Trench Excavation

Sixteen trenches were excavated between July 20 and July 26, 2006, timed to minimize the effect of tidal inundation on stratigraphic profile exposures (Figure 17). Trenches were dug with a backhoe using a four foot-wide bucket initially equipped with teeth but later replaced with a straight blade to provide cleaner exposures of the trench wall and base. The trenches were excavated 4.5 feet (1.4 meters) deep before metal shoring boxes were inserted. NWAA archaeologists periodically halted excavation to examine the exposure of the trench profile. Excavation of each trench ceased when at least several feet of sterile beach deposits were encountered or the water table was reached. A schematic of the stratigraphy for the roughly three-foot wide profile at the head of each trench was recorded on a standard Trench Description Form, which included a graphical representation of the deposits to vertical scale, narrative descriptions of the deposits, and a list of samples and artifacts taken from the profile. Depths of profile strata below ground surface were based on a datum spike or point placed as close to the head of the trench as possible, and recorded with the GPS unit.

Trenches 1, 2, 5, 6, 8, 11, 13, and 14 were placed along [redacted] corresponding with the predicted location of the barrier berm and shell midden, [redacted] Trenches 7 and 12 were placed [redacted] to characterize what were assumed to be beach deposits seaward of 45SN393. The remaining trenches were placed to the south of 45SN393 in what was predicted to be the former tidal lagoon. Trenches 3 and 4 were placed in an alignment south of Trenches 1 and 2; Trenches 9 and 10 were placed south of Trench 8; and Trenches 15 and 16 were placed south of Trench 14 (Figure 17; Appendix B). Table 1 summarizes the trench locations, dimensions, and sediments encountered during their excavation.

Spoils from the trenches in which Native American midden deposits were encountered were screened, including those from Trenches 5, 6, 8, 11, 13, and 14. Sediment from the archaeological layers, identified by their dark, charcoal-rich staining and association with fire-modified rock, shell, and bone, were stockpiled separately from the overburden and deeper sterile beach sediments. The archaeological sediments were passed through ¼-inch mesh screens by NWAA archaeologists supervised by an osteology specialist who examined each bone fragment to determine whether or not it was from a human. All artifacts and unmodified mammal bone fragments from the spoils were bagged with the general provenience of trench number, and brought to the NWAA lab for cataloguing and further analysis. Spoils from Trench 3, which encountered a concentration of early historic artifacts and faunal remains below plank decking of the Crown Lumber Company mill, were stockpiled and examined by hand. Diagnostic historic artifacts and faunal remains were collected from this pile.

Supervising NWAA archaeologists examined each trench profile and took samples from cultural strata. Constant-volume samples of one liter were obtained. CVS samples either came from a column at regular 10-centimeter intervals to obtain a continuous sedimentary sequence, or from within a specific layer to characterize the midden stratigraphy. Botanical samples were also taken from some profiles, either as isolated charcoal fragments or as bulk samples of charcoal-stained sediments.

Archaeological Borehole Sampling Program - 2006

The borehole sampling program drilled 85 boreholes throughout the Tank Farm between August 7 and September 9, 2006 (Figure 17). Forty-five boreholes were drilled using mud rotary methods; the

remaining 40 were excavated using a truck-mounted sonic drill. Total depths of the boreholes ranged from 6.7 feet to 40 feet deep for a total of 1469.7 drilled linear feet (Appendix B).

The mud rotary drilling system drove a four-inch-diameter sampler in two-foot or five-foot increments using a 140-pound hammer (Figure 18). Because of difficulties with retaining samples in the core barrel and due to percolation of groundwater and drilling mud through the sample, which removed the fine fraction sediments, use of the mud rotary drilling system was limited to the areas of the project where archaeological deposits were likely to be absent.

The sonic drilling method (also called vibracoring) used a rapidly oscillating drill head to advance a 20-foot-long core barrel (Figure 19). Coring started at two feet below the surface, the barrel was advanced to 15 fbs, and the resulting core sample was extruded directly from the core barrel in two to five-foot increments into plastic sleeves. The sleeves were then laid out in order, cut open, logged, and if midden was present, sampled (Figure 20).

For both mud rotary and vibracore drilling methods, sections of core samples in which midden was found were photographed and bulk samples were collected in 4-inch (10 cm) long increments through the length of the midden. Radiocarbon dating samples were retrieved and bagged separately.

The borehole sampling program followed a drill plan drawn up before fieldwork began. As drilling proceeded, locations of selected individual boreholes were modified depending on the field results showing the spatial extent of deposits. Each borehole was numbered in the field with an AH or other letter designation

Figure 19. The mud rotary drilling rig.

Figure 20. The sonic drilling or vibracore rig.

Figure 21. Inspection of vibracore samples.

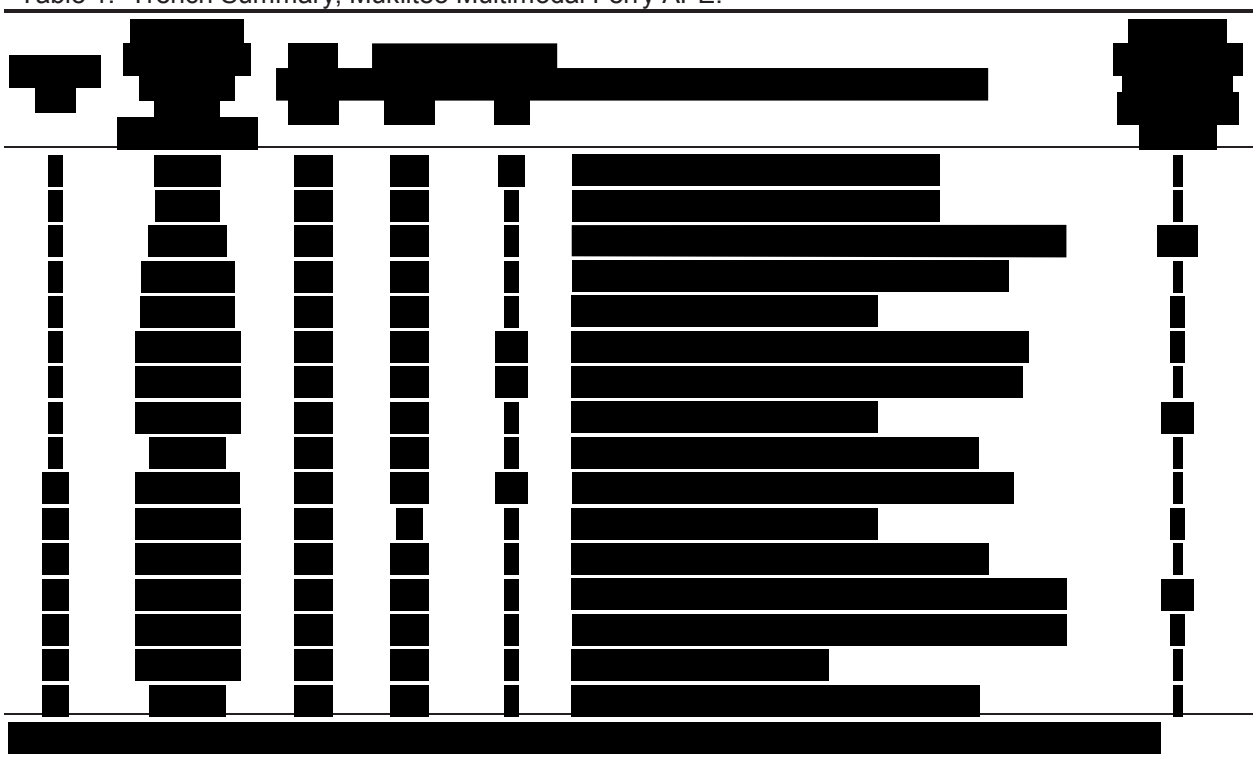
followed by an Arabic number, but for purposes of reporting the results, the AH/letter designations were dropped in favor of using a way to refer to the drilling method at each borehole. Boreholes preceded by MR were drilled using the mud rotary method, and those preceded by VC were drilled using the vibracore method.

The borehole drill plan extended from the entrance to the Tank Farm at the corner of Park Avenue and Front Street east to Tank Pad 4. Cores obtained by mud-rotary excavation were primarily limited to the former tidal wetlands located south of Front Street [redacted]. Since the cores obtained by the sonic drill (vibracore method) provided complete stratigraphic sequences, these cores were taken in the vicinity of the midden as well as in other portions of the study area (Figure 17; Appendix B). No boreholes were drilled in Tank Pad 1 or in the northwestern half of Tank Pad 2 during the 2006 investigations because there was about one foot of standing water on the tank pads.

Geotechnical Explorations – 2007

Additional archaeological borehole sampling was conducted in conjunction with geotechnical explorations completed by WSDOT in 2007 to assess load-bearing stability for proposed structures in the study area. During two phases of field work between March and October 2007, archaeologists logged 22 archaeological cores and monitored 28 geotechnical boreholes in the study area (Figure 17). Archaeological cores were drilled using the vibracore method described above, while the monitored

Table 1. Trench Summary, Mukilteo Multimodal Ferry APE.



geotechnical boreholes used mud rotary or hollow-stem auger drilling methods. All boreholes were recorded by archaeologists in the field using the methodology devised for the 2006 borehole sampling program; however, bulk samples were not retrieved from the boreholes during geotechnical explorations in 2007.

Between March 6 and April 22, 2007, three archaeological boreholes were logged and seven geotechnical boreholes were monitored on the Tank Farm Property, and 11 geotechnical bores were monitored off-shore immediately north of the property. Between October 9 and 24, 2007, a total of 19 archaeological boreholes were logged and 10 geotechnical boreholes were monitored at the Tank Farm Property and in the vicinity of the existing ferry terminal on Front Street. Boreholes were logged or monitored to total depths between 12 and 110 fbs (Table 2).

Table 2. Summary of Archaeological and Monitored Geotechnical Boreholes.*

TYPE OF BOREHOLE	NO. OF BOREHOLES	NO. OF MONITORED LINEAR FEET
2006 Boreholes		
Archaeological Mud Rotary	45	869.7
Archaeological Vibracore	28	600.0
	73	1469.7
2007 Boreholes		
Archaeological Boreholes	22	333.0
Geotechnical Boreholes	28	2497.9
Sub Total	50	2830.9
TOTAL	123	4300.6

*Archaeological boreholes are dug for archaeological purposes, while geotechnical boreholes are dug for geotechnical exploration. Geotechnical boreholes, however, like those noted here, may be monitored (examined) 1by archaeologists.

Archaeological borehole sampling completed during 2007 WSDOT geotechnical explorations included 17 cores in the Tank Farm property (Figure 17). Three cores were excavated in Tank Pads 1 and 2 [redacted], since cores had not been drilled in this area during the initial borehole sampling project. The remaining 14 cores extended the drill plan east to the eastern wall of Tank Pad 6 [redacted]

Due to proposed alterations to the existing ferry terminal, geotechnical explorations in October 2007 expanded the study area westward to include the vicinity of the existing terminal. At this time five additional archaeological cores were excavated on Front Street, at the Ferry Terminal Building site, and along SR 525 (Figure 17) [redacted] in the expanded study area.

The geotechnical boreholes were archaeologically monitored to further examine site stratigraphy near the site boundaries. Boreholes were monitored along Front Street just north of the tank pads and at the ferry boat loading ramp near the existing ferry terminal. In order to provide additional context for developing a landform history, boreholes off-shore immediately north of the study area were also monitored.

Classification of the Deposits

The trenching and coring programs revealed a complex array of individual depositional layers (lithofacies or facies) representing single depositional events. The facies are lateral changes in the lithologic

characteristics of deposits within a stratigraphic unit and are defined using physical properties of the sediments, hence the term lithofacies (Boggs 1995; Reading 1986). Facies analysis derives environmental interpretations from depositional sequences based on the principle that lateral shifts through time in the boundaries of adjacent depositional environments are represented vertically in the stratigraphic record by corresponding shifts in facies boundaries.

The facies type is the fundamental depositional unit in a spatial hierarchy that locates the individual facies type relative to the surrounding deposits, thus providing a way to determine the environment of deposition for an individual layer. The concept of facies association or assemblage provides the organizing principle for analysis at the next higher level in the depositional hierarchy. The facies types grouped into assemblages are considered to have been deposited adjacent to each other or in vertical succession in the same environmental setting. The lithofacies can be formed into assemblages because they represent the range of depositional events that frequently occur together in the same overall depositional environment. Lithofacies become stacked into stratigraphic units because the environments shift through time, permitting different lithofacies to accumulate along a vertical axis (Miall 2000:150).

Facies assemblages are the basic unit of analysis for this project and are defined by facies that share distinctive lithologic features or by stratigraphic relationships (that is, by the nature of their vertical or lateral boundaries). The advantage of this level of analysis is that it allows one to see more clearly associations between sediments and landforms (Bennett and Glasser 1996; Miall 2000). These larger, more inclusive units share common attributes such as gross geometry, shape of the units, and structure. Like the concept of facies, a facies assemblage is descriptive and is used to represent various types of depositional events that frequently occur together in the same overall depositional environment (Miall 2000). For the analysis of 45SN393 these facies assemblages are called strata, and each is composed of any number of individual lithofacies.

Table 3 shows how the classification system has been organized, and shows both the strata designations and the lithofacies nomenclature. Lithofacies are designated by a capital letter that indicates the dominant or primary grain size of the deposit. This capital letter is followed, in most cases, to its right side by a small letter describing a distinct secondary property of the same deposit. Secondary properties can be added indefinitely. For example, a gravelly sand would be designated Sg, and gravelly sands may be found as a component in a number of strata. Stratum II and Stratum IV, for example, both contain gravelly sands, but Stratum II is distinguished from Stratum IV by having archaeological facies such as sandy midden (Sae) or shell-rich sandy midden [S(ae, sh)], whereas Stratum IV does not contain archaeological layers but does have a few thin layers of detrital wood (Wd) or thin peat (Pw or Pf).

The system's purpose is to provide adequate descriptive data at small scales while sustaining geomorphic and landscape analyses at larger scales. Analogous to landscape elements in ecology, facies assemblages can be thought of as elements, or minimal homogenous parcels of land (Forman and Godron 1986; Stafford 1995), that are often arranged in patterns and exhibit varying degrees of connectivity and heterogeneity (Forman 1995). The geomorphic expression of facies assemblages at a larger scale are often referred to as geomorphic units, for example beaches, fans, and spits, which actually consist of smaller, well-defined, elements.

Table 3. Naming System Used to Classify the Depositional Sequence at 45SN393.

STRATUM DESIGNATIONS	LITHOFACIES	
	Modal Grain Size	**Modifiers**
I – Fill **II** - Midden **III** - Sandy barrier/berm deposit **IV** - Beach sediments **V** - Submerged sandy barrier/berm?	**G** = Gravel (> 2 mm) **S** = Sand (0.62 mm - 2 mm) **Z** = Silt (< 0.62 mm) **P** = Peat **W** = Wood	**Midden facies modifiers:** **Ah** = humic A horizon (may be charcoal-enriched as well) **ae** = generalized, or undifferentiated, midden; also used to designate archaeological layers in Stratum III. **f** = highly fragmented shell ("hash"). **sh** = high amount of shell **Secondary Lithologic Properties** **g** = gravelly **s** = sandy **z** = silty **m** = massive **sh** = shell or shelly **o** = organic-rich **p** = peaty **w** = woody peat **f** = f brous peat **d** = detrital wood (sea wrack, driftwood) **h** = historical wood **om** = organic layer, but not a peat **tr** = trace amount

The geomorphic concept of elements fits in nicely with the archaeological concept of place, defined as a set of landscape elements configured in a way that offers a higher probability of serving as a stopping point within a group's given settlement and economic system (Binford 1982; Wandsnider and Sullivan 1998). A landform may exhibit many elements but only a subset of the elements may actually possess the requisite characteristics to serve as attractive places for human hunters and gatherers. Furthermore, over time, different human mobility strategies in a region may share the same configuration of elements, creating localized high-density accumulations of artifacts at places due to re-use over long periods of time (Dewar et al. 1992; Stafford et al. 1992). By describing the geomorphic elements of a landform, the facies system provides a framework for relating cultural deposits to a geomorphic context.

Borehole Data Analysis

After completion of the initial fieldwork in 2006, the borehole data was compiled using Rockworks 2006 software. The lithostratigraphic classification of the deposits was used to create profiles of the archaeological deposits and to model site stratigraphy. The configuration of the boundary of the pre-contact archaeological site was determined based on the location of boreholes in which midden deposits were identified. Archaeological work completed during geotechnical explorations in 2007 extended the site boundary and further clarified the structure of the site deposits. Once a comprehensive model of site stratigraphy had been created, the borehole lithologic sequences were reevaluated based on expectations of the stratigraphic positioning of the midden deposits at the base of Stratum I, within Stratum II, and at the top of Stratum III.

Artifact and Sample Processing Methods

Artifacts and samples were brought to the NWAA lab from the field, and after being screened or sorted, were catalogued with unique numbers for artifacts and separate sample constituents (Appendix C). Artifacts were dry-brushed to remove dirt, and all samples were placed on trays and dried using a low

power drying oven. Constant-volume samples were passed through nested ¼-inch, ⅛-inch, and 1/16-inch sieves. In most cases, the 1/16-inch fraction was bagged without further sorting, and the ⅛-inch fraction was sorted into major constituents (shell, bone, charcoal, lithics, unmodified pebbles) and the artifacts and bone fragments analyzed further. The ¼-inch fraction was sorted into major constituents, and all faunal remains and cultural materials were analyzed. Bulk samples, primarily obtained for charcoal and other macrobotanical remains, were also placed on trays, dried, re-bagged and then sent to a paleoethnobotanist for further analysis.

All artifacts were analyzed at the NWAA laboratory, including lithic and bone artifacts and historic artifacts. The bulk samples for botanical analysis were split into two equal volumes. One half of each of 13 samples, plus one charcoal sample, were sent to Demeter Research, who separated and identified charcoal from the samples and assessed their suitability for radiocarbon dating. Later, the remainder of each sample was recombined with the other half of the original sample for a more comprehensive botanical analysis. Eight charcoal samples from the top and bottom of midden deposits exposed in four of the test trenches were submitted to Beta Analytic, Inc. for radiocarbon assay. These samples were of charcoal separated from the bulk samples and judged moderately suited or well-suited for dating.

Shell from the ¼-inch fraction and animal bone from the ¼-inch and ⅛-inch fractions of each trench CVS were analyzed, along with all bone collected from the trench spoils screening. Borehole bulk samples were screened in the laboratory and raw shell counts were obtained from the ¼-inch fraction. Shell and fish bone analysis was completed using NWAA comparative collections, which contain modern specimens of most representative taxa of these classes found throughout Puget Sound. Mammal bones were sorted in the NWAA laboratory and then taken to the Mammalogy skeletal collection at the Burke Museum of Natural History and Culture for further analysis by the NWAA zooarchaeologist. Bird remains were analyzed by Dr. Kristine Bovy (University of Rhode Island) using comparative material at Department of Ornithology of the Harvard Museum of Comparative Zoology. Analytical methods specific to material type are described in the individual results sections below or accompanying appendices.

Stratigraphy

The physical structure of the site was resolved into six strata with each stratum consisting of one or more facies. Stratum I, representing deposits associated with historic and modern land use, was not subdivided into individual facies. Strata II, III, IV, and V consisted of several distinct facies types related in complex ways. Stratum VI, the deepest deposit identified at the site, was observed in a limited number of boreholes and consisted of only a few facies types. Table 4 summarizes the composition of each stratum and the inferred environmental conditions under which each stratum was formed.

Table 4. Composition of Site Strata and Inferred Environments of Deposition.

STRATUM	DESCRIPTION	LITHOFACIES	INFERRED ENVIRONMENT OF DEPOSITION
I	Deposited since the beginning of historical occupation of the landform; includes early historical debris.	Not formally subdivided	Fill
II	The culture-bearing facies assemblage representing archaeological deposits created by pre-contact cultural activities on the landform.	**S** - sand; **Sg** - gravelly sand; pebble-sized gravel; **Aae** and **ae** - Undifferentiated midden matrix; **Ah** - A thin A horizon formed between occupations; **cs** - charcoal-stained; **sh** - shell/shelly	Archaeological midden on emergent portion of spit.
III	Moderately well-sorted sand containing few pebbles and fragmented natural shell; upper portion occasionally contains isolated archaeological deposits.	**S** (**ae**) - Culture-bearing sand **S** (**cs**) - Charcoal-stained sand **S** (**sh**) - Sand with crushed shell layer **Sg** - Gravelly sand **Zs** - Sandy silt	Beach barrier/berm cap overlying Stratum IV.
IV	Loosely consolidated pebbly sand and sandy pebble-gravel with detrital wood fragments (driftwood) and sea wrack; in places, submerged wetlands deposits.	**Sg** - Gravelly sand **Gs** - Sandy gravel **Wd** - Detrital wood (driftwood) **P** with **f** or **w** - Fibrous (f) or woody (w) peat.	Beach and spit
V	Moderately well-sorted medium sand containing fragmented natural shell.	**S** - Sand	Too few exposures to determine; may represent a submerged older barrier/berm.

Stratum I

Stratum I consists of all sediments deposited on the landform resulting from land use activities associated with the historic era and later by the Air Force (Figure 21). Formally, the deposits associated with the early town of Mukilteo and the operation of the Crown Lumber Company are included with this stratum, since this represents land use activities that have affected the archaeological deposits associated with pre-contact land use activities. In most places on the landform it is presumed that the top of Stratum II has been truncated, to an unknown depth, by activities associated with deposition of Stratum I.

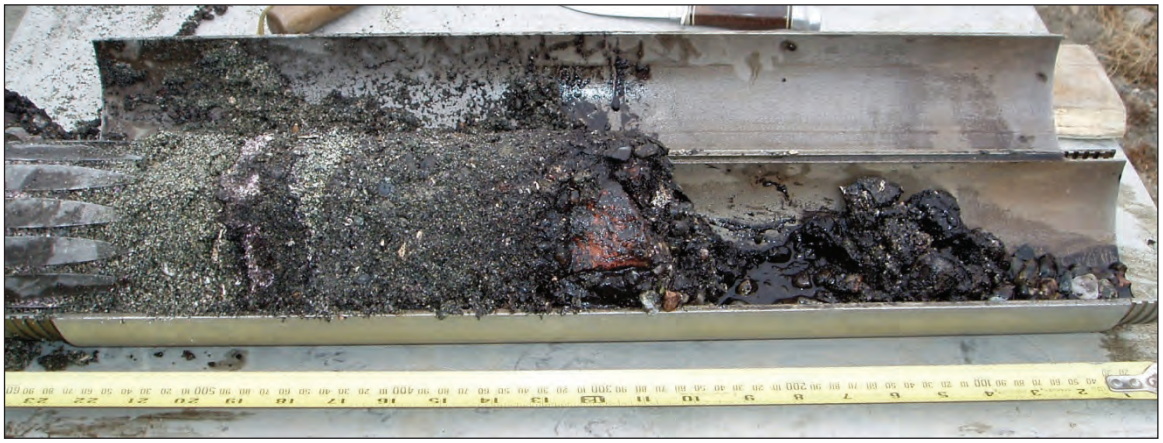


Figure 22. Typical expression of Stratum I, note the brick fragment at center.

Stratum II

Stratum II is the well-stratified archaeological midden depositional sequence [redacted] (Figure 22). This stratum includes archaeological facies (see Table 4) representing human-induced deposits associated with shifting locations of cultural activities during occupations of the spit. Figure 23 compares the stratigraphic sequences with the lithology from selected boreholes to show the internal structure of the midden and the high degree of place-to-place variability in the local depositional sequences; Figure 24 shows detailed profiles from selected backhoe trenches. Both figures show the archaeological deposits are periodically interbedded with a distinct moderately to well-sorted yellowish brown sand. Based on the lithology and the fact that they interbed with the archaeological deposits, the sand layers are interpreted to represent sandy overwash deposits created by waves breaking over the spit during storm events.

Figure 23. Typical expression of Stratum II, showing well-stratified midden deposits.

Stratum III

This is a thin layer of sand [redacted] extending laterally beyond the boundaries of the overlying Stratum II (Figure 25). Sediments comprising this stratum are predominantly moderately well-sorted to well-sorted medium to fine sand, with few pebble-sized gravels. Although the overlying Stratum II is composed of archaeological deposits associated with development of the midden, culture-bearing deposits are also found in the upper portion of the Stratum III sand underlying Stratum II. The shell content of these layers is considerably lower than those associated with Stratum II, and the facies tend to be thin charcoal-stained layers, or if shell is present, it is expressed as an isolated thin layer of finely crushed shell. In general, the lower contact of Stratum II with Stratum III is defined by a rapid decrease in cultural shell content and by a decline in the overall amount of pebble-gravel. Figures 26 and 27 show a series of north-south cross sections [redacted] see Figure 17). As can be seen from these cross sections, in almost every case where the Stratum II midden was found in the backhoe trenches or boreholes, the midden is found resting directly on Stratum III.

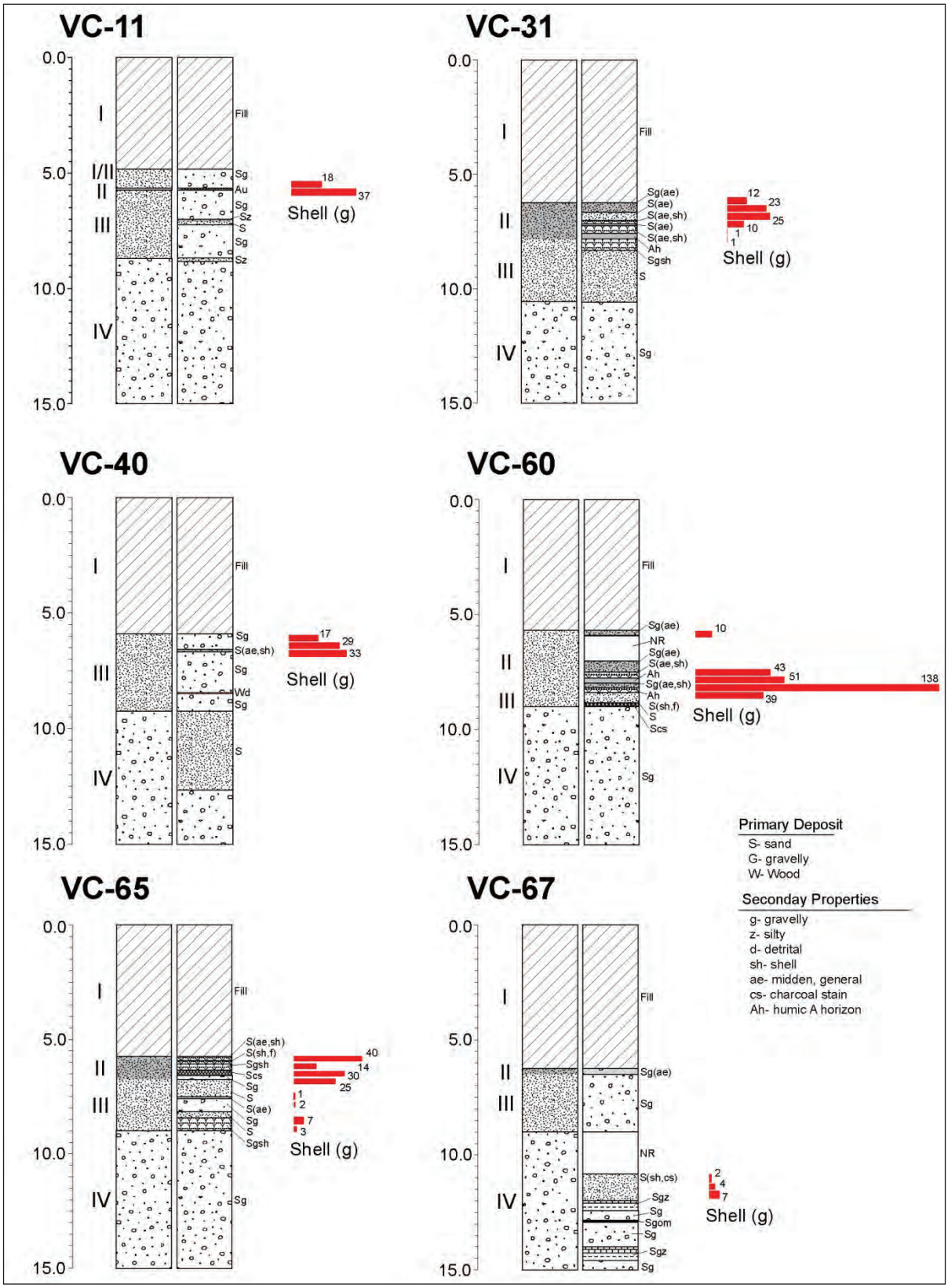


Figure 24. Stratigraphic sequences from selected boreholes showing the internal structure of the midden.

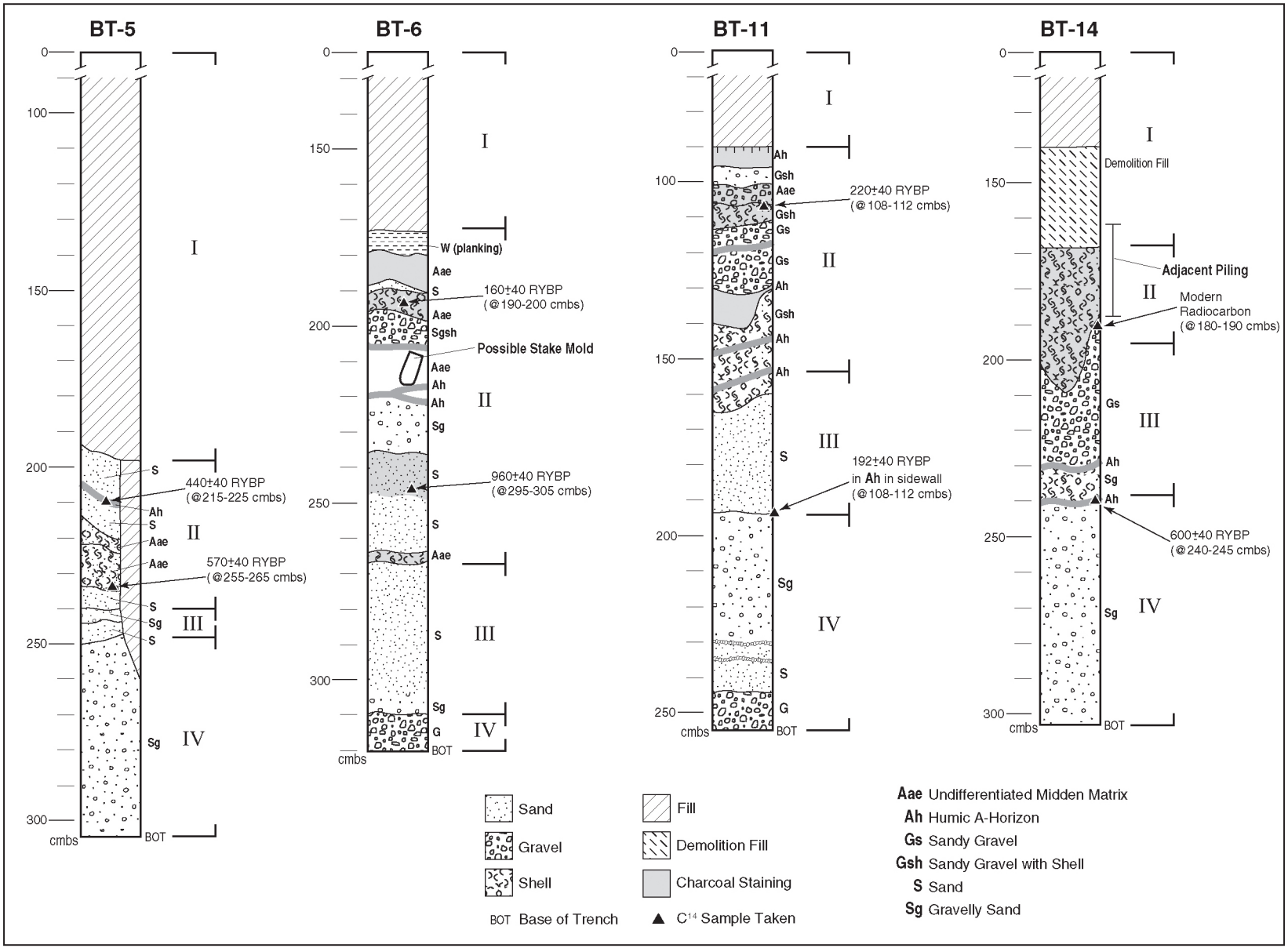


Figure 25. Detailed profiles from selected backhoe trenches.

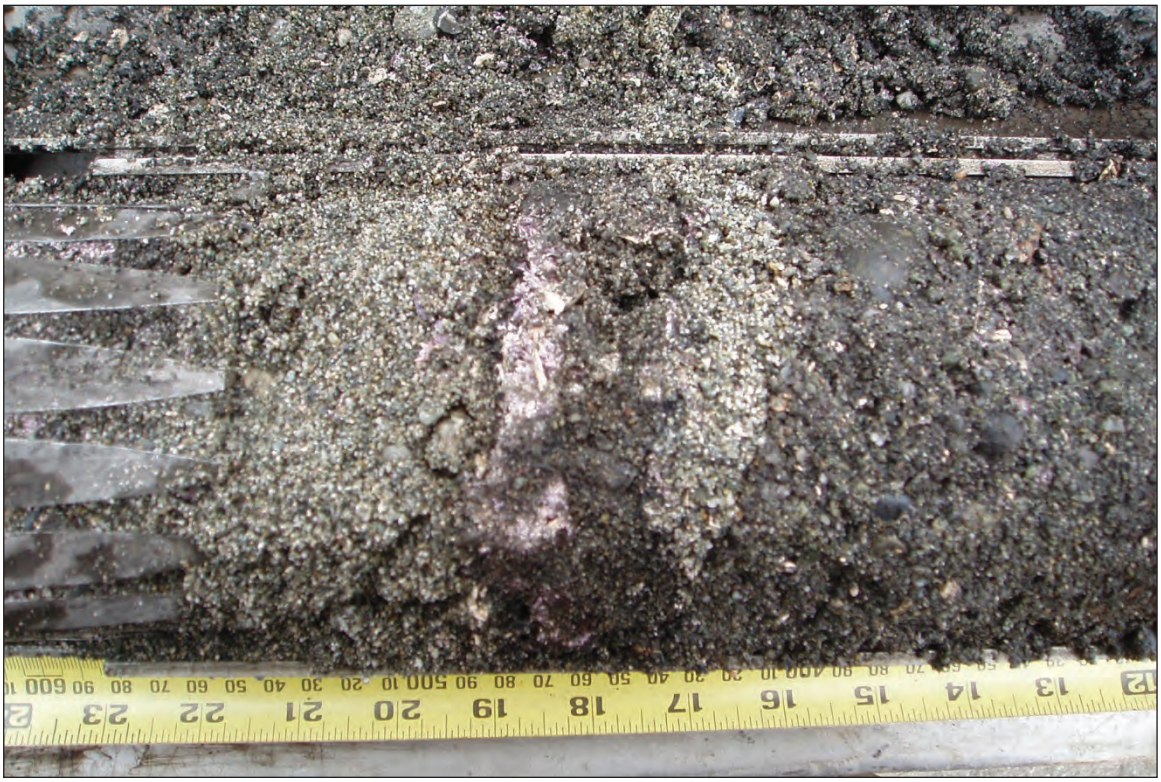


Figure 26. Typical expression of Stratum II (right) overlying Stratum III (left).

Stratum IV

By volume, Stratum IV is the most extensive stratum, occurring throughout the study area. The lithology is dominated by loosely consolidated sediments ranging between coarse sandy pebble-gravel and gravelly coarse sand (Figure 28). The vertical sequence, however, exhibits subtle bedding characterized by shifts in facies from woody debris to thin ephemeral fibrous and woody peats to muddy sand and gravel layers. Occasionally, a rip-up clast composed of weakly consolidated mud with dispersed granules (very fine pebbles) was retrieved, and in the eastern portion of the project area closer to the mouth of Japanese Gulch, there appeared to be a slight increase in the number of naturally fractured angular gravel.

These variations in the basic Stratum IV depositional sequence are thought to represent the formation of ephemeral driftwood zones or thin fringing wetlands during pauses in the accumulation of the stratum. The muddy rip-up clasts may be reworked glacial till introduced into the depositional sequence by erosion of the bluff to the south prior to emergence of the spit, or by debris flows coming out of Brewery Gulch and Japanese Gulch.

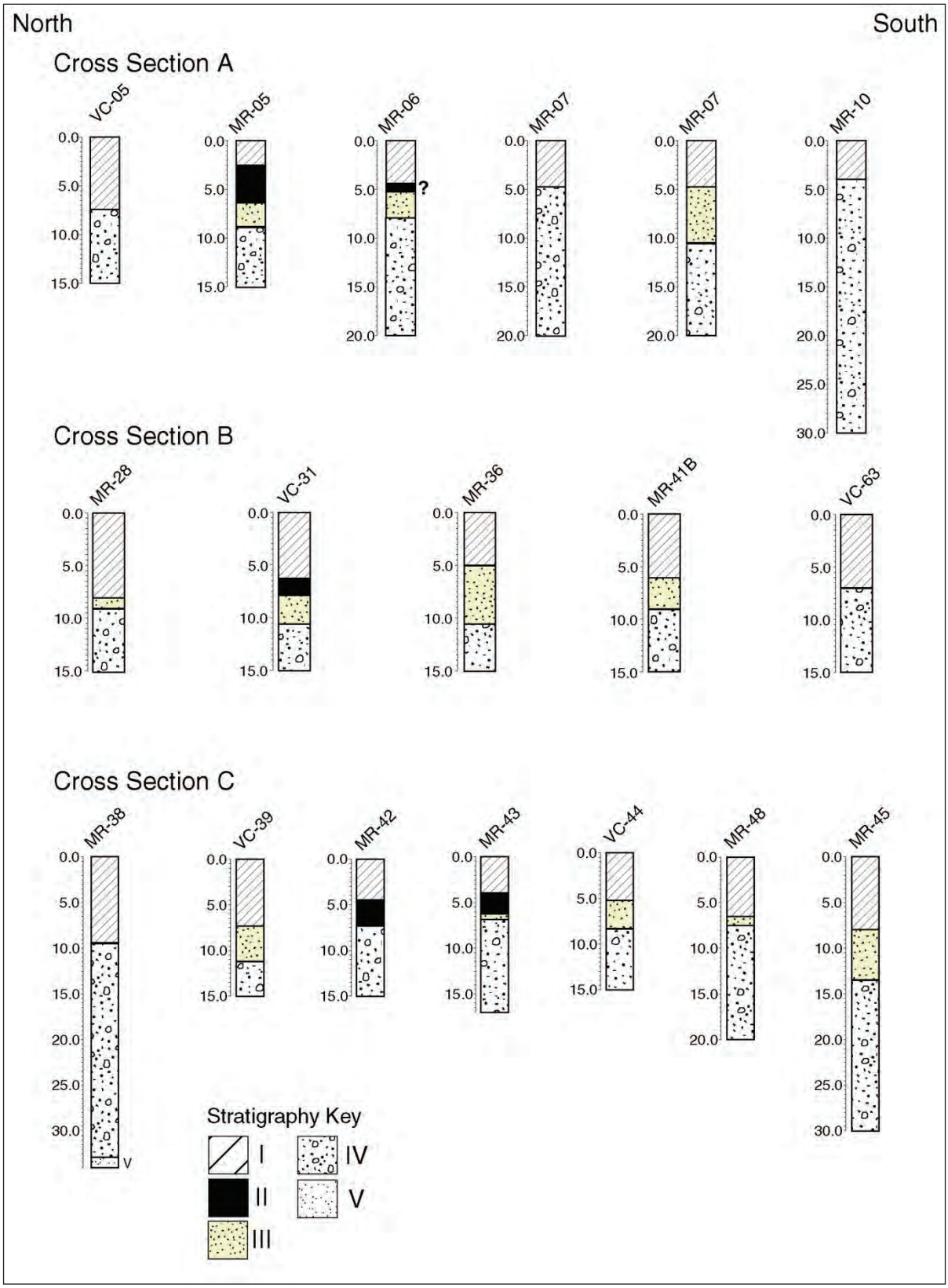


Figure 27. Cross Sections A through C (see Figure 16 for cross section locations).

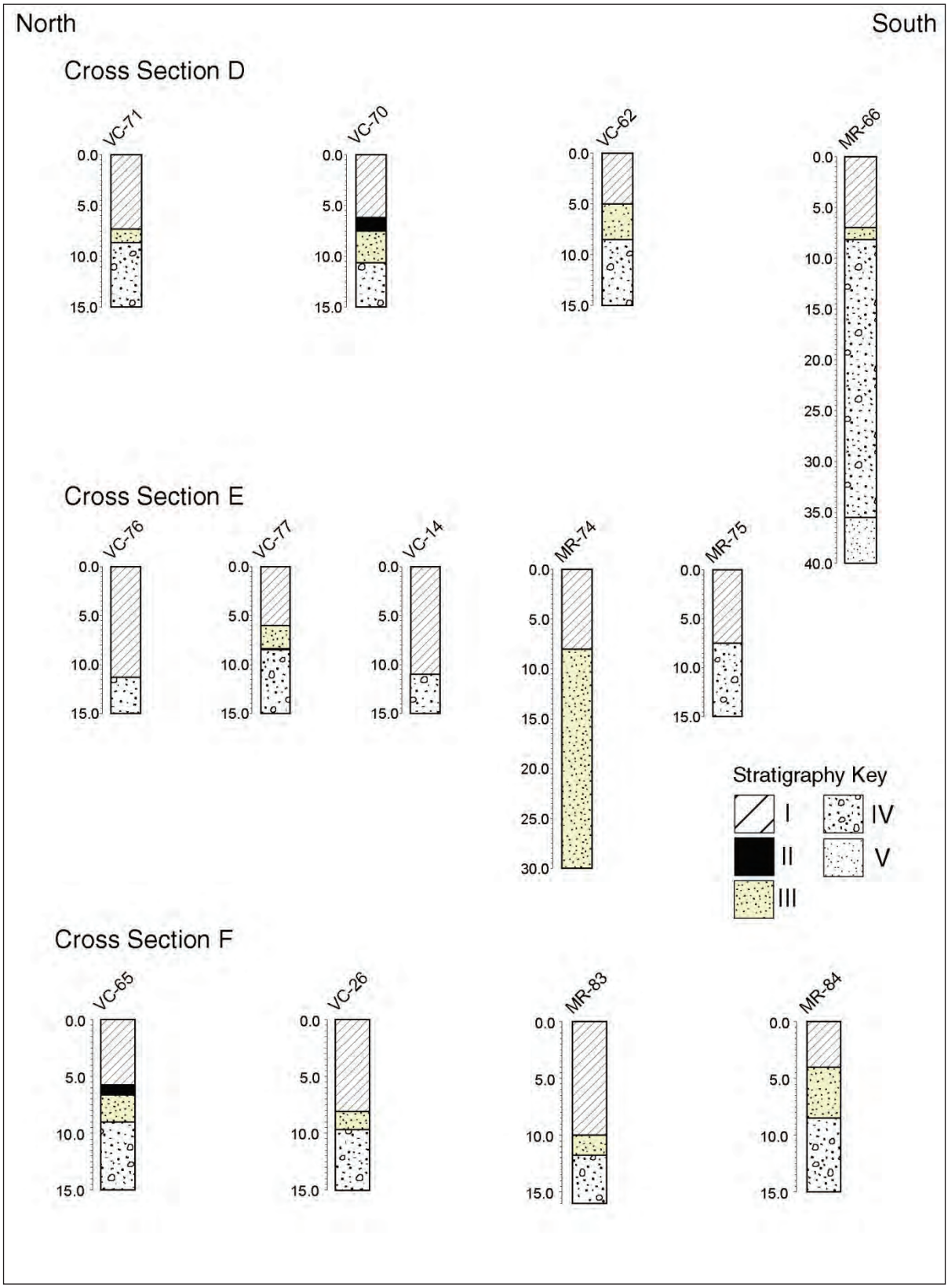


Figure 28. Cross Sections D through F (see Figure 16 for cross section locations).

Figure 29. Typical expression of Stratum IV.

The isolated branches and twigs scattered throughout Stratum IV are interpreted to represent pieces of driftwood caught on the exposed beach through time as Stratum IV accumulated. A zone of fibrous peat, sea wrack, and driftwood was consistently found at depths ranging between about 12 and 17 feet below surface (fbs), and was best-expressed in a group of boreholes in an area centered on MR-59 [redacted] (MR-45, MR-48, MR-51, MR-52, VC-53, VC-57, MR-59, MR-66, MR-68, and MR-79). Figure 29 shows the stratigraphy and lithology for selected boreholes [redacted]; the peat and detrital wood layers appear in the Stratum IV deposits in the boreholes [redacted]. The peat gradually thinned eastward and was replaced by branches and twigs probably representing driftwood accumulated around the edge of a small shallow lagoon. To the west, the peat was found in MR 10, [redacted] and in MR-6, [redacted] A radiocarbon sample retrieved from a layer of organic matter, twigs, and fibrous peat in MR-6 at 16.8 fbs (Figure 26), returned an age of 1640 ± 40 radiocarbon years before present (rcybp) (the 2-sigma calibrated calendrical age is AD 1420 to 1500). This represents a relatively rapid accumulation rate of about 5.8 centimeters (2.3 inches) per year for the upper portion of Stratum IV.

In several boreholes [redacted] the top of Stratum IV (or Stratum III when present) is characterized by distinct bedding capped by silt or interbedded organic matter and silt, underlying the fill deposits (Figure 29). This upper sequence is interpreted to represent the emergence of the modern cuspate foreland, and the shift from an open beach to the formation of tidal wetlands.

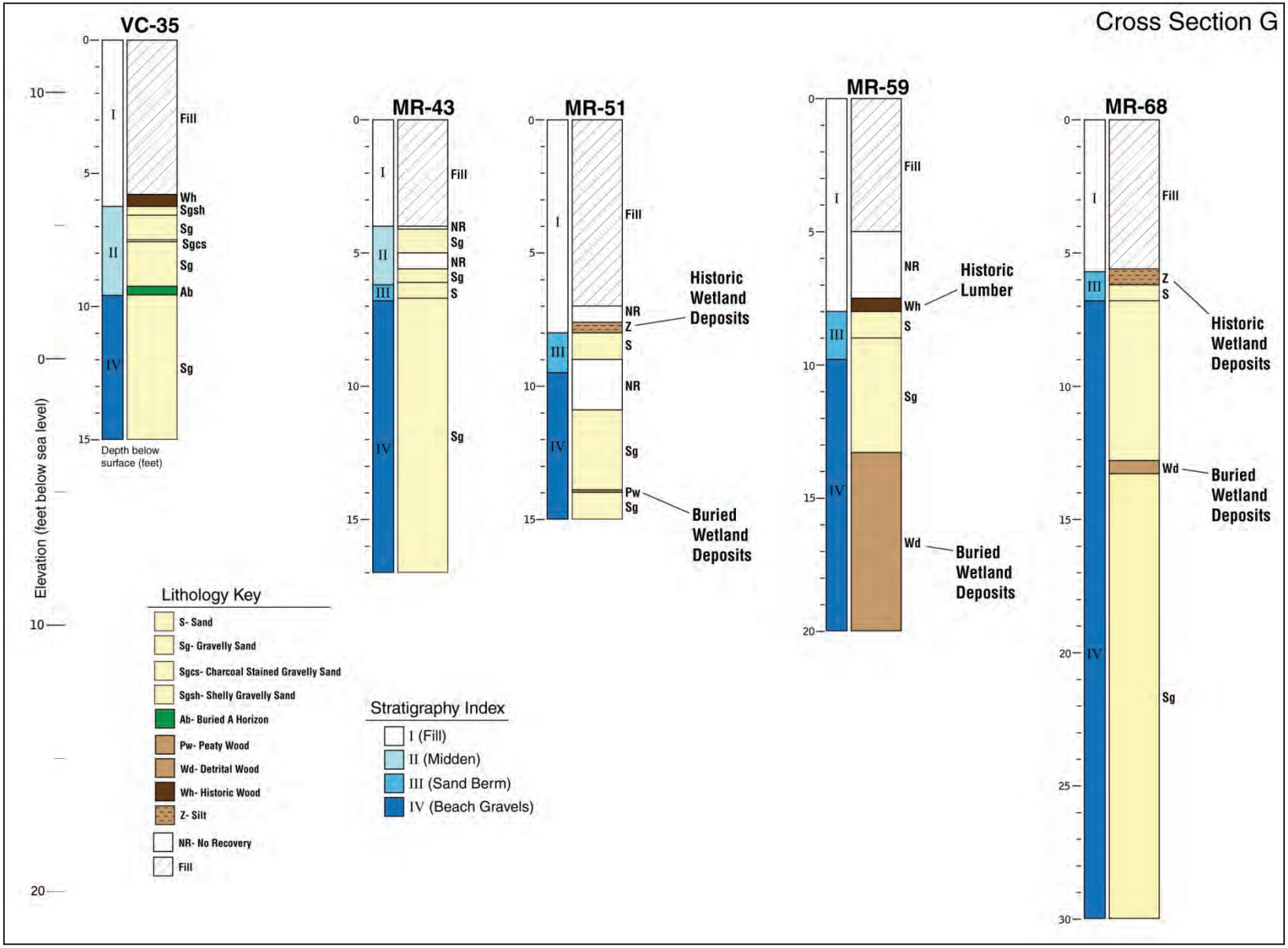


Figure 30. Cross Section G (see Figure 16 for cross section locations).

Stratum V

Stratum V was found in three archaeological boreholes at the deepest depths sampled by the archaeological borehole program, and in nine geotechnical boreholes [redacted] Stratum V is a "clean" sand similar in composition to Stratum III, but with a greater amount of dispersed natural shell fragments. No archaeological materials were found at the upper contact of this stratum, and given the lithologic similarity to Stratum III, it is presumed the clean sand represents a former sandy barrier ridge or berm on a now-submerged spit. In some of the deeper boreholes, the clean sand was found overlying relatively poorly-sorted sequences of gravelly sand marked by an increase in pebble-gravels and higher lithologic heterogeneity. This lower gravelly sand may represent older deposits from the pre-Vashon or Vashon periods; however, the limited number of deep exposures of Stratum V was not sufficient to define the lower sand as a separate facies or stratum.

A facies sequence of fine sand interbedded with lenses of peat and peaty silt between 27 and 60 fbs was found [redacted]. The peat-sand sequences were thickest in A-11, A-12, A-13, and A-14 and thinned eastward to a single peat layer at 45-46.5 fbs in A-15. The thickest peat layers appear as individual facies in the lithologic sequence (Figure 30). The fine sand interbedded with the peat sequences is similar to the clean sand that occurs at a similar depth at the top of Stratum V, and the peat-and-sand sequences may represent an intermittent low-energy environment occurring during the formation of the now-submerged barrier or berm.

Stratum VI

The top of Stratum VI, identified in nine geotechnical boreholes [redacted] between 79 and 110 fbs, is very dense, compact, silt and clay, often poorly sorted with varying small amounts of sand or scattered rounded pebble-gravels. The stratum represents glacial till sediments dating to the Vashon or pre-Vashon periods. Only 10 boreholes within the study area were drilled to the depth necessary to reach the contact with Stratum VI; however, it is presumed the till is laterally extensive throughout the study area [redacted] In the two boreholes drilled to 100 fbs in the vicinity of the existing ferry terminal (B-3 and B-4) [redacted] the contact with Stratum VI was not encountered, suggesting the upper surface of the till exhibits topographic relief.

Figure 31 illustrates stratigraphic relationships among the major geomorphic units. Stratum VI is comprised of glaciogenic till from the Vashon or pre-Vashon periods and represents the oldest deposits identified by archaeological explorations at the site. In its few exposures, Stratum V consistently overlies the till [redacted] As noted above, Stratum IV is ubiquitously distributed across the project area overlying Stratum V. Strata II and III are much more confined in their areal distribution, and are limited to a slight barrier ridge or berm [redacted] with Stratum III extending slightly laterally to the south. [redacted] Stratum II extends laterally southward.

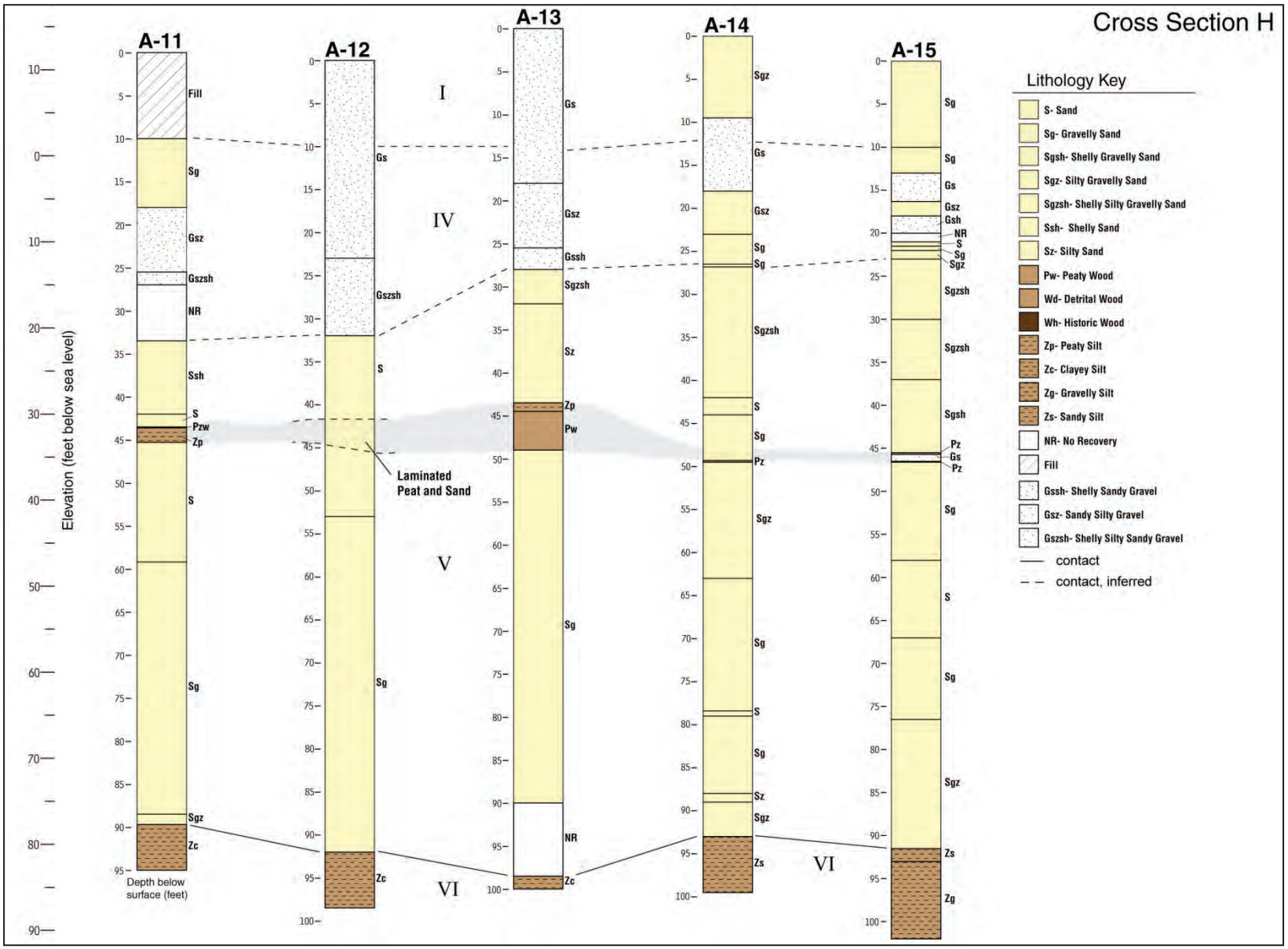


Figure 31. Cross Section H (see Figure 16 for cross section locations).

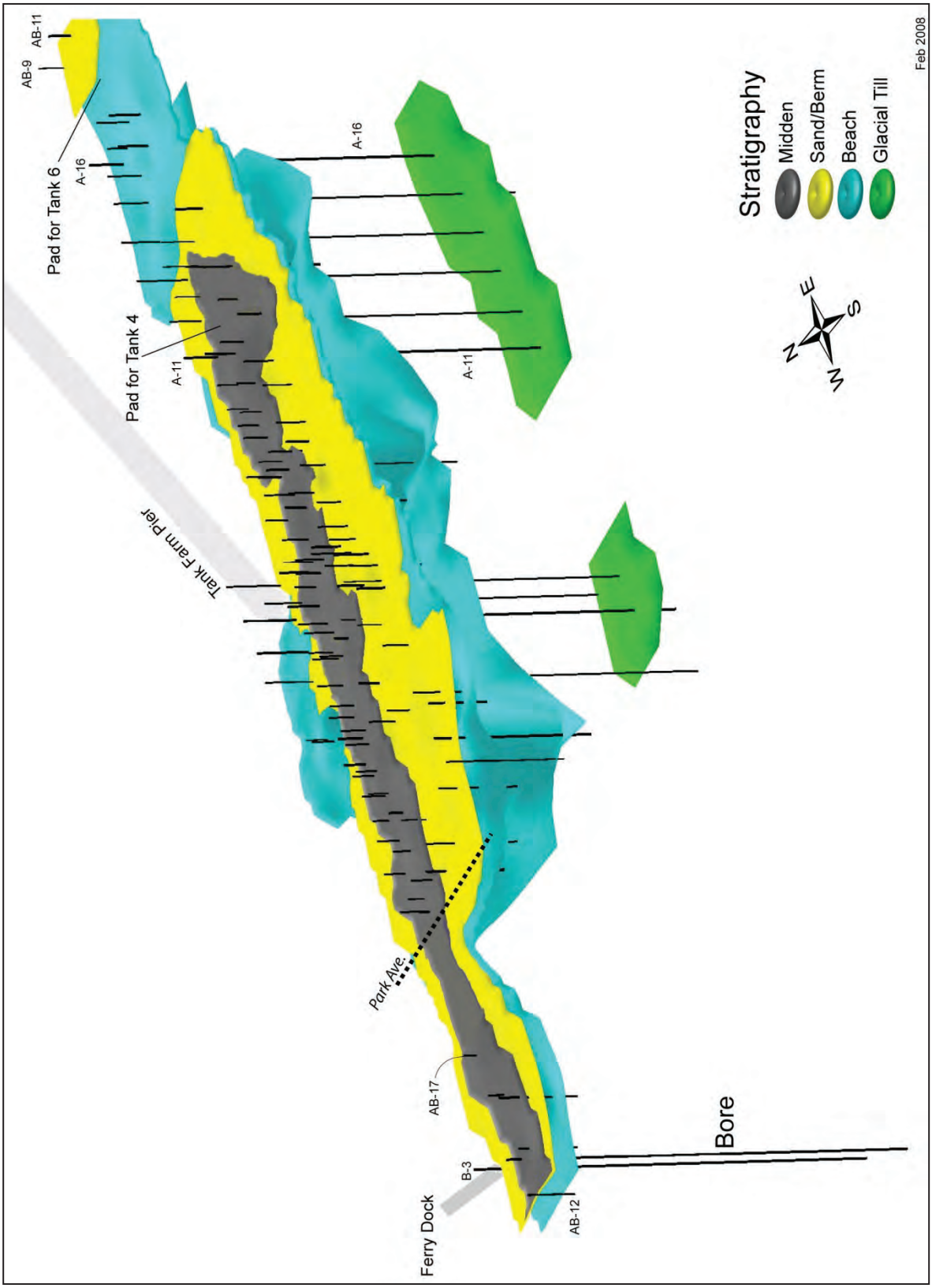


Figure 32. Stratigraphic model showing the relationship of the midden to the major site strata.

Historical Debris

Out of the total 107 archaeological boreholes drilled, 54 found historic debris at the contact between the fill and underlying intact deposits. The bulk of this debris consisted of wood of various kinds (Figure 32), often occurring in conjunction with burnt or charcoal-stained sediments. Wood debris most consistently appeared [redacted] but boreholes [redacted] encountered demolition debris, including concrete, brick, and metal, resulting from dismantling of Crown Lumber Company facilities (Figure 13). Thick planking or decking was found between Trench 4 and Trench 10 (MR-22, MR-27, and VC-63), and two boreholes encountered pilings (MR-2 and MR-41). Borehole CPT-24-07, [redacted] encountered planking overlying wood debris and sawdust.

A thin layer of black organic-rich pebbly sand containing small-sized historic debris such as wood and glass was observed at the base of the fill [redacted] (AB-3, AB-20, AB-16, AB-17). This layer directly overlies the midden deposits and in some cases the sediments appear to be mixed with the upper midden lithology. Stratum I likely truncates Stratum II in these areas, indicating disturbance to the upper portion of the archaeological deposits by early historic activity.

Figure 33. Wood from borehole sample.

Site Formation History

Based on the vertical depositional sequences revealed in all exposures created during archaeological testing of the project area, a preliminary model of landform development can be offered. Stratum VI, the basement stratum identified at the site, represents glacially deposited till dating to the Vashon or pre-Vashon period. The absence of Stratum VI in the boreholes [redacted] may evidence tectonic activity along the northern boundary of the Southern Whidbey Island fault zone, which has resulted in north side up vertical offsets of near-shore deposits in Possession Sound during the Holocene (that is, the north side of the fault rose due to earthquake activity) (Kelsey et al. 2004). However, the number of exposures of Stratum VI is too small to determine the true horizontal and vertical extent of the till.

Overlying the till, Stratum V gravelly sands are presumed to represent Vashon or pre-Vashon deposits, such as glacial outwash, while the upper clean sand with shell may represent a submerged spit formed during the Holocene.

The bulk of Stratum IV is believed to represent a thick accretionary deposit of loose beach sediments that accumulated along this section of shoreline due to alongshore drift during the late Holocene. The source of these sediments is from winnowing and reworking of the alluvial fan margin at the mouth of Japanese Gulch and from reworking of eroded bluff deposits east and south of the project area. During the period of time represented by Stratum IV, morphologically the shoreline was probably much more open to Puget Sound and characterized by a relatively narrow expanse of backshore area at the base of the southern bluff.

The presence of buried peat and a zone of fringing driftwood centered around a depth of 15 fbs within Stratum IV suggests that the area experienced at least one major increase in sediment influx, possibly in conjunction with a temporary reduction in the rate of sea level rise, that resulted in the temporary emergence of a paleospit above tide limit and enclosure of a small wetlands or shallow lagoon. After a brief period of subaerial exposure, the lagoon was buried about 1640 rcybp by additional loosely consolidated coarse-grained beach sediments. With renewed accumulation of sediments, the beach profile may have shifted southward toward the base of the southern bluff until the formation of the present spit isolated the bluff from direct wave attack. It is not known if the earlier spit formation was part of a larger paleo cuspate foreland like the modern landform.

Over the last 1,600 years, enough sediment accumulated that the eastern arm of the cuspate foreland forming Elliot Point emerged from the tidal limit and became a relatively stable landscape feature. Radiocarbon ages from the base of the Stratum II midden indicate the spit was fully emergent by at least 1,000 years ago. By the time human occupation of the spit began, sediment accumulation rates had slowed considerably, indicating the base of the southern bluff was now shielded by the spit from direct wave attack; reduction in sediment influx also may have been also due to decreasing frequency of debris flows in Japanese Gulch. The deposition of the Stratum III sand suggests that once the spit emerged, most of the coarser-grained sediment transported by alongshore drift passed along the front of the spit. The low amounts of shell in both Strata IV and III, but the high amounts in the archaeological deposits of Stratum II, further suggest that a sub tidal terrace, offering a suitable substrate for shellfish, also began to form in front of the spit shortly after emergence. Fine-grained sediments, such as silty peat, peaty silt, and organic streaks, at the top of Stratum IV in the southern portion of the study area indicate the

creation of a low-energy depositional environment, presumably in conjunction with the formation of the cuspate foreland. The bedding also preserved in places at the top of Stratum IV suggests the spit was periodically breached and opened to the Sound, and that closure of the cuspate foreland to form a tidal lagoon and wetland was a gradual process.

The distribution of lithofacies within Stratum II indicates a high degree of place-to-place variability (that is, the composition of the archaeological midden is not constant across the landform). The matrices of the shell-rich lithofacies include high amounts of sediment (sand and fine pebbles) mixed in with the archaeological materials. The well-stratified nature of the depositional sequence indicates little to no erosion along the spit, but periodic deposits of sand or fine gravel lacking archaeological materials show the landform was occasionally subject to overwash, probably by storm waves. The underlying Stratum III was probably also deposited in a similar manner. The preservation of thin humic soil A horizons (Ah), which represent brief periods of soil formation on the calcium-rich shell-bearing deposits, is another indicator the site experienced little or no erosion until the beginning of the historic period.

[redacted] Stratum II deposits are relatively thin and the configuration of the boundary of the midden indicates some variance in site formation history in this portion of the site. Former distributary channels on the alluvial fan at the mouth of Japanese Gulch [redacted] may have reached westward towards the base of the spit, reworking the beach deposits near the edge of the fan. Periodic avulsion of these channels during flood episodes in Japanese Gulch during the historic period could have eroded sediments deposited near the base of the spit where it attached to the fan. Interaction between beach sediments and the alluvial fan may account for the less well-defined boundary at the east end of the midden deposit.

Several recorded sites in the Puget Sound and the greater Puget lowland occupy accretionary shoreline features analogous to the cuspate foreland at 45SN393 (Table 5; Figure 33). Shell midden sites [redacted] to the north and [redacted] to the south provide comparative data from occupations of beach barrier berms associated with spits within the last 2,000 years. Hunter-fisher-gatherer use of changing sandspit landforms with berm and lagoon features in the Bellingham area share similar landform histories with the West Point site to the south of 45SN393 in Puget Sound (Lewarch et al. 1995:1.4). Locally, two historic village sites occupying spits are located west of 45SN393 [redacted] on Whidbey Island, and a third is situated at [redacted] Camano Island. Commonalities between spit sites in the region include well-stratified midden deposits deposited on or behind a beach berm, sometimes with evidence of occupation or utilization of protected wetland environments enclosed by the spits. Midden facies interbedded with sand layers deposited during inundation due to wave action along the landform are evidence of geomorphic processes at several spit sites. Further exploration of the midden deposits at 45SN393 would shed light on site formation in terms of the human occupation of an evolving landform.

Table 5. Radiocarbon Dates from Shell Middens in the Puget Sound Basin (selected numbers key to Figure 33).

MAP REF	SITE #	NAME	LOCATION	LANDFORM	EARLY DATE	REFERENCE
	45IS97	[redacted]	Whidbey Island	Bluff-Top	310 ± 60 BP	Luttrell et al. 2003
	45KP204	[redacted]	Bainbridge Island	Bay Beach	320 ± 40 BP	Shong 2011 Pers. Comm.
	45IS119	[redacted]	Whidbey Island	Bluff-Top	610 ± 50 BP	Nelson et al. 2010
	45IS263	[redacted]	Whidbey Island	Bay Beach	640 ± 40 BP	Smith et al. In Preparation
	45IS71	[redacted]	Whidbey Island	Bluff-Top	680 ± 70 BP	Wessen 2004
1	45TN240	[redacted]	Mud Bay	Bay Beach	ca 700 BP	Croes et al. 2005
2	45KP115	[redacted]	Port Orchard	Bay Beach	810 ± 60 BP	Lewarch et al. 2002
3	45WH9	[redacted]	Birch Bay	Spit	848 ± 108	Gaston and Grabert 1975
	45SJ507				880 ± 40 BP	Taylor et al. In Press
	45SJ120				900 ± 40 BP	Taylor et al. In Press
	45SJ277				930 ± 40 BP	Taylor et al. In Press
4	45WH67	[redacted]	Birch Bay	Bay Beach	940 ± 40 BP	Shantry et al. In Preparation
	45SJ26				950 ± 40 BP	Taylor et al. In Press
	45SJ481				990 ± 40 BP	Taylor et al. In Press
5	45JE16	[redacted]	Indian Island	Spit	ca 1000 BP	Blukis Onat 1976
	45SJ95				1010 ± 40 BP	Taylor et al. In Press
6	45SN39	--	Snohomish Delta	Estuarine	1020 ± 110	Dunnell and Fuller 1975
7	45IS13	[redacted]	Whidbey Island	Spit	1030 ± 60 BP	Luttrell 2005
	45SJ124				1040 ± 40 BP	Taylor et al. In Press
	45SJ47				1090 ± 40 BP	Taylor et al. In Press
	45SJ461				1090 ± 50 BP	Taylor et al. In Press
	45PI974				1110 ± 40 BP	Shantry et al. 2010
	45SJ150				1100 ± 50 BP	Taylor et al. In Press
	45SJ483				1120 ± 40 BP	Taylor et al. In Press
	45SJ60				1120 ± 40 BP	Taylor et al. In Press
	45SJ225				1120 ± 40 BP	Taylor et al. In Press
	45IS60	[redacted]	Whidbey Island	Bay Beach	1130 ± 40 BP	Luttrell et al. 2003
	45IS55	[redacted]	Whidbey Island	Bay Beach	1140 ± 40 BP	Luttrell et al. 2003
	45SJ61				1140 ± 40 BP	Taylor et al. In Press
	45SJ453				1160 ± 40 BP	Taylor et al. In Press
	45SJ6				1170 ± 40 BP	Taylor et al. In Press
	45SJ89				1170 ± 40 BP	Taylor et al. In Press
	45SJ202				1200 ± 40 BP	Taylor et al. In Press
8	45KI23	[redacted]	Seattle	Estuarine	1200 ± 60 BP	URS and BOAS 1987
	45SJ451				1210 ± 40 BP	Taylor et al. In Press
9	45KI437	[redacted]	Vashon Island	Spit	1230 ± 40 BP	Stein and Phillips 2002
	45SJ9				1300 ± 40 BP	Taylor et al. In Press
	45SJ460				1310 ± 40 BP	Taylor et al. In Press
	45SJ364				1340 ± 40 BP	Taylor et al. In Press
	45SJ147				1350 ±60 BP	Taylor et al. In Press
	45SJ509				1360 ± 40 BP	Taylor et al. In Press
10	45IS7	[redacted]	Camano Island	Bay Beach	1360 ± 60 BP	Kopperl In Preparation
	45SJ71				1380 ± 40 BP	Taylor et al. In Press
	45SJ72				1420 ± 40 BP	Taylor et al. In Press

Table 5. Radiocarbon Dates from Shell Middens in the Puget Sound Basin (selected numbers key to Figure 33).

MAP REF	SITE #	NAME	LOCATION	LANDFORM	EARLY DATE	REFERENCE
	45SJ307				1520 ± 40 BP	Taylor et al. In Press
	45SJ27				1540 ± 40 BP	Taylor et al. In Press
	45SJ251				1540 ± 40 BP	Taylor et al. In Press
	45SJ201				1570 ± 60 BP	Taylor et al. In Press
11	45IS2	[redacted]	Camano Island	Spit	1630 ± 50 BP	Schalk and Nelson 2010
12	45KP47	[redacted]	Port Madison Res	Spit	ca 1690 BP	Schalk and Rhode 1985
13	45KP2	[redacted]	Port Madison Res	Spit	ca 1700 BP	Schalk and Rhode 1985
	45SJ274				1860 ± 40 BP	Taylor et al. In Press
	45SJ421				1880 ± 40 BP	Taylor et al. In Press
14	45SN35	--	Snohomish Delta	Estuarine	1910 ± 120	Dunnell and Fuller 1975
15	45WH11	[redacted]	Birch Bay	Spit	1945 ± 98	Gaston and Grabert 1975
	45SJ23				1950 ±40 BP	Taylor et al. In Press
16	45WH100	[redacted]	Lummi Res	Spit	ca 2410 BP	Grabert and Griffin 1983
17	45SN41	--	Snohomish Delta	Estuarine	2040 ± 120	Dunnell and Fuller 1975
18	45WH114	[redacted]	Lummi Res	Spit	ca 2040 BP	Grabert and Griffin 1983
	45SJ279				2100 ± 40 BP	Taylor et al. In Press
	45SJ239				2340 ± 40 BP	Taylor et al. In Press
	45SJ282				2400 ± 50 BP	Taylor et al. In Press
	45WH564	[redacted]	Point Roberts	Bay Beach / Spit	2520 ± 60 BP	Baldwin and Arthur 2010
	45SJ450				2520 ± 40 BP	Taylor et al. In Press
	45SJ70				2550 ± 40 BP	Taylor et al. In Press
	45SJ2				2640 ± 40 BP	Taylor et al. In Press
	45SJ3				2670 ± 40 BP	Taylor et al. In Press
45S	J169		Decatur Island	Spit	2700 ± 120	Walker 2003
	45SJ407				3060 ± 40 BP	Taylor et al. In Press
	45SJ 165		Decatur Island	Bay Beach	3440 ± 40 BP	Bard and Ballantyne 2007
19	45SN93	[redacted]	Mukilteo	Bluff-Top	3600 ± 70 BP	Kopperl 2005
	45SK46	[redacted]	Fidalgo Island	Bluff-Top	3650 ± 70 BP	Mather 2009
20	45WH17	[redacted]	Boundary Bay	Spit	ca 4100 BP	Grabert et al. 1978
21	45KI428/429	[redacted]	Seattle	Spit	ca 4000 BP	Larson and Lewarch 1995
22	45PI72	[redacted]	Steilacoom	Bluff-Top	5260 ± 70 BP	Wessen 1989

Figure 34. Selected shell middens with radiocarbon dates coded by landform contains sensitive cultural resources information that is exempt from public disclosure pursuant to provisions of the Public Records Act (RCW 42.56.300).

Figure 34. Selected shell middens with radiocarbon dates coded by landform (numbers code to Table 5).

Features

One cultural feature was distinguished from the remainder of the strata within the shell midden deposit in the south profile of Trench 6. A depression or pit with poorly defined boundaries was observed in the lower right (western) portion of the profile (Figure 34), mostly exposed around the bottom corner of the trench shoring box, which prevented investigation beyond characterization of the profile and bulk sampling of a portion of the deposits within the feature. The upper boundary of the feature is about 240 centimeters (94 inches) below ground surface, and about 70 centimeters (28 inches) below the top of the general shell midden stratum. The deepest portion of the feature that was exposed was about 300 centimeters (118 inches) below ground surface and 130 centimeters (51 inches) below the top of the shell midden stratum. A layer of poorly sorted coarse sand and fragmented shell overlies the feature, which appears to have been dug into beach sand and truncates one thin (3-4 centimeter/1.2-1.6 inch) black possibly cultural stratum at about 265 centimeters (104 inches) below ground surface.

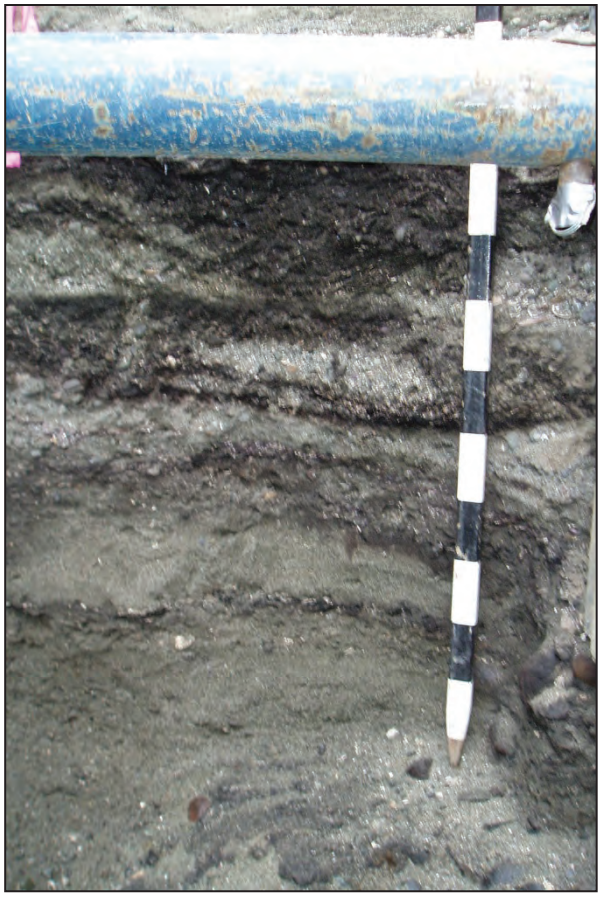


Figure 35. Depression or pit observed in the south wall of Trench 6.

The sediments within the feature are primarily lightly charcoal-stained sand and gravel, fragmented shell, fire-modified cobbles and cobble fragments, and crushed charcoal. The inaccessibility of the majority of the feature and inability to obtain a plan view, better cross-sections, or additional samples preclude much further interpretation. A bulk sample of about 1.6 liters was obtained from sediments near the base of the feature, and was submitted for botanical and radiocarbon analysis. The sample contained charcoal from maple, alder, Douglas fir, yew, and western red cedar, as well as starchy edible plant tissue and one goosefoot seed. An accelerator mass spectrometry (AMS) radiocarbon date was obtained from one of the fragments of charcoal from alder, a short-lived species, and yielded the oldest age associated with cultural deposits at the site, 960±40 radiocarbon years BP (see below). Although the age of the thin, deeper cultural stratum into which the feature is cut was not determined, it is likely older than the feature.

Radiocarbon Chronology

Charcoal samples from the top and bottom of the shell midden deposit in Trenches 5, 6, 11, and 14 were submitted to Beta Analytic, Inc. for AMS dating (Table 6; Appendix D; Figure 24). Samples from shorter-lived hardwood taxa and from younger branch portions of woody plants were isolated when possible to minimize the possibility of radiocarbon ages being affected by old wood. These samples provided bracketing dates of the shell midden deposit and information about the horizontal development of the

shell midden across much of its length, between Trenches 5 and 14 (207 meters/679 feet). Table 6 summarizes the radiocarbon dates. Calibration of radiocarbon ages to calendar years was done using the INTCAL98 program and database (Stuiver et al. 1998). The original radiocarbon analysis report from Beta Analytic, Inc. is given in Appendix D. The one anomalous date, Beta-219893, was taken on a charcoal sample that contained more radiocarbon than the modern (AD 1950) reference standard at the Beta laboratory, which resulted in an effectively modern date. The sample came from what appeared to be the uppermost intact shell midden stratum in Trench 14, immediately beneath historic fill. A wooden piling had been punched through that stratum, which may have introduced modern charcoal into that layer.

Table 6. Summary of AMS Radiocarbon Dates Obtained from 45SN393 Charcoal Samples.

BETA NO.	TRENCH NO.	DEPTH (cm bs)	CONVENTIONAL RADIOCARBON AGE	RADIOCARBON AGE AND CALIBRATION INTERCEPT	2Σ (95%) CALIBRATED CALENDRICAL AGE RANGE	SHELL MIDDEN ACCUMULATION RATE*
219887	5	215-225	440±40 BP	510 BP	530 - 450 BP (AD 1420 - 1500)	0.38 cm/year
219888	5	255-265	570±40 BP	550 BP	650 - 520 BP (AD 1300 - 1430)	
219889	6	190-200	160±40 BP	270, 200, 150, 20, 0 BP	290 - 0 BP (AD 1660 - 1950)	0.14 cm/year
219890	6	295-305	960±40 BP	920 BP	950-780 BP (AD 1000 - 1180)	
219891	11	108-112	220±40 BP	290 BP	310 - 260, 220 - 140, 20 - 0 BP (AD 1640 - 1680, 1730 - 1810, 1930 - 1950)	0.25 cm/year
219892	11	192-200	590±40 BP	550 BP	650 - 530 BP (AD 1300 - 1420)	
219893	14	180-190	Modern	modern	0 BP (AD 1950)	0.12 cm/year
219894	14	240-245	600±40	630, 600, 560 BP	660 - 530 BP (AD 1290 - 1420)	

* Based on difference between top and bottom radiocarbon ages of shell midden, divided by maximum thickness between charcoal samples (Stein et al. 2003).

The radiocarbon chronology from the trench samples suggests that human occupation of 45SN393 took place over the past 1,000 years. The radiocarbon ages from the base of the shell midden deposit in Trenches 5, 11, and 14 are within one standard deviation of each other, between 570±40 and 600±40 rcybp, while a substantially older date of 960±40 rcybp was obtained from the base of Trench 6 in a depression or pit feature. The terminal dates in each trench are more variable, ranging from 440±40 rcybp in Trench 5 to essentially modern (and possibly contaminated) charcoal at the top of the shell midden in Trench 14.

The chronology suggests that initial deposition of the shell midden occurred across much of the Point Elliott [redacted] at about the same time, between approximately AD 1290 and AD 1430. Thickness of the midden [redacted] varies, as do the estimated midden accumulation rates in each trench. The midden profile exposed in Trench 6 is the thickest of the four trenches considered here (about 115 centimeters/45 inches) and, based on the radiocarbon dates, accumulated at a slow rate (0.14 centimeter/0.06 inch per year) relative to two of the three other dated midden exposures. The shell midden in Trench 5, [redacted] has the earliest terminal date and the most rapid

estimate of depositional accumulation. Trenches 6 and 11, [redacted] have slower accumulation rates and terminal date ranges that encompass the earliest Euroamerican contact. Trench 14, [redacted] has a modern but anomalous date and consequently a slow accumulation rate.

Sample and Artifact Summary

Sample Analyses

A total of 41 one-liter constant volume samples (CVS) was taken from the six trench profiles within 45SN393. Their weight varied between 920.1 grams and 1658.9 grams, averaging 1332.3 grams. The general constituents of each CVS included pebbles, shell, bone, and other objects such as isolated modern debris intrusive to the shell midden. Fluctuations in the proportion of each constituent, primarily between the shell and pebble fractions, characterize the shell midden matrix. The table in Appendix C summarizes the constituents in the ≥¼-inch fraction and the ⅛-inch fractions of each trench CVS.

Artifact Analyses

A total of 175 lithic artifacts and 8 modified bone artifacts were found at 45SN393 during testing. The majority of these artifacts were from the screened spoils of the trenches. Although artifacts such as small lithic flakes, beads, and other items that would fall through ¼-inch mesh screens are most likely present at the site, no such material was found in any ⅛-inch CVS fraction. Table 7 summarizes the lithic and bone artifacts by provenience.

Although the sample size of the lithic and bone artifact assemblage found during testing at 45SN393 was small, recovery of artifact types was noticeably different between units. As expected, most of the artifacts were found in the trench spoils, which provided a greater volume of archaeological deposits for screening than the core samples. Lithic artifacts were found in each trench with shell midden deposits, however the number of artifacts within each trench varies greatly. Lithic counts from the trenches have a roughly unimodal distribution [redacted] Trench 5 contained the fewest lithics (n=5), while Trench 8 [redacted] contained the most (n=96), and the two [redacted] trenches contained relatively few lithic artifacts (nTrench 13 = 11; nTrench 14 = 21). The unimodal distribution of lithic artifacts remains the same when adjusted for volume of screened shell midden in each trench (Table 7). Four cores, VC-31, MR-33, MR-59, and MR-85, each contained one lithic artifact recovered from a CVS. All modified bone artifacts (with the exception of the beaver tooth fragments from Trench 6) were found in Trench 14.

Lithic Artifacts

The lithic artifacts found at 45SN393 represent a variety of expedient and more carefully formed tools and tool-making debris. Analysis of the lithic artifacts provides information on the ways in which the occupants of 45SN393 made, used, maintained, and discarded their stone tools.

The lithic assemblage included flakes and shatter, cores, split or edge flaked pebbles/cobbles, projectile points, a ground stone adze blade and hammerstones (Table 7). The majority of lithic artifacts were found in Trench 8, including one of the projectile points and the adze blade. Raw material at the site is

Table 7. Artifacts from 45SN393 by Provenience.

OBJECT	TRENCH NUMBER						CORE NUMBER				TOTAL
	5	6	8	11	13	14	31	33	59	85	
LITHIC ARTIFACTS											
Technological Byproduct											
Debitage	4	24	61	6	8	12	1	1			117
Core			4	1							5
Specialized Debitage											
Linear Flake			2								2
Pebble/Cobble-Derived											
Split Pebble			4			1					5
Split Cobble									1		1
Modified Objects											
Edge Modified Flake		3	18	3	2	3					29
Edge Modified Linear Flake			1								1
Edge Modified Core	1		3		1	2					7
Modified Split Pebble			1								1
Modified Split Cobble						1					1
Edge Altered Cobble										1	1
Hammerstone						2					2
Projectile Point		1	1								2
Adze Blade			1								1
Total Lithic Count	5	28	96	10	11	21	1	1	1	1	175
Total Lithic %											100
BONE ARTIFACTS											
Beaver Tooth Fragment		4									4
Toggling Harpoon Valve						1					1
Bone Point						1					1
Ground Bone Fragment						1					1
Bone Chisel						1					1
Total Bone Artifact Count	--	4	--	--	--	4	--	--	--	--	8
Total Bone Artifact %	--	50	--	--	--	50	--	--	--	--	100
TOTAL ARTIFACT COUNT	5	32	96	10	11	25	1	1	1	1	183
TOTAL ARTIFACT %											100

dominated by locally available igneous rocks including basalt, dacite, andesite, and rhyolite (combined in this analysis as volcanic rock), followed by metasediment, cryptocrystalline stone (CCS), siltstone, quartzite, petrified wood, volcanic breccia, and a single occurrence of nephrite (Table 8).

The lithic assemblage is dominated by debitage including flakes, flake fragments and shatter which comprise 85.1% of the 175 objects recovered. The majority of the flakes (n=107) and all of the shatter (n=12) are unmodified and encompass 68% of the assemblage. Two unmodified and one modified flake are categorized as specialized linear flakes. Microblades are defined as flakes that have approximately parallel sides, are less than 5 cm long and 1 cm wide (Kooyman 2000:74-75). The linear flakes were not considered microblades because they fail to meet these criteria, although they are similar in appearance. Of the 137 flakes, 30 (21.8% of the flakes and 17.1% of the assemblage) have been edge

Table 8. Lithic Assemblage by Material Type.

OBJECT	MATERIAL TYPE								TOTAL
	Vol.	CCS	Qzt.	Pet. Wd.	Metased.	Siltstone	Breccia	Neph.	
TECHNOLOGICAL BY-PRODUCT									
Debitage	65	7	5	2	30	8	--	--	117
Core	--	2	1	--	1	1	--	--	5
Subtotal #	65	9	6	2	31	9	--	--	122
Subtotal %	53.3	7.4	4.9	1.6	25.4	7.4	--	--	
SPECIALIZED DEBITAGE									
Linear Flake	1	--	--	--	1	--	--	--	2
Subtotal #	1	--	--	--	1	--	--	--	
Subtotal %	50	--	--	--	50	--	--	--	
PEBBLE/COBBLE DERIVED									
Split Pebble	3	--	--	--	2	--	--	--	5
Split Cobble	--	--	--	--	--	--	1	--	1
Subtotal #	3	--	--	--	2	--	1	--	6
Subtotal %	50	--	--	--	33.3	--	16.7	--	
MODIFIED OBJECTS									
Edge Modified Flake	24	--	--	--	4	1	--	--	29
Edge Modified Linear Flake	--	--	--	--	1	--	--	--	1
Edge Modified Core	5	1	--	--	1	--	--	--	7
Modified Split Pebble	--	1	--	--	--	--	--	--	1
Modified Split Cobble	1	--	--	--	--	--	--	--	1
Edge Altered Cobble	--	--	--	--	1	--	--	--	1
Hammerstone	--	--	--	--	--	--	2	--	2
Projectile Point	--	1	--	1	--	--	--	--	2
Groundstone	--	--	--	--	--	--	--	1	1
Subtotal #	30	3	--	1	7	1	2	1	45
Subtotal %	66.7	6.7	--	2.2	15.6	2.2	4.4	2.2	
TOTAL #	99	12	6	3	41	10	3	1	175
TOTAL %	56.6	6.9	3.4	1.7	23.4	5.7	1.7	0.6	100

modified either through use or secondary retouch. The remainder of the modified assemblage includes cores, a split pebble, a split cobble, one edge altered cobble (removed flakes would have been a useable size), hammerstones, projectile points, and the groundstone adze blade. A selection of lithic artifacts is shown in Figure 35. The lithic analysis data sheets and code sheets are given in Appendix E.

The lithic artifacts found at 45SN393 are a diverse assemblage with a few specialized tool types. The specialized tools include two projectile points, an adze blade, a wedge tool, and two hammerstones. Locally available raw materials, in the form of sub-rounded pebbles and cobbles, were reduced on-site via bipolar and/or freehand reduction primarily for the production of expedient flake stone tools. The majority of the debitage is indicative of early to middle-stage reduction and roughly two-thirds of the debitage retains some amount of cortex regardless of reduction technique. The two freehand reduction cores retain no cortex and exhibit multiple platforms. One of the bipolar cores exhibits flake scars indicative of microblade production. Two other bipolar cores exhibit linear flake scars that extend the length of the core and a split pebble displays a linear flake scar on the ventral surface suggesting the production of small linear flakes, quite similar to microblades, was an important activity. The bipolar cores are the result of sub-rounded pebble/cobble reduction. Minimal reduction effort was expended in tool production, as evidenced by the paucity of late stage reduction flakes and the scarcity of tools displaying bifacial or unifacial surface modification. In fact very few flake tools display evidence of secondary retouch edge modification, suggesting edge alteration of flakes was not required for the

Figure 36. Selection of formed lithic tools from site 45SN393 (site number - catalog number).

majority of the tasks undertaken. The types of wear modification observed on the tools are indicative of a variety of cutting, sawing, and scraping activities that would be expected with occupation, such as processing plant and animal food and working wood or other plant material to make shelters, watercraft, or personal objects.

Several nearby shell midden sites occupied during the same time period as 45SN393 have analyzed lithic assemblages. The two most recent cultural components defined at the West Point site temporally overlap with 45SN393 (Lewarch and Bangs 1995). At West Point, both bipolar and freehand reduction technologies were employed to reduce locally available raw materials for expedient tool use, but only during the earlier components prior to 1500 BP. By 1500 BP, the area was no longer a year-round occupation but a small specialized activity camp, and tools manufactured from non-local CCS were brought into the area (Lewarch and Bangs 1995:7-176). In comparison, at 45SN393, reduction of local raw materials produced the majority of the assemblage.

A lithic assemblage more similar to that of 45SN393 was recovered from the English Camp shell midden (45SJ24). Although a smaller sample, the 45SN393 lithic assemblage has several commonalities with the post-1000 BP component recovered English Camp (Close 2006; Kornbacher 1992). Both contain similar types of formed tools, evidence of microblade production, evidence of both freehand and bipolar reduction, and an emphasis on non-retouched expedient tools primarily manufactured through bipolar reduction. Kornbacher (1992:181-183) describes a decrease in chipped stone tools at English Camp including small bifaces over time between the pre-1000 BP and post-1000 BP components. The paucity of bifacial tools and lack of bifacial thinning flakes in the 45SN393 assemblage is also similar to the more recent (post-1000 BP) portion of the English Camp assemblage. Unlike 45SN393, however, the raw crystalline volcanic rock used in tool production at English Camp was transported to the site from other locations (Close 2006:160-161). In this case, English Camp and West Point are similar in that stone considered most desirable for tool manufacture was transported into the area either in raw material form, or as finished tools. On the other hand, at 45SN393 tool manufacture was primarily accomplished through reduction of raw materials readily available on-site.

The lithic assemblage collected from the Duwamish No. 1 Site (45KI23), [redacted] is very extensive with a wide variety of artifact types not found in the 45SN393 assemblage. However, bipolar and freehand reduction of locally available raw materials was still a common occurrence and all manufacturing stages are represented including finished formed tools. The majority of the local basalt debitage does not exhibit cortex and is unmodified. Within the modified basalt flake group, those with cortex exhibit more occurrences of use without retouch while those without cortex exhibit more occurrence of retouch shaping than use (Campbell 1981:317-378). This is in contrast to the 45SN393 assemblage in which the majority of the debitage exhibits cortex, late-stage manufacturing flakes are rare, the majority of the tools regardless of cortex presence are not shaped, and the only two formed chipped stone tools are of CCS. Campbell (1981:464) also reports increasing diversity of lithic materials in the more recent components of Duwamish No. 1, and it is possible that the CCS artifacts from site 45SN393 are indicative of such a change as well.

A common thread among the West Point, English Camp, Duwamish No. 1, and 45SN393 assemblages is one of freehand and bipolar reduction of raw material sources primarily for the production of expedient tools. However, the West Point, English Camp, and Duwamish No. 1 assemblages all show diachronic change in terms of tool manufacture and/or the use of raw material resources. Functionally discrete areas within each of the sites have been demonstrated based on stratigraphically controlled excavation.

This is not currently possible for the present 45SN393 lithic assemblage. It is intriguing that shoreline occupation sites in Western Washington, while exhibiting much in common, also exhibit variation in terms of the raw materials chosen, the distribution of living, work, and refuse areas within the site and the tools manufactured and used in daily life. Additional, controlled investigation of 45SN393 could provide more information regarding regional and local variations for shoreline locations occupied during roughly the same time period.

Modified Faunal Remains

Sophisticated bone tool technology is a hallmark of Northwest Coast Native Americans. A wide variety of implements have been found preserved in shell midden deposits that span the past several millennia, including the Mukilteo Shoreline site. Eight fragments of modified mammal bone and teeth were found during test excavation at 45SN393, all in spoils screened from Trenches 6 and 14. Because of the very small sample size a formal classification system was not developed for this assemblage, however the descriptions of each artifact are based on attributes of modified faunal remains given by Larson (1995a) for the West Point site, following Matson's (1976; Matson et al. 1991) classification developed for the Glenrose Cannery Site near Vancouver, BC. The modified faunal assemblage is shown in Figure 36, and includes four beaver tooth fragments, a bone chisel fragment, a bone point, a toggling harpoon valve fragment, and one fragment of partially ground bone. Each artifact is fully described in Appendix E.

Four fragments of the lower incisor of a beaver (*Castor canadensis*) were found in the screened spoils of Trench 6 (Figure 36, a). Beaver incisors, when found in archaeological sites, are often presumed to have been used as graving tools (e.g., Matson 1976:173) and ethnographic observations and modern use of hafted beaver incisors support these inferences (e.g., Stewart 1996). Suttles (1951:96) also noted beaver teeth used to make dice by the Strait of Georgia-area Saanich tribe (see also Smith 1940:218-219).

The bone chisel fragment was found in the spoils of Trench 14 and is the pointed end of a chisel, ground from the shaft portion of a bone from a medium to large-sized mammal, probably a cervid (Figure 36, b). Following the criteria used for the West Point assemblage (Larson 1995a:10-3, 10-6 following Matson et al. 1991:41), it is categorized as a chisel based on use-wear polish on the single bevel of the bilaterally tapering end but little or no evidence of more forceful battering. The bevel has been ground to a tip on the interior, marrow cavity side of the shaft fragment. The artifact is 5 centimeters (2 inches) long, and 1.5 centimeters (0.6 inch) wide at the distal end. Chisels and similar wedge-shaped bone tools have been found at West Point, Duwamish No. 1, and are not uncommon in assemblages from other Puget Sound sites. Northwest Native Americans have used tools such as bone chisels and wedges for working wood and other material, and description of the tools and finished products of their work abound in ethnographic sources for the region (e.g., Smith 1940:320-321; Stewart 1996).

One bone point fragment was found at 45SN393, in screened spoils from Trench 14. It is 3.5 centimeters (1.4 inches) long from tip to broken end (Figure 36, c). Points with one or both ends ground to a sharp tip are relatively common in bone artifact assemblages recovered from shell middens across Puget Sound. Similar artifacts from the West Point site were categorized as small or large bone unipoints, bipoints, point tips, and point mid-sections. Although bipoints have been frequently associated with fishing activities by Puget Sound Native Americans (e.g., Chatters 1981, 1988; Schalk and

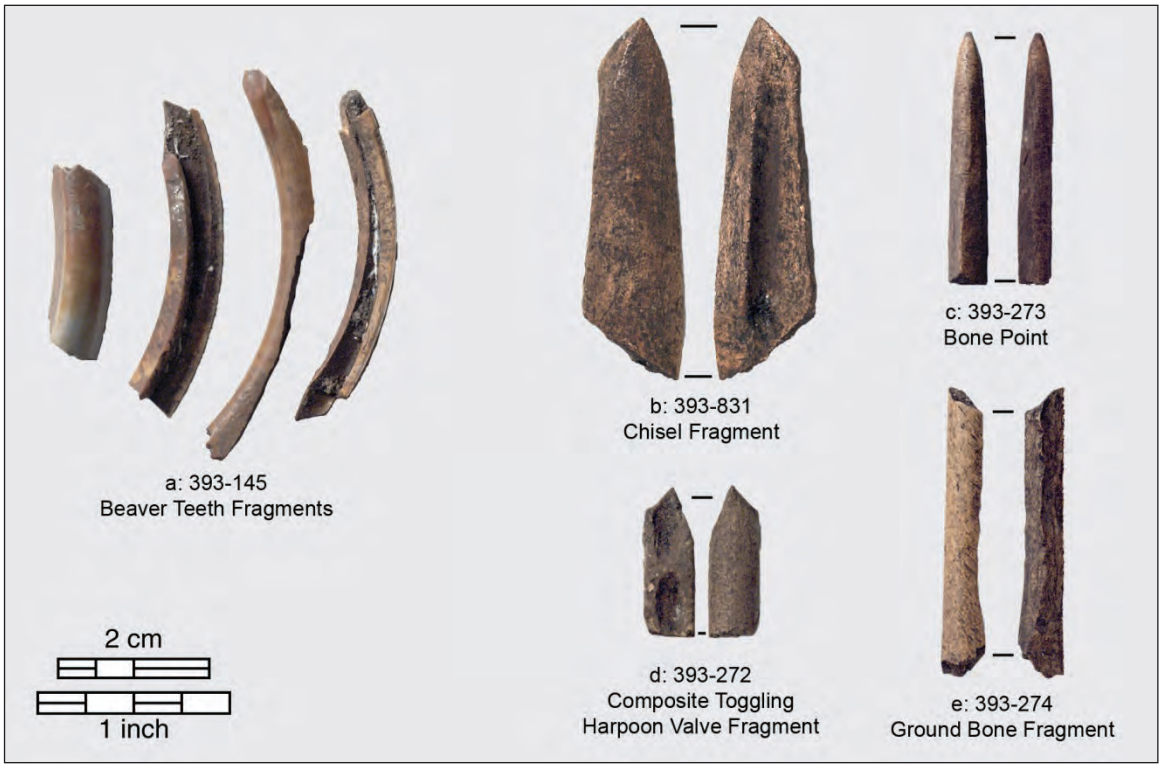


Figure 37. The modified faunal assemblage (site number - catalog number).

Rhode 1985), unipoints have been ethnographically observed used to arm small composite toggling harpoons and arrows, and were also placed along the edge of wooden paddles to make herring rakes (Roll 1974; Stewart 1996).

The toggling harpoon valve fragment (Figure 36, d) was found in the screened spoils of Trench 14. Although composite toggling harpoon valves are absent in the large bone tool assemblage at West Point, similar artifacts have been found in shell middens in other parts of Puget Sound, such as at Old Man House (Gaston and Jermann 1975:40), along Quartermaster Harbor in Vashon Island (Phillips 2002), and on Utsalady Bay on the north end of Camano Island (Bryan 1963). Descriptions of Native American use of toggling harpoons for spearing fish are given by Smith (1940:266) for the Puyallup and Nisqually, and for sea mammal hunting by Suttles (1951:106) for the Straits Salish. A fragment of partially ground mammal bone was found in the spoils of Trench 14 (Figure 36, e). Because it is incomplete, placing the artifact within a particular class of ground bone tool or estimating where it is situated along a hypothetical manufacturing sequence is not possible.

Despite being a small assemblage from the testing fieldwork, the modified faunal remains reflect a variety of activities at the site and a well-developed ground bone tool technology. Functions usually ascribed to the harpoon valve fragment and bone point are hunting and fishing, and those ascribed to the beaver teeth and chisel are inscribing and working raw material such as bone or wood (e.g., Stewart 1996). This range of artifacts is expected in assemblages that date to the last 1,000 years, when it is often surmised that the cultural patterns seen in the ethnographic record become more widely adopted throughout the Pacific Northwest (e.g., Matson and Coupland 1995).

Large terrestrial mammal bone was an important raw material for tool manufacture as well as subsistence on the Northwest Coast (Hodgetts and Rahemtulla 2001), and is shown to be so in the 45SN393 assemblage. Hypothetical manufacturing sequences were developed for the large modified bone and antler assemblage at the Duwamish No. 1 site (Campbell 1981:379-403). Here, a dimensional classification of modified faunal fragments allows placement of bone, antler, or shell artifacts into these models along the use-life of the object. Only one bone artifact at the Mukilteo Shoreline site, Cat # 45SN393-274, appears to have been deposited into the shell midden at a point prior to completion along the manufacturing sequence. A lack of modified but unshaped bone fragments in the assemblage may suggest that bone tool technology was limited at the site to maintenance, use, and discard of tools, however the presence of unmodified bone shaft fragments of cervids (see below) may indicate otherwise.

Unmodified Faunal Remains

The shell midden deposit of 45SN393 contains abundant remains of shellfish, fish, birds, and mammals. Data from the analysis of these remains that can answer questions about Native American subsistence highlight the research potential of the site and hence its significance. A sample of the faunal remains collected from excavations at 45SN393 was analyzed in an attempt to answer such questions. For each major faunal type, summary tables of the various animal taxa identified from the sample are followed by discussions providing additional information about taxonomic and body part representation for each faunal class. Full descriptive summaries and analysis data sheets are given in Appendix E.

Shellfish

For this analysis, the shellfish remains from the trench constant volume samples were compared quantitatively for an indication of changes in shellfish consumption at 45SN393 over time. This comparison examines shell weight in grams in the ¼-inch fraction because taxonomic identification of smaller specimens may skew measures of abundance and weight towards certain taxa. Shell weight provides a consistent measure of a particular shellfish taxon and a means of quantifying relative change in taxa across space and through time. Table 9 lists the weight of taxa identified from each trench CVS but does not include two taxa, geoduck (*P. Abrupta*) represented by two specimens found in the trench spoils and moon snail (*Polinicies* sp.) represented by one specimen found in a core sample. The descriptive summary in Appendix E includes all taxa found during analysis.

The analyzed shellfish assemblage represents a broad but typical array of shellfish species for central Puget Sound shell middens. The assemblage is weighted toward cockle (*Clinocardium* sp.) and littleneck (*P. staminea*) clams, which is not surprising given the present substrate of the intertidal zone near the site. Based on the analyzed assemblage, almost all of the shellfish deposited at 45SN393 could have been gathered in the immediate vicinity of the Point Elliott [redacted] Geoduck is the only unusual taxon, and to date has only been identified elsewhere in central Puget Sound at the Duwamish No. 1 site (Campbell 1981). Geoduck have been identified near 45SN393 in modern shellfish surveys in very low numbers, but in greater abundances to the east and south along the mainland shore and along the south shore of Whidbey Island across Possession Sound from Point Elliott (Anchor 2005; Goodwin 1973:51). During occupation of 45SN393 prior to historic filling, the tidal lagoon south of the berm may have provided an adequate habitat for geoduck, or this taxon may have been transported from some distance to the site.

Table 9. Shellfish Taxonomic Abundance in Weight (g) by 1-Liter Constant-Volume Sample.

		GASTROPODS		BIVALVES							BARNACLES			
TRENCH NO	DEPTH (cmbs)	Lottidae	*Nucella* sp.	Mytilidae	*Clinocardium* sp.	*Tresus* sp.	*Macoma* sp.	c.f. *Protothaca staminea*	*Saxidomus giganteus*	Unidentified Bivalve	cf *Semibalanus cariosus*	Balanidae	Unidentified Shell	TOTAL
5	190-200			0.2	0.2			3.9	1.6	10.1	0.9	0.5		17.4
	200-210			1.5	0.8			4.5	3.0	4.9	1.3	0.2		16.2
	210-220		9.1	3.5	0.4	3.9		0.3	4.5	22.5		0.8	0.2	12.4
	220-230		3.6	0.2	2.3			4.2		8.0				18.3
	230-240		50.1	0.3	27.7			91.9	3.7	33.7				207.4
	240-250		29.9	0.2	0.2			63.0		22.6		0.1	0.9	116.9
6	175-185		0.9					0.7		3.1				4.7
	185-195			0.3				0.1		6.8	1.4			8.6
	195-205		0.4	0.8						12.8		2.2		16.2
	205-215		0.3	3.5	0.5			0.4		33.1		0.4	1.2	39.4
	215-225		0.7	10.3	0.8			2.2		17.8	8.2	1.8		41.4
	225-235		0.3	18.8	0.6			1.1		5.5		1.8		29.0
	235-245	0.1	1.2	5.5	0.2			2.7		4.5		0.1		43.1
	245-255		30.0	2.6	0.1			16.6		7.0		0.6		37.0
	255-265		9.9	0.2	0.1			1.5		2.3				4.1
	38978							30.9						30.9
8	215-220									1.9		0.1	0.1	2.1
	235-245	0.1	6.9	1.0	1.2	11.8		2.4		35.3	1.5	0.3		60.5
11	90-95				0.5					5.7	0.6		0.7	7.5
	105-110			0.7	0.2			0.1		4.0		0.1		5.1
	132-135			12.1				0.8		24.1		2.3		39.3
	150-152		0.1	4.6	44.1			5.9	26.9	47.2		1.6	0.6	131.0
	155-158		1.1	3.6	55.3			0.1		20.7	0.4			81.2
	160-162		5.0	3.2	8.8			16.1		32.1		0.3		65.0
	160-165		1.9	14.3	36.7			10.1		28.2		1.1		92.3
13	240-250			7.2	7.3	2.5		11.6		10.2		2.1		46.4
	38816			1.4	3.1			3.8	0.9	20.0	1.0	0.1		48.9
	270-278			3.2	0.4			51.2	21.7	32.1		0.1		113.5
	278-280			1.5	2.6	0.4		12.8	44.5	18.2				90.1
14	170-180			0.3				1.0		4.7				6.0
	180-190			2.0	1.0			0.5		6.1				9.6
	190-200			0.5	0.3			1.6		3.8	2.7	0.1		9.0
	200-210		0.5		0.8	2.0		4.2		8.2				15.7
	205-208			0.1	0.8			9.5		2.5				12.9
	210-220		1.8	0.1	1.7		0.6	2.2		14.3				20.7
	220-230		9.5	1.3	2.7			9.3		22.6		0.3	0.7	46.4
	230–235		10.9	2.6	13.6	37.1		11.3	15.2	17.5	1.1	0.1		107.8
	230–240		1.1	6.8	7.4		0.1	9.9	35.0	50.2		0.1		95.6
	240-245		1.5	0.6	0.2			2.4		16.3			0.1	21.1
	240-250		0.8	1.4	0.3			2.4		21.0		0.1		16.0
	250-255			0.8	0.5			3.5		9.4	0.2	0.3		14.7
	Total	0.2	177.5	117.2	223.4	57.7	0.7	396.7	157.0	651.0	19.3	17.6	4.5	1822.8

Changes over time in relative taxonomic abundance of shell can be investigated using broader taxonomic categories than the range identified during the analysis. Taxa such as macoma (*Macoma* sp.), horse clams (*Tresus* sp.), and geoduck were found in small numbers and omitted, while other classes such as limpets and whelks were combined into larger units. Figure 37 shows overall variability in shell composition within the four trenches with bracketing radiocarbon dates. The total percentage of gastropods (Lottidae and *Nucella* sp.), mussels (Mytilidae), cockles, and Venus clams (including littleneck and butter [*Saxidomus* sp.] clams) varies from trench to trench, with the greatest relative abundance of gastropods in Trenches 5 and 6, mussels in Trench 6, cockles in Trench 11, and Venus clams in Trench 14. Despite the overall abundance of gastropods in Trench 5, the uppermost midden layers are predominantly Venus clam and lack gastropods, while gastropods make up between about 30% and 50% of the assemblages from the deeper layers. Trench 6 provided a thicker midden deposit than Trench 5 and more individually defined strata within the midden, some characterized by thin layers of crushed mussel shell. The analyzed CVS assemblages reflect this, with proportion of mussel fluctuating throughout the sequence and being absent in a few samples but comprising between 50% and 90% of the assemblages by weight between 185 and 245 centimeters below surface (cmbs). The Trench 11 profile also contained several thin, dense crushed mussel shell layers in the upper portion of the midden, and had very high proportions of mussel shell in the two samples between 105 and 135 cmbs. One sample from above these layers and the samples from deeper within the midden, however, show greater proportions of cockle. Venus clams are the predominant shellfish in Trench 14, with samples from 170-180, 205-208, 230-240, and 250-255 cmbs (this last sample being below the shell midden deposit) containing greater proportions of littleneck and butter clams than samples from the intervening layers.

Analysis of the material recovered during testing suggests a generalized pattern of harvest of locally available shellfish species, but there is variability in the spatial patterning of specific relative shellfish abundance, both horizontally between trenches and vertically between stratigraphically sequential CVS. Because of the difficulty of associating the CVS shellfish remains with artifacts primarily found in the spoils, or features that could not readily be defined in the trench profiles, further inferences from the testing data are limited. Broad-scale shifts in taxonomic abundance and inferred changes in harvest intensity of particular shellfish types, such as the shift from mussels to Venus clams between temporal components at the West Point site (Larson 1995b:13/25-26), are not apparent in the 45SN393 assemblage. Unidirectional changes, including an abrupt decrease in gastropods between the lower and upper layers of Trench 5 and a dramatic increase in mussel shell in the upper layers of Trench 11, may reflect shifts in particular shellfish harvesting strategies over time or changes in the concurrent use of particular portions of the site. Such inferences, however, require more detailed information on spatial associations of specific deposits within the general shell midden stratum.

The shell assemblage is highly fragmented, which may be attributed to shellfish processing or post-depositional processes such as high-energy wave action from storms striking the beach berm and/or historic or modern human-induced processes that likely aided in fragmentation. Although only the ¼-inch fraction was examined for relative taxonomic abundance, comparison of screen size proportions in overall shell amounts in each CVS suggests that, by weight, the finer fraction comprises a substantial part of the midden matrix. The CVS sequence in most trenches shows fluctuation in the proportion of ⅛-inch shell weight to ¼-inch shell weight with depth, while Trenches 5 and 8 show directional trends of decreasing finer shell fractions with depth (Appendix F).

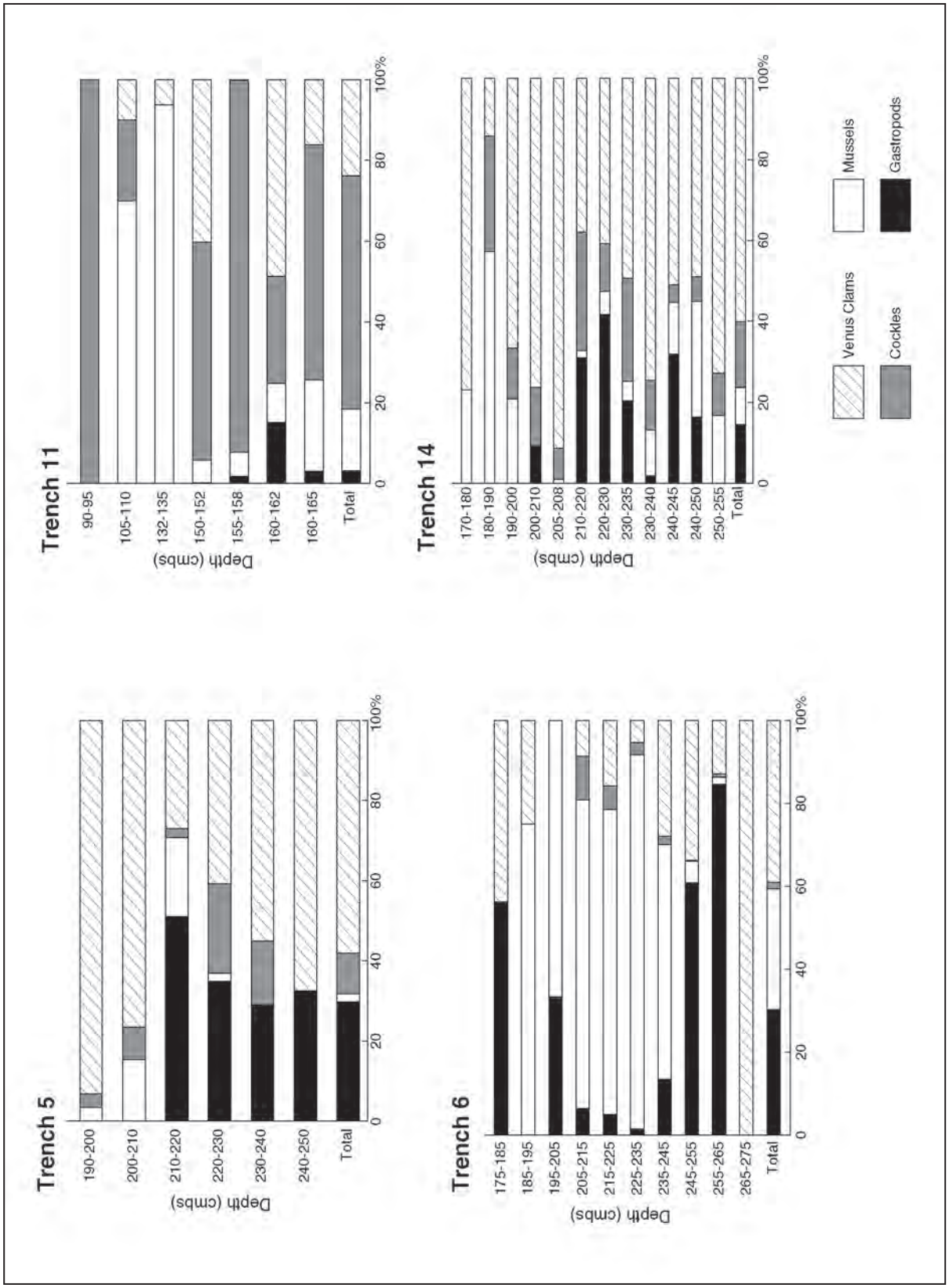


Figure 38. Graphs of relative taxonomic abundance of major shellfish between trenches.

Burned shell fragments in the assemblage may represent cooking, post-consumption disposal, or post-depositional processes within the shell midden, any of which would change shell color and texture and increase fragmentation (Claassen 1998). Burned shell was identified as such in the analyzed assemblage based on color if they were blackened, were gray throughout, or from exposed breaks showing white on the exterior surface of the shell and gray in the interior. A total of 152 shell fragments out of 5,299 analyzed (2.8%) were burned, or 67.8 grams of a total of 2,360.1 grams (also about 2.8%). These burned specimens were of most of the identified taxa and distributed throughout most of the trenches and several of the core CVS.

Fish

Fish bones were sorted in the trench CVS samples from 45SN393, and the ¼-inch and ⅛-inch fractions analyzed. A total of 705 specimens were analyzed, 330 (46.8%) of which were identified to at least the taxonomic level of Order. Quantification is by the number of identified specimens for a particular taxon (NISP). Other methods of quantification were not used, such as Minimum Number of Individuals (MNI), which is the minimum number of individuals of a particular taxon represented by an aggregate of specimens. This method is not as likely to be biased from differential fragmentation of specimens, however it has been shown in several studies that NISP and MNI are highly correlated (e.g., Grayson 1984). Because of this correlation, the dependence of MNI calculations on aggregation methods, and the small sample size of specimens from paired fish elements, fish were quantified by NISP. MNI can be calculated, however, from the raw data in this analysis found in Appendix E. Table 10 lists NISP of particular fish taxa by trench and by screen size, in standard phylogenetic order following Hart (1973).

Table 10. Fish NISP from 45SN393 Trench CVS

TRENCH NO. / SCREEN SIZE	*S. acanthias*	*H. colliei*	*C. harengus pallasi*	*Oncorhynchus sp.*	Embiotocidae	*R. vacca*	Scorpaenidae	Cottidae	*L. armatus*	Pleuronectiformes	Pleuronectidae	*L. bilineata*	*P. stellatus*	Unid. Fish	TOTAL
5 / ¼	1	1	-	1	-	-	1	1	-	-	-	-	-	2	**7**
5 / ⅛	-	-	-	19	-	-	-	-	1	-	-	1	-	13	**34**
6 / ¼	-	-	-	6	-	-	-	-	-	1	-	1	-	2	**10**
6 / ⅛	-	-	1	19	1	-	-	4	1	1	1	-	-	52	**80**
8 / ¼	-	-	-	1	-	-	-	-	-	-	-	-	-	-	**1**
8 / ⅛	-	-	-	1	-	-	-	-	-	-	-	-	-	-	**1**
11 / ¼	-	-	-	15	1	1	-	2	-	2	-	-	1	6	**28**
11 / ⅛	3	-	1	94	-	-	-	3	1	5	2	-	-	210	**319**
13 / ¼	-	-	-	1	-	-	-	1	-	1	-	-	-	-	**3**
13 / ⅛	-	2	-	7	1	-	-	9	-	4	-	-	1	30	**54**
14 / ¼	-	1	-	13	1	2	-	1	-	2	-	-	1	-	**21**
14 / ⅛	-	-	-	77	1	-	-	2	1	4	2	-	-	60	**147**
Total ¼	1	1	-	37	2	3	1	5	-	6	-	1	2	10	**70**
Total ⅛	3	2	2	217	3	-	-	18	4	14	5	1	1	365	**635**
Grand Total	**4**	**4**	**2**	**254**	**5**	**3**	**1**	**23**	**4**	**20**	**5**	**2**	**3**	**375**	**705**

The remains of eight taxonomic fish families and several more specific genera and species within those families were identified in the 45SN393 assemblage. These taxa represent fish commonly found in the vicinity of Point Elliott today (Miller and Borton 1980), and would likely have been available nearby over the past 1,000 years as well. The richness of this assemblage, 13 identified taxa, is not as large as other analyzed fish bone assemblages from similar extensive shell middens, such as West Point (Wigen 1995), or from smaller shell middens with more specialized fish bone assemblages, such as the herring processing site of Burton Acres on Vashon Island (Kopperl 2001). In terms of evenness, this assemblage reflects a focus on salmonids (*Oncorhynchus* sp.), with much smaller numbers of sculpins (Cottidae, including *L. armatus*) and flatfish (Pleuronectiformes, including Pleuronectidae, *L. bilineata*, and *P. stellatus*) and isolated specimens of dogfish (*S. acanthias*), ratfish (*H. colliei*), herring (*Cl. harengus pallasi*), surfperch (Embiotocidae, including *R. vacca*), and rockfish (Scorpaenidae). This may in part be due to sample size and the ease of identifying salmonid vertebra fragments in fine-fraction samples relative to other taxa, resulting in inflated salmonid NISP values (Wigen and Stucki 1988). Small body size of most of the fish taxa present in the 45SN393 assemblage, coupled with the generally fragmented condition of the midden fauna, has resulted in the majority of fish remains being found in the ⅛-inch fraction of each CVS. Herring, Pacific staghorn sculpin, and right-eyed flounder remains were identified in this fraction and not the ¼-inch fraction, while remains of pile surfperch and rockfish may have been present in the finer fraction but were only identifiable in specimens recovered in ¼-inch screen.

Of the 714 analyzed fish remains, 336 or 47% were identified to a specific skeletal element or element group. The majority are vertebrae or vertebra fragments, which is not surprising given the previously mentioned ease of identifying small fragments of salmonid vertebrae. Of the skeletally identified specimens, only 55 or 16% of the specimens came from fish heads, including the cranium, jaws and teeth, and branchial (gill) region. A total of 281 or 84% came were post-cranial specimens including elements of the vertebral column, interhaemel spines, and the epural element of the tail. Herring, sculpin, surfperch, flatfish, and salmon are all represented by both cranial and post-cranial elements, indicating that entire fish were processed at 45SN393. Factors such as bone density, degree of burning, and ground-water saturated depositional environments are known to structure the survivorship of fish remains (Butler and Chatters 1994; Lubinski 1996; Pegg 1999), however the sample size from this assemblage is too small to quantify these effects.

Skeletal elements of varying density are represented, from relatively dense vertebrae and teeth of larger fish such as salmonids to very delicate cranial elements of smaller fish such as herring, suggesting good overall preservation. Burned fish bones are present in small numbers in the assemblage, recorded during analysis as being either charred or calcined. Color is the most commonly used characteristic for identifying thermal alteration of bone, although numerous chemical processes unrelated to burning can have a similar effect on the structure of bone (Lyman 1994; Shipman et al. 1984). The most effective means of identification of burned bone and the temperature range in which a specimen has been burned is by scanning-electron microscopic examination of the specimen's crystalline structure (e.g., McCutcheon 1992). Because the procedure was not practical for this analysis, it was assumed that specimens exhibiting blackening, whitening, or a combination of the two underwent some form of thermal alteration. Blackened specimens were identified as "charred", and are assumed to have been carbonized at a relatively low temperature. Whitened specimens that also exhibited a brittle, chalky texture were identified as "calcined", and are assumed to have been heated to higher temperatures in which much of the organic material within the mineral structure of the bone has been removed. A total of 20 specimens, 2.8% of the entire analyzed assemblage (the same proportion as shellfish remains), were either charred or calcined. Of these burned bones, 10 were charred and 10 were calcined. The

specimens are distributed throughout CVS from Trenches 6, 11, 13, and 14 in proportion to the total numbers of fish bones in those samples. By identified taxon, the burned specimens are from ratfish, salmonid, surfperch, and sculpin. Most of these specimens are found by taxon in the same proportion as that of burned specimens overall with the exception of the very small number of ratfish teeth, of which half (n=2) of the specimens were burned. Burned fish bones within the 45SN393 assemblage suggest either cooking, heat smoking or drying, or disposal of fish in fire, although their small numbers and random distribution throughout the assemblage preclude more detailed inferences.

Birds

Bird remains from four taxonomic families (ducks, loons, grebes, and alcids) and several genera and species within those families were identified for this analysis. A total of 57 bird specimens were found distributed throughout all of the trenches with shell midden deposits except Trench 13, in addition to one bird specimen from a CVS from Core MR-12. Most of the bird remains from the trenches were found in the screened spoils, however several specimens were found in both CVS ¼-inch and ⅛-inch fractions.

The taxonomic names of birds used here follow the Seventh Edition of the American Ornithologists' Union check-list (1998), as well as recent changes to this check-list (e.g., Banks et al. 2003). The avian osteological terms used follow Howard (1929). The modern range distributions of the birds are discussed, using information primarily from Wahl et al. (2005). Table 11 lists the bird remains identified for this analysis. A complete descriptive summary and the raw data are included in Appendix E. Because of the small overall sample size of bird remains and the paucity of specimens recovered from the ⅛-inch fraction, the table lists taxa by Trench or Core number only.

Table 11. Bird Remains from 45SN393.

	DUCKS				LOONS		GREBES				ALCIDS				
TRENCH NO	Anatinae	*Anas* sp.	*Mergini*	*Melanitta* sp.	*Gavia* sp.	*G. stellata*	Podicipedidae	Large Podicipedidae	Small Podicipedidae	*Podiceps* sp.	c.f. Alcidae, small	Alcidae, medium	Alcidae, large	Unid. Aves	**TOTAL**
Trench 5														4	**4**
Trench 6					3		2					1		3	**9**
Trench 8														2	**2**
Trench 11					1	1							1	3	**6**
Trench 14	4	1	2	1			1	1	1	2	1			22	**36**
Core MR12														1	**1**
Total	**4**	**1**	**2**	**1**	**4**	**1**	**3**	**1**	**1**	**2**	**1**	**1**	**1**	**35**	**58**

Bird remains were found in small numbers in most of the test trenches and one core at 45SN393. Trench 14 contained the greatest number of bird bones representing the greatest number of taxa, all except those of loons which were found in Trenches 6 and 11. Only one specimen, a thoracic vertebra from Trench 5 of an unidentified bird, was noted as possibly burnt on one edge. The small sample size

precludes further inference regarding distribution of bird bones throughout the site or generalizations about taphonomic processes specific to bird remains in the shell midden. The taxonomic richness of the bird bone assemblage is high relative to some bird bone assemblages analyzed from other large shell midden sites, such as West Point, and considering its small sample size (e.g., Lyman 1995). Large bird bone assemblages from Old Man House, Duwamish No. 1, Tualdad Altu, and *He'bolb* suggest the taxonomic richness that may be present at 45SN393 and obtainable with large enough samples.

Mammals

Because mammal bones are a much rarer class of faunal remains than shellfish and fish at 45SN393, they were collected from the trench spoils which provided the majority of this data. The spoils collection provides mammalian taxonomic presence/absence information and some indication of distribution across space, but not stratigraphically within each trench. The very small sample size from each trench and core CVS that contained mammal remains highlights a need for larger collection units that have the same stratigraphic precision as the CVS to obtain an adequate sample of rarer classes of fauna as well as artifacts if this site is further investigated.

Taxonomic names and phylogenetic ordering are based on the classification in Wilson and Cole (2000). Quantification is by NISP. Because of the correlation between NISP and MNI, the dependence of MNI calculations on aggregation methods (in the case of mammals, by trench in most cases), and the small overall sample size of mammal remains, this analysis uses NISP. MNI can be calculated, however, from the raw data in this analysis.

A total of 85 specimens were identified to mammalian taxa finer than Class level, from three Orders and six Families. Most of these specimens were of porpoise (Phocoenidae), harbor seal (*P. vitulina*) and deer (*Odocoileus* sp.) with lesser amounts of sea lion (Otariidae), elk (*C. elaphus*), black bear (*U. americanus*), and cow (*Bos* sp.). Another 211 specimens were identifiable only as having come from a mammal. Table 12 lists the mammalian remains identified at 45SN393.

Table 12. Mammalian Remains Identified (NISP) at 45SN393.

UNIT	Otariidae	c.f. Otariidae	*P. Vitulina*	*U. Americanus*	Phocoenidae	*C. Elaphus*	*Odocoileus* sp.	Cervidae	*Bos* sp.	Unid. Large Mammal	Unid. Mammal	TOTAL
Trench 5, Spoils			2		1		2	2			13	20
Trench 6, Spoils			2		17	5	3		1		42	70
Trench 6, 175-185 cmbs											1	1
Trench 6, 215-225 cmbs											4	4
Trench 8, Spoils			3	1	1		8	3			21	37
Trench 11, Spoils		1	10				1				58	70
Trench 13, Spoils					7		2				3	12
Trench 14, Spoils	3		3				3		1	1	64	75
Core MR-5, 122 cmbs			3								4	7
TOTAL	3	1	23	1	26	5	19	5	2	1	210	296

Mammal remains were primarily identifiable in the larger fragments recovered in ¼-inch screens, mostly from the trench spoils but also in the larger fraction of the CVS samples. Eight mammalian taxa were identified, representing both terrestrial (black bear, elk, deer) and marine (sea lion, harbor seal, porpoise) animals found in the Puget Sound lowlands and Possession Sound near Point Elliott today, and are well known archaeologically and ethnographically as having been hunted by Native Americans. The remains of domestic cow, however, are considered intrusive to the shell midden deposit. The sample sizes of mammal remains identifiable to specific taxa are small, none show signs of burning, and very few exhibit cutmarks. Inferences about butchery and carcass transport decisions and post-depositional density-mediated preservation of mammalian remains are therefore not made from this assemblage, but could be made if a larger sample is obtained from 45SN393.

Botanical Remains

Carbonized plant remains from thirteen sediment samples and one charcoal sample were initially submitted to Demeter Research for selection of charcoal best-suited for radiocarbon dating, followed by a more general analysis of macrobotanical remains from those samples and interpretation of the paleoethnobotany at 45SN393. Data from the analysis provides an indication of the kinds and parts of plants used at the site as well as information on the suitability of specimens for radiocarbon dating. The complete botanical analysis report is given in Appendix G.

From a total of 26.5 liters of botanical sample sediments, 174.7 grams of carbonized wood and bark fragments (n=9,429) were separated. Of this amount, 51.1 grams (n=728) of charcoal were further identified. By weight, the majority of the identified charcoal was from Douglas fir (*P. Menziesii*), closely followed by charcoal from the birch family (Betulaceae). Identified in smaller amounts were alder (*Alnus* sp.), hemlock (*T. heterophylla*), western red cedar (*T. plicata*), pine (*Pinus* sp.), maple (*Acer* sp.) and bigleaf maple (*A. macrophyllum*), yew (c.f. *Taxus* sp.), and hawthorn (c.f. *Crataegus* sp.).

The wood taxa in the archaeological deposits are reflective of wood available in the nearby forests and as driftwood along beaches. The dominance of the conifers Douglas fir, western red cedar, hemlock (three types common in other Puget Sound archaeological sites), together with the hardwoods maple and alder, and broad-leafed shrubs, are similar to the major constituents of the Puget Sound area forests. The archaeological charcoal appears for the most part to be the generalized remains of fuel-wood, gathered from the forests and/or beaches without much preference for particular species. Yew (appearing in a few of the archaeological samples) also grows in the Puget Sound forests, but usually as isolated individuals, and its inclusion may be from its technological use rather than as fuel. The heavy durable wood was considered by all coastal groups to be valuable for carving (Gunther 1945:16; Pojar and MacKinnon 2004; Suttles 1951:83). Yew has not been previously identified archaeologically in central Puget Sound sites. Madrone, a conspicuous element of the Puget Sound forests, was not identified from this site, and it also seems to be absent from other Northwest coast archaeological wood assemblages. It is a puzzling omission, since madrone is an excellent fuel wood. Pojar and MacKinnon (2004:49) cite a traditional Straits Salish story in which madrone played an important role, and is therefore not used as fuel even up to the present.

The seed types recovered with some regularity for the site include goosefoot (*Chenopodium* sp.), bedstraw or cleavers (*Galium* sp.), a long grooved grass type probably belonging to the barley taxon (Hordeae), seeds of cress or mustard, seeds of sedge or bulrush, and of a probable knotweed species (*Polygonum* sp.). Small fruits are represented by a blackberry/raspberry seed (*Rubus* sp.) and four elderberry seeds (*Sambucus* sp.).

The goosefoot, bedstraw, grass, mustard, sedge/bulrush, and knotweed are all weedy annuals that thrive in open, disturbed and/or wet habitats. All would probably have grown in the vicinity of the site. Representatives of these taxa are all known to have economic uses by North American peoples (although Gunther 1945 lists neither a Chenopodium nor a Polygonum use in her Ethnobotany of Western Washington), and their presence due to deliberate gathering and economic use by the inhabitants of the site is plausible. For example, bedstraw often grows abundantly along the driftwood zones of beaches, and Pojar and MacKinnon (2004:330) record use of the dried plants to start fires. Because the same few seed types are found repeatedly in a number of contexts at the site, they may have been used as part of established cultural practice. However, there is no strong evidence as to whether the seeds were from gathered plants or adventitious inclusion in the cooking fires. The same is true for the fruit seeds - *Rubus* berries and elderberries are well-known food sources of the northwest people, and the seeds may have been from gathered fruits. But the sparse occurrence in the samples is not strong evidence as to whether their inclusion was economic or accidental.

All but one of the analyzed botanical samples came from relatively thin, charcoal-stained or charcoal-rich strata exposed in the profiles of Trenches 5, 6, 11, and 14. The exception is a sample from the base of a vaguely discernable depression or pit feature filled with black sediment, fire-modified rock, and crushed shell observed in the profile of Trench 6. The thin, level strata from which the other samples came are inferred as occupation surfaces, while the feature in Trench 6 may represent a different, more specialized function or activity. Although testing at 45SN393 has not yielded features in the same number or diversity as sites such as West Point and Duwamish No. 1 which are amenable to exploration of feature variability and inference of function through dimensional classification, a basic expectation that may be used here is that the botanical contents will differ between the strata interpreted as generalized occupation surfaces and the stratum interpreted as a specialized feature. A lower diversity of plant taxa and parts may be expected in a sample from a specialized feature than a sample from a surface in which a variety of activities took places. An exception would be a pit or depression that was purposely filled with refuse from a combination of other activities and may include a diverse set of plant remains (e.g., Lewarch et al. 1995:12/30). The feature contains wood charcoal from six taxa, a greater diversity than most of the other samples, along with a greater amount of starchy plant tissue by weight than any of the other samples, and one goosefoot seed. Conversely, there is also a sample (Trench 6, 218-223 cmbs) from what appears to be a specialized context within the thin strata above the feature; rather than mixed wood types the sample consisted of only Douglas fir in an organic matrix that also included abundant shell, fragments of burnt bone, and fairly abundant seeds.

The plant remains from 45SN393 establish a tentative and preliminary pattern of plant use by the coastal inhabitants of this site. This pattern includes: generally non-selective use of the local environment for fuel-wood (except for the apparent exclusion of madrone), and the economic use of certain small-seeded weedy annuals as well as berries. Systematic flotation analysis of other coastal sites and synthesis of regional data will clarify this pattern.

Summary of Animal and Plant Utilization at 45SN393

From analysis of the assemblage of faunal and botanical remains from 45SN393, it is clear that a wide variety of locally available animals and plants were used by the Native American occupants of the site. The animals that were brought to the site not only provided meat in both large packages (e.g. elk, sea lion) and small (e.g., clams, sculpins) but were also a source of raw material such as hide, sinew, bone,

antler, feathers, shell, and oil to manufacture clothing, tools, ornaments, and other goods for use or trade.

The plants identified for this analysis are limited to carbonized fragments and are primarily of various tree species. Starchy tissue fragments that may have been from edible parts of plants were found in very small amounts, and are likely under-represented in this assemblage relative to the wood charcoal. The volume of wood burned as fuel for hearths or food smoking, or as signal fires at the site, is probably much greater than that of seeds, berries, nuts, and other edible portions of plants that must have been deposited, burned and unburned, at the site. Less common wood taxa such as yew were found as charcoal and may have been burned for fuel, but may also represent burned fragments of objects from which yew was commonly carved such as arrow or spear shafts.

The faunal assemblage provides an indication of how the site was used throughout the year. Some resources such as shellfish would have been available as a general class of food year-round. Seasonal indicators, on the other hand, include species that are only available at particular times of the year, such as salmon, herring, and migratory waterfowl, and also specimens from individual animals that were harvested at a particular age that occurs at a regular time during the annual cycle, such as newborn harbor seals. Table 13 lists the seasonally-restricted taxa found (aggregated into larger taxonomic units in some cases) and their availability near Point Elliott throughout the year. Although the presence of certain taxa at the site may be attributed to stored food obtained at a different time or place than when consumed, such as dried salmon, the taxonomic and demographic composition of the faunal assemblage suggests utilization of a suite of animal resources available near the site at different times throughout the entire year. Microscopic study of seasonal markers of shellfish was beyond the scope of this analysis, but may provide more fine-grained seasonality data in the future.

Table 13. Availability of Seasonally Restricted Animal Taxa Found at 45SN393.

RESOURCE	MONTH											
	J	F	M	A	M	JN	JY	A	S	O	N	D
Spotted Ratfish	*	*	*	X	X	X	*	*	*	*	*	*
Pacific Herring		**X**	**X**									
Salmonids	**X**				**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**
Pacific Staghorn Sculpin	•	**X**	•	•	•	•	•	•	•	•	•	•
Ducks	X	X	X	*	*	*	*	*	*	*	X	X
Loons	*	•	•	*	*	*	*	*	*	*	*	*
Grebes	•	•	•								•	•
Sea Lions	X	X	X	X							X	X
Harbor Seals (newborn)							**X**	**X**	**X**			
Elk	•	•	•	•	•	•	•	X	X	X	X	•
Deer (fawn)					•	**X**	•					

* Uncommon in the region during this period
• Available in the region during this period
X Abundant or primarily hunted or fished ethnographically in the region during this period
X Breeding or bearing young during this period

Although unmodified faunal remains found in shell midden sites are usually associated with subsistence practices, the presence of some faunal constituents may be due to natural or non-subsistence cultural processes. Erlandson and Moss (2001) and Lyman (2002) note a wide variety of terrestrial and marine animals that feed on aquatic prey and may bring their remains into the shell midden, which is often interpreted in terms of its anthropogenesis. Animals such as raccoons (present in the 45SN404 faunal assemblage; see below), mustelids, dogs and foxes, seals and sea lions, and a variety of birds are some of the animals that may deposit bone, shell, or other parts of animals into a shell midden. Some of these animals may introduce these remains as stomach contents when they are caught and brought to the site by the human occupants. Lyman (1994; 2002) encourages taphonomic analysis of faunal assemblages to identify agents that may have incorporated particular remains into a deposit and agents that may have affected faunal remains after initial deposition. Non-tool modification observed on the analyzed faunal specimens is limited to a few cutmarks, limited burning on one bird bone and some fish and shell specimens, and erosion of some bone surfaces that were more likely caused by physical or chemical weathering than corrosion from passing through a digestive tract, and none of the mammal or bird bones exhibit gnawing or puncture marks. Additionally, no rodent bones were identified in the screen spoils or the small screen size fractions of any CVS. Although the lack of these indicators in the faunal assemblage and the clear archaeological context of the shell midden in general suggest that most of the bones and shells in the midden represent human hunting, fishing, and gathering efforts, other agents should not be dismissed and any further faunal samples from the site should be examined for such taphonomic agents.

Faunal remains may also be deposited into a shell midden because of non-subsistence cultural reasons such as tool manufacturing. Several bone tools and modified beaver teeth found at 45SN393 attest to the need for faunal raw materials to make a variety of implements. The faunal remains analyzed here are included in this analysis because they are not modified, however they may represent portions of animals brought to the site not for food but for their value as tools. Hodgetts and Rahemtulla (2001) note the value of cervid bones to Northwest Coast Native Americans for tool manufacture reflected in ethnographic documentation and the archaeological record. The small samples of modified faunal remains and unmodified mammal remains preclude attempts to connect any hypothesized bone tool manufacturing strategy that took place at the site with the particular taxonomic and skeletal representation of the unmodified fauna at the site. There is no reason not to assume, however, that the remains of cervids, black bear, sea mammals, birds, fish, and molluscs at 45SN393 represent not only a broad range of subsistence pursuits by Native Americans but also the need for other parts of these animals to help build the implements and ornaments essential to their culture.

Site Synthesis

The north-facing shoreline of Point Elliott has been occupied by Native Americans for approximately 1,000 years. The cuspate foreland and vicinity provided a variety of resources that would have drawn Native communities to the berm throughout the annual subsistence cycle. The Mukilteo Shoreline site (45SN393) contains the remnants of this occupation, including a thick, horizontally extensive shell midden over 500 meters (0.3 mile) in length. The midden is characterized by intact, bedded layers of crushed shell, charcoal and charcoal-stained sediments, and fire-modified rock deposited on top of the clean sand and gravel of the beach berm that formed at Point Elliott prior to human occupation. The alkaline depositional environment of the shell midden has created ideal preservation conditions for bone, in the form of both unmodified faunal remains and fragments of mammal bone and beaver teeth modified into tools. Within the shell midden strata are the remains of animals that were hunted, fished,

and gathered by the Native occupants of the site, the plants that they ate and the wood that they used for fuel and implements. Stone tools and tool-making debris reflect the kinds of stone implements they used, how they used them, and the various ways in which the tools were made. Test excavations and sampling of 45SN393 indicate that these important data classes are present with intact archaeological integrity. The data classes have the demonstrated potential to address important questions about a variety of research domains representative of the pre-contact Native American occupation of Point Elliott and central Puget Sound over the last 1,000 years.

Despite the horizontal breadth of the shell midden, radiocarbon dates from three test trenches point to initial occupation about 600 years before present along much of the midden. A date from near the base of one trench, from charcoal in a shallow depression or pit feature, of about 1000 BP represents earliest use of the site before more widespread occupation. The terminal radiocarbon dates from the four trenches range between about 440 BP and modern times, [redacted] have somewhat obscured the archaeological details of the final years of Native American occupation. The kinds of artifacts found and the character of the shell midden support the radiocarbon chronology of occupation over roughly the last 1,000 years, and place the site within the Late Period of Puget Sound culture history. Corresponding with the San Juan phase of the more refined Strait of Georgia sequence to the north, the last thousand years prior to Euroamerican contact were marked by large populations that settled in permanent or semi-permanent winter villages. These communities, however, were usually mobile throughout much of the year for economic reasons and because of important social and ceremonial obligations. No evidence of the kinds of structures people may have lived in was found during testing at 45SN393. However the diverse suite of animal remains found at the site reflects an environment that drew people to Point Elliott throughout the year.

The occupants of 45SN393 utilized several technological strategies to make stone and bone implements for a variety of functions. Hammerstones and the flakes and cores that result from chipped-stone tool manufacture were found at the site, and reflect both free-hand and bipolar methods of flaking stone tools. Bipolar techniques, fracturing stone between a hammer and anvil, were used to expediently make many simple flake tools from locally-available volcanic rocks. Other artifacts show fine workmanship applied to more exotic materials, including a projectile point made of petrified wood and a ground nephrite adze blade.

Although very few by-products of a ground bone tool-making industry were found during testing, some modified faunal remains were recovered, along with unmodified mammal long bone shaft fragments that may have been intended for future manufacture. A ground bone toggling harpoon valve, bone point, bone chisel, and ground beaver tooth reflect sea mammal hunting, fishing, and tool- or implement-making activities, perhaps including incising of art objects of bone or stone.

A very large proportion of the archaeological deposit by volume is the remains of shellfish that were discarded at the site. These shells are from gastropods such as whelks, limpets, and moonsnail; mussels; clams such as cockle, littleneck, butter, and horse clam; geoduck; and barnacles. The samples analyzed during testing suggest that the majority of shellfish, by weight, are the Venus clams (littleneck and butter clams), followed by cockles, gastropods, and then mussels. Geoduck are notable; although found in very small amounts at 45SN393, they have only been identified in one other archaeological site in central Puget Sound despite their natural abundance in the region. Although the shellfish assemblage reflects generalized gathering of species locally available in the sandy and gravelly intertidal zone

mantling Point Elliott or nearby beaches, the proportions of particular kinds of shellfish within individually analyzed samples fluctuate across the site among trenches, and vertically through time within the stratigraphic sequences of individual trenches. This may reflect specialized activity areas within the site, individual dumping episodes of the shells of particular kinds of molluscs, or changes through time, seasonally or more long-term, in shellfish abundance or gathering strategies.

The bones of fish, birds, and mammals were found at the site in much smaller numbers than shells, but provide a stronger indication of the year-round draw of this environment to the occupants of the site. Native Americans fished the near-shore eel-grass beds as well as the open waters of Possession Sound and nearby rivers and streams. The bones of salmon, flatfish, sculpins, surfperch, dogfish, ratfish, herring, and rockfish were found in samples obtained from testing. Harvesting these fish would require different fishing techniques at various times of the year. Analyzed bird bones suggest a marine-oriented focus on diving ducks, loons, grebes, and alcids such as murres, murrelets, and auklets. Mammal bones reflect hunting both on land and at sea, most likely by boat. Harbor seal, deer, and porpoise remains were found in roughly equal number, with lesser amounts of sea lion and elk. A molar from a black bear is the only specimen from this species. Bones from newborn harbor seal and deer, along with bones from migratory birds, reflect different times of year that hunting likely occurred. Although specific butchering and processing strategies cannot be inferred from the small sample obtained from testing, the occupants of 45SN393 likely hunted and fished farther afield to obtain some of their subsistence resources than they did to gather shellfish and catch some near-shore fish species in the open waters [redacted] or the more protected tidal lagoon [redacted]

No human remains were found during test excavations. While this could be related to the small volume excavated during testing, Ames and Maschner (1999:137, 181) suggest—based on rather limited data—that the Northwest Coast practice of interring the dead in middens drops off sharply after approximately AD 1000, the time period when humans are believed to have first occupied the Mukilteo spit. Human remains could still be encountered in the midden deposits or in the site vicinity.

The charcoal fragments and seeds found in botanical samples taken from 45SN393 are as informative as the shells and animal bones. Charcoal from both conifers (Douglas fir, hemlock, pine, and cedar) and hardwoods (maple and alder) were found in moderate to large amounts in the samples. These species are common as standing trees in nearby forests and as driftwood along the beach, and would be appropriate fuel for hearth fires, earth ovens, or for smoking and drying shellfish, fish, and meat. Charcoal from yew was found in small amounts, yet it is significant in its value for making bows and arrow shafts and has not been identified in other central Puget Sound archaeological sites. Seeds from a variety of grasses, sedges, and fruit-bearing plants that grow in disturbed or wetland environments were found. Given the evolving tidal marsh behind the Point Elliott barrier berm and continual occupation of the growing barrier berm itself, such plant species are expected. Although obvious indicators of plant processing such as earth ovens or other well-defined features were not found in the test excavations, small dispersed amounts of amorphous, bubbly fragments of charred starchy plant tissue, perhaps from camas or similar bulbs, were found that suggest such processing did occur at the site.

Results of testing at the Mukilteo Shoreline Site suggest that it was an important year-round occupation that played a prominent role in the settlement systems of Native American communities that inhabited other contemporaneous sites as well. More extensively excavated sites, such as West Point, Duwamish No. 1, Old Man House, and Cama Beach, contain archaeological deposits from the last 1,000 years and have been interpreted as major winter villages or seasonal processing camps in centralized locations

along or near the shoreline of central Puget Sound, with similar artifact and faunal assemblages as 45SN393. Point Elliott would have been a valuable place not only for the year-round availability of certain subsistence resources, but also as a strategic landform near the intersection of south Puget Sound, the protected tidewaters east of Whidbey Island, the entrance to Hood Canal, and the exit to the Strait of Juan de Fuca through Admiralty Inlet. The site is also near the mouth of the Snohomish River, which provides a transportation route east to foothills, the Cascade crest, and beyond.

The archaeological investigation had the desired results of establishing preliminary boundaries and content for the Mukilteo Shoreline Site, 45SN393. Geoarchaeological investigations were able to construct the physical framework of the site, establish the depositional context for the shell midden, and construct a preliminary landform history. Information contained within the site has the potential to answer scholarly research questions, and the site was recommended eligible for National Register of Historic Places listing under Criterion D.

Supplemental Studies

Additional geotechnical studies, conducted between 2007 and 2010 for City of Mukilteo parks and road improvement projects, further refined the boundaries of the Mukilteo Shoreline Site (45SN393). Review of data from 11 geotechnical test pits and six boreholes in 2007 documented deep historical period fill overlying lagoon sediments [redacted] No archaeological deposits were encountered (Gillis 2007). The following year, during a second phase of the Lighthouse Park project, data from two additional boreholes were reviewed. Both of these boreholes, [redacted], contained archaeological midden deposits (Rinck and Heideman 2008). Archaeological monitoring of ten additional boreholes followed in 2009 in an attempt to trace the extent of the Mukilteo Shoreline Site (45SN393) [redacted] Midden deposits were identified in seven of the ten boreholes, [redacted] (Rinck 2009, 2010). Archaeological monitoring of utility trench excavation during implementation of the Lighthouse Park project documented both intact and disturbed sections of site 45SN393 [redacted] (Shong et al. 2010).

Data from archaeologically monitored boreholes, drilled in 2006-2007 for the WSF ferry terminal project, established the [redacted] boundary of the Mukilteo Shoreline Site (45SN393), as presently understood. [redacted] Ten archaeologically monitored boreholes were drilled [redacted] No evidence of midden deposits or other pre-contact cultural material was found in any of the 10 bores. Although the Japanese Gulch Creek delta has been identified as a relatively high probability area for pre-contact Native American resources, periodic flooding or other disturbance may have dispersed any cultural material that was present. No pre-contact cultural material was identified during excavations at the Japanese Gulch Site (45SN398) higher on the delta fan, although evidence for occupation and use of this landform may be closer to the shoreline. The amount of testing on the delta fan, however, related to the borehole and Japanese Gulch Site efforts was very limited and pre-contact cultural material could still be encountered in the area.

3.2 OLD MUKILTEO TOWNSITE (45SN404)

A portion of the [redacted] property was assessed for cultural resources in 2005 as part of environmental studies for the Port of Everett's Satellite Rail/Barge Transfer Facility (Schumacher 2005). No cultural resources were identified during the survey and, because of previous disturbance and depth of fill in the area, none were expected to be encountered during construction. The U.S. Army Corps of Engineers (USACE), however, the lead federal agency for the project, recommended archaeological monitoring of construction excavation [redacted] due to sensitivity of the underlying landforms for pre-contact Native American sites and early historical period activity. Monitoring occurred in 2006, and two buried historical archaeological sites, 45SN404 and 45SN398, were identified in the area (Shong 2006a, 2006b).

Site 45SN404 was encountered [redacted] during utility line trenching for the Port of Everett/USACE project. Observed historical materials included deteriorated lumber, burned brick, and historical artifacts, remains identified through historical research as the Crown Lumber Company store and butcher shop (Miss et al. 2008; Sanborn Fire Insurance Map 1912; Shong 2006b).

Later in 2006, archaeological test excavations were conducted at the site, also part of the Port of Everett/USACE project, to evaluate the property's historical significance. During these investigations historical period fill overlying the site was mechanically removed and a 20-inch-wide L-shaped trench, 32 feet in length, was hand excavated in the location of the former store. Below the undifferentiated fill was a discrete charcoal-rich layer that included abundant artifacts consistent in style and date with operation of the store between about 1900 and 1938. A layer of brick and mortar was found beneath the burned layer, and below that a layer of deteriorated dimensional lumber, identified as remains of a wooden deck that supported the building over the marsh (Shong 2006b). A site form and a determination of eligibility form, recommending the property eligible for listing in the National Register of Historic Places, were completed and submitted to the Washington Department of Archaeology and Historic Preservation and the USACE (Shong 2006b; Miss and Shong 2006b).

More extensive investigations—further testing and data recovery—were conducted at the site between 2006 and 2009, part of environmental studies for WSF [redacted] (Ferland et al. 2010; Miss et al. 2006, 2008; Rinck and White 2008). These studies recovered valuable information regarding the early Mukilteo commercial district and expanded site 45SN404—by then characterized as the Old Mukilteo Townsite rather than the Crown Lumber Company Store—[redacted] Figure 38).

Research Domains and Questions

To be eligible for listing in the NRHP, historical cultural resources must demonstrate integrity and relevance to questions posed by historical archaeologists. Data from archaeologically identified features and artifacts are integrated with historical records to address current historical archaeological research questions. Four research domains and associated questions were identified for site 45SN404 prior to the 2006-2007 studies. These are summarized below.

Figure 39. Sanborn map contains sensitive cultural resources information that is exempt from public disclosure pursuant to provisions of the Public Records Act (RCW 42.56.300).

Figure 39. Sanborn map, 1912, showing the Old Mukilteo Townsite (45SN404).

Chronology and Site Formation: Euroamericans may have made occasional use of the Mukilteo berm before Frost and Fowler filed claims in 1858, and it is possible that some evidence of such activity may be found. More likely, however, is evidence of the Bay View Hotel and other later nineteenth century buildings. The original and later buildings were built on pilings over, or on the shore of, the tidal marsh. Specific questions and goals of the research include:

- Are there structural remains and other artifacts that pre-date 1900?
- Is there evidence of building removal that pre-dates the Crown Lumber Mill?
- Is there evidence of the Crown Lumber Mill?
- What are the effects from mid-twentieth century fill placement on artifacts and structural remains?
- Is there evidence of any natural or human-induced disaster, e.g. floods, fires, or earthquakes?

Data classes that may be applied to these questions include site foundations and structural features, time-sensitive artifacts and assemblages, historic maps, photographs, and written and oral testimony.

Trade and Commodity Flow: When first settled, British presence in the region was strong and was supplied through Victoria or Ft. Vancouver. Dependence on American goods shipped through Portland and Seattle probably increased through time, especially after the settlement of the US-Canadian border in 1846, although the British did not leave the San Juan Islands until 1872. Logging in the 1860s centered on the Snohomish River and brought more prosperity to Mukilteo. With its deep-water harbor, Mukilteo became a stopping place for ships traveling up and down Puget Sound and for travelers intent on catching a river steamer inland to Snohomish City. Mukilteo was a fuel station, a freight transfer point, and by 1877 the home of the first salmon cannery on Puget Sound and an important center for loggers and settlers. Specific questions and goals of the research include:

- Is there evidence amongst the artifact assemblage for British or American origin?
- Is there evidence of the fluctuating population in Mukilteo before the lumber mill arrived?
- Is there evidence of early trade with Indians?

Data classes from the site that may be applied to these questions include artifacts with identifiable trademarks, features such as dumps and privies, and historical records.

Foodways: Composition of meals, methods of preparation, menus, and ways of serving are expected to change through time as Mukilteo became increasingly linked to a regional social and economic network. Use of local foods, for example the abundant salmon of Possession Sound, may have gradually tapered off, but never ended from the mid-nineteenth to mid-twentieth century. More direct participation in a market economy characterized by increase in more prepared foods may be evident with the arrival of railroad links to Seattle. Such changes may be particularly evident in remains associated with hotels where meals were served. An international cosmopolitanism may even have been present. Specific questions and goals of the research include:

- Is there evidence of changing use of local game, fish, or plant food?
- What use was made of preserved foods, condiments, and other commodities?
- Is there evidence of ethnically or culturally distinctive meals, meal preparation, or serving, e.g. Chinese, Japanese, Scandinavian?

Data classes from the site that may be applied to these questions include identifiable food containers, faunal and botanical remains, features such as dumps and privies, and historical records.

Social and Economic Status: Earliest assemblages are expected to reflect a more egalitarian social structure than later ones when the town was well established and supported by the lumber mill. Settlement that included families appears to have been relatively early, with the Fowler family settling at Mukilteo in the 1860s, but many of the occupants of the region were men who logged or fished and came to town to visit the saloons. The Mukilteo vicinity also has a long history of Asian settlement. The first cannery on Puget Sound was established here in 1877 and in 1887 a new cannery and wharf were installed that employed Chinese labor. The Mukilteo Lumber Company mill attracted many Japanese workers so that by 1905 the population of Mukilteo numbered approximately 200 Euroamericans and 150 Japanese (Whitfield 1926:590). The Crown Lumber Company constructed a small housing complex for its Japanese workers along lower Japanese Gulch. Specific questions and goals of this research include:

- Are women and/or children represented in the artifact assemblage?
- Do styles of construction or artifact assemblages change with shifting community prosperity?
- Are there artifacts or food remains that can be used to characterize economic status and used to compare Old Mukilteo with other working and rural communities of the period?
- Is there cultural material that reflects the presence of Asian individuals or an Asian community?

Data classes that may be applied to these questions include artifact assemblages with status-diagnostic materials (e.g., ceramics, personal adornments, intra-site comparative collections), faunal remains suggesting relative economic differences (e.g., more or less desirable portions of meat, from the perspective of different ethnic groups), and historical records.

Geoarchaeological and Archaeological Field Studies

Test trenches and mechanical borings completed as part of the 2006-2007 investigations identified historic remains in an area [redacted] (Figure 17, Appendix B). Archaeological methods were identical to those described for 45SN393. The historic debris, as a whole, represents a portion of Mukilteo's business district dating from at least 1880 to 1940, although a date as early as the 1860s is possible based on the settlement history of Mukilteo and the manufacturing dates for some of the recovered artifacts (McConnell 1977).

Vertical and Horizontal Distribution

Historical cultural material was noted in four backhoe trenches and several of the cores (see 45SN393 stratigraphic discussion above). Artifacts were collected from two of the trenches and combined with the previously collected material to characterize the site. With the majority of the material coming from the original discovery and Trench 3, the most basic partition of the artifacts is by position above or below the Crown Lumber Company decking.

In Trench 1, a historical debris layer was noted between 6.2 feet below the surface (fbs) (1.9 meters below surface [mbs]) and 7.2 fbs (2.2 mbs). The debris layer was inundated by the water table soon

after exposure, although brick and dimensional lumber were observed. In Trench 2, a historical debris layer was noted between 4.6 fbs and 5.2 fbs (1.4 mbs and 1.6 mbs). The debris consisted of partially burned dimensional lumber and a small amount of vessel glass and earthenware ceramics. The associated matrix was heavily disturbed suggesting the deposit represents demolition debris. Persistence of buildings in photographs at this location suggests the demolition was part of the U.S. Army's World War II-era site preparation. In Trench 3, the Crown Lumber Company decking, piles, and possibly other structural debris were found 4.3 fbs and 5.9 fbs (1.30 mbs and 1.80 mbs) capping approximately 8 inches (20 centimeters) of charcoal-stained silt intermixed with historical debris. The underlying historical debris consisted primarily of whole and fragmented bottles, vessel glass, earthenware, porcelain, and sawed mammal bones. In Trench 4, a thin layer of burned structural debris, dominated by tar paper, cardboard, a cluster of several hundred 16-penny wire nails and several ¾-inch-thick shiplap boards, ceramic tube insulators, white glass (melted), and red brick fragments, was found between 3.3 fbs and 3.6 fbs (1.0 mbs and 1.1 mbs). This material may represent the south wall of the Crown Lumber Company store.

Analyses

Artifacts

Artifacts were classified by material and form (Table 14). Historical materials were examined to identify details of manufacture, function, and age. Faunal materials were subjected to a separate analysis.

Ceramics

Ceramics are divided into three distinct categories based on material: earthenware, porcelain, and stoneware. Earthenware is a large category including a variety of different ware body types ranging from porous,

Table 14. Artifact Summary for 45SN404.

OBJECT/ MATERIAL	N=	% OF ASSEMBLAGE
Faunal		
Mammal	37	7.9
Other Bone	5	1.1
Ceramic		
Earthenware		
Cup	1	0.6
Decorative	10	5.9
Figurine	1	0.6
Pipestem	2	1.2
Plate/ Platter	58	34.3
Chamber Pot	5	3.0
Other Tableware	22	13.0
Unknown	33	19.5
Porcelain		
Cup	1	0.6
Decorative	8	4.7
Figurine	1	0.6
Plate	6	3.6
Other Tableware	4	2.4
Unknown	5	3.0
Stoneware	12	2.6
Crock/ Jar	8	4.73
Other/ Unknown	4	2.37
Glass		
Automatic Machine Bottle	22	4.7
Hand Manufacture Bottle	36	7.6
Unknown Process Bottle	58	12.3
Auto and Semi-Automatic Jar	4	0.9
Jar Lid Liner	8	1.7
Decorative Vessel	7	1.5
Flat Glass	8	1.7
Button	2	0.4
Unknown	58	12.3
Metal		
Ammunition	1	0.2
Clothing Clasp	2	0.4
Nails and Hardware	11	2.3
Other/ Unknown	8	1.7
Leather		
Footwear	12	2.6
Other		
Milled Lumber	3	0.6
Other	18	3.8
Total	**469**	**100**

unrefined earthenwares to vitrified ironstone (Mullins 1988). The majority of these wares were glazed to prevent the absorption of liquids into the vessel and also for decoration. The earthenware class is dominated by white-bodied, refined wares, mostly whiteware and ironstone. The porcelain class is comprised of extremely dense, white-bodied, non-porous wares and does not differentiate between hard or soft-paste types (Mullins 1988:14). Porcelain artifacts are the second largest category of ceramics at this site. Stoneware items are dense completely vitrified wares, often made from unrefined pastes. Stoneware artifacts are the least common ceramic category at this site and are associated with slip or salt-glazed utilitarian vessels like storage pots, jugs, or crocks (Mullins 1988:45).

Earthenware at this site mostly consists of tableware items. Decorated plates and saucers in this collection incorporate a variety of techniques including transfer-print, gilding, and decals, all of which were common at the end of the turn of the twentieth-century (Mullins 1988) (Figure 39, d). Gilded vessels in this collection are items with one or two bands of gold that were applied via a liquid mixture of gold and other precipitates. The result after precipitation is a delicate ring of gold that appears around the rim of previously glazed vessels (Mullins 1989:11) (38, b). Gilded ceramic sets had a mid-ranged retail price when compared to other ceramic tableware sets (Montgomery Ward Company 1969:531). Decalcomania is a printing method that involves placing a color decal on a glazed vessel and was first introduced in 1892 (Mullins 1988:34). This technique can produce very detailed designs and appears on virtually every vessel form manufactured during the twentieth-century.

Identified maker's marks indicate that most ceramics here were manufactured in England at the turn of the twentieth century (Table 15). The trend away from European ceramics did not occur in the United States until the early twentieth century (Wegars 1982:2-3). The only identified domestic ceramic artifact was manufactured by the W.S. George Pottery Company (Figure 39, a). This company was founded by William Shaw George, a producer of semi-porcelain tablewares, who also owned other potteries throughout Pennsylvania and Ohio in the twentieth century (Lehner 1988:162). This mark was used between the 1930s and 1940s.

Table 15. Identified Ceramic Maker's Marks.

MANUFACTURER	LOCATION	PRODUCTION DATES
W.S. George Pottery Company	East Palestine, Ohio	late 1930s to 1940s
Arthur J. Wilkinson, Ltd.	Burslem, England	from 1896
J. & G. Meakin, Ltd.	Hanley, England	from 1890
John Edwards	Staffordshire, England	c. 1880-1900
R.H. & S.L. Plant, Ltd.	Staffordshire, England	from c. 1898

European "bone china" and hard-paste Chinese and Japanese porcelains are primarily blue, transfer-print items and are a mixture of tablewares and decorative items. None of the decorative motifs on these artifacts has been identified. Porcelains are a small portion of this assemblage, perhaps because they cost more in the United States than English imports. Porcelains have historically been considered more desirable and exotic than other ceramics (Mullins 1988; Herbert and Schiffer 1975).

Figure 40. Selected ceramic artifacts from site 45SN404.

Unrefined stoneware fragments primarily represent utilitarian storage vessels and were affordable because they were manufactured locally. Stoneware at this site is rare and represents a small number of crocks or food jars. As glass and metal manufacturing techniques improved during the nineteenth century, stoneware vessels were largely replaced (Greer 1999). By the twentieth century, stoneware jars were all but extinct in large-scale food manufacturing.

Glass

Glass artifacts represent the largest portion of this assemblage and can provide valuable information about product consumption, manufacturing techniques, and trade networks. Most of the glass (57.1%) is from various bottles, mostly medicines, beverages, and extracts. The largest percentage of glass fragments (60.1%) are colorless or aqua-colored vessels, including storage jars, soda bottles, extracts, medicines, and unknown vessels. Green, olive, and brown vessel glass, typical of alcoholic beverages, comprise 25.6% of the glass assemblage. The remainder of the glass assemblage (14.3%) is a collection of canning jar lids, decorative items, buttons, or unidentified items.

Because glass artifacts were widely used in product packaging, they have the potential to provide valuable information on available manufacturing technology at the time of their deposition. Market forces also motivated the proliferation of glass vessels through a combination of demand for cheap bottles for products and development of the technological capability to fulfill this demand. Developments in glass manufacturing technology at the end of the nineteenth century eventually culminated in the automation of the industry in the early twentieth century (Miller and Sullivan 2000). Despite proliferation, bottles still retained enough value to be recycled by businesses and citizens alike and the bottle reuse industry was a thriving business in the United States into the twentieth century (Busch 2000).

Identifiable maker's marks on vessel glass were analyzed in order to determine origins of these vessels and the date ranges of their manufacture (Table 16). All of the identified vessels from this site were produced domestically during the early twentieth century and many of these products were made locally. Most of the bottles have marks characteristics of fully automatic bottle-making machines, which became prevalent after the development of the Owens bottle-blowing machine in 1903 (Miller and Sullivan 2000:163).

Table 16. Identified Glass Vessel Maker's Marks (Toulouse 1972).

MAKER'S MARK	MANUFACTURER	LOCATION	DATES OF USE
"IO" in a diamond	Owens-Illinois Glass Company	Clarksburg, West Virginia	1930-1963
"I" in diamond	Illinois Glass Company	Alton, Illinois	1916-1929
Anchor and "H"	Anchor Hocking	Lancaster, Ohio	since 1938
"H" and "A"	Hazel-Atlas Glass Company	Wheeling, West Virginia	1923-1964
S.G.Co.	Possibly Seattle Glass Company	Renton, Washington	1905-1907
"NW"	Northwestern Glass Company	Seattle, Washington	since 1931
"J.A.F.& Co."	J.A. Folgers & Company	San Francisco, California	1900/ 1910- 1929
A.L. Van Valley	A.L. Van Valley Bottling Works	Everett, Washington	1895-1941
Everett Bottling	Everett Bottling Works	Everett, Washington	since 1902

Two artifacts (404-9 and 404-141) made for local soda bottling companies have been identified. One complete, colorless soda bottle (404-9) is from a vessel made for the Everett Bottling Works (Figure 40, c). This bottling facility was founded in 1902 by Peter Edward Misgen and Alexander E. Kick, who also founded the Sedro-Woolley Bottling Works in 1903 (Hensrud and Halford 1998:11). In 1906, Kick bought out the Everett Bottling Works, which also bottled the Angeles Brewing Company's beer. It is unknown when this company stopped operation. Another fragment (404-141) is from a bottle made for the A.L. Van Valley Bottling Works of Everett. This company was founded by A.L. Van Valley in 1895 and operated until his death in 1941 (Hensrud and Halford 1998:18).

Two other artifacts were made by nearby glassworks. A complete, brown bottle (404-22) bearing the mark "S.G.Co." was possibly made by the Seattle Glass Company of Renton, Washington, although other glass companies also used this mark (Whitten 2004). This glass factory operated between 1905 and 1907 and was known to produce brown beer bottles. Another complete, brown bottle (404-21) was made by the Northwestern Glass Company of Seattle (Figure 40, a). This manufacturer has been in operation since 1931 (Toulouse 1972:390-391).

By the twentieth-century, glass manufacturing was becoming increasingly dominated by large, national conglomerates. The Owens-Illinois Glass Company was founded in 1929 and is an example of conglomeration of the glass industry during the early twentieth-century. Through consolidation and incorporation of smaller glass companies, the Owens-Illinois Company operated twenty plants in the United States by the 1930s (Lockhart 2006:23). A complete glass vessel from this site (404-15) was manufactured by Owens-Illinois and bears a coded maker's mark that can be traced to the specific factory within the Owens-Illinois group (Figure 41, a). Based on its maker's mark, this vessel was made at a plant in Clarksburg, West Virginia in 1936 by bottle mold number 4 (Lockhart 2006:23; Toulouse 1972:403). A brown half-pint liquor bottle (404-23) was manufactured by the Anchor-Hocking Glass Corporation (Figure 40, b). This company was formed through a merger between the Anchor Cap Corporation and Hocking Glass Company during the 1930s and has continued consolidation of other glass manufacturers throughout the twentieth century (Toulouse 1972:46-49). The mark on this vessel has been used since 1938.

A colorless extract bottle embossed "J.A.F&CO." (404-36) contained product made by the J.A. Folger Company of San Francisco (Figure 42, b). The Folger Company was founded in 1850 and was known for its spices, extracts, and flavorings prior to 1929 (Toulouse 1972:274). This particular mark was used between 1900 and 1929. Today, this company is best known for its coffee. Another colorless bottle is embossed "3 in One Oil Co." (404-10) (Figure 42, c). The date of this vessel is unknown, but the manufacturer is known for its lubricant oil and is still in operation today.

Metal

Few metal artifacts were collected. The ten nails in this assemblage were collected as representative of the many observed. Of these three are square, cut nails and five are round, wire nails. Steel cut nails, which are generally square-shaped, came to replace wrought iron cut nails during the 1880s and 1890s as steel manufacturing technologies improved. Steel wire nails were invented in the 1860s but did not come to dominate the market until the 1920s (Wells 1998:87). A pocket watch of unknown origin (404-105) is also among recovered metal artifacts (Figure 43, b). Pocket watches of similar size and shape are advertised in the 1895 Montgomery Ward catalog and were widely available by the end of the nineteenth-century (Montgomery Ward Co. 1969).

Figure 41. Selected large bottles from site 45SN404.

Figure 42. Selected other glass artifacts from site 45SN404.