EXHIBIT A

ENVIRONMENTAL ASSESSMENT OF PROPOSED GEODUCK HARVEST
ALONG THE EASTERN SHORELINE OF WHIDBEY ISLAND,
IN ISLAND COUNTY, AT THE LANGLEY NORTH GEODUCK TRACT (#03550)

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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 on 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 six 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 along the eastern shoreline of Whidbey Island, in the vicinity of the city of Langley, is described below.**

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Proposed Harvest Dates: 2016-2017

Tract name: Langley North geoduck tract (Tract #03550)

Description: (Figure 1, Tract Vicinity Map)

The Langley North geoduck tract is approximately 132 acres (Table 1) located along the eastern shoreline of Whidbey Island in the North Puget Sound Geoduck Management Region. The tract begins about 600 yards westerly of the Langley marina and continues northwesterly for about 3,000 yards. The commercial tract area lies between the -18 and the -70 foot (MLLW) water depth contours.

The geoduck tract is bounded by a line projected from a point on the -18 foot (MLLW) water depth contour in the southeastern portion of the tract at 48°02.701' N. latitude, 122°24.787' W. longitude northwesterly along the -18 foot (MLLW) water depth contour to a point at 48°03.329' N. latitude, 122°26.623' W. longitude; then northeasterly to a point in the northwestern portion of the tract on the -70 foot (MLLW) water depth contour at 48°03.420' N. latitude, 122°26.405' W. longitude; then southeasterly along the -70 foot (MLLW) water depth contour to a point at 48°02.734' N. latitude, 122°24.772' W. longitude, then southerly to the point of origin (Figure 2). This estimate of the tract boundary was made using GIS, and the 2012 WDFW pre-fishing survey data. All

contours are corrected to MLLW. Contour GIS layers from Dale Gombert (WDFW) were generated from NOAA soundings. Shoreline data was from DNR, digitized at 1:24000 scale in 1999. The -18 foot (MLLW) water depth contour was used for the shallow water boundary. The -70 foot (MLLW) water depth contour was used for the deep water boundary. The southeastern boundary intersects aligns with the 430 yard DOH prohibited area boundary line. The latitude and longitude positions are reported in WGS84; degrees and decimal minutes to the closest thousandths of a minute. Corner latitude and longitude positions were 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 verified by DNR prior to any geoduck harvest. Any variance to the stated boundary will be coordinated between WDFW and DNR prior to geoduck harvesting episodes.

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 have been 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 water currents. Water currents may be moderate to strong in the vicinity of the Langley North tract. Currents may reach a maximum flood velocity of 0.7 knots and maximum ebb velocity of 3.5 knots (Tides and Currents nautical software; station #1466; April 26, 2016 to April 26, 2017) in this part of Puget Sound. This station location is 3.7 miles west of Partridge Point and provides a rough approximation of water current velocities in this part of Puget Sound. Tides and Currents software does not provide a station estimate for the southern part of Saratoga Passage, where this geoduck tract is located.

Compact substrate and shell were both observed during dig sampling (Table 2). The surface substrate within this tract is primarily sand (Table 3). Sand was observed as the

dominant substrate type on 70 out of 70 transects.

Water Quality:

The Washington Department of Health (DOH) has classified this tract as Approved for commercial shellfish harvest. An area East of this tract is classified by DOH as "Prohibited" for commercial shellfish harvest and is not included as a part of the commercial tract area. DNR will verify the health status of the Langley North tract prior to any state monitored commercial geoduck harvest.

The following data on water quality has been provided by the Washington Department of Ecology (DOE) for Admiralty Inlet (ADM 002) at 48.1875° N. latitude; 122.8417° W. longitude. The DOE latitude and longitude positions are recorded in decimal degrees. For 2008 (most recently completed data year available) at water depths between 30 to 69 feet, the mean reported dissolved oxygen concentration was 6.8 mg/l with a range between 5.2 mg/l to 8.2 mg/l. The mean salinity at this station was 31.1 psu with a range between 30.7 psu to 31.6 psu. The mean water temperature at this DOE station in 2008 was 47.7°F with a range of temperatures between 45.5°F to 50.4°F.

Biota:

Geoduck:

The Langley North geoduck tract proposed harvest area is approximately 132 subtidal acres and currently contains an estimated biomass of 196,812 pounds of geoducks (Table 1). The current biomass estimate is made by subtracting harvest from the 2012 pre-fishing biomass estimate. The tract was surveyed in 2003 and 2012 by WDFW and transect locations are depicted in Figure 3. The results of the 2003 and 2012 surveys are used in the preparation of this environmental assessment (2003 dig station data and 2012 transect data). Eight geoduck dig stations were rated "very easy" or "easy" to dig. Three dig stations (#s 8, 41, and 71) had a rating of "some difficulty" in digging; with depth in substrate, compact, shell, and turbidity listed as characteristics that hindered digging (Table 2). The abundance of geoducks in this harvest area is very low, with an estimated

average density of 0.017 geoducks/sq.ft. The geoduck density on survey transects range between 0.0015 to 0.0637 geoducks/sq.ft. (Table 3). The average weight of geoducks at the Langley North tract is 1.99 pounds, which is similar to the average weight of geoducks throughout Puget Sound at 2.1 pounds. The weights of geoducks within this tract are variable. The lowest average whole weight is 1.54 pounds per geoduck at station #28 and the highest average whole weight is 2.64 pounds per geoduck at station #75 (Table 4). Transect start positions and individual transect counts from the 2012 survey are referenced 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 commercially available portion of the total Puget Sound population includes geoducks that are found in water depths between the -18 feet and -70 feet (MLLW) contours. 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 primarily to geoduck's low rate of natural recruitment. WDFW has studied the regeneration rate of geoducks on certain previously harvested tracts scattered throughout Puget Sound. The estimated average time to regenerate a new crop of geoducks after removal of 100% of the original geoducks on a tract is 39 years. The longest regeneration time is 73 years, and the shortest regeneration time is 11 years. In actual fishing 100% of the geoducks are never removed from a tract. The average percentage of removal of the tracts mentioned above was 69%. Over the last decade, regeneration of geoduck tracts may have been affected by illegal harvest or other causes of geoduck mortality. The regeneration 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, such as rockfish and lingcod. The bottoms are relatively flat and composed of soft sediments which provide few attachments for macroalgae, which also is associated with rockfish and lingcod. Various species of fish were observed during the 2012 survey at the Langley North tract including skate egg cases, unspecified flatfish, sculpins, starry flounders, sand dabs, skates, rock soles, and unspecified rockfish (Table 6).

WDFW marine fish managers were asked of their concerns of any possible impacts on groundfish and baitfish that geoduck fishing would have. 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 should be preserved for any spawning herring. There are no Pacific herring spawning grounds along the shoreline in the vicinity of the Langley North tract. The closest documented herring spawning grounds are located in Holmes Harbor, at Camano Head, and in Tulalip Bay (Figure 4-a). These documented herring spawning grounds are about 0.5, 1.6, and 4.1 miles, respectively, from the Langley North geoduck tract. As a precautionary measure, the Langley North 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 eelgrass beds (a known herring spawning substrate and important subtidal habitat) and geoduck harvest.

Surf smelt spawning has not been documented in the immediate vicinity of the Langley North tract (Figure 4-b), (http://wdfw.wa.gov/fish/forage/graphics/smeltgnd.gif). 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. In general, there is substantial vertical separation between surf smelt spawning (slack high tide) and geoduck harvest activity (-18 ft. to -70 ft., MLLW).

Sand lance spawning has been documented in the vicinity of the Langley North tract (Figure 4-b), (http://wdfw.wa.gov/fish/forage/graphics/lancegnd.gif). Sand lance

populations are widespread within Puget Sound, the Strait of Juan de Fuca and the coastal estuaries of Washington. 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 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 about 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 lance are a significant component in the diet of many economically important resources in Washington. On average, 35% of juvenile salmon diets are comprised of sand lance. Sand lances are particularly important to juvenile chinook salmon, where 60% of their diet is comprised of sand lance. 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 (-18 ft. to -70 ft., MLLW). Geoduck fishing on the Langley North 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 rockfish as "endangered" under ESA (federal Endangered Species Act). The listing 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. 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 "threatened" species under the federal ESA. Critical habitat for summer run chum salmon populations include all marine, estuarine, and river reaches accessible to the listed chum salmon between Dungeness Bay and Hood Canal and 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 out-migration may be as late as mid-April. The Langley North 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.

There are two main Puget Sound chinook salmon spawning tributaries in the vicinity of the Langley North tract, the Stillaguamish and Snohomish rivers. Sub-tributaries of the Stillaguamish River have spring runs with natural production and 5-year geometric means ranging from 155 to 953. The main tributary run may be extinct. Sub-tributaries of the Snohomish river have spring, summer, summer/fall, and fall runs. The origin and production is natural and wild with a status of depressed. The main tributary run is considered to be extinct. Sub-tributaries of the Snohomish River have 5-year geometric means ranging from 664 to 1,474. The mouth of the Stillaguamish river is about 11 miles from the Langley North geoduck tract. The Snohomish river sloughs range from about 5.5 to 6 miles from the Langley North geoduck tract.

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) water depth 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 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 impacts on salmon populations.

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. 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. The horizontal separation between the tributaries that support a steelhead run and the Langley North tract will assure that geoduck harvest will likely have no impact on steelhead 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 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 Langley North geoduck tract is at the fringe of the critical habitat range of green sturgeon. There are no reports of green sturgeon inhabiting major tributaries (Stillaguamish and Snohomish rivers) in the same marine basin as the Langley North tract. Further, nocturnal behavioral activities of juvenile green sturgeons (Deng *et al.* 2002) are temporally separate from daylight geoduck harvest activity, and interactions would not be expected. During the winter, juveniles select low light habitat, likely deep pools with some rock structure. Wintering juveniles forage actively at night between dusk and dawn and are inactive during the day, seeking the darkest available habitat.

Based on horizontal separation between geoduck harvest at the Langley North tract and green sturgeon spawning habitat, nocturnal foraging behaviors of juvenile green sturgeon, and use of a hand operated gear type that is selective for geoduck clams, we anticipate no adverse effects on ESA recovery efforts for green sturgeon populations.

Invertebrates:

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

> Mollusks (nudibranchs, horse clams, jingleshell oysters, stubby squid, and geoducks); echinoderms (sunflower stars, short-spined stars, sand stars, and brittle stars); unspecified annelid worms; cnidarians (sea pens, burrowing anemones, and plumed anemones); tunicates, and crustaceans (Dungeness crabs, red rock crabs, hermit crabs, and shrimp).

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.

WDFW and DNR have studied the effects of geoduck harvest on the population of Dungeness crab at Thorndyke Bay in Hood Canal. The results of 4.6 years of study have shown no adverse effects on crab populations due to geoduck fishing. Dungeness crab are found on this tract in high abundance. Dungeness crab were observed on 63 of 70 total transects (900 sq. ft./transect) during the 2012 biological survey of this harvest area, or 90% of transects done in this area.

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 out to -360 ft.(MLLW) water depth contour (Figure 5, Dungeness Crab Habitat Map). Dr. Dave Armstrong at the University of Washington has determined that Dungeness crab utilize Puget Sound bottoms from the +1 ft. level out to the -330 ft. level. The entire crab habitat along this tract is approximately 828 acres. There were about 110,839 harvestable geoducks in the entire 132 acre tract harvest area, from the 2012 pre-fishing survey estimate. With a harvest of 85%, the total number harvested would be 94,213 geoducks. Approximately 1.18 square feet of substrate is disturbed for every geoduck harvested, so 94,213 x 1.18 =

111,171 square feet of substrate disturbed. This equals about 2.6 acres. This is about 0.31%, less than 1%, of the total available crab habitat in the vicinity of this tract. Based on the low amount of disturbance, plus the lack of effects observed at the Thorndyke Bay study, we conclude that any effects on Dungeness crab will be very minor, if they occur at all. Don Rothaus of WDFW (personal communication, 2/6/14) indicates that Dungeness crab may be in soft shell condition between mid-March through mid-June and that it would benefit crab if geoduck harvest occurred outside of this molt-period, when crab are vulnerable.

Aquatic Plants:

Large attached aquatic plants are not generally found in geoduck beds in large quantities. Light restriction often limits plant growth to areas shallower than where most geoduck harvest occurs. The only aquatic plants observed during the geoduck survey at Langley North tract were foliose green algae, unspecified small red algae and a diffuse diatom layer (Table 7).

John Boettner and Tim Flint, from the WDFW Habitat Division, have stated that as long as geoduck fishing was restricted seaward of the eelgrass beds they have no concerns about the fishing. This was confirmed by WDFW Habitat Division who stated that the existing conditions in the fishery Final Supplemental Environmental Impact Statement (FSEIS) are sufficient to protect fish and wildlife habitat and natural resources. 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 on May 8, 2003 by WDFW divers swimming the entire shoreward boundary of the tract along the -16 ft. (MLLW) water depth contour. Eelgrass was documented at a maximum depth of -16 ft. (MLLW) during this survey. The shoreward boundary of this tract will be no shallower than the -18 ft. water depth contour (MLLW), which should provide sufficient buffer to minimize geoduck harvest impacts to any eelgrass beds in the vicinity of this 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. During the spring (March-May) a small

number of gray whales may be in the vicinity of the Langley North geoduck tract, *en route* to feeding grounds in Saratoga Passage, Port Susan and Skagit Bay.

Killer whales may also be observed in the vicinity of this tract. The Southern Resident stock of killer whales resides mainly in the San Juan Islands throughout spring and summer (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 (http://www.nwr.noaa.gov/Marine-Mammals/Whales-Dolphins-Porpoise/Killer-Whales/ESA-Act-Status/Listing-Final.cfm). 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). 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, dabbing 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 the 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 upland properties adjacent to this tract are designated as urban and residential shoreline environments, with marine fish and wildlife habitat conservation areas. Subtidal areas located at -60 ft. (MLLW) water depth contour and deeper are designated aquatic shoreline environment. 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:

Recreational fishing occurs in proximity to this geoduck tract. Recreational fishing is open year round for surfperch. Rockfish fishing is closed. Lingcod can only be taken May 1 to June 15 by hook and line or May 21 to June 15 by spearfishing. The WDFW 2015/2016 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 is a popular location for both recreational and commercial Dungeness crab fishing. 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 North 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:

Saratoga Passage is used by recreational and commercial vessels traveling into and from the San Juan Islands, Strait of Juan de Fuca, and Puget Sound. The passage is not a major shipping lane. The relatively shallow nature of geoduck harvesting should reduce the risk of any significant navigational conflicts. The Washington Department of Natural

Resources will notify the local boating community prior to any state supervised geoduck harvest.

Summary:

The commercial geoduck harvest is proposed for one tract along the eastern shoreline of Whidbey Island. The most recent tract survey occurred in 2012 by WDFW. The current biomass estimate for the 132 acre harvest area is 196,812 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. (MLLW) water depth contour along the tract. To reduce potential impacts to Dungeness crab, geoduck harvest should be avoided between March 15 through June 15. No significant impacts are expected from this harvest.

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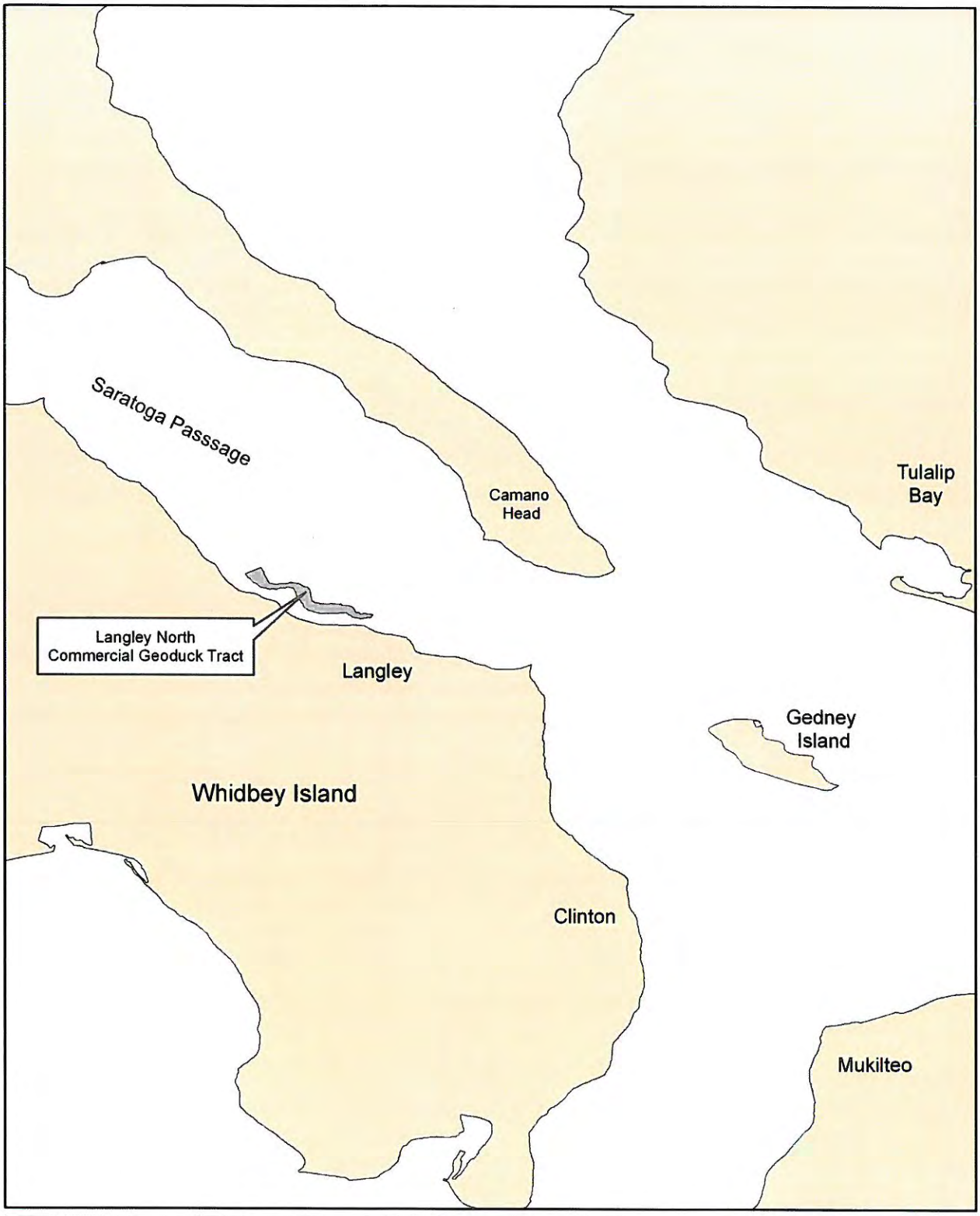
# Figure 1. Tract Vicinity Map, Langley North Commercial Geoduck Tract #03550

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1:150,000
1 inch = 2.37 miles

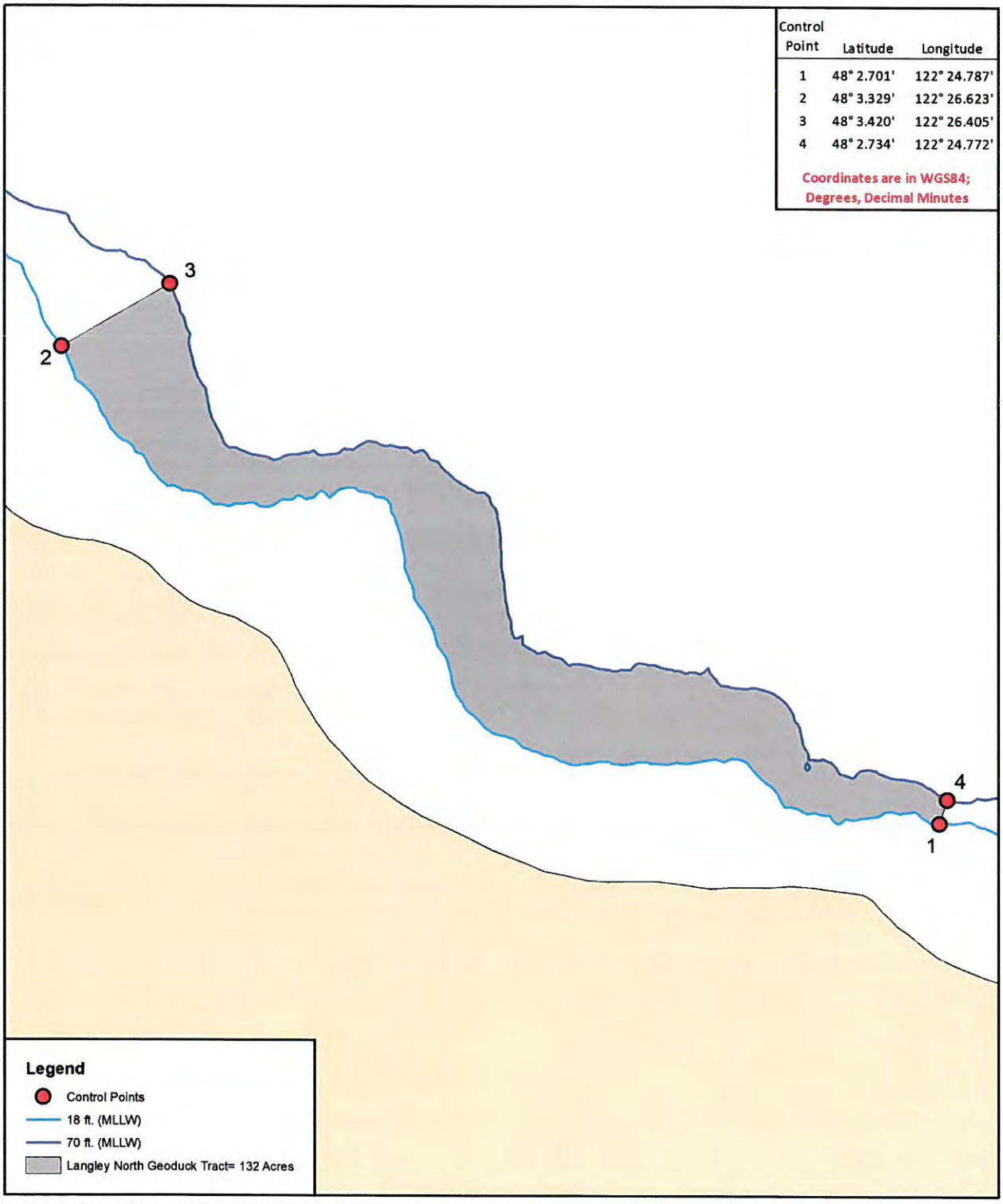
Data Sources:
Projection for data is GCS_Washington Geographic System 1984, Units: Meters. Coastline layer is from DNR, 1: 24,000 scale, created 09-20-99. Contours are from NOAA soundings.

0 1 2 4 6 Miles

Washington Department of FISH and WILDLIFE

Map Date: July 21, 2010
Map Author: O. Eveningsong
File: Data\Ocean\Geoduck

# Figure 2. Control Points Map, Langley North Commercial Geoduck Tract #03550

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1 inch = 0.24 miles

Data Sources:
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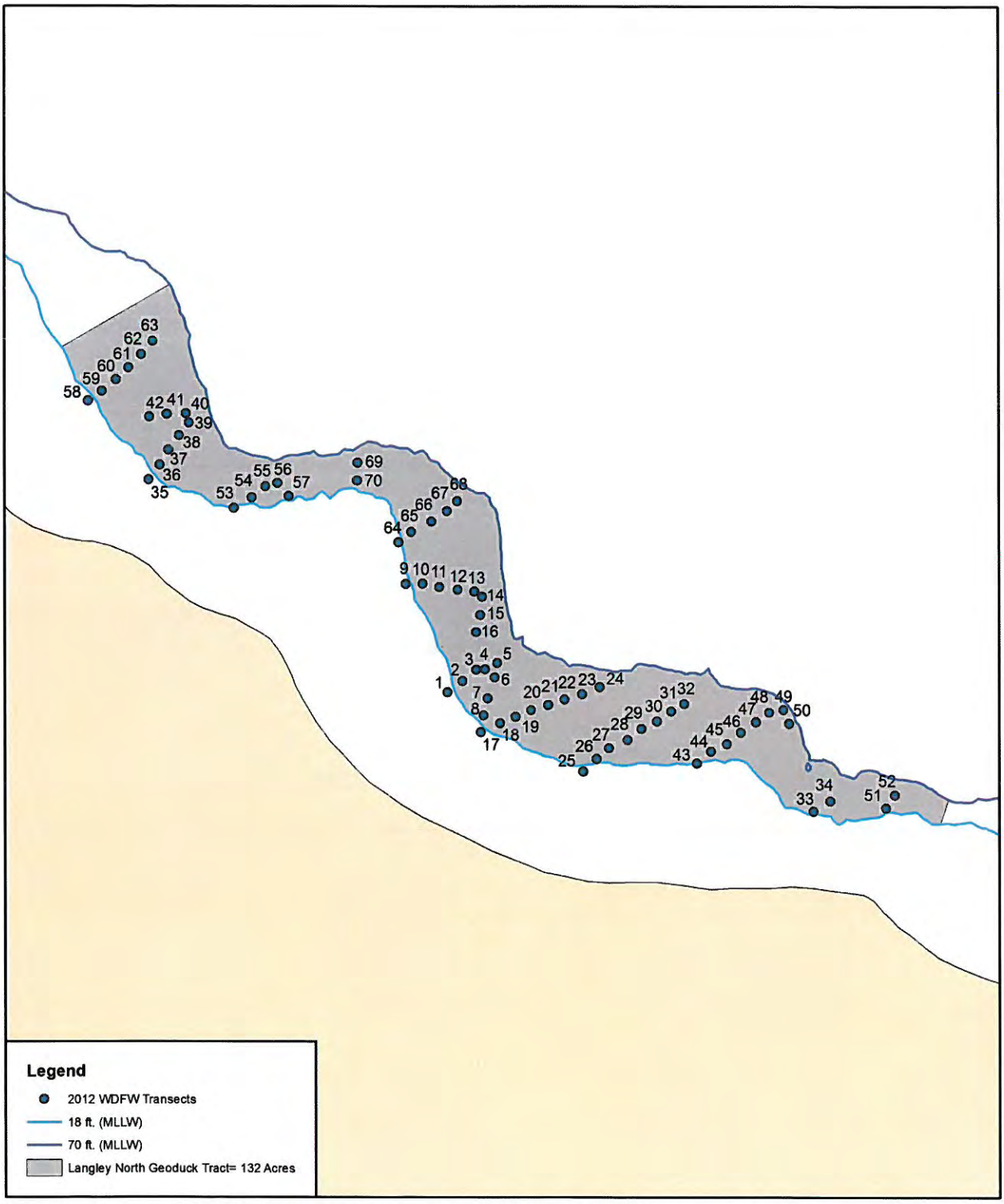
0 0.075 0.15 0.3 0.45 Miles

Washington Department of FISH and WILDLIFE

Map Date: January 29, 2014
Map Author: O. Eveningsong
File: Data\Ocean\Geoduck

# Figure 3. Transect Map, Langley North Commercial Geoduck Tract #03550

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1 inch = 0.24 miles

Data Sources:
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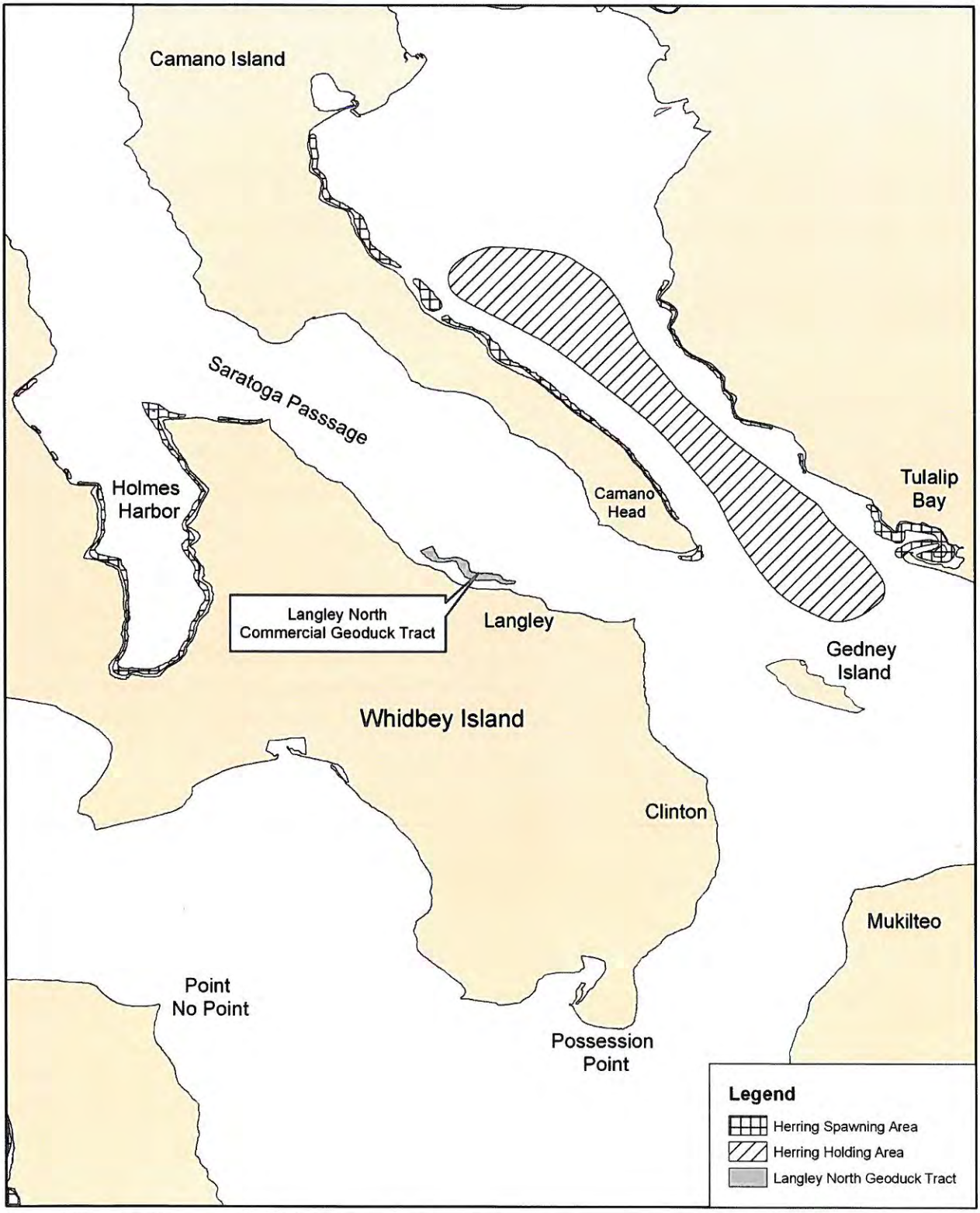
0 0.075 0.15 0.3 0.45 Miles

Washington Department of FISH and WILDLIFE

Map Date: January 29, 2014
Map Author: O. Eveningsong
File: Data\Ocean\Geoduck

# Figure 4-a. Herring Spawning Areas Near the Langley North Commercial Geoduck Tract #03550

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1 inch = 3.16 miles

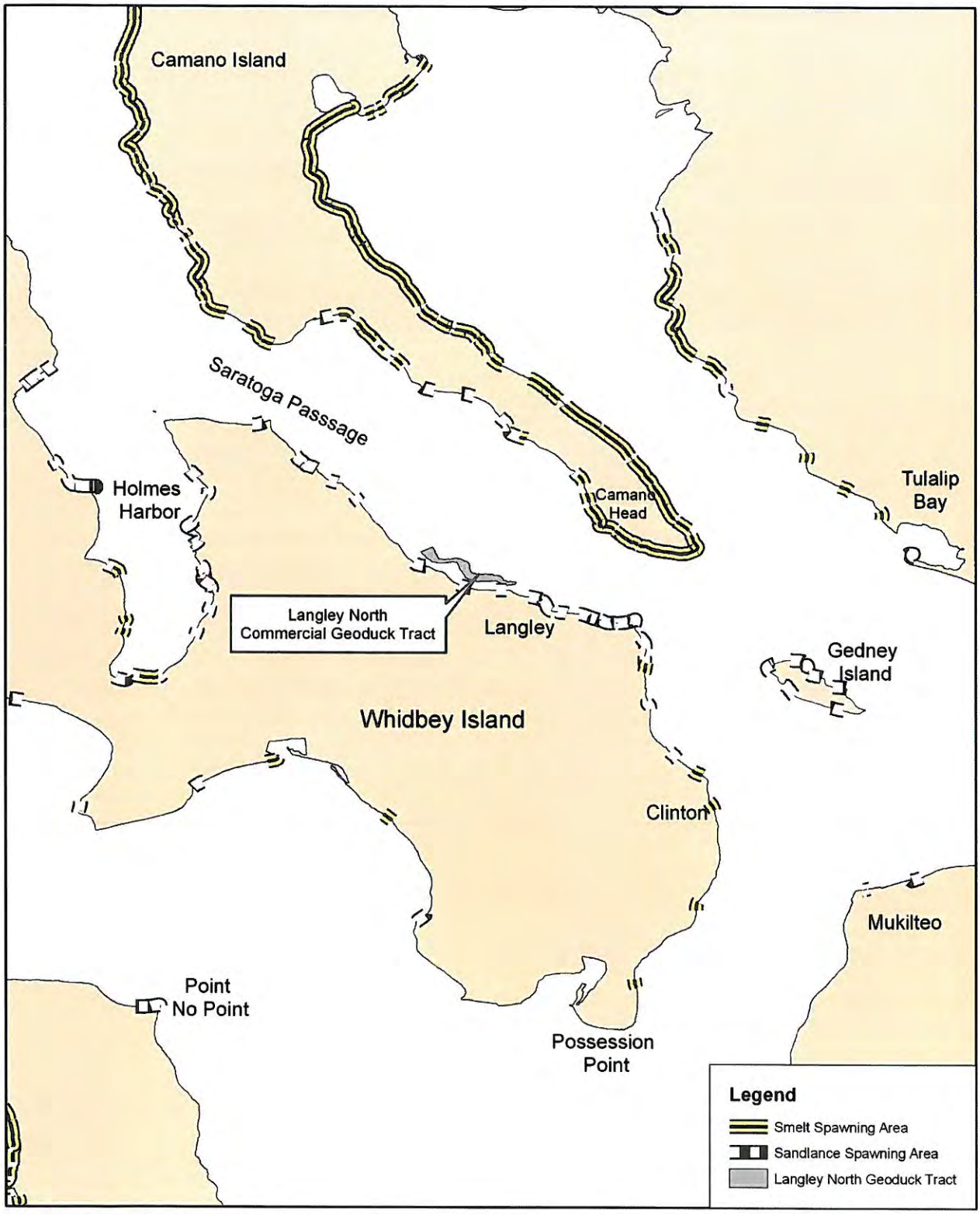
Data Sources:
Projection for data is GCS_Washington Geographic System 1984, Units: Meters. Coastline layer is from DNR, 1: 24,000 scale, created 09-20-99. Contours are from NOAA soundings.

0 1.5 3 6 9 Miles

Washington Department of FISH and WILDLIFE

Map Date: July 21, 2010
Map Author: O. Eveningsong
File: Data\Ocean\Geoduck

# Figure 4-b. Smelt/ Sandlance Spawning Areas Near the Langley North Commercial Geoduck Tract #03550

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1 inch = 3.16 miles

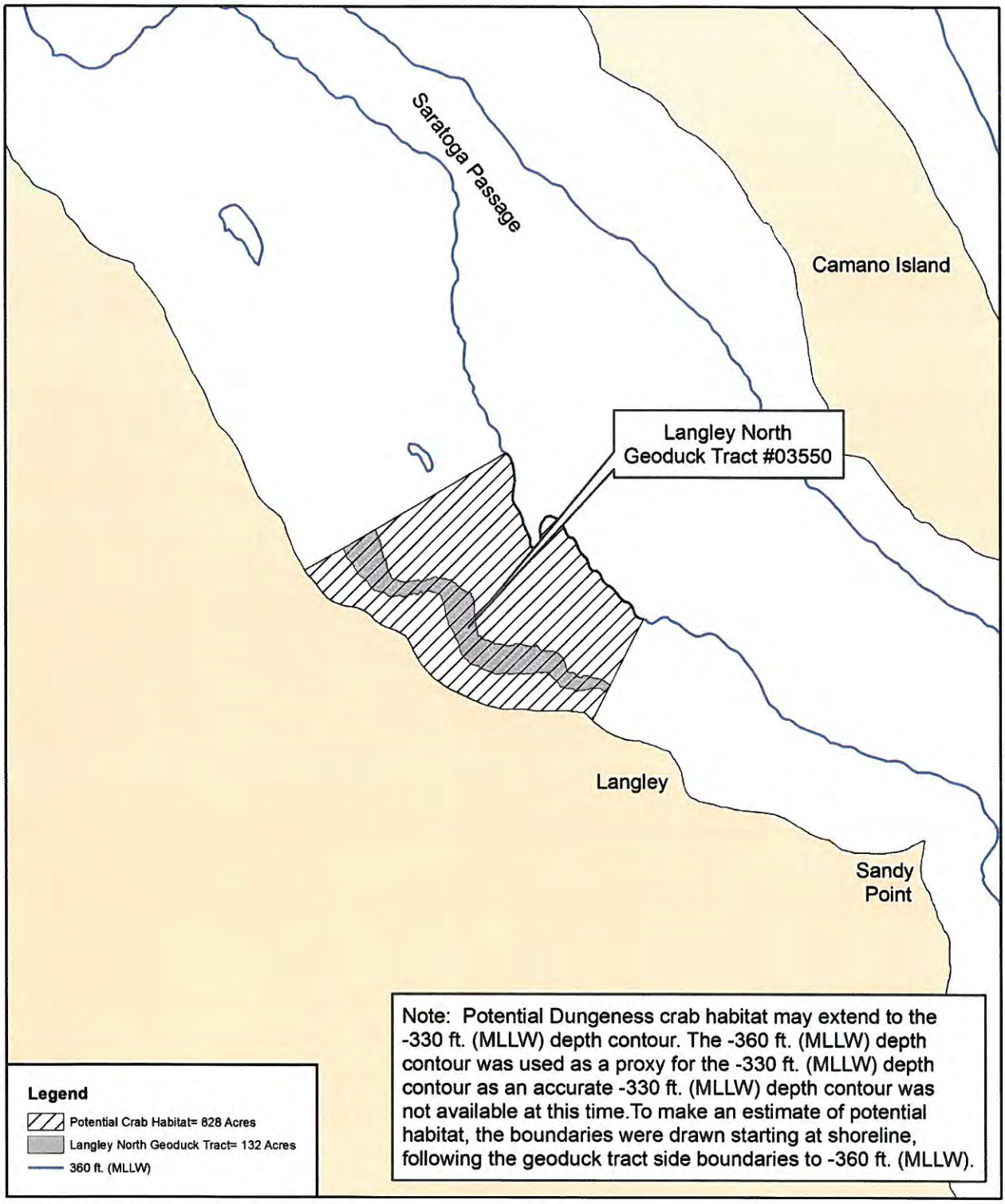
Data Sources:
Projection for data is GCS_Washington Geographic System 1984, Units: Meters. Coastline layer is from DNR, 1: 24,000 scale, created 09-20-99. Contours are from NOAA soundings.

0 1.5 3 6 9 Miles

Washington Department of FISH and WILDLIFE

Map Date: July 21, 2010
Map Author: O. Eveningsong
File: Data\Ocean\Geoduck

# Figure 5. Potential Dungeness Crab Habitat Map, Langley North Commercial Geoduck Tract #03550

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1:50,000
1 inch = 0.79 miles

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 0.25 0.5 1 1.5 Miles

Washington Department of FISH and WILDLIFE

Map Date: February 6, 2014
Map Author: O. Eveningsong
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## 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 Plants Observed**

This table summarizes marine plants 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**

Langley North geoduck tract # 03550.

| | |
|---|---|
| Tract Name | Langley North |
| Tract Number | 3550 |
| Tract Size (acres)[a] | 132 |
| Density of geoducks/sq.ft.[b] | 0.017 |
| Total Tract Biomass (lbs.)[b] | 196,812 |
| Total Number of Geoducks on Tract[b] | 99,109 |
| Confidence Interval (%) | 20.5% |
| Mean Geoduck Whole Weight (lbs.) | 1.99 |
| Mean Geoduck Siphon Weight (lbs.) | 0.50 |
| Siphon Weight as a % of Whole Weight | 25% |
| Number of Transect Stations | 70 |
| Number of Geoducks Weighed | 107 |

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

[b.] Biomass is based on the 2012 and 2003 WDFW pre-fishing geoduck survey biomass of 220,105 lbs. minus harvest of 23,293 lbs. through August, 2015

| | |
|---|---|
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**Table 2: DIGGING DIFFICULTY TABLE**

Langley North geoduck tract # 03550, 2003 WDFW 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) |
|---|---|---|---|---|---|---|---|---|---|
| 21 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | Y |
| 28 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | Y |
| 33 | 1 | 1 | 2 | 0 | 0 | 0 | 1 | 0 | Y |
| 60 | 1 | 1 | 2 | 1 | 0 | 0 | 1 | 0 | Y |
| 71 | 2 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | Y |
| 8 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | Y |
| 41 | 2 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | Y |
| 46 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | Y |
| 55 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | Y |
| 75 | 1 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | Y |
| 82 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | Y |

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

Langley North geoduck tract # 03550, 2012 WDFW pre-fishing geoduck survey

| Transect | Start Depth (ft) [a] | End Depth (ft) [a] | Geoduck Density (no. / sq ft) [b] | Substrate [c] sand | wood debris |
|---|---|---|---|---|---|
| 1 | 20 | 33 | 0.0193 | 2 | |
| 2 | 32 | 44 | 0.0207 | 2 | |
| 3 | 44 | 57 | 0.0207 | 2 | |
| 4 | 57 | 61 | 0.0089 | 2 | |
| 5 | 61 | 54 | 0.0059 | 2 | |
| 6 | 54 | 41 | 0.0059 | 2 | |
| 7 | 41 | 31 | 0.0252 | 2 | |
| 8 | 30 | 20 | 0.0104 | 2 | |
| 9 | 20 | 29 | 0.0178 | 2 | |
| 10 | 29 | 36 | 0.0237 | 2 | |
| 11 | 36 | 43 | 0.0326 | 2 | |
| 12 | 43 | 52 | 0.0193 | 2 | |
| 13 | 52 | 55 | 0.0119 | 2 | |
| 14 | 55 | 53 | 0.0074 | 2 | |
| 15 | 53 | 49 | 0.0148 | 2 | |
| 16 | 49 | 44 | 0.0281 | 2 | |
| 17 | 20 | 29 | 0.0178 | 2 | |
| 18 | 29 | 35 | 0.0178 | 2 | |
| 19 | 35 | 41 | 0.0637 | 2 | |
| 20 | 41 | 45 | 0.0356 | 2 | |
| 21 | 45 | 49 | 0.0163 | 2 | |
| 22 | 49 | 53 | 0.0163 | 2 | |
| 23 | 53 | 59 | 0.0119 | 2 | |
| 24 | 63 | 63 | 0.0074 | 2 | |
| 25 | 20 | 27 | 0.0089 | 2 | |
| 26 | 27 | 33 | 0.0222 | 2 | |
| 27 | 32 | 38 | 0.0193 | 2 | |
| 28 | 38 | 44 | 0.0281 | 2 | |
| 29 | 44 | 48 | 0.0252 | 2 | |
| 30 | 48 | 53 | 0.0104 | 2 | |
| 31 | 53 | 57 | 0.0104 | 2 | |
| 32 | 57 | 63 | 0.0015 | 2 | |
| 33 | 19 | 43 | 0.0089 | 2 | |
| 34 | 43 | 59 | 0.0044 | 2 | |
| 35 | 21 | 36 | 0.0089 | 2 | |
| 36 | 36 | 44 | 0.0281 | 2 | 1 |
| 37 | 44 | 51 | 0.0059 | 2 | |
| 38 | 52 | 60 | 0.0044 | 2 | |
| 39 | 60 | 60 | 0.0015 | 2 | |
| 40 | 60 | 53 | 0.0030 | 2 | |
| 41 | 53 | 47 | 0.0044 | 2 | |
| 42 | 47 | 41 | 0.0237 | 2 | |

**Table 4: GEODUCK SIZE AND QUALITY**

Langley North geoduck tract # 03550, 2003 WDFW pre-fishing geoduck survey

| Dig Station | Number Dug | Avg. Whole Weight (lbs.) | Avg. Siphon Weight (lbs.) | % of geoducks on station greater than 2 lbs. |
|---|---|---|---|---|
| 21 | 10 | 1.77 | 0.50 | 40% |
| 28 | 12 | 1.54 | 0.38 | 0% |
| 33 | 10 | 2.36 | 0.57 | 75% |
| 60 | 10 | 2.53 | 0.69 | 90% |
| 71 | 10 | 1.98 | 0.52 | 44% |
| 8 | 10 | 1.66 | 0.37 | 20% |
| 41 | 9 | 1.66 | 0.39 | 30% |
| 46 | 10 | 2.21 | 0.57 | 60% |
| 55 | 10 | 1.59 | 0.33 | 20% |
| 75 | 11 | 2.64 | 0.77 | 91% |
| 82 | 10 | 1.59 | 0.38 | 30% |

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

Langley North geoduck tract # 03550, 2012 WDFW pre-fishing geoduck survey

| Transect | Corrected Geoduck Count per 900 sq. ft. Transect | Geoduck Siphon Show Factor [a] | Latitude [b] | Longitude [b] |
|---|---|---|---|---|
| 1 | 17 | 0.75 | 48° 02.866 | 122° 25.812 |
| 2 | 19 | 0.75 | 48° 02.882 | 122° 25.781 |
| 3 | 19 | 0.75 | 48° 02.898 | 122° 25.753 |
| 4 | 8 | 0.75 | 48° 02.899 | 122° 25.735 |
| 5 | 5 | 0.75 | 48° 02.908 | 122° 25.710 |
| 6 | 5 | 0.75 | 48° 02.888 | 122° 25.715 |
| 7 | 23 | 0.75 | 48° 02.859 | 122° 25.728 |
| 8 | 9 | 0.75 | 48° 02.835 | 122° 25.736 |
| 9 | 16 | 0.75 | 48° 03.014 | 122° 25.904 |
| 10 | 21 | 0.75 | 48° 03.015 | 122° 25.869 |
| 11 | 29 | 0.75 | 48° 03.011 | 122° 25.834 |
| 12 | 17 | 0.75 | 48° 03.008 | 122° 25.796 |
| 13 | 11 | 0.75 | 48° 03.006 | 122° 25.761 |
| 14 | 7 | 0.75 | 48° 02.999 | 122° 25.745 |
| 15 | 13 | 0.75 | 48° 02.974 | 122° 25.748 |
| 16 | 25 | 0.75 | 48° 02.950 | 122° 25.755 |
| 17 | 16 | 0.75 | 48° 02.812 | 122° 25.741 |
| 18 | 16 | 0.75 | 48° 02.825 | 122° 25.701 |
| 19 | 57 | 0.75 | 48° 02.834 | 122° 25.669 |
| 20 | 32 | 0.75 | 48° 02.844 | 122° 25.637 |
| 21 | 15 | 0.75 | 48° 02.852 | 122° 25.602 |
| 22 | 15 | 0.75 | 48° 02.860 | 122° 25.569 |
| 23 | 11 | 0.75 | 48° 02.868 | 122° 25.533 |
| 24 | 7 | 0.75 | 48° 02.878 | 122° 25.497 |
| 25 | 8 | 0.75 | 48° 02.761 | 122° 25.527 |
| 26 | 20 | 0.75 | 48° 02.779 | 122° 25.500 |
| 27 | 17 | 0.75 | 48° 02.794 | 122° 25.475 |
| 28 | 25 | 0.75 | 48° 02.806 | 122° 25.438 |
| 29 | 23 | 0.75 | 48° 02.822 | 122° 25.410 |
| 30 | 9 | 0.75 | 48° 02.833 | 122° 25.378 |
| 31 | 9 | 0.75 | 48° 02.847 | 122° 25.350 |
| 32 | 1 | 0.75 | 48° 02.858 | 122° 25.323 |
| 33 | 8 | 0.75 | 48° 02.714 | 122° 25.049 |
| 34 | 4 | 0.75 | 48° 02.729 | 122° 25.015 |
| 35 | 8 | 0.75 | 48° 03.149 | 122° 26.438 |
| 36 | 25 | 0.75 | 48° 03.170 | 122° 26.416 |
| 37 | 5 | 0.75 | 48° 03.191 | 122° 26.399 |
| 38 | 4 | 0.75 | 48° 03.211 | 122° 26.378 |
| 39 | 1 | 0.75 | 48° 03.229 | 122° 26.358 |
| 40 | 3 | 0.75 | 48° 03.242 | 122° 26.365 |
| 41 | 4 | 0.75 | 48° 03.240 | 122° 26.404 |
| 42 | 21 | 0.75 | 48° 03.236 | 122° 26.440 |
| 43 | 15 | 0.75 | 48° 02.776 | 122° 25.294 |

**Table 5. Continued**

| Transect | Corrected Geoduck Count per 900 sq. ft. Transect | Geoduck Siphon Show Factor [a] | Latitude [b] | Longitude [b] |
|---|---|---|---|---|
| 44 | 39 | 0.75 | 48° 02.793 | 122° 25.266 |
| 45 | 67 | 0.75 | 48° 02.804 | 122° 25.233 |
| 46 | 36 | 0.75 | 48° 02.820 | 122° 25.205 |
| 47 | 16 | 0.75 | 48° 02.835 | 122° 25.174 |
| 48 | 1 | 0.75 | 48° 02.849 | 122° 25.147 |
| 49 | 5 | 0.75 | 48° 02.853 | 122° 25.117 |
| 50 | 8 | 0.75 | 48° 02.834 | 122° 25.104 |
| 51 | 40 | 0.75 | 48° 02.721 | 122° 24.900 |
| 52 | 17 | 0.75 | 48° 02.739 | 122° 24.882 |
| 53 | 32 | 0.75 | 48° 03.113 | 122° 26.261 |
| 54 | 9 | 0.75 | 48° 03.128 | 122° 26.226 |
| 55 | 0 | 0.75 | 48° 03.144 | 122° 26.198 |
| 56 | 3 | 0.75 | 48° 03.149 | 122° 26.173 |
| 57 | 3 | 0.75 | 48° 03.131 | 122° 26.149 |
| 58 | 7 | 0.75 | 48° 03.256 | 122° 26.566 |
| 59 | 20 | 0.75 | 48° 03.270 | 122° 26.538 |
| 60 | 35 | 0.75 | 48° 03.286 | 122° 26.510 |
| 61 | 8 | 0.75 | 48° 03.303 | 122° 26.485 |
| 62 | 8 | 0.75 | 48° 03.322 | 122° 26.460 |
| 63 | 1 | 0.75 | 48° 03.341 | 122° 26.437 |
| 64 | 44 | 0.75 | 48° 03.071 | 122° 25.921 |
| 65 | 52 | 0.75 | 48° 03.086 | 122° 25.895 |
| 66 | 43 | 0.75 | 48° 02.101 | 122° 25.865 |
| 67 | 36 | 0.75 | 48° 02.116 | 122° 25.832 |
| 68 | 8 | 0.75 | 48° 03.130 | 122° 25.801 |
| 69 | 11 | 0.75 | 48° 03.180 | 122° 26.009 |
| 70 | 40 | 0.75 | 48° 03.155 | 122° 26.009 |

[a.] The default 0.75 show factor was used to correct 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**

Langley North geoduck tract # 03550, 2012 WDFW pre-fishing geoduck survey

| # of Transects where Observed | Group | Common Name | Taxonomer |
|---|---|---|---|
| 2 | ANEMONE | BURROWING ANEMONE | *Pachycerianthus fimbriatus* |
| 67 | ANEMONE | PLUMED ANEMONE | *Metridium* spp. |
| 5 | ASCIDIAN | SESSILE TUNICATE | Unspecified Tunicate |
| 3 | BIVALVE | HORSE CLAM | *Tresus* spp. |
| 1 | BIVALVE | JINGLESHELL OYSTER | *Pododesmus macrochisma* |
| 1 | CEPHALOPOD | STUBBY SQUID | *Rossia pacifica* |
| 25 | CNIDARIA | SEA PEN | *Ptilosarcus gurneyi* |
| 63 | CRAB | DUNGENESS CRAB | *Cancer magister* |
| 70 | CRAB | HERMIT CRAB | Unspecified hermit crab |
| 1 | CRAB | RED ROCK CRAB | *Cancer productus* |
| 7 | FISH | FLATFISH | Unspecified flatfish |
| 1 | FISH | ROCK SOLE | *Lepidopsetta bilineata* |
| 1 | FISH | ROCKFISH | Unspecified *Sebastes* spp. |
| 3 | FISH | SANDDAB | *Citharichthys* spp. |
| 6 | FISH | SCULPIN | Unspecified Cottidae |
| 2 | FISH | SKATE | Unspecified *Raja* spp. |
| 5 | FISH | STARRY FLOUNDER | *Platichthys stellatus* |
| 9 | FISH EGGS | SKATE EGG CASE | *Raja* spp. egg case |
| 2 | NUDIBRANCH | ARMINA | *Armina californica* |
| 22 | NUDIBRANCH | HERMISSENDA | *Hermissenda crassicornis* |
| 6 | SEA STAR | BRITTLE STAR | Unspecified brittle star |
| 12 | SEA STAR | SAND STAR | *Luidia foliolata* |
| 31 | SEA STAR | SHORT-SPINED STAR | *Pisaster brevispinus* |
| 29 | SEA STAR | SUNFLOWER STAR | *Pycnopodia helianthoides* |
| 14 | SHRIMP | SHRIMP | Unspecified shrimp |
| 26 | WORM | SABELLID TUBE WORM | *Sabellid* spp. |
| 7 | WORM | TEREBELLID TUBE WORM | *Terebellid* spp. |

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**Table 7: MOST COMMON AND OBVIOUS PLANTS OBSERVED**
Langley North geoduck tract # 03550, 2012 WDFW pre-fishing geoduck surveys

| # of Transects Where Observed | Taxonomer |
|---|---|
| 66 | Diatoms |
| 11 | *Ulva* spp. |
| 2 | Unspecified small red algae |

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