Tacoma - Pierce County
Health Department
Healthy People in Healthy Communities
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Pollution Prevention, Identification & Correction Manual

Protocol & Guidelines

Surface Water Program
Updated September 17, 2013

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Contents

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Introduction

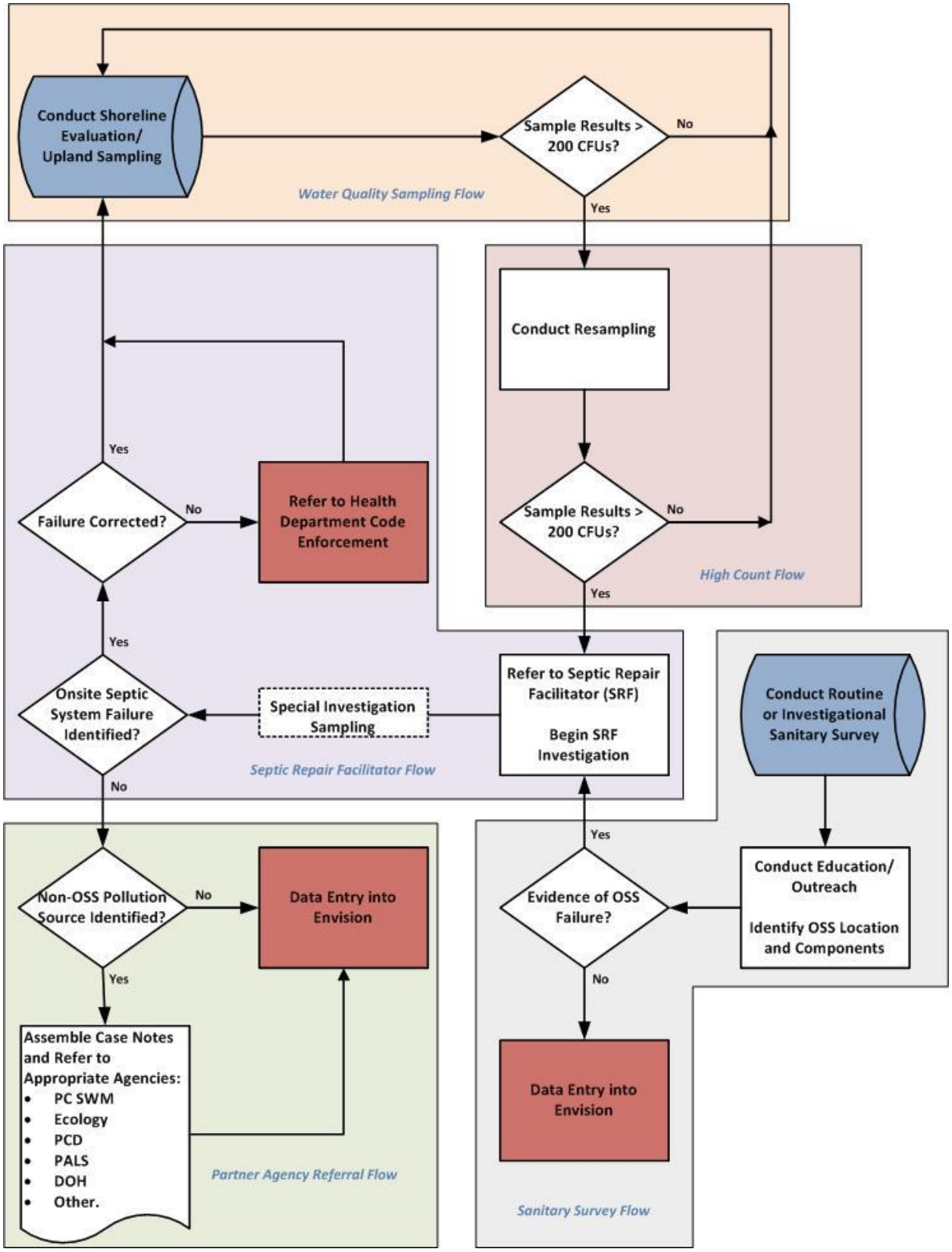
The Tacoma-Pierce County Health Department Surface Water Program (Health Department) works in partnership with Pierce County Surface Water Management (SWM), Pierce Conservation District (PCD) and numerous other governments and stakeholders to protect and improve shellfish watersheds by preventing, identifying and correcting sources of water pollution. This water quality team is called the Pierce County Shellfish Partners. The team vision is *Governments and stakeholders are actively working together to improve water quality in the shellfish watersheds of Pierce County* and the mission is *Protect and improve shellfish watersheds by preventing, identifying and correcting sources of water pollution*.

This manual describes the pollution prevention, identification and correction activities of the Health Department and identifies coordination of activities with the partners. The first section of the manual describes the pollution prevention activities, the second section covers the identification activities, and the final section details the correction activities.

Pollution Identification Activities

Pollution sources are generally identified through water quality sampling and/or sanitary survey work and these source identification tools are detailed in the following section. Pollution sources are also identified through citizen complaints, self referrals, septic system industry inspections, and partner activities. These identification tools are not detailed in this manual. *Figure 1. PIC Process Overview* shows the flow of activities to identify and then correct sources of bacterial pollution.

Figure 1. PIC Process Overview



Water Sampling Protocol for Fecal Coliform and E. coli Bacteria

Background

The Health Department has been actively conducting water sampling for fecal coliform and E. coli bacteria to identify sources of bacteria since the 1980s. Originally the sampling was conducted to support a specific grant to improve the water quality of Burley Lagoon and Minter Bay. Initially, sampling focused on the shoreline but evolved to include upland sampling, high count re-sampling, and special investigation sampling. Sampling efforts increased dramatically in 2007 with the aid of additional funding from Pierce County Surface Water Management (SWM). Monitoring now includes:

- Shoreline evaluations (shoreline sampling) conducted routinely in ten different bays, once or twice per year. These bays have commercial shellfish growing areas and are more susceptible to water quality degradation than shellfish areas along the open shoreline due to more limited water circulation and a greater influence from freshwater.
- Upland sampling, conducted generally on the same day when the Washington State Department of Health (DOH) collects marine water samples. Upland sample stations have been established on the larger tributaries in six shellfish watersheds.
- High count re-sampling when a sample result equals or exceeds 200 colony- forming units (cfu)/100 ml.
- Special investigation sampling, conducted when high count re-samples equal or exceed 200 cfu/100ml or when there is some other indication that a significant source of fecal coliform is present.

Currently the Health Department's Surface Water Quality Database contains data for over 5,000 samples collected since 2007.

In addition to samples collected by the Health Department, staff also review data collected by DOH, SWM and other agencies to determine if additional source identification work is needed. Health Department staff review the monthly DOH results for all samples collected in Pierce County and any fecal coliform counts above 33 cfu/100ml are forwarded to the Surface Water Program team for consideration.

Purpose

Water sampling is a method of identifying sources of fecal coliform pollution. Sampling routinely takes place near confluences of freshwater flows to marine water shellfish areas (shoreline evaluations) and at selected upstream locations on the larger tributaries (upland sampling). Sites with sampled fecal coliform counts equal to or exceeding 200 cfu/100 ml are re-sampled (high count sampling) to see if the site should be investigated further to identify and correct the issue. Frequently, additional sites need to be sampled (special investigations) to better determine the location of the bacterial source. If the source is determined to be of anthropogenic origin, the corrective action is then handled by the Health Department's Septic Repair Facilitator (SRF), the Code Enforcement Program, and/or a partnering agency.

Initial Preparation

Identifying When to Sample

Shoreline Evaluations

Around October 1st of each year, determine via a random method the order that shoreline evaluations will be conducted. This order will be followed for the water year (October 1st through September 30th). Evaluations will be conducted at least once each year at ten different bays during the wet season (October through April) and, if resources allow, once during the dry season (May through September). The ten bays where shoreline evaluations are conducted include:

- Burley Lagoon
- Henderson Bay, Wauna shoreline
- Minter Bay
- Mayo Cove (Penrose Point State Park)
- Filucy Bay
- Dutchers Cove
- Vaughn Bay
- Rocky Bay
- Amsterdam Bay
- Oro Bay

Upland Sampling

Upland sampling is conducted for six watersheds generally on the same day as DOH's marine water sampling (the DOH sampling schedule is usually available the third or fourth week of the previous month). These six watersheds include:

- Burley Lagoon Watershed
- Minter Bay Watershed
- Filucy Bay Watershed
- Dutchers Cove Watershed
- Vaughn Bay Watershed
- Rocky Bay Watershed

Office/Lab Preparation for Sampling

Surface Water staff coordinate to determine specific locations and types of samples to be collected for the current sampling event. In general, shoreline evaluation sampling and upland sampling are not conducted around specific storm events. Frequently, special investigation sampling events are conducted during storm events, often targeting storms with approximately 0.2- 1.0" precipitation within a 24-hour period.

Follow the steps below before leaving the office:

1. Calibrate parameter probe(s). See Parameter Probe Calibration Protocol.
2. Fill cooler with two blue ice packs from freezer located downstairs in the "Rat Lab". Samples must be kept at or below a temperature of 10°C and must not be allowed to freeze. Under these conditions they should also be delivered to the lab within six hours to ensure accurate bacterial analysis.
3. Prepare sample record sheet. When considering where to collect replicate samples, choose sites where high counts are expected and/or where the flows are consistent (i.e. streams, continuous flow from a pipe, etc).
4. Log sampling event information into the Surface Water Outlook electronic calendar, if not previously entered.
5. Field staff should be appropriately attired for the current weather conditions. See Appendix D for a list of materials.
6. If shoreline sampling will be conducted, review the *Shoreline Sampling Information* binder and the tide table to ensure tides are low enough to accomplish the sampling.
7. If upland sampling will be conducted, review the *Key Peninsula Upland Sampling* binder to review sample locations.
8. Prior to leaving the Health Department, make sure all required items listed in the Equipment/Materials section are present in the vehicle.
9. Ensure that the vehicle fuel tank is at least ½ full. Refuel if necessary.

Field Sampling

1. Park only in appropriate locations and respect property rights. If using an unidentified Health Department vehicle, place a printed logo on dashboard.
2. Ensure that all necessary sample collection materials are brought into the field. Fill a cooler with an adequate number of sample bottles.
3. For shoreline evaluations:
    a. Start at the far end of the shoreline to be sampled and collect samples on the return trip.
    b. Take the cooler to ensure samples remain at the proper temperature after collection.
    c. Use the GPS, and current maps if desired, to locate sites and *note on the sample recording sheet which sites are not flowing*. Note new sites that are observed and sampled. Obtain GPS coordinates for all new sample sites. See Global Positioning System (GPS) Protocol for specific instruction.
    d. Write a short description for new sites or sites with significant changes. Include obvious landmarks, type of flow (pipe, stream, seep, high flow, etc.), and distance from the nearest established sample station.
4. When arriving at an established sample station:
    a. Check the site description to make sure it matches as accurately as possible.
    b. Update GPS coordinates if different from previously recorded.
    c. Note significant weather patterns, animal presence, etc.

d. If there is a site with **NO FLOW**, or a flow of less than one gallon per minute where a sample cannot be collected, make sure to note the time on the record sheet next to the site name. Also record sites that cannot be located.

*In general, light flows of <1 gpm and/or seeps, should **not** be sampled. However, consideration may be given to suspect sites (i.e. sites with a history of problems, nearby upland residences with current issues, heavy algae, etc.)*

5. Obtain the following water quality parameters: Potential Hydrogen Ion Activity (pH), Conductivity (µS) and Temperature (°C).
    a. Rinse a designated 250ml bottle 2-3 times with water from the flow prior to filing the bottle to prevent cross-contamination between sites. Use a sampling stick or rubber gloves if necessary.
    b. Fill the bottle to near full with the water that will be used for the sample. Remove the cap and insert the probe into the mouth of the sample bottle, submerging it in the collected water.
    c. Record the temperature reading first, before the sample has a chance to be affected by ambient air temperature.
    d. Allow the pH and conductivity readings to adjust and settle as much as possible before recording.
    e. Measure or estimate the average flow in gallons per minute and record.

    (One 8 oz. (250 ml) bottle fills up to the shoulder in approximately 4 seconds when water is flowing at a rate of 1 gpm)
6. Collect the sample
    a. Label a new 250mL bottle before sampling. Include TPCHD, date, time and sample ID. Use the appropriate identifiers in the sample ID to designate the type of sample. See Sample Type Descriptions and Labeling Protocol for specific guidance.
    b. Record the collection time on a Field Sample Sheet.
    c. Use a sampling pole or rubber gloves if necessary.
    d. Collect a sample from an area where the flow is running the strongest, being careful not to take in any debris or sediment that may contaminate the sample. Collect samples using the following techniques:
        - Approach the collection point from a downstream direction with care being taken not to disturb the bottom sediments; collect the samples while facing upstream (against the flow) at approximately 15 to 30 cm below the water surface, or at half the depth of the water column (when the depth of the stream is less than twelve inches).
        - For streams of sufficient depth, fill the sample bottle using the “U” scoop motion to address the fact that bacteria may be concentrated in the surface micro layer.
        - For shallow streams where it is not possible to use a “U” scoop motion, collect the sample such that there is the least amount of sediment disturbance as possible.

- For extremely shallow flows, such that a depression must be dug in the sediment to enable sampling, allow sufficient time for the disturbed sediment to settle prior to collecting the sample. In addition, note that this sample required making a depression in the sediment on the Field Sample Sheet.

e. Seal sample bottle tightly before storing in the cooler with the ice packs.

7. Replicates should be collected consistent with the original sample and immediately following collection of the original sample. Roughly one replicate per every 10 samples should be collected to maintain a percentage of at least 10% as part of the QA/QC process. If less than 10 samples are collected in a sampling event, a replicate should still be collected. Replicates are generally collected at previously designated sites (due to a history of high bacteria levels or other known issues), or where a clean sample can be taken from an uninterrupted flow.
8. Use the Field Sample Sheet to complete a laboratory supplied Chain of Custody form.
9. Call the lab (**Water Management Laboratories- ph: 253.531.3121**) and provide the following information:
    a. Your name and affiliation with the Health Department.
    b. Number of samples to be tested.
    c. Name of watershed(s) where samples were collected.
    d. The type of bacteria to be tested. Freshwater tests will generally be for fecal coliform and sometimes E. coli.
    e. The approximate time of arrival.
10. At the lab:
    a. Ensure all samples are intact and received prior to signing the release.
    b. Keep the pink carbon copy of the Chain of Custody form.
    c. Ask for sampling bottles to replenish our supply.
11. Return to the Health Department.
    a. Remove all necessary materials from vehicle.
    b. Attach the Field Sample Sheet to the pink carbon copy of the Chain of Custody form and put in the Data Manager's inbox.
    c. Return ice packs and cooler to the "Rat Lab".
    d. Recalibrate and store parameter probe(s).

Water Result High Count Resampling

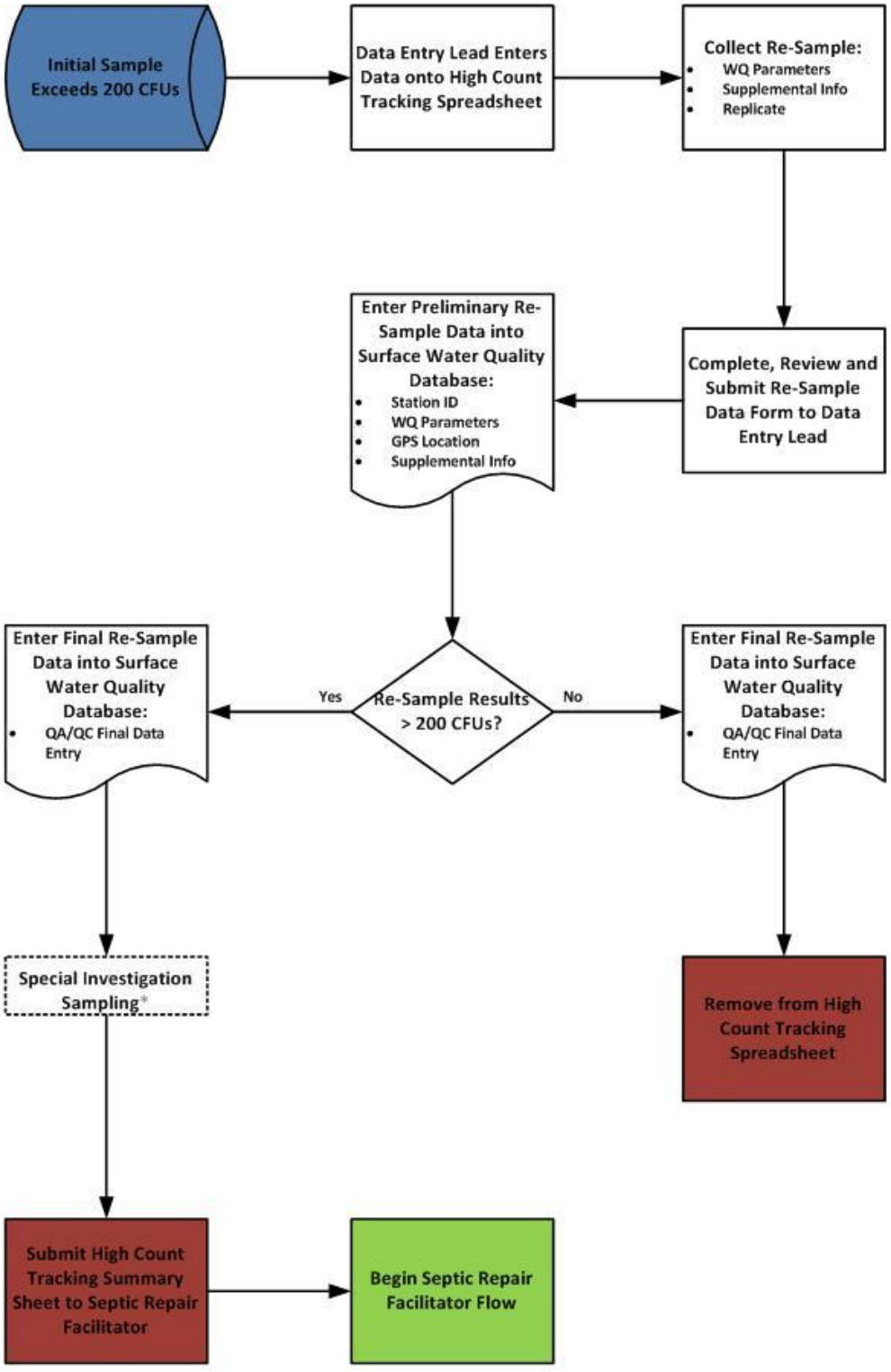
When a water quality result equals, or exceeds, 200 cfu/100ml the site is added to the high count spreadsheet and the site will be re-sampled as soon as possible (Figure 2). On some occasions re-sampling is not conducted if the original result was only slightly above 200 cfu/100ml, the flow was low (less than 10 gpm), or there was significant rainfall during the sampling event.

Some sites have flow only during rainstorms and for these sites, the re-sampling would need to wait until both tidal conditions and rain conditions are sufficient to collect another sample. For sites adjacent to properties that are used only seasonally, the re-sampling may need to be postponed until the adjacent property is occupied.

If a re-sample result is equal to, or greater than, 200 cfu/100ml the site is generally referred to the Septic Repair Facilitator for further investigation to determine the bacterial source(s). If the re-sample result is less than 200 cfu/100ml and the sample was collected under similar conditions to the high count sample, the result is entered into the database but generally no further action is taken at the site. If the original sample result was greater than 1,000 cfu/100ml, at least two consecutive re-samples of less than 200 cfu/100ml would be needed to remove the site from the high counts list. Depending upon circumstances and weather conditions, it may be that several counts below 200 cfu/100ml will be needed before a site is removed from the high count spreadsheet.

If the original sample result was greater than 1,000 cfu/100ml, re-sampling may include E. coli analysis in addition to fecal coliform. This is used to help assess if the source is fecal in origin, vs. decaying organic matter.

Figure 2. High Count Resampling Work Flow



**SI Sampling to determine source outside of regular sampling stations.*

Special Investigation Sampling

If a bacterial source is suspected, special investigation sampling is conducted to confirm the source. Special investigation sampling is usually conducted following a high count from a resample but can also be undertaken when a concern arises from a sanitary survey visit or a citizen complaint. It is often targeted to storm events but may be scheduled around the expected use of adjacent residences. The SRF is usually the field lead for special investigation sampling.

Sample Type Descriptions and Labeling Protocol

- **Shoreline**: Labeled with initials of water body and three-digit site number (i.e. Burley Lagoon is BL001). Shoreline samples are collected during shoreline walks that are done twice every water year.
- **Upland**: Labeled with initials of water body, followed by a "U" for upland, and a three-digit number (i.e. BLU001). Upland samples are taken on the same day as the Washington State Department of Health's monthly ambient monitoring. Most sites are not on the shoreline.
- **Special Investigation**: Labeled as either shoreline or upland with a "SI" in front (i.e.: SIBL001). SI can be either a shoreline or upland, and are sampled to determine the source of a previous sample with a bacterial count greater than 200cfu/100mL.
- **New Sample**: Labeled as a shoreline, upland, or special investigation sample, followed by an "N" to indicate a new site. Then use the number of the sample site in closest proximity to the new site, outlining in comments/description the relationship between the two. (i.e. BL001N)
- **Replicate**: Labeled as a shoreline, upland, or special investigation with an "R" following the label (i.e. BL001R). Taken for QA/QC as outlined in 2012 PIC QAPP. Replicates can also be taken on new sample sites (i.e. BL001NR)
- **Re-sample**: Labeled as a shoreline, upland, or special investigation sample followed by "Resample" on the bottle and/or Chain of Custody (i.e.: BL001 Resample). Resamples are taken when initial sample result is >200 cfu/100mL.

Instrumentation

Background

Sample collection and data interpretation are fundamental elements in implementing pollution identification and correction measures. Locating the exact sample station on each return trip is a key consideration of regular monitoring. This is challenging since shorelines are dynamic ecological systems with tidal action altering the physical appearance of these areas between visits. In the past the Health Department has used a variety of tools to enable staff to continuously locate sample stations. Increased funding has allowed the Health Department to purchase hand held GPS units, greatly enhancing the Surface Water Program's efficiency and reducing location uncertainty.

Fecal coliform data interpreted outside the context of water quality can lead to a limited understanding of potential impacts. Additional data parameters such as temperature, pH, and conductivity provide a more robust interpretation of the sample. Available funding has provided the Health Department with

portable water quality probes that facilitate the collection of accurate surface water quality parameter data.

Water Quality Parameter Interpretation[1]

Temperature affects the solubility of oxygen in water, the rate of photosynthesis by algae and higher plants, the metabolic rates of aquatic organisms, and the sensitivity of organisms to toxic wastes, parasites, and diseases. Many of the physical, biological, and chemical characteristics of a surface water system are directly affected by temperature. Fecal coliform bacteria are considered mesophiles and as such their optimum temperature range is generally considered to be in the 10-40° C range.[2]

pH, or potential for hydrogen, is a general measure of the acidity or alkalinity of a water sample. The pH of water, on a scale of 0 to 14, is a measure of the hydrogen ion concentration. A higher pH means there are more hydronium ions available. Too low or too high of a pH can inhibit bacterial growth. The preferred range of pH for many aquatic organisms, including most fecal coliform bacteria, is 6.5 to 8.5. Changes in pH can be caused by atmospheric deposition, surrounding rock, and wastewater discharge.

Solubility and bio-availability are also determined by pH. Generally speaking, a lower pH will increase the solubility of such things as oxygen, metals, and nutrients. As these constituents are dissolved in the water, they become more available to aquatic organisms.

Because polluted conditions are typically correlated with increased photosynthesis in stream conditions, pollution may cause a long-term increase in pH. A common concern is a change in natural pH levels caused by the discharge of municipal or industrial effluents. Most effluent pH is fairly easy to control, and all discharges in Washington State are required to have a pH between 6.0 and 9.0 standard pH units, a range that protects most aquatic life. Therefore, although these discharges could have a measurable impact on pH, it would be unusual (except in the case of treatment plant malfunction) for pH to extend beyond the range for safety of aquatic life. However, due to its influence on the availability and solubility of all chemical forms in the stream, small changes in pH can have many indirect impacts on a stream.

Conductivity is a measure of the ability of water to pass an electrical current. Conductivity in water is affected by the presence of inorganic dissolved solids such as chloride, nitrate, sulfate, and phosphate anions (ions that carry a negative charge) or sodium, magnesium, calcium, iron, and aluminum cations (ions that carry a positive charge). Organic compounds like oil, phenol, alcohol, and sugar do not conduct electrical current very well and therefore have a low conductivity when in water. Conductivity is also affected by temperature: the warmer the water, the higher the conductivity. For this reason, conductivity is reported as millisiemens/centimeter (mS/cm) at 25 degrees Celsius (25° C).[3]

[1] Washington State Department of Ecology, A Citizens Guide to Understanding and Monitoring Lakes and Streams
[2] Dictionary of Biology, Definition of Mesophillic, http://www.encyclopedia.com (August 1, 2012).
[3] United States Environmental Protection Agency, Water: Monitoring & Assessment – Fecal Bacteria. http://water.epa.gov/type/rsl/monitoring/vms511.cfm (August 1, 2012).

Water temperature, pH, and conductivity are measured in the field with the Oakton PCSTestr 35 meter. This meter has a resolution of 0.1 degrees C for temperature, 0.1 units for pH, and 1 uS for conductivity.

The Washington Administrative Code addresses the water quality standards of Washington State's surface waters in WAC 173-201A.

Parameter Probe Calibration Protocol

Instrument: Oakton PCSTestr 35
Protocol adapted from the Oakton Instruction Manual

- *Use only certified accurate pH buffers and certified accurate conductivity standards.*
- *Prepare instrument(s) prior to field use. The readings should be recorded again following use in the field, but the probe does not need to be recalibrated unless a reading varies significantly.*
- *Change pH buffers and conductivity standards monthly. Record dates in the comments section of the log.*

pH Calibration

1. Press the **ON/OFF** button to turn the meter on.
2. Press the **MODE/ENT** button to select the pH mode.
3. Rinse sensor with DI water in designated spray bottle.
4. Immerse the sensor in 4.01 pH buffer and allow the number to settle.
5. Record this number in the Calibration Meter Log.*
6. Press the **CAL** button to display the un-calibrated pH value (top number) and the closest automatic calibration value (bottom number). Allow the number to settle.
7. Press the **MODE/ENT** button to confirm the calibration value. The top number will blink twice and the bottom number will begin to scroll through the remaining pH buffers (7.00 and 10.01).
8. Repeat steps 3-7 with the 7.00 and 10.01 pH buffers. Press the **CAL** button to return to the measurement mode.

** Use the comments section of the Log to record any unusual observations.*

Conductivity Calibration

1. Press the **MODE/ENT** button to select the conductivity mode.
2. Rinse sensor with DI water in designated spray bottle.
3. Immerse the sensor in 84 µS conductivity standard and allow the number to settle.
4. Record this number in the Calibration Meter Log.*
5. Press the **CAL** button to display the un-calibrated pH value (top number) and the closest automatic calibration value (bottom number). Allow the number to settle.
6. Press the **MODE/ENT** button to confirm the calibration value. The top number will blink twice and the bottom number will begin to scroll through the remaining conductivity standards (1413 µS and 12.88 mS).
7. Repeat steps 3-6 with the 1413 µS and 12.88 mS conductivity standards.

Use the comments section of the Log to record any unusual observations.

Flow Gauging

The Health Department regularly records an estimated flow rate for each water sample collected during a shoreline sampling event. Gauging the flow of shallow creeks and streams may also become necessary. In either case, the rate of flow helps one to understand the potential loading of pollutants into the water body.

When gauging flow one must consider the source and apply the appropriate method. For point source flows such as pipes, the preferred technique is to use the Bucket Method. In cases where shallow streams and creeks are to be assessed Health Department staff use a velocity meter to assist in calculating flow.

Bucket Method

Materials/Equipment:

- Container with Known Volume (Gallons are preferred)
- Stopwatch
- Nitrile/Latex Gloves
- Field Notebook/Writing Instrument

1. Use a container of known volume (gallons) to collect water from the source of flow.
2. Simultaneously start the stopwatch timer and begin collecting water with the bucket. Collect the water as close to the source as possible.
3. When the container is full, stop the timer and record seconds that have passed (time).

Calculate the rate of flow using the equation:

Flow (gpm) $= G \Big/ \frac{t}{60}$ ***Where*** *G = volume of container (gallons) and t = time to fill container (seconds)*

1 Gallon =	3.79 Liters
	4 Quarts
	8 Pints
	16 Cups
	128 Ounces

Flow Gauge Instrument

Velocity must be less than 26 feet per second. Velocities less than 1.5 feet per second will require minor field calibration before accurate readings can be collected.

Review the Calibration and Care of the Model 2100 Current Velocity Meter document for calibration and care procedures. This document is located in Appendix E.

Materials/Equipment

- Instrument: Swoffer Model 2100 Current Velocity Meter
- Model 2100-12 Top Set Wading Rod
- Measuring Tape (Field/Survey style)
- Field Notebook/Writing Instrument
- 2 Stakes/Anchors

1. Prepare the Wand and Velocity Meter:
    a. Remove the sensor protection cap (if used) and install the propeller rotor using the Rotor Installation Wrench (1/16" Allen wrench). This setscrew in the side of the sensor body need only be snug to the shaft. DO NOT OVER-TIGHTEN.
    b. Connect the Sensor Wand to the *Model 2100* Indicator by using the twist lock electrical connector. Align the connector carefully, press the two halves together and twist the collar.
    c. Rotate the Indicator selector switch to the **CALIBRATE** position. The display should read about **186** (feet per second mode- see page 63 in the Appendix).
    d. Rotate the selector switch to the **COUNT** position. Spin the propeller and confirm that the indicator reads increasing counts (sensor output pulses) as the propeller spins.
    e. Rotate the selector switch to the minimum update time (first position from the left hand **OFF** position).
    f. Place the sensor in the stream with the propeller facing into the flow.
    g. Press and release the **RESET** button to zero the display.
    h. The next figure, which appears on the display, will be the stream velocity. That velocity will remain on the display until the next update period ends. The figure in the display will always be the velocity of the last averaging period. (The indicator **does not** provide a "moving average" nor instantaneous "real time" velocity.

2. Use a measuring tape to span from one side of the stream to the other. The tape should be perpendicular to the direction of flow and kept taut while being anchored to each side of the creek. Record the stream width.

3. Using the steps outlined below (Step 4) obtain stream velocity readings starting from the very edge of the opposite bank (0 feet). Work your way across the stream using the flow gauge to measure the water velocity.
    a. Collect velocity readings at one-foot intervals for streams with widths greater than 3 feet. For streams with narrow widths (< 3 feet), collect velocity readings at 0.5-foot intervals. Use the measuring tape as a guide.
    b. Take three readings at each interval.
    c. Record the stream depth and the distance from the starting bank, at each interval.

4. Follow the steps below to obtain velocity readings. To identify Wand components refer to the diagram below.
    a. At the appropriate interval, place the Sensor Wand vertically in the stream and point the propeller rotor into the stream flow. Record the distance from the stream bank for each interval.

b. Always stand downstream of the Wand. Do not stand upstream of the Wand. Remove any obstacles (rocks, debris, etc.) that may obstruct flow. Ensure the propeller is able to rotate freely.
c. With the Foot of the Guide Rod at the streambed, adjust the Depth Rod up or down until the tip of the propeller intersects the stream surface.
d. Read the stream depth on the Depth Rod Scale. Depth is measured at the top of the Slide Index fitting. Record this value.

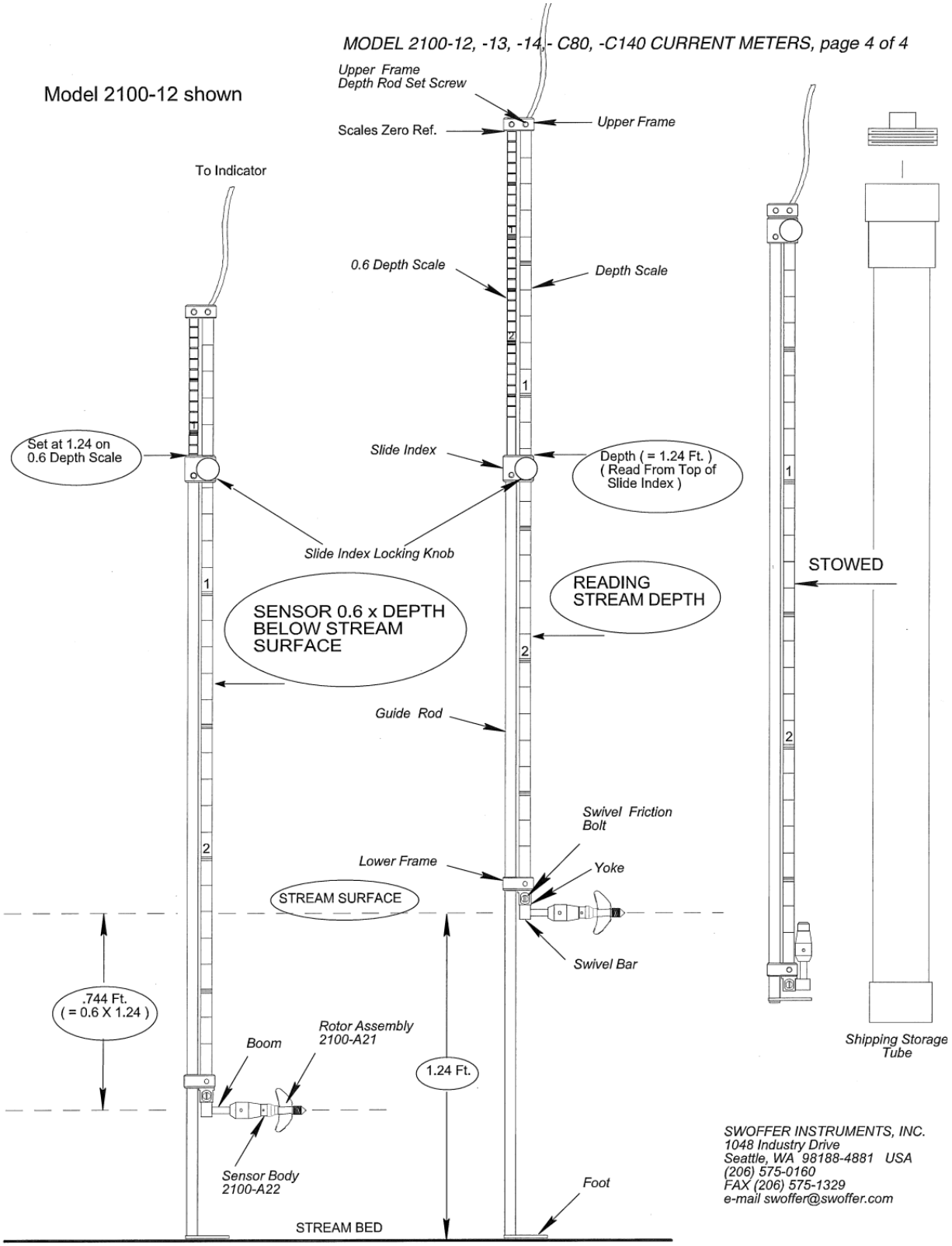
Note: Demarcations on the Depth Rod Scale are in 1/10 foot increments, not inches.

e. Next lower the sensor until the top of the Slide Index fitting is opposite the corresponding numerical depth reading on the 6/10 Depth Scale. The sensor propeller is now at 6/10 of the stream depth from the surface of the stream.
f. Record the generated velocity value.
g. Collect two more values and record the values for each.
h. Move to the next interval and repeat Step 4 for each interval.

5. Calculate the total volume of flow using the recorded velocity, depth and distance information by inputting these values into the Flow Calculations Template excel spreadsheet.

6. The Swoffer 2100 Current Velocity Meter has a Range from 0.1 to 25 feet per second, a resolution to hundredths of a foot, and an accuracy of potentially within 1%. However, based upon past field checks at USGS gaging stations, the error range will more likely be plus or minus 10%.

Figure 3. Swoffer Wand Diagram



Global Positioning System (GPS) Basic Field Operation Protocol

Instrument: Garmin 62S GoMap Unit *(accurate within +/– 3.7 meters)*

Complete Operation Manual

Batteries

The GPS units take two AA batteries to operate. Turn the GPS unit on while in the office to make sure the batteries have a charge. Press the rubberized button just above the "Property of TPCHD" sticker to turn on the unit. Expect a maximum of eight (8) hours of use with new batteries.

To replace the batteries:

1. Look on the back of the unit for a small metal rectangular loop near the bottom of the unit; lift this loop upright and twist it gently counter-clockwise 90 degrees.
2. Lift the back plate off, this reveals two AA batteries. There is a diagram which shows the proper polarity on the battery holder for each battery.
3. Gently pry each battery out of the holder.
4. Put new batteries in place making sure they are oriented for polarity.
5. Once the batteries are replaced insert the small tab at the top of the back cover into the unit, then snap the bottom of the cover into place.
6. Finally turn the small metal loop clockwise to secure the back plate and fold the loop flush with the cover.
7. Dispose of old alkaline batteries in the Battery Recycle Bin located in the Health Department's Mail Room.
8. If using rechargeable batteries, place them in the appropriate charger.

Operation

Turn the unit **ON** by pressing the rubberized button on the side just above the "Property of TPCHD" sticker on the right hand side. Turn the unit **OFF** by pressing and holding the same button until the unit powers off.

The unit will go into "sleep mode" after a few moments of non-use. To "wake" it, press the **Four-Way Toggle**.

Once powered on, press the **PAGE** button until the Map icon rotates to the front and then press the **ENTER** button. This will take you to the Map function.

Prior to immediate use (minutes before obtaining coordinates) ensure the unit is ON and AWAKE and allow the unit to establish its current spatial location. The accuracy of this unit is approximately +/- 3.7 meters.

In the lower center of the LCD display you'll see an arrow. This represents the present location and is set to point toward the top of the display. In the upper left corner of the display is another arrow which will indicate north. In the upper center of the display is a small bar (Zoom Bar) with a number above it,

indicating zoom level. The zoom level can be adjusted from five hundred (500) miles to twenty (20) feet by pressing either the **IN** or **OUT** buttons.

As the operator changes position the Location Arrow will remain stationary, pointed to the top of the display. The map/landscape will change to indicate your heading and location.

Previously logged sample stations are depicted with Flags. Distance to Flags can be estimated by comparing the Zoom Bar at the top center of the display to the distance between the Location Arrow and the Flag. The length of the bar will be indicated by a number directly above the bar, typically eighty (80) to three hundred (300) feet depending on the selected zoom level.

A description of the sample station is available by using the **Four-Way Toggle** to move a white arrow to the desired Flag. The Flag has been selected when a Sample Station ID appears in a new white banner at the top of the display. When the Sample Station ID is in the banner, press the **ENTER** key to view a description of the Sample Station. This is the same information that appears in the Health Department's Surface Water Quality Database (SWQD). Previously logged Sample Stations will appear on the display as the operator approaches them.

Logging New Sample Stations

1. Press the **MARK** button on the lower left of the device. A new window will appear with several fields including "Note" and "Location".
2. Navigate through the fields by using the **Four-Way Toggle**. Selected fields will be highlighted in light blue.
3. A three digit number will appear in a field near the top of the display.
4. Use the **Four-Way Toggle** to select the "Note" field, then press the **ENTER** button.
5. A virtual keyboard will appear. Use the **Four-Way Toggle** to move the cursor to a letter or number. Press the **ENTER** button to select specific characters. Enter in the proposed station ID number (See Sample Type Descriptions and Labeling Protocol).
6. After attributing the location with a unique sample station ID, use the **Four-Way Toggle** to move the cursor to the bottom of the display and select "Done". Then press the **ENTER** button. The previous menu will re-appear with the new sample station ID displayed in the "Note" field.
7. Use the **Four-Way Toggle** to move the cursor down to the lower right of the display so that "Done" is selected. Press the **ENTER** button. The new sample station is recorded and will show up on the map display.

Updating Sample Station IDs

Sample station locations have been found for many of the stations by using either Google Earth or the Pierce County GIS application. Sometimes it is necessary to refine the locations by using the GPS units in the field. If you find that the marker for the station is more than 50 feet different than the location displayed on the GPS unit you should take the following steps to determine updated latitude and longitude for the sample station.

1. Press the **MARK** button on the lower left of the device. A new window will appear with several fields including "Note" and "Location".
2. Navigate through the fields by using the **Four-Way Toggle**. Selected fields will be highlighted in light blue.

3. A three digit number will appear in a field near the top of the display.
4. Use the **Four-Way Toggle** to select the "Name" field, then press the **ENTER** button.
5. A virtual keyboard will appear. Use the **Four-Way Toggle** to move the cursor to a letter or number. Press the **ENTER** button to select specific characters. Enter in the station ID number that you are updating (See Sample Type Descriptions and Labeling Protocol).
6. Use the **Four-Way Toggle** to select the "Note" field, then press the **ENTER** button.
7. A virtual keyboard will appear. Use the **Four-Way Toggle** to move the cursor to a letter or number. Press the **ENTER** button to select specific characters. Enter a note that says "Corrected Location".
8. After attributing the location with a unique sample station ID, use the **Four-Way Toggle** to move the cursor to the bottom of the display and select "Done". Then press the **ENTER** button. The previous menu will re-appear with the new sample station ID displayed in the "Note" field.
9. Use the **Four-Way Toggle** to move the cursor down to the lower right of the display so that "Done" is selected. Press the **ENTER** button. The new sample station is recorded and will show up on the map display.

Retrieving Latitude and Longitude Coordinates

When you return to the office you are able to retrieve the coordinates and notes for any new stations or updated station locations. You will need access to a computer, a mini-USB cable and the GPS unit.

1. Connect the GPS unit to the computer with the mini-USB cable. The GPS unit should power on by itself at this point. If this is the first time the GPS unit is used on the computer there will be a slight delay as the computer finds and installs the appropriate driver for the GPS unit.
2. The GPS unit will appear as an external drive, much like a USB thumb drive.
3. Double-click the icon for the GPS unit. Open the Garmin folder, then the GPX folder.
4. Waypoints that are created are stored in files labeled "Waypoints_Day_Month_Year".
5. Drag the waypoints created on the desired days to the desktop, this will copy the file to your computer and leave the original file on the GPS unit.
6. Double-click on the waypoint file. This will prompt Microsoft Excel to start and it will attempt to handle this file.
7. Click Yes/OK on the next four dialog boxes that appear.
8. The waypoints will appear in an Excel Spreadsheet. There will be twelve columns filled with a variety of data including timestamp, elevation, and software version of the GPS unit. The columns most useful are Latitude, Longitude, Name and Comment.
9. You can copy and paste the data to any number of applications including an Access database, Google Earth.

Surface Water Quality Database - Data Collection and Entry

Background

The Surface Water Program database has evolved significantly since sampling first began in the 1980s. Originally, data were kept in paper records and all analysis was conducted using a calculator, graph paper, and paper charts. The program began using Excel spreadsheets for data storage and analyses in the mid-1990s and, to a very limited extent, still uses Excel spreadsheets. However, nearly all data are now stored in an Access database. This database is linked to a GIS layer in Pierce County's *Countyview*

system and is available to all *Countyview* users. The database and associated GIS layer are also provided periodically to Ecology and DOH.

Purpose

The Health Department is committed to collecting and retaining data relating to the surface water quality of Pierce County. These data can later be used for trend analysis and historical review but the primary purpose is to guide pollution identification and correction efforts. Data are only significant if there is confidence that they were collected under standard protocols and accurately entered into a database. Furthermore, the methods of data entry must remain consistent to ensure a uniform and meaningful database. The following protocol pertains to data being entered into the Health Department's Surface Water Quality Database (SWQD) in an effort to standardize data entry.

Data collection

All data collected by the Surface Water Program are stored in paper files at the Health Department and/or electronically, in an Excel spreadsheet, the Surface Water Quality Database, and/or in the Health Department's main database, Envision.

The temperature, pH, conductivity, and flow measurement results are initially entered onto the field sheets. The field sheets, when not in use or when full, are kept at the Health Department. These results for the Shoreline Evaluations and Upland sampling are first reviewed by the Quality Control/Data Lead and then entered into the Surface Water Quality Access database.

The fecal coliform results and E. coli results are first faxed by Water Management Laboratories, Inc. to the Technical Lead and are considered initial results. The Quality Control/Data Lead keeps these faxes, along with the chain of custody copy that was provided by lab staff to field staff when the samples were delivered to the lab. The Technical Lead then receives in the mail a paper copy of the final results from the lab. The Quality Control/Data Lead compares the initial results to the final results, the chain of custody sheet that is attached with the final results to the copy originally provided, and reviews the final results to the attached chain of custody. Only after this review are the results entered into the Health Department's Surface Water Quality Database. The replicate results are also tracked separately in an Excel spreadsheet that calculates the Relative Percent Difference of the log-transformed results.

The Access database is used to update the GIS layer quarterly so that the results are available geospatially. Paper copies of the results are stored in a file cabinet that is located in the Surface Water Program area of the Health Department.

The sanitary survey information including dye test information, if a dye test is conducted, is kept in paper files and also entered into the Envision database.

Data are reviewed prior to entry into an electronic format to ensure that all required data fields have been included, parameters monitored are characteristic of expected results, and laboratory analytical results are characteristic of expected results. When the Quality Control/Data Lead determines the dataset is incomplete or includes uncharacteristic results, the Technical Lead is consulted for a decision

regarding the validity of the data. Data may only be excluded with the approval of the Quality Control/Data Lead and the Technical Lead. Once it is determined that the data are acceptable, staff perform data entry. All data input receives a 100% review after input is complete to assure no transcription errors have occurred. The Surface Water Quality Access database and Envision database are backed-up on a daily basis to minimize the risk of data loss caused by electrical or computer malfunctions.

Computerized information systems are maintained by the Health Department's Information Technology Program and technical assistance is also provided by key individuals in the Environmental Health Division.

SWQD Data Entry Protocol

Data QA/QC Process

- If the final results sheet (mailed copy) is in, compare it to the field sheets for times and sample location. Also make sure this information matches on the attached Chains of Custody.
- Compare the preliminary (faxed copy) results to the final results to make sure they match.
- If everything matches correctly, the pink chain copies and faxed preliminary results can be recycled. Keep the final results and the field data sheets together.

Data Entry Process *for samples taken* within *Shellfish Protected Areas*

- After the QA/QC process, bring up the Surface Water Quality Database (SWQD), EPA Grant Replicate table, and High Counts list.
    - File pathways
        - EPA Replicate Table: F:\LIBSHARE\SRCPRO\WATER\Surface Water\Shellfish Watersheds Program\Water Quality Data
        - High Counts List: F:\LIBSHARE\SRCPRO\WATER\Surface Water\Marine Shoreline & Shellfish
    - Go into the SWQD
        - Click "Enter Sample Results" on the main screen to enter field data
            - Enter the site name, sample date, and sample time for each
            - If the site is a NO FLOW, put a reason for No Sample Taken; if the site is not found, record in comments. The "Grant" field should be N/A and the "Sample Type" field should be regular, unless otherwise indicated on field sheet.
            - If a sample was taken, enter the recorded temperature, pH, conductivity, and flow. Record any written comments about the site. If there is a new site description, update in Add/Update site information. The "Grant" field should be Shellfish EPA and the "Sample Type" should

be the type of sample taken (unless it is part of the Minter Upland sampling, which is under the Centennial grant).
        - For replicates, indicate time in the comments.
    - ***If final results are received after field data has been entered***, click "Sample Site Summary" from the main screen to enter results.
        - Use "Find Site" to search for the site name.
        - Click on the icon to the left of the corresponding sample date to enter data results.
        - Click "Close Form" (check to make sure results appear) and make sure to click into the site name field before searching for a new site.
- Adding a new site to the SWQD or updating location information (ie: coordinates or site descriptions).
    - In the SWQD click on "Add/Update Site Info" on the main screen.
    - Use our naming system to create new names. Refer to PIC Protocol for shellfish/ other areas (need first 3 letters of the waterbody).
        - Go to QA/QC Reports and Queries and create a report of site for that water body.
        - Look for a number to use that is closest to the current site name.
        - Add site info and click "Add Record"- Note that coordinates must be used or the site will not be recorded.
        - Go back to enter the field data and final sample results.
- Replicates applicable to the Shellfish EPA grant should be added to the excel table to be tracked.
- High counts in Shellfish EPA grant areas should be added to the High Counts list.
    - Double check the high counts list to be sure no new samples or resamples have come in below a count of 200 or as a "NO FLOW".
    -

Data Entry Process *for samples taken* outside of *Shellfish Protected Areas (ie: investigative work on the Tacoma side of the Narrows Bridge, creeks and streams).*

- Bring up the Surface Water Quality Database (SWQD) after completing the QA/QC process. The EPA Replicates table and High Counts list do not apply to these samples.
- Follow the procedure to enter field data, as outlined above.
    - Designate work as N/A in the "Grants" field.

Follow the procedure to enter result, as outlined above.

SWQD Available Reports

Fecal Results > 200: This report lists fecal sample results greater than 200. This report can be limited by watershed, site location and date range.

Reporting (Ray's) Sample Count: This report lists samples taken within a user-defined date range, with a total count at the end of the report. This count is used for quarterly reporting.

Sample Count Summary: This report lists a count of samples taken by watershed within a used-defined date range. A grand total is tallied at the end of the report.

QA/QC Lat Long: This report lists all site locations that do not have a latitude or longitude value. Latitude and Longitude are required for mapping purposes.

QA/QC Sample Results Data Entry: This report is a detailed listing of all sample result data entered for a user-defined date. The user can use this report to verify that all data were entered accurately.

QA/QC Results by Watershed: This report lists fecal and e-coli results for a user-defined watershed, by date samples were taken.

QA/QC Site Information: This report lists Site Locations within a user-defined watershed. The report lists site ID, site description and latitude and longitude.

Sanitary Surveys

Background

The Health Department has been conducting sanitary surveys in support of protecting and improving Pierce County's surface water quality since 1988. Health Department staff have visited over 1,000 properties as part of sanitary survey work in 10 different bays located in the shellfish growing areas of Pierce County.

Shellfish Watersheds Program staff generally conduct a sanitary survey of each shellfish bay every six years. Sanitary surveys are done in the bays or other enclosed waters, and not along the open water areas, such as Carr Inlet or Case Inlet, unless a marine water quality problem is detected through DOH's sampling. The sanitary survey consists of visiting shoreline properties, identifying the residents' participation in recent operation and maintenance activities, and visually examining the property for an indication of a possible septic problem. If a problem is suspected, the septic system is tested, using a tracer dye, to determine if the system is failing.

Purpose

Sanitary surveys are an important element of many of the grants conducted by the Health Department's Surface Water Program. The specific purpose and methodology of the sanitary survey may differ slightly depending on the funding source's goals but in most situations the surveys serve two functions: identifying and correcting failing septic systems and educating property owners about how to minimize their impact on the environment. Sanitary surveys can also provide missing information for the Health Department's septic system database. The sanitary survey process addresses the EPA National Estuary Program Pollution Identification and Correction Program Grant Award requirements to help identify and correct failing septic systems, but also provides a pollution prevention component.

The questionnaire and visual inspection of the property and immediate down gradient area are helpful to learn about problems with the septic system and identify failures. If the responses to the questionnaire or the visual examination of the property indicate that the septic system may be failing,

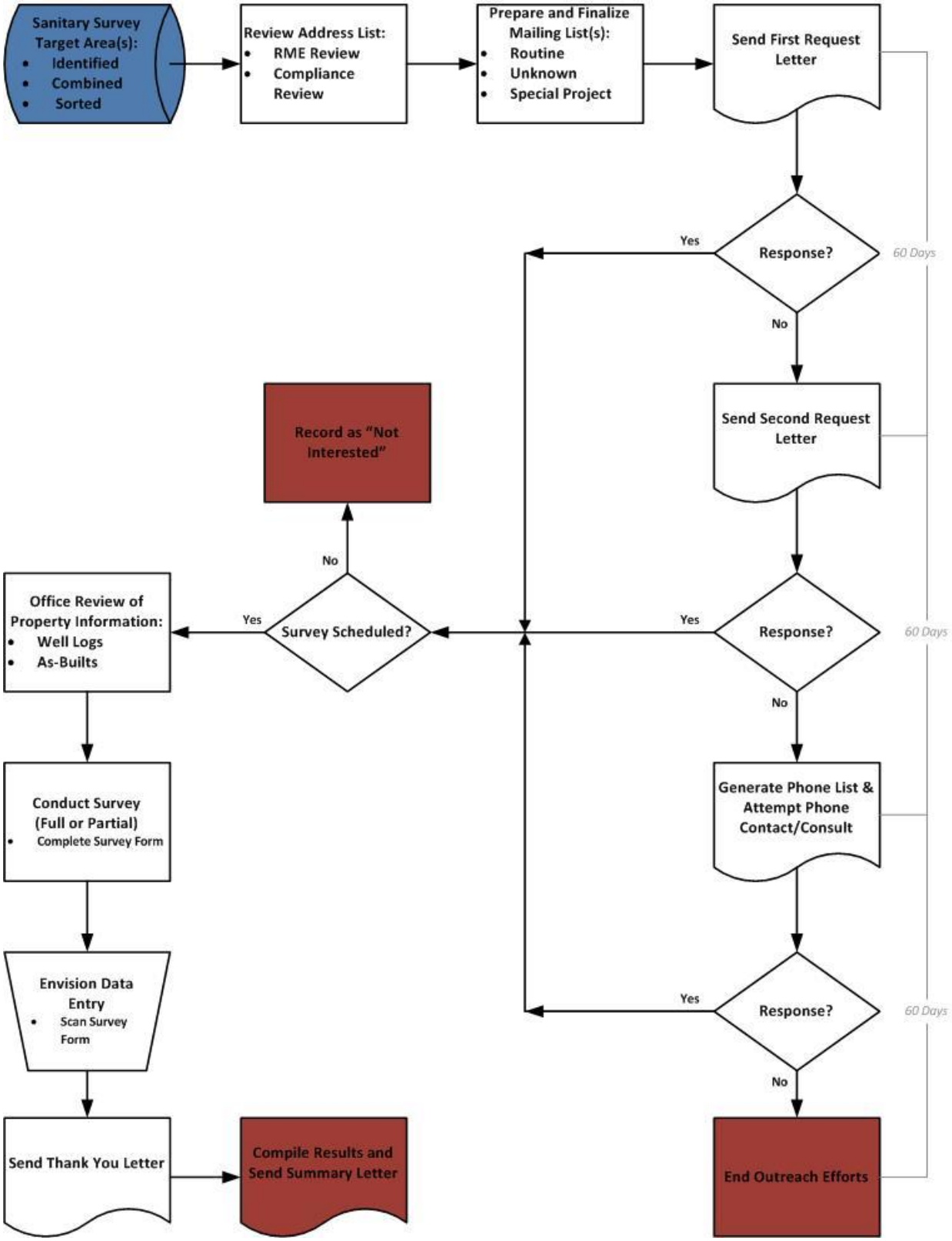
with surfacing sewage, a dye test is arranged to determine system status. Signs of a failing septic system include water pooled in the yard, excessive algal growth in flows off the property, a white coating (sometimes with blackish scum) on the sediment of flows off the property, lush vegetation with soft soil, and/or the presence of a sewage odor.

Health Department staff provide education and outreach materials to residents and property owners as part of a sanitary survey. A core set of materials are provided at each site visit and through a series of questions it is determined if additional information may be useful to the resident/property owner.

In addition to identifying failing septic systems and educating the resident/property owner about how to reduce their impacts on Puget Sound, most sanitary surveys have several additional purposes. Health Department staff regularly interact with shoreline communities. Cooperative relationships are often created and those relationships facilitate goodwill towards the Health Department, establishing our commitment to public health. Permission to park or investigate the shoreline is often granted through this direct communication with shoreline property owners.

Health Department staff frequently review and tailor education materials and outreach efforts based on lessons learned in the field, responses from property owners, and a community's specific pollution concerns.

Figure 4. Sanitary Survey Work Flow



Bay Selection

The Health Department focuses on one particular shoreline area or bay each year. This is done on a rotating basis, ensuring that targeted areas are surveyed approximately once every six years. The current rotation list is documented here: 2012-2013 Shoreline Evaluation Schedule.

Initial Mailings

The Health Department may send up to two letters to shoreline property owners encouraging them to contact staff. The initial letter informs owners of the purpose of the survey and any services or incentives the Health Department is offering such as technical assistance and drinking water sampling. If no contact is made by the property owner, a follow-up letter is sent out approximately two months later. This letter reiterates the material in the initial letter but also indicates how many surveys have been recently conducted in their area. If neither letter generates a response, phone numbers are obtained for as many of the non-participating properties as possible and calls are made to request septic system information and site visits. Throughout the letter mailing process, staff communicates with responsive property owners.

Office Review

Health Department staff contact property owners to schedule an appointment to conduct the sanitary survey. Preliminary information regarding the property and OSS is gathered at this time, thereby completing relevant (Office) portions of the Sanitary Survey Form. The remainder of the form is completed during the field visit. Often times property owners are willing to call the Health Department and provide information, but are not interested in a site visit with staff. On these occasions staff members gather as much information as possible via the telephone. The Health Department can also conduct an inspection without the presence of the property owner *if* the property owner has provided verbal consent.

Health Department staff review the available Health Department records contained in the microfilm database for shoreline properties located within the bay scheduled to be surveyed. When properties are found to be lacking an OSS record drawing, staff will first conduct a thorough search of the database to connect older existing records to current property tax parcels whenever possible. See the Guide to Unknown Septic Searches section for guidance on this specific process.

If no information can be attributed to the property, the Health Department contacts property owners via written requests to schedule a sanitary survey to inspect the site for a visual idea of the system.

Field Visit

Scheduled sanitary survey field visits are often performed by two Health Department employees. The lead engages the property owner, completes the Sanitary Survey Form, provides Education/Outreach Materials and answers questions. Meanwhile the second employee inspects the grounds looking for surfacing sewage or other visual indications of a failing OSS. The sanitary survey is concluded when the form has been completed, the grounds have been inspected, any necessary samples have been collected and the property owner's questions have been addressed.

The following materials are provided to all households visited for a sanitary survey:

- The brochure "Septic Sense, Scents, and Cents"
- The brochure "How to Inspect Your Septic System"
- The fact sheet on the Septic Repair Grant and Loan Project
- A dye packet for water leak detection
- The general natural yard care fact sheet
- A fact sheet about the proper disposal or yard waste
- A fact sheet on less toxic household cleaning products, and
- The brochure "Pets & Water Quality"

In addition to providing the core packet of information, staff will ask a series of questions to assess if the resident is interested in receiving additional information. The questions asked are as follows:

- Are you interested in additional information about septic systems? We can give you a DVD that explains how to maintain your type of septic system and have other helpful information.
- Do you have your own well? If so, are you interested water quality testing? We can test your water for bacteria at no cost.
- Would you like additional information on natural yard care?
- Would you like information on controlling pests? We have information on moles, aphids, slugs, ants, and other pests.
- Would you like additional information on household hazardous waste?
- Do you have any questions or concerns about mold?
- If you have young children, would you be interested in information about lead paint? Also, we have a thorough brochure that discusses a variety of environmental health concerns that especially affect children.
- Do you harvest shellfish off your beach or elsewhere in Pierce County? If so, we have a brochure we update yearly and also have an excellent brochure on Paralytic Shellfish Poison.
- Do you have questions about the disposal of pharmaceuticals?

The additional materials will then be provided that are pertinent to the topics of interest.

Record Keeping - Envision Data Entry

Select pieces of the collected data, from both the office review and field visit, are entered into the Envision database and the hard copies of the Sanitary Survey Forms are scanned for electronic archive storage. Once the required information is entered into the Envision database, it is accessible for reporting.

Envision Data Entry Protocol – Sanitary Survey

Follow-up Mailings

Immediately after a sanitary survey visit, Surface Water staff send a Thank You Letter expressing the Health Department's gratitude for the property owner's participation and providing any relevant sampling results. Once all the surveys have been completed, a Summary Letter is distributed to all property owners in the survey area, outlining the number of total surveys completed, the number of failures identified, and any updates on water quality in the area.

Guide to Unknown Septic Searches

Background

The Health Department began permitting septic system installation in the late 1940s. The oldest Health Department approved septic system record drawing is dated 1947. Not all systems were permitted and not all permitted systems submitted a record drawing until Washington State developed and implemented its first septic system regulation in 1974. The Health Department's septic system staff estimate that there is a 50% success rate for the retrieval of record drawing designs for systems constructed in the 50s and 60s. Prior to then, state regulations governing design, construction and setbacks of septic systems were non-existent.

Since the late 1940s the Health Department has registered over 14,580 septic systems in the Key Peninsula-Gig Harbor-Islands (KGI) watershed. The average life span of a septic system is variable and dependent on factors such as frequency of use, soil conditions, tank construction, pumping, and system design. A conservative estimate for the lifespan of a properly installed system is approximately 15-20 years, though some have been known to function for 50 years or more.

Purpose

Given the historical context, it is reasonable to expect that septic systems installed prior to 1974 are at higher risk of failure due to design standards, lack of regulation, and age. Identifying septic system components for properties with unknown septic systems is a specific task under the Washington State Department of Health 2012 Pathogens Grant, and is an important element in pollution identification and correction activities performed by the Health Department.

Shoreline properties lacking septic system information in the Health Department's electronic database are generally older and have a greater potential threat to surface water quality than newly installed systems. A thorough search of the database using a list of the parcels with unknown records as a reference will sometimes yield a miscategorized septic system record drawing or other relevant information.

Components can then be identified and high risk septic systems can be targeted for further investigation. Shoreline surveys may be conducted either due to a complaint, referral, or if an area is identified for potential public health risks. When a shoreline survey indicates elevated levels of fecal coliform, the case is then referred to the Health Department's Septic Repair Facilitator who will proceed with further source identification activities.

Process

1. Obtain a list of unknown septic systems. This should be in the form of an excel spreadsheet.
2. Make sure the following information is present:
    - Parcel number
    - Owner's name(s)
    - Parcel address (city and zip are also useful)
3. Use the resources described below to help identify and match a septic system record drawing to a parcel. The most obvious way to do this is by looking for a parcel number associated with the

drawing; however this information may not always be correct or available. In this case, using a variety of resources to compare information is the best option.*

**Septic system record drawings are not always available. Sometimes an accurate representation of the system may be found in well drawings, Report of System Status (RSS) reports or through septic maintenance sketches.*

4. When a septic system record drawing match has been found, a picture of the drawing should be printed out for component identification. The parcel number and owner's name (as written on the unknowns list) should be written at the top to keep track of which septic system record drawing is associated with which property (some owners have multiple parcels).
5. If there are any inconsistencies between the information found on the unknown list and the information found through research, be sure to note them down. For example, the address might have been recorded incorrectly or changed at a later date, or the parcel may have been newly created or, more frequently, resulted from the division of a larger parent parcel.
6. Keep track of parcels missing septic system record drawings, as well as those that have been identified.
7. When a number of septic system record drawings have been collected (generally grouped by bay), the system components should be examined for identification. Identified systems should be labeled and recorded in an excel spreadsheet. Systems that cannot be identified should also be recorded for future sanitary surveys.

Primary Resources

Microfilm Database

http://oldintranet.tpchd.org/sourceprotect/filetrack/maintenance/microfilm/search

The microfilm database is the location of septic system record drawing drawings and other related documents. In order to find septic system record drawings in this database you will need to enter search terms such as the owner's last name, the parcel number, or the address. You can print the septic system record drawing by clicking the print icon from the menu at the bottom of the screen.

In the Search Terms field any term used to describe the property may be entered. Sometimes it is relatively easy to find a septic system record drawing simply by searching for the owner's last name, the parcel number, or the address. Try these search terms first to make sure nothing is accidentally overlooked.

If there is still no match, variations of the property's address sometimes yield better results. This is generally because the way it is recorded in the microfilm differs from the way it is recorded to the spreadsheet of unknowns. For example, if the address is 12345 670th AVE KPN, trying the following searches may lead to the right results:

12345
670th AVE KPN
670th AV KPN
670th AV KN
670th AV

Review the page(s) of search results carefully. The list of results can be very long. Use the find (ctrl+f) function to locate a match. It is also a good idea to double check some of the nearby addresses to make sure the parcel number you are looking for has not been attributed to a different address.

Pierce County Assessor-Treasurer website

http://epip.co.pierce.wa.us/CFApps/atr/ePIP/search.cfm

This website contains summary information held by the Pierce County Assessor's office for individual Pierce county tax parcels. The assessor's webpage contains a link to a public GIS record where a satellite image of the property can be viewed. Look up the parcel number here first to ensure that the septic system record drawing you are searching for exists. Vacant land will not have a septic system record drawing.

The most helpful information can be found under the following headings:

Summary

The owner's name and address on record will not always match what is on the unknown septics list because they are pulled from different sources.

Use code: If it is vacant land, there will not be a septic system record drawing. Make sure to double check the GIS record to ensure the satellite imagery supports the vacant land use code.

Land

Utilities: The field will state "sewer/septic installed" if the property is served by a septic system or municipal sewer connection.
Acres: Can be reviewed to compare parcel sizes on septic system record drawing drawings, if needed.

Buildings

Double check the property type and the number of bathrooms present (if any) to make sure that it is possible to search for the septic system record drawing of the record you are reviewing in the microfilm database.

Sales

Sales data from 1997 to present is located in this section. This information can be compared to the Sales Document resource. It is important to verify the owner's name because the name of a previous owner may still be attached to a septic system record drawing.

Map

Public GIS (link at bottom of the page): This opens a separate link with a variety of viewing options. The aerial setting shows satellite imaging of the parcel, while the road setting shows the labeled county roads and parcel numbers. Webtools allow the user to move between layers, or overlay the text on the satellite image. This feature is most useful when a septic system record drawing is suspected to belong to the parcel and a comparison of the property layout is needed to come to a conclusion. It can also be used to verify that the land is vacant.

Recorded Documents

This link is most useful when it is necessary to look at the historical layout of parcels, especially when the addresses do not match up because the street names have been changed. To use this link, there

must be information under Tax Description on the Summary page displaying a Section, Township, Range, and Quarter. These are necessary search criteria.
To find a historical record: Accept the terms given on the introduction page, and look for the Real Estate category on the left side of the second page. Under this heading there should be a link called Search MAP Index. Clicking this link brings up a blue box where the Section, Township, Range, and Quarter can be entered and searched. This should display a list of documents and links. The images of these documents are found by scrolling to the right. Check the images for matches between the historical layout and current layout of the parcels in plats.

Sales.txt document

Sales.txt

This document is a long list of sales in Pierce County since the 1950s. It can be used to locate the last name associated with a parcel which can then be used to locate the septic system record drawing in the microfilm database.

Use the find (ctrl+f) function to search for the last name of the parcel owner or the parcel number. Be sure to start at the very top or very bottom of the document and scroll in the opposite direction when searching. The find function will only review the document once, which may result in accidental skipping of certain search results if the process is begun in the middle of the document.

Be careful not to edit the document!

Searching by parcel number does not always return results. When this occurs the owner's name should be the next search term used. This is a very large, very long document, and the name may show up many times throughout. Be sure to verify that the name you locate matches completely, and is associated with the correct parcel number. Parcel numbers may also appear multiple times if the property has been sold often.

Sampling for Optical Brighteners

Background

Nearly all laundry soaps on the market today contain fluorescent white dyes called Optical Brighteners to improve the look of white cotton fabrics. Fabrics treated with Optical Brightener dyes will absorb ultraviolet rays in sunlight and reflect them as blue rays. Due to the ubiquitous use of products with Optical Brighteners, these dyes are pervasive in domestic wastewater. Without adequate sewage treatment, Optical Brighteners may be present in both surface water and groundwater.

These dyes are only removed through natural adsorption onto soil or organic materials, or through photo decay. The detection of Optical Brighteners in surface water indicates the lack of sufficient waste water treatment and the likely presence of a direct gray water discharge to surface water. The detection of Optical Brighteners has also been used to effectively trace unpredictable surface and groundwater movement, pesticide travel in agricultural areas, storm drain cross-connections, and to

differentiate between human and animal waste. Because they fluoresce in the blue region of the visible spectrum, Optical Brighteners are easily detected with a long wave fluorescent UV or black light.

Purpose

Optical Brightener sampling is a supplement to the overall pollution source identification program and is generally used to help determine if a dye test is needed.

Procedure

1. Obtain a supply of untreated cotton pads. Make sure to check them under a long wave Ultra Violet fluorescent light to verify that no Optical Brighteners are present before using. Store unused pads in new plastic zip-lock bags. Before beginning an Optical Brightener sampling process, avoid direct contact with laundry soaps and detergents for at least 24 hours.
2. Use a vinyl-coated porous container (plastic screen mesh is generally used), or a sturdy copper or galvanized wire to hold the cotton packet secure while allowing water to pass through it. Do not use wire that may rust, as rust will leave stains on the cotton pads. Do not anchor the pad against a flat surface, but leave at least an inch of space between the pad and the anchor.
3. Avoid placing sampling packets in large bodies of water as this will dilute the concentration of Optical Brighteners that may be present. The best places to sample include storm drains, pipes, seeps and small streams.
4. Leave Optical Brightener packets in the field for one week. This allows ample time for laundry to be done, especially when a single residence is being monitored. The length of sampling time can be reduced if the sample cannot be read due to background interference (build up of sediment on the packets).
5. After packets are retrieved, rinse them in the sampling waters to remove as much sediment as possible.
6. Create a label to indicate the location, day of placement, and day of removal. *Make sure to check label material for the presence of Optical Brighteners before using.* Attach the label to a zip-lock bag and gently squeeze packets to remove as much water as possible without tearing or ripping. Store samples in a cool, dark area.
7. Allow packets to dry out (preferably overnight) on a monofilament line. *Do not use cotton line as it may contain Optical Brighteners.* Clean line with a damp, non-exposed cotton sampling pad or replace line after each drying.
8. Cut open the packets and place the cotton pads on a table in a dark room. The darker the room, the easier it will be to read the results. Use a non-exposed cotton pad as a control for comparison. View pads using a long wave 4-6 watt fluorescent Ultra Violet light for analysis.
9. The three possible Qualitative Results include: Positive, Retest, and Negative. A pad that is positive for Optical Brighteners will glow (fluoresce). A pad that is negative will look similar to the control pad. All other samples that cannot be determined will be retested.
10. If only a portion of the pad has fluoresced it could be the result of uneven exposure due to the way the pad was placed in the water. If this is the case and the reason for the unevenness can be explained, the pad should be considered positive. Paper and cotton dust that becomes

attached to the pad may cause specks or spots to fluoresce. These must not be used to indicate a positive result.

11. After the Qualitative Result for each pad has been determined, the result should be recorded for each sampling location.
12. As a quality control check, a designated portion of samples may be submitted to a lab to obtain quantitative results. Samples can be shipped via FedEx, UPS, or USPS first class or priority mail to:

    Ozark Underground Laboratory, Inc.
    1572 Aley lane
    Protem, MO 65733

    Samples do not need to be shipped under refrigeration or overnight delivery, however care should be taken to avoid sending samples when excessive delays are possible (ie: over a weekend).
13. For sites with a positive result, the next step will generally be to conduct a dye test to confirm either a failing septic system with surfacing sewage or a direct gray water discharge to surface water.

Dye Testing Procedures

Background

The Health Department has been using dye tests to detect problems and confirm failures in septic systems since the mid 1980s. Dye tests can be used in conjunction with sanitary surveys when a problem is suspected or when high bacteria levels are detected through shoreline sampling efforts. It is particularly useful for evaluating the status of systems bordering the shoreline because the dye can be traced through outflows draining into the marine environment.

Purpose

Dye testing is an investigative tool used by the Health Department's staff to determine the operational status of an onsite septic system suspected of impacting surface water quality. Often times the Health Department will rely on a positive dye test to confirm the failure. With the exception of severe failures at isolated residences, the application of any single dye test is not always conclusive. Due to variables such as close proximity of multiple residences, flow, subsurface conditions, system components, and the nature of the failure, multiple dye tests may need to be performed before the Health Department can determine if/where the septic system is failing.

Procedures

1. Get permission from owner(s) of suspect property to enter the house to conduct the dye test.
2. One week prior to the scheduled dye test, place background charcoal packets in locations where high counts (≥200) of fecal coliform have been found through shoreline sampling efforts and/ or places where a flow is suspected to be connected with the system. This may involve clipping packets to the insides of pipes with binder clips or using copper wire to attach packets to stationary objects (i.e. large stones) in streams or tidally influenced areas.

3. After one week, collect background packets and replace with new charcoal packets for the dye test. The background packets are kept frozen until the first set of dye test packets are brought in.
4. At this time, the dye test is ready to be conducted. First, verify that the fixtures are in proper working condition by flushing the toilet and running the sink. If no leaks are observed and the toilet flushes properly, empty a bottle of green fluorescein dye into the system. Half of the bottle of dye should go into the toilet and the other half into a sink. Always wear gloves when handling dye.
5. Immediately check sites where charcoal packets were placed for presence of dye. The dye will be a very obvious bright fluorescent green. If possible, check the septic tank for dye presence as well.
6. For 3 to 4 days following the test, revisit the sites where charcoal packets have been placed for visual inspection of dye leaving the system.
7. Collect the dye packets after one week and keep frozen for at least 24 hours before eluting (see elution procedures). Make sure to use a new pair of gloves for each used charcoal packet collected to avoid contamination between samples after dye testing has been conducted.
8. If the elution of these packets produces an obvious showing of dye, elute the background packets to confirm that no outside influences are causing dye to show up in the packets. In this case, unless dye shows up in the eluted the background packets, the system may be confirmed as failing. If dye presence cannot be confirmed, another dye test may be conducted following the same procedures.

Materials

Charcoal packets- Made by staff: cut mesh screen into strips and staple together to form a pocket which can be filled with approximately 2 teaspoons of charcoal.

Fluorescein dye- Obtained by order from the Ozark underground Laboratory. See the website at www.ozarkundergroundlab.com.

Elution of Dye

Handling Elution Chemicals

Dye elution solution consists of a 10% ammonia hydroxide solution and a 90% isopropyl alcohol solution. The ammonia hydroxide solution contains 30% ammonia hydroxide and 70% water. The isopropyl alcohol solution contains 70% isopropyl alcohol and 30% water.

Before handling chemicals, refer to the Material Safety Data Sheets for health and safety information.

Mixing the Elution Solution

Under the vented hood with the vent running, and while wearing eye protection and gloves, pour the appropriate amount of isopropyl alcohol solution into the 100ml graduated cylinder. Add only the amount needed to allow approximately 20ml of elution solution for each charcoal packet. Then, add 10% of the total volume of 30% ammonia hydroxide into the jar. For example, if you have five charcoal packets to elute, pour 90ml of isopropyl alcohol into the cylinder then add 10ml of ammonia hydroxide.

Use of Elution Solution

1. Wear gloves and eye protection.
2. Attach an identification label to a clean bottle listing: location, date of retrieval, and note if this is a background, week 1 or week 2 packet.
3. Turn on the vent hood.
4. Using sanitary procedures, rinse charcoal packs vigorously under cold tap water to remove sediment that may obscure dye. The dye is preserved in the charcoal and is not affected by rinsing.
5. If duplicate packets were placed, put the duplicate into a ziplock bag marked with the location and retrieval date. This duplicate is stored in the sample freezer in the downstairs storage room and may be sent to Ozark Underground Laboratory for spectrofluorophotometric analysis if necessary. Contact information is below:

   1572 Aley Lane
   Protem, Missouri 65733
   Phone: 417-785-4289
   Fax: 417-785-4290
   Email: sales@undergroundlab.com

6. With dedicated scissors, cut the charcoal pack and pour into the marked bottle. Rinse the scissors with tap water before using to cut each sampler. Rinse and store scissors dry.
7. Under the vented hood, gently pour approximately 20 ml of elution solution into the marked bottle. Tighten the cap firmly.
8. Gently mix the charcoal and solution for about 20 seconds and place the vial in the vented hood. After one hour, observe the solution for the presence of dye, looking at the eluted sample against the white wall of the room. If you are uncertain as to the presence of dye, turn off the room light and examine the sample using the mag-type flashlight. The flashlight beam should be projected through the sample at a 90 degree angle from your viewpoint.

9. Check the sample again 24 hours and 48 hours after elution for the presence of dye. Record the findings on the *Septic System Dye Test and Elution* form.

Safety Procedures for Eluting Dye from Charcoal Packets

Most of the safety precautions guard against exposure to ammonium hydroxide via several mechanisms.

> *Ammonium hydroxide is non-flammable but it is corrosive and the fumes are extremely toxic to the upper respiratory tract, skin and eyes.*

- Always use ammonium hydroxide in the fume hood.
- Transfer ammonium hydroxide to smaller containers outside where ventilation is best.
- Wear new clean gloves at all times.
- Use goggles or other eye protection.
- Make sure to have eye wash bottles available and accessible during the elution process.
- Clean counters with bleach solution before (?) and after eluting dye packets.

In case of:

Contact with eyes-

- Rinse with water (or eye wash) for at least 15 minutes keeping eyelids open.

Contact with skin-

- Flush with water at least 15 minutes
- Remove contaminated clothing.
- Cover irritated skin with an emollient.

Serious skin contact-

- Wash with disinfectant soap
- Cover skin with anti-bacterial cream

Inhalation-

- Remove to fresh air
- Seek medical help and provide oxygen if trouble breathing.

Ingestion-

- Do not induce vomiting unless directed by medical personnel
- Seek medical attention

Small spill-

- Dilute with water and mop up
- Neutralize residue with dilute acetic acid if necessary

Large spill-

- Use water spray curtain to divert vapor drift.
- Soak up with DRY earth, sand etc.
- Neutralize with acetic acid if necessary.

Pollution Correction Activities

Septic Repair Facilitator

Purpose

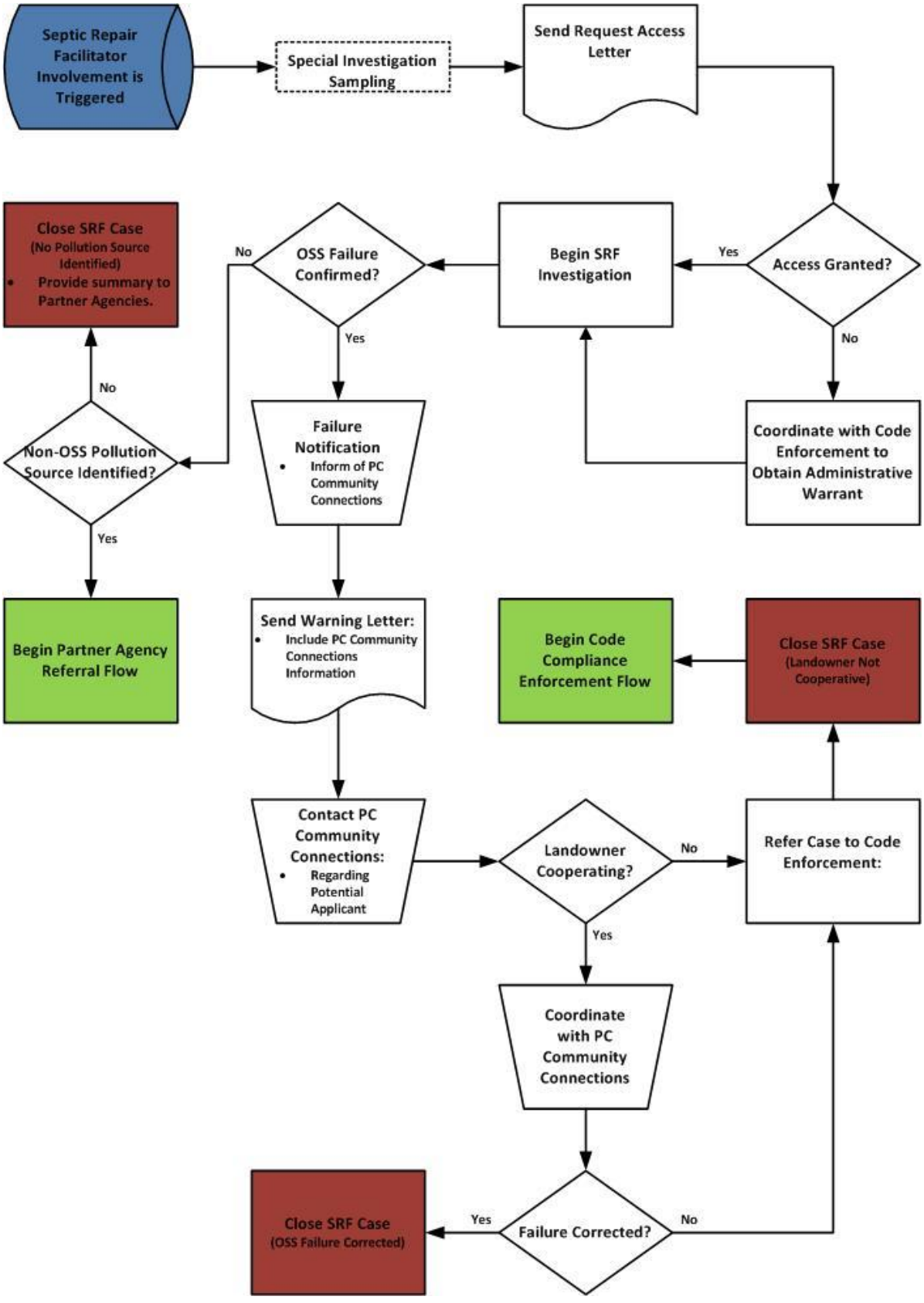
The Septic Repair Facilitator (SRF) bridges the functions of Surface Water, OSS, and Code Enforcement Programs to facilitate timely resolution of repairs and violations. The SRF also is the lead staff person at the Health Department to address poor animal keeping practices that are adversely impacting water quality.

Once a septic system concern or potential failure is identified by the Health Department's Surface Water staff, the SRF will assess the site conditions and the status of the septic system. Relevant

testing/monitoring will be conducted as needed to determine what corrective action may be required. If a repair is necessary, the SRF will discuss the problem with the property owner, describe options for resolution, and serve as the liaison between the property owner and the OSS program. The SRF will clearly communicate the department's requirement for a remedy, the timeframe for repairs, and consequences for failing to address the needed repair(s) in the stated timeframe. If property owners are unable or unwilling to correct the failure, the issue will be referred to the Health Department's Code Enforcement Program. If the failure is on the marine shoreline in a shellfish growing area, the SRF will notify DOH as soon as possible to inform them of the failure and will again notify DOH once the failure has been repaired.

For water quality problems caused by poor animal keeping practices, the SRF will send a letter to the property owner, informing them that their operation is adversely impacting water quality and that this problem needs to be addressed. The SRF will work with partnering agencies, Pierce Conservation District (PCD) and, if needed, Ecology to ensure that the problem is resolved.

Figure 5. Septic Repair Facilitator Work Flow



Background

In 2010 the Tacoma-Pierce County Board of Health delineated the Key Peninsula Marine Recovery Area (MRA) as an Area of Special Concern for septic systems. An Area of Special Concern is an area with definite boundaries delineated through public process, within which there are additional or higher requirements for septic systems to reduce the incidence of failures and reduce the impacts of septic systems upon public health.

Along with the delineation of the MRA, the higher level of monitoring in the shellfish watersheds by the Health Department Surface Water Program identified many failing septic systems that were on problematic sites and were quite difficult to repair. Over time, it became apparent that property owners working to repair their failing septic system were confused and frustrated about how to approach the repair and the repair process. Hence, the Health Department decided to develop the new SRF position, with this person facilitating the repair process. Funding for the SRF position was provided for a three-year period by the EPA. The SRF also was needed to follow through with partnering agencies on addressing other sources of bacterial pollution.

Protocol

The SRF interacts with property owners when a failing septic system or poor animal keeping practices may be impacting surface water quality. Usually the indication of a problem is the result of high count sample results collected through the Health Department's shoreline evaluation or upland sampling efforts. The SRF may also become involved due to observations made during a Sanitary Survey, or through a referral from another Health Department program. Regardless of how the SRF becomes aware of a potential pollution source, the first step towards correction is contacting the property owner(s) to investigate and determine the bacterial source(s). *Figure 4* depicts the work flow for the Septic Repair Facilitator.

The SRF establishes contact with the property owner(s) or legal representative and acquires permission for further investigation to determine the nature of the pollution source. The SRF investigation will require property access to thoroughly examine the likely causes of pollution. If the pollution is attributed to poor management practices or animal handling, the issue is generally referred to PCD, SWM, Ecology, and/or the Health Department Code Enforcement Program.

The SRF must communicate to the property owner the need for investigation and the risks of identifying a bacterial source. Identified bacterial sources such as failing septic systems or poor animal keeping practices need to be corrected. It is the expectation of the Health Department that property owners within the shellfish areas of Pierce County will cooperatively comply with all applicable regulations as they pertain to illegal discharges to surface waters. The SRF must communicate what the Health Department requires and the consequences of non-compliance. If the property owner is unwilling to grant the Health Department access to conduct a thorough investigation, then the SRF will refer the issue to the Health Department's Code Enforcement Program.

Once property access has been granted, the SRF conducts a cursory inspection to identify obvious sources of pollution. If no obvious signs of septic system failure or other visible pollution source exist,

but shoreline sampling consistently indicates fecal impact, then the SRF will ask the property owner to allow one or more Dye Tests.

When it has been determined that a septic system is failing the SRF will attempt to diagnose the general cause of the failure. It is probable that additional samples will need to be collected before a diagnosis can be made. These additional samples may include analysis for fecal coliform, E. coli, and, possibly, nutrients. It may also be necessary to conduct additional dye tests.

When a failing septic system has been confirmed the SRF will notify the property owner as soon as possible. The SRF will communicate the issue(s) and provide technical advice on the most appropriate repair. Documentation will be sent stating that the property's septic system was found to be out of compliance and the Health Department's expectations regarding its use and repair.

The SRF will go over the enforcement process and any available options with regards to temporary repairs/controls. Additionally, the SRF will refer the property owner to contacts at Pierce County Community Connections for information on possible financial assistance.

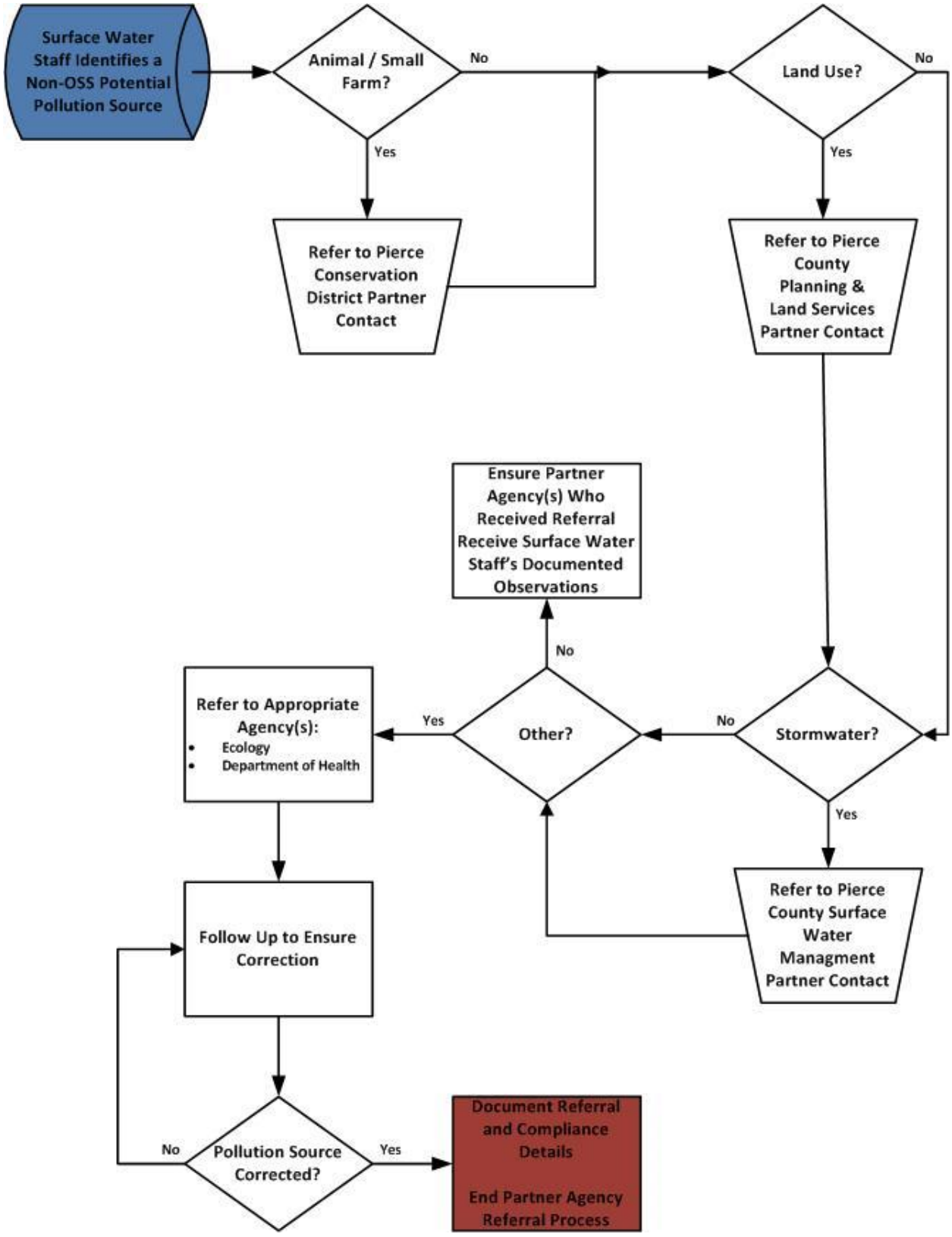
If the property owner is not willing to repair the failure, the issue will be referred to the Health Department's Code Enforcement Program.

The Code Enforcement program uses a multi-step and graduated approach to enforcement action that allows multiple opportunities for voluntary compliance and affords due process to the property owner. If the property owner is unable or unwilling to comply with the Health Department's requirements a Notice of Violation and Order to Correct will first be issued. Continued non-compliance may result in a Certificate of Non-Compliance (CNC) being filed with the Pierce County Auditor's office. If these efforts are unsuccessful, the Health Department can issue a Health Order and have water and/or electricity shut off to the property. Finally, the Health Department can post the property with a Notice to Vacate if all other efforts are unsuccessful.

If the high bacterial counts are caused by poor animal keeping practices, the SRF will send a letter to the property owner, informing them of the problem and requesting that they work with PCD to address the situation. The SRF will then track progress on this site and will request enforcement assistance from SWM and Ecology if the property owner decides not to work with PCD. The following steps depict the general correction process for properties with poor animal keeping practices and the agencies involved:

1.	**Health Department, SWM, DOH, Ecology**	Identify problem parcels through water quality results or field visit.
2.	**Health Department, SWM, DOH, Ecology**	Contact other partners to see if landowner is working with another agency.
3.	**Health Department, SWM, DOH, Ecology**	If impact is determined of a high concern, confirm WQ impact. If determined as a significant concern, send an appropriate notice of violation. For Ecology or SWM, if of a moderate concern send the standard inspection letter recommending that the landowner correct the problem or contact the PCD for assistance within 30 days. The PCD and other appropriate agencies should receive a copy of the letter.
4.	**PCD**	Within the 30 days, the landowner should attempt to contact PCD to request assistance. PCD will notify referring agency regarding communication with the landowner. The landowner will receive a copy of any correspondence.
5.	**PCD**	Work with landowner to develop a corrective action plan. *Per PCD policy, cost share assistance for mitigation practices will be considered on a case by case basis.*
6.	**Health Department, SWM, DOH**	Allow 6 months to implement corrective action plan to address identified WQ impact. Send appropriate notice of violation or refer uncooperative landowners to Ecology for enforcement.
7.	**PCD**	Provide quarterly progress reports on corrective action(s) to referring agency.
8.	**Health Department, SWM, DOH**	SWM as lead: If the landowner has not contacted the PCD within 30 days of receiving the initial standard inspection letter, confirmed IDDEs will get an appropriate notice of violation and unconfirmed IDDEs will be sent to Ecology, Health Department as lead: If the landowner has not contacted the PCD within 30 days of receiving the letter informing them of the problem, Ecology will be requested to provide assistance, including any necessary enforcement.

Figure 6. Partner Agency Referral Work Flow



Pollution Prevention Activities

PIC Education and Outreach Efforts

Background

A large majority of Pierce County residents are served by a septic system. Education of homeowners about their systems and ways to protect the quality of Puget Sound is vital to our goal. The Health Department, partner organizations, and non-profit agencies play active roles in protecting water resources in the MRA and other shellfish areas of Pierce County. The Health Department is committed to building partnerships and working together in achieving common goals.

Maintaining water quality sampling, pollution prevention activities and facilitating repairs of failing septic systems are common water quality protection measures. However, community members must also play a role in protecting their water supply, including involvement with septic system operation and maintenance measures.

The Health Department, with the help of partner organizations, will implement a campaign to educate community and business members and to encourage them to adopt actions which are protective of water quality in the MRA.

Purpose

Initial activities will be focused in the KGI Watershed. The Key Peninsula portion of the KGI Watershed was designated as a MRA in 2007 through the Health Department's On-Site Sewage Management Plan and covers approximately 63 square miles.

The Health Department will pilot a septic system maintenance and water quality education and outreach campaign to raise awareness about new septic maintenance regulations and evaluate its effectiveness for possible replication in other Pierce County communities. Staff will work with the residents to promote an understanding of connections between a healthy environment, including water quality, and active septic operation and maintenance activities.

Additionally, education and outreach activities will be aimed at homeowners in the MRA. Emphasis will be placed on raising the level of awareness and concern regarding water protection and to motivate homeowners to adopt behaviors that minimize human impact upon water quality. Staff will work with the residents to promote an understanding of the value of healthy marine water quality within environmentally sensitive areas of the KGI Watershed.

Summary of Efforts

- Baseline septic homeowner survey
- O & M Advisory group
- Sanitary surveys

- Information booths at public events
- Community workshops, etc.

Figure 7. Education and Outreach Efforts

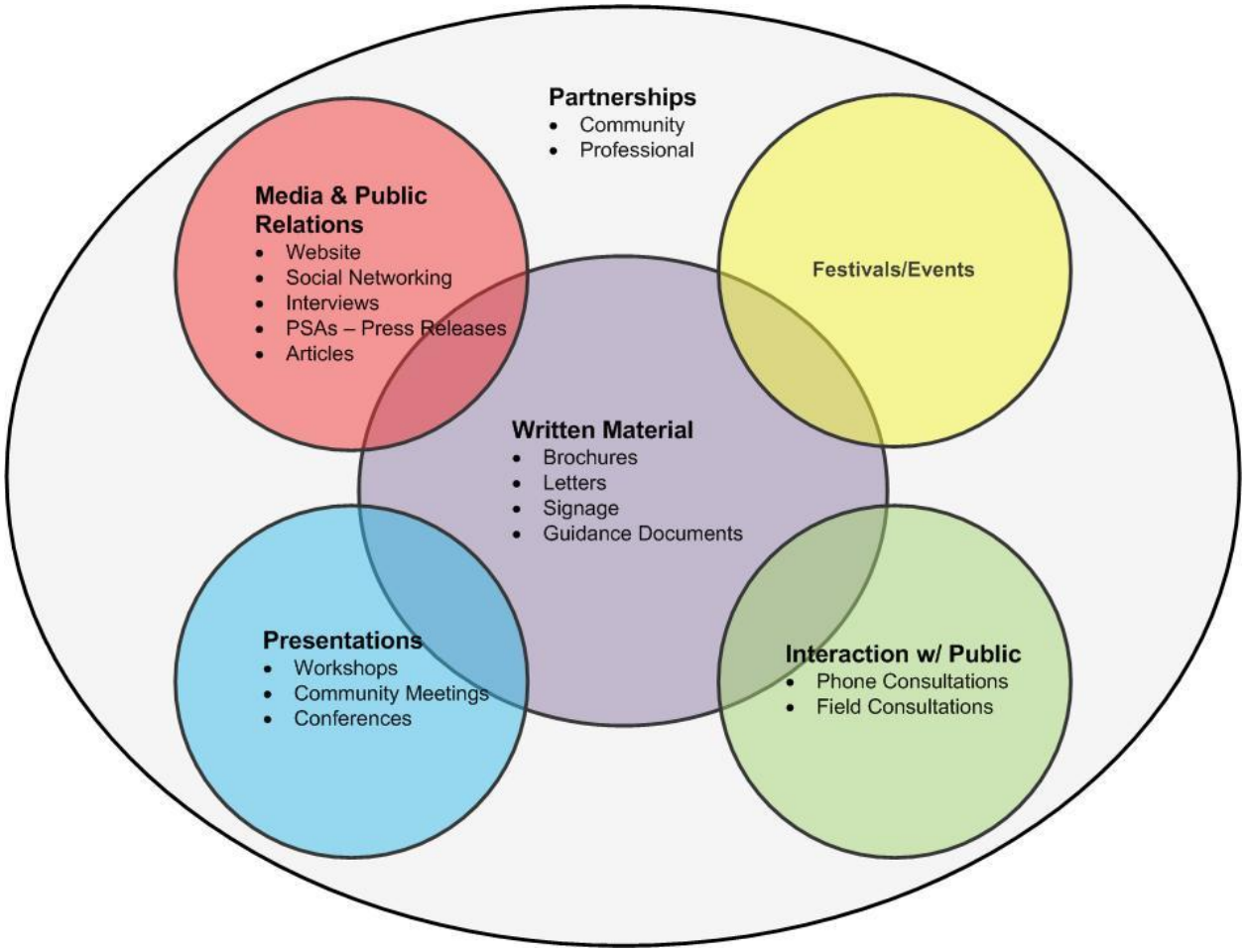
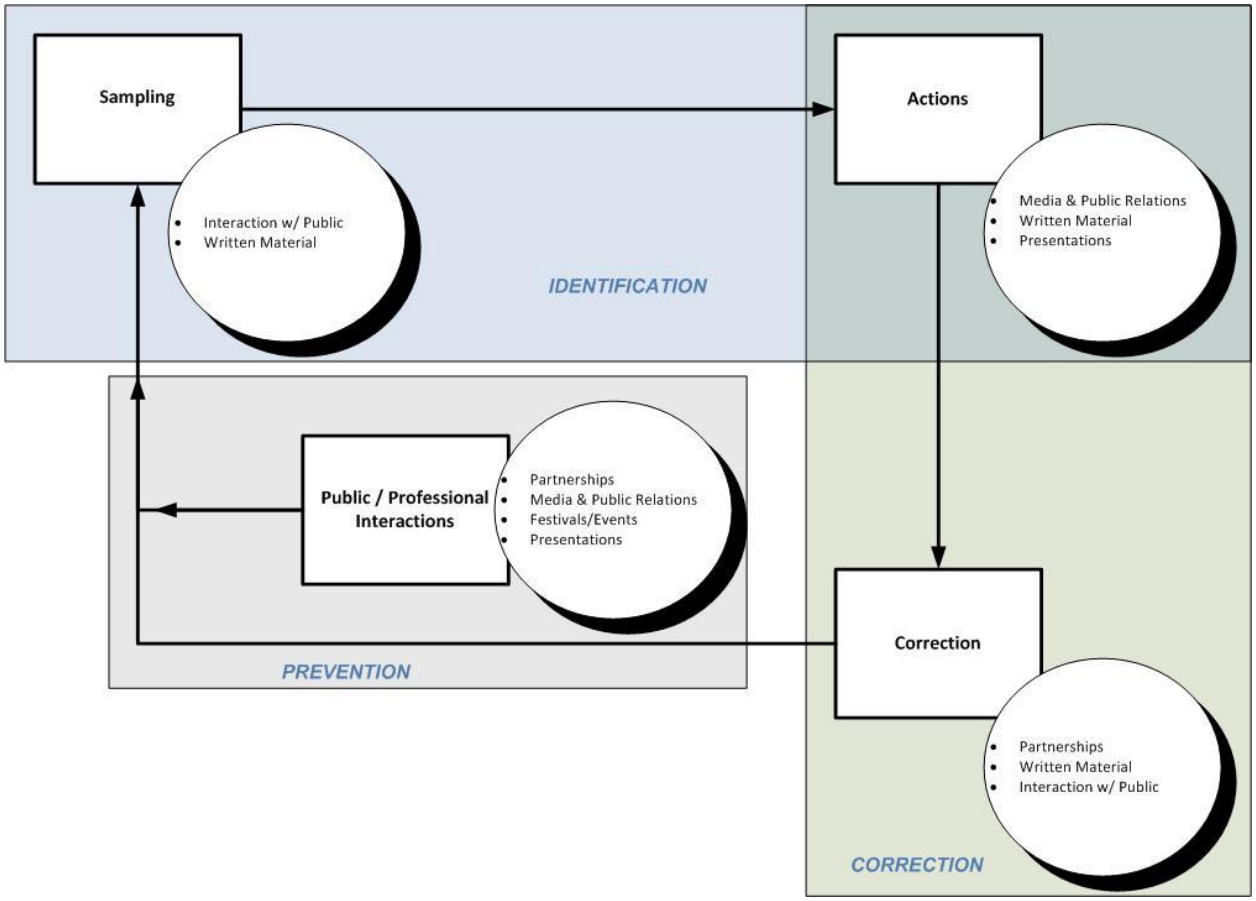


Figure 8. Education and Outreach Strategy



Protocol Document Control

Background

This PIC Protocol document was constructed by updating and compiling numerous internal sources that the Health Department's Surface Water Program had previously produced. Most of these documents are currently found in the *Documents* subfolder of the *PIC Protocol* folder. The complete file path is:

F:\LIBSHARE\SRCPRO\WATER\Surface Water\SW General\Projects & Activities\PIC Protocol\Documents

After these documents were combined to form a basic outline of the Protocol, the document as whole was repeatedly edited for content and overall clarity. As a result of this process the final text of the document varies significantly from the text of the original.

Purpose

The Protocol is a comprehensive guide to the Pollution Identification and Correction program, as it is currently implemented. The PIC Protocol must be regularly updated with the most recent practices and procedures of the Surface Water staff to ensure its relevancy.

Identical versions of the supporting documents are also saved in their respective areas in the Surface Water program files. One should be aware of this redundancy and strive to update all versions of a document.

Editing

Depending on which portion of the Protocol you are editing, it may also be necessary to update the original contributing documents. Documents that are referenced outside of the Protocol as a whole, such as the Parameter Probe Calibration Protocol and the Dye Elution Procedure, should be accurately maintained. It is equally important to update the Protocol when any significant changes are made to the corresponding original documents.

Minor edits to the Protocol can be made directly on the MS Word copy of the document. Larger edits should be made either on a separate copy of the Protocol or on the original document, and should undergo a peer-review before any changes are made to the final version of the Protocol. Final versions should be saved in portable document format (pdf) before dissemination to outside agencies.

Materials used to support certain elements of the Protocol (i.e., educational materials distributed during Sanitary Surveys) should be stored in the appropriate folder under the *PIC Protocol* folder, and then hyperlinked to the Protocol document. Collecting all materials used in the Protocol in one central location helps avoid broken hyperlinks and facilitates the updating process.

Appendices

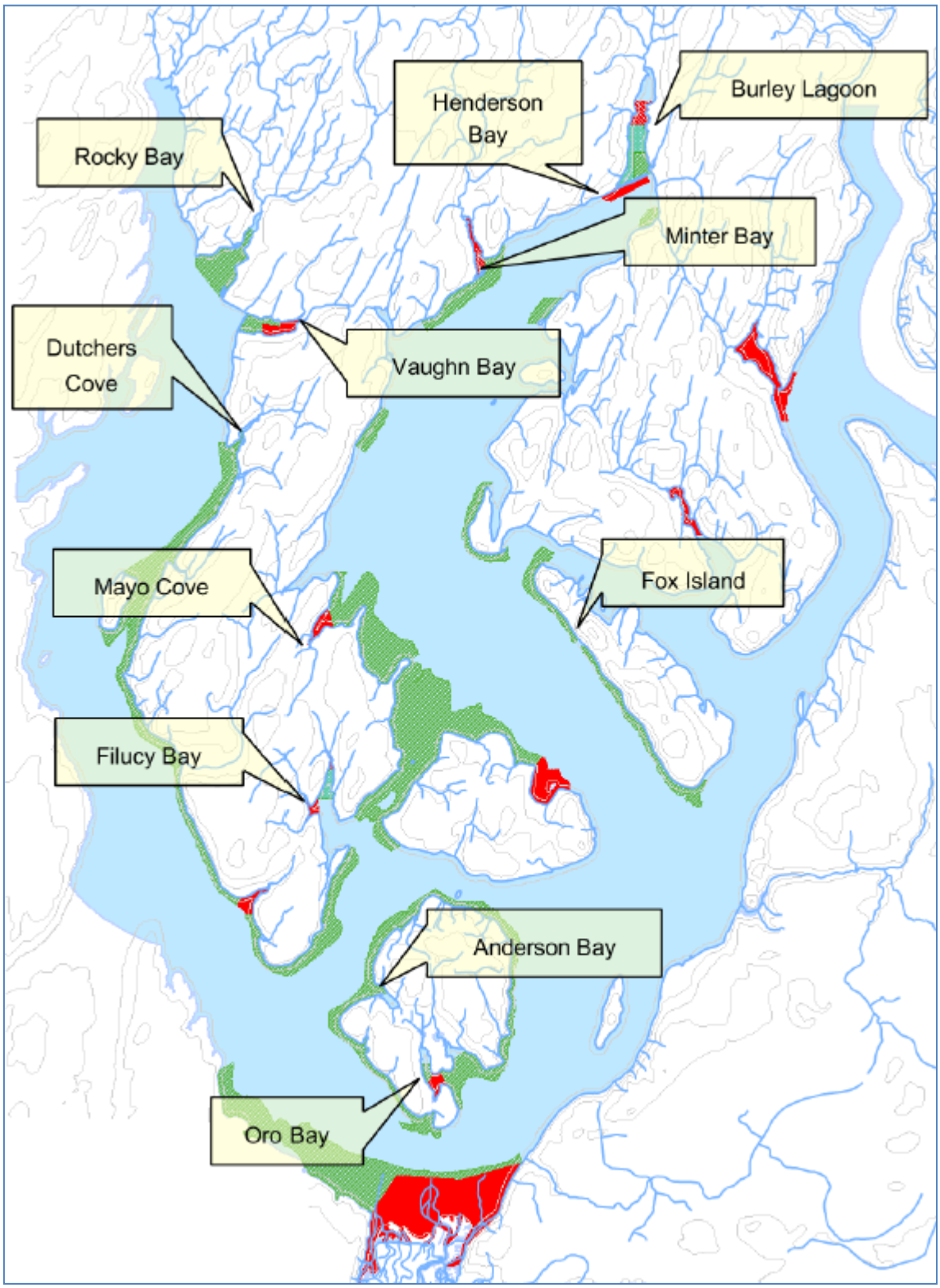
Appendix A: Glossary of Abbreviations

PIC	Prevention, identification, and correction
Health Department	Tacoma-Pierce County Health Department
SWM or PC SWM	Pierce County Surface Water Management
PCD	Pierce Conservation District
PALS	Planning and Land Services
DOH	Washington State Department of Health
Ecology	Department of Ecology
EPA	Environmental Protection Agency
cfu	colony forming units
gpm	gallons per minute
pH	potential hydrogen ion activity
µS and mS	microsiemens and millisiemens (conductivity)
°C	degrees Celsius (temperature)
ml	milliliters
QA/QC	Quality Assurance/ Quality Control
QAPP	Quality Assurance Project Plan
pdf	portable document format
GPS	Global Positioning System
GIS	Geographic Information System
SWQD	Surface Water Quality Database
PSA	Public Service Announcement
SRF	Septic Repair Facilitator
RME	Responsible Management Entity
OSS	Onsite Sewage System

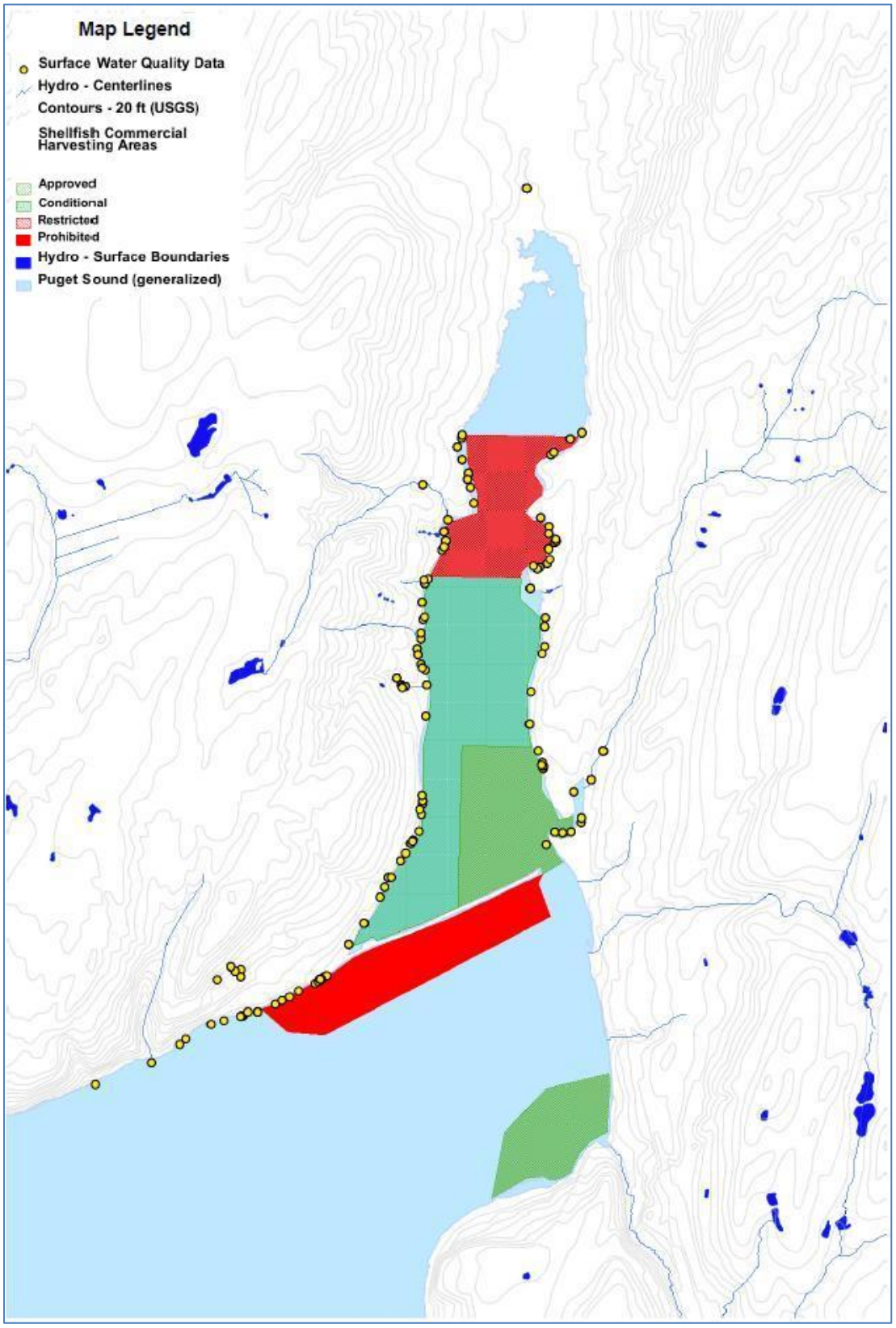
O&M	Operation and Maintenance
RSS	Report of System Status
CNC	Certificate of Non-Compliance
MRA	Marine Recovery Area
KGI	Key Peninsula/ Gig Harbor Islands (watershed)

Appendix B: Pollution Identification & Correction Implementation Areas

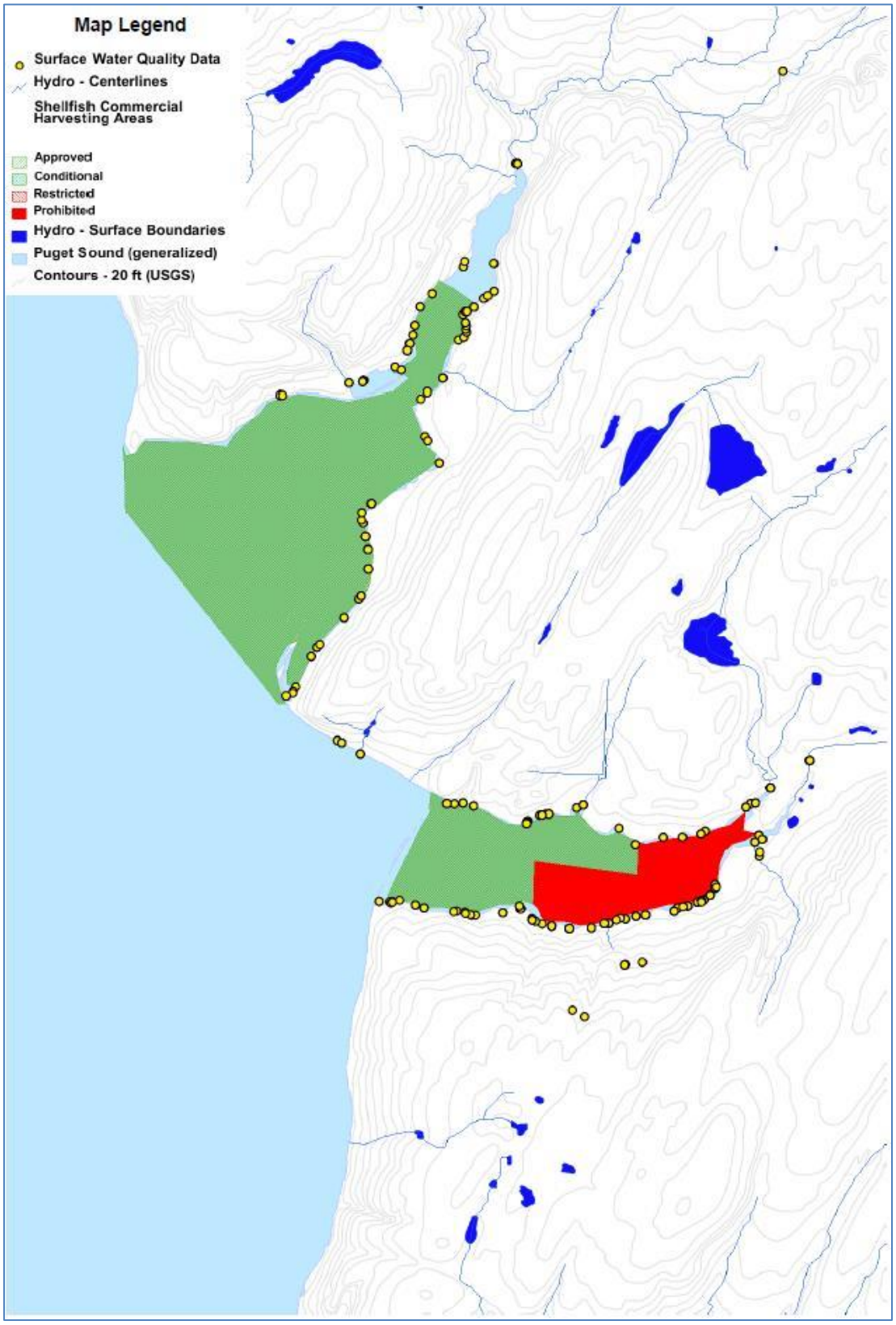
Key Peninsula, Gig Harbor and Islands (KGI)



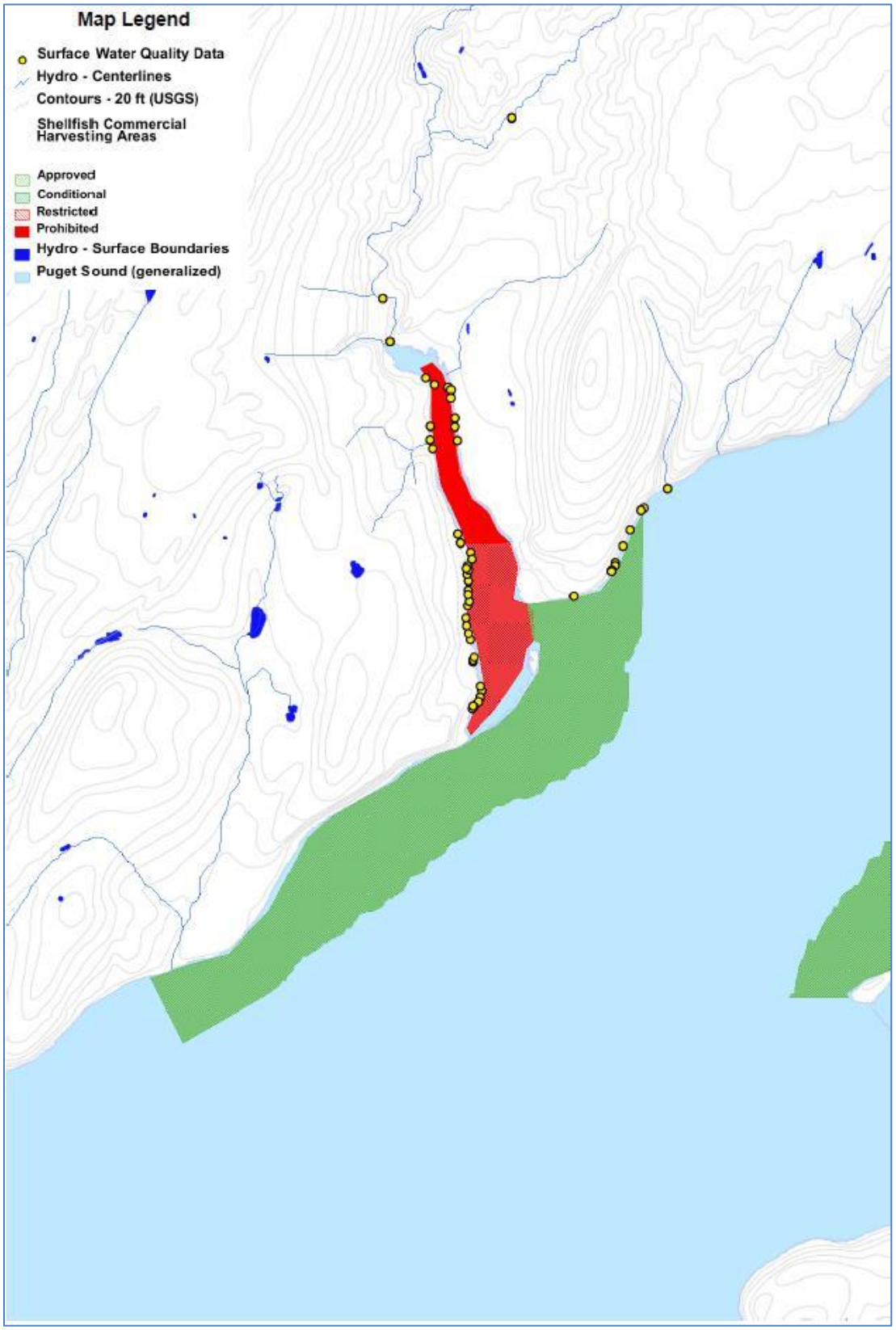
Burley Lagoon & Henderson Bay



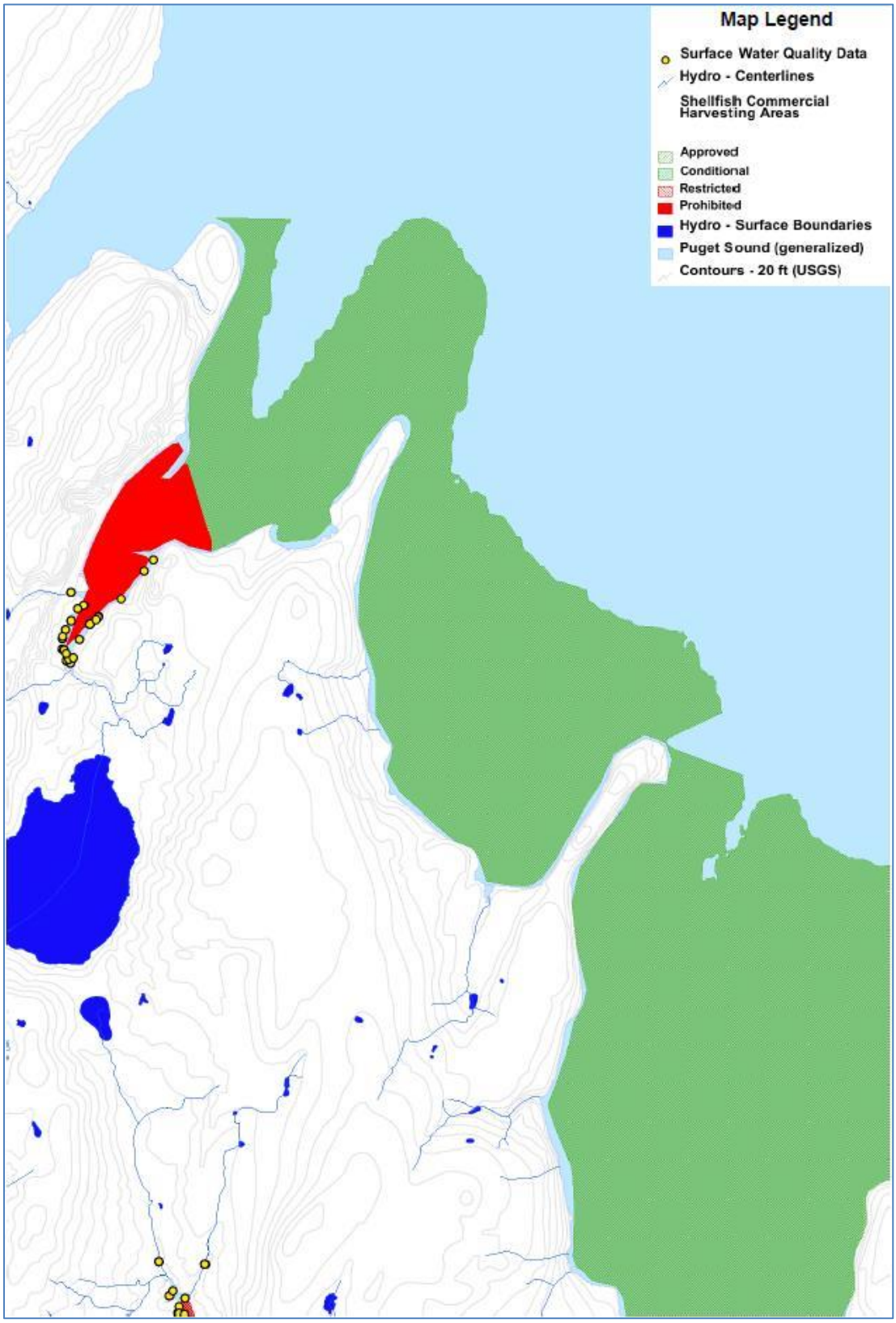
Rocky Bay and Vaughn Bay



Minter Bay


Map Legend
Surface Water Quality Data
Hydro - Centerlines
Contours - 20 ft (USGS)
Shellfish Commercial Harvesting Areas
Approved
Conditional
Restricted
Prohibited
Hydro - Surface Boundaries
Puget Sound (generalized)

Mayo Cove


Map Legend
Surface Water Quality Data
Hydro - Centerlines
Shellfish Commercial Harvesting Areas
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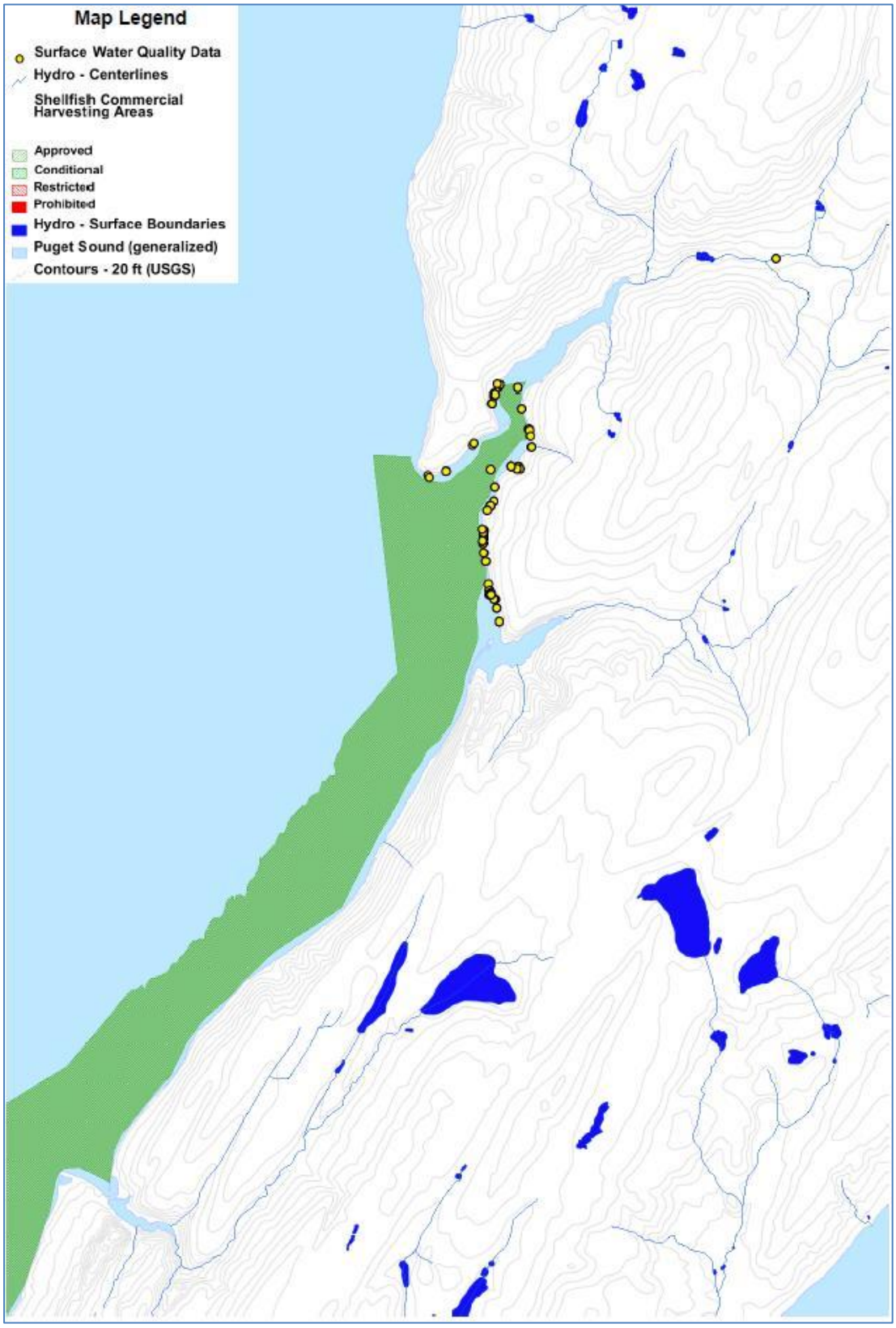
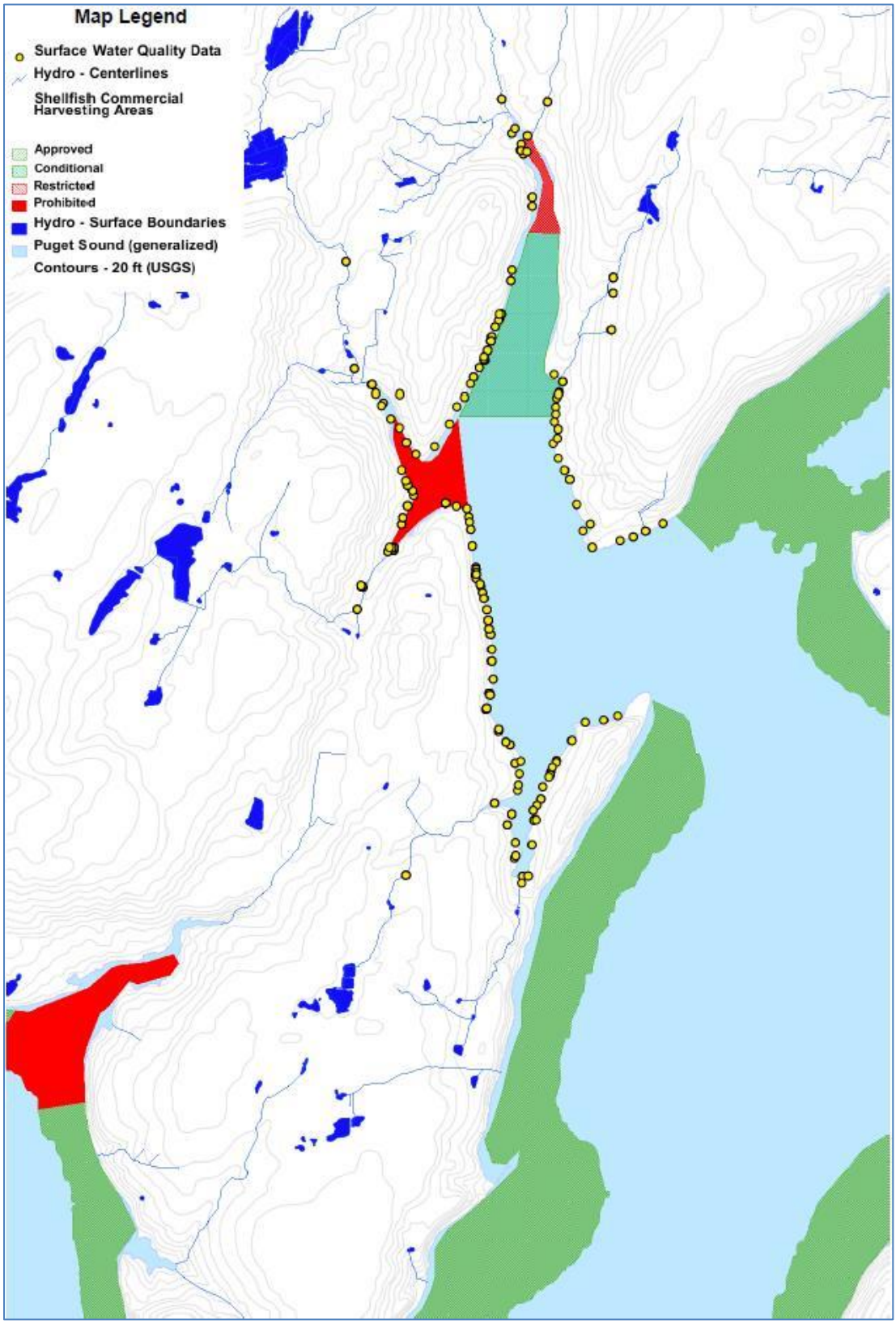
Hydro - Surface Boundaries
Puget Sound (generalized)
Contours - 20 ft (USGS)

Dutchers Cove



Filucy Bay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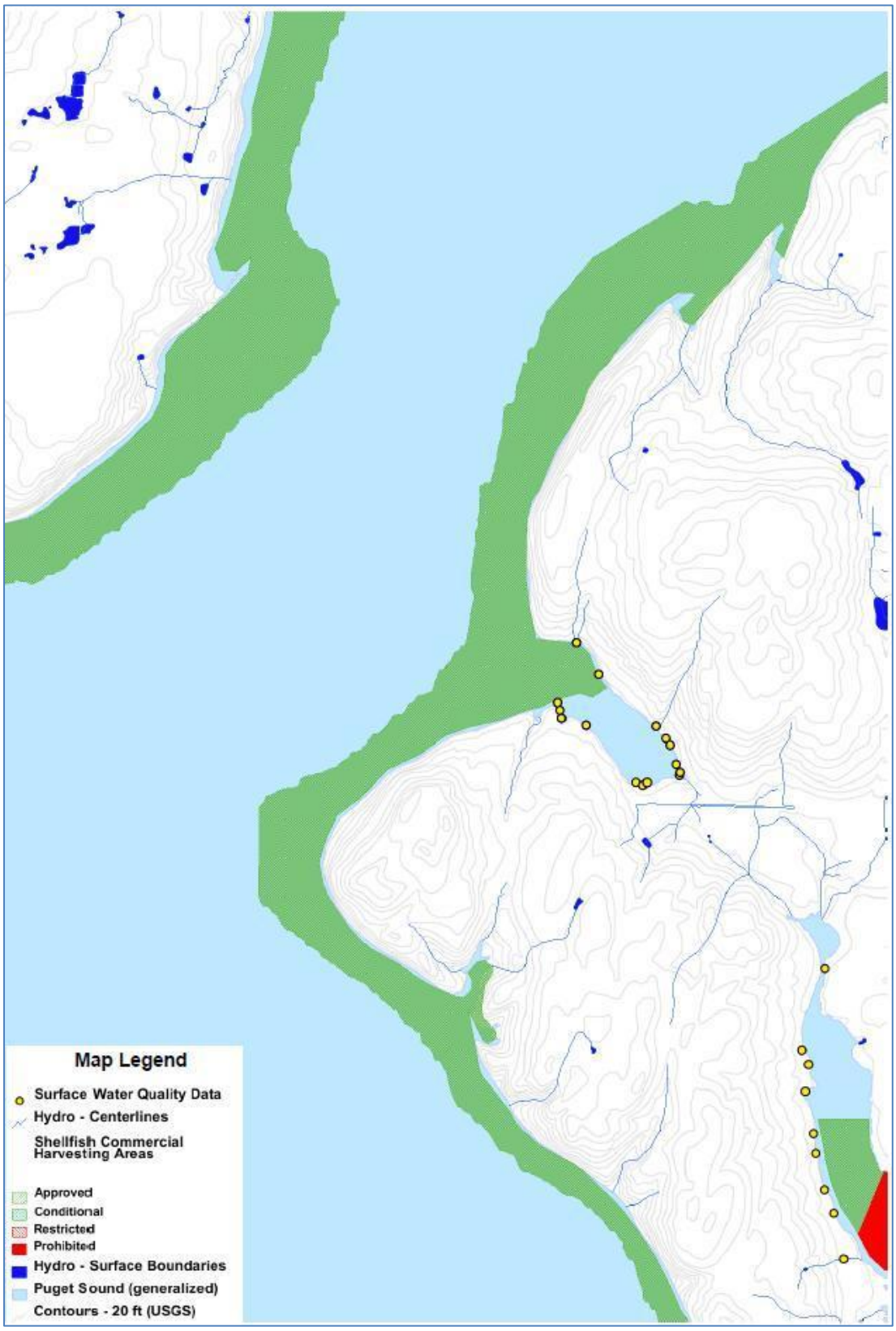
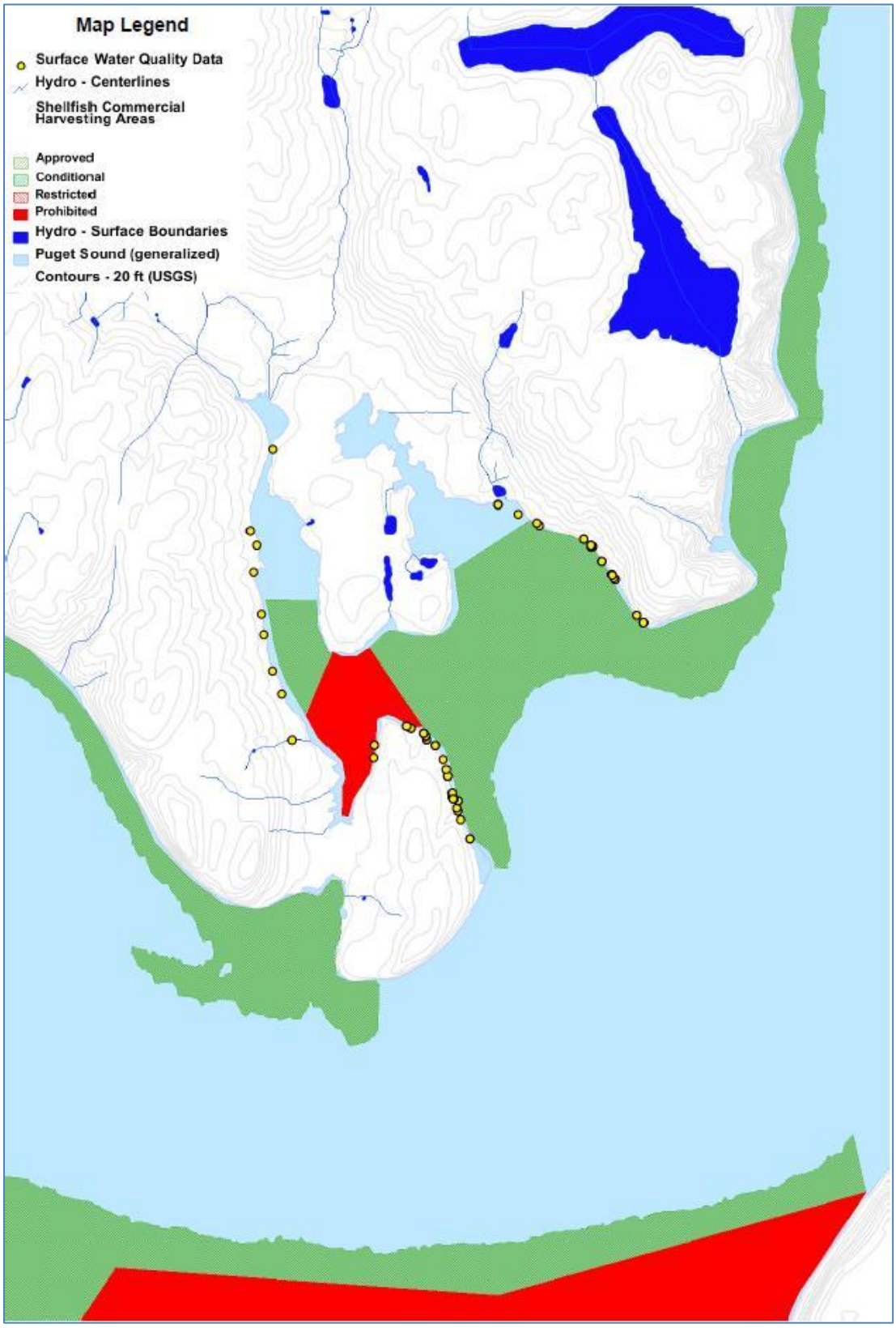
Surface Water Quality Data
Hydro - Centerlines
Shellfish Commercial Harvesting Areas
Approved
Conditional
Restricted
Prohibited
Hydro - Surface Boundaries
Puget Sound (generalized)
Contours - 20 ft (USGS)

Amsterdam Bay



Oro Bay


Map Legend
Surface Water Quality Data
Hydro - Centerlines
Shellfish Commercial Harvesting Areas
Approved
Conditional
Restricted
Prohibited
Hydro - Surface Boundaries
Puget Sound (generalized)
Contours - 20 ft (USGS)

Appendix C: Education Materials for Distribution

Aphids	Mold	Protecting Drinking Water	Pharmaceutical Disposal
Cleaning Products	Moles	Researching Household Products	Drinking Water Sampling
Fertilizers	Moss	Safe Cleaning Products	Weed Control
Hazards Waste Disposal	Landscaping	Shellfish Harvesting	Qs for Septic Professionals
Pesticides	Protecting Children	Slug Abatement	Septic O&M Handout

Appendix D: Shoreline Sampling Equipment& Materials

Health Department

☐Field Sample Sheet ☐High Counts List ☐ Spare GPS Batteries (AA)
☐Parameter Probe ☐Cell Phone ☐Camera
☐Ferry Ticket(s) ☐GPS Unit(s) ☐ Shoreline Sampling Binder
☐Cooler(s) with Blue Ice *(holds roughly 18 bottles)*

Vehicle

☐Rain Coat ☐Orange Safety Vest ☐Designated Parameter Bottle
☐Pen(s)/Pencil(s) ☐Timepiece ☐Boots/Hip Waders
☐Shovel ☐Sun Protection ☐Latex / Nitrile Gloves
☐Hand Sanitizer ☐Sampling Pole ☐Chain of Custody Forms
☐Sample Bottles (each full bottle weighs about 0.5 lbs)

Appendix E: Septic Repair Facilitator Letters and Materials

Request Letter

Failure Compliance Letter

Warning Referral Letter

Property Owner Brochure

Appendix F: Swoffer Velocity Meter Calibration and Care

CARE OF THE 2100 SENSOR

The Sensor and propeller rotor assembly of the *Model 2100* Current Meter is the single most important part of the instrument and great care must be observed for its continued accurate output.

Keep the Sensor/Propeller assembly above the streambed when taking readings and avoid rocks and other hazards when moving from one measuring site to another. This prevents damage to the Rotor, Rotor Shaft, Propeller and the Sensor Body.

Never transport or store the sensor wand with the propeller rotor installed. *Use the 1/16" hex screwdriver to loosen the setscrew and remove the entire rotor assembly when not using the Model 2100.*

Always replace the batteries in the Model 2100 Indicator with fresh ones.

1. During rough use check the propeller frequently for frayed leading edges and for cracks. Chipped or cracked props should be replaced. Frayed leading edges can be brought back to acceptable levels of operation by reshaping them with 150 grit (or finer) sandpaper. Propellers that show signs of being bent or misshapen should be discarded.

2. Rotational friction is by far the biggest cause of erroneous data especially at velocities below 2 feet per second. Check the freedom of rotation frequently especially in turbid water or after rough handling. In some measuring situations it may be necessary to completely disassemble the rotor and clean the parts with clear water after each immersion. Use spare rotor assemblies and interchange them often. ***Never leave the rotor assembly attached to the sensor after taking readings.***

3. Water is the lubricant for the *2100-A21* rotor. "Canned air" and spray type degreasers may be used to regularly clean the "bore" of the Rotor (**2100-A27**) and the polished surfaces of the Rotor Shaft (**2100-A26**). Avoid oil & grease. Cleaning the rotor and its parts may be accomplished by using soap and water , alcohol, distilled water, etc. Avoid using any chlorinated solvents or strong alkalies. And remember whatever you use also needs to be cleaned off enough to satisfy environmental requirements.

4. The Rotor Assembly (**2100-A21**) should spin very freely when held in the vertical position (propeller pointing up) and simply blow lightly on the propeller. If it does not, clean the bore of the Rotor and the surface of the Rotor Shaft thoroughly.
   One method to determine an acceptable level of low-velocity performance by a particular Rotor Assembly is to perform a "Spin Test":
   Install the Rotor on the sensor, connect the sensor to the Indicator, and place the Indicator in the **COUNT** mode. With the propeller pointing up blow very hard straight down on the propeller. *At the instant you stop blowing* hit the **RESET** key on the indicator and allow the rotor to coast to a stop. A rotor, that will perform to the low velocity limits of its design, produces counts on the indicator of at least 300.

5. If the Rotor begins to "buzz" when spun by hand it means that the bore diameter of the Rotor (**2100-A27**) and the outside diameter of the Shaft (**2100-A26**) are too far apart. In this case it is advised to replace the Rotor with a new one. If the shaft shows visible signs of wear replace it also. Severe buzzing indicates that the rotor is bouncing off the shaft as it rotates around it. This slows the rotor significantly especially at velocities above 3 FPS and will cause readings to be slower than actual. **Note:** Some slight buzzing may be heard in the later versions of the rotor when it is spun "dry". This buzzing should cause no significant loss of efficiency.

6. Periodically examine the Thrust-Bearing Nut (**2100-A23**) and check inside on the bottom (the bearing surface). If a pronounced "cup" begins to form (wear from the ball-shaped end of the Rotor Shaft) the **2100-A23** should be replaced. This is especially necessary when using the *Model 2100* in low-flow situations, 2 FPS or lower.

7. The Photo-Optics in the sensor body must be kept clean. Use soap and water and a soft toothbrush to keep the "eyes" clean if necessary. *Be careful and do not scratch the Photo-optics as this could cause unwanted light scattering and therefore erroneous readings.* Likewise the Fiber optics "eyes" in the base of the Rotor (**2100-A27**) should also be kept clean.

Treat the *Model 2100* Rotor Assembly and Sensor with care and it will continue to produce accurate data with minimum maintenance.

CALIBRATION OF THE MODEL 2100 CURRENT METER

The *Model 2100* Current Meter is designed to be easily calibrated by the user. This calibration must be done with each Rotor you use. *The calibration numbers recommended by SWOFFER INSTRUMENTS, INC. are not necessarily correct for all measuring situations, therefore for optimum accuracy you should calibrate the rotors before use and at or near to the velocities expected to be encountered.*

If very accurate velocity measurements are required then you must calibrate your *Model 2100* system and check the calibrations often. The instructions below should be followed very carefully for reliable measurements using the *Model 2100*.

IMPORTANT NOTE: "Calibrating a sensor" is actually calibrating a particular propeller rotor for use with the *Model 2100* Indicator. If you use more than one rotor assembly you must check the calibration for *each* rotor assembly and adjust the Indicator Calibration Numbers accordingly as you switch from one propeller assembly to another.

Calibration numbers correctly matching a rotor assembly to a 2100 indicator are especially important at the lower velocities (1.5 FPS and lower) and can vary greatly depending on many factors; bearing surface condition in the rotor, make-up of the water being measured (amount of suspended particulates), any damage to the propeller, rotor, shaft, thrust-bearing nut, etc.

What a calibration number is:
The Model 2100 rotors produce four pulses per revolution. Each of the four fiberoptic "eyes" in the rotor triggers an electrical pulse from the sensor. These pulses are called "Counts" and are read by the Model 2100 Indicator. The Indicator uses these counts, measuring the number of them against an internal timer to determine velocity. The two calibration numbers in the Model 2100 therefore represent the number of counts a specific rotor produces as it travels through 10 feet and 10 meters of still water. When the sensor is *stationary* and water is moving past the propeller, a specific number of counts produced in a specific amount of time determines velocity when you know how many counts are produced per foot or meter (pitch). The calibration numbers then can also be referred to as Pitch.

Although rotor/propeller combinations are "similar" they are not necessarily "identical" and therefore each may have a slightly different Calibration Number. Always remember that the Calibration Numbers shown on the Indicator's display represent the Calibration Numbers for a single rotor assembly only. Double check all rotor assemblies used for any measuring job and make sure that each is within your accepted tolerance for calibration variation. Each rotor assembly may have a different calibration number. Only go out into the field with specific knowledge of each rotor assembly's calibration number. Make sure that the calibration number in the 2100 Indicator matches the rotor that is attached to the sensor before relying on readings.

CHECKING AND CHANGING CALIBRATION OF THE MODEL 2100

Before applying corrections to the *Model 2100* rotate the selector switch to the **CALIBRATE** position. A figure will appear in the display and will be either the FEET calibration number or the METERS calibration number depending on the position of the FEET/METERS switch (located in the battery compartment). For most measuring applications the calibration numbers will be about:

FEET	=	**186**
METERS	=	**610**

If the displayed figures are much lower than these figures the first thing to check is the battery. A weak battery can allow the indicator calibration numbers to "drift" downward slightly and will cause errors in measurements. Be sure to connect the sensor to the indicator when confirming battery strength. Always keep a *full charge* 9-volt battery in the compartment as a spare.

It is important to note that errors in measurements due to Calibration Number variation will be in direct percentage proportion to the difference *between the ideal (correct) Calibration Number for any rotor assembly and the number that the indicator displays.*
Example: If the calibration number is 186 for a particular rotor assembly and the Indicator-displayed number is 184 then the velocity error due to calibration error will be about 1%.

METHOD

To determine a reliable calibration number for your *Model 2100* perform the following: This is something you **must** do if you are working with slow flows (below about 1.5 FPS) and for measurements taken in very shallow streams.

Mark a straight course of 10 to 20 feet in length in a body of calm, current-free water along which the sensor can be towed by walking the course. A swimming pool or dock into a quiet lake serves well. Rotate the selector switch to the **COUNT** position. If the display does not show all zeros press and release **RESET**. (The decimal point does not show in the count mode.)

Place the sensor in the water a few feet before the beginning of the course, 6 to 12 inches below the surface. Make sure that the wading wand remains vertical throughout the distance traveled and that the tip of the propeller rotor faces directly into the direction of travel..Do not "crab" the rotor in the stream as you walk.

Begin walking the sensor through the course at a rate close to that which you will be measuring. If shallow flows are to be encountered try to duplicate those conditions when making calibration checks. Using the wand rather than the sensor as a guide, press and release **RESET** at the instant the wand enters the course. The indicator will begin counting the number of sensor pulses generated as you walk. At the instant the wand leaves the course press and release **START/STOP**. The display now shows (and will hold) the number of pulses generated over the course length. Several passes through the course in both directions are recommended to develop a reliable average figure. Repeat the above process as many time as necessary to establish an average for each rotor assembly you are to use.

Determine the average number of pulses generated through the course. If your course length is not 10 feet in length compute the number of pulses that the sensor would generate if the course were exactly 10 feet. This will be the CALIBRATION NUMBER that the *Model 2100* Indicator should hold for accurate measurements with that rotor assembly in feet per second:

$$\text{FEET CAL. No.} = \frac{\text{10 x AVERAGE No. OF PULSES}}{\text{COURSE LENGTH (IN FEET)}}$$

This number can then be multiplied by 3.281 (the number of feet in one meter) to determine the calibration number for meters.

Next, rotate the selector switch to the **CALIBRATE** position. Put the **FEET/METERS** switch (in battery compartment) in the "F" (FEET) position and the indicator will display the Calibration Number it presently holds for measuring in Feet Per Second. With a good battery it should be 180-186 (2" size props only). If your derived Calibration Number is different from the number displayed you can change the calibration number by using the **CAL ADJUST** screws at the bottom end of the indicator. Remove the **CAL ADJUST** cover screws (black plastic fillister-head screws). Then USING ONLY A JEWELER'S SCREWDRIVER (to prevent damage to the adjustment screw) rotate the screw clockwise to increase the displayed number and counterclockwise to decrease the number. Do the same for the Meters calibration number if necessary.

Each calibration adjustment screw is a 15-turn potentiometer with very fine resolution and plenty of latitude for normal adjustment given a full charge 9-volt battery.

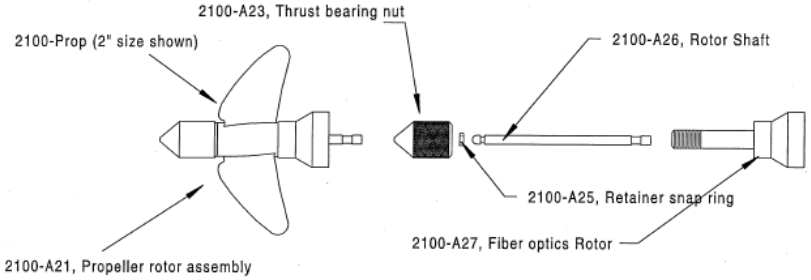
REPLACE THE ADJUSTMENT COVER SCREWS AFTER MAKING CALIBRATION CORRECTIONS. The Model 2100 INDICATOR IS NOT WATER RESISTANT WITHOUT THESE COVER SCREWS IN PLACE!

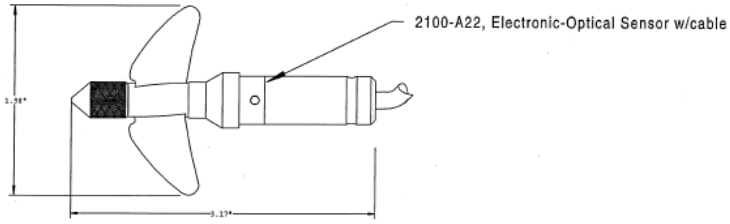
Note and store *with the Model 2100 Indicator* your new Calibration Number(s). Every time the instrument is used the calibration numbers and rotor assembly(s) that generated them should be confirmed and matched (rotate 2100 meter switch to **CALIBRATE**) before relying on readings. Also be sure to check the calibration number while the sensor is connected to the indicator to achieve maximum battery current draw.

IMPORTANT: Errors in measurements due to Calibration Number variation will be in direct percentage proportion to the difference between the ideal (correct) Calibration Number and the number that the indicator displays.

Approximate Calibration Nos.

PROP	*feet*	*meters*
2" propeller	186	610.27
3" propeller	130	426.53
1 3/8" propeller	217	711.98





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