Established by Congress, OSRI supports research, education, and demonstration projects that improve understanding and response to oil spills in Arctic and sub-Arctic marine environments.
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Oil Spill Recovery Institute
OSRI Research Plan 2016-2020

July 2015

I. Purpose of this Document

This document provides guidance for the development of annual work plans by describing funding focus areas and the context for specific projects and partnerships, although it does not commit the OSRI Board to support any of the projects described. It is also intended to provide a structure that OSRI’s partners can use to identify opportunities for collaboration.

II. Program Introduction

A. Background

The Prince William Sound (PWS) Oil Spill Recovery Institute (OSRI) was authorized in 1990 by the United States Congress to “identify and develop the best available techniques, equipment, and materials for dealing with oil spills in the Arctic and sub-Arctic marine environments”; and, also to “determine, document, assess and understand the long range effects of the EXXON VALDEZ oil spill on the natural resources of Prince William Sound. . . and the environment, the economy and the lifestyle and wellbeing of the people who are dependent on them (Title V, Section 5001, Oil Pollution Act of 1990).” In 1996, the act was amended to expand the area of emphasis from the Exxon Valdez oil spill region to the Arctic and sub-Arctic marine environments. A 2005 amendment extends OSRI programs to continue until one year after the completion of oil exploration and development efforts in Alaska.

The Oil Pollution Act of 1990 identifies the PWS Science and Technology Institute (known as the PWS Science Center) in Cordova, Alaska, as administrator and home for OSRI. Between 1992 and 1995, Congress appropriated $500,000 for the OSRI program. Since 1996, when amendments instituted a funding mechanism for OSRI, the program has received annual interest earnings from a $22.5 million portion of the National Oil Spill Liability Trust Fund. In 2012, the amount that OSRI receives interest from was raised to $35.3 million.

OPA90 also set up an Advisory Board to determine policies of and programs supported
by OSRI. This includes oversight of the development of strategic plans, research plans, and annual work plans. The Advisory Board includes three federal, three state, two oil and gas industry, two fishing industry, two native community, and two at-large representatives. Additionally, there are non-voting members from the Institute of Marine Science/University of Alaska Fairbanks, and the Prince William Sound Science Center.

The OSRI Advisory Board meets at least twice each year to set policies and review the implementation of OSRI programs. The Board’s structure includes four committees - Executive, Scientific and Technical, Financial and Work Plan - each of which meet as needed throughout the year. Annual work plans are adopted by the Advisory Board in the early fall and outline continuing projects and new project solicitations to be issued in the coming year.

OSRI’s first strategic plan for oil pollution research and development (1995) focused on the risks and costs of oil spills. Recognizing GLOBEC’s conclusions about our weakness in making physical and biological predictions, and the consequential impact on our understanding of damages caused by oil spills, the OSRI program incorporated GLOBEC’s goals and approach to improve prediction of natural changes. This approach also improves our assessment of costs, a key element in identifying the best oil spill prevention and response technologies. The mission and goal statements of the OSRI strategic plan were reviewed and modified in 2002, 2008, and 2015. Five-year research plans have been developed based on each of the strategic plans.

OSRI solicited its first proposals for grant projects in late 1997. Since 1998, OSRI has awarded approximately $800,000 a year to support a wide range of projects. The projects awarded funds in any given year are outlined in the annual work plan. Since 2005, the work plans have been based on the five-year Science Plan. The Science Plan is organized around four strategic goals: Understand, Respond, Inform and Partner. To address the Understand goal, OSRI sponsored physical oceanography and meteorological programs designed to improve the ability to determine and forecast weather and ocean conditions in Prince William Sound. That effort led to OSRI’s support of a Prince William Sound Observing System, a pilot project for the Alaska Ocean Observing System (www.aoos.org). OSRI also contributed to research investigations of zooplankton, fish, and birds within PWS and the Copper River Delta regions. Additionally, OSRI partners with the North Pacific Research Board in support of ecological research addressing areas of overlap in their missions.

OSRI works with a wide array of industry and agency organizations to sponsor technological improvements for oil spill response. This includes contributing to the testing of new skimmer technologies, sensitivity index maps, new remote sensing
technologies, and sponsoring workshops to identify best practices and research needs. With the increased desire to develop in the offshore regions of the Arctic, there is increased emphasis to improve technologies for oil spill response in ice-laden waters.

OSRI sponsors educational and informational programs at all levels. It supports K-12 classroom programs and recently worked to include more technology in the education programs. It also sponsors undergraduate scholarships and graduate fellowships. Workshop support is provided to help disseminate OSRI research to agencies and spill responders.

**B. Establishing Legislation**

The Oil Pollution Act of 1990 (OPA 90) established the Prince William Sound Oil Spill Recovery Institute (OSRI) in Cordova, Alaska. OSRI is administered through the Prince William Sound Science and Technology Institute (aka Prince William Sound Science Center: PWSSC). As legislated, OSRI functions to “conduct research and carry out educational and demonstration projects designed to 1) identify and develop the best available techniques, equipment, and materials for dealing with oil spills in the Arctic and Subarctic marine environment; and 2) complement Federal and State damage assessment efforts and determine, document, assess, and understand the long range effects of Arctic or Subarctic oil spills on the natural resources of Prince William Sound and its adjacent waters, (as generally depicted on the map entitled “Arctic or subarctic oil spills dated March 1990”) and the environment, the economy, and the lifestyle and well-being of the people who are dependent on them, except that the Institute shall not conduct studies or make recommendations on any matter which is not directly related to Arctic or Subarctic oil spills or the effects thereof.”

**C. Mission Statement, Goals, and Objectives**

The OSRI Advisory Board and members of the Scientific and Technical Committee conducted a strategic planning session on October 14, 2014. The purpose of the planning session was to evaluate the mission statement, goals, and objectives that guide OSRI programming. The mission and goals were then released for public comment and adopted in February 2015.
Mission Statement
OSRI supports research, education, and demonstration projects that improve understanding and response to oil spills in Arctic and sub-Arctic marine environments.

Goals and Objectives
UNDERSTAND
Attain an interdisciplinary understanding of Arctic and sub-Arctic marine environments as it pertains to: baseline conditions; the sources, fate, and effects of spilled oil; and the recovery of those environments following a spill.
• Evaluate short and long-term effects
• Identify chemical, biological, and physical impacts and consequences
• Identify the impacts of oil spill response options
• Evaluate impacts from oil spills on the economy, the lifestyle and well-being of people, and resiliency of communities and resource users
• Achieve long-term coastal and ocean observing capabilities

RESPOND
Enhance oil spill response and mitigation capabilities in Arctic and sub-Arctic marine environments.
• Identify and evaluate new prevention and response technologies
• Evaluate relative benefits and consequences of specific response and mitigation techniques
• Fill knowledge gaps on the behavior of spilled oil

INFORM
Share information and educate the public on the issues of oil spill prevention, response, and impacts.
• Publish scientific and technical results in open literature
• Brief the response community on OSRI products
• Facilitate the exchange of information and ideas through workshops and other forums
• Educate future researchers and responders through K-12 programs, undergraduate internships, and graduate fellowships
• Convey information to the general public through various media
• Be a source of expertise

PARTNER
Partner with others to take advantage of shared funding, facilities, knowledge, and experience.
• Coordinate with other efforts related to OSRI’s mission
• Expand OSRI’s involvement in Arctic research through partnership opportunities

**D. R&D Grant Policies and Procedures**

OSRI initially adopted a research and development grant program based on policies and procedures used by the National Science Foundation (NSF), National Oceanic and Atmospheric Administration's (NOAA) National Undersea Research Program and the *Exxon Valdez* Oil Spill Trustee Council. The basic document that governs the OSRI program is the Grant Policy Manual (GPM). The GPM undergoes periodic updates to make the program run as efficiently as possible. The last update was in October 2008. The GPM provides guidance on the various provisions of program management. All OSRI staff, committee members, and Advisory Board members will follow the guidelines contained in the GPM when processing and managing OSRI grants. The OSRI GPM and other OSRI documents and forms, including application packages, are available on the OSRI web site at [www.pws-osri.org](http://www.pws-osri.org), or by request.

**E. Roles and Responsibilities**

The Oil Spill Recovery Institute is housed within the Prince William Sound Science Center, which has fiduciary responsibility for OSRI. The staff structure of OSRI is related to the PWSSC as shown in Fig. 1.

![Figure 1. OSRI and PWSSC staff chart and relationship between the organizations](image-url)
The following roles and responsibilities are defined to be:

1. **Advisory Board** – Set strategic direction, review progress toward accomplishing strategic goals, promote OSRI program results and products to the oil spill and marine science communities, define duties of OSRI director and other staff, appoint and evaluate director, establish subcommittees, approve bylaws, set broad annual scientific priorities, approve annual program plan and large grant awards, seek operational coordination with the Prince William Sound Science Center and its Board of Directors, resolve complaints and financial award issues, act to fill vacancies on the Board, review fiscal reports, and assist the OSRI Executive Director and Research Program Manager with partnerships.

2. **Executive Director** – Supervises the OSRI Research Program Manager and assists with administrative support to implement OSRI programs, promotes OSRI programs through outreach efforts (e.g. web page, annual report, meetings, etc.), and communicates with the Advisory Board on a regular basis concerning administrative and fiduciary issues.

3. **Research Program Manager** – Plans research programs, prepares annual work plans in consultation with the Work Plan Committee and the Advisory Board, works with OSRI Executive Director on fiduciary issues, and implements the work plan as approved by the Advisory Board. Coordinates proposal reviews, works with the Scientific and Technical Committee on future research direction, proposal selections and recommendations to the Advisory Board, and ensures compliance with all policies and procedures of the Grant Policy Manual.

4. **Scientific and Technical Committee** – Provides advice and recommendations to the Research Program Manager, Executive Director, and Advisory Board regarding the direction, selection, and support of research projects related to Arctic or sub-Arctic oil spills. Acts as the proposal selection panel using review comments and recommendations submitted by technical peer reviewers. Provides recommendations to the Advisory Board on program plans, proposal and fellowship awards.

5. **Clerical Staff** - provide administrative support to the Research Program Manager and Executive Director to carry out the OSRI Program.

**F. Application and Award Process**

OSRI staff, STC, and Advisory Board members will follow the guidelines and procedures detailed in the Grants Policy Manual (GPM). The OSRI GPM and the annual OSRI program descriptions are available on the OSRI web site at [www.pws-osri.org](http://www.pws-osri.org), or by request from the Research Program Manager.

**III. Programming by Goal**

The specific programmatic focus areas will be described by the primary goal that each
area fits under. Most programs address more than one goal. For instance, a workshop that facilitates the exchange of information (Inform goal) may address identifying new response technology (Respond goal). Or environmental research may address both the Understand and Respond goals. And the Partner goal applies to all goals.

A. Understand: Attain an interdisciplinary understanding of: the fate and effects of spilled oil in Arctic and sub-Arctic marine environments; and the recovery of those environments following a spill

a. Evaluate short and long-term effects.
b. Identify chemical, biological, and physical impacts and consequences.
c. Identify the impacts of oil spill response options.
d. Evaluate potential impacts from oil spills on the economy, life-style and well-being of communities and resource users.
e. Achieve long-term coastal and ocean observing capabilities.

Three research program areas have been identified as focal areas for the Understand program.

1. Degradation and Toxicity

The use of dispersant, chemical herders and degradation enhancing substances are a part of the array of oil spill response options that may be considered during a spill. Some products have not been tested by an independent lab to determine the resulting efficacy or toxicity. The ones that have been tested generally have not included Arctic species or environmental conditions. Before the use of any additive during oil spill response, it is important to understand the probable ecological benefits and harm that may come about from its application.

Many treatments are designed to enhance natural degradation by stimulating bacterial growth or altering oil to allow more effective consumption of the oil by the bacterial community. We desire to understand how rapidly degradation takes place, how completely the oil degrades, and the toxicity of the remaining oil.

When considering toxicity, we desire to understand not only the historical measures of acute toxicity, but the sublethal effects as well. Sublethal but significant effects of prolonged or acute exposure to additives, oil, and the combination of the two on critical biological functions in organisms are of great concern. It is important to evaluate the sublethal effects, including delayed responses, and to tie those effects to changes in the individual organism’s ability to survive as well as to population level effects. We would like to know the duration of sublethal effects or whether they can be reversed. Toxicological studies can evaluate these effects on reproduction, immune function, and other useful endpoints. Testing should include both the additive by itself and combined
with oil.

Of particular interest to OSRI is to conduct toxicity testing on organisms important to the food web and people of Arctic and sub-Arctic regions. The testing of toxicity and degradation in must use environmental conditions representative of the area. We desire tests that replicate the expected concentrations and exposure that would occur in ocean conditions.

Potential projects include:

- **Degradation additive effectiveness.** Several products have been proposed as additives to spilled oil to speed up the natural degradation of oil by microbes. Few have been tested in conditions expected in the Arctic or sub-Arctic. Some have not been tested by independent parties. We desire to test the efficacy of these agents prior to a spill so we can understand their potential for spill remediation and their potential effects on the environment. There is a need to understand what the natural response time is to the additive and what end and intermediate products are produced. Linking the efficacy to toxicity is also desirable for understanding the impact of using these products. We expect the tests to cost $50K-$100K depending on the scope and complexity of the testing.

- **Sublethal toxicity.** Sublethal effects, such as alteration in immune function, fertility, or organ function are potential effects of low concentrations of oil in the water column. Exposure of individuals to a sublethal dose of oil could have long-term detrimental effects on the health and sustainability of that population. This may occur because of reduced immunological function or reproductive potential. Sublethal exposure at the egg or larval stage may also cause deformities or reduced heart function that can reduce survival at these stages. Sublethal toxicity studies are expected to require 2-4 years to complete and cost $100K-$150K per year to run.

- **Toxicity of chemical herders.** Chemical herders are designed to be applied to the surface of the ocean to cause an oil slick to contract to a point where a burn can be conducted efficiently. While herders have been around for some time, there hasn’t been much attention paid to them until recently when their potential for application in ice environments was recognized. Slicks in broken ice provide the near ideal conditions for application of herders so understanding their fate and effects are important for Arctic spill response. The recent focus of research has been on formulations and efficacy. There remains a need for understanding the potential ecological impact of these additives through toxicological testing. We expect such testing to cost $75K- $125K per year for one to two years.

- **Hydrocarbon impact.** Much remains to be understood about the effects of low
levels of hydrocarbon on primary and secondary productivity. There is much to learn about the sublethal effects of hydrocarbon exposure on intertidal and planktonic communities and the time required for those communities to recover from exposure to hydrocarbons. Such studies are expected to cost $100+K per year and, to be successful, are likely to require partnerships with other funding entities.

2. Ecological Research

Understanding impacts of spills begins by understanding the ecology of the area. This ranges from understanding circulation to predict areas likely to be impacted, to understanding the species that are present at various times of year. In a large spill, prioritization must occur to determine where to deploy resources in order to protect areas that may be difficult to clean or that have important ecological function. Decisions will also need to be made on the response options to protect organisms on or in surface waters. Knowing what organisms can be found at any time and their location is therefore important.

Certain geographic regions may need additional attention for understanding the impact of a spill. Shipping across the Great Northern Route and along the Great Circle Route will both pass through portions of the Aleutian Islands where there is little information available to understand the potential impacts of an oil spill. Exploration and development efforts in the Chukchi and Beaufort Seas are drawing additional attention to the Arctic waters. This attention provides opportunities to partner with other organizations to improve our understanding of how the Arctic ecosystem functions.

Partnership opportunities are expected to arise with the North Pacific Research Board (NPRB) through their Arctic Integrated Ecosystem Research Program or through the existing joint funding program with OSRI which focuses on the annual NRPB Request for Proposals. OSRI will continue to seek out partnership opportunities for Arctic research, such as working with the North Slope Science Initiative or with the Alaska Ocean Observing System. In other regions there are also potential connections with Exxon Valdez Oil Spill Trustee Council sponsored research, Prince William Sound Regional Citizens’ Advisory Council, and the Cook Inlet Regional Citizens’ Advisory Council.

Potential projects include:

- *Synthesis of existing species and habitat information.* In order to develop predictive models that can allow us to estimate what species should be expected in a given habitat at any given time of year, we need to establish what is known about those organisms (as to when and where they can be found), and that
knowledge must be on a scale appropriate for habitat association and spill response. Two types of projects are envisioned. The first is a series of white papers that summarize the existing knowledge about a group of organisms. These are expected to cost $25K - $50K each and would take less than a year each to produce. This type of effort will be linked to efforts to develop spill response information tools such as to environmental sensitivity index maps or as guides for responders as described under the Respond goal.

- **Species surveys.** Based on the results of the white papers (described above), research is planned to fund mapping of spatial or temporal variability in key species. Two very likely gaps to emerge are the need to understand the seasonal patterns of larval fish and invertebrates, which would be affected by dispersed oil, and seasonal patterns of intertidal fish, which are commonly forage items for higher trophic levels. Past experience suggests such studies will cost between $75K and $100K per year and will require two to three years to complete. These studies may also be of interest to NPRB and EVOS.

- **Regional studies.** If shipping occurs along the Great Northern Route, it will intersect shipping following the Great Circle Route in the Western Aleutians. This puts the area at high risk for a spill and yet there is little information about the oceanography and ecology of the Western Aleutians. The Arctic is another area that has an increasing risk of spill due to shipping and oil and gas exploration and development. OSRI will seek partnerships to support synthesis of existing knowledge or integrated ecological research in areas at higher risk from oil spills. OSRI expects that it would need to contribute $100K per year for two to five years for such efforts.

- **Habitat mapping.** Habitat mapping programs such as ShoreZone mapping of the intertidal zone provides critical information necessary for understanding oil spill impacts. It would now be helpful to extend the habitat maps into the sub-tidal zone so that all habitats that might be impacted by an oil spill are mapped. It is also necessary to develop predictive tools that associate organisms with habitat types. OSRI is not able to afford mapping large areas, but may be able to partner with other organizations to collect the desired information. As was shown with the ShoreZone project, large areas can be mapped through partnerships. OSRI may be able to contribute $50K-$100K to a partnership effort for habitat mapping or tying species use to mapped habitats.

- **Ocean circulation.** Spill response is heavily dependent on accurate predictions of the oil trajectory. OSRI has supported several studies of ocean circulation and model development. Projects that build upon the previous research to enable more accurate predictions of ocean circulation will be considered. Projects lasting one to two years with budgets of $50K to $100K per year will be considered.

- **Fate of carcasses.** One of the most contentious parts of settling claims from oil
spills is determining the injury, or loss, of marine wildlife. Estimates of mortality are made by collecting carcasses and then multiplying by some factor to account for the carcasses that were not collected. A carcass may not be collected because it sinks or drifts out of the search area, is picked up by scavengers on the beach, or is just not found by the searchers. It is also important to be able to distinguish the level of mortality above and beyond natural mortality. There are several potential studies that can help improve our ability to estimate spill related mortality. OSRI will look for partnerships with the U.S. Fish and Wildlife Service and others to support related research. These studies are expected to cost between $25K and $100K and last for three years.

3. Ocean Observing

Effective spill response and understanding of potential ecological impacts requires knowledge of the winds and ocean currents. In order to develop the tools and techniques needed to provide the appropriate measurements, OSRI has worked with the Alaska Ocean Observing System for the past ten years to develop an observing system in Prince William Sound that includes meteorological and oceanographic measurement and modeling activities. During the summer of 2009, that observing capability was tested. The system was tested for being able to provide data necessary for modeling efforts, the capabilities of the atmospheric and oceanic models, and the ability to provide the output to spill response modelers and other user groups.

Our desire is to see improved and sustainable ocean observing capabilities throughout the Arctic and sub-Arctic marine systems and to learn from the recent efforts how to most effectively proceed in expanding the observing capabilities. We must evaluate past efforts and identify solutions for those components found to be problematic. We need to understand how to: maintain the models either running or in standby mode; the cost required; and how long models might last if there is no maintenance. Since the marine environment changes dramatically around the state, the observation capabilities required may be very different outside of Prince William Sound. OSRI’s future efforts should focus on identifying the observational needs throughout Alaskan marine environments to help guide the future expansion of observation capabilities and testing of new capabilities, rather than the purchase of equipment to expand the existing system.

Previous efforts have also focused on the development of observational capabilities and those capabilities have not been used to address questions of importance to ecological or spill response research. OSRI may consider projects designed to utilize these observational capabilities. Such projects include the maintenance of the Snotel stations for development or validation of hydrological models described earlier, or using the circulation models to predict larval drift to help understand the pathways for ecosystem
recovery. We will also consider support for further model validation work.

All efforts should be in partnership with the Alaska Ocean Observing System.

Potential projects include

- **Evaluation of Prince William Sound Ocean Observing System (PWSOOS).** An evaluation of the Prince William Sound Ocean Observing System should be conducted. The evaluation should include a cost benefit analysis of observational and modeling capabilities including a cost analysis for expansion of the system. Since PWSOOS was a demonstration project, expectations were not for perfect performance. The evaluation should examine which components worked and which failed, and discuss the reasons for failure and if those problems have been or can be overcome. The evaluation should look at who the expected user groups were and determine if they used the system as expected. It should also examine what is required to maintain such a system of observations and models into the future. It is expected that the evaluation would take a year and cost $50-100K.

- **Determination of appropriate model scaling.** There are large changes in bathymetric and topographic complexity around Alaska that may allow or require differences in 3-D model scaling to be used. For instance, the atmospheric and oceanic circulation models developed for the mountainous fjord environments of southeast and southcentral Alaska may require higher spatial resolution than those developed for the broad and fairly flat landscape of the Beaufort Sea coastal area. Since higher spatial or temporal resolution requires more computer capacities it makes sense to use models that are scaled appropriately for the area. It is expected that model scaling studies would be appropriate for both atmospheric and ocean circulation models and they would require a year of effort at the cost of approximately $100K per model.

- **Determination of appropriate ocean circulation model capabilities.** There are many types of ocean circulation models available. Each has its strengths and weaknesses. It may or may not be appropriate to use a coupled sea ice and ocean model designed for the Beaufort in the tidal flats of Cook Inlet. A workshop is envisioned that would address the question of what are the appropriate model requirements for different marine environments found in the Arctic and sub-Arctic regions. Of particular interest is how models are able to treat the edges to better understand potential impacts on the nearshore region. It is expected that the project would take a year and cost $50K.

- **Application of ocean circulation modeling for prediction of larval drift or mixed layer depth evolution.** Considerable effort has been placed into the development of circulation models for the purpose of assisting oil spill response and ecological
studies. OSRI will consider funding projects that utilize the resources developed in the past to study issues of importance to oil spill response, such as the evolution of the mixed layer depth, or larval drift patterns that provide for recruitment of organisms from unaffected areas. It is expected that such research programs will take one to three years and cost approximately $100K per year.

- **Model Validation exercise.** The observation program in Alaska relies on being able to use atmospheric, oceanic, wave, and biological models to fill in where observations are not practical. These models are under constant refinement and require periodic validation exercises to ensure they are properly representing the actual conditions observed. Validation exercises occurred in 2004 and 2009. Major changes to the ocean circulation models occurred after the 2004 exercise and a new hydrological model was developed in response to the findings of the 2009 exercise. It is expected that OSRI would contribute $100K to $150K over one to two years to support components of a validation program that can continue to test the capabilities and identify areas for improvement.

### B. Respond: Enhance oil spill response and mitigation capabilities in Arctic and sub-Arctic marine environments.

- a. Identify and evaluate new prevention and response technologies.
- b. Evaluate relative benefits and consequences of specific response and mitigation techniques.
- c. Fill knowledge gaps on behavior of spilled oil.

Four research program areas have been identified as focal areas for the Respond program. These program areas and the projects included within them are based on building upon the work being done by NOAA, BSEE Oil Spill Response Research, USCG, Regional Citizen Advisory Councils, and industry. In particular the ice related programs are to build upon the findings of the Joint Industry Project conducted by SINTEF between 2006 and 2011 and the Arctic Response Technology JIP that is currently underway.

#### 1. Spill Response Information Tools

Several products useful to spill responders have been developed in the recent years. These include the ShoreZone maps, the Geographic Response Strategies, the Geographic Resource Information Network, Alaska Oil Spill Permits Tool, and the Alaska Ocean Observing System. With so many areas where information is available, some personnel may not be aware of these and other local resources. This leads to different groups involved in the spill response using different sources of information and different tools to visualize it. In order to assure that such resources are readily available during an emergency, OSRI would like to support the work that helps gather needed information
and provide it in an easy to visualize manner or allow existing tools to work together better. OSRI looks to support tools that use open data standards and will avoid developing proprietary systems.

One commonly used tool is the Environmental Response Management Application (ERMA), which was developed through a grant from the Coastal Response Research Center. It is a geographic information tool that contains historical and real-time information for spill responders with mechanisms to input information during a spill. It appears that NOAA’s Emergency Response Program will be adopting this tool for application throughout the country in the future. Any tools developed in this program will need to be able to be compatible with ERMA.

During a spill, the incident command structure includes a number of different sections that all require specific types of information to be available. The Operations Section needs to know how their teams can access areas or conditions that may limit recovery operations. The Planning Section needs to understand what resources are most at risk and the weather and currents in order to predict where the spill may spread. The Logistics Section needs to know what resources are available for recovery, medical facilities, and housing facilities. It is important to work with each of these sections to determine exactly what type of information they need, if new information tools are necessary, if there are important pieces of information available that are not currently being used, and if new information needs to be collected to demonstrate the systems.

This focus area is linked to the Understand goal. Findings under that goal provide the information about what is where and when it is needed by the environmental planners. Development of new information tools may in turn help improve our understanding of nearshore biology by gathering diverse information together, which will allow interdisciplinary research to be conducted.

Potential projects include:

- *Scoping workshops*. Workshops with a small number of spill responders would be used to identify information needs for the development of new products. Workshops would be designed to bring together responders assigned to a particular section with information tool designers to outline what information is desired and how it is most likely to be accessed. These workshops would be used to provide the information needed to develop new information, tools, and products. We expect to contribute approximately $10K-$25K per workshop.

- *Information components*. It is anticipated that some information needs will not be fulfilled using existing information. In fact, some existing data sets have limitations and we may decide additional information is needed. For example, the
pictures and video associated with the ShoreZone mapping effort may be of interest to several groups in the operations and planning sections; however, those images are all taken at low tide during the summer (so that the biology and geology of the intertidal can be mapped). In areas with large tides, the shoreline may not be recognizable at high tide to a person who only has a picture of it at low tide. Also the access to the beach may be very different in winter and summer. Having imagery from high tide and in the winter may be important to some of the sections. Such imagery would be collected under this section. We anticipate funding up to three efforts to collect additional information necessary to necessary to complete an information tool. In some cases the information needs may require supporting development of new collection systems, such as a fixed wing deployable weather package. The costs of projects are anticipated to range from $25K to $75K.

- **New tools.** New information tools will be developed and demonstrated to make the existing information easier to access for individual response sections. Such efforts may include making it easier for people to access the complete ShoreZone image archive in their area, indexing of that imagery to allow rapid access to a particular location, and the development of tools that combine existing information into a simple access point. We anticipate providing $25K-$75K for the development of new spill response information tools.

### 2. Best Practices

Best practices and field guides for operations are essential tools to be able to guide activities during oil spills. This focus area would aim to develop best practices documents similar to the *Best practices for migratory bird care during oil spill response* or *Advancing oil spill response in ice-covered waters* manuals. Activities in this focus area are most likely to range from developing dedicated workshops with a final written report to providing support to pre-existing groups to allow for a facilitator or technical writer in order to improve and document their efforts. The exact efforts each year will depend on the needs of other groups and our ability to build partnerships to develop best practices.

Potential projects include

- **New documents.** Some best practice documents will need to be created. Potential topics may include: best practices for marine mammal care during oil spill response; managing fisheries during spill response; and working with the media during a spill response. The exact topics will be determined by the ability to find partners in the efforts and through input from the Scientific and Technical
Committee as they identify new needs. We expect document development to require one to two years and cost $25K-$100K for each effort.

- Updates. Best practices may change as new technology and information become available. Similar to the development of new documents there may be a need to update existing documents, such as the **Field Guide for oil spill response in Arctic waters**. We expect updates to require one to two years and cost $25K-$100K for each effort.

- **General support.** In many cases relatively minor support will be needed to contribute to an effort, allow for improved participation in workshops designed to improve best practices, or ensure well written documents as the final product. We will set aside $15K-$25K per year for such efforts. We recognize that this funding may not be spent if there is no demand for it.

3. Oil Spill Detection and Tracking

The rapid and efficient response to oil spills requires being able to detect and track them. Detection commonly relies on aerial over-flights for visual detection. This is not practical at night, during inclement weather, and in ice, all common conditions in Arctic and sub-Arctic environments. Several new approaches for detection at night and during inclement weather (such as infrared and x-band microwaves) are being tested and shifted into an operational mode. Some of the systems are designed for specialized aircraft, which may be too large, expensive, and technical to transition to individual oil spill response organizations. OSRI will focus on adapting or testing technologies designed for a variety of vessels and aircraft that may be used for spill response in Alaska. It will also be important to develop systems that can help guide responders to the thickest portions of the oil by providing a measure of oil thickness.

Spill detection in and under ice has made advances recently. The use of microwave radar, acoustic systems, and optical sensors have been tested and have demonstrated potential for detecting oil in and under ice. To date, the work has focused on proving the ability to detect oil in and under flat sea ice. The inclusion of rafted and ridged ice is a natural extension of that work. Work remains on detection in frazil, slush, and grease ice as well.

Tracking of oil spills can be accomplished using visual observations, tracking buoys, and, in some cases, remote sensing techniques. For spills in ice, it may be necessary to track the ice for a long time period before a response option becomes feasible. Because of the divergence of ice over time, it will be necessary to deploy a large number of buoys or develop other techniques for monitoring the ice location. For open water spills, it is desirable to reduce the size and cost of the buoys, and increase the probability that the buoy will remain with the oil.
Potential projects include:

- **Development of airborne systems for detection of oil in ice.** Normal airborne surveillance techniques for detecting oil spills will not work for spills under ice. There are currently efforts to develop microwave radar and nuclear magnetic resonance systems to allow rapid airborne surveys. Other sensors such as radar, infrared, and laser fluorosensors need to be validated for operations in ice conditions. It is expected that some of these sensors will not be able to discriminate oil contained in leads during portions of the winter or that modifications may be necessary before they can be used in the Arctic. OSRI will consider partnering with other organizations to continue development and testing of airborne systems for detecting oil under snow and ice. Projects are expected to take one to three years and cost $25K-100K per year.

- **Testing of sensors for detecting oil in and under ice.** Considerable progress is being made in the Arctic Response Technology JIP to test aerial and subsurface sensors for detecting oil in and under flat-solid sea ice. Flat sea ice is only one of many ice conditions that a potential oil spill may be expected to encounter. Rafting and ridging create unique challenges for detection as does early ice formation conditions, such as grease and slush ice. There is an opportunity to learn from the existing tests to identify the most promising suite of sensors and continue to expand the laboratory testing to determine the utility of the sensors under a broader range of conditions. Projects are expected to take one to three years and cost $75K-$150K per year.

- **Improve oil tracking buoys.** Oil tracking buoys provide a means to mark an oil spill in a manner that can be tracked independently from environmental conditions. There are several issues that need to be addressed, including: reducing cost, improving operational life, and improving the ability to remain with the oil. These improvements may be made to the existing satellite tracked drifters; through development of systems using alternative communication routes, such as cell phones; and the consideration of passive tags, such as radio frequency identification tags. Projects are expected to last one to three years at a cost of $50K-100K per year.

- **Satellite tracking of ice movement and divergence.** With synthetic aperture radar satellites, it may be possible to track the motion and divergence of an area of ice through a winter. The ability to track the motion over periods of weeks has been clearly demonstrated, but for the purpose of a spill, it may take months before a response can be made, or it may be necessary to watch an area to detect oil missed by recovery efforts when it surfaces in the spring. A demonstration of the ability for satellite tracking of ice throughout a winter is expected to take two years and cost $100K-$150K per year.
4. Spill Response in Ice.

As existing oil resources decrease, there will be increasing pressure to develop new discoveries in the ice-covered oceans. The presence of ice makes spill response much more complicated than in open water. Equipment and tactics need to be developed or modified to allow response during ice formation, on thicker winter ice, in broken thick ice flows, and on pack and landfast ice. The oil may flow below the ice, become encapsulated in the ice for long periods of time, or rise to cover leads in the ice. Different approaches are likely to be needed in the fall and spring transition periods between ice-covered and open waters. The ability to respond to a spill in the ice requires a better understanding of the fate and behavior of oil, the development of means to contain the oil under the array of conditions, and the development of means to recover the oil.

Potential projects include:

- **Improving ice processing capabilities in skimmers.** Skimming operations in ice are difficult. When small ice particles such as frazil or brash ice are present, many skimmers will not process the ice, causing it to build up in front of the skimmer and inhibit operations. In instances where the skimmers are able to collect the oil ice mixture, there remains a need to separate the ice from the oil to reduce the storage capacity requirements. Research is needed to help identify new designs that are able to efficiently remove oil in the presence of small pieces of ice and to separate ice from oil. Projects are expected to take one to three years and average between $75K and $150K per year.

- **Containment of oil in and under ice.** Containment of oil is desirable to reduce the area being impacted. New containment systems and techniques are desired for operation in broken ice or below ice. Projects are expected to take one to three years and average between $75K and $150K per year.

- **Collection of oil in and under ice.** Current tactics for removing oil under ice involve drilling holes into the oil pool to allow collection at the surface. Newly spilled oil can move along the bottom of the ice to allow a single collection point to retrieve oil from a larger area. If the oil has been exposed to sunlight for a couple days, the oil can melt up into the ice, stopping its ability to flow to a retrieval point. Similarly, ice growth can restrict the movement of oil. New techniques for collecting oil under ice or moving oil to a surface collection point could enhance oil recovery. Projects would be expected to demonstrate feasibility of retrieval techniques and typically take one to two years at $50K-$100K per year.

- **Understanding and improving oil burning in ice.** Burning of oil should be considered in any oil spill response. In the Arctic, burning may be one the most effective manners to remove oil from the environment, but there are several issues that need to be better understood to improve decision on the use of burning and to
improve the techniques used. Improvements include safer ignition systems, improved containment and concentration systems, and more efficient burning techniques to reduce the smoke generated. It may also be necessary to determine weathering characteristics of oil on the ice surface as well as oil surfaces in the spring. Projects are expected to take one to two years and average between $50K - $100K per year.

- **Determine the fate and behavior of oil in broken ice.** Ice will act as a natural boom in some conditions. At the same time, strong currents in a lead can pull oil off the water surface and transport it under the ice, or the movement of ice can cause the oil to be pumped into the water column. The fate and behavior of oil in a variety of broken ice conditions needs to be determined. In particular, we seek to understand how that fate and behavior relates to the effectiveness of spill response countermeasures. Projects are expected to take one to three years and average between $100K and $200K per year.

- **Handling techniques for Arctic Animals.** Marine mammals and seabirds are important components of subsistence foods in the Arctic. There is limited capacity for rehabilitation of the large marine mammals present around the ice environment. New techniques are necessary to be able to prevent mammals, such as polar bears and walrus, from entering a region with spilled oil. Projects are expected to take one to three years and average between $100K and $200K per year.

- **Supporting development of testing facilities.** We expect much of the experimentation necessary to address the research topics identified in this section will be done in large-scale laboratory facilities. There are very few such facilities and existing facilities have limitations that prevent testing of some equipment or the ability to replicate important field conditions. OSRI will consider contributing support to development or modification of facilities that allow a greater range of testing to occur. Contributions are expected to range between $25K and $100K.

**C. Inform: Share information and educate the public on the issues of oil spill prevention, response, and impacts.**

- a. Publish scientific and technical results in the open literature.
- b. Brief the response community on OSRI products.
- c. Facilitate the exchange of information and ideas through workshops and other forums.
- d. Educate future researchers and responders through K-12 programs, undergraduate internships, and graduate fellowships.
- e. Convey information to the general public through various media.
- f. Be a source of expertise on oil spill prevention, response, and impacts.
This goal is tightly linked with the programs of the other goals. For instance, the objective to publish results in open literature is included in this goal, but will be carried out through the efforts funded under the Understand and Respond sections. The briefing of oil spill removal organizations and conveying of information will occur as a result of the development of products under the other goals. Workshops or conferences are a means to convey information or to guide the development of best practices, new techniques, and equipment. This goal also encompasses the education component which aims to develop the next generation of researchers and responders and keep the public informed of improvements in response techniques and our understanding of the marine ecosystems potentially affected by oil spills.

1. Workshops and Conferences

Workshops, conferences, and symposia provide methods to distribute OSRI products and convey information, and also provide a mechanism to develop products, such as best practices. Conferences, workshops, and symposia that cover areas outlined in this research plan will be considered for support. The funding structure for these programs may need to be flexible. Conference sponsorships can be identified relatively far in advance; however, many important workshop opportunities are identified with a shorter lead time and will require a flexible funding structure.

- **Conference sponsorship.** OSRI will look to support the regularly scheduled conferences that are avenues for OSRI-sponsored investigators to present their results, or provide avenues for OSRI to brief potential users of OSRI-funded products. Sponsorship is expected to be between $2K and $8K per conference.

- **Workshop support.** OSRI will support workshops aligned with OSRI’s goals and objectives. Support may range from being the organizer and major sponsor to providing support funding that will assure the completion of reports and/or other aspects necessary to providing a quality final product. Workshops can be useful for the development of best practices, or to convey ecological risks of response options. Workshop support is expected to range from $1K to $50K.

2. Education

Development of future researchers, engineers, and others involved in oil spill response requires an education component that exposes students to the issues important to ecology and technology. OSRI has been a strong supporter of education programs targeting students from kindergarten to graduate school. The existing education programs reach a wide range of ages and provide very good information. These include the Discovery Room program that works with K-6th graders in Cordova. The Discovery Outreach
program takes components of the Discovery Room to other communities in Alaska, both in Prince William Sound and beyond. Summer camps involving students from third grade through high school and adult education have been supported by OSRI. We also support projects to incorporate more technology into the materials available. Higher level education components include an undergraduate scholarship and the graduate research fellowships.

- **Graduate Research Fellowship** program. The Graduate Research Fellowship (GRF) program is designed to provide partial support for students in master’s or doctoral programs. It also provides a means to work on the programs outlined in the various goals of this research plan. This program has resulted in numerous peer-reviewed publications. OSRI will solicit proposals for the GRF program subject to available funding. OSRI will strive to maintain at least two students in the GRF program with additional students if funding allows. Fellowships may be funded for up to four years. Doctoral students may apply for a two-year extension during their fourth year for a total of six years of funding. Fellowships will be funded at $25-$30K per year.

- **Undergraduate internship.** Undergraduate internships provide a mechanism to support students who will become the future workforce, but who are not necessarily continuing their education in graduate school. This is particularly true of students getting degrees designed to prepare for jobs with oil spill recovery organizations or agencies involved in spill response. This program will be designed to provide internships for students to work with oil spill response organizations or agencies dealing with Arctic and sub-Arctic spills. The program is expected to cost $15K per internship.

- **Oil spill response short course.** In addition to internships, it is desirable to develop an oil spill short course that can be taught at community colleges throughout Alaska. It is envisioned that the course would combine aspects of the Science of Oil Spill course offered by NOAA and the Hazardous Waste Operations and Emergency Response (HAZWOPER) course needed by spill responders. As this is envisioned as a new college level course, the curriculum and teaching materials will need to be developed and tested through delivery. The program is expected to cost $25K per year for development, then delivery and refinement.

- **K-12 education.** Development of future oil spill responders and ecologists begins early in the education process by getting students interested in science and technology. To help encourage students into these fields, OSRI contributes to the
Prince William Sound Science Center’s Headwaters to Ocean program. The program is aimed at K-12 students and creates opportunities to get students excited about environmental science and technology by involving the students directly in collecting data, building remotely operated vehicles, and learning about the marine environment. Activities can take place in the classroom or in the field throughout the year. Hands-on activities are expected to be emphasized. There is a desire to continue the program and expand the delivery to other areas around the state. It is anticipated that this will be accomplished by developing materials that can be transferred to other education facilities and the partnerships necessary for delivery. This can include traveling to schools around the state to teach, delivering the materials through programs where students from around the state come together, developing distance learning approaches, and partnering with summer education programs for delivery of the materials. It is desirable to ensure course evaluation criteria are developed and tracked. OSRI intends to contribute at a level of $65 - $75K per year.

- *Ocean Science and Technology.* While the OSRI-sponsored education program has been very strong, it is just beginning to include technology components and expand its geographic scope. It is desirable to develop products or programs that take the education programs beyond the Prince William Sound area and develop new technology programs. Potential efforts include: a workshop with other appropriate education groups to outline methods to transfer ocean science and technology education programs to other regions; development and testing of additional technology-focused education programs; and development and testing of ocean science programs targeted at students throughout the Arctic and sub-Arctic regions. These materials may also be developed for outreach activities to communities. Similar efforts have occurred and future efforts should be informed by those past efforts. We anticipate projects will be completed within a year with a budget of $10K to $20K.

3. Outreach

Outreach through several mechanisms provides the opportunity to inform members of the public on the research findings and technological developments sponsored by OSRI. OSRI has contributed to a winter lecture series in Cordova, which is also broadcast to Valdez and sometimes other regional locations. Additional support has been given to the *Field Notes* radio program aired throughout PWS, printed materials developed for visitors, and community events, such as the Shorebird Festival, that involve people from a large geographic area.
• **Outreach.** It is important that the results of OSRI-sponsored efforts are widely distributed to the public. Recently, outreach has focused on those activities conducted by the OSRI Research Program Manager that are targeted toward specific audiences through venues such as the International Oil Spill Conference. Conference attendance will remain an important outreach tool. The desire is to disseminate OSRI efforts more broadly through a wide array of media options, such as printed materials, radio broadcasts, and video or computer presentations. There is a desire to expand outreach efforts through visits to coastal communities where balanced information regarding spill response can be presented. This may be done by the RPM or contracted out. It is expected to cost $5K-$10K per year to visit two communities.

• **Materials.** Many organizations have identified the importance of developing unbiased (balanced) information materials about oil spills, oil spill response, and oil spill impacts that can be shared by various means. OSRI is well suited for development and review of such materials. Materials are expected to be developed for delivery through the web, print materials, and potentially radio or video materials. This work may be done through the RPM budget or contracted out depending on the level of complexity. It is expected that the development, review, and distribution of outreach materials will cost $10K-$25K per year.

**D. Partner: Partner with others to take advantage of shared funding, facilities, knowledge, and experience.**

a. Coordinate with other efforts related to OSRI’s mission.

b. Expand OSRI’s involvement in Arctic research through partnership opportunities.

The Partner goal outlines the preferred approach to achieving the projects outlined in the previous goal sections. The science plan outlines a scope of desired research that is outside the funding capabilities of OSRI alone. Whenever appropriate, partnerships will be developed to help further programs outlined in this plan. OSRI expects to maintain its partnerships with the Alaska Ocean Observing System and North Pacific Research Board to fund programs outlined in the Understand goal. We will seek to develop new partnership opportunities through participation in the efforts of groups like the North Slope Science Initiative, the Coastal Response Research Center, and the Exxon Valdez Oil Spill Trustee Council. OSRI will continue to seek opportunities to partner with industry (Shell, Conoco-Phillips, BP, American Petroleum Institute and others), government (Interagency Coordinating Committee for Oil Pollution Research, Bureau of
Safety and Environmental Enforcement, United States Coast Guard, Alaska Department of Environmental Conservation, and others), oil spill response organizations (Alaska Clean Seas, Cook Inlet Spill Prevention and Response Inc., and others), and other interested groups to further the development of new response technologies and tactics.

We anticipate additional opportunities will develop to partner on projects related to the Arctic as the U.S. becomes the chair of the Arctic Council. Recent plans for areas of emphasis during the US chairmanship include a thematic area covering Arctic Ocean safety and stewardship with goals relevant to OSRI to:

- expand information sharing on the environmental impacts of hazardous substances, mechanical recovery efficacy, and in-situ burning in open water, broken ice, and hard packed ice; and
- increase sharing of oil spill preparedness and response capabilities and continue the development of specialized pollution response resources and operational guidelines for responses in broken ice and ice covered areas.

Partnerships through the Emergency Prevention, Preparedness, and Response (EPPR) Working Group of the Arctic Council can address the goals of the U.S. chairmanship and OSRI.

The Interagency Coordinating Committee for Oil Pollution Research (ICCOPR) is a committee with members from federal agencies involved in oil pollution prevention, response, and restoration. They are currently revising their research and development priorities. There is considerable overlap between OSRI and ICCOPR research priorities that can lead to partnerships with the various agencies involved.

OSRI is willing to consider a variety of roles in partnerships, from serving as a contributing member to leading the development of new programs. We recognize that flexibility in funding allows OSRI to contribute to programs that may need a small amount of funding support to produce a quality product. At the same time, OSRI will provide the leadership necessary to ensure significant gains are made in our ecological understanding of and our capability to respond to oil spills.

E. Other Programs:

These programs provide oversight for achieving the goals listed earlier. It includes the Research Program Manager position and funding for the Scientific and Technical Committee meetings.

1. Research Program Manager

As described in section II.E.3, the Research Program Manager (RPM) plans research
programs, prepares annual work plans in consultation with the Work Plan Committee and the Advisory Board, works with OSRI Executive Director on fiduciary issues, and implements the work plan as approved by the Advisory Board. The RPM also coordinates proposal reviews, works with the Scientific and Technical Committee on future research direction, proposal selections and recommendations to the Advisory Board, and ensures compliance with all policies and procedures of the Grant Policy Manual. Specific tasks are described below.

• Preparation of annual work plan in consultation with the board-appointed work plan committee and in accordance with the five-year research plan. 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.

• Develop white papers describing the state of knowledge on subjects OSRI is considering funding.

• 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. 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 ED 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.

• Prepare and publish an annual report for broad distribution.

• Supervise maintenance of the OSRI website.

• Develop web materials describing our knowledge related to oil spills and their effects.

• Collaborate with the OSRI ED to develop and maintain cooperative agreements with other organizations for research and education programs, for example with the Exxon Valdez Oil Spill Trustee Council, the two Regional Citizens’ Advisory
Councils, 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 Bureau of Safety and Environmental Enforcement, and the Joint Industry Program.

- Periodically represent OSRI at professional meetings and workshops.
- Maintain files and a library on oil pollution issues.
- Provide leadership in planning future research programs and work plans.
- Prepare technical reports on OSRI programs.

2. Scientific and Technical Committee

This program provides funding to support the functions of the OSRI STC, and to support board and STC travel-related expenses associated with OSRI partnerships such as the JIP, NPRB, etc. The STC generally will meet twice a year: once to evaluate proposals and help provide direction for the next year and the second time to develop a work plan for the following year.

E. Timeline and Budget:

The exact amount of funding available each year depends on current interest rates and the amount of principal dedicated to OSRI. Past annual deposits have ranged from $225K to $1,210K. It is anticipated that deposits will be in the $700K to $900K range during this five-year period. To account for the changes in annual funding, the programs to be funded each year are determined by the STC and the work plan committee of the Advisory Board.

The process for developing the annual work plan is as follows: The RPM will meet with the STC in the spring to discuss upcoming partnership opportunities and prioritization of projects within the research plan. From that meeting, the RPM develops a draft work plan. A work plan committee that includes members of the Advisory Board and STC then meets in early summer to review and revise the draft work plan. The revised draft is then presented to the full Advisory Board in September or October for approval.

Once the work plan is approved, then requests for proposals will be developed and released as appropriate. In some cases, partners will release the requests for proposals and OSRI will contribute funding to the program selected by the partner.