ENVIRONMENTAL ASSESSMENT OF
CONTINUED GEODUCK CLAM HARVEST IN KITSAP COUNTY,
VINLAND GEODUCK TRACT (#20750)

Commercial geoduck harvest is jointly managed by the Washington Departments of Fish and Wildlife (WDFW) and Natural Resources (DNR) and is coordinated with treaty tribes through harvest plans. Harvest is conducted by divers from subtidal beds between the minus 18 foot (corrected to mean lower low water –(MLLW)) and the minus 70 foot (MLLW) water depths. Harvest is rotated around Puget Sound in seven geoduck management regions. The fishery, its management, and its environmental impacts are presented in the Final Supplemental Environmental Impact Statement for the Puget Sound Commercial Geoduck Fishery (WDFW & DNR, May 2001). The proposed continued harvest in Kitsap County is described below.

Harvest Years: 2024 - 2025

Tract Name: Vinland Geoduck Tract (#20750)

Description: (Figure 1, Tract Vicinity Map)

The Vinland commercial geoduck clam tract is approximately 139 subtidal acres along the eastern shoreline of northern Hood Canal, south of Navigation Marker #9 and south of the Lofall (#20700) geoduck tract. The tract begins about 8,000 yards south of the Hood Canal Bridge and continues southwesterly for about 2,200 yards. The commercial tract area is deeper than and seaward of the -20 foot (MLLW) depth contour, to provide a buffer between eelgrass beds found at a maximum depth of -18 feet (MLLW) and geoduck harvest. Harvest vessels must remain seaward of a line 200 yards seaward and parallel to the ordinary high tide (OHT) line during harvest.

The Vinland tract is bounded by a line projected from a Control Point (CP) on the -20 foot (MLLW) water depth contour at 47°48.032’ N latitude and 122°41.043’ W longitude (CP 1) southerly along the -20 foot (MLLW) water depth contour to a point at 47°47.007’ N latitude and 122°41.457’ W longitude (CP 2); then westerly to a point on the -70 foot (MLLW) water depth contour at 47°7.094’ N latitude and 122°41.944’ W longitude (CP 3); then northerly along the -70 foot (MLLW) water depth contour to a point at 47°48.071’ N latitude and 122°41.129’ W longitude (CP 4); then easterly to the point of origin (Figure 2). Harvest divers must remain within the tract boundary, deeper than the -20 ft. (MLLW) water depth contour and shallow of the -70 ft. (MLLW) water depth contour. These latitude and longitude positions in WGS84 datum will be field verified by DNR prior to any geoduck harvest.

Substrate:

Geoducks are found in a wide variety of sediments ranging from soft mud to gravel. The most common sediments where geoducks are harvested are sand with varying amounts of mud and/or gravel. The specific sediment type of a bed is primarily determined by the water current velocity. Coarse sediments are generally found in areas of fast currents and finer (muddier) sediments in areas of weak currents. The major impact of harvest will be the creation of small holes where the geoducks are removed. The holes fill in within a few days to several weeks and have no long-term effects. The substrate holes refill in areas with strong water currents much faster than in areas with weak currents. Water currents are moderate at the Vinland tract. “Tides and Currents” nautical software predicts a maximum flood current velocity of 1.4 knots and maximum ebb velocity of 1.7 knots at Hood Canal South Point Station (ID#1586). Strong water currents at this location may increase turbidity and decrease underwater visibility.

The surface substrates at the Vinland tract consist of sand, mud, or mixtures of these substrate types. Sand is the predominant substrate type on 31 out of 50 stations. Mud is predominant on 16 out of 42 stations. On three stations sand and mud are roughly in equal proportions.

Water Quality:

The Washington Department of Health (DOH) has classified this tract harvest area as approved for commercial geoduck harvest. Prior to opening the tract, DNR will take biotoxin samples to confirm acceptable levels. A closure zone is located approximately a mile south of this tract (Floral Point Prohibited Area), but it does not affect subtidal geoduck harvest on this tract.

The Washington State Department of Ecology tests water quality parameters at the marine water monitoring station #HCB010 located at North latitude 47° 40.020’, West longitude 122° 49.235'. During the period of April 2005 through December 2013 (most current data available) at the 33 foot water depth, the mean reported dissolved oxygen (DO) concentration was 7.6 mg/L with a minimum concentration of 4.1 mg/L and a maximum concentration at 12.9 mg/L. The lower value in this range is above a critical DO threshold of approximately 3 mg/l. Persistent DO below 3 mg/l is thought to have a detrimental effect on many marine animals. In recent years, persistent low dissolved oxygen has caused marine animal mortalities in the southern part of Hood Canal. Geoduck harvest has never been listed a causal event contributing to low dissolved oxygen or “ammonia plumes” in Hood Canal. The mean salinity on this station was 29.1 psu at the 33 foot water depth, with minimum and maximum values ranging from 27.5 to 30.3 psu. The maximum water temperature at the 33 foot water depth was recorded at

13.5 °C and the minimum temperature recorded was 7.6 °C, with mean temperature of 10.2 °C. The physical oceanography characteristics of this area will continue to be monitored by geoduck harvest managers through Environmental Assessment reviews and updates.

Biota:

Geoduck:

The Vinland tract currently contains an estimated 1,660,297 pounds of geoducks (Table 1) and the tract area is approximately 139 acres. Geoducks at this location are considered commercial quality (Table 2). Geoduck density on the tract is moderate, currently estimated to be 0.17 geoducks/square foot. The average pre-fishing transect densities range from a low of 0.025 geoducks/square foot on transect 1 to a high of 1.307 geoducks/square foot on transect 41 (Table 3). The geoducks on the Vinland tract are moderately sized, averaging 1.63 pounds per geoduck compared to the Puget Sound average of 2.42 pounds per geoduck clam. The lowest average whole weight (1.23 pounds) was observed at station 18 and the highest average whole weight (2.40 pounds) was observed at station 2 (Table 4).

The Vinland tract was previously harvested in 1994 and 436,580 pounds were reported as harvested. The Vinland tract was re-surveyed in 2004 to derive a new geoduck biomass estimate for the tract. The specific start location for each geoduck transect of the 2004 survey is listed in Table 5. Harvest began again on the Vinland tract in 2005. A total of 2,786,285 pounds of geoduck have been landed since 2005.

Geoducks are managed for long term sustainable harvest. No more than 2.7% of the fishable stocks are harvested (total fishing mortality) each year in each management region throughout Puget Sound. The fishable portion of the total Puget Sound population includes geoducks that are found in water deeper than -18 feet and shallower than -70 feet (corrected to mean lower low water (MLLW)). Other geoducks which are not harvestable are found inshore and offshore of the harvest areas. Observations in south Puget Sound show that major geoduck populations continue to depths of 360 feet. Additional geoducks exist in polluted areas and are also unavailable for harvest, but continue to spawn and contribute to the total population.

The low rate of harvest is due to geoduck's low rate of natural recruitment. WDFW has studied the regeneration rate of geoducks on certain tracts throughout Puget Sound. The estimated average time to regenerate a tract to its original density, after removal of 65 percent of the geoducks, is 55 years. The recovery time for the Vinland tract is unknown. The research to empirically analyze tract recovery rates is continuing.

Fish:

Geoduck beds are generally devoid of rocky outcroppings and other relief features that attract or support fish. The bottoms are relatively flat and composed of soft, unstable sediments which provide few attachment points for macroalgae. Marine macroalgae is often associated with the presence of rockfish, lingcod, and other fish species. The fish observed during the survey at the Vinland tract were various unidentified flatfish, starry flounders, English soles, sanddabs, skates, and sculpins (Table 6).

WDFW marine fish managers were asked of their concerns regarding possible impacts of geoduck fishing on groundfish and baitfish. Greg Bargmann of WDFW stated that geoduck fishing would have no long-term detrimental impacts and may have some short-term benefits to flatfish populations by increasing the availability of food. Dan Penttila of the WDFW Fish Management Program recommended that eelgrass beds within the harvest tract be preserved for any spawning herring. The Vinland tract is not located within documented herring spawning grounds or pre-spawner holding areas for the Port Gamble Herring Stock (Figure 4; 2008 Washington State Baitfish Stock Status Report). Geoduck harvest should have no impact on Pacific herring stocks at this location.

Sand lance spawning has been documented along the shoreline inshore of the Vinland tract (Figure 4). Sand lance populations are widespread within Puget Sound, Hood Canal, the Strait of Juan de Fuca and the coastal estuaries of Washington. They are most commonly noted in areas such as the eastern Strait and Admiralty Inlet. However, WDFW plankton surveys and ongoing exploratory spawning habitat surveys suggest that there are very few if any bays and inlets in the Puget Sound basin that will not be found to support sand lance spawning activity. Sand lance spawning occurs at tidal elevations ranging from +5 feet to about the mean higher high water line. After deposition, sand lance eggs may be scattered over a wider range of the intertidal zone by wave action. The incubation period is approximately four weeks. Sand lances are an important part of the trophic link between zooplanktons and larger predators in the local marine food webs. Like all forage fish, sand lances are a significant component in the diet of many economically important resources in Washington. On average, 35 percent of juvenile salmon diets are comprised of sand lance. Sand lances are particularly important to juvenile Chinook salmon, and comprise approximately 60 percent of their diet. Other economically important species, such as Pacific cod (*Gadus macrocephalus*), Pacific hake (*Merluccius productus*) and dogfish (*Squalus acanthias*) feed heavily on juvenile and adult sand lance. There is substantial vertical separation between sand lance spawning (+5 feet to mean higher high water) and geoduck harvest activity (-20 ft. to -70 ft., MLLW). Geoduck harvest on the Vinland tract should have no detrimental impacts on sand lance spawning.

NOAA Fisheries Service announced on April 27, 2010, that it was listing canary and yelloweye rockfish as "threatened" and bocaccio as "endangered" under ESA (federal Endangered Species Act). The listings became effective on July 27, 2010. Historic high levels of fishing and water quality are cited as reasons that these rockfish populations are in peril and have been slow to recover. On January 23, 2017, canary rockfish were delisted based on newly obtained samples and genetic analysis (Federal Register 82 FR 7711). Geoduck fishery managers are tracking this process and will take actions necessary to reduce the risk of "take" of any listed rockfish species that could potentially result from geoduck harvest activity.

Two salmon populations, Puget Sound Chinook salmon and Hood Canal summer run chum salmon, were listed by the National Marine Fisheries Service on March 16, 1999, as a threatened species under the federal Endangered Species Act. Critical habitat for summer run chum salmon populations includes all marine, estuarine, and river reaches accessible to the listed chum salmon between Dungeness Bay and Hood Canal, as well as within Hood Canal. The timing for summer run chum spawning is early September to mid-October. Out-migration of juveniles has been observed in Hood Canal during February and March, though may occur as late as mid-April.

Critical habitat for Puget Sound Chinook salmon includes all marine, estuarine and river reaches accessible to listed Chinook salmon in Puget Sound. WDFW recognizes 27 distinct stocks of Chinook salmon: 8 spring-run, 4 summer-run, and 15 summer/fall and fall-run stocks. The existence of an additional five spring-run stocks is in dispute. The majority of Puget Sound Chinook salmon emigrate to the ocean as sub-yearlings. There are no tributaries identified in the immediate vicinity of the Vinland tract which support runs of Hood Canal summer-run chum or Puget Sound Chinook salmon.

The geographic separation (horizontal) of this tract from known spawning tributaries and vertical separation of geoduck harvest (deeper and seaward of the -18 ft. MLLW contour) from juvenile salmon rearing areas and migration corridors (upper few meters of the water column) reduces or eliminates potential impacts to salmon populations. Charles Simenstad from the University of Washington School of Fisheries stated that the "exclusionary principle of not allowing leasing/harvesting in water shallower than -18 ft. MLLW or (within) 200 yards from shore; 2 ft. vertically from elevation of lower eelgrass margin, and within any regions of documented herring or forage fish spawning should under most conditions remove the influences of harvest- induced sediment plumes from migrating salmon." Geoduck harvest should have no impact on salmon populations.

The distinct population segment (DPS) of steelhead known as Puget Sound steelhead (*Oncorhynchus mykiss*) was listed as threatened under the federal Endangered Species

Act on May 11th, 2007 (Federal Register, Vol. 72, p.26722; May 11, 2007). The listing became effective 30 days from that date. Hatchery stocks are considered part of the DPS since they exhibit a level of genetic divergence relative to the local natural populations that is no more than what occurs within the DPS (Federal Register, Vol. 70, p.37215; June 28, 2005). The listed group of steelhead includes only anadromous (ocean-going) but not resident forms (commonly called rainbow trout). The action covers more than 50 stocks of summer- and winter-run steelhead. On January 14, 2013, NOAA proposed a rule describing critical habitat for Puget Sound steelhead. The Puget Sound DPS of steelhead includes all naturally spawned anadromous winter-run and summer-run steelhead populations in streams within the river basins of the Strait of Juan de Fuca, Puget Sound, and Hood Canal, Washington, bounded to the west by the Elwha River (inclusive) and to the north by the Nooksack River and Dakota Creek (inclusive), as well as the Green River natural and Hamma Hamma winter-run steelhead hatchery stocks. Non-anadromous "resident" *O. mykiss* occur within the range of Puget Sound steelhead, but are not part of the DPS due to marked differences in physical, physiological, ecological, and behavioral characteristics (71 FR 15666, March 29, 2006). This critical habitat overlaps many of the marine, estuarine and river reaches inhabited by Puget Sound Chinook. Strategies designed to protect Puget Sound Chinook salmon will also protect Puget Sound steelhead. More information can be found on the NOAA website at: https://www.federalregister.gov/articles/2013/01/14/2013-00241/endangered-and-threatened-species-designation-of-critical-habitat-for-lower-columbia-river-coho#h-21.

Green sturgeon have undergone ESA review in recent years, due to depressed populations. NOAA Fisheries Service produced an updated status review on February 22, 2005, and reaffirmed that the northern green sturgeon Distinct Population Segment (DPS) warranted listing as a species of concern, however proposed that the southern DPS should be listed as threatened under the ESA. NMFS published a final rule on April 7, 2006, listing the Southern DPS as threatened (71 FR 17757), which took effect June 6, 2006. The green sturgeon critical habitat proposed for designation includes the outer coast of Washington within 110 meters (m) depth (including Willapa Bay and Grays Harbor) to Cape Flattery and the Strait of Juan de Fuca to its United States boundary. Puget Sound proper has been excluded from this critical habitat designation. The Vinland geoduck tract is outside of the critical habitat range of green sturgeon; therefore geoduck harvest at this location will have no adverse effects on ESA recovery efforts for green sturgeon populations.

Invertebrates:

Many different kinds of invertebrates, which are common to geoduck beds, were observed on this tract (Table 6). The most common and obvious of these include:

Mollusks (moon snail egg cases, nudibranchs, horse clams, horse mussels, truncated mya clams, heart cockles, false geoducks, and geoducks); echinoderms (burrowing sea cucumbers, sand stars, sunflower stars, short-spined stars, blood stars, and sand dollars); sabellid and chaetopterid tube worms; cnidarians (sea pens, sea whips, burrowing anemones, striped anemones, crimson anemones, and plumed anemones); tunicates; and crustaceans (Dungeness crabs, red rock crabs, graceful crabs, hermit crabs, ghost shrimp, unidentified shrimp, and decorator crabs).

Geoduck harvest has not been shown to have long-term adverse effects on these invertebrates. Geoduck harvest can depress localized populations of some benthic invertebrates, however, most of these animals recover within one year.

There is on-going interest from recreational and commercial crab fishers about interactions between geoduck harvest activity and Dungeness crab populations. Dr. Dave Armstrong at the University of Washington has determined that Dungeness crab utilize Puget Sound bottoms from the +1 foot level out to the -330 foot level. The California Department of Fish and Wildlife suggest that coastal Dungeness crab can be found in waters as deep as 750 feet (https://wildlife.ca.gov/Conservation/Marine/Life-History-Inv-And-Plants). Jensen (2014) and WDFW information (WDFW Biologist Don Velasquez, personal comm. 7/23/15) confirm a similar vertical distribution in Puget Sound, though the highest densities are found between the 0 to 360 foot water depth contours.

To determine the potential impacts to Dungeness crab, the percentage of substrate disturbed during fishing was calculated and compared to the entire crab habitat within the vicinity of the tract. The crab habitat was measured from the +1 foot level and seaward out to mid-channel of Hood Canal (Figure 5). The entire potential crab habitat along and within this tract is approximately 986 acres. There were about 2,686,000 harvestable geoducks in this tract (pre-fishing estimate). With a minimum harvest level of 65 percent, the total number harvested would be 1,777,380 geoducks. Approximately 1.18 square feet of substrate is disturbed for every geoduck harvested, so 1,777,380 x 1.18 = 2,097,309 square feet. This equals about 48.1 acres. This is 4.9% of the total available crab habitat in the vicinity of the tract. Based on the low abundance of Dungeness crab on this tract prior to harvest, and the low amount of disturbance, we conclude that any effects on Dungeness crab will be very minor, if they occur at all

Aquatic Algae:

John Boettner and Tim Flint, from the WDFW Habitat Division, have stated that if geoduck fishing is restricted to seaward of the eelgrass beds, they have no concerns about the fishing and agree that the existing conditions in the fishery SEIS are sufficient to protect fish and wildlife habitat and natural resources.

Large attached aquatic algae are not generally found in geoduck beds in large quantities. Light restriction often limits algal growth to areas shallower than where most geoduck harvest occurs. Aquatic algae observed on the geoduck survey of this tract (Table 7) includes: Laminaria algae (observed at one station), large and small foliose red algae, Ulva, and a diffuse diatom layer.

During previous dive surveys, eelgrass was observed in a nearly continuous band, the deepest occurrence extending to -18 ft. (MLLW) water depth. The shallow boundary of geoduck harvest is set at least two vertical feet deeper and seaward of the deepest occurrence of eelgrass to protect all eelgrass from harvest activity. The shoreward boundary of the Vinland tract will be no shallower than the -20 ft depth contour (MLLW).

Marine Mammals:

During the spring (March-May) a small number of grays whales may be foraging in the vicinity of the Vinland geoduck tract. Precautions should be taken by commercial divers, when gray whales are in the area, to be aware of whale movements and behavior to eliminate the remote risk of entanglement with vessels, hoses, and lines. Killer whales have also been frequently observed in northern Hood Canal in recent years. The Southern Resident stock of killer whales was listed as “endangered” under the federal Endangered Species Act (ESA) by the National Marine Fisheries Service on November 15, 2005. This is in addition to the designation of this stock in May 2003 as “depleted” under the Marine Mammal Protection Act. More information and a recovery plan for this stock can be found at the NOAA website: (https://www.fisheries.noaa.gov/action/listing-southern-resident-killer-whale-under-esa). Hand pick shellfish fisheries, like geoduck harvesting, are considered Category III under the Marine Mammal Authorization Program for Commercial Fisheries. This means that there is a “rare or remote” likelihood of marine mammal “take,” (Brent Norberg, NOAA, pers. comm. 5/15/06). In an email dated 5/29/2007, Brent Norberg of NOAA Fisheries stated he has no marine mammal concerns regarding geoduck harvest at this site.

Seals are common inhabitants in the Hood Canal and are frequently observed in the vicinity of this geoduck bed. No conflicts have been observed between marine mammals and geoduck harvest.

Birds:

A variety of marine birds are observed in the vicinity of northern Hood Canal. These include birds such as murres, murrelets, grebes, loons, scoters, dabbling ducks, mergansers, buffleheads, cormorants, and gulls. Geoduck harvest does not appear to have any effect on these birds or their use of the waters where harvest occurs. A study by DNR and WDFW was conducted at northern Hood Canal to learn the effects of geoduck fishing on bald eagles (Watson et al., 1995). A significant conclusion of this study is that commercial harvest of geoduck is unlikely to have any adverse impacts on bald eagle productivity.

Other Uses:

Adjacent Land Use:

This proposed tract and upland properties adjacent to this tract are designated as rural shoreline environment. To minimize possible disturbance to adjacent residents, harvest vessels are not allowed within 200 yards of the high tide line (mean high water or MHW) or shallower than -20 feet (MLLW), whichever is farther seaward. Harvest is only allowed during daylight hours and no harvest is allowed on Saturdays, Sundays, or state holidays.

The only visual effect of harvest is the presence of the harvest vessels on the tract. These 35-40 foot boats are anchored during harvest and all harvest is conducted out of sight by divers. Noise from compressors and pumps may not exceed 50 dB measured 200 yards from the noise source.

Fishing:

Recreational harvest of bottomfish is closed in Hood Canal (Marine Area 12). This is not a prime recreational fishing area for other fish species. Recreational crab fishing occurs in proximity to this geoduck bed. The WDFW Sport Fishing Rules pamphlet describes additional seasons, size limits, daily limits, specific closed areas, and additional rules for salmon and other marine fish species. This area may also have tribal commercial crab fishing during certain seasons. Geoduck fishing on this tract is managed in coordination with the treaty tribes through state/tribal harvest management plans. The non-Indian geoduck fishery should not conflict with any concurrent tribal fisheries nor any recreational fisheries.

Navigation:

Hood Canal is used by recreational, commercial, and U.S. Navy vessels. The waters in the vicinity of Vinland are typically used by smaller vessels. Due to the shallow nature of geoduck harvesting, this fishery should not result in any significant navigational conflicts. US Coast Guard regulations, including notices of security zones, will be reviewed by the Washington Department of Natural Resources prior to beginning a round of harvesting. The DNR will notify the local boating community of the presence of the geoduck boats.

Summary:

Continued geoduck harvest is proposed for the Vinland geoduck tract, and fishing may occur during any month of the year. The commercial tract is classified Approved for shellfish harvest by DOH. To reduce the possible impacts to herring, eelgrass habitat, and migrating salmon, the geoduck harvest will be seaward and deeper than the -20 foot water depth contour (MLLW) along this tract. There is a potential for crab and geoduck gear conflicts during certain times of the year, and these fisheries will be coordinated whenever possible, to avoid conflicts. Though not identified as a problem in northern Hood Canal, low dissolved oxygen will continue to be monitored as the fishery progresses. The anticipated environmental impacts of this harvest are within the range of conditions discussed in the 2001 Final Supplemental Environmental Impact Statement. No significant impacts are expected from this harvest.

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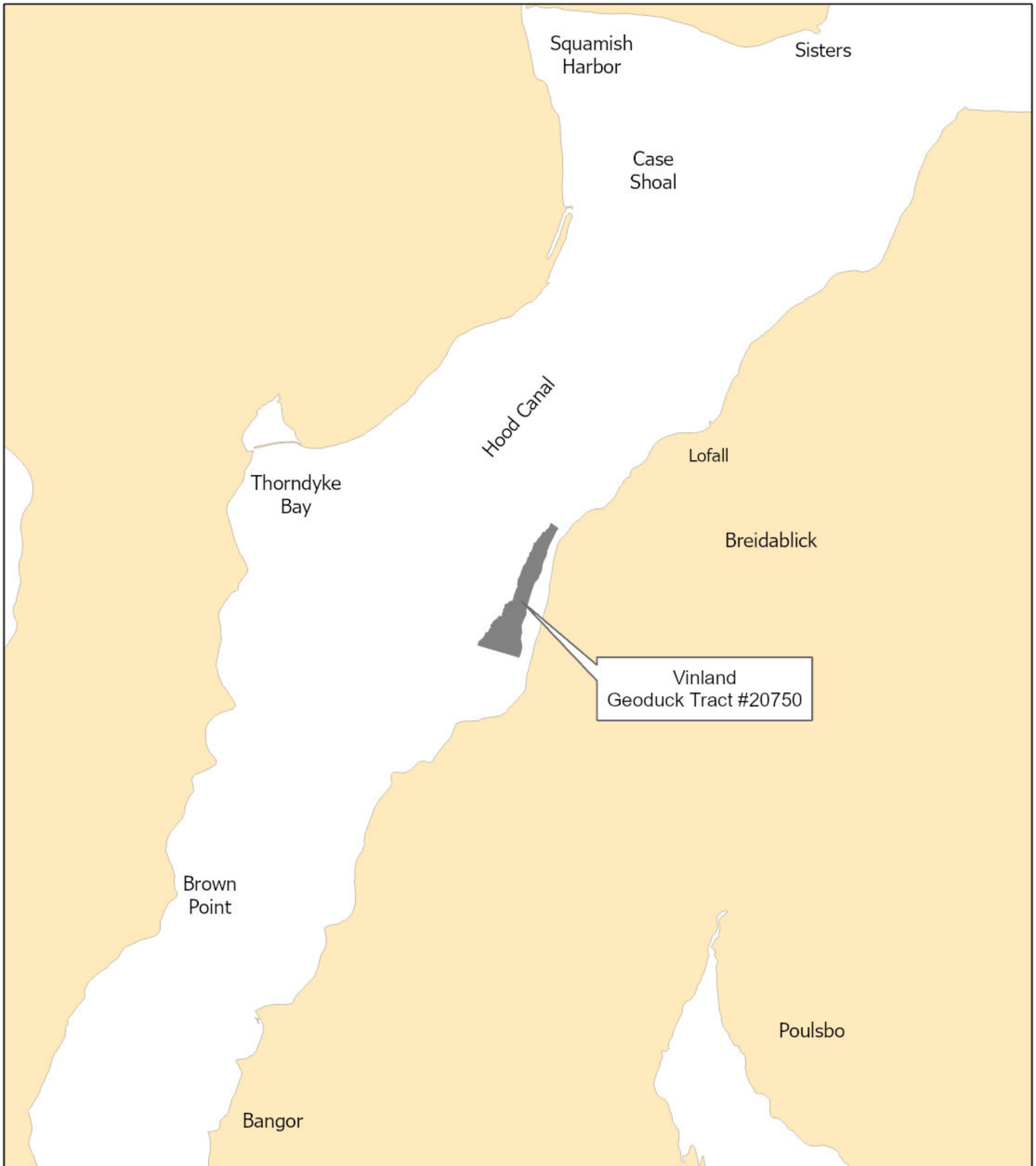
Figure 1. Vicinity Map, Vinland Commercial Geoduck Tract #20750



N
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1:80,000

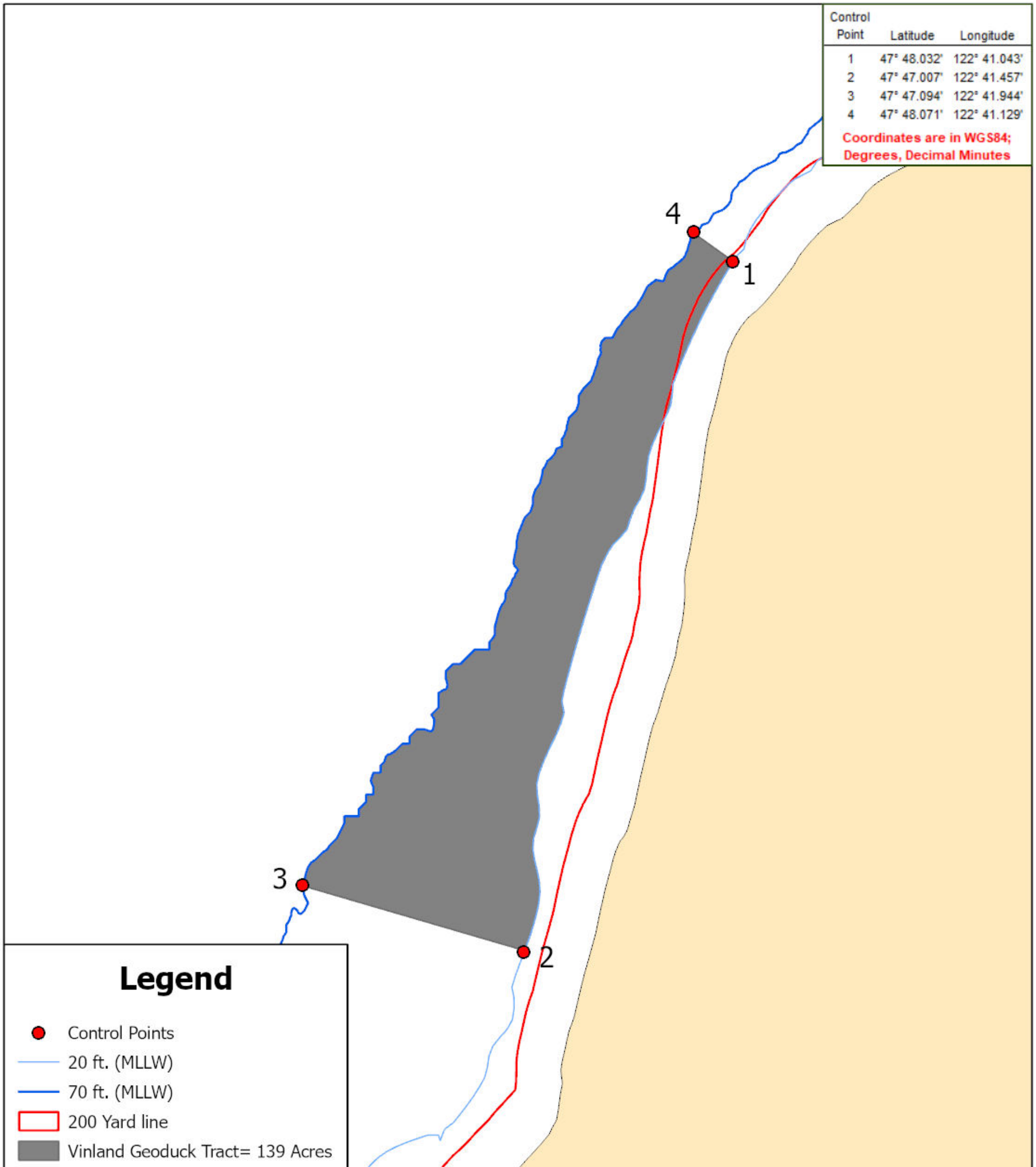
Data Sources:
Projection for data is GCS_Washington Geographic System 1984, Units: Meters. Coastline layer is from DNR, 1: 24,000 scale, created 09-20-99. Contours are from NOAA soundings.

0 0.5 1 2 3 Miles

Washington Department of FISH and WILDLIFE

Map Date: April 11, 2024
Map Author: O. Working
File: Data\Ocean\Geoduck

Figure 2. Control Points Map, Vinland Commercial Geoduck Tract #20750



Control Point	Latitude	Longitude
1	47° 48.032'	122° 41.043'
2	47° 47.007'	122° 41.457'
3	47° 47.094'	122° 41.944'
4	47° 48.071'	122° 41.129'

Coordinates are in WGS84; Degrees, Decimal Minutes

N W E S

1:15,000

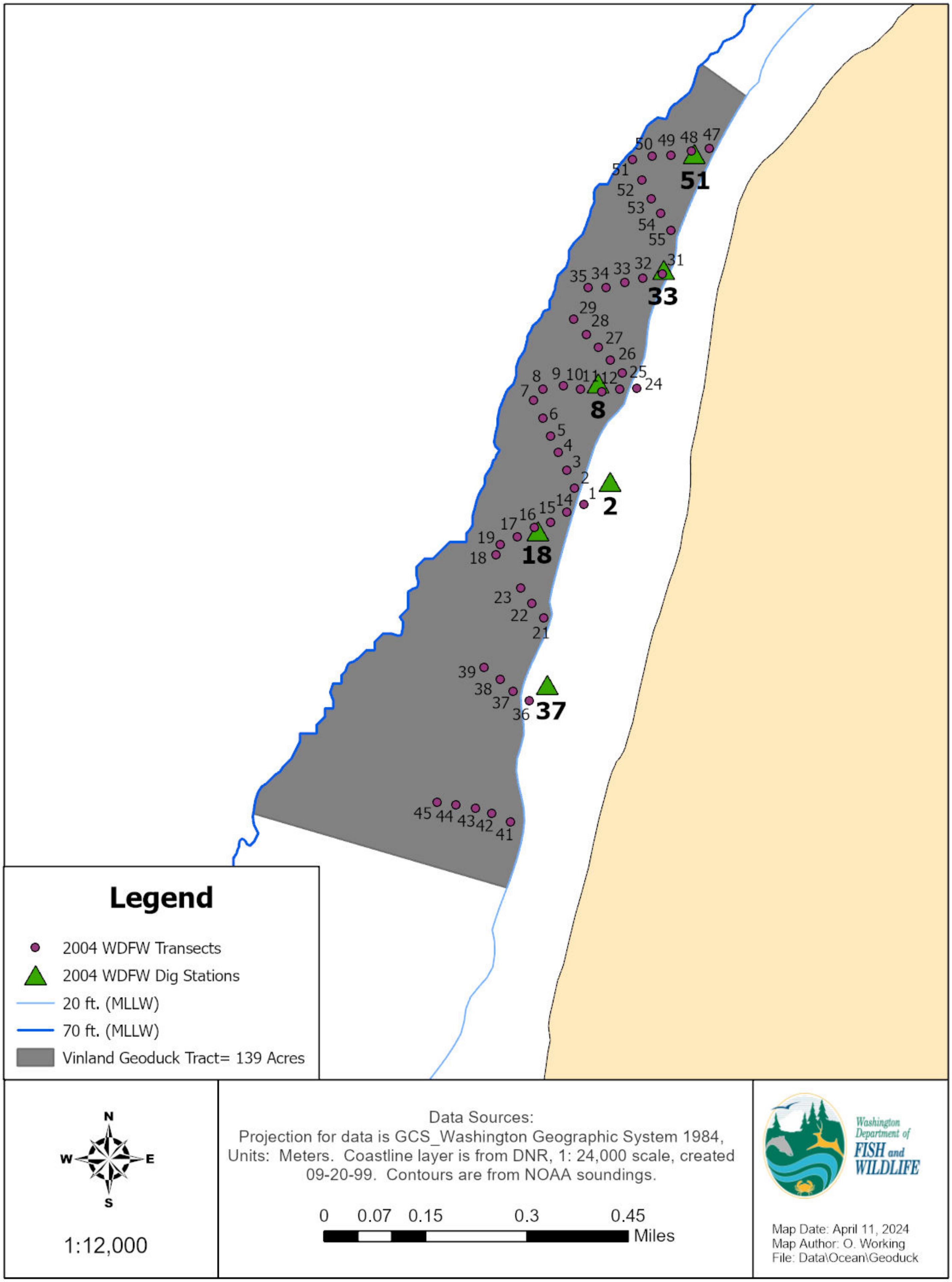
Data Sources:
Projection for data is GCS_Washington Geographic System 1984, Units: Meters. Coastline layer is from DNR, 1: 24,000 scale, created 09-20-99. Contours are from NOAA soundings.

0 0.07 0.15 0.3 0.45 Miles

Washington Department of FISH and WILDLIFE

Map Date: April 11, 2024
Map Author: O. Working
File: Data\Ocean\Geoduck

Figure 3. Transect and Dig Station Map, Vinland Commercial Geoduck Tract #20750



Data Sources:
Projection for data is GCS_Washington Geographic System 1984, Units: Meters. Coastline layer is from DNR, 1: 24,000 scale, created 09-20-99. Contours are from NOAA soundings.

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Map Date: April 11, 2024
Map Author: O. Working
File: Data\Ocean\Geoduck

Figure 4. Fish Spawning Areas Near the Vinland Commercial Geoduck Tract #20750

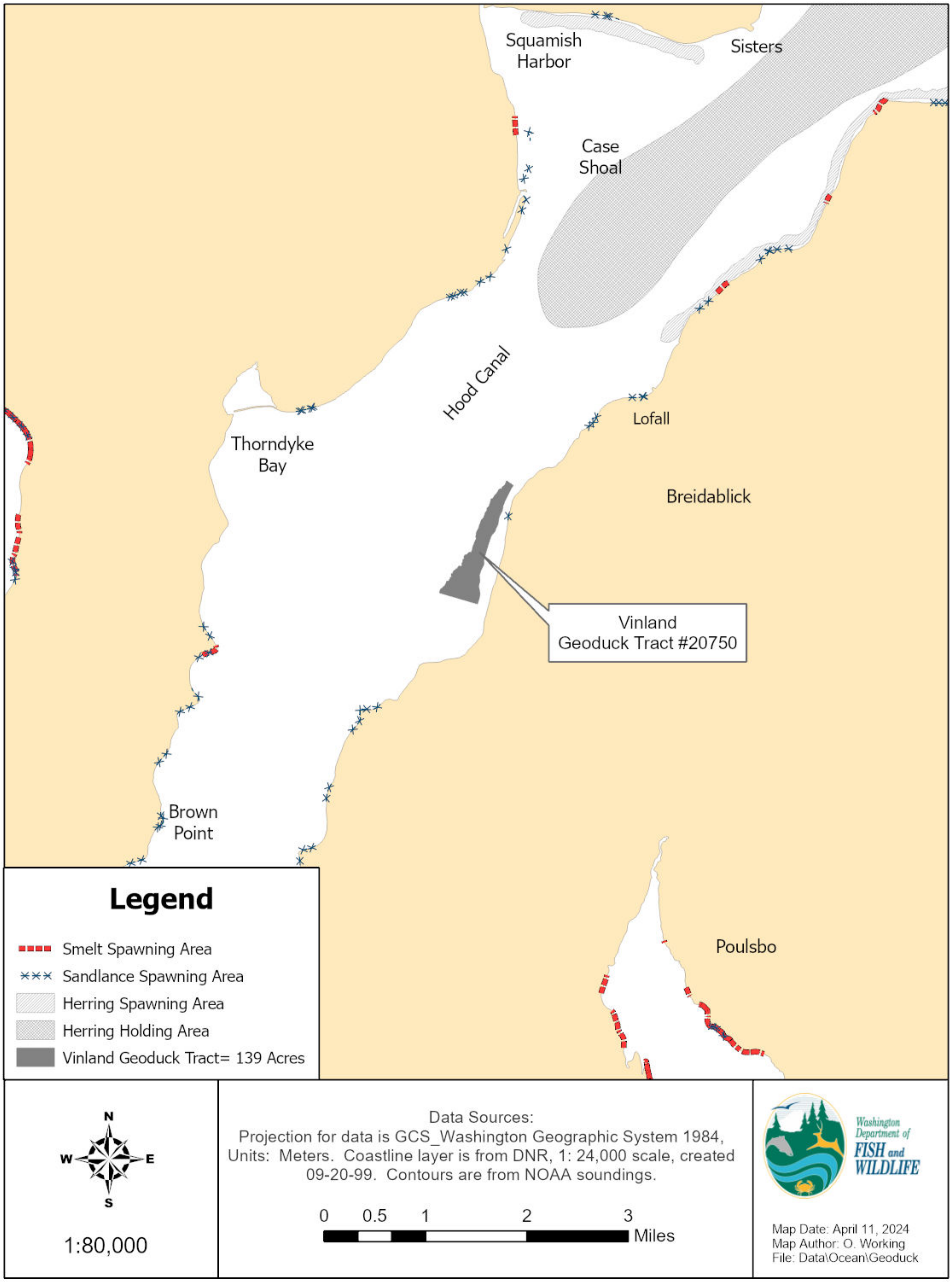
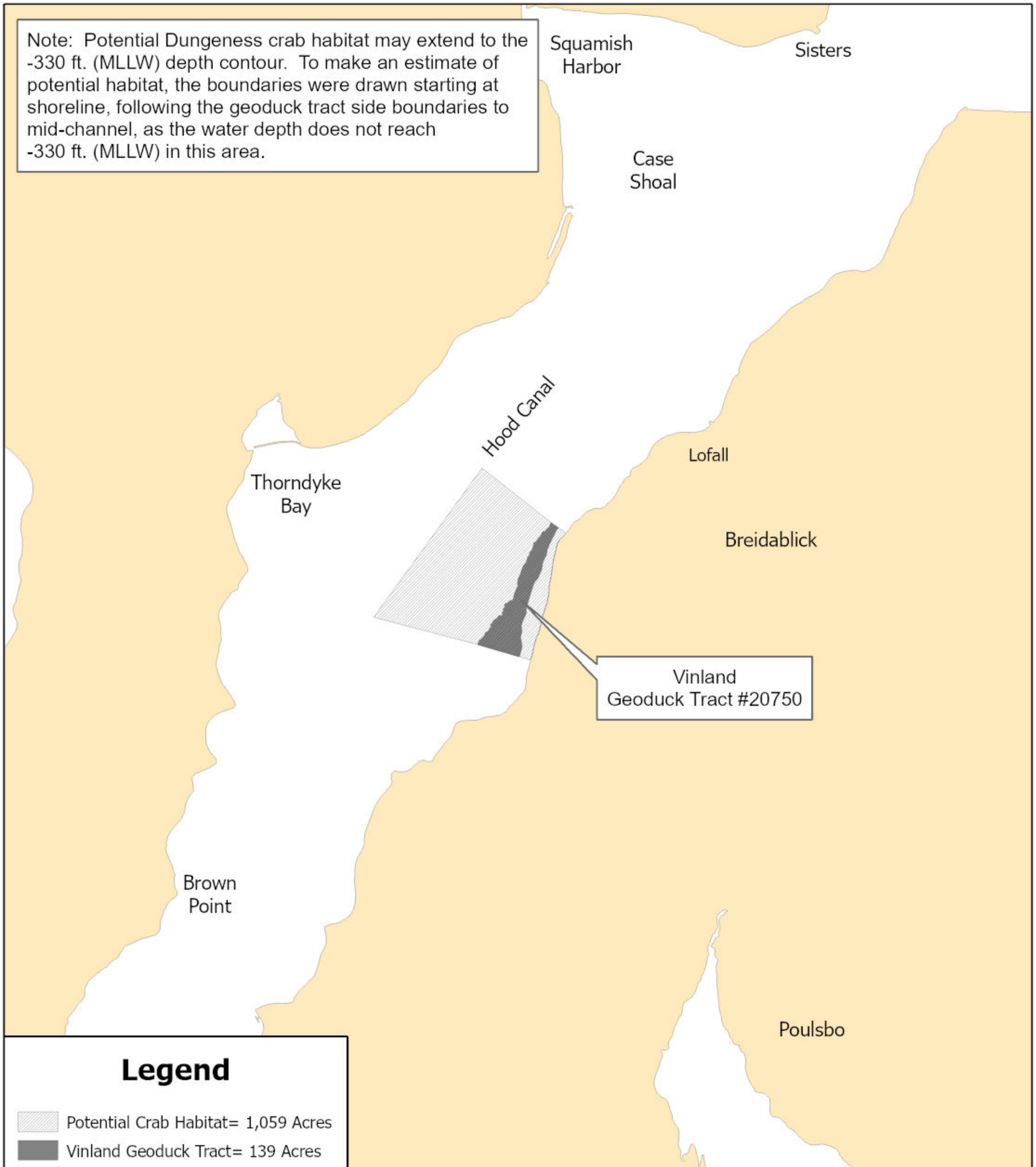


Figure 5. Potential Dungeness Crab Habitat Map, Vinland Commercial Geoduck Tract #20750



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1:80,000

Data Sources:
Projection for data is GCS_Washington Geographic System 1984, Units: Meters. Coastline layer is from DNR, 1: 24,000 scale, created 09-20-99. Contours are from NOAA soundings.

0 0.5 1 2 3 Miles

Washington Department of FISH and WILDLIFE

Map Date: April 11, 2024
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File: Data\Ocean\Geoduck

EXPLANATION OF SURVEY DATA TABLES

The geoduck survey data for each tract is reported in seven computer-generated tables. These tables contain specific information gathered from transect and dig samples and diver observations. The following is an explanation of the headings and codes used in these tables.

Tract Summary

This table is a general summary of survey information for the geoduck tract including estimates of *Tract Size* in acres, average geoduck *Density* in animals per sq.ft., *Total Tract Biomass* in pounds with statistical confidence, and *Total Number of Geoducks*. Mass estimators are reported in average values for *Whole Weight* and *Siphon Weight* in pounds. Geoduck siphon weights are also reported in *Siphon Weight as a percentage of Whole Weight.* Biomass estimates are adjusted for any harvest that may occur subsequent to the pre-fishing survey.

Digging Difficulty

This table presents a station-by-station evaluation of the factors contributing to the difficulty of digging geoduck samples with a 5/8" inside nozzle diameter water jet. Codes for the overall subjective summary of the digging difficulty are given in the *Difficulty* column. An explanation of the codes for the dig difficulty follows:

Code	Degree of Difficulty	Description
0	Very Easy	Sediment conducive to quick harvest.
1	Easy	Significant barrier in substrate to inhibit digging.
2	Some difficulty	Substrate may be compact or contain gravel, shell or clay; most geoducks still easy to dig.
3	Difficult	Most geoducks were difficult to dig, but most attempts were successful.
4	Very Difficult	It was laborious to dig each geoduck. Unable to dig some geoducks.
5	Impossible	Divers could not remove geoducks from the substrate.

Abundance refers to the relative geoduck abundance; a zero (0) indicates that geoducks were very sparse, a one (1) indicates that they were moderately abundant and a two (2) indicates that they were very abundant. *Depth* refers to the depth that the geoducks were found in the substrate. A zero (0) indicates that they were shallow, a one (1) indicates that they were moderately deep and a two (2) indicates that they were very deep. The columns labeled *Compact*, *Gravel*, *Shell*, *Turbidity* and *Algae* refer to factors that contribute to digging difficulty by interfering with the digging process. A zero (0) in one of these columns indicates that the factor was not a problem, a one (1) indicates that the factor caused moderate difficulty and a two (2) indicates that the factor caused a significant amount of difficulty when digging. *Compact* refers to the compact or sticky nature of a muddy substrate. *Gravel* and *Shell* refer to the difficulty caused by these substrate types. *Turbidity* refers to the turbidity within the water near the dig hole caused by the digging activity. High turbidity makes it difficult to find the geoduck siphon shows. The difficulty of digging associated with turbidity varies with the amount of tidal current present. Therefore, the turbidity rating refers only to the conditions occurring when the sample was collected. *Algae* refers to algal cover, which also makes it difficult for the diver to find geoduck siphon shows. Because algal cover varies seasonally, this value only applies to the conditions when the sample was collected. The *Commercial* column gives a subjective assessment of whether or not it would be feasible to harvest geoducks on a commercial basis at the given station.

Transect Water Depths, Geoduck Densities and Substrate Observations

This table reports findings for each transect. *Start Depth* and *End Depth* (corrected to MLLW) are given for each transect. *Geoduck Density* is reported as the average number of geoducks per square foot for each 900 square foot transect. *Substrate Type* and *Substrate Rating* refer to evaluations of the substrate surface. A two (2) rating indicates that the substrate type is predominant. A one (1) rating indicates the substrate type was present.

Geoduck Weights and Proportion Over 2 Pounds

This table summarizes the size and quality of the geoducks at each of the stations where dig samples were collected. Weight values for any geoduck dig samples that were damaged during sampling to the extent that water loss occurred, are excluded from calculations. The *Number Dug* column lists the number of geoducks collected. The *Avg. Whole Weight (lbs.)* column gives the average sample weight of whole geoduck clams for each dig station. The *Avg. Siphon Weight (lbs.)* column gives the average weight of the siphons of the geoducks for each dig station. The percentage of geoducks greater than two pounds is given in the *% Greater than 2 lbs.* column.

Transect - Corrected Geoduck Count and Position Table

This table reports the diver *Corrected Count*, the geoduck siphon *Show Factor* used to correct the count, and the *Latitude/Longitude* position of the start point of each survey transect. Raw (observed) siphon counts are “corrected” by dividing diver observed counts for each transect with a siphon “show” factor (See WDFW Tech. Report FPT00-01 for explanation of show factor) to estimate the sample population density. Transect positions are reported in degrees and decimal minutes to the thousandth of a minute, datum WGS84.

Most Common and Obvious Animals Observed

This table summarizes the animals, other than geoducks, that were observed during the geoduck survey, and reports the total number of transects on which they were present (*# of Transects Where Observed)*. This is qualitative presence/absence data only, and only animals that can be readily seen by divers at or near the surface of the substrate are noted. The *Group* designation allows for the organization of similar species together in the table. Whenever possible, the scientific name of the animal is listed in *Taxonomer*, and a generally accepted *Common Name* is also listed. Many variables may make it difficult for divers to notice other animals on the tract, including but not limited to poor visibility, diver skill, animals fleeing the divers, animal size, or cryptic appearance or behavior (in crevasses or under rocks).

Most Common and Obvious Algae Observed

This table summarizes marine algae observed during the geoduck survey, and reports the total number of transects on which they were seen (*# of Transects Where Observed)*. This is qualitative presence/absence data only, and only for macro algae, with the exception of diatoms. At high densities diatoms form a "layer" on or above the substrate surface that is readily visible and obvious to divers. Other types of phytoplankton are not sampled and are rarely noted. Whenever possible, the scientific name or a general taxonomic grouping of each plant is listed in *Taxonomer*.

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Table 1. GEODUCK TRACT SUMMARY

Vinland geoduck tract # 20750.

Tract Name	Vinland
Tract Number	20750
Tract Size (acres) [a]	139
Density of geoducks/sq.ft. [b]	0.17
Total Tract Biomass (lbs.) [b]	1,660,297
Total Number of Geoducks on Tract [b]	1,021,002
Confidence Interval (%)	22.3%
Mean Geoduck Whole Weight (lbs.)	1.63
Mean Geoduck Siphon Weight (lbs.)	0.38
Siphon Weight as a % of Whole Weight	23%
Number of 900 sq.ft. Transect Stations	50
Number of Geoducks Weighed	63

[a.] Tract area is between the -20 ft. and the -70 ft. (MLLW) water depth contours

[b.] Biomass is based on the 2004 WDFW pre-fishing geoduck survey biomass of 4,446,582 pounds, minus total harvest of 2,786,285 pounds through April 11, 2024

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Table 2. DIGGING DIFFICULTY TABLE

Vinland geoduck tract # 20750, 2004 WDFW pre-fishing survey.

Dig Station	Difficulty (0-5)	Abundance (0-2)	Depth (0-2)	Compact (0-2)	Gravel (0-2)	Shell (0-2)	Turbidity (0-2)	Algae (0-2)	Commercial (Y/N)
2	1	1	1	0	0	0	0	0	Yes
8	0	2	1	0	0	1	0	0	Yes
18	1	1	0	1	0	0	2	0	Yes
33	2	2	1	1	0	0	1	0	Yes
37	0	2	1	0	1	1	0	0	Yes
51	2	1	0	1	0	0	1	0	Yes

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Table 3. TRANSECT WATER DEPTHS, GEODUCK DENSITIES, AND SUBSTRATE OBSERVATIONS

Vinland geoduck tract # 20750, 2004 WDFW pre-fishing survey.

Transect	Start Depth (ft.) [a]	End Depth (ft.) [a]	Geoduck Density (no. / sq.ft.) [b]	Substrate [c] mud	Substrate [c] sand
1	20	27	0.0254		2
2	27	34	0.1937		2
3	34	40	0.5111	1	2
4	40	45	0.6476	2	1
5	45	52	0.6492	2	
6	52	59	0.6825	2	
7	58	56	0.4857	2	
8	56	49	0.4730	2	
9	49	39	0.5444		2
10	39	32	0.4683		2
11	32	26	0.2524		2
12	26	20	0.0937		2
14	29	37	0.4297		2
15	37	44	0.6650	1	1
16	44	50	0.5882	2	
17	50	57	0.6078	2	
18	57	58	0.2549	2	
19	58	51	0.2974	2	
21	25	32	0.0997		2
22	32	40	0.4085	1	2
23	40	50	0.3644	1	2
24	20	28	0.3585	1	2
25	28	35	0.3363	1	2
26	35	43	0.3926	1	2
27	43	51	0.3881	1	1
28	51	59	0.3200	2	1
29	59	65	0.2578	2	1
31	30	37	1.1552		2
32	37	44	1.1834	1	2
33	44	52	1.0370	1	2
34	52	58	0.8836	1	2
35	58	65	0.7037	1	2
36	20	32	0.3915		2
37	32	42	1.1093		2
38	42	52	1.0176	1	1
39	52	62	0.3351	2	
41	31	42	1.3072	1	2
42	43	51	0.7734	2	1
43	51	50	0.0327	2	1
44	51	49	0.0414	2	
45	49	50	0.0349	2	
47	33	44	0.6340		2
48	44	54	0.0871		2
49	54	62	0.0850		2

Table 3. Continued

Transect [a]	Start Depth (ft.) [b]	End Depth (ft.) [b]	Geoduck Density (no. / sq.ft.) [c]	Substrate [d] mud	sand
50	62	70	0.2266		2
51	70	60	0.1590		2
52	60	51	0.0414		2
53	51	43	0.0305		2
54	43	35	0.3965		2
55	35	23	0.0980		2

[a.] Five tranects were eliminated because they fell shallow of -20 ft. (MLLW)
[b.] All depths are corrected to mean lower low water (MLLW)
[c.] Densities were calculated using a daily siphon show factor
[d.] Substrate ratings: 1 = present; 2 = predominant; blank = not observed

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Table 4. GEODUCK SIZE AND QUALITY

Vinland geoduck tract # 20750, 2004 WDFW pre-fishing survey.

Dig Station	Number Dug	Avg. Whole Weight (lbs.)	Avg. Siphon Weight (lbs.)	% of geoducks on station greater than 2 lbs.
2	11	2.40	0.58	82%
8	11	1.40	0.35	0%
18	10	1.23	0.30	0%
33	11	1.53	0.35	9%
37	10	1.68	0.41	10%
51	10	1.48	0.27	10%

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Table 5. TRANSECT CORRECTED GEODUCK COUNT AND POSITION TABLE

Vinland geoduck tract # 20750, 2004 WDFW pre-fishing survey.

Transect [a]	Corrected Count	Show Factor [b]	Latitude [c]	Longitude [c]
1	23	0.7	47° 47.513	122° 41.254
2	174	0.7	47° 47.534	122° 41.272
3	460	0.7	47° 47.556	122° 41.288
4	583	0.7	47° 47.579	122° 41.306
5	584	0.7	47° 47.600	122° 41.321
6	614	0.7	47° 47.621	122° 41.336
7	437	0.7	47° 47.642	122° 41.351
8	426	0.7	47° 47.663	122° 41.366
9	490	0.7	47° 47.684	122° 41.381
10	421	0.7	47° 47.705	122° 41.396
11	227	0.7	47° 47.726	122° 41.411
12	84	0.7	47° 47.747	122° 41.426
14	376	0.7	47° 47.789	122° 41.456
15	581	0.7	47° 47.810	122° 41.471
16	514	0.7	47° 47.831	122° 41.486
17	531	0.7	47° 47.852	122° 41.501
18	223	0.7	47° 47.873	122° 41.516
19	260	0.7	47° 47.894	122° 41.531
21	87	0.7	47° 47.936	122° 41.561
22	357	0.7	47° 47.957	122° 41.576
23	319	0.7	47° 47.978	122° 41.591
24	132	1.7	47° 47.979	122° 41.592
25	84	2.7	47° 47.980	122° 41.593
26	62	3.7	47° 47.981	122° 41.594
27	49	4.7	47° 47.982	122° 41.595
28	309	0.7	47° 47.731	122° 41.258
29	249	0.7	47° 47.750	122° 41.283
31	936	0.7	47° 47.683	122° 41.187
32	959	0.7	47° 47.699	122° 41.211
33	840	0.7	47° 47.715	122° 41.234
34	716	0.7	47° 47.731	122° 41.258
35	570	0.7	47° 47.750	122° 41.283
36	317	0.7	47° 47.259	122° 41.347
37	899	0.7	47° 47.271	122° 41.379
38	824	0.7	47° 47.285	122° 41.404
39	271	0.7	47° 47.300	122° 41.435
41	857	0.7	47° 47.103	122° 41.377
42	507	0.7	47° 47.113	122° 41.413
43	21	0.7	47° 47.119	122° 41.445
44	27	0.7	47° 47.123	122° 41.482
45	23	0.7	47° 47.125	122° 41.518
47	416	0.7	47° 47.975	122° 41.034
48	172	1.7	47° 47.971	122° 41.067
49	109	2.7	47° 47.964	122° 41.106
50	80	3.7	47° 47.963	122° 41.142
51	64	4.7	47° 47.958	122° 41.180
52	53	5.7	47° 47.931	122° 41.161
53	45	6.7	47° 47.908	122° 41.142

Table 5. Continued

Vinland geoduck tract # 20750, 2004 WDFW pre-fishing survey.

Transect [a]	Corrected Count	Show Factor [b]	Latitude [c]	Longitude [c]
54	40	7.7	47° 47.889	122° 41.123
55	35	8.7	47° 47.868	122° 41.103

[a.] Five tranects were eliminated because they fell shallow of -20 ft. (MLLW)
[b.] Daily siphon show factor was used to correct combined geoduck counts
[c.] Latitude and longitude are in degrees and decimal minutes (NAD27), and have not been transformed into WGS84 datum

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Table 6. MOST COMMON AND OBVIOUS ANIMALS OBSERVED

Vinland geoduck tract # 20750, 2004 WDFW pre-fishing survey.

# of Transects where Observed	Group	Common Name	Taxonomer
1	ANEMONE	BURROWING ANEMONE	*Pachycerianthus fimbriatus*
1	ANEMONE	CRIMSON ANEMONE	*Cribrinopsis fernaldi*
47	ANEMONE	PLUMED ANEMONE	*Metridium* spp.
13	ANEMONE	STRIPED ANEMONE	*Urticina* spp.
1	ASCIDIAN	SESSILE TUNICATE	Unspecified Tunicate
4	BIVALVE	HEART COCKLE	*Clinocardium nuttalli*
29	BIVALVE	HORSE CLAM	*Tresus* spp.
1	BIVALVE	TRUNCATED MYA	*Mya truncata*
2	BIVALVE	FALSE GEODUCK	*Panomya* spp.
31	BIVALVE	HORSE MUSSEL	*Modiolus rectus*
32	CNIDARIA	SEA PEN	*Ptilosarcus gurneyi*
50	CNIDARIA	SEA WHIP	*Stylatula elongata*
2	CRAB	DECORATOR CRAB	*Oregonia gracilis*
5	CRAB	DUNGENESS CRAB	*Cancer magister*
2	CRAB	GRACEFUL CRAB	*Cancer gracilis*
25	CRAB	HERMIT CRAB	Unspecified hermit crab
1	CRAB	RED ROCK CRAB	*Cancer productus*
14	CUCUMBER	BURROWING CUCUMBER	Unspecified burrowing Holothurian
1	FISH	ENGLISH SOLE	*Parophrys vetulus*
16	FISH	FLATFISH	Unspecified flatfish
12	FISH	SANDDAB	*Citharichthys* spp.
3	FISH	STARRY FLOUNDER	*Platichthys stellatus*
2	FISH	SKATE	Unspecified Raja spp.
4	FISH	SCULPIN	Unspecified Cottidae
12	GASTROPOD	ARMINA	*Armina californica*
1	GASTROPOD	DENDRONOTUS	*Dendronotus* spp.
2	GASTROPOD	WHITE LINED DIRONA	*Dirona albolineata*
3	GASTROPOD	ROSY TRITONIA	*Tritonia diomedea*
13	GASTROPOD	NUDIBRANCH	Unspecified nudibranch
9	SEA STAR	SUNFLOWER STAR	*Pycnopodia helianthoides*
22	SEA STAR	SAND STAR	*Luidia foliolata*
8	SEA STAR	SHORT-SPINED STAR	*Pisaster brevispinus*
2	SHRIMP	GHOST SHRIMP	Unspecified ghost shrimp
25	WORM	ROOTS	*Chaetopterid* polychaete tubes
4	WORM	SABELLID TUBE WORM	*Sabellid* spp.

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Table 7. MOST COMMON AND OBVIOUS ALGAE OBSERVED

Vinland geoduck tract # 20750, 2004 WDFW pre-fishing survey.

# of Transects where observed	Taxonomer
2	Diatoms
1	*Laminaria* spp.
9	*Ulva* spp.
6	Unspecified Small Red Algae
4	Unspecified Large Red Algae

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