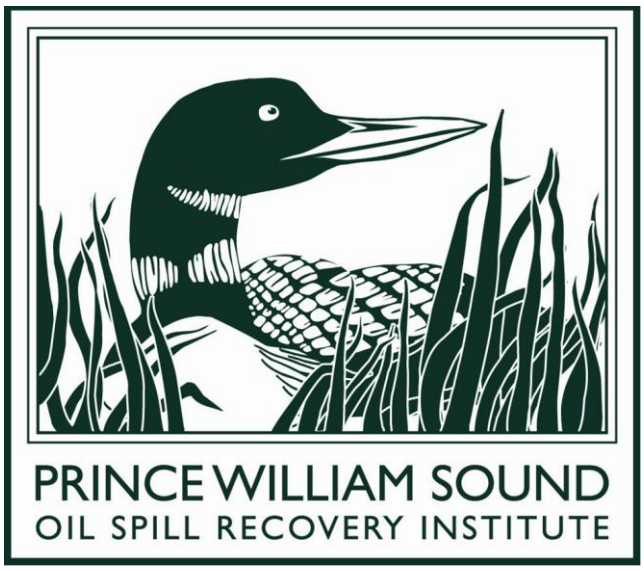

2008 Work Plan
Prince William Sound Oil Spill Recovery Institute

August 2007

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2008 Work Plan

I. Purpose and organization of this document

This document describes the Oil Spill Recovery Institute (OSRI) 2008 Work Plan in the context of the overall Science Plan approved by the OSRI Board in February 2005 for fiscal years 2005 through 2010. The Science Plan should be referenced for detailed descriptions of the OSRI Program, the planning process and supporting documents. The annual reports and previous work plans should be referenced for more information regarding previously funded projects. The 2008 Work Plan provides descriptions of projects proposed for funding in the 2008 fiscal year beginning October 1, 2007 and a brief description of projects funded in previous years, but continuing to be conducted in FY08. The OSRI Science Plan and previous OSRI Work Plans can be found on the internet at: www.pws-osri.org.

II. OSRI Strategic Goals and FY08 Work Plan New Projects

The Advisory Board of OSRI and the Executive Committee of the Board of Directors for the PWSSC conducted a strategic planning session in 2002. The purpose of the planning session was to evaluate the past, the present, and plan for the future of OSRI and the PWSSC through 2012. Four goals were identified as part of the strategic plan: Understand, Respond, Inform, and Partner (see OSRI Science Plan). The fiscal year (FY) 2008 Work Plan has been placed in the context of these four goals.

A. Goal #1 Understand:

Attain a four-dimensional interdisciplinary understanding of Prince William Sound (PWS) to enable detection and prediction of spill-related impacts and subsequent recovery.

Real time physical observations of surface and subsurface current direction and magnitude and biological observations on resources in the path of the spill are absolutely essential to effective and timely oil spill response. Without a reliable forecast of the direction and speed of a spill, and knowledge of the resources likely to be impacted, even the best clean up technologies in the world may be misapplied.

1. Physical science programs

The OSRI science plan outlines an approach for addressing goal #1. This approach is to develop and test modeling and observational capabilities by contributing to the Prince William Sound Observing System (PWSOS). There are two primary goals of the Prince William Sound Observing System. The first is to combine long-term monitoring with short-term hypothesis-driven process studies to understand mechanisms underlying the regional ecosystem dynamics. Understanding the circulation and the patterns of water exchange will provide a solid scientific foundation for addressing fisheries and ecosystem management needs related to long term oceanic and climatic variability. The second goal is to provide information to the major user groups in PWS including the coastal communities, oil and gas transportation industry (tanker traffic and oil spill response), air taxis, commercial fishermen, recreational and commercial boaters, and Coast Guard search and rescue operations. For example, the high-resolution wind, wave and ocean current forecast products will provide improved information to recreational and

commercial vessel and aircraft operators and enhance the safety of oil tanker traffic in PWS. The improved physical and ecological forecasting products will enable resource managers (e.g., PWS hatchery and commercial fishing organizations) to make informed and scientifically sound management decisions on food supply, predation, and human activities such as commercial and recreational fishing.

a. ***Meteorology*** (OSRI cost: $9K telemetry, $21K NRCS $10K logistics [Total $40K])
Meteorological and precipitation data for ocean circulation models
Understanding the circulation of Prince William Sound requires accurate measurements of wind fields and precipitation. Snow melt runoff and rain fall leads to a freshwater layer that sets up the surface circulation. Wind stress then modifies the circulation creating local and seasonal circulation patterns. By understanding the basic meteorological conditions we hope to improve our ability to model the meteorology of Prince William Sound, improve our understanding of the forcing driving seasonal changes in circulation, and provide oil spill response organizations with necessary data.

Snowpack Telemetry (SNOTEL) stations set up in partnership with the Natural Resources Conservation Service (NRCS), measure precipitation from snow and rain throughout the year and feed drought predictions. They are fully-automated, land-based stations that are usually set up in remote locations. In 2004 the state of Alaska had 46 stations. Since the summer of 2005, six new SNOTEL stations have been deployed at sea level in PWS, and two additional stations at alpine elevations. Another three alpine stations are planned. The fully deployed system in PWS will have five pairs of sea-level and alpine stations with a pair in each of the four quadrants (Northeast, Northwest, Southwest, Southeast) of the Sound and another representing the central basin (Table 1). The Nuchek station adds meteorological data near the important shipping lanes through Hinchinbrook Entrance.

Each station in PWS measures wind speed and direction, air temperature, air pressure, precipitation from rain and snow, and solar radiation. Four stations (one sea level station in each quadrant of the sound) also have digital cameras that transmit pictures every fifteen minutes to the internet so the actual weather conditions in each area can be seen. Data transmitted by the weather stations will be accessible through the Alaska Ocean Observing System (AOOS, aoos.org) and PWSOS (pwsoos.org) web pages and archived at the University of Alaska Fairbanks.
The SNOTEL stations provide important information about the amount of freshwater stored as snow in the watershed of Prince William Sound, an important driver of summertime circulation in the Sound. Deployment of most of the SNOTEL Stations were funded by a combination of grants to the Prince William Sound Science Center (PWSSC) from the National Oceanic and Atmospheric Administration (NOAA), Exxon Valdez Oil Spill Trustees Council (EVOS) and AOOS (Congressional earmarks), and OSRI. Annual maintenance costs for all stations except the one at Nuchek will be provided by OSRI, at least, through 2010. The installation cost for the Nuchek station was provided by the PWS Regional Citizens' Advisory Council and ongoing maintenance is planned by a variety of sources.

Table 1. Location of SNOTEL stations.

PWS Quadrant	Site name	Location	Deployment date
SW	Chenega Bay/Port San Juan	Sea level	May/June 2005
	Jackpot Cirque	Alpine	2007
NW	Esther Island	Sea level	May/June 2005
	Mt. Doran/Port Wells	Alpine	2007
NE	Tatitlek	Sea level	May/June 2005
	Sugarloaf Mt, Valdez	Alpine	2007
SE	Strawberry Reef/Copper River Delta	Sea level	July 2006
	Mt. Eyak	Alpine	August 2005
Central Basin	Seal Island	Sea level	May/June 2005
	Naked Island	Alpine	2007
Hinchinbrook Entrance	Nuchek	Sea level	August 2005

Deployment of Jackpot Cirque, Naked Island, and Mt Doran SNOTEL stations has occurred more slowly than planned because these are wilderness study areas that require special permits from the U.S. Forest Service. The Valdez area SNOTEL site is now planned for Sugarloaf Mt. due to logistical and permitting constraints. These sites are now scheduled for installation in summer or fall 2007.

The annual operating cost for the weather stations is about $4,000 per station per year. The operating costs include regular maintenance, calibration of sensors, access to the sites, and telemetry related expenses. The FY08 budget includes $40K for maintenance of ten sites, under the assumption that all ten stations will be operating.

b. *Oceanography* (OSRI cost: $160K)
Water exchange between PWS and the Gulf of Alaska and seasonal variations of hydrographic properties in central PWS
A primary component in improving our understanding of the circulation of Prince William Sound is the collection of oceanographic measurements. These measurements allow direct studies of circulation, the exchange of water between Prince William Sound and the Gulf of Alaska (GOA), and provide validation data for testing circulation models.

The OSRI funded oceanography work is a constituent of the Prince William Sound Observing System (PWSOS). In its current state, the program encompasses three components: 1) Long-term monitoring of the water exchange between the Gulf of Alaska and Prince William Sound, 2) Monitoring of the seasonal variability of the hydrographic properties and circulation in PWS, and 3) Long-term monitoring of sea water temperature, salinity and fluorescence at nearshore sites in northern and western PWS.

The goal of the mooring component of the five-year observational oceanography program is to provide an improved description of the flow through the straits connecting PWS with the GOA. This is a necessary step towards a better understanding of the relationship between circulation variability and biological variability in PWS. The current mooring program addresses two limitations of previous mooring programs (lateral variations not accounted for and lack of data in the near surface part of the water column). Knowledge acquired from this five-year program should be sufficient to allow future monitoring of the exchange using a single downward-looking ADCP at the NDBC buoys.

The "water exchange" moorings deployed by Prince William Sound Science Center (PWSSC) since June 2005 consist of 2 moorings in Hinchinbrook Entrance (HE) and 2 moorings in Montague Straits (MS). Each of these moorings is composed of 2 internally recording Acoustic Doppler Current Profilers (ADCP) and 3 conductivity-temperature (CT) sensors (Fig. 3). Both ADCPs are positioned around 100 m depth, one upward-looking and one downward-looking. The CTs are positioned at about 30 m, 100 m, and 10 m above the bottom. In addition, in 2007 the Seal Rocks NDBC buoy in Hinchinbrook Entrance is expected to be equipped with a downward-looking ADCP and a near-surface CT and repositioned roughly mid-way between the two PWSSC moorings.

Initial costs for equipping the moorings at Hinchinbrook and Montague were supported by other entities, while OSRI funds support most of the semi-annual servicing and data analysis costs. The moorings will be in place through 2010.

A second component of the observational program consists of a regular monitoring of the hydrographic properties in the central basin of PWS and at the main entrances. A goal of this work is to acquire a description of the seasonal evolution of the hydrographic properties at these locations. This is done through seasonal vessel-based hydrographic surveys (three to four cruises per year) during which conductivity-temperature-depth (CTD) profiles are acquired at a number of stations. For each survey, four transects (west-east, north-south, HE and MS) are visited (giving a total of 28 stations), and extra stations may be added depending on the needs of the moment. The planned duration of this project is the same as for the "water exchange" moorings, that is through 2010.

The third component of the oceanography program is expected to begin in 2007. This component is the addition of telemetered, near-shore moorings with temperature, conductivity, and fluorescence measurements. AOOS is funding the design and installation of one mooring in 2007. The mooring uses equipment already owned by the Prince William Sound Science Center (PWSSC). The goal of the near-shore mooring

program is to provide real-time data for model assimilation and to provide biological data within the surface waters of the Sound. It is expected that the data from this project will be analyzed at PWSSC.

For the oceanography program, the data are being processed at PWSSC, archived at the University of Alaska Fairbanks (UAF), and posted on an internet site maintained at the Alaska Experimental Forecast Facility (AEFF) in Anchorage. There will be a monthly quality control at PWSSC and the quality controlled data will be sent to replace the raw data. The data from these observational campaigns will be downloadable and the diverse information relative to data acquisition and processing will be provided in downloadable data reports.

The approach to operating the programs described above is to fund a researcher at PWSSC and provide funding for additional expertise in mooring deployment and retrieval and parts for the mooring. More detail about the approach is provided below.

*PWSSC oceanography research fellowship; (*OSRI cost: $80K from the total $160K in Oceanography)

The intent of the OSRI Oceanography Research Fellowship is to 1) research diverse issues relevant to the OSRI mission; 2) to maintain the highest caliber of research possible; and 3) provide research staff to the PWSSC. The length of the position is two years, with possible one-year extensions if the project warrants the extra time. In 2007 the first fellowship position will end and another person will be recruited to start in FY08. The person will be recruited and hired by the PWSSC based on competitive ranking of criteria including but not limited to their task relevant expertise, education, experience, and recommendations from previous employers.

For the oceanography program, OSRI will fund a position to conduct basic and applied research in Prince William Sound and the Gulf of Alaska utilizing the ocean observing system to meet one or more of the OSRI research focus issues. The general research focus will be on understanding the physical circulation and mixing of PWS waters and how these affect oil spill trajectories in space and time. The research area includes the Sound and the adjacent Gulf of Alaska. This position will be responsible for the routine seasonal (3 to 4 times per year) oceanographic transects across Hinchinbrook Entrance and Montague Strait, as well as maintaining fixed moorings.

*PWS oceanography (Program expenses); (*OSRI cost: $80K from the total $160 in Oceanography)

In addition to the Post doctoral fellow the oceanography program requires funds to deploy and maintain the equipment used in this program. A total of $40K is used to maintain existing sensors and replace lost or damaged equipment. All CT and fluorescence sensors are to be calibrated and maintained on an annual basis. ADCPs require new batteries and other maintenance before each deployment. Mooring releases also require maintenance before each deployment.

Deploying equipment in the ocean is inherently risky. A long-term study requires a budget that allows for the replacement of lost or damaged equipment. The loss of a couple moorings early in this program has highlighted this need for replacement parts.

An additional $40K will be provided to contract for ship time and contracting the services of a mooring technician from the University of Alaska. David Leech with the University of Alaska Fairbanks (UAF) brings considerable experience with mooring deployment in Alaskan waters. The need for this experience became obvious when two moorings were lost in the same deployment. By contracting with UAF to lead the mooring deployments we hope to reduce the number of failures in the mooring systems.

2. Biological science programs

To improve our understanding of the impacts of *Exxon Valdez* oil spill and to improve the ability to assess impacts of future oil spills requires a biological research program. A socio-economic research program complements the biological program by connecting the biology to human use. To achieve the objective laid out in the Science Plan, OSRI will fund the following research programs.

a. *Funding partnership with the North Pacific Research Board (NPRB)* (OSRI cost: $62.5K)

The NPRB and OSRI have science plans that encourage research partnerships. Section 4.2.3 of NPRB's science plan directly responds to a strong recommendation of the National Research Council to seek partnerships with other entities to support joint research and funding of projects of mutual interest. Similarly, Section IV.A.5.b.i of OSRI's science plan identifies a potential partnership with NPRB to support ecological research projects in arctic and sub-arctic climates, generally within the NPRB geographic area of interest, but with particular emphasis on the Gulf of Alaska and Prince William Sound. Both organizations have a strong interest in ocean observing, habitat, ecological and socioeconomic studies (see section 3). The NPRB and OSRI have science and implementation plans that provide the foundation for defining research priorities of mutual interest in any given year.

Again this year, an opportunity exists to conduct collaborative research in the Gulf of Alaska and Prince William Sound. OSRI and NPRB each plan to commit $67.5K/yr for biological research in 2008. In the spring of 2007 the OSRI Scientific and Technical Committee (STC) identified the strongest areas of overlap between the two program areas as being, socioeconomic research and the near shore environment. It has been noted that the near shore environment is the most likely area to be impacted by an oil spill, therefore knowledge of the environment and ecology of this zone is of greatest use to OSRI. The previous two years of jointly funded work have been in this portion of the environment (Scott Johnson's Forage Fish project, and Mary Anne Bishop's tracking Copper Rockfish), and by developing a focused plan to study near shore ecology we will be able to pull together previous and future work to provide a comprehensive understanding of this subject. OSRI and NPRB developed two potential request-for-proposals (RFPs).

Fish distributions and near-shore habitat types. ($50K total)

Proposals are requested that will define relationships between the kinds and amounts of near-shore, shallow-water habitat (different geological features, floral assemblages, man-made structures, other, in water depth less than 30 meters) and the occurrence of selected fishes. Proposals should not include any new data collection but the intention should be to combine existing datasets to help increase our knowledge on forage fish habitat requirements and associations as well as to validate the use of shore zone and other mapping data. Previous ShoreZone mapping studies have produced detailed near-shore habitat maps, including features that may be critical rearing and reproductive habitat for demersal and pelagic species. If strong correlations can be demonstrated between habitat type and fish dependencies (any or all life stages), the information will assist resource managers protect stocks in specific near-shore regions. Proposals should demonstrate the ability to provide a quantitative and repeatable measure of habitat use by selected fishes, and statistical or other analyses must be sound.

Contaminants baseline assessment – ($75K total)

Subsistence usage of water resources as a main source of protein is a significant part of the Alaska Native culture. Hence, food safety is of great importance and of continued concern especially in light of changing ocean conditions. National programs such as National Oceanic and Atmospheric Administration's (NOAA) Mussel Watch Project do not currently have sufficient spatial coverage to characterize the various regions of the Gulf of Alaska, nor do they include toxaphene and the perflourinated octane sulfates (PFOS), both of which are found in subsistence species and subsistence dependent Alaska Natives. Proposals are sought to conduct a one-time baseline assessment in the Gulf of Alaska and Aleutian Islands to inform any proposed expansions of existing contaminant monitoring programs. Suite of analyses should include at minimum methylated PAHs and POPs; all responding proposals need to identify analytes and methods used. Justification for site selection, including a discussion of known potential sources of contamination, must be provided. It is not the intention of this RFP to support existing sites.

OSRI expects to contribute $67.5K to one or both projects. With the NPRB contribution the total request will be for $125K.

b. ***PWSSC Research Fellowships*** (OSRI cost: $80K)
The intent of this research fellowship is to 1) research diverse issues relevant to the OSRI mission); 2) maintain the highest caliber of science possible; and 3) provide research staff to the PWSSC. The fellowship is intended as partial support for the researcher who must also take a lead role in securing other funds to support process oriented studies that further our understanding of PWS, the Gulf of Alaska and the surrounding watersheds. To achieve the objective of this fellowship the STC has recommended that the funds be used in the following types of programs.

1.) Post doctoral fellowships; These moneys can be used to provide partial support of a Post doctoral student whose research focuses on biological studies in the Prince William Sound region relevant to the OSRI mission. The

funds are intended to act as a matching or gap fund, not as the primary source of funding. Requests for funding up to $40K will be considered.

2.) Proposal development workgroup meetings; The desire of this component of the program is to bring together groups of researchers to develop large proposals or white papers that lead to future funding opportunities advancing biological sciences relevant to the OSRI mission. Funding requests are expected to run between $10K and $20K per meeting. A multi-year collaborative proposal or a white paper designed to lead to future funding opportunities will be a required product of proposals to this funding.

3.) Visiting scientist; The purpose of this component is to bring new scientists to PWSSC with expertise that can enhance the existing programs. These funds are not intended to support existing collaborations. The visiting scientist will be expected to provide training in their area of expertise and/or develop collaborative research programs with the PWSSC staff regarding issues relevant to the OSRI mission.

3. Socioeconomic research (OSRI cost: $37.5K)
In FY08 OSRI and NPRB will support a joint request for proposals to address a socio-economic issue. The socio-economic RFP will aim to address the specific need of a regional economic impact model for estimating the community impacts of the changes to the natural resource base of marine resource dependent industries and activities. The resulting model should incorporate both traditional and emerging sectors, as well as consumptive and nonconsumptive uses, and account for the geographic characteristics of Alaska's coastal regions, as well as relate coastal communities to the rest of the state economy. The text of the RFP follows.

The coastal regions of Alaska have experienced and are experiencing considerable environmental and anthropogenic changes to marine and adjacent ecosystems, with potentially significant effects on natural resources available for commercial, recreational or subsistence harvest and other uses, as well as on the coastal economies, culture and social fabric. In order to anticipate and plan for these changes, coastal communities and resource planners in Alaska need to understand the size and directions of social, economic, and cultural responses to ecosystem changes. As a first step, a specific need is a model for estimating the community impacts of the changes and events that affect the natural resource base of marine resource dependent industries and activities. The model should focus on one or more communities with strong marine resource dependent economies, examining the effects of an oil spill along with other changes and influences on the marine environment and human uses thereof in the past two to three decades. The model may incorporate both traditional and emerging sectors, as well as consumptive and nonconsumptive uses, and should be designed to allow its extension to other coastal communities in Alaska. Proposers should document their reasons behind the communities chosen, assumptions and decisions about the scope of analysis, and explain how they expect their results can be built upon to create the larger model. Existing models can be adapted.

OSRI expects to contribute $37.5K towards this effort. This amount will be matched by NPRB to bring the total to $75K.

4. Data management (OSRI cost: $30K)
It is important that data collected by OSRI investigators and others is properly archived and accessible. To ensure that the investment in data collection is maintained into the future, OSRI funds are allocated for data management.

The AOOS Modeling and Analysis Group, at the University of Alaska Fairbanks, has developed a data archive and web-based dissemination system for AOOS. The data relevant to PWS will be archived and served to the internet through a mirror site housed at the Alaska State Climatologist on the University of Alaska Anchorage campus. The AOOS Data Management Advisory Committee (DMAC) will guide the data archiving and dissemination effort by developing standardized protocols under the auspices of the International Ocean Observing System. The web page for data dissemination is at http://www.aoos.org. This component of the Science Plan ensures sustained support for data dissemination and archiving through the UAA mirror site.

B. Goal #2 Respond:
Enhance the ability of oil spill responders to mitigate impacts of spills in Arctic and sub-Arctic marine environments.

This goal addresses the OSRI mandate to "identify and develop the best available techniques, equipment, and materials for dealing with oil spills in the Arctic and subarctic marine environment". The objectives listed in the science plan are to:

a) Fill knowledge gaps on behavior of spilled oil.
b) Fill knowledge gaps on the use and effectiveness of specific mitigation techniques.
c) Identify and evaluate new prevention and response technologies.

The components to achieve these objectives are described below.

1. Technology research and development
This work plan describes projects totaling $198.5K for projects related to Goal #2, oil spill response, OSRI has elected to fund a portfolio of initiatives.

(1) Co-sponsorship of a cold climate spill response project received by one of our partners (Minerals Management Service (MMS), Coastal Response Research Center (CRRC), Cooperative Institute for Coastal and Estuarine Environmental Technology (CICEET); or, solidification of our own RFP.

(2) The Joint Industry Program: Oil Spill Contingency for Arctic and Ice-infested waters, at the level of Minor Funder.

(3) Sponsorship of an oil-spill-recovery prize through the InnoCentive process.

(4) Model validation experiment.

a. Partnership proposals. (OSRI cost - $50K)
A number of agencies and organizations fund research in oil spill response. The missions of the various groups can be diverse, but have overlap with OSRI's mandate to identify and develop the best available techniques, equipment and materials for dealing with oil spills in the Arctic and sub-Arctic marine environment. Such organizations include, but are not limited to, Minerals Management Service (www.mms.gov), Coastal Response Research Center (www.crrc.unh.edu), Alaska Clean Seas (ACS, (www.alaskacleanseas.org), Prince William Sound Regional Citizens Advisory Council (PWSRCAC, www.pwsrcac.org), Cooperative Institute for Coastal and Estuarine Environmental Technology (http://ciceet.unh.edu), and the oil industry. In 2004-2005, a formal cold climate partnership was formed that included OSRI, CRRC, CICEET, and MMS; however, due to a lack of quality proposals and the effort required to maintain the partnership, it was dissolved in FY07. Instead, the partners agreed that if proposals were received that may be of interest to the other groups, that those proposals would be shared among the organizations.

By pursuing potential partnerships OSRI can leverage its limited funds to pursue larger projects. It should be noted that it is inherently expensive to work in the Arctic and sub-Arctic regions, which increases the cost of proposals. OSRI will both assist with partner developed research topics and develop its own research topics for potential RFPs. If partnerships are unavailable for the OSRI developed research topics OSRI will consider releasing the RFP as the sole funding source. The research topics will be guided by the OSRI science plan response subjects.

1) Develop and/or apply novel and cost-effective methods and technologies for preventing, recovering, reducing, or eliminating spilled contaminants.
2) Develop new sensors and technologies to detect and quantify contaminants in the environment.
3) Develop and/or apply novel and cost effective technologies and methods to remediate contaminated sediments and water.

Project topics will be further refined by other guiding documents, such as the OSRI funded report titled, *Advancing oil spill response in ice-covered waters* (http://www.pws-osri.org/publications/OilIce_final.pdf).

Potential areas of research include:

1) Developing an oil simulant for use in testing oil spill response equipment in Arctic waters.
2) Developing techniques to prevent ice buildup on recovery equipment.
3) Determination of the role of glacial sediments in the natural dispersion of oil.
4) Demonstration of the efficiency of solidifiers at cold temperatures.
5) Testing new spill recovery equipment in Arctic and sub-Arctic waters.
6) Update the oil spill tools to develop an oil-mass-balance calculator.

7) Developing techniques to increase the efficiency of biodegradation in cold climates.
8) Developing approaches for detection of oil in Arctic waters and/or ice covered seas.
9) An analysis of the cost effectiveness of technologies and methods used for the restoration of spill impacted habitats and ecosystems.
10) Developing techniques to remove oil from under ice.

A total of $50K is expected to be used to fund one or more proposals under this topic area.

b. Joint Industry Program (JIP): Oil Spill Contingency for Arctic and Ice-infested Waters. (OSRI cost, $45K for joint RFP with CRRC and $5K for travel associated with the JIP program and steering committee of the joint proposal)

SINTEF has, on behalf of the oil companies ChevronTexaco, ConocoPhillips, Shell, Statoil, TOTAL, and other prospective participants, performed a pre-project to prepare a state-of-the-art report on oil spill contingency in Arctic and ice-infested waters which identifies research and development needs in this area. Based on this, SINTEF, international R&D partners and the oil companies have formulated a Joint Industry Program (JIP) to advance Arctic oil spill contingency technology and knowledge. Further information on the JIP, including Questions and Answers, State of the Art Report, and the Joint Industry Program (JIP) Proposal can be found at http://www.pws-osri.org/programs/project_list.shtml. Reports from OSRI representatives attending steering committee meetings are also available online.

The overall objective of this JIP is:
• *Further development of tools and technologies for environmental beneficial oil spill response strategies for ice-infested waters.*
Program sub-objectives are:
• *To improve our ability to protect the Arctic environment against oil spills resulting from exploration, development, production and transportation activities.*
• *To provide improved basis for decision-making by responsible authorities:*
• *Advance the state-of-the-art in Arctic oil spill response:*
- *Address key problems/scenarios faced by program partners.*
- *Demonstrate workable response options for different ice conditions and oil types.*
- *Define limiting conditions for alternate response strategies.*
- *Investigate and develop improved response capabilities and strategies.*

Testing, development and verification of approaches developed in this JIP will take place at different levels:
• Small-scale (bench-scale) laboratory experiments.
• Meso-scale basin experiments (e.g. SINTEF oil-in-ice basin and meso-scale flume basin and S.L. Ross test basin).
• Meso-scale field experiments at the fjord ice in Svea, Svalbard.
• Large-scale field experiments in Canada and Norway.

The participation fee (the total cost as described in the overall budget of the JIP) will be divided equally between the oil companies. Cooperating organizations, such as OSRI, are not expected to provide financial support to the projects, but may assist with the following types of in-kind support to planned activities:

Vessels and other logistics for field experiments
Results and data related to oil in ice experiments which has been carried out previously
Contribution in working groups
Contribution related to arrangement of workshops and similar field trips
Sponsorship of an auxiliary RFP for study of Biological Effects in the JIP

In 2006 OSRI began working with CRRC to develop an RFP for a study of biological effects to compliment the work of the JIP. The OSRI Scientific and Technical Committee has requested a review paper on the effects of oil in ice on arctic biota before proceeding with the joint program. Assuming completion of that review $45K is budgeted for support of a biological effects project. This will be a multi-year project, conducted by a team of interdisciplinary researchers in microbiology, chemistry and toxicology. An additional $5K is budgeted for travel to attend the JIP planning meetings and the biological effects project steering committee meetings.

c. Oil-Spill-Recovery Prize through InnoCentive (OSRI cost, $25K for InnoCentive fees, $50K for prize money, and $5K for a challenge development workshop)

In FY07, OSRI began an alternative approach towards solving R&D challenges in the oil spill response field. Rather than developing an annual RFP to fund research that often only makes incremental steps towards meeting challenges, OSRI established a purse prize to reward a successful, innovative solution to a challenge facing the oil spill response community.

Leveraging a prize on the order of $50K-$100K, OSRI will save on the large research and development cost of multiple individual investigators working towards meeting a particular challenge. OSRI dollars pay for a successful solution rather than an individual attempts to provide a solution. This exciting new approach seems to be ever more prevalent in industry and technology.

The company, InnoCentive, has been identified to assist in this process (www.innocentive.com). InnoCentive matches top scientists to relevant research and development challenges facing leading companies around the globe. At InnoCentive groups posing problems (challenges) are called “Seekers” and individuals offering solutions are called “Solvers”.

Specific problem statements were developed during a workshop held by OSRI in February 2007. The development of challenges entailed sending out a request to partners for challenge ideas. Additional ideas came from the workshop and all of the concepts put forward were refined during the workshop. The concepts were then presented to the STC

for comments and acceptance before the process of developing the final draft of the challenges. Experts in the relevant fields were asked to assist in the writing, and to review the challenges before they were posted. The challenges include providing theoretical solutions to the following problems:

1) A method to break the viscous shear of oil for transfer from storage units through intake pumps in cold climate conditions.
2) A method to contain and collect submerged oil.
3) Develop a less expensive way to remove/neutralize lingering oil on cobble beaches.
4) Identify a method to remove/eliminate ice buildup.
5) Identify the constraints on using solidifiers and develop an approach to overcome those constraints.

It is expected that the first three challenges will have been posted in FY07. In FY08 OSRI will provide $25K to cover the annual fee for working through InnoCentive, $5K to host a workshop to develop at least three additional challenges, and $50K for prizes associated with posting additional challenges. OSRI staff will continue to foster partners to contribute to this program so that more challenges can be posted. We expect that some potential partners are awaiting the results of the initial challenges before deciding if they wish to contribute to this program.

d. Model Validation Experiment (OSRI cost $18.5K)
Over the last several years OSRI has contributed to the development and refining of atmospheric and oceanic models, and installation and upgrade of measurement systems. To test their capabilities requires experiments that collect the data required as inputs to the models and data that provides a measure of the output of the models. The Alaska Ocean Observing System is planning such an experiment which is now expected to be conducted in 2009. A brief description of the AOOS experiment follows.

Objective: To quantitatively evaluate the performance of forecast models in Prince William Sound including the Regional Atmospheric Model System (RAMS) and Regional Ocean Model System (ROMS) models, the Princeton Ocean Model (POM) at the Rosenstiel School of Marine and Atmospheric Sciences (RSMAS), the Simulating Waves Nearshore (SWAN) wave model, and the General NOAA Oil Modeling Environment (GNOME) oil spill trajectory model.

Methods: Model performance evaluations will be based on comparisons with 1) observational data collected during a four week field experiment in 2008, and 2) model performance during the 2004 experiment. The overarching questions are:

How well are the models able to predict atmospheric and oceanic water properties, wave conditions, and circulation patterns in different areas of PWS?
Have the model forecasts for the central basin improved from those in 2004?
What is the cost/benefit of the AOOS for oil spill trajectory modeling?

Observational data: The Alaska Ocean Observing System is now providing access to real-time and historical observational data for PWS from one data portal. These data are available to the developers of the atmospheric and ocean circulation models and the wave model to facilitate model validation and correction. During the field experiment, drifting buoys will be repeatedly deployed, retrieved, and redeployed during the two week period. There will be an emphasis on model validation of surface and deeper currents in the central basin, so the majority of drifter deployments will occur within the existing High-Frequency Radar field of view. Additional deployments will occur around the perimeter of the Sound to validate the velocity of surface currents forced predominantly by fresh water runoff and track the fate of Lagrangian drifters that mimic Coast Guard Search and Rescue targets as well as oil spill trajectories. Wave gauges will be deployed at locations of specific interest to users such as the PWS RCAC.

Model performance evaluation: 1) Evaluate for product performance - Has the AOOS demonstration project in PWS improved the ability of NOAA Hazmat models to forecast the trajectory of Lagrangian drifter buoys? 2. Evaluation of data utilization by partnering organizations – Does this data provide a useful service to other partnering organizations such as the USCG search and rescue operations? 3. Evaluation of the mechanics of data transfer – Is relevant data readily accessible between model developers and AOOS and from AOOS to NOAA Hazmat and other data users? 4. Evaluate for improvements in the understanding of dispersion in Prince William Sound – Has the development of the existing observational array and suite of models improved our understanding of the circulation and mixing in PWS? 5. Evaluate for improvements to the observing system - Do the models provide information on where new observation platforms are needed and where existing observation platforms are redundant?

OSRI is prepared to contribute up to $18.5K in FY08 for preparing buoys and training personnel in their use in anticipation of the AOOS experiment.

C. Goal #3 Inform: Disseminate information and educate the public on the issues of oil spill prevention, response, and impacts.

1. Education (Total OSRI cost: $76.5K for the programs described below)
OSRI intends to continue building upon the existing regional outreach programs. In addition, within the next year, OSRI will seek out partnering opportunities to broaden the geographic influence of the PWSSC education programs to state and national audiences and share expertise among a consortium of other education and outreach institutions.

a. *School Year Programs: Discovery Room, Outreach Discovery, Community Programs*
(OSRI Cost: $40K)
The Discovery Room and Outreach Discovery programs create the opportunity for hands-on science in both classroom and outdoor settings. The Discovery Room enhances the science curriculum for 200 Cordova students in kindergarten through sixth grade by providing hands-on lessons and activities related to a yearly theme. This school-year program is run in partnership with the U.S. Forest Service. Its goals are to encourage students to better understand and appreciate the PWS region while working within state

science standards. Since 2005, a Discovery Room Scientist program provided opportunities for up to ten 4-6 grade students a month to collect monthly data on a monitoring project related to the yearly theme.

Outreach Discovery takes Discovery Room lessons to the villages of Chenega Bay and Tatitlek. These lessons greatly enhance the limited resources these schools have available for science education. Community Programs serve adults and families in Cordova and include field trips, lectures, and seminars. The community programs are now run in partnership with the Marine Advisory Program and PWS Audubon Society.

b. Summer Programs: Forest to the Sea, Weekend Workshops (OSRI Cost: $12K)
From the Forest to the Sea summer camp program provides the tools and guidance for campers to understand the interdependence of all ecosystems. Hands-on education in the outdoor classroom and scientific knowledge, combined with positive experiences in the outdoors, builds a foundation for campers to grow into good environmental stewards and wise decision-makers. While immersed in their surroundings, participants learn how ecosystems are connected through interactive studies of the temperate rainforest, glacier, wetlands, and ocean. In 2008 the fourth Youth Environmental Leadership Program will take place and is designed to teach high school students how to identify environmental problems in their communities and how to address these problems through personal education and public outreach. This 10 day program focuses on the Copper River Watershed and Prince William Sound, and includes a 4 day rafting trip down the Copper River. The curriculum includes an introduction to the changes in oil prevention and response operations since the 1989 oil spill and visits are made to oil industry facilities in Valdez and/or along the pipeline corridor. The summer programs are run in partnership with the US Forest Service and Alaska River Expeditions. These programs are advertised throughout the state and scholarships are available to help attract students from other communities.

c. ***Coastal community outreach and education*** (OSRI Cost: $10K)
For 13 years the Prince William Sound Science Center has augmented local education curriculum with hands-on science programs and, in addition to Cordova students, has delivered these programs to Tatitlek and Chenega Bay. In order to expand the audiences reached by Science Center education programs, the Center has created broader partnerships with organizations like the Imaginarium and the Alaska Natural History Association to create hands-on programs for youth and adults that reach audiences beyond Cordova. The Science Center education staff has also taken the lead on coaching local high school students to participate in the National Ocean Science Bowl (NOSB) competition where students are able to learn and discuss important marine issues with students from throughout the state. The staff plans to continue exploring ways to expand the education programs, including utilizing the real time data streams and model output from the PWSOS in the classroom, by forging partnerships with other organizations outside of Cordova such as the Alaska SeaLife Center, Kachemak Bay Marine Research Reserve and the Center for Alaskan Coastal Studies.

d. ***Technology education activity demonstration*** (OSRI Cost: $13.5K)

In response to the National Research Council's 2002 review of OSRI's programs, OSRI intends to start a new education program in FY08. The program will develop and demonstrate a school activity related to the technologies used in detecting oil, recovering oil, or determining the effects of spilled oil. The activity is to be transferable to other locations in arctic and subarctic waters. Possible activities include, but are not limited to; have students work with spill recovery equipment, build and test small-scale oil recovery equipment of the student's design, operate a remotely operated vehicle to map a portion of the seafloor, build an oil detector, and test organisms for the presence of hydrocarbons. Possible activities may be modeled after the Lego Robotics or Marine Advance Technology Center (MATE) remotely operated vehicle competitions, or other such activities.

e. ***High school student scholarships*** (OSRI Cost: $0.5K)
OSRI will provide institutional sponsorship for the annual Cordova Science Festival by providing scholarships for winners of presentation categories, including posters, demonstrations, and oral presentations.

f. ***National Ocean Sciences Bowl*** (OSRI Cost: $14K)
OSRI will provide institutional sponsorship for the Alaska Tsunami Bowl ($4K), the regional competition for the National Ocean Science Bowl. This year support will also be provided to host the national finals in Alaska ($10K). This program encourages high school students to excel in math and science studies by involving them in a quiz-bowl competition focused on ocean sciences. OSRI will be supplying the organizers with oil-spill related questions to include in the competition.

2. Graduate Research Fellowships (OSRI cost: $25K per student per year)

Under Goal#3 of the OSRI strategic plan, the suggested focus areas for research projects funded by the OSRI fellowship program are: Social science, education, and outreach; economic, sociological, and/or anthropological research applicable to the effects of oil spills on coastal communities; application of ocean observing system products in coastal community education programs.

OSRI funds are provided to support graduate projects that will better understand the social and economic effects of oil spills on coastal communities, provide information needed by managers and decision-makers for oil spill response and recovery, and improve public awareness and understanding of marine and estuarine ecosystems.

a. Technology Scholarship; Beginning in 2007 one of the Graduate Research Fellowship positions was changed in to a "Technology Scholarship" aimed at an undergraduate student in a field related to oil spill response technology. That student is required to conduct an internship with an oil spill response organization. The scholarship is for a two year period at $25K/yr so the scholarship extends into FY08.

There are two Graduate Research Fellowship projects that extend into FY08.

b. Surface circulation in Prince William Sound; James Alanko, Ph.D. student. (funded for 2005-2008, University of Alaska Fairbanks). Due to a lengthy illness, this fellowship was deferred during FY06; it continued in FY07 and a final year of fellowship support ($25K) is planned for award to J. Alanko in FY08 to complete his studies.

J. Alanko's abstract describing his studies: "The temporal variability in Prince William Sound surface current patterns occurs over interannual, seasonal, synoptic, and tidal time scales and the spatial variability associated with these circulation patterns is significant. Yet the variability has been under sampled in both time and space. I propose to use newly available High Frequency radar technology to measure and analyze the surface currents of Prince William Sound and provide the first comprehensive study of the variability of surface circulation patterns. This technology will be used to provide hourly maps with spatial resolutions of approximately 2 km. I will also investigate the relationship of the surface current patterns to wind forcing, flow through Hinchinbrook Entrance and Montague Strait, and tides. As part of this project, I will investigate the use of surface current maps from High Frequency radar for trajectory analysis for oil spill contingency planning and for use in search and rescue scenarios. This work will address the research focus area specified in the GRF Program Description "Observations and Modeling": seasonal and interannual variation of oceanic or atmospheric circulation, stratification, and mixing.

Relevance to OSRI: This study is relevant to OSRI's goals in that it is demonstrates the application of HF-radar technology as a tool for oil spill responders and to improve public awareness of surface currents in PWS. An understanding of surface ocean currents are also needed for ecological studies involving planktonic organisms."

c. Promoting Sustainable Oil and Gas Development on Alaska's North Slope through Local-Scale Integration of Geophysical and Traditional Knowledge; Matthew Druckenmiller, Ph. D. student, (funded for 2007-2009, University of Alaska) $25K will be awarded in FY08 for M. Druckenmiller to continue his research.

M. Druckenmiller's abstract describing his studies: "Increased oil and gas activities in Alaska's Beaufort and Chukchi Seas may serve as a catalyst to more thoroughly investigate the research methodologies and institutional practices that incorporate local and traditional knowledge (LTK), thus promoting a sustainable future for North Slope communities, the coastal ecosystem, and the oil and gas industry itself. Most climate models and sea-ice investigations operate at resolutions not suited for observing the critical processes and variability that exist on the local level; therefore, information required by local institutions and oil and gas developers is often not readily available. Given that many Iñupiat Eskimos possess a valuable and nonreplicable understanding of local and regional sea-ice dynamics and unexpected and rare sea-ice events, their knowledge may greatly contribute to decisions made regarding oil and gas development and oil spill response planning and operations.

A systematic investigation of local scale sea-ice system services (SISS) and sea-ice hazards provides a framework for identifying stakeholder-relevant sea-ice variables and

collecting and documenting LTK. This project will: (1) investigate the landfast ice and adjacent pack ice in the Bering Strait and the Chukchi and Beaufort Seas using geophysical techniques, such as SAR satellite imagery and coastal radar, and the observations of various Iñupiat sea-ice experts, and (2) systematically document SISS and hazards through sea-ice use mapping and interviews. While my research in the broadest context will involve a diverse set of stakeholders, I intend to focus on sea-ice information relevant to oil and gas development and oil spills in ice-covered waters. The main product of this work will be a GIS-based map for use by planners and developers that geographically organizes sea-ice information by the local services and hazards it provides, while also temporally organizing key events in the ice-year, such as when landfast ice stabilizes or becomes dynamic in a specific location."

Relevance to OSRI: This study brings together local knowledge and a collection of scientific measurements to help identify critical sea ice ecological characteristics and hazard area. The information will be useful to contingency planners, response organizations, and ecological researchers working in ice covered regions. This is becoming more critical as oil and gas exploration begins to develop in the offshore waters of the Arctic.

d. Princeton Oceanographic Modeling Study: How Does a Semi-Enclosed Sea Respond to External and Internal Forcings? University of Miami. Ph.D. student. ($22.3K will be awarded to X. Wu in FY08 to complete his dissertation).

X. Wu's abstract describing his research: The goal of the present study is to understand the response of Prince William Sound (PWS) to such forcing as surface wind, atmospheric pressure, tides, buoyancy flux, inflow and mass structures at open boundaries, and bottom topography and to evaluate the relative roles played by these forcings in driving the synoptic and general circulation in the Sound. Specifically, the following questions are expected to be answered in the dissertation:
Why does a large cyclonic gyre occur in PWS in September with little year-to-year variability, while in other seasons the circulation pattern in central PWS could be transient in either the cyclonic or anti-cyclonic direction?

How does the seasonal inflow/outflow structure in Hinchinbrook Entrance (HE) change the circulation in PWS? Considering the sills just outside the two main entrances guarding the Sound from the Northern Gulf of Alaska coastal waters, and what controls the properties and variability of the PWS deep water?

What is the nature and strength of the buoyancy-driven (thermohaline) circulation in a small semi-enclosed sea such as PWS?

Associated with the complex bottom topography and density stratification in PWS, what roles do the tides, including barotropic and baroclinic components, play in influencing the general circulation? How much of the tidal energy is dissipated inside the Sound? What is the Sound's annual tidal energy budget?

Relevance to OSRI: This study is relevant to OSRI's goals because understanding patterns of ocean circulation and surface currents should help predict conditions that will determine the most appropriate response in the event of an oil spill. The circulation

models also support ecological studies by showing the connections within the marine habitat.

3. Outreach

a. *OSRI Advisory Board discretionary workshops* (OSRI cost: $22K)
These funds are for workshops or special projects at the discretion of the OSRI Advisory Board. Several workshops were held or supported by OSRI in FY06 and FY07. Workshops being considered for FY08 support include:

(1) **Detection of hydrocarbons in the marine environment**, (OSRI cost: $15K) OSRI will co-sponsor the workshop with the Alliance for Coastal Technology (ACT). Each partner will contribute $15K to bring researchers, manufacturers, and users together to identify the current state of technology and the needs of the users. The workshop will likely take place in September 2008 in Alaska.

(2) **Alaska Marine Sciences Symposium**. (OSRI cost: $2K) Each January, researchers from throughout Alaska are invited to participate in a 3-4 day conference. It is an excellent opportunity for presentation of new results and networking. OSRI will contribute $2K to support this workshop, which will be held in late January in Anchorage.

(3) **Alaska Forum on the Environment.** (OSRI cost: $5K) In 2008, the Annual Forum will be held February 11-15, 2008, at the Egan Center, Anchorage. Topics of this year's conference will include Climate change, Federal facility environmental activities, Contaminated sites and oil/hazardous substance releases, Rural and regional issues, Fish and wildlife, resources and invasive species, Solid waste management, Environmental health and contaminants, Energy resources and conservation, Mining projects, Environmental engineering and science, Environmental regulations, Environmental Justice, Emergency Response Management, Indian General Assistance Program Training, Restoration Advisory Board Meeting, Environmental management systems, Coastal America Alaska regional implementation, Environmental film festival, Hazwoper refresher training, Statement of Cooperation Executive Steering Committee meeting. Member agencies have been asked to allocate funds towards this workshop. OSRI will allocate $5K to the Alaska Forum on the Environment, and staff are encouraged to attend the workshop with waived registration fees.

b. *OSRI web page maintenance and upgrades* (OSRI cost: $6K, Support for upgrading the OSRI web site and ongoing maintenance).

c. Annual report (OSRI cost: $6K). The OSRI will contract for graphic design and printing of an annual report for FY07 that details the programmatic activities and provides a summary financial status report. This report serves as a document of recording and evaluating the process of the OSRI program.

D. Other Programs

1. Program coordination (OSRI cost: $113K). The position of OSRI Research Program Manager is a programmatic expense. The total costs include salary, benefits, travel and commodities. The Research Program Managers responsibilities include:

- Preparation of annual work plan in consultation with the Board-appointed Work Plan Committee and in accordance with the Five-Year Science Plan adopted in 2005. Compile information about potential projects, write brief project descriptions and prepare project budget estimates.
- Implement the work plan as approved by the Board. This includes drafting requests for proposals based on the Annual Work plan priorities, and coordinating the peer review process with OSRI's Scientific and Technical Committee and with other organizations OSRI partners with for research projects.
- Coordinate with the Chair of OSRI's Scientific and Technical Committee (STC) to assure regular transfer of information between the OSRI Board and the STC. Also provide assistance, as requested by the STC Chair, in scheduling meetings.
- Meet 2-3 times per month with the OSRI Executive Director (ED) to exchange information concerning program issues and contract awards. Work with the ED to develop a monthly program report for distribution to the OSRI Board.
- Assist the Executive Director to ensure compliance with all policies and procedures of the OSRI Grant Policy Manual.
- Coordinate the processing of contracts for successful proposals. Monitor progress and final report deadlines for these contracts.
- Prepare bi-annual reports on OSRI grant awards and research and education programs for distribution to the OSRI Board.
- Coordinate publication in the late fall/early winter of an Annual Report for broad distribution.
- Supervise maintenance of the OSRI website.
- Collaborate with the OSRI Executive Director to develop and maintain cooperative agreements with other organizations for research and education programs, for example with the Exxon Valdez Oil Spill Trustee Council, two Regional Citizens' Advisory Councils, and the Alaska Department of Environmental Conservation, the Alaska Ocean Observing System (AOOS), the North Pacific Research Board, the UNH/NOAA Coastal Response Research Center, US Minerals Management Service, and Norwegian SINTEF's Joint Industry Program.
- Periodically represent OSRI at professional meetings and workshops.
- Maintain files and a library on oil pollution issues focused on the Arctic and sub-Arctic.
- Provide leadership in planning future research programs and work plans.
- Prepare technical reports on OSRI programs.

2. OSRI Science and Technical Committee meetings (OSRI Cost: $18K). Funds are set aside to support the functions of the OSRI Science and Technical Committee, and to support travel related expenses associated with OSRI partnerships such as the JIP, NPRB, etc. In FY08, the STC plans to schedule a longer 2-3 day meeting for a broad review of OSRI programs.

III. Prior Years' Encumbered Projects Continuing in FY08

Because the OSRI projects are started at the beginning of each quarter many projects funded in 2007 will continue into fiscal year 2008. The purpose of this section is to identify those projects so that the work plan aligns with the FY08 budget sheets. These projects are listed as the Prior Years' Encumbered portion of the budget. If an existing project is to get new funding in FY08 – multi-year grants – the project description will reference the previously provided section. Because the exact amount of funds that are being carried forward will not be known until sometime in October, there are no dollar amounts provided with the individual projects.

A. Goal #1 - Understand

1. Physical science programs

a. ***Meteorology*** (Contracts through 06/30/07)

Meteorological and precipitation data for ocean circulation models

These funds are being carried forward for the maintenance of SNOTEL sites being conducted by the National Resource Conservation Service and MicroSpecialties as described on page 4 of this plan.

b. ***Oceanography*** (Contracted through 12/31/07)

Water exchange between PWS and the Gulf of Alaska and seasonal variations of hydrographic properties in central PWS

These funds are being carried forward for the oceanographic research being conducted by the Prince William Sound Science Center as described on page 5 of this plan.

2. Biological science programs

a. *Funding partnership with the North Pacific Research Board (NPRB)* (Contracted through 06/30/07)

OSRI and NPRB contributed $75K each to fund a Copper Rockfish and Ling Cod tracking demonstration project. The project is being conducted by Mary Anne Bishop of the PWSSC. The abstract of the proposal follows.

Nearshore habitats and their associated fish and wildlife communities are vulnerable to oil spill events. Following the Exxon Valdez oil spill, oil was detected in subtidal sediments associated with nearshore waters <20m deep. In some areas of Prince William Sound, oil persisted in these subtidal sediments for several years after the spill. This study proposes to study the residency and movements of copper rockfish (Sebastes caurinus) and lingcod (Ophiodon elongatus), two bottomfish that inhabit rocky, nearshore habitats. Both rockfish as a group and lingcod are currently of critical concern to fisheries managers throughout the Pacific Coast. At the same time, their use of the nearshore waters makes them vulnerable to oil spill events: rockfish were identified as a species group injured by the Exxon Valdez oil spill. The goal of this pilot project is to prove the efficacy of acoustic telemetry for documenting residency and movements of copper rockfish and lingcod in nearshore areas of Prince William Sound. Our project is modeled after methodology used by the Pacific Ocean Shelf Tracking (POST) project including acoustic tagging and moored hydrophone arrays. The proposed project is coupled to a USFWS and NOAA-funded study on artificial reefs. This combination of projects will further develop a comprehensive ecosystem- based understanding of the importance of

essential fish habitats in the nearshore waters of Prince William Sound. And this project will contribute to the understanding of the role that artificial reefs can play as a habitat restoration tool in the case of an oil spill.

b. *PWSSC Research Fellowships* (Contracted through 3/31/08)
Two fellowships were awarded in FY07.
Copper River Delta Fellowship, Dr. M. A. Bishop

Beginning in the spring of 2000, OSRI funded studies on the intertidal resources of the Copper River Delta at risk to oil spills. In 2003, the research program was expanded with new funding support from the Exxon Valdez Oil Spill Trustee Council's Gulf Ecosystem Monitoring program. The ultimate goal of the Copper River Delta research is to understand the spatial and temporal dynamics of the biological community of the Copper River Delta in order to predict how this community would respond to anthropogenic (e.g., an oil spill) or naturally induced changes (e.g., climate change) in the physical and chemical environment. The approach to achieve this goal has been to focus on the central part of the food web (benthic invertebrates) and then to add components that focus on higher (predators) and lower trophic levels (primary producers) as funding allows. The FY06 OSRI funding represented the third and final year of this project. The PWSSC Research Fellowship in FY07 is intended to provide 3 months salary to the principal investigator, Dr. Mary Anne Bishop, for the purpose of writing and submitting at least two peer-reviewed publications using results from this project. For further information on this project, see: http://www.pwssc.gen.ak.us/nearshore/MarineInvert-Bishop.html

Zooplankton Fellowship; Dr. T. Kline
Dr. Kline has conducted zooplankton investigations in PWS and the Gulf of Alaska for more than a decade. Recent results from his and other researchers' work indicate that the size and stable isotopic composition of *Neocalanus* populations may be a strong indicator for determining the strength of pink salmon runs in the following year. In FY2007, he will be continuing work to further our knowledge of the fundamental processes driving the PWS ecosystem, develop a systematic method for sampling *Neocalanus* and other zooplankton, to enable further hypotheses development, and contribute to the PWSOS.

The proposed project will develop sampling strategies needed for effective implementation of a zooplankton long-tem observational or monitoring program useful to PWSOS. It will sample zooplankton according to life history stages, using a state-of-the-art Hydrobios Multi-net. An immediate deliverable of this project will be measurements of the *Neocalanus* population. A times series status of zooplankton will be developed and posted at a website and will provide a context for comparisons. These comparisons are expected to lead to more accurate predictions of pink salmon marine survival. The PWSSC Research Fellowship in FY07 is intended to provide 3 months salary to the principal investigator, Dr. Thomas C. Kline so that he can continue work with zooplankton and submit at least one peer-reviewed publication.

3. Modeling
FY07 was the last year that model development was to be funded according to the

Science Plan. Two modeling efforts will continue into FY08.
a. *Atmospheric circulation modeling (by Peter Olsson, AEFF)* (Contracted through 6/30/08)

At the Alaska Experimental Forecast Facility (AEFF), a daily numerical weather forecast model— the Regional Atmospheric Modeling System (RAMS)— is operational for the region of Prince William Sound (PWS). As is true of all weather forecast models, this involves using a cluster of computers to solve a mathematical model approximating how we think the atmosphere works. In fact this is the same thing that the National Centers for Environmental Prediction (NCEP) does for the National Weather Service (NWS). What is different with our project is that while NCEP does this for all of Alaska, AEFF concentrates available computing power on the region of Prince William Sound. This allows for a finer-scale grid spacing (4-km) than the NCEP models (12.5 km at best). This finer grid-scale hopefully resolves smaller scale topographic effects that are not in the NWS simulations, such as williwaws and blocking by smaller terrain features

In our study we exploit the capability in RAMS of grid nesting, in effect telescoping down from a coarse grid-mesh grid that covers all of Alaska and surrounding oceans, to an intermediate grid that covers all of southern Alaska and the Gulf of Alaska, and ultimately down to the fine-mesh grid that covers PWS and its surrounding terrain/ocean.

The model simulations produce hourly (or less if necessary) 3-d forecast fields of a host of variables, including: temperature, pressure, winds (3-d), humidity, precipitation, and cloudiness. This is just a small sampling of variables of most interest to the typical user in PWS, a host of other 2- and 3-d variables are available and more can be calculated from the raw output.

The model can also act as an integrator of data, by filling in the gaps or data voids. Several weather stations have been deployed in the Sound and there are several C-MAN stations and NDBC buoys in the Sound. Still there are several data-sparse sections in a region where weather and wave conditions can vary dramatically over a scale of 10 km or so. The model can act to fill in the gaps, acting as surrogate observations in those places where direct observations do not exist. These are, of course, predictions and so will never replace having an actual observation at a given point in space and time

The RAMS output is currently available at the AOOS PWS web page: http://ak.aoos.org/pws/. To access the PWS RAMS images, choose the Forecasts selection from the menu across the top of the page.

In FY07 we will concentrate on incorporating more of the data from the real-time PWSOS meteorological observing system into the initial condition of the model. This should give us more accuracy in the close time scale. We also intend to go to a two-a -day forecast schedule, initializing forecasts at 0z and 12 Z, and integrating each forecast out to 36 hours. Thus, any forecast values used by a spill responder will be no more than 12 hours ahead in time. This will increase the amount of model data but should not present any special problems.

b. *Regional Ocean Modeling System (ROMS) Modeling, Data Assimilation and Real-Time Forecasting (by Yi Chao, JPL, and Xavier Capet, UCLA)* (Contracted through 12/31/07)

A major goal of the observing system in PWS is to develop an operational system that delivers information on physical and biological conditions in real-time to research and application users. This information includes raw data on environmental conditions, such as wind speed, air temperature, precipitation, ocean currents, ocean temperature, tide height, and water salinity as well as modeled forecasts of anticipated conditions. Forecasts for the atmospheric conditions in the Prince William Sound region have been developed using a Regional Atmospheric Modeling System (RAMS) with a 4 km resolution. The JPL/UCLA group now has the responsibility of developing a real-time forecasting capability for oceanographic conditions. The JPL/UCLA group is applying the Regional Ocean Modeling System (ROMS) to PWSOS. A major new feature of ROMS is the 3-dimensional variation (3DVAR) data assimilation system. A Pacific basin-scale ROMS has been developed with a resolution of 12.5-km. The Pacific basin-scale ROMS will provide the needed boundary conditions for the PWS ROMS configurations, which consist of three nested ROMS domains with 10-km, 3.6-km, and 1.2-km over the Pacific Northeast, Gulf of Alaska, and PWS, (the latter extends to the Copper River Delta to ensure that this important source of freshwater for PWS is included at the finest scale). As an alternative for the Pacific domain, we will have the option of using boundary data from oceanic data assimilation products, and our current version uses reanalysis by the Simple Ocean Data Assimilation (SODA; Carton et al., 2005).

The circulation in the sound is driven by an intricate mixture of buoyancy, wind, tidal and remote forcing. A number of technical issues implementing these forcing mechanisms have been overcome, and UCLA and JPL are currently in the early phase of validation of all grid levels. The numerical solutions (1 year for the 3 grid levels) already reproduce some interesting features. The eddy present in the central part of the Sound during most of summer 2004 is also a robust feature in the model even when forced by climatological monthly winds and in the absence of freshwater inputs. In addition, the structure of the currents across the Hinchinbrook Entrance shows strong baroclinicity and temporal variability in relation to the mesoscale activity present outside PWS on the slope.

During the last year (FY06) the focus was on a variety of different tasks. Open boundary sensitivity tests were conducted, mainly over the large L0 domain (Gulf of Alaska). To do so, an alternative L0 domain was designed to figure out the best configuration for the coastal currents. It appears that mean circulation characteristics are more satisfactory using the new L0 domain. Consequently new L1 (3.6km) and L2 (1.2km) nested domains have been developed (Figure 9). New topography datasets (from NOAA and OSRI) were merged to produce a more accurate topography for the PWS domain. This dataset has been implemented in PWS nested domain L2. Topography for domains L0 and L1 was also modified (GINA instead of Etopo2). This new L0/L1/L2 configuration

was under climatological conditions, and we observed the same interesting features as with the previous configuration (e.g., the eddy in the central part of PWS, the baroclinic structures of the exchanges across Hinchinbrook entrance). All the difficulties regarding the tidal forcing implementation were overcome. Implementation of the rivers run-off was initiated, first with simple and idealized cases, and some tests were performed.

Plans for next year (FY07) are to have a full implementation of the rivers run-off, and then to run a long experiment (several years) for the new L0/L1/L2 configuration with both tides and run-off at the same time. Special attention will be given to the validation with the help of available *in situ* datasets. Another focus will be on process studies to understand the main circulation inside PWS, its seasonal variability and sensibility to forcings and remote influence. Experiments should be conducted to figure out tides and run-off influence on the circulation inside PWS. The nature of the complex exchanges at Hichinbrook Entrance between PWS and the nearby ocean will also be investigated. Later plans will be to include interannual variability in the simulation runs.

4. Data management (Contracted through 6/30/08)

These funds are being carried forward for the data management work being conducted by the University of Alaska Anchorage as described on page 11 of this plan.

B. Goal #2 Respond:

1. *Joint Industry Program (JIP): Oil Spill Contingency for Arctic and Ice-infested Waters.* (Contracted through 21/31/07)
These funds are being carried forward to contribute to the JIP meeting being held in Anchorage in October 2007. The JIP program is more completely described on page 13 of this plan.

2. *Oil-Spill-Recovery Prize through InnoCentive* (Contracted through 6/30/08)
These funds are being carried forward for the technology prize process being conducted by InnoCentive as described on page 14 of this plan.

C. Goal #3 Inform:

1. Graduate Research Fellowships

a. Surface circulation in Prince William Sound; James Alanko, University of Alaska Ph.D. student. (Contracted through 6/30/08)
These funds are being carried forward for the Graduate Research Fellowship as described on page 19 of this plan.

b. Promoting Sustainable Oil and Gas Development on Alaska's North Slope through Local-Scale Integration of Geophysical and Traditional Knowledge; Matthew Druckenmiller, University of Alaska Fairbanks Ph. D. student (Contracted through 6/30/08)

These funds are being carried forward for the Graduate Research Fellowship as described on page 19 of this plan.

c. Assessment of River Otter Recovery *Kaitlin Ott* University of Wyoming. Masters student. (Contracted through 6/30/08)).

These funds are being carried forward for the Graduate Research Fellowship as described in the following abstract.

River otters (*Lontra canadensis*) were one of the first resources to recover from the impact of the 1989 *Exxon Valdez* oil spill (*EVOS*) in Prince William Sound (PWS). Nonetheless, genetic evidence suggests that the numerical recovery of otters in oiled sites resulted from recolonization from adjacent areas rather than from local reproduction. Because increased trapping pressure on otters in recent years occurs mainly in non-oiled areas of PWS, previously-oiled sites may become important source locations for these animals. Whether otter reproduction has been attained in previously-oiled areas, however, is unknown. In this project we propose to determine whether reproduction was recovered in otter populations inhabiting previously-oiled areas of PWS, using genetic tools and non-invasive fecal sampling. We will estimate abundance, genetic structure, and relatedness. We predict that if otter reproduction recovered, genetic similarity in previously-oiled areas as well as the degree of relatedness of individuals will be comparable to those in non-oiled areas. In addition, we will estimate dispersal of individual animals originating in previously-oiled areas to non-oiled areas from fecal DNA analyses and GIS mapping to evaluate whether previously-oiled areas can serve as sources for sustainable otter harvest.