ENVIRONMENTAL ASSESSMENT OF PROPOSED GEODUCK HARVEST
ALONG THE EASTERN SHORELINE OF PUGET SOUND
AT THE SEAHURST GEODUCK TRACT (#09060)

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**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 management plans. Harvest is conducted by divers from subtidal beds between the -18 foot and -70 foot water depth contours (corrected to mean lower low water, hereafter MLLW). Harvest is rotated throughout Puget Sound in seven geoduck management regions. The fishery, its management, and its environmental impacts are presented in the Puget Sound Commercial Geoduck Fishery Management Plan (DNR & WDFW, 2008) and the Final Supplemental Environmental Impact Statement (WDFW & DNR, 2001). The proposed harvest is along the eastern shoreline of Puget Sound, between the city of Des Moines and West Seattle, and is described below.**

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Proposed Harvest Dates: 2024-2025

Tract name: Seahurst geoduck tract (Tract #09060)

Description: (Figure 1, Tract vicinity map)

The Seahurst geoduck tract is a subtidal area with a proposed harvest area of approximately 106 acres (Table 1) along the eastern shoreline of Puget Sound in the South Puget Sound Geoduck Management Region. The southern boundary of the tract is just north of Three Tree Point and the tract extends northerly along the shoreline for approximately 2.5 miles (Figure 1). The commercial tract area lies between the -18 ft. and the -70 ft. (MLLW) water depth contours. This geoduck tract was most recently surveyed in 2016 by the Puyallup Tribe and a Supplemental survey was done in 2017 by WDFW.

The tract harvest area is bounded by a line projected southerly from a Control Point (CP) on the -18 foot (MLLW) water depth contour in the northeasterly portion of the tract at 47°29.139’ N latitude, 122°21.881’ W longitude (CP 1), south along the -18 foot (MLLW) water depth contour to a point at 47°27.248’ N latitude, 122°22.640’ W longitude (CP 2); then west to a point on the -70 foot (MLLW) water depth contour at 47°27.275’ N latitude, 122°22.690’ W longitude (CP 3); then northerly along the -70 foot (MLLW) water depth contour to a point at 47°29.090’ N latitude, 122°21.987’ W longitude (CP 4); then northeasterly to the point of origin (Figure 2).

This estimate of the tract boundary is made using Geographic Information System (GIS) data layers that were generated from NOAA soundings. All contours are corrected to mean lower low water (MLLW). The shoreline data is from DNR, digitized at 1:24,000 scale in 1999. The -70 ft. (MLLW) water depth contour is used for the deep water boundary, and the shallow water boundary is defined by the -18 ft. contour (MLLW). The latitude and longitude positions are reported in decimal minutes to the closest thousandth of a minute. Corner latitude and longitude positions are generated using GIS, and have not been field verified to determine consistency with area estimates, landmark alignments, or water depth contours. The delineation of the tract boundary will be field verified by DNR prior to any geoduck harvest. Any variance to the stated boundary will be coordinated between WDFW and DNR prior to 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 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 known long-term effects. The substrate holes refill in areas with strong water currents much faster than in areas with weak water currents. Water currents tend to be weak in the vicinity of the Seahurst tract. Currents reach a projected maximum flood velocity of 0.8 knots per hour and maximum ebb velocity of 0.6 knots (Tides and Currents software; station #1746; approach, Quartermaster Harbor entrance).

In both the 2016 Puyallup Tribe survey and a supplemental survey by WDFW in 2017, the subsurface substrates were noted as predominantly sand (Table 3). Numerous tires were also noted in 2017.

Water Quality:

Water quality is considered acceptable for shellfish harvest at the Seahurst geoduck tract, and the tract is classified by the Washington Department of Health (DOH) as “Approved” for commercial shellfish harvest. DNR will verify the health status of the Seahurst tract prior to any geoduck harvest.

The following data on water quality have been provided by the Washington Department of Ecology (DOE) for the Puget Sound Main Basin - East Passage SW of Three Tree Point (EAP001) at 47.4167° North latitude; 122.3800° West longitude. The DOE latitude and longitude positions are reported by DOE in decimal degrees. For 2010, (the most recent data year available) at water depths between 10 to 15 meters, the mean reported dissolved oxygen concentration is 8.5 mg/l, with a range from 6.8 to 11.5 mg/l. The mean salinity at this station was 29.5 ppt with a range from 28.8 to 30.2 ppt. The mean water temperature at this station was 10.3°C with a range from 8.8 to 13.2°C.

Biota:

Geoduck:

The Seahurst geoduck tract is approximately 106 acres. The abundance of geoducks in this harvest area is moderate with a current average density estimate of 0.03 geoducks/sq.ft. This area currently contains an estimated 444,551 pounds of geoducks (Table 1). This biomass estimate is made using 2016 Puyallup Tribe geoduck transect and dig sample data, and by subtracting an estimated 2,125,172 pounds of harvest to date. The commercial quality of geoducks sampled was not noted, nor were geoduck dig stations rated for digging difficulty (Table 2).

The density from the 2016 pre-fishing survey ranged from 0.01 geoducks/sq.ft. on transect L-4 to 0.33 geoducks/sq.ft. on transect E-1 (Figure 3; Table 3). The geoducks at the Seahurst tract, averaging 3.47 pounds, are significantly larger than the average weight of 2.1 pounds for geoducks in Puget Sound. The lowest average whole weight was 2.27 pounds at station #2 and the highest average whole weight was 4.89 pounds at station #1 (Table 4). Transect locations and pre-fishing geoduck counts, corrected with siphon "show factors," are listed in Table 5.

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 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 the Salish Sea. 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 Seahurst 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 and support many fish species. The bottoms are relatively flat and composed of soft sediments, providing few attachments for macroalgae that are often associated with many fish species. The fish observed during the 2017 supplemental survey at the Seahurst tract were various species of flatfish, sculpins, perch and brown rockfish (Table 6).

WDFW marine fish managers were asked of their concerns regarding any possible impacts geoduck fishing would have 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 groundfish 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. There are no Pacific herring spawning grounds along the shoreline in the vicinity of the Seahurst tract. As a precautionary measure, the Seahurst nearshore tract boundary will be along the -18 ft. (MLLW) water depth contour to provide year-round protection and a vertical buffer (at least 2 vertical feet) between potential herring spawning habitat (eelgrass beds) and geoduck harvest.

Surf smelt spawning habitat has been identified along the shoreline of the Seahurst geoduck tract (Figure 4). Surf smelt deposit adhesive, semitransparent eggs on beaches that have a specific mixture of coarse sand and pea gravel. Inside Puget Sound, surf smelt spawning is thought to be associated with freshwater seepage, where the water keeps the spawning gravel moist. Eggs are deposited near the water's edge in water a few inches deep, around the time of the high water slack. There is vertical separation between surf smelt spawning (slack high tide) and geoduck harvest activity (-18 ft. to -70 ft., MLLW).

Sand lance spawning areas have been documented along the shoreline of the Seahurst geoduck tract (Figure 4). Sand lance populations are widespread within Puget Sound, the Strait of Juan de Fuca and the coastal estuaries of Washington. They are commonly noted in the eastern Strait of Juan de Fuca 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. Spawning of sand lance occurs at tidal elevations ranging from +5 feet to approximately the mean higher high water line (MHHW). 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 zooplankton and larger predators in the local marine food webs. Like all forage fish, sand lance 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 lance are particularly important to juvenile Chinook salmon, and comprise 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 vertical separation between sand lance spawning (+5 feet to MHHW) and geoduck harvest activity (-18 ft. to -70 ft., MLLW). Due to vertical separation, geoduck fishing on the Seahurst 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.

On May 7, 2007, NOAA Fisheries Service announced listing of Puget Sound steelhead as “threatened” under ESA. This listing includes more than 50 stocks of summer- and winter-run steelhead. In NOAA’s 2011 5-Year Review, it was reported that for all but a few demographically independent populations of steelhead in Puget Sound, estimates of mean population growth rates obtained from observed spawner or redd counts are declining, typically 3 to 10% annually. Steelhead share many of the same waters as Puget Sound Chinook salmon, which are already protected by ESA, and will benefit from shared conservation strategies. There is a winter run of steelhead in the Green-Duwamish watershed that is rated “healthy.” This rating was made because spawner escapements have generally varied within a range of +/- 25% of the escapement goal of 2000 wild spawners. Spawning for this stock generally occurs between early March to mid-June. This is a native stock with wild production. The horizontal separation between the tributaries that support a steelhead run and the Seahurst tract supports a conclusion that geoduck harvest will likely have no impact on steelhead populations.

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 “threatened” species under the federal ESA. 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 late August to late October. Out-migration of juveniles has been observed in Hood Canal during February and March, though may occur as late as mid-April. Recent recovery and supplementation efforts have reversed the trend of decline in Hood Canal summer run chum salmon stocks. Total escapement for Hood Canal summer run chum salmon has reached historic high levels, and the risk of extinction has decreased for all stocks (Adicks, K. *et al*., 2007). The Seahurst tract is outside of the critical habitat range for Hood Canal summer run chum salmon.

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 subyearlings.

Major tributaries in the general vicinity of the Seahurst geoduck tract that support Chinook salmon runs are the Duwamish Waterway/Green River basin and the Lake Washington basin (mouth at Shilshole Bay; with Cedar River, Issaquah Creek, and north Lake Washington tributaries and sub-basins). Three viable runs of Chinook salmon have been identified in the Duwamish Waterway/Green River basin. The status of the spring run of Chinook salmon in the Duwamish Waterway/Green River basin is extinct. The status of the natural summer/fall run of Chinook salmon in the Duwamish Waterway/Green River basin is of mixed native and non-native origin; a composite of wild, cultured, or unknown/unresolved production; and healthy with a 5-year geometric mean for total estimated escapement at 4,889 fish. The timing of the Duwamish River run is uncertain and has a 5-year geometric mean for total estimated escapement at 5,216 fish. The status of the summer/fall run in Newaukum Creek is of mixed native and non-native origin; wild production; and healthy (NMFS, Appendix E, TM-35, Chinook Status Review).

The production of the Lake Washington summer/fall run of Chinook salmon is natural with a 5-year geometric mean for total estimated escapement at 557 fish. The status of the natural Cedar River summer/fall run of Chinook salmon is of native origin; wild production; with a 5-year geometric mean for total estimated escapement at 377 fish. The status of the mixed summer/fall run of Chinook salmon in Issaquah Creek is of non-native origin; a composite of wild, cultured, or unknown/unresolved production; and healthy. The status of the natural summer/fall run of Chinook salmon in the North Lake Washington tributaries is of native origin; wild production; with a 5-year geometric mean for total estimated escapement at 145 fish (NMFS, Appendix E, TM-35, Chinook Status Review).

Three Chinook salmon runs have been identified in the Puyallup River. The status of the spring run of Chinook salmon in the Puyallup River is extinct (NMFS, Appendix E, TM-35, Chinook Status Review). The status of the natural summer/fall run of Chinook salmon in the Puyallup River is undetermined with a 5-year geometric mean for total estimated escapement at 2,518 fish (NMFS, Appendix E, TM-35, Chinook Status Review). The fall run of Chinook salmon in the Puyallup River is of mixed or composite production of special concern with an unknown origin and run size (NMFS, Appendix E, TM-35, Chinook Status Review).

The geographic separation (horizontal) of this tract from known spawning tributaries and vertical separation from 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 harvest-induced impacts to salmon populations.

Charles Simenstad of the University of Washington School of Fisheries stated that the exclusionary principle of not allowing leasing/harvesting in water shallower than -18 ft. MLLW, the 2+ ft. vertically from elevation of the 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.

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 they 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" [pdf] (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 Seahurst 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 types of marine invertebrates frequently found on geoduck beds were observed on this tract. The most common and obvious groups include anemones, cnidarians, ascidians, mollusks, crustaceans, echinoderms, and various species of marine worms (Table 6). Geoduck harvest has not been shown to have long-term adverse effects on these invertebrates. Geoduck harvest can depress some local populations of benthic invertebrates, however most of these populations recover within one year.

There is ongoing interest from recreational and commercial crab fishers about interactions between geoduck harvest activity and Dungeness crab populations. Dungeness crab were not observed on the Seahurst tract during the 2017 supplemental survey. 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 Biologist Don Velasquez, (personal comm. 7/23/15) confirm a similar vertical distribution in Puget Sound, although 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 tract and shoreward of the tract to the +1 ft. level and seaward to the -360 ft. (MLLW) water depth contour (Figure 5). The entire crab habitat along this tract is approximately 771 acres. The 2016 pre-fishing survey estimated that there were approximately 740,931 harvestable geoducks in the entire 106 acre tract harvest area.. With a harvest of 65 percent, the total number harvested would be 481,605 geoducks. Approximately 1.18 square feet of substrate is disturbed for every geoduck harvested, so 481,605 x 1.18 = 568,294 square feet of substrate. This equals about 13.0 acres, which is approximately 1.7 percent of the total available crab habitat in the vicinity of this tract. Based on the low amount of disturbance, we conclude that any effects on Dungeness crab populations will be very minor, if they occur at all.

Algae:

Large, attached 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. Soft sediment substrates, such as those normally found on geoduck tracts, provide poor attachment and anchorage for large algae. Algae observed during the 2017 Supplemental geoduck survey include red algae, foliose green algae (*Ulva* spp.), diatoms and brown algae (*Laminaria* spp) (Table 7).

John Boettner and Tim Flint from the WDFW Habitat Division have stated that they have no concerns regarding geoduck fishing if it is restricted to seaward of the eelgrass beds.. The shallow boundary of geoduck harvest is set at least two vertical feet seaward of the deepest occurrence of eelgrass, to protect all eelgrass along the tract from harvest activities. An eelgrass survey was conducted at the Seahurst geoduck tract in 2016 by the Puyallup Tribe. It was reported that no eelgrass was observed deeper than -8 ft. (MLLW). The shoreward boundary of this tract will be no shallower than the -18 ft. water depth contour (MLLW), which should provide sufficient buffer for any eelgrass beds in the vicinity of the tract.

Marine Mammals:

Several species of marine mammals, including seals, sea lions, and river otters may be observed in the vicinity of this geoduck tract. There have also been sporadic reports of gray whales feeding near Bainbridge Island and rare reports of humpback whales near Vashon Island. Killer whales may also be observed in the vicinity of this tract, particularly between November and March. The Southern Resident stock of killer whales resides mainly in the San Juan Islands throughout spring and summer, but incursions south into Puget Sound occur more frequently during winter months (Brent Norberg, NOAA, pers. comm. 5/15/06). 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 draft conservation plan for this stock can be found at the NOAA website (https://www.fisheries.noaa.gov/action/listing-southern-resident-killer-whale-under-esa). Handpick shellfish fisheries, such as 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). Precautions should be taken by commercial divers when marine mammals are in the area to be aware of marine mammal movements and behavior to eliminate the remote risk of entanglement with diver hoses and lines.

Birds:

A variety of marine birds are common in Puget Sound and the general vicinity of this tract. The most significant of these are guillemots, murres, murrelets, grebes, loons, scoters, dabbling ducks, black brant, mergansers, buffleheads, cormorants, gulls, and terns. Blue heron, bald eagles, and osprey are also regularly observed. Geoduck harvest does not appear to have any significant 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 geoduck clam harvest is unlikely to have any adverse impacts on bald eagle productivity.

Other uses:

Adjacent Upland Use:

The shoreline waters seaward of the Ordinary High Water mark are designated as "Aquatic Shoreline" throughout King County. Upland properties immediately adjacent to the Seahurst tract are designated as "Incorporated" shoreline area (Final King County Comprehensive Plan, 2013).

To minimize possible disturbance to adjacent residents, harvest vessels are not allowed shoreward of the 200 yards seaward of the ordinary high tide line (OHT). Harvest is allowed only during daylight hours and no harvest is allowed on Saturday, Sunday, or state holidays.

The only visual effect of harvest is the presence of the harvest vessels on the tract. These boats (normally 35-40 feet long) are anchored during harvest and divers conduct all harvest out of sight. Noise from boats, compressors and pumps may not exceed 50 dB measured 200 yards from the noise source, which is 5 dBA below the state noise standard.

Fishing:

The waters in the vicinity of this geoduck tract (in Marine Area 11) are not prime sport fishing areas, however, some recreational salmon fishing for Chinook, Coho, and pink salmon could occur seasonally in proximity to this tract. Sport fishing is open year-round for surfperch. Rockfish fishing is closed. Lingcod can only be taken May 1-June 15 by hook and line, or May 21 to June 15 by spearfishing. 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. The fishing which does occur should not create any problems for the geoduck harvesting effort in the area.

Geoduck fishing on this tract is managed in coordination with the South Puget Sound Treaty Tribes through state/tribal geoduck harvest management plans. The non-Indian geoduck fishery should not be in conflict with any concurrent tribal fisheries.

Navigation:

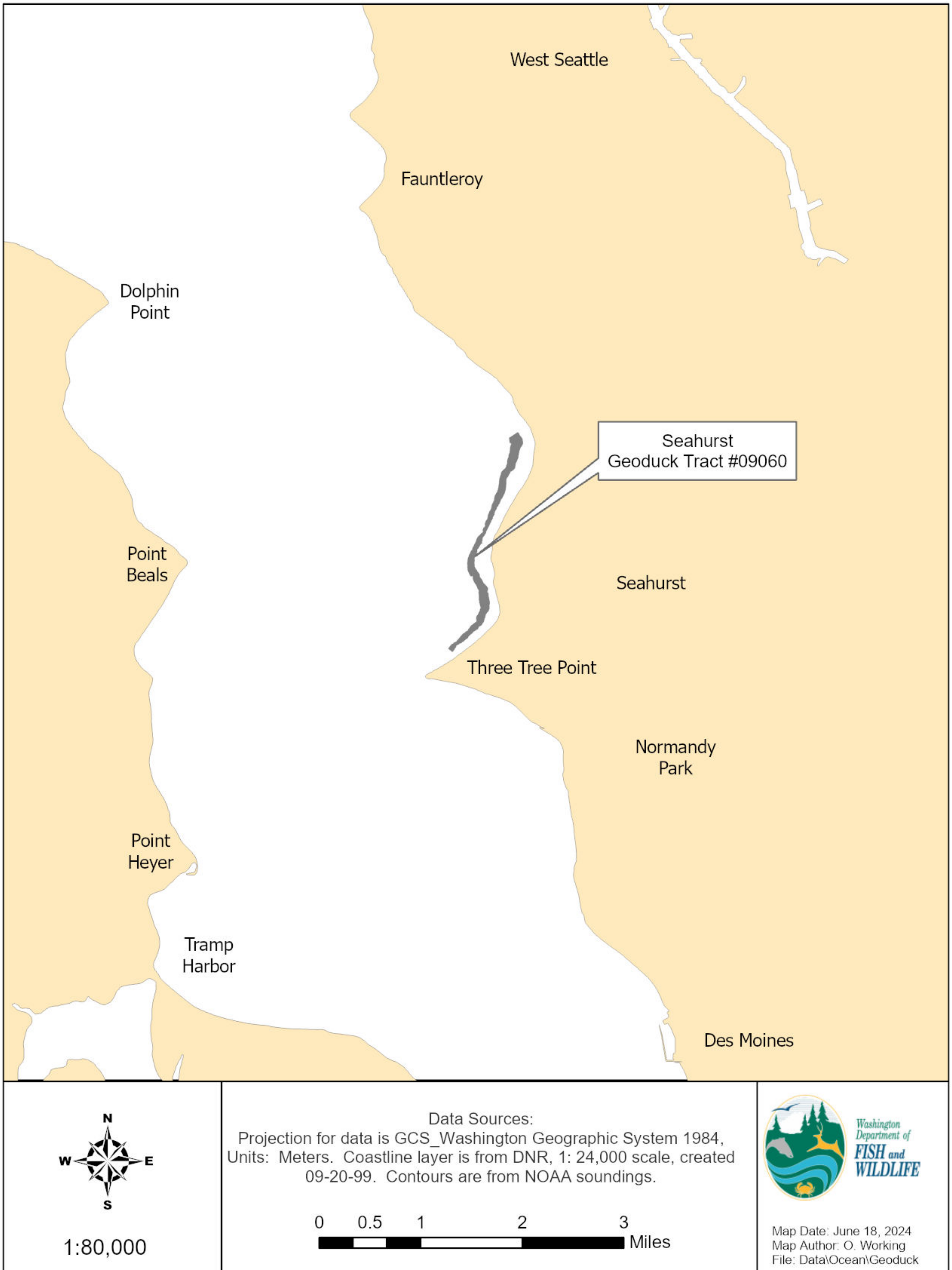
The Seahurst area is used by recreational and commercial vessels traveling in South Puget Sound. Geoduck harvesting at this site should not result in any significant navigational conflicts. The Washington Department of Natural Resources will notify the local boating community prior to any harvest.

Summary:

The proposed commercial geoduck harvest is for one tract along the eastern shoreline of Puget Sound. The tract was recently surveyed in 2016 by the Puyallup Tribe and in 2017 by WDFW. The current biomass estimate for the 106 acre harvest area is 444,551 pounds. The commercial tract is classified by DOH as “Approved.” The anticipated environmental impacts of this harvest are within the range of conditions discussed in the 2001 Final Supplemental Environmental Impact Statement. To reduce the possible impacts to forage fish and eelgrass, the harvest will be seaward of the -18 ft. water depth contour (MLLW) along the tract. No significant impacts are expected from this harvest.

File: 240723_Seahurst_09060_EA.doc

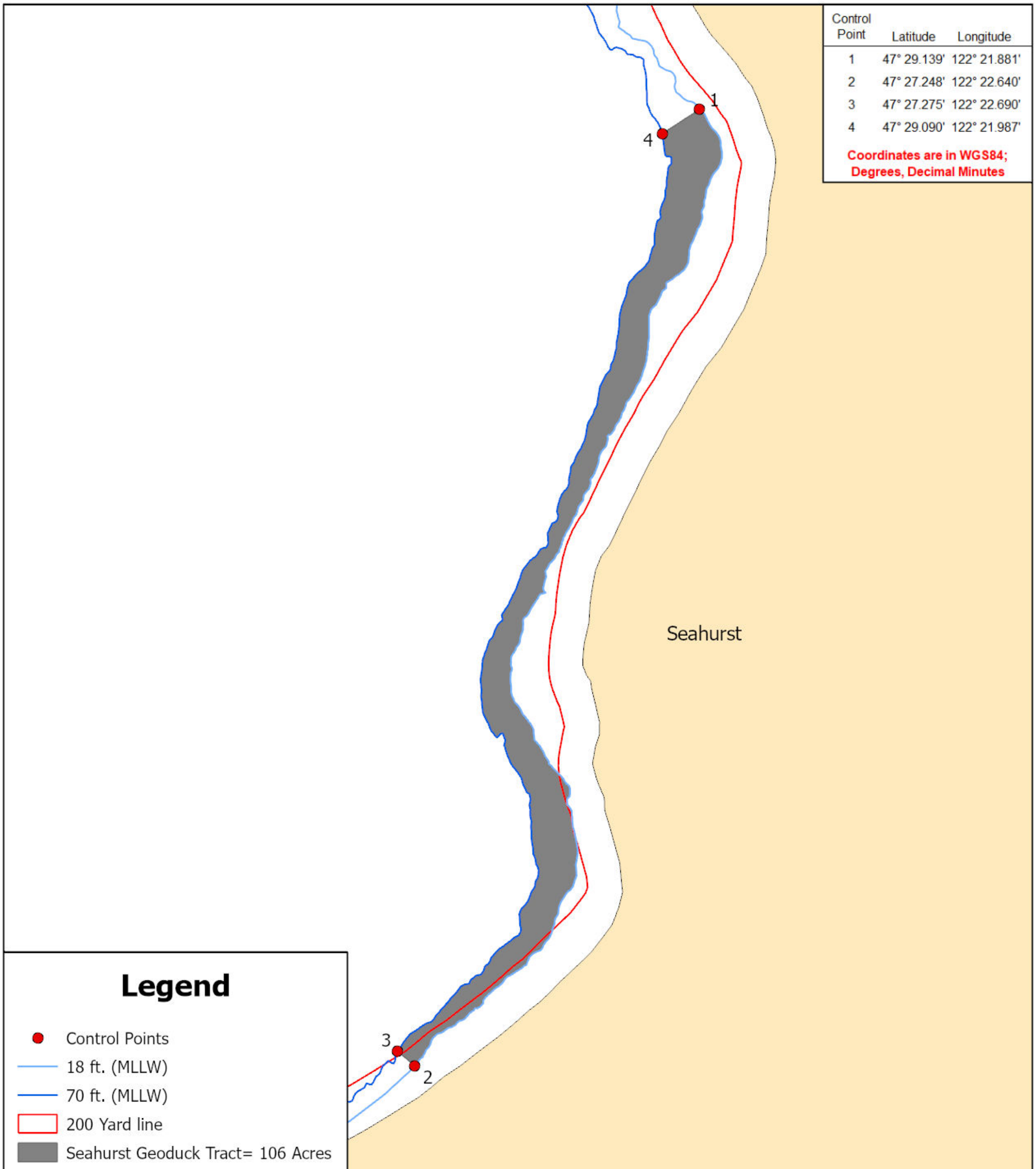
# Figure 1. Vicinity Map, Seahurst Commercial Geoduck Tract #09060




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.

Map Date: June 18, 2024
Map Author: O. Working
File: Data\Ocean\Geoduck

# Figure 2. Control Points Map, Seahurst Commercial Geoduck Tract #09060




| Control Point | Latitude | Longitude |
|---|---|---|
| 1 | 47° 29.139' | 122° 21.881' |
| 2 | 47° 27.248' | 122° 22.640' |
| 3 | 47° 27.275' | 122° 22.690' |
| 4 | 47° 29.090' | 122° 21.987' |

**Coordinates are in WGS84; Degrees, Decimal Minutes**

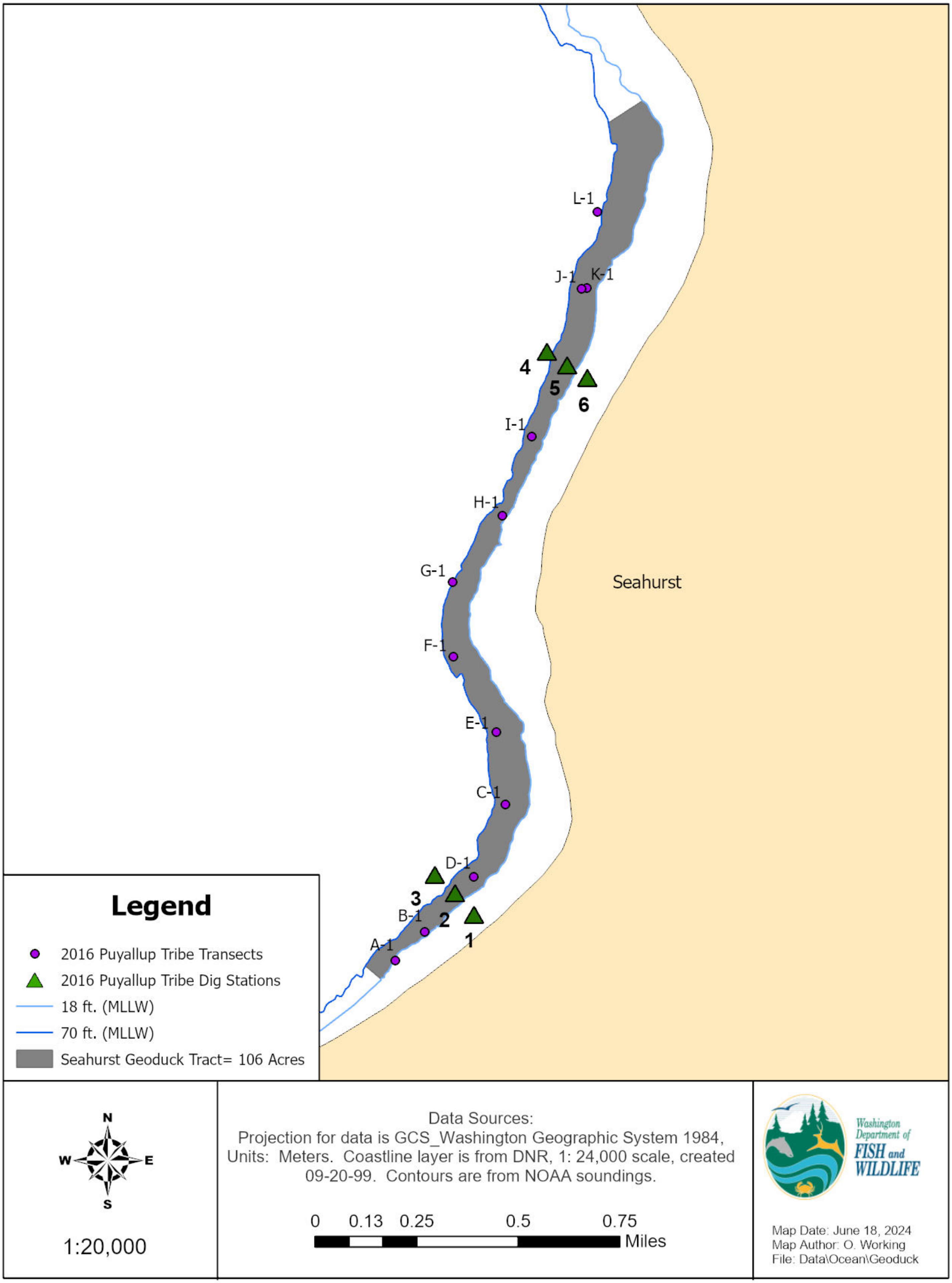
1:20,000

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 0.13 0.25 0.5 0.75 Miles

Map Date: June 18, 2024
Map Author: O. Working
File: Data\Ocean\Geoduck

Figure 3. Transect and Dig Station Map, Seahurst Commercial Geoduck Tract #09060




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.

Map Date: June 18, 2024
Map Author: O. Working
File: Data\Ocean\Geoduck

# Figure 4. Fish Spawning Areas Near the Seahurst Commercial Geoduck Tract #09060


N W E S

1:80,000

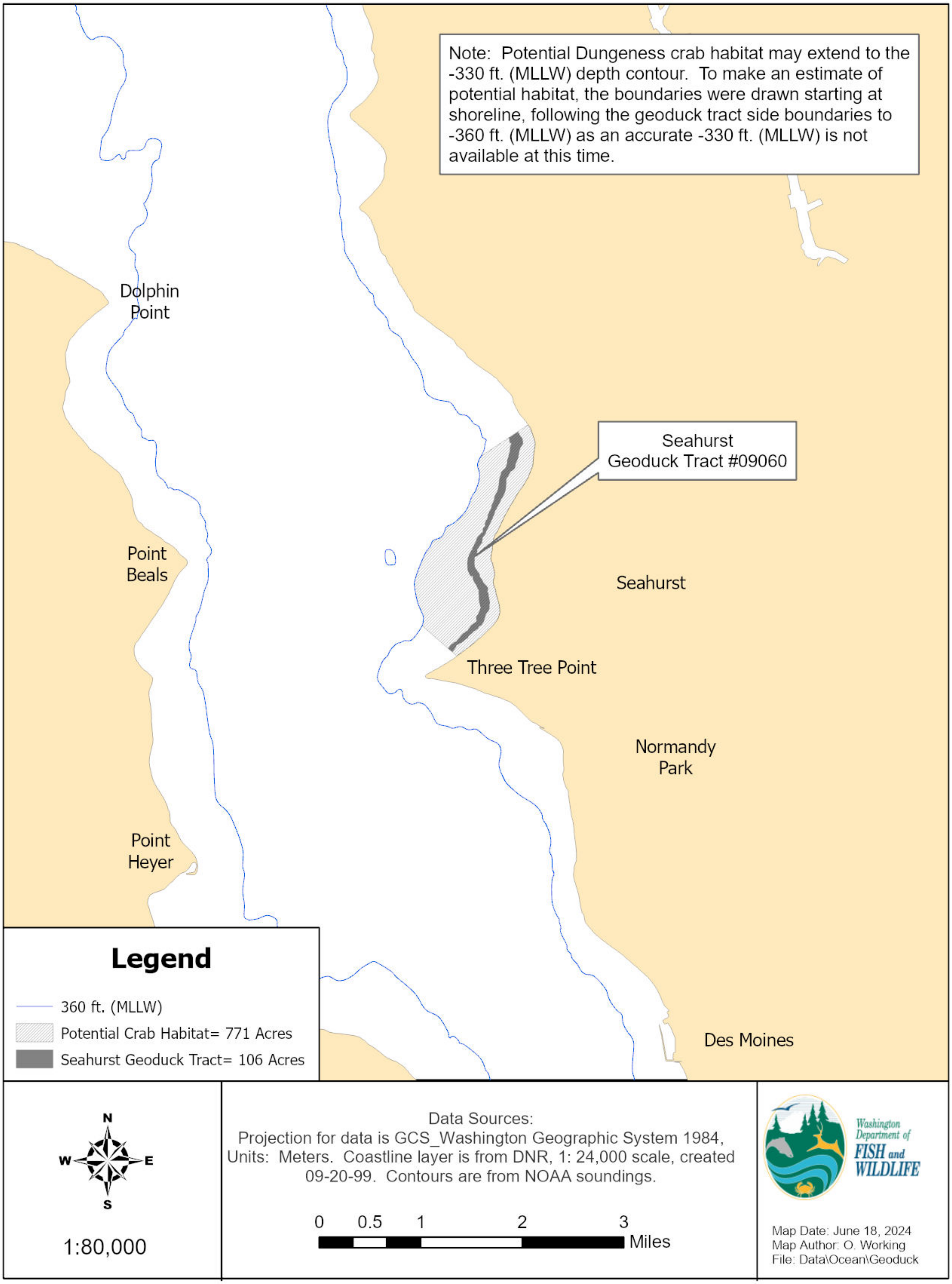
Data Sources:
Projection for data is GCS_Washington Geographic System 1984, Units: Meters. Coastline layer is from DNR, 1: 24,000 scale, created 09-20-99. Contours are from NOAA soundings.

0 0.5 1 2 3 Miles

Washington Department of FISH and WILDLIFE

Map Date: June 18, 2024
Map Author: O. Working
File: Data\Ocean\Geoduck

# Figure 5. Potential Dungeness Crab Habitat Map, Seahurst Commercial Geoduck Tract #09060



## 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**

Seahurst geoduck tract # 09060.

| | |
|---|---|
| Tract Name | Seahurst |
| Tract Number | 09060 |
| Tract Size (acres)[a] | 106 |
| Density of geoducks/sq.ft.[b] | 0.03 |
| Total Tract Biomass (lbs.)[b] | 444,551 |
| Total Number of Geoducks on Tract[b] | 128,178 |
| Confidence Interval (%) | 19.4% |
| Mean Geoduck Whole Weight (lbs.) | 3.47 |
| Mean Geoduck Siphon Weight (lbs.) | N/A* |
| Siphon Weight as a % of Whole Weight | N/A* |
| Number of Transect Stations | 31 |
| Number of Geoducks Weighed | 64 |

[a.] Tract area is between the -18 ft. and -70 ft. (MLLW) water depth contours

[b.] Biomass is based on the 2016 Puyallup Tribe pre-fishing geoduck survey biomass of 2,569,723 pounds minus harvest of 2,125,172 pounds through July 23, 2024.

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**Table 2. DIGGING DIFFICULTY TABLE**

Seahurst geoduck tract # 09060, 2016 Puyallup Tribe pre-fishing geoduck 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) |
|---|---|---|---|---|---|---|---|---|---|
| 1 | No dig station difficulty information was provided | | | | | | | | |
| 2 | | | | | | | | | |
| 3 | | | | | | | | | |
| 4 | | | | | | | | | |
| 5 | | | | | | | | | |
| 6 | | | | | | | | | |

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

Seahurst geoduck tract # 09060, 2016 Puyallup Tribe pre-fishing geoduck survey

| Transect | Start Depth (ft) [a] | End Depth (ft) [a] | Geoduck Density (no. / sq ft) [b] | Substrate [c] sand |
|---|---|---|---|---|
| A-1 | 62 | 34 | 0.2333 | 1 |
| A-2 | 34 | 26 | 0.0856 | 1 |
| B-1 | 62 | 41 | 0.2389 | 1 |
| C-1 | 65 | 60 | 0.1922 | 1 |
| C-2 | 60 | 55 | 0.2200 | 1 |
| C-3 | 55 | 50 | 0.2389 | 1 |
| C-4 | 50 | 37 | 0.1422 | 1 |
| C-5 | 37 | 21 | 0.0433 | 1 |
| D-1 | 62 | 42 | 0.2167 | 1 |
| D-2 | 42 | 31 | 0.1711 | 1 |
| E-1 | 62 | 44 | 0.3256 | 1 |
| E-2 | 44 | 21 | 0.1489 | 1 |
| F-1 | 63 | 48 | 0.2967 | 1 |
| F-2 | 48 | 37 | 0.0800 | 1 |
| G-1 | 63 | 44 | 0.2656 | 1 |
| G-2 | 44 | 26 | 0.1189 | 1 |
| H-1 | 65 | 33 | 0.1822 | 1 |
| H-2 | 33 | 26 | 0.1522 | 1 |
| I-1 | 69 | 58 | 0.1944 | 1 |
| I-2 | 58 | 32 | 0.1822 | 1 |
| I-3 | 32 | 23 | 0.1078 | 1 |
| J-1 | 65 | 54 | 0.2111 | 1 |
| J-2 | 54 | 50 | 0.2989 | 1 |
| J-3 | 50 | 38 | 0.1411 | 1 |
| J-4 | 38 | 18 | 0.0678 | 1 |
| K-1 | 70 | 51 | 0.1011 | 1 |
| K-2 | 51 | 37 | 0.0867 | 1 |
| L-1 | 68 | 59 | 0.0611 | 1 |
| L-2 | 59 | 47 | 0.0889 | 1 |
| L-3 | 47 | 26 | 0.0689 | 1 |
| L-4 | 26 | 36 | 0.0078 | 1 |

[a.] All depths are corrected to mean lower low water (MLLW)

[b.] Densities were calculated using 1.0 as the show factor

[c.] Substrate codes: 1 = present ; 2 = dominant

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**Table 4. GEODUCK SIZE AND QUALITY**

Seahurst geoduck tract # 09060, 2016 Puyallup Tribe pre-fishing geoduck survey

| Dig Station | Number Dug | Avg. Whole Weight (lbs.) | Avg. Siphon Weight (lbs.) | % of geoducks on station greater than 2 lbs. |
|---|---|---|---|---|
| 1 | 10 | 4.89 | N/A* | 100% |
| 2 | 11 | 2.27 | | 64% |
| 3 | 10 | 3.17 | | 100% |
| 4 | 12 | 2.97 | | 92% |
| 5 | 10 | 3.40 | | 100% |
| 6 | 11 | 4.41 | | 100% |

*Siphon weights were not taken

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**Table 5. TRANSECT CORRECTED GEODUCK COUNT AND POSITION TABLE**

Seahurst geoduck tract # 09060, 2016 Puyallup Tribe pre-fishing geoduck survey

| Transect | Corrected Geoduck Count per 900 sq. ft. Transect | Geoduck Siphon Show Factor [a] | Latitude [b] | Longitude [b] |
|---|---|---|---|---|
| A-1 | 210 | 1.0 | 47˚ 27.288' | 122˚ 22.596' |
| A-2 | 77 | 1.0 | | |
| B-1 | 215 | 1.0 | 47˚ 27.351' | 122˚ 22.506' |
| C-1 | 173 | 1.0 | 47˚ 27.628' | 122˚ 22.260' |
| C-2 | 198 | 1.0 | | |
| C-3 | 215 | 1.0 | | |
| C-4 | 128 | 1.0 | | |
| C-5 | 39 | 1.0 | | |
| D-1 | 195 | 1.0 | 47˚ 27.471' | 122˚ 22.355' |
| D-2 | 154 | 1.0 | | |
| E-1 | 293 | 1.0 | 47˚ 27.783' | 122˚ 22.295' |
| E-2 | 134 | 1.0 | | |
| F-1 | 267 | 1.0 | 47˚ 27.941' | 122˚ 22.435' |
| F-2 | 72 | 1.0 | | |
| G-1 | 239 | 1.0 | 47˚ 28.100' | 122˚ 22.445' |
| G-2 | 107 | 1.0 | | |
| H-1 | 164 | 1.0 | 47˚ 28.245' | 122˚ 22.291' |
| H-2 | 137 | 1.0 | | |
| I-1 | 175 | 1.0 | 47˚ 28.416' | 122˚ 22.205' |
| I-2 | 164 | 1.0 | | |
| I-3 | 97 | 1.0 | | |
| J-1 | 190 | 1.0 | 47˚ 28.735' | 122˚ 22.044' |
| J-2 | 269 | 1.0 | | |
| J-3 | 127 | 1.0 | | |
| J-4 | 61 | 1.0 | | |
| K-1 | 91 | 1.0 | 47˚ 28.734' | 122˚ 22.059' |
| K-2 | 78 | 1.0 | | |
| L-1 | 55 | 1.0 | 47˚ 28.900' | 122˚ 22.014' |
| L-2 | 80 | 1.0 | | |
| L-3 | 62 | 1.0 | | |
| L-4 | 7 | 1.0 | | |

[a.] A show factor of 1.0 was used to correct combined geoduck counts

[b.] Latitude and longitude are in WGS84 datum, degrees and decimal minutes

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**Table 6. MOST COMMON AND OBVIOUS ANIMALS OBSERVED**

Seahurst geoduck tract # 09060, 2017 WDFW Supplemental geoduck survey

| # of Transects where Observed | Group | Common Name | Taxon |
|---|---|---|---|
| 24 | ANEMONE | PLUMED ANEMONE | Metridium spp. |
| 16 | ASCIDIAN | SESSILE TUNICATE | Unspecified Tunicate |
| 24 | BIVALVE | HORSE CLAM | Tresus spp. |
| 24 | CNIDARIA | SEA PEN | Ptilosarcus gurneyi |
| 4 | CNIDARIA | SEA WHIP | Stylatula elongata |
| 18 | CRAB | GRACEFUL CRAB | Cancer gracilis |
| 24 | CRAB | HERMIT CRAB | Unspecified hermit crab |
| 8 | CRAB | RED ROCK CRAB | Cancer productus |
| 12 | CUCUMBER | SEA CUCUMBER | Parastichopus californicus |
| 2 | FISH | BROWN ROCKFISH | Sebastes auriculatus |
| 4 | FISH | C-O SOLE | Pleuronichthys coenosus |
| 4 | FISH | FLATFISH | Unspecified flatfish |
| 2 | FISH | PERCH | Unspecified Embiotocidae |
| 24 | FISH | SANDDAB | Citharichthys spp. |
| 24 | FISH | SCULPIN | Unspecified Cottidae |
| 2 | MISC | SPONGE | Unspecified Porifera |
| 8 | NUDIBRANCH | ARMINA | Armina californica |
| 2 | NUDIBRANCH | DENDRONOTUS | Dendronotus spp. |
| 10 | SEA STAR | FALSE OCHRE STAR | Evasterias troschelli |
| 2 | SEA STAR | LEATHER STAR | Dermasterias imbricata |
| 2 | SEA STAR | SUN STAR | Solaster spp. |
| 10 | SEA STAR | SUNFLOWER STAR | Pycnopodia helianthoides |
| 6 | SEA STAR | VERMILLION STAR | Mediaster aequalis |
| 24 | WORM | ROOTS | Chaetopterid polychaete tubes |
| 2 | WORM | SABELLID TUBE WORM | Sabellid spp. |

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**Table 7. MOST COMMON AND OBVIOUS ALGAE OBSERVED**
Seahurst geoduck tract # 09060, 2017 WDFW Supplemental geoduck survey

| # of Transects Where Observed | Taxon |
|---|---|
| 8 | Diatoms |
| 4 | Laminaria spp. |
| 24 | Ulva spp. |
| 24 | Small Red Algae |

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