Quality Assurance Project Plan:
Discovery Bay Olympia Oyster Restoration Project

July 2020

Prepared for: WA Department of Ecology
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Each study conducted for the EPA using National Estuary Program funds must have an approved Quality Assurance Project Plan (QAPP) describing the objectives of the study and the procedures to be followed to achieve those objectives. The plan and final reports for this project will be available on the Jefferson MRC's website and in the annual reports. Neither document necessarily reflects the views and policies of the EPA, nor does mention of trade names or commercial products constitute endorsement or recommendation for use. This QAPP is valid through July 2025.

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1.0 Abstract

The Olympia oyster (*Ostrea lurida)* is the only native oyster of the North American Pacific Coast and once thrived in coves, inlets and other protected tidelands in the Puget Sound. By the turn of the 20th century, a combination of overharvesting, pollution and non-native oyster cultivation led to a population collapse of the Olympia oyster. The Discovery Bay population is identified in the Washington State Department of Fish & Wildlife (WDFW) Olympia Oyster Recovery Plan (Blake and Bradbury 2012) as one of 19 populations targeted for enhancement or recovery. This bay hosts a small but healthy natural Olympia oyster population concentrated near its southwest shore. The Jefferson County Marine Resources Committee (MRC) has been involved with this population since 2002, assisting with surveys and assessments of test plots in the area in partnership with the Puget Sound Restoration Fund (PSRF), and has actively worked on restoration since 2014. This Quality Assurance Project Plan (QAPP) serves as a guide to expand the density and abundance of a small, self-sustaining population, to monitor biological data, quantify ecological parameters, evaluate restoration success, and facilitate adaptive management practices.

2.0 Background

2.1 Introduction and Problem Statement

There are seven Marine Resources Committees (MRCs) in the counties of northern Puget Sound created in 1998 when Congress authorized the Northwest Straits Marine Conservation Initiative. This initiative resulted from the 1998 Murray-Metcalf Northwest Straits Citizens Advisory Commission Report. The MRCs were created to provide local, broad-based, bottom-up input to the Northwest Straits Commission (NWSC) and affiliated county governments.

The Olympia oyster (*Ostrea lurida*), Washington's only native oyster, forms three-dimensional biogenic habitat that supports fish, invertebrates and other marine organisms (Blake and Bradbury 2012). Olympia oysters once thrived in coves, inlets and other protected tidelands across the Puget Sound. Now, less than 4% of the historical population exists due to overharvesting, pollution, and non-native oyster cultivation (PSRF 2012).

To restore Olympia oyster beds throughout Puget Sound, the Washington Department of Fish and Wildlife (WDFW) identified 19 priority waterbodies with a high likelihood of successful Olympia oyster restoration (Blake and Bradbury 2012). Three broad geographic areas in Jefferson County were identified as having suitable conditions for Olympia oyster restoration:

1. Discovery Bay
2. Kilisut Harbor
3. Quilcene Bay

The Jefferson County MRC, in partnership with WDFW and Jamestown S'Klallam Tribe (JST), has established a 0.5 acre Olympia oyster restoration site at Discovery Bay, WA. The Jefferson MRC continues to add more substrate (clean Pacific oyster shell) to enhance the habitat and provide

more area for natural Olympia oyster recruitment to occur (Jefferson MRC 2019). The MRC's current project goal is to facilitate population expansion by providing new habitat areas with appropriate substrate (clean cultch) in collaboration with resource co-managers.

2.2 Study Area

This QAPP only includes the Discovery Bay restoration site in Jefferson County. It was chosen as a restoration project site because the bay historically contained a significant population of native oysters and a small but healthy population is still present nearby (Blake and Bradbury 2012). We are working on two specific areas in lower Discovery Bay:

Powerline Area:
An area located in the bay adjacent to the powerlines on Washington Department of Natural Resources (DNR) tidelands between approximately +1.0 and 0.0 MLLW. The coordinates are 47.99505 N, 122.87777 W. Olympia oysters were found in the immediate vicinity attached to the occasional rock or other hard surfaces such as the foundations of the utility poles, but most of the project area had no "starter" substrate. The MRC placed clean Pacific oyster shells here in August 2014 and July 2016 not too far from the extant population. Monitoring began in 2015.

Lagoon Area:
An area adjacent to the remnant population in 2019. The coordinates are 47.997638 N, 122.882278 W. Our 2018 activities here were centered around permit applications. In 2019, with the help of co-managers, we collected baseline data on the extant population and added clean cultch near the extant population. Co-Managers and our permit conditions will guide us in how we continue to distribute new cultch in the Lagoon area.

See Appendix A for map of project areas.

2.2.1 History of the Study Area

In Discovery Bay, a railroad grade was constructed in 1914 atop fill placed on the tidelands. This created an artificial lagoon now entering the bay under a creosote railroad trestle. The Jefferson County Marine Resources Committee (MRC) worked with partners on a restoration effort to remove the railroad grade from the shoreline (Jefferson MRC 2010). The MRC has been involved with the Olympia oyster population here since 2002, including assisting with surveys and assessments of test plots in the area in collaboration with the Puget Sound Restoration Fund (PSRF).

In August 2014, eight cubic yards of clean shell (100 bags) were placed at the Powerline Area, following receipt of all required permits from state, federal and local agencies. No shell was placed within a 25-foot buffer around eelgrass patches that were located within or adjacent to the project area, as described in the HPA permit. Cultch was distributed over the ¼-acre area. (Coarsely crushed shell was placed in two smaller sub-plots to see what happened with smaller shell pieces, but these were no longer visible by spring of 2015 and that aspect of the test was abandoned.)

One of the project goals is to test the effectiveness of a low-density application of shell as a way to jump-start a population expansion. We aimed to initially place shells at a density of approximately 2 shells/sq. ft. In August 2015 (during the first year of monitoring), the WDFW Co-Manager Brady Blake recommended adding additional clean cultch to the site in 2016 to bring the available shell back up to our target density, as tides and wind waves had moved some of the initial shell out of the project area and some shell had settled deep into the mud. On July 21, 2016, 13 MRC volunteers dispersed an additional 80 bags of clean cultch on the project site. (The original installation permits prohibited in-water activity before July 15 of each year.)

This adaptive management action meant that a direct comparison of 2015 and 2016 data was influenced by this addition of new, clean shell. The 2016 data established a new baseline for 2017 and 2018 monitoring, although the 2016 project report did note some possible trends. In addition to the comparisons made in that report, the MRC found several Pacific oyster shells with large numbers of attached Olympia oyster just outside of the area where shell was placed. We assumed these had to be the Pacific oyster shell placed there in 2014, as we found only a few scattered shells present on or near the project site before the MRC began its work.

Three shell stacks from a Puget Sound Restoration Fund (PSRF) project have also been and will continue to be deployed each summer (May–August) starting in 2015 at this location; this approach for measuring recruitment allows PSRF to compare results from various sites around Puget Sound, while we focus on more detailed site information of interest to the MRC and WDFW.

2.2.2 Summary of Previous Studies and Existing Data

The WDFW first identified the need for native oyster restoration in their Olympia oyster Stock Rebuilding Plan (Cook et. al 1998, Blake and Bradbury 2012). The initial plan was not implemented but the Puget Sound Restoration Fund (PSRF) adopted aspects of the plan and created the goal of establishing 100 acres of Olympia oyster habitat by 2020 (PSRF 2012). As a part of this program, many MRCs began implementing Olympia oyster restoration projects within their counties. Currently, Clallam, Jefferson, and Skagit MRCs have implemented full-scale Olympia oyster restoration projects (Clallam MRC 2019, Jefferson MRC 2019, Dinnel et al. 2009).

The Jefferson County MRC, in partnership with WDFW and JST, has established a 0.5-acre Olympia restoration site in Discovery Bay, WA. The Jefferson MRC continues to add more substrate to enhance the habitat and provide more area for natural Olympia oyster recruitment to occur (Jefferson MRC 2019).

The Clallam County MRC, in partnership with the Jamestown S'Klallam Tribe (JST), has established a 1.5-acre Olympia oyster restoration site in Sequim Bay, WA. According to summary reports of the restoration at this site, "Olympia oysters are surviving, growing, reproducing and expanding their population area well beyond the bounds of the restoration site" (Clallam MRC 2019).

Skagit MRC has one of the most successful Olympia oyster restoration projects in Puget Sound. The Fidalgo Bay restoration site now has an estimated 2.9 million Olympia oysters and, with the addition of more habitat enhancing substrate, recruitment of juvenile Olympia oysters continues to occur (Dinnel 2018).

Whatcom MRC started the North Chuckanut Bay pilot study in hopes to contribute to the success of the Olympia oyster restoration projects. Limited data exists for North Chuckanut Bay specifically as only one Olympia oyster population study has been conducted, occurring in 2019 (Whatcom MRC 2019).

2.2.3 Parameters of Interest

The parameters of interest to this monitoring include:

- Recruitment, growth, and survival of Olympia oysters at plots with clean cultch added to improve habitat substrate near the small extant population.
- Natural recruitment of Olympia oyster spat, using the Puget Sound Restoration Fund's shell stack method, placing stacks within the restoration area of Discovery Bay.

Recruitment refers to the presence of newly settled juvenile Olympia oysters and the presence of multiple age (size) classes of Olympia oysters within each plot. Natural recruitment refers to the presence of juvenile Olympia oysters on clean cultch. In either case, recruitment will be quantified as the number of live Olympia oyster settlements per shell.

The number and size (mm) of spat will be recorded as well as percent shell cover within 0.25m^2 quadrats. If spat numbers are high, measurements will be taken of no more than the first 100 spat/quadrat.

PSRF Recruitment Monitoring

Use of shell-string collectors is based on the Puget Sound Restoration Fund's (PSRF) method of using shell stacks to assess natural recruitment. Three shell-string collectors will be placed at equal intervals within the restoration area about 15 feet apart, and the GPS location will be marked and recorded. The shell strings will be collected in late summer after a 3-month deployment.

Jefferson MRC receives the shell stacks already assembled from PSRF. The shell stacks are installed by pressing the dowel into the substrate so that the shells are nacre-side down and the tag label is at the top.

Figure 1. Shell stack collector.

2.2.4 Regulatory Criteria or Standards
Not applicable. Does not assess compliance or regulatory criteria.

2.3 Water Quality Impairment Studies
Not applicable.

2.4 Effectiveness Monitoring Studies
Not applicable.

3.0 Project Description

3.1 Project Goals

1. Expand Olympia oyster habitat and population in Discovery Bay, where the native oysters historically thrived.
2. Demonstrate that a low-impact strategy to encourage natural seed set from the existing Olympia oyster population can be successful. (For more details about completed work, see Jefferson MRC's 2016, 2017 and 2018 Olympia oyster project reports and maps.)

3.2 Project Objectives

1. Monitor recruitment, growth and survival of oysters in project enhancement areas, collecting data on estimated oyster numbers and size distribution.
2. Train and empower citizen scientists to conduct surveys using standardized methods.

3.3 Information Needed and Sources

This project is designed to collect baseline data to determine the status of low impact restoration methods in Discovery Bay and assess the need for adaptive changes following restoration actions. It will also be used to inform planning, research, project development, and implementation of future Olympia oyster restoration projects in Jefferson County. The restoration methods and results provide information on the feasibility of low impact restoration for other sites identified as a priority for Olympia oyster restoration where a small population is already present.

3.4 Project Tasks

1. Train new volunteers on oyster sampling methods.
2. Review previous season's data and discuss lessons learned and strategies for upcoming survey season.
3. MRC project lead schedules annual distribution of clean cultch.
4. MRC project lead schedules annual sampling event and communicates schedule to participating volunteers.
5. MRC project manager receives data and raw datasheets and provides report and data to NWSC.
6. NWSC reviews data and checks quality.

3.5 Systemic Planning Process

Not applicable.

4.0 Organization and Schedule

4.1 Key Individuals and Their Responsibilities

The Jefferson MRC is responsible for coordinating surveys at the site annually. The survey data are saved by the MRC Project Manager and copies are given to the NWSC. Key staff with the Jefferson MRC are identified below in Table 1.

Table 1 Organization of Project Staff

Role	Position Who is Responsible	As of 6/1/2020
Manages volunteer coordination, coordinates with the MRC Project Lead, and tracks training needs. Creates MRC reports and manages data. Writes QAPP.	MRC Project Manager	Monica Montgomery (Jefferson MRC)
Sets dates for fieldwork, manages volunteer coordination, and leads data collection following protocols and QAPP	MRC Project Lead	Neil Harrington (JST Biologist; MRC Co-chair/Tribal Rep)
Assist MRC project lead with surveying	MRC Volunteers	MRC members and community volunteers
Provide technical assistance when needed	Co-Managers	Brady Blake (WDFW),

		Chris Eardley (WDFW)
Reviews QAPP and ensures that all proposed actions meet the Washington Department of Ecology requirements	Project Quality Assurance Officer	Dana Oster (NWSC)

MRC: Marine Resources Committee
JST: Jamestown S'Klallam Tribe
WDFW: Washington Department of Fish and Wildlife
NWSC: Northwest Straits Commission

4.2 Special Training and Certifications

Citizen scientists participating in Olympia oyster population surveys will receive required training from the Project Lead and/or the Project Manager to participate in this project. The training will elaborate upon the protocol used during population surveys, describe basic oyster species identification, and demonstrate proper oyster measurement techniques. Citizen scientists will also be trained on how to complete field data sheets properly to report whole and accurate data. Training will also include safety precautions to prevent the spread of COVID-19 as well as precautions to prevent the spread of invasive species (see section 7.1).

The Project Manager and Project Lead work with WA Department of Fish and Wildlife (WDFW) shellfish biologist, Brady Blake, and WDFW shellfish policy coordinator, Chris Eardley, who provide training, technical guidance and recommendations for site management.

Before starting the population survey, citizen scientists will be provided with a copy of the protocol to review. The Project Lead and/or the Project Manager will explain the protocol step-by-step ensuring citizen scientists understand their roles. At each step of the protocol related to the process of collecting and recording data, the Project Lead and/or the Project Manager will demonstrate exactly how the process should be conducted. This will include proper use of calipers, how to toss quadrats, and how to count Olympia oysters. After the demonstration, each new citizen scientist will practice collecting data outside of the established plots for a few minutes. The data collection practice will include using calipers, tossing quadrats, counting dead and living oysters, and understanding what to record on the data sheet.

4.3 Organization Chart

Not applicable. See Table 1 for roles and responsibilities.

4.4 Project Schedule

Table 2 Project Schedule from March 2020 to September 2025

Event	FY 2020-2021	2022-2025
Recruit and train MRC Volunteers	Ongoing	Ongoing
Review previous season's data and discuss lessons learned and strategies for upcoming survey season.	March 2020*, 2021	Annually, in March
Placement of clean cultch at Powerline Area	Summer 2020*, April 2021	Annually, in April - until the site reaches at least

		50% shell cover
Placement of clean cultch at Lagoon Area	Summer 2020*, April 2021	Annually, in April - until the site reaches at least 50% shell cover
Monitor Powerline Site for % shell cover, # and size of spat	Late Summer 2020, 2021	Annually, May-August
Monitor Lagoon Site for % shell cover, # and size of spat	Late Summer 2020, 2021	Annually, May-August
Annual Summary Report	September 2020, 2021	Annually, in September

*Denotes activities that have already occurred.
Note: field activities and dates may change due to COVID-19 restrictions and safety.

4.5 Budget and Funding

Data collection for this program is primarily volunteer-run. Staff support for this program is provided by Jefferson County.

Table 1 Estimated Project Budget for FY 2020-2021

Staff Support	**Estimated Cost**
MRC Project Manager support (salary, benefits, and indirect)	$3,720.00
Supplies and Materials (clean cultch, incl. delivery)	$1,050.00
Travel	$200
TOTAL*	$4,970

*2020-21 funding comes from Washington State General Fund and EPA National Estuary Program through the Northwest Straits Commission to the Jefferson County MRC.

5.0 Quality Objectives

5.1 Data Quality Objectives

The overall quality objective for this project is to provide high quality data on Olympia oyster populations for Discovery Bay as part of the restoration project. The current QAPP will put forward a set of guidelines for current and future MRC members or staff to evaluate restoration success and facilitate adaptive management practices. Components of the QAPP include sampling methodology and monitoring frequency. To keep the QAPP current, the document will be revised as appropriate to capture any changes in the protocols or added tasks and submitted as addendums.

The quality objectives are met when volunteers:

- Perform Olympia oyster population surveys during the desired tidal height (≤ -1.0 Mean Lower Low Water (MLLW)).
- Conduct surveys annually while maintaining similar timing each year.
- Collect all height and count measurements of Olympia oysters in each subsample consistently and following the protocol.

- Return fully completed data sheets to the MRC Project Manager.
- Submit annual project reports to NWSC.

5.2 Measurement Quality Objectives

To achieve comparability over time, multiple actions will be taken during the population surveys. Protocols for surveys are designed to follow similar local protocols used by partner MRCs. Additionally, those protocols are modelled after regional steps for Puget Sound (Puget Sound Restoration Fund and WDFW), and national standards. Data collected is in accordance with established restoration guidelines for oyster restoration by NOAA (Wasson et al. 2014). The protocols for this project are provided in Appendix B.

Specific steps taken to assure measurement quality are as follows. Dial calipers will be used to collect oyster height and length measurements accurately and consistently to the nearest mm. A standard 0.25 m^2 quadrat will be used during the population survey for each of the five subsamples per plot. A handheld GPS device will be verified for accuracy according to manufacture requirements and used to mark plot and quadrat locations (recorded to 5 decimal places). Field data will be recorded on waterproof data sheets. Participating MRC members and citizen scientists not associated with the MRC are trained in and follow standard oyster measurement protocols (Appendix B). Citizen scientists will be accompanied by the MRC Project Lead and/or Project Manager.

5.2.1 Target for Precision and Sensitivity

Measurements for height and length will be taken to the nearest mm and considered accurate within ± 1mm. Volunteers should expect height measurements around 35 mm though smaller and larger Olympia oysters will be measured. Oysters with heights larger than 75 mm will not be counted as this is outside of the typical size range for Olympia oysters and, thus, is likely a different oyster species (Couch and Hassler 1989). Oyster heights less than 1 mm will not be counted as that would exceed the precision of the calipers and would negate our targeted accuracy of ± 1mm. The length measurements will follow the same parameters as the height measurements as there is limited published scientific information on maximum, minimum, and median lengths of Olympia oysters.

5.2.2 Target for Comparability, Representativeness, and Completeness

Data from population surveys are comparable with other Olympia oyster restoration projects as similar metrics are being obtained. For example, all MRCs record height and count of Olympia oysters as these are metrics recommended by NOAA (Wasson et al. 2014) and The Nature Conservancy (Baggett et al. 2014) for all oyster restoration projects.

The sampling frequency of one population survey per year captures growth that occurred over the year and allows for recruitment to be seen. Sampling between May through August allows for the MRC to capture growth that occurred over winter and consistently sampling during summer allows for comparison between years.

As sampling occurs once a year, it is considered complete and successful if that annual sampling event is maintained, meaning a 100% target for planned sampling events are achieved. Sampling

flexibilities are included by allowing some variability on the reoccurring month that samples are collected (see Table 2).

5.3 Acceptance Criteria for Quality of Existing Data

The data collection method described in this QAPP is nearly the same method employed in previous years at the Discovery Bay Olympia oyster enhancement site (since 2015), in order to create a long-term data set for assessing the efficacy of a low impact restoration strategy. One exception is that shell heights (technical term for length) were categorized as greater or less than 15 mm in the first two years of monitoring. Starting in 2017, and continuing forward, oysters are being measured to the closest mm using calipers.

5.4 Model Quality Objectives

Not applicable.

6.0 Study Design

6.1 Study Boundaries

This QAPP only includes the area encompassing Discovery Bay (See section 2.2).

6.2 Field Data Collection

See section 2.2 Study area for field locations. The sampling frequency is one population survey annually during the summer season, from May through August. The field protocol is described in Appendix C and is based upon global (Baggett et al. 2014) and regional recommendations by NOAA (Wasson et al. 2014), and follow similar protocols used by other MRCs (Clallam MRC 2019, Dinnel 2018).

6.3 Modeling and Analysis Design

Not applicable.

6.4 Assumptions of Study Design

The study design assumes the survey event would occur during a ≤ - 1.0 MLLW tidal event so all study plots are above the water line during surveys and during consistent times in the calendar year to capture Olympia oyster growth. Descriptions of the overall site condition and individual plot observations, such as noting the presence of algae, loss of shell or predation, are subject to interpretation of the volunteers and are considered qualitative.

6.5 Possible Challenges and Contingencies

Monitoring at each site will be constrained by two primary factors: Human resources to conduct the monitoring, and safe conditions. If weather or site conditions are unsafe, the survey is postponed to a time when they are safe. Safety considerations for survey teams will also include COVID-19 precautions.

7.0 Field Procedures

7.1 Invasive Species Evaluation

Samples are not collected, so deliberate transfer of invasive species is not possible in this project. Footwear used during field surveys could potentially act as a carrier of invasive species. When possible, footwear will be cleaned at the site. If volunteers are unable to do so, they will be instructed to brush off dirt and debris from the soles after the footwear has completely dried. Additionally, volunteers will be asked to clean their footwear away from any water source, if not at the site, to minimize the potential for spreading invasive species.

7.2 Measurement and Sampling Procedures

Monitoring will be done using 0.25 m^2 quadrats placed along transects within the project area. Transects will be evenly spaced 7 paces apart, with a random number determining the initial distance north of the powerlines (and one transect just south of the powerlines) to mark the starting point of each transect. Quadrats are then placed 5 paces apart on each transect, with a different random number determining the initial distance from the end of each transect. For each quadrat, the number and size of spat will be recorded, and approximate percent shell cover within the quadrat. If spat numbers are high, measurements will be taken of no more than the first 100 spat/quadrat.

See attached Discovery Bay Olympia Oyster Monitoring Protocol for details (Appendix B).

There is no preliminary baseline data about spat size and numbers collected. Anecdotally, at the time of clean cultch placement, only a few Olympia oysters were found and there was minimal substrate present for oysters to settle upon. It is therefore assumed that there were no Olympia oysters in the study area prior to the placement of clean cultch for this project.

Quantity:
All spat on either side of each shell in the quadrat will be counted.

Size:
Oysters are being measured to the closest mm using calipers.

7.3 Containers, Preservation Methods, Holding Times

Not applicable.

7.4 Equipment Decontamination

Not applicable.

7.5 Sample ID

Not applicable.

7.6 Chain of Custody

Not applicable.

7.7 Field Log Requirements
Each sampling event will include the completion of the Discovery Bay Olympia Oyster Monitoring Data Sheet included in Appendix C.

7.8 Other Activities
Not applicable.

8.0 Laboratory Procedures
Not applicable.

9.0 Quality Control Procedures
The following procedures will be used to maintain quality of data in this project:

1. Follow the standard procedures as described in the previous sections among plots and among volunteers. This includes filling out the field form completely. Each participant reviews the protocols prior to going out in the field each year. The Project Lead will also review the previous year's results and have a printed copy of last year's data on hand for comparison of Olympia oyster length.

2. Only individuals who successfully complete Olympia oyster measurement training will participate.

3. Only the MRC Project Lead and/or Project Manager will lead fieldwork activities and be responsible for the integrity of the sampling.

4. Prior to leaving the site the Project Lead will evaluate data sheets as they are submitted in the field to ensure completeness and address ambiguities. If any unusual results are found, they will be corrected before leaving the field. Any changes made to the data sheet will be initialed by the Project Lead or Project Manager.

5. Data sheets and GPS data are provided by the Project Lead to the MRC Project Manager for data storage and reporting.

9.1 Table of Field and Laboratory Quality Control
See steps listed above.

9.2 Corrective Action Processes
Sample collection is conducted by multiple volunteers. This often provides multiple sets of eyes and experience that can identify a potential issue with field sampling or data. If there are concerns about data while the team is surveying, they will start again and use a new datasheet. If questions arise regarding suspect data after leaving the field, the Project Manager or Project Lead will make necessary efforts to contact the responsible surveyor(s) for clarification. If the surveyors are unable to clarify the suspect data, that data will be considered inaccurate and not included during

analysis. If time allows, a second survey may be scheduled that season to document correctly that year's results.

10.0 Data Management Procedures

All project data will be maintained by the Project Manager in both paper and electronic forms. The project documents include this QAPP, data sheets, electronic files, permits, photo documentation, and annual reports.

11.0 Audits and Reports

11.1 Audits

Audits are not anticipated for this project. Progress reports and volunteer hours will be submitted annually.

11.2 Responsible Personnel

The MRC Project Manager is responsible for reporting annually to the NWSC on sampling activity.

11.3 Frequency and Distribution of Reports

A copy of protocols and QAPP will be developed to meet the needs of the restoration goals and reviewed annually. Raw data and a report on survey activities will be submitted annually. The report will include:

- A narrative of the field research
- A summary of sampling effort
- Results of the count, size, and recruitment surveys of Olympia oysters
- Raw data and data sheets
- Recommendations for any modification of the procedures and the overall program

12.4 Responsibility for Reports

The MRC Project Manager (see Table 1) is responsible for annual report submission to the NWSC.

12.0 Data Verification

12.1 Field Data Verification, Requirements, and Responsibilities

The Project Lead will evaluate data sheets as they are submitted in the field to ensure completeness and address ambiguities. If any unusual results are found, they will be corrected before leaving the field.

12.2 Laboratory Data Verification

Not applicable.

12.3 Validation Requirements, if Necessary

Not applicable.

12.4 Model Quality Assessment
Not applicable.

13.0 Data Quality (Usability) Assessment
13.1 Process for determining project objectives were met
The sampling objectives were met if all sample results are submitted to NWSC and reviewed by WDFW Co-Managers. The objective is to collect annual Olympia oyster population surveys from all plots successfully.

13.2 Treatment of non-detects
Not applicable.

13.3 Data analysis and presentation methods
Not applicable.

13.4 Sampling design evaluation
Not applicable.

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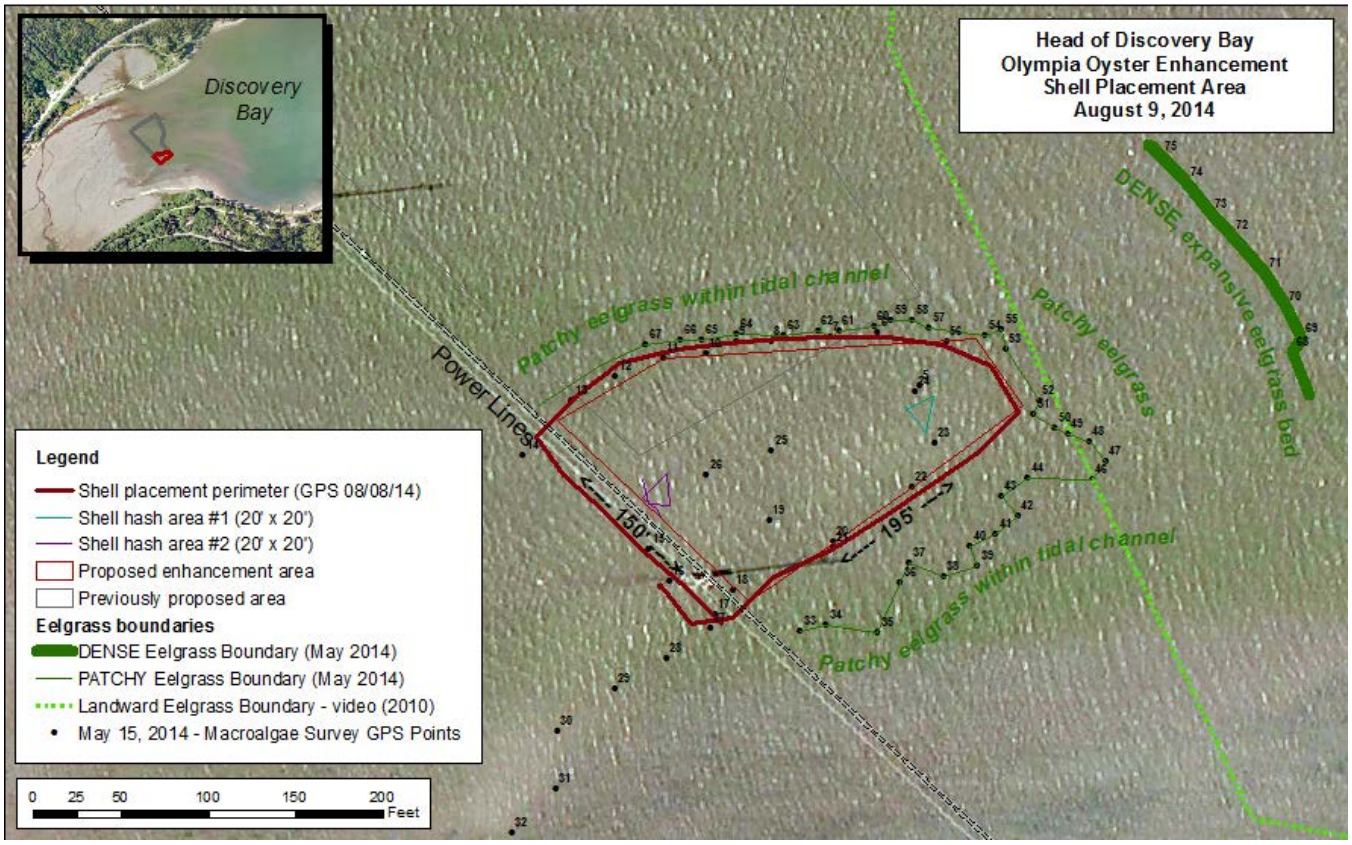
Appendix A

Discovery Bay Olympia Oyster Enhancement Site Maps

Powerline Area:

An area located in the bay adjacent to the powerlines on DNR tidelands between approximately +1.0 and 0.0 MLLW. General location (latitude/longitude coordinates) are 47.99505 N, 122.87777 W.



Lagoon Area:

An area adjacent to the remnant population in 2019. General location (latitude/longitude coordinates) is 47.997638 N, 122.882278 W.

Appendix B

Discovery Bay Olympia Oyster Monitoring Protocol *(Field notes in italics)*

Basic protocols approved by WDFW Shellfish Biologist Brady Blake, August 2015. New sequence of random numbers generated annually.

Goal:

To monitor oyster spat set on clean Pacific oyster shells placed in a ½-acre area in lower Discovery Bay. Shell placement is to test effectiveness of a low-impact strategy to encourage natural seed set from a nearby existing Olympia Oyster population. For more details about initial work, see Jefferson MRC's Olympia oyster project report and maps (2016, 2017, 2018, 2019).

Equipment:

- GPS & notebook for writing notes
- 100' tape measures—3 tapes for 3 teams
- camera for quadrat pix & people pix
- 3 sets of data sheets (on waterproof paper), pencils, clipboards **(*NOTE: 25 data sheets, with 4 blank pages not used).***
- Stakes or pin flags to mark transect start, end and quadrat centers. Wooden stakes & flags & flagging tape
- Flagging and 20 wire flags
- Volunteer sign-in forms
- Safety review & first aid kit
- Gloves
- Mudboots
- Calipers
- 4 x 5-gal buckets
- Collect shell stacks (in August)
- Snacks
- Compass or functioning GPS compass

Random numbers for July 13, 2018: **9, 3, 2, 3, 7, 1, 8, 5, 1, 9, 7, 6**

GPS Reference Point for project area: Δ = 3-pole wood powerline tower
GPS = Δ 47° 59.702'N and 122° 52.668'W ±16 ft.

Protocol:

Random numbers are used to locate the start of transects and quadrats within the project area (pace = one step of one leg). Because a number of shells have drifted south of the Powerlines (southern boundary of original project area, one transect parallel to and 9 paces south of the Powerline was added in 2018.

1. Use the Powerlines as the guidelines for the South boundary of the plot (it's actually SW edge). *NOTE: due to orientation, baseline was 20 degrees NE to allow more accurately follow the edge of the plot and visible shell. Transect lines were laid out parallel to the Powerlines for ease of orientation.*

2. Beginning at approximately the SE end of the Powerlines pole (GPS = Δ 47° 59.702'N and 122° 52.668'W ±16 ft.), Walk **South 9 paces** and mark the start of the Transect #1 with a stake. ***Record***

all GPS end points of all transects once they are marked. *These were then transferred to the first page of the data sheets for each transect from the field notebook.*

3. Go back to the Powerline SE end (GPS lat-long: *Δ noted above*), walk **North**, using flags to mark a long N-S Baseline transect on the E side of the plot. This line is where all the E-W transects will start from, except Transect #1.

4. Walk **3** [random number above] of paces in a N direction along the N-S Baseline to beginning point of Transect 2. Mark with a stake for beginning of Transect #2. *One person recorded GPS end points of all transects once they were marked, as only one person had the GPS).*

5. All subsequent transects are parallel to the powerlines and 7 paces north of the Transect 2.

6. Walk **7** more paces along the Baseline and mark beginning of transect #3 (using stakes or wire flags).

7. Repeat for each additional parallel transect until very little shell is seen on the ground at the north end of the project area.

8. From each Transect starting point, facing NW in a line parallel to the powerlines, walk a straight line out to the end of the visible shell, or when you reach the edge of the eelgrass, and put a tall, flagged stake in the mud. *(13 transects in total. We had more time after doing transect 12 at the end of the shell area, so added Transect 1A along the powerlines).* ***Again, see GPS points in field notebook.***

9. **Go back to the East starting point** of Transect #1 and **walk [random number] of pace**s. Put a wire flag at that point. You will place the quadrat frames on the ground with the stake at the center and the tape (or imaginary transect line) running through the center of the quadrat. After the first wire flag, **walk 5 more paces** and place another wire flag/quadrat in the same orientation. Repeat to the end of the Transect #1, with each quadrat 5 paces apart.

10. Repeat for each transect, starting at:
    - **3 paces for #2**
    - **7 paces for #3**
    - **1 pace for #4**
    - ***Repeat this pattern of (random) paces using random numbers list on first page, to start placement of the first quadrat along each transect, keeping all the other quadrat spacing at 5 paces apart.***

Quadrat Instructions

1. For each quadrat, you will
    a. Find all shell and put them in one quarter quadrat in preparation for data collection
    b. Measure and record the size of each Oly spat found on each shell
    c. Estimate percent cover of oyster shell.

2. Move all the shell into one or two quarter sections of the quadrat and then start inspecting and moving them into that first quarter section as you collect data. Pick up each shell piece and inspect it for Olympia oyster spat. Record sizes of all Oly spat found on each shell. Once you have counted a

shell, place it on the ground in that first quarter section that was emptied, *or place it outside the quadrat frame so you don't count it twice.*

To estimate overall coverage, place all the counted shells with edges touching so you can easily estimate the total % cover for that quadrat. **Record the % cover estimate on the data sheet for that quadrat and take a photo** (automatically time-stamped), so we can match them up (for percent cover.)

3. **Go to the next quadrat in that transect.**

4. *Clearly note on data sheet when you start a new quadrat, and also when you start a new transect.*

5. Repeat for each quadrat in each transect.

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Survey Date: _____ **Start Time:** _____

Low Tide & Time: _____ **End Time:** _____

Random # from Powerline to start of Transect #1:

	Transect 1	Flag #'s		Transect 5	Flag #'s
Random # to 1st flag					
LAT (start)					
LONG (start)					
LAT (end)					
LONG (end)					
	Transect 2	**Flag #'s**		**Transect 6**	**Flag #'s**
Random # to 1st flag					
LAT (start)					
LONG (start)					
LAT (end)					
LONG (end)					
	Transect 3	**Flag #'s**		**Transect 7**	**Flag #'s**
Random # to 1st flag					
LAT (start)					
LONG (start)					
LAT (end)					
LONG (end)					
	Transect 4	**Flag #'s**		**Transect 8**	**Flag #'s**
Random # to 1st flag					
LAT (start)					
LONG (start)					
LAT (end)					
LONG (end)					

Jefferson MRC Olympia Oyster Population Survey Data Form - Page 2 of 3

GPS	Transect 9	Flag #'s		Transect 13	Flag #'s
Random # to 1st flag					
LAT (start)					
LONG (start)					
LAT (end)					
LONG (end)					
	Transect 10	**Flag #'s**		**Transect 14**	**Flag #'s**
Random # to 1st flag					
LAT (start)					
LONG (start)					
LAT (end)					
LONG (end)					
	Transect 11	**Flag #'s**		**Transect 15**	**Flag #'s**
Random # to 1st flag					
LAT (start)					
LONG (start)					
LAT (end)					
LONG (end)					
	Transect 12	**Flag #'s**		**Transect 16**	**Flag #'s**
Random # to 1st flag					
LAT (start)					
LONG (start)					
LAT (end)					
LONG (end)					

SITE MAP & NOTES:

Jefferson MRC Olympia Oyster Population Survey Data Form - Page 3 of 3

Site Name: _____

Survey Date: _____

Names of Monitors: _____

	Flag #	Flag #	Flag #	Flag #	Flag #	Flag #	Flag #	Flag #	Flag #	Flag #	Flag #
Quadrat/Flag #											
Percent Cover											
Oly length (mm)	Oly (mm)										
1											
2											
3											
4											
5											
6											
7											
8											
9											
10											
11											
12											
13											
14											
15											
16											
17											
18											
19											
20											
21											
22											
23											
24											
25											

Random Number Table (between 1 & 50)

30	8	29	46	47	5	45	10	40
1	18	31	10	35	19	22	16	4
49	7	43	38	34	45	23	19	37
30	15	37	16	14	27	9	36	21
36	28	22	7	34	25	44	34	11
35	24	44	18	5	22	38	6	20
30	35	47	35	12	41	8	28	34
19	26	36	43	36	11	28	12	4
24	22	36	38	50	20	34	23	4
49	24	17	9	41	46	18	18	33
20	9	4	6	50	47	48	39	47
47	7	26	50	46	47	20	37	23
27	26	22	45	14	44	4	12	22
3	17	13	26	10	19	42	10	29
41	17	35	28	45	9	38	29	12
5	39	30	5	37	24	23	6	10
42	1	9	48	17	26	23	1	46
5	44	44	4	6	40	15	5	32
10	31	50	6	10	4	9	6	30
14	15	33	5	42	33	17	46	50
28	31	20	49	33	37	40	3	1
1	21	21	24	15	13	2	38	39
1	46	46	1	29	40	10	19	27
12	47	8	6	24	25	10	4	5
27	10	8	30	23	34	25	24	22
21	42	27	12	42	2	6	39	38
22	33	19	29	20	39	49	33	26
15	5	11	19	1	42	27	37	34
35	47	41	30	24	25	28	15	44
6	38	24	29	21	44	38	35	19
16	39	17	7	38	11	10	33	49
8	21	13	33	2	25	10	5	35
43	38	34	50	25	37	41	49	21
27	33	19	19	49	23	42	48	41
26	25	44	34	34	25	19	28	40
19	10	3	9	1	6	35	27	24
11	14	35	13	12	33	12	42	26
43	10	22	12	49	39	11	25	28
40	41	8	20	3	4	45	11	33
12	25	37	33	7	38	37	8	7
43	22	32	6	18	10	31	34	28
45	19	12	9	37	40	43	11	35