

# Bivalve Shellfish Beds

*Cruise ships that discharge treated sewage into Puget Sound under this MOU employ advanced systems that treat sewage to a very high degree using a combination of filtration, biological treatment, ultra-filtration, and disinfection. These systems are called Advanced Wastewater Treatment Systems (AWTS). The ultra-filtration process effectively removes nearly all bacteria from the treated sewage. However, viruses which tend to be smaller organisms may pass through the ultra-filtration membranes but are typically destroyed by the disinfection unit.*

*The Centers for Disease Control & Prevention reported 18 norovirus outbreaks on cruise ships in the Pacific Northwest since 2000. Cruise ships discharge into shallow waters along the shipping lanes, near some commercial shellfish beds. Today, national standards provide little guidance on setting shellfish closure zones based on viral risk and there is no reliable viral indicator standard in part due to difficulties in sampling and testing for norovirus.*

*Because shellfish in Puget Sound and Admiralty Inlet are valuable resources for Washington State, the Washington State Legislature commissioned the Washington State Department of Health (DOH) Office of Shellfish and Water Protection (OSWP) to study the potential risk to shellfish beds from virus contamination associated with cruise ship waste water discharges. DOH contracted with the University of Washington School of Public Health and Community Medicine to perform a risk assessment, which was completed in November 2007. The study used a quantitative microbial risk assessment method coupled with water quality modeling in Puget Sound. Some key findings of the study include:*

- When advanced wastewater treatment systems (AWTS) are functioning well, there is low concern for viral illness. Adequate disinfection is the key to effective norovirus inactivation.*
- Loss of disinfection could lead to potentially unacceptable virus levels in water over shellfish beds, even with the large dilution provided by ships under sail. However, using minimum dilution factors for when ships are moving at least 6 knots along the current route, dilution is estimated at 1,500,000:1 between the ship and the shore.*
- The UW study did not gather samples of norovirus concentrations in treated sewage from cruise ships or in the salt water over shellfish beds. Norovirus remains non-culturable, so there is very limited environmental data that is “norovirus specific.” In response, UW researchers used data for norovirus “surrogates” from other studies in their analysis.*
- Consumption data from Tribes that use shellfish beds closest to the path of cruise ships was used in the risk analysis. These rates are higher than for the general population. Raw oyster consumption rates were used as a conservative assumption for these areas.*

*The study included many conservative assumptions, but nonetheless concluded that well functioning AWTSs would not lead to norovirus accumulation in shellfish beds such that the median annual risk of potential illness to shellfish consumers from cruise ship discharges in Puget Sound is less than 10,000,000:1. This compares quite favorably with the calculated annual risk of norovirus illness from consumption of raw oysters in the general population, which the UW researchers calculated as about 1,000:1.*

*As described above, the potential risk of viral contamination of shellfish beds from cruise ship is extremely low when AWTS systems are functioning well. Additionally the geography of Puget Sound and the configuration of shipping lanes provide most shellfish beds some protection from potential contamination from passing ships. However, the signatories to the MOU understand the importance of shellfish resources to Washington State and have agreed to take the actions outlined on page \_\_\_ of the MOU to protect shellfish beds and human health while operating in Washington MOU waters.*

# Appendix x continued Bivalve Shellfish Beds 2008 Season

## 2008 Cruise Season Boundary Points

Id	Tract Name	LATITUDE	LONGITUDE
1	Apple Tree Cove	47.81274089040	122.48047265700
2	Apple Tree Cove	47.81255672180	122.47941651600
3	Apple Tree Cove	47.81197112760	122.47872458000
4	Apple Tree Cove	47.81129443870	122.47812835500
5	Apple Tree Cove	47.81056937740	122.47758747000
6	Apple Tree Cove	47.80992145700	122.47684781100
7	Apple Tree Cove	47.80931916930	122.47604614700
8	Apple Tree Cove	47.80895286530	122.47498673900
9	Apple Tree Cove	47.80852971000	122.47419683400
10	Apple Tree Cove	47.80812779070	122.47315426700
11	Apple Tree Cove	47.80748647770	122.47257436300
12	Apple Tree Cove	47.80668065230	122.47239303200
13	Apple Tree Cove	47.80586169470	122.47237830900
14	Apple Tree Cove	47.80507505630	122.47246917900
15	Apple Tree Cove	47.80443177020	122.47321819700
16	Apple Tree Cove	47.80389497510	122.47389983000
17	Apple Tree Cove	47.80348525790	122.47492954200
18	Apple Tree Cove	47.80310261180	122.47598949400
19	Apple Tree Cove	47.80237402570	122.47638256900
20	Apple Tree Cove	47.80219450150	122.47688158400

Id	Tract Name	LATITUDE	LONGITUDE
47	Tyee Shoal	47.61916098460	122.48420272400
48	Tyee Shoal	47.61865190330	122.48324910700
49	Tyee Shoal	47.61814655430	122.48229042500
50	Tyee Shoal	47.61761807860	122.48135871800
51	Tyee Shoal	47.61718007830	122.48033341700
52	Tyee Shoal	47.61670845870	122.47935532600
53	Tyee Shoal	47.61609072620	122.47855854300
54	Tyee Shoal	47.61543441750	122.47782569300
55	Tyee Shoal	47.61469777070	122.47729421200
56	Tyee Shoal	47.61394668260	122.47679893700
57	Tyee Shoal	47.61317098590	122.47657100600
58	Tyee Shoal	47.61237442300	122.47686659800
59	Tyee Shoal	47.61162109430	122.47735159900
60	Tyee Shoal	47.61083929010	122.47772883400
61	Tyee Shoal	47.61005751060	122.47810617700
62	Tyee Shoal	47.60927581650	122.47848390200
63	Tyee Shoal	47.60847990770	122.47877353100
64	Tyee Shoal	47.60766507680	122.47893589300
65	Tyee Shoal	47.60687831460	122.47927979300
66	Tyee Shoal	47.60609769090	122.47964967100
67	Tyee Shoal	47.60531536900	122.48000498600
68	Tyee Shoal	47.60457213290	122.48052049900
69	Tyee Shoal	47.60398226870	122.48118881300
70	Tyee Shoal	47.60407102430	122.48180079600

### 2008 Cruise Season Boundary Points

Id	Tract Name	LATITUDE	LONGITUDE
21	President Point	47.76301811440	122.46531995900
22	President Point	47.76227795780	122.46478860500
23	President Point	47.76153965240	122.46425163200
24	President Point	47.76079984240	122.46372318400
25	President Point	47.76012732540	122.46302154800
26	President Point	47.75945808780	122.46231363200
27	President Point	47.75877611500	122.46163224400
28	President Point	47.75821701680	122.46249970800
29	President Point	47.75769964180	122.46344179800
30	President Point	47.75709757920	122.46424411400
31	President Point	47.75642784290	122.46495166300
32	President Point	47.75568013190	122.46545052600
33	President Point	47.75491428200	122.46589325600
34	President Point	47.75413762450	122.46629389900
35	President Point	47.75340374390	122.46683607100
36	President Point	47.75266140050	122.46720422800
37	President Point	47.75189295980	122.46684018600
38	President Point	47.75123556490	122.46610769300
39	President Point	47.75058390610	122.46579489800
40	President Point	47.74994707310	122.46656628000
41	President Point	47.74921684450	122.46711888700
42	President Point	47.74848682750	122.46768011900
43	President Point	47.74775279740	122.46822961800
44	President Point	47.74701858040	122.46877863300
45	President Point	47.74627675290	122.46930377000
46	President Point	47.74561278720	122.46984543000

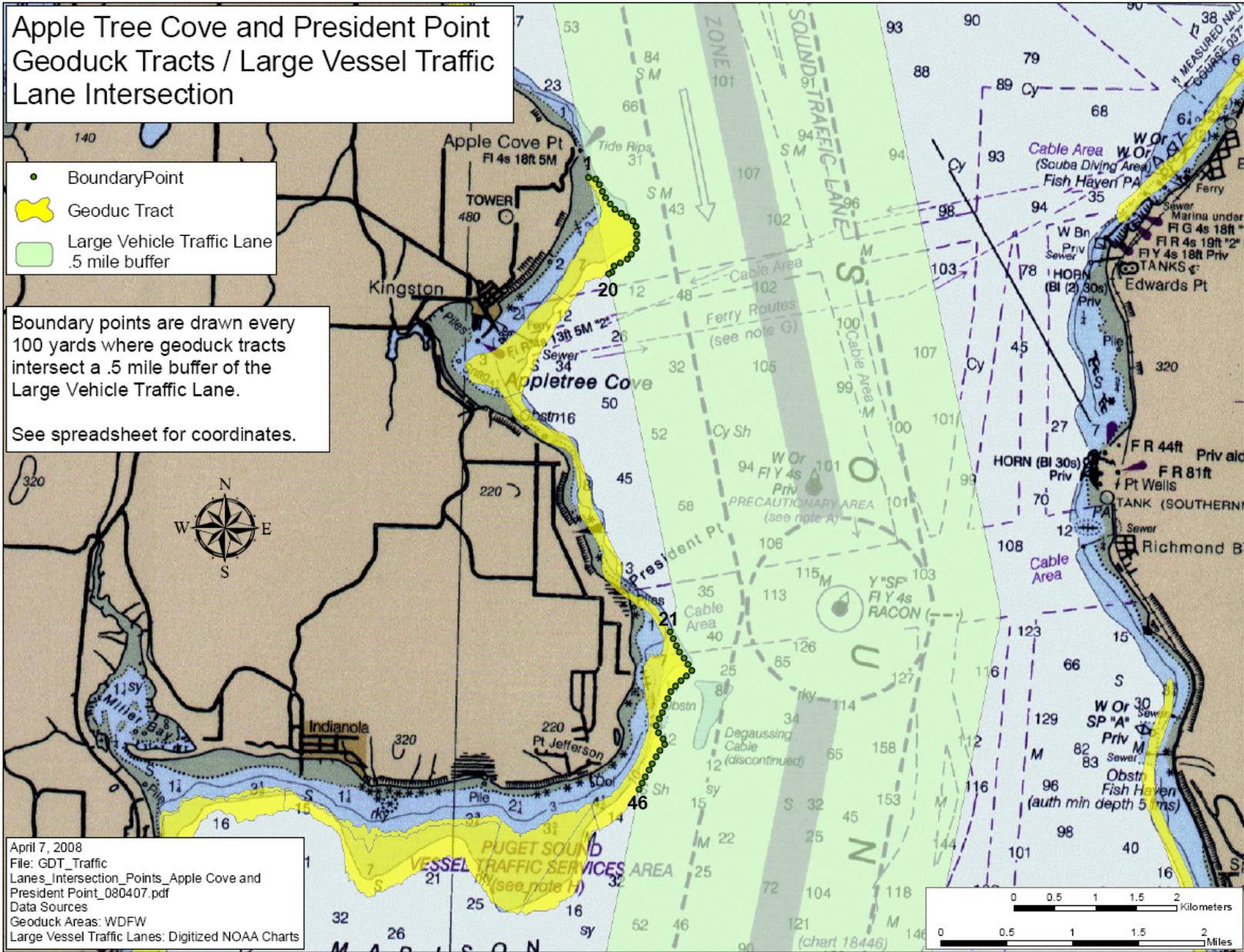
DATUM = HARN

# Apple Tree Cove and President Point Geoduck Tracts / Large Vessel Traffic Lane Intersection

- BoundaryPoint
- Geoduck Tract
- Large Vehicle Traffic Lane  
.5 mile buffer

Boundary points are drawn every 100 yards where geoduck tracts intersect a .5 mile buffer of the Large Vehicle Traffic Lane.

See spreadsheet for coordinates.



April 7, 2008  
 File: GDT\_Traffic  
 Lanes\_Intersection\_Points\_Apple Cove and  
 President Point\_080407.pdf  
 Data Sources  
 Geoduck Areas: WDFW  
 Large Vessel Traffic Lanes: Digitized NOAA Charts

# Tyee Shoal Geoduck Tract / Large Vessel Traffic Lane Intersection

- Boundary Point
- Geoduck Tract
- Large Vehicle Traffic Lane .5 mile buffer

Boundary points are drawn every 100 yards where geoduck tracts intersect a .5 mile buffer of the Large Vehicle Traffic Lane.

See spreadsheet for coordinates.

