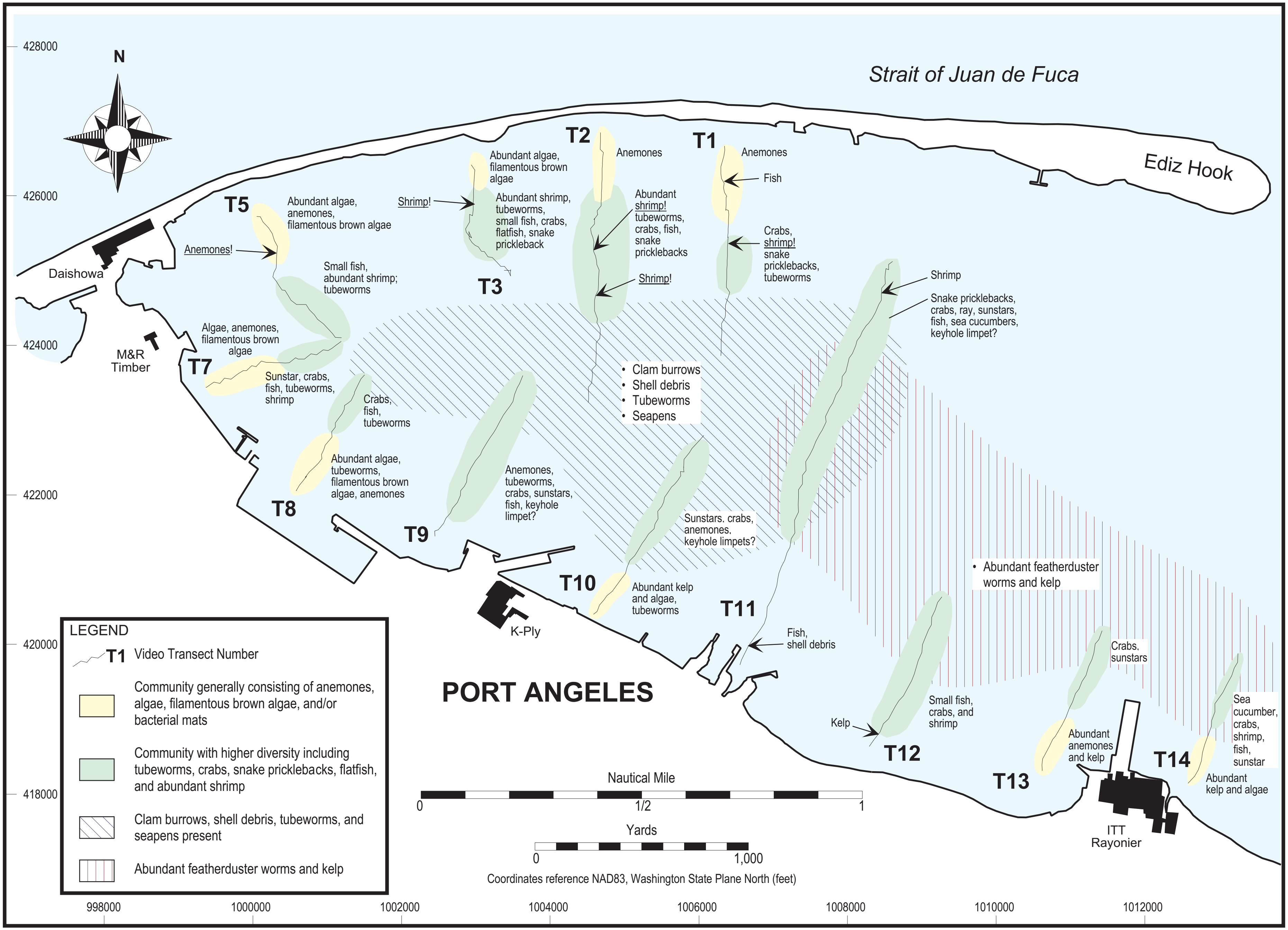


Figure 19. Epibenthic activity in Port Angeles Harbor based on towed underwater video.

Bacterial mat colonies can hinder the recovery of degraded, organically overloaded sediments. Bacterial mats act as a membrane over the underlying sediments, even if low dissolved oxygen conditions have ceased in overlying waters. The bacteria continue to feed off of the sulfate source, keeping underlying sediments anaerobic. Habitat value of this bottom type in terms of fish production is close to zero; prey are essentially non-existent and the low dissolved oxygen conditions are not tolerable by most fish species.

In-situ capping of degraded areas with clean sediment can be a potential remediation measure, provided wood waste input can be reduced or eliminated. Natural sedimentation has apparently "capped" the wood pulp deposit in the western central harbor (north of the Boat Haven). Surface sediments overlying the pulp deposit show well-developed RPD depths, feeding voids, and the presence of polychaetes feeding within the wood pulp layer (Figure 7). However, deposition of fine wood debris (pulp and wood chips) is likely regulated in part by water circulation in the harbor. The western harbor has the greatest potential for poor water circulation. Log rafting and other nearby wood-related activities also provide the greatest potential for wood waste accumulation on the harbor bottom. These two conditions have likely contributed to the degraded sediment conditions observed in the western harbor.

5.4 Organism-Sediment Index

The Organism-Sediment Index (OSI) provides a good summary metric for measuring the health of the benthic infaunal community and assessing stages of organic enrichment in Port Angeles Harbor. The OSI incorporates several of the parameters measured in this study (apparent RPD, infaunal successional stage, dissolved oxygen conditions, and sedimentary methane) into a numerical index sensitive to measuring benthic habitat quality.

OSI values in the central harbor were between +7 and +11, indicating healthy and undisturbed benthic conditions (Figure 17). Stressed or disturbed conditions (OSI values less than +6) were generally observed in the log booming grounds (Figure 17). An OSI value less than +6 reflects sediment with shallower apparent RPD depths and primary or Stage I infaunal succession. These areas are recently disturbed or in various stages of organic overloading due to wood waste deposition. Degraded benthic habitat (OSI values less than zero) was observed at stations 8, 12, 40, 43, and 95 in log booming areas in the western harbor. These areas have very shallow or non-existent RPD depths, no evidence of benthic infaunal colonization, and apparent high SOD.

Sedimentary methane and bacterial mats were also present in some of these areas. This late stage of degradation may be long lasting. Near-bottom oxygen in these areas is used up in the decay of organic matter and oxidation of reduced compounds such as methane, ammonia, and hydrogen sulfide.

6.0 CONCLUSIONS

The following conclusions can be made regarding the objectives of the Port Angeles Harbor wood waste study:

1. Map the horizontal extent of wood waste accumulations

Wood waste covers approximately 25 percent of the bottom of Port Angeles Harbor (Figure 6). Approximately 400 acres of harbor bottom is covered by wood debris in the north and west portions of the harbor, in the active log booming grounds near the Daishowa facility. Approximately 30 acres are covered near the public log dump, and approximately 55 acres are covered near the former ITT Rayonier booming grounds.

2. Measure the thickness of the accumulations

Abundant wood debris including logs and large bark/wood fragments was observed in the active and historical log booming grounds. Large piles of recently deposited logs were observed in the active log booming grounds along the northern portion of the harbor. Size and abundance of wood debris decreased offshore from the booming grounds.

Discreet measurement of wood waste thickness could only be made in areas of dense wood pulp or wood chip accumulation. Measurable wood pulp layers were observed in the northern harbor, near the Daishowa and M&R Timber facilities, near the public log dump, and near the former ITT Rayonier facility (Figure 6). The highest wood pulp accumulation (> 21cm) was measured at station 91, near the Daishowa facility.

A layer of wood pulp is buried under 6 to 8 cm of ambient silt in the western central harbor (Figures 6 and 7). The wood pulp layer measures from 5.1 cm thick at station 57 to >10.1 cm at station 45. The layer covers approximately 35 acres and represents a volume of about 9,500 cubic yards of wood pulp (wet-volume).

3. *Describe the wood waste encountered*

Five types of wood waste were identified on the bottom of Port Angeles Harbor:

- Logs or large wood pieces
- Small wood and/or bark chips (wood chips)
- Very fine wood particles and/or fibers (wood pulp)
- Trace to sparse wood pulp/chips mixed within the sediment column
- Sparse, scattered wood pieces on top of the sediment surface

4. *Measure the depth of the apparent RPD*

Mean apparent RPD depths in Port Angeles Harbor had a major mode around 2.25 cm (Figure 13). Deeper apparent RPDs were measured in areas where little or no wood waste accumulation was observed. Shallower or non-existent (i.e., zero) apparent RPD depths were associated with active and historical log booming grounds and indicate organic overloading. Stations with non-existent apparent RPD depths were observed at stations near the Daishowa facility, the public log dump grounds, the booming grounds near K-Ply, and the former ITT Rayonier grounds.

5. *Identify areas with potential for high SOD*

Apparent high SOD conditions exist in the western harbor near the Daishowa and M&R Timber facilities, the port log dump, the booming grounds near K-Ply, and the former ITT Rayonier grounds (Figure 15). These are areas of accumulation of fine wood waste (pulp) that is at least in part responsible for the high SOD. Other possible contributors to this condition are poor water circulation/flushing and organic loading from surface runoff. Several stations showed no apparent RPD depths and no evidence of benthic infaunal communities. Two stations showed sedimentary methane. Bacterial mats, which indicates organic enrichment and low dissolved oxygen conditions, were also observed at four stations in the western harbor.

6. *Evaluate the health of the benthic macroinvertebrate community*

The OSI provides a good summary metric for measuring the health of the benthic community in Port Angeles Harbor. OSI values in the central harbor were between +7 and +11 indicating healthy benthic conditions (Figure 17). High OSI values reflect deep apparent RPD depths, Stage

III infaunal communities, and low SOD. Stressed or disturbed conditions (OSI values less than +6) were generally observed in the log booming grounds. Degraded benthic habitat (OSI less than zero) was observed at stations 8, 12, 40, 43, and 95 in log booming grounds in the western harbor. Stations 8, 12, 13, 43, and 95 in these areas were azoic.

7.0 REFERENCES

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Rhoads, D.C., and J.D. Germano. 1986. Interpreting long-term changes in benthic community structure: a new protocol. Hydrobiologia 142: 291-308.

U.S. Department of Commerce and Environmental Protection Agency. 1979. Dynamics of Port Angeles and Approaches, Washington. Interagency Energy/Environment Report. National Oceanic and Atmospheric Administration, Environmental Research Laboratory, Seattle, Washington. EPA Office of Environmental Engineering and Technology, Washington, D.C. EPA-600/7-79-252.

APPENDIX A

Diagram of SVPS Camera Operation, and Bathymetry Map of Port Angeles Harbor

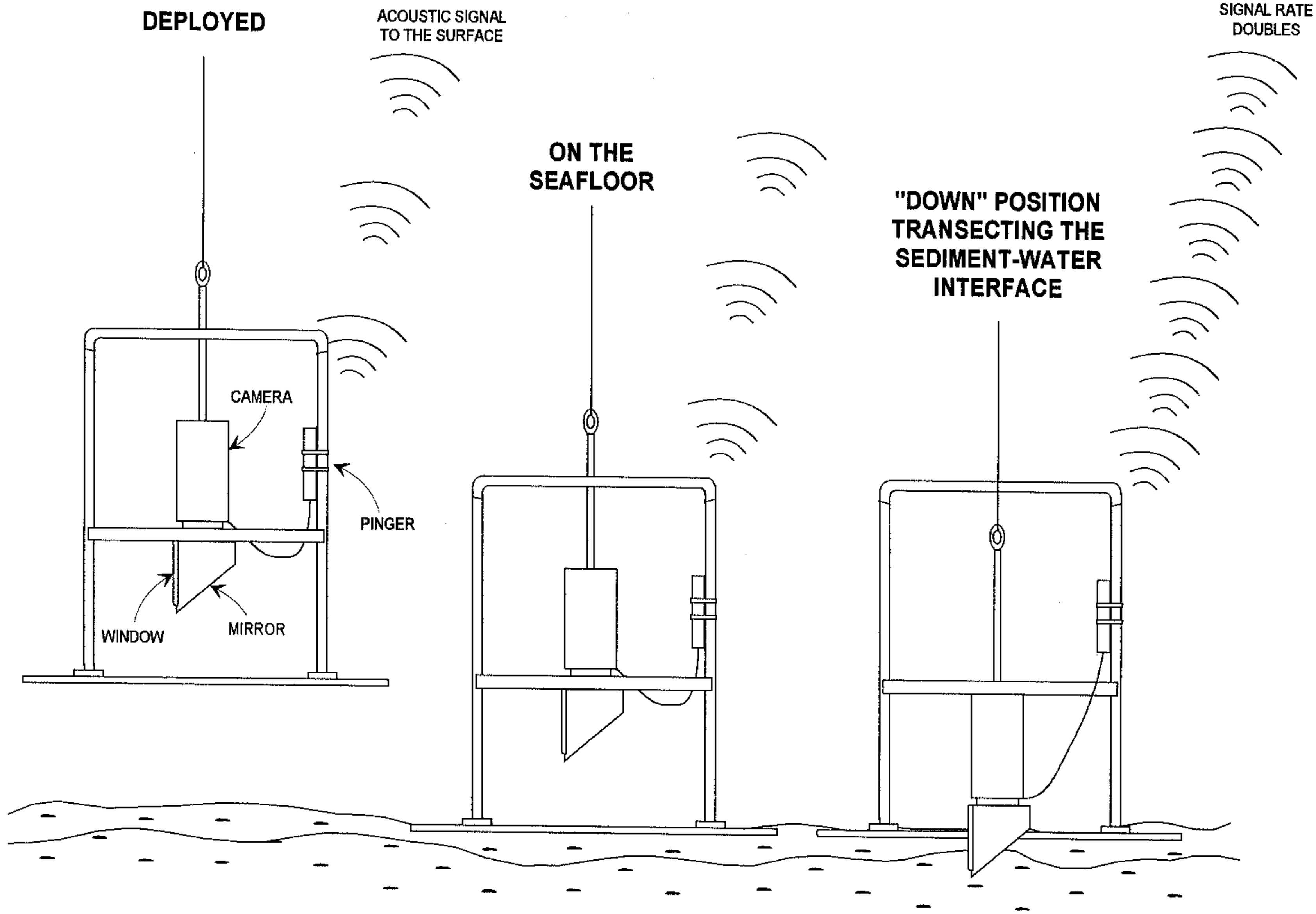

Figure A-1. Diagram of the Benthos model 3731 sediment-profile camera in operational mode.

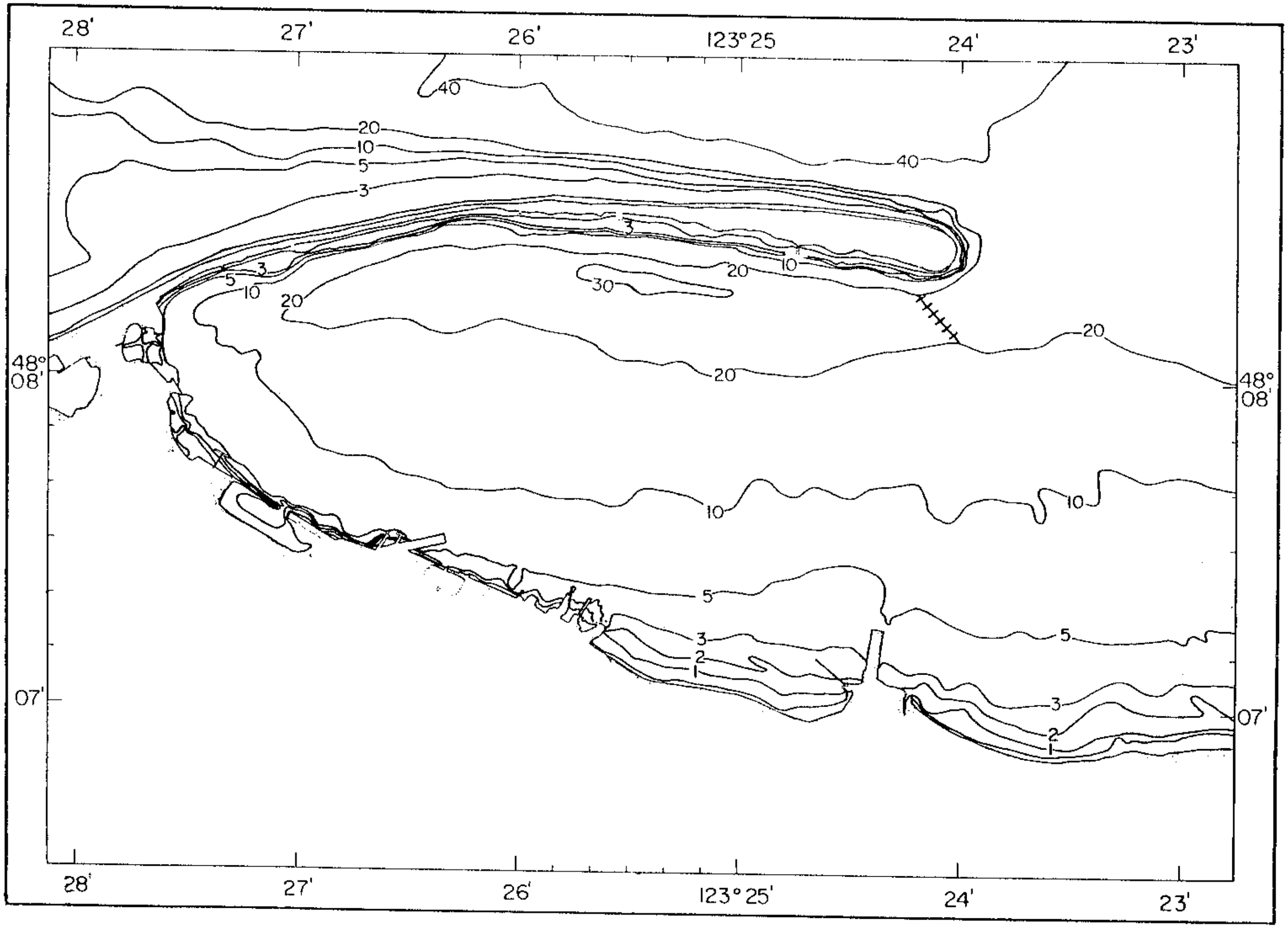

Figure A-2. Bathymetry (fathoms) in Port Angeles Harbor. One fathom = 6 ft = 1.83 m.
Source: U.S. Department of Commerce and Environmental Protection Agency, 1979.

APPENDIX B

Table B-1	**Station Coordinates**
Table B-2	**Plan-View Analysis Results**
Table B-3	**SVPS Image Analysis Results**

Table B-1. Station coordinates for the 1998 survey at Port Angeles.

Station	Date	Time	Latitude	Longitude
SVPS STATIONS				
1a	11/5/98	09:21:44	48° 08' 22.127" N	123° 25' 37.685" W
1b	11/5/98	09:22:40	48° 08' 22.208" N	123° 25' 37.147" W
1c	11/5/98	09:23:22	48° 08' 22.199" N	123° 25' 37.210" W
2a	11/5/98	09:34:17	48° 08' 15.605" N	123° 25' 53.989" W
2b	11/5/98	09:34:59	48° 08' 15.601" N	123° 25' 53.283" W
2c	11/5/98	09:35:42	48° 08' 15.599" N	123° 25' 53.409" W
3a	11/5/98	09:45:02	48° 08' 18.609" N	123° 26' 01.690" W
3b	11/5/98	09:45:44	48° 08' 18.613" N	123° 26' 01.130" W
3c	11/5/98	09:46:28	48° 08' 18.599" N	123° 26' 01.183" W
4a	11/5/98	09:57:39	48° 08' 18.609" N	123° 26' 11.607" W
4b	11/5/98	09:58:24	48° 08' 18.601" N	123° 26' 11.338" W
4c	11/5/98	09:59:04	48° 08' 18.607" N	123° 26' 10.755" W
5a	11/5/98	10:09:14	48° 08' 22.795" N	123° 26' 26.853" W
5b	11/5/98	10:10:07	48° 08' 22.800" N	123° 26' 26.868" W
5c	11/5/98	10:11:01	48° 08' 22.801" N	123° 26' 26.345" W
6a	11/5/98	10:21:26	48° 08' 09.556" N	123° 26' 25.443" W
6b	11/5/98	10:22:15	48° 08' 10.009" N	123° 26' 25.144" W
6c	11/5/98	10:23:00	48° 08' 10.259" N	123° 26' 24.476" W
7a	11/5/98	10:33:59	48° 08' 15.738" N	123° 26' 43.244" W
7b	11/5/98	10:34:38	48° 08' 15.607" N	123° 26' 43.134" W
7c	11/5/98	10:35:20	48° 08' 15.595" N	123° 26' 43.210" W
8a	11/4/98	15:07:11	48° 08' 19.200" N	123° 26' 58.789" W
8b	11/4/98	15:07:49	48° 08' 19.201" N	123° 26' 58.798" W
8c	11/4/98	15:08:29	48° 08' 19.200" N	123° 26' 58.801" W
9a	11/4/98	14:55:28	48° 08' 07.674" N	123° 26' 55.481" W
9b	11/4/98	14:56:12	48° 08' 07.801" N	123° 26' 55.122" W
9c	11/4/98	14:56:52	48° 08' 07.804" N	123° 26' 55.210" W
10a	11/4/98	14:35:48	48° 08' 11.392" N	123° 27' 08.277" W
10b	11/4/98	14:36:32	48° 08' 11.399" N	123° 27' 08.404" W
10c	11/4/98	14:37:10	48° 08' 11.400" N	123° 27' 08.404" W
10d	11/4/98	14:43:38	48° 08' 10.190" N	123° 27' 09.579" W
10e	11/4/98	14:44:24	48° 08' 10.204" N	123° 27' 09.602" W
10f	11/4/98	14:45:06	48° 08' 10.199" N	123° 27' 09.600" W
11a	11/4/98	14:12:19	48° 08' 04.838" N	123° 27' 21.574" W
11b	11/4/98	14:12:59	48° 08' 04.787" N	123° 27' 21.558" W
11c	11/4/98	14:13:38	48° 08' 04.801" N	123° 27' 21.609" W
12a	11/4/98	14:24:51	48° 08' 12.047" N	123° 27' 32.677" W
12b	11/4/98	14:25:28	48° 08' 11.987" N	123° 27' 32.300" W
12c	11/4/98	14:26:09	48° 08' 12.000" N	123° 27' 32.408" W
13a	11/4/98	12:40:58	48° 08' 04.889" N	123° 27' 43.193" W
13b	11/4/98	12:41:36	48° 08' 04.790" N	123° 27' 43.184" W
13c	11/4/98	12:42:17	48° 08' 04.799" N	123° 27' 43.203" W
14a	11/4/98	12:30:04	48° 07' 58.248" N	123° 27' 29.260" W
14b	11/4/98	12:30:41	48° 07' 58.190" N	123° 27' 29.403" W
14c	11/4/98	12:31:20	48° 07' 58.200" N	123° 27' 29.405" W
15a	11/4/98	12:16:52	48° 07' 47.400" N	123° 27' 18.578" W
15b	11/4/98	12:17:38	48° 07' 47.400" N	123° 27' 18.601" W
15c	11/4/98	12:18:18	48° 07' 47.400" N	123° 27' 18.600" W
16a	11/4/98	12:03:58	48° 07' 40.184" N	123° 26' 58.193" W
16b	11/4/98	12:04:55	48° 07' 40.202" N	123° 26' 58.201" W
16c	11/4/98	12:05:43	48° 07' 40.200" N	123° 26' 58.200" W

Table B-1. Station coordinates for the 1998 survey at Port Angeles, continued.

Station	Date	Time	Latitude	Longitude
17a	11/4/98	11:16:00	48° 07' 34.811" N	123° 26' 40.369" W
17b	11/4/98	11:16:40	48° 07' 34.804" N	123° 26' 40.117" W
17c	11/4/98	11:17:20	48° 07' 34.799" N	123° 26' 40.211" W
18a	11/4/98	11:03:04	48° 07' 30.006" N	123° 26' 15.555" W
18b	11/4/98	11:03:40	48° 07' 29.999" N	123° 26' 15.610" W
18c	11/4/98	11:04:20	48° 07' 30.000" N	123° 26' 15.600" W
19a	11/4/98	10:29:47	48° 07' 23.885" N	123° 26' 01.852" W
19b	11/4/98	10:30:23	48° 07' 23.992" N	123° 26' 01.792" W
19c	11/4/98	10:30:54	48° 07' 24.008" N	123° 26' 01.798" W
19d	11/4/98	10:36:54	48° 07' 24.627" N	123° 26' 01.816" W
19e	11/4/98	10:37:30	48° 07' 24.594" N	123° 26' 01.784" W
19f	11/4/98	10:38:05	48° 07' 24.611" N	123° 26' 01.084" W
20a	11/4/98	09:56:40	48° 07' 11.920" N	123° 25' 29.956" W
20b	11/4/98	09:57:22	48° 07' 12.053" N	123° 25' 30.000" W
20c	11/4/98	09:57:58	48° 07' 11.743" N	123° 25' 30.001" W
20e	11/4/98	10:01:57	48° 07' 11.400" N	123° 25' 30.000" W
20f	11/4/98	10:02:29	48° 07' 11.400" N	123° 25' 30.000" W
21b	11/4/98	09:00:43	48° 07' 13.200" N	123° 25' 06.599" W
21c	11/4/98	09:01:46	48° 07' 13.200" N	123° 25' 06.600" W
22a	11/4/98	09:16:22	48° 07' 04.691" N	123° 24' 54.062" W
22b	11/4/98	09:17:05	48° 07' 04.807" N	123° 24' 53.958" W
22c	11/4/98	09:17:47	48° 07' 04.801" N	123° 24' 54.018" W
23a	11/4/98	09:29:28	48° 07' 10.200" N	123° 24' 36.045" W
23b	11/4/98	09:30:13	48° 07' 10.202" N	123° 24' 35.991" W
23c	11/4/98	09:30:58	48° 07' 10.199" N	123° 24' 36.001" W
24a	11/4/98	09:42:06	48° 07' 18.001" N	123° 24' 46.687" W
24b	11/4/98	09:42:48	48° 07' 18.003" N	123° 24' 46.806" W
24c	11/4/98	09:43:26	48° 07' 17.999" N	123° 24' 46.803" W
25a	11/5/98	08:36:33	48° 07' 34.214" N	123° 25' 04.793" W
25b	11/5/98	08:37:12	48° 07' 34.196" N	123° 25' 04.080" W
25c	11/5/98	08:37:56	48° 07' 34.201" N	123° 25' 04.194" W
26a	11/4/98	10:17:20	48° 07' 25.799" N	123° 25' 38.328" W
26b	11/4/98	10:18:00	48° 07' 25.800" N	123° 25' 38.410" W
26c	11/4/98	10:18:34	48° 07' 25.800" N	123° 25' 38.402" W
27a	11/4/98	10:50:51	48° 07' 33.611" N	123° 26' 01.123" W
27b	11/4/98	10:51:23	48° 07' 33.602" N	123° 26' 01.210" W
27c	11/4/98	10:52:02	48° 07' 33.599" N	123° 26' 01.202" W
28a	11/4/98	17:04:48	48° 07' 50.990" N	123° 26' 11.975" W
28b	11/4/98	17:05:23	48° 07' 51.008" N	123° 26' 11.999" W
28c	11/4/98	17:06:02	48° 07' 50.999" N	123° 26' 12.001" W
29a	11/4/98	15:33:58	48° 07' 44.405" N	123° 26' 43.071" W
29b	11/4/98	15:34:50	48° 07' 44.400" N	123° 26' 42.539" W
29c	11/4/98	15:35:26	48° 07' 44.400" N	123° 26' 42.610" W
30a	11/4/98	15:22:19	48° 07' 55.232" N	123° 27' 08.878" W
30b	11/4/98	15:23:13	48° 07' 55.197" N	123° 27' 09.009" W
30c	11/4/98	15:23:54	48° 07' 55.200" N	123° 27' 09.001" W
31a	11/5/98	10:46:07	48° 08' 02.405" N	123° 26' 39.221" W
31b	11/5/98	10:46:52	48° 08' 02.398" N	123° 26' 38.937" W
31c	11/5/98	10:47:32	48° 08' 02.400" N	123° 26' 39.010" W
32a	11/5/98	10:56:57	48° 08' 07.179" N	123° 26' 10.790" W
32b	11/5/98	10:57:36	48° 08' 07.206" N	123° 26' 10.081" W
32c	11/5/98	10:58:25	48° 08' 07.203" N	123° 26' 09.691" W

Table B-1. Station coordinates for the 1998 survey at Port Angeles, continued.

Station	Date	Time	Latitude	Longitude
33a	11/4/98	16:13:16	48° 08' 13.209" N	123° 25' 20.409" W
33b	11/4/98	16:14:00	48° 08' 13.200" N	123° 25' 19.670" W
33c	11/4/98	16:14:42	48° 08' 13.200" N	123° 25' 19.802" W
34a	11/5/98	09:05:17	48° 07' 49.845" N	123° 25' 34.363" W
34b	11/5/98	09:06:12	48° 07' 49.794" N	123° 25' 34.177" W
34c	11/5/98	09:06:56	48° 07' 49.801" N	123° 25' 34.207" W
35a	11/4/98	16:26:46	48° 08' 02.398" N	123° 24' 56.932" W
35b	11/4/98	16:27:28	48° 08' 01.670" N	123° 24' 57.011" W
35c	11/4/98	16:28:07	48° 08' 01.790" N	123° 24' 57.000" W
36a	11/4/98	16:39:11	48° 08' 10.802" N	123° 24' 26.285" W
36b	11/4/98	16:39:55	48° 08' 10.796" N	123° 24' 26.410" W
36c	11/4/98	16:40:35	48° 08' 10.801" N	123° 24' 26.401" W
37a	11/5/98	08:20:06	48° 07' 45.002" N	123° 24' 32.901" W
37b	11/5/98	08:20:59	48° 07' 44.999" N	123° 24' 33.000" W
37c	11/5/98	08:21:41	48° 07' 45.000" N	123° 24' 33.004" W
38a	11/5/98	11:47:49	48° 08' 02.996" N	123° 27' 34.870" W
38b	11/5/98	11:48:33	48° 08' 03.002" N	123° 27' 34.355" W
38c	11/5/98	11:49:12	48° 08' 02.995" N	123° 27' 34.546" W
38a	11/6/98	13:05:37	48° 08' 02.986" N	123° 27' 33.599" W
38b	11/6/98	13:06:14	48° 08' 02.999" N	123° 27' 33.391" W
38c	11/6/98	13:06:49	48° 08' 03.008" N	123° 27' 32.934" W
39a	11/5/98	12:01:00	48° 08' 07.792" N	123° 27' 32.400" W
39b	11/5/98	12:01:43	48° 08' 07.801" N	123° 27' 32.404" W
39c	11/5/98	12:02:24	48° 08' 07.800" N	123° 27' 32.399" W
39a	11/6/98	12:40:32	48° 08' 07.200" N	123° 27' 31.251" W
39b	11/6/98	12:41:09	48° 08' 07.200" N	123° 27' 31.186" W
39c	11/6/98	12:41:47	48° 08' 07.200" N	123° 27' 31.200" W
40a	11/5/98	14:18:48	48° 08' 15.009" N	123° 27' 16.968" W
40b	11/5/98	14:19:37	48° 08' 15.104" N	123° 27' 16.696" W
40c	11/5/98	14:20:26	48° 08' 15.683" N	123° 27' 16.814" W
41a	11/5/98	14:29:36	48° 08' 07.053" N	123° 27' 15.643" W
41b	11/5/98	14:30:19	48° 08' 07.402" N	123° 27' 15.585" W
41c	11/5/98	14:31:00	48° 08' 07.900" N	123° 27' 16.089" W
42a	11/5/98	14:10:20	48° 08' 15.599" N	123° 27' 07.303" W
42b	11/5/98	14:11:00	48° 08' 15.600" N	123° 27' 07.191" W
42c	11/5/98	14:11:39	48° 08' 15.600" N	123° 27' 07.198" W
43a	11/5/98	12:12:26	48° 07' 51.031" N	123° 27' 27.568" W
43b	11/5/98	12:13:07	48° 07' 51.003" N	123° 27' 27.618" W
43c	11/5/98	12:13:49	48° 07' 50.998" N	123° 27' 27.598" W
44a	11/5/98	12:19:47	48° 07' 55.175" N	123° 27' 19.925" W
44b	11/5/98	12:20:28	48° 07' 55.198" N	123° 27' 19.828" W
44c	11/5/98	12:21:08	48° 07' 55.694" N	123° 27' 19.783" W
45a	11/5/98	12:28:24	48° 08' 01.756" N	123° 27' 14.341" W
45b	11/5/98	12:29:07	48° 08' 01.807" N	123° 27' 14.443" W
45c	11/5/98	12:29:55	48° 08' 01.800" N	123° 27' 14.393" W
46a	11/5/98	12:36:58	48° 08' 05.992" N	123° 27' 06.639" W
46b	11/5/98	12:37:42	48° 08' 06.001" N	123° 27' 06.600" W
46c	11/5/98	12:38:23	48° 08' 06.000" N	123° 27' 06.599" W
46d	11/5/98	12:40:34	48° 08' 06.000" N	123° 27' 06.600" W

Table B-1. Station coordinates for the 1998 survey at Port Angeles, continued

Station	Date	Time	Latitude	Longitude
47a	11/5/98	12:54:17	48° 08' 12.012" N	123° 26' 59.998" W
47b	11/5/98	12:54:59	48° 08' 12.000" N	123° 26' 59.998" W
47c	11/5/98	12:55:42	48° 08' 12.000" N	123° 27' 00.000" W
48a	11/5/98	13:10:18	48° 08' 15.601" N	123° 26' 51.598" W
48b	11/5/98	13:10:57	48° 08' 15.600" N	123° 26' 51.600" W
48c	11/5/98	13:11:38	48° 08' 15.600" N	123° 26' 51.600" W
49a	11/5/98	13:18:41	48° 08' 19.210" N	123° 26' 45.017" W
49b	11/5/98	13:19:26	48° 08' 19.199" N	123° 26' 44.997" W
49c	11/5/98	13:20:08	48° 08' 19.200" N	123° 26' 45.000" W
50a	11/5/98	13:27:54	48° 08' 21.583" N	123° 26' 38.442" W
50b	11/5/98	13:28:35	48° 08' 21.602" N	123° 26' 38.396" W
50c	11/5/98	13:29:16	48° 08' 21.600" N	123° 26' 38.399" W
51a	11/5/98	14:49:44	48° 07' 51.115" N	123° 27' 14.383" W
51b	11/5/98	14:50:35	48° 07' 51.035" N	123° 27' 14.648" W
51c	11/5/98	14:51:12	48° 07' 50.970" N	123° 27' 14.416" W
52a	11/5/98	14:39:36	48° 08' 01.166" N	123° 27' 02.334" W
52b	11/5/98	14:40:15	48° 08' 01.212" N	123° 27' 02.608" W
52c	11/5/98	14:41:00	48° 08' 01.196" N	123° 27' 03.090" W
54a	11/5/98	13:36:12	48° 08' 19.186" N	123° 26' 33.594" W
54b	11/5/98	13:36:52	48° 08' 19.198" N	123° 26' 33.601" W
54c	11/5/98	13:37:30	48° 08' 19.201" N	123° 26' 33.600" W
55a	11/5/98	14:58:37	48° 07' 42.005" N	123° 27' 11.423" W
55b	11/5/98	14:59:19	48° 07' 42.012" N	123° 27' 11.393" W
55c	11/5/98	15:00:03	48° 07' 42.723" N	123° 27' 11.397" W
56a	11/5/98	15:05:32	48° 07' 46.908" N	123° 27' 06.076" W
56b	11/5/98	15:06:15	48° 07' 46.804" N	123° 27' 05.998" W
56c	11/5/98	15:06:56	48° 07' 46.795" N	123° 27' 05.998" W
57a	11/5/98	15:14:27	48° 07' 51.598" N	123° 27' 02.475" W
57b	11/5/98	15:15:04	48° 07' 51.600" N	123° 27' 02.388" W
57c	11/5/98	15:15:45	48° 07' 51.600" N	123° 27' 02.400" W
58a	11/5/98	15:22:57	48° 07' 56.390" N	123° 26' 58.240" W
58b	11/5/98	15:23:37	48° 07' 56.403" N	123° 26' 58.199" W
58c	11/5/98	15:24:16	48° 07' 56.400" N	123° 26' 58.199" W
59a	11/5/98	15:30:20	48° 08' 01.784" N	123° 26' 50.316" W
59b	11/5/98	15:31:06	48° 08' 02.527" N	123° 26' 50.669" W
59c	11/5/98	15:31:40	48° 08' 02.430" N	123° 26' 50.906" W
60a	11/5/98	15:39:54	48° 08' 07.218" N	123° 26' 42.599" W
60b	11/5/98	15:40:34	48° 08' 07.193" N	123° 26' 42.598" W
60c	11/5/98	15:41:10	48° 08' 07.200" N	123° 26' 42.600" W
61a	11/5/98	15:51:24	48° 08' 12.517" N	123° 26' 35.983" W
61b	11/5/98	15:52:18	48° 08' 12.621" N	123° 26' 36.002" W
61c	11/5/98	15:52:56	48° 08' 12.592" N	123° 26' 36.000" W
62a	11/6/98	12:24:44	48° 08' 15.472" N	123° 26' 24.565" W
62b	11/6/98	12:25:20	48° 08' 14.883" N	123° 26' 24.617" W
62c	11/6/98	12:25:59	48° 08' 15.002" N	123° 26' 24.543" W
63a	11/6/98	13:26:51	48° 07' 45.665" N	123° 27' 22.932" W
63b	11/6/98	13:27:27	48° 07' 45.590" N	123° 27' 22.803" W
63c	11/6/98	13:28:06	48° 07' 45.599" N	123° 27' 22.794" W
64a	11/6/98	13:35:27	48° 07' 47.377" N	123° 26' 51.522" W
64b	11/6/98	13:36:17	48° 07' 47.405" N	123° 26' 50.931" W
64c	11/6/98	13:36:58	48° 07' 47.400" N	123° 26' 51.369" W

Table B-1. Station coordinates for the 1998 survey at Port Angeles, continued.

Station	Date	Time	Latitude	Longitude
65a	11/6/98	11:42:43	48° 07' 54.041" N	123° 26' 35.989" W
65b	11/6/98	11:43:20	48° 07' 54.252" N	123° 26' 35.997" W
65c	11/6/98	11:43:59	48° 07' 53.957" N	123° 26' 36.003" W
66a	11/6/98	11:34:02	48° 08' 06.013" N	123° 26' 31.075" W
66b	11/6/98	11:34:40	48° 08' 05.999" N	123° 26' 31.215" W
66c	11/6/98	11:35:15	48° 08' 05.999" N	123° 26' 31.204" W
67a	11/6/98	14:24:28	48° 07' 36.501" N	123° 26' 49.153" W
67b	11/6/98	14:25:12	48° 07' 36.611" N	123° 26' 49.197" W
67c	11/6/98	14:25:40	48° 07' 36.604" N	123° 26' 49.204" W
68a	11/6/98	09:42:13	48° 07' 15.703" N	123° 24' 26.268" W
68b	11/6/98	09:43:10	48° 07' 15.521" N	123° 24' 26.417" W
68c	11/6/98	09:43:44	48° 07' 15.565" N	123° 24' 26.401" W
69a	11/6/98	09:56:56	48° 07' 12.041" N	123° 24' 30.004" W
69b	11/6/98	09:57:36	48° 07' 12.002" N	123° 24' 29.954" W
69c	11/6/98	09:58:14	48° 07' 11.998" N	123° 24' 30.010" W
70a	11/6/98	11:26:36	48° 08' 04.212" N	123° 26' 23.376" W
70b	11/6/98	11:27:18	48° 08' 04.201" N	123° 26' 23.399" W
70c	11/6/98	11:27:52	48° 08' 04.199" N	123° 26' 23.401" W
71a	11/6/98	12:16:14	48° 08' 11.979" N	123° 26' 13.190" W
71b	11/6/98	12:16:54	48° 08' 12.008" N	123° 26' 13.201" W
71c	11/6/98	12:17:29	48° 08' 12.006" N	123° 26' 12.475" W
72a	11/6/98	13:44:15	48° 07' 41.906" N	123° 26' 25.101" W
72b	11/6/98	13:44:50	48° 07' 41.961" N	123° 26' 24.487" W
72c	11/6/98	13:45:27	48° 07' 42.009" N	123° 26' 24.593" W
73a	11/6/98	11:17:26	48° 08' 00.083" N	123° 26' 09.605" W
73b	11/6/98	11:18:00	48° 07' 59.989" N	123° 26' 09.607" W
73c	11/6/98	11:18:49	48° 08' 00.000" N	123° 26' 09.599" W
74a	11/6/98	11:07:33	48° 08' 09.584" N	123° 25' 50.296" W
74b	11/6/98	11:08:14	48° 08' 09.599" N	123° 25' 50.415" W
74c	11/6/98	11:08:49	48° 08' 09.601" N	123° 25' 50.402" W
75a	11/6/98	09:18:36	48° 08' 10.212" N	123° 25' 38.392" W
75b	11/6/98	09:19:16	48° 08' 10.198" N	123° 25' 38.402" W
75c	11/6/98	09:19:57	48° 08' 10.200" N	123° 25' 38.400" W
76a	11/6/98	09:08:22	48° 08' 16.754" N	123° 25' 39.597" W
76b	11/6/98	09:09:04	48° 08' 16.809" N	123° 25' 39.601" W
76c	11/6/98	09:09:42	48° 08' 17.002" N	123° 25' 39.595" W
77a	11/6/98	08:57:26	48° 08' 17.984" N	123° 25' 31.201" W
77b	11/6/98	08:58:08	48° 08' 17.999" N	123° 25' 31.200" W
77c	11/6/98	08:58:51	48° 08' 18.002" N	123° 25' 30.494" W
78a	11/6/98	08:48:28	48° 08' 22.810" N	123° 25' 23.370" W
78b	11/6/98	08:49:13	48° 08' 22.799" N	123° 25' 23.403" W
78c	11/6/98	08:49:54	48° 08' 22.800" N	123° 25' 23.400" W
79a	11/6/98	08:37:05	48° 08' 17.398" N	123° 25' 14.404" W
79b	11/6/98	08:37:46	48° 08' 17.400" N	123° 25' 14.403" W
79c	11/6/98	08:38:23	48° 08' 17.400" N	123° 25' 14.399" W
80a	11/6/98	08:25:31	48° 08' 15.603" N	123° 24' 59.127" W
80b	11/6/98	08:26:16	48° 08' 15.599" N	123° 24' 59.437" W
80c	11/6/98	08:26:53	48° 08' 15.600" N	123° 24' 59.400" W
81a	11/6/98	10:57:14	48° 08' 01.922" N	123° 25' 52.689" W
81b	11/6/98	10:57:55	48° 08' 01.113" N	123° 25' 52.818" W
81c	11/6/98	10:58:31	48° 08' 01.264" N	123° 25' 52.801" W

Table B-1. Station coordinates for the 1998 survey at Port Angeles, continued.

Station	Date	Time	Latitude	Longitude
82a	11/6/98	14:14:53	48° 07' 34.188" N	123° 26' 23.269" W
82b	11/6/98	14:15:28	48° 07' 33.875" N	123° 26' 23.359" W
82c	11/6/98	14:16:17	48° 07' 33.678" N	123° 26' 23.380" W
83a	11/6/98	13:51:01	48° 07' 36.032" N	123° 26' 10.115" W
83b	11/6/98	13:51:38	48° 07' 36.004" N	123° 26' 10.194" W
83c	11/6/98	13:52:36	48° 07' 36.010" N	123° 26' 09.511" W
84a	11/6/98	14:06:24	48° 07' 28.897" N	123° 26' 21.558" W
84b	11/6/98	14:07:00	48° 07' 28.792" N	123° 26' 21.593" W
84c	11/6/98	14:07:37	48° 07' 28.797" N	123° 26' 21.603" W
85a	11/6/98	13:58:19	48° 07' 25.749" N	123° 26' 10.789" W
85b	11/6/98	13:58:58	48° 07' 25.807" N	123° 26' 10.589" W
85c	11/6/98	13:59:35	48° 07' 25.801" N	123° 26' 10.853" W
86a	11/6/98	10:42:29	48° 07' 25.091" N	123° 25' 19.815" W
86b	11/6/98	10:43:06	48° 07' 25.214" N	123° 25' 19.783" W
86c	11/6/98	10:43:41	48° 07' 25.203" N	123° 25' 19.802" W
87a	11/6/98	10:07:27	48° 07' 09.502" N	123° 24' 45.602" W
87b	11/6/98	10:08:11	48° 07' 09.609" N	123° 24' 45.601" W
87c	11/6/98	10:08:47	48° 07' 09.602" N	123° 24' 45.600" W
88a	11/6/98	09:49:44	48° 07' 15.642" N	123° 24' 32.851" W
88b	11/6/98	09:50:31	48° 07' 15.597" N	123° 24' 32.998" W
88c	11/6/98	09:51:16	48° 07' 15.600" N	123° 24' 33.004" W
89a	11/6/98	09:34:14	48° 07' 21.624" N	123° 24' 25.085" W
89b	11/6/98	09:34:57	48° 07' 21.781" N	123° 24' 25.213" W
89c	11/6/98	09:35:39	48° 07' 21.558" N	123° 24' 25.139" W
90a	11/6/98	08:05:15	48° 07' 14.399" N	123° 24' 18.577" W
90b	11/6/98	08:06:02	48° 07' 14.400" N	123° 24' 18.606" W
90c	11/6/98	08:06:49	48° 07' 14.400" N	123° 24' 18.599" W
91a	11/6/98	12:47:07	48° 08' 09.065" N	123° 27' 39.096" W
91b	11/6/98	12:47:47	48° 08' 08.989" N	123° 27' 38.992" W
91c	11/6/98	12:48:23	48° 08' 08.999" N	123° 27' 38.997" W
92a	11/6/98	13:11:43	48° 07' 59.418" N	123° 27' 36.100" W
92b	11/6/98	13:12:24	48° 07' 59.599" N	123° 27' 35.924" W
92c	11/6/98	13:13:02	48° 07' 59.348" N	123° 27' 36.017" W
93a	11/6/98	13:17:40	48° 07' 54.665" N	123° 27' 32.895" W
93b	11/6/98	13:18:21	48° 07' 54.600" N	123° 27' 32.969" W
93c	11/6/98	13:19:00	48° 07' 54.598" N	123° 27' 33.009" W
94a	11/6/98	10:26:38	48° 07' 06.000" N	123° 24' 40.200" W
94b	11/6/98	10:27:15	48° 07' 06.000" N	123° 24' 40.200" W
94c	11/6/98	10:27:51	48° 07' 06.000" N	123° 24' 40.200" W
95a	11/6/98	14:31:14	48° 07' 38.539" N	123° 27' 00.962" W
95b	11/6/98	14:32:03	48° 07' 38.376" N	123° 27' 01.102" W
95c	11/6/98	14:32:38	48° 07' 37.753" N	123° 27' 01.284" W
TOWED VIDEO TRANSECTS				
1 – Start	11/3/98	08:18:41	48° 08' 27.602" N	123° 25' 51.081" W
1 – End	11/3/98	09:11:36	48° 07' 58.825" N	123° 25' 49.802" W
2 – Start	11/3/98	09:31:06	48° 08' 28.790" N	123° 26' 15.593" W
2 – End	11/3/98	10:20:33	48° 07' 54.487" N	123° 26' 16.231" W
3 – Start	11/3/98	10:50:04	48° 08' 23.539" N	123° 26' 40.603" W
3 – End	11/3/98	11:20:05	48° 08' 10.197" N	123° 26' 33.705" W
5 – Start	11/3/98	11:30:06	48° 08' 16.512" N	123° 27' 22.728" W
5 – End	11/3/98	11:54:44	48° 08' 00.601" N	123° 27' 05.233" W

Table B-1. Station coordinates for the 1998 survey at Port Angeles, continued.

Station	Date	Time	Latitude	Longitude
7 – Start	11/3/98	12:08:27	48° 07' 53.404" N	123° 27' 31.771" W
7 – End	11/3/98	12:30:43	48° 08' 00.039" N	123° 27' 04.683" W
8 – Start	11/3/98	12:40:19	48° 07' 40.201" N	123° 27' 13.145" W
8 – End	11/3/98	13:03:11	48° 07' 55.910" N	123° 27' 00.457" W
9 – Start	11/3/98	13:16:13	48° 07' 34.927" N	123° 26' 45 553" W
9 – End	11/3/98	13:40:45	48° 07' 57.085" N	123° 26' 28.647" W
10 – Start	11/3/98	13:52:31	48° 07' 25.210" N	123° 26' 13.563" W
10 – End	11/3/98	14:24:18	48° 07' 49.611" N	123° 25' 52.651" W
11 – Start	11/3/98	14:37:59	48° 07' 19.081" N	123° 25' 44.288" W
11 – End	11/3/98	15:31:09	48° 08' 13.231" N	123° 25' 17.272" W
12 – Start	11/3/98	17:07:46	48° 07' 08.736" N	123° 25' 18.605" W
12 – End	11/3/98	17:26:13	48° 07' 29 123" N	123° 25' 05.268" W
13 – Start	11/3/98	16:05:46	48° 07' 06.604" N	123° 24' 44.276" W
13 – End	11/3/98	16:23:55	48° 07' 25.945" N	123° 24' 32 869" W
14 – Start	11/3/98	16:32:38	48° 07' 05 500" N	123° 24' 15.819" W
14 – End	11/3/98	16:49:22	48° 07' 24.906" N	123° 24' 04.704" W

Table B-2. Plan-view qualitative analysis results.

Station	Rep	Epifauna	Algae	Wood	Sediment Description	Other
1	B	None	None	Log, particles?		
2	A	Goby?	None	15 cm piece, under dust of sediment		
	C	2 shrimp	Buried ulva	Small pieces under dust of sediment		
3	A	None	None	Log with sediment on top		
	B	Tube visible, some burrows/shows	None	None		Biogenic
	C	Shrimp	None	None		Healthy
4	A	None	None	Log?		
	B	None	None	Some pieces	Fish tracks?	
	C	None	None	Old decomposed log		
5	A	6 shrimp	Red algae	Moderate wood	Shell piece?	
6	A	1 shrimp, possible burrows	None	Buried?	Fish tracks?	
	B	Possible burrows	None	Buried pieces	Fish tracks	
	C	1 shrimp, possible burrows	None	Big piece buried	Fish tracks	
7	A	1 shrimp	None	None		Fuzzy image
8	B	None	None	Large log/ wood with sediment on top		
9	A	None	None	None	Bacterial mat with sediment on top	
	C	?	?	?		Fuzzy image
10	A	None	None	None	Fish tracks, grayish color	
	D	None	None	None	Fish tracks, fine sediment	
11	A	None	Brownish algae on surface	Possible buried fine wood?	Fine grained	
	B	None	None	Buried fine wood?		
	C	?	?	?		Fuzzy image

Table B-2. Plan-view qualitative analysis results, continued.

Station	Rep	Epifauna	Algae	Wood	Sediment Description	Other
12	A	None	Fine brown algae?	None	Bacterial mat, anaerobic below- also bulbs on top	
	C	None	None	None	Like 12A, but higher color contrast	
13	A	None	None	Fine distinct wood particles	Looks anaerobic	
	B	None	None	Distinct wood/bark		
	C	?	?	?		Fuzzy
14	B	None	Filamentous brown algae patches	None		
	D	None	None	None	Scattered bacterial mat?, anaerobic sediment below?	
15	A	None	Brownish algae	Fine wood?	Some white splotches shining through	
16	A	None	Patchy brown algae	None	Some indentations	
18	A	None	None	None	Brown spots, whittled surface texture, gas bubbles?	
19	A	None	Dense patchy brown algae over gray sediment	None		
	D	None	Similar to 19A, less dense matting, more sediment showing	Maybe wood pieces?		
20	A	None	None	None	Kelp? fronds, partially decomposed, buried in fine sediment	
	D	None	Ulva	None	Similar to 20A	
	E	None	Brown algae	None		

Table B-2. Plan-view qualitative analysis results, continued.

Station	Rep	Epifauna	Algae	Wood	Sediment Description	Other
21	A	None	Algae	None	Grayish sediment with brown spots	
	B	None	None	None	Disturbed	
	D	None	None	None	Disturbed	
22	A	None	Algae	None		
	B	None	Green and brown algae	None		
	C	None	Green algae over gravelly sands	None		
	D	None	None	None	Similar to 22C	
23	A	?	Green or brown algae	?		Dark image
24	A	Tube worms	?	?	Fine brown silt over reduced sediment	Kind of fuzzy image
	B	None	None	None	Gravels and sand with shell debris	
	C	None	Red/brown algae	None	Similar to 24B with red/brown algae	
	D	None	Red/brown algae	None	Similar to 24B with red/brown algae	
25	A	?	?	?		Dark image
	B	Tube worm clumps?	None	Possibly fine wood	Silty, fine shell debris	
	C	None	Green algae clump	None	Silty	
26	A	None	Patchy brown algae over gray sediment	None		
27	A	None	Some brown matting over silt	None	Fish tracks	
28	A	Burrows?	None	None	Silty	Healthy
29	A	None	None	Possible pieces buried	Gray silty	Healthy?
30	A	None	None	Fine particles wood?	Gray silt, like 29A	
31	A	None	None	Buried pieces	Gray silt	
	B	None	None	Buried pieces	Gray silt	Pieces of cable
	C	None	None		Fine gray silt, like 31A	

Table B-2. Plan-view qualitative analysis results, continued.

Station	Rep	Epifauna	Algae	Wood	Sediment Description	Other
32	A	None	None	Buried wood pieces		Healthy
	B	Burrows visible	None		Like 32A	
	C	None	None	None	Gray silt	
33	A	None	None	None	Fine silt	Appears healthy
	C	?	?	?		Fuzzy image
34	A	Burrows	None	None	Gray silt with burrows and fish tracks	Healthy
	B	None	None	Bark pieces	Gray silt with burrows and fish tracks	Also some mud clumps
	C	?	?	?		Fuzzy image
35	A	Flat fish	Old clump	None	Gray silt/sand	
	B	None	None	None	Gray silt/sand, couple gravels?	
36	B	Tube visible, burrows	None	None	Sandy	
	C	Burrows	Some algae or tube worms	None		
37	A	Disturbed	None	None		
	C	Tubes?	Algae clumps	None	Shell debris	
38	A	None	Dense algae mat with white/gray underlying sediment	None		
38	A~	None		None	Like 38A above, more patchy	
	C~	?	?	?		Darker image
39	A	?	?	?		Dark image
39	A~	None	Fine brown algae	None	Fine wood particles/ pieces	
40	A	None	Fine brown algae	None	Gray sediment/ sands?	

Table B-2. Plan-view qualitative analysis results, continued.

Station	Rep	Epifauna	Algae	Wood	Sediment Description	Other
41	A	None	Yellow brown algae	Pieces	White streak showing through	
	B	?	?	?		Partial image
	C/ 52A	None	None	Fine wood particles		
42	A	None	None	None	Gray sand/silt	
43	A	None	Dark brown algae spots/mat	None	Gray underlying sediment	
44	A	None	Dark brown filamentous algae	None	Dark brown coating on gray sediment	
45	A	None	None	Possible piece	Fish tracks	
	B	None	None		Similar to 45A	
46	A	None	None	Wood pieces buried		
	C	None	None	Like 46A, but less wood		
47	A	None	None	Buried wood pieces under silt		
	C	None	None	Buried wood pieces under silt		
48	A	?	?	Fine wood particles?		Fuzzy image
49	A	None	Algae	Wood		
	B	?	?	Wood		Poor visibility
	C	None	None	Wood, log, disturbed		
50	A	None	None	Fine wood		
51	B+	None	Filamentous brown algae?	Possible fine wood	Fine brown over silt	
52	C	None	None	Wood pieces under silt		
54	A	3 shrimp	?	?		Poor visibility
	C	None	None	Pieces with silt on top		

Table B-2. Plan-view qualitative analysis results, continued.

Station	Rep	Epifauna	Algae	Wood	Sediment Description	Other
55	A	None	Spots of fine brown algae mat	None	Gray silt	
	B	?	Fine brown algae spots?	?	Gray sediment	Poor visibility
56	A	Possible tubes	Light brown algae coat?	None	Gray silt	Fine biogenic particles on surface?
57	A	?	None	Wood pieces?	Similar to 56A	
58	A	None	None	Some wood pieces under silt	Gray silt	
	B	Possible burrows	None	Fine wood pieces possible	Gray silt	
59	A	None	None	Moderate wood pieces under silt		
	B	None	None	Moderate wood pieces under silt		
60	A/B/C	None	None	Fine sediment and/or fine wood particles		Overlapped images
61	B	None	None	Silt with wood pieces?		Partial image
62	A	None	None	None	Olive gray silt	
64	B	None	None	Fine sediment and/or fine wood		Overlapped images
65	A	Burrows	None	Wood pieces	Gray silt, fish tracks	
	B	?	?	?		Partial image
	C	Burrows	None	No wood	Silt, shell debris	
66	A	Tubes?	None	Wood pieces under silt		
	B	None	None	Wood pieces under silt	Gravels?	
67	B	None	None	Wood or crab		Overlapped image
68	A	None	Brown algae	Buried wood pieces	Gravels	
	B	None	Brown algae	Buried wood pieces	Gravels	Similar to 68A

Table B-2. Plan-view qualitative analysis results, continued.

Station	Rep	Epifauna	Algae	Wood	Sediment Description	Other
69	A	Tube mass	Kelp buried in silt	None		
	C	?	?	?		Poor visibility
70	A	Burrows?	None	None	Silty, shell debris	
	B	?	None	None	Rounded mud clasts, shells	Similar to 70A
71	A	Flat fish	None	None	Silty, fish tracks	
	C	?	?	None		Poor visibility
73	A	Burrows	None	None	Silty	
	B	None	None	None	Clasts, shell debris	
74	A	7 shrimp in green algae clump	None	None	Silty	
75	A	Flat fish, in motion	None	None	Silty	
76	A	None	None	None	Silty	
77	A	Crab, goby?	None	None	Silty, small clasts?	
78	A	None	Green	Some medium pieces		
	B	None	Green	Some medium pieces		
	C	Tubes?	None	Buried wood pieces		
79	A	3 shrimp	None	None	Silty, flat	
80	A	None	None	None	Silty, flat	
81	A	None	None	None	Silty, textured	
84	A	None	None	Fine wood?	Silt, sand	Overlapped images
86	A	Tubes on surface	Slight brown algae coat	Some pieces in silt		
87	A	None	Green	Large wood chunks		
	B	None	None	Large wood chunks		
88	A	?	?	Might be wood there		Poor visibility
89	A	None	Decomposed brown algae	Some wood pieces	Shell debris	
90	A	Tubes	Slight brown algae coat	Some buried wood?		

Table B-2. Plan-view qualitative analysis results, continued.

Station	Rep	Epifauna	Algae	Wood	Sediment Description	Other
91	A	None	Dense spots of brown algae coat	None	Sandy granular gray sediment	
	B	?	?	?		Poor visibility
92	A	None	Dense spots of dark brown algae	None		
	B	?	?	?		Partial image
93	A	None	Yes	None	Similar to 91A	Gas bubble, overlapped images
94	A	?	Green algae	?		Dark image

Table B-3. Image analysis results for the 1998 SVPS survey at Port Angeles.

REMOTS Image Analysis Data Abbreviation List

STAT	Survey station number
REPL	Replicate number
SS	Successional stage
GSMN	Minimum observed grain size
GSMX	Maximum observed grain size
GSMM	Major mode observed grain size
RDXMEAN	Redox rebound average depth (cm)
RPDMEAN	RPD average depth (cm)
METMEAN	Average depth of observed methane (cm)
OSI	Calculated organism sediment index value
SURF	Surface boundary roughness classification
LODO	Evidence of apparent low dissolved oxygen observed
PNMN	Minimum penetration depth (cm)
PNMX	Maximum penetration depth (cm)
PNRNG	Surface boundary roughness (range of penetration depth, max-min) (cm)
PENMEAN	Average penetration depth (cm)
ADDCMNT	Operator selected additional measurement comment
ADDVAL	Operator selected additional measurement (cm)
CMNT	Operator selected general comments

Table B-3. Image analysis results for the 1998 SVPS survey at Port Angeles.

STAT	REPL	SS	GSMX (phi)	GSMN (phi)	GSMM (phi)	RDXMEAN (cm)	RPDMEAN (cm)	METMEAN (cm)	OSI	SURF	LODO	PNMN (cm)	PNMX (cm)	PNRNG (cm)	PENMEAN (cm)
2	A	INDET	2	>4	4 to 3	0	5.59	0	99	PHYSICAL	NO	15.27	15.87	0.6	15.57
3	B	I	2	>4	>4	0	3.77	0	7	INDET	NO	10.15	12.94	2.79	11.54
3	C	I	2	>4	>4	0	1.94	0	4	PHYSICAL	NO	8.06	9.95	1.89	9
4	B	I on III	2	>4	>4	0	2.4	0	9	BIOGENIC	NO	13.68	14.23	0.55	13.96
5	A	I	2	>4	4 to 3	0	2.03	0	4	PHYSICAL	NO	11.09	13.03	1.94	12.06
6	A	I on III	2	>4	4 to 3	0	2.46	0	9	INDET	NO	8.46	9.05	0.6	8.76
6	B	I on III	2	>4	4 to 3	0	4.14	0	11	BIOGENIC	NO	11.84	13.08	1.24	12.46
7	A	I	2	>4	>4	0	2.04	0	4	BIOGENIC	NO	11.74	12.49	0.75	12.11
8	A	AZOIC	3	>4	>4	0	0	0	-8	PHYSICAL	YES	3.98	5.67	1.69	4.83
8	C	I on III	3	>4	>4	0	0.57	0	6	PHYSICAL	NO	17.11	17.91	0.8	17.51
9	C	INDET	>4	>4	>4	0	NA	0	99	PHYSICAL	YES	14.63	16.77	2.14	15.7
10	E	I on III	3	>4	>4	0	0.54	0	6	INDET	NO	9.2	9.4	0.2	9.3
11	A	I	2	>4	>4	0	3.23	0	6	INDET	NO	15.17	16.07	0.9	15.62
12	A	AZOIC	3	>4	>4	4.68	0	14.88	-10	PHYSICAL	YES	18.31	20	1.69	19.15
12	C	I	3	>4	>4	6.07	0	0	-3	BIOGENIC	YES	19.8	20.45	0.65	20.12
13	A	AZOIC	4	>4	4 to 3	0	NA	0	99	PHYSICAL	NO	2.64	5.37	2.74	4
14	B	I on III	3	>4	>4	8.56	1.23	0	7	INDET	NO	19.95	20.45	0.5	20.2
15	A	I on III	3	>4	4 TO 3	0	2.62	0	9	BIOGENIC	NO	17.56	18.46	0.9	18.01
16	A	I	3	>4	>4	0	2.7	0	5	BIOGENIC	NO	14.13	14.68	0.55	14.4
17	C	I on III	3	>4	>4	0	1.97	0	8	BIOGENIC	NO	11.79	12.39	0.6	12.09
18	A	I on III	3	>4	>4	0	0.57	0	6	INDET	NO	13.58	15.12	1.54	14.35
19	A	I on III	2	>4	>4	0	1.65	0	8	BIOGENIC	NO	12.44	12.99	0.55	12.71
19	D	I on III	2	>4	4 to 3	0	2.37	0	9	INDET	NO	10.6	11.64	1.04	11.12
20	F	INDET	2	4	4 to 3	0	2.04	0	99	PHYSICAL	NO	1.14	3.48	2.34	2.31
21	B	INDET	3	>4	4 to 3	0	NA	0	99	INDET	NO	7.26	7.66	0.4	7.46
22	C	INDET	-1	-1	<-1	0	NA	0	99	PHYSICAL	NO	0.15	0.3	0.15	0.22
23	C	INDET	2	>4	4 to 3	0	NA	0	99	PHYSICAL	NO	6.77	7.56	0.8	7.16
24	C	INDET	2	4	4 to 3	0	1.24	0	99	PHYSICAL	NO	1.79	2.79	1	2.29
25	A	I on III	2	4	4 to 3	0	2.82	0	9	PHYSICAL	NO	6.92	9.05	2.14	7.99
25	B	I on III	2	>4	4 to 3	0	3	0	9	BIOGENIC	NO	9.35	9.65	0.3	9.5
26	A	I on III	2	>4	4 to 3	0	3.25	0	10	BIOGENIC	NO	9.55	10.15	0.6	9.85
27	A	I on III	2	>4	4 to 3	0	2.26	0	9	BIOGENIC	NO	10.2	10.5	0.3	10.35
28	A	I on III	2	>4	4 to 3	0	3.22	0	10	BIOGENIC	NO	11.79	13.73	1.94	12.76
29	A	I on III	2	>4	4 to 3	0	1.52	0	8	BIOGENIC	NO	13.03	13.73	0.7	13.38

Table B-3. Image analysis results for the 1998 SVPS survey at Port Angeles, continued.

STAT	REPL	WOOD	WOODTYPE	WOODMEAN (cm)
2	A	YES	SPARSE, SCATTERED WOOD PIECES ON SURFACE	SC
3	B	YES	SPARSE, SCATTERED WOOD PIECES ON SURFACE	SC
3	C	YES	SPARSE, SCATTERED WOOD PIECES ON SURFACE	SC
4	B	NO		
5	A	YES	SPARSE, SCATTERED WOOD PIECES ON SURFACE	SC
6	A	YES	SPARSE, SCATTERED WOOD PIECES ON SURFACE	SC
6	B	YES	SPARSE, SCATTERED WOOD PIECES ON SURFACE	SC
7	A	YES	SPARSE, SCATTERED WOOD PIECES ON SURFACE	SC
8	A	YES	LARGE WOOD PIECE ON SURFACE	LOGS
8	C	NO		
9	C	YES	PULP/BACTERIAL MAT	3.7
10	E	NO		
11	A	YES	MODERATE PULP MIXED WITH SEDIMENT	3.7
12	A	YES	PULP/BACTERIAL MAT	0.4
12	C	YES	PULP/BACTERIAL MAT	0.2
13	A	YES	WOOD CHIPS MIXED IN WOOD PULP	2.8
14	B	YES	TRACE PULP MIXED IN TOP 5 CM	MX
15	A	YES	MODERATE PULP MIXED WITH SEDIMENT	1.4
16	A	YES	TRACE PULP MIXED IN TOP 3 CM	MX
17	C	NO		
18	A	NO		
19	A	NO		
19	D	NO		
20	F	NO		
21	B	NO		
22	C	NO		
23	C	YES	MODERATE WOOD CHIPS AND FIBERS MIXED IN SILTY	> 7.2
24	C	MO		
25	A	NO		
25	B	NO		
26	A	NO		
27	A	NO		
28	A	NO		
29	A	NO		

Table B-3. Image analysis results for the 1998 SVPS survey at Port Angeles, continued.

STAT	REPL	ADDCMNT	ADDVAL (cm)	CMNT
2	A	NOADDM	0	S/M; WOOD CHUNK; PELLETAL SURFACE
3	B	NOADDM	0	S/M; FINE WOOD FRAGS MIXD IN SURF LAYER
3	C	NOADDM	0	S/M; DETRITUS COVERED WOOD CHUNK
4	B	NOADDM	0	S/M; RELIC VOIDS; WORM @ DEPTH; PELLETAL S
5	A	NOADDM	0	S/M; WORM @ DEPTH; WOOD CHUNKS; SHELL FRAGS; RIPPLED
6	A	NOADDM	0	MUD>P; VOIDS; SHELL FRAG; WIPER SMEAR
6	B	NOADDM	0	S/M; VOIDS; ANENOME BURROW
7	A	NOADDM	0	S/M; BURROW?; BIOFOULING OF MASS IN FARFIELD
8	A	NOADDM	0	MUD>P; WOOD CHUNK IN FARFIELD; SEAGRASS; SULFIDIC
8	C	NOADDM	0	BLK FLOC/MUD>P; VOIDS; SHELL FRAGS @ DEPTH; THIN RPD
9	C	NOADDM	0	PULP/MUD; POSSIBLE SULFER REDUCING BACTERIAL MAT?; WIPER CLASTS
10	E	NOADDM	0	MUD>P; LIGHT FLOC ON SURF; RELIC VOID; THIN RPD
11	A	NOADDM	0	PULP/MUD?; FINE WOOD FRAGS IN SURF LAYER; BURROW
12	A	NOADDM	0	PULP FLOC/MUD; POSS BACTERIAL MAT?; VOID; METHANE BUBBLE
12	C	NOADDM	0	PULP FLOC/MUD; BACTERIAL MAT?
13	A	NOADDM	0	PULP FLOC/MUD; WOOD CHIPS; SUSPENDED PULP FLOC; ULVA/ENTEROMORPHA
14	B	NOADDM	0	PULP FLOC/MUD; BURROW
15	A	NOADDM	0	PULP FLOC/MUD; FILAMENTOUS BRN ALGAE @ SURF
16	A	NOADDM	0	MUD>P; FILAMENTOUS BRN ALGAE @ SURF; SURF BURROW
17	C	NOADDM	0	MUD>P; VOIDS; WORMS @ DEPTH; FILAMENTOUS BRN ALGAE @ SURF
18	A	NOADDM	0	MUD>P; RELIC? VOID; WIPER CLASTS
19	A	NOADDM	0	S/M; VOID; BURROW; POSS CREOSOTE? OR OIL
19	D	NOADDM	0	S/M; CREOSOTE? OR OIL; VOID?; WORMS @ DEPTH; WIPER SMEAR
20	F	NOADDM	0	MUD>P; RPD>P; SEA LETTUCE DRAGGED DOWN; SHELL FRAG; SMOTHERED BOTT
21	B	NOADDM	0	SEA LETTUCE @ SURF DRAGGED DOWN; SMOTHERED BOT
22	C	NOADDM	0	NO P; ROCKS; SHELLS; SEA LETTUCE; SCOURED BOT; SHELL LAG
23	C	NOADDM	0	MUD>P; WOOD CHIPS/FIBER BLANKET; PULL AWAY/NO RPD MEAS; SEA LETT DRAGD DOWN
24	C	NOADDM	0	MUD>P; RPD>P; ROCKS; SEA LETTUCE; RED/BRN ALGAE; SMOTHERED BOT
25	A	NOADDM	0	S/M; VOIDS; RIPPLED?; SHELL LAG
25	B	NOADDM	0	MUD>P; VOIDS
26	A	NOADDM	0	S/M; FILAMENTOUS BRN ALGAE @ SURF?; WORM @ DEPTH; VOIDS; BURROWS
27	A	NOADDM	0	MUD>P; VOIDS; BURROWS
28	A	NOADDM	0	S/M; VOIDS; BURROWS; WORM @ DEPTH
29	A	NOADDM	0	S/M; VOID; BURRROW; WORMS @ DEPTH

Table B-3. Image analysis results for the 1998 SVPS survey at Port Angeles, continued.

STAT	REPL	SS	GSMX (phi)	GSMN (phi)	GSMM (phi)	RDXMEAN (cm)	RPDMEAN (cm)	METMEAN (cm)	OSI	SURF	LODO	PNMN (cm)	PNMX (cm)	PNRNG (cm)	PENMEAN (cm)
30	A	I on III	2	>4	4 to 3	0	6.99	0	11	BIOGENIC	NO	18.36	19.45	1.09	18.91
30	B	I on III	2	>4	4 to 3	0	3.16	0	10	INDET	NO	15.32	16.37	1.04	15.85
31	A	I on III	2	>4	4 to 3	0	3.06	0	10	PHYSICAL	NO	16.17	17.96	1.79	17.06
32	C	I on III	3	>4	4 to 3	0	3.45	0	10	INDET	NO	8.26	13.18	4.93	10.72
33	A	I	3	>4	4 to 3	0	3.67	0	6	INDET	NO	10.5	11.34	0.85	10.92
33	C	I on III	3	>4	4 to 3	0	1.97	0	8	BIOGENIC	NO	7.66	8.11	0.45	7.89
34	A	I on III	3	>4	4 to 3	0	1.11	0	7	PHYSICAL	NO	4.51	5.18	0.67	4.85
34	C	I on III	3	>4	4 to 3	0	2	0	8	BIOGENIC	NO	7.23	7.95	0.72	7.59
35	A	I on III	3	>4	4 to 3	0	2.8	0	9	PHYSICAL	NO	7.9	10.51	2.62	9.21
36	C	I on III	3	>4	4 to 3	0	3.67	0	10	PHYSICAL	NO	7.13	8.05	0.92	7.59
37	B	I	3	>4	4 to 3	0	NA	0	99	PHYSICAL	NO	2.67	3.59	0.92	3.13
38	A	INDET	3	>4	4 to 3	0	NA	0	99	INDET	YES	20.77	20.77	0	20.77
39	B	INDET	3	>4	4 to 3	0	NA	0	99	INDET	YES	0.12	4.41	4.29	2.27
39	C	I	3	>4	>4	0	2.95	0	9	PHYSICAL	NO	11.23	13.13	1.9	12.18
40	A	I	3	>4	4 TO 3	0	0	0	-3	INDET	YES	16.15	17.95	1.79	17.05
41	A	I	3	>4	>4	0	2	0	4	PHYSICAL	NO	6.26	6.77	0.51	6.51
42	A	I	3	>4	>4	0	0	0	1	PHYSICAL	NO	15.9	16.97	1.08	16.44
43	C	AZOIC	3	>4	4 TO 3	0	0	0	-8	PHYSICAL	YES	8.36	8.92	0.56	8.64
44	C	I	3	>4	4 TO 3	0	4.85	0	7	INDET	NO	9.44	17.59	8.15	13.51
45	A	I	3	>4	>4	0	1.57	0	4	INDET	NO	15.44	16.56	1.13	16
45	B	I	3	>4	>4	0	1	0	3	INDET	NO	17.33	20.56	3.23	18.95
46	B	I on III	3	>4	4 TO 3	0	3.65	0	10	BIOGENIC	NO	14.97	15.74	0.77	15.36
47	A	I	3	>4	4 to 3	0	2.49	0	5	PHYSICAL	NO	10.62	12	1.38	11.31
47	B	I	3	>4	>4	0	1.67	0	4	PHYSICAL	NO	4.67	7.95	3.28	6.31
48	B	I	3	>4	4 to 3	0	3.58	0	6	INDET	NO	4.92	9.33	4.41	7.13
50	A	I	3	>4	>4	0	3.49	0	6	PHYSICAL	NO	14.46	15.85	1.38	15.15
51	A	I	3	>4	>4	0	2.25	0	4	BIOGENIC	NO	18.31	19.59	1.28	18.95
52	A	I	3	>4	4 to 3	0	3.37	0	6	PHYSICAL	NO	11.44	12.41	0.97	11.92
52	B	I on III	3	>4	4 to 3	0	3.34	0	10	INDET	NO	15.23	15.9	0.67	15.56
54	C	I	3	>4	4 to 3	0	1.69	0	4	PHYSICAL	NO	14.05	14.82	0.77	14.44
55	B	I	4	>4	>4	7.23	0	0	1	INDET	NO	16.97	18.62	1.64	17.79
55	C	I	4	>4	>4	7.9	0	0	1	INDET	NO	18.51	19.38	0.87	18.95
56	A	I on III	3	>4	4 to 3	0	1.5	0	7	BIOGENIC	NO	14.97	15.91	0.93	15.44

Table B-3. Image analysis results for the 1998 SVPS survey at Port Angeles, continued.

STAT	REPL	WOOD	WOODTYPE	WOODMEAN (cm)
30	A	YES	BURIED PULP LAYER	> 6.0
30	B	YES	TRACE PULP MIXED IN TOP 3.2 CM	MX
31	A	NO		
32	C	YES	SPARSE, SCATTERED WOOD PIECES ON SURFACE	SC
33	A	NO		
33	C	NO		
34	A	NO		
34	C	NO		
35	A	NO		
36	C	NO		
37	B	NO		
38	A	YES	PULP/BACTERIAL MAT	INDET
39	B	YES	PULP/BACTERIAL MAT	0.3
39	C	YES	TRACE PULP MIXED IN TOP 3.0 CM	MX
40	A	YES	TRACE PULP MIXED IN TOP 5 CM	MX
41	A	YES	SPARSE WOOD CHIPS MIXED IN TRACE PULP >6.5 CM	MX
42	A	YES	TRACE PULP/BACTERIAL MAT	0.2
43	C	YES	TRACE PULP MIXED IN >8.6 CM	MX
44	C	YES	SPARSE PULP MIXED IN TOP 4.8 CM	MX
45	A	YES	BURIED PULP LAYER	> 4.0
45	B	YES	BURIED PULP LAYER	> 10.1
46	B	YES	SPARSE, SCATTERED WOOD PIECES ON SURFACE	SC
47	A	YES	SPARSE, SCATTERED WOOD PIECES ON SURFACE	SC
47	B	YES	TRACE PULP/BACTERIAL MAT	0.5
48	B	YES	SPARSE, SCATTERED WOOD PIECES ON SURFACE	SC
50	A	YES	SPARSE PULP AND WOOD PIECES IN TOP 3 CM	MX
51	A	YES	BURIED PULP LAYER	> 6.8
52	A	YES	BURIED PULP LAYER	> 3.9
52	B	YES	BURIED PULP LAYER	5.6
54	C	NO		
55	B	NO		
55	C	NO		
56	A	NO		

Table B-3. Image analysis results for the 1998 SVPS survey at Port Angeles, continued.

STAT	REPL	ADDCMNT	ADDVAL (cm)	CMNT
30	A	DEPTH TO PULI	12.94	MUD/PULP; VOID
30	B	NOADDM	0	S/M; VOID; FINE WOOD FRAGS MIXD IN RPD LAYER
31	A	NOADDM	0	S/M; RELIC VOID; SHELL @ SURF; WIPER SMEARS
32	C	NOADDM	0	S/M; VOID
33	A	NOADDM	0	S/M; SHELL @ SURF
33	C	NOADDM	0	MUD>P; VOID; WIPER SMEAR
34	A	NOADDM	0	S/M; VOID; EROSIONAL; STRANDED TUBES
34	C	NOADDM	0	S/M; VOID; BURROWS; EROSIONAL
35	A	NOADDM	0	S/M; VOID; RIPPLED
36	C	NOADDM	0	MUD>P; VOID; RIPPLED; BIOFOULING ON SEAGRASS
37	B	NOADDM	0	MUD>P; BIG TUBES
38	A	NOADDM	0	OVER PEN; MUD>P
39	B	NOADDM	0	LOW P; MUD>P; BRN ALGAE; SULFER REDUCING BACT MAT; ANOXIC MUD
39	C	NOADDM	0	MUD>P; BRN ALGAE; BURROWS; TUBE MAT
40	A	NOADDM	0	MUD>P; WORM @ DEPTH; SULFIDIC
41	A	NOADDM	0	MUD>P; WOOD CHIPS; VOID; BURROW; EROSIONAL
42	A	NOADDM	0	S/M; WIPER CLAST; PATCHY SULFER REDUCING BACT?
43	C	NOADDM	0	S/M; RELIC BURROWS; SULFIDIC
44	C	NOADDM	0	PULL AWAY; MUD>P; PULP FLOC
45	A	DEPTH TO PULI	12.05	MUD/PULP; VOID?; PULP @ DEPTH
45	B	DEPTH TO PULI	8.87	MUD/PULP; PULP @ DEPTH
46	B	NOADDM	0	MUD>P; RELIC VOID
47	A	NOADDM	0	MUD>P; SHRIMP; WOOD STICKS
47	B	NOADDM	0	MUD>P; SILFIDIC
48	B	NOADDM	0	S/M; PELLETAL S/M; BIOFOULING OF WOOD IN FAR FIELD
50	A	NOADDM	0	MUD>P; BURROWS; WOOD CHIP
51	A	NOADDM	0	MUD/CLAY/PULP(OR SAND); BLUE=CLAY LAYER ABOVE PULP/SAND
52	A	DEPTH TO PULI	8.05	S/MUD/PULP; RIPPLED?
52	B	DEPTH TO PULI	7.64	MUD/PULP/MUD; VOID
54	C	NOADDM	0	MUD>P; RIPPLED?
55	B	NOADDM	0	MUD>P; SULFIDIC
55	C	NOADDM	0	MUD>P; SURFICIAL OXIDATION; SULFIDIC
56	A	NOADDM	0	MUD>P; VOID; BURROW

Table B-3. Image analysis results for the 1998 SVPS survey at Port Angeles, continued.

STAT	REPL	SS	GSMX (phi)	GSMN (phi)	GSMM (phi)	RDXMEAN (cm)	RPDMEAN (cm)	METMEAN (cm)	OSI	SURF	LODO	PNMN (cm)	PNMX (cm)	PNRNG (cm)	PENMEAN (cm)
57	A	I on III	3	>4	4 to 3	0	4.13	0	11	INDET	NO	14.77	15.7	0.93	15.23
57	B	I on III	3	>4	4 to 3	0	3.66	0	10	PHYSICAL	NO	11.3	18.55	7.25	14.92
58	A	I on III	3	>4	4 to 3	0	2.92	0	9	BIOGENIC	NO	14.4	15.86	1.45	15.13
59	A	I on III	3	>4	4 to 3	0	3.15	0	10	BIOGENIC	NO	14.3	15.65	1.35	14.97
60	A	I	3	>4	>4	0	2.1	0	4	PHYSICAL	NO	7.67	10.52	2.85	9.09
60	B	INDET	3	>4	>4	0	0.83	0	99	PHYSICAL	NO	14.56	16.06	1.5	15.31
61	B	INDET	3	>4	4 to 3	0	NA	0	99	PHYSICAL	NO	0.05	0.78	0.73	0.41
62	A	I	3	>4	4 to 3	0	5.5	0	7	PHYSICAL	NO	11.76	14.97	3.21	13.37
63	B	I on III	3	>4	>4	0	3.56	0	10	PHYSICAL	NO	16.22	17.46	1.24	16.84
64	A	I on III	3	>4	>4	0	2.59	0	9	BIOGENIC	NO	14.51	15.13	0.62	14.82
65	A	I on III	3	>4	>4	0	4.72	0	11	PHYSICAL	NO	17.31	19.59	2.28	18.45
66	A	I on III	3	>4	4 to 3	0	2.57	0	9	INDET	NO	12.33	13.21	0.88	12.77
67	A	I	4	>4	>4	0	0	0	1	PHYSICAL	NO	14.77	17.36	2.59	16.06
67	B	I	3	>4	4 to 3	0	2.8	0	5	PHYSICAL	NO	13.26	14.2	0.93	13.73
68	A	I	3	>4	3 to 2	0	NA	0	99	PHYSICAL	NO	0.52	0.83	0.31	0.67
69	A	I	3	>4	4 to 3	0	0.88	9.4	1	PHYSICAL	NO	13.37	14.56	1.19	13.96
70	A	I	3	>4	4 to 3	0	2.11	0	4	BIOGENIC	NO	7.46	12.49	5.03	9.97
70	C	III	4	>4	>4	0	1.39	0	7	BIOGENIC	NO	11.92	13.32	1.4	12.62
71	A	I on III	4	>4	>4	0	3.6	0	10	BIOGENIC	NO	17.51	18.45	0.93	17.98
72	A	I on III	4	>4	>4	0	2.6	0	9	BIOGENIC	NO	12.07	13.16	1.09	12.62
73	A	I on III	4	>4	>4	0	2.68	0	9	PHYSICAL	NO	10.1	10.67	0.57	10.39
74	A	I on III	4	>4	>4	0	3.31	0	10	PHYSICAL	NO	11.55	12.59	1.04	12.07
75	B	I	4	>4	>4	0	4	0	7	PHYSICAL	NO	12.54	13.68	1.14	13.11
76	A	I	4	>4	>4	0	2.67	0	5	PHYSICAL	NO	11.66	12.54	0.88	12.1
77	A	I	4	>4	>4	0	2.21	0	4	PHYSICAL	NO	12.59	14.04	1.45	13.32
78	A	I	4	>4	>4	0	2.94	0	5	PHYSICAL	NO	8.96	10.73	1.76	9.84
79	B	III	4	>4	4 TO 3	0	1.7	0	8	INDET	NO	8.24	8.86	0.62	8.55
80	A	I on III	3	>4	4 to 3	0	4.17	0	11	PHYSICAL	NO	11.68	12.17	0.49	11.93
81	A	I	3	>4	4 to 3	0	2.06	0	4	PHYSICAL	NO	5.43	5.98	0.54	5.71
82	A	I on III	4	>4	>4	0	2	0	8	BIOGENIC	NO	9.62	10.6	0.98	10.11
83	A	I on III	4	>4	4 TO 3	0	2.05	0	8	PHYSICAL	NO	12.28	13.32	1.03	12.8
84	A	I	4	>4	>4	0	0	0	1	BIOGENIC	NO	17.23	17.5	0.27	17.36
85	A	I on III	4	>4	>4	0	0	0	5	BIOGENIC	NO	16.85	17.5	0.65	17.17
85	B	I	4	>4	>4	0	1.29	0	3	PHYSICAL	NO	15.82	17.23	1.41	16.52
86	A	I on III	4	>4	>4	0	2.38	0	9	PHYSICAL	NO	8.7	9.84	1.14	9.27

Table B-3. Image analysis results for the 1998 SVPS survey at Port Angeles, continued.

STAT	REPL	WOOD	WOODTYPE	WOODMEAN (cm)
57	A	YES	BURIED PULP LAYER	> 3.2
57	B	YES	BURIED PULP LAYER	5.1
58	A	YES	SPARSE, SCATTERED WOOD PIECES ON SURFACE	SC
59	A	YES	SPARSE, SCATTERED WOOD PIECES ON SURFACE	SC
60	A	NO		
60	B	NO		
61	B	YES	SPARSE, SCATTERED WOOD PIECES ON SURFACE	SC
62	A	NO		
63	B	YES	SPARSE PULP MIXED IN >16.8 CM	MX
64	A	NO		
65	A	NO		
66	A	NO		
67	A	YES	TRACE PULP MIXED IN 0.5 CM	0.5
67	B	YES	MODERATE WOOD PIECES AND PULP MIXED IN > 13.7	MX
68	A	NO		
69	A	YES	MODERATE WOOD PULP MIXED IN >14.0 CM	MX
70	A	NO		
70	C	NO		
71	A	NO		
72	A	NO		
73	A	NO		
74	A	NO		
75	B	NO		
76	A	NO		
77	A	YES	SPARSE, SCATTERED WOOD PIECES ON SURFACE	SC
78	A	NO		
79	B	NO		
80	A	NO		
81	A	NO		
82	A	NO		
83	A	NO		
84	A	NO		
85	A	NO		
85	B	NO		
86	A	NO		

Table B-3. Image analysis results for the 1998 SVPS survey at Port Angeles, continued.

STAT	REPL	ADDCMNT	ADDVAL (cm)	CMNT
57	A	DEPTH TO PUL	12.02	MUD/PULP; BURROWS; VOID; PULP @ DEPTH
57	B	DEPTH TO PUL	7.88	MUD/PULP/MUD; VOIDS; WORMS @ DEPTH; EROSIONAL; WOOD FRAG
58	A	NOADDM	0	MUD>P; VOIDS; WORM @ DEPTH
59	A	NOADDM	0	MUD>P; VOID; SHELL FRAG NEAR SURF
60	A	NOADDM	0	MUD>P; BURROWS; SULFIDIC
60	B	NOADDM	0	MUD>P; SULFIDIC; WORM @ DEPTH?
61	B	NOADDM	0	LOW P; WOOD CHIPS; RIPPLED
62	A	NOADDM	0	S/M; VOIDS?; ORG DETRITUS
63	B	NOADDM	0	MUD>P; CREOSOTE OR RED-BRN ALGAE?; WOOD FRAGS IN MUD?; VOID
64	A	NOADDM	0	MUD>P; VOIDS
65	A	NOADDM	0	MUD>P; VOIDS; BURROWS; WIPER SMEAR
66	A	NOADDM	0	S/M; VOIDS; BURROWS
67	A	NOADDM	0	MUD>P; OIL OR CREOSOTE?; RED-BRN ALGAE?; SULFIDIC
67	B	NOADDM	0	S/M; RPD=FLOC LAYER; WOOD PULP & FRAG
68	A	NOADDM	0	LOW P; MUD>P; SM ROCKS; EROSIONAL
69	A	NOADDM	0	MUD>P; WOOD PULP MIXED IN MUD?; MANY METHANE BUBBLES IN RELIC VOIDS
70	A	NOADDM	0	MUD>P; WOOD; BURROW
70	C	NOADDM	0	MUD>P; VOID; BURROW; WORM @ DEPTH ABOVE VOID
71	A	NOADDM	0	MUD>P; VOID; WIPER SMEAR
72	A	NOADDM	0	S/M; VOID; WORM @ DEPTH
73	A	NOADDM	0	MUD>P; VOID
74	A	NOADDM	0	MUD>P; VOIDS; BURROW; WORM @ DEPTH
75	B	NOADDM	0	MUD>P; RIPPLED; EROSIONAL?
76	A	NOADDM	0	MUD>P; ERODED?; SULFIDIC @ DEPTH
77	A	NOADDM	0	MUD>P; BIOFOULING OF WOOD? OR ROCK?
78	A	NOADDM	0	MUD>P; RIPPLED; ERODED?
79	B	NOADDM	0	S/M; BURROW
80	A	NOADDM	0	MUD>P; BURROWS; BIVALVE @ SURF; WORM @ DEPTH; SURFICIAL EROSION?
81	A	NOADDM	0	MUD>P; SHELL LAG
82	A	NOADDM	0	MUD>P; VOID; FINE BRN ALGAE OR CREOSOTE?
83	A	NOADDM	0	MUD>P; VOIDS
84	A	NOADDM	0	S/M; RELIC VOID?; AMPHIPOD TUBES?
85	A	NOADDM	0	MUD>P; BURROW; VOID; WORM @ DEPTH; SULFIDIC
85	B	NOADDM	0	MUD>P; WIPER SMEAR
86	A	NOADDM	0	S/M; VOIDS; WORMS @ DEPTH; SCOURED SURFACE

Table B-3. Image analysis results for the 1998 SVPS survey at Port Angeles, continued.

STAT	REPL	SS	GSMX (phi)	GSMN (phi)	GSMM (phi)	RDXMEAN (cm)	RPDMEAN (cm)	METMEAN (cm)	OSI	SURF	LODO	PNMN (cm)	PNMX (cm)	PNRNG (cm)	PENMEAN (cm)
87	C	INDET	3	>4	3 to 2	0	0	0	99	PHYSICAL	NO	10.82	11.03	0.22	10.92
89	A	INDET	3	>4	4 to 3	0	NA	0	99	PHYSICAL	NO	0.87	3.04	2.17	1.96
90	A	I on III	3	>4	4 to 3	0	2.47	0	9	PHYSICAL	NO	8.1	10.43	2.34	9.27
91	C	INDET	3	>4	4 to 3	0	NA	0	99	INDET	NO	20.98	20.98	0	20.98
92	A	I on III	3	>4	4 TO 3	0	0.20	0	6	PHYSICAL	NO	19.46	20.87	1.41	20.16
94	C	INDET	-1	-1	<-1	0	NA	0	99	INDET	NO	0.05	0.05	0	0.05
95	A	INDET	4	>4	>4	0	0	0	99	PHYSICAL	YES	10.16	10.92	0.76	10.54
95	B	AZOIC	4	>4	>4	0	0	0	-4	PHYSICAL	NO	17.28	19.89	2.61	18.59

Table B-3. Image analysis results for the 1998 SVPS survey at Port Angeles, continued.

STAT	REPL	WOOD	WOODTYPE	WOODMEAN (cm)
87	C	YES	MODERATE FINE WOOD PIECES MIXED IN SED >10.9CI	MX
89	A	NO		
90	A	YES	SPARSE, SCATTERED WOOD PIECES ON SURFACE	SC
91	C	YES	PULP	>21.0
92	A	YES	TRACE PULP MIXED IN >20.0 CM	MX
94	C	YES	WOOD CHIPS/FRAGS	> 7.8
95	A	NO		
95	B	YES	TRACE PULP MIXED IN TOP 7 CM	MX

Table B-3. Image analysis results for the 1998 SVPS survey at Port Angeles, continued.

STAT	REPL	ADDCMNT	ADDVAL (cm)	CMNT
87	C	NOADDM	0	S>P; WOOD FRAGS MIXED IN MUD; SEA LETTUCE; BURROW; SUSPENDED WOOD FRAGS
89	A	NOADDM	0	LOW PEN; ROCKS; SHELLS; VARIOUS ALGAE; POOR SORTING
90	A	NOADDM	0	S/M; VOID; RED ALGAE; WOOD STICK
91	C	NOADDM	0	OVER PEN; MUD/PULP; POOR SORTING; WOOD FABRIC
92	A	NOADDM	0	MUD>P; PULP FLOC; VOIDS
94	C	NOADDM	0	NO P; WOOD CHUNKS/CHIPS/FRAGS
95	A	NOADDM	0	BLK MUD>P; SULFIDIC; RIPPLED; WORM @ DEPTH
95	B	NOADDM	0	BLK MUD>P; SULFIDIC

APPENDIX C

FIELD LOG

[redacted]

Notebook No. ________

Continued From Page ________

PROJECT Port Angeles Wood Waste Survey

Phone #s

Jim Norris (360) 385-4486

Brendan D II cell (360) 301-1580

Art Johnson (360) 407-6766
Ecology

SAIC cell (206) 972-8867

SAIC - Newport (800) 729-4210

SAIC - S.D. (619) 792-2151
Bob Pravins

Double Tree (360) 452-9215

Continued on Page

Signed [signature] Date 12/16/98

Read and Understood By Mary Hubbard Signed Date 12/16/98

Notebook No.

Continued From Page

PROJECT

Tues. November 3, 1998

0700 - Started preparing for day's operations

- Onboard: Jim Norris
  Lou Schwartz
  John Nakayama
  Art Johnson (Ecology)
  Mary Hubbard

0745 - John N. performed Health & Safety briefing

0800 - Started heading out to first transect start point: T1

0814 - On Station T1 - start point

0817 - Started Transect 1
- large wood logs
- piles of logs

0827 - stopped transect 1 - planning to start transect over
- scratch that - dropping camera back down & continuing Transect 1

0838 - continuing transect 1

0911 - stopped Transect 1

0915 - Tom Thompson & Pat Crane joined us on board
- Lou performed brief Health & Safety briefing for new

0921 - heading to Transect 2 start point

0930 - starting Transect 2

1023 - stopped at end of Transect 2 (changed video tape)

Continued on P

Read and Understood By

Mary Hubbard 12/16/98 [signature] 12/1

Notebook No. ______
Continued From Page ______

PROJECT ______

1027- Tom & Pat got back on their boat

1032- Mike McHenry came on board

1035 - Heading to start of Transect 3

1043 - Just about on station for Transect 3

1049- Starting Transect 3

1120- aborting rest of Transect 3

1123 - heading to start of Transect 5

1128 - on station

~1130 - Started transect 5

1154 - finished transect 5

1155 - Mike McHenry left

1205- Heading to start of Transect 7

1207- Setup for Track 7
- Started Track 7

1229 - end Track 7

1238- on station for Track 8

1239- started Track 8

1302- End Track 8 - last visitor left

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1305 On way to Track 9

1315 Starting Track 9

1340 End Track 9

1344 Enroute to Track 10

1350 Starting Track 10
— New Visitors on board — Ken Sweeney

1412 Lost power —

~1415 Regained power — continued on

~1420 Finished Track 10

1429 On way to start of Track 11

~1437 Started Track 11

1531 End of Track 11

1536 Heading to Track 13

1603 Starting Track 13

1623 Ended Track 13
Heading out to Track 14 (new "floating" track)

1633 Starting Track 14

1649 End of Track 14
Heading to ~~"floating" Track 15~~ Track 12

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PROJECT

1706 Start of Track 12

1726 End of Track 12
Heading back in

1800 End of day

Camera Set-up:

- 3 sets of weight packs
- Stop is at 13.5"

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Wed. November 4, 1998

0700 Started preparing for day's activities - John mounting planview on frame

On-board this morning:
John Nakayama
Lou Schwartz
John Nakayama
Mark Crooks, Ecology
Art Johnson, Ecology

0815 Lou briefed Mark on Health & Safety Plan

0839 Heading out to first waypoint: S21

Remote frame count = 1
Plan View " " = 4

Roll 1

Frame #	Station/Rep	Time	Remote Frame	Plan View Frame	Penetrat
			94	5	
2 A	S21/~~B~~	0900	95	~~5~~ 6	9.0
3	S21/C	0901	96	7	
	(Missed S21-A - similar to S21 B-C)			Extra = 8	
	S22/A	0915	97	9	
5	S22/B	0916	98*	10	10.5
6	S22/C	0916		11	

* Only 2 frames taken - not sure which replicate is which frame

Frame #	Station/Rep	Time	Remote Frame	Plan View Frame	Penetrat
	S23/A	0928	99	12	
7	S23/B	0929	100*	13	13.5
8	S23/C	0930		14	
				Extra = 15	

*Only 2 frames taken - not sure which replicate is which frame

0937 Heading to S24

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PROJECT (ft.)

CRFC	Station/Rep	Slide Frame#	Time	REMOTS Frame	H_2O Depth	Plan View Frame	Penetration
10	S24/A	9	0941	101		16.	
11	S24/B	10	0941:28	102		17	13.5"
12	S24/C	11	0942:50	103		18	
13	S20/A		0955:42	?		19	
14	S20/B		0956:24			20	
15	S20/C		0957:00			21	
16	* S20/D		0959:42	102		22	13.0"
17	S20/E	12	~~09~~1001:09	103		23	
18	S20/F	13	1001:32	104		24	

* Did not get logged, but similar to E F

CRFC	Station/Rep	Slide Frame#	Time	REMOTS Frame	H_2O Depth	Plan View Frame	Penetration
19	S26/A	14	1016:21	105		25	
20	S26/B	15	1017:02	106		26	12.5"
21	S26/C	16	1017:36	107		27	
22	S19/A	17	1028:49	*	35	28	?
23	S19/B		1029:24			29	
24	S19/C		1029:57	108		30	
25	S19/D	18	1035:56	109		31	?
26	S19/E	19	1036:33	110	35	32	
27	S19/F	20	1037.08	111		33	

* Only 1 frame taken for A-C - not sure which replicate is which frame

CRFC	Station/Rep	Slide Frame#	Time	REMOTS Frame	H_2O Depth	Plan View Frame	Penetration
28	S27/A	21	1049:53	112		34	
29	S27/B	22	1050:28	113	54	35	13 1/4"
30	S27/C	23	1051:07	114		36	
31	S18/A	24	1102:05	115*	47	37	13.5"
32	S18/B		1102:41	116		38	
33	S18/C	25	1103:22			39	

* Only 2 frames taken - not sure which replicate is which frame

CRFC = Conservative REMOTS Frame Count - MUST NOT EXCEED 36!

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CRFC	Station/Rep	Slide Frame #	Time	REMOTS Frame	Depth(Ft.)	Plan View Frame
34	S17/A	26	1115:01	117		40
35	S17/B	27	1115:40	118	44	41
36	S17/C	28	1116:21	119		42

—END OF ROLL 1

Note: 1118:00 - reset system clock b/c it was 1 minute ahead of boat's GPS tim

1123 John changing film in camera. Camera frame count read 29. Th the ~~z~~ frames count appears to be accurate, since we thou missed 7 frames. John also changed internal batteries

Roll 1 contains: S17-24, S26-27

Starting REMOTS Frame Count: 94

ROLL 2 Plan View Frame Count: 42

CRFC	Station/Rep	Slide Frame #	Time	REMOTS Frame	Depth(Ft.)	Plan View Frame
1	S16/A	2	1202:59	1		43
2	S16/B	3	1204:09	2	52	44
3	S16/C	4	1204:40	3		45
4	S15/A	5	1215:53	4		46
5	S15/B	6	1216:39	5	51	47
6	S15/C	7	1217:20	6		48
7	S14/A	8	1229:05	7		49
8	S14/B	9	1229:45	8	55	50
9	S14/C	10	1230:25	9		51
						Extra: 52
10	S13/A	11	1240:02	10		53
11	S13/B	12	1240:37	11	22	54
12	S13/C	13	1241:22	12		55

1245 Heading back in to put 2nd winch back on - Successful morning! B

CRFC = Conservative REMOTS Frame Count: must NOT exceed 36!

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ROJECT ______

1400 2nd winch back in place
Heading out to S11

CRFC	Station/Rep	Slide Frame #	Time	REMOTS Frame	Depth (ft.)	Plane View Frame	Penetration
						56	
13	S11/A	14	1411:24	1			
14	S11/B	15	1412:03	2	64	57	13.5"
15	S11/C	16	1412:42	3		58	
						59	
16	S12/A	17	1423:54	4			
17	S12/B	18	1424:36	5	52	60	13.5"
18	S12/C	19	1425:12	6		61	

• Some black mud, (including wood chips) adhering to the prism

CRFC	Station/Rep	Slide Frame #	Time	REMOTS Frame	Depth (ft.)	Plane View Frame	Penetration
						62	
19	S10/A	20	1434:52				
20	S10/B	x	1435:36		106	63	13.5"
21	S10/C	x	1436:13	7*		64	

*Only got 1 image - not sure which rep frame corresponds ~~to~~ to - will repeat station

CRFC	Station/Rep	Slide Frame #	Time	REMOTS Frame	Depth (ft.)	Plane View Frame	Penetration
						65	
22	S10/D	21	1442:42	8			
23	S10/E	22	1443:30	9	112	66	13.5"
24	S10/F	23	1444:09	10		67	
						68	
25	S9/A	24	1454:32	11			
26	S9/B	x	1455:15	12*	103	69	13.5"
27	S9/C	25	1455:55			70	

* Got 2 images - not sure which rep corresponds to which frame

CRFC	Station/Rep	Slide Frame #	Time	REMOTS Frame	Depth (ft.)	Plane View Frame	Penetration
						71	
28	S8/A	26	1506:15	13			
29	S8/B	x	1506:52	14*	79	72	13.5"
30	S8/C	27	1507:33			73	

Possible CH_4 bubbles, & sulfuric sediment on prism
* Got 2 images

~~31 S7/A~~
~~32 S7/B~~
~~33 S7/C~~

~~74~~
~~75 74~~
~~75~~

Changed mind - going to S30

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CRFC	Station/Rep.	Slide Frame #	Time	REMOTS Frame	Depth(ft.)	PlanView Frame
31	S30/A	28	1521:24	15		74
32	S30/B	29	1522:16	16	67	75
33	S30/C	30	1523:00	17		76
34	S29/A	31	1533:03	18		77
35	S29/B	32	1533:53	19	67	78
36	S29/C	33	1534:28	20		79

-END OF ROLL 2

ROLL 2 CONTAINS: S8-16, S29-30

Starting REMOTS Frame Count: 21
PlanView Frame Count: 79

ROLL 3

CRFC	Station/Rep.	Time	Slide Frame	REMOTS Frame	Depth(ft.)	PlanView Frame
1	S33/A	1612:19	1	94*		80
2	S33/B	1613:02	2	95	170	81
3	S33/C	1613:45	3	96		82

*Probably reset itself to 93 after the test shot

CRFC	Station/Rep.	Time	Slide Frame	REMOTS Frame	Depth(ft.)	PlanView Frame
4	S35/A	1625:51	4	97		83
5	S35/B	1626:34	5	98	123	84
6	S35/C	1627:13	6	99		85
7	S36/A	1638:14	7	100		86
8	S36/B	1638:57	8	101	142	87
9	S36/C	1639:38	9	102		88
10	S28/A	1703:52	10	103		89
11	S28/B	1704:28	11	104	79	90
12	S28/C	1705:07	12	105		91

~~Head~~
1708 Heading back in for the day.

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PROJECT

1800 Finished reloading film, removing plan view camera

END OF DAY

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Thurs. November 5, 1998

0700 John mounting plan view camera on frame
Mary picking out additional 53 waypoints

On board this morning:
Lou Schwartz
John Nakayama
Art Johnson, Ecology
Marc Crooks, Ecology
Mary Hubbard

Starting REMOTS Frame Cam
" PlanoView " "

Start of Roll 4

0750 Heading out to first station

CRFC	Station/Rep	Time	Slide Frame	REMOTS Frame	Depth (ft.)	PlanView Frame	Penetr
1	S37/A	0819:09	1	1		2	
2	S37/B	0820:04	2	2	73	3	10.5
3	S37/C	0820:42	3	3		4	
4	S25/A	0835:37	4	4		5	
5	S25/B	0836:17	5	5	56	6	12½
6	S25/C	0837:01	6	6		7	
7=Test			x(7)x	7=Test, then reset to 83			
8 ~~7~~	S34/A	0904:25	8	84		8	
9 ~~8~~	S34/B	0905:13	9	85	80	9	12½
10 ~~9~~	S34/C	0905:57	10	86		10	
						+ extra=11	
11	S1/A	0920:46	11	87		12	
12	S1/B	0921:43	12	88	106	13	13½
13	S1/C	0922:23	13	89		14	
14	S2/A	0933:19	14	90		15	
15	S2/B	0934:00	15	91	154	16	13½
16	S2/C	0934:44	16	92		17	

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CRFC	Station/Rep	Time	Slide Frame#	REMOTS Frame	Depth (ft.)	PlanView Frame	Penetration
17	S3/A	0944:05	17	93		18	
18	S3/B	0944:45	18	94	168	19	13.0"
19	S3/C	0945:30	19	95		20	
20	S4/A	0956:41	20	96		21	
21	S4/B	0957:25	21	97	164	22	13.5"
22	S4/C	0958:05	22	98		23	
23	S5/A	1008:17	23	99		24	
24	S5/B	1009:09	x	100*	162	25	13.5"
25	S5/C	1010:02	24			26	

* Only got 2 images - not sure which frame is which rep.

CRFC	Station/Rep	Time	Slide Frame#	REMOTS Frame	Depth (ft.)	PlanView Frame	Penetration
26	S6/A	1020:27	25	101		27	
27	S6/B	1021:15	26	102	124	28	13.5"
28	S6/C	1022:01	27	103		29	
29	S7/A	1033:01	28	104		30	
30	S7/B	1033:39	29	105	156	31	13.5"
31	S7/C	1034:21	30	106		32	
32	S31/A	1045:08	31	107		33	
33	S31/B	1045:53	32	108	98	34	13.5"
34	S31/C	1046:32	33	109		35	
35	S32/A	1055:58	x	110		36	
36	S32/B	1056:38	34	111*	119	37	13.5"
37	S32/C	1057:25	35			38	

didn't get logged on hard copy - printer problem
will have to retrieve from disk

*Only got 2 images - not sure which frame is which rep.

END OF ROLL 4

Roll 4 contains S1-7, 25, 31, 32, 34, 37

1102 Heading into drop off Marc

1135 Heading back out - going to station S38

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PROJECT

Start of Roll 5

Starting REMOTS Frame Count: 0
" Plan View " " :

CRFC	Station/Rep	Time	Slide Frame #	REMOTS Frame	Depth (ft)	Plan View Frame	Penet
1	S38/A	1146:51	2	1		~~39~~	
2	S38/B	1147:34	3	2	55	Multiple extra shots- John said OK to ignore from now on	13.
3	S38/C	1148:13	4	3			
	~~S39/A~~	~~1156:03~~ ← did not count - put over side but didn't take images					wc dc cc
4	S39/A	1200:12	5	4	~~58~~		135" K(
5	S39/B	1200:43	6	5	62		Ma
6	S39/C	1201:24	7	6			pr(
7	S43/A	1211:25	8	7			
8	S43/B	1212:08	9	8	44		13
9	S43/C	1212:49	10	9			
10	S44/A	1218:46	11	10			
11	S44/B	1219:28	12	11	58		13
12	S44/C	1220:07	13	12			
13	S45/A	1227:23	14	13			
14	S45/B	1228:10	15	14	68		1
15	S45/C	~~1228~~ 1228:55	16	15			

Layer of wood pulp on frame - "Weird stuff!"

CRFC	Station/Rep	Time	Slide Frame #	REMOTS Frame	Depth (ft)	Plan View Frame	Penet
16	S46/A	1235:59	x	16			
17	S46/B	1236:42	17	17	87		1
18	S46/C	1237:22	18	18			
19	S46/D	1239:35	19	19			
			20?	← This one appears to be a watershot			
20	S47/A	1253:17	21	20 ← cool shrimp picture!			
21	S47/B	1253:57	22	21	132		1
22	S47/C	1254:40	23	22			

Shackle got caught on these last 2 stations

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ROJECT

CRFC	Station/Rep	Time	Slide Frame#	REMOTS Frame	Depth (ft)	Penetration
23	S48/A	1309:17	24	23	146	13.5"
24	S48/B	1309:55	25	24		
25	S48/C	1310:37	26	25		
26	S49/A	1317:39	27	26	115	13.5"
27	S49/B	1318:25	28	27		
28	S49/C	1319:06	29	28		
29	S50/A	1326:53	30	29	86	13.5"
30	S50/B	1327:33	31	30		
31	S50/C	1328:14	32	31		
32	S54/A	1335:11	~~32~~	32	165	13 1/4"
33	S54/B	1335:51	33	33*		
34	S54/C	1336:29	34			

* Only got 2 images - not sure which frame is which rep.

1350 John changed film. Heading to S53

—END OF ROLL 5

Start of Roll 6 (Roll 5 contains: S38, 39, 43-50, 54)

Starting REMOTS Frame Count: 95

CRFC	Station/Rep	Time	Slide Frame#	REMOTS Frame	Depth (ft.)	Penetration
1	S42/A	1409:19	2	96	84	13.0"
2	S42/B	1409:59	3	97		
3	S42/C	1410:37	4	98		
4	S40/A	1417:49	5	99	48	8 1/2"
5	S40/B	1418:35	6	100		
6	S40/C	1419:23	7	101		

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CRFC	Station/Rep	Time	Slide Frame#	REMOTS Frame	Depth (ft.)	Pene
7	S41/A	1428:35	8	102	97	13
8	S41/B	1429:18	9	103		
9	S41/C	1429:58	10	104		
10	S52/A	1438:34	11	105	83	12
11	S52/B	1439:12	12	106		
12	S52/C	1439:57	13	107		
13	S51/A	1448:42	14	108	60	13
14	S51/B	1449:32	15	109		
15	S51/C	1450:11	16	110		
16	S55/A	1457:35	17	111	49	1
17	S55/B	1458:16	18	112		
18	S55/C	1459:00	19	113		
19	S56/A	1504:32	20	114	61	1
20	S56/B	1505:14	21	115		
21	S56/C	1505:53	22	116		
22	S57/A	1513:25	23	117	68	1
23	S57/B	1514:01	24	118		
24	S57/C	1514:43	25	119		
25	S58/A	1521:54	26	120	79	1
26	S58/B	1522:34	27	121		
27	S58/C	1523:13	28	122		
28	S59/A	1529:17	29	123	94	1
29	S59/B	1530:03	30	124		
30	S59/C	1530:37	31	125		

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ROJECT

CRFC	Station/Rep	Time	REMOTS Frame	Slide Frame#	Depth (ft)	Penetration
31	S60/A	1538:52	126	32	109	
32	S60/B	1539:31	127	33		13.5"
33	S60/C	1540:09	128	34		
34	S61/A	1550:22	129	35		
35	S61/B	1551:15	130	36	127	13.5"
36	S61/C	1551:53	131	37		

END OF ROLL 6

1557 Very successful day - heading back in

1645 Done for the day

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Fri November 6, 1998

On-board today: Lou Schwa
John Nakau
Marc Crooks
Mary Hubba

0715 Preparing for day's activities

0740 Heading out to 1st station S90

Michael Hom
410-965-4979

Starting REMOTS Frame Count: 0

Start of Roll 7

CRFC	Station/Rep	Time	Slide Frame#	REMOTS Frame Count	Depth (ft.)	Pe
1	S90/A	0804:16	2	1		
2	S90/B	0805:02	3	2	32	
3	S90/C	0805:49	4	3		
4	S80/A	0824:30	5	4		
5	S80/B	0825:15	6	5	182	
6	S80/C	0825:52	7	6		(hard
7	S79/A	0836:07	8	7		
8	S79/B	0836:46	9	8	190	
9	S79/C	0837:22	10	9		
10	S78/A	0847:30		10		
11	S78/B	0848:13	12	11	116	
12	S78/C	0848:54	13	12		
13	S77/A	0856:26	14	13		
14	S77/B	0857:07	15	14	188	
15	S77/C	0857:51	16	15		
16	S76/A	0907:22	17	16		
17	S76/B	0908:03	18	17	176	
18	S76/C	0908:40	19	18		

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CRFC	Station/Rep	Slide Frame #	Time	REMOTS Frame Count	Depth (ft.)	Penetration
19	S75/A	20	0917:35	19	143	13 1/4"
20	S75/B	21	0918:15	20		
21	S75/C	22	0918:56	21		
22	S89/A	23	0933:14	22	35	13 1/2"
23	S89/B	24	0933:57	23		
24	S89/C	25	0934:36	24		
25	S68/A	26	?	25		
26	S68/~~A~~B	27	0941:12 ← water shot	26	33	11 1/4"
27	S68/~~B~~C	28	0942:09	27		
28	S68/~~C~~D	29	0942:44	28* Got an extra shot		
29	S88/A	30	0948:43		28	12 1/2"
~~29~~ 30	S88/B	x	0949:31	29*		
31	S88/C	x	0950:15			

*Only got 1 shot - not resampling

CRFC	Station/Rep	Slide Frame #	Time	REMOTS Frame Count	Depth (ft.)	Penetration
~~30~~ 32	S69/A	31	0955:54	30	29	13.0"
~~31~~ 33	S69/B	32	0956:36	31		
~~32~~ 34	S69/C	33	0957:13	32		
35	S87/A	34	1006:25	33	21	13.0"
36	S87/B	35	1007:10	34		
37	S87/C	36	1007:46	35		

END OF ROLL 7

REMOTS Starting Frame Count 94

Roll 8

CRFC	Station/Rep	Slide Frame #	Time	REMOTS Frame Count	Depth (ft.)	Penetration
1	S94/A	3	1025:35	95	10	13.5"
2	S94/B	4	1026:13	96		
3	S94/C	5	1026:50	97		
4	S86/A	6	1041:27	98	43	12.0"
5	S86/B	7	1042:05	99		
6	S86/C	8	1042:40	100		

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CRFC	Station/Rep	Slide Frame #	Time	REMOTS Frame Count	Depth (ft.)	Penet
7	S81/A	9	1056:12	104		
8	S81/B	10	1056:54	102	109	13'
9	S81/C	11	1057:29	103		
10	S74/A	12	1106:31	104		
11	S74/B	13	1107:12	105	137	13½
12	S74/C	14	1107:47	106		
13	S73/A	15	1116:23	107		
14	S73/B	16	1116:58	108	102	13'
15	S73/C	17	1117:47	109		
16	S70/A	18	1125:34	110		
18	S70/B	19	1126:17	111	113	13'
18	S70/C	20	1126:51	112		
19	S66/A	21	1133:00	113		
20	S66/B	22	1133:38	114	~111	~8.
21	S66/C	23	1134:13	115		
22	S65/A	24	1141:40	116		
23	S65/B	25	1142:18	117	84	12'
24	S65/C	26	1142:57	118		

1150 Came back in to drop off Marc Crooks

1201 Heading back out to finish up stations - (15 remaining)

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PROJECT ____

CRFC	Station/Rep	Slide Frame #	Time	REMOTS Frame Count	Depth (ft).	Penetration
25	S71/A	22	1215:13	119		
26	S71/B	28	1215:51	120	137	12.5"
27	S71/C	29	1216:26	121		
28	S62/A	30	1223:42	122		
29	S62/B	31	1224:18	123	142	13.5"
30	S62/C	32	1224:56	124		
31	S39/A	33	1239:33	125		Took 2
32	S39/B	34	1240:06	126	51	13 1/4" lead weights
33	S39/C	35	1240:44	127		off each side
34	S91/A	36	1246:04	128		
35	S91/B	37	1246:44	129	45	13 1/4"
36	S91/C	38	1247:20	130		

END OF ROLL 8

Started Roll 9 — Starting REMOTS Frame Count: 1

CRFC	Station/Rep	Time	REMOTS Frame Count	Slide frame #	Depth (ft).	Penetration
1	S38/A	1304:34	2	3		
2	S38/B	1305:11	3	4	57	13 1/2"
3	S38/C	1305:47	4	5		
4	S92/A	1310:40	5	6		
5	S92/B	1311:25	6	7	41	13 1/4"
6	S92/C	1311:59	7	8		
7	S93/A	1316:38	8	9		
8	S93/B	1317:17	9	10	44	13 1/4"
9	S93/C	1317:57	10	11		

Put 2 weights back on each side prior to sampling this station

CRFC	Station/Rep	Time	REMOTS Frame Count	Slide frame #	Depth (ft).	Penetration
10	S63/A	1325:49	11	12		
11	S63/B	1326:24	12	13	41	13.0"
12	S63/C	1327:02	13	14		

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CREC	Station/Rep	Time	REMOTS Frame	slide frame	Depth(ft)	Penetration
13	S64/A	1334:25	14	15		
14	S64/B	1335:13	15	16	69	13 1/4"
15	S64/C	1335:55	16	17		
16	S72/A	1343:11	17	18		
17	S72/B	1343:46	18	19	69	13 1/2"
18	S72/C	1344:24	19	20		
19	S83/A	1349:57	20	21		
20	S83/B	1350:34	21	22	61	12 3/4"
21	S83/C	1351:33	22	23		
22	S85/A	1357:16	23	24		
23	S85/B	1357:54	24	25	37	13 1/2"
24	S85/C	1358:31	25	26		

"Black nasty goo!" (upon retrieval) Found small (1/2") dense heavy bullet-type thing on frame al

CREC	Station/Rep	Time	REMOTS Frame	slide frame	Depth(ft)	Penetration
25	S84/A	1405:19	26	27		
26	S84/B	1405:56	27	28	49	13 1/2"
27	S84/C	1406:32	28	29		
28	S82/A	1413:48	29	30		
29	S82/B	1414:24	30	31	53	13.0"
30	S82/C	1415:12	31	32		
31	S67/A	1423:23	32	33		
32	S67/B	1424:05	33	34	45	13.0"
33	S67/C	1424:36	34	35		
34	S95/A	1430:10	35	36		
35	S95/B	1430:58	36	37	49	13.0
36	S95/C	1431:33	37	38		

END OF ROLL 9

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PROJECT

14352

All Done! Heading back in to demob.

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Roll 1

(Frame) Print#	Station ID#
2	21A
3	21B
4	21C

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Plan View Slides

Roll 1 (P1)

	Frame#	Station ID
	X 5	21A
	X 6	21B
	X 7	21C
7 some overlap	8	21D
8th involved	9	22A
8	10	22B
(8½)	11	22C
	12	22D
	X 13	~~23A~~
	14	23A
	15	23B
	16	23C
	17	24A
	18	24B
	19	24C
	20	24D
0956	21	20A
0957	22	20B
1001	23	20D
1001	24	20E
1002	25	20F
1017	26	26A
1018	27	26B
1018	28	26C
1029	29	19A
1030	30	19B
1031	31	19C
1037	32	19D
1037	33	19E
1038	34	19F

Time	Frame#	Station ID
1051	35	27A
1051	36	27B
1052	37	27C
1103	38	18A
1103	39	18B
1104	40	18C
1116	41	17A
1116	42	17B
1116	43	17C
1117	44	17D
1204	45	16A
1205	46	16B
1205	47	16C
1217	48	15A
1217	49	15B
1218	50	15C
1229	51 x	14A
1230	52	14B
1230	53	14C
1231	54	14D
1241	55	13A
1241	56	13B
1242	57	13C
1412	58	11A
1413	59	11B
1413	60	11C
1415	61	11D
1425	62	12A
1425	63	12B
1426	64	12C
1436	65	10A
1436	66	10B

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Continuation of Roll (P2).

Time	Frame#	Stn. ID
1437	67	10C
1443	68	10D
1444	69	10E
1445	70	10F
1455?	71	9A
1457	72	9C
1508	73	8B
1508	74	8C
1522	75	30A
1523	76	30B
1524	77	30C
—	~~78~~	—
—	~~79~~	—
1534	80	29A
1535	81	29B
1535	82	29C
1554	83	(test shot)
1613	84	33A
1614	85	33B
1615	86	33C
1617	87	33D
1627	88	35A ← flat fish!
1627	89	35B
1628	90	35C
1639	91	36A
1640	92	36B
1640	93	36C
1705	94	28A
1705	95	28B
1706	96	28C
1706	97	28D
1902	98	End of day
?	99	
1904	100	
1904	101	

Time	Frame#	Stn. ID	
1258	69	X random	
1309	70	X test shot	
1310	71	48A	
1312	72	X 48C	
1319	73	49A	
1319	74	49B	
1320	75	X 49C	overlap
1328	76	50A	
1329	77	50B	
1329	78	X 50C	
1336	79	54A	
1337	80	Black → X 54B	
1337	81	54C	overlap
1410	82	42A	
1411	83	Black → X 42B	
1412	84	X 42C	overlap
1419	85	40A	
1420	86	Blacky but mounted X 40B	overlap
1420	87	X 40C	
1421	88	X 40D	
1430	89	41A	overlap
1430	90	Partial X 41B	
1431	91	combined X 41C	
1440	92	52A	
1440	93	X 52B	
1441	94	52C	overlap
1450	95	X 51A	
1450	96	51B	
1451	97	X 51C	
1451	98	X 51D	
1458?	99	55A	
1459	100	55B	
1500	101	X 55C	
1506	102	56A	

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<u>Time</u>	<u>Frame #</u>		<u>Stn. ID</u>	
1506	103	X	56B	
1507	104		56C	
1514	105		57A	
1515	106	X	57B	
1516	107	X	57C	
1523	108		58A	
1524	109	ok	58B	
1524	110	X	58C	
1530	111		59A	111 → 112
1531	112		59B	or 112 → [illegible]
1532	113	X	59C	
1540	114	X	60A	
1541	115	X	60B	
1541	116	X	60C	
1551	117		61A	
1552	118		61B	
1556?	119		?	
	120			

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Roll P3

Time	Frame #	Stn. ID
~~3~~	~~[illegible]~~	
0805	3	90A
0806	4	90B
0806	5	90C
0825	6	80A
0826	7	80B
0826	8	80C
0837	9 shrimp!	79A
0837	10	79B
0838	11	79C
0849	12	78A
0849	13	78B
0850	14	78C
0857	15 crab fish?	77A
0856	16	77B
0856	17	77C
0908	18	76A
0909	19	76B
0918	20	75A
0919	21	75B
0920	22	75C
0934	23	89A
0935	24	89B
0935	25	89C
0942	26	68A
0942	27	68B
0943	28	68C
0943	29	68D
0943	30	68E
0950	31	88A
0951	32	88B
0951	33	88C
0951	34	88D
0957	35	69A

Time	Frame #	Stn. ID
0957	36	69B
0958	37	69C
1007	38	87A
1008	39	87B
1008	40	87C
1008	41	87D
1026	42	94A
1027	43	94B
1027	44	94C
1029?	45	* H_2O
1042	46	86A
1043	47	86B
1043	48 (black)	86C
1044	49 (H_2O)	* 86D
1057	50	81A
1058	51 black	X 81B
1058	52	81C
1107	53 - shrimp!	74A
1108	54 - could sacrifice	74B
1108	55 X	74C
1117	56	73A
1118	57	73B
1118	58	73C
1126	59	70A
1127	60	70B
1128	61 X	70C
1134	62	66A
1134	63 (black) X	X
1135	64	66B
1135	65	66C
1142	66	65A
1143	67 ~~X~~ Part cutoff	65B
1144	68	65C
1216	69 flat fish	71A

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Time	Frame#		Stn. ID
1217	70	X	71B
1217	71		71C
1224	72		62A
1226	73	X	62B
1227	74		62C
1241	75		39A
1241	76	X	39B
1247	77		91A
1247	78		91B
	79	X	
	80	X	
?	81		
1306	82	X	38B
1307	83		38C
1311	84		92A
1312	85		92B
1317	86		93A
	87		
~~overlap~~	88		
	89		
	90		
1336	91		64B
1406	104		84A
	?		

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