Quartermaster Harbor Marine Hydrodynamic Study Quality Assurance Project Plan

A Targeted Watershed Grant
under the
2008 Puget Sound Initiative

August 2009

King County

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ABSTRACT

We propose to conduct a hydrodynamic study of Quartermaster Harbor (QMH) as part of a larger study – the Quartermaster Harbor Nitrogen Management Study. The expected outcomes of the hydrodynamic study are additional data and information on the tidal and density driven circulation of the harbor that will support the development, calibration, and testing of a hydrodynamic model of the harbor that will be developed as part of the larger study. The larger study is designed to evaluate the role of nitrogen in the risk of lethal, low-level dissolved oxygen events in QMH, a sensitive marine embayment of Vashon-Maury Island (VMI) in Puget Sound

1.0. INTRODUCTION

King County was awarded a West Coast Estuaries Initiative (WEI) grant by Region 10 of the U.S. Environmental Protection Agency (EPA) to conduct the Quartermaster Harbor Nitrogen Management Study. The goal of this study is to support the protection and restoration of Quartermaster Harbor (QMH)–a high value, coastal aquatic resource on Vashon-Maury Island (VMI) in Puget Sound. Partners working with King County on this grant-funded study include the University of Washington-Tacoma (UWT), and the Washington Department of Ecology (Ecology). The WEI grant will also support the enhancement of aquatic resource protection programs in an area threatened by growth pressures. This Quality Assurance Project Plan (QAPP) describes the marine hydrodynamic study planned as part of the Quartermaster Harbor Nitrogen Management Study (King County et al. 2009).

1.1 Study Need

Generally, the predictive reliability of any particular model is based on the ability of the model to accurately reproduce specific observations under a variety of conditions (NRC 2007). In the case of a model developed to provide the hydrodynamic circulation input to a water quality model, reliable predictions of tidal exchange, 2 and sometimes 3 dimensional circulation patterns and density stratification are needed. The ongoing marine monitoring program, including monthly water column sampling and high frequency sampling at fixed moorings described in the Quartermaster Harbor Nitrogen Management Study QAPP will provide salinity-temperature-density profiles along the longitudinal axis of the harbor for model calibration and testing. Pressure transducers at fixed moorings will also provide data to calibrate and test the ability of the hydrodynamic model to reproduce the amplitude and phase of tides as they pass in and out of the harbor. Although demonstrating the ability of the hydrodynamic model to accurately reproduce these observations will provide measures with which to evaluate the reliability of the calibrated model, additional hydrodynamic observations, specifically profiles of current velocity and direction would provide data that could be used to test the ability of the model to reproduce horizontal and vertical velocity distributions.

1.2 Description of Study Area

Quartermaster Harbor, located between Vashon and Maury Islands, is sheltered from the wind and waves and receives runoff from about 40 percent of Vashon-Maury Island (Figure 1). It is a shallow, protected embayment that comprises approximately 12.1 km^2 (3,000 acres) of water surface area in an inner and outer harbor. Inner QMH is especially sheltered and Judd Creek, located in the northwestern portion of the inner harbor, is the largest freshwater input. Transition zones between freshwater surface flows and the marine water within the bay include the estuaries at the mouth of Judd Creek, Fisher Creek, and Raab's Lagoon along with numerous smaller streams. Inner QMH is shallow, with a greatest depth of about 5 meters and very little tidal flushing. Outer QMH water depths range from about 11-46 meters with rapid tidal flushing.

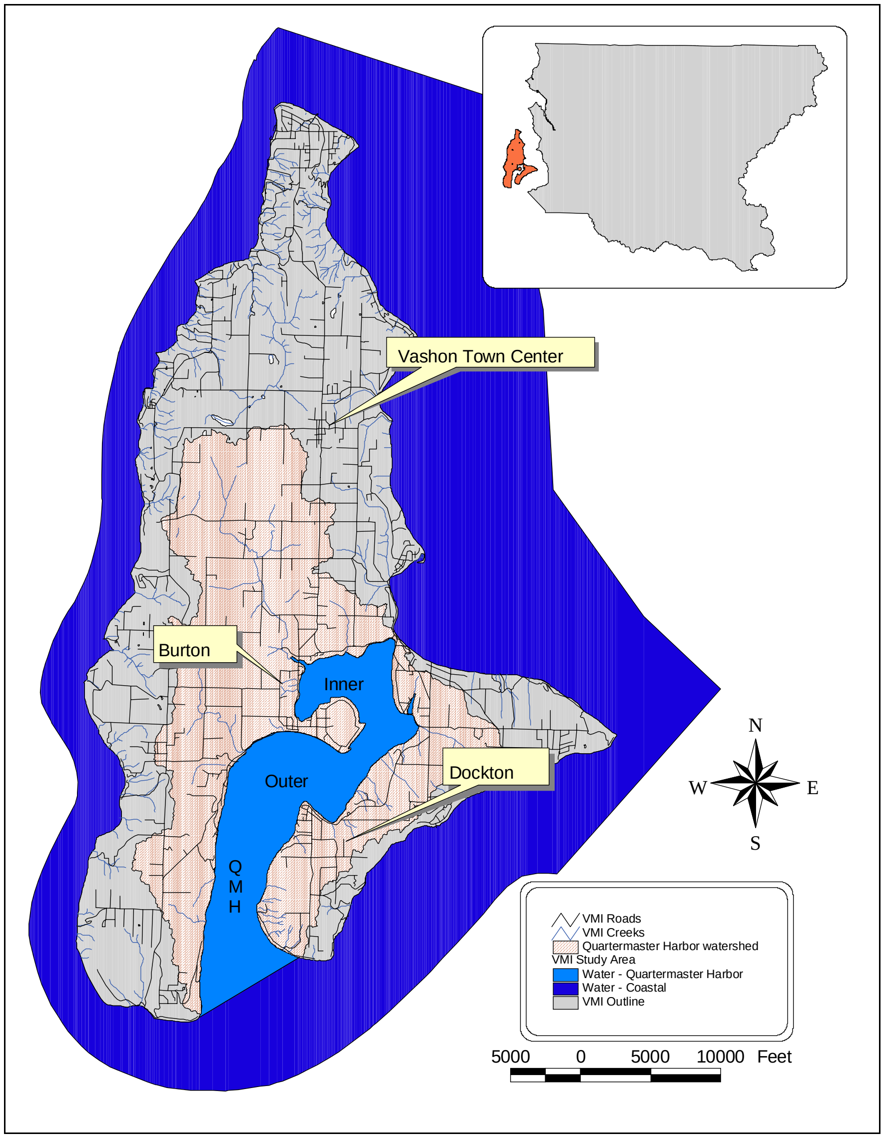

Figure 1. Map of Vashon-Maury Island highlighting the drainage area to Quartermaster Harbor. This cross-hatched area is also the study area for the Quartermaster Harbor Nitrogen Management Study.

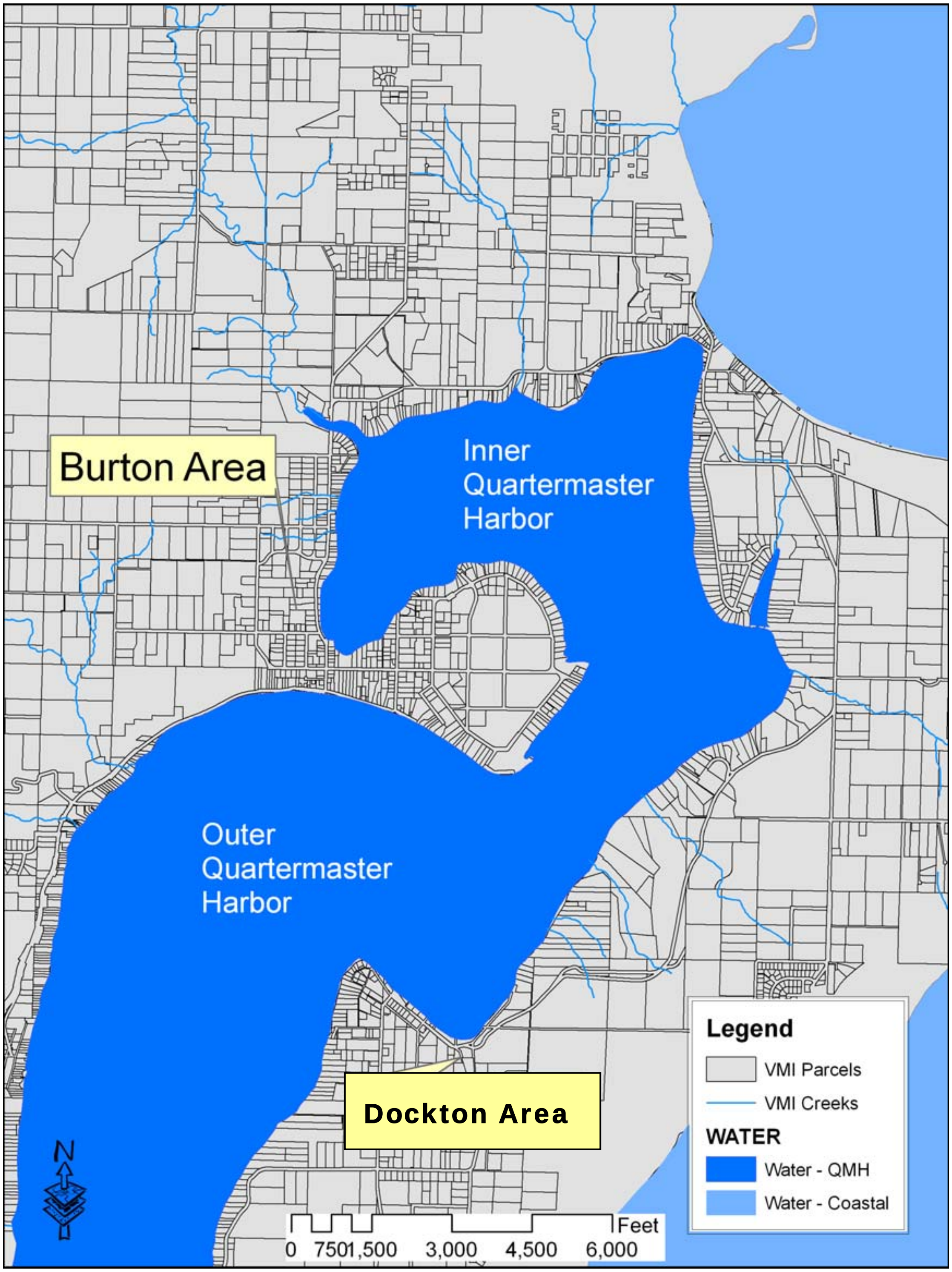

Figure 2. Map of Quartermaster Harbor showing the Burton and Dockton area. This map shows the increased density of development along the shoreline areas of Inner and Outer Quartermaster Harbor.

1.3 Historical Data Review

Quartermaster Harbor and the upland areas draining to the harbor have been the subject of water quality and quantity investigations beginning at least as far back as the early 1970s. The studies relevant to marine stratification and circulation in Quartermaster Harbor are summarized below. However, these summaries are not intended to be exhaustive. The reader is referred to the original sources for more detailed information.

Marine Park Study (University of Washington 1976)

Perhaps the most comprehensive study of QMH was conducted in the early 1970s by the University of Washington for the King County Division of Parks and Recreation (University of Washington, 1976). The study was conducted in response to public concerns over the expansion of overnight recreational boat moorage facilities at Dockton Park in QMH. The study included investigation of historical recreation patterns, land use, and environmental impacts; surficial soils and geology, landslide hazards, drain field performance, and beach forming processes; marine circulation, flushing rates, and water temperatures; marine biological conditions; magnitude and spatial extent of marine fecal contamination; and terrestrial vegetation and wildlife primarily in relation to recreational activities and values.

The University of Washington (1976) harbor circulation study was also published as a graduate study thesis by Turnbeaugh (1976). Based on a combination of physical observations–including drift drogues, velocity, direction, temperature, and salinity measurements–it appeared that the inner harbor had poorer circulation than the outer harbor with poorest circulation observed around the Burton dock and the mouth of Judd Creek. In general, current velocities and directions across the harbor changed over the course of a tidal cycle. In general, currents flowed into the harbor during the flood tide and out during the ebb tide, although a weak outward flowing counter current on the west side of the harbor entrance 2 hours after the maximum ebb tide (see Figure 3)

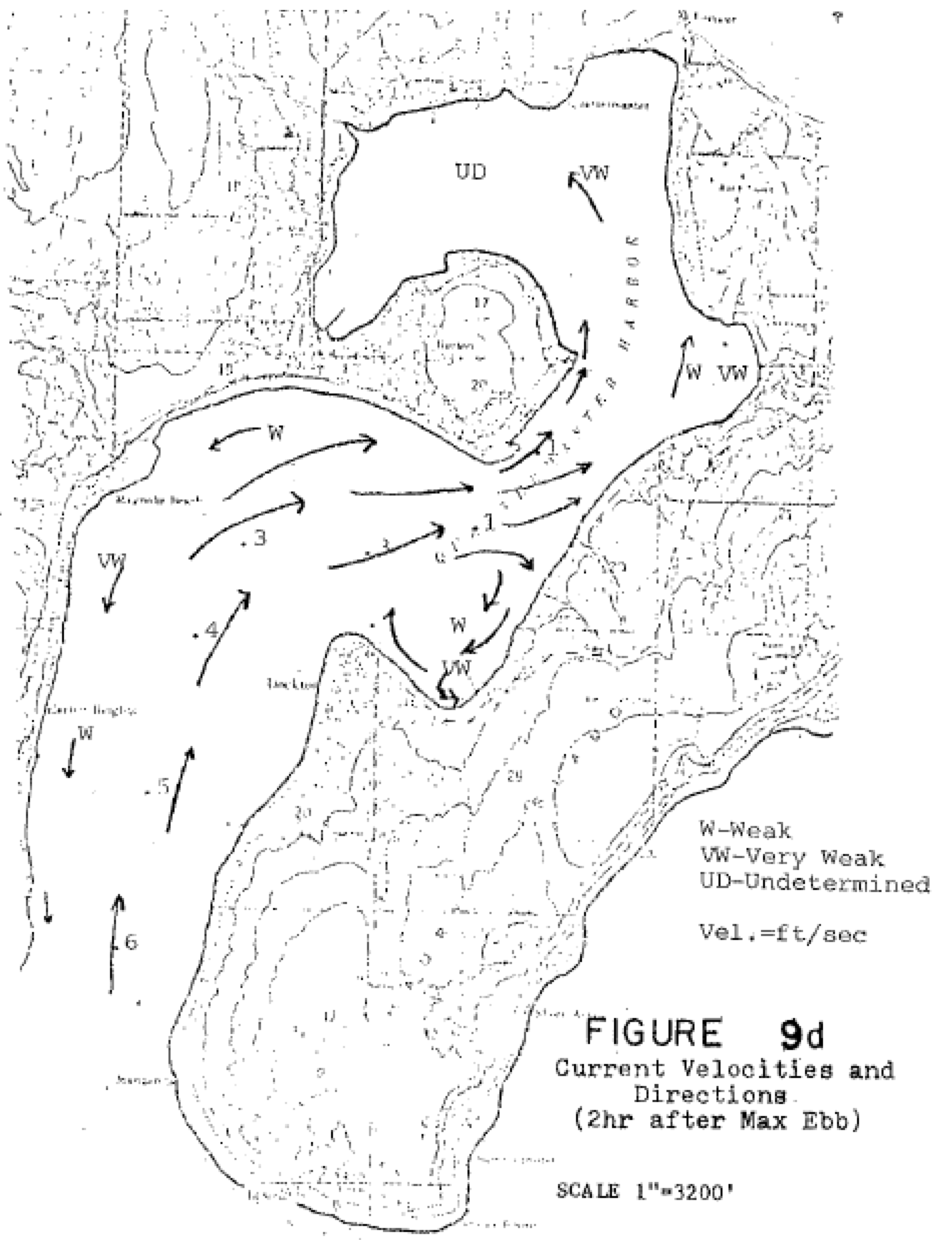

Figure 3. Map showing current velocities and directions 2 hours after maximum ebb tide in Quartermaster Harbor. Figure extracted from Turnbeagh (1976).

Washington State Department of Ecology

As part of the intergovernmental Puget Sound Assessment and Monitoring Program (PSAMP), Ecology conducts marine water quality monitoring at a number of stations in Puget Sound and along the Pacific coast in Grays Harbor and Willapa Bay. Some stations are monitored every year while some are monitored on a rotating schedule, with a total of about 40 stations monitored each year on a monthly basis. Rotating schedule stations have been located in outer Quartermaster Harbor (QMH001-Burton sampled Oct 1991-Sep 1992 and Oct 1994- Sep 1995) and in the inner harbor (QMH002-Quartermaster Harbor-Inner harbor sampled Nov 1997-Sep 1998, 2001, and 2004). Long term sampling in Puget Sound near Quartermaster Harbor has been conducted at EAP001 (East Passage SW of Three Tree Point) and CMB003 (Commencement Bay at Browns Point), both sampled approximately monthly since November 1989. Profiles of temperature, salinity, density, dissolved oxygen, light transmission, and pH are measured at 0.5 m intervals at each station. Discrete samples are also collected at various depths for laboratory analysis of fecal coliform bacteria, chlorophyll a, phaeopigment, nitrate, nitrite, ammonium, orthophosphate, and silica. Generally, discrete samples are taken at 0, 10, and 30 meter depths depending on the total depth at a particular station. Secchi disk depth is also recorded at each station. The locations of these core and rotating stations are shown in Figure 4.

Profiles of water column density, salinity, and temperature measured at Ecology's inner harbor station (QMH002) during 2004 (the most recent year for which Ecology data from Quartermaster Harbor are available) illustrate how density stratification and salinity-temperature profiles change over the course of the year (Figure 5**).** Generally, density stratification in the inner harbor is strongest during late spring and early summer when relatively cold (as compared to Puget Sound marine water) freshwater inflow to the surface of Puget Sound is greatest due to snow melt runoff from mountainous areas around the sound. Higher surface temperatures due to warm air and sunshine also contribute to greater stratification in summer. Weakest stratification occurs in fall when freshwater surface inflows are lowest. Weak stratification in fall may be a factor in the development of low dissolved oxygen levels measured at the same station during this period (Figure 6).

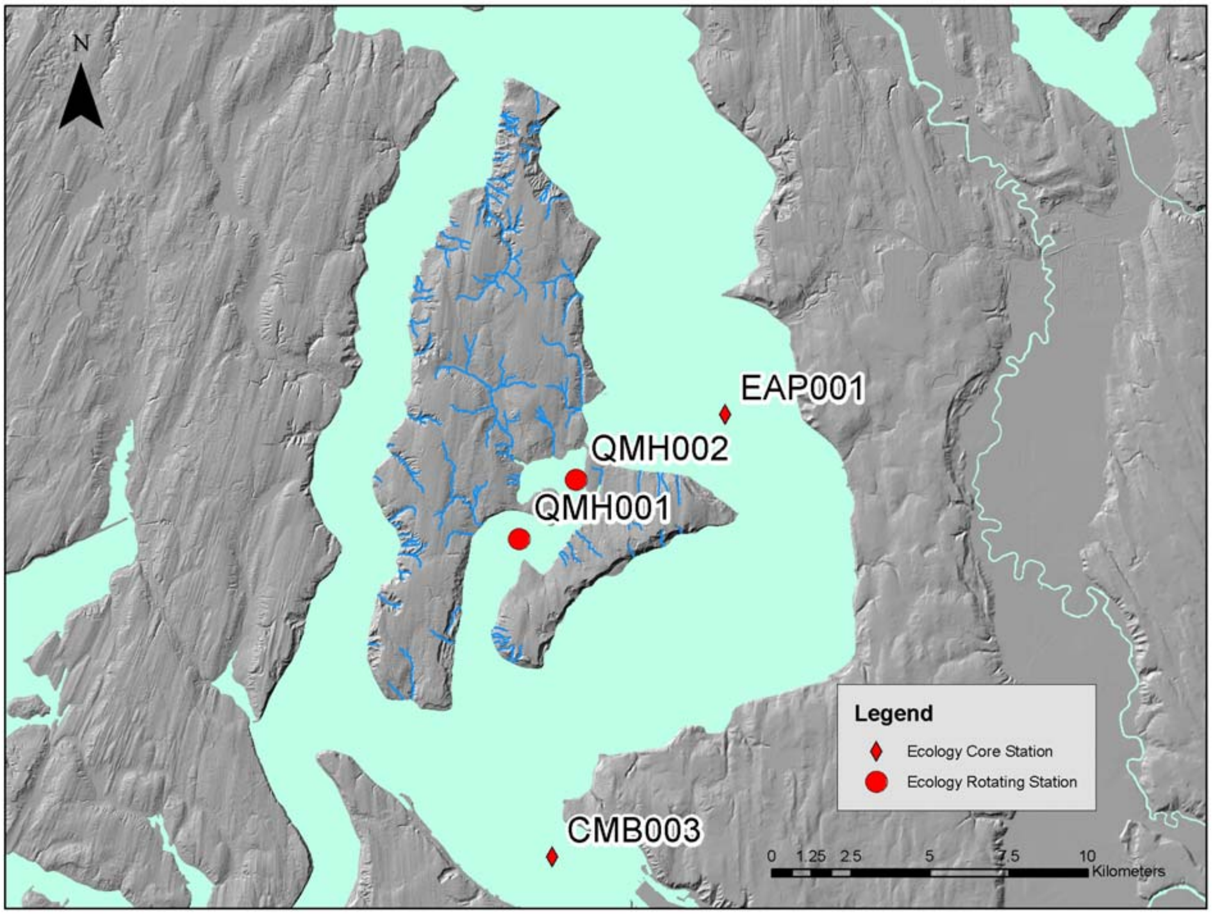

Figure 4. Map showing locations of Ecology marine monitoring locations within and near the vicinity of Quartermaster Harbor.

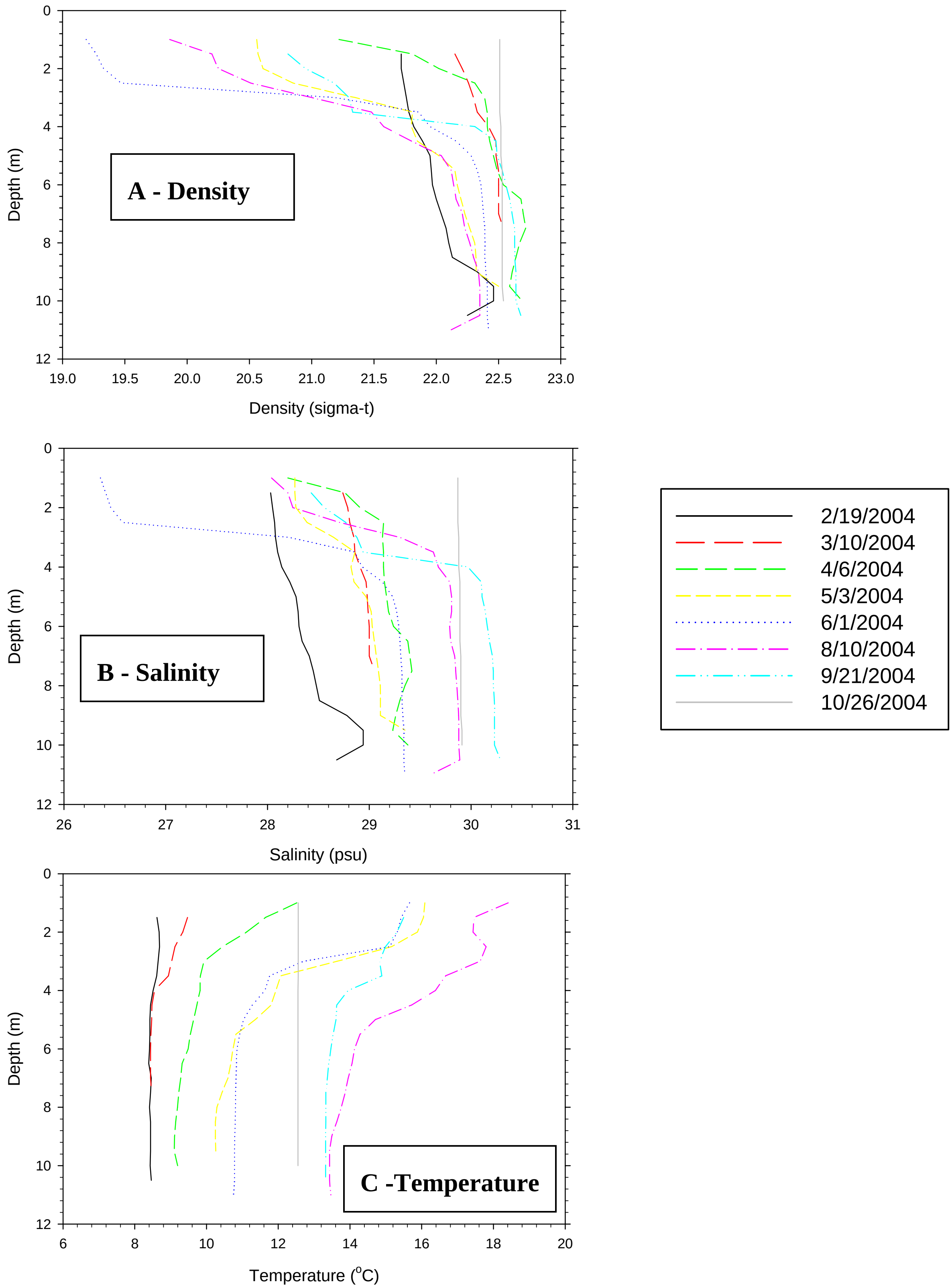

Figure 5. Graphs showing the monthly profiles of A) density, B) salinity, and C) temperature at rotating Ecology station QMH002 in Quartermaster Harbor in 2004.

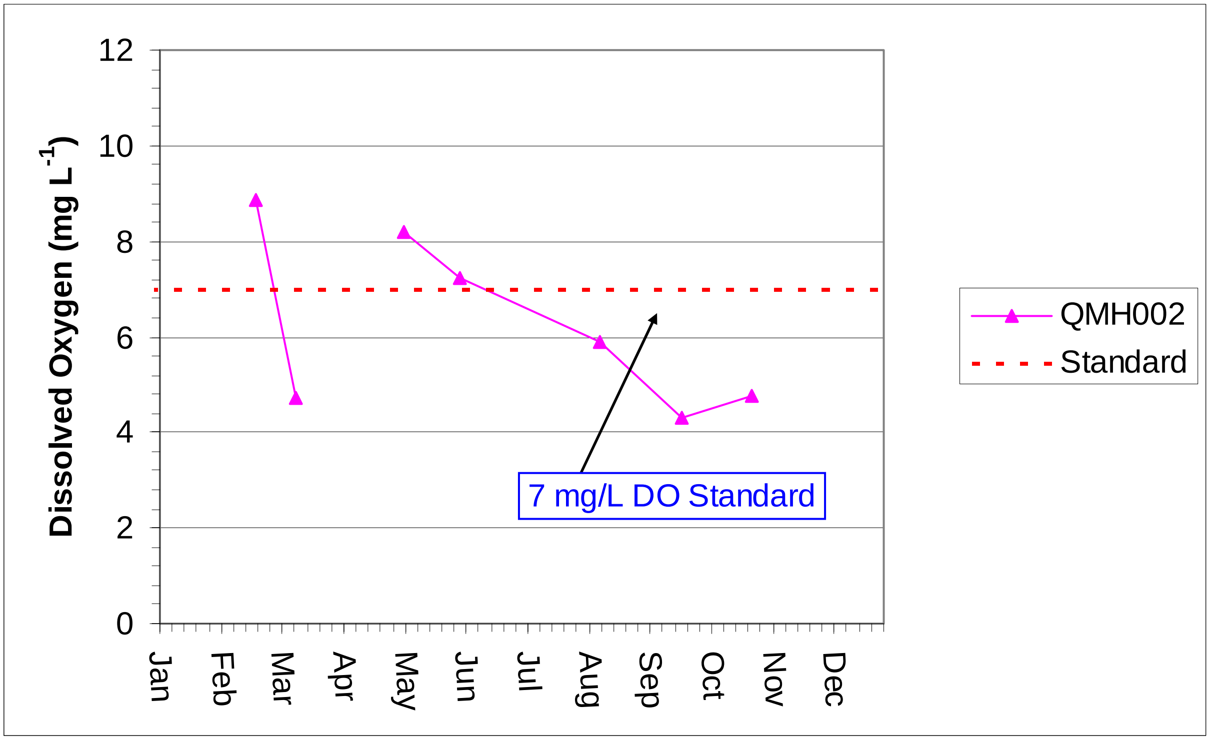

Figure 6. Graph showing the monthly discrete sampling results for dissolved oxygen at the 10-m depth for the rotating QMH002 Ecology station in Quartermaster Harbor in 2004.

King County Marine Monitoring in Quartermaster Harbor

King County's Water and Land Resources Division's Marine and Sediment Assessment Group supports a comprehensive long-term marine monitoring program that assesses water quality in the Central Puget Sound Basin on behalf of and in coordination with the King County Wastewater Treatment Division (King County, 2006). The marine monitoring program is part of the intergovernmental PSAMP effort, with the county's program focusing primarily on water quality within King County marine waters. In the last five years, sampling has been conducted by King County at four stations relevant to this study. East Passage (Station NSEX01) has been sampled since 2003 to assess physical and biological water column properties within the Central Basin. Beginning in 2006, discrete water column samples have been taken from publicly accessible docks in Quartermaster Harbor–outer harbor near Dockton (Station NSAJ02) and the inner harbor at the Quartermaster Harbor Yacht Club (Station MSWH01). Monthly discrete sampling has been conducted at these stations for fecal indicator bacteria (fecal coliform and Enterococci) and general water quality parameters (i.e., nitrate+nitrite, ammonia, total phosphorus, silica, salinity, temperature, chlorophyll, dissolved oxygen, total suspended solids (TSS), Secchi transparency, and photosynthetically active radiation [PAR]). Beginning in April 2008 through September 2008, semi-quantitative phytoplankton species composition and abundance analysis was conducted at Station MSWH01 bi-monthly during the bloom season. Beginning in April 2009, semi-quantitative phytoplankton species composition and abundance analysis will be conducted at Station NSAJ02 bi-monthly during the bloom season (April through September). General water quality parameters are collected concurrently with the phytoplankton samples.

In addition to discrete samples, water column profiles of temperature, salinity, density, dissolved oxygen, chlorophyll fluorescence, PAR, and turbidity light transmission since December 2005) have also been measured at the East Passage station (NSEX01) since 2003. An intertidal station at Burton Acres Park in the inner harbor has also been sampled monthly since 2006, but these samples are not analyzed for dissolved oxygen, turbidity, TSS, chlorophyll, salinity, Secchi, or PAR.

From December 2007 through December 2008, continuous data collection via a mooring was conducted at Station MSWH01. Dissolved oxygen, salinity, temperature, chlorophyll fluorescence, turbidity, pH, density, and meteorological data were collected every 15 minutes and telemetered to a web-based data server. In January 2008, the mooring was moved to Station NSAJ02 in order to collect data in deeper water than at Station MSWH01 (Figure 7).

A comparison of the density difference between surface and near-bottom samples collected at the inner harbor (MSWH01) and outer harbor station (NSAJ02) in 2008 support the interpretation of the Ecology data collected in Quartermaster Harbor in 2004 – i.e., that density stratification is strongest in late spring and early summer and weakest in fall and winter (Figure 8). The period of weak density stratification in late fall also coincides with low dissolved oxygen concentrations in near-bottom waters measured at these same stations in 2008 (Figure 9).

University of Washington-Tacoma

Work within Quartermaster Harbor grew out of a larger NOAA/ECOHAB study (2004-2008) with researchers from University of Washington-Seattle (UWS) and University of Washington-Tacoma (UWT) investigating the distribution of *Alexandrium catenella* (PSP causing dinoflagellate) cysts in the sediments of Puget Sound. In 2005, marine sediments were sampled, collected via short soutar cores and obtained water property data at 32 stations around Puget Sound and collected longer piston cores from 9 of these locations. In addition, in 2006, more in-depth mapping of cysts in the surface sediments of Dyes Inlet and Quartermaster Harbor was completed and investigated near bottom cyst suspension and transport over tidal cycles near the mouths of both bays using a bottom mounted turbulence meter, CTD, and timed closing bottles. The results from this work in the UWS/UWT–NOAA/ECOHAB study found two orders of magnitude higher concentration of *Alexandrium catenella* (PSP causing organism) cysts in the sediments of Quartermaster Harbor (QMH) than anywhere else in Puget Sound (Horner *et al*., 2008).

University of Washington-Tacoma staff has been collecting data on the biological, chemical, and physical characteristics of Quartermaster Harbor at seven stations since 2006 (Figure 10). Each station has a variety of data collected including Secchi disk, CTD profile, phytoplankton tow and water column samples. Additional data (temperature and salinity) are collected at a mooring in outer QMH at station 54 (Figure 10).

The data collected by UWT generally supports the patterns observed in the Ecology and King County marine monitoring (see Figure 11 and Figure 12).

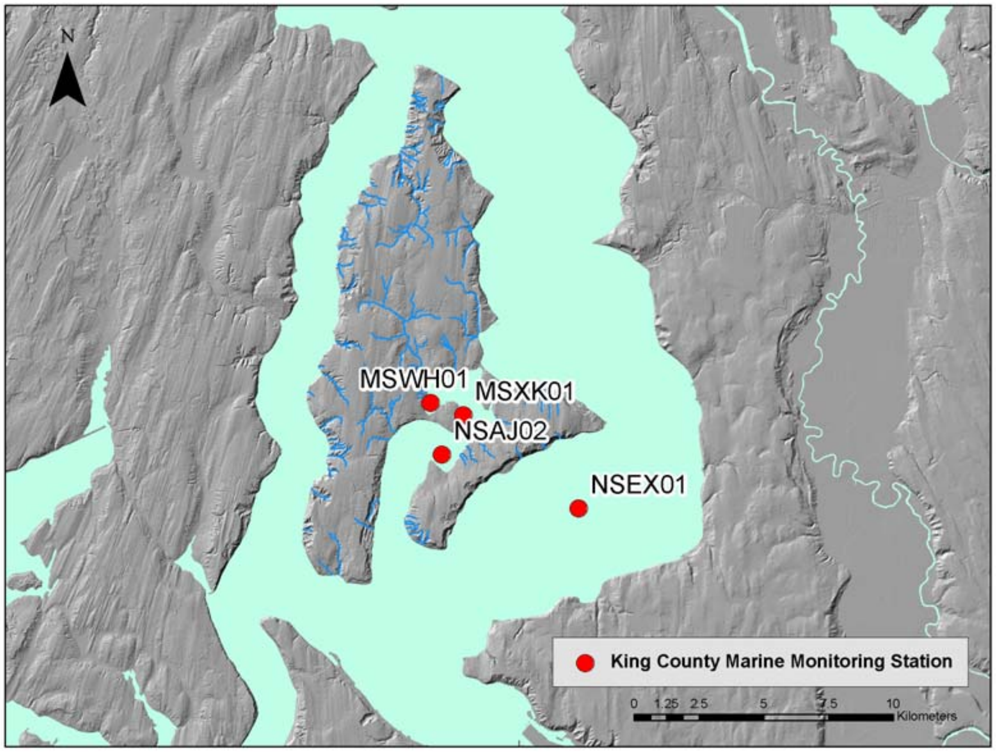

Figure 7. Map showing the King County monthly marine monitoring stations in Quartermaster Harbor and East Passage.

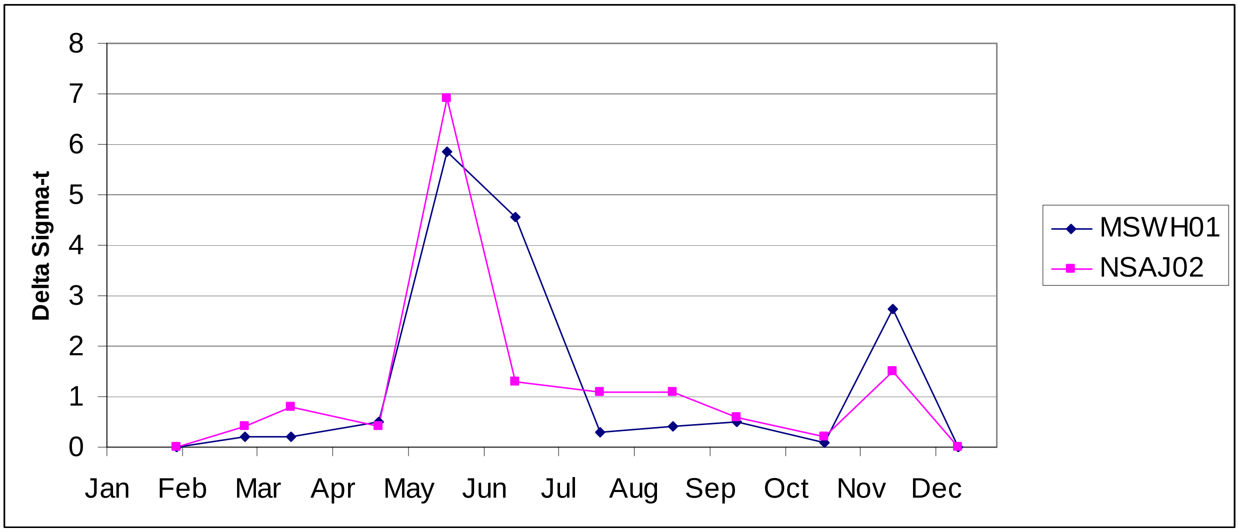

Figure 8. Graph showing the monthly difference in density between samples collected from the surface (1-m depth) and near bottom in 2008 for the two King County stations in Quartermaster Harbor.

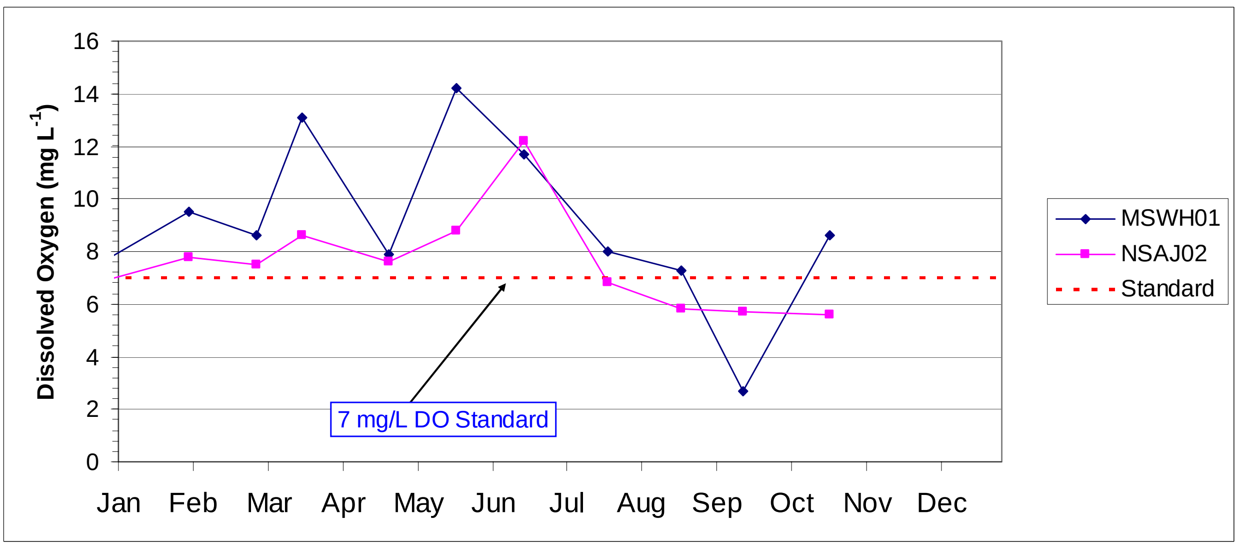

Figure 9. Graph showing the monthly discrete sampling results for dissolved oxygen at the 4 to 9-m depth for the two King County stations in Quartermaster Harbor.

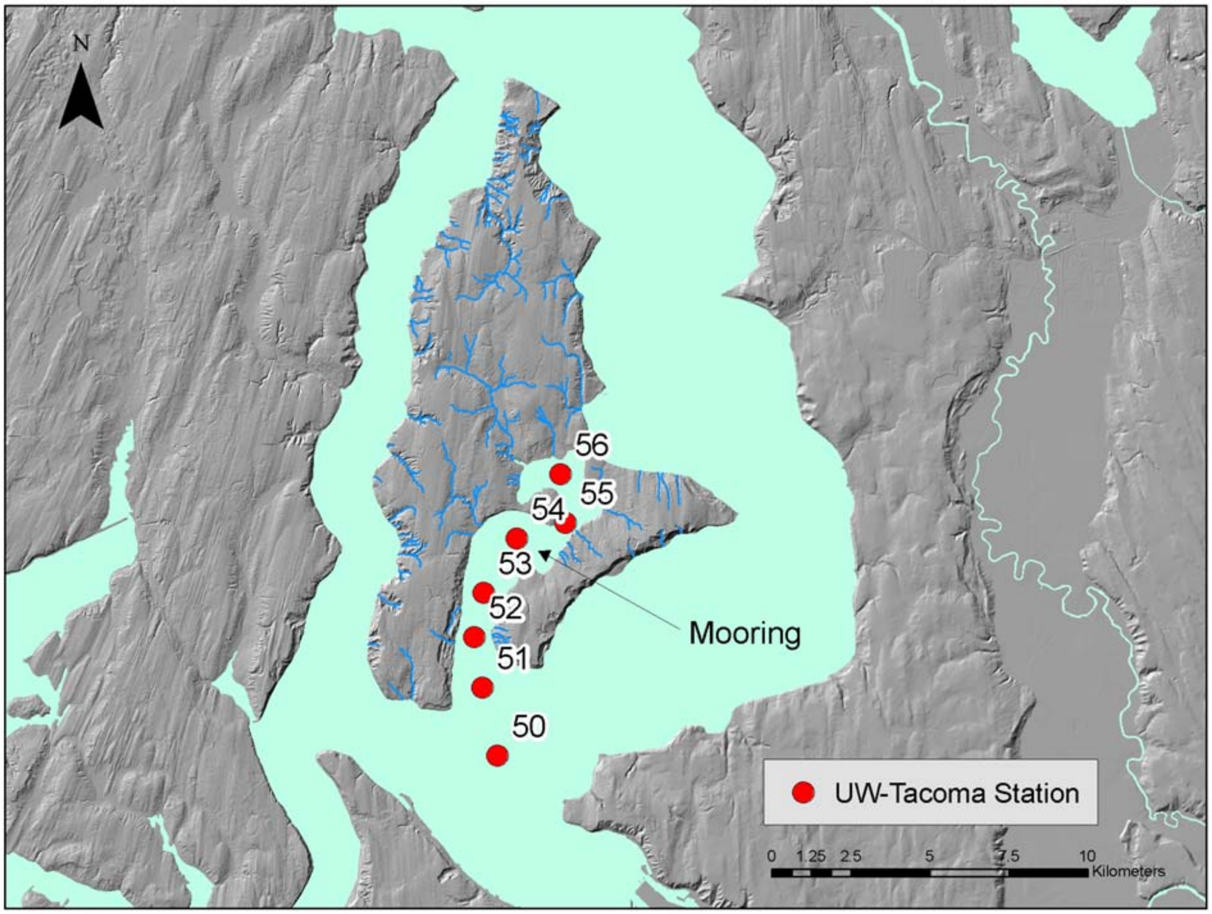

Figure 10. Map showing the University of Washington-Tacoma Quartermaster Harbor monthly marine monitoring stations.

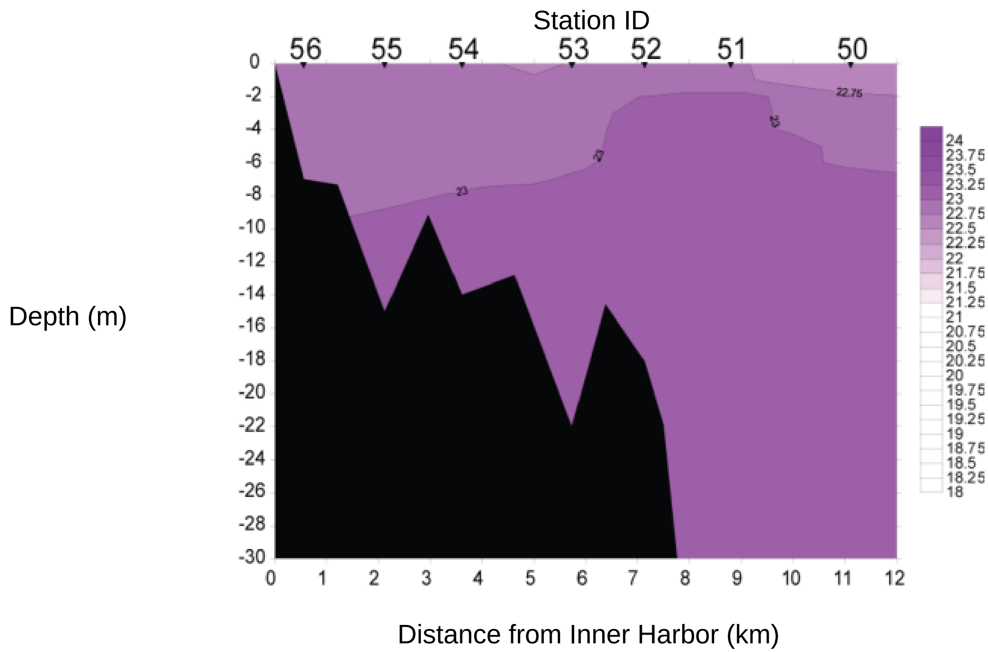

Figure 11. Graph showing contours of density (Sigma-t) along the centerline of Quartermaster Harbor defined by five stations profiled by UWT May 5, 2006.

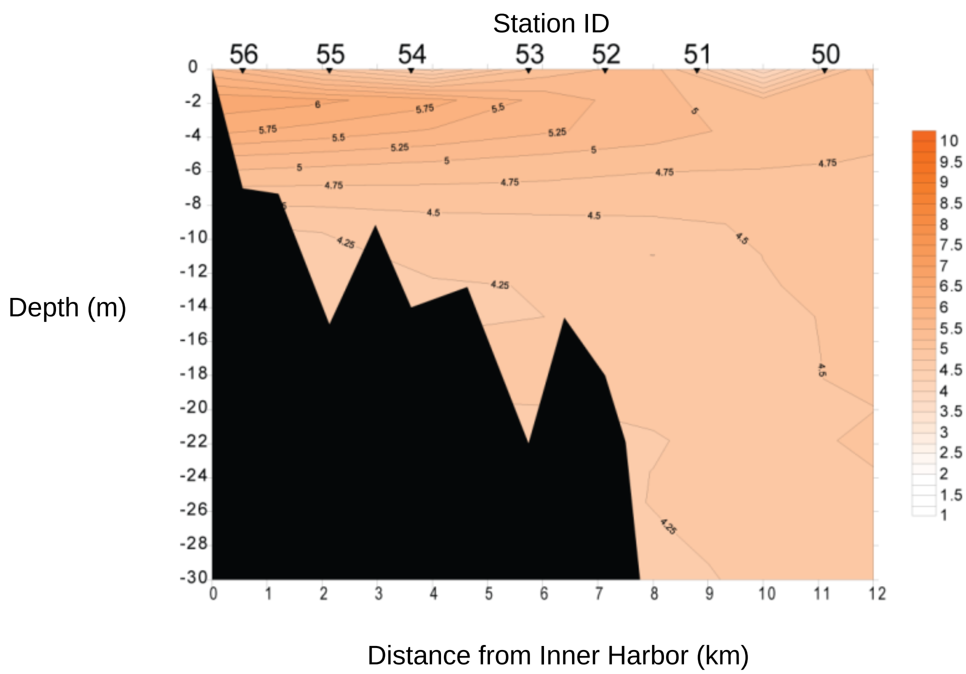

Figure 12. Graph showing contours of dissolved oxygen (mg/L) along the centerline of Quartermaster Harbor defined by five stations profiled by UWT May 5, 2006.

King County Vashon-Maury Island Water Resources Evaluation

King County's Water and Land Resources Division has been monitoring groundwater on VMI since 2001. These activities were initiated in support of the development of the Vashon-Maury Island Watershed Plan (King County 2005). In 2004, King County created an island-wide water resources project, the Vashon-Maury Island Water Resource Evaluation (WRE), to assess the status of groundwater on VMI. As part of this project, water quality and water quantity is being monitored at seven stream locations throughout the island. Three of these stream monitoring locations provide information regarding the quantity and quality of fresh surface water inputs to Quartermaster Harbor (Figure 13). Judd Creek and Fisher Creek are the largest tributary inputs to Quartermaster Harbor. These two tributaries are monitored continuously (15-minute intervals) for flow and water temperature. Mileta Creek, a smaller tributary to the harbor, is monitored monthly (grab samples) for water quality, including temperature. Figures of daily average flow (Figure 14) and temperature (Figure 15) in Judd Creek and Fisher Creek in 2008 indicate that fresh surface water inflows are generally at their lowest in late summer and fall and water temperatures are declining from a maximum daily average of about 15 ^{o}C in mid-summer.

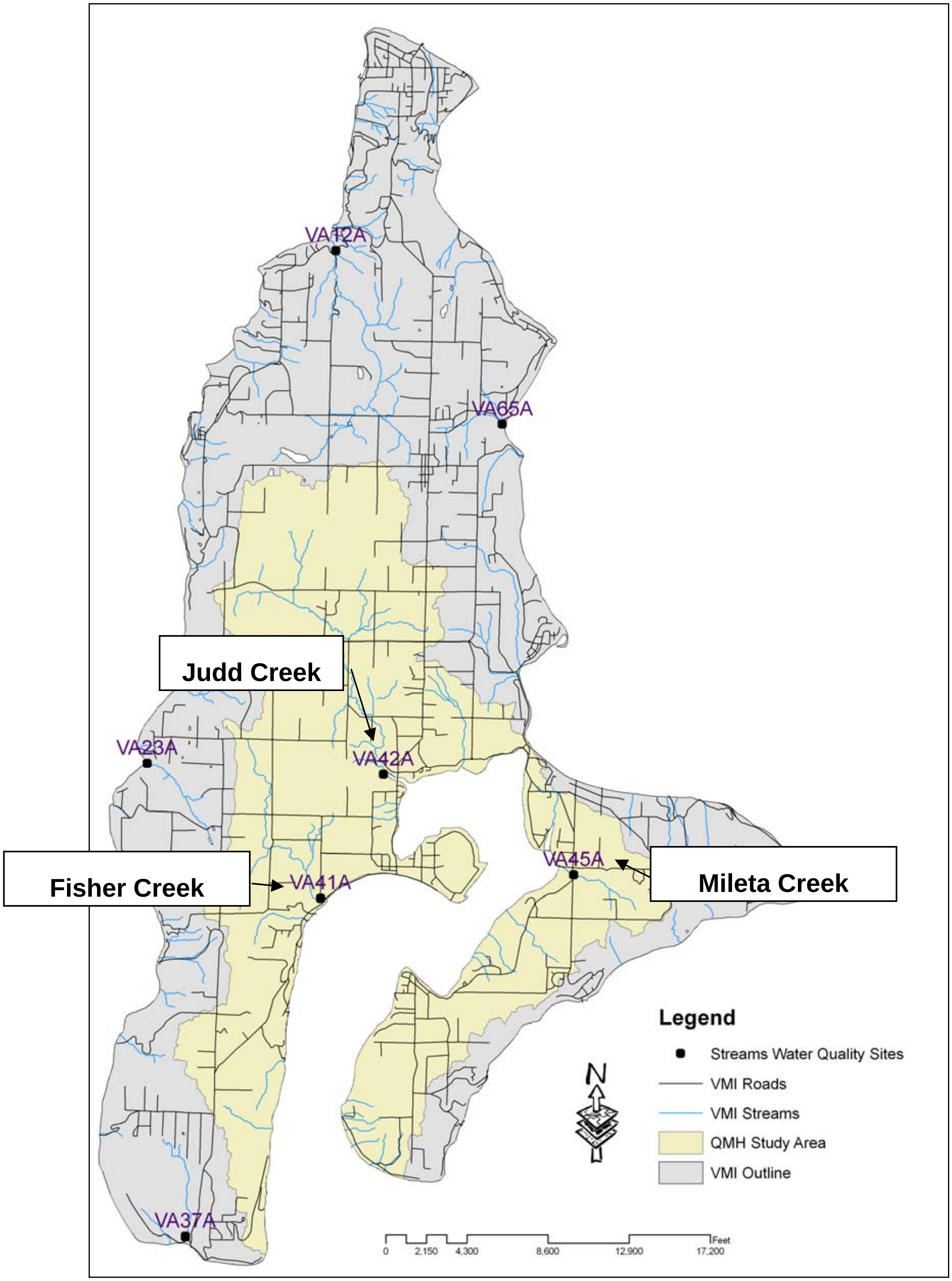

Figure 13. Stream water quality monitoring locations on Vashon-Maury Island.

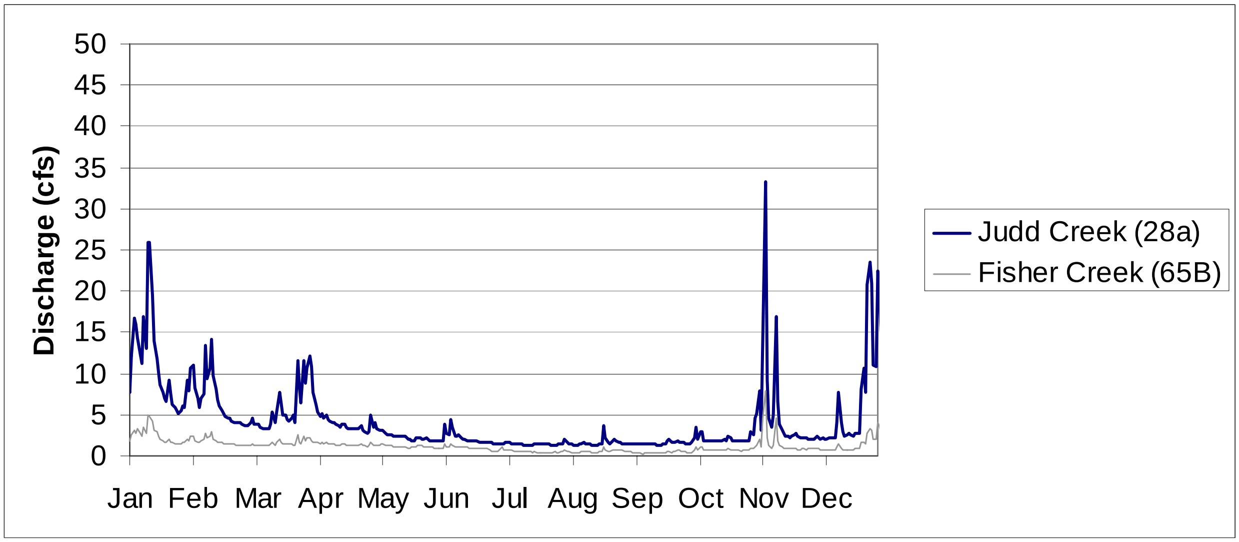

Figure 14. Daily average discharge measured near the mouth of Judd Creek and Fisher Creek in 2008.

Figure 15. Daily average water temperature observed in Judd Creek and Fisher Creek in 2008.

2.0. STUDY GOAL AND OBJECTIVES

2.1 Study Goal

The purpose of this study is to collect profiles of current velocity and direction in Quartermaster Harbor over a complete lunar tidal cycle during critical conditions in Quartermaster Harbor for hydrodynamic model calibration and testing. A transect consisting of four bottom-mounted acoustic Doppler current profilers is designed to provide an estimate of estuarine exchange between outer Quartermaster Harbor and the main basin of Puget Sound outside the harbor entrance. The expected outcome is increased confidence in hydrodynamic (and presumably water quality) model performance and reliability.

2.2 Project Management and Oversight

This study will be managed by King County and includes collaborators from the UW-T, Ecology, and the Groundwater Protection Committee. Although no formal technical advisory committee has been formed, this QAPP and products resulting from this study will be reviewed by the project team and technical reviewers assigned by EPA Region 10, primarily the EPA Project Monitor assigned to this grant.

3.0. PROJECT DESIGN

Acoustic Doppler Current Profilers (ADCPs) will be used to determine the current velocity and direction profiles along a transect across Outer Quartermaster Harbor. Four bottom-mounted ADCPs will be deployed in a transect across outer Quartermaster Harbor that is roughly perpendicular to the predominant flow direction for 30 days during the critical, late-summer conditions when dissolved oxygen levels are lowest. The proposed locations of these current meters is shown in Figure 16. Station descriptions, proposed coordinates, and instrumentation at each site are summarized in Table 1.

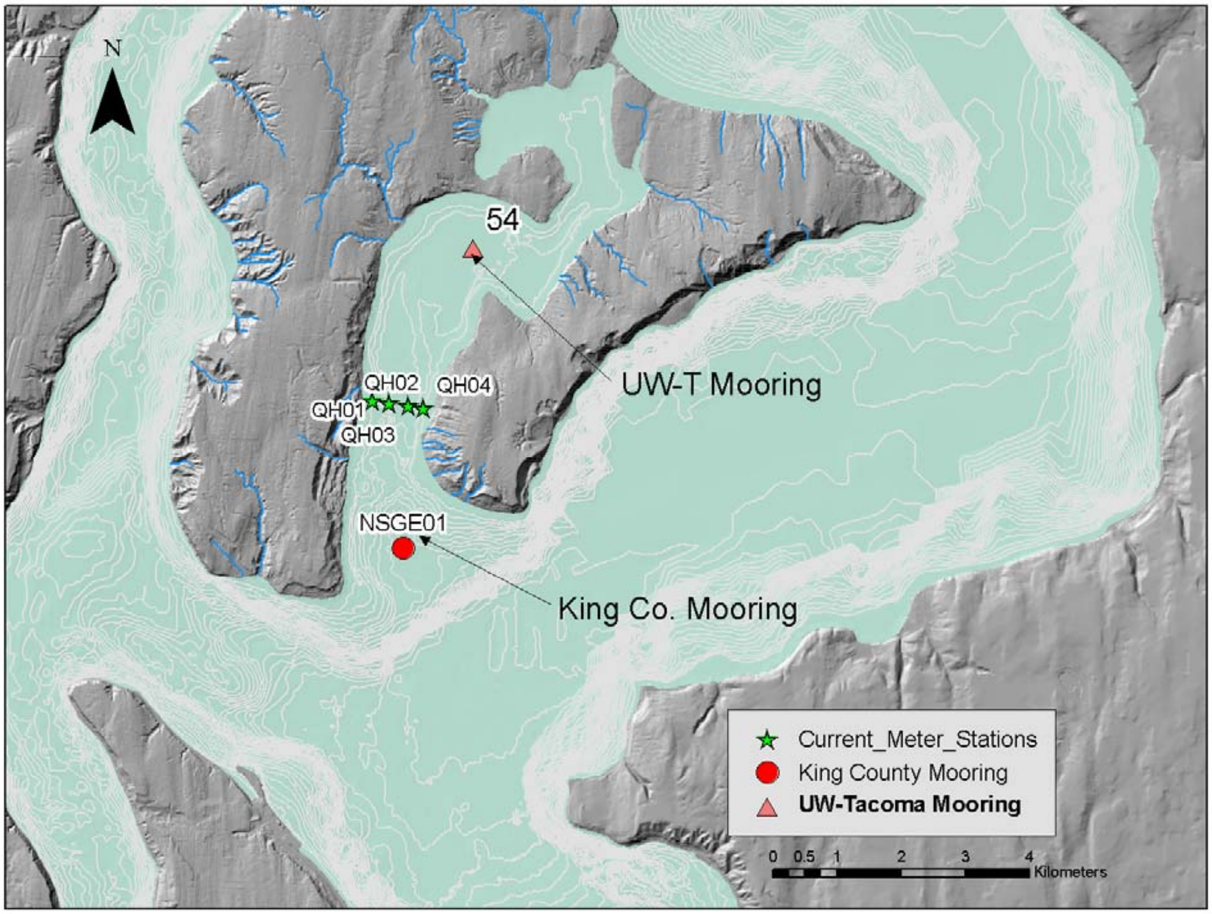

Figure 16. Map showing proposed locations of bottom-mounted Acoustic Doppler Current Profilers.

Table 1 Proposed station locations and instrumentation. Note proposed station coordinates may change slightly depending on site conditions encountered during deployment.

Station ID	Station Description	Approximate Depth in meters (feet)	Washington State Plan Coordinates in feet (Easting/Northing)	Instrumentation
QH01	Near western shoreline across outer harbor	6 (20)	1230773 / 135207	Sontek 1500 kHz
QH02	West side of main channel of outer harbor	11 (36)	1231607 / 135099	RDI Sentinel Workhorse 300 kHz
QH03	East side of main channel of outer harbor	16 (53)	1232575 / 134965	
QH04	Near eastern shoreline across outer harbor	6 (20)	1233355 / 134830	Sontek 1500 kHz

4.0. QUALITY OBJECTIVES

There are two types of quality objectives that need to be identified: Measurement Quality Objectives (MQOs) and Data Quality Objectives (DQOs). MQOs are "'acceptance criteria' for the quality attributes measured by project data quality indicators. They are quantitative measures of performance…" (USEPA, 2002). MQOs are the targets for precision, bias, and sensitivity against which QC results are compared. Precision is assessed from the results of replicate analyses of samples and standards. Bias is assessed from blanks and check standards and compared to their expected values. Sensitivity is related to the detection and reporting limits for the measurement method used. DQOs are needed in projects where the results are compared to a standard or used to select between two alternative conditions.

4.1 Measurement Quality Objectives

Field measurement objectives are difficult to establish because replicate samples cannot be calculated for ADCP deployments. Bias is not an applicable measure. The lowest value of interest is 0.05 m/s.

4.1.1 Precision, Accuracy and Bias

Accuracy is a measure of confidence in the data. The smaller the difference between the measurement and the "true" value, the more accurate the results. The pattern of these differences (typically higher or lower) indicate the amount of bias in the results. Results with high precision and low bias are more accurate than results with high bias and precision or high bias and low precision. Results may still be accurate if they have low bias and precision, but there will tend to be a random scatter of results around the true value. It is difficult to independently evaluate the precision, accuracy, and bias of data collected with these types of field instruments. Precision, accuracy, and bias will be determined primarily by the specifications of the instruments used in this study and care in following the manufacturer's recommended procedures for instrument calibration, programming, and deployment. Table 2 provides the manufacturers information on the precision, accuracy, and response time of the RDI Sentinel Workhorse ADCPs selected for use in this program.

Table 2 Manufacturer's specifications for the RD Instruments (RDI) Sentinel Workhorse Acoustic Doppler Current Profiler (ADCP) – 300 kHz model

Vertical Resolution (m)	Range (m) [a]	Std. Dev. (cm/s) [b]	
1 m	91 – 71	12.8	
2 m	102 – 78	6.1	

[a] Profiling range based on temperature values at 5 ^{o}C and 20 ^{o}C, salinity = 35 ppt

[b] Broadband mode single-ping standard deviation (Std. Dev.)

Velocity accuracy: 0.5 % of the water velocity relative to the ADCP ±0.3 cm/s.

Velocity resolution: 0.1 cm/s

Another, sometimes neglected, consideration for accuracy are the clock times of the computers used to set the field instrument clocks and the accurate documentation and tracking of either Pacific Standard or Pacific Daylight Time as the starting time when the field instrument is launched. All computers used to synchronize current meter clocks will be logged into the network and synchronized with local network time in the morning prior to launching and setting ADCP and pressure transducer clocks. The computer time will also be checked against atomic clock time (e.g., http://tycho.usno.navy.mil/cgi-bin/timer.pl) to verify that the computer clock displays the correct local time. Therefore, data files will be recorded in Pacific Daylight or Pacific Standard Time (PDT or PST) depending on the time of deployment. Strict adherence to these protocols will ensure that the ADCP and pressure transducer clocks are accurate to within a minute of local time over the course of a deployment.

4.1.2 Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represent a characteristic of a population, parameter variations at the sampling point or an environmental condition. This study is designed to collect data that adequately represents the current velocity at key locations during the most critical period. ADCPs will be deployed at stations with predetermined coordinates and sampling depths to represent specific site conditions, both compared to other locations and at each location over time.

4.1.3 Completeness

Completeness is defined as the total number of samples analyzed for which acceptable analytical data are generated, compared to the total number of samples submitted for analysis. Sampling at stations with known position coordinates in favorable conditions, along with adherence to standardized instrument setup and calibration procedures will aid in providing a complete set of data for this project. The goal for completeness is 100%. If 100% completeness is not achieved, the project team will evaluate if the data quality objectives can still be met or if additional samples may need to be collected and analyzed.

4.1.4 Comparability

Comparability is a qualitative parameter expressing the confidence with which one data set can be compared with another. This goal is achieved through using the same or very similar equipment, equipment setup, and calibration to collect representative samples, along with standardized data validation and reporting procedures. ADCPs used in the study will have the same or very similar technical specifications and will be set up and calibrated in a consistent manner to ensure comparability of the data among stations.

5.0. SAMPLING PROCEDURES

Appendix A includes instructions for the setup and deployment of ADCPs. The King County Standard Operating Procedures for current meter setup and deployment will also be followed (King County 2007). Two Workhorse Sentinel ADCPs (Teledyne RD Instruments - RDI) operating at a frequency of 300 kHz and two Sontek ADCPs operating at 1500 kHz will be used. The units will record 1.5 minutes of pings that will be ensemble averaged and saved at 6-minute intervals. The dopplers will be programmed for a quarter-meter bin distance and the number of pings shall be set so the expected velocity error is less than 0.8 cm/sec.

6.0. QUALITY ASSURANCE AND CONTROL

Quality assurance and control will be provided by project manager oversight, project staff training, and adherence to standard operating procedures referenced previously. Maintenance schedules, calibration schedules, and deployment instructions will be followed for all ADCPs.

7.0. DATA MANAGEMENT PROCEDURES

File naming conventions will identify the instrument, location, and sample date in the filename:

IIILLLDDDD.*

Where:

III = instrument name RDI=Teledyne RD Instruments Sentinel Workhorse 300 kHz Doppler

LLLL = Station for single sample or water body if multiple stations are recorded in a single file.

DDDD = Day file was downloaded from instrument yymmdd

For example,

RDIQH01091023.*

ADCP data will be downloaded from the proprietary ADCP proprietary binary files using Matlab code written by Ecology to interface with the proprietary ADCP software. The velocity vector components (x,y,z) at each station depth and the pressure transducer data from each station will be stored in an Access database. Supplemental field information will be recorded in field notebooks and transferred to the Access database.

The Project Manager will provide supervision of all data acquisition and management activities.

8.0. AUDITS AND REPORTS

A quality assurance assessment will be conducted prior to using the data for analysis, and the results will be included in the final report for this project.

9.0. DATA VALIDATION

Data validation is critical in the evaluation of how well instrument data meet project DQOs. During data processing, data will be critically reviewed by a qualified oceanographer to identify suspect data. Results that are suspect will be evaluated to determine appropriate corrective actions. Issues identified and any corrective action will be documented in reports associated with the use of these data in Quartermaster Harbor Nitrogen Management Study work products.

10.0. DATA ANALYSIS AND USE

The data will be analyzed using standard filtering and averaging techniques as appropriate to understand relationships between harbor circulation and the significant factors that influence observed circulation (e.g., freshwater inflow, tides, and wind). The usability of the data will be confirmed by comparing the model forced by the factors that drive harbor circulation to the ADCP observations.

In general, data processing steps prior to more detailed analysis will include removal of near-surface data compromised by sound reflection from the water surface and filtering out data based on signal-to-noise or a signal standard deviation threshold. Based on final instrument settings and resulting raw data, acceptable thresholds will be set for these parameters to separate acceptable from unacceptable data.

10.1 Reconciliation with User Requirements

Reports generated for this study will include identification of any data limitations determined through application of the Data Quality Objectives described in this project plan. This information will be communicated initially through annual project reports and will be mirrored in subsequent project reports that rely on data with known limitations, including, but not limited to, modeling reports and reports containing recommended updates to decision makers that update the King County Comprehensive Plan.

11.0. ORGANIZATION AND SCHEDULE

11.1 Project Staff list and roles

The project involves staff from King County Departments of Natural Resources and Parks (DNRP, including the King County Environmental Lab, KCEL) in collaboration with the UWT Environmental Science program, Washington Dept. of Ecology's Marine Monitoring Unit and the Vashon-Maury Island Groundwater Protection Committee. Detailed roles and responsibilities are:

Core Project Team:

Curtis DeGasperi–King County DNRP - Project Manager - responsible for: (1) supervising project implementation; (2) coordinating and tracking work, budgets and personnel; (3) preparing and presenting presentations and written reports; and team member for all surface water activities. Curtis will also assist with the selection and development of watershed and QMH water quality models.

Eric Ferguson–King County DNRP–Core Team Member–Lead team member for all groundwater related activities; developing and implementing project database and assist project manager as directed in all facets of project implementation. Conduct groundwater monitoring field work and deliver samples to KCEL for laboratory analysis.

Kimberle Stark–King County DNRP–Core Team Member - Lead team member for all marine water related activities.

Laurence Stockton–King County DNRP–Core Team Member–Lead team member in the development of policy and management recommendations and public outreach and communication activities.

Extended Project Team:

King County Environmental Laboratory (KCEL)–Deploy and maintain King County marine moorings and associated meteorological stations and conduct King County monthly marine ambient monitoring at QMH sub-tidal and inter-tidal stations.

King County Environmental Laboratory (KCEL)–Conduct King County monthly stream water quality monitoring on VMI and deliver samples to KCEL for laboratory analysis.

King County DNRP Hydrologic Monitoring Support–Maintain stream gauges and continuous temperature monitoring equipment as well as land-based precipitation and meteorological observation stations on VMI.

Cooperators:

Dr. Cheryl Greengrove–University of Washington -Tacoma–Dr. Greengrove and her staff and students will provide oceanographic instrumentation, scientific expertise, and conduct marine sampling activities in QMH to augment existing data sets and fill data gaps for nutrient and dissolved oxygen for model ground truthing and assist in presenting results at scientific meetings, in reports and papers.

Skip Albertson - Washington Department of Ecology (Ecology) - Ecology staff will assist with model selection and develop model selected to simulate the hydrodynamics of QMH. Skip will also collaborate on the coupling of the modeled hydrodynamics into the model selected and developed to simulate the effects of N-loadings on dissolved oxygen within QMH in current and BMP scenario conditions.

Vashon-Maury Island Groundwater Protection Committee (GWPC)–Committee members will facilitate public outreach on VMI, assist in developing Best Management Practices and policy recommendations.

11.2 Major Activities and Timelines

Field work will be conducted sometime between August and October 2009. Instruments and moorings will be calibrated, tested, and prepared prior to field deployment. Field work will entail the deployment of 4 bottom mounted ADCPs in Quartermaster Harbor at the locations specified above. These moorings will be retrieved approximately 30 days later. Initial data processing and analysis will be conducted within 1 week of retrieval to verify that usable data were collected. A summary of the data will be included in the annual water quality report (2009) prepared for the Quartermaster Harbor Nutrient Management Study (King County et al. 2009).

12.0. REFERENCES

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Appendix A. ADCP Deployment Standard Operating Procedures

ADCPs use a face seal because Teledyne RD Instruments at the old box seals failed more. Be careful!

To change the batteries, open the back of the ADCP (away from the heads). Be sure to add desiccant. Don't remove the back until you have identified beam 3 on the casing, so that you can put it back together the same way!

If you flip beam 3 so that it is to your right when you remove the back, mount the battery so that the white ponytail (and often the degauss sticker) are to your left. Feed the white ponytail through the rubber band on the battery pack so that it is taut (and feeds through from the left).

Add the backing plate, washers, and then wing nuts (to hand tight). Attach the desiccant with a rubber band wound around the wing nuts so that it does not get loose and touch the circuit board.

Re-grease the o-ring with Dow Corning 111 valve lubricant and sealant (or equivalent) silicone grease. Be sparing and remove all particles of sand or dirt.

Add the bolts so the nuts face the inside, and the bolt heads project toward the end or ends. Put one washer under the head of each bolt and two under the nut.

Plan your deployment with PlanADCP (see www.rdinstruments.com for details).

Calibrate the ADCP with a degaussed battery set in the open meadow away from cars.

Lazy Susan operator –

1) Brush the heads in order 1-2-3-4.

2) Rotate flat, 360 degrees on primary axis.

3) Rotate pitch/roll – lift by 10 – 20 degrees up on side 3, 360 degrees on primary axis.

4) Rotate roll/pitch – lift by 10-20 degrees up on adjacent side, 360 degrees on primary axis.

5) Final rotation – not as critical. Rotate somewhere between (and not as much), 360 degrees on primary axis.

Program the ADCP and start it now (okay to run it out of the water) if you are going to deploy it tomorrow. That saves the trouble of taking a laptop into the field.