ENVIRONMENTAL ASSESSMENT OF PROPOSED GEODUCK HARVEST ALONG THE EASTERN SHORELINE OF KITSAP PENINSULA, NEAR YUKON HARBOR, PUGET SOUND AT THE HARPER GEODUCK TRACT (#08340)

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 Kitsap Peninsula, near Yukon Harbor, Puget Sound, and is described below.

Proposed Harvest Dates: 2024-2025

Tract name: Harper geoduck tract (Tract #08340)

Description: (Figure 1, Tract vicinity map)

The Harper geoduck tract is a subtidal area with a proposed harvest area of approximately 131 acres (Table 1) along the eastern shoreline of Kitsap Peninsula, in Yukon Harbor, Puget Sound in the Central Puget Sound Geoduck Management Region. The southern boundary of the tract begins approximately 1,550 yards northwest of Point Southworth and continues westerly approximately 2,280 yards. The commercial tract area lies between the -19 ft. and the -70 ft. Mean Lower Low Water (MLLW) water depth contours.

The harvest area is bounded by a line projected from a point on the -19 foot (MLLW) water depth contour in the southeastern corner of the tract at 47°31.244’ N latitude, 122°30.246’ W longitude (CP 1) westerly along the -19 foot (MLLW) water depth contour to a point at 47°31.675’ N latitude, 122°31.801’ W longitude (CP 2); then northerly to a point on the -70 foot (MLLW) water depth contour at 47°31.865’ N latitude, 122°31.659’ W longitude (CP 3); then easterly along the -70 foot (MLLW) water depth contour to a point at 47°31.331’ N latitude, 122°30.246’ W longitude (CP 4); then southerly 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 -19 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 to moderate in the vicinity of the Harper tract. Currents reach a maximum flood velocity of 0.8 knots per hour and maximum ebb velocity of 0.9 knots (Tides and Currents software; station number 1731; southwest of Blake Island).

The subsurface substrate that hindered digging of geoducks during the 2009 Suquamish survey was gravel (Table 2). The surface substrates observed on this tract during the 2009 survey were mostly sand, with it being noted on 37 of 51 transects. During the 2009 survey, cobble was noted on 18 of 51 transects and mud was noted on 12 of 51 transects (Table 3-A). During the 2012 WDFW survey, sand and mud were the predominant substrates, with sand being the predominant substrate on 10 of 14 transects and mud being the predominant substrate on 4 of 14 transects (Table 3-B). Other substrate types including pea gravel, gravel, shell and boulder were also noted on several transects of the 2009 and 2012 surveys (Tables 3-A and 3-B).

Water Quality:

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

The following data on water quality has been provided by the Washington Department of Ecology (DOE) for the East Passage – Southwest of Three Tree Point station (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 (most recently completed data year available) at a water depth range of 7-20 meters, the mean reported water temperature at this station was 10.3 °C with a range from 8.7 to 13.6 °C. The mean salinity at this station was 29.5 psu with a range from 28.8 to 30.2 psu. The mean dissolved oxygen level at this station was 8.4 mg/l with a range from 6.7 to 11.9 mg/l.

Biota:

Geoduck:

The Harper geoduck tract proposed harvest area is approximately 131 acres. The abundance of geoducks in this harvest area is low with a current estimated average density of 0.13 geoducks/sq.ft. This area currently contains an estimated 1,472,168 pounds of geoducks (Table 1). This biomass estimate is made using 2009 Suquamish Tribe pre-fishing survey data, subtracting harvest that has occurred since the survey. At 3 of the 4 dig stations done in 2009, the geoducks were rated “very easy” to dig (Table 2). Abundance and depth in substrate were noted as the primary factors that may have hindered digging.

The average density from the 2009 pre-fishing survey ranges from 0.00 geoducks/sq.ft. on transects 65, 99, 109 and 110 to 1.20 geoducks/sq.ft. on transect #87 (Table 3-A). The average density from the 2012 supplemental pre-fishing survey ranges from 0.00 geoducks/sq.ft. on transects 1 and 9 to 0.24 geoducks/sq.ft. on transect 12 (Table 3-B). The average geoduck weight at the Harper tract is 1.99 pounds, which is slightly less than the average geoduck weight in Puget Sound of 2.1 pounds. Average geoduck whole weight ranged from 1.49 pounds at station 9 to 3.32 pounds at station 15 (Table 4). Geoduck counts corrected with siphon “show factors” and transect locations are listed in Table 5.

The Harper geoduck tract was surveyed in 1970 and 1980 by WDFW as part of the old Southworth tract (14 transects, 11 of which are within new configuration of tract; average density = 0.09). In 2009, the Suquamish Tribe conducted a pre-fishing survey (51 transects; Figure 3-A), and in 2012, WDFW conducted a supplemental survey (14 transects; Figure 3-B). The results of the 2009 and 2012 surveys are used in the preparation of this environmental assessment.

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 ft. and shallower than -70 ft. (corrected to mean lower low water - MLLW). Other geoducks which are not harvestable are found inshore and offshore of the harvest areas. Observations in south Puget Sound show that major geoduck populations continue to depths of 360 feet. Additional geoducks exist in polluted areas and are also unavailable for harvest, but continue to spawn and contribute to the total population.

The low rate of harvest is due to geoduck's low rate of natural recruitment. WDFW has studied the regeneration rate of geoducks on certain tracts throughout 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 Harper tract is unknown and 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, which provide few attachments for macroalgae that are often associated with many fish species. The fish observed during the 2017 Supplemental survey at the Harper tract were various species of flatfish, sculpins, perch and brown rockfish (Table 6).

WDFW marine fish managers were asked of their concerns regarding possible impacts of geoduck fishing on groundfish and baitfish. Greg Bargmann of WDFW stated that geoduck fishing would have no long-term detrimental impacts and may have some short term benefits to flatfish populations by increasing the availability of food. Dan Penttila of the WDFW Fish Management Program recommended that eelgrass beds within the harvest tract be preserved for any spawning herring. There are no Pacific herring spawning grounds along the shoreline in the vicinity of the Harper tract. As a precautionary measure, the Harper nearshore tract boundary will be along the -19 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 Harper tract 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 (-19 ft. to -70 ft., MLLW).

Sand lance spawning areas have been documented along the of the Harper 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 about the mean higher high water line. After deposition, sand lance eggs may be scattered over a wider range of the intertidal zone by wave action. The incubation period is approximately four weeks. Sand lances are an important part of the trophic link between zooplanktons and larger predators in the local marine food webs. Like all forage fish, sand 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 mean higher high water) and geoduck harvest activity (-19 ft. to -70 ft., MLLW). Due to vertical separation, geoduck fishing on the Harper 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 red 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 Harper 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 include 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 risk of extinction has decreased for all stocks (Adicks, K. *et al*., 2007). The Harper 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 Harper geoduck tract, which 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 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 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 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 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 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 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 a 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 of geoduck harvest (deeper and seaward of the -19 ft. MLLW contour) from juvenile salmon rearing areas and migration corridors (upper few meters of the water column) reduces or eliminates potential impacts to salmon populations. Charles Simenstad 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 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 Harper geoduck tract is outside of the critical habitat range of green sturgeon; therefore geoduck harvest at this location will have no adverse effects on ESA recovery efforts for green sturgeon populations.

Invertebrates:

Many different kinds of marine invertebrates, which are frequently found on geoduck beds, were observed on this tract during the 2012 survey. The most common and obvious groups include mollusks, crustaceans, echinoderms, cnidarians 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.

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 moderate numbers. Dungeness crab were observed on 7 of 15 transects (900 sq. ft./transect) during the 2012 WDFW biological survey of this harvest area, or 47% of transects done in this area. Dungeness crab which are present on the tract may experience peak molt in mid-April, based on data from the Kingston area (Cain, 10/15/01).

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

The entire crab habitat along this tract is approximately 791 acres. There were about 1,011,397 harvestable geoducks in the entire 131 acre tract harvest area, from the 2009 pre-fishing survey estimate. With a harvest of 65 percent, the total number harvested would be 657,408 geoducks. Approximately 1.18 square feet of substrate is disturbed for every geoduck harvested, so 657,408 x 1.18 = 775,741 square feet of substrate. This equals about 17.8 acres. This is about 2.3 percent 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.

Aquatic Algae:

Large attached aquatic algae are not generally found in geoduck beds in large quantities. Light restriction often limits algal growth to areas shallower than where most geoduck harvest occurs. Aquatic algae observed during the 2012 WDFW geoduck survey include *Saccharina latissima* and other Laminarian algae, *Ulva* (sea lettuce), *Desmarestia* algae, a diatom layer and small and large red algae (Table 7).

John Boettner and Tim Flint, from the WDFW Habitat Division, have stated that if geoduck fishing is restricted to seaward of the eelgrass beds, they have no concerns about the fishing and that the existing conditions in the fishery SEIS 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 at the Harper geoduck tract by the Suquamish Tribe. Eelgrass was found no deeper than 17'. The shoreward boundary of this tract will be no shallower than the -19 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). 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 behaviors 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 shoreline along the Harper geoduck tract is mostly designated as Semi-rural with a small portion as Conservancy (Kitsap County Shoreline Master Plan).

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 dB below the state noise standard.

Fishing:

The waters in the vicinity of this geoduck tract (in Marine Area 10) are not prime sport fishing areas, however, some recreational salmon fishing for blackmouth and silvers 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 Central 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:

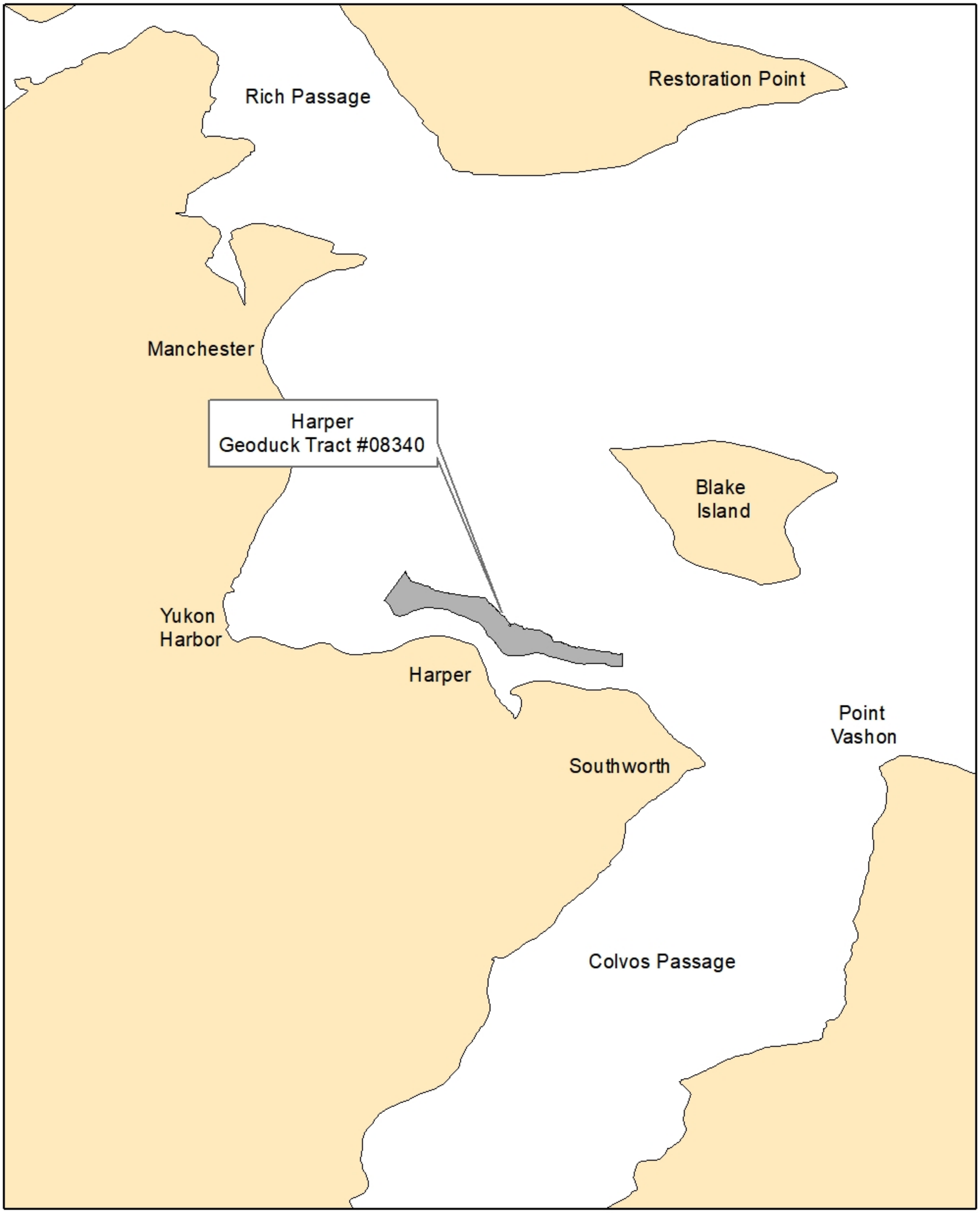
The Yukon Harbor area is used by recreational vessels traveling in Central Puget Sound and is not in a commercial vessel traffic lane. Geoduck harvesting at this site should not result in any significant navigational conflicts. The Washington Department of Natural Resources will notify the local boating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

Summary:

Commercial geoduck harvest is proposed for one harvest area of one tract along the eastern shoreline of Kitsap Peninsula near Yukon Harbor, Puget Sound. The tract was surveyed in 2009 by the Suquamish Tribe, and in 2012 the Washington Department of Fish and Wildlife conducted a supplemental survey. The current biomass estimate for the 131 acre harvest area is 1,472,168 pounds. This estimate is based on the 2009 Suquamish Tribe pre-fishing geoduck survey minus harvest. About 539,840 pounds of geoducks have been harvested on this tract since the pre-fishing survey. 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 -19 ft. water depth contour (MLLW) along the tract. No significant impacts are expected from this harvest.

File: 240123_Harper_08340_EA.doc

Figure 1. Vicinity Map, Harper Commercial Geoduck Tract #08340



N W E S

1:70,000
1 inch = 1.1 miles

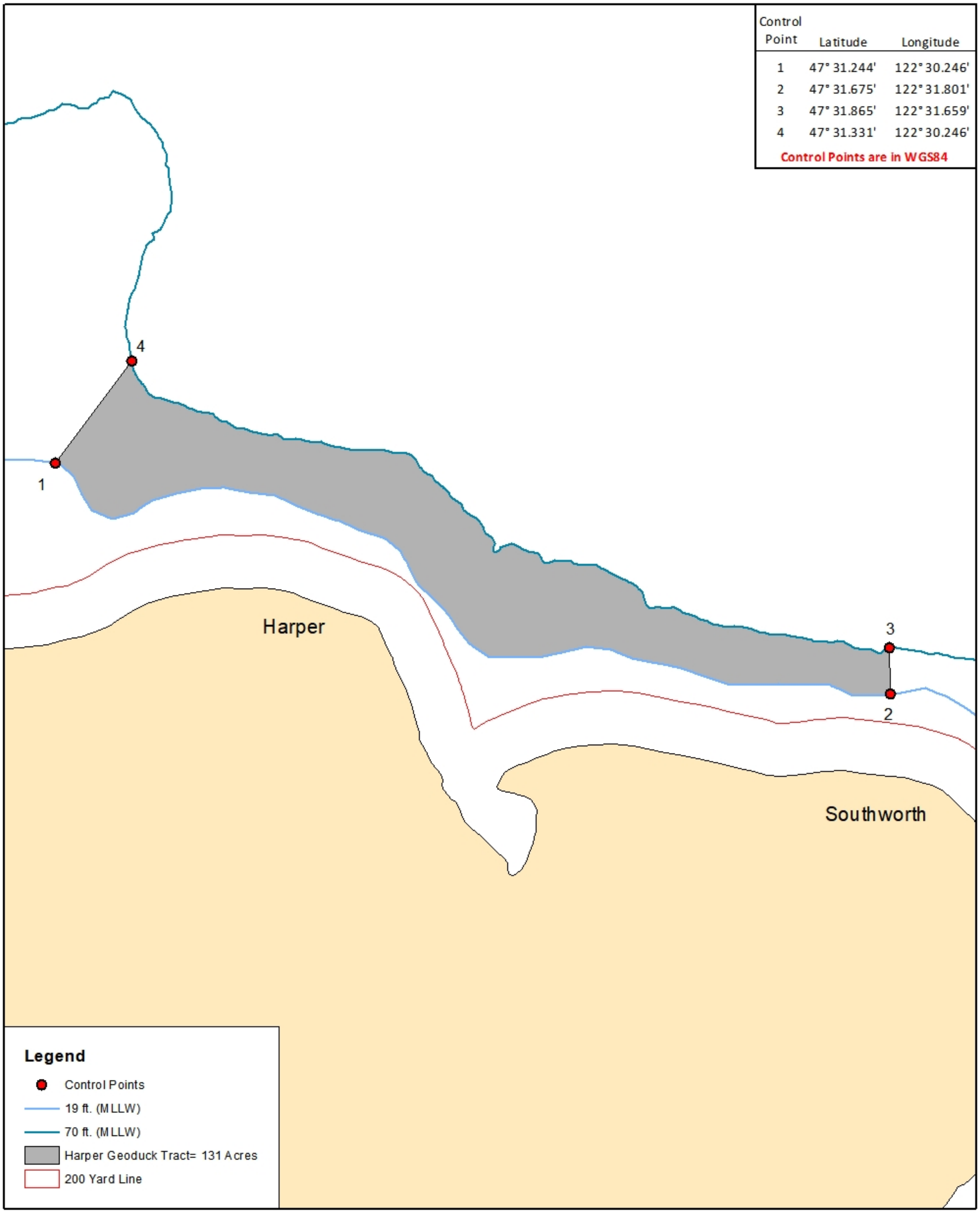
Data Sources:
Projection for data is GCS_Washington Geographic System 1984,
Units: Decimal Degrees. Coastline layer is from DNR, 1: 24,000 scale,
created 09-20-99. Contours are from NOAA soundings.

0 0.275 0.55 1.1 1.65 2.2 Miles

Washington Department of FISH and WILDLIFE

Map Date: February 21, 2020
Map Author: O. Working
File: Data\Geoduck\EAs\2020

Figure 2. Control Points Map, Harper Commercial Geoduck Tract #08340



Control Point	Latitude	Longitude
1	47° 31.244'	122° 30.246'
2	47° 31.675'	122° 31.801'
3	47° 31.865'	122° 31.659'
4	47° 31.331'	122° 30.246'

Control Points are in WGS84

N W E S

1:20,000

1 inch = 0.32 miles

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

0 0.075 0.15 0.3 0.45 0.6 Miles

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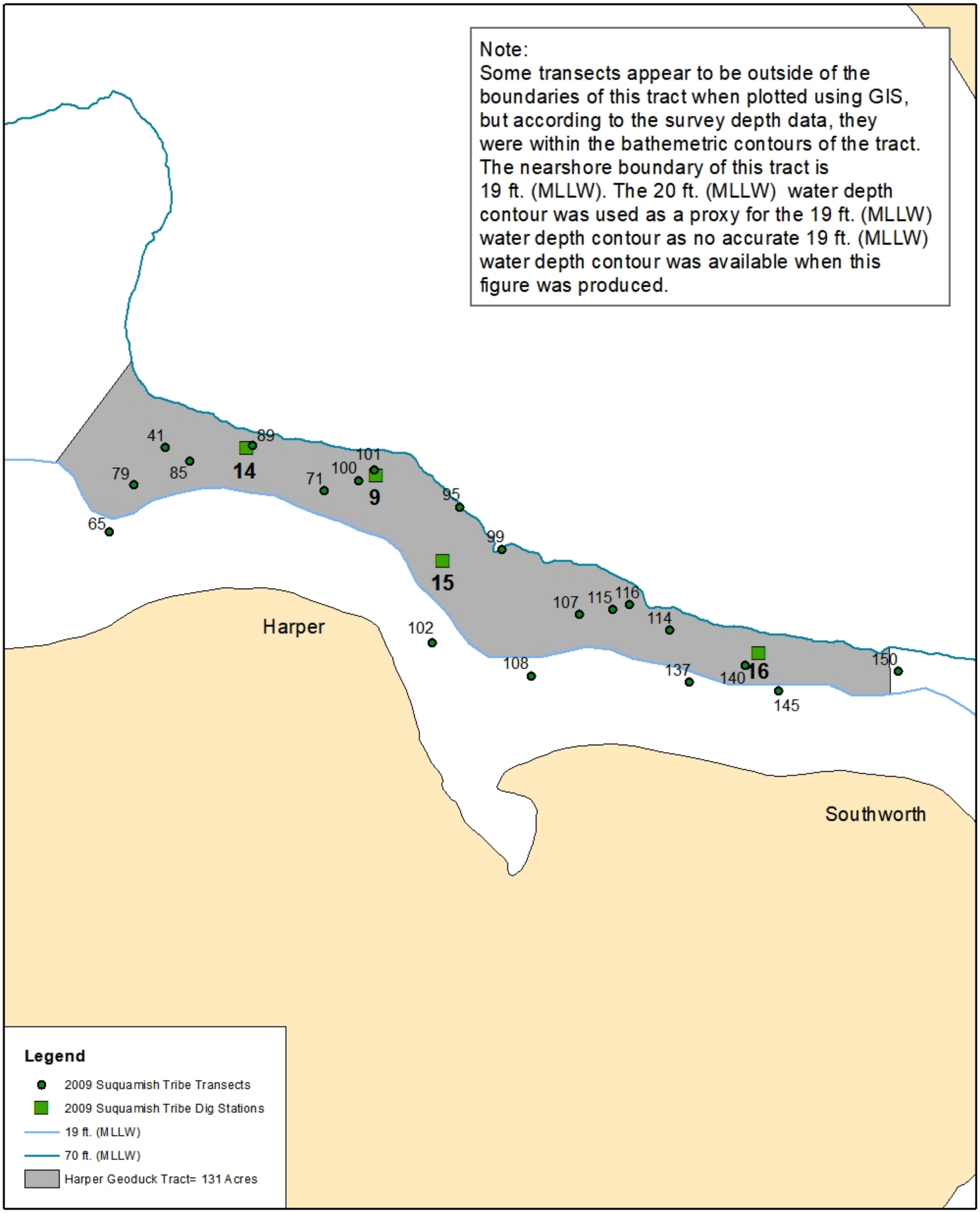
Map Date: February 21, 2020
Map Author: O. Working
File: Data\Geoduck\EAs\2020

Figure 3A. Suquamish Transects and Dig Stations, Harper Commercial Geoduck Tract #08340



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1 inch = 0.32 miles

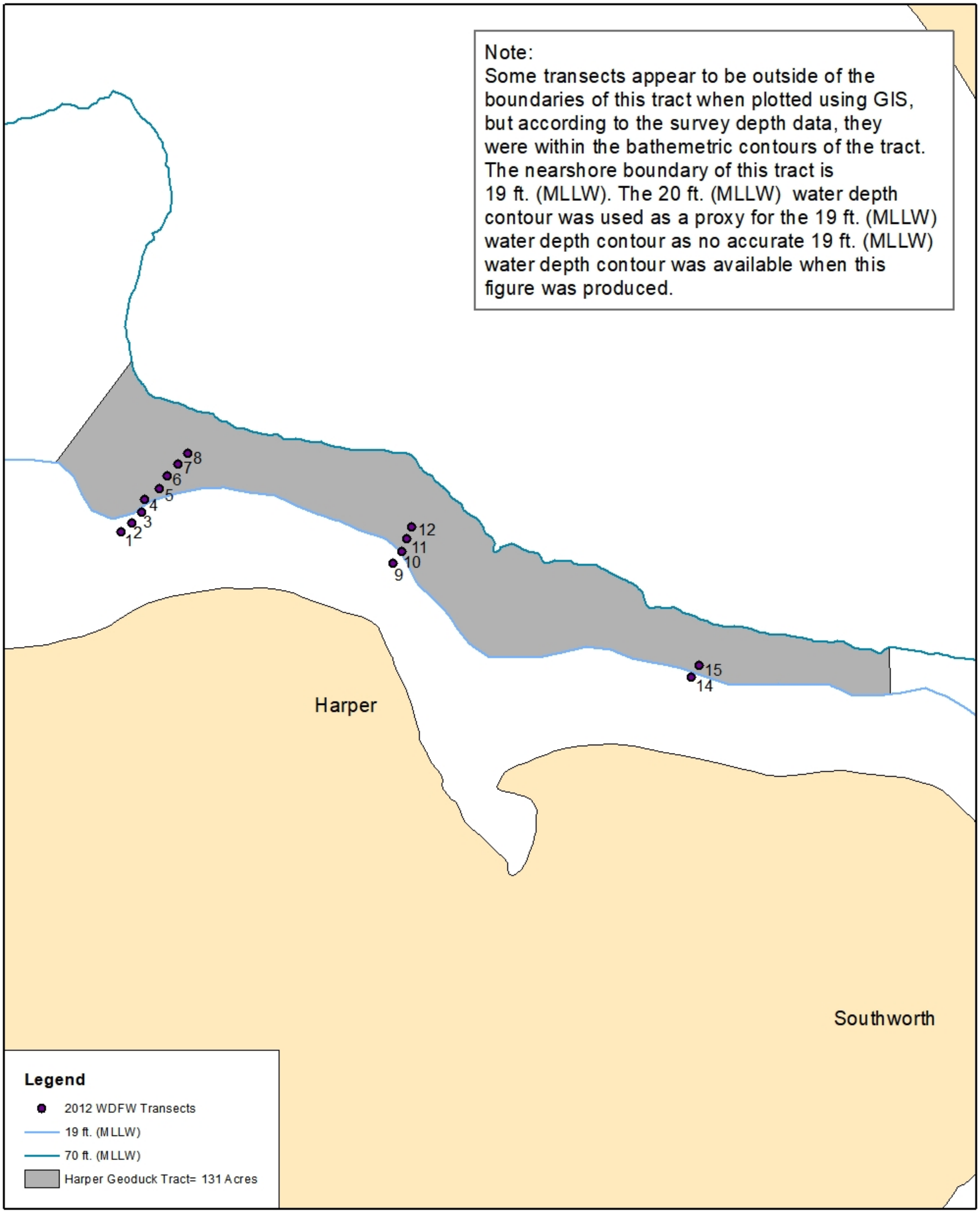
Data Sources:
Projection for data is GCS_Washington Geographic System 1984,
Units: Decimal Degrees. Coastline layer is from DNR, 1: 24,000 scale,
created 09-20-99. Contours are from NOAA soundings.

0 0.075 0.15 0.3 0.45 0.6 Miles

Washington Department of FISH and WILDLIFE

Map Date: February 21, 2020
Map Author: O. Working
File: Data\Geoduck\EAs\2020

Figure 3-B WDFW Transect Map, Harper Commercial Geoduck Tract #08340



N
W E
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1:20,000

1 inch = 0.32 miles

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

0 0.075 0.15 0.3 0.45 0.6 Miles

Washington Department of FISH and WILDLIFE

Map Date: February 21, 2020
Map Author: O. Working
File: Data\Geoduck\EAs\2020

Figure 4. Fish Spawning Areas Near the Harper Commercial Geoduck Tract #08340

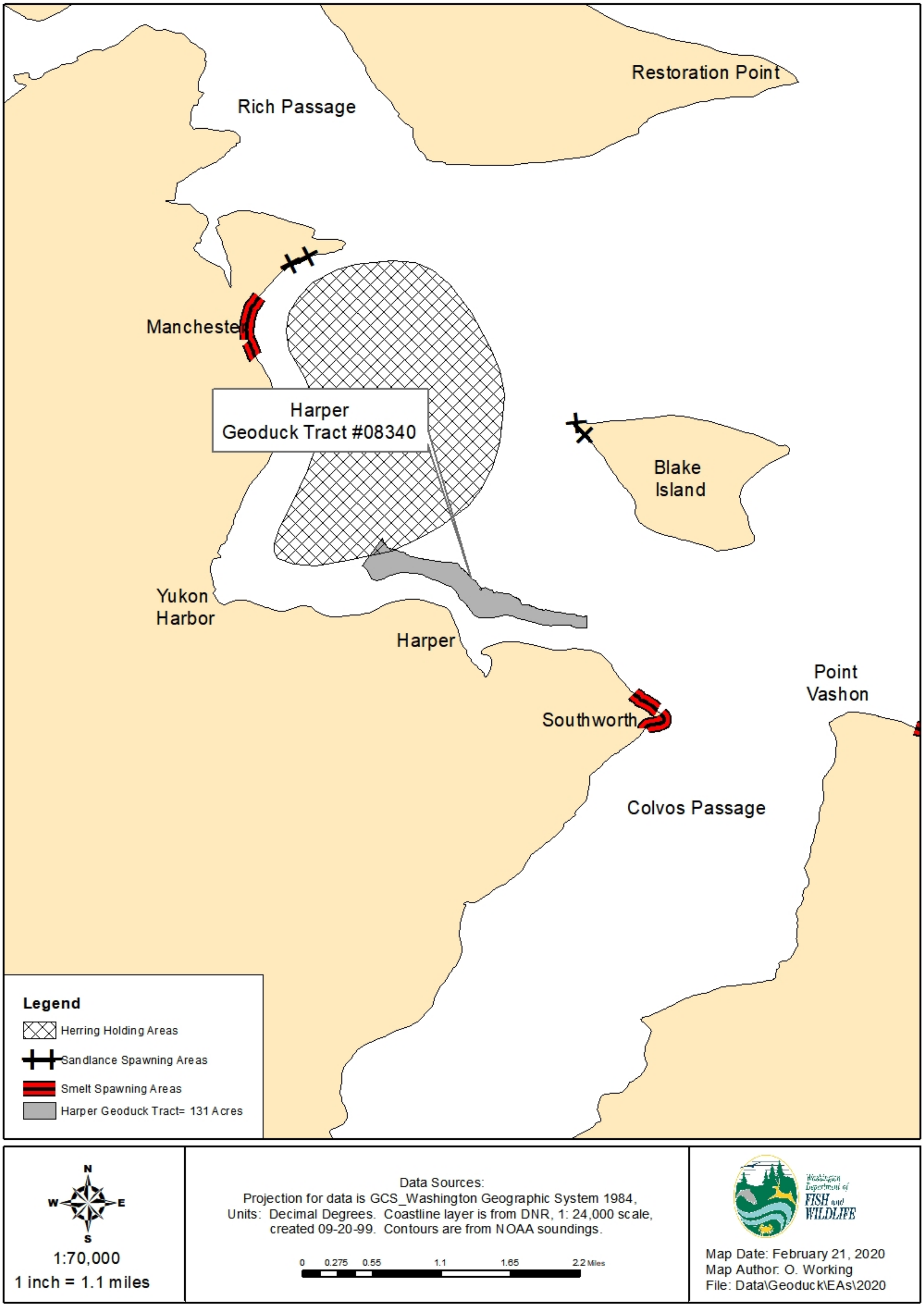
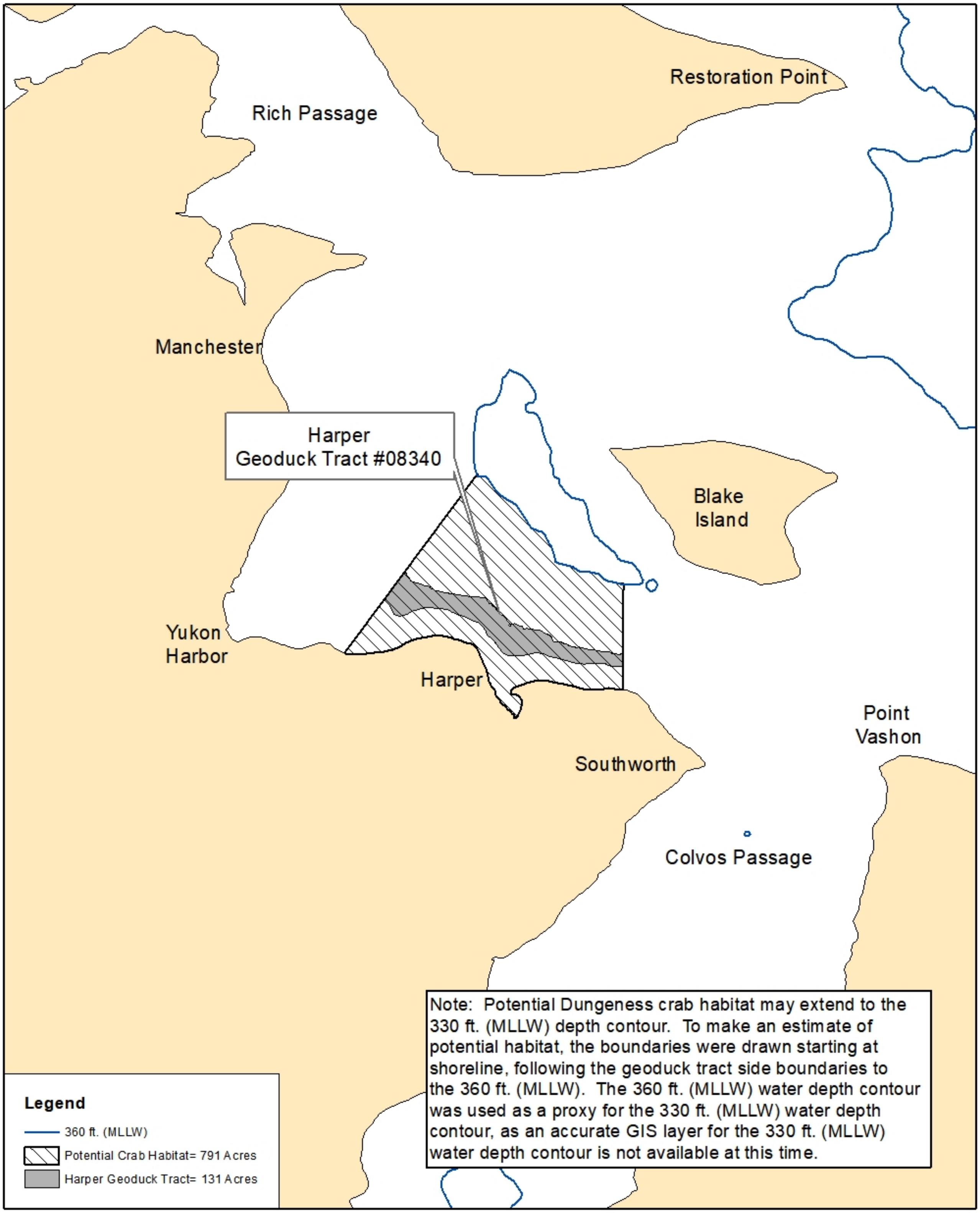


Figure 4. Dungeness Crab Habitat Map, Harper Commercial Geoduck Tract #08340



1:70,000
1 inch = 1.1 miles

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

0 0.275 0.55 1.1 1.65 2.2 Miles

Washington Department of FISH and WILDLIFE

Map Date: February 21, 2020
Map Author: O. Working
File: Data\Geoduck\EAs\2020

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*.

Last Updated: April 14, 2020
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Table 1. GEODUCK TRACT SUMMARY

Harper geoduck tract # 08340.

Tract Name	Harper
Tract Number	08340
Tract Size (acres)[a]	131
Density of geoducks/sq.ft[b]	0.130
Total Tract Biomass (lbs.)[b]	1,472,168
Total Number of Geoducks on Tract[b]	740,030
Confidence Interval (%)	35.8%
Mean Geoduck Whole Weight (lbs.)	1.99
Mean Geoduck Siphon Weight (lbs.)[c]	0%
Siphon Weight as a % of Whole Weight[c]	0%
Number of 900 sq.ft. Transect Stations	51
Number of Geoducks Weighed	38

a. Tract area is between the -19 ft. and the -70 ft. (MLLW) water depth contours

b. Biomass is based on the 2009 Suquamish Tribe pre-fishing geoduck survey biomass of 2,012,008 pounds minus reported harvest 539,840 pounds through January 23, 2024

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Table 2. DIGGING DIFFICULTY TABLE

Harper geoduck tract #08340, 2009 Suquamish Tribe pre-fishing survey.

Dig Station	Difficulty (0-5)	Abundance (0-2)	Depth (0-2)	Compact (0-2)	Gravel (0-2)	Shell (0-2)	Turbidity (0-2)	Algae (0-2)	Commercial (Y/N)
9	1	1	0	0	0	0	0	0	not provided
14	0	0	1	0	1	0	0	0	
15	0	1	1	0	0	0	0	0	
16	0	0	1	0	0	0	0	0	

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

Harper geoduck tract #08340, 2009 Suquamish Tribe pre-fishing survey.

				Substrate[c]					
Transect	Start Depth (ft.)[a]	End Depth (ft.)[a]	Geoduck Density (no. / sq.ft.)[b]	mud	sand	peagravel	gravel	shell	cobble
39	50	51	0.0659		1				
40	51	51	0.1620		1				
41	51	54	0.1996		1				
65	20	27	0.0000	substrate data not provided					
66	27	32	0.0556	substrate data not provided					
67	32	33	0.1389	substrate data not provided					
68	33	30	0.1556	substrate data not provided					
69	30	27	0.0583		1				1
70	27	28	0.1694		1				1
71	28	37	0.3444		1				1
76	23	25	0.0556						
77	25	25	0.0278		1			1	1
78	25	30	0.0389		1			1	
79	30	39	0.0722		1			1	1
85	33	35	0.5806	substrate data not provided					
86	35	41	0.6750	1	1				1
87	41	45	1.1972	1	1				1
88	45	57	0.4139	1	1				1
89	57	67	0.3667		1		1		
95	45	49	0.3218		1		1		
97	20	28	0.1533		1		1		1
98	28	34	0.1705		1		1		1
99	34	47	0.2318		1				1
99	47	62	0.0000		1				
100	50	53	0.4655		1				
101	53	64	0.4502		1		1		
102	20	51	0.0267		1	1			
103	51	38	0.0667		1	1			
104	38	38	0.0222		1				1
105	37	40	0.1111		1				
106	40	40	0.3289	1	1				1
107	40	38	0.1644	1	1				1
108	20	22	0.0133	1	1				1
109	22	22	0.0000	1	1				1
110	22	24	0.0000	1	1				1
111	24	28	0.0044	1	1				1
112	28	36	0.0178		1				
113	36	48	0.1378		1				
114	48	62	0.1911		1				
115	55	61	0.2133		1				
116	61	75	0.2044		1				
137	20	40	0.0833		1				
138	40	44	0.0833		1				

Table 3-A. Continued

Transect	Start Depth (ft.)[a]	End Depth (ft.)[a]	Geoduck Density (no. / sq.ft.) [b]	Substrate[c]: mud	sand	peagravel	gravel	shell	cobble
139	44	47	0.1574	1					
140	47	55	0.1343	1					
145	20	25	0.0000	substrate data not provided					
146	25	27	0.0463	substrate data not provided					
147	27	26	0.1296	substrate data not provided					
148	26	27	0.1250	substrate data not provided					
149	27	35	0.0417	substrate data not provided					
150	35	38	0.1574	1					

[a.] All depths are corrected to mean lower low water (MLLW)
[b.] Densities were calculated using a daily siphon show factor
[c.] Substrate ratings: 1 = present; blank = not observed

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Table 3-B. TRANSECT WATER DEPTHS, GEODUCK DENSITIES, AND SUBSTRATE
Harper geoduck tract #08340, 2012 WDFW supplemental survey.

Transect	Start Depth (ft.)[a]	End Depth (ft.)[a]	Geoduck Density (no. / sq.ft.) [b]	Substrate[c] boulder	cobble	mud	sand
1	19	23	0.0000				2
2	23	26	0.0059				2
3	26	28	0.0400	1	1		2
4	27	28	0.0430	1	1	2	
5	28	31	0.0222	1	1	2	
6	31	40	0.0933	1	1	2	
7	40	53	0.2030	1	1	2	
8	53	61	0.1185			1	2
9	20	28	0.0000	1	1		2
10	28	36	0.0459	1	1		2
11	36	46	0.1304				2
12	45	56	0.2400				2
14	27	36	0.1215				2
15	36	49	0.1807				2

[a.] All depths are corrected to mean lower low water (MLLW)
[b.] Densities were calculated using a daily siphon show factor
[c.] Substrate ratings: 1 = present; 2 = predominant; blank = not observed

Note: 2012 WDFW supplemental survey data is included to provide information on substrates, plants, and animals. These data were not used to estimate the geoduck biomass on this tract.

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Table 4. GEODUCK SIZE AND QUALITY

Harper geoduck tract # 08340, 2009 Suquamish Tribe pre-fishing survey.

Dig Station	Number Dug	Avg. Whole Weight (lbs.)	Avg. Siphon Weight (lbs.)	% of geoducks on station greater than 2 lbs.
9	10	1.49	not provided	0%
14	10	1.56		30%
15	10	3.32		88%
16	10	1.85		40%

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Table 5. TRANSECT CORRECTED GEODUCK COUNT AND POSITION TABLE

Harper geoduck tract #08340, 2009 Suquamish Tribe pre-fishing survey.

Transect	Corrected Count	Show Factor[a]	Latitude[b]	Longitude[b]
39	59	0.59		
40	146	0.59		
41	180	0.59	47° 31.704	122° 31.596
65	0	0.40	47° 31.545	122° 31.700
66	50	0.40		
67	125	0.40		
68	140	0.40		
69	53	0.40		
70	153	0.40		
71	310	0.40	47° 31.622	122° 31.300
76	50	0.40		
77	25	0.40		
78	35	0.40		
79	65	0.40	47° 31.634	122° 31.656
85	523	0.40	47° 31.678	122° 31.552
86	608	0.40		
87	1078	0.40		
88	373	0.40		
89	330	0.40	47° 31.707	122° 31.434
95	290	0.58	47° 31.592	122° 31.048
97	138	0.58		
98	153	0.58		
99	209	0.58	47° 31.514	122° 30.969
99	0	0.58		
100	419	0.58	47° 31.642	122° 31.236
101	405	0.58	47° 31.662	122° 31.207
102	24	0.25	47° 31.340	122° 31.099
103	60	0.25		
104	20	0.25		
105	100	0.25		
106	296	0.25		
107	148	0.25	47° 31.393	122° 30.824
108	12	0.25	47° 31.278	122° 30.915
109	0	0.25		
110	0	0.25		
111	4	0.25		
112	16	0.25		
113	124	0.25		
114	172	0.25	47° 31.363	122° 30.656
115	192	0.25	47° 31.403	122° 30.764
116	184	0.25	47° 31.411	122° 30.732
137	75	0.24	47° 31.266	122° 30.619
138	75	0.24		
139	142	0.24		
140	121	0.24	47° 31.298	122° 30.516
145	0	0.24	47° 31.249	122° 30.454
146	42	0.24		

Table 5. Continued

Transect	Corrected Count	Show Factor[a]	Latitude[b]	Longitude[b]
147	117	0.24		
148	113	0.24		
149	38	0.24		
150	142	0.24	47° 31.287	122° 30.230

[a.] Daily siphon show factor was used to correct geoduck counts
[b.] Latitude and longitude are in degrees and decimal minutes and are in WGS84 datum; not all transect positions were provided.

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Table 6. MOST COMMON AND OBVIOUS ANIMALS OBSERVED

Harper geoduck tract #08340, 2012 WDFW supplemental survey.

# of Transects where Observed	Group	Common Name	Taxonomer
11	ANEMONE	PLUMED ANEMONE	*Metridium* spp.
1	BIVALVE	HARDSHELL CLAMS	*Veneridae* spp.
8	BIVALVE	HORSE CLAM	*Tresus* spp.
1	BIVALVE	TRUNCATED MYA	*Mya truncata*
7	BIVALVE	FALSE GEODUCK	*Panomya* spp.
6	CNIDARIA	SEA PEN	*Ptilosarcus gurneyi*
7	CRAB	DUNGENESS CRAB	*Cancer magister*
1	CRAB	RED ROCK CRAB	*Cancer productus*
1	CRAB	GRACEFUL CRAB	*Cancer gracilis*
10	CRAB	HERMIT CRAB	Unspecified hermit crab
3	CRAB	DECORATOR CRAB	*Oregonia gracilis*
5	CUCUMBER	SEA CUCUMBER	*Parastichopus californicus*
2	FISH	FLATFISH	Unspecified flatfish
1	FISH	STARRY FLOUNDER	*Platichthys stellatus*
3	FISH	ROCK SOLE	*Lepidopsetta bilineata*
2	FISH	C-O SOLE	*Pleuronichthys coenosus*
1	FISH	SANDDAB	*Citharichthys* spp.
2	GASTROPOD	MOON SNAIL	*Polinices lewisii*
1	GASTROPOD	NUDIBRANCH	Unspecified nudibranch
1	NUDIBRANCH	ARMINA	*Armina californica*
2	NUDIBRANCH	HERMISSENDA	*Hermissenda crassicornis*
8	SEA STAR	SUNFLOWER STAR	*Pycnopodia helianthoides*
2	SEA STAR	SHORT-SPINED STAR	*Pisaster brevispinus*
1	SEA STAR	FALSE OCHRE STAR	*Evasterias troschelli*
4	SEA STAR	LEATHER STAR	*Dermasterias imbricata*
10	SEA STAR	SUN STAR	*Solaster* spp.
6	WORM	TEREBELLID TUBE WORM	*Terebellid* spp.

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Table 7. MOST COMMON AND OBVIOUS ALGAE OBSERVED

Harper geoduck tract #08340, 2012 WDFW supplemental survey.

# of Transects where observed	Taxonomer
8	*Laminaria* spp.
14	*Ulva* spp.
14	small red algae
1	large red algae
8	diatoms
11	*Desmarestia* spp.

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