MINUTE ITEM
This Calendar Item No. 73 was approved as Minute Item No. 73 by the California State Lands Commission by a vote of 3 to 0 at its 04-17-06 meeting.

Minute Item
73

04/17/06
W 26107
T. Lipscomb

PACIFIC GAS AND ELECTRIC COMPANY
(APPLICANT)

Regular Item 73. The Commissioners listened to a staff report concerning an application by PG&E for a gas line in the Delta. The item was approved as presented by a 3-0 vote.

CALENDAR ITEM
73

A 15 | 04/17/06
W 26107
S 5, 7 | T. Lipscomb

CONSIDER ADOPTION OF A PROPOSED MITIGATED NEGATIVE DECLARATION AND ISSUANCE OF A NEW GENERAL LEASE-RIGHT OF WAY USE

APPLICANT:

Pacific Gas and Electric Company
245 Market Street, Room 1052A-N10A
San Francisco, California 94105

AREA, LAND TYPE, AND LOCATION:

2.65 acres, more or less, of sovereign lands in Old River, Middle River, and Latham Slough, near McDonald Island, Lower Jones Island, Bacon Island, and Palm Tract, San Joaquin and Contra Costa counties.

AUTHORIZED USE:

The construction, use, and maintenance of a new 24-inch diameter welded steel natural gas pipeline using a horizontal directional drilling method (HDD) crossing at Old River, Middle River and Latham Slough.

LEASE TERM:

20 years, beginning April 17, 2006.

CONSIDERATION:

$1,110 per year; with the State reserving the right to fix a different rent periodically during the lease term, as provided in the lease.

SPECIFIC LEASE PROVISIONS:

Insurance: Lessee shall maintain limits of no less than:

1. General Liability: Each Occurrence $10,000,000
2. Workers' Compensation: Statutory requirements of the State of California.

Bonds:

1. Lease Performance Bond: $50,000

2. Construction Performance Bond: In an amount equal to the construction cost for those portions of the new pipeline that cross sovereign lands.

Other:

Applicant is required to submit for Commission staff's review and approval the final engineering design, and construction plans at least 60 days prior to construction for those portions of the project crossing sovereign lands.

OTHER PERTINENT INFORMATION:

1. Applicant must acquire the right to use the uplands adjoining the lease premises.

2. Pacific Gas and Electric Company (PG&E) is proposing to install and operate a new natural gas pipeline, Line 57C, near the existing Line 57B in the Sacramento-San Joaquin Delta area. Line 57C will originate at the yard next to the McDonald Island Compressor Station, and travel southwest through McDonald Island, Lower Jones Tract, Bacon Island, and terminate at Palm Tract. The pipeline will be approximately 6.4 miles long, of which approximately 2,312 feet will cross State lands, and will cross under existing irrigation ditches, Empire Cut/Latham Slough, Middle River, Old River and across agricultural fields. The existing Lines 57A and 57B were installed in 1949 and 1974, respectively, to expand and improve the reliability of the pipeline system connecting McDonald Island to the major PG&E transmission lines. Line 57A has been taken out of service. Both Lines 57A and 57B are included in the Master Lease, PRC 5438.1, between PG&E and the Commission.

3. The purpose of this project is to provide a second pipeline for the transmission of gas from PG&E's McDonald Island Storage Facility to the Bay Area Pipeline Loop, an important supply link for natural gas to the Bay Area. The current pipeline system provides no back up in the event of failure of Line 57B. Should Line 57B fail, all gas stored in the McDonald Island Facility would be unavailable to the PG&E gas transmission system and Bay Area Pipeline Loop. Line 57B is already subject to stresses because of levee movement and potential flooding of Bacon Island. The new pipeline, Line 57C, will improve the reliability of natural gas delivery from the McDonald Island Storage Field.

4. The new pipeline will be installed by common trenching on land and the Horizontal Directional Drilling (HDD) method under all waterway crossings

and most irrigation canals. The drill entry points, on each side of the affected waterways, are approximately 2,300 feet from the landward side of the waterway's levees. The Empire Cut/Latham Slough, Middle River, and Old River crossings will be drilled to a depth of approximately 70 to 90 feet below the river bottoms. Once the proposed pipeline crossings are installed, the only permanent surface facilities will be a valve lot and launcher/receiver assemblies for diagnostic smart pig inspection equipment.

5. The pipeline will be constructed, and tested, to meet U.S. Department of Transportation (DOT) construction and safety standards outlined in Title 49 Code of Federal Regulations (CFR) Part 192, *Transportation of Natural and Other GAs by Pipeline: Minimum Federal Safety Standards.* These regulations, which are intended to protect the public and to prevent natural gas facility accidents and failures, include specifications for material selection and qualification; odorization of gas; mimimun design requirements; and protection of the pipeline from internal, external, and atmospheric corrosion. Once constructed, the pipeline system will be operated and maintained in; accordance with all applicable Federal and state regulations.

6. Pursuant to the Commission's delegation of authority and the State CEQA Guidelines (Title 14, California Code of Regulations, section 15025), the staff has prepared a Proposed Mitigated Negative Declaration identified as CSLC ND No. 736, State Clearinghouse No. 2006022145. Such Proposed Mitigated Negative Declaration was prepared and circulated for public review pursuant to the provisions of the CEQA.

   Although the process for completing a proposed mitigated declaration does not provide for or require a public scoping hearing, staff of the Commission provided a detailed public notice for and convened public scoping meetings on December 12, 2005, in Sacramento with State agencies and in Holt for the public. The comments received through this process were addressed in the Proposed Mitigated Negative Declaration, which was submitted to the State Clearinghouse for circulation and mailed to interested parties on February 28, 2006. The public review period of 30 days, which was described in public notices in the Sacramento Bee, the Contra Costa Times and the Stockton Record, ended on March 30, 2006. Letters of comment were received from:

- CalTrans;
- San Joaquin Air Pollution Control District;
- Delta Protection Commission;
- San Joaquin County Public Works;
- Transmission Agency of Northern California (TRAC);
- The Delta Wetlands Project;
- Reclamation District 2028;
- Lower Jones Company;
- Reclamation District 2024; and
- Reclamation District 2038.

Responses to all comments received have been provided to each commentor and to the Commission for its consideration.

Based upon the Initial Study, the Proposed Mitigated Negative Declaration, and the comments received in response thereto, there is no substantial evidence that the project will have a significant effect on the environment; Title 14, California Code of Regulations, section 15074 (b).

7. A Mitigation Monitoring Program has been prepared in conformance with the provisions of the CEQA (Public Resources Code section 21081.6).

8. This activity involves lands identified as possessing significant environmental values pursuant to Public Resources Code sections 6370, et seq. Based upon the staff's consultation with the persons nominating such lands and through the CEQA review process, it is the staff's opinion that the project, as proposed, is consistent with its use classification.

APPROVALS REQUIRED:

U.S. Army Corps of Engineers, California Office of Historic Preservation, U.S. Fish and Wildlife Service, California Regional Water Quality Control Board, and NOAA Fisheries, California Department of Fish and Game, and the California Public Utilities Commission.

EXHIBITS:

A. Site Map and Location Map
B. Mitigation Monitoring Program

PERMIT STREAMLINING ACT DEADLINE:
April 17, 2006

RECOMMENDED ACTION:
IT IS RECOMMENDED THAT THE COMMISSION:

CEQA FINDING:
CERTIFY THAT A PROPOSED MITIGATED NEGATIVE DECLARATION, CSLC MND NO. 736, STATE CLEARINGHOUSE NO. 2006022145 WAS PREPARED FOR THIS PROJECT PURSUANT TO THE PROVISIONS OF THE CEQA, THAT THE COMMISSION HAS REVIEWED AND CONSIDERED THE INFORMATION CONTAINED THEREIN AND THE COMMENTS RECEIVED IN RESPONSE THERETO AND THAT THE MND NO. 736 REFLECTS THE COMMISSION'S INDEPENDENT JUDGMENT AND ANALYSIS.

ADOPT THE PROPOSED MITIGATED NEGATIVE DECLARATION AND DETERMINE THAT THE PROJECT, AS APPROVED, WILL NOT HAVE A SIGNIFICANT EFFECT ON THE ENVIRONMENT.

ADOPT THE MITIGATION MONITORING PROGRAM, AS CONTAINED IN EXHIBIT B, ATTACHED HERETO.

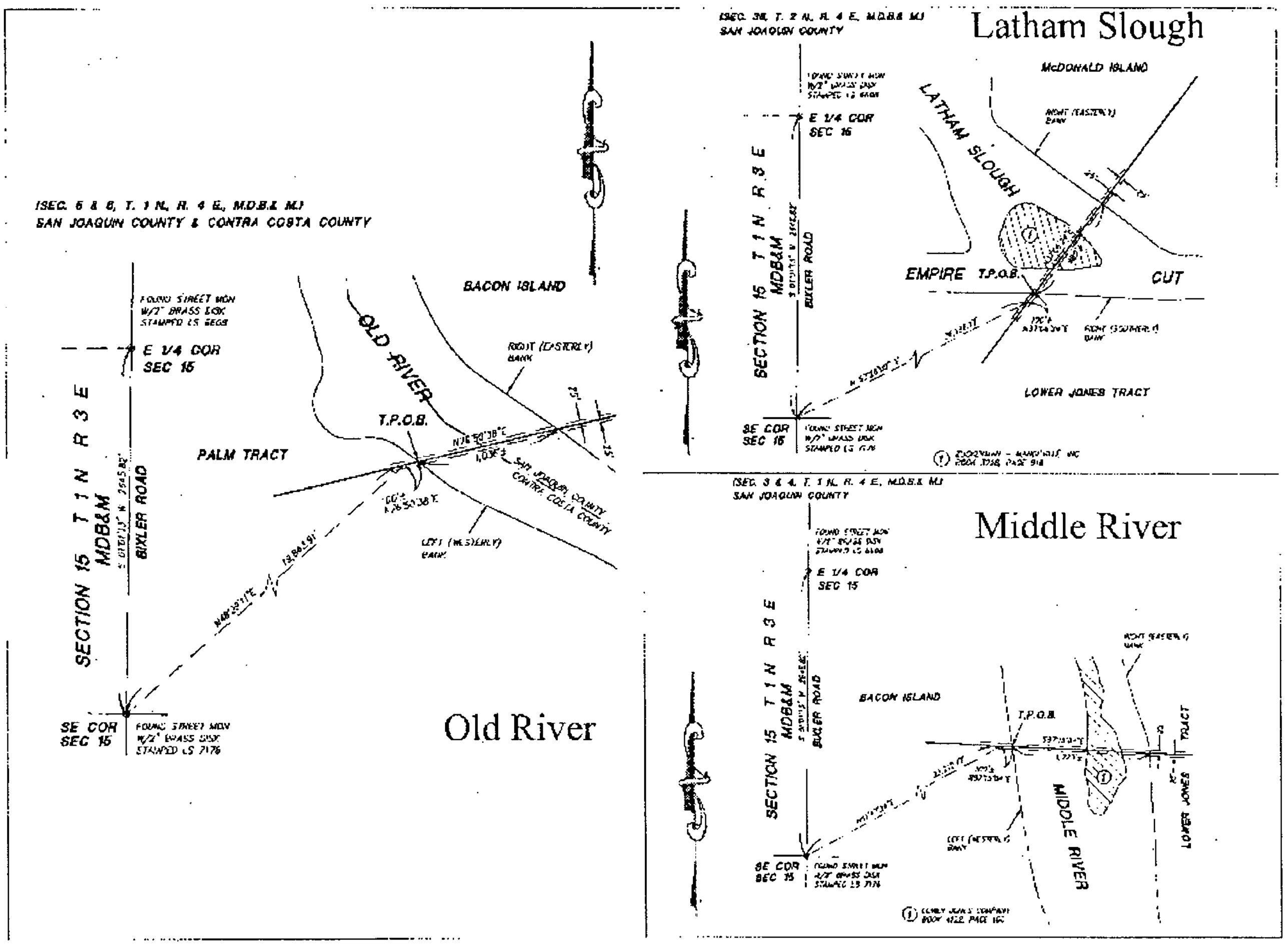
SIGNIFICANT LANDS INVENTORY FINDING:
FIND THAT THIS ACTIVITY IS CONSISTENT WITH THE USE CLASSIFICATION DESIGNATED BY THE COMMISSION FOR THE LAND PURSUANT TO PUBLIC RESOURCES CODE SECTIONS 6370, ET SEQ.

AUTHORIZATION:
AUTHORIZE ISSUANCE TO PACIFIC GAS AND ELECTRIC COMPANY OF A GENERAL LEASE-RIGHT OF WAY USE, BEGINNING APRIL17, 2006, FOR A TERM OF 20 YEARS, FOR THE CONSTRUCTION, USE, AND MAINTENANCE OF A NEW 24-INCH DIAMETER WELDED STEEL NATURAL GAS PIPELINE CROSSING USING A HORIZONTAL DIRECTIONAL DRILLING METHOD AS SHOWN ON EXHIBIT A ATTACHED AND BY THIS REFERENCE MADE A PART HEREOF; ANNUAL RENT IN THE AMOUNT OF: $1,110 PER YEAR; WITH THE STATE RESERVING THE RIGHT TO FIX A DIFFERENT RENT PERIODICALLY DURING THE LEASE TERM, AS

PROVIDED IN THE LEASE; GENERAL LIABILITY INSURANCE IN THE AMOUNT OF NO LESS THAN $10,000,000 FOR EACH OCCURANCE; WORKERS' COMPENSATION PURSUANT TO STATUTORY REQUIREMENTS OF THE STATE OF CALIFORNIA; LEASE SURETY BOND IN THE AMOUNT OF $50,000; AND A CONSTRUCTION PERFORMANCE BOND IN AN AMOUNT EQUAL TO THE CONSTRUCTION COST OF THOSE PORTIONS OF THE NEW PIPELINE THAT CROSS SOVEREIGN LANDS.

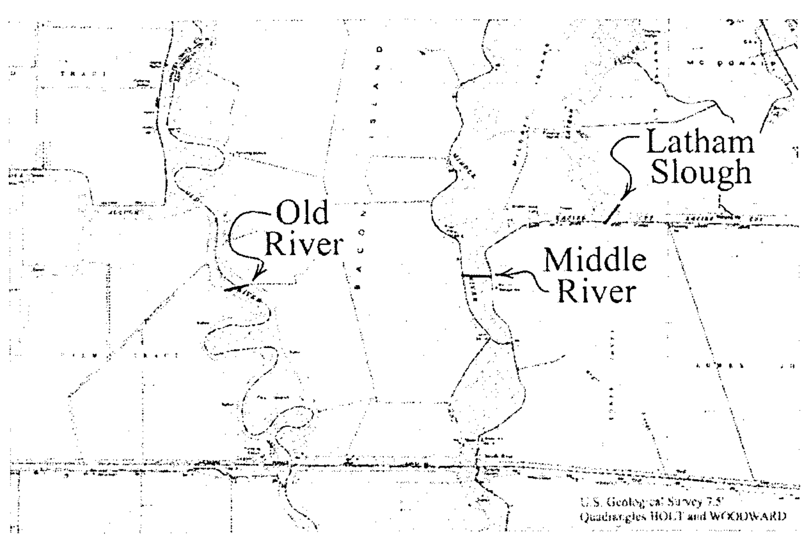
NO SCALE

SITE MAP



NO SCALE

LOCATION MAP



This Exhibit is solely for purposes of generally defining the lease premises, is based on unverified information provided by Lessee or other parties, and is not intended to be, nor shall it be construed as a waiver or limitation of any state interest in the subject or any other property.

EXHIBIT A
W26107

Pacific Gas & Electric
General Lease
San Joaquin and
Contra Costa Counties

DWC 03-27-2006

EXHIBIT B

List of Mitigation Measures for Line 57C IS/MND

Mitigation Measure AGR–a, c–1

The Applicant shall monitor all areas disturbed along the construction right-of-way to identify any area that may require additional restoration, noxious weed treatment, or erosion control. The applicant shall work with landowners to ensure fair settlement of any claims of crop loss, drainage problems, or property damage related to the pipeline and would repair and correct any areas identified as needing additional work in consultation with the landowner. The Applicant's contractor shall obtain landowner sign-off verifying all restoration has been completed to the satisfaction of the landowner prior to demobilizing from the right-of-way.

Mitigation Measure AGR–a, c–2

The Applicant shall conduct a risk analysis (including measuring the depth of the topsoil over the pipe) every seven years until there is only three feet of topsoil remaining over the pipeline. At that time, given the current Federal, State, and local regulations and local land uses, the Applicant shall consult with the California State Lands Commission (CSLC) to determine what resolution would be required. Possible solutions could include, but are not limited to:

a. addition of soil to maintain three feet of cover;

b. lowering the pipe;

c. placing a protective barrier over the top of the pipeline.

Mitigation Measure AIR–a, b–1

The construction contractor shall ensure that the following Bay Area Air Quality Management District measures are implemented during construction:

(a) Water all construction areas at least twice daily.

(b) Cover all trucks hauling soil, sand and other loose materials or require all trucks to maintain at least two feet of freeboard space.

(c) Enclose, cover, water twice daily or apply (non-toxic) soil binders to exposed stockpiles (dirt, sand, etc).

(d) Replant vegetation in disturbed areas as quickly as possible.

The construction contractor shall also ensure that the following San Joaquin Valley Air Pollution Control District measures are implemented during construction:

(e) All disturbed areas, including storage piles, which are not being actively utilized for construction purposes, shall be effectively stabilized of dust emissions using water, chemical stabilizer/suppressant, covered with a tarp or other suitable cover or vegetative ground cover.

(f) All land clearing, grubbing, scraping, excavation, land leveling, grading, cut and fill, and demolition activities shall be effectively controlled of fugitive dust emissions utilizing application of water or by presoaking.

(g) When materials are transported off-site, all material shall be covered, or effectively wetted to limit visible dust emissions, and at least six inches of freeboard space from the top of the container shall be maintained.

(h) Following the addition of materials to, or the removal of materials from, the surface of outdoor storage piles, said piles shall be effectively stabilized of fugitive dust emissions utilizing sufficient water or chemical stabilizer/suppressant.

Mitigation Measure AIR-e-1

The Applicant shall notify the San Joaquin Valley Unified Air Pollution Control District and Bay Area Air Quality Management District 48 hours prior to the beginning of the purging procedure.

Mitigation Measure BIO-a, b-1

The Applicant shall conduct Worker Environmental Awareness Program (WEAP) training for construction crews (primarily crew and construction foreman) before construction activities begin. The WEAP shall include a brief review of the special status species and other sensitive resources that could occur in the proposed Project site (including their life history and habitat requirements and what portions of the proposed Project area they may be found in) and their legal status and protection. The program shall also cover all mitigation measures, environmental permits and proposed Project plans, such as the Stormwater Pollution Prevention Plan (SWPPP), best management practices (BMPs), erosion control and sediment plan, and any other required plans. During WEAP training, construction personnel shall be informed of the importance of avoiding ground-disturbing activities outside of the designated work area. The designated biological monitor shall be responsible for ensuring that construction personnel adhere to the guidelines and restrictions. WEAP training sessions shall be conducted as needed for new personnel brought onto the job during the construction period.

Mitigation Measure BIO-a, b-2

Prior to any construction activities on the site, a protective fence shall be installed a minimum of one foot (or greater, if feasible) from the edge of all special status plant populations to be avoided in the immediate vicinity of the proposed construction areas. Prior to initiation of construction activities, a qualified biologist shall inspect the protective fencing to ensure that all special status plant populations have been appropriately protected. No encroachment into fenced areas shall be permitted during construction and the fence shall remain in place until all construction activities have been completed.

Mitigation Measure BIO-c-1

Prior to any construction activities on the site, a protective fence shall be installed a minimum of one foot (or greater, if feasible) from the edge of all wetland habitat to be avoided in the immediate vicinity of the proposed construction areas. Prior to initiation of construction activities, a qualified biologist shall inspect the protective fencing to ensure that all wetland features have been appropriately protected. No encroachment into fenced areas shall be permitted during construction and the fence shall remain in place until all construction activities have been completed.

Mitigation Measure BIO-c-2

The Applicant shall provide a copy of the "Contingency Plan, Inadvertent Release Prevention and Response Plan for Non-Hazardous Drilling Fluid" to the U.S. Army Corps of Engineers, U.S. Fish and Wildlife Service, National Marine Fisheries Service, Central Valley Regional Water Quality Control Board, and the California Department of Fish and Game for their review and approval. This may occur during the permitting process.

Mitigation Measure BIO-d-1

The Applicant shall provide all excavated, steep-walled holes and trenches in excess of 3 feet in depth with one or more escape ramps constructed of earthen fill or a wood/metal plank. If wildlife proof barricade fencing is available, it should also be used where appropriate. Escape ramps shall be less than a 45° angle. Trenches and pits shall be inspected for entrapped wildlife each working day before construction activities resume. Before such pits and trenches are filled, they shall be thoroughly inspected for entrapped animals. If any wildlife species are discovered, they should be allowed to escape voluntarily, without harassment, before construction activities resume, or removed from the trench or hole by a qualified biologist and allowed to escape unimpeded. All construction pipes, culverts, or similar structures that are stored at a construction site overnight shall be thoroughly inspected for trapped animals before the pipe is buried, capped, or otherwise used or moved. Pipes laid in trenches overnight shall be capped. If an animal is discovered inside a pipe, that section of pipe shall not be capped or buried until the animal has escaped. The Applicant shall not use plastic mono-filament netting (erosion control matting) or similar material because amphibians and snakes may become entangled or trapped in it. Acceptable substitutes include coconut coir matting or tackified hydroseeding compounds.

Mitigation Measure BIO-e, f-1

The Applicant shall provide a monetary compensation to the CDFG for disturbance on Palm Tract associated with the proposed Project at a minimum ratio of 1:1, or as determined in consultation with CDFG.

Mitigation Measure CUL-b-1

The following mitigation measure would protect any resources that may remain at the CA-SJO-189 site.

Prior to Project construction the following shall occur:

- Temporary exclusionary fencing, indicating a "Sensitive Environment Zone" shall be constructed along the south eastern edge of the McDonald Island temporary use area adjacent to CA-SJO-189.
- A qualified archaeologist familiar with CA-SJO-189 and the soil types surrounding the site shall be retained to assist with the fencing and ensure it is outside of the boundaries of CA-SJO-189.

Mitigation Measure CUL-c-1

Prior to Project construction, the Applicant shall retain a qualified paleontologist to design and implement a monitoring and mitigation program for the portions of the Project likely to impact paleontological resources (horizontal directional drilling techniques, and trenching on McDonald and Bacon Islands). The program shall include construction monitoring; emergency discovery procedures; sampling and data recovery, if needed; museum storage coordination for any specimen and data recovered; and preconstruction coordination and reporting.

Mitigation Measure CUL-d-1

If human remains are discovered, there shall be no further excavation or disturbance of the discovery site or within 50 feet until the Applicant has complied with the provisions of the State CEQA Guidelines section 15064.5(e). In general, these provisions require that the County Coroner shall be notified immediately. If the remains are found to be Native American, the County Coroner shall notify the Native American Heritage Commission within 24 hours. The most likely descendant of the deceased Native American shall be notified by the County and given the chance to make recommendations for the remains. If the County is unable to identify the most likely descendent, or if no recommendations are made within 24 hours, remains may be re-interned with appropriate dignity elsewhere on the property in a location not subject to further subsurface disturbance. If recommendations are made and not accepted, the Native American Heritage Commission will mediate the problem.

Mitigation Measure GEO-a (i, ii)-1

In accordance with the recommendation in the Preliminary Geotechnical Services Report *Pacific Gas & Electric Pipeline 57C Revised Route, San Joaquin County, California* (Kleinfelder, Inc. 2005), the Applicant shall design the pipeline to withstand a maximum considered earthquake of 6.7. The Applicant shall prepare a seismic analysis subject to review and approval by California State Lands Commission 60 days prior to the start of construction. The analysis shall substantiate how the pipeline has been modified to withstand a 6.7 seismic event.

Mitigation Measure GEO-a (i, ii)-2

In order to ensure the safety of excavations, OSHA-approved shoring shall be used at all times when shoring is required. Within construction activities on Palm Tract (Seismic Zone 4) potential impacts of ground shaking shall be assessed to determine the adequacy of OSHA-approved shoring. Any necessary enhancements to OSHA-approved shoring on Palm Tract shall be incorporated into the final trench design.

Mitigation Measure GEO-a (i, ii)-3

The Applicant shall design the proposed Project for seismic resistance, meeting the requirements of current seismological engineering standards such as the "Guidelines for the Design of Buried Steel Pipe" by American Lifeline Alliance and the "Guidelines for the Seismic Design of Oil and Gas Pipeline Systems" by American Society of Civil Engineers. All engineered structures, including pipeline alignment drawings, profile drawings, buildings and other structures, and other appurtenances and associated facilities, shall be designed, signed, and stamped by California registered professionals certified to perform such activities in their jurisdiction.

Mitigation Measure GEO-c-1

Project design shall incorporate all recommendations for HDD activities as recommended in the *Preliminary Geotechnical Services Report Pacific Gas & Electric Pipeline 57C Revised Route, San Joaquin County, California*, dated June 2005, prepared by Kleinfelder, Inc, as outlined below.

Mitigation of Adverse Drilling Conditions:

- Surface casing shall be installed at the bore entry side to control the drill path and reduce loss of circulation in the upper soils.
- The HDD drilling contractor shall prepare a drilling program specifically designed for the site soil conditions. This program shall include any additives the subcontractor may need to employ, including additives to increase gel and filter

cake strength, inhibit swelling, and reduce stickiness. Possible loss of circulation materials and grouting materials shall also be included in the plan.

- The entry point shall consist of a steel pipe driven at approximately a 10 to 15 degree angle to a competent soil strata or to at least a depth of 25 feet (equates to a length of approximately 100 feet).

Recommended Drilling Depth:

- The entrance and exit points of the HDD shall be stationed at least 400 feet from the toe of the levee.
- The depth of the bore beneath the toe of the levee and the bottom of the waterway shall be at least 60 feet.
- A soil buttress will not be needed at either the entrance or exit point, assuming that the HDD will occur during the summer or fall months when the adjacent river elevation is at its low point.

Inspection and Monitoring:

- Geotechnical engineering personnel shall be on site during the HDD activities to make physical observations of the levee and the toe of the levee in order to evaluate if any movement is occurring.
- The geotechnical engineering personnel shall have the authority to stop the boring operations if it appears as though damage is occurring to the levee.
- A pressure while drilling tool shall be utilized during the HDD.
- The drilling contractor shall develop a Drilling Fluid Program as part of the HDD Bore Plan, which shall take into account anticipated soil conditions, fluid selection, drill bit and reamer selection, and volume calculations.
- An Emergency Response Plan, shall be provided that would include provisions for having heavy equipment and material available, such as front-end loaders, soil and riprap stockpiles, geotextile fabric, etc., that can be used to buttress the levee in case movement is observed.

Drilling Fluid Selection:

- A Drilling Fluid Program Base Fluid shall be designed for site-specific soil conditions. The base fluid may consist of either a bentonite or polymer base and water with additives to achieve specific fluid properties; however, additives that are considered toxic to wildlife will not be allowed.
- In reactive soils the use of partially hydrolyzed polyacrylamide polymers to inhibit swelling and wetting agents to reduce stickiness may prove beneficial. Additives

may be needed to treat make-up water containing excess amounts of calcium or chlorine. Salt (chloride) is detrimental to base fluid performance and shall not be present in make-up water.

- The drilling contractor shall submit a base fluid design with a list of additives, loss of circulation materials, and grouting materials that may be used on the Project and material safety data sheets for approval at least 60 days prior to mobilization.

- The drilling fluid program, including the base fluid design, manufacturer's specifications and material safety data sheets should be submitted to the California State Lands Commission, the Reclamation Board, the Central Valley Regional Water Quality Control Board, and Department of Fish and Game, at least 60 days prior to mobilizing equipment to the site.

- For preliminary planning purposes, a bentonite drilling fluid composed of Bore Gel (or equivalent) mixed at an approximate proportion of five 50-pound bags per 400 gallons of clean water is recommended as a consideration. The procedures described in ASTM C-939 (flow cone method) are recommended to be utilized to monitor drilling fluid consistency.

Drill Bit and Reamer Selection:

- Drill bits and reamers shall be based on anticipated subsurface conditions and past experience.

- The use of mud motors shall be considered in cemented soil with Standard Penetration Test blow counts exceeding 60 blows per foot.

Drill Pad Support Line:

- Some ground improvement may be needed to provide support for the HDD drilling equipment. This may include a geotextile placed over compacted soil and covered with approximately 12 inches of aggregate base or large mats that can be removed after the hole is completed.

Mitigation Measure GEO-c-2

The Applicant shall conduct a site-specific subsidence study and submit a report certified by a California registered engineering geologist or geotechnical engineer for the CSLC staff review and approval prior to approval of construction by CSLC. In addition, the applicant shall verify the pipeline integrity due to the subsidence potential through the pipeline structural analysis. An operational mitigation measure to monitor the subsidence over the life of the pipeline shall be developed and submitted as part of the subsidence study for CSLC staff review and approval. Further, the geotechnical report shall provide an estimate of the difference, if any, between the soils underlying the pipeline and those surrounding the pipeline.

Mitigation Measure HAZ-d-1

During Project construction, the contractor shall monitor exposed soil for signs of contamination. If evidence of soil contamination is encountered during construction, work shall cease and an investigation will be performed by a qualified and approved environmental consultant to confirm contamination and determine its extent. The investigation will include sampling for laboratory analysis. This will determine what measures are necessary to determine how workers will be protected and how hazardous materials shall be handled and disposed of. Removal will be completed with an approved remediation plan by workers trained though the OSHA recommended 40-hour safety program (29 CFR 1910.120) shall remove hazardous materials. A health and safety plan will also be prepared by an approved and qualified industrial hygienist to protect the public and all workers in the construction area. As part of this process, the Applicant shall ensure that any necessary investigation and/or remediation activities conducted in the Project site are coordinated with the County's Fire Departments, the Contra Costa County Department of Health Services, Division of Environmental Health, and the San Joaquin County Department of Environmental Health, and, if needed, other appropriate State agencies.

Mitigation Measure HAZ-h-1

The Applicant shall develop and implement a peat fire prevention plan in addition to the fire protection plan required by the U.S. Department of Transportation, Office of Pipeline Safety. The plan shall be developed in consultation with the State Fire Marshall or other responsible fire-fighting agencies. The plan shall include specific measures to prevent ignition and spread of a peat fire, including, but not limited to: a "no smoking "policy in all work areas; required use of fire retardant blankets or other suitable barriers in areas where pipe welding, grinding, or cutting would occur; required presence of appropriate fire suppression equipment available at all time during activities that may result in ignition of peat soils; requirement of a training plan to all personnel prior to construction activities; and a two-hour fire watch following pipe welding, grinding and cutting activities.

Mitigation Measure HYD-i-1

The Applicant shall design the pipeline such that the pipe depth will be at least 70 feet deep for a distance equal to 40 percent of the scour hole length, measured from the center of the levee. After this distance, the pipeline can begin a gradual ascent toward the surface. However, the pipe shall not reach the surface within a distance less than 2,100 feet from the center of the levee for the Empire Cut crossing and 1,900 feet from the center of the levee for the Old River Crossing .

Mitigation Measure NOI-a-1

During HDD activities and hydrostatic testing, the following construction noise reduction measures shall be implemented:

- Use heavy-duty mufflers for stationary equipment and barriers around particularly noisy areas of the site or around the entire site;
- Use shields, impervious fences, or other physical sound barriers to inhibit transmission of noise to sensitive receptors;
- Minimize backing movements of equipment where possible;
- Prohibit unnecessary idling of internal combustion engines; and
- Designate a noise disturbance coordinator who shall be responsible for responding to complaints about noise during construction. The telephone number of the noise disturbance coordinator shall be conspicuously posted at the construction site.

Mitigation Measure EJ-1

The Applicant shall adopt a High Consequence Area type integrity assessment for the entire pipeline route.

Staff Recommended California State
Lands Commission Draft Report Titled

COMMERCIAL VESSEL FOULING IN CALIFORNIA:

ANALYSIS, EVALUATION, AND RECOMMENDATIONS TO REDUCE NONINDIGENOUS SPECIES RELEASE FROM THE NON-BALLAST WATER VECTOR

**Produced for the
California State Legislature**

By
L. Takata, M. Falkner and S. Gilmore

California State Lands Commission
Marine Facilities Division
April 2006

EXECUTIVE SUMMARY

Fouling community organisms attach or associate with submerged portions of structures. When associated with mobile structures such as vessels, nonindigenous fouling organisms can be moved from port to port and region to region, presenting the potential for a new invasion. Fouling has thus been considered an important mechanism for the introduction of nonindigenous species (NIS) in the marine and estuarine environments.

The Marine Invasive Species Act of 2003 (Act) directs the California State Lands Commission (Commission) to analyze and evaluate the risk of nonindigenous species release from commercial vessel mechanisms other than ballast water (essentially vessel fouling), in consultation with a Technical Advisory Group (TAG). This report summarizes the analysis, evaluation, and consultations conducted by the Commission in accordance with the Act, and offers recommendations to reduce the discharge of NIS from vessel fouling.

Considerations of the Commission and the TAG included the hull husbandry practices of the commercial vessel fleet, environmental conditions and vessel behaviors that influence fouling, and the fouling management frameworks that have been adopted or considered by other regions. The most difficult challenge for evaluating the risk of fouling for species introductions to the state was the limited amount of baseline information on vessel fouling and NIS across the types of vessels that regularly operate in California. A small minority of vessels or platforms that travel at very slow speeds, spend extended periods immobile, and rarely clean or paint hulls could be presumed to pose an elevated NIS risk. However, there was little information on the potential posed by a majority of the fleet that conducts regular vessel maintenance, spends relatively little time in port, and travels at normal speeds. There was also little information on how well the current hull maintenance practices of the majority of the fleet limit the transport and release of NIS.

The Commission believes, however, that these difficulties should not prevent California from moving forward with actions at this time. Some actions can be implemented immediately based on available knowledge, and others may be implemented to build the information and tools to refine management in the future. The Commission therefore recommends that legislation be adopted to:

1. ***Broaden the State program to include the control and prevention of NIS via commercial vessel fouling.*** Current legislation authorizes the Commission to adopt regulations to prevent NIS introduction only through ballast water. The authorization should be expanded to include vessel fouling.

2. ***Broaden the reporting requirements to include mandatory reporting on maintenance practices and other anti-fouling related behaviors of qualifying vessels operating in California waters.*** Information on those factors that tend to exacerbate fouling, coupled with biological surveys of fouling on those vessels, will supply data needed to better characterize the fouling NIS risk for California.

3. ***Expand enforcement components of the Act to address mandatory reporting in Recommendation 2.*** In order for the information collected in Recommendation 2 to yield meaningful results, a high proportion of reports must be submitted. Programs with uninforced reporting requirements experience low reporting rates, making any representative analysis impossible.

4. ***Authorize the Commission to develop and adopt regulations that prevent or minimize the introduction of NIS via vessel fouling.*** Regulations to define regular vessel maintenance practices for the control of NIS fouling on commercial vessels, and requirements or restrictions for vessels that do not adhere to defined practices are needed.

5. ***Expand and coordinate biological research directed towards characterizing the NIS risk posed by commercial vessel fouling with other Federal and State agencies.*** Baseline information on fouling and NIS that arrive on

commercial vessels will be critical for the formulation of future management actions.

6. ***Support continued long-term NIS monitoring in California waters.*** Long-term biological monitoring is necessary to evaluate the effectiveness of management efforts to prevent NIS introductions; particularly as new management actions are implemented.

7. ***Support research promoting technology development.*** A technology that can collect and contain in-water cleaning debris would be a desirable tool to prevent NIS release during in-water cleaning, while also providing commercial operators an avenue to clean hulls without placing a vessel in dry dock. Additionally, the advancement of antifouling coatings that are effective for preventing fouling accumulation and cause little or no water quality impact, will be critical for NIS prevention as regions implement bans on biocidal paints

8. ***Direct the State and Regional Water Quality Control Boards, in cooperation with the U. S. Environmental Protection Agency, to evaluate the effects of biocidal antifouling coatings from vessels on water quality.*** As authorized by the Clean Water Act, the State and Regional Water Quality Control Boards should conduct a full review to determine if biocidal antifouling coatings contribute to water quality impairments or to the exceedance of water quality criteria in California. Water quality plans and/or Total Maximum Daily Loads should be adopted or amended accordingly.

9. ***Expand the existing Marine Invasive Species Program's outreach and education program to include the fouling vector.*** Nonindigenous species transport and introduction through vessel fouling is a relatively new issue, and there is little to no awareness of its importance amongst key stakeholder groups.

10. ***Direct an appropriate agency to address the risk of fouling NIS introduction and spread in California through vessels under 300 gross***

registered tons. Any vessel or structure of any size may accumulate fouling and may be important mechanisms for the transport of NIS. The release and transfer of NIS through vessel types not included in the Act, including recreational and fishing vessels, should be examined by the agency(ies) with the appropriate authority, and recommendations to reduce NIS introductions from these mechanisms be provided to the Legislature.

ABBREVIATIONS AND TERMS

Act	Marine Invasive Species Act (Also Assembly Bill 433 of 2003)
ANZECC	Australian and New Zealand Environment Conservation Council
CA	California
CFR	Code of Federal Regulations
Commission	California State Lands Commission
IACS	International Association of Classification Societies
IMO	International Maritime Organization
KT	Knot
KTS	Knots
LCR	Lower Columbia River
m	Meters
MPH	Miles per hour
NIS	Nonindigenous species
PRC	Public Resource Code
Staff	Staff of the California State Lands Commission
TAG	Technical Advisory Group
TBT	Tributyltin
WSA	Wetted Surface Area

TABLE OF CONTENTS

I. PURPOSE

This report was prepared for the California Legislature pursuant to the Marine Invasive Species Act of 2003 (Act), codified as California Public Resources Code (PRC) Sections 71203-71210.5. The Act enhanced and reauthorized the original law, the Ballast Water Management and Control for Nonindigenous Species Act of 1999. In accordance with the Act, the California State Lands Commission (Commission) was charged with preparing an analysis of vectors (i.e., mechanism or pathway) other than ballast water, and relative risks of those vectors, for the introduction of nonindigenous species (NIS) from commercial vessels (Section 71210.5 of the PRC). Per the law, the analysis shall include the release of NIS from vessel hulls, sea chests (recessed boxes where water may be pumped aboard for engine cooling or for ballast), sea suction grids (grates that cover water intakes), other hull apertures, in-water propellers, chains, anchors, piping, and tanks, and shall be conducted in consultation with a Technical Advisory Group (TAG). This report summarizes the results of this analysis and offers recommendations to reduce the discharge of NIS from vessel vectors other than ballast water.

II. INTRODUCTION: NONINDIGENOUS SPECIES AND VESSEL FOULING

Also known as "introduced", "invasive", "exotic", "alien", or "aquatic nuisance species", NIS in marine, estuarine and freshwater environments may be transported to new regions through numerous human activities. Intentional and unintentional releases of fish and shellfish, aquaculture escapes, releases from the aquarium and pet industries, floating marine debris, bait shipping, and accidental release by research institutions are some of the mechanisms, or "vectors", by which organisms are transferred (U.S. Commission on Ocean Policy, 2004). However, in coastal environments, commercial shipping is the most important vector for the introduction of NIS (Ruiz et al., 2000; Hewitt et al., 2004) in one study accounting for one half to three-quarters of NIS introductions to North America (Fofonoff et al., 2003).

Once established, NIS can have severe ecological, economic and human health impacts to the receiving environment. Pimental et al. (2005) estimated approximately

$120 billion worth of losses annually in the United States due to NIS. The most infamous NIS example is the zebra mussel (*Dreissena polymorpha*) introduced to the Great Lakes from the Black Sea. They attach to hard surfaces in dense populations that clog intakes of municipal water systems and electric generating plants, resulting in costs of approximately a billion dollars a year (Pimentel et al., 2005). The Asian clam (*Potamocorbula amurensis*) spread throughout the San Francisco Bay and its tributaries two years after its introduction, and accounts for up to 95% of living biomass in some shallow portions of the bay floor (Nichols et al., 1990).

Attempts to eradicate NIS after they have become widely distributed are typically unsuccessful and costly (Carlton, 2001; McEnnulty et al., 2001; Meyerson and Reaser, 2002). Control is likewise extremely expensive. Prevention is therefore considered the most desirable way to address the issue. For managers, policy makers, and researchers dedicated to the prevention of marine and estuarine NIS introductions, ballast water has been the major focus during the last decade. However, vessel fouling, which is a less understood mechanism, has been gaining attention as another important vehicle for introductions.

Fouling organisms attach to submerged hard surfaces of both naturally occurring and man-made structures (Railkin, 2004). Fouling organisms such as mussels, seaweed, anemones, and sea squirts have been found on pier pilings, tide pool rocks, and oil platforms (Figure II.1). Barnacles, other seaweeds, and the plant-like limbs of bryozoans may be attached to mussel shells. Mobile organisms such as shrimp, worms, and sea snails may be tucked in nooks created by the larger animals. These associated mobile organisms are also part of this "fouling community".

Mariners have long been aware of fouling as a nuisance to vessel operations as it relates to vessel performance, fuel efficiency, and antifouling efficiencies. Fouling on the hull can create drag, increasing fuel consumption and potentially causing engine strain. In pipes, fouling can block inflowing seawater meant to cool machinery. To prevent such problems, vessel operators periodically clean underwater vessel parts, and utilize antifouling paints and antifouling systems.

Figure II.1: Mussel and Algae Fouling on a Vessel Propeller.

Though much of the outer surface of vessel hulls are treated with paints designed to discourage fouling growth, certain locations have been found to be more prone to fouling: dry docking support strips, waterlines, propellers, rudders, sea chests, and worn or unpainted areas (Coutts et al., 2003; Minchin and Gollasch, 2003; Coutts and Taylor, 2004; Ruiz et al., 2005) (See Section V, "Review of Current Knowledge on Vessel Fouling and Nonindigenous Species").

Despite efforts by the maritime industry to minimize vessel fouling, recent studies indicate that fouling is still an important mechanism by which nonindigenous organisms can be transported to new regions. Vessels that move at slow speeds, spend long periods in port, or are repainted infrequently, tend to accumulate more fouling (e.g. Coutts, 1999). Unlike the laminar areas of the hull that experience strong water motion, sheltered recesses of vessels appear to be more hospitable for fouling organisms. Thus, studies have documented extensive fouling communities on towed vessels, in sea chests, and on recreational vessels. In Hawaii, fouling is believed to be responsible for more successful marine introductions than any other mechanism (Eldredge and Carlton, 2002). For North America, one study estimated that at least 36% of introduced invertebrates and algae arrived via fouling (Fofonoff et al., 2003).

In addition, the nature of fouling observed on vessels may change as restrictions on biocidal antifouling paints are adopted. Biocidal antifouling coatings deter the attachment of fouling organisms by leaching toxic compounds, such as those that contain tributyltin (TBT), copper, and zinc. Because these compounds are also detrimental to non-target organisms, many regions have adopted or are considering restrictions on their use. Tributyltin (TBT) is a highly effective antifouling agent that has been restricted by many nations in line with the 2001 International Maritime Organization (IMO) Convention on the Control of Antifouling Systems on Ships. Most non-TBT coatings available utilize copper compounds as biocides, though they are generally less effective and their longevity is shorter than TBT (Lewis, 2002). In addition, bans and restrictions on copper-based paints are being considered in a number of places, including the San Diego region. Biocide-free silicon-based coatings are available, but are more costly to apply and are currently only practically effective for active, swift vessels (those that cruise over 15 knots [KTS]) (Lewis, 2002; International Marine Coatings, 2006). As new coatings are developed and vessels shift to different antifouling coatings with potentially lower efficacies, there are concerns that the risk posed by fouling as a transport mechanism for NIS may increase (Nerhing, 2001).

Since 2000, the Commission has administered California's ballast water management program. In 2003, the Act expanded these responsibilities, directing the agency to formulate recommendations to prevent introductions through non-ballast, commercial vessel vectors – essentially vessel fouling. As required by the legislation (PRC Section 71210.5), Commission Staff (Staff) assembled a Technical Advisory Group (TAG) composed of representatives from state and federal resource agencies, the commercial shipping industry, and the scientific research community.

III. TECHNICAL ADVISORY GROUP PROCESS

The Act (PRC Section 71210.5) requires Staff to consult with a TAG to prepare an analysis of non-ballast commercial vessel vectors for NIS introductions. Staff convened and facilitated a multidisciplinary TAG made up of representatives from the shipping industry (Chevron Shipping Company LLC, Pacific Merchant Shipping Association, Matson Navigation), academia (Portland State University, University of California at Davis), research institutes (Cawthron Institute, Smithsonian Environmental Research Center, San Francisco Estuary Project), government agencies (California State Water Resources Control Board, U.S. Fish and Wildlife Service), and other interested parties (See Appendix B for a list of Commission TAG participants). Input was received during facilitated meetings that began with a collaborative workshop, followed by three TAG meetings. Discussions and areas of agreement were then considered by Staff to help guide recommendations put forward in this report.

Discussions began in May 2005 with a cross interest, collaborative one-day workshop co-sponsored and conducted by the Staff and the California Sea Grant Extension Program. The workshop objective was to share information and evaluate hull borne transport of invasive species for both the commercial maritime industry and recreational boating community. Attendees included scientists, and representatives from California ports and harbors, state and federal Agencies, environmental organizations, universities, hull coating companies, the commercial maritime industry, and the recreational boating community (See Appendix A for a list of workshop participants).

The workshop began with informational presentations from several experts on fouling issues to inform attendees prior to their participation in afternoon break-out discussions. Speakers included vessel coating and maintenance professionals, a legal expert from the Sea Grant Law Center, and scientific experts from Hawaii, New Zealand, and the Smithsonian Environmental Research Center (See Appendix C for a workshop summary). Topics presented included:

- Overviews of hull borne aquatic invasive species in North America, Hawaii and New Zealand
- Management strategies that have been adopted or considered for fouling NIS in New Zealand and Hawaii
- Information on how various antifouling coatings prevent fouling growth, and the water quality problems presented by some coatings

- Hull husbandry practices of commercial vessels
- International, federal and state policies related to vessel fouling and antifouling coatings

Speakers participated in a panel-style question and answer session following the formal presentations. During the afternoon session, attendees were placed into break-out groups and asked to provide input on potential management considerations. These group sessions identified data gaps and outreach needs related to vessel fouling and NIS.

Three additional TAG meetings were convened by Staff between August and December of 2005, which focused on commercial vessel fouling. These meetings included representatives from the shipping industry, scientists, government agencies, and other interested parties (See Appendix B for a list of Commission TAG participants).

The objective of the August TAG meeting was to continue information sharing begun during the May workshop, but focused exclusively on commercial vessels. TAG members discussed the definition of "Non-ballast vessel-based vectors," as stated in the Act. Further discussions addressed how environmental characteristics, and vessel behaviors and maintenance practices may influence vessel fouling (See Appendix D for summary of August TAG meeting).

The October and December TAG meetings focused on the development of potential management frameworks to prevent NIS introductions via vessel fouling. During the October meeting, the TAG reviewed fouling management frameworks of other regions including codes of practice, regulations, informational surveys, and risk assessment techniques, and began to discuss their potential for application in California. The TAG additionally began discussing and prioritizing information and research needs (See Appendices E and F for meeting summaries).

At the final meeting in December, the TAG considered the pros and cons of hypothetical management options that ranged from industry education and outreach to potential regulations. This final meeting culminated in an informal list of areas where more information would be beneficial for the development of future management actions (See Figure III.1).

Staff compiled and organized meeting notes to assist in the analysis of non-ballast commercial vessel vectors (See Appendices C-F for meeting summaries). The following list summarizes the major points that emerged during TAG discussions, and that framed the development of priority information gaps and action items. (These items are listed in the next portion of this section):

- Vessel fouling poses an NIS risk that needs to be addressed.
- Much of the merchant fleet is well maintained, and likely poses lower risk.
- There is generalized knowledge on factors that facilitate fouling accumulation on vessels.
- The extent of fouling risk in North America is unclear. There has been limited modern research conducted primarily in other regions, and it may be difficult to apply this data directly to California.
- Dry dock facilities are in high demand and booked well in advance. There is little flexibility for unplanned dry docking events for the purposes of out-of-water hull cleaning.
- Biocidal antifouling paints pose water quality concerns.

As a result of the considerations listed above, several items were identified during the TAG process that members believed deserved priority attention. These are listed below and discussed further in focused sections of this report:

- Compile additional data and research to develop a comprehensive and effective framework to prevent NIS introductions via vessel fouling in California. Specific data and research needs identified by the TAG were:

- How the periodicity and type of commercial vessel maintenance relates to the accumulation and composition of fouling communities (e.g. dry dock vs. in-water cleaning frequency, type of antifouling paint).
- The quantity of fouling and characterization of species found on vessels that call to California.

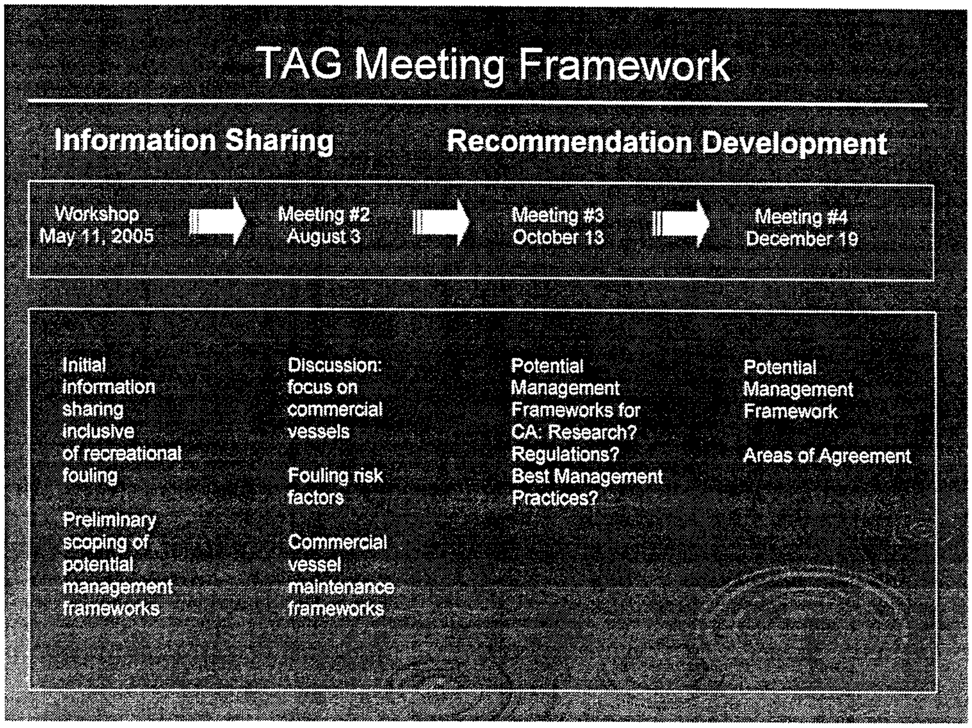


Figure III.1: Overview of major discussion areas and timing during Vessel Fouling Technical Advisory Group meetings.

- Specific conditions that constitute a high risk vessel (e.g. vessel speed, husbandry, route, sedentary time, etc…).

➢ Develop protocols that may be used to flag a high risk vessel arrival to California.
➢ Develop response measures to prevent NIS release.
➢ Develop technologies that contain and collect fouling effluent during in-water cleaning.
➢ Develop standardized data collection protocols and procedures for diver or ROV surveys.

- Increase outreach and education regarding vessel fouling as a vector for NIS introductions.

Areas of agreement from the collaborative workshop and TAG meetings provided valuable multi-disciplinary input to Staff during its evaluation of vessel fouling. TAG discussions confirmed that many questions remain regarding vessel fouling as an NIS vector, although discussions did offer some guidance for where future efforts should be focused. The information and suggestions provided by the TAG were considered and incorporated into this report by Staff.

IV. MERCHANT FLEET EFFORTS TO KEEP VESSELS CLEAN

Vessels travel faster through water when their hulls are clean and smooth, free from fouling organisms such as barnacles, algae, or mollusks. Fouling control is important to protect the hull from corrosion, reduce drag, and save fuel. Vessel owners and operators have long understood these relationships, utilizing various mechanisms to prevent or reduce fouling, including regular dry docking where hulls are mechanically cleaned and antifouling compounds are applied, and periodic in-water hull cleaning.

Antifouling compounds such as lime, arsenic, mercury, and pesticides (e.g. DDT) were used to coat vessel hulls prior to the 1960's (IMO, 2002). Unfortunately, frequent reapplication of these compounds was necessary, increasing operating costs, and arsenic and DDT have since been shown to have significant negative impacts on the environment. In the 1960's, the chemical industry developed biologically effective and cost-efficient organotin-based antifouling paints (e.g. tributyltin), that were believed to be less harmful than the biocides used at the time. These antifouling paints were designed to slowly release biocide, allowing vessels to go for as long as five years before reapplication.

By the mid-1970's, most oceangoing vessels had tributyltin (TBT)-based antifouling paints applied to their hulls. Tributyltin was found to be highly effective at keeping the hull smooth and clean, however, subsequent studies have shown TBT to have significant environmental impacts. Tributyltin and other organotin compounds leach into the water, persist in waters and sediments, and contaminate a range of non-target aquatic organisms. Tributyltin causes shell deformation in sea oysters, reduces resistance to infection in fish, is absorbed throughout the food chain, and has been found to be highly toxic to humans. As a result, several countries imposed rules to limit the use of TBT in antifouling paints. In 1999, the IMO adopted Resolution A.895 (21) "Antifouling Systems Used on Ships". The Resolution prohibited the application of organotin compounds on ships after January 2003 with a complete prohibition by January 2008. With the impending TBT-ban, paint manufactures have been developing TBT-free antifouling and fouling-release (non-biocidal) coatings. Many vessels currently utilize coatings with copper or zinc as the active biocide in place of TBT. Some use slippery silicon-based coatings which contain no biocides but make it difficult for organisms to adhere, or remain attached to the vessel.

The application of antifouling compounds is generally conducted in conjunction with regularly scheduled hull maintenance operations required by classification societies, though hull coating and cleaning is not explicitly required. Classification societies, such as American Bureau of Shipping, Del Norske Verita, and Lloyd's Register, are organizations that establish and apply technical standards related to the design, construction, and survey of vessels. The majority of vessels are built and surveyed based on classification society standards, which are published as rules. Ninety four percent of all commercial vessels operating in international trade belong to one of several societies that are part of the International Association of Classification Societies (IACS) (IACS, 2004).

Vessels built in accordance with IACS rules are assigned a class designation and are subject to regular surveys to ensure that ships remain in compliance with those rules. Classification society rules include requirements for periodic hull surveys. While these rules are directed at ensuring safety and structural integrity rather than NIS prevention, they incidentally serve to control vessel fouling to a certain degree. The frequency that most vessels routinely clean hulls and reapply antifouling paints is associated with the hull maintenance rules of their classification. In general, each classed vessel is subject to a specified program of periodic surveys. These specific programs are based on a five-year cycle that consists of annual surveys (in-water), intermediate surveys (in-water or dry dock), and class renewal special surveys (dry dock) that take place every fifth year. As a vessel ages, the rigor of each survey increases. For example, older vessels generally require more frequent out-of-water surveys and some vessels operating in certain areas, such as Alaska's Prince William Sound, are subject to more frequent inspections (see Appendix D). Additionally, an incident that may have compromised the integrity of the hull (e.g. collision, grounding or allision) generally requires an out of water dry dock survey.

Vessels generally dry dock only as frequently as needed or required because dry docking facilities are limited, making scheduling difficult and costly. While reapplication of antifouling compounds is normally not required by societies, vessel owners commonly take advantage of required dry dockings and elect to clean and reapply antifouling compounds at the same time. Because fouling continues to accumulate between required dry dockings and can reduce fuel efficiency, most companies also conduct interim in-water cleanings. These are conducted as needed, according to the results of frequent fuel consumption and speed performance tests (see Appendix E).

Most commercial vessel owners operating in California waters conduct regular hull maintenance for structural and economic reasons, not for NIS prevention. Therefore, while we may speculate that frequently dry docked and cleaned vessels pose "less" risk than those that are not maintained according to classification society rules, there is still a great deal of information needed on how much NIS prevention is achieved through adherence to these practices.

V. REVIEW OF CURRENT KNOWLEDGE ON VESSEL FOULING AND NIS

Staff and TAG members reviewed existing scientific information in order to evaluate the risk posed by commercial vessel fouling for NIS introductions in California, and to provide informed considerations for potential management recommendations. Information examined included peer reviewed and gray literature studies and discussions with scientists on the TAG with research expertise on NIS and commercial vessel fouling. Unfortunately, little research has been conducted on vessel fouling and its role as an NIS transport mechanism, particularly for North America. One limited study was conducted in the Port of Oakland, two are underway for the Pacific Coast, and a handful of studies have been completed in the Hawaiian Islands. The majority of research consists of smaller studies conducted on a combination of commercial and recreational vessels in Australia and New Zealand. In light of the limited amount of information, the TAG and the Commission examined generalized factors that affect fouling accumulation on vessels, the relative risk posed by vessels exhibiting those factors, and how factors may or may not apply to merchant traffic in California. Emphasis was placed on topics that could guide the development of ship-based management strategies that may help prevent NIS introductions via vessel fouling to the State.

Vessel Movement and Maintenance Effects on Fouling

Certain vessel movement patterns and maintenance practices have been observed to affect the diversity (variety of species) and quantity of fouling observed on commercial vessels. These factors influence the ability of free swimming or floating organisms to attach to a vessel, the ability of fouling organisms to remain affixed, or affect the ability of the organism to survive voyages.

Immobile Periods: The amount of time a vessel spends in port or at anchor has a notable influence on fouling. Many floating or free swimming organisms are better able to attach or "settle" on surfaces while vessels are immobile, and vessels that spend long stationary periods have been observed to have heavier fouling communities (Skerman, 1960; Rainer, 1995; Coutts, 1999). One study also indicated that fouling accumulates more quickly and more heavily in enclosed basins (e.g. marinas) likely because water and organisms are flushed out less frequently in comparison to inshore coastal areas (Floerl and Inglis, 2003).

Vessel Speed: Vessel speed influences the quantity and diversity of fouling species observed on vessels. At high speeds, many organisms are unable to remain attached to vessels, or are less able to endure forceful water moving past the surface. Less robust organisms may be dislodged or may be unable to survive. Slow speeds are less stressful, allowing many fouling organisms to remain attached or continue settling on the vessel surface (Foster and Willan, 1979; Carlton and Hodder, 1995). Thus, slower moving vessels have been observed to accumulate thicker fouling than do faster vessels that travel over 18-20 KTS (Michin and Gollasch, 2003; Coutts and Taylor, 2004).

Voyage Duration: Shorter voyages have been observed to be more advantageous for the survival of fouling communities than longer voyages. The prolonged exposure to harsh physical conditions of the open ocean during a long voyage may be detrimental to fouling organisms, or they may be deprived of food for an untenable length of time (Coutts, 1999).

Age of Antifouling Paint: As discussed in Section IV, "Merchant Fleet Efforts to Keep Vessels Clean", commercial vessels regularly utilize antifouling coatings to discourage hull growth that can create drag. The majority of coatings in use today function by slowly releasing biocidal toxic agents (e.g. copper or zinc compounds) that kill fouling organisms or affect their ability to attach to the treated surface. The age of antifouling paint is strongly related to the diversity and amount of fouling organisms on both commercial vessels and recreational boats (Coutts, 1999; Floerl and Inglis, 2005). Older coatings have been observed to be less effective, presumably because the activity of the biocidal toxins decreases with time.

In-water cleaning: In addition to periodic application of antifouling paints, vessel operators and owners may also have fouling growth removed through scrubbing while the vessel remains in the water, in between paint applications. While in-water cleaning is effective for removing fouling organisms in the short term, research on recreational vessels suggests that it may increase the amount of fouling in the long term. It is suspected that this may occur because the mechanical removal of fouling leaves traces of scraped organisms, including shell or tissue (Floerl, 2005; Floerl et al., 2005). For some fouling species, these remnants act as a signal for unattached fouling organisms in the water column to settle (Railkin, 2004). Additionally, in-water cleaning can dislodge viable organisms at a destination port which may facilitate introductions of NIS (see discussion in this section, "Transfer from Vessel to Port", that follows).

Environmental Factors that Influence Fouling – Salinity and Temperature

As vessels transit from one port to another, they typically pass through changing salinity and temperature conditions, and these factors are believed to be important determinants of the survival of fouling organisms. While some organisms are able to survive a wide range of environmental conditions, many are not. Dramatic or rapid changes in either salinity or temperature are stressful for many organisms. In one case, this attribute was utilized to treat a heavily fouled vessel that had been moored for five years at a high salinity location (33-35 parts per thousand) in Washington State. Freshwater immersion resulted in approximately 90% removal of the original fouling growth (Brock et al., 1999). Organism intolerance to wide salinity and temperature fluctuations may also partially explain why higher levels of fouling are observed on vessels traveling on short voyages at similar latitudes where salinity and temperature levels tend to be more consistent (Coutts and Taylor, 2004).

In addition to voyage route, temperature and salinity also vary depending on other interacting variables. Season, amount of precipitation, and depth of a vessel's submerged surfaces are some of the major components that influence both temperature and salinity levels in any given location, and thus may affect vessel fouling.

Location on a Vessel

Fouling is not uniformly distributed on submerged portions of vessels. Some areas are particularly prone to fouling even on vessels with behaviors not generally conducive to fouling (e.g. travel at high speeds, spend little time in port). Areas sheltered from strong water forces, where antifouling coatings are less frequently renewed, or where antifouling systems may be irregularly utilized tend to exhibit higher levels of fouling

(Coutts and Taylor, 2004). The Act specifically directs that the Commission include an analysis of specific vessel components. These "...shall include but not be limited to...hulls, sea chests, sea suction grids, other hull apertures, in-water propellers, chains, anchors, piping and tanks," (Public Resources Code (PRC) Section 71210.5). The TAG and Staff therefore considered and prioritized the relative fouling risk associated with specific vessel areas.

Areas on a vessel that are shielded from strong water flow have been noted to foul even in cases where main portions of the hull are clean. Studies have noted higher numbers and/or diversity of fouling organisms in sheltered areas and in crevices around rudders or propellers, intake pipes, gratings, and bow thrusters (Figure V.1) (Ranier, 1995; Coutts and Taylor, 2004). In particular, recent research has documented extensive fouling communities in the sea chests of some vessels (Dodgson and Coutts, 2002, Coutts et al., 2003). Larger mobile organisms, such as crabs, snails, and shrimp have been found in addition to immobile fouling organisms affixed to vessel surfaces.

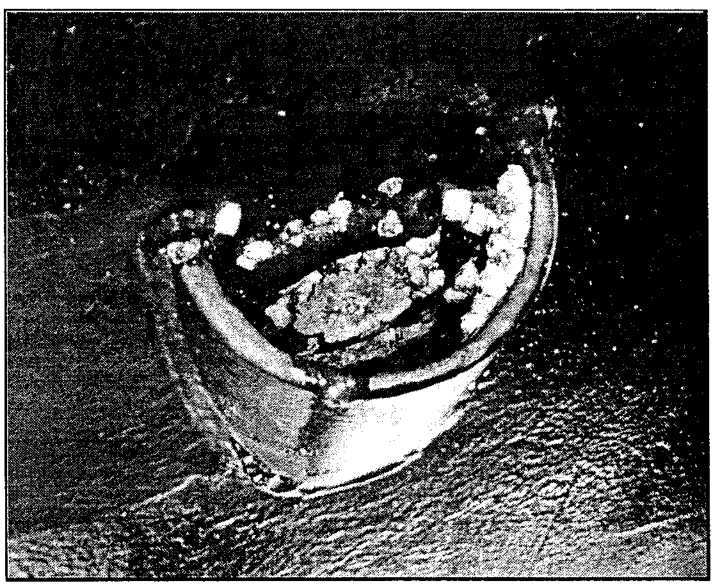


Figure V.1: Intake opening on a vessel hull.

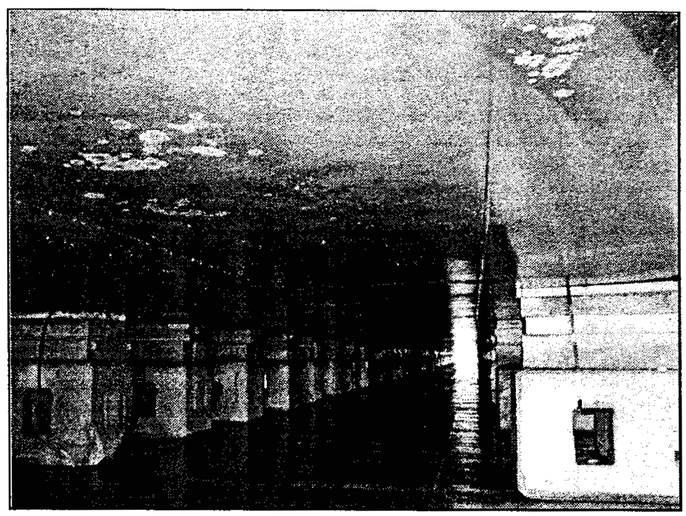
Note that fouling is visible, though surrounding exposed areas are clean.

For vessels that are well maintained (cleaned and painted frequently) lowest risk areas are portions that are exposed to strong water movement such as the main hull, and areas of the rudder exposed to the intense flows generated by the propeller. There was no information available regarding fouling of propellers and anchors, which were explicitly listed in the Act.

As noted earlier in this section, older antifouling coatings appear to be less effective at preventing fouling accumulation. Portions of a vessel that are coated less frequently may thus pose a higher risk, even if they are subjected to strong water motion. Studies in Tasmania and New Zealand have found high diversities of organisms on localized parts of the hull where support blocks prevented cleaning and/or painting during the most recent dry dock service (Coutts, 1999; Coutts and Taylor, 2004). These "dry dock support strips" are placed at intervals under the length of the hull to suspend a vessel when it is brought into dry dock for repairs, maintenance, cleaning, or painting (Figure V.2). Though many dry dock operations alternate the location of the blocks so hull areas beneath them are serviced during every other docking, the antifouling coating is older at those locations in comparison to the rest of the hull.

Figure V. 2: Vessel on dry dock blocks.

The rectangular blocks suspend the vessel for maintenance, repair, and paint re-application.



Transfer from a Vessel to Port

Because fouling communities consist of organisms that are either physically attached or that associate with vessel surfaces, NIS must be transferred from the vessel to a recipient port for possibility of introduction. This may occur through:

- Spawning or Egg Release

- Detachment (drop off a vessel)
- Mechanical removal (dislodged from a vessel)

Spawning or egg release can expose a recipient site to the young of fouling organisms even if the adults are otherwise unable to detach from a vessel. For example, egg-bearing crabs too large to escape sea chests have been found in vessels arriving to New Zealand and Tasmania (Dodgshun and Coutts, 2002; Coutts et al., 2003). For many marine invertebrates, certain environmental events such as changes in salinity or temperature can trigger spawning. In particular, rises in sea temperature can cause spawning for many temperate species (Michin and Gollasch, 2003), and likely triggered spawning of an NIS mussel species found attached to a vessel that had been towed from the Washington-Oregon area to Hawaii (Apte et al., 2000).

For mobile organisms in particular, transfer to a recipient port may be accomplished by simply dropping off a vessel. Organisms capable of independent detachment associated with fouling communities include crabs, fishes, sea stars, shrimp, snails and plankton (Foster and Willan, 1979; Carlton and Hodder, 1995, Dodgshun and Coutts, 2002; Coutts et al., 2003). Even in some documented cases involving the introduction of immobile fouling organisms, detachment is suspected as the only mode of transfer (Michin and Gollasch 2003).

Organisms can be dislodged if the vessel is bumped or during the process of in-water or dry dock cleanings. In-water cleaning is typically conducted between dry dock maintenance intervals to ensure that drag caused by fouling is kept to a minimum, and to meet classification society maintenance requirements (See Section IV, Merchant Fleet Efforts to Keep Vessels Clean). During in-water cleaning, fouling material is scraped or scrubbed from the underwater portions of the vessel, and can result in organisms dropping to the seafloor (Michin and Gollasch, 2003). A study in New Zealand on in-water scraping of smaller vessels (less than 49 meters [m]) indicated that 72% of the discarded organisms remained alive (Floerl et al., 2004), though it is not clear if other cleaning techniques (e.g. brushing) on larger commercial vessels would yield similar results.

During cleaning in a dry dock, fouling is often removed via abrasive blasting or hydroblasting. Though organisms dislodged during dry dock pose a theoretical NIS threat, increasing concerns over toxic substances entering the water have resulted in strict disposal requirements for effluent from dry docks. For example, the National Point Source Discharge Permit issued to the commercial dry dock in San Francisco prohibits the direct discharge of particulates and effluent into waters of the State (California Regional Water Quality Control Board, San Francisco Bay Region, 1999). Fouling material along with other waste particulates are generally placed in holding tanks and/or discharged to municipal wastewater systems or to a landfill. Thus, the potential for fouling introductions from dry docks theoretically presents limited risk (Godwin et al., 2004; Davidson et al., 2005).

Studies Conducted on U.S. Pacific Coast

Because fouling appears to be affected by factors that vary in relation to the type of commerce and environmental conditions of a specific region, it is important to consider field research conducted locally. A summary of studies conducted in the U.S. Pacific region are reviewed here.

Port of Oakland, 2004

A pilot study on nine containerships arriving to the Port of Oakland in 2004 found patterns of fouling that varied in some aspects from studies conducted in other regions. As in other studies, the most fouling was observed in sheltered, non-hull locations on each ship. In contrast, the overall amount of fouling was much lower than had been observed on vessels in New Zealand (Coutts and Taylor, 2004; Ruiz et al., 2005). This is likely partially due to the high average speed of the vessels in the study (24-28 MPH, or 21-24 KTS) and their short port residency time (less than 24 hours). In contrast to other studies, little fouling was found in dry dock support strip areas though the condition of antifouling paint there was poor. The authors suggest that containerships arriving to Oakland may have lower levels of fouling in comparison to other vessel types with differing movement patterns. However, they caution that the limited number of vessels examined and the focus on only one ship type make any generalizations premature.

Wetted Surface Area (WSA) of Commercial Vessels Arriving to California Ports
Any submerged portion of a vessel represents a potential for fouling accumulation. Thus, an estimate of total amount of submerged surface area from all vessels that arrive to a region can provide some indication of the rate and pattern with which individual organisms may arrive (propagule pressure), and how they may contribute to NIS establishment. As part of a larger study to investigate fouling NIS potential on vessels arriving to the West Coast, the Aquatic Bioinvasions Research and Policy Institute provided preliminary data on hull "wetted surface area" (WSA) of vessels arriving to California for this report. This analysis was based on vessel arrivals from the ballast water reporting forms submitted to California between July 2003 and June 2005.

For the two years analyzed, 189.5 million square meters (m^2) of hull surface area has arrived to ports in the State (≈ 95 million m^2 per year). Forty-one percent arrived from Pacific Coast ports of North America (California, Oregon, Washington, British Columbia and Alaska). The remaining 59% (111.8 million m^2) arrived from overseas ports in 71 countries throughout the Pacific, Atlantic and Indian Oceans, highlighting the global scale of possible introduction via this mechanism. Containerships dominated California arrivals, accounting for 55% of the total WSA for the state, and were the most frequent visitor and one of the largest ship types on average (second only to tankers in terms of average WSA) (Figure V.3).

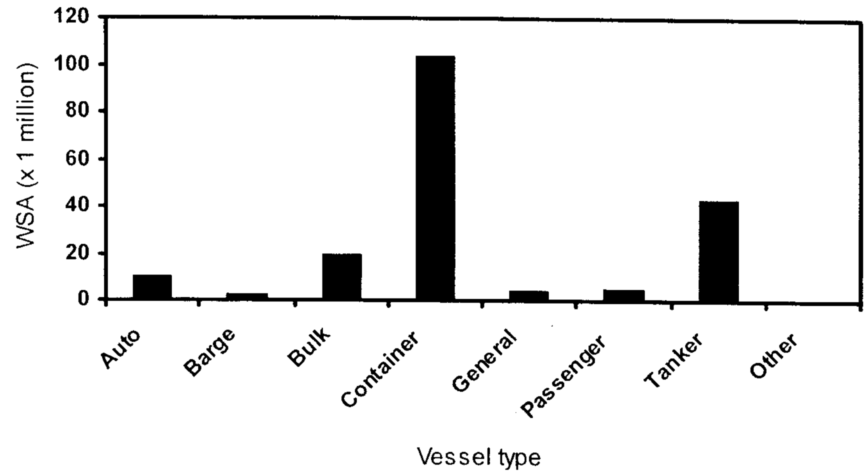


Figure V.3: Total wetted surface area (WSA) arriving to ports from July 2003 - June 2005 in California by vessel type.

The magnitude of the threat of invasion to California's coastal waters from hull fouling is significant. The two-year total of WSA entering California waters equates to 1½ times the area of San Francisco County. However, without reliable data on biofouling densities across different vessel types, the ability to determine the full extent of propagule pressure to the State from commercial hull fouling is limited. A first effort at gathering this data will be made later in 2006, with the longer term aim to determine how different vessel types, voyage routes, hull husbandry regimes, and recipient port conditions influence hull fouling transfers and species establishment.

Wetted Surface Analysis and Vessel Fouling Surveys in the Lower Columbia River

In a preliminary study, vessel fouling and its potential for introductions in the Lower Columbia River (LCR) was evaluated through: WSA calculations for vessels arriving between July 2002 and June 2005, a biological analysis of fouling on 10 vessels surveyed in dry dock and on 7 vessels surveyed on video, and an evaluation of the suitability of the Lower Columbia River for invasion.

Over 40.5 million m^2 of WSA arrived in the region between July 2002 and June 2005. The scale of potential introductions was global – vessels arrived from 377 different ports in 66 countries. The vast majority (85%) of overseas arrivals came from Asian ports of the Northwest Pacific. Vessel WSA was dominated by bulk carriers (>50%). Fouling on vessels examined on dry dock was highly variable; it ranged between >90% and <1% of the WSA. High levels of fouling tended toward vessels that remained within either marine or freshwater conditions and had not been cleaned within the last two years. Minimal fouling levels were associated with vessels that commonly traversed a range of salinity conditions, such as barges that frequent the LCR. Two vessels with the highest number of species had traveled to the LCR from overseas and had not spent much time in freshwater. Many of the taxa on these vessels were probably nonindigenous to the Pacific Northwest region. Finally, the authors conjecture that the dramatically varying salinity and highly variable flow rates in the LCR may serve to limit some invasions (Davidson et al., 2005).

Implications of Current Knowledge

The review of current research provided in this section allows for broad generalizations regarding NIS invasion risk posed by fouling on commercial vessels. However, the extent to which these principals apply to the U.S. West Coast and California are unclear due to the limited amount of information available. Fouling and associated NIS introductions are highly dependent on environmental conditions, vessel maintenance practices, type of shipping traffic, and vessel movement patterns, which can be regionally unique. Fouling factors also interact. A single vessel may exhibit behaviors that fall into both higher and lower risk categories, resulting in fouling NIS risk that can be complex and difficult to evaluate. This is especially the case for North America and California, where very little locally based research has been conducted on vessel fouling and its relationship to NIS introductions.

In a minority of instances where vessels or maritime structures exhibit exaggerated characteristics that contribute to fouling accumulation, the NIS risk has been observed to be high. For example, the decommissioned *USS Missouri* was observed to have accumulated at least 116 fouling species during its five-year residency in Bremerton, Washington (Brock et al., 1999), before it was to be relocated to Hawaii. Towed vessels or maritime structures that move extremely slowly and spend very long periods immobile have been observed to be problematic in New Zealand and Hawaii (Rainer, 1995; Godwin, 2003; Coutts, 2005 (a)). In 2001, a barge that had arrived in New Zealand from the Philippines before 1991 and which had not been dry docked since its arrival, was observed to have accumulated over 28 tons of fouling organisms (Coutts, 2005(b)). A heavily fouled floating dry dock that was towed to Hawaii in 1992 from the Philippines is thought to be responsible for the establishment of several NIS to Pearl Harbor (Coles et al., 1999). An oil platform towed for 68 days at an average of 3.7 MPH (3 KTS) from Japan to New Zealand arrived with over a ton of fouling (Foster and Willan, 1979). A floating dry dock towed to Hawaii from San Diego in 1999 had high levels of fouling the included 34 NIS, and an algal species became established as a result (Godwin, 2003).

The majority of vessels in regular operation, however, do not exhibit similarly extreme characteristics. As noted in Section IV, most companies clean and paint hulls regularly for operational safety, to reduce maintenance costs, and to minimize drag-related fuel costs. Many minimize time in port and maximize transit speed in order to move cargo quickly for maximal profit. Because there have been no fouling studies across a broad range of vessel types, vessel movement patterns, and maintenance practices, it is not known what kinds of fouling patterns result on vessels that exhibit more common behaviors or that engage in a combination of behaviors with differing fouling effects (e.g. a swift vessel that typically spends three days in port; a freshly painted vessel that has been moored for two weeks). Thus, while it may be possible to identify irregular situations that likely pose a high risk, it is not clear what level of risk is presented under more typical commercial vessel behaviors.

It is also notable that any vessel or structure of any size may accumulate fouling, and if mobile, can serve to transport NIS. Factors that influence fouling on commercial vessels also apply to other structures, including private boats or yachts, fishing vessels, and navigational buoys (Railkin, 2004). For example, the historical replica ship of the Golden Hinde transported over 64 species at various legs of its voyage from Yaquina Bay, Oregon to San Francisco Bay, California in 1987. The vessel spent 30-day layovers at three ports prior to and during its 4-4.5 MPH (3.5-4 KT) trip (Carlton and

Hodder, 1995). In a Hawaii study, 21 NIS were found on 12 overseas personal craft, though all but one of the NIS had already become established in the state (Godwin et al., 2004). In New Zealand, recreational yachts have been suspected as a probable introduction vector for several problematic NIS (Floerl and Inglis, 2005). Though the Act explicitly directs the Commission to evaluate the NIS risk posed by vessels over 300 gross registered tones able to carry ballast, it is important to note that a complete picture of the fouling NIS vector extends beyond commercial vessels.

VI. EXISTING FRAMEWORKS FOR THE MANAGEMENT OF VESSEL FOULING

A range of strategies for minimizing NIS introductions through commercial vessel fouling have been proposed or adopted by various countries, states/territories and regions. To date, no country has adopted national regulations for commercial vessels explicitly for the prevention of NIS introductions through vessel fouling. The types of management frameworks vary widely because there has is little information on the efficacy of management strategies for the vector. In some cases, the primary impetus for management is not fouling NIS prevention, but the minimization of toxic antifouling paint release into the water as residues are scraped off during hull cleaning. The TAG and Staff examined the benefits and drawbacks of these strategies, and their potential for the prevention of fouling NIS in California.

Federal and California Codes and Statues

The Federal code (Code of Federal Regulations [CFR] Section 151.2035 (5) and (6)) and the California statue (California Public Resources Code Section 71204 (e) and (f)) contain nearly identical language prescribing minimum maintenance actions to control fouling. However, both are limited in scope and specificity. They require that anchors and anchor chains be rinsed upon retrieval at their place of origin, and that fouling organisms be regularly removed from hulls, piping and tanks and be disposed of according to local, State or Federal regulations. Parameters are not defined regarding the "regular" removal of fouling. Despite this, the U.S. Coast Guard has utilized their regulation to intervene when decommissioned Suisun Bay Reserve Fleet vessels were moved from one Captain of the Port Zone to another for dismantling. Much of the

Suisun Bay fleet has been immobile for years, if not decades, with little or no hull maintenance.

Hawaii

In Hawaii, a draft information framework for the management of fouling NIS was developed by the Alien Aquatic Organism Task Force, a stakeholder group formed by the Hawaii Division of Aquatic Resources. The framework has not yet been officially adopted, and the State currently monitors maritime arrivals for high risk vessels through an informal network of state, federal, academic and private groups. Response is conducted through this informal network as much as possible.

The draft framework separates fouling NIS management into three components. "Pro-active measures" are geared towards minimizing high risk arrivals to Hawaii, and include education and outreach, maritime activity monitoring, and the evaluation of arrivals for potential high risk vessels. The second component addresses the response to a high risk event, and these "reactive measures" may involve an investigation of the identified vessel, and/or a determination of actions to minimize the potential for NIS introduction. The third component, "post-event measures", involves the development of long term management measures once it is determined that they are needed (Godwin, 2005).

In order to assist with the identification of potentially high risk vessel arrivals during the pro-active stage, an evaluative risk matrix was developed (See Figure VI.1). Its components are based on vessel movement and maintenance patterns that influence fouling, though some of its specific parameters have not yet been defined (Godwin et al., 2004) (see Section V, "Review of Current Knowledge on Vessel Fouling and Nonindigenous Species"). In the proposed matrix, vessels arriving from outside of the state that do not adhere to international maintenance codes of practice, and spend long periods immobile would be flagged. In addition, certain vessel types are designated as high risk, based on prior NIS fouling surveys conducted in Hawaii. These would include vessel types that often travel at slow speeds and spend long periods inactive (e.g.

barges, platforms, floating dry docks). Potential reactive measures for high risk vessels include restricting time in port to essential operations, quarantine, or out of water cleaning for those intent on an extended stay.

New Zealand

The Biosecurity New Zealand (formerly New Zealand Ministry of Fisheries) is the primary agency responsible for the prevention and management of marine NIS in New Zealand. There are currently no regulations in place related to the prevention of fouling NIS, however information gathering efforts are conducted through a survey. The survey is included on the ballast water declaration form required of all arriving vessels, and asks three questions relating to vessel maintenance and activity:

- When was the vessel last dry-docked and cleaned?
- Has the vessel been laid up for three months or more since it was last dry docked and cleaned? If yes, state when and where.
- Do you intend to clean the hull in New Zealand? If yes, state when and where.

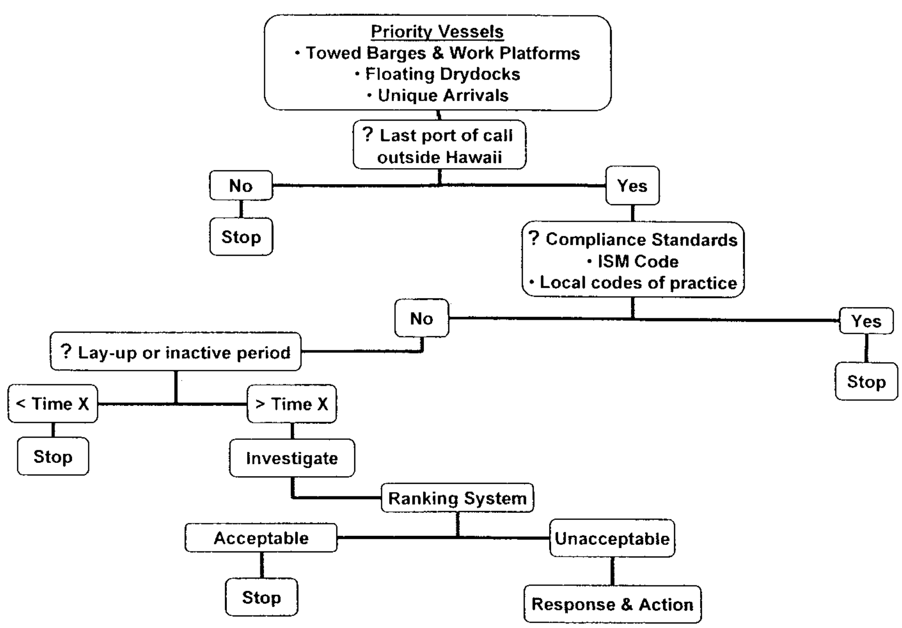


Figure VI.1: Preliminary "risk matrix" developed in Hawaii to assist with the identification of arrivals that pose a high fouling NIS risk to the state. From: Godwin, 2005.

In addition, New Zealand's fishing industry adopted voluntary codes of practice in December 1996, following the highly publicized arrival of a fishing vessel in 1994 with approximately 90 tons of fouling (Hay and Dodgshun, 1997; Coutts, 2005(a)). The code requests that foreign owned or sourced vessels be free from growth prior to entering New Zealand's Exclusive Economic Zone. If this cannot be assured, the vessel should be inspected, and either cleaned before departure or have fouling removed in a manner that does not allow organisms to enter the marine environment.

Biosecurity New Zealand is currently considering several options for the regulation of hull cleaning practices. Proposed rules may require that out-of-water cleaning facilities to contain, collect and dispose of or treat fouling material in a manner that prevents discharge of organisms to the marine environment. Additionally, proposed rules may include a ban on in-water cleaning, regulations targeting high risk vessels only, or the adoption of codes of practice for in-water cleaning operations (Coutts, 2005 (a); New Zealand Ministry of Fisheries, 2006).

Australia

Though Australia has not implemented nationwide regulations related to fouling on vessels larger than 25 m, all states and territories prohibit in-water cleaning on commercial-sized vessels (Hirst, 2006; New Zealand Ministry of Fisheries, 2006). Most of these prohibitions are variants of the Australian and New Zealand Environment Conservation Council (ANZECC) codes of practice (See discussion that follows on ANEZCC codes of practice), and in some cases have been adopted primarily to prevent biocidal antifouling paint flakes from entering the water or dropping to the sea floor. Currently, protocols tailored to specifically address fouling NIS are in very early stages of development (Hirst, 2006).

In late 2005, Australia announced the implementation of national regulations to prevent fouling NIS introductions on internationally traveling vessels under 25 m. Though the regulation does not apply to commercial vessels, it is reviewed in this report because it