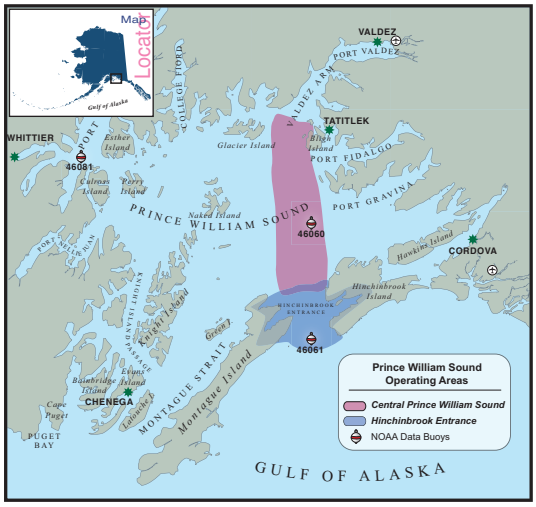
Regional Citizens' Advisory Council

Estimating the Response Gap for Two Operating Areas in Prince William Sound, Alaska

INTRODUCTION

Technological advancements in mechanical and non-mechanical oil spill response systems have contributed to more-proficient oil spill response operations. Yet, there are still times, referred to here as the "Response Gap" when environmental conditions may allow oil transportation or production but preclude effective spill response operations. The Prince William Sound Regional Citizens' Advisory Council commissioned studies to estimate the response gap in two areas of Prince William Sound, Alaska for mechanical and non-mechanical response operations.



METHODS

1. Establishing Operating Areas and Assembling Environmental Factors Datasets

Data from the National Data Buoy Center's Buoys 46060 (West Orca Bay) and 46061 (Seal Rocks) gave readily-available observations for wind speed, wave height, wave period, and temperature in Central Prince William Sound and at Hinchinbrook Entrance. Because reliable data on other aspects of visibility (such as rain or fog) was not available, twilight tables were used as the best available measure of visibility. Currents and ice were not considered because: (a) only ocean currents are likely to be encountered by the open-water response systems operating in PWS and there is no way to measure local currents such as tide rips, and (b) ice is not a common phenomenon in the selected operating areas.

A single dataset was assembled by aligning the hourly observations from the Central PWS data buoy with concurrent observations from the Hinchinbrook Entrance data buoy. Upon omitting data gaps, a dataset was generated containing about 42,000 concurrent observations for Central PWS and Hinchinbrook Entrance from 2000 through 2005.

2. Establishing and Applying Operational Limits

Operational limits were based on best professional judgment as informed by a thorough review of published literature on oil spill response, existing contingency plans, regulatory standards, and available oil spill response drill/exercise/spill after-action reports. Response limits were defined by establishing the following three categories within the continuum of each environmental factor: **Green (response operations possible)**, **Yellow (response operations possible but effectiveness impaired)**, **Red (response operations not possible or effective)**.

3. Establishing and Applying Operational Limits

Interactions between environmental factors have a big effect on response operating limits. These interactions were accounted for by developing a simple set of rules to calculate a Response Gap Index (RGI) for each observational period. The tabulation of the Red RGI results in a reasonable estimate of the Response Gap.

The RGI was computed as follows:

- **If any environmental factor is ruled Red, then RGI = Red**
- **If all environmental factors are ruled Green, then RGI = Green**
- **If only one environmental factor is ruled Yellow and the remainder are ruled Green, then RGI = Green**
- **If two or more environmental factors are ruled Yellow, then RGI = Red**

4. Establishing and Calculating a Response Gap Index

Once assembled, the dataset was analyzed statistically to provide insights into the various environmental conditions found in the two operating areas. The following results were generated:

- Histograms and cumulative-distribution plots of significant wave height, wind speed, wind direction, wind gusts, and air temperature.
- Joint-probability-distribution plots of wave height and modal wave period: annual, winter, and summer.
- Daylight curves, based on the civil-twilight data.

RESULTS RESULTS RESULTS RESULTS RESULTS

Data results were first reviewed by environmental factor for each operating area.

Central Prince William Sound

Table 1. Comparison of estimated response gap in the Central Sound by environmental factor: green (response not impaired).

Environmental Factor	Mechanical	Dispersants	In-situ Burning
Wind (knots)	91.9%	35.5%	76.8%
Sea State (feet)	84.7%	42.2%	79.2%
Temperature (ºF)	99.7%	100.0%	99.7%
Visibility (nautical miles)	62.5%	62.5%	62.5%

Table 2. Comparison of estimated response gap in the Central Sound by environmental factor: yellow (response impaired).

Environmental Factor	Mechanical	Dispersants	In-situ Burning
Wind (knots)	7.8%	30.5%	12.6%
Sea State (feet)	13.7%	36.7%	18.4%
Temperature (ºF)	0.3%	0.0%	0.3%
Visibility (nautical miles)	37.5%	0.0%	0.0%

Table 3. Comparison of estimated response gap in the Central Sound by environmental factor: red (response not possible/effective).

Environmental Factor	Mechanical	Dispersants	In-situ Burning
Wind (knots)	1.0%	34.0%	10.6%
Sea State (feet)	1.6%	21.0%	2.4%
Temperature (ºF)	0.0%	0.0%	0.0%
Visibility (nautical miles)	0.0%	37.5%	37.5%

Hinchinbrook Entrance

Table 4. Comparison of estimated response gap at Hinchinbrook Entrance by environmental factor: green (response not impaired).

Environmental Factor	Mechanical	Dispersants	In-situ Burning
Wind (knots)	83.6%	41.2%	66.1%
Sea State (feet)	46.2%	81.0%	33.0%
Temperature (ºF)	99.5%	100.0%	99.5%
Visibility (nautical miles)	62.5%	62.5%	62.5%

Table 5. Comparison of estimated response gap at Hinchinbrook Entrance by environmental factor: yellow (response impaired).

Environmental Factor	Mechanical	Dispersants	In-situ Burning
Wind (knots)	13.5%	31.0%	15.1%
Sea State (feet)	34.6%	12.0%	39.0%
Temperature (ºF)	0.5%	0.0%	0.5%
Visibility (nautical miles)	37.5%	0.0%	0.0%

Table 6. Comparison of estimated response gap at Hinchinbrook Entrance by environmental factor: red (response not possible/effective).

Environmental Factor	Mechanical	Dispersants	In-situ Burning
Wind (knots)	2.9%	27.7%	18.8%
Sea State (feet)	19.2%	7.0%	28.0%
Temperature (ºF)	0.0%	0.0%	0.0%
Visibility (nautical miles)	0.0%	37.5%	37.5%

Finally, the RGI was used to incorporate consideration of the combined effects of the different environmental factors, resulting in an estimation of the amount of time in each season that a mechanical, in-situ burning, or dispersant response would likely be effective or ineffective based on the factors incorporated in these studies.

Table 7. RGI for each technology and all technologies combined for the Central Sound.

Season		Mechanical	Dispersants	In-situ Burning	All Technologies
Entire Year	Green	87.4%	25.1%	55.0%	90.3%
	Red	12.6%	74.9%	45.0%	9.7%
Summer	Green	95.8%	23.9%	75.2%	97.7%
	Red	4.2%	76.1%	24.8%	2.3%
Winter	Green	76.9%	26.7%	30.0%	81.2%
	Red	23.1%	73.3%	70.0%	18.8%

Table 8. RGI for each technology and all technologies combined for the Hinchinbrook Entrance.

Season		Mechanical	Dispersants	In-situ Burning	All Technologies
Entire Year	Green	62.6	38.4	42.1	69.9
	Red	37.7	61.6	57.9	30.1
Summer	Green	84.4	43.5	64.7	90.2
	Red	15.6	54.7	35.3	9.8
Winter	Green	35.4	29.7	14.1	44.8
	Red	65.4	70.3	85.9	55.2

The results of this study are not intended to be used to determine that any response tactic should be executed or would necessarily be successful or effective. For more information, including a detailed explanation of the methodology, data, and results, please see: ***http://www.pwsrcac.org/projects/osprops/gap.html.***