Washington State Department of Ecology

Spill Prevention, Preparedness and Response Program

Chapter 173-182 WAC
Oil Spill Contingency Plan Rules

Final Cost Benefit Analysis for Oil Spill Contingency Planning

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FINAL COST BENEFIT ANALYSIS FOR THE OIL SPILL CONTINGENCY PLAN RULES

CHAPTER 173-182 WAC

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Executive Summary

Ecology is adopting a new Washington Administrative Code (WAC) regulatory chapter 173-182 which revises and consolidates two existing chapters of rules: Chapters 317-10 (vessel plans) and 173-181 WAC (facility plans). The existing rules were adopted in 1991 and 1993 respectively, pursuant to state law (Chapters 88.46 and 90.56 of the Revised Code of Washington).

The following factors were taken into consideration when drafting the adopted rules:

Technical Expertise: The technical expertise and administrative experience the Department of Ecology (Ecology) has gained during 15 years of implementing existing contingency plan rules. These include – "lessons learned" from spill responses of various sizes, participation and evaluation of hundreds of oil spill drills, technical studies, international literature reviews, extensive feedback from plan holders, resource managers and other stakeholders, administration of the contingency plan and contractor review and approval process, and other factors. In addition, Ecology has considered the specific goals and objectives set by the Washington state legislature, as well as the unique and peculiar aspects of Washington's waters and economy that warrant a higher level of protection against the effects of oil spills than that provided by uniform national federal standards.

Guidance to Rule: During the first rule development process which took place in the early 1990's, representatives from industry recommended that the rules be adopted without incorporating specific spill response planning, performance or drill standards. As a result of this input, the state adopted and applied these requirements through guidance documents instead. Ecology has determined that its existing guidance should be formally incorporated into its rules and has achieved this in the new draft rules.

Cost Benefit Analysis: Findings from this Cost Benefit Analysis (CBA) regarding the probable quantitative and qualitative costs and benefits of the draft rules.

Overview of Costs and Benefits Analysis

In preparing this CBA, Ecology evaluated the probable qualitative and quantitative costs and benefits that would accrue through implementation of the rules, as well as the specific directives of the Washington State statutes that these rules implement. Based upon the probable quantitative and qualitative benefits described within this report, Ecology has determined that the total probable benefits of the adopted rules that accrue to society as a whole outweigh the probable costs of implementation.

Small Business Economic Impact Statement

A Small Business Economic Impact Statement has been prepared. The adopted chapter of rules as adopted has a disproportionate impacts on small businesses.

Ecology has incorporated the following provisions into the draft rules to reduce the compliance burden on small businesses: longer compliance phase-in periods, a process to request alternative (equivalent) compliance to recognize the specific operations of a small business, encouragement for umbrella planning (single plan submission covering multiple vessels or facilities) that allows costs to be shared and several mechanisms to share the costs of the required drills.

Least Burden Analysis

The adopted rules incorporate some cost reducing features while providing the minimum requirements to improve response to a "worst case spill" as required by law, including use of a single plan to meet both the federal and state contingency planning requirements, and allowing plan holders to reference the information, tools and policies found in the Northwest Area Contingency Plan, rather than repeating the information in each individual plan. For further discussion, refer to section 6.0 of this report.

1.0 Introduction

In this chapter:

1.1 Background
1.2 Oil Spill Management
1.3 Oil Spill History
1.4 Specific Directives of the Statute

1.1 Background

The Legislature directed Ecology to establish a comprehensive regulatory program that protects our natural, cultural, and economic resources from the damages of oil spills. A new regulatory chapter (173-182 WAC) is adopted which revises and consolidates two existing chapters of rules: Chapters 317-10 (vessel plans) and 173-181 WAC (facility plans). The existing chapters of rules have been in place since the early 1990s. This is the first time they have been adopted.

1.1.1 Administrative Procedure Act (APA)

State law (RCW 34.05.328), requires that prior to adopting a rule, agencies in Washington State must:

> *"…(c) determine that probable benefits of the rule are greater than its probable costs taking into account both qualitative and quantitative benefits and costs and the specific directives of the statute being implemented."*

This cost benefit analysis contains:

- Background information on oil spill risk and spill response;
- An economic analysis of the probable costs and benefits of the adopted Contingency Planning rules (Chapter 173-182 WAC);
- A Least Burdensome Alternative Analysis (see RCW 34.050.328(1) (e)).

1.2 Oil Spill Risk Management

It is estimated that over 20 billion gallons of oil and hazardous chemicals are transported through Washington State each year, by ship, barge, pipeline, rail, and trucks. Washington's waters support some of the most productive and valuable ecosystems in the world, and spills on land or water can threaten public health, safety, the environment, tribal cultural values and the economy. Equipment failure, human error, poor training and lack of thorough planning to minimize the impacts of spills can lead to unintended and potentially enormous consequences. Even small oil leaks, drips and spills lead to cumulative impacts that degrade our ecosystems by a "thousand cuts."

The mission of the Spills program is to protect Washington's environment and public health and safety through a comprehensive spill prevention, preparedness and response program. Through preparedness, we focus on protecting Washington waters by maintaining a continual state of readiness in case of large and small oil spills. Operators of larger commercial vessels and oil handling facilities are required to develop and use state approved oil spill contingency plans. These plans help to assure that when oil spills occur, the responsible party is able to rapidly mount an immediate, effective response.

1.3 Oil Spill History

The acute and long term impact of oil spills on an ecosystem will vary by the oil type and degree of oiling, timing and location of spill, length of exposure and the timing and effectiveness of the response. The same can be said for the cost of cleaning up a spill. Response costs can vary widely, although the lack of pre-spill data makes any post-spill cost analysis complex. At the height of the response to the Exxon Valdez spill, more than 11,000 personnel, 1,400 vessels, and 85 aircraft were involved in the cleanup. Trajectory computer models and historical experience informs us of what such a spill in Puget Sound, off the Washington coast or on the Columbia River might entail.

Examples of worst case planning in Washington:

Facilities *range in volume from 50 barrels for a smaller fuel transfer site to more than 655,000 barrels for a Puget Sound refinery.*

Typical tank and non-tank vessels *range from 5000 barrels to more than 900,000 barrels.*
One barrel roughly equals 42 gallons.

The majority of areas within Puget Sound are not subject to large scale flushing, and oil tends to remain in the environment and quickly begin to impact shorelines. Washington has the largest commercial shellfish production in the nation. Intertidal oysters, clams, and mussels are easily contaminated by oil spills. Spills on the river system tend to flush down stream and either move out of the river or strand on shorelines near back eddies of the river. Tidal and river flow influences can cause re-floating and re-oiling above the high tide area. In addition, oil that strands on the shoreline is often driven into the sediment and continues to be toxic for some time. Short winter days and wet weather create working conditions with limited visibility. Some of the largest spills in Washington's history have occurred off the Washington coast and predominant coastal currents have pushed impacts to both Canada and the Oregon coast. Spills on the coast prove to be a great logistical challenge due to shoreline access and the volatile ocean conditions. It is not an underestimate to believe that the same level of resources needed for the Valdez spill in Alaska would be needed here as well.

The need to respond as soon as possible, with trained operators and systems of equipment that are enhanced for maximum effectiveness, is critical to increase the opportunity for on-water recovery and reduce shoreline oiling. The adopted contingency plan rules set standards that emphasize those effective, early response actions. In addition, the adopted rules speak to tracking oil spills in low light or darkness conditions, and aerial support to help guide skimming systems into the thickest concentrations of oil. The adopted rules require trained people, practice drills and systemized inspections of the equipment and maintenance practices. This ensures that the equipment will work and that operators have planned how to put these complex recovery systems together under a variety of potential spill scenarios. Drills allow all of the participants in an incident command system to practice working together in advance of an emergency. All of these things provide for a qualitative benefit to be gained by the citizens of the state. We are better prepared, with the correct equipment, and partnerships forged ahead of time. The response communities can more rapidly and effectively clean up oil, minimize impacts and protect the economy and unique environments of Washington State.

1.4 Specific Directives of the Statute

The legislature (see RCW 90.48.010) has declared that it is the public policy of the state of Washington "to maintain the highest possible standards to insure the purity of all waters of the state consistent with public health and public enjoyment thereof, the propagation and protection of wild life, birds, game, fish and other aquatic life, and the industrial development of the state, and to that end require the use of all known available and reasonable methods by industries and others to prevent and control the pollution of the waters of the state of Washington. Consistent with this policy, the state of Washington will exercise its powers, as fully and as effectively as possible, to retain and secure high quality for all waters of the state."

In RCW 90.56.005, the legislature declares further that "water borne transportation as a source of supply for oil and hazardous substances poses special concern for the state of Washington." Additionally, the legislature found "that prevention is the best method to protect the unique and special marine environments in this state…the technology for containing and cleaning up a spill of oil or hazardous substances is at best only partially effective.. and preventing spills is more protective of the environment and more cost-effective when all the response and damage costs associated with responding to a spill are considered. Therefore, the legislature finds that the primary objective of the state is to achieve a zero spills strategy to prevent any oil or hazardous substances from entering waters of the state."

(3) The legislature also finds that…

> *(b) Even with the best efforts, it is nearly impossible to remove all oil that is spilled into the water, and average removal rates are only fourteen percent;*
> *(c) Washington's navigable waters are treasured environmental and economic resources that the state cannot afford to place at undue risk from an oil spill;*
> *(d) The state has a fundamental responsibility, as the trustee of the state's natural resources and the protector of public health and the environment to prevent the spill of oil; and*
> *(e) In section 5002 of the federal oil pollution act of 1990, the United States congress found that many people believed that complacency on the part of industry and government was one of the contributing factors to the Exxon Valdez*

spill and, further, that one method to combat this complacency is to involve local citizens in the monitoring and oversight of oil spill plans. Congress also found that a mechanism should be established that fosters the long-term partnership of industry, government, and local communities in overseeing compliance with environmental concerns in the operation of crude oil terminals. Moreover, congress concluded that, in addition to Alaska, a program of citizen monitoring and oversight should be established in other major crude oil terminals in the United States because recent oil spills indicate that the safe transportation of oil is a national problem.

(4) In order to establish a comprehensive prevention and response program to protect Washington's waters and natural resources from spills of oil, it is the purpose of this chapter…

(f) To provide broad powers of regulation to the department of ecology relating to spill prevention and response.

Authority to promulgate contingency plan rules is contained in chapters 88.46 RCW (vessels) and 90.56 RCW (facilities). RCW 90.56.040 grants authority to the department which is supplemental to and in no way reduces or otherwise modifies the powers granted to the department by other statutes. In carrying out the purposes of the statutes in the adoption of rules for contingency plans, Ecology is required to, the greatest extent practicable, implement this chapter in a manner consistent with federal law. *See* RCW 90.56.070 and 88.46.020.

Onshore and offshore facilities and covered vessels are required to have a contingency plan for the containment and cleanup of oil spills and for the protection of fisheries and wildlife, shellfish beds, natural resources, and public and private property from such spills. The department is mandated ("shall") to adopt and periodically revise standards for the preparation of contingency plans.

And RCW 88.46.060 states:

"… (1) Each covered vessel shall have a contingency plan for the containment and cleanup of oil spills from the covered vessel into the waters of the state and for the protection of fisheries and wildlife, shellfish beds, natural resources, and public and private property from such spills. The department shall by rule adopt and periodically revise standards for the preparation of contingency plans…(b) Be designed to be capable in terms of personnel, materials, and equipment, of promptly and properly, to the maximum extent practicable, as defined by the department, removing oil and minimizing any damage to the environment resulting from a worst case spill..."

Similarly, RCW 90.56.210 states:

"…(1) Each onshore and offshore facility shall have a contingency plan for the containment and cleanup of oil spills from the facility into the waters of the state and for the protection of fisheries and wildlife, shellfish beds, natural resources, and public and private property from such spills. The department shall by rule adopt and

periodically revise standards for the preparation of contingency plans…(b) Be designed to be capable in terms of personnel, materials, and equipment, of promptly and properly, to the maximum extent practicable, as defined by the department removing oil and minimizing any damage to the environment resulting from a worst case spill…"

RCW 90.48.010

The legislature has declared "the public policy of the state of Washington [is] to maintain the highest possible standards to insure the purity of all waters of the state consistent with public health and public enjoyment thereof, the propagation and protection of wild life, birds, game, fish and other aquatic life, and the industrial development of the state, and to that end require the use of all known available and reasonable methods by industries and others to prevent and control the pollution of the waters of the state of Washington. Consistent with this policy, the state of Washington will exercise its powers, as fully and as effectively as possible, to retain and secure high quality for all waters of the state."

In addition, the 2004 Washington State Legislature (see RCW 90.56005 (2), Laws of 2004, ch. 226, § 1(1)) adopted a "zero spill goal" finding that:

"…*the primary objective of the state is to achieve a zero spills strategy to prevent any oil or hazardous substances from entering waters of the state."*

The adopted rules help achieve this goal by improving plan holder awareness of the costs of spills, leading to investment in spill prevention and response, as well as by increasing the rapidity with which oil is removed from the environment immediately after significant spills and reducing long term contamination.

Over the last decades, the occurrence of major oil spills in Washington has been reduced; yet, small to moderate sized oil spills are a continuing reality. And while they are infrequent, we can expect that major oil spills have and will continue to occur in Washington waters. Therefore the legislature determined that the level of regulation for oil spill contingency plans requires planning to remove oil and minimizing damage from a possible *worst case* spill.

2.0 Methodology Used in this Cost Benefit Analysis

In this chapter:

2.1 Data Collections

Ecology reviewed the existing economic literature on the costs imposed by oil spills in order to estimate the benefits of cost reductions through improved, efficient on-water cleanup. The selected literature is listed in the Reference section. In addition Ecology contracted out oil spill trajectory, fate and effect studies of oil spills in Washington, examined their cleanup, the socioeconomic costs associated with spills, the effects of additional equipment and trained responders, and the net change potentially created by this rule development. Finally Ecology conducted a cost survey of regulated businesses to estimate the cost impact of the rule amendment. These results are provided in the cost sections of this report and in the SBEIS.

2.1.1 Modeling

Ecology used modeling to simulate natural world spill oil spill scenarios to examine the impact from various size spills under a variety of environmental conditions. The modeling compared spill scenarios in various geographic locations with different response options:

1. No response;
2. Federal level cleanup;
3. State level cleanup;
4. 3rd response option with more equipment and trained responders;
5. In-situ burn and application of dispersants.

The model used data on varying environmental conditions, oil distribution over time (trajectory), habitat data, and oceanographic information to simulate possible impacts during an oil spill. The trajectory, oil removal, and shoreline impact results from modeling were then used to estimate socioeconomic costs. For further discussion, refer to www.ecy.wa.gov/programs/spills/spills.html.

2.1.2 Cost Survey

In December 2003, Ecology conducted a survey of facility and vessel plan holders and state approved response contractors (PRCs). Ecology designed the survey jointly with input from twelve facility or vessel companies and PRCs. The survey was designed to sort through the cost of current activities being done under both the state rule and long-standing guidance, and federal regulations in effect during 2003. This input group was used to assure that the survey considered all the applicable costs and that the wording was clear for the likely respondents. The phrasing of the questions was designed to allow Ecology to estimate unit costs so that as the rule changed, one could extrapolate the cost impact.

The responses came in between December of 2003 and April of 2004. Ecology received data from 13 of 25 regulated facilities, 5 of the 13 PRCs, and 8 of the 13 vessel companies. There may be some bias in the data in that more of the responses came from large companies with more than 50 employees in the state of Washington. However, the returned instruments covered only half of the entities, but most of the economic activity. (A copy of the blank survey instruments can be found at the www.ecy.wa.gov/programs/spills/spills.html)

2.2 Contingent Valuation Method

The contingent valuation method (CVM) is used to estimate economic values for all kinds of ecosystem and environmental services. It can be used to estimate both *use* and *passive use values*, and it is the most widely used method for estimating passive-use values. It may also be one of the most controversial of the non-market valuation methods.

The contingent valuation method involves directly asking people in a survey how much they would be willing to pay for specific environmental services. In some cases, people are asked for the amount of compensation they would be willing to accept to give up specific environmental services. It is called "contingent" valuation, because people are asked to state their willingness to pay, *contingent* on a specific hypothetical scenario and description of the environmental service.

The contingent valuation method is referred to as a "stated preference" method, because it asks people to directly state their values, rather than inferring values from actual choices, as the "revealed preference" methods do. The fact that CVM is based on what people say they would do, as opposed to what people are observed to do, is the source of both its greatest strengths and its greatest weaknesses.

Contingent valuation is one of the only ways to assign dollar values to passive-use values of the environment—values that do not involve market purchases and may not involve direct participation. They include everything from the basic life support functions associated with ecosystem health or biodiversity, to the enjoyment of a scenic vista or a wilderness experience, to appreciating the option to fish or bird watch in the future, or the right to *bequest* those options to your grandchildren. It also includes the value people place on simply knowing that giant pandas or whales exist.

It is clear that people are willing to pay for passive use, environmental benefits. However, these benefits are likely to be implicitly treated as zero unless their dollar value is somehow estimated. So, how much are they worth? Since people do not reveal their willingness to pay for them through their purchases or by their behavior, the only option for estimating a value is by asking them questions.

Passive-use values:
Reflect value that people assign to aspects of natural environment that they care about but do not use in a commercial, recreational, or other manner.

Use value:
Value derived from actual use of a good or service. Uses may include indirect uses. For example, enjoying a television show about whales provides an indirect use value for the whales.

Bequest Value:
The value that people place on knowing that future generation will have the option to enjoy something.

3.0 Summary of Benefits

In this chapter:

3.1 Quantitative Analysis

The benefits of preparedness and thorough, measurable contingency planning are many fold. Careful planning leads to the ability to respond to a spill more rapidly, effectively and with appropriate resources that are well maintained. Damages from spills are minimized when responsible parties are trained and organized to respond. Preparedness also drives better awareness of spill risks and leads to more investments in prevention. Rapid response and cleanup has two effects. First, the immediate cost of on-water cleanup rises because of the broader pre-staging of equipment and people. Second, the rapid response removes more oil on the water, which reduces the costs of shoreline cleanup, socio-economic damages, penalties, and long term natural resource damages.

The following section uses the modeling method to calculate the probable benefits of the adopted rules.

3.1.1 Society's Willingness to Pay

Oil spills are unacceptable to citizens. After the 1989 *Exxon Valdez* oil spill, comprehensive prevention and response laws were passed at the national and the state level. These laws targeted prevention and cleanup of spills and imposed liability for response and damages on the responsible parties ("spiller pays"). These included the Oil Pollution Control Act and the Washington state laws. [1] The public's engagement on this issue is an indication of their *willingness to pay* to avoid oil spills and willingness to pay to clean up after a spill. It is this value that Ecology has attempted to estimate in this report.

Ecology determined that people placed the same value for an increase of 3% to 9% improvement in on-water cleanup as they would for 100% prevention of oil spill for 10 years worth of oil spill.

The formula must first net out the share of spill reduction attributable to the transfer rules. The formula is:

Value for 10 years = Average % Removal X Value for 100% removal X Number of Households

This generates a value that can be counted twice. Once for the first 10 years and again, but discounted, for the second 10 years. The total probable value is $16.5 million.

3.1.2 Benefits of Reduced Natural Resource Damages

In the United States, natural resource trustees determine whether damage to public trust resources from oil spills has occurred and assess commensurate damage costs to the spiller. Damages to natural resources are evaluated by identifying the functions or 'services' provided by the resources, determining the baseline level of the services provided by the injured resource(s), and quantifying the reduction in service levels as a result of the contamination. Then the dollar value of damages is assessed based on the cost of restoring injured resources to their baseline condition, compensation for the interim loss of injured resources pending recovery, and the reasonable cost of a damage assessment. Trustees quantify injuries and identify possible restoration projects. Economic and scientific studies assess the injuries to natural resources and the loss of services. These studies are also used to develop a restoration plan that outlines alternative approaches to speed the recovery of injured resources and compensate for their loss or impairment from the time of injury to recover.

If we can reduce the amount of initial damage to the resources then we can reduce the ultimate damage assessment. Early response will likely reduce damage assessments for some areas of impact as the oil is removed prior to a wider spread impact. For further discussion of data, **see Appendix 2: Review of Natural Resource Damage.**

3.1.3 The Benefit of Improved On-Water Removal

One expected gain from the adopted rules is an increase in on-water recovery before the oil impacts the shore. This is due to regulatory requirements for planning standards, equipment maintenance, drills and standards for efficient use of recovery systems. In the modeling scenarios, ranges between 0% and 19% more of a large spill were simulated to be removed using the state and 3rd higher alternatives.

[1] RCW 90.56.010 Definitions. RCW 90.56.210 Contingency plans. RCW 88.46.010 Definitions. RCW 88.46.060 Contingency plans. RCW 90.56.060 Statewide master oil and hazardous substance spill prevention and contingency plan--Evaluation and revision or elimination of advisory committees.

Table 5.1

Percentage of Oil Removed	State minus Federal	Dispersants Minus State Removal	In-Situ Burn Minus State Removal	3rd Option minus Federal
Min	-6.0%	-6.0%	-15.0%	-13.0%
Max	19.0%	0.0%	6.0%	10.0%
Mean	3.2%	-3.8%	-1.0%	2.1%

Table 5.1 Modeled removal of oil spills on the water

This gain in on water oil recovery comes from an expectation that more rapid, efficient deployment will improve removal. On-water recovery is more effective before the oil spreads, becomes entrained in a water column or turns into mousse. The rapid response impact has been modeled for a worst case spill.

Most of this research was done for 25,000 to 65,000 barrel spills. However, in the Phase II: Draft Report Volume I: Model Description, Approach, and Analysis February 2006 [2] simulated spill size was varied with some worst damage runs, which modeled a change in the amount of oil spilled from 25,000 barrels to 250,000 barrels. The equipment and planning needed for a worst case spill will also help with smaller spills. The modeling effort produced few results for this. **Table 5.2** displays the results from scenarios where it was possible to compare spill response by size of spill.

For large spills, the sheer magnitude of the spill overwhelms the required equipment and responders, and the percentage gain in oil removal drops. The most comparable scenarios summarized in the table below are for the Juan de Fuca 250,000 barrel crude and the 25,000 barrel bunker spills. The reader can note that with the larger spill, almost twice as much oil is removed, but the percentage share removed is reduced from 9.1% to 2.1% with the adopted state requirements. It can not be shown whether the implication of these two data points would magnify for much smaller spills. The results are similar for adding the adopted state requirements to the federal program and for adding the Option 3 requirements to the state requirements.

[2] Most of the data for this section was taken from worst case spill scenarios for 65,000 and 25,000 barrel spills. Evaluation of the Consequences of Various Response Options, Using Modeling of Fate, Effects and NRDA costs for Oil Spills into Washington Waters, Deborah French-McCay, Jill Rowe, Nicole Whittier, Subbayya Sankaranarayanan and Claudia Suàrez, Applied Science Associates, Inc. Dagmar Schmidt Etkin, Environmental Research Consulting, 2005, 2006

Table 5.2

Table 5.2: Percent of Hydrocarbon Mechanical Removal, Various Spills by Size and Type

Scenario	Average HC mechanical removal change for worst damage spills	Average HC mechanical removal change for 50 percentile spills
Outer Coast – Crude 250,000		
Duntz Rock		
Fed to WA	1.7%	
WA to Opt. 3	.6%	
Juan de Fuca – Bunker 25,000		
Fed to WA	9.1%	
WA to Opt. 3	8.8%	
Juan de Fuca – Deisel 65,000		
Fed to WA	3.6%	
WA to Opt. 3	2.9%	
Juan de Fuca – Crude 250,000		
Fed to WA	2.1%	
WA to Opt. 3	1.9%	
Juan de Fuca – Crude 250,000		
Fed to WA		2.1%
WA to Opt. 3		1.6%
Lower Columbia – Bunker C 25,000		
Fed to WA	1.9%	
WA to Opt. 3	3.4%	
Upper Columbia – Bunker C 25,000		
Fed to WA	1.4%	
WA to Opt. 3	3.0%	
Outer Coast Sea Lanes – Bunker C 150,000		
Fed to WA	4.1%	
WA to Opt. 3	0.3%	
Grays Harbor – Bunker C 250,000		
Fed to WA	8.4%	
WA to Opt. 3	9.0%	

The data from these studies has helped frame our determination, though there are some limitations that must be presented. This mathematical model does not fully simulate natural world processes. In other words, models can not fully replicate natural world conditions or results because of the inherent assumptions that are built into models and the unpredictability of the Earth's natural processes. In some of the modeled scenarios, the 50th percentile spill, which is based on shoreline impact, is not always the same one for each equipment level within each scenario. Thus for comparison purposes, one is comparing results for different spills. This creates several issues:

- This may be the reason that adding equipment, responders, and dispersants or in-situ-burning generates negative effects for the percent of oil removed for some scenarios. Ecology does not believe these negative values would be seen in a real response. However, the effect can also work in the opposite direction for some scenarios. Therefore Ecology is averaging the gains and losses across the scenarios.
- This averaging does not necessarily help when evaluating the addition of dispersants and in-situ-burns. The in-situ-burns and dispersants will reduce the overall total cost of spill response and should increase the removal of oil on water. These alternatives are treated as an addition to the state program for this analysis and therefore the averages themselves are also negative.
- These 50th percentile choices were based on extent of shoreline oiling. The reductions in shoreline oiling are greater than the reductions in on-water cleanup. If the shores are less oiled, then it is not likely that the alternatives actually reduce on-water removal. Some of the shoreline shift can be due to greater deployment of shoreline protection, but not all of it. Again, Ecology questions these negative values in a real world spill and must consider this caution when making this analysis.
- Finally, it is unlikely that the estimated share of on-water removal that is attributed to federal requirements in the models is realistic. The existing guidance standards being incorporated into these adopted rules generate over 25% of the recovery equipment currently in use. Given a 65,000 barrel spill, it is unlikely that this much equipment is simply redundant. Further the speed of deployment (early response action) is increased, making the equipment more effective in the first crucial hours before oil spreads and recovery efficiency decreases.[3] It is unlikely that this contributes only 3% to the current levels of cleanup.

Dispersant: means those chemical agents that emulsify, disperse, or solubilize oil into the water column or promote the surface spreading of oil slicks to facilitate dispersal of the oil into the water column.

In situ burn: means a spill response tactic involving controlled on-site burning, with the aid of a specially designed fire containment boom and igniters.

Once the estimated removal of oil spilled is complete for a 20 year set of spills, the estimate can be used to determine how much the damages have been reduced.

[3] The data for this section of the document draws heavily Response Cost Modeling for Washington State Oil Spill Scenarios Supplemental Information, Applied Science Associates, Inc. Dagmar Schmidt Etkin, Environmental Research Consulting, 2005, 2006.

Table 5.3

Table 5.3: Percentage Change in Hydrocarbon Removal for Scenarios by the following Contingency Planning Shifts: Federal to State Requirements, State Requirements to State plus dispersants, State Requirements to State plus In Situ Burning, and State Requirements to 3rd Option.

Percent of spilled hydrocarbon mass mechanically removed and/or burned (%)

	Run Result		Change in 50th Percentile Run Based on Shore Costs				Change in Mean			
Scenario	50th Run Based on Shore Costs	Mean	State Minus Federal Removal	Dispersants Minus State Removal	ISB Minus State Removal	3rd Option Minus State Removal	State Minus Federal Removal	Dispersants Minus State Removal	ISB Minus State Removal	3rd Option Minus St. Removal
OC-Crud-N	-	-								
OC-Crud-R-ST-base	65	65	1%				19%			
OC-Crud-R-Fed	64	46								
OC-Crud-R-3	67	52				2%				-13%
OC-Crud-R-ISB	66	50			1%				-15%	
OC-Crud-C-ST-base	59	59		6%				-6%		
OC-Crud-C-Fed	57	43								
OC-Crud-C-3	59	48				0%				-11%
S1-Bunk-N	-	-								
S1-Bunk-R-ST	88	85	1%				-2%			
S1-Bunk-R-Fed	87	87								
S1-Bunk-R-3	93	91				5%				6%
S1-Bunk-R-ISB	88	91			0%				6%	
S1-Dies-N	-	-								
S1-Dies-R-ST	71	48	9%				1%			
S1-Dies-R-Fed	62	47								
S1-Dies-R-3	76	58				5%				10%
S2-Crud-N	-	-								
S2-Crud-R-ST	68	67	3%				2%			
S2-Crud-R-Fed	65	65								
S2-Crud-R-3	67	72				-1%				5%
S2-Crud-R-ISB	69	68			1%				1%	
S2-Crud-C-ST-base	66	64		-2%				-3%		
S2-Crud-C-Fed	64	58								
S2-Crud-C-3	67	66				1%				2%
SI-Crud-N	-	-								
SI-Crud-R-ST	67	68	2%				6%			
SI-Crud-R-Fed	65	62								
SI-Crud-R-3	70	70				3%				2%
SI-Crud-C-ST-base	67	66		0%				-2%		
SI-Crud-C-Fed	65	60								
SI-Crud-C-3	70	71				3%				5%
IS-Crud-N	-	-								
IS-Crud-R-ST	72	69	5%				5%			
IS-Crud-R-Fed	67	64								
IS-Crud-R-3	76	72				4%				3%
IS-Crud-C-St-base	66	64		-6%				-5%		
IS-Crud-C-Fed	61	56								
IS-Crud-C-3	70	68				4%				4%
C1-Bunk-N	-	-								
C1-Bunk-R-ST	82	76	4%				1%			
C1-Bunk-R-Fed	78	75								
C1-Bunk-R-3	82	80				0%				4%
C2-Bunk-N	-	-								
C2-Bunk-R-ST	78	73	0%				-6%			
C2-Bunk-R-Fed	78	79								
C2-Bunk-R-3	80	78				2%				5%
Average			3%	-4%	1%	2%	3%	-4%	-3%	2%

3.1.4 Benefit of Reduce Shoreline Impacts

Under the adopted rules, the planned for quantities of boom are tied more directly to the geographic response plans (GRP's) identified in the Northwest Area Contingency Plan and the amount of boom needed for enhanced skimming. A result of the rule, boom is more broadly staged in order to arrive at spills early and therefore shorelines, habitats and resources are afforded greater protection and on-water recovery is maximized. Shoreline protection is critical to reduce economic and environmental damages, and the public is clear that these areas must be protected as soon as possible and before the oil hits. With early timeframes as called out in the adopted rules and standards for equipment maintenance and drills, deployment of booms for protection is highly probable. Another way to protect shorelines is greater on-water recovery. Oil collected on water will not ultimately strand on the shorelines of the state.[4] In general, the modeled state requirements reduce the total shoreline impact by 7% when compared with the federal requirements. In-situ-burning and dispersants also reduce shoreline oiled in the modeling scenarios. The average impact for the 3rd option in the modeled scenarios indicates increase in shoreline oiling; however, this seems illogical and Ecology believes this is an anomaly of the model. It is unrealistic to imagine that in the natural world, more equipment deployed more rapidly would actually have this effect.

Table 6.1

Percentage Reduction in Area of Shoreline Oiled				
	Add State Effort	Add ISB	Add Dispersants	Add 3rd Option
Outer Coast – Crude	5%	3%	-6%	-8%
Strait of Juan de Fuca – Bunker C	0%	55%		38%
Strait of Juan de Fuca – Diesel	0%			14%
Strait of Juan de Fuca – Crude	6%	17%	9%	12%
San Juan Island – Crude	17%		-9%	6%
Inner Strait Crude	-6%		11%	-19%
Lower Columbia – Bunker C	40%			-50%
Upper Columbia – Bunker C	-4%			2%
Average	7%	25%	1%	-1%

Table 6.1: Percentage Reduction in the area of Shoreline Oiled by Area and Type of Additional Effort

Note: minus signs mean an increase in shoreline oiled.

Table 6.2 shows that most scenarios indicate an increase in the percentage of shoreline that is more lightly oiled (a positive effect). In general the state requirements increase the percentage of the shoreline that is lightly oiled by 8% when compared with the federal requirements. In-situ-burning, dispersants, and the 3rd option requirements also increase the percentage of the shoreline lightly oiled, thus reducing the cost per square meter of cleanup.

[4] The data for this section of the document draws heavily on Evaluation of the Consequences of Various Response Options, Using Modeling of Fate, Effects and NRDA costs for Oil Spills into Washington Waters, Deborah French-McCay, Jill Rowe, Nicole Whittier, Subbayya Sankaranarayanan and Claudia Suàrez, Applied Science Associates, Inc. Dagmar Schmidt Etkin, Environmental Research Consulting, 2005, 2006.

Table 6.2

Change in percent of Shoreline <1000 g/m2				
	Add State Effort	Add ISB	Add Dispersants	Add 3rd Option
Outer Coast – Crude	-2%	5%	5%	8%
Strait of Juan de Fuca – Bunker C	0%	0%		0%
Strait of Juan de Fuca – Diesel	17%			29%
Strait of Juan de Fuca – Crude	22%	24%	6%	-19%
San Juan Island – Crude	4%		2%	2%
Inner Strait Crude	24%		19%	26%
Lower Columbia – Bunker C	-1%			0%
Upper Columbia – Bunker C	3%			0%
Average	8%	10%	8%	6%

Table 6.2: Change in the percentage of shoreline with light oil and lower cleanup costs by area and type of effort.

Table 6.3

Shoreline Cleanup Cost Factors						
Oil Type	Bunker C		Diesel		ANS Crude	
Shoreline Type	<1 mm	>1 mm	<1 mm	>1 mm	<1 mm	>1 mm
Rocky shoreline	$14	$78	$2	$4	$7	$39
Gravel beach	$20	$140	$3	$5	$10	$70
Sand Beach	$24	$78	$3	$6	$12	$39
Mud flat	$70	$156	$10	$18	$35	$78
Wetland	$80	$172	$11	$21	$40	$86
Artificial	$8	$46	$1	$2	$4	$23
Year 2003 $ per m2. Not including disposal costs						

Table 6.3. Shoreline Cleanup Costs

The cost per square meter of shoreline cleanup varies based on the level of oiling. For heavy oils the average cost of cleaning up heavily oiled beach is 3.1 times more than cleaning up a lighter oiling. For light oils the cost is 1.8 times higher.

3.1.5 Benefits of Reducing Environmental and Socioeconomic Cost of Spills

Oil spills result in socioeconomic impacts on the affected region, local communities, residents, the state, and the federal government. These impacts include damages to real and personal property, loss of use of natural resources (parks and recreation areas), and loss of income and expenses (fishing, tourism, recreation, shipping and other commerce). As a major shipping port and tourist and recreation area, Puget Sound and the Columbia River are particularly vulnerable to socioeconomic impacts from oil spills.

Industry will accrue losses from oil spills, particularly in response cost, including equipment and labor, shoreline cleanup costs, and less measurable losses to personal and public property, as well as foregone uses of natural resources for income or subsistence. Socioeconomic losses can also impact Tribal Nations reliance on subsistence fishing.

Environmental damages create some of the socioeconomic losses, but some also stand alone. The deaths of shellfish, birds, fish, and mammals are an inherent loss to society. The loss of habitat extends these losses over time. Some impacts from a spill can be avoided through rapid response (early response action). There are some cases in which even the most rapid response may do little to minimize the impact. For example the toxic effects in the immediate areas exposed to a spill. This analysis deals with the probable avoidable damages.

The impacts of oil spills can be reduced to some extent by faster response times, if the response is capable of protecting geographic areas that are unique to the state, require specialized equipment, or if a substantial share of the oil is removed on water before it has a chance to spread and cause harm to the water column and shorelines. There is also a chance for reduction when industry is allowed to propose an equivalent solution that meets the particular operations or risks posed by the company. [5] Each of the reducible damages is addressed by some part of the adopted rules. The value of these damages is estimated in **Table 7.1** below.

Table 7.1

Table 7.1: Environmental and Socioeconomic Damage Estimates

Costs by Quantity and Oil Type			
		Environmental Damage	Socioeconomic Cost
Oil Type	Volume (Gallons)	2005$ / Gallon	2005$ / Gallon
Volatile Distillates	<500	$51	$69
	500-1,000	$48	$281
	1,000-10,000	$37	$425
	10,000-100,000	$32	$191
Light Fuels	<500	$90	$85
	500-1,000	$85	$350
	1,000-10,000	$74	$531
	10,000-100,000	$69	$212
Heavy Oils	<500	$101	$159
	500-1,000	$96	$637
	1,000-10,000	$90	$955
	10,000-100,000	$80	$531
Crude Oil	<500	$96	$53
	500-1,000	$92	$212
	1,000-10,000	$85	$318
	10,000-100,000	$77	$149

The weighted average of these costs provides an estimate of the value that may accrue for removal on an overall per gallon basis for a large number of spills. The costs were weighted based on the share of spills in each of the sized classes. Further weighting by the shares of light and heavy oils give an average value of $124 per gallon for socioeconomic damages and $86 for environmental losses.

[5] Etkin, Dagmar Schmidt, 2005, "Socioeconomic Cost Modeling For Washington State Oil Spill Scenarios: Part II", Environmental Research Consulting.

Table 7.2

Volume (Gallons)	Percent of Spills	Environmental Average		Socioeconomic Average	
		Light Oils	Heavy oils	Light Oils	Heavy oils
<500	98.19%	$71	$101	$77	$150
500-1,000	0.55%	$67	$96	$316	$600
1,000-10,000	0.63%	$56	$90	$478	$899
10,000-100,000	0.50%	$51	$80	$202	$497
>100,000	0.24%	$51	$80	$202	$497
Weighted Average of Costs		$70.31	$100.42	$81.84	$159.61
Overall Weighted Average			$86.75		$124.30

Table 7.2: Weighted Average of Environmental and Socioeconomic Costs

Running 7000 spills allows Ecology to use this weighted average. The larger savings come from the larger spills.

3.1.6 Remainder Costs

The probable quantitative gains described above can be subtracted from the probable quantitative costs. The remaining net probable costs will provide a probable benefit in the event of a large spill, which cannot be predicted. The full cost impact of such a spill is likely to resemble the costs of other such spills. The costs of true worst case spills dwarf the costs of the adopted rules. Being large, even with a high degree of preparation and planning, such a spill will overwhelm capacity. In this case we will experience the smaller percentage gains from rapid response that is estimated in the modeling scenarios to capture, on average, 3% more of the spill on water.

3.1.7 Passive Use Losses

A 1992 contingent valuation study of lost passive use values resulting from the Exxon Valdez oil spill has been updated several times since then.[6] The revisions and indexing put the passive use value for American citizens at $11.0 billion in 2006 dollars. In the original study people were asked about their willingness to pay to prevent a single such spill expected to occur within the original spill area only once in the next 10 years. It is interesting to note that one of the problems confronting the economists who analyzed the Exxon Valdez spill was that some survey respondents believed the spill was closer to Seattle. [7] Extrapolating this value to the removal of oil from likely spills in Washington, it would then have a value of $110 million per 1% of all spills removed for a 10 year period. For a 3.2% reduction, this value would be over $600 million in a 20 year period.

Passive use is clearly an important component of what is lost in a spill. Decision makers must first consider whether it is appropriate to extrapolate from willingness to pay for prevention, to willingness to pay for improved on-water recovery. The next decision is whether it is appropriate to extrapolate a willingness to pay beyond the borders of Washington for this cleanup. If the answer to both these questions is yes, then the adopted rules is justified. Alternatively, decision makers can look at the values from other settings and ask if they believe that citizens of Washington would be willing to continue to pay $6 in extra costs per household in order to maintain the current level of response.

[6] Literature discussion on both passive use studies in: Evaluation of Probable Costs and Benefits of Proposed Oil Transfer Rules, Entrix, 2006.
[7] On Designing Constructed Market in Valuation Surveys, Robert Cameron Mitchell, Environmental and Resource Economics, June 2002, 22, pgs 279-321.

For example, a 1995 case study of willingness to pay to prevent spills on the California coast indicates the value placed on prevention at $76.45 per household.[8] The spills described in the study oiled 10 miles of coast and killed 12,000 birds. By comparison, the scenarios studied for these rules involve only the central coastline of California where this rule affects Puget Sound, the Strait of Juan de Fuca, the outer coast, and the Columbia. Estimated damages to shore birds for some of the scenarios we studied for the adopted rules are far higher. The California scenario involved prevention and immediate response through the use of a tug escort. Thus the case study assumed 100% of spills would be immediately addressed for a 10 year period. Therefore, the losses for the California study may be more appropriate for the smaller, more frequent spills than for the worst case spills which we are required to prepare for in Washington law. [9]

3.1.8 Stockholder Losses

In addition to payouts by the responsible party after a spill, there are stock losses both for that company and the other companies in the industry. This can be accompanied by reduced demand for the product of an identifiable company.[10] When the Exxon Valdez spill occurred, the stock holders lost between $4.7 and $11.3 billion dollars,[11] but the industry, as a whole, experienced loss half again as large as Exxon alone. Further, the poor response pattern and final damages had an effect that was almost as large as the losses generated at the first news of the spill.[12] These losses were as large if not larger than the cleanup costs and damages alone. Summing all losses together, one has a value of over $2,000 per gallon.

If a large spill took place in the Columbia River, the Strait of Juan de Fuca, or Puget Sound, there is a potential for a similar reaction.[13] We see this reaction in much smaller spills than a worst case volume. Given the larger neighboring population, the economic damages would be higher and the press visibility would be greater. On the other hand, the Exxon Valdez was the first major spill of its kind and the industry and stockholders woke up to the liability and demand damage potential. To some extent the shock of this reckoning is already included in current market prices.

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[8] Valuing Oil Spill Prevention: A case study of California's Central Coast, Richard T Carson, Michael B. Conaway, W. Michael Hanemann, Jon A. Krosnick, Robert C. Michael, Stanley Presser, Kluwer Academic Publishers, 2004. Notes: This value must be indexed for inflation. There were a variety of exclusions. E.g. if the 15% of the respondents who objected that the oil companies should pay for the tug and not the citizens were excluded the results would have be $8.74 higher.

[9] RCW 90.56.010 Definitions. RCW 90.56.210 Contingency plans. RCW 88.46.010 Definitions. RCW 88.46.060 Contingency plans. RCW 90.56.060 Statewide master oil and hazardous substance spill prevention and contingency plan--Evaluation and revision or elimination of advisory committees.

[10] Estimating the Costs of the Exxon Valdez Oil Spill, Johnathan D. Jones, Christopher L. Jones, and Fred Phillips-Patrick, Research in Law and Economics, 1994, Volume 16, 109-149, JAI Press Inc. Pg 129 Industry losses were 16.8 billion where Exxon's losses were estimated at $11.3 billion. 18,000 people sent in their Exxon credit cards.

[11] ibid pg 134.

[12] Ibid On page 129 Exxon's CAR (cumulative abnormal return) after the first news came out was -.107. The final CAR was -1.97 5 months later, as the level of damage became apparent. The same relative values for the oil industry as a whole were -.041 and -.084 or approximately double.

[13] One of the problems confronting the economists who analyzed the Exxon Valdez spill was that some survey respondents believed the spill was closer to Seattle. Pg 306. On Designing Constructed Market in Valuation Surveys, Robert Cameron Mitchell, Environmental and Resource Economics, June 2002, 22, pgs 279-321.

Stockholder losses cannot be extrapolated to small spills.

Stock and demand impacts are important to larger companies and to individuals and companies that are holding their stock. The total losses also include political shifts as part of the fallout from a large spill. In the case of the Exxon Valdez, changes in tax status and lack of access to oil field drilling areas transferred wealth from one set of people to another set. Taxes shift wealth in the present. Postponing oil exploration postpones economic gains and environmental losses, transferring them to a future generation. Large companies may therefore have different incentives than small companies as they view the costs of these adopted rules. Thus if a small company had a large spill, this value would not necessarily accrue. However, a large company like Exxon is more likely to survive, where a small one is more likely to face bankruptcy.

Exxon Valdez			
Breakdown of costs of the spill that generated the law			
Note this assumes industry absorbed all the costs of the spill			
	Low	Medium	High
Spill Size – gallons		11,000,000	
EXXON – Stock holder losses	$4,700,000,000	$8,000,000,000	$11,300,000,000
Lost Oil, salvage and repair of vessel		$30,000,000	
Out of court settlement		$1,150,000,000	
Fines		$25,000,000	
Waterway Restoration		$100,000,000	
Other impacts			
Wealth Loss other stockholders		$9,800,000,000	
Alaska Tax Code Changes		$2,000,000,000	
Chevron Improvements		$350,000,000	
Oil Industry rapid response locations		$250,000,000	
PV Foregone – Arctic Refuge Not Opened for 16 yrs		$7,098,813,637	
Total Industry Impacts	$27,100,000,000	$30,400,000,000	$33,700,000,000
Cost per gallon		$2,764	

3.1.10 Summary of Compliance Benefits

The compliance benefits depend on the likelihood of future spills. There are three ways to look at the issue:

First: If all the costs of the adopted rules were borne by Washington citizens, then each household would be paying an average of $6 per year. Decision makers need to decide whether they believe that Washington households are willing to pay an average of $6 per year in order to maintain readiness at current levels. In this case, Ecology expects that they would.

Second: The total estimated benefits for the rule depends to an extent on whether it is reasonable to expect a major oil spill. Probable benefits extrapolated to the general range of spills are dwarfed by such an incident. The probable quantitative benefits are $40 million without a 65,000 barrel spill and $240 million if one occurs and if that spill has similar ramifications as those of the Exxon Valdez spill. The last massive spill took place in the Washington/Oregon area was in 1968 and it is up to the reader to decide whether something like this is likely to reoccur. Even though the spill is unlikely to occur we must plan for a worst case

Third: There are passive use values that are in addition to the direct benefits in the second category. Extrapolating the additional passive use values from a prevention study to a cleanup study, then those probable quantitative benefits would range from $20 million to $191 million. The primary difference between these numbers is extrapolation of a willingness to pay to the nation as well as Washington citizens.

3.2 Qualitative Analysis

This section of the report is intended to inform the public of how Ecology considered and weighed probable qualitative benefits along with the probable quantitative benefits reflected in the analyses. The adopted rules' probable costs and expenditures are more easily tabulated, but converting subjective values into monetary equivalent is much more difficult and, in some cases, simply not possible. Probable qualitative benefits for which we have not assigned an absolute monetary value include: effectively responding to a worst case spill, preventing the ongoing detrimental impacts of a worst case spill, protecting cultural and spiritual values of traditional tribal lands, decreasing impacts to endangered species, such as Puget Sound orcas, preserving recreational opportunities, creating a level playing field, and not rolling back contingency plan standards to where they were over twelve years ago.

The Legislature itself recognizes that not all costs and benefits relating to oil spill prevention, preparedness and response can be quantified.

1989 RCW 90.56. *1989 c 388 § 1*

> *"The legislature finds that oil spills can cause significant damage to the environment and natural resources held in trust by and for the people of this state. Some of these damages are unquantifiable, and others cannot be quantified at a reasonable cost. Both quantifiable and unquantifiable damages often occur despite prompt containment and cleanup measures. Due to the inability to measure the exact nature and extent of certain types of damages, current damage assessment methodologies used by the state inadequately assess the damage caused by oil spills."….. [1989 c 388 § 1.]*

3.2.1 Current compliance by regulated community

Although the CBA reflects that these rules will result in "new" costs, it is important to remember that over the last decade most industries have actually already incurred the majority of the costs we have described. Much of the existing preparedness standards existed as guidance, as discussed earlier. Even so, industry has invested over the decade to comply. Most recent examples include the moving of the Park Responder to the more strategic staging location in Port Angeles, and the purchases of fast water boom and training of personnel for the pipeline in eastern Washington.

Ecology has determined that there is a probable qualitative benefit to be gained from moving from the long standing guidance into rules. Standards developed in guidance give no assurance of stakeholder involvement in the process of development. Guidance could also be changed frequently, thus impacting industry and citizens in an irregular manner.

There is also a qualitative benefit to not "rolling back" the standards to where they were prior to 1991, which would essentially return Washington to pre-Exxon Valdez standards. The unique and particular characteristics of Washington's waters, aquatic resources, shorelines, economy and culture have been substantially protected since the existing rules and guidance were put into place in 1991. The goal of effective environmental regulation should be to allow for greater, not lesser, protection of the environment as technologies improve and costs of compliance can be phased in. Since many industries in Washington are in compliance with the majority of the standards reflected in the adopted rules, weakening the existing standards would not be warranted.

3.2.2 Value of creating a "level playing field" for industry

Equity has a qualitative benefit that accrues to businesses in the same sector of a competitive market. The adopted rules ensure that the contingency plan standards are measurable and evenly enforceable by Ecology.

Theoretically these adopted rules would not be necessary if all companies voluntarily complied with guidance. However, if voluntary compliance is not uniform, companies that do not do as much have an unfair competitive advantage. It really only takes a few companies to change the nature of the competitive environment. Once a few companies cut costs and prices other companies may not be able to compete in the long term. They could either reduce their efforts or leave the market. If there are fewer companies to support the equipment and infrastructure needed to respond to worst case spills, then in the long term, cleanup and response effectiveness will be unacceptably reduced. Further, without the rule amendment there would be no incentive to new business to meet the standards of existing business and could allow even existing business to become lax in their contingency plan investments.

The cost of spills and the cleanup and damages must be borne by the buyer of the final product. This is generally done through requiring the entity that created damage to restore the harmed party's interests. To do otherwise skews the competitive pricing structure that forms the basis for most economic analysis. Those who can escape liability have an unfair competitive advantage. The liabilities may be too large and under capitalized companies cannot pay it. Having measurable rules in place that require preparation for spills precludes undercapitalized ventures from shifting the costs of the spills to the public.

3.2.3 Cultural and spiritual/ceremonial values

Human interest is not concerned with material or financial interest alone, but with beauty and a flourishing natural world as well. Valuing nature means engaging with rich and diverse cultural processes - the meanings, values, knowledge and practices which shape nature. The question is how our moral values for the environment can be articulated and taken into account in making policy decisions.

The environmental values shared by many Washingtonians are of deep historical and cultural significance, this holds fundamentally true for Washington's tribal nations as well. Tribal culture is closely tied to and has co-evolved with productive and functional ecosystems. Tribes and tribal members possess property and self government rights that predate the formation of the United States and the creation of the State of Washington, and are guaranteed under treaties and federal law. Due to federal laws and inherent tribal sovereignty, each reservation in the state constitutes a bordering jurisdiction for environmental purposes. Environmental actions outside the reservation affect the tribe and the residents of the reservation just as the actions within the reservation affect the state and its citizens.

Many of Washington's tribes are located near marine transportation corridors and have exposure to the risks of oil spills. The Makah Tribe, for example, has a *Usual and Accustomed* marine area located at the marine transportation crossroads of the Strait of Juan de Fuca and the Pacific Ocean. Their cultural resources are placed at the entrance to a United States high volume port complex, Canada's largest port, and the world's third largest Naval complex, a National Marine Sanctuary, a National Park, a National Fish Hatchery and a National Wildlife Refuge. If a spill were to occur in this area it is difficult to assign a monetary value on the loss of the connection of the tribe to its culture, history, environment and heritage.

In another real world example, the Doe-kag-wats estuary, impacted by a moderately sized Foss Maritime oil spill at Point Wells in 2003, is known to the Suquamish tribal nation as the Place of Deer. Although we were able to monetize the impact from the shellfish closures, the marsh and beach the loss to the tribe, and the spiritual and cultural impact could not be properly compensated.

This cultural and spiritual impact is affected further by existing legal rights. The right to usual and accustomed access would imply a willingness to sell value and not a willingness to pay value. In cases where the right would not be for sale at any price, the wedge between the values we can estimate through typical methods and the actual appropriate value is large.

3.2.4 Value of protecting endangered species

Although some cost-benefit methodologies allow us to attach a dollar figure to a particular individual bird, it is not as easy to attach a dollar value to the preservation of an entire endangered species, such as Puget Sound orcas, or preservation of endangered species habitat. A worst case spill has the potential to impact or eliminate endangered species that live in Washington in the water or on land.

3.2.5 Existence values

Existence value: The value that people place on simply knowing that something exists, even if they will never see it or use it.

It is likely that citizens outside of Washington value the shoreline. The marine shoreline of the state is about two thousand seven hundred miles long, a length greater than the combined coastlines of Oregon and California. There are roughly three million acres of submerged land and more than three hundred islands in our marine waters. People value tide pools, unspoiled, undeveloped and rugged landscapes. During certain seasons, the shorelines host migratory bird populations of international significance. Puget Sound was one of the first estuaries to be designated by the Environmental Protection Agency as a Estuary of National significance. The Columbia River is the largest river in volume flowing into the Pacific Ocean in the Western Hemisphere, and is the fourth largest by volume in North America. Like the Grand Canyon, people come from all over the country and world to see the Columbia, the surrounding habitat, environmental beauty, and economic wonder. With the importance of the Columbia to the Pacific Northwest, it has made its way into the culture of the nation. There was an overwhelming response to the Exxon Valdez and there is no reason to assume that it would be different for a major spill in Washington.

3.2.6 Benefits of Preparedness: Culture and Cost

There is a direct correlation between the decision-making process during a spill and the final economic costs. Some qualitative benefits of preparedness include pre-spill risk analysis and mitigation, integration of good science and policy into spill decisions, a clear command/control organization for spill response, and ultimately collaborative, objective driven responses.

The infrequency of major oil spills may have contributed to the complacency that exacerbated the effect of the Exxon Valdez spill. This spill significantly influenced the development of both federal and state laws for prevention, planning and response. And today, in the wake of the aftermath of Hurricanes Katrina and Rita, there is again a national consensus that we must be better prepared to respond to natural and human caused disasters. In a report on the lessons learned from the Katrina response, the President found that despite reforms that encourage a proactive, anticipatory approach to the management of incidents, the culture of our response community has a fundamental bias towards reaction rather than initiative. As a result, our national efforts too often emphasize response and clean-up efforts at the expense of potentially more cost-effective anticipatory actions that might prevent or mitigate damage. Preparedness drives investment in prevention and another qualitative benefit of the rules could be derived from preventing a catastrophic oil spill as it will require affected industries to always be vigilant.

3.2.7 Summary of Qualitative Benefits

There are many qualitative benefits to be gained from updating the existing rules and moving the long-standing guidance into rules. Guidance is not fully enforceable and standards in rules provide more certainty to industry and other stakeholders. The value of creating a “level playing field” for industry is important, as all will be held accountable in the same manner.

The citizens of Washington have deeply held environmental values that are of deep historical and cultural significance to Washington's tribes as well. Some qualitative benefits of preparedness include pre-spill risk analysis and mitigation, integration of good science and policy, a clear command/control organization, and collaborative, objective driven responses. Better preparedness in general will lead to a prompt and proper response which is an important way to avoid many long term impacts of spills as the oil is removed or contained earlier.

4.0 Summary of Compliance Costs

In this chapter:

4.1 Baseline and Assumptions for Cost Analysis

The existing laws and rules form the baseline for the cost analysis. These laws and rules include Washington law, the existing rule, federal laws and regulations, and for vessels on the Columbia, the Oregon rules. Each of these requirements generates costs that existed before the adoption of the amendment.

Only the laws and regulations count toward this baseline. Guidance does not count toward the baseline because it is voluntary.

The probable cost and benefit of the adopted rules is partially a function of the sizes and types of spills expected, and the impacts they might have. Ecology has used existing data on typical spills in conjunction with the worst case spills modeling to extrapolate the probable costs and benefits. The following are assumptions used in the baseline for this cost analysis.

4.1.1 Washington Law, Existing Rules and Guidance

Washington's oil spill law sets a high standard by requiring full details in planning for a worst case spill as well as random practice drills to test the effectiveness of plans.

The existing rules are more specific in most areas; however, these rules do not specify with exact numbers the amount of equipment that a worst case spill response entails. Rather, these rules require that the plans be sufficient to respond *promptly and properly* and to the *maximum extent practicable* to a worst case spill.

More detailed descriptions of equipment and people needed are contained in several guidance documents written to accompany the rules. For example, equipment benchmarks were prepared for vessels operating in five designated planning zones in Washington, as well as for four types of facilities required to submit oil spill plans. These benchmarks were published, complied with by industry and tested in drills for more than 10 years.

Ecology must estimate the cost of the rule change based on the transition from the existing rule to the adopted rule. The guidance is not a rule and therefore can't be used in this analysis to provide the baseline for costs.

The adopted rule essentially adopts much of the guidance into rule, with a few changes. Thus even thought the costs described are large, in every day work, the cost of compliance should not change much for the affected companies.

4.1.2 Existing Response Assets

Some states and nations have developed a response system that employs a state-sponsored response organization, and requires all companies to invest equally in maintaining the system. Washington State has a response system that is open to the competitive market, with a mix of cleanup cooperatives and for-profit companies.

In some high cost areas, particularly response equipment, the business community is collectively already doing more than the existing guidance and rules and more than the adopted rules require. In this case it is the business environment, not the rules that drives the capital investment, creating both costs and benefits. In other words the market as well as regulation has driven substantial effort and capital acquisition.

The acquisition of capital in excess of Ecology requirements may also be driven by:

- Concern over spill liabilities;
- Concern lest another company's spill equipment be tied up elsewhere;
- Unwillingness to provide cost savings to a direct competitor through providing a contract;
- A wish to provide for one's own compliance without having to share capital with other companies;
- A wish to force other competitors into capital acquisition; or
- Good opportunities combined with long term expectations of future needs for the equipment due to regulatory trends.

The fact that companies have done more than Ecology requires them to do means that only part of the equipment is actually acquired for compliance purposes.

4.1.3 Federal Requirements

The federal requirements form part of the baseline. There are federal requirements which in some cases equal the state standards, and in other cases differ. Federal requirements for example have different/longer timeframes allowed for response as a planning basis, and depend on whether a water body is declared to be a high or low volume port and using designated, centralized locations to calculate the timeframes. The federal rules result in more centralized staging of equipment and personnel and slower deployment times to outlying areas of Puget Sound and the Columbia River, but much of the training, drilling, and equipment requirements calculated here are costs incurred under the federal baseline.

4.1.4 Oregon

Washington also shares regulation of the Columbia River with Oregon. Similar planning standards have been implemented by both states for many years, so the costs of complying with Oregon rules also presents a baseline that we have considered in this analysis. This part of the baseline applies only to vessel traffic on the Columbia.

4.1.5 Baseline Summary

In drafting this CBA, Ecology has evaluated the shift from the baseline federal requirements to the adopted rules because:

- The existing rules were general and performance based;
- The guidance is not a rule;
- The federal requirements form an absolute minimum but in some cases are more specific than the existing state rules;
- The amendment adopts substantial portions of the guidance and have more specific requirements that are similar to the federal requirements; and
- This methodology provides conservative assumptions in making this analysis.

In many ways the application of the guidance has been a long pilot test of the adopted rules. For that reason, detailed costs for certain areas of existing compliance are available. The new costs above the existing program are primarily limited to possible shifts in equipment and potential staffing in areas further away from the central Puget Sound, such as parts of the Columbia River, Neah Bay and the San Juan Islands.

4.2 Types of Expected Costs

With the assistance of the input group that designed the cost survey, it is expected that industry's costs relating to these rules will come from:

- Equipment that must be maintained in readiness for spills;
- The cost of writing and maintaining plans;
- Conducting drills to test the plans;
- The cost of personnel training; and
- Overhead of maintaining manpower.

These costs are typical of emergency response preparations.

The vessels, facilities, and response contractors reported annualized costs totaling $36 million for the existing system of plans, training, personnel, equipment and contracts. Ecology estimated an additional $5 million for both existing upland storage [14] and new equipment. The adopted rules will change little of this.

Annualized costs for equipment are based on straight line depreciation.

[14] The addition of upland equipment probably overstates the cost of equipment for this analysis. The analysis is therefore more conservative in that it probably overstates the cost of the rule.

Approximately $13 million of this cost is due to the guidance that is now incorporated into the adopted rules.

4.3 Contingency Planning

Preparedness involves a cycle of activity (e.g., developing plans, procedures and policies, training, purchasing and maintaining equipment, conducting drills and incorporating lessons learned back into plans). The cycle is necessary to involve coordination among a combination of federal, state, local, tribal, private sector, and non-governmental entities.

Guidance: The guidance to support the rules described benchmarks to further clarify the prompt and proper planning standard. Equipment needs for various timeframes were dependent on the type of facility, type of oil and the geographic area (zone) in which the vessels transited. The equipment needs included boom, recovery and storage devices, over flights, in-situ burn and dispersants.

4.3.1 Existing state rules as a baseline

The existing chapters of rules require that plans provide *full details* for a worst case spill response. Plans are approved for five years and may be reviewed again after spills and drills to look for lessons learned. Under the existing rules, plan holders were required to identify initial response actions, list their response teams, describe methods to contain and remove oil from water and shorelines, equipment locations, interim and permanent storage of wastes, follow a drill program and rely on response contractors that are approved by Ecology. The most explicit standards found in the rules are the one hour (for facilities) and two hour (for vessels) requirements to provide initial deployment of response equipment and personnel at the site of the spill, given suitable safety conditions. These are similar to the federal "Average Most Probable Discharge" standards.

4.3.2 Federal rules as a baseline

Many of the federal planning requirements are similar to the state's guidance. [15] Regulated companies are able to submit a core plan that meets both state and federal requirements, and adding an appendix that contains the other state specific standards.

Federal standards for equipment are highest at facility transfer locations and highest in locations designated as *high volume ports*. The Puget Sound has such a designation, while the Columbia River does not. Equipment times in general for the federal planning standards are longer and are calculated from a defined location (the local Coast Guard office for example), which tends to centralize equipment caching.

[15] BC-States Task Force Integrated Vessel Response Plan Format Guidelines for Tank Vessels.

Federal Requirements for High Volume Ports						
Required by/hours	6 Hour			12 Hour		
	Boom	24 hr Recovery	Storage	Boom	24 hr Recovery	Storage
Federal Standards – Vessel (HVP)	---	---	---	30,000 ft	12,500 bbls	25,000 bbls
Federal Standards – Facilities (HVP)	30,000 ft	12,500 bbls	25,000 bbls	30,000 ft	12,500 bbls	25,000 bbls
Required by/hours	24/30 Hour			36 Hour		
	Boom	24 hr Recovery	Storage	Boom	24 hr Recovery	Storage
Federal Standards – Vessel (HVP)	30,000 ft	12,500 bbls	25,000 bbls	30,000 ft	25,000 bbls	50,000 bbls
Federal Standards – Facilities (HVP)	30,000 ft	25,000 bbls	50,000 bbls	30,000 ft	25,000 bbls	50,000 bbls
Required by/hours	48/54 Hour			60/72 Hour		
	Boom	24 hr Recovery	Storage	Boom	24 hr Recovery	Storage
Federal Standards – Vessel (HVP)	30,000 ft	25,000 bbls	50,000 bbls	60,000 ft	50,000 bbls	100,000 bbls
Federal Standards – Facilities (HVP)	30,000 ft	30,000 bbls	100,000 bbls	30,000 ft	30.000 bbls	100,000 bbls

This deployment schedule also drives the baseline costs of manpower and training since someone must safely deploy the equipment.

There is one significant difference in the applicability of the vessel rules. In August 2005, the Coast Guard began to require that non-tank vessels (cargo, passenger, fishing, etc) submit contingency plans. The regulatory standards are contained in federal laws, rules and a Navigation and Vessel Inspection Circular (guidance). Final rules are under development and the new program will become enforceable in 2006.

The state rules have required non-tank planning from the early 1990's. The state rules allow non-tank vessel companies to form cooperatives and share the cost of compliance collectively. One result of the new federal rules should be that the costs to industry to maintain the equipment should be shared now across a broader community.

In addition, there are pending federal requirements for aerial observations, in-situ and dispersant use. It is estimated that the federal rules will become effective soon after the adopted state rules, and that the requirements will be aligned.

4.3.3 Anticipated streamlining in adopted rules

The new rules provide some streamlining of plan requirements, for example Ecology no longer requires a system for categorizing spills by size and type or writing scenarios for small and worst case spills. The rules rely on the regional planning efforts by allowing references to the Northwest Area Contingency Plan (NWACP) for environmental sensitivities (GRPs), disposal plan, ICS job descriptions, ICS process, communications systems, and description of the relationships with other plans. This results in a reduction in cost for plan upkeep. The development of umbrella plans is encouraged; for example, a company with several facilities or multiple vessels can submit one plan and gain a savings in plan upkeep. In the new rules, annual updates or a letter to Ecology affirming no changes is required.

4.3.4 Current on-going costs to develop plans and expected change

There are no costs attributable to this part of the adopted rules that are not already imbedded in the equipment cost estimate. Developing and maintaining plans is a complex and costly undertaking. Businesses report costs for developing the contingency plans at over $750,000 per year under the existing rules. Over $400,000 of these costs are imposed under the baseline of the federal requirements, with less than $300,000 attributed to the existing state rules.

4.4 Equipment

As adopted, these standards either equal or exceed the federal contingency planning standards and address spill assessment, boom requirements, recovery and storage of oily waste, in-situ burn and dispersants, shoreline cleanup, aerial observation, and availability of workboats to support spill response.

These adopted standards emphasize early response actions. Storage requirements have remained essentially the same as the existing guidance, except for the transfer locations and pipelines. The adopted requirements will result in a wider distribution of response equipment, for example, equipment staged closer to Washington's coastal entrances. It is believed that the majority of the new requirements can be met by restaging existing equipment, though some labor costs may be new.

An existing cost has been reduced by the adopted rules which no longer include a 1 or 2 hour performance standard. The new rules instead describe a systematic approach to confirming appropriateness and adequacy of equipment through drills. Early action standards for pipelines and pipeline tank farms are identified (under the guidance, these were determined on a case by case basis.)

The adopted rules contain new requirements for shoreline cleanup, but mirror the federal standards entirely. There are new adopted standards for dispersants which mirror federal requirements, with the exception that an offset in recovery equipment at various time frames is not allowed. Industry has been asking for this for some time. Ecology expects that the dispersant and In-situ burn planning requirements will not result in a new cost. New requirements for aerial observation mirror pending federal requirements.

The adopted rules define how the mobilization and deployment of equipment will be calculated for planning purposes. The adopted state rules will be compatible with the federal rules. The conservative assumption of 5 knots/35 miles per hour travel speed used by Ecology may be slower than the actual delivery speed. Ecology will use 5 knots/35 miles however the plan holder can submit data to show an alternative speed. Thus the cost estimates for equipment in this document may be high.

The adopted rules also address planning for ground water which is addressed under the federal Environmental Protection Administration and Office of Pipeline Safety rules.

In the above examples, it is expected that a small cost would be incurred during the plan development process, but no actual expenditures above the federal baseline will be incurred.

4.4.1 Current on-going costs for equipment and expected change

Equipment generates over half of the cost of the existing guidance and new rule. As discussed previously, the impact of the adopted rules are defined based on the shift from the existing rules (federal and state) to the adopted new rules, ignoring the fact that most of the amendments were already in guidance. The shift in equipment is laid out in **Appendix 1**.

Ecology looked at existing caches of response equipment were compared with that needed to satisfy rule requirements, using simplified assumptions for logistical support, mobilization times, and transit times and GIS analysis. A comprehensive equipment list including positional coordinates was compiled using the Western Regional Response List internet listing (http://wrrl.us/index.html), which is an oil spill response equipment inventory database hosted by Genwest Systems. Positional corrections were made to this listing where identified and the Canadian Burrard Clean resources were culled from the list. Ownership was not considered, in other words, it was assumed that cooperation exists and all equipment was available. Ecology also examined equipment caches identified in oil spill response plans and primary response contractor applications.

For each type of response equipment it was assumed that all necessary support (e.g., workboats for protective booming and collecting oil, trucks and trailers for overland transit, etc.) were available. Potential transit distance over-water per time was calculated using an assumed mobilization time of one hour and travel speed of 5 knots. Overland transit speed was assumed to be 35 mph.

GIS Analysis:
The comprehensive equipment list was plotted as a GIS layer along with planning standard areas. Using ARCVIEW GIS tools, portions of the comprehensive equipment list were selected and tallied based on the planning standard and requisite transit routes and distances. Distance from equipment locations to planning standard areas was determined using radial (as the crow flies) assumptions, over-water transit routes, and highway routes. If geography was not conducive to a radial assumption, then over-water transit routes were considered. If a shortage was noted we then considered over-land transit routes.

Looking at the detail in **Appendix 1** Ecology finds that for the Neah Bay staging area, Grays Harbor, the San Juan Islands, and some areas on the Columbia River, the adopted rules will impose capital costs if plan holders do not cooperate. In the extreme, with no cooperation, the costs could be large. In the remainder of the state it appears that the existing equipment caches exceed the combined requirements of all existing rules and guidance, as well as the requirements of the draft adopted rules.

Table 1 displays shortages that may exist for vessels if and only if one assumes that the 5 knot speeds of travel apply and no overland delivery of equipment is considered. This is a conservative assumption.

Table 1

Impacts for Vessels											
Ecology Rule Amendment as Average Percentage of Existing Equipment by type by Area											
	Avg.	Padilla Bay	San Juan	Commencement Bay	Nisqually	Dungeness	Neah Bay	Gray's Harbor	Cathlamet	Vancouver	Tri-Cities
Boom Average	28%	11%	27%	11%	52%	47%	19%	57%	8%	14%	38%
Recovery Average	19%	24%	24%	18%	16%	20%	49%	37%	0%	0%	0%
Storage Average	48%	60%	69%	35%	51%	31%	58%	77%	19%	0%	84%
Equipment: Need to Provide, Transfer, or to Demonstrate Faster Transport											
	Sum	Padilla Bay	San Juan	Commencement Bay	Nisqually	Dungeness	Neah Bay	Gray's Harbor	Cathlamet	Vancouver	Tri-Cities
Added Boom Ft.	23,000				2,000			1,000	10,000	9,000	1,000
Added Recovery Bbls.	-										
Added Storage Bbls.	99,410						6,310	12,100			81,000

Table 2 displays the equipment needed for Facilities. If equipment is shared and travel is faster than 5 knots, and overland transport of equipment is considered, then some of this need may not occur. Further, some of this equipment will be driven by the oil transfer rule. However, given that this rule has not yet been adopted, it is displayed and estimated for this rule. A substantial share of the cost may be covered by existing upland storage, which can be listed in a plan. However, none of this storage was reported in any of the survey responses, so its cost is added here.

Table 2

Impact for Facilities			
Ecology Rule Amendment as Average Percentage			
of Existing Equipment by type by Area			
	Weighted Average	HVP	Non HVP
Boom Average	3%	1%	33%
Recovery Average	13%	13%	61%
Storage Average	74%	47%	100%
Impacts for Facilities			
Equipment: Need to Provide, Transfer, or to Demonstrate Faster Transport			
	Sum	HVP	Non HVP
Added Boom Ft.	-	-	-
Added Recovery Bbls.	12,450	-	12,450
Added Storage Bbls.	119,000	-	119,000

Ecology tried to estimate potential storage capacity in the upland because the rule allows that to be counted in the plans. However, that has proved difficult. None of the facilities reported the cost of upland storage in the survey. Further the range of costs is large. If the right sized tank happens to be empty at the time of a spill, the cost can be low. If the facility needs to use a larger tank then the costs rise. If demurrage occurs because some tanks were used, then the costs can be an order of magnitude higher. In fact, if one were operating with the expectation of large spills, old single hulled tankers and barges, located set aside to be used for temporary confinement of spilled material may be the least expensive option, followed by sets of smaller bolted tanks. The reason existing upland storage is cost effective is that each plan holder regards a spill as rare. Given demurrage costs, plan holders may not wish to store another company's spilled oil and water mix.

The weighted share of equipment costs has been calculated in this study. Since the guidance is being incorporated into the adopted rules, the current cost of equipment required in the guidance is a cost of this amendment. In addition the value of upland tanks used for storage must be added. Further, some equipment may have to be stationed in another spot or new capacity may need to be purchased. Ecology estimate multipliers to use in conjunction with the value of existing equipment.

Companies have purchased more equipment than the Federal rules, the new Washington amendment, and the Oregon rules require. The state is therefore not the primary cost driver. Given this level of over compliance it is hard to assess the cost. Much of the equipment was purchased some time ago and the resale value is sometimes different from the purchase price. Therefore Ecology has used straight line depreciation and replacement as the basis for estimating an annual cost of the existing equipment. The state share of the equipment is calculated by using the equipment required in the amendment and then subtracting the equipment already required in the baseline (federal program, and the state of Oregon requirements).

State Increase = Equipment required in the amendment – baseline equipment

The resulting percentage state share of all existing equipment is estimated by dividing the state increase by the total equipment already deployed.

State % Increase = State Increase / Existing Equipment

This calculation is done for each type of equipment in each area and an average value is generated. That average percentage is then multiplied times the value of each type of equipment in the adopted rules. The value of the equipment is based on the total annualized value of each type of equipment taken from 2003-2004 survey data.

Table 3

Equipment Basis for Shares	Boom	Removal	Storage	Weighted Share
Equipment Share Survey Cost	4.86%	40.04%	55.09%	
PRCs	3.11%	39.50%	51.45%	94.06%
Facilities	1.20%	0.01%	0.00%	1.21%
Vessels	0.56%	0.53%	3.64%	4.73%
State Share of Total Capacity	15.83%	16.04%	56.84%	
New Equipment Basis Multiplier	6%	3%	29.97%	
State Share of Cost	0.82%	6.64%	40.70%	48.2%
On shore storage cost multiplier			1.64%	

Table 3: Estimating the Weighted Share of Equipment Costs for the Proposed Rules

The estimated annualized cost of existing equipment required by the state is $12 million. The estimated total annualized cost of existing equipment is $30 million. This includes both reported costs and estimated costs of unreported upland storage. Taken as a whole, the existing caches of equipment in the state exceed the requirements of both federal and state requirements. Ecology encourages plan holders to share equipment, especially storage. If they do not, the costs will be higher.

The 48% displayed here is also used as the basis for estimating the state share of PRC contract cost and training costs.

4.5 Drills

As adopted, the drill requirements closely follow Washington's long-standing existing guidance and practice, with some exceptions. The amendment is compared to the baseline in order to estimate the cost. The unit cost of different types of drills used in guidance was used to estimate the cost of the change.

4.5.1 Existing State rules as baseline for drills

Since the initial development of the rules standard, the drill program evolved considerably in Washington and was described in published guidance documents. Actual practice in the drill program followed the standards as discussed below and not this standard described in the rules. Actual practice was more similar than different from the practices described in the federal rules.

The existing rules called for:

- One limited deployment per year;
- One unannounced full scale deployment drill each year.

A limited deployment means a short term deployment of response equipment and people. An unannounced full scale deployment means demonstrating all of the personnel and equipment necessary to show that the contingency plan is adequate to meet a worst case spill. This type of drill could last for several days and the rules detail that plan holders were to be chosen at random for participation.

The drill requirements could be partially met by deployment in actual spill responses. Response contractors could be excused from full deployment drills if, during a twelve month period, they had already performed to the department's satisfaction in a deployment drill.

Guidance: The state's drill guidance was modeled after the federal program and calls for two deployment drills and one tabletop drill each year. At least once every three years, the tabletop must be a worst case size drill. Unannounced tabletop and deployment drills called for by Ecology are conducted.

Historically Ecology sponsored 1 to 3 unannounced drills per year. Plan holders are tested and then would not need to participate for another 3 years (except if plan deficiencies are found). These unannounced drills were not additional drills and could alleviate one or more of the required drills in a year. And the drill guidance required that "away team" members be mobilized in Washington once every 5 years for tabletop drills.

Ecology staff evaluates the performance at drills and provide written comments on the effectiveness of plans as demonstrated at the drills.

4.5.1 Federal rules as baseline for drills

The federal requirements are written as both rules and guidance (the national preparedness and response exercise program or PREP). Drills are tracked over a three year cycle, with objectives that must be met to demonstrate the adequacy of plans. The standard for drills includes:

- internal call-out procedure drills (4 each year);
- emergency procedure drills (4 each year);
- tabletop drills (1 each year, one every 3 years must be a worst case drill);
- deployment drills (1-2 each year);
- unannounced drills called by the federal government.

If a plan holder chooses to follow a different drill program than that described under PREP, then the alternative program must equal or exceed these drills in type and frequency.

The federal program allows for self certification of drills. A significant difference between the state's drill program and the federal program is the written evaluation that is provided to the plan holder by the state. There is a small cost saving to plan holders for the paperwork in evaluating and tracking drill objectives provided by the state, which can be used to demonstrate compliance with the federal rules.

4.5.2 Anticipated change for drills by the adopted rules

The adopted rules closely follow Washington's long-standing existing guidance and practice, with some exceptions. Drills are tracked over a three year cycle, with equivalent PREP objectives that must be met to demonstrate the adequacy of plans.

- There is a new adopted standard that twice in a three year period; a deployment drill must include the testing of a geographic response plan strategy. These are pre-identified strategies that are contained in the Northwest Area Contingency Plan.
- Unannounced drills will be conducted on an "as necessary" or random basis, and do not constitute an additional drill requirement. For this analysis, the

number of unannounced drills is expected to be no more than 2 per 3 year cycle for each plan holder.
- The scope and frequency of tabletop and deployment drills under the new rules remains consistent with the federal requirements, with the exception of one additional deployment drill required for vessel plan holders in Washington.

The following are areas where a savings can be gained over the current rules:
- The tabletop drill: in 2 of the 3 years, the drill can be of a smaller scale than that required in the existing rules (requiring a full scale deployment).
- Plan holders can collectively share credit for GRP drills conducted by a response contractor. Only part of this is a savings, as the existing rules allowed spill responders to be excused from full deployment if they had already participated in a drill in the last year. Being excused was more general in the existing rules however; it did not allow the plan holder to simply take credit for its contractor's GRP deployments.
- Plan holders can get credit for drills conducted out-of-state.

The following are areas where costs can be greater over the current rules:
- The adopted rules require three drills per year instead of two for some plan holders.
- The revision requires that away team members be mobilized in Washington once every five years for a tabletop drill. This was the standard contained in the long-standing guidance, but was not described in the rules.
- The existing rules called for one limited deployment drill, though in practice two deployments were conducted.
- In the first triennial cycle an unannounced drill or scheduled inspection is intended to survey, assess, verify, inspect or deploy response 50% of the resources within the region. In the second triennial cycle, the other 50% of the resources will be addressed.

Again, it should be noted that the majority of these costs are not likely to truly be new, since industry has been following the guidance for many years.

4.5.3 Current on-going costs of drills and expected change

Reported costs for drills required by the state are approximately $3 million per year and costs for drills required by the federal program are about $1.5 million per year.

The data on drilling costs had more problems than other data from the survey. Much of the reported cost includes drills that were done out-of-state (while the fixed facilities conduct all of their drills in Washington, many of the vessel companies rotate their drills between Washington and other states). It is unclear what share of the costs of out-of-state drills should accrue to Washington since the drills were intended to meet both the requirements of either the federal government or another states, and often not the requirements of Washington's rules. Some respondents reported costs for unannounced drills that were not conducted in Washington and some reported participation in more drills than are required in Washington. This was particularly true of vessels. Ecology has been unable to remove many of these issues from the analysis, thus the drill costs are probably overstated. Most changes should be cost neutral.

The largest cost change is created by dropping the requirement for each company to participate in a full-scale unannounced deployment drill every year. For this analysis, we considered that these unannounced drills will be done in a more focused manner and each company should not need to participate in more than two out of every three years. *These savings are prospective only because Ecology did not actually ask for compliance with this part of the existing rule in practice.* As the drill program evolved in the state, Ecology did not enforce the annual requirement for full-scale unannounced drills but instead practiced a more focused unannounced drill program as well participating in scheduled, industry led drills. However, it is the shift in the legal requirements that must be valued for this analysis. Because they are not the norm, the data available on the cost of these drills is limited.

- The estimated savings for vessel companies is $45 thousand every third year or $15 thousand per year.
- The estimated savings for facilities is $11,000 every third year or $3,700.
- The estimated savings for the response contractors ranges from $3,000 (small response contractors) to $18,000 (large response contractors) per drill. The response contractors report billing less than this to their plan holders, so these costs may be included elsewhere in the contract, such as flat annual costs.

An additional probable cost is imposed by an added limited deployment drill. These costs range from $4,000 to $8,000 per drill. These costs vary based on the company reporting.

The net effect for most vessels and some large facilities is a net reduction in costs. Response contractors should also see cost reductions. There is an expected small reduction in total existing drilling costs. The net effect for an existing rule to a new rule comparison is an expected $200,000 reduction in costs. This reduction is prospective only because Ecology did not declare as many unannounced deployment drills as the existing rule required.

4.6 Training

Training is a critical component for preparedness and the benefits are great when team members train together in advance of a spill. The statute requires that plans incorporate periodic training programs and state the number, training preparedness, and fitness of personnel assigned to direct and implement the plan.

Guidance: The guidance had more detail about the type of training appropriate to maintain a level of readiness.

4.6.1 Existing rules as a baseline

The existing rules required that plans describe the type and frequency of spill response operations and safety training that each individual in a spill response position received to attain the level of qualification demanded by their job description, including safety training, training to minimize operational risks. The rules also stated that training records may be audited by Ecology.

4.6.2 Federal rules as baseline for training

There are federal standards for health and safety training, Incident Command System training, familiarity with regional and national plans, and operational training for oil transfer activities, as well as training for oil spill equipment use.

4.6.3 Anticipated change for training by the adopted rules

The new rules require that plan holders commit to the training of personnel to implement the plan and continue to require that the plan describe the type and frequency of training that each individual listed in the plan receives. The key difference between the existing and new rules is the inclusion of a list of specific training topics, as appropriate to the person receiving the training: Incident Command System, Northwest Area Contingency Plan policies, use and location of Geographic Response Plans, the contents of the plan and worker health and safety as appropriate. There is also a requirement that new employees complete the training program prior to being assigned job responsibilities which require participation in emergency response situations. The new rules also allow the verification of training records.

4.6.4 Current on-going costs and expected changes in costs of training

Training costs under the current rule, existing guidance, and current federal requirements are $4 million per year. This training would be necessary for either the state or the federal requirements and are therefore not a direct cost of the adopted rules. However, training is driven by the need to have experience working with the equipment, among other things. Therefore the percentage of equipment costs was applied to the total training costs as a mechanism for estimating this cost. This gives a cost of $1.7 million.

4.7 Overhead costs

Overhead costs such as insurance and indirect costs associated with management under the current rules and the federal requirements are $3.4 million per year. This cost would be necessary for either the state or the federal requirements and should not change. They are therefore not a cost of the adopted rules.

4.8 Summary of compliance costs

The total cost of the state requirements under the adopted rules are approximately $6.8 million per year. Most of these costs are for equipment that is added to existing federal requirements or, for vessels navigating the Columbia River, existing Oregon requirements.

Table 4

Items	State Requirements
Planning	
Equipment Annualized	$ 11,884,258
PRC & Letter of Agreement	$ 4,555,228
Drill Costs	$ (229,710)
Training	$ 1,764,455
Overhead	$ -
Other Costs	$ -
Total: Net out PRC Overlap*	$ 13,419,002

The present value of the total cost is $220 million. The present value is calculated based on a 20 year life span for the rule. The discount rate of 2.16% is based on average I bond rates for the last 8 years.

5.0 Net Benefits

In this chapter:

5.1 Quantitative Net Benefits

A reader may conclude that the rule amendment will yield quantitative net benefits if they believe one of the following:

- Citizens are willing to continue to pay approximately $6 per year through their fuel bills to cover the cost of the current level of cleanup preparedness, above the federal level.
- There is likely to be a large spill in the next 20 years and people across the country have a passive use value comparable to the value expressed in the Exxon Valdez passive use study.

Thus there is no clear net or loss. The range of benefits overlaps the cost estimate. The calculation is as follows:

- The probable costs of the rule are estimated to be $13.4 million per year with a present value of $220 million.
- The probable present value of the benefit of the rule is $40 million given a typical set of spills with a possible addition of $20 to $198 million in additional gains in the event of a major spill.
- The net ranges from minus $179 million to plus $18 million.

5.2 Ecology Determination of Net Benefits

Ecology believes, given the unquantified benefits described above, that the citizens of Washington would be willing to continue paying $6 per year in order to maintain the current level of response capability.

In preparing this CBA, Ecology evaluated the probable qualitative and quantitative costs and benefits that would accrue through implementation of the rules, as well as the specific directives of the Washington State statutes. This analysis finds that the probable quantitative costs of the adopted rule appear to outweigh the probable quantitative benefits, but not all costs and benefits can be quantified. Ecology has determined that the total probable benefits of the adopted rules that accrue to society as a whole outweigh the probable costs of implementation.

6.0 Least Burden Analysis

The adopted rules are both less burdensome for businesses and provide greater net benefits than various options considered in this rule making. The following are areas where savings can be gained over the current rules:

- No requirement to create a system for categorizing spills by size and type.
- No requirement to create a scenario within the plan for small and worst case spills.
- Allowing references to the Northwest Area Contingency Plan (NWACP) for environmental sensitivities (GRPs), disposal plan, ICS job descriptions, ICS process, and description of the relationships with other plans. Savings are gained by planning at the regional level, rather than requiring plan holders to meet this requirement individually.
- The ability to develop a single plan for both federal and state requirements. Encouraging the development of umbrella plans where costs can be shared.
- Responder equipment lists may be referenced from the response contractor applications and the Regional Equipment list (located at the Region 10 RRT web site).
- No requirement to describe and include the communication systems that the plan holder will use.
- Storage requirements maintained at the existing level, except at transfer locations and for pipeline companies. Allowing 50% of storage requirements to be met through shore side facilities and a higher percentage in inland areas where the banks of rivers may be narrower.
- Adopting a federal standard for shoreline cleanup.
- The options suggested by the environmental community were not selected because it would increase costs. In areas where there is sufficient equipment for compliance with the rule the suggested levels in this option would be met. In areas where there may be shortages at forecast speeds, it would cost a great deal to add the equipment. Finally it may make it difficult for companies to shift their storage sites.

Allowing for many options for sharing costs of drills (joint credit, out of state credit, credit for actual spill responses) that were successful in minimizing damages, reducing costs for federal drills by providing plan holders written evaluations and cross triennial cycle tracking of objectives.

Appendix 1: Crosswalk for Planning Standards

This table represents a simplification of the various regulatory standards and contains assumptions about oil type, spill size and facility type. B=4X means 4X length of vessel, S=2X means twice the recovery rate, etc.

Federal Standards	1 hr. at transfer locations	2 hr. at transfer locations	6 hr.	12 hr.	24/30 hr.	36 hr.	48/54 hr.	60/72 hr.
High Volume Port	AMPD	AMPD	Tier 1 = 15%		Tier 2 = 25%		Tier 3 = 40%	
Vessel	B= 2,000 feet	R=50K, S=100K		B=30K R=12.5K S=25K		B=30K R=25K S=50K		B=30 R=50K S=100K (60 hrs)
Facility	B= 2,000 feet	R=50K, S=100K	B =30K R =12.5K S=25K		B=30K R =25K S=50K (30 hrs)		B=30 R=50K S=100K (54 hrs)	
Non High Volume Port								
Vessel	B= 2,000 feet	R=50K, S=100K			B=30K R=12.5K S=25K (24 hrs)		B=30K R=25K S=50K (48 hrs)	B-30 R-50K S-100K (72)
Facility	B= 2,000 feet	R=50K, S=100K		B=30K R=12.5K S=25K		B =30K R=25K S=50K		B=30 R=50K S=100K (60 hrs)
Oregon Standards	1 hr. Resident	2 hr. Resident	6 hr. Resident or Adjacent	12 hr.	24 hr.	48 hr.		
Facility on Columbia River	B=4X	B=8X	R=10% or 12,000 bbls S=3X	B=35,000 or 15,000 non-persistent R=15% or 36,000 bbls S=3X	Boom as needed, R=20% or 48,000 bbls S=3X	R=25% or 60,000 bbls S=3X		
Vessels in Subzones 2, 3, 4	N/A	1000 feet on-site, 4X available	B=10,000 feet, R=2% or 12,000 bbl S=3X	B=40,000 feet, R=5% or 36,000 bbls S=3X	boom as needed 12% or 48,000 bbls S=3X	R=17% or 60,000 bbls S=3X		
Old Rule OR/WA	1 hr.	2 hr.	6 hr.	12 hr.	24 hr.	48 hr.	72 hr.	
Facility	B=4X	B=8X	R=10% or 12,000 bbls S=1X persistent, 5X non persistent	B=10 or 30,0000 R=15% or 36,000 bbls S=1X persistent, 5X non persistent	R=20% or 48,000 bbls S=1X persistent, 5X non persistent	R=25% or 60,000 bbls S=1X persistent, 5X non persistent		
Pipelines	case by case determination		R=10% or 12,000 bbls S=1X persistent, 5X non persistent	B=10,000 or 15,000 R=10% or 12,000 bbls S=1X persistent, 5X non persistent	Boom as needed R=20% or 48,000 bbls S=1X persistent, 5X non persistent	R=25% or 60,000 bbls S=1X persistent, 5X non persistent		
Vessels		B=4X overflight assessment for outer coast	B=10 or 20K, R=2% or 12000 S=1X	B=40,000 feet, R=3-5% or 36,000 bbls S=1.5X	boom as needed 12% or 48,000 bbls S=2X	R=17% or 60,000 bbls S=2-3X	R=20% or 72,000 bbls S=must keep up	

Appendix 1: Crosswalk for Planning Standards

New WA Proposed Rule	1.5 hr.	2 hr.	3 hr.	6 hr.	12 hr.	24 hr.	48 hr.	
Transfer locations	in oil transfer rule	in oil transfer rule		B=10000 feet R=10% or 12,500 bbls S=2X	B=Additional 20,000 feet 15% or 36000 bbls S=2X	B=additional 20,000 feet R= 20% or 48,000 S=3X	boom as needed R=25% or 60000 bbls S=as needed	
Transit locations			B= 1000 with boat	B=additional 10,000 feet R=3% or 12,000 bbls S=1X	B=Additional 20,000 feet R=10% or 36,000 bbls S=1.5	B=Additional 20,000 feet, R=14% or 48,000 bbls S=2X	boom as needed R=25% or 60000 bbls S=as needed	
Transmission pipelines	assessment	Boom use formula or 2000 feet		B= additional 5000 feet R = 10% or 12,500 bbls S=1X	B= Additional 20,000 feet R= 15% or 36,000 S=2X	Boom as needed R= 20% or 48,000 S=3X	boom as needed R=25% or 60000 bbls S=as needed	
San Juan		B= 1000 with boat resident	B =Additional 2,000 or 4X. Resident	B= Additional 10,000 feet R= 3% or 12,500 bbls S=1X	B= Additional 20,000 feet R= 10% or 36,000 bbls S=1.5	B = additional 20,000 feet, R= 14% or 48,000 bbls S=2X	boom as needed R=25% or 60000 bbls S=as needed	
Padilla Bay	B= 1000 with boat	B=Additional 2,000 or 4X		B= Additional 10,000 feet. R = 3% or 12,500 bbls, 50% in shallow water S=1X	B= Additional 20,000 feet R= 10% or 36,000, 20% in shallow water S=1.5	B =Additional 20,000 feet, R= 14% or 48,000 bbls S=2X	boom as needed R=25% or 60000 bbls S=as needed	
Commencement Bay	B= 1000 with boat	B= Additional 2,000 or 4X		B = Additional 10,000 feet R =3% or 12,500 bbls S=1X	B = Additional 20,000 feet R= 10% or 36,000 bbls S=1.5X	B= Additional 20,000 feet, R= 14% or 48,000 bbls S=2X	boom as needed R=25% or 60000 bbls S=as needed	
Nisqually		B= 1000 with boat	B= Additional 2,000 or 4X	B= Additional 12,000 feet 2,400 calm water – current. R= 3% or 12,500 bbls, 50% in shallow water S=1	B= Additional 20,000 feet 1000 calm water – current. R= 10% or 36,000 bbls 50% in shallow water S=1.5	B= Additional 20,000 feet, R= 14% or 48,000 bbls S=2X	boom as needed R=25% or 60000 bbls S=as needed	
Dungeness		B= 1000 with boat	B= Additional 2,000 or 4X	B= Additional 7,000 feet 3,000 feet open water. R= 3% or 12,500 bbls, 50% in open water S=1X	B= Additional 20,000 feet R= 10% or 36,000 bbls 50% open water S=1.5X	B= Additional 20,000 feet, R= 14% or 48,000 bbls S=2X	boom as needed R=25% or 60000 bbls S=as needed	
Neah Bay		B= 1000 with boat-resident	B= Additional 2,000 or 4X resident	B= Additional 6000 feet 4000 open water R= 3% or 12,500 bbls 100% open ocean S=1X resident	B= Additional 20,000 feet R= 10% or 36,000 bbls 60% open water S=1.5X	B= Additional 20,000 feet, R= 14% or 48,000 bbls S=2X	boom as needed R=25% or 60000 bbls S=as needed	

Appendix 1: Crosswalk for Planning Standards

New WA Proposed Rule	1.5 hr.	2 hr.	3 hr.	6 hr.	12 hr.	24 hr.	48 hr.	
Copalis		B= 1000 with boat	B=Additional 2,000 or 4X	B= Additional 12,000 feet 6,000 feet open water. R= 3% or 12,500 bbls 100% open water S=1X	B= Additional 20,000 feet R= 10% or 36,000 bbls 60% open water S=1.5X	B= Additional 20,000 feet, R= 14% or 48,000 bbls S=2X	boom as needed R=25% or 60000 bbls S=as needed	
Grays Harbor		B= 1000 with boat	B= Additional 2,000 or 4X	B= Additional 6000 feet 2000 feet open water 3000 calm water current. R= 3% or 12,500 bbls 25% shallow water S=1X	B= Additional 20,000 feet R= 10% or 36,000 bbls 50% open water, 25% shallow water S=1.5X	B= Additional 20,000 feet, R= 14% or 48,000 bbls S=2X	boom as needed R=25% or 60000 bbls S=as needed	
Willapa		B= 1000 with boat	B= Additional 2,000 feet of boom, or 4 times	B= Additional 10000 feet 6000 calm water current. R= 3% or 12,500 bbls 10% shallow water S=1X	B= Additional 20,000 feet 1000 calm water current. R= 10% or 36,000 bbls 50% open water 25% shallow water S=1.5X	B= Additional 20,000, R= 14% or 48,000 bbls, S=2X	boom as needed R=25% or 60000 bbls S=as needed	
Cathlamet		B= 1000 with boat resident	B= Additional 2,000 or 4X resident	B= Additional 7,000 feet 4,200 feet calm water – current R= 3% or 12,000 bbls 10% shallow water S=1X	B= Additional 20,000 feet, 5,000 calm water – current R= 10% or 36,000 bbls, 25% open water, 25% shallow water S=1.5X	B= Additional 20,000, 10,000 calm water – current. R= 14% or 48,000 bbls, 25% open water S=2X	boom as needed R=25% or 60000 bbls S=as needed	
Vancouver		B= 1000 with boat	B= Additional 2,000 or 4X	B= Additional 6000 feet 3000 calm water current. R= 3% or 12,000 bbls 10% shallow water S=1X	B= Additional 20,000 feet, 5,000 feet of calm water – current capable.R= 10% or 36,000 bbls, 25% shallow water S=1.5	B= Additional 20,000, 10,000 calm water – current. R= 14% or 48,000 bbls, S=2X	boom as needed R=25% or 60000 bbls S=as needed	
Tri Cities		B= 1000	B=Additional 2,000 or 4X	B= Additional 8000 feet 4800 calm water current. R= 3% or 12,000 bbls 10% shallow water S=1X	B= Additional 20,000 feet, 5,000 feet of calm water – current capable. R= 10% or 36,000 bbls, 25% shallow water S=1.5X	B= Additional 20,000, 10000 calm water – current. R=14% or 48,000 bbls, S=2X	boom as needed R=25% or 60000 bbls S=as needed	

Appendix 2: Natural Resource Damage Assessment Modeling

Introduction

The purpose of this appendix is to estimate the relationship between Natural Resource Damage Assessment (NRDA) and the total amount of light or heavy oil spilled on water. This document shows this relationship based on the currently available data. Ecology will accept additional data during the comment period.

Data Overview and Analysis

For this analysis data was collected from numerous on-line sources. Data collected consists of: spill name, spill location, date of the spill, amount of substance spilled, type of substance and NRDA cost. Spills ranged from 25 gallons to millions of gallons. Only spills with NRDA data were considered. Spills took place from 1984 to 2006. Most data was collected from government sources. All the cost data was converted to July 2006 dollars using the CPI[1]. Majority of the spills were small, which makes sense since the probability of a large spill such as Exxon Valdez repeating in a single year is low (refer to Probability of large spill.xls[2]). The data used in this analysis is constrained by numerous factors, which should be taken into account while interpreting the resulting statistics.

- **Sample size**: The number of spills is limited. NRDA cost information is difficult to find, many spill cases have been settled out of court keeping the information private. Responsible parties are not obligated to disclose cost information.

- **Human error and rounding**: Even though most of the spill data was found on government websites, the possibility of human error and omission is possible. Some spill quantities or NRDA costs were rounded (when comparing different sources).

- **Conversion inaccuracies:** Some spills only had barrels spilled information, which needed to be converted to gallons spilled. A standard 42gallons/barrel[3] multiplier was used.

- **Data limitations**: Data on the context of most spills is limited. Analysis was only done on the spill size, NRDA cost and NRDA/g cost. This analysis does not directly take into account if the spill occurred in an ecologically sensitive

[1] ftp://ftp.bls.gov/pub/special.requests/cpi/cpiai.txt
[2] Probability of large spill.xls
[3] http://en.wikipedia.org/wiki/Barrel

area, which had endangered species, or not, the percent of the oil successfully cleaned up on the water, or the level of cleanup mounted.

- **Consistency of NRDA costs with time**: Some of the spills in the data sample occurred in the early 80's and some in the mid 90's. The change of procedures in the NRDA and oil spill response over time can have an effect on costs. This effect is not accounted for in the analysis.

- **NRDA Value based on rule**: Many of the spills in the data sample were evaluated using WAC 173-183. This is only used when spills are smaller and when there is no unusual circumstance and therefore all parties can agree to its use. This data has a marked impact on the conclusions of the analysis for heavy oil.

Therefore, the analysis presented should only be considered as illustrating broad trends.

Ecology selected spills that met the following criteria for analysis.

- Spills which occurred in the United States.

- Spills which had available data for NRDA.

- Spills which could be distinguished by location and type of material spilled.

After filtering through all the spills[4], 430 spills[5] remained for analysis (75 spills were left out). These 430 spills were used to generate 14 variables[6] (east coast spill, west coast spill, heavy oil, light oil, quantity of light oil, quantity of heavy oil, quantity of all oils, NRDA costs, NRDA per gallon costs, and also natural logs of the previous five categories). Natural log of NRDA was regressed on the natural log of quantity of oil spilled (See Table I a for the results of the regression), and then on natural log of light oil spilled (See Table I b for the results of the regression) and natural log of heavy oil spilled (See Table I c for the results of the regression). Results from all three regressions came back statistically significant.

Using the results from the regression (lnNRDA on lnQuantity) two equations were derived. One equation was used to estimate NRDA, and the other equation was used to estimate NRDA/g.

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[4] CompiledData.xls, SpillInfo.xls, RDASpillsMore.xls
[5] NewAnalysis (version 1).xls
[6] CompiledDataAnalysisUpdate.xls, NewAnalysis (version 1).xls

1. NRDA equation:

$$y = 10.97250248 * x^{1.022165225}$$

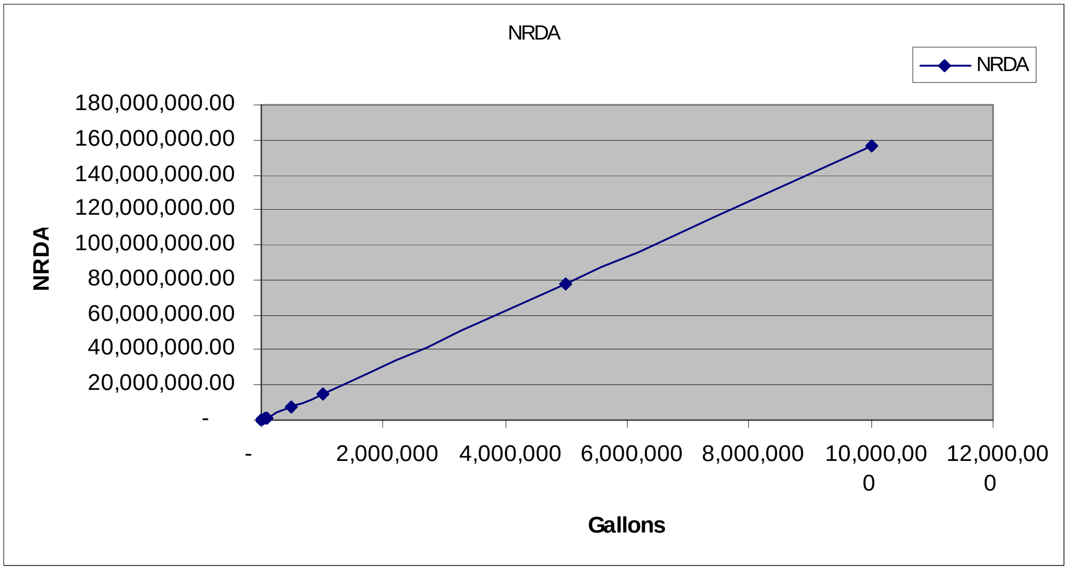
Where y = NRDA, x = quantity of oil.

2. NRDA/gallon equation:

$$y = 10.97250248 * x^{0.022165225}$$

Where y = NRDA/g, x = quantity oil.

Graph 1. NRDA. All oil.

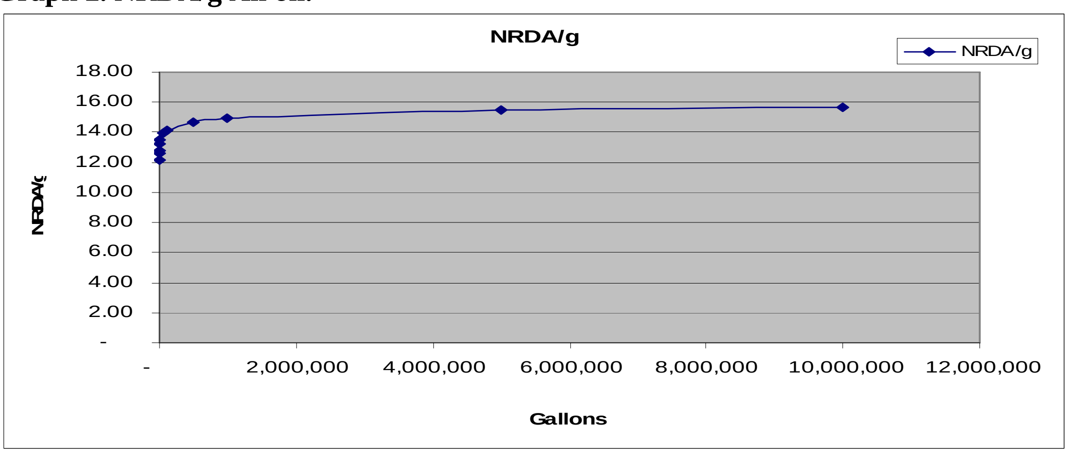


Using equation 1, the following graph can be calculated..

The oil quantities used can be found in Table II a.

This table demonstrates that as more oil is spilled the higher is the NRDA cost. The NRDA increase is almost linear in the graph. As the size of the oil spill increases, the NRDA cost increases, but at a diminishing rate. This diminishing rate is very low, allowing the relationship to look linear. The maximum spill size for this data was 12,000,000 gallons, and the regression should not be viewed as valid beyond this value because there are no real data points in the sample to compare results with.

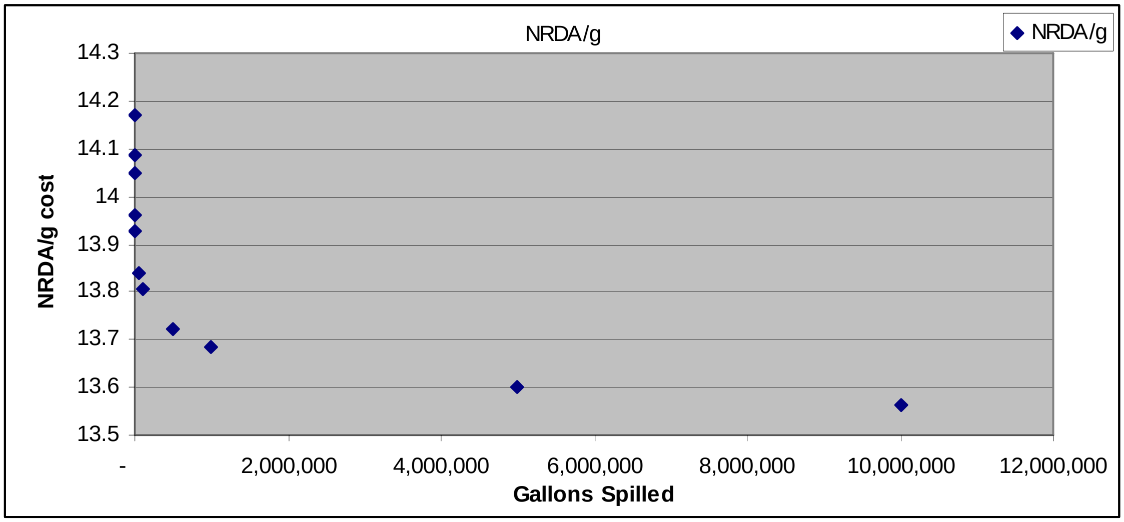
Graph 2. NRDA/g All oil.



Using equation 2, for heavy oil, the following graph (Graph 2) can be calculated.

The oil quantities used can be found in Table II b.

Graph 3. NRDA/g (original 104 spills) All oil.



This graph demonstrates that as more oil is spilled the NRDA/g cost increases. As you can see on the graph, there is a rapid increase in NRDA/g costs with low amounts of oil spilled, and then a slower increase in NRDA/g costs with larger spills. The maximum spill size for this data was 12,000,000 gallons, and the regression should not be viewed as valid beyond this value because there are no real data points in the sample to compare results with. This result is very different from the original analysis (Graph 3), which demonstrated that there was a rapid decrease in NRDA/g costs with low amounts of oil spilled, and then a slower decrease in NRDA/g costs with larger spills. This variation can be explained by the increase of the sample size of spills. Additional 330 oil spills were added to the analysis, providing a larger data sample. However this data is based on NRDA awards under WAC 173-183. The law is generating a different range of values than full NRDA which involves extensive scientific investigations. A further reason for the variation is that the 330 new spills were all post 1991, at which time new laws and regulations where implemented.

Two more regressions were run to see the effect light and heavy oil had on NRDA. Using the results of the light oil regression (lnNRDA on lnLight), two equations were derived. One equation was used to estimate NRDA, and the other equation was used to estimate NRDA/g.

3. NRDA equation for light oil:

$$y = 19.86918973 * x^{0.8680795}$$

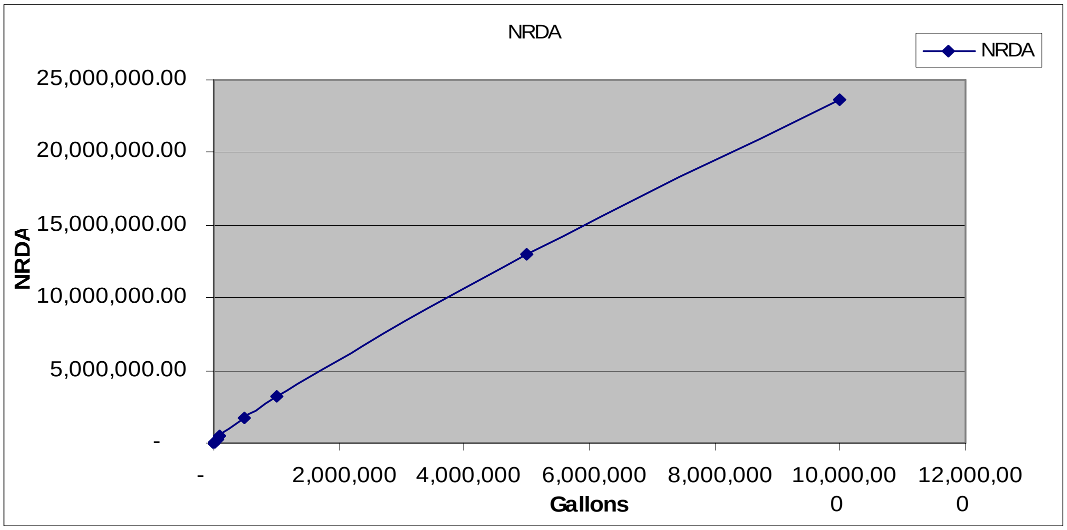
Where y = NRDA, x = quantity of light oil.

4. NRDA/gallon equation for light oil:

$$y = 19.86918973 / x^{0.1319205}$$

Where y = NRDA/g, x = quantity light oil.

Graph 4. NRDA. Light oil.

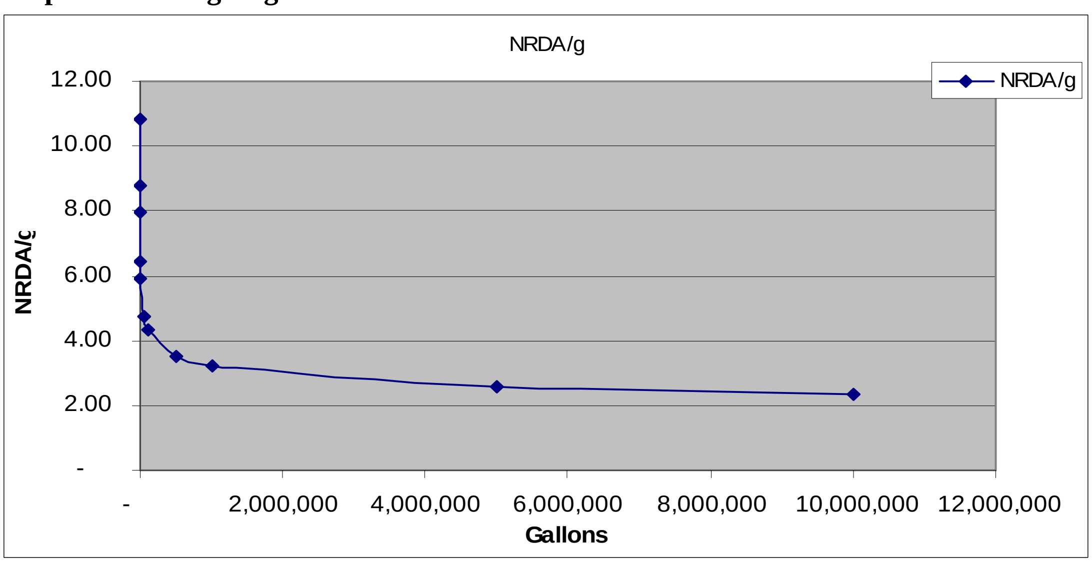


Using equation 3, the following graph can be calculated.

The oil quantities used can be found in Table II c.

This table demonstrates that as more oil is spilled the higher is the NRDA cost. The NRDA increase is almost linear in the graph. As the size of the oil spill increases, the NRDA cost increases, but at a diminishing rate. This diminishing rate is very low, allowing the relationship to look linear. The maximum spill size for this data was 12,000,000 gallons, and the regression should not be viewed as valid beyond this value because there are no real data points in the sample to compare results with.

Graph 5. NRDA/g. Light oil.



Using equation 4, for heavy oil, the following graph can be calculated.

The oil quantities used can be found in Table II d.

This graph demonstrates that as more oil is spilled the NRDA/g cost decreases. As you can see on the graph, there is a rapid decrease in NRDA/g costs with low amounts of oil spilled, and then a slower decrease in NRDA/g costs with larger spills. The maximum spill size for this data was 12,000,000 gallons, and the regression should not be viewed as valid beyond this value because there are no real data points in the sample to compare results with. This result is very different from the regression, which regresses NRDA on the quantity of oil spilled. There are several reasons for this discrepancy. First, light oil disperses and evaporates much quicker than heavy oil, leaving less chance to get on shore and cause more damage. Second, our sample contains 430 total spills, of which only 30 are light oil spills, which is only about 7% of the sample, the rest is comprised of heavy oil.

Using the results of the heavy oil regression (lnNRDA on lnHeavy), two equations were derived. One equation was used to estimate NRDA, and the other equation was used to estimate NRDA/g.

5. NRDA equation for heavy oil:

$$y = 10.51386807 * x^{1.034277908}$$

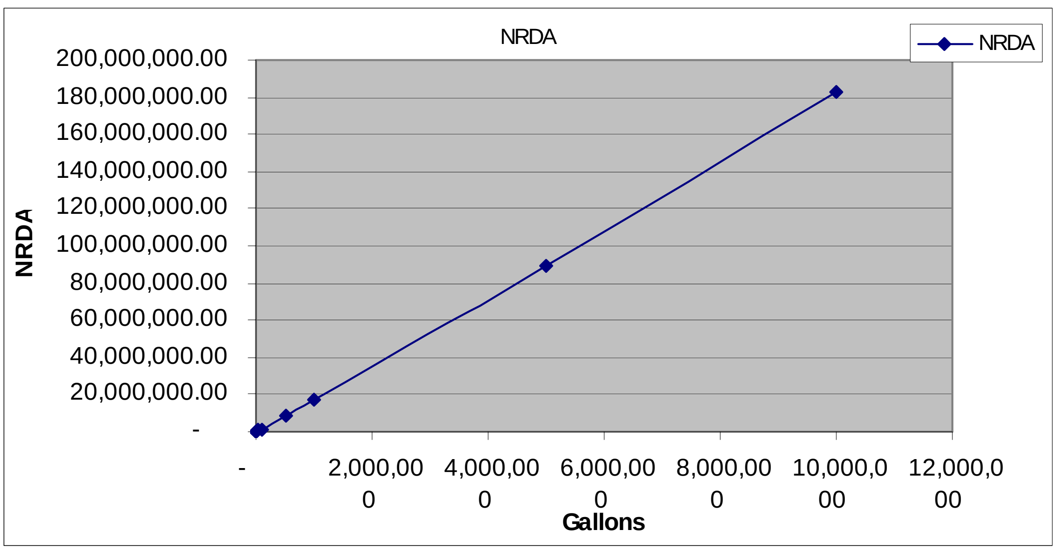
Where y = NRDA, x = quantity of heavy oil.

6. NRDA/gallon equation for heavy oil:

$$y = 10.51386807 * x^{0.034277908}$$

Where y = NRDA/g, x = quantity of heavy oil.

Graph 4. NRDA. Heavy oil.

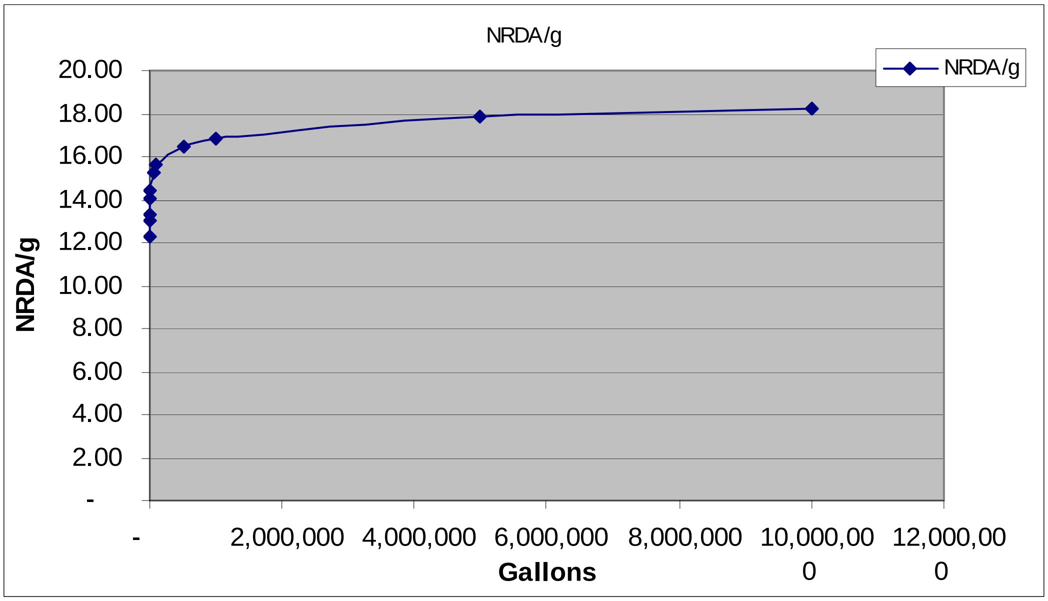


Using equation 5, the following graph can be calculated.

The oil quantities used can be found in Table II e.

This table demonstrates that as more oil is spilled the higher is the NRDA cost. The NRDA increase is almost linear in the graph. As the size of the oil spill increases, the NRDA cost increases, but at a diminishing rate. This diminishing rate is very low, allowing the relationship to look linear. The maximum spill size for this data was 12,000,000 gallons, and the regression should not be viewed as valid beyond this value because there are no real data points in the sample to compare results with.

Graph 5. NRDA/g. Heavy oil.



Using equation 6, for heavy oil, the following graph can be calculated.

The oil quantities used can be found in Table II f.

This graph demonstrates that as more oil is spilled the NRDA/g cost increases. As you can see on the graph, there is a rapid increase in NRDA/g costs with low amounts of oil spilled, and then a slower increase in NRDA/g costs with larger spills. The maximum spill size for this data was 12,000,000 gallons, and the regression should not be viewed as valid beyond this value because there are no real data points in the sample to compare results with. This result is very different from the light oil regression. There are several reasons for this discrepancy. One of them is that heavy oil does not disperse and evaporates as quickly as light oil, leaving more chance to get on shore and cause more damage.

Model Validity

The results that were provided by these regressions were statistically significant. The R squared residual for the all oils quantity regression was .85, .82 for the light oil regression and .85 for the heavy. R Squared is the relative predictive power of a model as measured by explained variance. R squared is a descriptive measure between 0 and 1. The closer it is to 1, the greater your ability to predict. The t-statistic came up significant for both variables in all three regressions: 19.18 and 49.05 in the all oils regression, 6.12 and 11.22 for the light oil regression, and 18.32 and 48.06 for the heavy oil regression. The F statistic was 2405.71 for the all oils regression, 125.81 for the light oil regression and 2310.06 for the heavy oil regression, while significance f (also known as the p-value) was 8.8344E-178 for all oils, 7.19774E-12 for the light and 8.2015E-168 for the heavy, which means all the models were significant.

Conclusion

The data used in this analysis is constrained by numerous factors, previously listed, which should be taken into account while interpreting the resulting statistics. Therefore, the analysis presented should only be considered as illustrating broad trends. The analysis performed shows that as the quantity of oil spilled increases, the NRDA increases almost linearly with a slight diminishing rate for both light and heavy oils. The analysis also shows that as the quantity of oil spilled increases, the NRDA/g costs decreases at a diminishing rate for the light oil, and increases at a diminishing rate for the heavy oil.

TABLE I

Regression: (a)

lnNRDA on lnQuantity.

Regression Statistics	
Multiple R	0.921391
R Square	0.848961375
Adjusted R Square	0.848608481
Standard Error	1.006769574
Observations	430

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	2438.39378	2438.39378	2405.712239	8.8344E-178
Residual	428	433.8143693	1.013584975		
Total	429	2872.208149			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*
Intercept	2.395392369	0.12485918	19.18475169	1.20087E-59	2.149978898
ln Quantity	1.022165225	0.020840074	49.0480605	8.8344E-178	0.9812036

Upper 95%	*Lower 95.0%*	*Upper 95.0%*
2.640805839	2.149978898	2.640805839
1.06312685	0.9812036	1.06312685

Regression: (b)

lnNRDA on lnLight

Regression Statistics	
Multiple R	0.904412875
R Square	0.817962649
Adjusted R Square	0.811461315
Standard Error	0.933462806
Observations	30

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	109.6288942	109.6288942	125.8145872	7.19774E-12
Residual	28	24.39787869	0.87135281		
Total	29	134.0267728			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	2.989170277	0.488353489	6.120915167	1.32266E-06	1.988823516	3.989517038	1.988823516	3.989517038
ln Light Q	0.8680795	0.077391631	11.21671018	7.19774E-12	0.709549932	1.026609069	0.709549932	1.026609069

Regression: (c)
lnNRDA on lnHeavy

Regression Statistics	
Multiple R	0.923596852
R Square	0.853031145
Adjusted R Square	0.852661876
Standard Error	1.005503915
Observations	400

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	2335.55544	2335.55544	2310.056748	8.2015E-168
Residual	398	402.3931733	1.011038124		
Total	399	2737.948614			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	2.352695154	0.128398572	18.32337473	8.00453E-55	2.100270976	2.605119332	2.100270976	2.605119332
ln Heavy Q	1.034277908	0.02151919	48.06304971	8.2015E-168	0.991972422	1.076583393	0.991972422	1.076583393

TABLE II

(a) NRDA		
y =	10.97250248	*x^1.022
x	NRDA	
100	1,215.17	
500	6,296.50	
1,000	12,787.96	
5,000	66,261.95	
10,000	134,575.68	
50,000	697,315.66	
100,000	1,416,223.55	
500,000	7,338,286.19	
1,000,000	14,903,800.84	
5,000,000	77,225,347.31	
10,000,000	156,841,960.92	
(b) NRDA/g		
y =	10.97250248	*x^.022
x	NRDA/g	
100	12.15	
500	12.59	
1,000	12.79	
5,000	13.25	
10,000	13.46	
50,000	13.95	
100,000	14.16	
500,000	14.68	
1,000,000	14.90	
5,000,000	15.45	
10,000,000	15.68	
(c) NRDA		
y =	19.86918973	*x^.868
x	NRDA	
100	1,082.28	
500	4,376.24	
1,000	7,987.64	
5,000	32,298.34	
10,000	58,951.95	
50,000	238,374.44	
100,000	435,088.55	
500,000	1,759,297.12	
1,000,000	3,211,124.61	
5,000,000	12,984,304.50	
10,000,000	23,699,362.29	

(d) NRDA/g		
y =	19.86918973	/x^.132
x	NRDA/g	
100	10.82	
500	8.75	
1,000	7.99	
5,000	6.46	
10,000	5.90	
50,000	4.77	
100,000	4.35	
500,000	3.52	
1,000,000	3.21	
5,000,000	2.60	
10,000,000	2.37	
(e) NRDA		
y =	10.51386807	*x^1.034
x	NRDA	
100	1,231.17	
500	6,505.00	
1,000	13,322.82	
5,000	70,392.35	
10,000	144,169.75	
50,000	761,734.08	
100,000	1,560,098.65	
500,000	8,242,923.97	
1,000,000	16,882,236.04	
5,000,000	89,198,838.96	
10,000,000	182,687,097.36	
(f) NRDA/g		
y =	10.51386807	*x^.034
x	NRDA/g	
100	12.31	
500	13.01	
1,000	13.32	
5,000	14.08	
10,000	14.42	
50,000	15.23	
100,000	15.60	
500,000	16.49	
1,000,000	16.88	
5,000,000	17.84	
10,000,000	18.27	

NRDA Data References:

1. EstimatedDataNotCoveredCharts25gak.xls - Dagmar Schmidt Etkin's data with Washington spills starting at 25 gallons.
2. ftp://ftp.bls.gov/pub/special.requests/cpi/cpiai.txt - Consumer Price Index historical data.
3. http://www.darrp.noaa.gov/library/pdf/costsofs.pdf (p.21-22) - spill info for some of the spills.
4. http://www.uscg.mil/hq/g-m/nmc/gendoc/coop.pdf (p.14) - Nautilus NRDA information.
5. http://www.astswmo.org/Working%20Folder%20with%20Publications%20-%20Sept.%2026%202005/nrdsur.txt - Presidente Rivera NRDA info.
6. http://fs1.fbo.gov/EPSData/DOC/Synopses/3055/50-DSNC-1-90013/CvrLtrtoAmend001-90013.pdf - World Prodigy NRDA info.
7. http://en.wikipedia.org/wiki/Barrel - conversion data for gallons per barrel of oil.
8. http://www.dfg.ca.gov/ospr/organizational/scientific/nrda/NRDA.htm - links to the California NRDA and spill data.
9. http://www.prbo.org/cms/docs/marine/CCS%20Plan_chpt%207_web.pdf (p.173) - Torch/Platform Irene spill volume data.
10. http://www.etc-cte.ec.gc.ca/databases/TankerSpills/Default.aspx - Lists of spills around the world.
11. Probability of large spill.xls – calculates the probability of a large spill occurring.
12. CompiledData.xls – Compiled lists of spills.
13. CompiledDataAnalysisUpdatedRegression.xls – Compiled lists of spills with regression analysis.
14. SpillsInfo.xls – Additional list of spills, includes spills which were not used in the analysis.
15. http://www.ecy.wa.gov/programs/spills/preparedness/RDA%20web%20page%20report-by%20date.pdf – New added spills.
16. RDASpillsMore.xls - List of compiled and edited spills.

Appendix 3: Drill Comparison

Federal Standards	Self certification or Agency Evaluation	QI notification	Emergency Procedures	Spill Management Team tabletop-evaluation based on 15 core components	Facility owned equipment deployment, using operators and representative samples of equipment	OSRO equipment deployment 1000 feet of each type of boom in the inventory. One of each type of skimming system.	Internal unannounced	Government initiated unannounced	credit for spill response
Vessels	self certification	quarterly	quarterly	annually		annually	annually one of the exercises must be unannounced	annually with no repeat for 36 months	yes
Facility	self certification	quarterly	optional	annually	facility owned equipment semi-annually	facilities with osro equipment annually	annually one of the exercises must be unannounced	annually with no repeat for 36 months	yes
Pipelines	self certification	quarterly	quarterly	annually	facility owned equipment semi-annually	facilities with osro equipment annually	annually one of the exercises must be unannounced	annually with no repeat for 36 months	yes
Oregon Standards		Oregon may require plan holders of approved plans to participate in one announced drill or one unannounced limited drill annually.							
facility	self certification								
Vessels	self certification								
Pipelined	self certification								
Existing WA Rule		Plan holders may be required to participate in one unannounced full deployment drill annually. Plan holders may be required to participate in one announced, limited deployment drill annually NOTE: A FULL-SCALE EXERCISE as described in USDOT PREP guide means: A full-scale exercise is used to evaluate a response organization's total, integrated, operational capabilities, involves all levels of the organization and could involve all aspects of a response operation (e.g., notification, assessment, initial response, recovery, disposal, etc.). Many area exercises conducted under PREP would be considered full-scale exercises. Full-scale exercises are designed to mirror real-life incidents as closely as possible. This type of activity enables the organization to validate a multitude of functions and teams, as well as to evaluate the interaction and coordination among the participants. The purpose of a full-scale exercise is to exercise the range of response functions in a response plan to the maximum extent practical. A full-scale exercise will incorporate a high degree of realism, extensive involvement of personnel and resources, and an increased level of stress on player participants. This type of exercise would include mobilization of personnel and resources to different sites, and the actual movement of these resources and personnel required to demonstrate coordinated response capability. As with functional exercises, this type of activity should include operations and coordination among policy level personnel, but with a much broader participation. The extent of involvement and mobilization will be determined by the design, scope and objectives of the exercise.							
Facility	evaluation								
Pipelines	evaluation								
Vessels	evaluation								

Appendix 3: Drill Comparison

New WA Proposed Rule	Self certification or evaluation	Spill Management Team tabletop- evaluation based on 15 core components	Worst case tabletop, exercise entire plan	deployment drills	GRP deployment	internal unannounced	government initiated unannounced	scheduled inspections	credit for spill response/pre-booming
Vessels	evaluation	annually	once every three years	semi annually	twice out of every six deployment drills	encouraged	either randomly or when specific problems are noted with individual plan holders		yes
Facilities	evaluation	annually	once every three years	semi annually	twice out of every six deployment drills	encouraged	either randomly or when specific problems are noted with individual plan holders		yes
Pipelines	evaluation	annually	once every three years	semi annually	twice out of every six deployment drills	encouraged	either randomly or when specific problems are noted with individual plan holders		yes
PRCs								all response equipment listed in the plan will be surveyed, assessed, verified, inspected or deployed within the first 6 years	