



# San Gabriel Valley Council of Governments

## AGENDA AND NOTICE

### OF THE MEETING OF THE ENERGY, ENVIRONMENT AND NATURAL RESOURCES (EENR) COMMITTEE

Wednesday, February 15, 2017 – 12:30 PM

Upper San Gabriel Valley Municipal Water District (602 E. Huntington Dr; Monrovia, CA)

Chair  
**Denis Bertone**  
City of San Dimas

Vice Chair  
**Liz Reilly**  
City of Duarte

Members  
**Claremont**  
**Duarte**  
**Glendora**  
**Rosemead**  
**San Dimas**  
**Sierra Madre**  
**South Pasadena**

Thank you for participating in today's meeting. The EENR Committee encourages public participation and invites you to share your views on agenda items.

**MEETINGS:** *Regular Meetings of the EENR Committee are held on the third Wednesday of each month at 12:30 PM at the Upper San Gabriel Valley Municipal Water District, 602 E. Huntington Drive, Monrovia, CA.* The EENR Committee agenda packet is available at the San Gabriel Valley Council of Government's (SGVCOG) Office, 1000 South Fremont Avenue, Suite 10210, Alhambra, CA, and on the website, [www.sgvkog.org](http://www.sgvkog.org). Copies are available via email upon request ([sgv@sgvcog.org](mailto:sgv@sgvcog.org)). Documents distributed to a majority of the Committee after the posting will be available for review in the SGVCOG office and on the SGVCOG website. Your attendance at this public meeting may result in the recording of your voice.

**CITIZEN PARTICIPATION:** Your participation is welcomed and invited at all EENR Committee meetings. Time is reserved at each regular meeting for those who wish to address the Committee. SGVCOG requests that persons addressing the Committee refrain from making personal, slanderous, profane or disruptive remarks.

**TO ADDRESS THE EENR COMMITTEE:** At a regular meeting, the public may comment on any matter within the jurisdiction of the Committee during the public comment period and may also comment on any agenda item at the time it is discussed. At a special meeting, the public may only comment on items that are on the agenda. Members of the public wishing to speak are asked to complete a comment card or simply rise to be recognized when the Chair asks for public comments to speak. We ask that members of the public state their name for the record and keep their remarks brief. If several persons wish to address the Committee on a single item, the Chair may impose a time limit on individual remarks at the beginning of discussion. **The EENR Committee may not discuss or vote on items not on the agenda.**

**AGENDA ITEMS:** The Agenda contains the regular order of business of the EENR Committee. Items on the Agenda have generally been reviewed and investigated by the staff in advance of the meeting so that the EENR Committee can be fully informed about a matter before making its decision.

**CONSENT CALENDAR:** Items listed on the Consent Calendar are considered to be routine and will be acted upon by one motion. There will be no separate discussion on these items unless a Committee member or citizen so requests. In this event, the item will be removed from the Consent Calendar and considered after the Consent Calendar. If you would like an item on the Consent Calendar discussed, simply tell Staff or a member of the Committee.



In compliance with the Americans with Disabilities Act, if you need special assistance to participate in this meeting, please contact the SGVCOG office at (626) 457-1800. Notification 48 hours prior to the meeting will enable the SGVCOG to make reasonable arrangement to ensure accessibility to this meeting.



**PRELIMINARY BUSINESS**

1. Call to Order
2. Roll Call
3. Public Comment (*If necessary, the Chair may place reasonable time limits on all comments*)
4. Changes to Agenda Order: Identify emergency items arising after agenda posting and requiring action prior to next regular meeting (*It is anticipated that the EENR Committee may take action on the following matters*)

**CONSENT CALENDAR** (*It is anticipated that the EENR Committee may take action on the following matters*)

5. EENR Meeting Minutes  
*Recommended Action: Approve.*
6. Correspondence  
*Recommended Action: Receive and File.*

**PRESENTATIONS** (*It is anticipated that the EENR Committee may take action on the following matters*)

7. San Gabriel Canyons Improvement Project Update – Robert Romanek, Project Manager, Watershed Conservation Authority  
*Recommended Action: For information only.*
8. Clean Water Through Oyster Aquaculture Development – Antonio Gonzalez, President, William C. Velasquez Institute  
*Recommended Action: For information only.*

**DISCUSSION ITEMS** (*It is anticipated that the EENR Committee may take action on the following matters*)

**ACTION ITEMS** (*It is anticipated that the EENR Committee may take action on the following matters*)

**UPDATE ITEMS** (*It is anticipated that the EENR Committee may take action on the following matters*)

9. Los Angeles Community Choice Energy JPA  
*Recommended Action: For information.*
10. National Forest Foundation Community Collaborative  
*Recommended Action: For information.*
11. SGVCOG Water Committee Update  
*Recommended Action: For information.*
12. San Gabriel Valley Energy Wise Partnership  
*Recommended Action: For information.*

**COMMITTEE MEMBER ITEMS**

**STAFF ANNOUNCEMENTS**

**ANNOUNCEMENTS**

**ADJOURN**



**SGVCOG EENR Committee Unapproved Minutes**

Date: January 18, 2016

Time: 12:30 PM

Location: USGVMWD (602 E. Huntington Drive, Monrovia)

**PRELIMINARY BUSINESS**

1. Call to Order  
This meeting was called to order at 12:30 pm
2. Roll Call

**Members Present**

Duarte	L. Reilly
Rosemead	M. Clark
San Dimas	D. Bertone
South Pasadena	D. Mahmud
Sierra Madre	J. Capoccia
West Covina	J. Toma

**Absent**

Claremont  
Glendora

**COG Staff**

Marisa Creter, Staff  
Christian Cruz, Staff

3. Public Comment (If necessary, the Chair may place reasonable time limits on all comments)  
R. Yeung commented on the Air Quality Management Plan (AQMP).
4. Changes to Agenda Order: Identify emergency items arising after agenda posting and requiring action prior to next regular meeting (It is anticipated that the EENR Committee may take action on the following matters)  
There were no changes to the Agenda.

**CONSENT CALENDAR** (It is anticipated that the EENR Committee may take action on the following matters)

5. EENR Meeting Minutes
6. Correspondence  
**There was a motion to approve consent items 5-6. (M/S: L. Reilly / D. Mahmud).**

[Motion Passed]

<b>AYES:</b>	Duarte, San Dimas, South Pasadena, Sierra Madre, West Covina
<b>NOES:</b>	
<b>ABSTAIN:</b>	
<b>ABSENT:</b>	Claremont, Rosemead, Glendora

**PRESENTATIONS** (It is anticipated that the EENR Committee may take action on the following matters)

- 7. Regional Organics Management Strategy – Jeff Duhamel, CEO, MuniEnvironmental
- 8. Mosquito and Vector Control Agency Resources for the SGV – Jason Farned, Public Information Officer, SGV Mosquito and Vector Control

**DISCUSSION ITEMS** (It is anticipated that the EENR Committee may take action on the following matters)

**ACTION ITEMS** (It is anticipated that the EENR Committee may take action on the following matters)

**UPDATE ITEMS** (It is anticipated that the EENR Committee may take action on the following matters)

- 9. Los Angeles Community Choice Energy JPA  
**There was a motion to recommend the Board support the staff recommendation in the LACCEE report. (M/S: L. Reilly / D. Mahmud).**

**[Motion Passed]**

<b>AYES:</b>	Duarte, San Dimas, South Pasadena, Rosemead, Sierra Madre, West Covina
<b>NOES:</b>	
<b>ABSTAIN:</b>	
<b>ABSENT:</b>	Claremont, Glendora

- 10. National Forest Foundation Community Collaborative  
 L. Reilly reported on this item.
- 11. SGVCOG Water Committee Update  
 D. Mahmud reported on this item.
- 12. San Gabriel Valley Energy Wise Partnership  
 M. Creter reported on this item.

**COMMITTEE MEMBER ITEMS**

**STAFF ANNOUNCEMENTS**

**ANNOUNCEMENTS**

**ADJOURN**

Meeting adjourned at 1:47 p.m.

# Ways Trump May Alter California's Environment and Energy Landscape

by [Emily Guerin](#) with Stephen Gregory

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The San Gabriel Mountains have been designated as a national monument. Josh Leclair/Flickr

Ninety-seven percent of climate scientists [agree](#) that human activities are the leading cause of steadily rising temperatures around the globe.

President-elect Donald Trump, however, has called global warming "[bulls\\*\\*t](#)" and a "[hoax](#)," making him soon to be one of, if not the only, [world leader to deny the science behind climate change](#). He's also threatened to defund the Environmental Protection Agency and bring back the flagging coal industry.

Not surprisingly, environmentalists and climate activists are alarmed by what a Trump presidency will mean for efforts to reduce human-generated emissions that are warming the planet.

And they wonder what Trump's policies might mean for California, which is considered a pioneer in efforts to conserve the environment and fight climate change.

## **Trump has signaled he will roll back progress on climate change at a national level**

Under the Obama Administration, the United States was on track to regulate carbon dioxide emissions from power plants as part of the Clean Power Plan. The U.S. had also signed onto the Paris climate agreement, which

took effect earlier this month, and had [pledged](#) to cut greenhouse gas emissions by 26 to 28 percent compared to 2005 levels by 2025.

Now the future of both those actions are [in question](#). Trump has said he wants to pull out of the Paris agreement and scrap the Clean Power Plan, while scrapping other Obama environmental regulations.

California has been working to reduce its greenhouse gas emission since the passage of AB-32 in 2006. The state has already reached the goals envisioned under the Clean Power Plan and is on track to cut even more. The state has largely relied on a "cap-and-trade" program, in which regulators set limits on carbon emissions and allow polluters to buy and sell carbon permits to stay under those limits.

As it stands now, the Clean Power Plan would give California opportunities to trade emissions permits with neighboring states and to be a model for them as they develop their plans to comply with the new regulation.

But the future of the Clean Power Plan is unclear under a Trump administration. The rule has been challenged in federal court. Trump could choose to no longer defend it, and he could appoint a new justice to the Supreme Court who favors overturning it.

California will likely continue with its efforts to reduce greenhouse gas emissions even with the Clean Power Plan.

Instead, for Californians, Trump's election means a return to the days of President George W. Bush, when the state operated largely on its own in terms of climate and environmental policy. After all, it was under the Bush Administration that California passed AB 32, the first of its kind climate legislation, and it did so precisely because of federal inaction on climate change, according to Cara Horowitz, co-executive director of the Emmett Institute on Climate Change and the Environment at UCLA's law school.

## **California's climate policies are not threatened by a Trump presidency**

Passed in 2006, AB 32 required California to reduce its greenhouse gas emissions to 1990 levels by 2020. Since then, the state has [reduced its emissions](#) by over seven percent, as the population has increased by the same amount. This fall, another landmark bill deepened and extended those cuts. [SB 32](#) commits the state to cutting emissions by 40 percent below 1990 levels by 2030.

In the meantime, California has rolled out a suite of programs to help the state meet its emissions reduction goals, the most well known of which is [cap and trade](#). Regulators slowly decrease the cap over time. Polluters who lower their emissions below the cap can make money by selling carbon credits to power plants, refineries and other polluters that can't meet their targets. The program is meant to incentivize efforts to reduce pollution.

Trump can't overturn California's cap and trade program (although it currently embroiled in a state [lawsuit](#) challenging its legality). Nor can he overturn SB 32.

"We're too committed as a state, and frankly we have too much as a state to back down on our climate policies," said Horowitz.

From the worst drought in half a millennia, to a long coastline vulnerable to sea level rise, to a wildfire season that is 78 days longer than it was in 1970, Californians, "see the effects of climate change every day and we're very committed to our climate policies, no matter what happens at the federal level," Horowitz said.

## **Who Trump appoints to head federal agencies will likely have a huge impact on California**

Beyond climate, President Trump's attitudes towards the environment will resonate most deeply in traditional environmental issues: things like clean air, clean water, endangered species, land conservation and energy development.

One way to tell how he's leaning is to track who is appointed to head agencies tasked with safeguarding or developing those resources, according to Ann Nothoff, California advocacy director at the Natural Resources Defense Council.

Trump has surrounded himself with climate change deniers, oil industry executives, and lawmakers from fossil fuel dependent states like North Dakota who are eager to expedite production of oil, gas and coal from federal lands.

Nothoff said she is especially keeping her eye on who Trump appoints to head the Department of Interior, which oversees agencies like the National Park Service, the Bureau of Land Management, the US Fish and Wildlife Service and the Bureau of Reclamation.

Trump himself has pledged to [increase oil and gas production](#) on federal land, which [fell](#) under the Obama administration. That could impact California, the nation's number three oil state, where [seven percent of oil wells are on federal land](#), according to the BLM.

## **Trump's EPA, in particular, will affect clean air and clean water in California**

Trump has threatened to eliminate EPA entirely, although he recently walked back that comment, saying he wants to [focus](#) the agency on ensuring clean air and water. But there are many ways to do this, some of which are top down and regulatory, while others are more voluntary and market-based.

One of the ways, EPA has traditionally ensured clean air and drinking water is creating emissions and concentration standards that polluters have to meet, enforcing them with penalties, and passing stricter ones over time. Horowitz worries a Trump EPA will let that approach slide, becoming business and industry friendly at the expense of public health. "It's very clear he's one of those Republicans who sees environmental protection and business interests at odd with each other as opposed to things that can and should co-exist," she said.

California is legally allowed to pass state standards that are stricter than federal ones, but Horowitz says that's difficult. "Without a really robust federal partner, we could see California's progress on air quality slipping."

## **California benefits from federal support for renewable energy, which a Republican-controlled Congress could cut off**

Last December, lawmakers [cut a deal](#) to extend federal tax credits for the wind and solar industries through 2017 and 2019 respectively. The deal would need Congressional approval to be extended. And it could even be cut off prematurely, [writes solar energy columnist](#) Christian Roselund.

Trump has previously expressed his distaste for federal subsidies for clean energy. According to a memo released in late October, Trump pledged to "cancel all wasteful climate spending," according to the Washington Post. Investors are clearly already worried: [solar stocks plunged](#) following news he had won the election.

This has huge implications for California, which has [nearly half](#) of the solar power generation in the country.

"Subsidies at the federal level can all have a role to play in how effectively we deploy clean energy, how much it competes on a playing field with fossil fuels," Nothoff said.

However, as with climate change policy, state policies encouraging solar development will not be affected by this election.

## California's newly minted National Monuments likely to stay in place

Under the Antiquities Act, President Obama created a number of national monuments in California in the past eight years, including the San Gabriel Mountain National Monument in 2014. Experts say it's highly unlikely that President Trump would reverse those designations because they've mostly received bipartisan support and it's unclear the Antiquities Act allows presidents to strip monument designations from locations that already have it.

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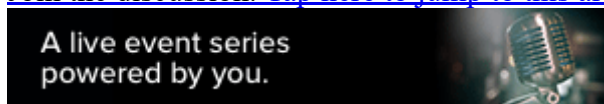
### Related Links

- [Cow emissions and the fight against global warming Article](#)
- [Trump says he has 'open mind' on climate, but EPA pick raises questions Article](#)
- [This VR demo shows how sea level rise could impact Santa Monica Audio](#)
- [Brown: California's climate fight won't stop under Trump Article](#)
- [FACT CHECK: Donald Trump's first 100 days action plan Article](#)

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# REPORT

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DATE: February 15, 2017

TO: Energy, Environment and Natural Resources Committee

FROM: Phil Hawkey, Executive Director

**RE: SAN GABRIEL CANYON IMPROVEMENTS PROJECT**

## **RECOMMENDED ACTION**

For information only.

## **BACKGROUND**

The Angeles National Forest (ANF) and Watershed Conservation Authority (WCA) have partnered to develop and implement a comprehensive master development plan for the San Gabriel Canyon Improvements Project Area (SGC Project). The total project site is comprised of 165 acres along a 2.5-mile stretch of the San Gabriel River and encompasses the riverbed, public roads and all existing recreational facilities within the project site (Attachment A). The Project is divided into five areas as follows:

- Oaks Area (downstream project site to the intersection of Glendora Mountain Road; includes Oaks River Overlook Day-use area and Oaks picnic area);
- Junction Area (between Glendora Mountain Road and the Cattle Canyon Confluence);
- Cattle Canyon Confluence (Confluence Area) (confluence of Cattle Canyon Creek and the East Fork of the San Gabriel River);
- Coyote Flat, East Fork Scenic Overlook, Fire Station and Canyon Areas (includes the East Fork Trailhead Parking, East Fork Scenic Overlook, and Coyote Flat Picnic area); and
- Heaton Flat Area (East Fork Scenic Overlook to Heaton Flat).

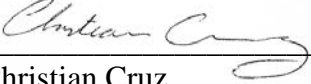
This project includes some of the most heavily utilized recreational destinations within the San Gabriel Mountains. The SGC Project focuses on visitor access, amenities, and utilization of recreational opportunities within the region. Over the years, heavy use has had a negative impact on the environment including damage to vegetation, soil compaction and erosion, on-site litter, and stream alteration. This Project aims to develop recreation infrastructure to better manage recreation use and balance the needs for resource protection.

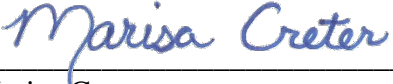
In August 2016, the project was awarded \$125,000 in funding to support youth engagement activities, including environmental and conservation education. The funding is being used to deploy youth (aged 16 to 24) on-site outreach along the East Fork of the San Gabriel River during high-use recreational periods. This outreach is focused on trash abatement and reducing in-stream modifications and habitat damage.

Rob Romanek, Project Manager from the WCA, will present an update on this project.

# REPORT

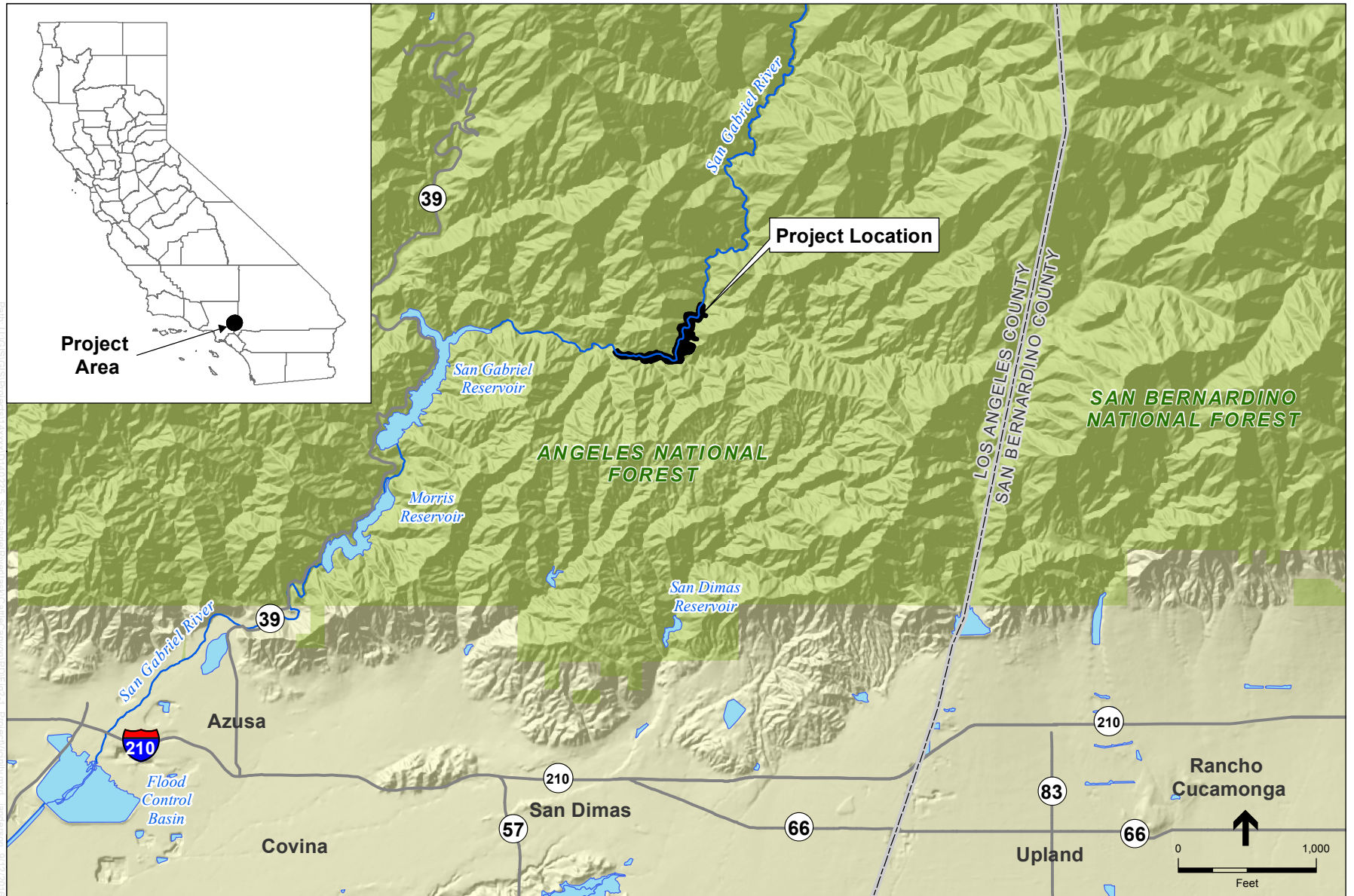
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Prepared by:   
Christian Cruz  
Management Analyst

Approved by:   
Marisa Creter  
Assistant Executive Director

## **ATTACHMENTS**

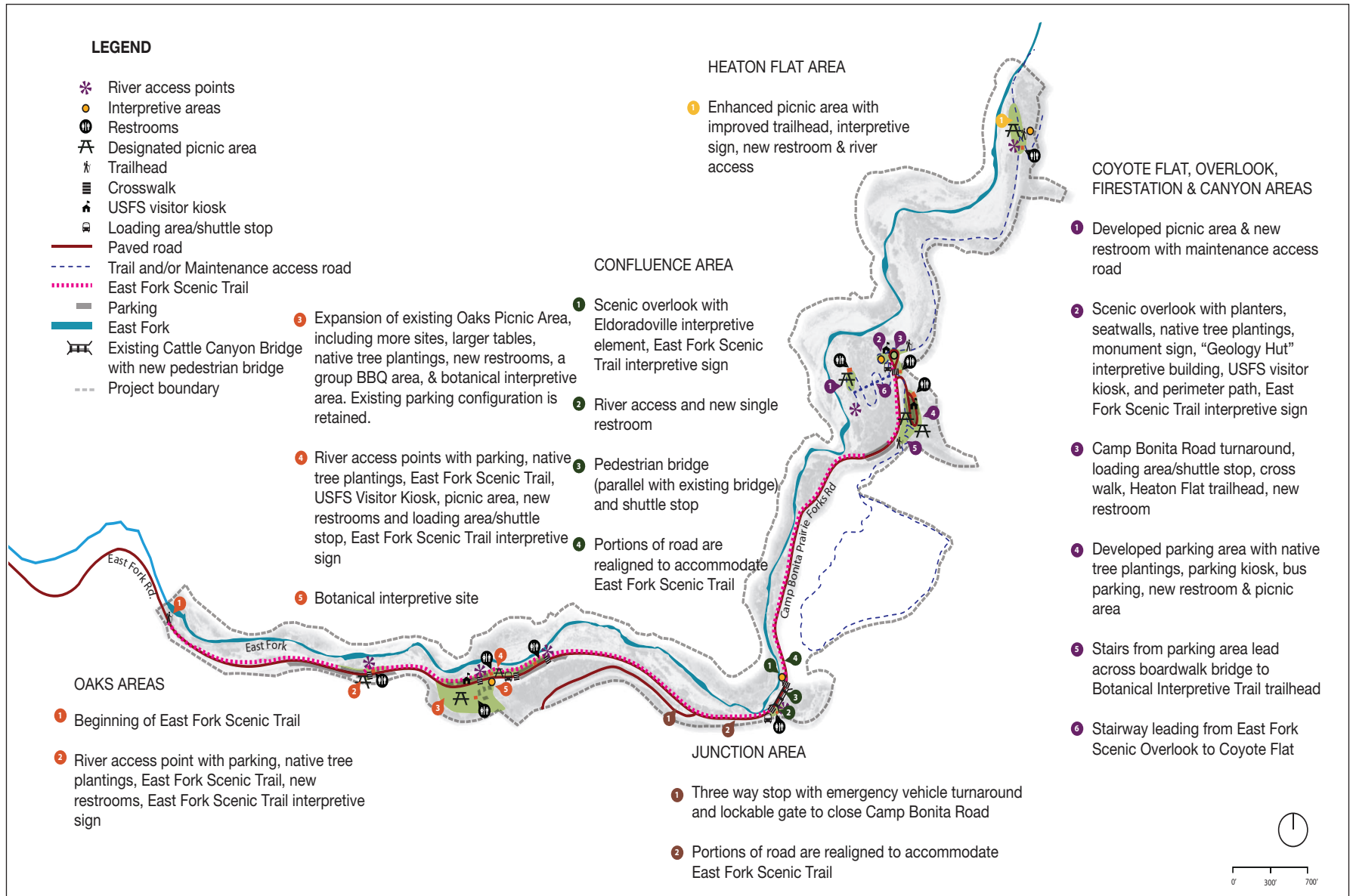
Attachment A – SGC Project Map



SOURCE: USGS; Glendora Topoquad

Cattle Canyon Project. 140225

**Figure 1**  
Project Vicinity



SOURCE: BlueGreen Consulting

Cattle Canyon Project . 140225

**Figure 2**  
Conceptual Site Plan

DATE: February 15, 2017

TO: Energy, Environment and Natural Resources Committee

FROM: Phil Hawkey, Executive Director

RE: **CLEAN WATER THROUGH OYSTERS AQUACULTURE DEVELOPMENT**

## **RECOMMENDED ACTION**

For information only.

## **BACKGROUND**

The Clean Water through Oyster Aquaculture Development Project (CWOAD) is intended to address water quality issues in the Los Angeles coastal areas by constructing oyster reefs that will filter water and remove pollutants. The primary pollutants of concern in the proposed waters are toxic materials, metals, and bacteria. Oysters are able to remove heavy metals, such as zinc and copper, as well as toxins from the surrounding water. There have been three similar large-scale projects in New York Harbor, San Francisco Bay, and Chesapeake Bay; and several smaller scale projects that have introduced oysters into the ecosystem to enhance habitat and improve water quality.

The areas that the CWOAD project is focusing on include the Dominguez Channel, Los Angeles River, the Colorado Lagoon, the Marina del Rey, and Cabrillo Beach. Phase I of the Project seeks to conduct a feasibility analysis to determine if the construction of oyster reefs in suitable areas will have meaningful improvement in water quality. If the establishment of oysters is found to be feasible, then Phase II and Phase III will construct oyster reefs. The goals of the Phase I Feasibility study are as follows:

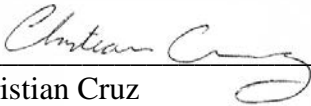
- Gather available information on specific habitat requirements and factors affecting success of reef projects;
- Identify potential areas where reefs can be constructed without affecting marine traffic or creating an attractive nuisance in popular beach areas;
- Collect water quality and habitat data in identified areas meeting the above objective that appear to have suitable habitat to determine if required habitat constituents are present at the sites;
- Identify a subset of sites that have the greatest potential to support the construction of reefs.
- Determine if sufficient native spat is available to seed beds; if not, identify potential sources of Olympia oyster seed;
- Determine if the oysters can remove pollutants at a high enough rate to improve water quality;
- Evaluate options for disposal of harvested and tainted oysters; and
- Evaluate the overall feasibility of the project and develop recommendations for next steps.


# REPORT

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A draft report will be developed at the end of Phase I and it will discuss the potential for natural colonization of oysters and will identify the best locations for the construction of oyster reefs. The report will address whether meaningful levels of water quality improvement can be attained through this project.

Antonio Gonzalez, President of the William C. Velasquez Institute, will present an overview of this project.

Prepared by:   
Christian Cruz  
Management Analyst

Approved by:   
Marisa Creter  
Assistant Executive Director

## **ATTACHMENTS**

Attachment A – CWOAD Proposal

A WCVI Proposal

# Clean Water through Oyster Aquaculture Development (CWOAD)

A Public Health, Clean Water and STEM Initiative

September 2016



## Introduction

America's coastlines and marine habitats have often been contaminated by commercial activity and urban runoff. Fortunately efforts abound to reverse this trend by mitigating practices and policies that pollute the coastal environment and cause risks to public health.

LA County is no exception to either of these trends. Shipping, refining and other industrial activities in the Los Angeles and Long Beach harbor areas have long contaminated water. Moreover, urban runoff from the Los Angeles and San Gabriel Rivers contributes additional pollutants that endanger public health. The areas that the CWOAD project is focusing on include the Dominguez Channel, Los Angeles River, the Colorado Lagoon, the Marina del Rey, and Cabrillo Beach (Figures 1, 2, and 3). For the purposes of this proposal, any actions in the Los Angeles River will be deferred to a later date after the ongoing restoration projects in the river are complete and it has been determined that additional actions in the Los Angeles River estuary will not interfere with other efforts.

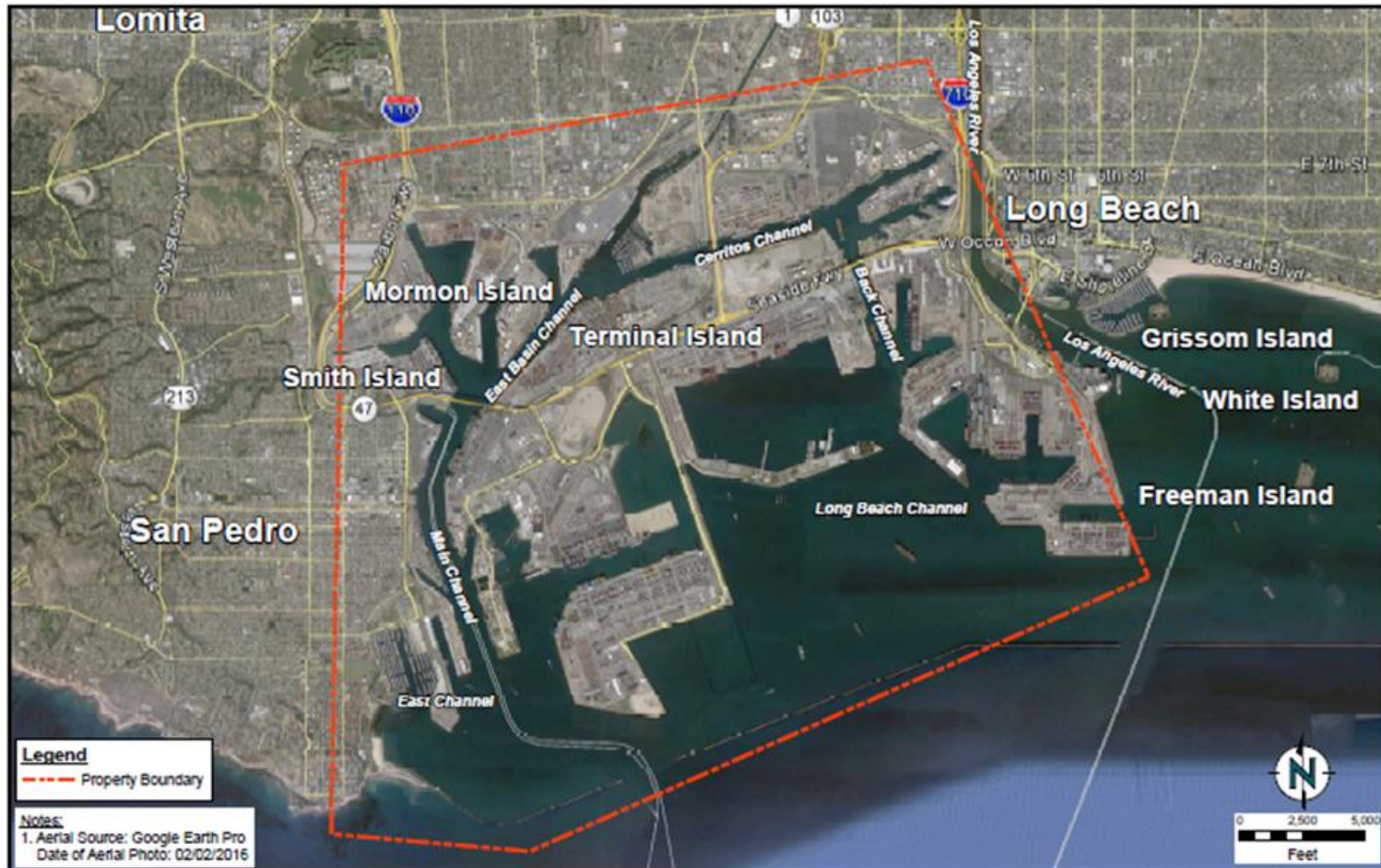
The Clean Water through Oyster Aquaculture Development (CWOAD) is intended to address water quality issues in the Los Angeles coastal areas by constructing oyster reefs that will filter water and remove pollutants. Oysters are filter-feeding bivalves that historically formed reefs or beds in estuaries throughout temperate latitudes, including the southern California Coast. The oysters themselves and the reefs they build can provide a number of important ecosystem benefits including filtration of the water column, enhanced denitrification rates, enhancement of fish stocks, and coastal protection (Ermgassen et al. 2012, Grizzle et al. 2008, Newell et al. 2002, Peterson et al. 2003, Scyphers et al. 2011, Gili and Coma 1998; Prins et al. 1998).

## Background

### Oysters as Filterers/Ecological Engineers


Three large-scale (New York Harbor, San Francisco Bay, and Chesapeake Bay) and several smaller scale projects have introduced oysters into the ecosystem to enhance habitat and improve water quality. Many of the projects undertaken to date have focused on the benefits of increased filtration on reduction of phytoplankton and on the uptake of nutrients (e.g., Rossi-Snook et al. 2010). Filtration results in the deposition of organic and inorganic particles to the bottom of the estuary, which leads to enhanced denitrification rates in the sediments (Newell et al. 2002), and the enhanced richness and abundance of benthic macrofauna and microbes due to the increase in food abundance (Norkko et al. 2001; Nocker et al. 2004). Furthermore, sediment nutrient enrichment (Booth and Heck 2009) and the increased water clarity resulting from the removal of suspended organisms tends to promote the growth of submerged aquatic vegetation (Newell and Koch 2004), which is a critical nursery habitat for a wide range of marine species (Heck et al. 2003). Therefore, filtration is a critical component of ecosystem function.

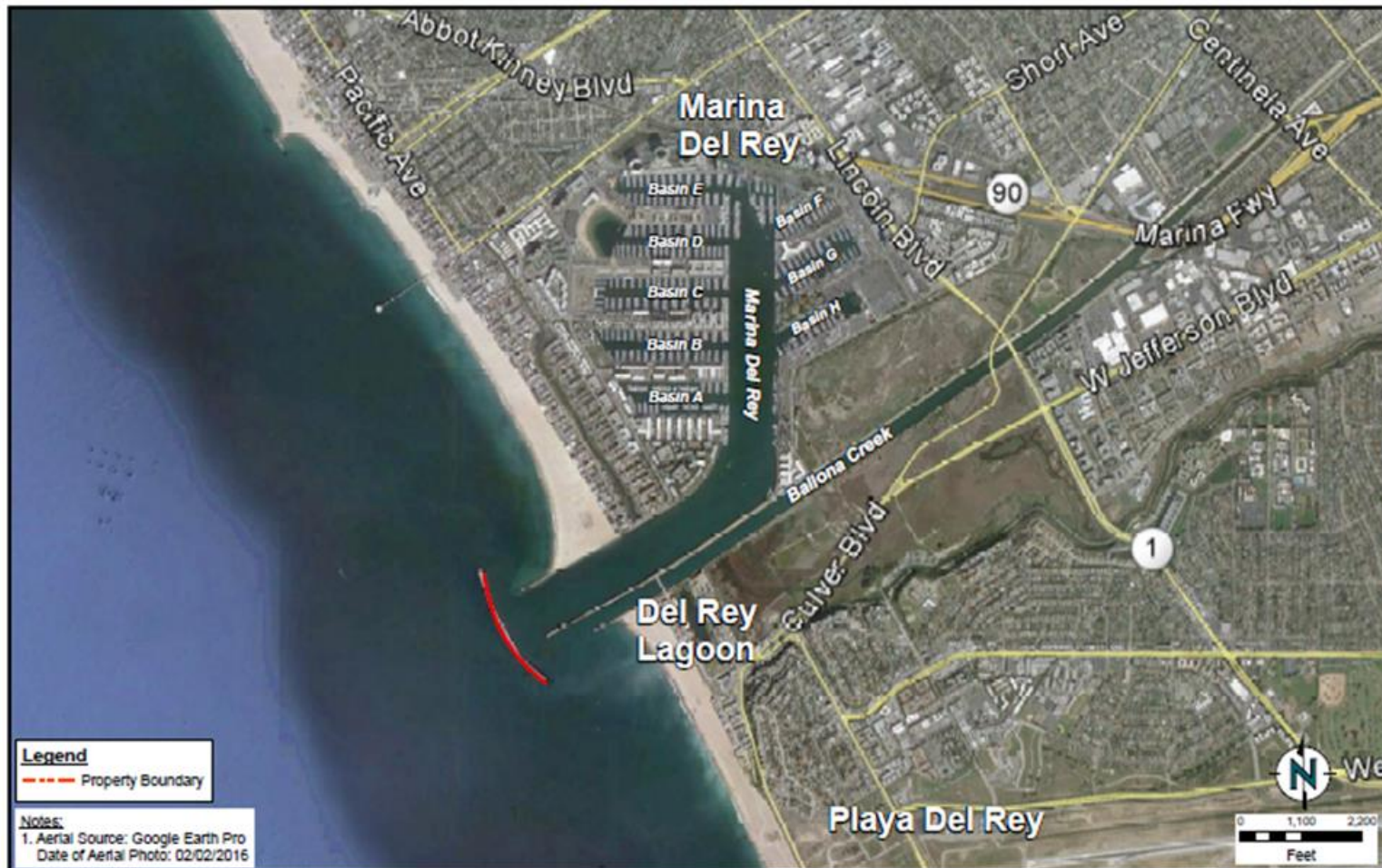
Ermgassen et al. (2012) estimated the filtration rate of the pre-commercial exploitation population of Olympia oysters at in Washington State approximately 36 percent of the waters within the estuaries they evaluated. The results of the Ermgassen et al. (2012) study also suggest that filtration rates of the Olympia oyster are highest in a temperature range between 68 to 86°F (20 and 30°C). Therefore, the filtration rate would likely be higher in the warmer waters offshore of Los Angeles due to the higher water temperatures.



<p>DRAFTED BY: Mfisher      Date: 02/02/2016</p>	<p><b>Cabrillo Beach and Dominguez Channel Candidate Locations</b></p>	<p>Figure <b>1</b> PROJECT DORALIVE</p>
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 <p>DRAFTED BY: M.Fisher      Date: 6/27/2016</p>	<p>Colorado Lagoon Candidate Locations</p>	<p>Figure 2</p> <p>PROJECT: 00RAMLVE</p>
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	<h3>Marina Del Rey Candidate Locations</h3>	<p>Figure <b>3</b></p>
<p>DRAFTED BY: M.Fisher      Date: 9/27/2016</p>		<p>PROJECT: DORAM/LIVE</p>

The primary pollutants of concern in the proposed waters for the establishment of oyster reefs are toxic materials, metals, and bacteria. Oysters are able to remove heavy metals, such as zinc and copper, as well as toxins from the surrounding water (Quayle 1969, Suryawanshi et al. 2011, Bu-Olayan and Subrahmanyam 1996, Heideri et al. 2013, Lee et al. 1996) and in many parts of the world are used to track applications of dangerous chemicals such as DDT (Liebezeit et al. 2011, Ju et al. 2009, Castañeda-Chávez et al. 2011). In general, oysters tend to bioaccumulate metals in proportion to the concentration present in local sediments (Hardiman and Pearson 1995, Sanders 1984, Va'zquez-Sauceda et al. 2007, Siva et al. 2010). Oysters are also known to bioaccumulate bacteria. Bacteria density in oysters can be as much as 4.5 times as high as the concentrations in the surrounding water (Scott et al. 1982). Cressman (2003) found fecal coliform bacteria to decrease by as much as 45 percent with the presence of oyster reefs.

Removal of contaminants such as metals was not included in the goals of prior projects that established oyster reefs. The removal of nutrients through filtration of plankton is well understood. Therefore, this project would represent the first known use of oysters for that purpose. Given the novelty of this approach, our proposal includes an evaluation of the potential range of pollutant removal that may be attained as a function of the concentration of pollutants in the various locations under evaluation. This is discussed further, below.

#### Water Quality Issues in the Proposed Project Area

The pollutants found in the Dominguez Channel, the Colorado Lagoon, the Marina del Rey, and Cabrillo Beach include ammonia, copper, cadmium, lead, mercury, chromium, nutrients, bacteria, dichlorodiphenyltrichloroethane (DDT), polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs), 2-methylnaphthalene, Benzo(a)pyrene (3,4-benzopyrene-7-d), benzo(a)anthracene, chlordane, chrysene, dieldrin, phenanthrene, pyrene, toxaphene, and zinc (Table 1; California Water Resources Control Board 303(d) list, [http://www.waterboards.ca.gov/water\\_issues/programs/tmdl/integrated2010.shtml](http://www.waterboards.ca.gov/water_issues/programs/tmdl/integrated2010.shtml)).

**Table 1. Pollutants listed under the California Water Resources Control Board 303(d) list by location.**

Location	303(d) Category	Pollutants	Approved TMDL Date	Scheduled Date for TMDL Approval
Cabrillo Beach - Inner	5	DDT, bacteria, PCBs	2004 (bacteria)	2019
Cabrillo Beach - outer	5	DDT, bacteria, PCBs	2003 (bacteria)	2019
Cabrillo Marina	5	Benzo(a)pyrene (3,4-benzopyrene-7-d), DDT, PCBs		Benzopyrene: 2021 (Benzopyrene), 2019 others
Colorado Lagoon	5	Chlordane, DDT, dieldrin, bacteria, lead, PAHs, PCBs, zinc		2019
Dominguez Channel	5	Ammonia, Benzo(a)pyrene (3,4-benzopyrene-7-d), benzo(a)anthracene,	2007 (coliform bacteria)	2019 others

Location	303(d) Category	Pollutants	Approved TMDL Date	Scheduled Date for TMDL Approval
		chlordan, chrysene, coliform bacteria, DDT, dieldrin, lead, PCBs, phenanthrene, pyrene, zinc		
Marina del Rey	5	Chlordane, copper, DDT, dieldrin, bacteria, lead, PCBs, zinc	2004-2006	The toxic pollutants TMDL is currently being revised <sup>1</sup>

1/ [http://www.waterboards.ca.gov/water\\_issues/programs/tmdl/#rb4](http://www.waterboards.ca.gov/water_issues/programs/tmdl/#rb4)

## Purpose and Need

The need to improve water quality in the Los Angeles harbors and coastal areas is apparent. Oysters have the ability to accumulate substantial quantities of pollutants. We are proposing to determine if the construction of oyster reefs in suitable areas is feasible and to determine if meaningful improvement in water quality can be attained. Establishment of oyster beds in Los Angeles' estuaries will have additional benefits including the provision of habitat for fish, invertebrates, and birds, and protection of shorelines from wave action. If the establishment of oysters is found to be feasible (Phase I and II of the project), and reefs are constructed (future phases of the project), oyster reefs would be posted in many languages to warn of contamination. Oysters would also be harvested regularly and either disposed of in a proper landfill or potentially used in animal feed (dependent upon the level of contamination in the oysters) to permanently remove contaminants from the local environment.

## Approach

The project is intended to be conducted in phases, starting with a Phase I feasibility analysis. This proposal covers that phase of the project. If, upon completion of the Phase I feasibility project, we find that the project appears to be feasible, additional funding will be sought to complete Phase II which would include a small scale test of installations to determine the best installation methods and to ensure that the information collected in Phase I is correct. If the results of the first two phases indicate that a larger scale project would be successful and would remove substantial pollutants, Phase III would be implemented, including installation of a larger number of oyster reefs. Phase I has been scoped in detail and is described below. Phases II and III are not yet scoped in detail, but are described generally following the description of the Phase I study. We anticipate that the results of the Phase I study will affect the scoping of Phases II and III. We also recognize that Phases II and III may not be conducted if the results of Phase I do not indicate that the project is feasible.

## Phase I: Feasibility Analysis

The specific goals and objectives of the Phase I feasibility analysis are the following:

- Gather available information on specific habitat requirements and factors affecting success of reef projects.

- Identify potential areas where reefs can be constructed without affecting marine traffic or creating an attractive nuisance in popular beach areas.
- Collect water quality and habitat data in identified areas meeting the above objective that appear to have suitable habitat to determine if required habitat constituents are present at the sites.
- Identify a subset of sites that have the greatest potential to support the construction of reefs.
- Determine if sufficient native spat is available to seed beds; if not, identify potential sources of Olympia oyster seed.
- Determine if the oysters can remove pollutants at a high enough rate to improve water quality.
- Evaluate options for disposal of harvested and tainted oysters.
- Evaluate the overall feasibility of the project and develop recommendations for next steps.

If the Phase I feasibility analysis finds that the installation of oyster reefs is feasible and is likely to improve water quality, testing of methods to install the reefs, reef construction, and monitoring of success will likely be completed in future Phases of the project.

The Phase I feasibility analysis will be completed in 6 tasks. Descriptions of these tasks are provided below.

### **Task 1. Gather Existing Information**

The existing literature and available databases will be reviewed. The intent of this review will be to determine what is currently known regarding the habitat requirements of oysters, current habitat conditions in the proposed estuaries, and the known distribution of oysters in the area. As part of this task, we will also interview persons involved in other oyster reef projects across the country and oyster growers on the Pacific coast.

The intent of this review will be to determine what is currently known regarding:

- Habitat associations of Olympic and Pacific oysters,
- Existing information on habitat conditions including flow, salinity, tidal fluxes, dissolved oxygen, temperature, nutrients, sediment transport, and pollutants at the four potential locations,
- Known distribution of existing populations of oysters within a reasonable distance from the project area that may provide natural sources of oyster spat,
- The relative advantages and disadvantages of various approaches to providing oyster substrate, including but not necessarily limited to reef balls, riprap, mini-reefs of oyster shells within bags, placement of large shell reefs, or suspension of chains or necklaces of oyster shell above the bottom,
- Other efforts conducted to establish oyster reefs, with special attention to conditions that resulted in successes and failures, and
- Additional information gained through interviews with growers on the Pacific coast.

Betsy Peterson of Puget Sound Restoration Fund, who has led the efforts in restoring Olympia oysters to Puget Sound, has agreed to assist with the project. We will also learn from the experience of the Billion Oyster Project in New York City as well as other efforts in Chesapeake Bay, Puget Sound, and the San Francisco Bay Area.

In addition to gathering existing information, the growers at existing oyster production facilities and organizations such as the Pacific Coast Shellfish Growers Association will be contacted to gather additional information. Specifically, we will be asking for information on the following:

- Additional information on habitat requirements of Olympic and Pacific oysters, including susceptibility to increasing acidity of ocean waters;
- Additional information and insights regarding successes and failures in efforts to establish oyster reefs or oyster grow operations in open water, the approaches that seem to work the best, lessons learned about deployment and maintenance of placed substrates, recruitment success, and other comments they may have regarding establishing oyster populations;
- The potential availability of adult oysters or spat, including the seasonality and the quantity of availability;
- The potential to utilize existing facilities to get a head start on growing oysters to release size.

A report summarizing the information attained under this task will be developed.

### **Task 2. Determine Preliminary Set of Potential Installation Sites**

The first step in this task will be to map potential sites from aerial photographs. We will be looking for little used areas, back bays, and other locations out of the way of commercial and recreational port and marina traffic and locations that are not near public water access areas such as beaches, parks, schools, and boat ramps. During this process, we will also be interviewing port, marina, and park representatives to get their input. We have visited the sites once already and feel that there is a reasonably good potential that viable sites can be found in each of the study areas.

Once a map of potential areas has been developed, we will then visit potential sites by boat to take notes on boat traffic, water depth, obvious habitat constituents or habitat deterrents (e.g. marine vegetation or sewage outfalls). This site visit will likely eliminate a number of potential sites, resulting in a set of more realistic potential sites. New York's Billion Oyster Project and the Chesapeake Bay Oyster project have each developed guidelines for selection of sites suitable for installation of oyster reefs. We will use the information collected during the site visits and the site selection guidance document to identify a set of sites that appear to have the greatest potential for installation of oyster reefs. These sites will be candidates for further site monitoring. Final site selection will also be dependent upon the support of local land managers. Once a final list of candidate sites has been developed, we will select up to three sites in each of the four study areas (Dominguez Channel, Cabrillo Beach, Marina del Rey, and Colorado Lagoon) which represent the sites that appear to have the greatest potential to successfully support oyster reefs.

The deliverable for this task will be a document summarizing the findings completed in this task. The document will include pictures of sites determined to be candidates for further evaluation.

### **Task 3. Documentation of Physical Conditions at Potential Sites to Determine if Suitable Habitat Conditions are Present**

The site visit alone will not provide sufficient information to determine the adequacy of the subset of sites (identified in task 2) for installation of oyster reefs. We will need additional information regarding water quality and sediment flux at the sites. Water quality is important since we need to ensure that salinity, dissolved oxygen, and temperature are in a suitable range and sediment flux is important since we need to ensure that the installations will not get buried in sediment deposited at the site. We propose to install monitoring stations that will document flow, salinity, dissolved oxygen, and temperature at the sites (up to 12 sites) identified in Task 2. We also propose to install equipment that will document the sediment flux in the project area. These stations will be monitored for one year.

In addition to the monitoring stations, we propose to conduct one year of quarterly sampling of the environmental conditions in the study area. Samples collected will include flow, salinity, dissolved oxygen, temperature, nutrients, and water quality samples to test for pollutants. The flow, salinity, dissolved oxygen, and temperature information will be used to calibrate and validate the samples collected by permanently installed monitoring equipment. Water quality samples will be submitted to a State of California approved laboratory for analysis and will provide information regarding other chemical constituents in the water that may affect survival and/or growth of oysters in the project area. While in the field, we will also download data from the continuously recording equipment and conduct maintenance of that equipment as needed.

Existing information on habitat conditions and habitat requirements of Olympic and Pacific oysters and new site-specific information will be used to identify locations where habitat conditions are present in the project vicinity that are appropriate to support oyster production.

The deliverable for this task will be a report documenting the physical and chemical properties of each site. All laboratory information, including QA/QC samples, will be appended to the report. The report will list the best candidate sites for deployment of oyster reefs in the study areas.

#### **Task 4. Determination of Existing Distribution of Olympic and Pacific Oysters**

If oysters are currently present within a reasonable distance of the project area, it may be possible to rely upon natural recruitment of oyster spat on artificial substrates established in the estuary. Natural beds of Olympia and Pacific oysters are known to occur in the Los Angeles area. Local oyster spat is preferred. We propose to conduct surveys along the shorelines of the estuaries and the coast of the Pacific within a reasonable distance of the project area to determine where populations of Olympic and Pacific oysters occur. To help minimize costs, these surveys will coincide with one or more of the quarterly water quality sampling events.

The deliverable for this task will be a memo summarizing the locations of beds of Olympia and Pacific oysters identified during the surveys.

#### **Task 5. Evaluation of Potential Water Quality Benefits of Installing Oyster reefs**

The feasibility analysis needs to address not only the feasibility of establishing reefs, but also the expected improvements in water quality. If meaningful reductions in pollutants cannot be attained, then the project as a whole may not be feasible for the purposes of removal of pollutants.

We propose to conduct a literature search and also collect existing data on accumulation of toxins by mollusks as a function of the concentration of toxins in the water they occupy. The preference will be to collect data on accumulation of toxins in oysters, but we suspect that such information may be sparse. Hence, we will expand the literature search to other similar species. The Mussel Watch program (<https://data.noaa.gov/dataset/national-status-and-trends-mussel-watch-program>) collects information on toxins in mussels all along the Pacific and Atlantic coasts. This data may be valuable in bracketing the likely range of toxin accumulation as a function of the concentrations of toxins in the water s occupied by mussels. We will define the rate of toxin accumulation in terms of unit area or volume of mussels/oysters.

Assuming that reefs can be established, we will use the information gained from the literature search and the evaluation of existing data to estimate the area or volume of reefs that would be necessary to remove substantial quantities of pollutants in Los Angeles area estuaries. If substantial removal of pollutants does not appear to be feasible, the project will recommend no further evaluation. If substantial removal of pollutants appears to be feasible, tables will be

developed summarizing the area or volume of reefs that would need to be installed to attain various levels of pollutant reduction.

The range of expected toxin uptake and the area/volume of oysters that would be required to attain meaningful improvements in water quality will be evaluated relative to the locations identified in Tasks 2 through 4 that are found to be feasible for the installation of reefs. If the only locations that appear to be feasible for installing reefs have water quality that is relatively low in toxins, the expected benefits to water quality may be low. On the other hand, if sites appear to be feasible where water quality is poor, the benefits to water quality would be expected to be higher. The evaluation of potential improvements in water quality will take into consideration the locations of likely viable sites for reef installation.

A report summarizing the results of this task will be developed.

### **Task 6. Draft and Final Report**

A draft report will be developed that incorporates the reports completed at the end of Tasks 1 through 5. The report will summarize existing information on habitat conditions and habitat requirements of Olympic and Pacific oysters, and new site-specific information. The report will discuss the potential for natural colonization and will identify the best locations for the construction of oyster reefs. The report will address the likelihood of attaining meaningful levels of water quality improvement. Finally, the report will provide recommendations for the next phase(s) of the project. The Draft report will be circulated to appropriate reviewers and a Final document will be developed which incorporates the reviewers' comments.

## **Phase II: Testing and Validating Results of Feasibility Study**

Phase II of the project will only be conducted if the results of Phase I indicate that installation of oyster reefs to improve water quality is feasible. Phase II will validate the Phase I results through the installation and monitoring of a small number of test reefs. The objectives of Phase II include:

- Determine the best approach(es) to constructing oyster reefs
- Determine if survival of oysters is in the range anticipated
- Determine if accumulation of pollutants are as expected
- Initiate involvement of local schools
- Conduct public outreach regarding the testing sites

### **Task 1: Permitting and Agency Interactions**

The installation of test reefs will require permits. At minimum, we anticipate the need for approval from the National Marine Fisheries Service for compliance with the Endangered Species Act, permits from the Corps of Engineers in compliance with Sections 404 and 10 of the Clean Water Act, Coast Guard approval and permits, and various state and county permits. Permit applications and discussions with the agencies will commence early in the Phase II stage.

During the discussions with the pertinent agencies, we will also discuss Phase III of the project to determine if Phase III can be permitted and to determine the likely permit conditions and restrictions that would be placed on the Phase III stage. Permitting conditions are an important consideration related to the feasibility of the project. Early discussions with the agencies will also explore the possibility of designating the population of oysters planted in the estuaries as experimental populations, exempt from consideration as a beneficial use. The intent of the project is to develop populations of oysters that are intentionally exposed to contaminants and are intended to bioaccumulate pollutants to reduce the pollutant loads in the water bodies they

occupy. As such, the oysters are expected to contain contaminant levels in excess of standards for biotic tissues.

### **Task 2: Collection of Spat from Native Sources**

If native oysters are present and collection permits can be attained, we will collect spat in the field which will be brought to an existing oyster hatchery to initiate growth of oysters in preparation for the Phase II test deployment of young oysters in the estuaries.

### **Task 3: Testing of Potential Approaches to Placement and Growing of Oysters**

The purpose of this task is to determine which approaches for constructing oyster habitats with suitable substrate are most likely to be successful in the project area. Once the approaches to constructing oyster habitat that appear to be most viable have been identified, we propose to install small test installations to further determine the likely success of the various possible approaches. Several approaches (e.g. reef balls, bags of shells etc.) will be employed at several locations. The installations will be monitored for one year to determine if oysters have settled onto the substrate, to determine the viability of any recruited oysters, and to determine the short-term longevity of the installed facilities.

### **Task 4: Testing of Bioaccumulation Rate of Oysters in the Test Installations**

During the one year test period, oysters will be collected from each of the study areas on a quarterly basis and tested for the pollutants of concern in the study area. The rate of uptake will be determined. We will also document any change in the rate of uptake over time. Optionally, we may consider further testing the uptake rate within a laboratory setting. The uptake rates will be compared to the expected range of uptake rates identified in Phase I of this study to determine if the bioaccumulation in situ is similar or different from the expected range of rates. If accumulation is less than expected, the feasibility of the project will be reconsidered using methods outlined in Phase I of the project.

### **Task 5: Developing Hatchery as Part of STEM Program**

Even though natural recruitment of spat may be feasible, we will develop a hatchery at a participating local high school as a science, technology, engineering, and mathematics (STEM; <http://innovation.ed.gov/what-we-do/stem/>) project in order to involve students through experiential learning and to speed up the development of the oyster beds. We will use the New York City Billion Oyster Project as a model of decentralized hatcheries located in local schools. We will also review germane permitting issues. This task will likely be funded through a different funding source than the rest of the Phase II tasks.

### **Task 6: Development of Action Plan for Installation of Beds**

If the test plots indicate that survival of oysters is expected to be satisfactory and that the uptake of pollutants is expected to be high enough to result in a meaningful reduction of pollutants with a population that is reasonably achievable, we will develop an action plan for installation of oyster beds. The action plan will address the following:

- Preferred Locations
- Implementation of Phase III Operations
- Spat Sources
- Substrate
- Timing
- Continued testing
- Monitoring
- STEM project involvement/coordination

- Managing Harvest of Oysters

If the test plots indicate that survival of oysters is expected to be unsatisfactory and/or that the uptake of pollutants is not expected to be high enough to result in a meaningful reduction of pollutants with a population that is reasonably achievable, Phase III will not be implemented.

### Task 7: Reporting

A draft and final report covering the outcomes of the phase II study will be developed. The report will include documentation of methods and locations used to collect spat, methods used to deploy test reefs, survival of oysters, biological conditions throughout the test period around the test reefs, bioaccumulation rates within the oysters, an assessment of whether the bioaccumulation rates are likely to result in a meaningful reduction on pollutants if Phase III of the project is completed, and recommendations for Phase III, which may include recommendations to discontinue the project and/or documentation of the recommended action plan.

### Phase III

Phase III will be implemented only if the testing and information gathering conducted in Phases I and II indicate that the project is feasible and is likely to successfully reduce pollutants. The overall goals and objectives of Phase III are:

- Install oyster reefs at a scale that is likely to improve water quality in the sites determined to be feasible in Phases I and II. All installed reefs will be located away from easy access areas and will be posted in several languages to indicate that the oysters are not to be consumed due to the unacceptable level of toxins.
- Improve water quality in the Los Angeles area estuaries, specifically in the Dominguez Channel, Colorado Lagoon, Marina del Rey, Cabrillo Beach, and (in the future) the Lost Angeles River estuary.
- Create areas of improved habitat for fish, invertebrates and birds
- Provide educational and training opportunities to children in disadvantaged communities through involvement with the STEM program (science, technology, engineering, and mathematics) program (<http://www.stemedcoalition.org/>).

A detailed scope and budget for this task has not been developed. We anticipate that the lessons learned in Phases I and II will likely have a significant effect on the scope and budget for Phase III.

### Budget

The budget for Phases I and II are detailed below. Lessons learned in Phase I will likely affect the Phase II budget; therefore, the Phase II budget is not provided in as great of detail and is likely to change once Phase I has been completed. As was indicated previously, Phase II will not be implemented if Phase I indicates that the overall project is not likely to be feasible as measured by survival of the oysters and the overall expected effect of the full project on water quality in the study areas.

Table 1. Phase I budget. Completion dates assume funding in the fall of 2016. If funding as attained at a later date, all completion dates will slide to reflect the time funding is attained.

Task #	Task	Completion Date	Total Cost
1	Gather Existing Information	Spring 2017	\$43,550

2	Determine Preliminary Set of Potential Installation Sites	Spring 2017	<b>\$14,800</b>
3	Documentation of Physical Conditions at Potential Sites to determine if Suitable Habitat Conditions are Present	Install equipment in summer, 2017, complete summer 2018	<b>\$67,430</b>
4	Determination of Existing Distribution of Olympic and Pacific Oysters	Summer and fall, 2017	<b>\$20,080</b>
5	Evaluation of Potential Water Quality Benefits of Installing Oyster reefs	Summer, fall, 2018	<b>\$12,000</b>
6	Draft and Final Report	Fall, 2018	<b>\$ 16,500</b>
<b>TOTAL</b>			<b>\$174,360</b>

Table 2. Phase II budget.

Task #	Task	Total Cost
1	Remitting and agency interactions	<b>\$66,000</b>
2	Collection of spat from native sources	<b>\$15,000</b>
3	Testing of potential approaches for placement and growing of oysters	<b>\$61,000</b>
4	Testing of bioaccumulation rate of oysters in test installations	<b>\$12,000</b>
Optional Task 4 subtask	Testing of bioaccumulation rate of oysters within a laboratory setting	<b>\$50,000</b>
5	Developing a hatchery as part of the STEM program	<b>\$175,000</b>
6	Development of action plan for installation of oyster beds (phase III)	<b>\$15,000</b>
7	Draft and Final Report	<b>\$ 16,000</b>
<b>TOTAL</b>		<b>\$410,000</b>

## Project Team

The project team is continuing to grow as project planning proceeds. The primary scientists of the project team from Ramboll Environ include Greg Reub, Brian Hester, Domoni Glass, and Colin Ray. Brief biosketches for each of these scientists are provided below. We have received messages indicating that the Conservation Corps of Long Beach are available to assist with Phase I of the project. Specifically, they are interested in assisting with water testing and site analysis. Betsy Peterson of Puget Sound Restoration Fund, who led the efforts in restoring Olympia oysters to Puget Sound, has verbally agreed to assist with the project.

**Greg Reub** is a fisheries biologist with over 30 years of experience related to environmental assessment, mitigation, and restoration of natural resources, with special emphasis on habitat alterations of the aquatic environment. Mr. Reub has been involved in assisting numerous shellfish farming companies comply with environmental regulations and the development of Best Management Practices for the past 10 years. He has provided technical leadership, analysis, reporting and monitoring and expert witness services. He was responsible for the first Biological Assessment for a consortium of geoduck farmers and has assisted with permitting and compliance issues. He has also provided support related to oyster and mussel cultivation. The major issues have involved water quality, biodiversity, sensitive species and at times, social and economic effects. Greg is also the owner of a shellfish production business. Most recently he has worked closely with state and federal agencies and private companies (including NOAA Fisheries and U.S. Fish and Wildlife Service), providing environmental compliance services related to the Endangered Species Act, NEPA, Magnuson-Stevens Fishery Conservation and Management Act, Marine Mammal Protection Act, Coastal Zone Management Act, Fish and Wildlife Coordination Act, and other applicable federal laws and executive orders. Mr. Reub earned an M.A. in Ecology and Systematic Biology from San Francisco State University, has a B.S. in Wildlife and Fisheries Sciences with a Minor in Chemistry, and maintains several professional certifications and memberships.

**Brian Hester** is an expert in marine, estuarine, and freshwater toxicological evaluations (waters and sediment). He is also the laboratory director for Ramboll Environ ecotoxicology facility in Port Gamble, WA. He also performed evaluations of dredged materials, Toxicity Identification Evaluations (TIE), and contaminant and non-contaminant stressors, in addition to toxicity-testing methods development. Brian is experienced in field collection of sediments and biological samples, and data analysis and statistical testing. Other related research he has done involved the using aquatic organisms as biosensors to indicate the presence of contaminants of interest.

**Domoni Glass** is an aquatic ecologist with over 30 years of experience in natural resource assessment and management, management of complex projects, and statistical analysis. Domoni has worked with a wide variety of industries completing assessments of environmental effects on aquatic resources and providing assistance with project permitting in California and other states. She has worked extensively in marine and freshwater environments. She has worked with private, public and aboriginal entities in the development of watershed assessments, water quality cleanup plans, habitat restoration projects, and other land use planning efforts. Domoni earned an M.S. in Fisheries from the University of Washington, completed 5 years of graduate studies at the same university, and maintains several professional certifications and memberships.

**Collin Ray** has ten years of experience in field and laboratory research in marine, estuarine, and freshwater environments. Mr. Ray leads laboratory programs including testing procedures and analyses: use of spectrophotometers; water quality analyses; marine and freshwater bioassays and maintenance of in-house cultures of organisms. All testing is done in compliance with USEPA standards. He is skilled in the use of sediment core and grab sampling devices, and diver-operated core samplers. Mr. Ray is experienced in collecting marine animals for use in laboratory biological assessments and chemical analyses.

## Project Experience

Ramboll Environ is a premier global consultancy, trusted by clients to manage their most challenging environmental, health, and social issues. Over the last 30 years, we have earned a reputation for technical and scientific excellence, innovation, and client service. We apply integrated, multi-disciplinary services and tailor each solution to our client's specific needs and challenges, with an independent, science-first approach that ensures that the strategies we develop and the advice we provide are both objective and defensible.

Ramboll Environ is functionally linked to Ramboll Group's network of experts, which includes more than 12,000 employees across 300 offices in 30 countries around the world. Ramboll Environ provides clients a wide range of strategic and technical support services, including:

- Impact Assessment and Mitigation Planning
- Biodiversity Studies/Ecosystems Services Assessments
- Sustainable Development Support Services
- Water Quality Management
- Air Quality Management
- Ecological Impacts Management
- Compliance Assurance Planning and Assistance
- Carbon Management
- Industrial Hygiene & Safety
- Corporate Social Responsibility
- Energy & Environmental Technology

- Integrated Industrial Wastewater Management
- Risk Assessment & Risk Management
- Waste Management
- Occupational Health and Safety Sciences

From a global network of offices and affiliates, Ramboll Environ and Ramboll Group have successfully completed projects in more than 100 countries.

The project team includes a set of individuals with expertise in study design, statistical analysis, bioaccumulation studies, shellfish operations, and permitting within the State of California. Ramboll Environ was previously involved in the San Francisco and Sacramento River Delta oyster projects and has conducted environmental assessments in marine and estuarine environmental throughout western United States, including Los Angeles area estuaries.

Ramboll Environ also has wealth of experience in conducting bioaccumulation and toxicity studies with marine, estuarine and freshwater invertebrates and fish. In addition to routinely conducting standardized tests on an array of freshwater and marine organisms, we also develop and employ test methodology with new end-points. We conduct hundreds laboratory bioaccumulation and toxicity studies with clams, mussels, and shellfish each year, evaluating the uptake and effects of a wide variety of contaminants of concern. With both static and flow-through seawater capabilities in our laboratory, we are able to emulate a variety of field conditions in order to better understand contaminant-organism relationships. We conduct field and laboratory bioaccumulation studies to support site-specific assessments of bioavailability and tissue burden for use in risk assessments. As an example, we conducted an evaluation of the bioaccumulation and growth effects of organophosphorus pesticides in adult oysters. This program required the modification of standard methods and the used of specialized diluter systems to provide continuous exposures and the development of shell-growth endpoints.

Examples of some of Ramboll Environ's project experience is provided below.

## Natural Resource Assessment and Restoration

### San Francisco Bay & Sacramento River Delta Living Shoreline Project

The San Francisco Bay and Sacramento River Delta Living Shorelines Project was a multi - objective habitat restoration pilot project managed and funded by the State Coastal Conservancy. The project included collaboration with scientists from San Francisco University, U.S. Geological Survey Western Ecological Research Center, and Ramboll Environ. Other funding partners included U.S. EPA and the San Francisco Estuary Partnership, the Wildlife Conservation Board, and NOAA Fisheries. The project was intended to help implement several of the research and restoration recommendations in the San Francisco Bay Sub-tidal Habitat Goals Report ([www.sfbaysubtidal.org](http://www.sfbaysubtidal.org)). This was a pilot project. The experimental restoration work included construction of artificial reefs using 'home-made' concrete balls and bags filled with oyster shells and planting of eelgrass beds. The work was conducted to learn more about the best locations and techniques for supporting native oyster and promoting the growth and expansion of eel grass beds, gather information about fish, invertebrate, and bird use of the reefs, and assess whether the reefs can provide physical benefits such as reducing wave action and protecting adjacent shorelines. With support from partners and the local community, Ramboll Environ constructed and 'planted' artificial reefs offshore from the Marin Rod & Gun Club, at the City of Berkeley pier and in the southern portion of San Francisco Bay. Monitoring work was conducted periodically by Ramboll Environ and other partners to quantify

oyster recruitment and the growth of eel grass beds, as well as note the benefits to other aquatic organisms.

### **Biological Evaluation of Geoduck Aquaculture Activities to ESA-listed Species, Essential Fish Habitat and Forage Fish in Puget Sound**

ENVIRON has completed numerous biological evaluations to support new farm permits throughout Puget Sound. The various projects focused on the influence of direct and indirect impacts from shellfish aquaculture within Puget Sound. Some of the issues addressed include invertebrate community distribution, salmonid and forage fish utilization, migration of turbidity plumes, nutrient availability, temperature differences, and a host of other water quality parameters. The projects have involved development of Best Management Practices (BMPs) and allowed for a platform that combines sustainable farming practices, community involvement, and water quality issues within Puget Sound.

### **Port of Los Angeles and Long Beach: PCB and DDX Sediment TMDL Special Studies**

The ports of Los Angeles and Long Beach contracted Ramboll Environ to help characterize the contribution of harbor sediments to observed tissue concentrations in resident fish in the harbor. Ramboll Environ designed and implemented a study to evaluate the contribution of sediment associated PCBs and DDX to resident fish. Selected fish species, invertebrates and sediment were collected from a variety of areas throughout the harbor and analyzed for PCBs and DDX. This data will be used in conjunction with a separate fish tracking study (conducted by Long Beach State University) evaluating real-time fish movement and behavior for targeted species in the harbor to parameterize a spatially explicit exposure model and develop more realistic estimates of the contribution of harbor sediment to observed fish tissue concentrations. These results will then be used to develop focused management actions to improve water quality and reduce contaminant concentrations in fish.

### **Environmental Review, Umami Sustainable Seafood, Inc., Mexico and Croatia**

Umami operates bluefin tuna farms, consisting of two land-based processing facilities (in Ensenada, Baja California, Mexico and near the Dalmatian Islands, Croatia), as well as eight marine farming locations (two in Mexico and six in Croatia). ENVIRON reviewed the land-based operations for 1) an Environmental Site Assessment (ESA) that meets the substantive requirements of ASTM International's Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process E-1527-05 (the "ASTM Standard"; to the extent possible for international sites); and 2) a limited compliance review (LCR) of environmental matters and asbestos-containing materials (see Attachment A for a detailed scope of work). For the Company's marine fishing sites in Croatia and Mexico, Ramboll Environ examined; 1) fisheries management [e.g., impacts of the operations on the populations of bluefin tuna, the associated feeder fish, and other potentially affected marine and benthic organisms]; 2) potential impacts on the surrounding environment [e.g., by parameters such as nutrients and dissolved oxygen]; and 3) compliance with state, regional, and federal permitting obligations.

### **Evaluation of Habitat Conservation Plans and Programmatic Biological Assessments for Examination of Aquaculture Industry Compliance Options Taylor Shellfish Farms.**

Ramboll Environ personnel assisted in examining options for Endangered Species Act Compliance for their Washington State Operations. Taylor Shellfish is the largest aquaculture operation on the West Coast and wanted to examine the advantages and disadvantages of the different ESA compliance options available to them. Ramboll Environ personnel briefly reviewed well over 500 Habitat Conservation Plan summaries (e.g. Biological Opinions or agency summaries) and then extracted more detailed information from a subset of those HCPs. Examples of the relevant

issues examined include Covered Species (number and type), Covered Area, Covered Activities, duration of plan, types of effects/take, Conservation Measures, and response of Services to proposed plan.

**Programmatic Biological Assessment, (BA) Intertidal Geoduck Culture, Geoduck growers consortium (Taylor Shellfish, Chelsea Farms and Seattle Shellfish).**

Ramboll Environ personnel completed the development of a Programmatic Biological Assessment to address the potential impacts from the existing and envisioned intertidal culture of geoduck clams in Puget Sound. The geographic area is generally the south Puget Sound area of Washington. We are employing a two-phased approach to provide a cost effective and flexible approach to this permitting exercise. Existing data sources are acquired, reviewed and analyzed for their projected relevance to the proposed action, and the potential impacts to rare species and essential fish habitat.

**Evaluation of the Use of Activated Carbon in Enhanced Natural Recovery Amendments, Lower Duwamish River**

In order to evaluate remedial options for the Lower Duwamish River CERCLA site, Ramboll is conducting a pilot study to evaluate the potential effectiveness of enhanced natural recovery (ENR) layers with and without the addition of activated carbon for reducing the bioavailability of PCBs. Side-by-side half-acre plots of ENR and ENR with activated carbon were placed in intertidal, subtidal, and scour plots in the Lower Duwamish River. The availability of PCBs is being evaluated for three years following ENR and ENR-AC placement using SPME fibers and laboratory exposures of clams and polychaete. The recovery of the benthic community is being evaluated using sediment profile imagery (SPI) and benthic community sampling and analysis. The findings of this study will provide direct input in the proposed remedy for the site.

**Endangered Species Act Compliance Support for Washington DNR State-Owned Aquatic Lands—Habitat Conservation Plan Technical Assistance**

ENVIRON provided support to Washington Department of Natural Resources (WDNR) for development of the NEPA EIS for their State Owned Aquatic Lands (SOAL) Habitat Conservation Plan. ENVIRON staff directed the development of Conservation to provide Section 10 Endangered Species Act compliance support to the Washington Department of Natural Resources This project examined activities and species over 2.4 million acres (Pacific Ocean, Puget Sound, rivers and lakes) and developed an innovative model to quantify effects of activities and benefits from conservation measures.

As part of this project, five major technical documents were prepared: Covered Species, Covered Habitat, Covered Activities, Potential Effects and Conservation Measures and Expected Outcomes. For the Covered Species Technical Report, the team evaluated current and historic distribution, population status, habitat use and factors affecting continued existence for 87 aquatic species across the State of Washington. The Covered Habitat Report characterized important marine and freshwater habitats for approximately 2.4 million acres encompassed by SOAL. The Covered Activities Technical Report characterized the type, size, timing and location of over 4,000 uses authorized by Washington DNR. The team also developed an innovative habitat-based approach for describing the level of take and related impacts on habitat and species resulting from activities authorized by Washington DNR on SOAL.

**Marine Environmental Impact Assessment, Candelaria Copper Mine, Northern Chile.**

ENVIRON staff completed marine environmental studies for the Candelaria Copper Mine Project in northern Chile, South America, to determine potential impacts and site location for a major copper

transport facility. The studies were focused on establishing baseline conditions and conducting long-term monitoring for biological, chemical and toxicological aspects of the water, sediments, and biota.

### **Chinook River Restoration Project, Ducks Unlimited, Lower Columbia River, WA.**

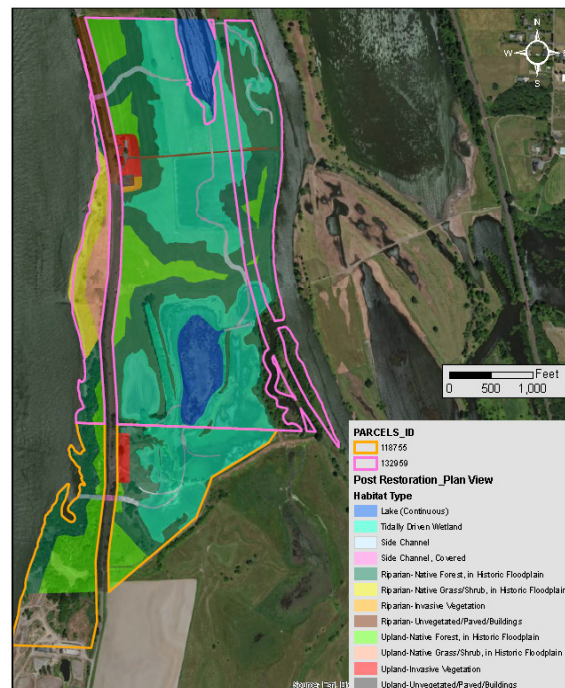
Ramboll Environ conducted the hydraulic and engineering feasibility assessment of conceptual restoration alternatives for a habitat restoration project in the lower Columbia River basin. The project site consisted of approximately 1,050 acres of estuarine and riparian wetlands surrounding a complex network of tidal channels. The project objective was to recover the natural wetlands habitat by restoring tidal flows through the study area. Collected data and performed water resource modeling to develop predictive hydrologic and hydrodynamic models and evaluate the feasibility of the proposed restoration actions. The calibrated models were applied for the proposed alternate configurations to predict the flows, velocities, and water surface elevations to help identify the best restoration option available.

### **Economic Analysis of Nature Based Adaptation to Climate Change – Ventura County, CA**

Ramboll Environ worked with The Nature Conservancy (TNC) as part of their Coastal Resilience Ventura project to evaluate alternative climate change adaptation strategies. The goal of the project is to analyze all economic costs and benefits of nature-based and engineering-based adaptation alternatives for Ventura County. The approach uses changes in the ecosystem service levels for both alternatives including habitat, recreation, and erosion prevention. The built environment is being evaluated for flood and hazard damages as well as regional economic losses. The team is working closely with stakeholders representing city governments, state agencies, emergency managers, and the US Navy. ENVIRON is providing literature reviews on various economic tools that may be used to evaluate climate change, and approaches to estimating baseline conditions.

### **Round Lake Habitat Banking Credit Analysis**

The Round Lake project involves the development of appropriate habitat credit values to be used in a habitat bank. The bank is intended to be used to offset impacts to Chinook salmon in the Columbia River estuary. Credits for habitat improvements are calculated and available for purchase to offset impacts of other projects on species of federally listed salmonids under the Endangered Species Act. ENVIRON completed a Habitat Equivalency Analysis (HEA) under a contract to AECOM. The mitigation bank is being developed in cooperation with National Marine Fisheries Service. The project site is separated from the Columbia River by a levee. Two proposed levee breaches combined with site grading and vegetation enhancement and management will be used to restore site hydrology, provide access to rearing habitat for juvenile salmonids, and enhance this restored habitat. These actions will convert Round Lake, which is a shallow, isolated lake, into side channel and floodplain habitats. Installation of native vegetation will increase food production and



structure to support aquatic species. The combination of restoring tidally driven hydrology and restoring riparian and upland habitats will provide the habitat lift that supports the credits.

**West Hayden Island Mitigation Strategy and Concepts, Port of Portland, Portland, Oregon**

The Port of Portland planned to redevelop 800 acres of West Hayden Island into a mixed use parcel that includes a marine industrial terminal (300 acres) and a recreational/ wildlife preserve (500 acres). Ramboll Environ investigated mitigation concepts and prepared a report and drawings that presented two conceptual mitigation plans for negotiations with the City of Portland. These concepts were developed, in part, based on available geospatial data and our hydrodynamic and sediment transport modeling study results. Ramboll Environ modeled the two mitigation scenarios to estimate how they would evolve through time in order to assess short- and long-term stability and maintenance needs. As part of this effort, we evaluated several alternatives with regard to dredging requirements, hydraulic connectivity, and potential risk to adjacent properties. Fourteen habitat types were examined and analyzed for different mitigation actions. Habitat and overlay analyses were used to determine impacts.

**Environmental Effects of Aquaculture in Mid-Norway – Norwegian Seafood Federation, Norway**

Ramboll establish documentation of environmental effects as a result of the aquaculture activity in Mid - Norway. This type of documentation is a prerequisite for an objective and rational assessment of today's operations, and as a rational basis for an assessment of how the industry might evolve further in the region. The project will help the fish farming companies certified for the ASC standard to document environmental impact of salmon farming. The Mid – Norway region produces 225 000 metric tons salmon. Activities include monitoring escaped farmed salmon in regional fjord systems and rivers, establishment of simulation models for water currents and predict inter-farm sea lice and virus spreading, documentation of effects on eutrophication, and documentation of effects on close to farm and distant seabed recipients.

**Permitting**

Ramboll Environ’s NEPA and environmental permitting specialists have extensive experience developing and managing Environmental Impact Statements and Environmental Assessments, and meeting various Federal, state and local permitting requirements. By drawing on the combined skills of our experts, we are uniquely able to provide powerful decision support advice for regulatory compliance, mitigation and alternative solutions for clients throughout the United States.

The firm’s specialists have managed client projects for compliance with NEPA, Endangered Species Act (ESA), Clean Water Act (CWA), Clean Air Act (CAA), Oil Pollution Act (OPA, California Environmental Quality Act (CEQA) and other state and federal regulations. Our scientists and engineers provide investigation, assessment and remediation services in air, terrestrial and aquatic environments, including lakes, rivers and coastal marine and estuarine areas. Services offered in this complex arena are used to support varied regulatory requirements such as FERC power plant licensing, HUD regulations (24 CFR Part 58), ESA Section 7 consultations, waterfront development permit applications and other local, state and federal regulatory programs.

Examples of some of the projects undertaken by Ramboll Environ that required permitting and permit knowledge are provided below.

**Southern California Gas Company Permitting and Regulatory Compliance**

ENVIRON staff supported Southern California Gas Company with natural resource permitting and regulatory compliance for gas company operations and maintenance projects throughout Southern and Central California. Primary responsibilities included preparing California Department of Fish and Game Streambed Alteration Agreements and Clean Water Act 404 applications for projects within jurisdictional waters, participating in informal Section 7 consultations with US Fish and Wildlife Service and the US Forest Service, consulting with the Army Corps of Engineers for jurisdictional determinations, and conducting surveys for state and federal listed species.

#### **City of Richmond – Chevron Refinery Modernization Project**

Ramboll Environ led a multi-disciplinary technical team in analyzing a broad range of environmental issues and developing a full environmental impact report (EIR) in compliance with CEQA for the Chevron Richmond refinery in California. Ramboll Environ also authored the air quality (including health risk), GHG, biological resources, energy, noise and public safety sections of the EIR. Our experts participated in regular weekly internal meetings with city and Chevron technical staff, subcontractors and external counsel during this three-year process. In addition, Ramboll Environ participated in public outreach, including attending public workshops and meetings with the mayor and city council members. The EIR was certified in July 2014 and approved by city council in August 2014.

#### **Port of Los Angeles: SoCal Intl Gateway EIR CEQA**

Ramboll Environ assisted the Port of Los Angeles in preparing a state of California environmental impact report (EIR) for the planning, design, construction and operation of a near-dock intermodal rail facility. Ramboll Environ managed the overall EIR CEQA process, including managing a team of subcontractors involved in developing various environmental resource area analyses, developing documentation for the overall EIR, managing the EIR production and certification process, and public engagement. We assisted the port through the successful completion of the draft EIR, recirculated draft EIR, final EIR and Board of Harbor Commissioners' certification of the document.

#### **San Diego Unified Port District: Climate Action Plan**

Ramboll Environ led the preparation of a climate action plan for the Port of San Diego. Our experts drafted technical appendices, and prepared the GHG inventory for baseline (2006) and future (2020, 2035 and 2050) Port-related sources, including operations (e.g., ocean going vessels, recreational boating, rail and trucks) and other Port tenant operations (e.g., industrial, shipbuilding, lodging and commercial). Ramboll Environ worked with San Diego Gas and Electric (SDGE) to develop updates to the 2012 GHG inventory. Staff identified, evaluated and quantified applicable GHG mitigation measures. Evaluation criteria included timeframe, reduction potential, cost, technical feasibility and co-benefits. Ramboll Environ assisted the Port in selecting emissions reduction targets, and quantified mitigation measures to help the Port reach emissions reduction targets. We developed a draft implementation and monitoring plan for tracking progress of GHG mitigation and adaptation, performed a vulnerability assessment and risk analysis for sea level rise impacts on Port tidelands, and identified and evaluated adaptation strategies. Ramboll Environ also provided guidance on issues related to the California Environmental Quality Act (CEQA), and assisted with public outreach by attending meetings, responding to questions, and preparing presentations and agenda items.

#### **Tensas Parish Port Project**

Ramboll Environ performed a site review for the proposed Tensas Port Project in north-central Louisiana to evaluate potential permitting or approval constraints or issued that would hinder development into a port complex. This review included potential cultural resources, threatened

and endangered species, contamination issues, air and water discharge permitting issues, wetland and levee crossing permits, and other siting considerations.

**Rentech Biofuels Facility**

**Port of Kalama Expansion Project**

Ramboll Environ completed an environmental assessment of the potential impacts of the construction of a proposed new liquid natural gas (LNG) processing facility and a new terminal berth at the Port of Kalama, in Washington State, USA. The site is located within the Columbia River estuary and is tidally influenced. The project would require extensive dredging to deepen the channel at the site of the new terminal berth. The environmental assessment included an evaluation of potential impacts on air quality, wetlands, terrestrial resources (including one bird listed under the U.S. Endangered Species Act (ESA)), and aquatic resources. The aquatic resources of greatest concern included 11 salmon populations, green sturgeon, and eulachon, all of which are listed as threatened or endangered under the ESA. The actions that were evaluated included the construction and operation of the new berth and the LNG facility, dredging, and the movement of ships into the port. Concerns regarding dredging included disturbance of critical habitat for threatened or endangered species, noise effects on fish and terrestrial species, and sediment (turbidity) effects on fish, including effects on migration patterns. Concerns regarding the construction of the terminal berth were primarily related to the displacement of habitat, potential attraction of aquatic predator species, the potential for accidental spillage of toxic materials into the water, and short term turbidity and noise effects. Shipping concerns included wake stranding of juvenile fish and the potential to introduce non-native species through ballast water or on ship hulls. The project proponent designed numerous actions and features that would minimize the potential impacts and also proposed construction of fish and wildlife habitat to offset impacts to important species. As mitigated, Ramboll Environ concluded that the project may affect, but would not significantly affect the threatened and endangered species in the project area.

**NEPA/CEQA/EIR/EIS, Proposed Use of Rotenone in Lake Davis, California Department of Fish and Game. Lake Davis, California.**

Ramboll Environ examined ecological and human health risks from the proposed use of rotenone to eradicate illegally introduced northern pike from a reservoir in the headwaters of the Sacramento River drainage. Ramboll Environ participated in public meetings to discuss findings, and communicate risks. Staff used standard ecological and human health risk assessment paradigms to estimate exposure and risks to fish, wildlife and sensitive human populations, and characterized risks relative to NEPA/CEQA thresholds for significant impacts.

## Citations

- Baker P. 1995. Review of ecology and fishery of the Olympia oyster, *Ostrea lurida* with annotated bibliography. J Shellfish Res 14:501–518.
- Birch, G.F., A. Melwani, J.-H. Lee and C. Apostolatos. 2014. The discrepancy in concentration of metals (Cu, Pb and Zn) in oyster tissue (*Saccostrea glomerata*) and ambient bottom sediment (Sydney estuary, Australia). Marine Pollution Bulletin 80 (2014) 263–274.
- Booth, D.M., and K.L. Heck Jr. 2009. Effects of the American oyster, *Crassostrea virginica*, on growth rates of the seagrass *Halodule wrightii*. Mar Ecol Prog Ser 389:117–126
- Bu-Olayan, A.H. and M.N.V. Subrahmanyam. 1996. Accumulation of copper, nickel, lead and zinc by snail, *Lunellu coronatus* and pearl oyster, *Pinctada radiata* from the Kuwait coast before and after the gulf war oil spill. The Science of the Total Environment 197 (1997) 161-165.
- Castañeda-Chávez, Ma del Refugio, F. Lango-Reynoso, C. Landeros-Sánchez. 2011. DDT in *Crassostrea virginica* (Gmelin, 1791) of Coastal Lagoons in the Gulf of Mexico. Journal of Agricultural Science Vol. 3, No. 1; March 2011.
- Cook, A.E., J.A. Schaffer, B.R. Dumbauld, and B.E. Kauffman. 2000. A plan for rebuilding stocks of Olympia oysters (*Ostreola conchaphila*, Carpenter 1857) in Washington State. J Shellfish Res 19:409–412.
- Cressman, K.A. 2003. Effects of intertidal oyster reefs on water quality in a tidal creek estuary. Master Thesis, Department of Biological Sciences. Univ. NC, Wilmington, NC. <https://libres.uncg.edu/ir/uncw/f/cressmank2003-1.pdf>.
- Elsy, C.R. 1935. On the structure and function of the mantle and gill of *Ostrea gigas* (Thunberg) and *Ostrea lurida* (Carpenter). Trans R Soc Can 29 (V):131–158.
- Ermgassen, P.S.E., M. W. Gray, C. J. Langdon, M. D. Spalding and R. D. Brumbaugh. 2013. Quantifying the historic contribution of Olympia oysters to filtration in Pacific Coast (USA) estuaries and the implications for restoration objectives. Aquatic Ecology. 47(2):149-161. <http://link.springer.com/article/10.1007/s10452-013-9431-6>.
- Gibson, G. 1974. Oyster mortality study: Summary report 1966-1972. US Department of Commerce, National Marine Fisheries Service.
- Gili J-M, R. Coma. 1998. Benthic suspension feeders: their paramount role in littoral marine food webs. Trends Ecol Evol 13:316–321.
- Grizzle R.E., J.K. Greene, and L.D. Coen. 2008. Seston removal by natural and constructed intertidal eastern oyster (*Crassostrea virginica*) reefs: a comparison with previous laboratory studies, and the value of in situ methods. Estuar Coast 31:1208–1220.
- Grizzle, R.E., J. Lodge, K. Moser-Smith, and P. Malinowski. 2013. Oyster restoration research project (ORRP) Final Technical Report. ORRP Phase I: experimental oyster reef development and performance results. [http://www.hudsonriver.org/download/ORRP\\_Phase1.2013.pdf](http://www.hudsonriver.org/download/ORRP_Phase1.2013.pdf).

- Hardiman, S. and B. Pearson. 1995. Heavy metals, TBT and DDT in the Sydney rock oyster (*Saccostrea commercialis*) sampled from Hawkesbury River estuary, NSW, Australia. Marine Pollut Bull. 30(8):563-567.
- Heck, K.L. Jr, G. Hays, and R.J. Orth. 2003. Critical evaluation of the nursery role hypothesis for seagrass meadows. Mar Ecol Prog Ser 253:123–136.
- Heck K.L. Jr, G. Hays, and R.J. Orth. 2003. Critical evaluation of the nursery role hypothesis for seagrass meadows. Mar Ecol Prog Ser 253:123–136.
- Heirderi, B., A.R. Bakhtiari, and g. Shirneshan. 2013. Concentrations of Cd, Cu, Pb and Zn in soft tissue of oyster (*Saccostrea cucullata*) collected from the Lengeh Port coast, Persian Gulf, Iran: A comparison with the permissible limits for public health. Food Chemistry 141 (2013) 3014–3019.
- Hochachka, P., and G. Somero. 2002. Biochemical Adaptation. Mechanism and Process in Physiological Evolution. Oxford University Press, New York.
- Hwang, H. M., H.-M. Hwang, R. S. Carr, G. N. Cherr, P. G. Green, E. D. Grosholz, L. Judah, S. G. Morgan, S. Oglef, V. K. Rashbrook, W. L. Rose, S. J. The, C. A. Vines, and S. L. Anderson. 2013. Sediment quality assessment in tidal salt marshes in northern California, USA: an evaluation of multiple lines of evidence approach. Science of the Total Environment 454:189-198.
- Ju L. Gan, Xiao P. Jia, Ting Jia, Qinlin And Wen G. Cai. 2009. Distribution and change of DDT and HCH levels in oysters (*Crassostrea rivularis*) from coast of Guangdong, China between 2003 and 2007. Journal of Environmental Science and Health Part B (2009) 44, 817–822
- Kellogg, J.L. 1915. Ciliary mechanisms of lamellibranchs with descriptions of anatomy. J Morphol 26:625–701.
- Latta, M. and K. Boyer. 2012. The San Francisco Bay Living Shorelines: Nearshore Linkages Project. Produced for the State Coastal Conservancy by ESA PWA. <http://scc.ca.gov/webmaster/ftp/pdf/restore-shoreline/sfbay-living-shorline-project-052412.pdf>.
- Latta, M. and K. Boyer. 2015. The San Francisco Bay Living Shorelines: Nearshore Linkages Project. Summary of Key Findings Two Years Post-installation April 30, 2015. <http://www.sfbaylivingshorelines.org/SF%20Bay%20Living%20Shorelines%202014%20Monitoring%20Summary.pdf>.
- Leibezeit, G., D. Brepohl, J. Rizzi, F. Guebert, M. Krome, E. Machado, and U. Pijanowska. DDT in Biota of Paranaguá Bay, Southern Brazil: Recent Input and Rapid Degradation. Water Air Soil Pollut (2011) 220:181–188.
- Lodge, J., R. Grizzle, L. Coen, A. Mass Fitzgerald, M. Comi, and P. Malinowski. 2015. Community Based Restoration of Oyster Reef Habitat in the Bronx River: Assessing Approaches and Results in an Urbanized Setting. Final Report of the NOAA/WCS Regional Partnership Grant, New York, NYMcGraw, K.A. 2009. The Olympia oyster, *Ostrea lurida* (Carpenter 1864) along the West coast of North America. J Shellfish Res 28:5–10.
- Newell R.I.E., and E.W. Koch. 2004. Modeling seagrass density and distribution in response to changes in turbidity stemming from bivalve filtration and seagrass sediment stabilization. Estuaries 27:793–806.

- Newell R.I.E., J.C. Cornwell, and M.S. Owens. 2002. Influence of simulated bivalve biodeposition and microphytobenthos on sediment nitrogen dynamics: a laboratory study. *Limnol Oceanogr* 47:1367–1379.
- Nocker, A, J.E. Lepo, and R.A. Snyder. 2004. Influence of an oyster reef on development of the microbial heterotrophic community of an estuarine biofilm. *Appl Environ Microbiol* 70:6834–6845. doi:[10.1128/AEM.70.11.6834-6845.2004](https://doi.org/10.1128/AEM.70.11.6834-6845.2004).
- Norkko A., J.E. Hewitt, S.F. Thrush, and G.A. Funnell. 2001. Benthicpelagic coupling and suspension-feeding bivalves: linking site-specific sediment flux and biodeposition to benthic community structure. *Limnol Oceanogr* 46:2067–2072.
- Peabody, B., K. Griffin. 2008. Restoring the Olympia oyster, *Ostrea conchaphila*. *Habitat Connections* 6:1–6.
- Peter-Contesse, T, and B. Peabody. 2005. Reestablishing Olympia oyster populations in Puget Sound, Washington. Puget Sound Restoration Fund.
- Peterson, C.H., J.H. Grabowski, and S.P. Powers. 2003. Estimated enhancement of fish production resulting from restoring oyster reef habitat: quantitative valuation. *Mar Ecol Prog Ser* 264:249–264. doi:[10.3354/meps264249](https://doi.org/10.3354/meps264249).
- Peterson C.H., J.H. Grabowski, and S.P. Powers. 2003. Estimated enhancement of fish production resulting from restoring oyster reef habitat: quantitative valuation. *Mar Ecol Prog Ser* 264:249–264. doi:[10.3354/meps264249](https://doi.org/10.3354/meps264249).
- Polson M.P., D.C. Zacherl. 2009. Geographic distribution and intertidal population status for the Olympia oyster, *Ostrea lurida* (Carpenter 1864), from Alaska to Baja. *J Shellfish Res* 28:69–77.
- Prins T, Smaal A, Dame R (1998) A review of the feedbacks between bivalve grazing and ecosystem processes. *Aquat Ecol* 31:349–359
- Quayle, D.B (1969). *Pacific oyster culture in British Columbia*, p. 23. First Edition. Ottawa: The Queen’s Printer.
- Remane, A., and C. Schlieper. 1971. *Biology of brackish water*. E. Schweizerbart’sche Verlagsbuchhandlung Stuttgart, Germany.
- Rossi-Snook K., G. Ozbay, and F. Marengi. 2010. Oyster (*Crassostrea virginica*) gardening program for restoration in Delaware’s Inland Bays, USA. *Aquacult Int* 18:61–67.
- Sanders, M. 1984. Metals in crab, oysters, and sediment in two South Carolina estuaries. *Maine Pollut Bull.* 15(4):159-161.
- Scott, G.I., T.I. Sammons, D.P. Middaugh, and M.J. Hemmer. 1982. Impacts of water chlorination and coliform bacteria on the American oyster, *Cassostrea virginica* (Gmelin). In: W.B. Vernberg, A. Calabrese, F.P. Thurberg, and F.J. Vernberg (eds.). *Physiological Mechanisms of Marine Pollutant Toxicity*. Academic Press, NY.
- Scyphers, S.B., S.P. Powers, K.L. Heck, and D. Byro. 2011. Oyster reefs as natural breakwaters mitigate shoreline loss and facilitate fisheries. *PLoS ONE* 6:e22396.
- Siva, P.R.M., C.J. Hardaway, and J. Sneddon. 2010. Determination of cadmium, chromium, copper, iron, lead, and zinc in oysters from southwest Louisiana by inductively coupled plasma-optical emission spectrometry. *Instrumentation Science and Technology*, 38:448–457.

- Stafford, J. 1915. The native oyster of British Columbia. Report of the British Columbia Commission of Fisheries, pp 141–160.
- Stenzel, H.B. 1971. Oysters. In: Moore RC (ed.) Treatise on invertebrate paleontology, part N. University of Kansas Press, Kansas, pp 953–1224.
- Suryawanshi, G.D., A.M. Shaikh, and U.H. Mane. 2011. Heavy metals concentration in rock oyster *Crassostrea cattuckensis* from Ratnagiri coast. J. Ecophysiol. Occup. Hlth. 11(2011) 175-180.
- Vázquez-Sauceda, M. G. Aguirre-Guzmán, J. G. Sánchez-Martínez, and R. Pérez-Castaneda. 2011. Cadmium, Lead and Zinc Concentrations in Water, Sediment and Oyster (*Crassostrea virginica*) of San Andres Lagoon, Mexico. Bull Environ Contam Toxicol (2011) 86:410–414.
- Wasson, K., C. Zabin, J. Bible, E. Ceballos, A. Chang, B. Cheng, A. Deck, T. Grosholz, M. Latta, and M. Ferner. 2014. A guide to Olympia oyster restoration and conservation environmental conditions and sites that support sustainable populations in central California. UC Repro Graphics. San Francisco, CA. [http://www.sfbaysubtidal.org/PDFS/Oysterreport-10\\_7-2014.pdf](http://www.sfbaysubtidal.org/PDFS/Oysterreport-10_7-2014.pdf).
- White, J.M., J.L. Ruesink, and A.C. Trimble. 2009. The nearly forgotten oyster: *Ostrea lurida* (Carpenter 1864) (Olympia oyster) history and management in Washington State. J Shellfish Res 28:43–49.

## **Appendix A: Resumes**

Resumes for Key Ramboll Environ staff are provided. Additional team members may be identified as the project planning expands.

# DOMONI R GLASS

## Manager 9

Domoni Glass is a fisheries biologist with over 30 years of experience in natural resource assessment and management, and has managed numerous complex and controversial projects. Domoni has worked with a wide variety of industries completing assessments of environmental effects on aquatic resources and providing assistance with project permitting. She has worked extensively in marine and freshwater environments. She has also worked extensively with private, public and aboriginal entities in the development of watershed assessments, water quality cleanup plans, and other land use planning efforts. She has frequently facilitated agreements among public and private, including several highly controversial efforts.

### EDUCATION

**Graduate Studies, Natural Resource Management**  
University of Washington

**BS, Fisheries Biology**  
University of Washington

### EXPERTISE

- Endangered Species Act
- Conservation Planning
- Water Resource & Watershed Planning
- Fisheries and Aquatic Habitat
- Water Quality

### SELECTED PROJECT EXPERIENCE

- *Port of Kalama Expansion Project:* Completed an assessment of the effects of a port expansion project in the Columbia River estuary on marine and freshwater species, including 13 populations listed under the U.S. Endangered Species Act. Project included construction and operation of a new port facility which required dredging.
- *Due Diligence Assessment for Offshore Tuna Net Pen Facilities:* Conducted an environmental review of two tuna net pen projects located in Mexico and Croatia. The review consisted of reviewing permits and permit compliance documents to determine if the parent company was in compliance with environmental requirements. Also completed an evaluation to determine whether environmental or endangered species issues may become a liability to future operations.



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- *Los Angeles Oyster Re-introduction Project*: Currently participating in a program intended to reintroduce oysters to the estuaries in the Los Angeles area. To date, the project has included a review of potential reintroduction methods and the estimated quantity of pollutants that oysters may uptake in the area.
- *Endicott Causeway Investigation*: Manager of a large multi-year aquatic resource investigation conducted on Alaska's North Slope investigating the effects of an offshore causeway on the Beaufort Sea on oceanography and fish habitat. Program included assessment of fish abundance and movement, habitat associations, feeding studies, and changes in population health and structure.
- *Yukon Delta Project*: Investigator for project designed to determine the distribution and movement timing of key salmonid species on the Yukon delta, estuary, and lower Yukon River and to identify regions and period that fish species would be most sensitive to oil exposure should a spill occur.
- *Susitna Hydroelectric Project*: Project manager. Completed a third party review of study plans and study reports addressing the potential effects of a hydroelectric project in Alaska on beluga whale populations in Cook Inlet, Alaska and on the habitats and food sources of the whales. Studies included the effects of the proposed project on hydrology, water quality, ice formation, fish habitat, fish abundance, and geomorphology, each of which has the potential to affect whale habitat or prey abundance.
- *Marine Mammal Surveys, Chukchi Sea*: Conducted surveys of marine mammals (primarily walrus and seals) in the northern Chukchi Sea. Documented behavioral reactions to oil drilling activities.
- *NASA Rocket Fuel Test Site Environmental Assessment*: Conducted a study to assess potential consequences of exposure of freshwater and marine aquatic organisms to contaminants discharged from rocket testing at a NASA test site.
- *Puget Sound Fisheries Studies*: Coordinated field and laboratory personnel, coordination of data analysis, and implementation of sampling program in Puget Sound focused on evaluating abundance and distribution of fish and documenting the occurrence of disease.
- *Biofuel Processing and Shipping Project*: Completed due diligence assessment focused on natural resources for a biofuel facility located on the shore of the Pacific in Washington State; project included assessment of potential impacts of oil spill at docking facility on marine resources.
- *Cascade Reservoir TMDL Technical Advisory Committee*: A TMDL is a water quality cleanup plan. Completed a watershed analysis in support of this TMDL for phosphorus, which covered 318,000 acres. Completed assessments of effects of forest practices and assisted with the assessment of urban and agricultural land uses. With the assistance of other forestland managers, wrote the implementation plan for forested lands, developed and implemented monitoring plan. Also wrote grant applications and administered grants used to fund improvement projects throughout the basin. Served as an active participant and interim chair (the position rotated through the group) of the Cascade Reservoir Technical Advisory Committee which was charged with providing oversight of the assessment of land management activities affecting nutrient loads in the reservoir and developing a the management plan included in the TMDL. Facilitated group decisions through a consensus based approach. Received a special accommodation from the Idaho Department of Environmental Quality for contributions to this effort.
- *Chehalis River Bridge Evaluation*: Managed a project which evaluated the effects of a large road fill across the floodplain of the Chehalis River in Washington State on flooding upstream of the bridge. Developed alternatives for relieving the backwater effect of the bridge. The preferred alternative has been selected.

- *China Creek Floodplain Restoration Project*: Currently involved with a study that will document the effectiveness of a planned floodplain reconnection project located in the State of Washington. The study will document changes in aquatic habitat with the installation of the project.
- *Chisapani Hydroelectric Project, western Nepal*: Completed assessment of the potential effects of a proposed hydroelectric project on fisheries and endangered crocodiles on the Chisapani River in the western Terai of Nepal.
- *California Sports Park Development*: Completed the review of water quality and hydrology sections of a Draft Environmental Assessment addressing a large development in Los Angeles.
- *Endangered Species Recovery Planning for Klickitat County, WA*. Under contract to Klickitat County, provided support and assistance to NOAA Fisheries on the development of the Columbia River steelhead recovery plans (White Salmon River, Klickitat River, Rock Creek, and a roll-up document) and with the development of implementation plans supporting the recovery plans.
- *Endicott Environmental Monitoring Program Aquatic Resources Evaluations*. Principle investigator and discipline manager of aquatic resource studies conducted on Alaska's North Slope. The program was a multidisciplinary effort involving the assessment of the effects of oil development infrastructure on the relative abundance and movement of fish and on fish habitat. The project included a substantial nearshore oceanography component that supported the assessment of project effects on fish habitat. The final product of the program was a synopsis of Beaufort Sea coastal ecology and a description of the interaction of that ecological system with oil development infrastructure.
- *Excursion Inlet Hydroelectric Project*: Completed a pre-feasibility assessment for a proposed hydroelectric project in southeast Alaska. The assessment included an inventory of the distribution of fish species in the affected rivers (two potential locations) and identification of existing passage barriers.
- *Third Party Review of Impact Assessment of the Sidney, Australia, and Desalinization Plant*: Completed a review of a large number of study reports on fish, benthos, circulation, sediment, and water quality generated to support the assessment of the likely impacts of a desalinization plant located near Sydney Australia. Provided review comments on the adequacy of the information and the overall assessment of project effects.
- *Hells Canyon/Snake River TMDL*: Under contract to Idaho Department of Environmental Quality and in cooperation with Oregon Department of Environmental Quality, compiled applicable narrative and numeric water quality criteria and/or standards for the States of Idaho and Oregon and EPA. Compare the various standards and to identify the most stringent criteria. Defined seasonal and temporal suitability conditions for specific species and identified areas of critical sensitivity.
- *Kenai Fisheries Investigations*: Under contract to ADFG, conducted studies enumerating salmonids adult returns and harvest levels in Cook Inlet.
- *Klickitat County Conservation District Biological Assessments*: Completed biological assessments in compliance with the Endangered Species Act for three stream restoration projects proposed by the local Conservation District.
- *Klickitat River Watershed Assessment and Watershed Management Plan*: Managed a watershed assessment and development of a watershed plan development under Washington's watershed planning act for the Klickitat River basin. Coordinated the assessment of water use, water available for allocation, water quality, and fish habitat quality for the watershed. Facilitated the development of a basin Management Plan designed to meet future water demand while protecting or enhancing

water quality and water quantity. Parties involved included representatives of State and County agency, environmental interests, tribes, irrigators, the City of Goldendale, Public Utility Districts, timber industry, grazers, and the public at large. Developed the watershed plan based drawn from scientific underpinnings and based upon the facilitated agreements.

- *Little Klickitat Fish Habitat inventory*: Currently working on an in-depth inventory of the characteristics of freshwater habitat and fish populations throughout the Little Klickitat River. Data collection includes a wide range of parameters documenting the quality and quantity of spawning and rearing habitat in 5 basins. Migration barriers are also being evaluated. Estimates of carrying capacity of the basins and factors limiting population size will be developed.
- *Little Klickitat River Shade and Thermal Refuge Studies*. Conducted two studies in the Little Klickitat River. The first focused on estimating shade levels throughout the basin based on aerial photography verified with extensive field measurements. The second developed a longitudinal profile of stream temperature based on field measurements, used field measurements to identify thermal refuge areas, and evaluated the rate of change in stream temperature following substantial shifts in streamside shading.
- *Middle Columbia River Steelhead Recovery Plan*: Participant on the Washington Gorge team that assisted NMFS with the development of the Middle Columbia River Steelhead Recovery Plan and currently participating on the Washington Gorge Implementation Team which is tracking implementation of the plan. Have provided assistance to NMFS on many related ESA documents, including the 5-year review currently underway. Also assisted with the development of the portions of the Lower Columbia River Recovery Plan and implementation of that plan related to the White Salmon River.
- *Middle Fork Payette TMDL*: Worked cooperatively with IDEQ, EPA, and the Forest Service in completing the assessment of sediment sources from forested lands in support of the TMDL, participated on the technical advisory committee, aided in development of implementation plan, assisted with grant applications.
- *Modelling of Sediment Runoff from Forested Lands*: Coordinated the development of a GIS model that estimates the amount of sediment delivered to streams from forest roads; the model (WARSEM) has been adopted by the States of Washington and California.
- *Nisqually River Watershed Assessment*: Managed the watershed assessment in the Nisqually River basin, completed in compliance with Washington's watershed planning act. Summarized water rights, water use, future water demand, public water system data, water quality data, and fisheries information for 6 sub-basins. Developed an overall water budget and recommendations for future investigations.
- *Okanagan River Fish Habitat Improvement Project*: Co-manager of a habitat restoration project conducted in the Okanogan River, Washington. The project evaluated aquatic habitat restoration opportunities over a three mile length of the Okanogan River. Hydrologic analyses were conducted at potential sites to ensure that the proposed restoration would function as expected. Sites recommended for enhancement were surveyed and recommended designs were developed.
- *Pacific Lumber Company Watershed Analysis Methods Development and Implementation*: Co-managed a highly controversial project focused on implementing Pacific Lumber Company's habitat conservation agreement for management of their redwood forests in California. Worked with a group of landowners, environmental groups, and state and federal regulatory agencies to develop watershed analysis methods to be applied on Pacific Lumber Company lands. Facilitated meetings and discussions working towards consensus of this diverse group. Agreement was reached and the

detailed methodology was published. The methods included assessment of resources and development of a management plan that minimized or avoided adverse impacts to aquatic resources and selected wildlife species. Methods were then implemented in a watershed containing old growth redwood forests. Coordinated studies and facilitated the development of the plan.

- *Rentech Biofuels Facility, California*: Developed wastewater and stormwater alternatives and BMP design to meet the requirements of the regional General NPDES permits for construction and operations. Completed assessment of baseline conditions and project impacts on hydrology and water quality. Also completed an assessment of project effects on fish species including the Santa Ana sucker which is listed as endangered under the Endangered Species Act. Baseline information and assessments were captured in sections of the CEQA EIR for the project.
- *Rock Creek and Eastern Tributaries Fish Habitat Inventory*: Completed an in-depth inventory of the characteristics of freshwater habitat and fish populations throughout roughly 1/3 of Klickitat County, Washington. Data collection included a wide range of parameters documenting the quality and quantity of spawning and rearing habitat in 5 basins. Estimates of carrying capacity for salmon in the basins and the habitat factors limiting population size were estimated. Opportunities to improve stream flow (the limiting factor) were identified.
- *Rock Creek Shade and Channel Morphology Study*: Completed measurements of canopy closure in a 40,000 acre basin in eastern Washington to identify areas where improvements in riparian shade have the potential to reduce stream temperature. The project also included modeling of channel morphology and bedload transport to identify areas where channel restoration projects could be expected to be stable.
- *Round Lake Habitat Equivalency Assessment*: Currently working on an assessment of the relative value of habitats to be developed in a large habitat restoration project located on an island in the lower Columbia River. The restoration credits gained by the project will be used as a mitigation bank to offset future impacts to lower Columbia River salmon populations.
- *Swale Creek Temperature Study*: Conducted an assessment of the current temperature conditions in a 303(d) listed stream in eastern Washington. Evaluated current and potential shading along the stream. Modeled potential temperature based on estimated of maximum possible shade. Evaluated historic conditions using General Land Office survey records from the mid 1800s.
- *Timber/Fish/Wildlife Adaptive Management Committees*: Actively participated on several committees formed to develop and implement study plans that address unknowns and monitor the effectiveness of Washington's new Forest Practices rules. Each of these committees is made up of a diverse array of state and federal agencies, landowners, and tribes. Decision-making processes were based on consensus.
- *Valsetz Water Storage Concept Project*: Managed a preliminary assessment of the feasibility of constructing a water storage project in a basin in the mid-coastal area of Oregon. Conducted extensive field studies on existing fish habitat conditions and fish distribution, collected data on stream flow, climate, and water quality. Using the results of hydrologic modeling (1-D and 2-D), completed a simple model which evaluated the potential effects of the project on fish habitat.
- *Warm Springs Biological Evaluation Template*: Developed a template to be used to guide the completion of Biological Evaluations on the Warm Springs Reservation in the Deschutes Basin, Oregon. The template covered the range of activities typically implemented by the Warm Springs Conservation District.

- *Washington Department of Natural Resources Watershed Analyses*: Coordinated and facilitated watershed analyses conducted under the Washington State Watershed analysis Methodology for 8 watersheds and participated in an additional 7 analyses conducted throughout the state.
- *Washington's Forest and Fish Agreement (and Subsequent Habitat Conservation Plan)*: The State of Washington developed new forest practices regulations with the intent of attaining Federal assurances that operations following those rules would not violate the Endangered Species Act. Worked closely with a wide range of stakeholders to identify potential impacts of forest management activities on aquatic species and to develop forest management practices that would minimize or avoid those impacts. Participants included representatives from the timber industry, federal and state agencies, counties, environmental groups, and tribes.
- *Wood River Lake Fisheries Investigations, upstream of Dillingham and Aleknagik, Alaska*: Project involved the enumeration of escapement of mature sockeye salmon into the Wood River lakes region, monitoring of prey concentrations and limnology in juvenile sockeye rearing areas, and monitoring the growth and distribution of juvenile salmon in the region.
- *Klickitat River Nitrate Study*: Completed study evaluating the extent of elevated nitrate concentrations in groundwater within the Klickitat River basin. Evaluated potential sources using water quality parameters and developed recommendations for addressing the problem.
- *Rock Creek Fish Habitat Inventory*: Completed an in-depth inventory of the characteristics of freshwater habitat and fish populations throughout roughly 1/3 of Klickitat County. Data collection included a wide range of parameters documenting the quality and quantity of spawning and rearing habitat in 5 basins. Migration barriers were also evaluated. Estimates of carrying capacity of the basins and the habitat factors limiting population size were estimated.
- *Rock Creek Watershed Management Plan*: Participated on the team which developed a watershed plan for the series of basins extending from mid-Klickitat County to Kennewick, Washington. The plan is designed to meet future water demand, improve water quality, and protect aquatic resources. .
- *GovNET Telecommunications project*: Provided oversight of NEPA compliance for a large telecommunications project located throughout the State of Arizona.
- *Rentech Biofuels Facility, California*: Developed wastewater and stormwater alternatives and BMP design to meet the requirements of the regional General discharge permits for construction and operations. Completed assessment of baseline conditions and project impacts on hydrology, water quality, and ESA listed fish species. Baseline information and assessments were captured in sections of the CEQA EIR (California equivalent of NEPA) for the project.
- *US Army Corps of Engineers Emergency Levee Repair Environmental Assessments and Biological Assessments*: Completed Environmental Assessments in compliance with NEPA and Biological Assessments in compliance with the Endangered Species Act for 7 emergency levee repair projects in western Washington.
- *RCW 90.82 Programmatic Environmental Impact Statement, Washington Department of Ecology*: Member of the team supporting the development of Washington State Department of Ecology's programmatic Environmental Impact Statement (EIS) covering the adoption and implementation of watershed plans developed under RCW 90.82 (<http://www.ecy.wa.gov/biblio/0306013.html>). The EIS was completed in fulfillment of the State Environmental Protection Act requirements.
- *Missouri River Master Water Control Project, Fisheries Investigations; US Army Corps of Engineers*: In support of an EIS (developed under NEPA) evaluating the effects of various water management

strategies on public resources, evaluated fish populations, fisheries habitat, and other aquatic characteristics within the entire Missouri River Basin (Ft. Peck Montana to St. Louis Missouri). The Missouri River drains roughly one-half of the continental U.S.

- *Kelso-Beaver Natural Gas Pipeline Project; Portland General Electric*: Project manager for an interdisciplinary interstate gas pipeline project in Oregon and Washington. Evaluated project effects and completed an Environmental Report summarizing project effects, a Biological Assessment in compliance with the Endangered Species Act, an erosion and sediment control plan, a cultural resource report, and the Environmental Assessment completed in fulfillment of NEPA requirements (which was adopted by Federal Energy Regulatory Commission (FERC)) as well as all activities associated with completing the state and local permitting process.
- *Columbia River Salmon Flow Measures Options Analysis/Environmental Impact Statement, and System Operation Review; US Army Corps of Engineers*: Evaluated potential effects of proposed Columbia and Snake River reservoir drawdown options on resident fish populations including white sturgeon and bull trout. Evaluations required integration with water quality, sedimentation, hydrology and wildlife specialists in order to address interaction between resources. Completed Environmental Impact Statement sections regarding resident fish.
- *Columbia River Dredging and Beneficial Use of Dredge Material Environmental Assessment and Clean Water Act Evaluation; US Army Corps of Engineers*: Coordinated a multidisciplinary program to complete the Environmental Assessment in fulfillment of NEPA requirements, Biological Evaluations for endangered species, and Clean Water Act (Section 404(b)(1)) evaluations for a dredging project in the Columbia and Snake Rivers.

# BRIAN WILLIAM HESTER

## Manager / Ecotoxicology Laboratory Director

Brian is the laboratory director for Ramboll Environ ecotoxicology facility in Port Gamble, WA. He is an expert in marine, estuarine, and freshwater toxicological evaluations (waters and sediment). He has also performed evaluations of dredged materials, Toxicity Identification Evaluations (TIE), and contaminant and non-contaminant stressors, in addition to toxicity-testing methods development. Brian is experienced in field collection of sediments and biological samples, and data analysis and statistical testing. Other related research he has done involved the using aquatic organisms as biosensors to indicate the presence of contaminants of interest.

### CAREER

2007-2014

**Laboratory Manager / Project Manager, NewFields Northwest, LLC.**

2003-2007

**Laboratory Manager / Project Manager, Weston Solutions, Inc.**

1999-2003

**Laboratory Technician/Senior Scientist, MEC Analytical Systems, Inc.**

### COURSES/CERTIFICATIONS

USDA Importation Permit for Foreign or Quarantined Soils, 2015

Transportation Worker Identification Credential (TWIC), 2015

Hyalella Azteca Advisory Group Member, 2015

40-Hour HAZWOPER Certification, 2015

### PROJECTS

#### **Sediment Sampling and Analysis**

**Pearl Harbor Channel, Hawaii, United States**

**Field Technician, Laboratory Manager**

Assisted in field collection of more than 200 sediment core samples from 56 locations throughout the main channel using a vibracore and box core. Managed Tier III laboratory testing of samples to determine the suitability of this material for ocean disposal.

### CONTACT INFORMATION

**Brian William Hester**

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United States of America

### EDUCATION

1993-1998

B. S. Environmental Science  
University of California

**Laboratory Testing for the City and County of San Diego Co-Permittees' Storm Water Compliance Program**

**San Diego, California, United States**

**Project Manager**

Directed this laboratory testing program for a county-wide stormwater monitoring program to identify links between toxicity and chemistry.

**Dredged Material Evaluations for Southeast Region**

**North Carolina, Florida, South Carolina, Georgia, United States**

**Project Manager**

Managed ongoing Tier III laboratory analysis of potential dredged material. Testing included suspended particulate phase, solid phase, and bioaccumulation potential following guidelines for USEPA Region IV. Project locales included Cape Fear, NC; Canaveral Harbor, FL; Charleston Harbor, SC; Brunswick Harbor, GA; and Savannah Harbor, GA.

**Evaluating Effluent/Leachate from Ferry Terminal maintenance Activities**

**Port Townsend/Point Defiance, Washington, United States**

Managed a sampling and testing program for the Washington Department of Transportation. This was an NPDES regulatory program monitoring power-washing and painting activities at state operated ferry terminals in Port Townsend and Point Defiance, WA.

**Site Specific Sulfide Criterion for Produced Water Discharges**

**United States**

**Assistant Project Leader/ Marine Research Specialist**

Collaborated on the method development and subsequent testing of a site-specific toxicity evaluation for determining the toxic effects of hydrogen sulfide on marine organisms. This involved the development of a continual dosing system to maintain stable concentrations of hydrogen sulfide during the testing periods. Testing included repeated testing of a suite of 7 marine species. The data from these tests was combined with an extensive literature search to estimate a site-specific criterion for hydrogen sulfide.

**Toxic Cleanup Program**

**Puget Sound, Washington, United States**

Managed the biological testing phase of two large, regional sediment investigations. These investigations were directed through the Washington Department of Ecology's (WDOE) Toxics Cleanup Program (TCP) in support of cleanup efforts throughout the Puget Sound. The significant challenge of analyzing 111 samples within holding times and budget was achieved with careful coordination and planning. Sediment samples were analyzed following PSEP bioassay procedures and were evaluated under the Sediment Management Standards for evaluating sediment quality.

**Site Specific Evaluation of Chemical Availability at the Frog Pond, South Florida Water Management District**

**South Florida, United States**

**Laboratory Manager**

This program was conducted to assist South Florida Water Management District in determining the mobility, availability, and toxicity of agriculturally related chemicals in soils at the Frog Pond Detection pond project site. The SFWMD was developing a "leaky reservoir" to help restore water levels in the Everglades. NewFields assessed the potential risk for toxicity and bioaccumulation to freshwater invertebrates in the area, including Florida apple snails. Since soils were going to be effectively changed to sediments, NewFields used a laboratory aging process that simulated the flooding and drying process anticipated at the site. Once soils were "aged", toxicity and bioaccumulation tests were conducted at the NewFields laboratory and the Harbor Branch Oceanographic Institute. Served as laboratory manager conducting toxicity testing and bioaccumulation evaluations at the NewFields laboratory.

**Expanded Screening Level Era for Soils Proposed for the U.S. Sugar Land Acquisition  
 South Florida, United States**

**Laboratory Manager**

This program was conducted to assist the South Florida Water Management District make initial decisions regarding the purchase of the USSC lands by determining the level of risk associated with the purchase of 187,000 acres of former agricultural property near the Everglades. This testing program included an evaluation of soil chemistry, toxicity, and bioaccumulation for strategic locations within the proposed purchase area. Served as laboratory manager for planning, conducting toxicity testing and bioaccumulation evaluations and supporting data interpretation.

**Midwest Refinery/Pine River Site, Site Investigation**

**United States**

**Project Leader**

Directed toxicity testing of sediments collected from potentially contaminated freshwater systems. Testing included *Hyalloella azteca* and *Chironomus dilutus*. This investigation incorporated the sediment toxicity data with the chemical and physical properties to evaluate the sites.

**NPDES Effluent Testing, Toxicity Identification Evaluation (TIE) Testing**

**Orange County, California, United States**

**Principal Investigator**

Directed the monthly testing of wastewater discharged by Orange County Sanitation District (OCSD). The testing included fathead minnow juvenile, larval (acute), abalone (chronic), and sea urchin (fertilization). TIE testing was performed when toxicity was identified.

**Water Effects Ration(WER) Study**

**California**

**Project Co-Leader**

Oversaw aquatic bioassay testing to evaluate the toxicity of ammonia in San Gabriel and Los Angeles Rivers to the amphipod *Hyalloella azteca*. These studies were implemented to ascertain the site-specific water effects ratio for ammonia in these receiving waters.

**Dredged Material Evaluation, ANAMAR**

**Puerto Rico**

**Assistant Project Leader**

Managed a portion of a Tier III laboratory analysis of potential dredged material. Testing included suspended particulate phase and bioaccumulation potential following guidelines for USEPA Region II/USACE New York District 1992.

**Evaluation of the Effects of Dispersed Petroleum in the Ice-Free, Cold Water Environments of Beaufort and Chukchi Seas, Field and Laboratory operations**

**Barrow, Alaska, United States**

Conducted field and laboratory operations (on water and on ice) for a major on-going research program in Barrow AK. Assisted in development of specialized bioassay test protocols and conducted bioassay testing under Arctic conditions with regional specific species. Deployed standardized and specialized equipment to be deployed under extreme Arctic conditions to collect and maintain arctic organisms for laboratory testing. Assisted in development of bioassay test protocols and conducted bioassay testing under Arctic conditions.

**PUBLICATIONS**

2013

**The acute toxicity of chemically and physically dispersed crude oil to key arctic species under arctic conditions during the open water season.**

Environmental Toxicology and Chemistry. Accepted manuscript online: June 13, 2013.

Authors: Gardiner WW, Word JQ, Word JD, Perkins RA, McFarlin KM, Hester BW, Word LS, Ray CM.

2013

**Bioassay Endpoint Refinements: Bivalve Larval and Neanthes Growth Bioassays. U.S. Army Corps of Engineers. DMMP/SMS Clarification Paper. Aquatic Toxicity Testing Using Chlorinated Phenolics that are Constituents of Pulp Mill Effluent: Using Dendroaster excentricus and Ceriodaphnia dubia.**

Thesis Manuscript for Western Washington

Authors: Kendall D, McMillan R, Gardiner W, Hester B, Word JD.

2003

**Southern California Bight 2003 Regional Monitoring Program (Report) Vol. 1: Sediment Toxicity.**

Southern California Coastal Research Project (SCCWRP). May 19, 2005

Authors: Bay SM, Mikel T, Schiff K, Mathison S, Hester B, Young D, Greenstein D.

**MEMBERSHIPS**

American Society for Testing and Materials (ASTM)

Society of Environmental Toxicology and Chemistry (SETAC)

# COLLIN M. RAY

**Laboratory Coordinator / Ecotoxicology**

Collin has ten years of experience in field and laboratory research in marine, estuarine, and freshwater environments. Mr. Ray leads laboratory programs including testing procedures and analyses: use of spectrophotometers; water quality analyses; marine and freshwater bioassays and maintenance of in-house cultures of organisms. All testing is done in compliance with USEPA standards. Skilled in the use of sediment core and grab sampling devices, and diver-operated core. Mr. Ray is experienced in collecting marine animals for use in laboratory biological assessments and chemical analyses.

**EDUCATION**

2007

**BS Environmental Science**

University of Washington

**COURSES/CERTIFICATIONS**

40-Hour HAZWOPER Certification, 2015

American Red Cross Adult CPR & First Aid Training, 2015

**SPECIFIC AREAS OF EXPERTISE INCLUDE:**

- Overseeing the biological assessments of environmental samples
  - Following standardized national and regional protocols as well as specialized testing programs
  - Laboratory protocols and analyses including: dredge material characterizations, National Pollutant Discharge Elimination System (NPDES) compliance programs and Puget Sound Estuary Program (PSEP) testing.
  - Responsible for laboratory adherence to quality assurance metrics and standard operating procedures.
- Field supervision and collection of sediments, biological and chemical samples.
- Data analysis and statistical testing using ToxCALC™ and CETIS™.
- Experienced in sediment sampling, including use of vibracore, boxcore, and VanVeen samplers.
- Scientific dive surveys.
- Planning and conducting environmental restoration projects.

**CONTACT INFORMATION**

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 Port Gamble, 98364  
 United States of America

## PROJECTS

### **Natural Resource Damage Assessment (NRDA) in Response to Deepwater Horizon Spill**

Field crew leader in various collection efforts: forensic oil and tar-ball samples, sediments, water, invertebrate tissue, sea grass leaves, oyster larvae and adults, and substrate characterization. As crew leader, directed the collection and enumeration of oysters inside and outside of oyster lease sites focusing on areas from Lake Borgne to Barataria Bay. Recruitment studies were also performed in these areas to assess the potential impacts to larval oyster. Assisted in the development of sediment sampling protocols and equipment for collection of nearshore and offshore sediments.

### **Oil Spill Response in Tropics, Literature Review**

#### **Coauthor**

Served as coauthor for the literature review to support the application of Net Environmental Benefit Analysis (NEBA) for oil spill response planning in tropical marine environments. As part of an international, multidisciplinary team, wrote sections on the toxicity of oil and treated oil.

### **Compliance Monitoring and Toxicity Identification Evaluations of Oil Drilling Rig Effluents**

Managed the laboratory program for biological assessment of more than twenty waste streams from two drill rigs. Project included determination of appropriate test species through sensitivity comparisons of organisms to standard reference toxicants and PAH exposures. Initial screening of effluent samples was performed with echinoderm fertilization tests, followed by a suite of standard whole effluent toxicity (WET) tests as needed. Overall, 56 screening tests, 32 WET test suites and six toxicity identification evaluations were performed over the span of three months.

### **Logging Mill Site Remedial Investigation, Field Study, Port Gamble, Washington**

Investigation of contamination in inter to sub-tidal areas adjacent to former sawmill. Managed field activities including numerous scientific dives mapping eelgrass beds, measuring in-situ sulfide concentrations and water quality of sediment porewater at various depths. Data collected were used in prioritizing clean up areas as well as for delineating healthy eelgrass habitat for preservation.

### **Yakima Site Wetland Remedial Investigation/Feasibility Study, Ecological Risk Assessment and Cleanup Action Plan, Yakima, Washington**

As part of a site investigation, conducting an RI/FS of wetland sediments that have elevated levels of cadmium, zinc and lead. Assisted in sampling and managed the laboratory effort including forensic toxicity studies and acid volatile sulfide (AVS) and simultaneously extracted metals (SEM) analyses in order to better understand the source(s) of toxicity in wetland sediments. The toxicity identification studies refined the site footprint and implicated zinc from offsite sources as the primary source of toxicity. Supports this program, with future efforts including an ecological risk assessment for potential uptake of site-related metals, as well as a feasibility study and cleanup action plan in the wetland that may include sediment removal and restoration.

### **Evaluation of the Effects of Dispersed Petroleum in the Ice-Free, Cold-Water Environments of the Beaufort and Chukchi Seas**

#### **Laboratory & Field Scientist**

Deployed standard and specialized field sampling equipment to collect arctic species for laboratory testing in an on-going research program pertaining to dispersed oil in Barrow, Alaska. Standard equipment included: plankton ring nets and sameoto sampler deployed by boat and shore based beach seine and Fyke net. Assisted in development of specialized bioassay test protocols and conducted bioassay testing under Arctic conditions.

**Laboratory Demonstration of Environmental Factors and their impact on Early Life Stage Development of Pacific Herring**

**Field & Laboratory Scientist**

Field team leader for collection of viable gonad samples from gravid herring in San Francisco Bay area. The laboratory based study simulated field conditions of temperature, salinity, and tidal fluctuations and their effect on developing herring embryos.

**Central Coast Long-term Environmental Assessment Network (CCLEAN), Moss Landing, California**

**Chief Scientist**

Provided oversight for the benthic sampling while collecting chemistry samples to assess depositional sites off Moss Landing, California.

**Newport Bay Dredge Material Management Program; Newport Bay, California**

**Field & Laboratory Scientist**

Assisted in the field effort for the collection of sediment samples by Vibracore throughout Newport Bay. Conducted bioassay testing on sediment samples for determination of disposal suitability.

**Biological Testing of Sediment in Fidalgo Bay, Anacortes, WA**

**Laboratory & Field Scientist**

Conducted sediment sampling with Van Veen grab sampler and benthic trawl with otter trawl type net, performed biological assessment, and produced a technical report in support of sediment management study for Washington Department of Ecology Toxics Cleanup Program.

**Marine and Freshwater Bioassay testing**

**Laboratory Technician**

Provided laboratory support in conducting numerous laboratory bioassays:

- Bioaccumulation Testing for Inner Harbor Navigation Channel; New Orleans, LA
- Wood Waste Sediment Biological Evaluation; Anacortes, WA
- Sediment Biological Evaluation; Des Moines and Pleasant Harbor Marinas, WA
- Sediment Biological Evaluation; Commencement and Fidalgo Bays, WA
- Bioaccumulation Testing; San Francisco Ship Repair Drydock #2 and Oakland Inner Harbor, CA
- Dredge Material Biological Testing for Ocean Disposal; Balboa Marina, Newport Bay, CA
- Dredge Material Biological Testing for Ocean Disposal; Marina Park, Newport Bay, CA
- Dredge Material Biological Testing for Ocean Disposal; Port Canaveral and Manatee Bay, FL
- Dredge Material Biological Testing for Ocean Disposal; Arecibo and San Juan Harbor, Puerto Rico
- Dredge Material Biological Testing for Ocean Disposal; Cape Fear, NC
- Dredge Material Biological Testing for Ocean Disposal; Brunswick and Savannah Harbors, GA
- Bayer CropScience; Ecological Risk Assessment; Middlesex, NJ

**PUBLICATIONS**

2013

**The acute toxicity of chemically and physically dispersed crude oil to key arctic species under arctic conditions during the open water season.**

Environmental Toxicology and Chemistry. Environ Toxicol Chem. 2013 Oct;32(10):2284-300. doi: 10.1002/etc.2307. Epub 2013 Aug 14

Authors: Gardiner WW, Word JQ, Word JD, Perkins RA, McFarlin KM, Hester BW, Word LS, Ray CM.

**MEMBERSHIPS**

Society of Environmental Toxicology and Chemistry (SETAC)

Poulsbo Marine Science Center Board member

# GREGORY S REUB

## Principal Senior Fisheries Biologist

Mr. Reub has 30 years' experience related to environmental impact assessment, mitigation, and restoration of water resources with a focus on fisheries. Mr. Reub currently provides senior direction and technical input on integration of science-based strategies, planning and assessment of ecosystem services to maximize efficiencies in conservation, sustainability, enhancement and restoration of natural resources. He has been involved in fisheries biology his entire career and has focused on the shellfish industry for the past 10 years. He also owns and operates two small geoduck (world's largest burrowing clam) aquaculture farms in Puget Sound, Washington. Mr. Reub is known for developing and working with interdisciplinary teams to solve interrelated physical, chemical, biological and social/economic issues into a Net Ecosystem Services Analysis (NESA) that allows successful integration of real issues across the landscape and use of an interrelated approach to address realities associated with ecosystem services. This approach has been successfully used for restoration prioritization, remedial options analysis, conservation planning, climate adaptation planning and impact assessment.



### CONTACT INFORMATION

#### Gregory S Reub

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525 Columbia Street NW  
Suite 204  
Olympia, 98501  
United States of America

### EDUCATION

1990

#### MA, Ecology & Systematic Biology

San Francisco State University, San Francisco, CA, United States

1977

#### BS, Wildlife & Fisheries Science, Minor Chemistry

South Dakota State University, Brookings, SD, United States

### EXPERTISE

- Finfish and Shellfish Biology and Management
- Habitat Restoration and Conservation Planning
- Ecological Valuation & Ecosystem Markets
- Environmental and Water Resource Management Plans
- Environmental Impact Assessment & Mitigation

### CREDENTIALS

#### Professional Affiliations and Activities

- American Fisheries Society
- Ecological Society of America
- Society for Ecological Restoration
- American Water Resources Association
- International Association of Impact Assessors
- Advisory Council – Capitol Land Trust

## PROJECTS

### REPRESENTATIVE FINFISH AND SHELLFISH IMPACT AND MITIGATION PROJECTS

**Washington Department of Natural Resources Endangered Species Act (ESA) Compliance – Habitat Conservation Plan for State-owned Aquatic Lands, Washington.** Mr. Reub served as Technical Manager to assist in the NEPA compliance and also served as Project Manager and technical lead to assist in planning for conservation of threatened, endangered, and other species of concern that can be affected by activities on state-owned aquatic lands, including oysters and other shellfish; a major industry in the state. The Project area includes 2.6 million acres of streams, rivers, lakes, and marine waters (e.g. pacific coast, Puget Sound, Columbia River and a large variety of leased activities). Mr. Reub developed a framework to quantify affects from activities and benefits from conservation measures that is used to prioritize cost effective mitigation for take of listed species.

**Environmental Compliance and Best Practices for Various Shellfish Farming Companies – Washington, Oregon and California.** Mr. Reub has been involved in assisting numerous shellfish farming companies comply with environmental regulations and development of Best Management Practices for the past 10 years. He has focused on support related to oyster, clam and mussel cultivation. He has provided technical leadership, analysis, reporting and monitoring and expert witness services. Regulatory issues have involved the ESA, Shoreline Management Act, National Environmental Policy Act, Clean Water Act among other federal and state regulatory mandates.

**Biological Assessment for Geoduck Clam Culture, Puget Sound Washington.** Mr. Reub was responsible for the first Biological Assessment for a consortium of geoduck clam farmers and has assisted with permitting and compliance issues for several years. The major issues have involved water quality, biodiversity, sensitive species and at times, social and economic effects.

**ESA 4(d) rules NEPA and RegFlex Findings, Washington, Oregon, and California** - Project Manager for a National Marine Fisheries Service (NMFS) project to make the necessary findings under National Environmental Policy Act (NEPA), and the Regulatory Flexibility Act (RegFlex) associated with its adoption of Section 4(d) rules under the Endangered Species Act (ESA). The scope of the Project includes all of the threatened runs of anadromous salmon and steelhead in California, Oregon, and Washington. This work was done for the Protected Species Division of NMFS in Portland, Oregon.

**Pier D and Manchester Fuel Pier Fish Investigations, Puget Sound, Washington** - Project Manager for resolution of environmental issues raised by the Suquamish Tribe regarding Navy construction and dredging projects in Sinclair Inlet. This project involved assessing the impact of a fuel pier on fish migration and the risk of contaminated sediments to fisheries resources important to the tribe.

**Similkameen River Water Storage and Hydroelectric Project, Okanogan County, Washington** - Mr. Reub served as the fisheries task lead for a feasibility study that examines the potential to build a new dam in north central Washington. Three main alternatives are being examined with one option extending well into Canada. The Project would be a major water storage and hydroelectric generation project with complex fish and wildlife issues.

**Yakima and Upper Columbia River Subbasin Management Plans, Eastern Washington** - Served as Project Manager for subbasin management plan development in the Yakima and upper Columbia River. The subbasins include the upper Columbia River mainstem, Okanogan, Methow, Chelan, Entiat, Wenatchee, and Yakima. This phase of the project provides the basic information for development of future management and prioritization of restoration and recovery projects for fish and wildlife. The project involves collection organization and presentation of vast amounts of data and other information.

**Fisheries Task Lead. Alaska Railroad Corporation Railroad Extension EIS, Fairbanks to Delta Junction, Alaska.** Mr. Reub led the aquatic resources (fisheries) efforts for development of the EIS for

the Alaska Railroad Corporation. He helped prepare the third party Environmental Impact Statement (EIS) for the lead federal agency, the Surface Transportation Board. The Project would extend the mainline track from the vicinity of Eielson AFB to the Delta Junction/Fort Greely area, a distance of about 80 miles. Field sampling was recently completed and included integration of methods and data from the hydrology and geomorphology team. The evaluation of possible impacts from the proposed rail expansion will include anadromous, resident, recreational, subsistence, and personal use fishery resources along the proposed railway corridor.

**Fisheries Representative, Snap Lake Diamond Mine EIS and Water License, near Mackay Lake, Northwest Territories (NWT).** Senior Fisheries Consultant for Dogrib Treaty 11 Council regarding development of De Beers underground Snap Lake Diamond Project; reviewed operation plans, EIS, and supporting technical reports; prepared detailed technical comments and assessments for Council. Conducted detailed and comprehensive analysis of potential fisheries impacts from changes in quantity and quality of water and other impacts related to changes in physical and chemical habitat characteristics.

**Fisheries Representative, Ekati Diamond Mine EIS and Water License, near Lac de Gras, NWT.** Senior Fisheries Consultant for the Dogrib Treaty 11 Council regarding the development of BHP Ekati's proposed Sable, Pigeon and Beartooth diamond mine; reviewed mine operation plan, project description, EIS and related technical documents. Issues examined included effects of groundwater, surface water and tailings and waste rock management plans on aquatic and fisheries resources. He assisted in development of appropriate surveillance network and aquatic effects monitoring programs. Also assisted in preparation of detailed technical submissions to NWT Water Board.

**Fisheries Technical Lead, Endicott Environmental Monitoring Program near Prudhoe Bay, Alaska.** Responsible for water quality, fish and invertebrate distribution, and abundance and fish overwintering programs. This study involved monitoring and impacts determinations due to oil field development. Studies focused on impacts of causeways and roads on fisheries and other aquatic resources. Reub was responsible for field data collection (including winter data collection), data analysis, impact and mitigation development and report writing.

**Fisheries Biologist, Waterflood Environmental Monitoring Program and the Lisburne Development Environmental Studies, Prudhoe Bay to Colville River, Alaska.** Served as fisheries field team leader and assisted in database management, analysis and report preparation for two large oil field development environmental studies. These involved both offshore, nearshore, and large river studies for the studies focused on nearshore and river system impacts related to the Colville River and Sagavanirktok River.

**Interdisciplinary Team Leader for Fish and Wildlife Resources and Fisheries Principal Investigator, Eight Fathom Bay and Ushk Bay Timber Sale NEPA EISs, Southeast Alaska.** Responsible for management, data collection and analysis, and reporting to describe the affected environmental and potential impacts/mitigation for different timber harvest scenarios. Both study areas are over 100 square miles, and included potential impacts to freshwater and marine fisheries resources. Developed a watershed-based analysis to predict potential impacts to fisheries resources from activities such as timber harvest, storage, road building and rafting of logs.

**Alaska Regional Support to NOAA Fisheries for Planning and NEPA Compliance, Anchorage, Alaska.** Served as Project Manager to provide support to NOAA fisheries, Alaska. The focus of the contract is to assist in planning, NEPA and related environmental compliance services related to Endangered Species Act, Magnuson-Stevens Fishery Conservation and Management Act, Marine Mammal Protection Act, Coastal Zone Management Act, Fish and Wildlife Coordination Act, and other applicable federal laws and executive orders.

**Development of Fisheries Protection Guidelines for Yukon, Canada Placer Mined Streams, Yukon.** Served as fisheries lead and co-author for a set of documents developed for Department of Fisheries and Oceans, Canada to assist in protection and restoration of impacts from placer mining.

These documents provide guidance for on-the-ground protection and restoration of aquatic resources that can be implemented by the independent mining operators.

**Over 25 Major Hydroelectric Licensing and NEPA Projects.** Mr. Reub has served as Fisheries Biologist and/or Project Manager for over 25 hydroelectric Projects from Alaska to South America. The licensing and environmental compliance almost always had a fisheries focus.

### Other Representative Landscape Planning and Permitting Assignments

- Manager/Team Leader to establish baseline information for a major oil spill in the Gulf of Mexico
- Yakima and Upper Columbia River Subbasin Management Plans, Washington
- Assistance and lead development of several oil spill plans in the Gulf of Mexico, land based operations and offshore in Alaska.
- Conducted numerous Natural Resource Damage Assessments (NRDAs) under the US hazardous waste and oil spill laws as Project Manager, Technical Lead and/or Expert
- Fisheries lead for Entiat Watershed Planning Project, Entiat and Madd Rivers, Washington
- Led Cedar River Resource Inventory and Management Plans, Western, Washington
- Led Washington Department of Ecology Watershed Analysis, Washington
- Fisheries lead Alaska Railroad Corporation Railroad Extension EIS. Fairbanks to Delta Junction, Alaska
- Fisheries Biologist Endicott Environmental Monitoring Program. Prudhoe Bay, Alaska.
- Fisheries Biologist Waterflood, Kuparuk and Lisburne Oilfield Development EISs. North Slope, Alaska.
- Fisheries Biologist Colville River Fish Monitoring. North Slope, Alaska.
- Biological Lead - Sable, Pigeon and Bear Tooth Mine Developments, Northwest Territories, Canada
- Led development of Fisheries Protection Guidelines for Yukon Placer Mined Streams, Yukon, Canada.
- Fisheries lead Eight Fathom Bay and Ushk Bay Timber Sale EISs. Southeast Alaska.
- Project Manager and Fisheries Biologist Monitoring and Implementation Plan for the National Petroleum Reserve (NPR), North Slope, Alaska.
- Assistant Program Director for Exxon Valdez Oil Spill Biological Programs and Project Manager for herring, crustacean and bottom fish resources and also advisor for the salmon studies.

### Selected Restoration Design and Conservation Planning Experience

**Stream Relocation and Floodplain Reconnection, City of Centralia, Washington.** Currently serves as Principal in Charge and Sr. Biologist for relocation, restoration and floodplain reconnection for China Creek. The existing creek is channelized and contributes to flooding in the area. The new design includes duplicating the historic channel meander using geomorphological principles, two floodplain restoration/relief ponds, development of hydraulic models (HEC-RAS and SWMM) and production of the final design plans and specifications. The project includes water quality and streamflow monitoring. The design provides for greatly improved fish and invertebrate habitat, improved floodplain function and riparian habitat restoration.

**The Nature Conservancy Coastal Resilience Project, Ventura County, California.** – Lead ecologist and ecosystem services analysis to investigate values for options related to restoration and mitigation for climate change impacts such as sea-level rise and storm surge using green options (natural approaches such as allowing wetlands to expand into agriculture lands) or grey (more engineered solutions such as sea walls). Mr. Reub provided a quantification of ecosystem services as a result of the green vs. grey mitigation. The analysis shows substantial benefits related to allowing the integration of green adaptation measures into preparing for climate change impacts.

**Chehalis River Oxbow Reconnection project, Chehalis Confederated Tribes, Oakville, Washington.** – Principal and biological lead for final design for construction of floodplain reconnection in an existing oxbow in the Chehalis River floodplain. This included design of floodplain relief/restoration

ponds, wetland design, and design of reconnection channels. This 80 acre project was completed from beginning of design through construction in approximately one year.

**Chehalis Floodplain Evaluation and Hydraulic Design of Floodplain Relief Bridge, Chehalis Confederated Tribes, Oakville, Washington.** – Served a Principal in Charge and Sr. Biologist for restoration of the Chehalis River floodplain through construction of new culvert structures under the existing levee road, removal of an old road in the flood plain and replacement with an efficient bridge in the Chehalis River floodplain. The project focus was to improve floodplain function, reduce flooding and improve fish habitat.

**Allen Creek Restoration Design, Chehalis Confederated Tribes, Oakville, Washington.** – Currently Principal and Biological Lead for design and planned construction of restored reach of Allen Creek, that includes design of historic channel meander using geomorphological principles, hydraulic design to handle 50-year design flow, and stream bank protection and bioengineering design for high flood flows. This design was coordinated with county, state and federal permitting agencies for permitting process.

**Review of Chehalis River Water Retention Structures Scoping Document and Proposed Studies, Chehalis River Basin Flood Authority, Washington.** – Reviewed Water Retention Structure Scoping Document submitted by EES to the Client, identified numerous deficiencies and recommended phased approach to identify correct feasibility alternatives, initiate monitoring program, and satisfy regulatory requirements.

**Similkameen and Colville Rivers Sediment Transport Enhancement Design, Colville Confederated Tribes, Washington.** – Mr. Reub served as Principal in Charge and Sr. Fisheries reviewer for the investigation of options and design of a fisheries enhancement project for salmon and steelhead in the Similkameen River in north central Washington.

**Tonasket Creek Restoration, Colville Confederate Tribes, Washington.** – Principal in Charge and Sr. Reviewer for a creek restoration effort that includes quantitative analysis and estimate of surface water and groundwater contribution to creek, definition of losing and gaining creek reaches, and design of artesian well/water pipeline to replenish losing creek water.

**Salmon Creek Restoration Design, Colville Confederated Tribes, Washington.** – Mr. Reub provided evaluation of salmon and steelhead restoration needs and designs for approximately six miles of the lower reach of Salmon Creek, a tributary to the Okanogan River in north central Washington. The restoration focused on providing migration habitat below an irrigation withdrawal where the channel had been substantially degraded.

**Yakima and Upper Columbia River Subbasin Management Plans, Eastern Washington** - Served as Project Manager for subbasin management plan development in the Yakima and upper Columbia River. The subbasins include the upper Columbia River mainstem, Okanogan, Methow, Chelan, Entiat, Wenatchee, and Yakima. This phase of the project provides the basic information for development of future management and prioritization of restoration and recovery projects for fish and wildlife.

**Cedar River Resource Inventory and Management Plans, Western, Washington.** – Principal Investigator for the aquatics task on the Cedar River Resource Inventory and Management Plans Project for Seattle Water Department. The Cedar River Watershed is over 200 square miles and supplies the greater Seattle area with a large portion of the domestic and commercial water supply. The project included data collection and analysis and development of a GIS based, integrated, and multidisciplinary management system for the watershed.

**Washington Department of Ecology Watershed Analysis, Washington.** – Fisheries and Water Quality Task Manager as part of four watershed analyses for the Washington Department of Ecology including the Chehalis, Kettle, Pend Oreille, and Little Spokane rivers. These studies assisted in water rights and allocation decisions and other water management issues in the state.



## Appendix B: Letters of Support

Presently, we have attained letters of support from the following entities:

- Ena Alacaraz and Associates
- Mia Lehrer and Associates
- Climate Resolve
- Mountains Recreation Conservation Authority
- LA River Revitalization Corporation
- Mark Vargas and Associates
- Amigos de los Rios
- Water Conservation Partners

Letters of support will be appended at a later date.