

SANITARY SURVEY
OF
DRAYTON HARBOR

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WASHINGTON STATE DEPARTMENT OF HEALTH
OFFICE OF FOOD SAFETY AND SHELLFISH PROGRAMS

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I. Executive Summary

Prior to October 7, 1999, most of Drayton Harbor was classified as Prohibited, with only 920 acres in the western portion classified as Approved. On that date, the last Approved portion of the harbor was downgraded, making the entirety of this embayment classified as Prohibited. Following a review of current water quality data, an evaluation of pollution sources, and shoreline survey information, the Office of Food Safety and Shellfish Programs, Washington State Department of Health (DOH) now recommends the following actions:

- an area 575 acres in the central portion of Drayton Harbor, encompassing sampling stations 3, 4, 5, 6, and 12 (see Map 3, Proposed Classification Boundaries, page 27) be classified as Conditionally Approved, closed by DOH to shellfish harvest following one-half inch or more of rainfall over a 24-hour period.
- all other portions of Drayton Harbor remain classified as Prohibited.

A data summary of water quality samples collected from stations 3, 4, 5, 6, and 12 indicated that these stations meet the National Shellfish Sanitation Program (NSSP) standards for a Conditionally Approved commercial shellfish growing area (see Table 1, Marine Water Data Summary, page 16). This proposed Conditionally Approved area of 575 acres represents roughly one-fifth of the area of the entire inner harbor of 2550 acres.

In the September 1999 Sanitary Survey Report, the 30-sample data set contained water samples collected between August 16, 1995 and December 29, 1998, the poor quality of which resulted in a Prohibited classification. DOH Sanitary Survey Report utilizes a 'moving window' data set comprised of the most recent 30 samples collected from stations in the growing area under consideration. This report necessarily utilizes a completely different 30-sample data set comprised of samples collected between June 16, 1999 and February 23, 2004. The water quality of this 30-sample data set permits a Conditionally Approved classification for a portion of the harbor. Between August 1995 and June 1999, some of the high fecal coliform results dropped off the 'moving window' 30-sample data set. These more recent results indicate improvements in water quality, especially at sample station 4.

Since the classification downgrade in 1999, significant improvements have been made with regard to the pollution sources listed below:

- manure and livestock management on farms in the Dakota and California Creek watershed
- discharges from the two marinas near the mouth of Drayton Harbor
- sewage leaking from the City of Blaine sewage collection system
- discharges of partially treated sewage from the treatment plant
- process wastewater discharges from seafood processors
- stormwater runoff associated with heavy rain events
- failing individual on-site septic systems

A discussion of the improvements made to these pollution sources since 1999 can be found in Section III, Pollution Source Survey, page 2.

II. Description of Growing Area

A. Location Map Showing Growing Area

Map 1, a regional map showing Drayton Harbor in relation to the Canadian border, the Strait of Georgia, and the City of Bellingham, is located on page 25. Maps 2 and 3, detailed maps showing the current and proposed classification boundaries, are located on pages 26 and 27 respectively.

B. Description of Area

Drayton Harbor is a relatively small embayment approximately one and a half miles wide and two miles long, encompassing an area of almost four square miles (2550 acres; 1032 hectares). The embayment is enclosed by the Semiahmoo Spit to the west, leaving an opening to Semiahmoo Bay slightly less than 300 meters wide. Although the average depth throughout most of this shallow bay is three to nine feet, the central portion of the bay is much deeper, nearly 70 feet at the mouth at high water. Broad mud flats, which are exposed at low tide, extend as far as a thousand meters to the west of the eastern shoreline.

The Drayton Harbor watershed drains an area of approximately 60 square miles, 90% of which is via the drainage systems of Dakota and California Creeks. The remaining 10% of the watershed drains directly into the bay via roughly 20 minor drainages; streams and storm drains. Most of the watershed is rural residential, mixed with agricultural and forested land. The City of Blaine, situated along the northeastern shoreline, is densely urbanized, and the Semiahmoo Resort, on the northwestern shoreline, is less densely urbanized but with a fluctuating population. Both the city and the resort are served by the Blaine sewage treatment plant, located at the southwestern extremity of the Semiahmoo Spit.

C. History of Growing Area Classification

1. Date of Last Sanitary Survey

The last Sanitary Survey Report was completed by DOH in September 1999. The downgrade to a Prohibited classification in October 1999 resulted from the recommendations in this report.

2. Previous Classification(s) Map(s)

Map 2, Current Classification Boundaries, on page 26, shows the classification status of Drayton Harbor as of October 7, 1999, when the entire harbor was re-classified as Prohibited.

III. Pollution Source Survey

A. Summary of Sources and Location

1. Map Showing the Location of Major Sources of Actual or Potential Pollution

Map 4, Potential Pollution Sources, on page 28, shows the location of the various pollution sources in Drayton Harbor, along with the location of the DOH water quality sampling stations.

2. Table of Sources of Pollution Referenced to the Map

The potential pollution sources shown on Map 4 are as follows:

- agricultural discharges: deficient manure and livestock management practices on farms located in the Dakota and California Creek watersheds
- Port of Bellingham Marina: boat wastes from commercial and recreational watercraft; also, feces from large bird populations (gulls, cormorants, pigeons, ducks, etc.) on the rip-rap breakwater and the various building roofs and docks
- Semiahmoo Marina: boat wastes from recreational watercraft and bird populations within the marina; also, feces from concentrations of seals, which haul out on the floating breakwater surrounding the marina
- Blaine sewage collection system: cracks or breaks in pipes, manholes, or lift stations located along Marina Drive; and, the jointed submarine force main which transports untreated sewage under the harbor mouth
- Blaine sewage treatment plant (STP): discharges of partially treated effluent from the STP into Semiahmoo Bay
- seafood processors: discharge of process wastewater from these facilities into the area around sampling station 15
- stormwater discharges: several discharge points along the shoreline potentially transport pollution to the harbor from a variety of sources
- individual on-site septic systems (OSS): failing OSS situated along the creeks and the eastern and southern shoreline of Drayton Harbor

B. Identification and Evaluation of Pollution Sources

A summary of the actual and/or potential pollution sources is included in sections 1 through 5, below:

1. Domestic Wastes

In 1994, DOH completed a shoreline survey of Drayton Harbor. This survey documented numerous pollution sources along the eastern and southern shorelines of the harbor. In 1997 and 1998, Whatcom County Health and Human Services (HHS) completed a survey OSS along the near shoreline of the harbor, from the Canadian border around the eastern shore to Shintaffer Road, including the entire east Blaine area. By May 1999, 53 of 54 identified failing OSS had been repaired (out of 252 systems surveyed). In 2002 and 2003, Whatcom County inspected 77 OSS (due to complaints or loan applications) and found 22 failures; all of these failures have since been repaired.

All the residences and businesses located within the Blaine city limits are connected to the sewage collection system. Untreated sewage from these customers is conveyed by gravity to a pumping station located on Marine Drive. From this pumping station, sewage is conveyed by means of a

force main (a pressurized sewer pipe) under the harbor mouth to the end of the Semiahmoo Spit. Sewage from the Semiahmoo Resort is combined with that from the City of Blaine and is piped via force main to the STP located at the base of the spit. (See Map 4, Potential Pollution Sources, on page 28). Any leakage in this sewage collection system could seriously impact the water quality in the shellfish growing waters of Drayton Harbor.

In the past, this system has been subject to excessive infiltration and inflow (I and I), which caused overflows or bypasses of sewage (combined with stormwater) to Drayton Harbor. These bypasses were manual releases from Lift (pumping) Station #1, discharged deliberately to avoid sewage overflows from the collection system or backflow of sewage into homes or businesses in the low lying areas of Blaine. Since 1999, major steps have been taken to avoid overflows and bypasses, one of which was the installation of four large bladders at Lift Station #1, which function as temporary storage containers when the system is surcharged. The Blaine Public Works Department has also made significant improvements in the sewage collection system, reducing the I and I problem. As a result of this work, there have been no manual sewage bypasses necessary since 2000. The location of the sewage collection system, the submarine force main, the STP and the effluent outfall pipe are shown on Map 4, on page 28. The closure zone associated with the STP discharge extends northeastward beyond Tongue Point to the harbor mouth, which prohibits recreational harvest on the outside of the spit but does not affect commercial harvest in the vicinity of sampling station 4. See Section VII, B; Legal Descriptions, on page 13, for a detailed description of the proposed Conditionally Approved area; also, see Map 3, Proposed Classification Boundaries, on page 27.

Homes and businesses located along the eastern shoreline of the harbor which are not in the city limits (from the south bank of Dakota Creek around the southeastern shore to 500 meters west of Shintaffer Road), are not connected to the Blaine sewage collection system. Of necessity, the buildings in this area make use of OSS. See Map 4, on page 28.

2. Stormwater

In 1996, Whatcom County designated Drayton Harbor as a Water Resource Special Management Area, which required more stringent standards for land clearing activities, such as temporary erosion and sediment control, phased clearing, and soil stabilization. In 1999, these regulations were further enhanced to provide water quality protection. Also in 1999, the county designated Drayton Harbor watershed as a Stormwater Special District, which required permanent on-site stormwater quality and quantity facilities for development on lots less than five acres. In 2002, specific development standards were adopted to assist in implementing the regulations described for Stormwater Special Districts, addressing on-site stormwater through dispersion, infiltration, runoff

treatment and detention. Additional amendments to these land use ordinances were adopted by the Whatcom County in 2003.

The City of Blaine has replaced a significant amount of sewer line in the downtown area over the past ten years in an effort to reduce infiltration and inflow of stormwater and groundwater into the sewage collection system. Prior to the sewer line replacement process, combined sewer overflow (CSO) events occurred several times a year, during heavy rainfalls. However, once the old lines were replaced and connections between sewer and stormwater lines eliminated, there has not been a CSO event since 2000. In 2003, the Puget Sound Restoration Fund (PSRF) sponsored dye tests in the Blaine sewer system which detected no cross connections between sewer lines and priority storm drains, and no leakage into marine waters along Marine drive or at the harbor mouth.

3. Agricultural waste

In 1994 there were 20 commercial dairies located in the Drayton Harbor watershed (Dakota and California Creeks). The Whatcom Conservation District (CD) reported that seven of these dairies had been sent warning letters from the EPA for water quality violations, specifically for fecal coliform violations. The CD also estimated that up to 15 of these dairies did not have adequate manure storage. Since the 1999 classification downgrade to Prohibited, all commercial dairies in the Drayton Harbor watershed now have dairy nutrient management plans in place, certified by the Whatcom CD, proscribing unseasonable applications of liquid manure, creating non-application zones proximate to ditches and streams, and requiring grass filter strips to protect from surface runoff of bacteria and nutrients. A direct result of these improvements has been a corresponding improvement in water quality throughout the watershed; all the sampling stations in the two creeks established by the Protection District Committee now comply with both parts of the Washington State water quality standard.

4. Wildlife areas

Significant numbers of mammals and birds have been observed at various times in Drayton Harbor, mainly in the vicinity of the two marinas situated near the harbor mouth. Gulls and pigeons are present throughout the year, primarily in the commercial end of the Port of Bellingham Marina, along with increasing numbers of cormorants observed on the rip-rap breakwater at the commercial end of the Blaine marina, near DOH station 8. Migratory waterfowl are present in large numbers during the spring and fall migration seasons. Substantial populations of seals have been observed hauled out on the southern portions of the Semiahmoo Marina floating breakwater.

5. Industrial wastes

Wastewater from the seafood processing plants located at the southwest end of the Port of Bellingham Marina is discharged immediately north of

the end of Marina Drive, in the vicinity of DOH sampling station 15. Following extensive remedial actions, the bacteriological quality of the effluents discharged by the seafood processors has improved from a fecal coliform geometric mean of 397 in 1999, down to 10 in 2003.

IV. Hydrographic and Meteorological Characteristics

A. Tides

1. Type

Drayton Harbor is subject to mixed tides, predominantly semi-diurnal, characterized by a large inequality in the high water heights, low water heights, or both. There are usually two high and two low tides each tidal day but occasionally the complex tidal patterns of this region will result in only one high and one low tide in a single day.

2. Amplitude

The mean tidal range in Drayton Harbor is 5.9 feet; the mean higher high water level is 9.5 feet; the mean tide is 5.6 feet. The typical highest tide of the year occurs around the time of the winter solstice (January 21) at 11.2 feet; the typical lowest tide usually occurs early in June at -4.1 feet, a difference of 15.3 feet. The largest single 24-hour tidal swing typically occurs in December, at 14.8 feet.

B. Rainfall

1. Amount

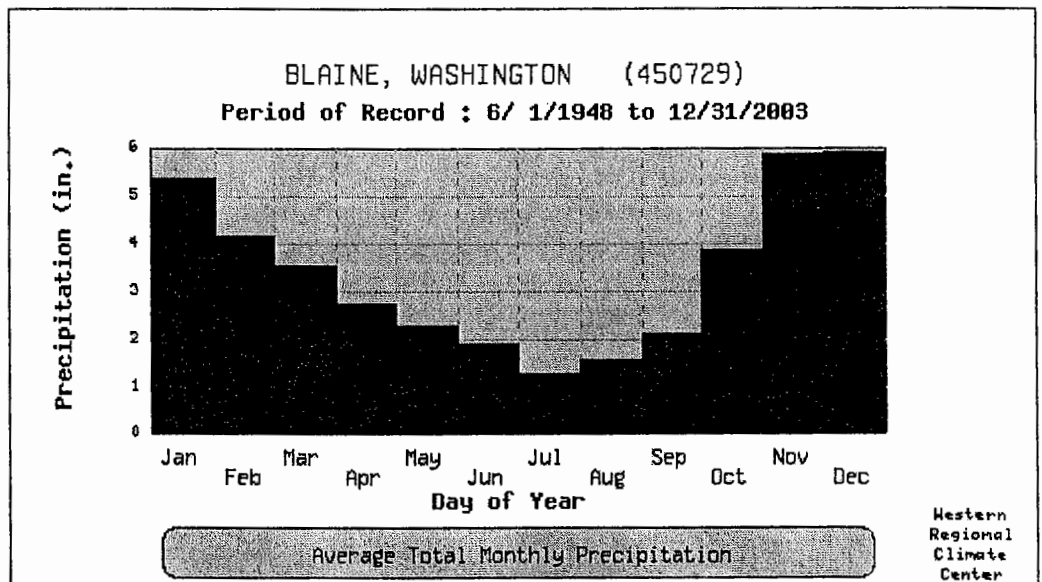
The table below shows the mean, high, and low amounts of rainfall recorded during each month; the annual values for these columns, and the average number of days during each month when the rainfall is greater than or equal to 0.5 inches during a 24-hour period. Since this report recommends a re-classification from Prohibited to Conditionally Approved (based on a rainfall of 0.5 inches), the numbers in the last column are of particular interest, indicating an average of 24 days a year when a closure of the shellfish growing would be initiated due to rainfall.

Precipitation at Blaine (Drayton Harbor), 1948-2003

	Mean	High	Low	1 Day Max.	Days: ≥ 0.5 in.
January	5.43	11.69	1.02	2.25	4
February	4.10	9.38	0.14	2.04	2
March	3.55	7.98	0.93	1.48	2
April	2.78	5.70	0.37	1.61	1
May	2.28	5.42	0.49	1.50	1
June	1.94	5.44	0.36	1.60	1

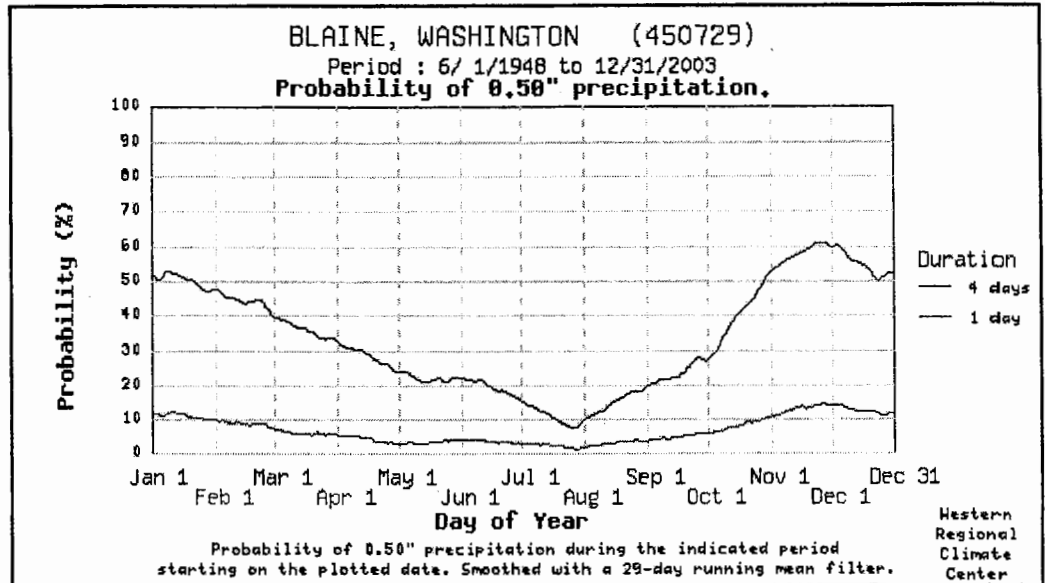
	Mean	High	Low	1 Day Max.	Days: ≥ 0.5 in.
July	1.29	3.33	0.0	1.41	1
August	1.54	5.23	0.0	2.75	1
September	2.06	5.30	0.16	2.20	1
October	3.90	11.36	0.48	1.84	2
November	5.93	10.65	0.91	3.37	4
December	5.96	10.01	1.26	2.43	4
Annual	40.75	52.70	24.76	3.37	24

The graph below displays some of the information shown in the table above but presents the average monthly precipitation in graphical form.



2. When

The graph below shows the probability of one half inch of precipitation, the amount which would close the Conditionally Approved area to commercial shellfish harvest in Drayton Harbor.



3. Identify frequency of significant rainfalls

Under a Conditionally Approved classification, significant rainfalls (causing a harvest closure) would be equal to or greater than 0.5 inches in a 24-hour period. The right-hand column of the first rainfall graph on page 6 shows the average number of days by month (and the year) that a closure of the shellfish growing area would be initiated, the highest being during January, November, and December, each with four days. The average number of days during the year causing a rainfall closure is 24.

Although the winter months are shown as typically having the heaviest rainfalls, the graphs also show that even during the typically dry months of April, May, June, and July, one day rain events exceeding one inch in a 24-hour period have been recorded at Blaine (Drayton Harbor).

C. Winds – Seasonality and effects on pollution dispersion

Winds in the vicinity of Drayton Harbor tend to blow mainly from the south, southeast, east, and northeast during the winter months, and from the west, predominantly southwest, and south during the summer months. High wind conditions occur frequently during the winter months, especially when wind direction shifts from southeast to northeast. Winds can contribute significantly to vertical mixing of the waters in the harbor. Water lying over the shallow areas in the eastern areas tends to move in the direction of the prevailing wind, materially affecting the distribution of pollutants originating along the eastern shore.

D. River discharges

Dakota and California Creeks account for roughly 90% of the freshwater inflow to Drayton Harbor. The discharges from these creeks however are relatively low

and constitute a very small percentage of the total water volume of the embayment, even at low tidal levels.

1. Volumes

Dakota Creek generated an average discharge of 62 cubic feet per second (cfs) during the 1989-90 period, as recorded by the U.S. Geological Survey. During the same period, California Creek recorded an average discharge of approximately 30 cfs.

2. Seasonal

The maximum daily discharge rates for both creeks is highest during the rainy months of November, December, January, and February, corresponding to the months of the highest rainfall recorded in the Drayton Harbor watershed. Discharge rates of these two creeks respond to rainfall in the watershed at any time of the year.

E. Summary discussion concerning actual or potential interaction between transport mechanisms and pollution sources.

There have been several hydrographic (circulation) studies conducted by various entities in an effort to understand and evaluate the complex water flow patterns in Drayton Harbor. Understanding these patterns leads to an understanding of the pollution transport mechanisms, particularly with regard to whether effluent from the Blaine STP outfall, or pollutants originating in the vicinity of the harbor mouth, or in the watershed can reach the shellfish growing areas. These studies have employed various chemical dyes and drogues (floats) set at various depths, released at various locations on particular phases of the tidal cycle, tracked by boat, and the tracks mapped to show current directions and velocities.

The first of these hydrographic studies was conducted in 1976 by students and faculty at Western Washington University. This study focused on the Blaine STP outfall, and demonstrated that effluent from the outfall can reach the harbor mouth on a spring (strong) flood tide, but not on a neap (weak) flood tide. An ebb tide circulation study was conducted in 1995 by Geoff Menzies, then of Drayton Harbor Oyster, Inc., by releasing shallow drogues at the mouth of Dakota and California Creeks (due to the very shallow depths in this region of the harbor), demonstrating that surface currents from these creeks tend to flow to the northwest, following the southwestern shoreline, and that winds can significantly influence the surface currents in these shallow waters.

During that same year, DOH staff and Mr. Menzies released shallow drogues on a strong flood tide in a line across the harbor mouth and inside the rip-rap breakwater at the Port of Bellingham Marina. The drogue in the harbor mouth nearest the marina was transported rapidly past sampling stations 8 and 6, ending up in the vicinity of station 4 (see Map 2, on page 26). The northernmost drogue released inside the marina entrance remained essentially stationary throughout the tidal cycle.

Mr. Menzies conducted another hydrographic study in 1997, this time focused on transport of effluent from the Blaine STP outfall. The results of this study substantiated the conclusions of the 1976 Western Washington study; that effluent discharged at the Blaine STP outfall can reach the harbor mouth in one strong flood tide cycle of six hours, but not on a weak tide.

The most recent hydrographic evaluation of Drayton Harbor current patterns was conducted on July 14, 2003 by DOH staff using drogues and dye. This study was designed by Frank Meriwether of DOH to determine if the high fecal coliform concentrations detected at sampling station 8 adversely affect the water quality at station 4, where oysters had been planted by the Drayton Harbor Community Oyster Farm in anticipation of harvest in the spring of 2004. Results of the dye study indicate that dilution of the station 8 waters is substantial and rapid during the mid and late periods of the flood tide cycle. However, the paths taken by the drogues showed that water from station 8 can pass through the area around station 6, when flooding water is just beginning to cover the adjacent mudflats. For this reason, the hydrographic evaluation report recommended that shellfish not be harvested from the area immediately around station 6. Although station 6 does pass the NSSP water quality standards, the samples are necessarily collected at a higher (deeper) stage of the tidal cycle, when there is sufficient water depth for the sampling boat to reach the sampling site.

Harvest from the Drayton Harbor Community Oyster Farm around station 4 however, would be permissible if three criteria are met. In November 2002, these criteria were conveyed by DOH in a letter to the Drayton Harbor Shellfish Protection District Advisory Committee. The letter states, in part:

“In summary, we can approve commercial harvests of shellfish from the beds monitored by stations 4 and 6, even if stations 8 and 15 fail the water quality standards, provided that:

- The water quality standards are met at stations 4 and 6. (A conditionally approved classification could be applied if pertinent requirements are met),
- It is shown that the contamination at stations 8 and 15 receives sufficient dilution under various stages of flood tide before getting to the shellfish beds, and
- It is shown that the shellfish beds are not impacted by human fecal contamination.”

The first criterion has been satisfied as shown in Table 1, Marine Water Data Summary, on page 16. Station 4 shows a geometric mean value of 5.1 and an estimated 90th percentile value of 27, well within the NSSP standards of 14 and 43 respectively. Station 6 also meets the standards with values of 5.1 and 23. These values are the result of analysis under a Conditionally Approved classification methodology, in which all water quality data collected following a rainfall of 0.5 inch/24-hours (on the sampling day and four days prior) is excluded from the data set. The Conditionally Approved area in Drayton Harbor would be closed to harvest for five days under these same rainfall conditions.

The second criterion has been satisfied by the results of the DOH dye and drogoue hydrographic study of November 2003, which demonstrated that drogues released in the vicinity of station 8 (considering this site as a pollution source) passed just north of station 6 (but well north of station 4), carried by the flood current on a true course of approximately 055° (measured clockwise from true north). One half hour after the drogoue release, a bolus of Rhodamine dye at an approximate concentration of 2500 parts per billion (ppb), was released at station 8 and dye concentrations read by means of grab samples and a flow-through fluorometer. Readings taken at station 8 one minute after the initial dye release showed substantial and rapid dilution. Readings taken several minutes later showed continued substantial dilution, ranging from a trace of dye (<0.5ppb) to 1.0 ppb. At the conclusion of the dye study, trace concentrations of dye were detected throughout the test area, reinforcing the conclusions of rapid and substantial dilution at station 8. This study explains how the fecal coliform concentrations can be so high at station 8 (geometric mean of 31.7 and 90th percentile of 258) and so low at station 4 (5.1 and 27 respectively).

The third criterion has been satisfied due to the fact that the potential sources of human fecal contamination which could impact the shellfish growing area of Drayton Harbor have been investigated and ruled out. These potential human sources are:

- the sewage collection system leaking untreated human sewage: a great deal of work has been done by the City of Blaine in this area; replacing pipelines along Peace Portal Drive, removing combined sewer overflows in the process, video examination of the pipelines, joints, and manholes along Marine Drive, repairing the cracks and breaks which were found during the process (2001).
- the submarine force main leaking untreated human sewage: the force main, which was installed in 1997, is periodically and routinely pressure tested by the City of Blaine and has consistently passed these tests.
- infiltration and inflow (I and I) problems causing the sewage collection system to surcharge, leading to sewage bypasses: I and I problems noted in the 1999 Sanitary Survey Report have been addressed and essentially solved through extensive work in this area by the City of Blaine. There have no combined sewer overflows (CSO) since the winter rainy season of 1999-2000.
- sewage treatment plant malfunctions, leading to discharges of partially treated sewage: the STP closure zone established by DOH protects the area on the outer shore of Semiahmoo Spit up to the harbor mouth, even in the event of a total lack of disinfection.
- failing shore on-site septic systems leaking untreated or partially treated sewage: every individual on-site septic system failure which was discovered during the various shoreline surveys conducted since 1997 has been repaired.
- vessels in the commercial marina have been boarded and inspected by the Port of Bellingham to ensure that "Y" valves in the output lines of marine toilets are fixed in the closed position.

V. Water Quality Studies

A. Map of sampling stations

Map 2, Current Classification Boundaries, on page 26, and Map 3, Proposed Classification Boundaries, on page 27, show the location of the DOH sampling stations in Drayton Harbor.

B. Sampling plan and justification

All samples were collected under the systematic random sampling (SRS) method. The sample schedule was spread throughout the year to allow seasonal variations to be examined. The schedule for each sampling event was developed several weeks in advance of the actual sampling run to eliminate the targeting of any particular meteorological condition. Samples were collected during both ebb and flood tidal conditions between June 16, 1999 and February 23, 2004, the time period presented in this report

Marine water samples were collected in accordance with Chapter IV of the National Shellfish Sanitation Program Model Ordinance. DOH uses the following procedures when collecting water samples from shellfish growing areas:

Samples are collected from approximately six inches below the surface using 100ml, sterile plastic bottles. Samples are immediately placed in an iced, insulated cooler. During the sampling, staff records the time, tidal phase, surface water temperature, and salinity at each sampling station. The samples are transported to the Washington State Public Health Laboratory in Seattle and processing begins with 30 hours after collection. Water samples are processed using the American Public Health Association A-1 Modified (5 tube, 3 dilution) method."

C. Sample Data Analysis and Presentation – Tables Containing the Basic NSSP Statistics

1. Station by station array

Water quality data from individual sampling stations from 6/16/1999 to 2/23/2004 are located in Table 2, on pages 17 to 23.

2. Daily sampling results and number of samples collected for survey

Water quality data for each sampling day, and for each sampling station, is presented in Table 2, on pages 17 to 23.

3. Overall compliance with NSSP criteria

When examined under the condition of one-half inch of rainfall in a 24-hour period (eliminating all water quality data collected under that condition), stations 3, 4, 5, 6, and 12 comply with the NSSP water quality criteria for a Conditionally Approved commercial shellfish growing area. Stations 8 and 15 do not comply with the NSSP criteria, but are located

within the STP and/or marina closure zones established by DOH, and are therefore classified as Prohibited by definition.

4. Classification of stations

A correlation between rainfall and fecal coliform concentration enables the areas around stations 3, 4, 5, 6, and 12 to be classified in the proposed Conditionally Approved area. The two stations, 8 and 15, located within the closure zones are necessarily classified as Prohibited.

VI. Interpretation of Data in Determining Area Classification

A. Effects of meteorologic and hydrographic conditions on bacterial loading

Table 1, Summary of Marina Water Quality, on page 16, displays the geometric mean and estimated 90th percentile of samples collected when rainfall was less than 0.5 inches/24 hours on the sampling day, and four days prior. Under these conditions the proposed Conditionally Approved area complies with the NSSP water quality standards.

Table 3, Rainfall Exclusions, on page 24, displays the sampling dates when water quality data was excluded from the data set because rainfall exceeded 0.5 inch prior to sample collection. There were eleven sampling days excluded, nine of which occurred during the rainy winter months; four in January, one in February, three in November, and one in December. These results demonstrate the impact of rainfall on water quality in Drayton Harbor, which occurs mainly during the winter months.

B. Variability in the data and causes

Table 2, Station-by-Station Array, on pages 17 through 23, shows the date, time, tide, water temperature, salinity, and fecal coliform (FC) concentration for each sampling station during the time frame of the data set presented in Table 1. All FC results greater than 43 are emphasized with a gray highlight. For example, of the 34 samples collected at station 4, only three samples exceeded 43, two at 49 and one at 350. These three samples represent only 8.8% of the total. The geometric mean of all 34 samples, including the three high numbers, is 5.1, a value that demonstrates the relatively low variability of this data set. Station 6 shows a similar pattern, with only two samples out of 34 (5.9%) exceeding 43, one at 49 and one at 70, also with a geometric mean of 5.1. Even at these sampling stations, which are clearly adversely affected by rainfall, elevated bacteria levels are relatively infrequent, as demonstrated by the low geometric mean values.

VII. Conclusions

A. Map or chart showing classifications

Map 3, Proposed Classification Boundaries, on page 27, shows the location of the proposed Conditionally Approved area and the location of the individual sampling stations in Drayton Harbor.

B. Legal descriptions

The proposed Conditionally Approved area in Drayton Harbor is described by a line originating on the east shore of the Semiahmoo Spit directly west of station 12, at latitude 48.9831 N. and longitude 122.7841 W.; then extending southeast 1450 meters to a point directly south of station 3, at lat. 48.9722 N. and lon. 122.7741 W., then extending northeast 1835 meters to a point directly east of station 4, at lat. 48.9808 N. and lon. 122.7531 W., then extending north 550 meters to a point northeast of station 6, at lat. 48.9857 N. and lon. 122.7541 W., then extending west 1210 meters to the south corner of the Semiahmoo Marina breakwater, lat. 48.9847 N. and lon. 122.7708 W., then extending west 485 meters to a point on the Semiahmoo Spit, 900 feet southwest of the point where the breakwater connects to the spit, at lat. 48.9858 N. and 122.7768 W., and then follows the shoreline of the spit 650 meters to the origin. For a graphic representation of this area, see Map 3, Proposed Classification Boundaries, on page 27.

C. Management plan (if Conditionally Approved)

The Conditionally Approved area will be managed on a rain accumulation of one-half inch in a 24-hour period, as measured at the City of Blaine sewage treatment plant, located at the southwest end of the Semiahmoo Spit, at latitude 48.9778 N. and longitude 122.7925 W. When more than one-half inch of rain accumulates in a 24-hour period, shellfish harvest from the Conditionally Approved area will be immediately closed for a period of five days.

D. Recommendations for Sanitary Survey improvement

1. Monitoring schedule, stations, etc.

The NSSP Model Ordinance, Chapter IV. Shellstock Growing Areas, 1999 Revision, requires a Conditionally Approved area based on rainfall events to be sampled a minimum of six times a year when the area is open for harvest. However, because of the high fecal coliform concentrations still present at stations 8 and 15, the marine waters in this area should be sampled more frequently, and monitoring and analysis be continued of stormwater discharges, freshwater creeks, and the waters inside the rip-rap breakwater of the Port of Bellingham Marina.

This report further recommends that additional sampling stations be established along the eastern shoreline of the Semiahmoo Spit, south from station 12 to Shintaffer Road, so that the clam resource present in this area can eventually be harvested.

2. Comments

Although a portion of Drayton Harbor is recommended in this report for an upgrade from Prohibited to Conditionally Approved, the pollution sources causing the unusually high fecal coliform concentrations at stations 8 and 15 have not been confirmed. This situation requires continuing investigation and analysis to confirm these sources.

TABLE 1

SUMMARY OF MARINE WATER QUALITY

Growing Area: **DRAYTON HARBOR**

Classification: Prohibited

From 06/16/1999 To 02/23/2004

Fecal Coliform Organisms/100 ml

The summary shown below represents samples collected when rainfall was less than 0.5 inch/24-hours on sampling date and four days prior.

Station Number	Classification	Number of Samples	Range	Geometric Mean	Est. 90th Percentile	Meets Std.
3	Prohibited	30	1.7 - 79.0	5.5	20.0	Yes
4	Prohibited	34	1.7 - 350.0	5.1	27.0	Yes
5	Prohibited	30	1.7 - 33.0	4.0	14.0	Yes
6	Prohibited	34	1.7 - 70.0	5.1	23.0	Yes
8	Prohibited	34	1.7 - 540.0	31.7	258.0	No
12	Prohibited	30	1.7 - 79.0	4.0	18.0	Yes
15	Prohibited	31	1.7 - 540.0	17.0	133.0	No

All tides information is presented.

The standards for Approved shellfish growing waters are: a fecal coliform geometric mean not greater than 14 organisms/100 ml; and, an estimate of the 90th percentile not greater than 43 organisms/100 ml. The above table shows bacteriological results in relation to National Shellfish Sanitation Program (NSSP) standards.

† All samples have been verified.

TABLE 2: STATION-BY-STATION ARRAY

Growing Area: DRAYTON HARBOR

Sampling Station Number: 3

Classification: Prohibited

Sample Date	Sample Time	Tide	Fcoli/100ml	Temperature	Salinity
06/16/1999	06:21	Flood	4	14	29
07/20/1999	11:51	Flood	1.7	20	24
08/17/1999	08:36	Flood	4.5	17	25
09/15/1999	08:35	Flood	4.5	15	27
10/13/1999	08:23	Ebb	11	11	28
11/17/1999	10:05	Flood	7.8	10	25
02/22/2000	14:24	Flood	7.8	8	29
04/13/2000	10:35	Flood	4.5	12	28
06/01/2000	11:40	Ebb	11	14	20
09/21/2000	09:23	Flood	1.7	15	25
03/08/2001	12:25	Flood	7.8	7	30
05/17/2001	08:36	Ebb	6.8	12	30
07/11/2001	09:01	Flood	1.7	18	25
09/26/2001	08:40	Flood	4.5	14	30
03/27/2002	08:34	Ebb	7.8	7	28
05/22/2002	08:54	Ebb	1.7	13	25
07/31/2002	08:17	Flood	1.7	16	25
09/18/2002	08:35	Ebb	6.8	14	28
11/14/2002	08:46	Flood	11	10	30
04/09/2003	09:28	Ebb	6.1	9	32
06/11/2003	08:29	Ebb	1.7	15	22
07/10/2003	14:24	Flood	1.7	18	25
08/04/2003	09:46	Flood	1.7	18	
09/04/2003	13:50	Flood	1.7	15	30
10/13/2003	09:26	Ebb	7.8		33
10/28/2003	08:50	Ebb	13	11	32
11/05/2003	11:31	Flood	7.8	7	32
12/15/2003	09:40	Flood	49	7	33
01/22/2004	08:24	Ebb	79	6	24
02/23/2004	10:08	Ebb	33	8	30

Number of Samples: 30

Range: 1.7 - 79

Geometric Mean: 5.5

Estimated 90th Percentile: 20

† All samples have been verified.

Growing Area: DRAYTON HARBOR
 Sampling Station Number: 4
 Classification: Prohibited

Sample Date	Sample Time	Tide	Fcoli/100ml	Temperature	Salinity
06/16/1999	06:25	Flood	1.7	15	28
07/20/1999	11:55	Flood	1.7	19	24
08/17/1999	08:41	Flood	4	17	25
09/15/1999	08:41	Flood	2	15	27
10/13/1999	08:17	Ebb	7.8	12	29
11/17/1999	10:11	Flood	4.5	10	25
02/22/2000	14:28	Flood	27	8	28
04/13/2000	10:30	Flood	1.7	12	28
06/01/2000	11:44	Ebb	11	15	20
09/21/2000	09:27	Flood	2	15	28
02/14/2001	08:40	Flood	49	7	24
03/08/2001	12:29	Flood	13	7	30
05/17/2001	08:40	Ebb	350	12	25
07/11/2001	09:04	Flood	2	17	25
07/24/2001	10:43	Ebb	1.7	17	28
09/12/2001	10:29	Flood	4.5	17	26
09/26/2001	08:47	Flood	4.5	14	30
10/23/2001	10:40	Flood	2	10	30
03/27/2002	08:38	Ebb	17	7	28
05/22/2002	08:58	Ebb	1.8	13	25
07/31/2002	08:22	Flood	2	16	25
09/18/2002	08:40	Ebb	4.5	14	28
11/14/2002	08:51	Flood	1.7	10	30
04/09/2003	09:32	Ebb	1.7	9	32
06/11/2003	08:41	Ebb	1.7	15	22
07/10/2003	14:27	Flood	2	18	25
08/04/2003	09:36	Flood	1.7	18	
09/04/2003	13:54	Flood	1.7	15	30
10/13/2003	09:17	Ebb	7.8		33
10/28/2003	08:39	Ebb	7.8	11	32
11/05/2003	11:25	Flood	7.8	7	32
12/15/2003	09:30	Flood	13	7	33
01/22/2004	08:29	Ebb	33	6	24
02/23/2004	10:00	Ebb	49	8	30

Number of Samples: 34

Range: 1.7 - 350

Geometric Mean: 5.1

Estimated 90th Percentile: 27

† All samples have been verified.

Growing Area: DRAYTON HARBOR
 Sampling Station Number: 5
 Classification: Prohibited

Sample Date	Sample Time	Tide	Fcoli/100ml	Temperature	Salinity
06/16/1999	06:17	Flood	1.7	16	28
07/20/1999	11:47	Flood	1.7	20	25
08/17/1999	08:32	Flood	2	17	24
09/15/1999	08:30	Flood	4	16	26
10/13/1999	08:28	Ebb	1.7	12	28
11/17/1999	10:01	Flood	33	10	22
02/22/2000	14:21	Flood	15	8	30
04/13/2000	10:40	Flood	11	12	28
06/01/2000	11:38	Ebb	7.8	14	22
09/21/2000	09:20	Flood	4.5	15	25
03/08/2001	12:22	Flood	4.5	7	30
05/17/2001	08:29	Ebb	1.7	12	30
07/11/2001	08:46	Flood	1.8	18	25
09/26/2001	08:35	Flood	11	14	30
03/27/2002	08:31	Ebb	2	8	28
05/22/2002	08:50	Ebb	2	13	25
07/31/2002	08:13	Flood	1.7	16	25
09/18/2002	08:30	Ebb	1.7	14	28
11/14/2002	08:42	Flood	11	10	30
04/09/2003	09:20	Ebb	1.7	9	32
06/11/2003	08:25	Ebb	2	15	22
07/10/2003	14:19	Flood	1.7	18	28
08/04/2003	09:56	Flood	1.7	19	
09/04/2003	13:46	Flood	1.7	15	30
10/13/2003	09:30	Ebb	4.5		33
10/28/2003	08:55	Ebb	23	11	32
11/05/2003	11:37	Flood	2	7	32
12/15/2003	09:46	Flood	11	7	33
01/22/2004	08:20	Ebb	33	6	24
02/23/2004	10:13	Ebb	7.8	8	30

Number of Samples: 30
 Geometric Mean: 4.0

Range: 1.7 - 33
 Estimated 90th Percentile: 14

† All samples have been verified.

Growing Area: DRAYTON HARBOR
 Sampling Station Number: 6
 Classification: Prohibited

Sample Date	Sample Time	Tide	Fcoli/100ml	Temperature	Salinity
06/16/1999	06:27	Flood	2	15	28
07/20/1999	11:58	Flood	1.7	19	24
08/17/1999	08:45	Flood	11	17	25
09/15/1999	08:45	Flood	4.5	15	27
10/13/1999	08:12	Ebb	17	12	30
11/17/1999	10:15	Flood	13	10	25
02/22/2000	14:30	Flood	23	8	29
04/13/2000	10:26	Flood	7.8	12	28
06/01/2000	11:46	Ebb	1.7	14	25
09/21/2000	09:30	Flood	4.5	15	25
02/14/2001	08:45	Flood	7.8	7	25
03/08/2001	12:31	Flood	7.8	7	30
05/17/2001	08:44	Ebb	33	12	30
07/11/2001	09:07	Flood	1.7	17	25
07/24/2001	10:47	Ebb	4.5	17	28
09/12/2001	10:37	Flood	1.7	17	26
09/26/2001	08:53	Flood	2	14	30
10/23/2001	10:43	Flood	1.7	10	30
03/27/2002	08:41	Ebb	2	7	28
05/22/2002	09:03	Ebb	1.7	13	28
07/31/2002	08:25	Flood	1.7	16	25
09/18/2002	08:44	Ebb	11	14	28
11/14/2002	08:55	Flood	2	10	30
04/09/2003	09:36	Ebb	1.7	9	32
06/11/2003	08:44	Ebb	1.7	15	22
07/10/2003	14:29	Flood	2	18	26
08/04/2003	09:30	Flood	2	18	
09/04/2003	13:57	Flood	1.7	15	30
10/13/2003	09:14	Flood	4.5		33
10/28/2003	08:33	Flood	49	11	32
11/05/2003	11:20	Flood	7.8	7	32
12/15/2003	09:25	Flood	33	7	33
01/22/2004	08:33	Ebb	70	6	24
02/23/2004	09:55	Ebb	33	8	30

Number of Samples: 34

Range: 1.7 - 70

Geometric Mean: 5.1

Estimated 90th Percentile: 23

† All samples have been verified.

Growing Area: DRAYTON HARBOR
 Sampling Station Number: 8
 Classification: Prohibited

Sample Date	Sample Time	Tide	Fcoli/100ml	Temperature	Salinity
06/16/1999	06:30	Flood	7.8	15	28
07/20/1999	12:01	Flood	1.7	19	24
08/17/1999	08:49	Flood	27	17	25
09/15/1999	08:49	Flood	6.8	15	27
10/13/1999	08:05	Ebb	110	13	26
11/17/1999	10:19	Flood	79	10	23
02/22/2000	14:32	Flood	23	8	28
04/13/2000	10:23	Flood	27	11	28
06/01/2000	11:49	Ebb	1.7	14	24
09/21/2000	09:06	Flood	4.5	15	25
02/14/2001	08:49	Flood	49	6	24
03/08/2001	12:14	Flood	170	7	30
05/17/2001	08:20	Ebb	130	12	30
07/11/2001	08:33	Flood	170	17	25
07/24/2001	10:51	Ebb	49	17	28
09/12/2001	10:47	Flood	23	18	27
09/26/2001	08:57	Flood	2	14	30
10/23/2001	10:48	Flood	4.5	10	30
03/27/2002	08:46	Ebb	240	7	26
05/22/2002	09:07	Ebb	17	13	26
07/31/2002	08:31	Flood	350	16	25
09/18/2002	08:45	Ebb	33	14	28
11/14/2002	08:58	Flood	27	10	30
04/09/2003	09:41	Ebb	22	9	32
06/11/2003	08:46	Ebb	23	15	22
07/10/2003	14:32	Flood	2	17	26
08/04/2003	09:24	Flood	7.8	18	
09/04/2003	13:36	Flood	49	14	30
10/13/2003	09:10	Flood	350		33
10/28/2003	08:26	Flood	79	11	32
11/05/2003	11:16	Flood	33	8	32
12/15/2003	09:20	Flood	540	7	33
01/22/2004	08:36	Ebb	350	6	25
02/23/2004	09:47	Ebb	70	8	30

Number of Samples: 34

Range: 1.7 - 540

Geometric Mean: 31.7

Estimated 90th Percentile: 258

† All samples have been verified.

Growing Area: DRAYTON HARBOR
 Sampling Station Number: 12
 Classification: Prohibited

Sample Date	Sample Time	Tide	Fcoli/100ml	Temperature	Salinity
06/16/1999	06:14	Flood	2	16	28
07/20/1999	11:44	Flood	2	20	25
08/17/1999	08:28	Flood	1.7	17	24
09/15/1999	08:25	Flood	1.7	16	26
10/13/1999	08:32	Ebb	1.7	12	26
11/17/1999	09:57	Flood	33	10	22
02/22/2000	14:17	Flood	33	8	28
04/13/2000	10:44	Flood	4.5	12	28
06/01/2000	11:25	Ebb	1.7	13	25
09/21/2000	09:10	Flood	2	15	25
03/08/2001	12:18	Flood	4.5	7	30
05/17/2001	08:25	Ebb	79	12	28
07/11/2001	08:52	Flood	1.7	18	25
09/26/2001	08:30	Flood	1.7	14	30
03/27/2002	08:27	Ebb	4.5	8	28
05/22/2002	08:46	Ebb	1.7	13	25
07/31/2002	08:09	Flood	1.7	16	25
09/18/2002	08:25	Ebb	1.7	14	28
11/14/2002	08:39	Flood	4.5	10	30
04/09/2003	09:11	Ebb	1.7	9	32
06/11/2003	08:21	Ebb	1.7	15	22
07/10/2003	14:16	Flood	4	8	26
08/04/2003	10:03	Flood	1.7	19	
09/04/2003	13:42	Flood	2	15	30
10/13/2003	09:34	Ebb	2		33
10/28/2003	09:02	Ebb	7.8	12	32
11/05/2003	11:42	Flood	4.5	6	32
12/15/2003	09:50	Flood	33	7	33
01/22/2004	08:16	Ebb	23	6	24
02/23/2004	10:18	Ebb	33	8	30

Number of Samples: 30
 Geometric Mean: 4.0

Range: 1.7 - 79
 Estimated 90th Percentile: 18

† All samples have been verified.

Growing Area: DRAYTON HARBOR
 Sampling Station Number: 15
 Classification: Prohibited

Sample Date	Sample Time	Tide	Fcoli/100ml	Temperature	Salinity
06/16/1999	06:33	Flood	540	15	29
07/20/1999	12:03	Flood	4.5	19	24
08/17/1999	08:52	Flood	2	17	25
09/15/1999	08:54	Flood	2	15	28
10/13/1999	08:42	Ebb	540	12	28
11/17/1999	10:40	Flood	350	10	22
02/22/2000	14:36	Flood	33	8	30
04/13/2000	10:19	Flood	33	11	28
06/01/2000	11:21	Ebb	6.8	13	25
09/21/2000	09:06	Flood	4.5	15	25
02/14/2001	08:53	Flood	49	6	25
03/08/2001	12:11	Flood	13	7	30
05/17/2001	08:16	Ebb	17	13	28
07/11/2001	08:30	Flood	9.2	17	25
09/26/2001	08:23	Flood	4.5	14	30
03/27/2002	08:22	Ebb	49	8	25
05/22/2002	08:40	Ebb	23	13	25
07/31/2002	08:04	Flood	2	17	25
09/18/2002	08:20	Ebb	23	14	25
11/14/2002	08:34	Flood	11	10	28
04/09/2003	09:45	Ebb	14	9	32
06/11/2003	08:14	Ebb	4	15	22
07/10/2003	14:34	Flood	2	17	26
08/04/2003	09:18	Flood	13	17	
09/04/2003	13:33	Flood	1.7	14	30
10/13/2003	09:05	Flood	33		33
10/28/2003	08:20	Flood	79	12	32
11/05/2003	11:12	Flood	13	7	32
12/15/2003	09:15	Flood	22	8	33
01/22/2004	08:39	Ebb	31	6	25
02/23/2004	09:40	Ebb	170	8	30

Number of Samples: 31

Range: 1.7 - 540

Geometric Mean: 17.0

Estimated 90th Percentile: 133

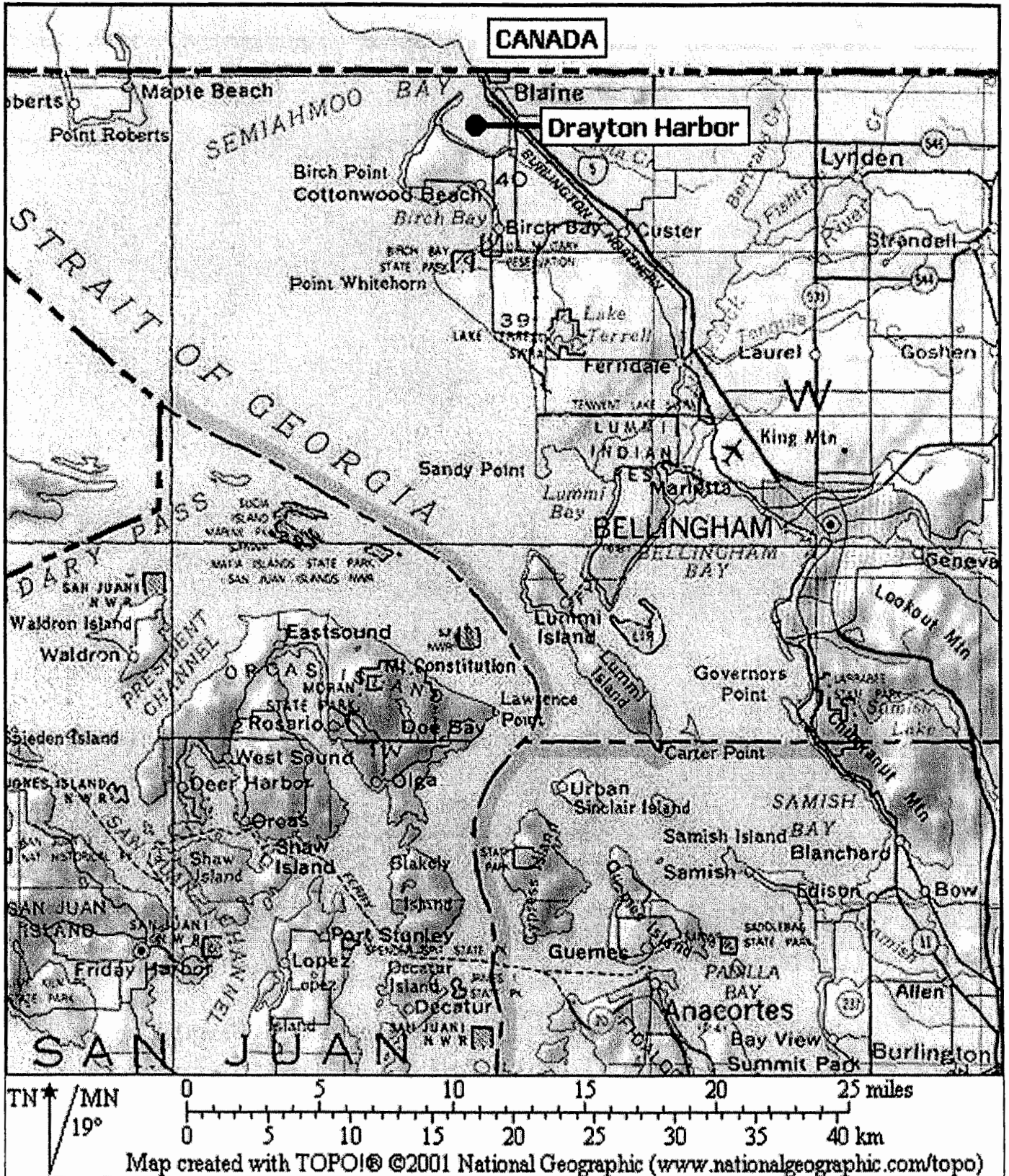
† All samples have been verified.

TABLE 3: RAINFALL EXCLUSIONS

Rainfall (in inches/24 hours): Sample Date to 4 Days Prior
 (If 0.5 inches or more, that day's results are **excluded** from data set)

Sample Date	Day 0	Day 1	Day 2	Day 3	Day 4	Data is . .
06/16/1999	0.13	0	0	0	0	Included
07/20/1999	0	0	0	0	0	Included
08/17/1999	0	0.46	0.44	0.04	0.38	Included
09/15/1999	0	0	0	0	0	Included
10/13/1999	0.33	0.07	0	0	0.08	Included
11/17/1999	0.27	0.44	0.12	0.25	0.36	Included
02/22/2000	0.25	0.3	0	0	0	Included
04/13/2000	0	0	0	0	0	Included
06/01/2000	0	0.02	0.03	0	0.46	Included
09/21/2000	0	0.03	0	0	0	Included
11/29/2000	0.34	0	0.09	0.57	0.34	Excluded
01/24/2001	0.03	0	0	0.63	0	Excluded
02/14/2001	0	0	0	0	0	Included
03/08/2001	0.17	0	0	0	0	Included
05/17/2001	0	0.38	0.26	0.42	0	Included
07/11/2001	0	0	0	0	0	Included
07/24/2001	0	0.02	0	0	0	Included
08/22/2001	0.61	0.40	0	0	0	Excluded
09/12/2001	0	0	0	0	0	Included
09/26/2001	0.45	0	0	0	0	Included
10/23/2001	0.27	0.3	0.48	0.09	0	Included
11/08/2001	0	0	0	0.39	0.62	Excluded
01/09/2002	0	0.5	0.4	0.3	0	Excluded
03/27/2002	0.2	0.02	0.02	0	0	Included
05/22/2002	0	0.06	0.04	0.12	0	Included
07/31/2002	0	0.03	0	0	0	Included
09/18/2002	0	0	0.05	0.37	0	Included
11/14/2002	0.17	0.14	0.36	0.3	0.27	Included
01/08/2003	0	0	0	0	0.77	Excluded
04/09/2003	0.43	0.12	0.14	0.39	0.1	Included
05/05/2003	0.07	0.6	0	0	0	Excluded
06/11/2003	0	0	0	0	0	Included
07/10/2003	0	0	0	0	0	Included
08/04/2003	0	0	0	0	0	Included
09/04/2003	0	0	0	0	0	Included
10/13/2003	0.2	0.36	0	0	0.15	Included
10/28/2003	0.41	0.02	0	0	0	Included
11/05/2003	0	0	0	0	0	Included
11/20/2003	0.02	1.55	0.66	0.23	0.28	Excluded
12/01/2003	0	0	1.12	0.65	0	Excluded
12/15/2003	0.03	0.12	0.12	0.07	0.03	Included
01/07/2004	0.77	0	0	0	0.06	Excluded
01/22/2004	0	0	0	0.25	0.37	Included
02/03/2004	0.09	0.02	0.25	0	0.94	Excluded
02/23/2004	0.03	0	0	0	0.1	Included

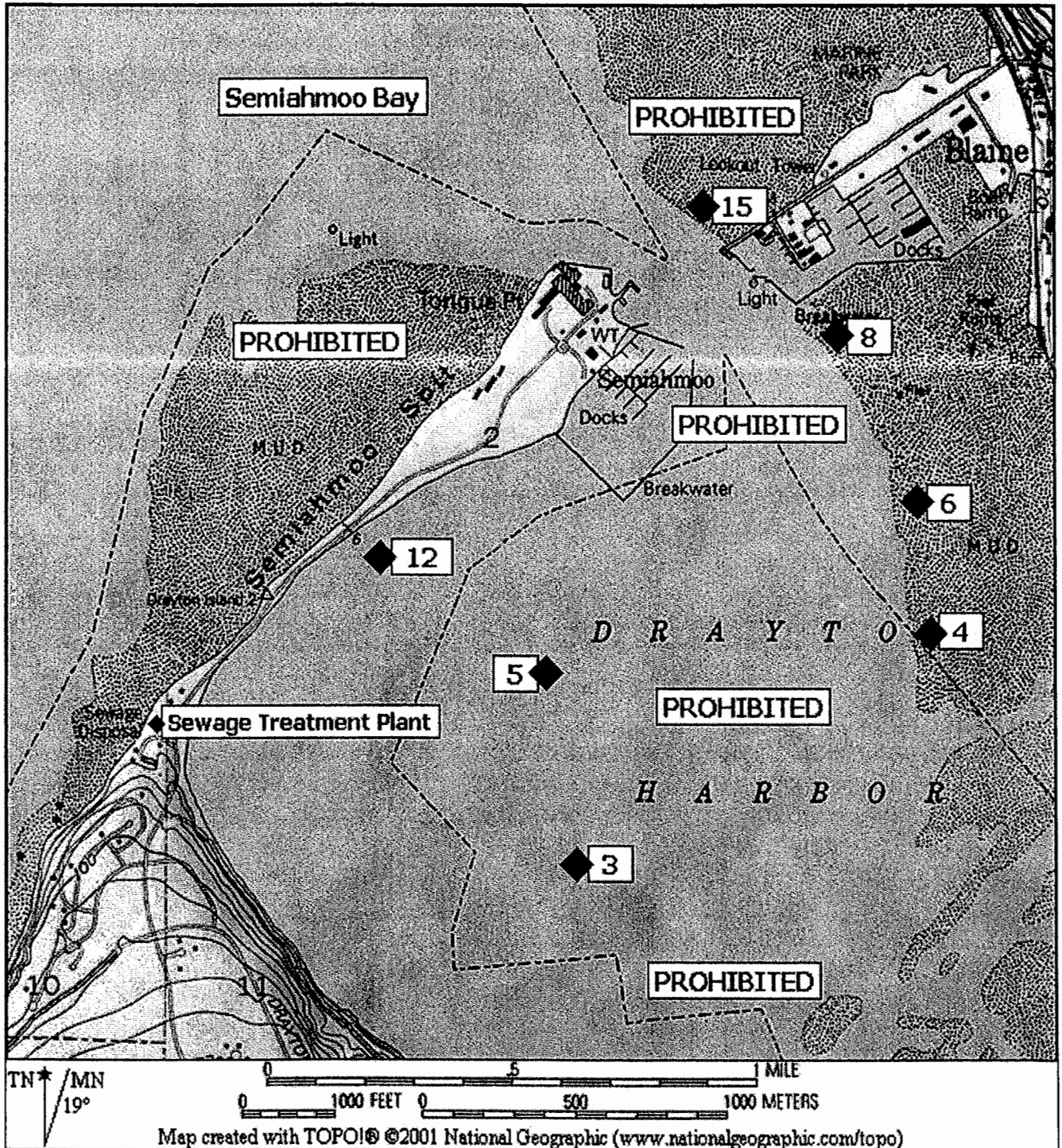
MAP 1: DRAYTON HARBOR Regional Map



Map created with TOPO!® ©2001 National Geographic (www.nationalgeographic.com/topo)

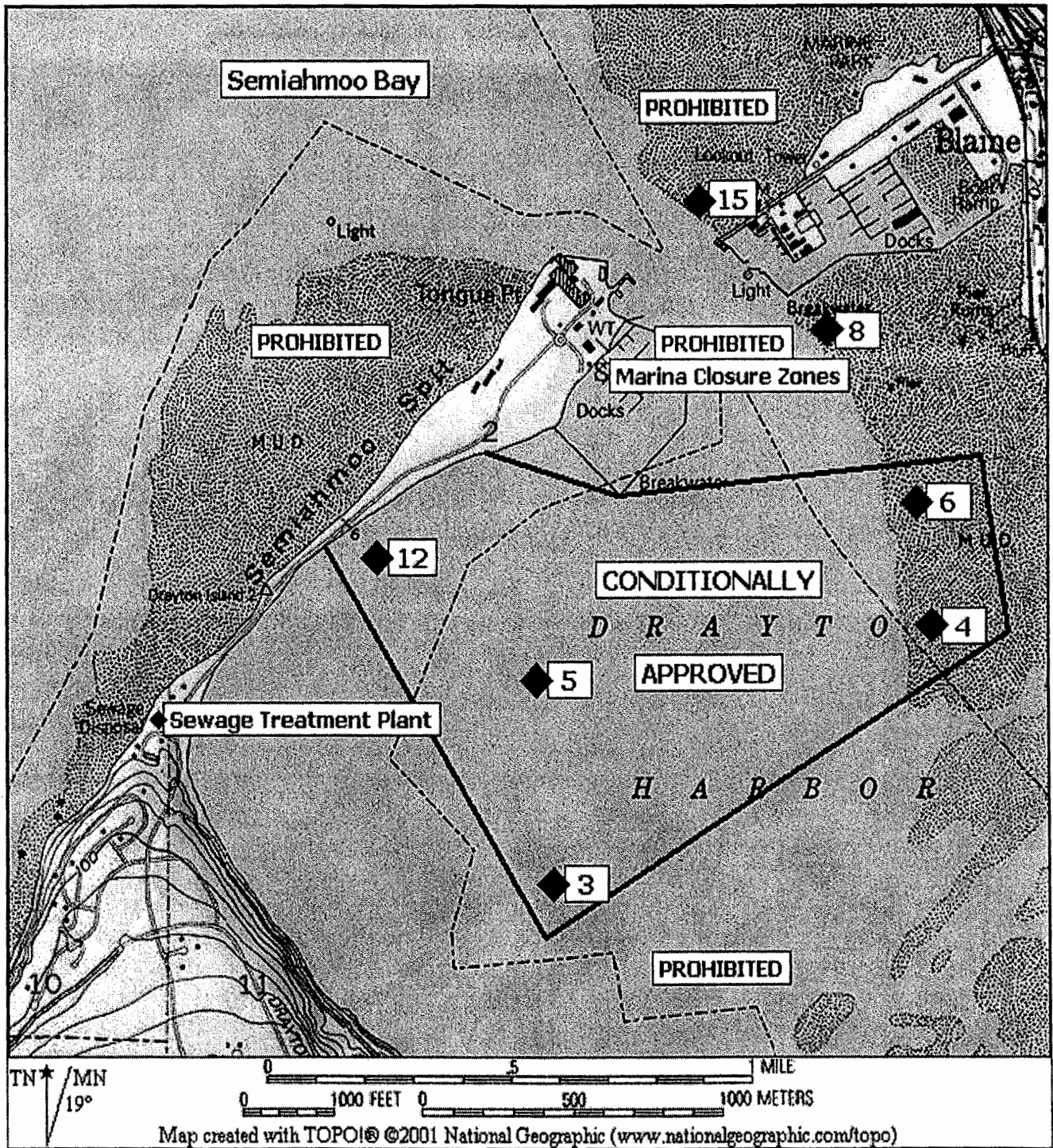
MAP 2: DRAYTON HARBOR

Current Classification Boundaries



MAP 3: DRAYTON HARBOR

Proposed Classification Boundaries



MAP 4: DRAYTON HARBOR

Potential Pollution Sources and the Location of Water Quality Sampling Stations

