STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
PO Box 47775 • Olympia, Washington 98504-7775 • (360) 407-6300

October 3, 2011

Jamestown S'Klallam Tribe
ATTN: Ron William Allen
1033 Old Blyn Highway
Sequim, WA 98382

Re: Water Quality Certification Order No. **8772** for Corps Public Notice No. **NWS-2009-900** for the planting, maintenance, and harvest of a geoduck aquaculture farm within Kilisut Harbor of Puget Sound, at Beach 2 on the northeast shore of Indian Island, Jefferson County, Washington

Dear Mr. Allen:

On November 13, 2009, the Jamestown S'Klallam Tribe submitted a Joint Aquatic Resource Permit Application (JARPA) to the Department of Ecology (Ecology) for a Section 401 Water Quality Certification (401 Certification) under the federal Clean Water Act for the establishment of a 1.5 acre commercial geoduck aquaculture farm at Beach 2 on the northeast shore of Indian Island.

On behalf of the State of Washington, Ecology certifies that the work described in the JARPA and the public notice complies with applicable provisions of Sections 301, 302, 303, 306 and 307 of the Clean Water Act, as amended, and applicable state laws. This Certification is subject to the conditions contained in the enclosed Order.

If you have any questions, please contact Lori Ochoa at (360) 407-6926. The enclosed Order may be appealed by following the procedures described in the Order.

Sincerely,

Perry J Lund
Southwest Regional Office
Shorelands and Environmental Assistance Program

LO:th
Enclosure

BY CERTIFIED MAIL: 7010 1670 0002 4158 0602

cc: Pam Sanguinetti, Corps of Engineers
Kelly Toy, Jamestown S'Klallam Tribe
Randy Hatch, Point No Point Treaty Council
Gary D. Martin, NAVMAG Indian Island
William Kalina, NAVMAG Indian Island
Jules Michel
Laura Hendricks, Sierra Club

e-cc: ecyrefedpermits@ecy.wa.gov
Loree' Randall, HQ
Rick Mraz, SWRO/SEA
Deb Cornett, SWRO/WQ
Lori Ochoa, SWRO/SEA

IN THE MATTER OF GRANTING A WATER QUALITY CERTIFICATION TO The Jamestown S'Klallam Tribe in accordance with 33 U.S.C. 1341 (FWPCA § 401), RCW 90.48.120, RCW 90.48.260 and Chapter 173-201A WAC	)	**ORDER # 8772** Indian Island Geoduck Aquaculture Project, Kilisut Harbor, Puget Sound, Jefferson County, Washington.

TO: Jamestown S'Klallam Tribe
ATTN: Ron William Allen
1033 Old Blyn Highway
Sequim, WA 98382

On November 13, 2009 the Jamestown S'Klallam Tribe submitted a Joint Aquatic Resource Permit Application (JARPA) requesting a Clean Water Act (CWA) Section 401 Water Quality Certification from the Department of Ecology (Ecology) and a CWA Section 404 Permit from the U.S. Army Corps of Engineers (Corps). A request to withdraw and re-apply for a 401 Certification was submitted on October 7, 2010. A joint public notice regarding the request was distributed by the Corps for the above-referenced project pursuant to the provisions of Chapter 173-225 WAC on January 7, 2010. Ecology issued an additional public notice on February 14, 2011.

The proposed project is located within Kilisut Harbor of Puget Sound at Beach 2 on the northeast shore of Naval Magazine Indian Island, at 100 Indian Island Road, Port Hadlock, Jefferson County, Washington, 98339; SW Section 19, Township 30 North, Range 1 East; WRIA 17 Quilcene-Snow Watershed.

The project proposes to install a 1.5-acre commercial geoduck farm on Beach 2 of NAVMAG Indian Island. Project activities include the planting of geoduck shellfish between about the -1.3 to +2.0 tidal elevation – mean lower low water (MLLW). Approximately 12,000 square feet of the site would be planted annually. The geoducks would be seeded by hand by placing three to four seed into each 4 – 6 inch diameter by 8 – 12 inch long PVC tube, which is sunk into the substrate. The tubes would be positioned approximately one and a half feet apart. For predator control, each individual tube would be covered with a plastic net secured with a band. Planting would occur at minus tides from April through August. The tubes and netting would remain in place for about two years.

The first harvest will take place approximately 4 - 6 years after planting. Harvest will occur by hand at low tide using a high volume, low pressure water hose injected directly into the sediment adjacent to the geoduck siphon. This procedure loosens the sediment around the geoduck and allows it to be removed by hand. Pumps for the hoses are run by a small internal combustion engine and are typically located in a small boat just offshore of the harvest site.

AUTHORITIES:

In exercising authority under 33 U.S.C. § 1341, RCW 90.48.120, and RCW 90.48.260, Ecology has examined this application pursuant to the following:

1. Conformance with applicable water quality-based, technology-based, and toxic or pretreatment effluent limitations as provided under 33 U.S.C. §§1311, 1312, 1313, 1316, and 1317 (FWPCA §§ 301, 302, 303, 306 and 307);

2. Conformance with the state water quality standards contained in Chapter 173-201A WAC and authorized by 33 U.S.C. §1313 and by Chapter 90.48 RCW, and with other applicable state laws; and

3. Conformance with the provision of using all known, available and reasonable methods to prevent and control pollution of state waters as required by RCW 90.48.010.

WATER QUALITY CERTIFICATION CONDITIONS:

Through issuance of this Order, Ecology certifies that it has reasonable assurance that the activity as proposed and conditioned will be conducted in a manner that will not violate applicable water quality standards and other appropriate requirements of state law. In view of the foregoing and in accordance with 33 U.S.C. §1341, RCW 90.48.120, RCW 90.48.260, Chapter 173-200 WAC and Chapter 173-201A WAC, water quality certification is granted to the Jamestown S'Klallam Tribe subject to the conditions within this Order.

A. General Conditions:

1. For purposes of this Order, all submittals required by its conditions shall be sent either by regular mail to Ecology's Southwest Regional Office, SEA Program, Attn: Federal Permit Manager, P.O. Box 47775, Olympia, WA 98504-7775 or via e-mail to loch461@ecy.wa.gov. Any submittals shall reference Order No.**8772** and Corps No. **NWS-2009-900**.

2. This Order only authorizes those activities identified in the JARPA dated November 13, 2009 and the *"Proposed Eel Grass Study Design for the Jamestown Geoduck Farm (Indian Island)"* dated August 17, 2011or as otherwise specified or modified by this Order. The Jamestown S'Klallam Tribe must contact Ecology if a change is proposed to any technologies or methodologies on the project site.

3. Within 30 days of receipt of updated information, Ecology will determine if the revised project requires a new water quality certification and public notice or if a modification to this Order is required.

4. This Order shall be rescinded if the U.S. Army Corps of Engineers does not issue a Section 404 permit.

5. Copies of this Order shall be kept on the job site and readily available for reference by Ecology personnel, the Jamestown S'Klallam Tribe, the Harvest Manager, lead workers, and government inspectors.

6. The Jamestown S'Klallam Tribe shall provide access to the project site upon request by Ecology personnel for site inspections, monitoring, necessary data collection, and/or to ensure that conditions of this Order are being met.

7. Nothing in this Order waives Ecology's authority to issue additional orders if Ecology determines that further actions are necessary to implement the water quality laws of the state. Further, Ecology retains continuing jurisdiction to make modifications hereto through supplemental order, if additional impacts due to project installation or operation are identified (*e.g.*, violations of water quality standards, downstream erosion, etc.), or if additional conditions are necessary to further protect water quality.

8. The Jamestown S'Klallam Tribe shall ensure that all appropriate harvest managers and lead workers at the project site have read and understand relevant conditions of this Order and all permits, approvals, and documents referenced in this Order. The Jamestown S'Klallam Tribe shall provide Ecology a signed statement (see Attachment A for an example) from each harvest manager that they have read and understand the conditions of this Order and the above-referenced permits, plans, documents and approvals. These statements shall be provided to Ecology before any site preparation or planting begins at the project site.

9. This Order does not authorize direct, indirect, permanent, or temporary impacts to waters of the state or related aquatic resources, except as specifically provided for in conditions of this Order.

10. Failure of any person or entity to comply with the order may result in the issuance of civil penalties or other actions, whether administrative or judicial, to enforce the terms of this Order.

B. Water Quality Conditions:

1. The point of compliance as specified in WAC 173-201A-210(1)(e)(i) allows a radius of 150-foot temporary turbidity area of mixing from the point of the in-water activities.

2. For this project, the project boundary will be defined by the nozzle endpoint (farthest reach) of the hose from a fixed barge and the following is considered to be an exceedance of the standard:

a. 5 NTU over background turbidity when the background turbidity is 50 NTU or less, or more than a ten (10) percent increase in turbidity when the background turbidity is more than 50NTU, at the point of compliance when a turbidimeter is used OR
b. Project-related turbidity visible 150 feet from the boundary of the project area.

3. Geoduck harvest activities shall be monitored daily during daylight harvests with a turbidimeter as follows:
   a. Two hours after the start of harvest activities;
   b. Four hours after the start of harvest activities;
   c. At the end of the harvest for that day*

   ***Note:** If the period "four hours after the start of harvest" occurs within one hour of the end of harvest, that sample will suffice for the end of harvest sample.

4. Background samples shall be collected outside the area of influence of the in-water work. Background samples shall be collected at the same frequency as the point of compliance samples.

5. Monitoring and documentation shall occur at: 100 feet (within the mixing zone), 150 feet (the point of compliance), and 200 feet down-current from the project boundary.

6. Results of the water quality monitoring shall be documented in a report and submitted to Ecology within 90 days of the end of the harvest cycle for that season. The report must include:

   a. Sampling information (date, time, sample location, sample results, name of personnel collecting the sample, and weather conditions).

7. If water quality exceedances are observed outside of the point of compliance, work shall cease immediately and the Jamestown S'Klallam Tribe or the contractor shall assess the cause of the water quality problem and take immediate action to stop, contain, correct the problem and/or prevent further water quality turbidity exceedances. If an exceedance occurs, the Jamestown S'Klallam Tribe shall follow the protocols and notification procedures below:

   a. Notify Ecology within 24 hours of exceedances that are detected through water quality monitoring. The Jamestown S'Klallam Tribe shall, at a minimum, provide Ecology with the following information:
      i. A description of the nature and cause of the exceedance,
      ii. The period of the exceedance, including exact dates, duration, and times and/or the anticipated time when the project will return to compliance; and
      iii. The steps taken, or to be taken, to reduce, eliminate, and prevent recurrence of the exceedance.

iv. In addition, within five (5) days after notification of an exceedance, the Jamestown S'Klallam Tribe shall submit a written report to Ecology that describes the nature of the exceedance(s), corrective action taken and/or planned, steps to be taken to prevent a recurrence, photographs, and any other pertinent information.

b. Mitigation and/or additional monitoring may be required as a result of the exceedance(s).

8. If, after the first four weeks of monitoring the harvest activities, no turbidity exceedances are detected, the Jamestown S'Klallam Tribe can submit the data and a request to suspend the monitoring. At that time Ecology will review the data and provide a written response to whether monitoring can be suspended or not.

D. Timing Requirements:

1. This Order expires ten (10) years from the date of issuance of the Corps permit.

E. Notification, Documentation and Reporting Requirements:

1. The Jamestown S'Klallam Tribe shall provide a copy of the final Corps Permit to Ecology's Southwest Regional Office Federal Permit Manager within two (2) weeks of receipt of the permit.

2. Pre-project baseline site conditions shall be documented by photograph from border to border of the project area and submitted to Ecology within 90 days of receipt of this authorization.

3. An As-Built Report must be submitted within three months (90 days) of the completion of planting. The As-Built shall include:

   a. Project Area;
   b. Property boundaries;
   c. Planted areas with the dates of planting;
   d. Unplanted areas with dates of proposed planting;
   e. Beach access points (if applicable);
   f. Landing areas in relation to the tidal height of +5 MLLW or higher;
   g. Photo documentation of the planted project area.

4. Photographic site documentation (taken from border to border of the project area) of final site conditions shall be submitted to Ecology six months prior to the expiration of this authorization.

5. The Jamestown S'Klallam Tribe shall also provide written notification (FAX, e-mail or mail) to Ecology's Southwest Regional Office Federal Project Coordinator for the following activities:

a. At least ten (10) days prior to any site preparation;
b. At least ten (10) days prior to the onset of the planting for that season;
c. At least ten (10) days prior to the removal of tubes and/or nets for that season;
d. At least ten (10) days prior to the start of harvesting for that season;
e. Within fourteen (14) days after the completion of the harvest cycle for that location.
f. Immediately following a violation of any condition of this Order.

NOTE: These notifications shall include the Jamestown S'Klallam Tribe's name, project name, project location, the number of this Order, contact and contact's phone number.

F. Conditions for In-water Activities:

The implementation of the proposed project has the potential to cause exceedances of applicable water quality standards, to result in the pollution of water of the state, and/or impair beneficial uses. The following conditions are placed on the project activities in order to protect beneficial uses and to ensure compliance with applicable water quality standards and other appropriate requirements of state law.

General

1. No staging or work areas are allowed at tidal heights of +5 or higher (MLLW). In order to ensure the proper location of staging areas, the +5 foot tidal elevation is to be permanently marked at the property boundaries such that the markers are visible at high tide.

2. All equipment, materials, and vessels, excluding emplaced tubes and nets, shall be removed from the project area each day. Nothing is to be stored on the project site.

3. No fertilizers, pesticides, herbicides, antibiotics, vaccines, growth stimulants, anti-fouling agents, or other chemicals shall be utilized in the operation of this shellfish farm.

4. All equipment, vessels and hose pumps shall be maintained and fueled at an off-site location.

5. Dive (wet) harvest in the project area is not authorized by this Order.

6. The area of planting shall only occur as depicted in the *"Proposed Eel Grass Study Design for the Jamestown Geoduck Farm (Indian Island) Site Plan"* dated August 17, 2011. (Attachment B).

Site Preparation

7. No grading, filling, or re-contouring of the site is authorized by this Order.

8. No channelizing or redirecting of surface water bodies entering the project area is authorized by this Order.

Site Access

9. The designated landing zone shall be located to avoid forage fish spawning areas and shall not exist higher than +5 tidal elevation at MLLW unless specifically approved by Ecology.

Gear

10. If nursery bins are used, the overall footprint of the bins shall not be more than one tenth of one per cent (0.001) of the project area and no individual bin shall be left in place for more than four months during any twelve month period. If the bins are to be stacked, the trays shall not exceed three feet in height.
11. Nursery bins shall not be located above +5 MLLW or in eelgrass beds.
12. No plywood or other material shall be placed underneath the nursery bins.
13. No other types of nursery grow-out facilities are authorized by this Order.
14. All tubes shall be permanently marked or tagged to identify ownership.
15. Tubes, nets, and bands shall be made of a material suitable for use in the marine environment.
16. Tubes and nets shall be removed from the beach as soon as they are no longer needed, and not to exceed a period of twenty-four months unless otherwise approved by Ecology.
17. Harvest hoses shall be kept under control by the harvesters in such a manner that they do not cause uncontrolled erosion or scouring of the sediment. The hoses shall be fitted with an on-off valve and shall be turned off when not in use for harvesting.
18. The harvest pump intake shall be screened with a 1/8 –inch mesh to prevent fish from entering the system. The screen shall remain in place whenever water is withdrawn through the pump intake.
19. Prior to engaging in any activities with the potential to cause a disturbance (e.g., net or tube maintenance or removal, harvest) the Jamestown S'Klallam Tribe shall visually survey the area to determine if herring spawn is present within the planted area. If spawn is present, project activity shall be postponed until the eggs have hatched.

Eelgrass

20. Eelgrass for regulatory purposes of this Order is *Zostera marina.*
21. Eelgrass recruitment into planted areas will not be regulated. Should eelgrass recruit into the planted shellfish bed, no additional buffers or harvest limitations will be imposed.
22. Buffers from eelgrass shall be measured from the landward edge of the bed where eelgrass coverage is less than 30%.
23. Vessels shall be operated so that eelgrass beds will not be damaged by propeller wash, anchoring, grounding, or shading.

24. When a hose must traverse an eelgrass bed it shall be configured as follows: a single hose shall extend from the barge to an area landward of the edge of the eelgrass bed and outside the eelgrass buffer. At that point a splitter may be used to separate the single hose into multiple hoses.

25. Eelgrass beds shall be monitored as identified in the *"Proposed Eelgrass Study Design for the Jamestown Geoduck Farm (Indian Island)"* dated August 17, 2011.

Site Maintenance and Monitoring

26. Site inspection shall occur at a minimum of once per month while materials (tubes and/or nets) are present on the beach. During site inspection of the farm site, check nearby beaches for debris from project activities.

27. The Jamestown S'Klallam Tribe shall keep a written record of the site inspections. The record shall include:
    a. Inspectors name;
    b. Date and time of inspection;
    c. Type and amount of aquaculture gear found

28. A copy of the inspection record shall be submitted to Ecology twice annually on May 1 and October 1 until all of the gear is removed from the beach.

G. Emergency/Contingency Measures:

1. Any work that is out of compliance with the provisions of this Order, or conditions causing distressed or dying fish, or any discharge of oil, fuel, or chemicals into state waters, including wetlands, or onto land with a potential for entry into state waters, is prohibited. If these occur, the Jamestown S'Klallam Tribe or operator shall immediately take the following actions:
    a. Cease operations that are causing the compliance problem.
    b. Assess the cause of the water quality problem and take appropriate measures to correct the problem and/or prevent further environmental damage.
    c. In the event of finding distressed or dying fish, the Jamestown S'Klallam Tribe shall collect fish specimens and water samples in the affected area within the first hour of the event. These samples shall be held in refrigeration or on ice until the Jamestown S'Klallam Tribe is instructed by Ecology on what to do with them. Ecology may require analyses of these samples before allowing the work to resume.
    d. Immediately notify Ecology's Southwest Regional Spill Response Office at (360) 407 - 6300 and the Washington State Department of Fish and Wildlife of the nature of the problem, any actions taken to correct the problem, and any proposed changes in operations to prevent further problems.

YOUR RIGHT TO APPEAL

You have a right to appeal this Order to the Pollution Control Hearing Board (PCHB) within 30 days of the date of receipt of this Order. The appeal process is governed by Chapter 43.21B RCW and Chapter 371-08 WAC. "Date of receipt" is defined in RCW 43.21B.001(2).

To appeal you must do the following within 30 days of the date of receipt of this Order:

- File your appeal and a copy of this Order with the PCHB (see addresses below). Filing means actual receipt by the PCHB during regular business hours.
- Serve a copy of your appeal and this Order on Ecology in paper form - by mail or in person. (See addresses below.) E-mail is not accepted.

You must also comply with other applicable requirements in Chapter 43.21B RCW and Chapter 371-08 WAC.

ADDRESS AND LOCATION INFORMATION

Street Addresses	Mailing Addresses
Department of Ecology Attn: Appeals Processing Desk 300 Desmond Drive SE Lacey, WA 98503	**Department of Ecology** Attn: Appeals Processing Desk PO Box 47608 Olympia, WA 98504-7608
Pollution Control Hearings Board 1111 Israel Rd SW STE 301 Tumwater, WA 98501	**Pollution Control Hearings Board** PO Box 40903 Olympia, WA 98504-0903

CONTACT INFORMATION

Please direct all questions about this Order to:

Lori Ochoa
Department of Ecology
Southwest Regional Office
P.O. Box 47775
Olympia, WA 98504-7775
loch461@ecy.wa.gov

MORE INFORMATION

Pollution Control Hearings Board Website
www.eho.wa.gov/Boards_PCHB.aspx

Chapter 43.21B RCW - Environmental Hearings Office – Pollution Control Hearings Board
http://apps.leg.wa.gov/RCW/default.aspx?cite=43.21B
Chapter 371-08 WAC – Practice and Procedure
http://apps.leg.wa.gov/WAC/default.aspx?cite=371-08
Chapter 90.48 RCW – Water Pollution Control
http://apps.leg.wa.gov/RCW/default.aspx?cite=90.48
Chapter 173.204 WAC – Sediment Management Standards
www.ecy.wa.gov/biblio/wac173204.html
Chapter 173-200 WAC – Water Quality Standards for Ground Waters of the State of Washington
www.ecy.wa.gov/biblio/wac173200.html
Chapter 173-201A WAC – Water Quality Standards for Surface Waters of the State of Washington
www.ecy.wa.gov/biblio/wac173201A.html

SIGNATURE

10/3/2011
Date

Perry J Lund, Unit Supervisor
Shorelands and Environmental Assistance Program
Department of Ecology
Southwest Regional Office

Attachment # A

Jamestown S'Klallam Tribe
Indian Island Geoduck Aquaculture Project
Order # **8772**

Statement of Understanding
Water Quality Certification Conditions

I, _____, state that, I will be involved as an agent or contractor for the Indian Island Geoduck Aquaculture Project in the planting, maintenance, and/or harvest of geoduck within Kilisut Harbor of Puget Sound on Beach 2 of NAVMAG Indian Island at 100 Indian Island Road, Port Hadlock, Jefferson County, Washington 98339. I further state that I have read and understand the relevant conditions of the Washington Department of Ecology Water Quality Certification Order **#8772** and the applicable permits and approvals referenced therein that pertain to the project-related work for which I am responsible.

_____ _____
Signature Date

_____
Title Phone

_____
Company

Proposed Eel Grass Study Design for the Jamestown Geoduck Farm (Indian Island)

Survey Design

A single treatment plot, consisting of approximately ¼ acre located on the shoreward boundary of the geoduck farm, will be planted with geoduck seed. The planting area is planned to be approximately 400 ft x 30 ft, and will be located 10 feet from the agreed eel grass boundary. A control plot approximately 200 ft in width will be established 100 ft from the geoduck bed on the up current side (Figure 1).

The experimental design and sampling methods are designed to provide data to test whether the distance between the aquaculture activity and the eel grass bed has any significant effect on eel grass density within established eel grass beds. A secondary objective is to determine if the boundary of the established eel grass bed moves as a result of the geoduck aquaculture activity.

Sample Event Timing:

There will be five sampling events conducted:

1. One sampling event will be conducted prior to geoduck planting,
2. A second sampling event will occur 18 to 24 months after the geoducks have been planted when predator tubes are removed,
3. A third sampling event will occur within two weeks before harvest
4. A fourth sampling event will occur shortly after the geoduck beds have been harvested, and
5. A final sampling event will occur 6 to 12 months after the geoduck beds have been harvested.

All sampling events will occur at low tide within the months of July or August, to the extent feasible.

Sample Transects:

There will be six sample transects associated with the treatment plot. Sample transects will be placed perpendicular to shore and extend from the edge of the geoduck bed to approximately 25 ft into the eel grass bed. The first transect for the treatment plot will be located approximately 30 ft from the treatment plot boundary on the down-current edge of the geoduck bed. The next four transects will be spaced approximately 75 ft apart moving in an up-current direction. The sixth and final transect will be located approximately 30 ft from the up-current edge of the geoduck bed. Transect lengths will be approximately 35-40 ft total length (see Figure 1).

Similarly, for the control plot there will be three, 35-ft long transects placed approximately 75 ft apart (see Figure 1). The starting point for the control plot transects will begin 10 feet from the agreed to eelgrass boundary. The transects will extend 25 ft into the eelgrass bed.

All transect locations will be fixed for the duration of the study using rebar driven into the substrate to monument the beginning and end of each transect.

Sample Quadrats:

Eight, 1-m^2 sample quadrats will be located at either 5-ft or 10-ft intervals along each sample transect starting from the edge of the treatment plot (or 10 ft from the outward edge of the eel grass bed for the control plot). Each transect will extend about 25 ft into the eel grass bed. Additional sample quadrats will be located 2.5 feet on either side of the 10-ft sample quadrat located approximately on the edge of the eel grass bed. The purpose of these samples is to obtain additional information near the margin of the eel grass bed. Quadrat spacing for the two quadrats located beyond the quadrate located 5 ft from the eel grass boundary (15 ft from the treatment plot) and into the eel grass bed will be 10 ft. Sample quadrat locations along each transect are fixed, so that they can be re-sampled at each sample event. There are a total of 8 sample quadrats per transect, and therefore, a total of 72 samples collected during each sample event.

Two types of data will be collected from each 1-m^2 sample quadrat.

- *Z. marina* shoot density count and
- Percentage cover estimates.

<u>Percentage Cover Sample Quadrats:</u> A 1-m^2 sample frame (inner dimensions) will be placed on each sample location. A digital camera will be used to take an overhead shot of each sample quadrat. These digital images will be used to estimate the percentage of each sample quadrat covered by eel grass at low tide. Processing of these images will be conducted in the office. All photos documenting coverage will be archived and permanently stored.

<u>Stem Density Sample Quadrats:</u> Samples for monitoring the density of *Z. marina* shoots will consist of 20 cm by 20 cm quadrats (0.04 m^2 density quadrats). Each density quadrat will be placed in the center of the 1-m^2 sample frame. The total number of *Z. marina* shoots within each density quadrat will be counted and recorded in the field.

In addition to the quadrat samples, a photographic record will be kept of the area above each transect within the treatment plot and the control plot to establish and compare the movement of eel grass within these areas over time.

Data Analysis:

A longitudinal, matched-sample design will be the basis for all data analyses. The change in each metric (percentage coverage or stem density) in each specific sample quadrat from one

sample event to the next will be the basic unit of analysis. Both the direction of the change (increase or decrease) and size of the change will be examined.

Exact methods of analysis will be determined after a thorough exploratory data analysis examining the distribution properties of the data. Conclusions from the exploratory data analysis will determine if parametric or non-parametric statistical methods will be used. The basic hypothesis tested is that any change observed in the data collected from transects associated with the treatment plots is not significantly different from the change observed in data collected from transects associated with the control plot.

The Washington Department of Fish and Wildlife has established interim statistical guidelines when comparing eel grass densities between two sites. Those guidelines are as follows:

- Low probability of a Type I error - concluding there is loss of eel grass when, in fact, there is not. Recommended Type 1 error rate is 0.10.
- Low probability of a Type II error - failing to detect a loss of eel grass when, in fact, there is one. This is addressed by selecting a small value for β (resulting in high statistical power, $(1-\beta)$). Recommended power is 0.90 to provide a low probability of a Type II error.
- Effect threshold - the difference in mean eel grass density between sites. This is recommended to be 20%, meaning we desire to detect decreases in mean eel grass density of 20% or more with the α and $(1-\beta)$ levels recommended above.

The evaluation of statistical significance will follow these guidelines. The power and effect size of any non-significant statistical tests will also be evaluated with respect to these guidelines. Statistical analyses will be conducted by a biometrician at the Northwest Indian Fisheries Commission.
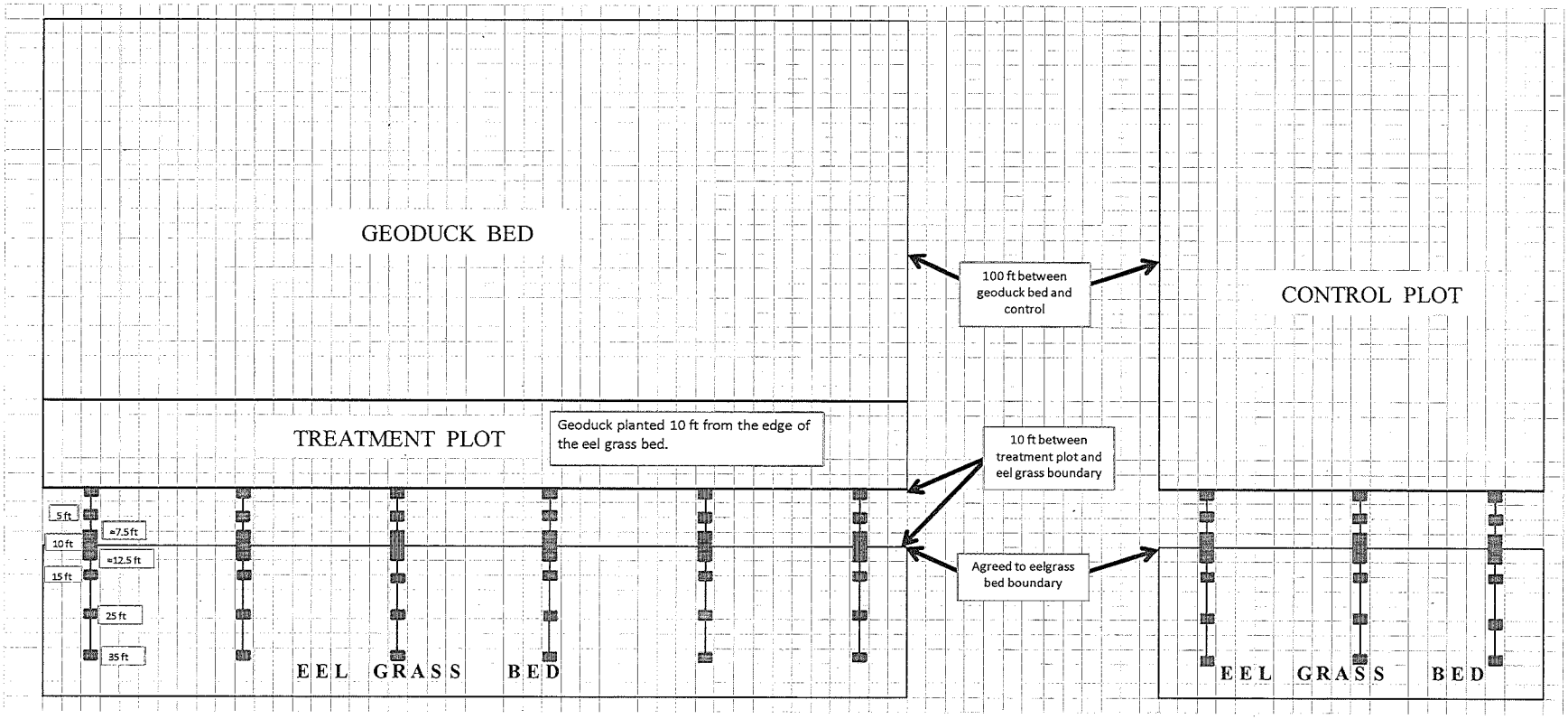
FIGURE 1. EEL GRASS SURVEY DESIGN