Documentation and Analysis of the Rayong Oil Spill

Characterizing the health, economic, and social impacts of the incident and response

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Characterizing the Health, Economic, and Social Impacts of the Incident and Response

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Abstract

Our goal was to identify the key characteristics associated with a decrease in trust or increase in perceived risk between local businesses and the company at fault for the Rayong Oil Spill. We found that the fishing and tourism industries experienced negative economic impacts. The company's lack of corporate transparency and inconsistent monetary compensation led to decreased trust and increased risk associated with long-term impacts. Future researchers can expand our research to improved oil spill response protocols in the future.

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Authorship Page

Athena Casarotto, Wongsathorn Jiraphanvanich, Amy Kampa, Waranya Limpiwattakee, Pimchaya Luangaramvej, James Whyte, and Cody Woodard-Wallace all participated in the outlining, writing, and editing of each section in this final report. The following breakdown lists the primary authors and editors of each section. The authors drafted most of the text in each corresponding section and the editors contributed with revisions of grammar, voice, content, and formatting.

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Executive Summary

On 27 July 2013, a pipeline owned by the Petroleum Authority of Thailand, Global Chemical Plc. (PTTGC) leaked crude oil into the Gulf of Thailand off the coast of Koh Samet, a popular tourist island in Mueang Rayong District of the Rayong Province. Tourists in the area were evacuated and emergency response teams entered the affected areas. Dispersants, chemicals that break up oil, were applied to the oil spill, causing much of the oil to mix with the seawater and sink to the bottom of the ocean. The remaining oil flowed to Ao Phrao, a popular tourist beach on Koh Samet, where clean-up crews worked to remove the oil. While the aesthetic condition of the beach was restored by clean up teams within the first two weeks, the health, social, and economic impacts still affect local communities currently --six months after the spill.

Our team worked under sponsorship from the School of Global Studies at Thammasat University to report the environmental, health, and economic impacts and environmental damage associated with the Rayong Oil Spill. We focused on the level of trust felt by business owners in Mueang Rayong District and their perceived risk for harm in the event of another spill.

Background

Oil spills negatively impact the economy through the destruction of natural resources and livelihoods of the people in contaminated areas. Local merchants and businesses suffer due to loss of tourism until the coastal environment and the reputation of the area can be restored. In Mueang Rayong District, the tourism industry on Koh Samet draws consumers to the area and promotes economic growth in the entire district. Sought by tourists and restaurants in Thailand, seafood from the Rayong area is a valued commodity. Besides tourism and fishing, Rayong Province is a major industrial hub for Thailand with multiple chemical companies, processing plants, and factories. Chemical spills and hazardous materials are a major concern of the area and have affected community members in the past. After the oil spill, the tourism and fishing industries suffered due to consumers' concern over contaminated beaches and seafood.

PTTGC used dispersants to control the oil slick. While the dispersant used, Slickgone NS, was approved by the government, media coverage and community concern has focused on the potential for long term contamination in the area due to residual oil and dispersants in the ocean. In 2010, a similar dispersant was used in response to the Deepwater Horizon Oil Spill and has been associated with cancer and other serious health impacts. Community members

have raised concerns over the amount of information shared by PTTGC about the amount of oil spilled and the procedure in which dispersants were added.

Goal and Objectives

The goal of this project was to identify the key characteristics that may have caused a decrease in trust or increase in perceived risk between the local businesses and PTTGC. To complete this goal we determined the most significant impacts to community members based on interviews we conducted. We determined the influence of the incident on industries in Mueang Rayong District such as local fishermen, resort and restaurant owners, and tourism service providers. We determined how the perception of the area's safety by tourists and locals has been changed by the oil spill and how this has impacted the economy and trust felt toward PTTGC.

Our goal was achieved by completing of the following objectives:

1. Determine how community members were economically affected by the oil spill.
2. Determine how the health of community members was affected by the oil spill.
3. Determine the actions that were done to help community members.
4. Determine what information was available to community members.
5. Determine the perceived risk for impacts from a future oil spill.
6. Determine the trust between impacted populations and PTTGC.

Methodology

Interviews with local business owners were completed in two trips to Mueang Rayong District where the oil spill occurred. Interviews captured an overview of existing economic and health impacts, the level of trust felt towards PTTGC, and the perceived risk associated with a future oil spill. We assessed the health impacts using data from the Rayong Provincial Health Office and through interview questions given to business owners. To analyze risk and trust, we asked participants to describe their trust in PTTGC and to describe their level of perceived risk of impacts after another oil spill in the future. We determined the public perception of PTTGC by completing a sentiment analysis of posts related to the spill from the first four months after it occurred. Twitter posts were analyzed for positive and negative sentiment and used to determine how the attitude associated with the oil spill evolved. Additionally, we posted questions on Pantip, a Thai Internet forum, to determine the reasons tourists did not return. To gain in-depth information about the response process coordinated by PTTGC, the impacts that emerged, and the current concerns, we interviewed authority figures associated with the

Ministry of Natural Resources, fishing villages, the Ban Phe subdistrict, Small Fisheries, Rayong Tourism Association, and Greenpeace. The interviews with authority figures provided necessary background information to the interviews we conducted with local business owners.

Findings and Conclusions

We developed the following findings in completing our interviews and research of the oil spill:

Short-term health impacts minor; long-term health impacts are unknown.
We determined from health data and interviews that the majority of community members did not experience symptoms related to crude oil and dispersant exposure. The long-term health impacts have not yet emerged and are unknown.

Quantity of seafood was impacted by contamination.
Fishermen village leaders described a decrease in the amount of fish available for them to harvest. This combined with difficulty of selling the fish to consumers who are concerned with contamination is causing significant economic hardships.

Media caused a large impact on the local economy.
Local business owners stated that the media coverage of the oil spill, especially the contamination of seafood and the environment, caused decreased consumer confidence.

Business owners feel they would be more affected if another spill occurred.
Many of the business owners we interviewed said that the impacts from another oil spill would be worse due to the lasting impacts of the oil spill on 27 July. While many of the business owners believe another oil spill not likely to occur, many of the authority figures were less confident in the ability of PTTGC to prevent oil spills.

The amount of information shared by PTTGC about the compensation and the volume of oil spilled are a concern.
The compensation allotted by PTTGC for each type of affected community member was not outlined publicly. Compensation amounts distributed by PTTGC were inconsistent within each industry and business owners reported that some community members manipulated the system to receive unwarranted compensation. The company reported that 54,350 liters of oil were

spilled, but a variety of calculation methods conclude much larger amounts.

Residual oil and environmental damage is a cause of decreased trust in the response process.

Fishermen were especially concerned about residual contamination caused by the dispersed oil in the ocean. They believe the contamination issue will not be properly addressed since the plans for long-term rehabilitation have not yet been adequately described by PTTGC.

The analysis of our collected data led to conclusions about the impacts of the oil spill that affected the trust and risk felt by local business owners towards PTTGC. We developed the following conclusions:

Causes of a decrease in trust of PTTGC:

- Lack of corporate transparency
- Inconsistent monetary compensation plan
- Long-term impacts unaddressed by current response methods

Causes of an increase in perceived risk:

- Long-term impacts are unknown
- Reduction in local economic activity
- Long-term impacts unaddressed by current response methods
- Plans to prevent future incidents have not been publicized

Recommendations

Our documentation of the factors that affected the communal trust of PTTGC and the perceived risk of further impacts can provide future researchers with necessary insight into the human dimension impacts of oil spills and the response process. We have defined areas to focus further research that can be used to plan future response methods. Areas of recommended research include: long term environmental, economic, and health impacts; response procedure modifications; assessing trust and risk; and information dissemination.

From this research, response methods can be improved to predict the concerns of the affected community. This project focused on public opinion and determining human dimension impacts. While we have identified areas where PTTGC has fallen short, the focus of our project is documentation of the human dimension impacts.

Chapter 1: Introduction

Society's dependence on oil is a controversial subject. Accidents in the oil industry can produce harmful environmental effects and are common topics of debate. The environmental well-being of coastal regions in particular is directly linked to these regions' socio-economic stability, and they can suffer greatly from marine-based oil spills. Former US Vice President Al Gore wrote about long-term impacts of oil spills following the Deepwater Horizon Oil Spill in the Gulf of Mexico, stating that effects include "the loss of jobs in the fishing and tourism industries; the destruction of the health, vitality, and rich culture of communities in the region; imminent bankruptcies; vast environmental damage expected to persist for decades; and the disruption of seafood markets nationwide" (Gore, 2010, para. 3). Water pollution impacts marine plants and animals and causes environmental damage that leads to serious economic, health, and social issues.

On 27 July 2013, a pipeline owned by PTT Global Chemical, Plc. (PTTGC) a flagship company of the Thai state-owned oil company Petroleum Authority of Thailand (PTT), ruptured while transferring oil from an undersea reservoir to a tanker. The epicenter of this oil leakage was located in the Gulf of Thailand, 35 kilometers from Ao Phrao beach on Koh Samet. This incident led to the rapid evacuation of locals and tourists in the area and eventually resulted in closure of Ao Phrao beach for revitalization. PTTGC and members of the Thai Navy worked at Ao Phrao beach to bring the area back to its original aesthetic conditions. At sea, dispersants were added to the oil to keep it from spreading further.

Many factors need to be considered in planning response methods to oil spills, but the initial response tends to focus on preventing environmental damage before planning ways to support affected community members (IOTPF, 2013; PTTGC, 2013). Ideally, responding agencies and the oil company would communicate potential hazards of the oil spill to all community members and potential visitors of the affected area and also provide economic assistance to locals (Webler et. al., 2010). Transferring information to community members in an efficient and effective fashion is a challenging yet essential task.

The inhabitants of coastal areas affected by the Rayong Oil Spill currently face a weakened economy, loss of nature-based cultural values (Sarnsamak, 2013; Wangkiat, 2013), and mistrust in data that were reported (Fuller, 2013). These communities have an economic or close geographic relationship to the oil spill and are most at risk for a reduced quality of life if the consequences of the spill are not addressed. The risks for a decreased quality of life caused by

oil spills should be determined to help understand how oil spills endanger communities and how relief should best be distributed in affected areas to maximize trust felt towards the authority figures. The School of Global Studies at Thammasat University has identified this gap in response planning and information outreach as areas needing further study.

Information published by the media can have a direct impact on the local community. Controversies emerge around unknown response procedures as outlined in the coverage of past oil spills like the Deepwater Horizon Oil Spill. After the Rayong Oil Spill, it was reported by PTTGC that up to 54,340 liters of oil were discharged into the ocean, and the beaches near Ao Phrao were closed due to suspicion of high levels of heavy metals and water toxicity (PTT Global Chemical, 2013b). Newspaper articles discussing the use of dispersant chemicals added to the negative feedback about the spill. Oil spill dispersants can harm an environment in addition to the negative effects of crude oil (Shafir, 2007). Reports of the oil slick hitting Koh Samet did not focus specifically on Ao Phrao beach where most of the oil accumulated, leading to decreased tourist demand for goods and services on the entire island. In addition to the effects of media coverage, the existing environmental damage after the spill is expected to have long-term effects on the flora, fauna, and human health. The economic impacts of the spill are still felt and many of the community members are still not satisfied with the compensation process.

Controversies and confusion have emerged regarding reports about the extent of the oil spill. While PTTGC created a public outreach team to help in the aftermath of the oil spill, the extent of their work and its effectiveness has not been studied. Interviews with community members and analyses of facts about the oil spill available to the public online and in published media sources can outline the true extent of the situation. Combining this information with the stated goals of PTTGC and their actions can help to breach the gap in understanding about the human dimension impacts and information dissemination after the Rayong Oil Spill. This can result in a minimization of impacts and improved spill response.

The goal of our project was to identify the key characteristics that may have caused a decrease in trust or increase in perceived risk between the local businesses and PTTGC. Our project team first determined the existing economic and health effects in the regions affected by the Rayong Oil Spill. We defined key informants, the information provided to the public about the spill, and the populations most at risk for decreased quality of life in the event of a future spill. We then determined the level of trust between impacted populations and the organizations responsible for spill response and determined how this trust was affected by oil spill impacts. The most persistent and damaging human dimension impacts in areas near Rayong were

identified. Data were collected using interviews, research of environmental reports, and a review of social media posts. It is our intent that our insight on the factors affecting trust and risk and the effects of the response to the Rayong Oil Spill can lead to further research for improvement of oil spill response in the future.

Chapter 2: Literature Review

This chapter provides background information about oil spills and their impacts on the environment and humans. The international response procedure and decision-making process for responding to oil spills is examined and the use of dispersants and the potential harmful health and environmental impacts on flora and fauna are discussed. The health, social, and economic impacts that occur as a result of oil spills are described. The second half of this chapter describes the Rayong Oil Spill incident, the clean-up procedure and rehabilitation actions carried out by PTTGC, and the human dimension impacts that have emerged. The results of studies conducted on the environmental contamination in Rayong after the oil spill are outlined. Efforts of community outreach and information dissemination by PTTGC are described as well as the media coverage of the event and the impact of the oil spill on the tourism industry. Flaws in the response process and factors decreasing the trust between the affected community members and PTTGC are discussed including flaws in the procedure itself, flaws in the compensation process, and withheld or incorrect information. Contamination concerns and the correlation with the risk of long term illnesses such as cancer are introduced as a major issue in the Rayong area.

2.1 Oil Spills as a Global Problem

Oil spills present a high level of danger in sourcing energy from crude oil. The petroleum industry provides much of the world's energy. Crude oil is sourced from the Earth, transferred to refineries, processed into multiple types of fuel, and distributed to customers. While this process provides fuel to the world, there is a high risk of environmental damage when pipelines or tanker ships leak. Most analyses of oil spills are focused around the financial and environmental impacts of the oil industry and the spill area. Despite the fact that humans rely heavily on crude oil, environmental activists are pushing to move away from our dependence on crude oil, citing climate change caused by carbon emissions as the largest hazard caused by crude oil dependence (Greenpeace, 2011).

Many guidelines exist to help prevent oil spills. One source of guidelines is the United States Pipeline & Hazardous Material Safety Administration website (2013). In the United States, state and federal laws regulate practices for extracting oil. Oil is extracted from oil fields worldwide and is transported from the drilling location to a refinery through pipelines. The upkeep of pipelines and proper procedures for pumping the oil are vital to preventing spills. An

analysis of spills showed that about one third of pipeline spills that occurred in the United States between 2010 and 2012 were caused by corrosion, incorrect operation, and equipment failure.

2.2 Responding to Oil Spills

Most countries have regulations and guidelines with procedures to follow in the event of an oil spill. This section will describe the methods used to respond to oil spills that are internationally recognized. In all cases, a central decision-maker decides what technologies to use to clean-up the spill and is in charge of monitoring its status (ITOPF, 2013).

2.2.1 Creating and Maintaining Contingency Plans

The respondents at oil spills involve at least the company responsible for the spill and a government agency to ensure the spill is properly addressed. In the United States, the government agencies US Environmental Protection Agency (US EPA) and the US Coast Guard and the oil company follow contingency plans to dispatch the proper clean-up teams, and then choose methods of stopping the spread of oil (US EPA, 2012).

Other countries have contingency plans and government agencies in place to protect their surrounding environment like the PTTEP Australasia that works intensively with the government Australian Maritime Safety Authority (AMSA) to regulate safety on vessel shipments (PTTEP Australasia, 2013). The Nigerian National Emergency Management Agency created a contingency plan to respond to oil spills in 2011 after coordinating response efforts less formally for years with chaotic results (Oil Daily, 2002). As recognized in an article about the Nigerian contingency plan, a centralized plan ensures that the companies at fault are liable for their mistakes. The centralized plan strengthens the public opinion of the government when it can form a more organized response to oil spills. Using contingency plans to carry out an organized approach can prevent extensive environmental damage from oil spills.

Contingency plans are constantly reviewed and revised by the authorities responsible for carrying them out. After the 2010 Deepwater Horizon oil spill in the Gulf of Mexico, the United States Environmental Protection Agency (2011) described problems with the contingency plan that became apparent in the aftermath of the spill. Several shortcomings were uncovered, including the use of dispersant chemicals that caused toxic chemical accumulation, an imperfect testing procedure for dispersant evaluation, and the lack of preparedness and clarity in defining oil spills of National Significance -- a category of oil spills that allows for more drastic measures to be taken and the allocation of resources on a national level. By revising the contingency

plans, they will evolve as technology and human behavior evolve.

2.2.2 Response Procedures

The extent of the oil spill must be determined in order to plan response techniques and to dispatch clean-up crews. The US EPA (2012) has published a detailed plan that describes evaluation tools for assessing the extent of damage. Researchers Kirby and Law (2010) described factors that determine the nature and extent of the biological consequences of oil spills including the type of oil defined mainly by its viscosity, oil dosage, physical environmental factors, and prevailing weather conditions. The weather conditions affect the behavior of the oil slick and the effectiveness of the dispersant chemical used --mild winds will help to distribute the dispersant more thoroughly but high winds will make it difficult to direct the spray of dispersants on the spill (Fiocco, 1999). The physical environmental conditions include the ocean depth at the location of the oil spill and the type of shoreline ecosystem on the beaches where oil may wash up. Shallower depths are associated with a higher risk of damage to coral reefs due to the accumulation of oil and dispersant chemicals on the ocean floor (Hoff, 2010). The types of shoreline have been defined by vulnerability for planning oil spill response. The clean-up actions suggested by Gundlach et. al. (1978) for protecting shoreline ranging from exposed rocky headlands (least vulnerable) to salt marshes and mangroves (most vulnerable). Table 2.2-1 shows the shoreline characteristics and suggested response techniques for adequate protection. The effects of oil spills on flora and fauna are discussed further in section 2.3.2.1.

2.2.2.1 Internationally Outlined Response Procedure

As a safety measure, oil companies prepare oil spill incident response plans with a prepared protocol to be strictly followed and practiced (Pirom, 2013). A response plan details all the necessary actions needed to be taken during and after a leakage or an oil spill. The basic composition of the plan includes the following steps for marine oil spills:

1. Identify the source of leakage and prevent the leakage from discharging further
2. Monitor the movement and predict the direction of the oil spill
3. Utilize booms to create boundaries preventing spread of oil and use skimmers to remove the oil patches within the booms. Secure sensitive areas such as economic, tourist and environmentally diverse areas.
4. Apply dispersants to films of oil to break down oils into small droplets so that it can be broken down by natural dispersion wave actions and then decomposed by microorganisms.

5. Employ human work force and machinery to clean off affected areas such as beach, rocks and sand.

Who Responds

Once a leakage has been identified and information about the type of oil and leakage conditions is disseminated, all necessary response units are notified (PTTEP Australia). On site, the response units identify the amount of oil that has leaked in order to plan proper response procedures such as how many booms to use and the amount of dispersant needed to control the situation. The equipment required for the response unit is determined by what type of oil is discharged into the sea. At normal sea, booms will be deployed in a J pattern in order to reduce the gap that may occur during the plantation. If the weather is clear and the sea is calm a sorbent boom can be utilized. The amount and type of dispersant to be used also depends on the specific type of oil spilled, weather conditions, and physical conditions of the area that the spill occurred. The pollution control unit submits a request for the use of the chosen dispersant to a government agency or ministry. After permission is granted by the governing agency, the emergency team applies the dispersant. Throughout the process, the head of the company makes necessary contact with the media.

Monitoring the Spill

Once primary equipment is put in place, the spill is monitored to track the status of the natural degrading of the oils. Surface slicks of condensate, light oils, and diesel tend to dissipate naturally. The rate in which this occurs will be dependent on the oil type (light or heavy), sea state (mixing energy) and winds (mixing energy). Natural degradation will allow for a more efficient cleanup which requires less dispersant chemical to be applied. Figure 2.2-1 shows the decision making process. If the oil is not expected to impact the shoreline, natural weathering is the main form of degradation.

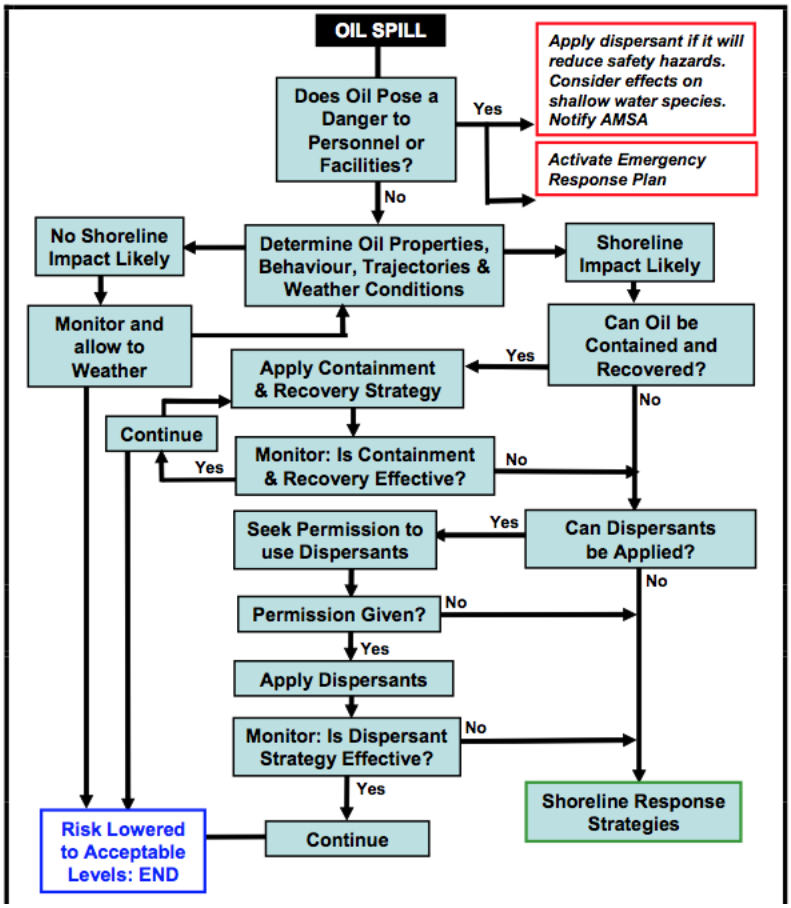


Figure 2.2-1: Flowchart for Oil Spill Response (PTTEP Australia, p.66).

The flowchart shows that after carrying out each recovery strategy, conditions must be monitored before considering the cleanup complete. A study by Kirby and Law (2010) details the importance of proper post-spill monitoring and assessment and discusses mitigation options to minimize some of the negative results. The report is based on the Pollution Response in Emergencies: Marine Impact Assessment and Monitoring (PREMIAM) project, which improved previous post-incident monitoring. Choosing a technology is not everything; the United States Congress Office of Technology Assessment (1990) describes the importance of not only choosing the proper response method, but also sufficiently training personnel and engineers to make well-informed and timely decisions.

Recommended Response Procedures

The effectiveness of response procedures depends on the type of crude oil and the amount of time since the spill occurred (PTTEP Australasia). A detailed protocol for responding

to marine oil spills is outlined by feasibility in Table 2.2-1. Each method is ranked with a scale ranging from recommended (R) to not recommended (a red box) due to danger or the likelihood of adverse effects. The chart includes recommendations for four types of crude oil defined by increasing density and viscosity: Type 1: Condensate, Type II: temperate motor diesel and light crudes, Type III: marine diesel, medium crudes, Type IV: bunker C fuel oils, heavy crude oils.

Table 2.2-1: Response Advised by Oil Type (PTTEP Australia, p.68)

Est. Time to Impact	<48 HOURS				>48 HOURS			
Oil Group[1]	I	II	III	IV	I	II	III	IV
Immediate Response Strategies								
Natural Recovery	R	F			R	R	F	C
Containment & Recovery		R	R	R		R	R	R
Dispersant Application		C	C	C		C	C	C
Physical Break-up								
Sorbent Recovery	C	F	F	F	C	F	F	
Shoreline Protection	R	R	R	R	R	R	R	R
In Situ Burning								
Secondary Response Strategies(Day 2 and beyond)								
Natural Processes	R	F			R	R	C	
Containment & Recovery	NR	R	R	R	NR	R	R	R
Dispersant Application	NR	C	C	C	NR	C	C	C
Physical Break-up								
Sorbent Recovery	NR	R	R		NR	F		
Shoreline Protection	R	R	R	R	R	R	R	R
In Situ Burning								

Key

R *Recommended - preferred option.*
F *Feasible, but not preferred option. Assessment needed.*
NA *Feasible but not available because of location of resources or other logistics constraint.*
C *Conditional. May have adverse effects. Assessment and approval required.*
NR *Not required. Oil not expected to persist.*
Not recommended - either not feasible, not safe or has significant adverse effects.
Not likely to be encountered.
(1) *Oil Group (refer to Attachment 3):*
- *I Condensates.*
- *II Temperate motor diesel and light crudes.*
- *III Tropical diesel, marine diesels. Medium crudes.*
- *IV Bunker C Fuel oils, Heavy Crudes. High pour point or high wax crudes with water temperatures below the pour point.*

Note: The application of the methods adopted using these guidelines will depend on the circumstances of the spill.

Table 2.2-1 shows that dispersants are recommended conditionally. Their use requires outside approval and they are used for oil types II, III, and IV if containment and recovery and natural recovery (for oil type II) are not fully effective. The dispersants should be applied to a thin layer of oil that results after containment and recovery has been attempted. Figure 2.2-2 shows the decision-making process for conducting the containment and recovery process.

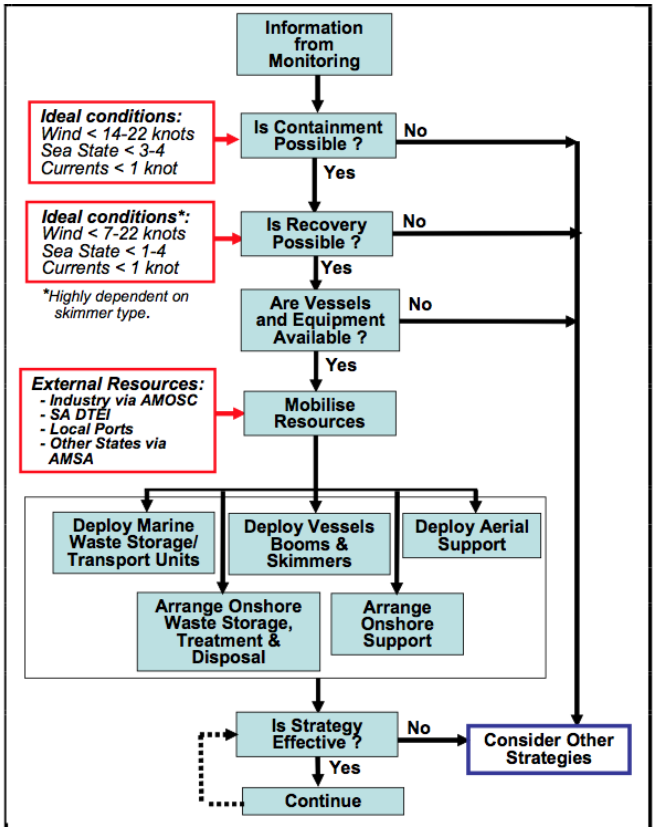


Figure 2.2-2: Guidelines for marine response (PTTEP Australia, p.71)

This flowchart shows that other strategies should be sought if containment is impossible, if recovery (physical removal; skimming) is not feasible, if the proper equipment is not available, or if containment and recovery process were not effective. The next advised strategy defined in Table 2.2-1 is dispersants in most cases.

Dispersants

Dispersants are chemical agents that assist the breakup of surface slicks of oil from seawater. They allow natural degradation to occur after the smaller droplets of oil mix with the water, usually within the 10 meters of the surface. Type I oil -- light or rapidly spreading oil slicks -- do not require dispersants since natural dispersion can occur and in this case, using a dispersant on these types of oil may cause adverse environmental effects. However, dispersant use is suggested for spills of high paraffin oils if temperatures are above the pour point (the temperature at which the oil loses its flow characteristics) of the oil because it may assist in avoiding the formation of persistent waxy residues. In most cases, dispersants may only be applied after approval has been given by the relevant ministry, but they may be used

immediately if used to reduce a fire or explosion risk posed by the discharge. Figure 2.2-3 shows the decision making process for using dispersants. It shows that dispersants are advised only after alternative methods have been considered and if the weather conditions are suitable for using dispersants. If the use of dispersants is ineffective, shoreline response methods are considered.

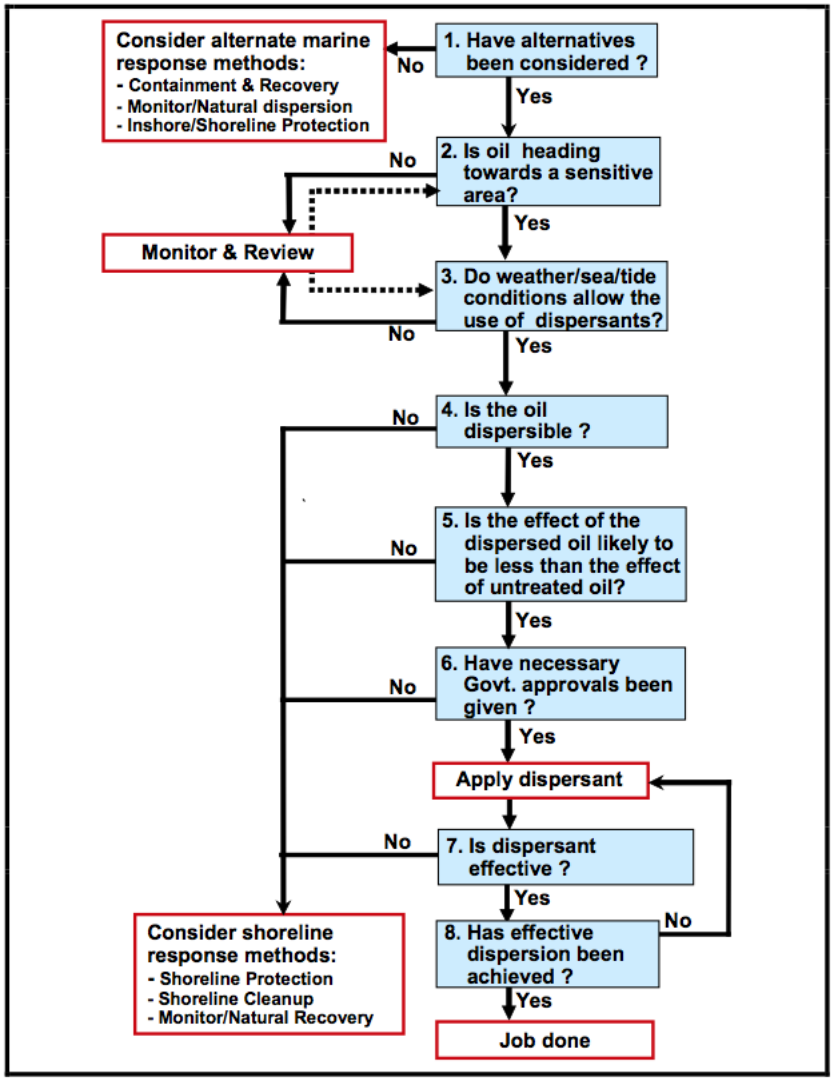


Figure 2.2-3: Dispersant Use Decision Tree (PTTEP Australia, p.83)

A follow up plan must be outlined for controlling the dispersed oil. Physical methods will be less effective; for example, sorbent booms will not work well with dispersed oil. After dispersants are used, the natural recovery process will begin, but this process should be monitored in order to track the amount of oil remaining in the ocean.

2.2.2.2 Role of Non-Government Organizations

An organization called the National Response Corporation (NRC) (NRC, 2011) coordinates oil spill responses globally. It provides services to assist in the decision-making process and sometimes helps review and create plans and assist with the design of response techniques based on site analysis. This centralized organization will assist the government departments and the oil company that cleans the oil spill allowing them to focus solely on the spill. By contrast, government departments and agencies face inevitable concerns about public dissent that may influence their decisions during response and may lead to future issues with oil sales and public support for government.

Greenpeace is a non-governmental environment organization that has adopted the mission statement: “ensures the ability of the Earth to nurture life in all its diversity” (Greenpeace East Asia, 2012). Its role is to exhibit direct actions to raise concern for important environmental issues that require intervention. It raises environmental issues to public knowledge and pressures influential industries and agencies to reach a clean solution. Greenpeace correlates oil spills to oil exploration and is concerned about the exploitation of inappropriate oil drilling. Greenpeace supports the idea of renewable energy commercialization and therefore implements the campaign ‘Go Beyond Oil’ (2013b). The campaign is dedicated to reduce and eventually demolish the world's consumption of oil through activist activities such as petitions against firms that pursue oil drilling as a venture. Greenpeace's ‘Go Beyond Oil’ campaign works to pressurize the governments that permit oil exploration in their territories. The organization is willing to carry out protests and expose the unethical activities being conducted by oil companies. This company has even investigated our focus incident -- the oil spill in Rayong Province, Thailand.

Greenpeace Thailand with the head activist Mr. Ply Pirom specialized on Rayong oil spill is intensively working with the head of small fisheries (Pirom, 2013). They have made a considerable amount of analysis on the incident by collecting pictures of the oil spill, the fixed pipeline system, and the response protocol. Documents outlining the analysis of the amount of oil spilled in the sea were also issued by Greenpeace (see section 2.4.6 for further discussion of these controversies). The duty of Greenpeace in relation to the Rayong Oil Spill is to publicize and raise awareness of PTTGC’s protocol on the cleaning of the spill and monitoring the quality of water. It also serves its purpose to help fishermen achieve their compensation and justice. An online petition is available for anyone interested in supporting the cause of stopping oil exploration in the Gulf of Thailand (Greenpeace International, 2013b).

2.3 Impacts of Oil Spills

The impacts of an oil spill on the community vary depending on factors such as the amount of oil spilled, whether it spread to the shore, and the amount of dispersants that were used. In this section, we will describe the environmental impacts and then the human impacts resulting from oil spills.

2.3.1 Environmental Impacts from Marine Oil Spills

Oil spills cause damage in all locations and have common factors associated with their impacts. While oil spills on land cause large amounts of damage, the oil is easier to control and generally involves soil clean-up. We will focus on marine oil spills in this section.

2.3.1.1 Effect on Flora and Fauna

Birds, fish, and other marine animals in the area can be covered with the difficult-to-remove pollutant. Oil spills are devastating for marine birds as documented by Piatt, Lensink, Butler, Kendziorek, and Nysewander (1990) in a study of the immediate effects of the Exxon Valdez oil spill on marine birds.

Oil spills affect the local wildlife through ingestion and through direct contact (CSIRO, 2013). The local wildlife suffers the greatest due to direct exposure to the oil. Direct exposure can cause smothering when animals are covered in oil. Birds are considerably affected when their feathers lose their water resistant qualities when coated with oil and mammals can lose the insulating properties of their fur (Clark, 2013). Response teams gather affected animals and treat their skin with mild detergents. This helps recovery, but treatment of inhaled vapors in oil spill responders is near impossible and will still cause sickness or death (National Oceanic and Atmospheric Administration, 2013a). One study of marine birds affected by the Exxon Valdez oil spill estimated that between 100,000 and 300,000 birds were killed as a result of the spill (Piatt et. al., 1990). This depletion of birds has negative implications on the region's biodiversity.

Fish are impacted directly from the oil as it seeps into the water. Oil spilled in shallow water is especially harmful to fish and fish eggs (National Oceanic and Atmospheric Administration, 2013a). Mobile fish are able to swim to avoid some of the oil and give more consideration to their ingested food. They also have enzymes in their digestive systems that can break down some of the contaminants. Shellfish are less mobile, and many are filter feeders that cannot avoid the ingestion of contaminants through the water. The type of oil spilled determines the impact on fish. Light crude oil will cause acute damage over a short period of

time and heavy oil will cause less damage but the residuals may cause harm in the long run.

Animals in a wider range can be indirectly impacted by the oil spill through ingestion of contaminated prey (CSIRO, 2013). The organic compounds in crude oil are harmful and sometimes toxic when ingested by animals. The toxic chemicals can work their way through the food chain with the potential to reach humans. The Material Safety Data Sheet of light, sour crude oil describes the harmful effects of contact with the substance for humans and is further described in section 2.3.2.2 (NGL Supply Co., 2012).

Immediate damage to flora will also occur when the oil is released (Gundlach, 1978). The harmful effects of oil spills on coastal environments were described by Gundlach and were classified by vulnerability. Table 2.3-1 shows the distinct levels of vulnerability defined by Gundlach and ranked from least vulnerable to most vulnerable from 1 to 10. Marine oil spills cause the most damage to mangroves and coral reefs. These vulnerable coastal environments may take years to recover and the damage will impact local economies as well.

Table 2.3-1: Vulnerability of Coastal Environments (Gundlach, p.21)

Vulnerability Index	Shoreline Type	Identifying condition
1	Exposed rocky headlands	Waves reflect the oil from shore
2	Eroding wave-cut platforms	Most oil removed naturally by waves
3	Fine-grained sand beaches	Oil doesn't penetrate the fine, packed sediment
4	Coarse-grained sand beaches	Oil sinks into sediment
5	Exposed, compacted tidal flats	Most oil will not adhere to compacted flats
6	Mixed sand/gravel beaches	Rapid oil penetration in pores of sediment
7	Gravel beaches	Rapid oil penetration in pores of sediment
8	Sheltered rocky coasts	Oil build-up in areas of reduced wave action
9	Sheltered tidal flats	Oil build-up due to low waves. Areas of high biological activity affected if not protected
10	Salt marshes and mangroves	Oil build-up if not protected. Highest priority to prevent build-up.

2.3.1.2 Impacts of Dispersant Use

In the response process, the vulnerability of the locations oil is expected to reach is assessed to determine whether a dispersant should be used. The dispersant will inhibit the oil slick from reaching shore, but the chemical used still affect the health of ecosystems**.** As

explained by the United Nations Development Programme (2000), the toxic chemicals from crude oil and dispersants lead to decreased biodiversity, reduced food productivity, and degradation of the general quality of coastal areas. As noted by CSIRO (2013), oil that is not removed and disposed of during the clean-up process accumulates in sand where it can remain for many years until it is naturally broken down by erosion into less harmful organic molecules.

Several negative health impacts are associated with the use of dispersants (CSIRO, 2013). The dispersant used to clean-up the Deepwater Horizon oil spill, Corexit, has been associated with severe long-term toxic effects including damage to blood, liver, and kidneys, cancer, birth defects, and genetic mutations (Wangkiat, 2013). Slickgone NS was used at the Rayong Oil Spill and is currently the internationally-approved dispersant (Dasic International Ltd., 2013). The toxicological information for Slickgone NS is shown in its Material Safety Data Sheet in Figure 2.3-1 (Dasic International Ltd, 2009).

Slickgone NS

Revision	2
Revision date	16-Apr-2009

11. TOXICOLOGICAL INFORMATION	
Acute toxicity	Ingestion may cause nausea and vomiting.
Corrosivity	May cause irritation to eyes. May cause degreasing of the skin. Potential for aspiration if swallowed.
Repeated or prolonged exposure	Repeated or prolonged exposure may cause dermatitis.
Mutagenic effects	No mutagenic effects reported.
Carcinogenic effects	No carcinogenic effects reported.
Reproductive toxicity	No teratogenic effects reported.

Figure 2.3-1: Slickgone Toxicological Information (Dasic International Ltd, p.3)

Direct exposure can cause irritation and ingestion can cause nausea and vomiting. No carcinogenic or mutagenic effects are associated with Slickgone. Dispersants cause the oil to be incorporated with the ocean. Figure 2.3-2 shows the dispersion process that occurs when dispersants are used.

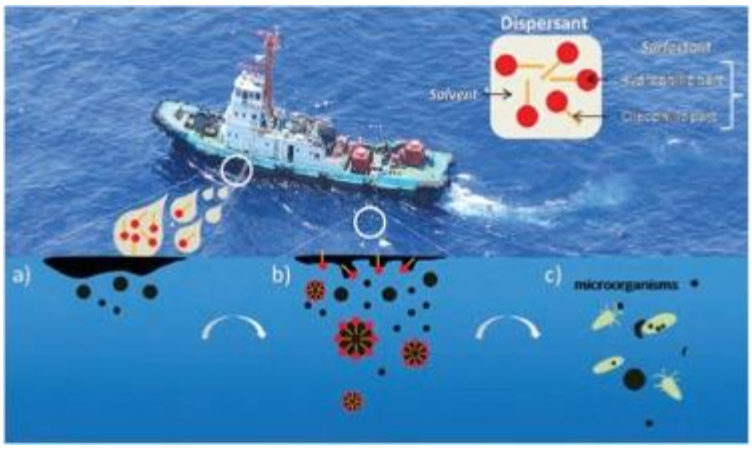


Figure 2.3-2: Chemical Dispersion Process (Kingtong, 2014, p.3)

As shown by steps a, b, and c in the figure, the oil is integrated with the seawater and then biodegraded by naturally occurring microorganisms such as bacteria and fungi. The amount of time for biodegradation defines the extent of residual environmental contamination. The extent of contamination depends on the type of ecosystem that the oil and dispersants are affecting and factors like the water flow in the area (Kingtong, 2014). Shallower areas with less water flow will experience more negative impacts from the oil. Toxicity of the dispersant and oil mixture is a major environmental concern. Sea grass, corals and fish spawning areas are highly sensitive to dispersed oil and the use of dispersants is not recommended. A detailed account of the effect on coral reefs after the Rayong Oil Spill can be referred to in section 2.4.2. According to a study of the effect of dispersants on mussels and sea grasses, significant exposure of dispersants has a negative impact (Scarlett, 2005). The results from the test showed that dispersants produce potentially harmful and potentially permanent effects on the respiratory organs of mussels. It was also found that the stresses caused by dispersants disrupted the ability of sea grasses to carry out photosynthesis. The study concluded that flora species are more sensitive to the dispersant than the shelled fauna because they are more directly exposed. Slickgone NS was the least toxic of all the dispersants studied and is recommended for responding to oil spills when dispersants are required. However the amount of dispersant must be proportional to the amount of oil slick in order to minimize negative impacts on marine life.

2.3.2 Human Impacts

The human dimension impacts should be considered when planning the response process. Procedures that are suitable environmentally and logistically may not be ideal for long-term effects on human health and social well-being. Planning for the human dimension impacts

of oil spills was the subject of a large project carried by Webler, Tuler, and Lord (2010) through the Social and Environmental Research Institute (SERI). Dow, Lord, Tuler, and Webler (2010) compiled available resources to assess the vulnerability of affected communities. The impacts are divided into the categories economic, health, cultural, social, and governance, while vulnerability is considered based on "levels of exposure, sensitivity, and resilience" regarding the oil spill effects (p. 3). A summary table of the human dimension impacts created by Dow et. al. is shown in Table 2.3-2. This table can be a reference for development of methods for analyzing the human dimension impacts.

Table 2.3-2: Human Dimension Impacts of Oil Spills (Webler et. al., 2010, p 3)

Health	**Social**
Acute health	Change in behaviors
Chronic health	Change in relationships and interaction
Injuries	Change in make-up of community
Mental anguish	Infrastructure and social services
Mental trauma and depression	Stigmatization
	Unfair treatment

Cultural	**Economic**
Degradation of natural heritage	Change in income
Interruption of customary activities	Costs
Violation, damage, destruction of cultural sites	Damage to tangible private property
	Disruption of normal economic activities
	Lost livelihoods

Experience and Use of Natural Environment	**Governance**
Access to natural environment and infrastructure	Crime enforcement
Deterioration in non-market use	Hearings and new legislation or regulation
Impaired experience	Participation
Loss of recreation opportunity	Preparedness and capacity of response and
Quality and availability of housing	planning
Quality of community infrastructure	

2.3.2.1 Economic Impacts

Oil spills negatively impact the economy through destruction of resources and livelihoods. A publication by the United Nations, World Bank, and World Resources Institute (2000) relates the impacts of ecosystem degradation on the global economy. Haque, Murty, and Shyamsundar (2011) describe the link between the economy and ecosystems, particularly in the ecotourism industry. They used Environmental Valuation to consider the value of natural resources and described the drop in value if a national park experienced a natural disaster. Not only does the value suffer from environmental damage, but the degradation of the park and surrounding areas leads to decreased biodiversity and watershed degradation, which in turn lowers the tourism revenue potential for the area.

With a degraded economy comes an overall drop in welfare and subsequent human dimension hardships. The economic effects such as change in income, damage to property, and losses due to degraded sources of livelihoods are described by Webler et. al. (2010) (see Table 2.1-1). In the short run, delays from oil spills can be especially detrimental to industries such as agriculture and manufacturing. Shipping may be delayed due to the oil spill -- perishable goods have to be shipped before they spoil, and items have to reach their destination on time in order to keep industries profitable. Long-run impacts are felt by industries such as food service and tourism. Tourists may change travel plans when they hear about the damage from an oil spill. Hotels and restaurants dependent on tourism will suffer lower demand for services while restaurants reliant on local seafood will need to find outside sources of seafood, and these will be more expensive and less sought by consumers. The lasting impacts caused by economic effects are significant impacts to humans in the area for the long-term -- even after the oil is cleaned up.

Lasting impacts to the fishing and tourism industry came as a result of the Deepwater Horizon oil spill that occurred on 20 April, 2010. The spill and BP's response were televised heavily and public trust of the company decreased tremendously. The company paid a total of $13 billion in compensation to business owners (Ritchie, 2013) and the negative media coverage of the area drastically affected the tourism industry. Some shrimp and oyster fishing areas were shut down due to losses taken by the once $6.2 billion industry. The Deepwater Horizon spill likely served as the final blow for some companies already struggling from the lasting damage of Hurricane Katrina (Schmit, 2010). The event caused long-term local economic crisis, and major depreciation of human well-being.

2.3.2.2 Health Impacts

Oil contamination and remediation efforts lead to the accumulation of toxic chemicals in the environment (United Nations Development Programme, 2000, p.76). These toxic effects can be reflected in marine animal consumption warnings, such as those put in place for Koh Samet in Rayong Province by the Thailand Disease Control Department (Sarnsamak, 2013). Consumption of contaminated marine animals causes short-term sickness and depression as well as long-term imbalances of blood cells.

Crude oil is a mixture of petrochemicals which includes the most toxic chemicals in gasoline and other harmful organic chemicals such as benzene (Ormrat, 2014). An associate professor and director of the Program on Reproductive Health and the Environment at the University of California at San Francisco, Tracey Woodruff wrote that many of the chemicals present in crude oil are neurotoxins that affect the brain (O'Hanlon, 2014). Woodruff wrote that short-term effects of benzene, toluene, and xylenes, which are compounds found in gasoline cause dizziness, euphoria, nausea, blurry vision and headaches. In the long term, adult leukemia and other cancers have been found to relate to the contamination of benzene.

Methods for anticipating the vulnerability of health effects from oil spills are detailed by Dow et. al (2010) and include using data on existing health conditions in the area to determine the potential for larger impacts. According to the NGL Supply Company (2012) Material Safety Data Sheet for light, sour crude oil, inhalation and direct skin contact are the main routes of contact. Health effects to consider include acute and chronic physical effects and mental health effects. The effects differ with the type of substance and the extent of exposure. A major source of harm is failure to wear protective gear, which should include a respiratory mask, protective gloves, and hazardous material suit.

2.3.2.3 Social Impacts

Social changes associated with oil spills may include family disruptions due to lost employment and unrest in communities that are upset with the parties responsible for the oil spill. The social impacts of oil spills are more difficult to plan for, as noted by Dow et. al. (2011). Residents in an affected area can feel anger and uncertainty, and weakening social ties. A community can ‘feel’ contaminated, leading to less desire to welcome others and be proud of their locale. Societal impacts link mental health and economic impacts.

2.4 Rayong

Rayong is one of Thailand's developing industrial provinces. An article published by Social Watch considered the area Thailand's "number one toxic hotspot" (Hassarungsee, 2010, para. 6). A high amount of crude oil in the area negatively impacts the locals' health and environment. Many reports on air and water pollution have shown that there are areas in Rayong Province with higher amount of pollution than standard levels. Water samples taken randomly from 25 ponds in the estate were tested and showed presence of toxic substances in hazardous levels. Cadmium and zinc were 6 and 10 times the standard levels while manganese, lead, and iron tremendously exceeded off of the safety limits. The Rayong Public Health Office had reported that many groundwater sources were contaminated with metallic elements such as iron, lead, manganese, and chloride with the amount beyond drinking water standard.

Rayong is located in southern Thailand and is a popular tourist destination known for its beaches, waterfalls, and other natural attractions (Tourism Thailand). The area is known for supplying seafood products which are a popular tourist souvenir. Figure 2.4-1 shows the location of Rayong Province in Thailand.

Figure 2.4-1: Rayong Province (Wikipedia, Rayong Province)

Rayong consists of eight districts, but we will focus on Mueang Rayong District where the oil spill had the most impact. Figure 2.4-2 shows this district.

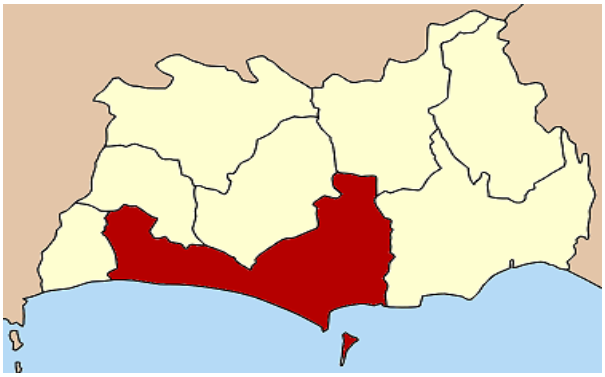


Figure 2.4-2: Mueang Rayong District (Wikipedia, Mueang Rayong)

Mueang Rayong District is the site of the Map Ta Phut Industrial District which is Thailand's largest industrial and petrochemical hub. Khao Laem Ya -- Mu Ko Samet National Park on the island Koh Samet is a popular tourist destination.

2.4.1 Oil Spill Incident

The Rayong Oil Spill occurred on 27 July 2013, in the Gulf of Thailand. Petroleum Authority of Thailand Global Chemical Plc. (PTTGC), the Thai state-owned company responsible for the spill, claims that 54,340 liters of Oman blend crude oil leaked from a pipeline off the coast of Rayong Province during the transfer of crude oil between the Grecian tanker, M.T. Maran Plato and an undersea well (Wangkiat, 2013). Satellite images indicate that the spill covered approximately 9 square km of water when it first occurred. Some of the slick flowed to Koh Samet Island where it accumulated at Ao Phrao Bay (Coconuts, 2013). The satellite image in Figure 2.4-3 shows the spill on 29 July 2013.

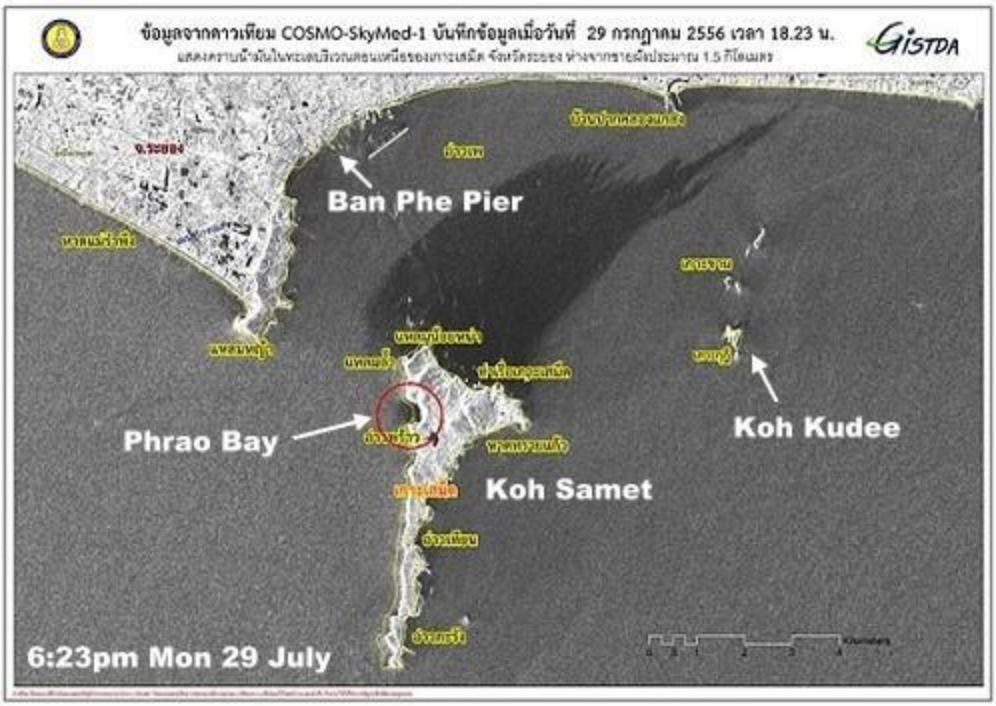


Figure 2.4-3: Satellite Image of Rayong Oil Spill on 29 July 2013 (Barrow, 2013)

It can be seen in the figure that the oil flowed around the northern tip of Koh Samet to accumulate at Phrao Bay.

Later satellite images show that the spill shrank to 5 square km within the first week. The satellite image in Figure 2.4-4 shows the location of the oil spill on 31 July 2013. The oil slick is shown to have affected Ao Phrao most drastically with the east side of Koh Samet being unaffected by the slick. According to a phone interview conducted on a reporter from the Bangkok Post, the oil slick hit Ao Phrao most drastically and caused the most damage there.

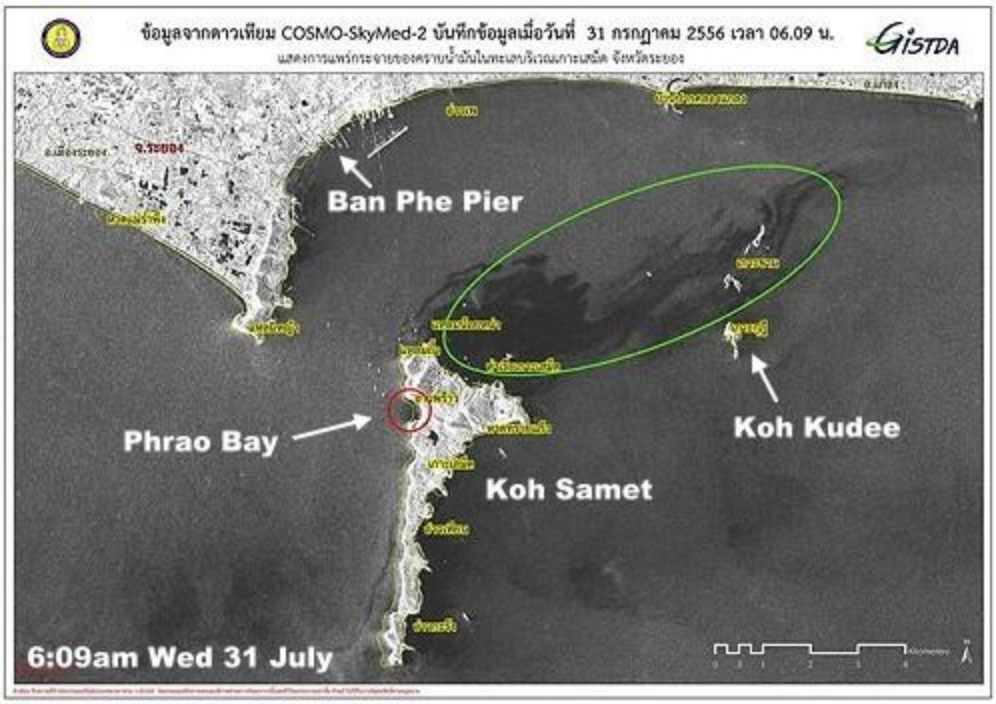


Figure 2.4-4: Satellite Image of Rayong Oil Spill on 31 July 2013 (Barrow, 2013)

The satellite image shows that two days after the oil spill, the oil had accumulated at Phrao Bay but had ceased to flow around the northern tip of Koh Samet. The size of the oil slick on the surface of the sea was decreasing due to the dispersants that caused the oil to mix with the seawater and deposit at the bottom of the ocean. Greenpeace estimated that of the oil spilled, 20 percent of the oil flowed to Koh Samet and 80 percent of the oil that spilled was deposited at the bottom of the sea (Pirom, 2013).

The oil that spread to Koh Samet flowed 35 km in distance from the origin of leakage onto the beach at Koh Samet's Ao Phrao as shown in Figure 2.4-5.

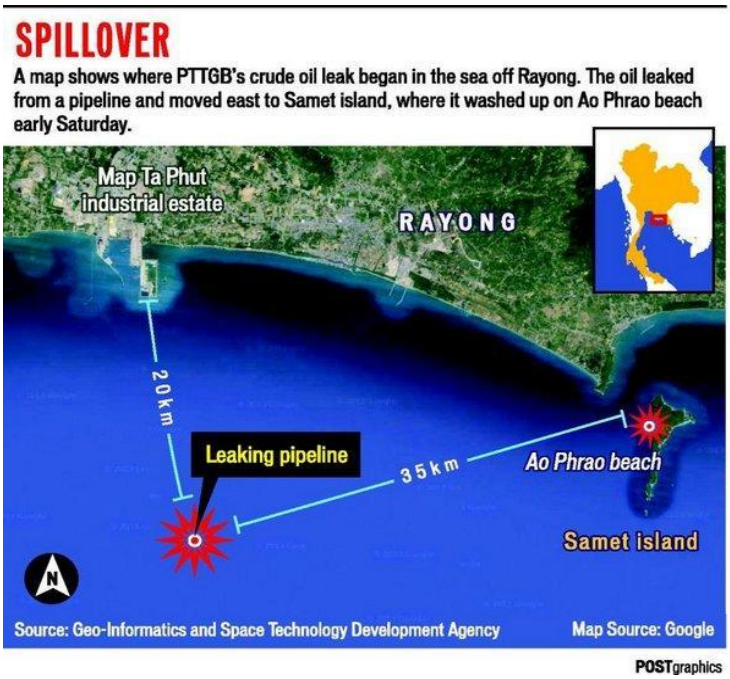


Figure 2.4-5: Distance of Ao Phrao from leak (Bangkok Post, 2013)

The beach at Ao Phrao Bay was closed and the tourists were evacuated when the oil spill occurred (Bangkok Post, 2013, 29 July). The navy deployed at least 300 soldiers to help clean up the spill (Fernquest, 2013). The Thai Post, one of the Thai print media, has claimed that the damage from the spilled oil was not caused merely by the pipeline rupture, but also due to the bad weather including strong waves and winds (Thai Post, 2013). The report shows that the height of the waves at the time of the spill were around 1 to 2 meters and the wind speed was around 15 to 35 km per hour. Weather history for Rayong does not reflect these high winds, however. The wind speed was on average a mild speed of around 9 kilometers per hour for 27-29 July but the history did reference wind gusts up to 22 kilometers per hour (Wunderground, 2013).

2.4.1.1 Timeline of Rayong Oil Spill

The timeframe that the oil spill and response process occurred was published on the PTTGC oil spill incident website (PTT Global Chemical, 2013a). This is shown in Table 2.4-1. The document was published on 2 August 2013 and included the actions carried out already to clean up the oil and the description of the groups made by PTTGC to address the impacts of the event. Some important actions carried out by the company after 3 August included compensating local business owners and Kao Laem Ya Moo Koh Samet National Park,

promoting the area by holding seafood fairs and a “Big Clean Day” to increase confidence in the area as well as hosting a marathon and water sports event on the island. Several celebrities visited the area to help promote the island. The timeframe of the entire process is found in Appendix O.

Table 2.4-1: Timeframe of Cleanup Process (PTT Global Chemical, 2013a)

Sequence of Incident	
27-Jul-13	Leak in pipe between a vessel and refinery
	Leakage resulted in oil spill approximately 50,000 liters
	PTTGC shuts valve, surface oil collected, dispersants sprayed
28-Jul-13	5 ships from PTTGC and 5 from Royal Thai Navy and an aircraft from oil spill Response Limited on scene
	10:00 pm Last oil slick hits Koh Samet (northwest coast)
	30 PTTGC staff clean oil from shore
29-Jul-13	Floating boom added to oil accumulated at Phrao Bay
	Beach cleanup with absorbent boom, debris collection collected for waste disposal at Refinery
30-Jul-13	Phrao Bay cleanup continued day and night
	Oil removing operation directions from PTTGC and General of Marine Dept.
	100 soldiers of Royal Thai Navy collect debris
	100 soldiers of Royal Thai Navy and 60 volunteers collect oil from beach using shovels
	Debris transferred to trucks by 100 volunteers
31-Jul-13	Community relations team sent from PTTGC to collect information about impacts and community members' concerns
	PTTGC finishes preparing short and long-term recovery plans
1-Aug-13	PTTGC continues cleaning Ao Phrao bay. Oil slick there has significantly decreased
2-Aug-13	Phrao almost back to normal. Continue cleaning with vacuums and shovels
	Trash removed using a crane

The outline of the cleanup process shows that only 30 PTTGC staff were available to clean up the oil on Ao Phrao on the night the last of the oil slick reached the shore. By the third day, 30 July, at least 300 workers were on the beach to clean the oil. This increase in workers could reflect a larger amount of damage than originally predicted by the company.

2.4.2 Environmental Damage

The Bangkok Post reported on 14 August 2013 that results from lab tests on seafood obtained from Koh Samet's fish markets conducted by Chulalongkorn University showed contamination with mercury (Wipatayotin, 2013). In addition, the levels of mercury in seawater at Ao Phrao and Koh Samet were reported to be 29 times higher than the safety standard and more than 70% of corals at Ao Phrao had been bleached. Since 20 August 2013, locals and tourists are recommended to be careful when swimming in the sea and to report immediately if feeling unwell after being immersed in the seawater to the relevant authorities.

The environmental damage was felt right away. When the oil reached the Ao Phrao shore, everything that the oil touched was partly damaged. The sand and rocks were coated with the oil (West, 2013). According to the vulnerability index shown in Table 2.3-1 (Gundlach, 1978), the beaches of Ao Phrao are ranked around 3 to 4 on the scale of 1 to 10 for the range of low to high impact. Oil sank into the sediment where cleanup was necessary in order to restore the area.

Following the incident and the use of Slickgone NS, researchers from Ramkhamhaeng University and Burapha University carried out an investigation of the environmental damages caused to the marine lives and its ecosystem. An official oil spill environmental damage report using the research was issued by the Ministry of Natural Resources and Environment (Saithong, 2014) in collaboration with organizations such as the Department of Marine and Coastal Resources, the National Park Wildlife Department, the Plant Conservation Department, and the Pollution Control Department. Rayong Province was divided into three areas to clearly distinguish the damaged areas as shown in Figure 2.4-6.

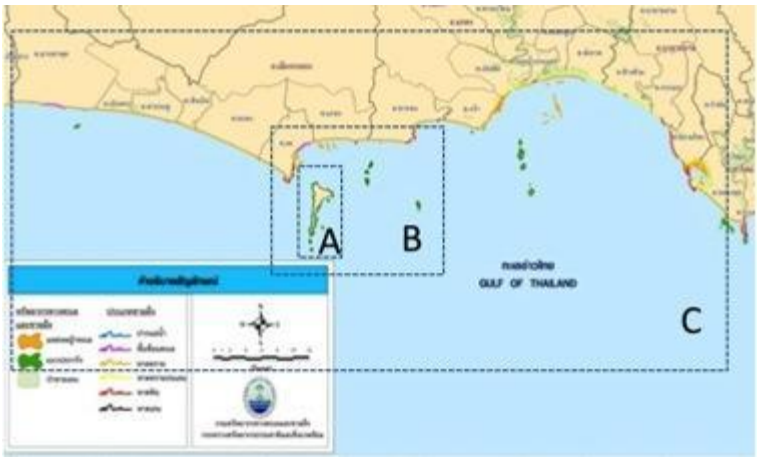


Figure 2.4-6: Three Areas to Define Impacts (Saithong, 2014, p.33)

The three areas expand from the focal point of Koh Samet. The vicinity of Koh Samet, Area A, was severely affected by crude oil deposited on Koh Samet shorelines. The larger area including Koh Samet and nearby islands Koh Kudee, Koh Talu and Kao Laem Ya, Area B, were moderately affected due to oil films in its surrounding waters. The area from the site of leakage to Koh Munnai, Pak Nam Prasae and Ao Koong Ga Bane, Area C, may suffer from future impacts caused by long-term contamination.

2.4.2.1 Effect on Coral Reefs

A team of divers were sent by the Department of Marine and Coastal Resources and its departments mentioned previously (Saithong, 2014) to investigate the quality of corals on 2 August 2013 at 12 stations (Koh Kudee, Koh Pla Teen, Koh Kharm-Koh Gruay, Laem Ya Koh Samet, Ao Giw Nah Nok, Ao Phai, Ao Look Yon, Ao Loong Dum, Ao Noy Na, Laem Noy Na, Ao Phrao Neur and Hin Ao Phrao beach). It was found that most corals and marine lives show no sign of damage. The common corals and marine lives in the vicinity of these 12 stations include sponges, sea urchins, and *Tridacna* -- mollusks that are embedded within corals. Only a small population of these marine animals showed signs of abnormality. This population had membrane inflammation that was caused by exposure to crude oil and dispersants. Eventually, the inflammation led to excess production of mucus over its surface. Figure 2.4-7 shows some marine animals that were inflamed.

Figure 2.4-7: Sea Urchins on a Dive on 2 August 2013 (Saithong, 2014, p.34)

On 7 August 2013, a team of divers was sent to investigate the condition of the corals at the southern part of Ao Phrao. It was noted that there are apparent abnormality on the *Porites lutea* colonies. This observation includes:

1. Part of the *Porites lutea* colony started or have bleached
2. Uneven distribution of color
3. 50-80% of the *Porites lutea* itself is bleached
4. Discoloration of the *Porites lutea*; pale appearance
5. Excess secretion of mucus on the membrane

Other corals such as *Leptastrea* and *Favia* showed sign of inflammation similar to what was found on *Porites lutea*. In addition, nearly all the *Pavona cactus* was bleached in the area. Even though no crude oil was found to be deposited on the coral, the bleaching of the corals in the areas seems to be progressing rapidly. Figure 2.4-8 shows the mucus on the coral.

Figure 2.4-8: Sea Urchins on a Dive on 7 August 2013 (Saithong, 2014, p.35)

The study of the effects of marine lives on the exposure to crude oil conducted by the Burapha University showed that there were negative impacts on the marine lives in the area. The study was conducted on a type of sessile clam called *Saccostrea cucullata* that attaches itself on corals and rocks (Kingtong, 2014). This type of clam can be found commonly around Koh Samet areas and at all of Thailand's shorelines.

The *Saccostrea cucullata* samples were collected from Ao Phrao area, an area which was severely affected by oil deposition. It can be seen that there is an increment of mucous cells at the mantle. Moreover, Transmission Electron Microscope (TEM) exhibited an excess production of granules in the mucous cells. The increment in the mucous cells suggested that the membrane of the mantle was severely affected by the exposure to crude oil, in which a certain active compound in crude oil triggered the excess production of mucous cells and then eventually mucous on its membrane. The excess mucous secreted on the membrane acts as a protective layer against compounds that they might be exposed to.

Labial palps and the gills of the *Saccostrea cucullata* can also be seen with excess layer of mucous cells. However, there was no sign of abnormality in the digest glands. It is suggested that the dispersant used and the crude oil may have dissolved in water and affected the outer membranes of these *Saccostrea cucullata*.

The impacts on coral reefs and other marine species will be monitored with time. The

health of these sensitive ecosystems is important for not only environmental well-being, but also the tourism industry.

2.4.2.2 Long-Term Hydrocarbon Contamination

Research teams from prestigious institutes were set off to monitor the water contamination in the Rayong area of the Gulf of Thailand after the oil spill (Makesumphan, 2014). The study of the amount of hydrocarbon and heavy metals contaminants was conducted at 60 sites in which 46 sites were located in the coastline of Rayong and 14 sites were located on the coastline of Koh Samet. Hydrocarbons (the molecules that make up crude oil and other naturally occurring chemicals) can accumulate in the environment and contribute to the toxicity of water and the environment. This harms the ecosystems dependent on the sea. To test the amount of hydrocarbon contamination in the water and sand after the oil spill, water was sampled by the Ekman grab sampler method and the sand was sampled by utilizing hand corer method. The samples were collected systematically on five sampling trips: 12-14 September 2013, 26-28 September 2013, 9-11 October 2013, 24-26 October 2014, and 23-26 December.

The first sampling on the 12-14 of September 2013 exhibited a significant presence of hydrocarbons in the sea and the sand. The results showed that after 3 months of cleaning, the level of hydrocarbon contamination were significantly high at the stations near Ao Phrao. The average safety limit of hydrocarbon contamination in water is 1µg/L. The first samples showed around 9 µg/L for samples from the Ao Phrao water surface. The results show that the hydrocarbons have severely affected the site. While the Ao Phrao hydrocarbon content on the surface exceeded 9 times of the safety limit, the water surface in the vicinity of Rayong was seemingly unaffected by the oil spill because those samples did not show an unsafe amount of hydrocarbons. Further results showed that the point of leakage exhibited a large amount of hydrocarbon contaminants in the surface of the water. The hydrocarbon contamination exceeded the safety limit by 8 times and was much higher than the average sample taken in the Gulf of Thailand. The results of samples in the area showed a trail of increased contamination in the path that the oil slick traveled from the spill location to the Koh Samet Ao Phrao area.

The second sampling was conducted on 26-28 September 2013, which was two weeks after the first sample date. Results and a comparative analysis showed a decrease in the hydrocarbon contaminant level at Ao Phrao which had decreased by threefold since the first sampling. This shows that the clean-up procedure had reduced the amount of contaminants on the water surface to near-safe levels. The results from the second sampling show that Ao Phrao suffered most from the oil spill due to oil travelling on shore causing damage to the ecosystem

and the beach. Other samples were taken to test the amount of hydrocarbon contamination at the seabed. The results show that a portion of the hydrocarbons were deposited under the sea. Once again, the first samples taken in September showed more contamination than the second sample, which was taken 2 weeks later.

When analyzing the contamination in the Rayong area, the existing contamination from years of industrial activity must be considered. Many of the contaminants that are associated with oil spills can also accumulate from industrial activity. The results of this study focused specifically on sites of significance to the Rayong Oil Spill such as Ao Phrao Bay and the oil leakage site. This can help to isolate the impacts from the oil spill. A comparison of the contamination levels before and after the oil spill would also help show the true effects of the oil spill.

2.4.2.3 Mercury Contamination

Investigation and analysis of the water quality was conducted repetitively since the date of occurrence. Water and sand samples were taken from 60 different stations scattered all over the Rayong province and Koh Samet. The mercury levels were evaluated and published in a report by research teams from Burapha University (Makesumphan, 2014). Results from the tests concluded that the mercury level has not exceeded the safety limit of 0.10 µg/L. The samples were collected at two week intervals systematically as described in section 2.4.2.2 starting on 12 September 2013. Each date of testing showed a decreased amount of mercury. Mercury levels were also tested on marine animals, and the average mercury level was well below the safety limit of 0.5 µg/L issued by the Ministry of Health.

2.4.3 Recovery

PTTGC worked with the Ministry of Natural Resources and Environment and Laem Ya Moo Koh Samet National Park to create a response plan to treat environmental damage and assist community members. According to the published plans by PTTGC (PTT Global Chemical, 2013a), five programs were created with the following areas of focus:

1. Environmental damage
2. Impact on fishing organizations
3. Compensation for business owners and residents; long-term monitoring
4. Reviewing PTTGC’s emergency plans for future oil spills
5. Improving coordination between public and private sectors

Initially, the oil at sea and at Ao Phrao Bay was cleaned up and the area appeared to be restored. However, according to the restoration plan given to us by the Department of Natural Resources, the impacts from the Rayong Oil Spill incident have become more noticeable over time (Saithong, 2014). The impacts include:

1. Damage to the ecology such as coral bleaching
2. Damage to marine and coastal lives especially clams and crabs
3. Damage to human services such as travel and diving sites
4. Contamination on the beaches such as hydrocarbon build-up and tarballs

In the seven months following the spill, the recovery plan has been operated using both passive and active restoration strategies. The operation was classified into two categories including the natural resources and environment recovery plan and the follow-up and assessment plan. Each plan consists of the following subordinate activities:

The natural resources and environment recovery plan:

1. Recovery of impacts on the ecology
2. Recovery of impacts on coastal and marine lives
3. Recovery of impacts on ecological service
4. Follow-up of possible future impacts
5. Environmental revitalization recovery plan for sustaining the tourism industry of Koh Samet

The follow-up and assessment plan:

To track condition of and conduct necessary rehabilitation for:

1. Marine seawater quality
2. Coral reefs
3. Sea grasses
4. Beach ecology
5. Mangrove ecology
6. Rare marine animals
7. Contamination in the water

For the recovery plan to run smoothly and efficiently, nine main and auxiliary agencies were in charge of the operation including the Marine and Coastal Agency, Pollution Control Department, Department of National Parks, Wildlife, and Plant Conservation, Department of Environmental Quality Promotion, Department of Fisheries, Chulalongkorn University, Kasetsart

University, Burapha University, Ramkamhaeng University, King Mongkut's Institute of Technology Ladkrabang, and Mahidol University. The recovery plan from the Department of Natural Resources outlined the plans for studies and report compilations that will be carried out in order to address the effects of the oil spill and spread knowledge of its impacts. A table of these plans is found in Appendix P.

2.4.3.1 Clean-Up

Clean-up decisions were made by PTTGC, and approved by the Pollution Control Department (Pirom, 2013). As reported by PTTGC to Bangkok Post (Wangkiat, 2013), the first response made to minimize the damage of the spill was to place a 200-meter long boom and try to contain the spread of the floating oil. Oil skimmers were then used to remove as much oil from the surface of the water as possible. According to a document created by PTTGC of response procedures and remedial action, dispersants were sprayed from ships and aircraft to stop the spread of oil and clean-up crews were then dispatched to set up booms and remove oil from beaches (PTT Global Chemical, 2013). Table 2.4-1 shows the procedures carried out from 27 July to 2 August.

The oil spill from the PTTGC started to impact 500 meters of shoreline of Ao Phrao on 28 July 2013. A team from Oil Spill Response Limited (OSRL) was sent to secure the shoreline at three specific locations (PTT Global Chemical, 2013b). Thai military personnel, PTTGC workers and local volunteers began their operation in cleaning the residual of oil on the shorelines of Ao Phrao. The highest priority was to remove all free-floating oil as quickly as possible. This was achieved by utilizing manpower, skimmers and pumps. The oil removed was transferred to waiting empty storage tanks and the remaining oil on the sand was removed using sorbent materials. Figure 2.4-9 shows the division of Ao Phrao Bay into three sections. The area was also classified by shoreline type including Sandy Beach as shown in yellow and the Rocky Platform shown in green.

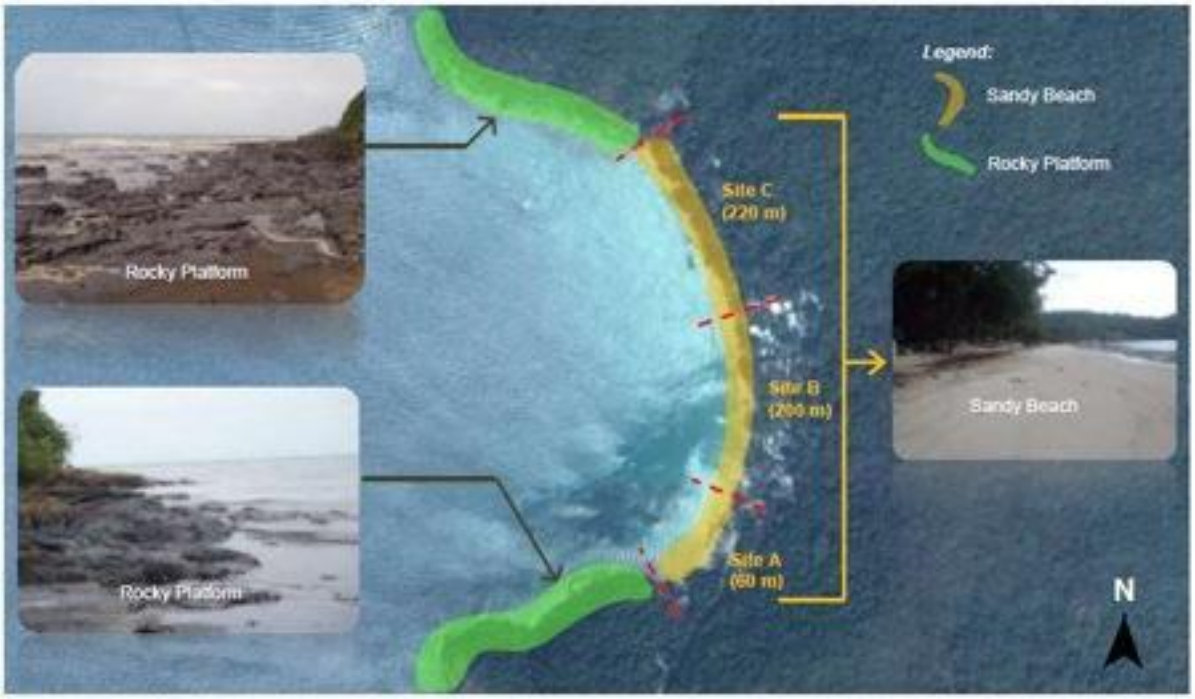


Figure 2.4-9: Ao Phrao Site Divisions: Sandy Beach and Rocky Platforms (PTT Global Chemical, 2013b, p.3)

The bulk of oil on the water surface was removed to a satisfactory level on 2 August 2013 and the priority was changed from cleaning the water surface to cleaning up stranded oil and oiled beach sediments. Due to the high wave energy characteristics of Ao Phrao beach, surf washing was recommended by the OSRL team for the cleanup of buried oil in order to prevent the large scale removal of waste material for disposal. Ploughing was carried out to expose the buried oil to the tidal cycle, thus remobilizing it from the beach sediments on the incoming tide. Sorbent booms that were placed along the shoreline subsequently collected the remobilized oil. The ploughing process was facilitated to allow the naturally occurring bacteria and other organisms to degrade the oil more rapidly. Several tidal cycles of surf washing coupled with ploughing were recommended by OSRL team attempting to restore the beach profile as much as possible. Figure 2.4-10 shows the conditions at Ao Phrao before the oil accumulated.

Figure 2.4-10: Conditions of Sites on Ao Phrao on the Morning of 27 July 2013 (PTT Global Chemical, 2013b. p.3)

The progression of the cleanup showed a steady need of reinforcements from 30 members at Ao Phrao beach to over 300 cleanup workers on the beach on the third night after the oil spill (PTT Global Chemical, 2013a). The company assembled the following teams for remedial action:

1. Clean-up team – oil cleaning in affected areas both on and off shore.
2. Restoration team – monitor and speculate the recovering of marine ecosystem in affected areas.
3. Remedy team – alleviate public individual affected by the spill.
4. Legal team – insurance team investigating the cause of incident.
5. Communication team – publicize information to the public and deliver accurate messages to the public and private sectors.

The efforts of these teams are ongoing and the complete incident report and revitalization plan will be published by PTTGC by the end of 2014.

2.4.3.2 Mitigation Plans

On its website, PTTGC has issued a mitigation plan for each the short-term and the long-term timeframes. The mitigation plan for short-term includes:

1. Eliminate of oil stains on shorelines
2. Clean up the sea, beach, and rocks which have been affected by the spill
3. Set up petition centers for impacted locals
4. Work closely with environmentalists and experts to study and monitor the impact on marine lives such as corals and outline a rehabilitation plan
5. Investigate the cause of the leakage and why it spread uncontrollably

PTTGC has successfully eliminated the oil stains on shorelines and, to a certain extent, cleaned up the sea, beach and rocks in Ao Phrao and its vicinity. Petition centers are hosted at areas outlined by the municipality and has not satisfied most stakeholders, which can be referred to 2.4.3.3 Compensation Plan. Environmentalists and experts from prestigious institutes such as Chulalongkorn University, Chulaporn Institute, and Ramkhamhaeng University have been working closely with PTTGC to monitor the situation of the oil spill and its effect on the environment and people. In addition, Department of Marine and Coastal Resources, National Park Wildlife and Plant Conservation Department and the Department of Pollution Control played a major role alongside PTTGC groups. These measures have all been implemented, but to varying extents. The satisfaction of affected community members is not complete. According to an article by The Bangkok Post, around 500 local fishermen held a protest demanding better compensation on 27 August (Bangkok Post, 2013, 28 August). They said that some had waited a month without receiving the compensation they were promised. Non-government organizations such as EnLAW Thai Foundation, Ecological Alert and Recovery Thailand, Greenpeace Southeast Asia, and the Good Governance for Social Development and the Environment Institute expressed concern at this time regarding the acts by PTTGC to combat the environmental damage because the procedures were not publicized yet. They urged the Prime Minister to fund an independent investigation.

The long-term measures (PTT Global Chemical, 2013b) issued by PTTGC include:

1. Monitor the impact on the environment after the restoration is completed and take action if any apparent impact arises.
2. Explore fact finding investigation result and improve operating procedures standard to build confidence to stakeholders
3. Fairs and promote tourism

PTTGC has progressively monitored the impact on the environment, but it is still too early to foresee the long-term impact of the spill. The company has attempted to compensate all impacted locals while promoting tourism in the area. Fishermen are concerned with the long-term contamination and held a conference on 11 February to discuss the environmental contamination and tarballs (residual oil that surfaced from the ocean) that washed up on Baan Loong Sri Beach on 8 February (see Appendix N for the interviews we conducted at this conference). They also discussed the irreversible impact that the oil spill has seemingly caused to the fish stock in the area.

2.4.3.3 Compensation

To carry out the compensation process, the affected areas are divided into three basic categories, which are: stakeholders at Ao Phrao, stakeholders at Koh Samet and its surroundings, and shorelines of Rayong areas (Eastern Province Office of Strategy Management, 2013). According to the Governor of The Rayong Province, Mr. Vichit Chartpaisit, actions are taken seriously for the implementation of the compensation for the affected locals. Primary responses were constructed to alleviate the economic impact that followed oil spill event. A response unit was established on 31 July 2013 to alleviate the impact on the members of Rayong. This was to provide opportunities for affected locals to submit an official account of the impact they were experiencing. Response units are allocated to each area so that interested stakeholders could submit official documents and related forms for the redemption or compensation. The unit would then evaluate the impact and issue appropriate compensation based on the impacts. There were three different locations with Response units in Rayong Province: Municipality of Ban Phe, Office of National Park and Conference hall, Municipality of Klaang, and Head of Chaang Area. The Rayong Province has assembled a cabinet of referees to evaluate the documents received from the impacted locals from the oil spill incident. Four bodies that were put in place to evaluate the documents include:

1. Referees evaluating the impacts on business owners, hotels and resorts, restaurant and service sectors.
2. Referees evaluating the impacts on fishermen
3. Referees evaluating the impacts on health
4. Referees evaluating the impacts on other contributing factors

From a close account of the amount of queries submitted from locals since the 25 August 2013 the total official documents received accounts to 8813 cases. The cases are divided into sector as such:

1. Hotels and Restaurant – 1363 cases
2. Fishermen – 2675 cases
3. Health – 1 case
4. Other – 4774 cases

1892 cases have been given compensation, which it is divided into:

1. Hotels and Restaurant – 174 cases
2. Fishermen – 1175 cases

3. Health – 0 cases
4. Other – 543 cases

The details on the compensation procedure were determined by PTTGC based on the level of impact the affected locals reported. PTTGC used two standard methods in planning the compensation: the Estimate Income Method and the Native Method.

The outlined compensated sectors included small business stakeholders, large business stakeholders, and other businesses.

1. Small businesses were allocated 500 baht per day for 30 days since the day of incident. The PTTGC compensation committee defined small business stakeholders as: street vendors, small merchants, groceries stores, motorcycle drivers, speedboat and tube rentals, laundry and dry cleaning services, fresh water delivery trucks, diving instructors, cabs and song taew transport, stylists, tattooing, masseuses, fabric merchants, motorcycle garages, electronics, banana boats rental, bookshops, jet ski rentals, ferries and speed boats, boat rentals and fishermen.
2. Larger businesses will be will be evaluated by the committee and referees for the appropriate amount of compensation
3. Other businesses will be evaluated by submitted documents for amount of compensation

In reference to the possibility for insufficient compensation, PTTGC planned for businesses that to request additional compensation within 15 days of receiving their first amount of compensation.

According to Khun Klao, Head of the Municipality of Baan Phe, compensation criteria is subjected to flexibility due to occurrence of new occupations. It is to be noted that there are two bodies that governs the eligibility of compensation of candidate and its amount. The two offices include the municipality and the PTTGC compensation committee. Each of the two offices follows differing criteria. The process will be conducted first by the municipality after the assessment document had been submitted by the affected individual. The information in the document includes their names, occupation, the amount of impact, and their anticipated amount of compensation. The municipality will screen this information thoroughly ensuring that the asking amount is proportional to the impact. The municipality will evaluate the information bestowed within the documents and its impact via on field analysis of the individuals. Once the information has been authenticated and confirmed by the committee of the municipality, the amount of compensation will be issued according to the level of impact and the reasonable asking amount. Once a conclusion has been established with a defined amount of

compensation, the municipality would transfer this document to the PTTGC compensation committee for another screening. The amount that the municipality and PTTGC compensation committee allocate differed accordingly hence it cannot be concluded exactly the amount individuals received. The compensation amount was not fixed and was consequently dependent on the committee. This mode of evaluation affected larger businesses such as hotels, resorts and authorized medium to large businesses more than small occupation such as masseuses and squid merchants.

2.4.4 Human Impacts in Rayong

The human impacts in Rayong are documented most thoroughly in newspaper articles. The articles progress from describing the initial environmental damage and clean-up process to the resulting economic damage. Health impacts and concerns are described throughout the newspaper articles and progress from reporting short-term exposure impacts to longer-term issues such as contaminated seafood and swimming bans in place. Some of the articles that were published are as follows:

Popular island beach closed by oil slick --Bangkok Post, 29 July

Oil spill clean-up chemicals: What are they? --Bangkok Post, 31 July

Spill bigger than it looks, expert says --Bangkok Post 1 August

Gulf of Thailand Oil Spill: Toxic matter 'may enter food chain in 3 months'. --The Nation 3 August

Tests find mercury in Ao Phrao seawater --Bangkok Post, 14 August

Fishermen want bigger payouts --Bangkok Post, 28 August

In this section, we will discuss the human impacts already documented after the Rayong Oil Spill and the areas of potential impacts that were reported.

2.4.4.1 Economic Impacts

Tourism and seafood related businesses are the main sources of income in Rayong Province. Koh Samet is a popular destination for tourists all over the world and is a top destination for Russian and Chinese tourists (Lefevre, 2013). Not long after the oil spill, tourists were evacuated from Koh Samet by the order of Tourism Minister Somsak Phurisisak. The area was left smothered with oil, leaving a very unpleasant impression for tourists planning to visit the area. In reference to the contaminated island, Russian tourist Daria Volkov from Moscow said, "We're staying on another beach but we're not taking any chances. We are checking out" (p.8).

Mr. Chairat Triattanajaraspon, the chairman of the Provincial Tourist Association said that some tourists in the area of Koh Samet especially ones near Ao Phrao were seen leaving, and many prospective tourists cancelled their visit (see Appendix N for the complete interview account). Mr. Chairat said the contamination in the area greatly affected the number of consumers for both the tourism industry and the fishing industry (Haque, 2011).

As discussed in section 2.4.2.1, the side effect from the use of dispersants to the oil slick causes severe environmental side effects to corals in the area. Oil spills cause damage to fish as discussed in section 2.3.2.1 and in the description of the difficulties fishermen are reporting in Rayong (discussed further in results section and interviews found in Appendix N). The oil caused fish to migrate to areas which are unaffected leading to the reduced amount of fish in frequently fished areas of Rayong Province (Munprasit, 2014). Fisheries and fish related industries were affected from the loss of fish when the amount of fish exported and sold per day was significantly reduced. Less shrimping could be done due to the reduced amount of shrimp that could be caught. In addition to the decreased amount of fish, consumers lost trust in the produce of the Rayong province due to fear of contamination. This led to further depreciation of transactions in the fishing related industries.

According to fishermen who depend on crab farming (Kingtong, 2014), after the occurrence of the oil spill, the population of blue crab significantly decreased. The amount of blue crab harvested per day decreased. This led to the decreased income to the fishermen. Even though some seafood could be sold to merchants at fish markets, the agreed price for the seafood was often significantly decreased or reduced by half; this eventually led to debt accumulation for fishermen since their fixed cost of fuel stayed constant but their harvests decreased. In addition, fish markets and merchants were also affected due to lack of consumers. Seafood merchants keep the origin of the seafood ambiguous to encourage purchase of the product.

In efforts to help impacted business owners recover, PTTGC has executed the compensation plan detailed in section 2.4.3.3. The compensation plan executed so far is merely a short-term solution, and long-term plans to restore the area have not been published. However, with Mr. Booncherd Suwanatip, PTTGC Vice Manager of Waste Control and Safety, claimed in a phone conversation with us that the full sustainability report will be available to the public at the end of March 2014 once the report has been approved by the board of directors of PTTGC.

2.4.4.2 Health Impacts

Many people are concerned with the health impacts of the dispersants used due to the fact that they can cause kidneys, cancers, and liver problems. Furthermore, it has been reported that more dispersants were used by PTTGC than the standard limitation for the amount of oil reportedly spilled. According to the supplier, the acceptable ratio between dispersants to spilled oil is 1 part dispersant to 20-30 parts oil, that is, 2,500 liters of dispersants per 50,000 liters of the oil (Dasic International Ltd., 2013, p.7). PTTGC claimed that the waves were high and has strong prevailing wind hence led PTTGC to apply more dispersants to accelerate the restoration (PTTGC, 2014). Even though modern dispersants are improved to exhibit low toxicity to marine lives, they are toxic when used in excess.

It is difficult to determine the exact health issues that occurred after the Rayong Oil Spill from qualitative damage because the short-term symptoms from crude oil (dizziness, nausea, and headache) are not extreme and would likely not justify visiting a clinic or hospital. Epidemiological data from the Koh Samet Health Clinics showed that tests indicated a non-threatening level of toxicity (Provincial Health Organization, 2014). However, the perceived health impacts and the concern of community members are the most important factors in determining the true impacts on community members. According to Mr. Booncherd Suwanatip *via* a phone conversation, PTTGC Vice Manager of Waste control and Safety, one individual, a flight attendant of Thai Airways international was affected by the exposure to crude oil. This caused an immediate dizziness and nausea to the individual. The PTTGC compensation committee compensated the individual with 50,000 baht for medication and health check-up at a hospital in Bangkok.

2.4.5 Public Relations and Corporate Responsibility

PTTGC formed a community relations team and recovery team to help community members after the oil spill (PTTGC, 2013). The teams visited the affected communities in Rayong and Koh Samet to assess the impacts being felt and make compensation plans. These plans for compensation were not carried out fully, however, and resulted in a protest by fishermen in August 2013. Little has been shared with the community publicly but the full incident report is expected to be published by the end of 2014. The company created a publicly available website to share information about the oil spill (http://pttgc-oilspill.com).

2.4.6 Controversies and Topics of Debate

PTTGC is the major stakeholder in the oil spillage event. PTT Global Chemical Public Company Limited or locally recognized as PTTGC is a Thai state owned oil and gas company (PTT Global Chemical, n.d.). It revolves around the fabrication of energy supply in Thailand, which in turn also deals with neighboring countries; the company aims to serve the majority of Thailand. The company has full stake in extensive submarine gas pipelines at the Gulf of Thailand, networks of liquefied petroleum gas (LPG) terminal that runs throughout the Kingdom. It also participates in the country's energy grid via electricity generation, petrochemical production, gasoline retailing, and oil and gas exploration.

2.4.6.1 Role of the Government

Collaboration between the Thai government and PTTGC group can be seen as suspicious due to controversy with the data issued by the Pollution Control Department (Sarnsamak, 2013c). A point of debate is that there is no transparency regarding this issue considering that PTT is a very profitable group that has the ability to influence the Thai government. PTTGC is a subsidiary of the Thai state-owned oil and gas company PTT Plc., which is owned by the Thai government. Personal connections between the two groups likely still exist (Saiyasombut, 2013). Environmentalists claim that the Thai government is trying to hastily rid of the problem and enhance their reputation by declaring the spill site safe. This causes a global dispute in the transparency of the Thai government duties and produces misleading upbeat assessments for the public to absorb.

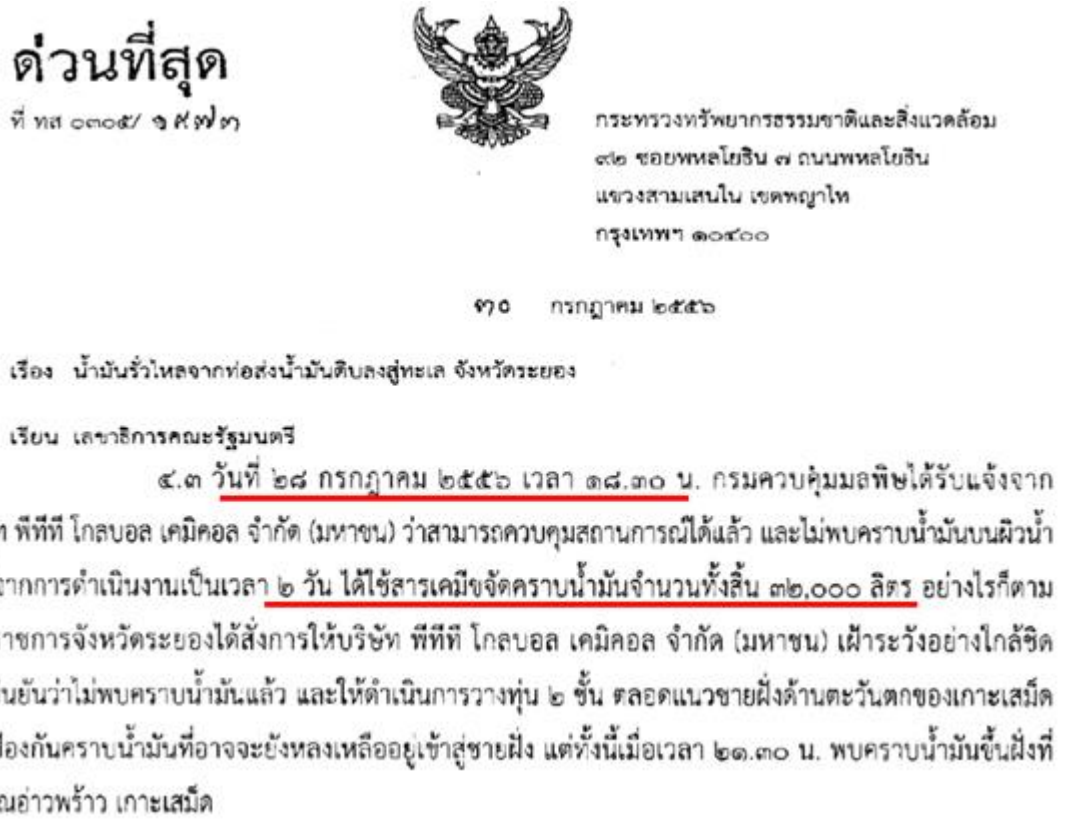
Criticism is bestowed upon the Thai government due to its misleading data issued from the Pollution Control Department; high mercury readings that exceed safe levels were obtained officially by the Pollution Control Department, but rejected by the Thai cabinet. Later tests with lower mercury readings were issued and endorsed. The past controversies have led to some concerns over the validity of the reports from the government about the Rayong incident (Bangkok Post, 2013, 28 August). Some scholars and NGOs are conducting independent research to add to the actions by PTTGC and the Thai government.

2.4.6.2 Dispersant Use

As outlined in the section 2.3.2.2, proper plans for dispersant use must consider all possible alternatives and conjure a map of balanced advantages that may occur at the sea surface and under water after its use (ITOPF, 2013). The potential side effects of the use of

dispersants in the specific situation must have been clearly outlined as well as the amount of dispersant to be used. This means that the amount of oil discharged into the sea and the thickness of the slick must be taken into consideration to make these plans.

As reported by PTTGC and shown in Figure 2.4-9, 32,000 liters of Slickgone NS was approved by the Pollution Control Department, allowing PTTGC to apply the dispersants on the oil (Pirom, 2013).



ด่วนที่สุด

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กระทรวงทรัพยากรธรรมชาติและสิ่งแวดล้อม
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เรื่อง น้ำมันรั่วไหลจากท่อส่งน้ำมันดิบลงสู่ทะเล จังหวัดระยอง

เรียน เลขาธิการคณะรัฐมนตรี

๕.๓ วันที่ ๒๘ กรกฎาคม ๒๕๕๖ เวลา ๑๘.๓๐ น. กรมควบคุมมลพิษได้รับแจ้งจาก บริษัท พีทีที โกลบอล เคมิคอล จำกัด (มหาชน) ว่าสามารถควบคุมสถานการณ์ได้แล้ว และไม่พบคราบน้ำมันบนผิวน้ำ ทั้งนี้จากการดำเนินงานเป็นเวลา ๒ วัน ได้ใช้สารเคมีขจัดคราบน้ำมันจำนวนทั้งสิ้น ๓๒,๐๐๐ ลิตร อย่างไรก็ตาม ผู้ว่าราชการจังหวัดระยองได้สั่งการให้บริษัท พีทีที โกลบอล เคมิคอล จำกัด (มหาชน) เฝ้าระวังอย่างใกล้ชิด เพื่อยืนยันว่าไม่พบคราบน้ำมันแล้ว และให้ดำเนินการวางทุ่น ๒ ชั้น ตลอดแนวชายฝั่งด้านตะวันตกของเกาะเสม็ด เพื่อป้องกันคราบน้ำมันที่อาจจะยังหลงเหลืออยู่เข้าสู่ชายฝั่ง แต่ทั้งนี้เมื่อเวลา ๒๑.๓๐ น. พบคราบน้ำมันขึ้นฝั่งที่ บริเวณอ่าวพร้าว เกาะเสม็ด

Figure 2.4-11: Official Approval for the Use of 32,000 Liters of Slickgone NS (Pirom, 2013).

The application method outlined by the Slickgone NS provider states that 1 liter of Slickgone NS (undiluted) can disperse 20 to 30 liters of crude oil. From a simple calculation using the ratio of 1:30 of Slickgone NS to oil and 32,000 liters of Slickgone NS, this would correspond to 960,000 liters of oil in the sea. The reported value of oil from PTTGC spill was only 54,340 liters. The high mixing energy present due to the wave conditions that PTTGC claimed were in the area would have increased the activity of the dispersant with oil. However,

the wind conditions would have made it more difficult to apply the dispersants. Nevertheless, the discrepancy exists between the amount of dispersants used and the amount of oil spilled.

Adding to the controversy, Greenpeace and other authorities, the response by PTTGC seems to be flawed and unprepared (Bangkok Post, 2013, August 28, Pirom, 2013). Basic procedures had not been conducted properly after the oil spill incident (Lamworaniran, 2014). The booms used did not meet the international standard; the PTTGC booms were short and contained gaps allowing oil to leak out as shown in Figure 2.4-10.

Figure 2.4-12: Boom Used at Rayong Spill (Small Fisheries, 2013)

The arrow in the photo shows a flaw in the boom used to prevent oil from spreading. It was claimed that PTTGC did not properly carry out the required preliminary protocols (as described by the international oil spill response flow chart shown in Figure 2.2-3) before deciding to use the dispersant as the primary control technique. A substantial amount of crude oil was claimed to sink to the bottom of the ocean. Tar balls have washed ashore, likely due to the shift in seasons – warm weather causes the oil to resurface and flow to the shore. Tarballs were collected by a shoreline patroller (see interview in Appendix A) and the samples were exhibited at the conference for concerned fishermen held at the Star Hotel on 11 February 2014. The samples are shown in Figure 2.4-11.

Figure 2.4-13: Tarball Sample Collected from Baan Loong Sri Beach on 8 February 2014 (Small Fisheries, 2013).

Actual response methods conducted by PTTGC are not yet fully publicized, but the discrepancies that have emerged outline key areas of concern that may lead to necessary improvements to the PTTGC response plan in the future. The contingency plan for PTTGC will be revised based on shortcomings they had similar to the US EPA revision to the contingency plan after the Deepwater Horizon oil spill (United States Environmental Protection Agency, 2011).

2.4.6.3 Media Reports

Interviews and reports published by New York Times and many reputable news agencies significantly show that PTT on the whole is dealing well with its issue (NY Daily News, 2013). They focused their reports on the efforts of cleaning up the beaches and reporting that it would revert back to its aesthetic state in time to welcome tourists during the high seasons. Points of consensus focus on facts that can be verified visually such as the cleanliness of the beaches and coastal areas. After this initial agreement, unseen contamination is a cause of concern and discrepancies. Contamination in water and food was a topic mentioned often by media reports (Sarnsamak, 2013a; Wangkiat, 2013). Media articles have reported that revitalizing the marine life would require several years and the condition of the water will require years to optimize. Other articles focused on the clean-up procedure carried out by PTTGC and the protests and concerns of local fishermen (Fuller, 2013; Bangkok Post 2013, 28 August).

Reports have also focused on water tests and other scientific evidence to show the true condition of the water. Articles have stated that it is hard for community members to trust the PTTGC itself and other responsible Thai officials (Sarnsamak, 2013c). Tourists that did not know that there was an oil spill could agree that the performance by PTTGC in cleaning the surface is adequate. Further analysis should be considered in order to achieve the true point of consensus.

2.4.6.4 Contamination Concern

Contamination from the oil spill led to many community concerns. One concerned expert, Dr. Rossukon Pumpunwong is known as the “enzyme expert” (data gathered from a personal visit). She has focused on eliminating the contamination present in everyday life caused by industrial contamination like the long-term contamination present from the Rayong Oil Spill and other industries in Rayong. She has discovered ways to ferment enzymes with various natural resources and she claims that these enzymes can prevent serious diseases like cancer and birth defects. One of her enzymes she developed disperses oil. This enzyme was produced by fermenting leaves for over 40 years. According to Dr. Rossukon, dispersants used by PTTGC were man-made chemicals, which will lead to further contamination and harmful health impacts. As industrial expansion continues, community concerns for contamination will continue.

2.4.6.5 PTTGC Response Procedure

Referring to the internationally outlined contingency plan in section 2.2.2.1, it could be seen that PTTGC’s readiness towards the response was flawed due to the lack of preparation and communication disputes between each response units (PTT Global Chemical, 2013b). Controversies that have been analyzed by the company itself include:

1. The lack in effective communication and incorrect authorized signatory between the PTTGC and the Oil Spill Response Limited (OSRL) resulted in the delay in the resource mobilization of the C-130 aircraft.
2. Lack of clarity in communication between the Singapore EOC and PTTGC’s command led to the delayed installation services.
3. Lag time of 5 hours caused when PTTGC assumed that the Hercules aircraft would be activated upon sending the mobilization form and enquiries on aircraft-related information. However, the Oil Spill Response Limited (OSRL) reference point for the

mobilization of Hercules was after PTTGC's instruction to load dispersant into the tank causing lag time.

4. Permit was not issued prior to commencement of spraying operations the Oil Spill Response Limited (OSRL) will use this case for future reference to clarify mobilization procedures to its client and request for the permit from before the commencement of the spraying operation.
5. Groups of workers from different parties without proper instructions given to them. Crowd control became a major issue. Therefore, the site supervisor was assigned on the following day to control the cleanup operations.
6. Smell of hydrocarbon was evident on the 29 July 2013. However, only one gas monitor presented on site to monitor the benzene level. Though this gas monitor indicated the work zone was within safe range, it was recommended that there should be more than one gas monitor to measure the parameters along the beach.
7. There was not a proper site setup, for instance, no boundaries of work zones, security, or decontamination area.
8. Slipping hazards was encountered when conducting shoreline survey at bedrock platform and the assessment was stopped if it was unsafe to proceed.
9. A lot of media presented on site and there was no security plan in place to refrain the media from entering the cleanup work zone.

These shortcomings outlined by PTTGC will lead to revisions to the contingency plan for future oil spills.

2.4.6.6 Volume of Oil Spilled

The volume of oil that spilled has become a topic of debate. PTTGC declared that the volume of the oil spill was 54,340 liters (PTT Global Chemical, 2013b). However, there are many different ways to calculate the volume. One method of calculating the oil spill is by using a satellite image of its area and calculating a volume from that. Another method is by using the amount of dispersant reported and using the ratio of dispersant to oil.

A volume of oil spilled can be calculated by the ratio of dispersant to oil recommended. PTTGC used 32,000 liters of Slickgone NS, to disperse the oil by PTTGC. The ratio of dispersants dictates that 1 liter of Slickgone NS can recover up to 30 liters of crude oil. Therefore, the calculation will result in somewhere between 640,000 and 960,000 liters of oil that was spilled.

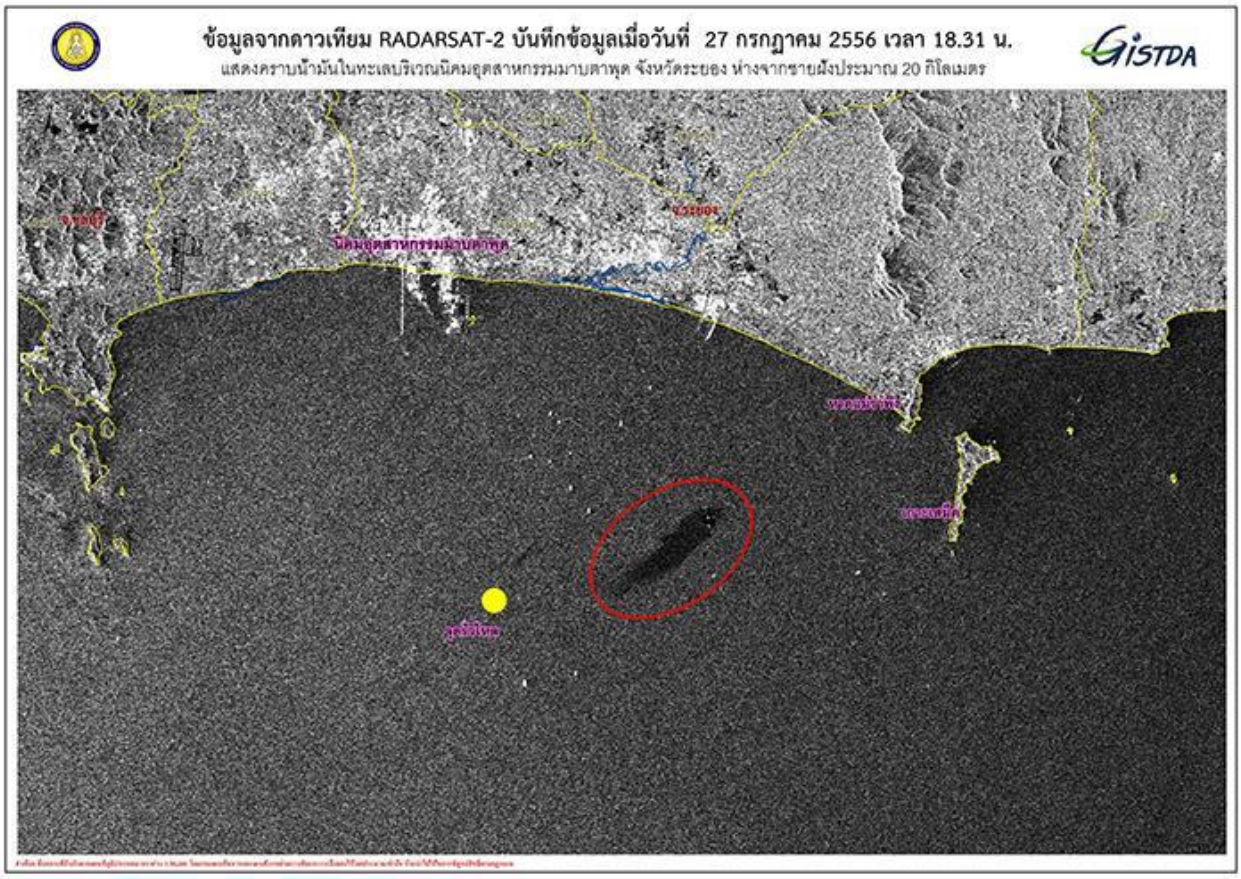

Figure 2.4-14: Satellite Image of the Oil Spill Used to Determine Slick Size (Barrow, 2013).

The volume of oil that has spilled can also be calculated from the area of the satellite image. The satellite image shown in Figure 2.4-14 has been used resulting in the ellipse shape with the radii of 750 meters and 4150 meters (Phuket Gazette, 2013) and the thickness of the light crude oil is 0.0000254 meter (International Spill Control Organizations, n.d.). The formula for the volume of oil spilled is the area of the slick times its thickness (Skytruth, n.d.), where the area can be calculated by multiplying the two radii with pi. Therefore, the volume of the oil that was spilled from this calculation was 248,240 liters.

2.4.7 Risk and Trust in the Rayong Community

It is important to have priorities and timelines well planned out in case of an oil spill. Little is publicly known about the exact organization and priorities of the response to the Rayong Oil Spill. However, due to news coverage, the timeline of responses has been made public (Sarnsamak, 2013; Sky, 2013; Wangkiat, 2013). Without a direct account of priorities and

response methods from the oil company, the public has based its opinions on news articles and an overall perception of the event.

One concern addressed by a former Interactive Qualifying Project team from WPI is the line of communication among stakeholders involved in petrochemical pollution (Chaiwattanaroj et. al., 2009). Some cases were found where the public was receiving conflicting messages from different sources, which confused them. The IQP noted a negative response from the public in Rayong caused by mistrust. While experts working for industries and the government controlled response techniques, many residents did not trust the monitoring techniques, data, or services. The IQP group learned through interviews that many people had been physically affected by pollution in Rayong. The group concluded that negative perception and mistrust of the government occurs when community members are unable to control response to petrochemical risks. With past mistakes, the trust in central authorities is stretched further. Public perception of response processes defines the general attitude of the event and can be associated with further social implications such as unrest and a lowered sense of well-being.

To apply the results found in the IQP, it can be paralleled that community members affected by any oil spill will develop a perception of risk of the situation based on information that is shared with them, their observations, and the impacts that they experience. Their risk perception is associated with a level of trust in authority figures. In the Rayong community, suspected misrepresentation of information and opinions of hasty decisions for clean-up methods lead to a depreciated level of trust.

At the conference held by PTTGC on the 27 January 2014 at Golden City Rayong, PTTGC discussed revitalization plan and the detailed analysis of the impacted area of Ao Phrao (Kingtong, 2014). The conference addressed economic, health, and social issues which have been inflicted on the local business stakeholders such as fishermen, local food stalls, and resort owners. Professors from prestigious Thai universities attended the conference to present their thorough evaluation and statistics of the water and contaminants in the water at Ao Phrao. Stakeholders that attended the conference mainly consisted of local shoreline fishermen who depend on the Rayong shorelines. Many issues raised during the conference revolved around the lack of integrity of PTTGC in addressing the environmental issues and in sharing information about plans for rehabilitating the area. Information presented by professors mostly accounted for the analysis of heavy metals reporting mercury, cadmium, zinc, nickel presented before and after the oil spill. A close account of the progress of the PTTGC clean-up crew is also touched upon and a comparative analysis of the conditions was reported.

Issues that PTTGC faces are mainly the lack of trust from the local business stakeholder

since the conference was not mainly focused on informing the locals. Community members at the conference voiced their concerns that there are no long-term plans published for the revitalization of Ao Phrao and also most funds and environmental responses are directed to Ao Phrao rather than the Rayong coastlines (references based on our attendance to the conference). Economic issues are the most tangible impacts so far and were also addressed the most by PTTGC. Some members of the conference said that even though PTTGC made a good impression on the cleanup of the affected area of Ao Phrao, they said that no campaign have been launched to regain tourist confidence regarding unseen contamination. In addition the loss of marine lives such as fish and blue crab in the area caused a major loss of income towards the shoreline fisherman. Concerned fishermen said that the conservation plan for fish and crabs were not yet published by PTTGC. Concern over coral reefs was also expressed. Finally, community members expressed interest in being part of the rehabilitation process carried out by PTTGC.

The company will need to address the issues voiced by concerned community members in order to build a firm trust on the community. Some revitalization plans have been issued, but further action has not yet been taken to reassure the trust towards PTTGC from the community.

2.5 Summary

In conclusion, oil spills in Thailand share similarities with oil spills that have occurred elsewhere, including how the spills occurred, the decisions that responders made, and impacts that have emerged. No oil spill response method has been perfect, and learning from past mistakes is a key to doing better in the future. We specifically will focus on information outreach during the oil spill clean-up and aftermath because we have determined a research gap exists regarding the public perception of the way the oil spill was cleaned and how the community members were treated. The economic damage felt by community members was a drastic impact from the oil spill that was improperly addressed by PTTGC when they failed to provide the reimbursements they promised. Health impacts have been associated with past oil spills like the Deepwater Horizon Oil Spill, but they have not yet emerged from the Rayong Oil Spill. Understanding the correlation between the environmental impacts, the economic impacts, and the information shared by PTTGC will help to thoroughly plan response methods in Thailand.

Chapter 3: Methodology

We first identified the high-impact areas of Mueang Rayong District, the region within the Rayong Province where the oil spill occurred. We then determined stakeholders and used prior research to identify which business owners we believed would be most affected. Using this information, we generated structured and semi-structured interviews to assess the impact that the oil spill had on the aforementioned stakeholders. We then developed an understanding of the current status of Rayong beaches and coral reefs by correlating information from different organizations in Mueang Rayong District. To gain a better understanding of the oil spill clean-up process, we contacted the company who spilled the oil, Petroleum Authority of Thailand Global Chemical (PTTGC), Plc. in Rayong, and gathered the published daily response from PTTGC and compared the actual response to the international protocol for oil spill response. Finally, we analyzed Twitter and Pantip posts and online newspaper articles that pertained to the Rayong Oil Spill to validate information from the various interviews we conducted. Our work has allowed us to gather specific information that can be used in many different ways.

Our goal was to identify the key characteristics that may have caused a decrease in trust or increase in perceived risk between the local businesses and PTTGC. To achieve our goal we wanted to answer the following research questions:

1. How were businesses in the Mueang Rayong District of the Rayong Province impacted by the oil spill?
2. How did the risk associated with the oil spill affect tourism?
3. What are the health issues reported from the oil spill?
4. What was done for the local business owners to help them after the spill? Was what was done as compensation insufficient?
5. What facts about the oil spill response plans were available to local business owners in Mueang Rayong District? How was information disseminated?
6. Do business owners feel that their community is at risk of another oil spill? If so, do they feel they will be taken care of?
7. Which industries were most impacted from the oil spill?
8. What areas of Mueang Rayong District have the least trust in PTTGC and the response of the government?

3.1 Data Collection from Interviews

The method of data collection is important to the validity and analysis of data. To best collect data at an efficient pace, we split our group of seven members into two groups of two and one group of three and each group was given interview protocols. While splitting our groups into these three groups, we assured that each group had one Thai speaking member so they could communicate with the interviewee and translate to English, and one English speaking member so that the translation to English could be written down.

3.1.1 Interview Protocol

To assure a quality collection of data, we put in place one set of protocols for our first trip (Appendices E, F, G and H) and modified those protocols into new ones for our second trip (Appendices I, J, K, L, and M). The following Appendices correspond to the following interview protocols:

Appendix E: Trip 1 Health and Economic Impact Interview Protocol
Appendix F: Trip 1 Tour Guide Interview Protocol
Appendix G: Trip 1 Diving Instructor Interview Protocol
Appendix H: Trip 1 Government Officials Economic Impact Interview Protocol
Appendix I: Trip 2 Economic Impact Protocol
Appendix J: Trip 2 Tourism Focused Interview Protocol
Appendix K: Environmental Damage Interview Protocol
Appendix L: Trip 2 Fishing Related Interview Protocol
Appendix M: Trip 2 Government Officials Interview Protocol

3.1.2 Types of Local Businesses

To create a more defined and manageable group of interviewees, we decided to group the ninety-three interviews into six categories. The categories and their descriptions are as follows:

Fishing: This category includes fishing village leaders, fisherman, and fishing boat owners.
Non-Seafood Merchant: This category includes all stationary merchants who sell products that are not related to seafood.
Seafood Merchant: This category includes fish vendors and the people who buy the fish from the fisherman and sell to the fish vendors.
Tourist Services: This category includes anyone who loans or sells goods or services to tourists.

Street Vendors: This category includes owners and managers of any travelling businesses, such as carts, walking vendors, and ice cream trucks.
Restaurants: This category includes any owners or managers of stationary food establishments.

3.2 Locations of Largest Impact

To find the areas of largest impact we contacted the Daily News and the Bangkok Post newspapers. Ao Phrao, a beach on Koh Samet, was determined to have experienced the greatest environmental impact. We used this information to plan our first trip to Mueang Rayong District, intending to go to the places with the largest impacts, including Ao Phrao on Koh Samet and Hat Mae Ram Pueng. After analyzing the data, we came to realize that the scope of our project needed to extend into the Ban Phe Area because the effect of the oil spill had affected this area more economically than environmentally. This information was used to plan our second and final trip to Mueang Rayong District. Figure 2.5-1 and Figure 2.5-2 in Chapter 2 show the areas hit by the oil itself.

3.2.1 Visits to Rayong Province

Our team completed two trips to Mueang Rayong District. The first trip was conducted from 26 January 2014 to 29 January 2014. The goal of the first trip was to interview as many business owners as possible while also conducting a few interviews with more authority figures in the area. We organized each day of the trip by setting up these interviews with authorities while in Bangkok. The interview protocol used during the first trip to Mueang Rayong District was based on the occupation of the interviewee. The data is reported in Chapter 4 in bar graphs so that trends in the data can be easily visualized. The results from our first trip were used to create more focused interview questions for our second trip.

Our second trip to Mueang Rayong District was completed 11 February 2014 through 13 February 2014. The goal of this trip was to interview figures of authority and leave time to use snowball sampling to find fisherman, village leaders, and NGOs to interview. After our second trip we correlated the data from these interviews with the interviews of the smaller business owners from the first trip to find validated trends related to trust of PTTGC.

3.2.2 Status of Affected Areas

The current status of the area was determined while interviewing local organizations and businesses within the Mueang Rayong District. We interviewed The Department of Marine and

Coastal Resources Research and Development Center, Greenpeace activist, The Marine and Coastal Resources Conservation Center, Department of Marine Coastal Resources, Eastern Coastal Fisheries, and a Marine Coastal Patroller in the Mueang Rayong District. We gained information pertaining to the clean-up response as well as the current status of the affected area. We conducted separate interviews with Mr. Chairat Trirattanajarasporn, the President of the Rayong Tourism Association, and Mr. Pongpakorn Singhakhetvittayabon, the Vice President of the Ban Phe subdistrict, to determine the extent of impacts felt by the tourism industry in Rayong. We requested specific data pertaining to the number of tourists in the area before and after the oil spill. This information was validated with information from previously conducted interviews with local businesses.

3.3 Economics

The community of Mueang Rayong District depends heavily on the tourism industry and is well known for the large amount of seafood exported from the area. The goal of the economic questions was to find the types of businesses that were affected the most and the causes of their income fluctuation. The target population for our interviews was anyone who owned or managed a business in the area of Mueang Rayong District, and any authority figures within the area. We then used the data we gathered from business owners and looked for a correlation to the information given by the authority figures within the tourism industry and the fishing village leaders.

3.3.1 Fishing

The Rayong Province is highly dependent on its fishing industry as a source of both food and revenue. We used our fishing industry and economic interview protocols (Appendix L and Appendix I) to gain an understanding of the interviewees' perceptions of the impact of the oil spill. The people who we decided to interview came to us through snowball sampling after we went to a Marine and Coastal fisheries conference on Tuesday, 2 February 2014 at the Star Hotel in Rayong. We were able to interview the fishing village leaders of Par Kun, Hin Dum, Pak Nam, Bang Kra Sher, and Klong Kra Sher. The information we received from those interviews was the information given to those five fishing villages. With this data we were able to see what semantic information was transmitted to the villagers and compare it to the answers gathered from other fishermen.

3.3.2 Tourism

The tourism industry relies entirely upon positive public perception of an area. When the oil slick reached Ao Phrao, all tourists were evacuated immediately and the clean-up began. The main goal of the Economic and Tourism protocols (see Appendix I and Appendix J) was to understand the flow of information to potential tourists about the condition of the area and the economic impact that the lack of tourists caused on the local businesses. To get a sufficient amount of data, we asked ninety-three local businesses questions pertaining to their economic changes, and asked two tourism experts questions pertaining to the levels of tourism in the Mueang Rayong District.

3.4 Social Impacts

The social impacts of trust in PTTGC and associated risks following an oil spill are impacted by economics and health. Questions that involved trust or future risk were correlated to health, economics, or any gaps in the response to the oil spill. To find the public attitudes about trust and risk in the area we asked the trust and risk questions to each interviewee. To analyze the data and find trends, we took qualitative data from the interviews with the eleven authority figures and compared it to the quantitative data of the ninety-three business owners.

3.4.1 Flow of Information

The flow of information about the oil spill and its response process affects the level of trust that the community has towards the company and government. To understand the information given to the community, we asked people in different areas of Mueang Rayong District what information they received about the oil spill, the response plan, and the compensation plan. The sources of the information was noted in order to track key informants. These questions were asked to all of our interviewees.

3.4.2 Social Media

Social media websites are an effective way to engage with world events, receive details from multiple sources, and locate multiple opinions in a centralized location. Social media sites allow people to connect to and inspect small and large-scale events. Posts on social media sites can include text, images, video, and links to further information. Each post provides a news story or a snapshot of a feeling or opinion. We used a high-level overview of the social media site Twitter during and following the oil spill to shed light on people's overall emotions.

An examination of social media posts during the Rayong Oil Spill allowed us to capture the thoughts and actions of community members during and after the spill. Our primary social media focus was Twitter. We were able to see the emotions of the oil spill unfold. We completed this study a full six months after the spill occurred, but analyzed the tweets from the first four months after the spill. The posts were analyzed quantitatively based on words in each post that show feeling. The results were coded by assigning scores to positive or negative words in posts to create quantitative data from the text. Use of social media sites is not universal, as some members of the local community are not a part of the Twitter community, but the posts provided insight into the overall opinion toward the oil spill nonetheless.

To acquire all the tweets about the Rayong Oil Spill and PTTGC, four searches were run on https://twitter.com/search-home. The four search terms were 'oil Rayong,' 'spill Rayong,' 'spill PTT OR PTTGC,' and '#thaioilspill.' The searches were run on 20 February 2014. The text of the tweets from all searches was copied into a single document. The text was cleansed of web page elements, arranged in a consistent format, and processed into file that could be read in Excel. The tweets were listed by day and duplicate tweets between the multiple searches were removed.

A sentiment analysis engine was required to give a numerical value for the feeling of each tweet. A sentiment analysis engine compares input text to a dictionary of terms for which it already has sentiment values. As happy and sad words are added to the dictionary, the engine becomes more capable of accurate sentiment prediction. The service Repustate was used to analyze tweet sentiment. The engine assigned values between 0 and -1 to tweets with negative sentiments and values between 0 and 1 to those with positive sentiment.

To obtain many Thai-based opinions we used Pantip as a method for questioning. Pantip is one of the most popular online forums used in Thailand where community members visit to share opinions and answer surveys. To obtain information, we posted the following questions: "Did you go to Rayong/Koh Samet before the Rayong Oil Spill? Did you go to Rayong/Koh Samet after the Rayong Oil Spill? Why did you go to Rayong/Koh Samet after the oil spill? Why did you not go to Rayong/Koh Samet after the oil spill?" under the lobbies Green Zone, Environment Chat Room, Blue Planet, Travel Chat Room, and Suan Lumpini, the Health Chatroom.

3.5 Summary

The overall goal of our interviews was to gather data in an efficient and effective way while following the interview protocol that was set prior to investigation. Using social media as

an additional means of data collection helped support our results and gave them additional context. By following the preset protocol and by adapting to data from our first trip to Mueang Rayong District, we were able to acquire more useful data on the second trip. The resulting combination of local business interviews, authority figure interviews, and social media analysis allowed us to create a meaningful set of correlated data.

Chapter 4: Results and Analysis

The goal of this project was to identify the key characteristics that may have caused a decrease in trust or increase in perceived risk between the local businesses and PTTGC. We gathered results from research and interviews conducted on two trips to Rayong. In addition to interviews, we used the social media site, Twitter, and the web board, Pantip, to analyze posts that were made at the time following the oil spill. This section describes our findings of the local business' trust in PTTGC in the following areas which correspond to each of our six objectives:

1. Economic Impact
2. Health Impact
3. Compensation and rehabilitation plan
4. Information outreach
5. Perceived risk
6. State of environment and trust of cleanup

The combination of our interview results and research of the response actions and plan shows the impacts that were felt by the business owners in Mueang Rayong District. We present our findings in this section by objective and research question. For each objective and research question, we will describe our quantitative and qualitative results followed by our findings.

4.1 Locations Visited and Population Studied

We first describe the population we assessed. Figure 4.1-1 shows the areas we visited on our two trips to Rayong and their distance from the origin of the oil spill.

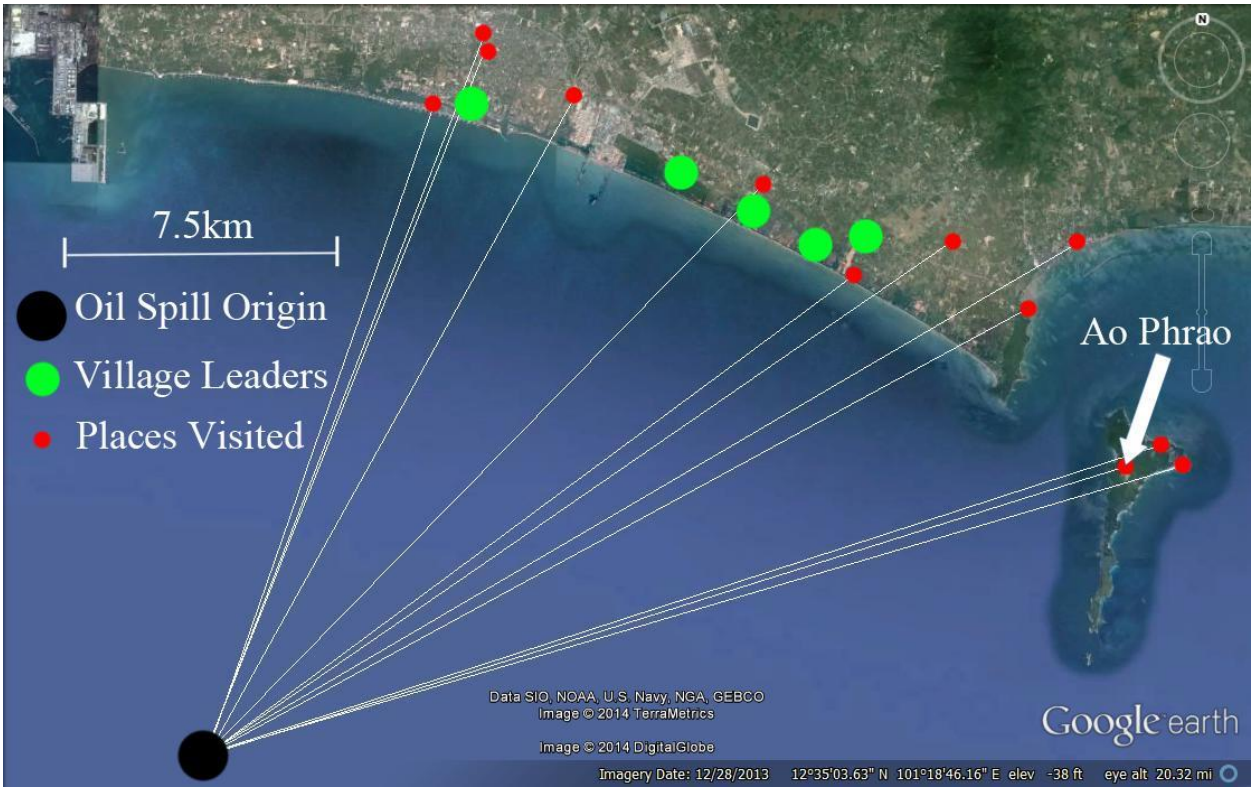

Figure 4.1-1: Areas Visited in Rayong Province

In these areas, we conducted a total of 93 economic impact interviews with local business owners. Figure 4.1-2, shows the occupations of the Rayong business owners that we interviewed. We focused on these industries because they were the most abundant in the visited areas and the impact on them would effectively represent the economic impact of the area.

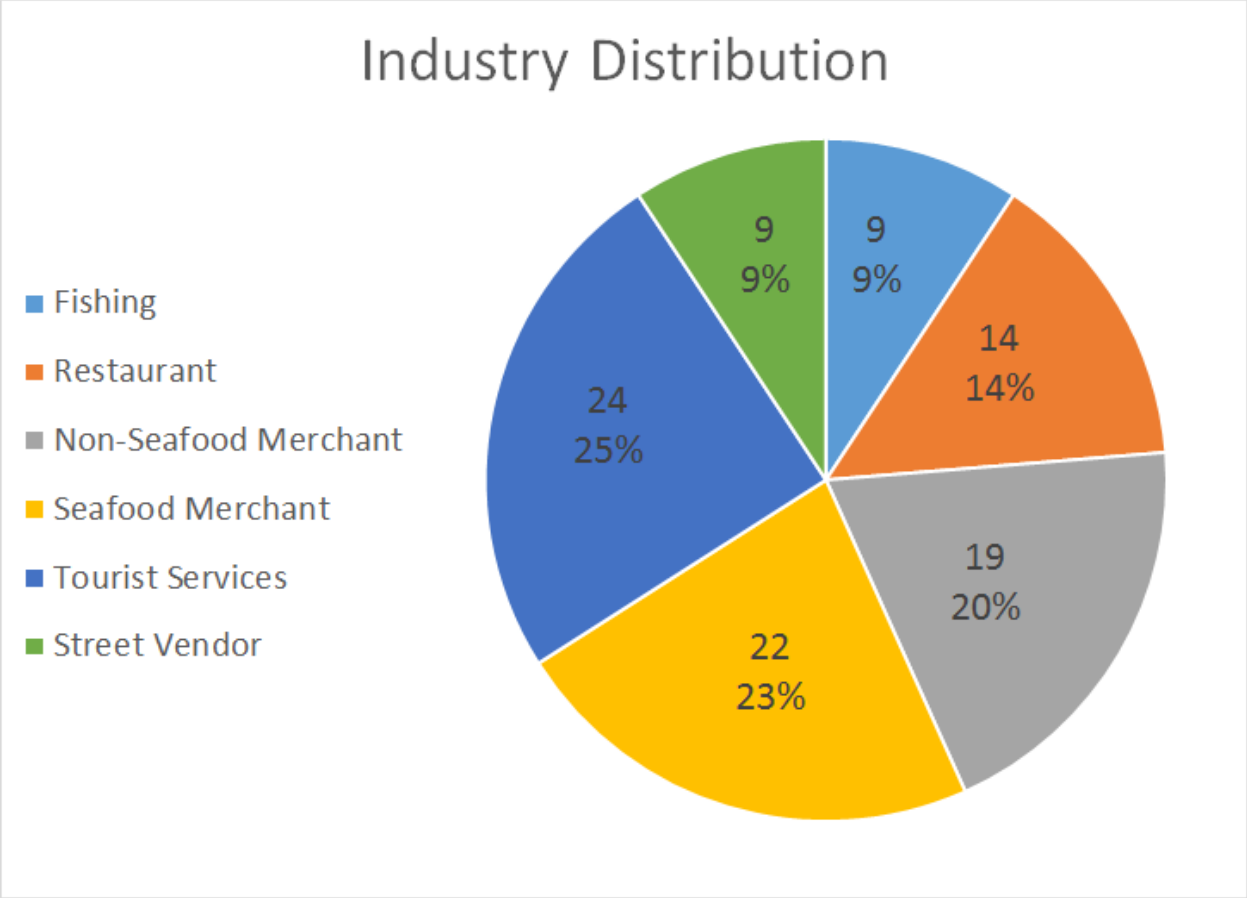

Figure 4.1-2: Distribution of Interviewees by Industry

4.2 Objective 1: Determine Economically Impacted Members in Mueang Rayong District

We determined the economic impact on local business owners in Mueang Rayong District using questions that reflects the state of their businesses before and after the oil spill event. The questions aim to critically document their impressions towards the impact on their business that arises due to the oil spill. The economic impact interview aids the exploration of the change in revenue, what impacts have the local business owners felt, and which factors contributed to the decrease in revenue. Compiled results from the interview led to the understanding of the impact distribution, which are reported in our findings.

4.2.1 Research Question 1

We gathered data to address our research question: **How were businesses in Mueang Rayong District economically impacted by the oil spill?** The results were classified by type of business.

Figure 4.2-1 shows the decreased revenue reported by local business owners.

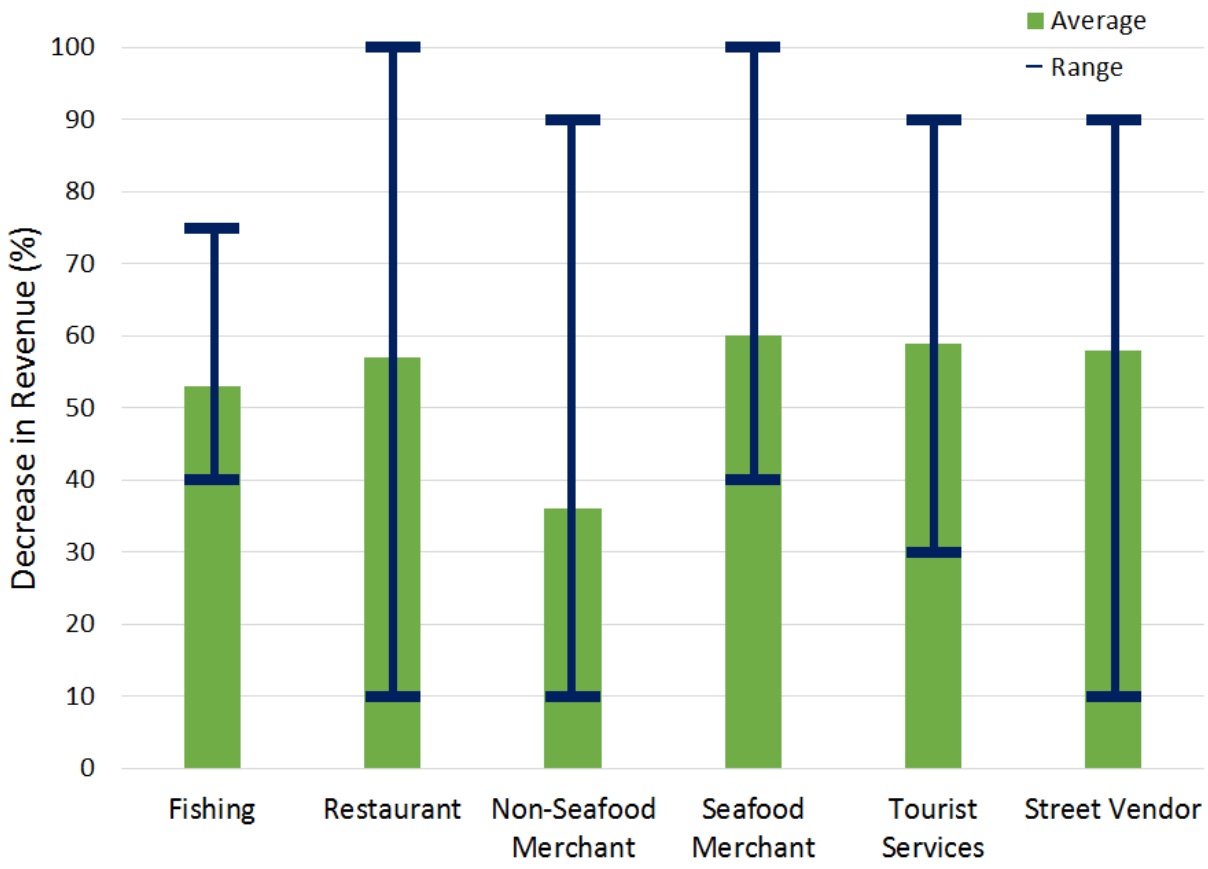

Figure 4.2-1: Revenue Data Gathered From Interviews

Of the businesses we assessed, the restaurant industry and seafood merchants reported a revenue decrease of up to 100%. The least impacted industry based on our studied population was the non-seafood merchants who reported an average decrease of almost 30%. Seafood merchants were the most impacted and reported an average decrease of about 65%.

Finding #1: Seafood related industries were impacted by contamination

The quantitative and qualitative results from our interviews showed that seafood merchants were most economically impacted. This finding was backed by a statement from the leader of Klong Gra Cher Fisheries describing the hardships merchants felt:

"Merchants [of seafood] were impacted a lot because their source of fish was lost. Some merchants had to switch from selling fish to just processing squid. These people now make 100 THB revenue per day after originally making 1000 THB per day before the spill. One seafood merchant [I know] is 66 years old and cuts up 100 kilograms of squid per day to make 3 THB per kilogram."

When the fishermen cannot fish or have difficulties catching fish, the seafood merchants struggle to support their employees and families. The fisherman village leader of Par Kun & Hin Dum discussed the loss of fish in the area: "*we have lost 60-70% of the fish we normally catch. A lot of fish are seemingly extinct*." The impacts of their difficulties directly impact the seafood merchants.

We interviewed one woman who said she had long-lasting economic impacts. She could not sell her dried fish after the oil spill and was forced to deposit the fish into a freezer through a storage company. Since the fish could not be sold at a typical market price and no consumer wanted to purchase the product, it remained in the freezer. Fish exports to Taiwan and Singapore have been stopped due to fear of contamination. The price for freezing storage will increase linearly relating to the amount of time the product is left in. The pricing system for the freezer starts at 3 baht/kg per month and increases to 6 baht in the next month, 9 baht for the next following month, etc. Accumulated product that has been left in the freezer has lost its value since the rental for the freezer now exceeds the value of the fish. The income per day fluctuates without a trend, and some days there were no income at all since the fish cannot be sold. However, locals in the area still have confidence in purchasing the products. The economy in the area is reverting back to normal since PTTGC's advertising campaign has regained some tourists' confidence. From this case study and many like it, it can be determined that long-term impacts are possible in the event of an oil spill and considerations of these long-term impacts were not made by PTTGC.

After conducting our interviews, we sorted each location of the interviews by the distance from Ao Phrao Bay, where the oil slick first hit. Figure 4.2-2 shows the percentage of reported revenue decrease of each interviewee graphed against the distance they are from Ao Phrao. The bubble size is relative to the number of interviewees at that area who reported the same revenue decrease. The black line represents the average revenue decrease at regular intervals,

averaging about 60% for distances closer than 10 km, and dropping steadily to about 30% at 22.5 km away from Ao Phrao.

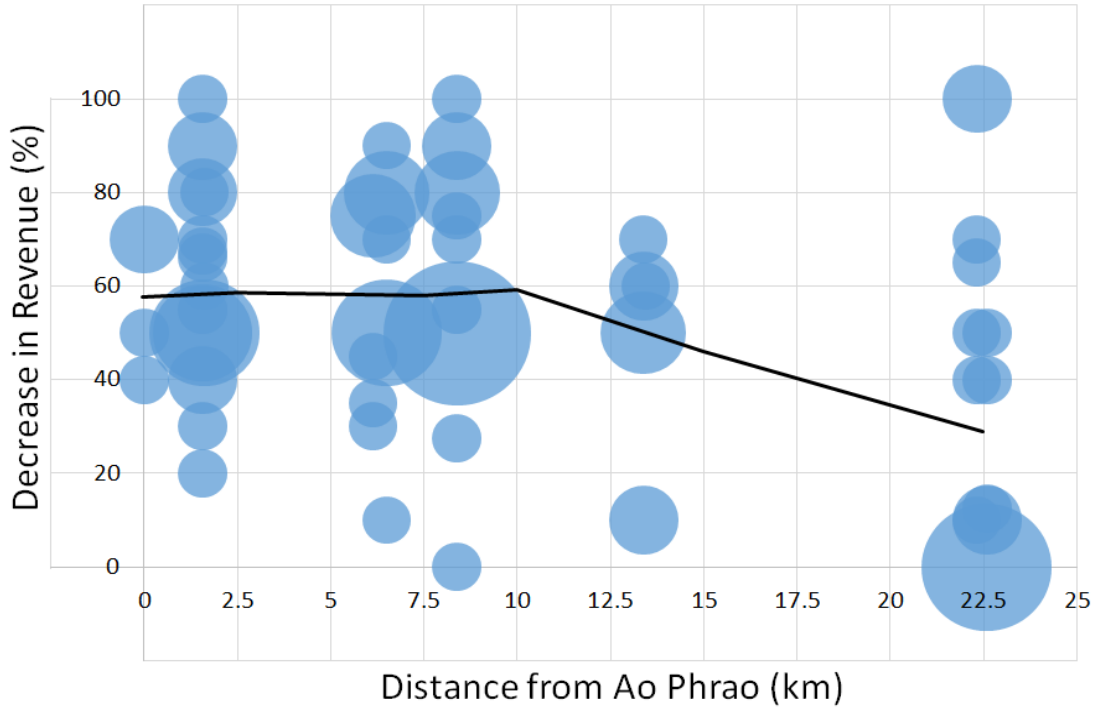

Figure 4.2-2: Decrease in Revenue by Distance from Ao Phrao

From the analysis of the interviews made by affected fishermen and head of fisheries a mutual trend of distrust can be seen. The situation was so severe and not address to a point in which fisheries decided to hold a conference at the Star hotel on the 11 February 2014 to discuss a potential lawsuit against PTTGC. The recurring inability to catch the usual amount of fish, inability to breed blue crabs and oysters, and the lack of consumers to purchase these fresh produce adds pressure to the distrust of the fishing industries to PTTGC.

Finding #2: Interviewees tend to perceive their own economic impacts as significant, regardless of region, but Koh Samet and Rayong were impacted differently.

Based on our interviews with local businesses, the difference in economic impact varied only slightly within Mueang Rayong District. Koh Samet was economically impacted the same as the Rayong coast around Ban Phe, which is 6.1-6.4 km away from Ao Phrao. Businesses on both the Rayong coast and Koh Samet base their income on foreign and Thai tourists. Our farthest interviews occurred in Pak Nam subdistrict, 22.5 km from Ao Phrao, and reported an

average decrease of 30%. However, when we interviewed subjects in Ban Phe subdistrict and on Koh Samet, both groups reported a belief that they were experiencing severe economic impacts that were specific to their area and the assistance given to them there. Mr. Pongpakorn, the Vice President of Ban Phe subdistrict, stated that Ban Phe was still feeling impacts when we interviewed him in February while Koh Samet was better off: *"The first three months of the oil spill Ban Phe and Koh Samet lost 90% of its income. But now Ban Phe is at 80% loss and Koh Samet is only losing about 10% is normal amount of income."* The difference in impact may be due to the dependence on foreign versus Thai tourists. According to Mr. Chairat Trirattanajarasporn, President of the Rayong Tourism Association, PTTGC funded advertising and campaigns to support the business owners in Rayong (see Appendix N). The company focused mostly on the Koh Samet area and less on the Rayong mainland. Business owners in Rayong's mainland showed concern with PTTGC's focus on Koh Samet since the impact extends to the whole of Mueang Rayong District, not only Koh Samet.

To further verify our finding, one authority figure in the area stated that the majority of advertising and promotions were done for Koh Samet, which was later verified by PTTGC's timeline document recorded in section 2.5.1.1. According to updates issued by PTTGC on their blog, the company hosted various events such as the PTTGC Samet Smart Smile on the 16 November 2013 to regain confidence towards Koh Samet and the Koh Samet Aquathlon International Championship on the 20 November 2013 to regain confidence of the sea safety and promote swimmers to swim across to Rayong shorelines from Koh Samet. However events hosted for Rayong mainland were minimal.

4.2.2 Research Question 2

We gathered information about the economic impact on tourism through the interviews with local business owners and authority figures in the Rayong area to address the research question: **How did the risk associated with the oil spill affect tourism?**

Mr. Chairat Trirattanajarasporn, Owner of Tamnanpar Restaurant and President of Rayong Tourism Association, said: "*After the first week, the news about the oil spill widely spread causing the impact to increase massively*" (see Appendix N). As for the decrease in tourism, he stated "that there was a 50-60% decrease in tourism after the oil spill due to both the oil spill and the rainy season. Currently there is a decrease in income of about 20-30%, not only because of the oil spill, but also because of the protests in Bangkok."

Our interviews with local business owners confirmed these statements. All industries reported lost income due to a decreased level of tourism. Less tourists are there to promote the

local flow of income. They stated that media coverage of the contamination led to fewer tourists and an increased perception of risk in the area.

We submitted a survey to Pantip and received 85 respondents to our questions. As seen in figure 4.2-4 69% (Roughly 59 people) of the respondents traveled to Rayong or Koh Samet before the oil spill, and as seen in Figure 4.2-3, only 16%(Roughly 14 people) traveled to Rayong/Koh Samet after the oil spill.

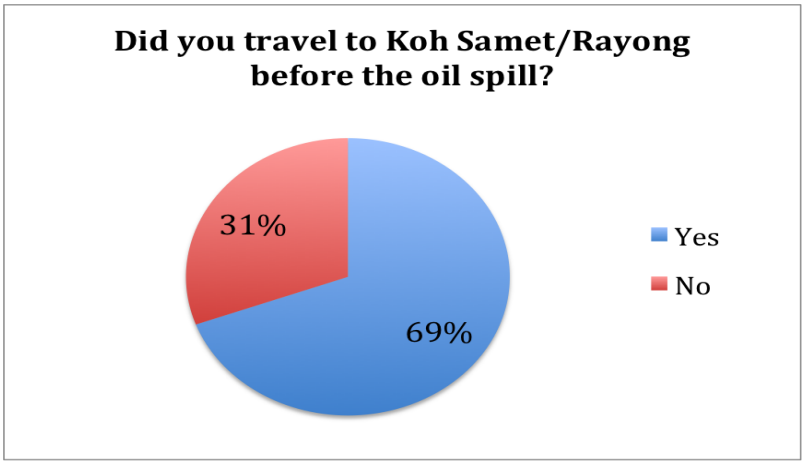

Figure 4.2-3: Percentage of Koh Samet/Rayong Tourists Before the Spill

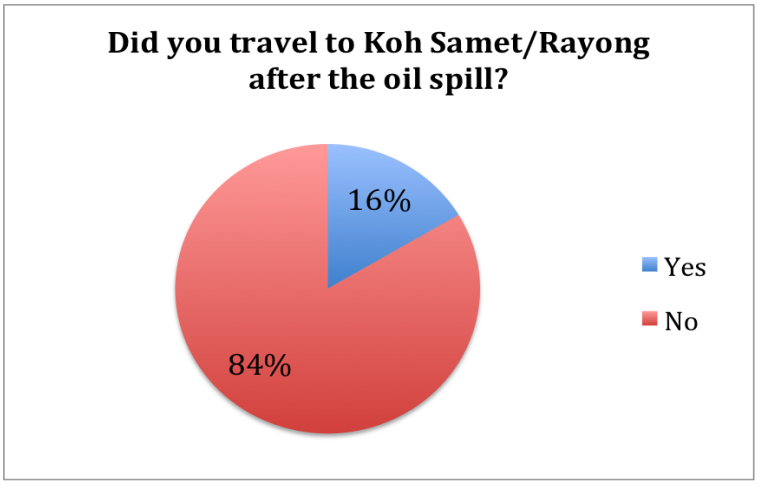

Figure 4.2-4: Percentage of Koh Samet/Rayong Tourists After the Spill

Figure 4.2-5 shows that out of the 84% (roughly 46 people) who stated they did not travel to Koh Samet or Rayong after the oil spill, 40% (roughly 18 people) chose not to return based on mistrust, risk associated with the oil spill, or more beautiful beaches.

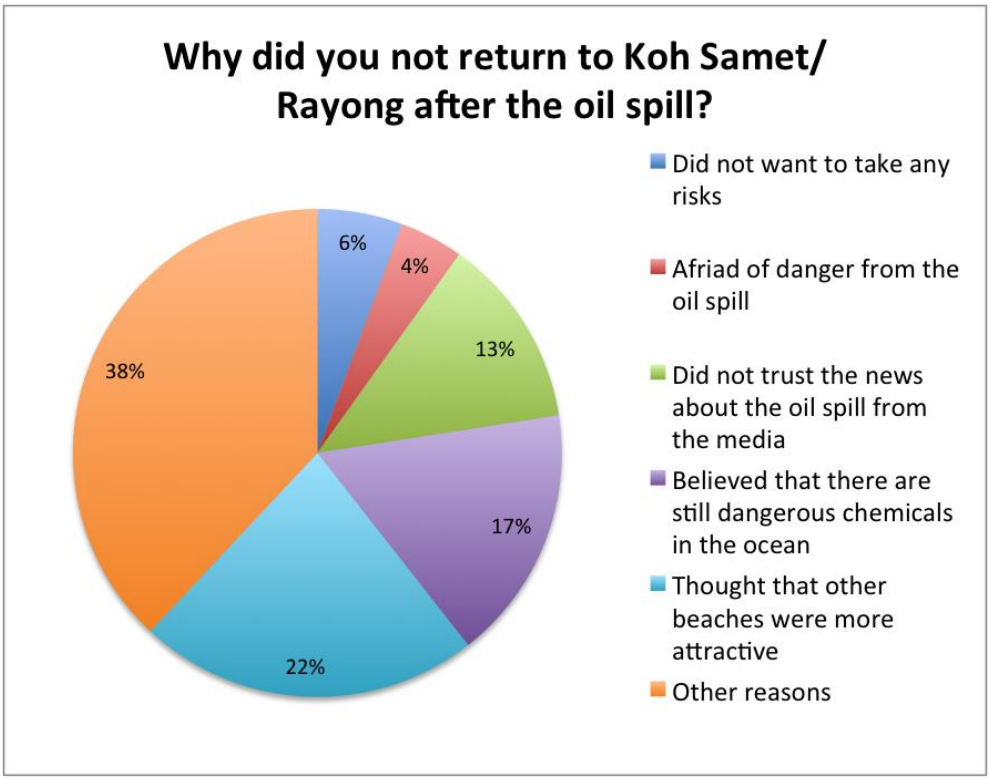

Figure 4.2-5: Reasons Participants Did Not Return to Rayong

Figure 4.2-6 shows that out of the 16% (roughly 14 people) who stated that they traveled to Koh Samet or Rayong after the oil spill, 50% (7 people) chose to return based on trust towards PTTGC, attractive promotions, or no fear that the oil spill was dangerous.

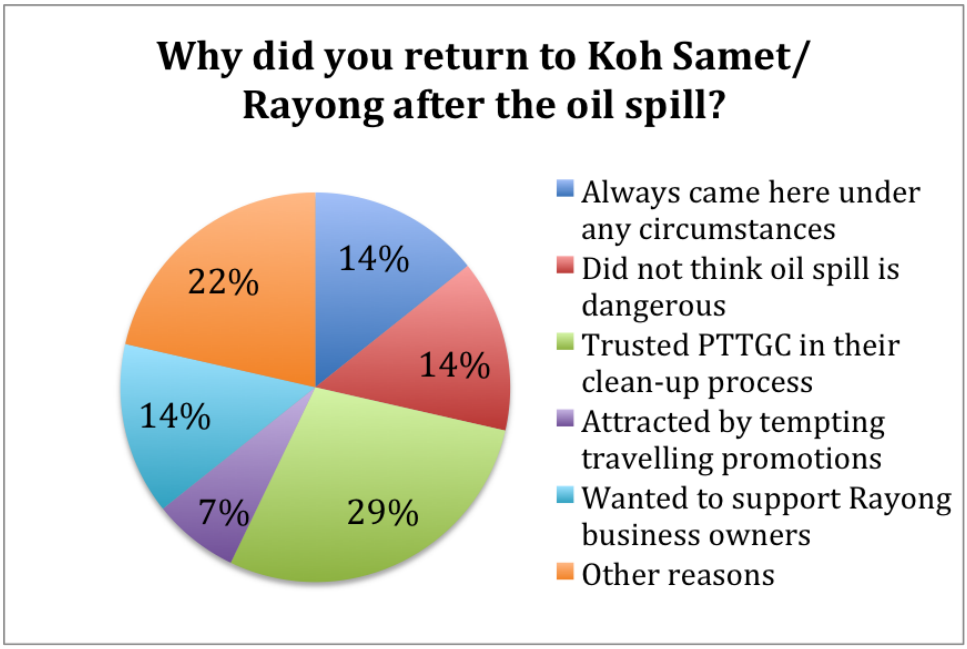

Figure 4.2-6: Reasons Participants Returned to Rayong

4.2.3 Media Influence

The media reporting process after the oil spill occurred was a commonly mentioned contributor of lost revenue. Of the 74 interviews conducted to tourism dependent industries, 15 mentioned that the media reports contributed to their decrease in revenue. While business owners that we interviewed acknowledged that the oil spill and the clean-up were topics covered by the media, many stated that the media did not adequately document the area after the oil was cleaned up. Business owners were also harmed by the generalizations that media made --especially those at Koh Samet. Only Ao Phrao was hit by the oil spill, but the media stated that the entire island was affected. Rayong tourism also suffered due to lowered tourism interest. Since most people around the world have access to news media, the reports shown have a large impact on the opinions of the viewers. The audience is even larger with internationally globalized medias e.g. CNN. The information which was portrayed about the Rayong Oil Spill may have caused concern and fear to the potential tourists that would have gone to Mueang Rayong.

Finding #3: Tourism decreased due to media coverage and concerns of contamination.

Our data shows that the main cause of decreased tourism was due to media coverage of the oil spill which led to a mistrust of the area --in terms of health safety concerns. Both Thai

tourists and European tourists who normally visit the area did not visit, however, resort owners at Ao Phrao stated that the European tourists have regained confidence in the area.

Tourism in Rayong, which hosts more Thai tourists, are continuing to have a decrease in revenue. This may be due to the shorter-term planning of vacations and trips taken in Thailand. European tourists may book their trips well in advance, but the Thai tourists are more likely to travel with a short-term planning process and can easily change their destination to a similar island. The current decrease in Thai tourism may be better attributed to the current protests in Bangkok and political situation of Thailand than the oil spill and contamination.

4.3 Objective 2: Determine the Health Impacts of Oil Spill

We determined the health impact on local business owners in Mueang Rayong using data from the Provincial Health Office to reflect whether health issue is apparent due to the oil spill. This information will aid the understanding of what types of short-term health impacts have occurred and what long-term health impact will occur in the future.

4.3.1 Research Question 3

We searched health data from the Provincial Health Office for signs of increased toxicity or reported symptoms potentially caused by the oil spill and got information from our interviews with business owners about illnesses from the oil spill. This information helped answer our research question: **What are the health issues reported from the oil spill?**

Data from the Provincial Health office reported that one person of 2,102 people studied had a high level of benzene measured in a urine sample. Of the people in Koh Samet who sought medical care from 27 July 2013 to 10 August 2013, 30.9% of them were seeking medical care due to health impacts of the oil spill (Provincial Health Office, 2014).

In our interviews, local business owners on Koh Samet and in the Rayong mainland generally did not report health effects of the oil spill. A few business owners mentioned dizziness and irritated skin. In the interviews we conducted on our first trip, 29% of those asked reported a health impact from the oil spill.

From our interviews, we learned that on Ao Phrao where most of the cleanup process occurred, medical tents were provided by PTTGC where workers routinely provided urine samples to test for toxicity. Doctors from the local hospitals and clinics were also available to respond to any medical situations.

The long-term health impacts have yet to emerge, but we encountered much anxiety in this area particularly associated with contaminated fish and the risk for cancer to develop. The head of Small Fisheries who acts as a contact for Greenpeace made the following statement about long-term health impacts caused by industrial contamination in Rayong: *"Everywhere, not just Rayong, has issues with contaminated water and food caused by industries. Heavy metals get into all of the food from the sea. Even if the amount of heavy metals doesn't exceed the safety limit, it will still accumulate in humans. Rayong in particular has a lot of contamination issues because it is an industrial area. Rayong has six times more cancer than the rest of the world"* see Appendix N for complete interview). Our research of the health effects of oil spills is found in Chapter 2, Section 2.3.2.2.

Finding #4: Short-term health impacts were minor; Long-term health impacts are a source of concern.

The finding that short-term health impacts were small follows from our research of health data from the Provincial Health Organization in the time following the spill. The most commonly reported health impacts included dizziness, nausea, itchiness after going swimming, and stress or anxiety due to loss of income. We found little evidence of elevated levels of toxicity. Health impacts may continue to emerge in the long-term, and the perceived risk for these impacts was apparent in our interviews we conducted.

4.4 Objective 3: Determine Actions Done to Help Business Owners

To understand what have been done to help the business owners, questions are directed to business owners to explore their impression towards performance of the clean-up company. The interview base to evaluate distribution monetary compensation has been done and how PTTGC has promoted tourism in the area. The findings shows how PTTGC addressed these issues.

4.4.1 Research Question 4

We conducted interviews with village leaders and local business owners to address our research question: **What was done for local business owners to help them after the spill? What did they want that was missing or was any action insufficient?**

We evaluated the role of authorities in helping locals after the oil spill through our interviews conducted on the second trip. We also asked the local business owners what was done to help them after the spill and if the response could have been done better.

4.4.1.1 Promoting the Area

Mr. Chairat Trirattanajarasporn, owner of Tamnanpar Restaurant and president of Rayong Tourism Association, and several of the business owners we interviewed said that PTTGC supported advertising of the Koh Samet area and sponsored promotions for his restaurant and other tourist attractions. The manager in one of the resort at Mae Rum Pueng Beach said that the PTTGC promoted the resort by sponsoring customers a “buy 1 night; get 1 free night”. Customers will pay the normal rate for the first night and PTTGC will pay the resort for the second night. This helped compensate for the loss of revenue for the resort and also in turn promoted tourism in Rayong.

4.4.1.2 Compensation

We learned that there were some standard compensation protocols that PTTGC used to determine the amount to pay each business, which is outlined in Table 4.4-1:

Table 4.4-1: Compensation by Industry

Local Business Stakeholder	**Amount (baht)**
Fishermen	30,000 per boat
Restaurant	15,000 per restaurant
Koh Samet taxi	24,000 per vehicle
Laundry services	15,000 per company
Street merchant	9,000 - 45,000 per shop according to size

All local business owners we contacted described the level of monetary compensation provided by PTTGC. They said that a pre-determined amount of compensation or public plan was not available, but they filled out forms describing their impacts and their business. After they returned their forms, many received compensation money. The PTTGC committee evaluated their forms and gave an amount of monetary compensation as they deemed necessary.

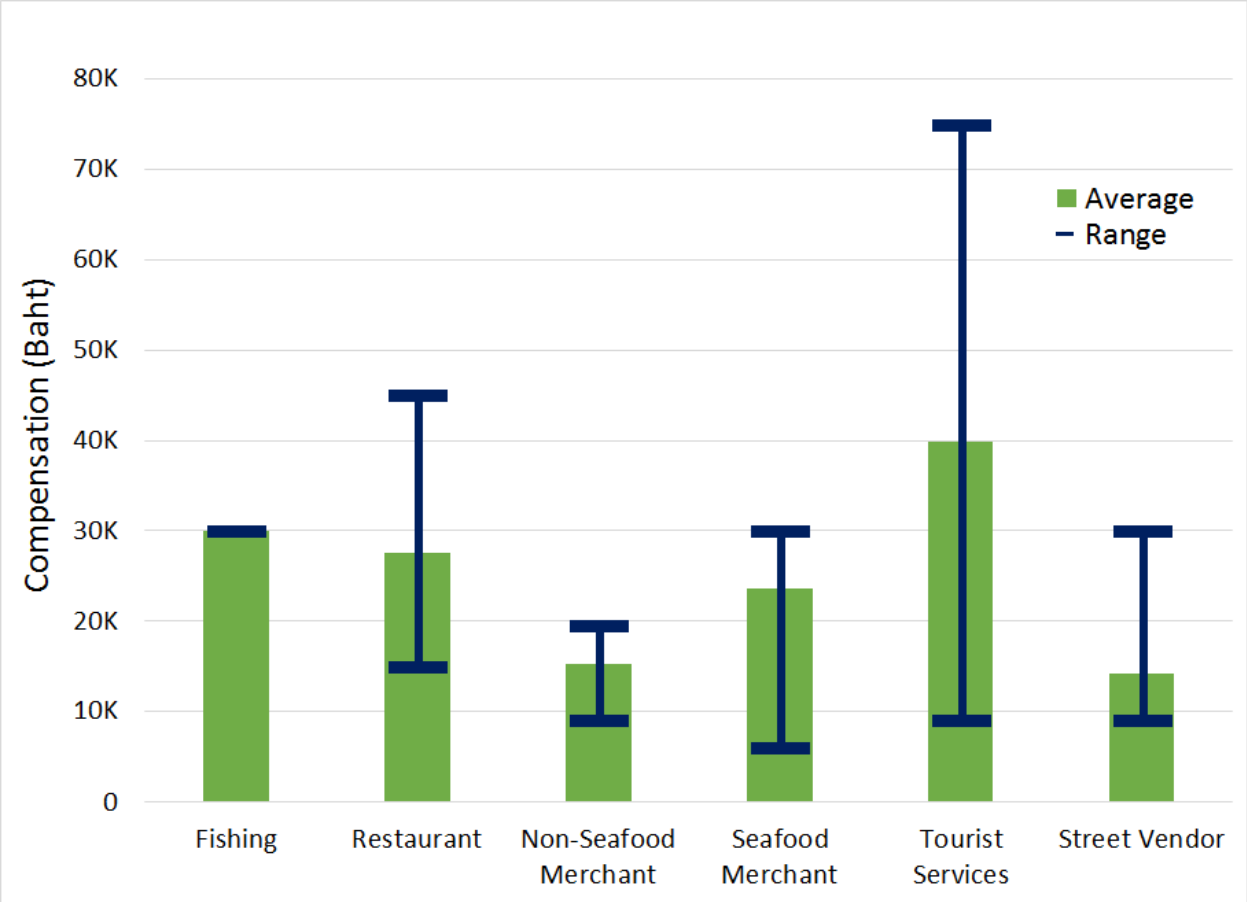

Figure 4.4-1: Monetary compensation from PTTGC by Industry

When we attended the conference held by PTTGC for community members, we were given their rehabilitation plan. During mid-August, after Ao Phrao had been fully cleaned, PTTGC published a shorter-term response plan which we described in section 2.5.3.1 (PTTGC, 2013). The same compensation plan given at the conference was also given to us but we were told that there were confidentiality concerns since it has not been published yet. It is still being finalized for approval. The documented compensation plan is part of the whole sustainability report that will be issued at the end of March 2014.

Finding #5: PTTGC's monetary compensation plan was considered adequate by some and not by others; many said it was unorganized and was not publicized.

Those who wanted compensation had to apply. Official documents and related forms for the redemption of compensation had to be submitted at designated response units. Then the level of impact on each applicant was evaluated. Once a defined amount of compensation had been settled, the municipality would transfer this document to the PTTGC compensation

committee where it would be evaluated a second time. Sometimes the municipality and PTTGC's compensation committee issued different amounts for the same case. The amount of compensation was inconsistent and the amount received depended on the committee. The method was unorganized and affected larger businesses such as hotels and resorts more than small businesses such as masseuses and squid merchants.

The compensation process was complex and sometimes required official documents. For example, a certificate of boat ownership was needed for the amount of compensation specified for a boat. The amount of compensation given did not provide long-term support for businesses since impacts on the business lasted more than one round of compensation.

4.4.1.3 Satisfaction with Response

Local business owners were asked if they were satisfied with the oil spill response. The results are shown in Figure 4.4-2.

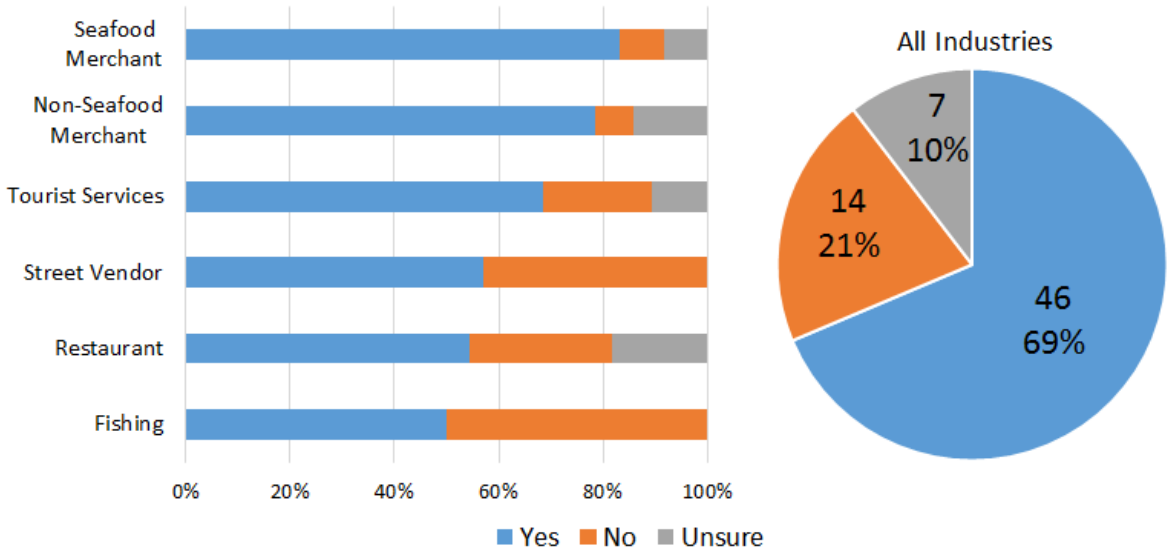

Figure 4.4-2: Satisfaction by Industry towards the Clean-up

Up to 69% of all the interviewees from all industries shows high satisfaction towards the PTTGC's clean-up process. The highest satisfaction by industry would be seafood merchant which corresponds to over 80% satisfaction whereas fishing industry has the least satisfaction of 45%. The fishing industry and street vendors exhibited the most dissatisfaction towards the cleaning process. This is due to the abrupt loss of income from fishing due to the contamination that fishermen think caused fish to move elsewhere. An unexpected trend can be seen from the

seafood merchants since they had the highest satisfaction, but it was claimed that their source of seafood is far from Rayong and they are not directly affected by the clean-up process like the fishermen.

When we attended the conference held by PTTGC for shoreline fishermen in Rayong, we noted that the people who attended were not happy with the way PTTGC had conducted their response. Attendees who spoke up about their concerns were upset about the lack of integrity on how PTTGC is going to address the social issues in addition to the environmental issues in the long-term. There were no consistent updates on the current conditions of the Rayong shorelines. They stated that the compensation given from PTTGC did not satisfy the affected people or address the long-term and still cannot solve the problems regarding the loss of fish. They stated that there are no long-term plans for the monitoring of the Ao Phrao environmental conditions, and most funds and environmental responses were mostly directed to Ao Phrao. The Rayong coastal areas were also affected due to the oil spill but no campaign or events were hosted to bring back tourist awareness. There is still a lack of tourists on the Rayong coastal areas which forces restaurants and businesses to shut down due to lack of income. The loss of marine lives such as fish and crabs in the shoreline caused a major loss of income towards the shoreline fisherman. Also PTTGC has not published information on the cleaning of the environment regarding the fish, blue crabs, corals, and water management scheme and shoreline management. Struggle on the difference in level of compensation for different groups of stakeholders caused a lot of concerns. Some unaffected individuals sought compensation and received it while some individuals who were severely affect did not receive the full amount or at all. There were also concerns over the water quality in the coastal areas of Rayong which will require PTTGC's action.

4.5 Objective 4: Determine the Information Available to Community Members

In order to understand the information flow and how locals received information, interview questions were given to village leaders and other people in authority positions (see Appendix N for interview results). The interview questions aimed to analyze how information was distributed, how locals receive the information and what types of information was available to them. The findings showed an overview of the flaws in the information flow towards the local business owners.

4.5.1 Research Question 5

We interviewed village leaders, other people in positions of authority, and local business owners to address our research question: **What facts about the oil spill response plans were available to local business owners in Mueang Rayong? How was information disseminated?**

The Director of Marine and Coastal Resources Conservation Center stated that his department was responsible for distributing environmental information to provincial community members. They held a conference and large group meetings for people to express their concerns and learn about the oil spill. Mr. Pongpakorn, Vice President of the Ban Phe subdistrict said that information was given by PTT to the news sources, but the information was not complete. He said *"I believe that the company hasn't shared all of the information related to the oil spill because they still haven't cleared up a lot of the issues that people have."* The fisherman village leader of Par Kun & Hin Dum stated that he shared information from NGO's like Greenpeace with the villagers to keep them updated about the oil spill.

Of the 17 interviews we conducted on our second trip of business owners in the Ban Phe area, the following sources of information, shown in Table 4.5-1 were reported as sources of information about the oil spill and the response process.

Table 4.5-1: Information Sources Reported

Source of Information in Ban Phe Area	**Number of Interviewees**
Word of mouth from people traveling in Koh Samet area	5
Navy and government representatives	4
PTT representatives	5
Provincial office	3
News	1
Village leaders	1

Finding #6: Information from PTTGC representatives and government representatives were major sources of oil spill knowledge for the local business owners in the Ban Phe area.

It is important to have adequate information following a major event in order to keep community members aware of the event and potential hazards presented by it. We identified PTTGC representatives and government representatives as well as media sources and word of mouth as the key methods of sharing information.

4.5.2 Public Knowledge of PTTGC Response Plans

We called the public relations (CSR) division of PTTGC to find out what information was available to community members. The CSR directed us to their website, www.pttgc-oilspill.com and told us that if we wanted further information, we would need to fill out a consent letter. We were required to describe in detail the information we required, our purpose for access, and our association with any organizations.

We assessed the website and found news updates from 30 July 2013 to 8 November 2013 and also their working progress from 27 July 2013 to 6 August 2013. Other information such as dispersant and materials used to clean up the oil can also be found. The site stated that the dispersant used was 'Slickgone NS TYPE 2/3' and it was approved by the Ministry of Agriculture Fisheries and Food of England. PTTGC stated that this biodegradable dispersant would disperse the oil into small droplets which then would be broken down by microorganism and wave actions in the sea.

From the website the overall compensation was mentioned to be more than 162.64 million baht. However, the website was lacking the current status of the impacted area and a breakdown of the compensation process.

4.5.3 Public Knowledge of PTTGC Monetary Compensation Policy

Business owners in Rayong were asked about their awareness of PTTGC's plans for monetary compensation. They reported that the plan was not disseminated, but compensation forms were distributed by the village leaders.

Finding #7: The amount of information shared by PTTGC about the compensation plan and the environmental rehabilitation status was a concern for authority figures and local business owners.

PTTGC has not fully publicized all of its knowledge to the local people. Some information is still confidential and requires a consent letter in order to obtain it. Monetary compensation plans were not available to the public and caused some concern about the level of compensation received by different people. Environmental rehabilitation plans for the sea or coral was not fully published by PTTGC, however some relevant information can be obtained from Kao Laem Ya Moo Koh Samet National Park (Saithong, 2014). Local business owners were concerned about the long-term plans since none have been issued yet and the company seems to not put this issue as its priority.

4.6 Objective 5: Determine the Perceived Risk for Impacts of a Future Oil Spill

Interview questions were structured in order to reflect the local business' perceived risk of another oil spill. The questions aimed to determine the perceived risk to the well-being of the interviewees in the event of a future oil spill.

4.6.1 Research Question 6

We conducted interviews with business owners in Mueang Rayong to address the research question: **Do business owners feel that their community is at risk of another oil spill and if so, would they be taken care of?**

Interview results showed mixed feelings that an oil spill could occur. As seen in Figure 4.6-1, 33% of the people we interviewed said that they did not think another oil spill will occur because the company have learned its lesson, and improved protocols should have been implemented.

Interview Question: Do you think an oil spill will happen again here?

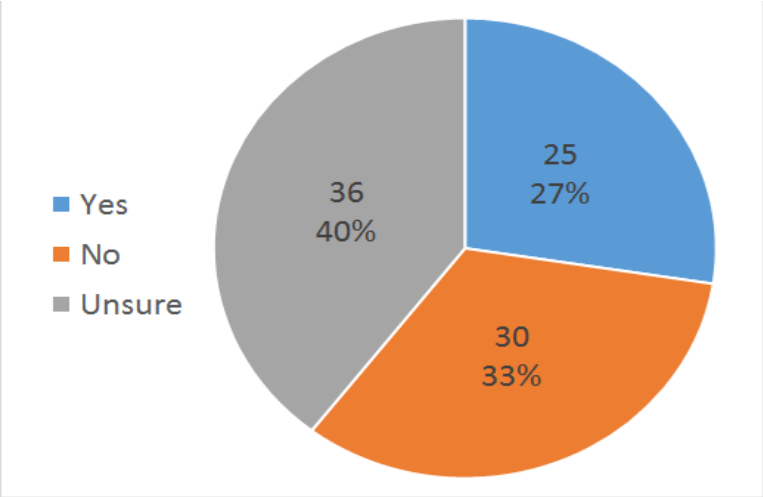

Figure 4.6-1: Interview Data on Perceived Potential Impact of another Oil Spill

4.6.2 Risk of Future Impacts

The majority of the interviewed population is concerned that if another oil spill occurred, they would be more affected, as seen in Figure 4.6-2.

Interview Question: If another oil spill occurred, how would it affect you?

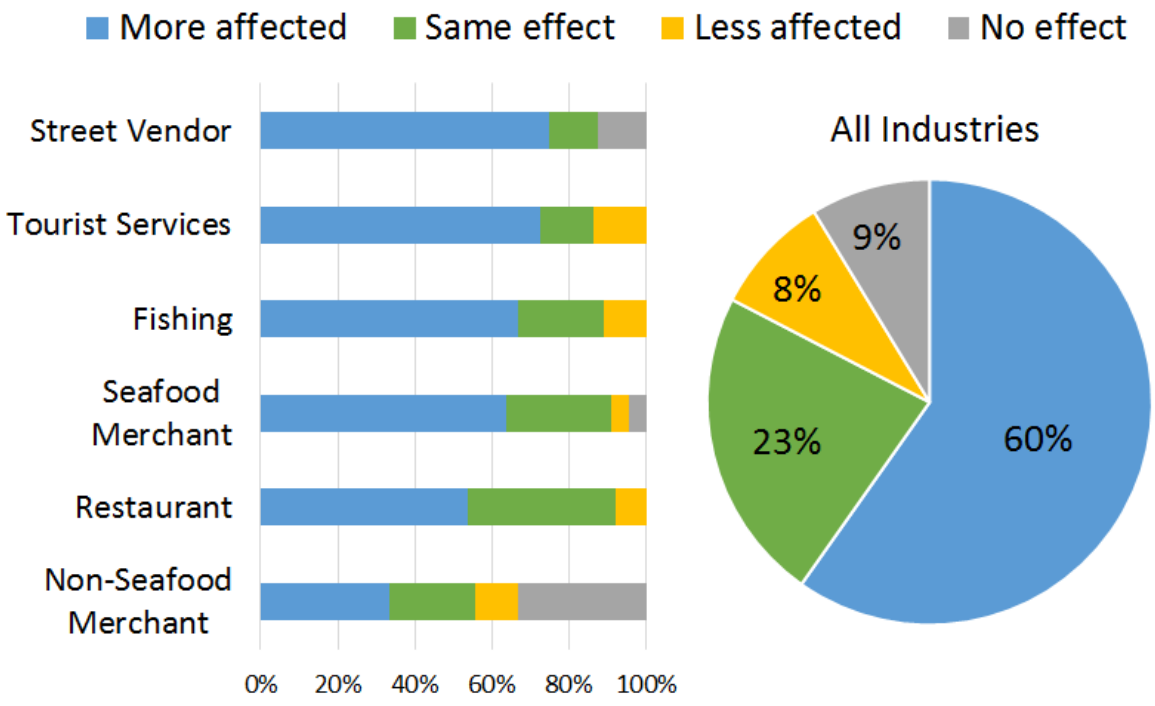

Figure 4.6-2: Effect of Another Oil Spill on Each Industry

The economic impact that may arise due to another oil spill would be devastating as stated in a response by a resort owner on Ao Phrao: *"Think of it this way: if you are wounded and then get wounded again before it heals, it will be worse the second time"*. A future oil spill would lead to a decrease in trust in all industries, especially the fishing and tourism industries since there would be a loss of fishing areas and marine life. The fishing industries have been significantly impacted economically already, and another spill would only elevate the problem. The long term contamination and decreased quantity of marine life in the area has not yet been addressed while long-term impacts on the marine life have yet to emerge. From interviews made with fishermen perceived risk includes the permanent contamination of seafood, loss of blue crab, lack of clean water to breed seafood, future environmental damage due to tar balls, and lack of fishing areas for sufficient amount of seafood.

4.7 Objective 6: Determine the Level of Trust Felt Towards PTTGC

The social impacts from the oil spill that we addressed in our interviews focused on the level of trust that local business owners and fishermen have towards the oil cleanup, the compensation process, and their belief that they will be protected in the future.

4.7.1 Research Question 7

We interviewed local business owners to address the research question: **Do you trust the company that cleaned up the oil spill?** The results are shown in Figure 4.7-1. We separated the results according to industry.

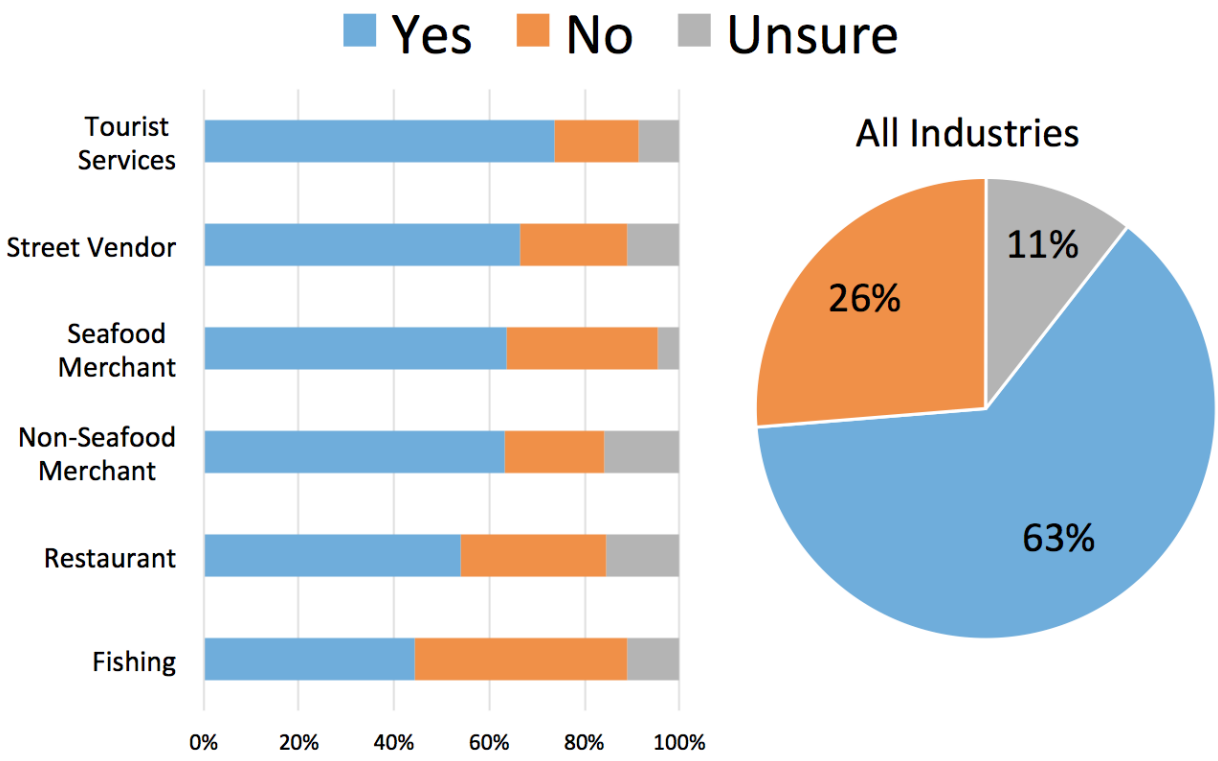

Figure 4.7-1: Trust Interview Question Results

According to the interviews, tourist services have the most trust in PTTGC. This may be due to the fact that the tourist areas were restored already and they were not directly impacted by the sea contamination. The tourist services believed information that they were told by PTTGC, governmental organizations, village leaders, etc. On the other hand, fishermen, who have the least trust in PTTGC, did not believe what they heard about the contamination, mainly

because they had first-hand experiences from the contamination of their livelihoods. According to the interviews, fishermen have seen dead sea creatures washed up on the shore. Tarballs that were washed up from the bottom of the ocean were frequently found and collected by fishermen.

The environmental impacts due to the oil spill have caused people to have a decreased level of trust in PTTGC as shown in this quote from the village leader of Pak Nam Baan Rao fishing village: “The damage to the fish and the oil on the bottom of the ocean are major issues that have not been addressed. This should be publicized so that everyone knows that the contamination is still present and in need of attention.” The head of Small Fisheries who acts as a contact for Greenpeace said: “Recently, dead fish and squids have been seen to wash ashore and its numbers are substantial.” Bags of dead squid were collected on the shoreline alongside with tar balls. These phenomena caused concerns to the fishermen in the area because if the seafood continues to die, it would result in a major loss of habitat. Washed up tar balls caused concerns regarding the unseen environmental damage under the sea. This confirms the fishermen lost trust towards the cleaning process by PTTGC.

Finding #8: Most business owners trust the response process

We found that 63% of all the interviewees from all industries state that they trust the company with the clean-up. Trust is seen to be high in all industries except the fishing industries. This is because PTTGC has implemented campaigns to bring back tourism to the area. Since the tourism in the area is beginning to be revitalized, trust no longer acts as an element of dispute towards PTTGC. Since the income of most business owners is returning to normal, PTTGC is no longer to blame. PTTGC made good progress upon cleaning areas affected by the oil slick, such as the resorts on Ao Phrao and hosted various tourist campaign on Koh Samet. This enhanced the trust of business owners on Koh Samet since progression could be seen by the increasing number of visitors.

Finding #9: The fishing industry had the least amount of trust of the company.

The fishing industry seems to be the most negative in terms of trust. This is because the effect on the fish population and the amount of fish in the area has significantly decreased. The impact on the fish cannot be approached and solved in short-term and this affects severely the income of fishermen. Only 45% of the fishermen we interviewed trust that the PTTGC can clean the impacted area and bring it back to normal. Fishermen will endure the most direct impact when compared to other industries like restaurant, and street vendor. In addition, fish merchants

purchase bulk seafood from places far from the Rayong shorelines, and are not directly affected in comparison to shoreline fishermen who rely on the fish they catch.

Qualitative data from our interviews with authority figures showed the perception of the spill response process. Information shared with local business owners focused mainly on efforts to relieve the environmental damage. Controversies became evident from some interviews that focused on the response procedure and the way the oil spill was cleaned up. The head of Small Fisheries who acts as a contact for Greenpeace worked to assess the spill outcomes. He said that the international mitigation plan for cleaning up oil spills was not properly followed. He said that instead of skimming oil off of the surface first, the dispersant was directly added to the thick layer of oil after surrounding it with a boom. This caused a large amount of the oil to be deposited on the bottom of the ocean. He stated "*20 percent of the oil flowed to Ao Phrao and 80 percent of the oil fell to the bottom of the ocean after the dispersant was used*." Interview results showed that the steps taken in the cleanup process were not publicized. This has led community members to feel that the company has something to hide, as suggested by the Head of the Pak Nam Baan Rao Fisheries: *"This information [about the cleanup process] should be publicized so that everyone will know about the contamination that is still present and needing attention."*

Another source of concern was the repair of the pipe that leaked. The head of the Pak Nam Baan Rao Fisheries and the Marine Coastal Patroller said that they inspected the pipe that was broken and repaired. They said "*The pipe is still old and in bad shape. It is rusted and has barnacles growing on it. PTTGC doesn't seem to have changed their pipe setup to prevent future issues. The pipe needs to be updated and/or replaced*"

Finding #10: Non-seafood merchants and those in the tourism industry trust PTTGC

Fishermen are in the only industry that is affected by direct and long-term impact due to loss of marine life which led to the lack of fish for harvest, resulting in a 45% lack of trust. Since the fish population cannot be brought back to normal in the short-term, unlike the cleaning of Ao Phrao, trust will play a major factor governing the fishermen's impression on PTTGC and its cleaning protocols. Non-seafood merchants and tourism have other sources of income from tourists and locals. In addition, non-seafood merchants do not depend directly on fishermen and experience even less impact. They provide alternative services like necessities to locals and small amount of existing tourists. Unlike the tourism industry and non-seafood merchants, the fishing industries does not recover from only 'cleaning' but will require the long-term monitoring.

4.7.2 Sentiment Analysis of Tweets Related to the Spill

In order to gain an understanding of public perception of the Rayong Oil Spill and PTTGC, we completed a sentiment analysis of tweets. Tweets are pieces of information 140-characters or less that are publically posted on the social network Twitter. Each tweet expresses a differing degree of sentiment, or feeling. One tweet represents only a single feeling or opinion about an event or topic. When many tweets are analyzed, overall perception can be uncovered. The number of tweets posted about the Rayong Oil Spill per day is shown in Figure 4.7-2.

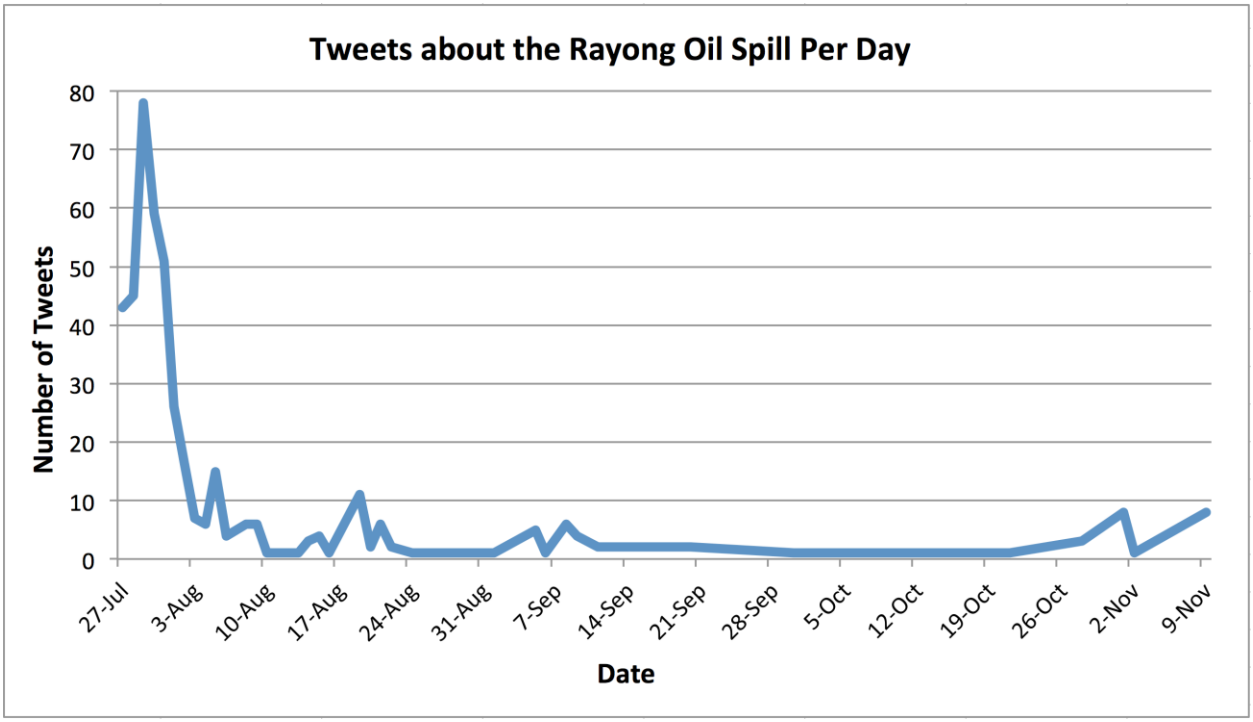

Figure 4.7-2: Number of Tweets Related to the Rayong Oil Spill Per Day

There were 441 tweets about the Rayong Oil Spill and PTTGC between 27 July 2013 and 27 November 2013. Of these tweets, 191 were neutral and had a sentiment value of 0. Only the tweets from the first four months after the Oil Spill were analyzed because tweets after this time period were infrequent and less relevant. Relevant tweets ranged in sentiment from very positive or negative to neutral. Examples of tweets and their sentiment values are displayed in Table 4.7-1.

Table 4.7-1: Examples of Tweet Sentiment

Sentiment Description	Tweet Text	Numerical Sentiment Value
Positive tweets described clean beaches and successful clean up.	“RT @MarcoChen0428: Do the boats operate normally between Rayong & Koh Samet? => Yes everything is normal. No problems. No sign of oil too.”	0.61741
	“PTT to restore Rayong beaches environment damaged by oil slick http://ow.ly/nyGco”	0.22533
Neutral tweets included news reports and articles.	“Workers remove crude oil during a clean-up operation on the beach of Phrao Bay on Samet Island in Rayong... http://fb.me/6zhuklVlH”	0
	“Oil Spill Situation near Samet Island in Rayong http://thailand.prd.go.th/view_news.php?id=6899&a=2 â€¦ via @prdthailand”	0
Negative tweets expressed displeasure towards dirty beaches or ineffective response.	“The Department of Pollution Control is warning people in Rayong against touching the spilled crude oil or going too close to the spill....”	-0.46591
	“Dead shellfish spark toxic water fears: RAYONG --The mass death of shellfish along a five-kilometer stretch of... http://bit.ly/16QDfVl”	-0.53845

The sentiment engine returned values that corresponded with the feeling of each tweet. 441 data points are sufficient to determine public perception of the situation. As shown in Figure 4.7-3, most of the tweets were written in the two weeks after the spill, corresponding with PTTGC's physical beach clean-up. This is when there was the greatest news presence and when the event was fresh in people's minds. There are positive, negative, and neutral tweets, but most tweets after the first two weeks are negative. A trend line of the 250 non-neutral tweets shows a decline in sentiment. The tweets reflect that people do not remember the event favorably and are worried about the long-term impacts.

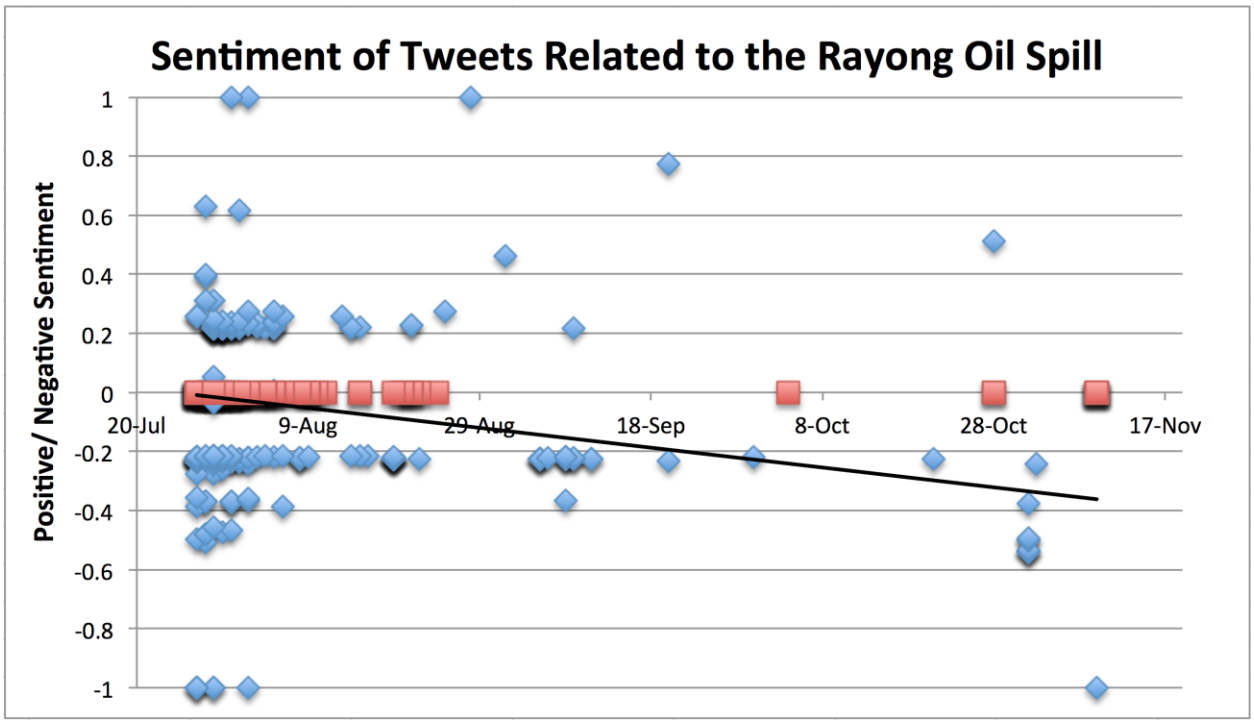

Figure 4.7-3: Sentiment of Tweets Related to the Rayong Oil Spill

The Twitter searches that were used in this analysis were not geographically limited. Relatively few tweets include a geographic location and limiting the search would have returned too few results.

Finding #11: There is a Correlation of Perceived Risk and Trust

Perceived risk in Rayong and the trust felt towards PTTGC are correlated. We determined that Rayong has a negative sentiment trend based on the analysis of Twitter Posts.

This means they have a high risk and low to moderate level of trust as verified by interviews with authority figures. Nine out of eleven authority figures displayed distrust in PTTGC and their response. Mr. Pongpakorn, the Vice President of the Ban Phe subdistrict stated *"The information was given by PTT to the news sources and to us daily, but I believe that the company is hiding the information because they didn't clear up a lot of the issues that people had."* Mr.Chairat Trirattanajarasporn, President of Rayong Tourism Association, said when asked if a future oil spill would occur: *"Another oil spill is definitely going to happen as there has been a number of oil leakage accidents happened in the past, but the amount of oil spilled was not as high as this time."* The full interviews with authority figures are found in Appendix N.

4.8 Limitations in Data Aggregation

Our data collection process had some limitations. They are mostly limitations that are expected by any social scientist conducting structured interviews in a foreign language and deal with issues of controversial information and confidentiality.

4.8.1 Information Lost in Language Translation

Information critical to understanding can be lost when translating between languages. Translations allow meaning to be understood by people who speak different languages, but translated words or phrases may not have the same connotation or magnitude as the original word. The perception of an answer or a description of a situation may be changed slightly by translation.

Our interviews were conducted by Thai speaking group members who then translated the conversation in real time to English speakers taking notes. This allowed us to have interview results that could be read by all group members. It was necessary to have one person talking and one person writing to maximize the amount of information gathered. Language translation may have changed the qualitative data that was collected.

While it was helpful having three out of seven team members who are fluent in Thai, it was a limiting factor in that we could conduct a maximum of three interviews at once. Though the results were appealing, we could have potentially obtained more data per turn. The same limitation applies to the team's ability to translate documents from Thai to English, contact Thai-speaking organizations, and accessing data and reports online that are only available in Thai.

Since most of the Ban Phe fishermen are from Cambodia, we were not able to interview them due to language barriers.

4.8.2 Confidential Information

Some of the individuals that we interviewed or received data from are in governmental positions or are employed by PTTGC. Upon receiving some files, we were instructed not to distribute the contents and that they were only for our knowledge. Due to these limitations, some supplemental information cannot be used in this report toward the aggregation of data or the formation of conclusions.

4.8.3 Sources of Bias

Biases that influence the responses of interviewees are expected to occur in the findings we have obtained from the interviews with different stakeholders. The interviewees ranged from street vendors to high ranked officers that are working closely with PTTGC. The response towards a specific question may vary depending on the group they belong to. Stakeholders related to the cause of the spill tended to be more defensive on what information they relayed whereas the affected stakeholders tended to be more critical and emotional with their answers. Industries that received differing amounts of compensation vary in opinion. Stakeholders of the same industries that received higher amount of compensation expressed differing levels of satisfaction from the stakeholders that received less compensation. Biases may have occurred due to the difference in understanding of the oil spill and its impact on the economy of Mueang Rayong District. The level of education the interviewee had and the interpretation of the questions asked were other potential reasons for bias.

4.9 Chapter Summary

Trust concerns vary drastically from industry to industry, causing concern about the response from PTTGC. The oil spill incident led to an environmental impact in the area causing major concerns for the immediate and long-term impacts on marine life. Even though tourism and the economy of the Rayong Province is getting back to its normal state, PTTGC has yet to address the environmental impacts. While some industries are satisfied with the cleaning and the recovery process, local fisherman village leaders plan to file a lawsuit against PTTGC for inadequate response to the environmental damage.

Chapter 5: Conclusions and Recommendations

Our conclusions were based on the results we presented in Chapter 4 and directly correspond to our project goal: to determine what factors led to a decrease in trust or a decrease in perceived risk between local businesses and PTTGC. After analyzing the health and economic impacts, assessing the level of trust currently held by local business owners, and gauging the amount of risk that local businesses feel for a future oil spill, we created findings that led to the conclusions and recommendations discussed in this chapter.

5.1 Causes of a Decrease in Trust of PTTGC

The actions of PTTGC following the Rayong Oil Spill caused the public to reevaluate trust of the company. Our primary investigation uncovered sources of decreased trust in PTTGC.

Lack of corporate transparency

The information related to the Rayong Oil Spill released by PTTGC has been inconsistent. The information is difficult to find and obtain, and certain information requires the use of a consent form.

Inconsistent monetary compensation plan

Information about the compensation plan travelled by word of mouth. Compensation did not correlate with the needs of business owners. Businesses in the same industry were not given the same or amount of money or equal compensation.

Long-term impacts may not be addressed by current response methods

PTTGC has not been able to demonstrate that their policies will keep people and the environment safe from long-term damage.

5.2 Causes of an Increase in Perceived Risk

The people already affected by the economic impacts and contamination in the area expect greater damage in the event of a future oil spill. One interviewee said it was similar to being wounded and then being injured again in the same place before the wound could heal.

Long-term impacts are unknown

The long-term impacts, including health, economic and environmental impacts, have not yet occurred after the Rayong Oil Spill. Long-term impacts have been documented in other oil spills. The Rayong area could see longer lasting repercussions.

Reduction in local economic activity

There was a significant drop in the revenue for virtually all local businesses. The tourism industry has regained some strength due to the advertising for the area. The fishing industry has not recovered as the people in the area still do not believe that the fish is safe and the seafood has become more difficult to catch.

Plans to prevent future incidents have not been publicized

Since the plans to prevent future incidents and impacts have not been publicized yet, community members feel more at risk for another oil spill occurring and for experiencing greater impacts. They believe that if the PTTGC procedures for pumping oil in the Gulf of Thailand remain unchanged, the likelihood of another oil spill occurring is higher. If the procedure for responding to oil spills is not revised, they believe this would intensify any impacts from a future spill.

5.3 Recommendations to Focus Future Research to Improve Oil Spill Response

We have defined key factors that led to decreased trust and increased risk towards the company responsible for the oil spill. We have created recommendations to focus on for researchers to expand on our work. By considering the recommendations for future research, they should be able to help develop a more conclusive report to be used in not only Thailand, but future oil spill responses in general.

5.3.1 Recognizing Impacts

The Rayong Oil Spill caused environmental damage which led to health, social, and economic impacts. Before our project, little information was available about these human dimension impacts. We were able to conclude that the negative impacts led to a decreased level of trust of the local business owners towards PTTGC. Analysis of the existing environmental impacts fostered a diverse understanding of the associated health and economic impacts that emerged from the oil spill. Future impact assessments could be conducted on children, elderly and industrial workers which will provide alternative views of the oil spill and response.

The timeframe in which future research will be done does not allow for the assessment of short-term impacts due to recall bias and negative sentiment associated with the oil spill that has been allowed to develop with time. Future interviews should focus on long-term impacts. Information about the short-term impacts can be compiled from data about the economic activity and health records of the area and from media coverage in the time following the oil spill.

We were able to conclude that the oil spill caused economic impacts. We know that a decreased amount of tourism, depreciation of seafood quantity, and concerns about contaminated seafood contributed to the revenue decrease. However, further economic research should be done on the true extent of economic impact on stakeholders by industry. We suggest using the annual economic reports published on the NESDB (National Economic and Social Development Board) to determine how the Rayong economy was impacted overall. We can extrapolate that the oil spill led to decreased consumer confidence in Rayong. The Consumer Confidence Index can be calculated by economists through a survey of the Rayong community members. The index is defined as “the degree of optimism on the state of the economy that consumers are expressing through their activities of savings and spending” (Wikipedia, n.d.-a). Further economic analysis could include a consumer demand assessment focusing on the seafood from Rayong. The analysis would be conducted through interviews of potential consumers in areas that may purchase Rayong seafood to determine if households would buy more, less, or the same amount of specific products. This could help researchers conclude which types of products are associated with a negative sentiment regarding future consumption.

We concluded that the short-term health impacts from the Rayong Oil Spill were minor and that the long-term impacts have not yet emerged. We recommend continuing to assess the health of the community members by monitoring health records of the area. This can be done through epidemiological data from the Rayong Provincial Health Organization. In addition to monitoring the health of the Mueang Rayong area, we suggest monitoring the health of clean-up crew members who may not be from Rayong but were still exposed to the oil. After identifying clean-up crew members we suggest to determine what type of personal protective equipment was worn during clean-up and to request permission for monitoring the long-term health records of the participants.

5.3.2 Modifying Response to Prevent Community Concerns

We determined that community members are concerned about the residual oil at the bottom of the ocean, the fairness of the compensation plan, and the information withheld from

PTTGC such as the amount of oil that was spilled and plans for long-term rehabilitation. A future researcher could determine the exact response procedure that was carried out and then relate it to the community concerns that we outlined. We recommend focusing on the actions of the following teams that PTTGC formed after the oil spill:

- Clean-up Team
- Restoration Team
- Communication Team
- Remedy Team

The long-term rehabilitation plan will be published by PTTGC as well as the complete incident outline by the end of 2014. These documents can be used pinpoint the weak areas associated with community concerns of the response process which then can be compiled for PTTGC to improve their future oil spill response.

5.3.3 Assessing Trust

We concluded that residual oil and contamination was a factor that led to a decrease in the level of trust felt by business owners in Mueang Rayong District towards PTTGC. We evaluated trust by directly asking interview questions to local business owners, but future researchers could focus on analyzing trust of any group using a trust questionnaire such as the questionnaire outlined by Social Partnership Forum (Social Partnership Forum, n.d.) which was suggested by Dr. Ludington from Chulalongkorn University. Participants can be asked to define the range of trust they feel towards different topics. We suggest including the following topics:

- Food Safety limits
- Protection from hazardous materials
- Local government will keep community members safe
- PTTGC responded properly to the oil spill
- PTTGC will prevent oil spills

After trust has been evaluated, conclusions can be made that can inform PTTGC (or other industries) about the level of trust felt by members of Mueang Rayong District. This will help them gain and maintain trust by focusing their efforts on the most important topics first.

5.3.4 Assessing Risk

We associated risk with the potential for lower quality of life or the potential for harm to be done. Based on our interview results, we concluded that fishermen and seafood merchants felt the most at risk if a future oil spill occurred. We recommend that a future researcher use a

questionnaire to focus on perceived risk such as the questionnaire created by Erasmus University Medical Center that was suggested to us by Dr. Ludington from Chulalongkorn University. In the questionnaire, the participants would score potential dangers using a scale of the likelihood of the danger occurring. We recommend including environmental, economic, and health dangers. This process will be able to quantitatively show the perceived risk associated with the types of dangers that are associated with oil spills.

5.3.4.1 Improving Information Dissemination

In our research we determined that perceived risk is increased not only by the impacts felt directly, but also by the lack of information available to those affected by the event. Future researchers could use surveys or interviews to determine the key pieces of information that are unknown or believed to be unknown by local community members of Mueang Rayong District. The participants could be asked to rank by importance a list of types of facts necessary to understand the event and the response process such as the list that follows:

- Response procedure
- Clean-up procedure
- Potential health risks
- Incident details
- Expected impacts

We recommend that future researchers expand from our results of what is currently unknown to business owners (response methods, amount of oil spilled, and organization of the compensation plan). By assessing the information that continues to be shared, conclusions can be made based on what facts are most important.

Further study could be done focusing on newspaper articles reporting the Rayong Oil Spill. Compared to the social media sites like Twitter and Facebook, newspapers can be less dynamic and slower to report events. However, this form of communication usually contains more complete information presented in an organized way. Newspaper articles can provide results from interviews conducted directly after the spill and during clean up. They can provide understanding about spill response and direction for possible follow-up interviews. Issues and response procedures that were repeated in multiple articles can be traced over time to evaluate their reported effectiveness. The resulting outline of the sentiments communicated by the way newspapers reported the oil spill response can be combined with the results we gathered from Twitter sentiments and our interview results. In this way, the role of information dissemination via media can be completed and applied to the level of perceived trust in the area.

5.4 Final Remarks

Our project addresses only some of the aspects of the Rayong Oil Spill. It is not a complete picture of the event and cannot be used to determine the true actions done by PTTGC or what went wrong. It provides future researchers with helpful background information, an evaluation of the short-term impacts that emerged, and a description of the intermediate impacts that were emerging at the time of project completion. Further research in the areas we have identified can complete the research we have begun. The resulting compilation of research can be used to improve Thailand's oil spill response procedures in the future. Improvements can be made that will benefit not only the reputation of PTTGC, but also the well-being of community members and the environment.

Annotated Bibliography

References are listed below. Annotations are included for the benefit of future researchers and describe the key points of the sources, the relevance of each source, the relationship to other references, and how it can be applied to our project.

Archer, J., Daniel, A., Kirwan, B., O'Donovan, P., Poset, S., & Salley, A. (2010). *The environmental effects of the BP oil spill and offshore drilling*. University of North Carolina. Retrieved from http://www.unc.edu/~asalley/GEOG284/index.html

This article does an amazing job outlining the different economic impacts that the oil spill in the Gulf of Mexico had on both the local economy and the national economy. This is extremely useful to understand the impacts that the people in Thailand must have felt and could potentially still feel. This article outlines the different industries that are affected, and what jobs are made available by an impact like this.

Our group can potentially use this article and its links to see more impacts that the oil spill in the Gulf of Mexico has caused in the local community. There may also be some national benefits for local businesses to stay stable, as there is something of the sort in the U.S.

Bangkok Post. (2013, July 29).Popular island beach closed by oil slick. *The Bangkok Post.* Retrieved from the LexisNexis Academic database.

Bangkok Post. (2013, August 1). Spill bigger than it looks, expert says. *The Bangkok Post.* Retrieved from the LexisNexis Academic database.

This article has a helpful graphic of the path the oil traveled (directly to Aoa Phrao Bay).

Bangkok Post. (2013, August 28). Fishermen want bigger payouts. *The Bangkok Post.* Retrieved from the LexisNexis Academic database.

This article is about the inconsistencies of the compensation plan by PTTGC. 500 fishermen held a protest on August 27 to share their concerns about not getting compensation yet after waiting a month after the spill. Also, the role of NGOs is described and includes "the EnLAW Thai Foundation, Ecological Alert and Recovery Thailand, Greenpeace Southeast Asia, and the Good Governance for Social Development and the Environment Institute. They said they did not trust the investigation and disaster response carried out by PTTGC and other agencies because details were not publicized. Nor did they involve independent experts and people's representatives."

Barrow, R. (2013, August 1). Satellite image of oil spill in Rayong. *Richard Barrow in Thailand.* Retrieved November 10, 2013, from http://www.richardbarrow.com/2013/08/satellite-image-of-oil-spill-in-rayong-on-thursday-1-august/%20

This includes a satellite image of the oil spill. This is helpful to understand how the oil was spreading after the spill especially in regards to the tourist attractions (Koh Samet and Koh Kudee). Understanding the extent of the spill is also gained through this source.

Bender, K., & Taylor, R. (1987). Oil spill contingency planning in Thailand. *International Oil Spill Conference Proceedings*, 1987(1), 161-166.

This 1987 study identified key areas of potential environmental damage as a result of an oil spill in the Gulf of Thailand and gave recommendations for a more effective response plan. Tainted fisheries are dangerous for both the wildlife and the consumers of fish. Sub-lethal levels of contaminates are still quite dangerous because the fish can still be caught, sold, and eaten. Fish can be tainted by both oil and dispersants so mechanical clean-up methods are recommended. Coastal mangrove forests can be near fisheries or aquaculture ponds. This must be taken into account when choosing to use dispersants. Coral reefs contain endangered species and are especially sensitive to oil spills. The study mentions Koh Samet as a growing tourist area. An investigation of the current state of tourism in Koh Samet should be completed. The results of previous contingency plans in Thailand affect how the country deals with oil spills in the modern day. These studies are always completed when current procedures are deemed ineffective.

CBS. (2010, May 5). *Seven technologies used to clean the gulf oil spill*. Retrieved from http://www.cbsnews.com/news/seven-technologies-used-to-clean-the-gulf-oil-spill/

This website outlines the ways that the Gulf of Mexico Oil spill was cleaned up in seven simple and easy to read ways.

Chaiwattanaroj, S., Herrera, M., Holmberg, R., Rattanabumrung, W., & Shapiro, H. (2009). *Risk communication in Thailand: A case study in Rayong Province* (Undergraduate Interactive Qualifying Project No. E-project-030609-235610). Retrieved from Worcester Polytechnic Institute Electronic Projects Collection: http://www.wpi.edu/Pubs/E-project/Available/E-project-030609-235610/

This former IQP was completed as an assessment of Risk Communication in Rayong. One of our topics of interest is perceived risk in Rayong and its effect on the oil spill response. This report addresses a lot of important issues associated with petrochemical pollution, which is the main issue we are dealing with in our own project. It will be useful to study this report more thoroughly to gain a better insight into the current risk communication that's happening in Rayong Province.

Clark, J. (2013). *Other oil clean-up methods*. Retrieved from http://science.howstuffworks.com/environmental/green-science/cleaning-oil-spill.htm

This article from How Stuff Works describes the harmful effects of oil on animals and the environment. It describes the response methods and has a helpful compilation of further sources to use for future reference.

Coconuts Bangkok. (2013, August 1). *Koh Samet oil spill dispersing*. Retrieved from http://bangkok.coconuts.co/2013/08/01/koh-samet-oil-spill-dispersing

The Geo-Informatics and Space Technology Development Agency indicated the size of the Rayong Oil Spill based on satellite imagery both when the spill initially happened as well as images taken five days later.

Cooke, J. (2013, August 5). *Thailand Reunited Koh Samet Oil Spill Situation Update 30/7/13*. Retrieved October 29, 2013, from http://uk.blog.tourismthailand.co.uk/2013/07/30/ko-samet-oil-spill-situation-update-30713/)

CSIRO. (2013, June 6). *Environmental impact of oil spills*. Retrieved from http://www.csiro.au/Outcomes/Oceans/Hot-ocean-topics-index/Environmental-impact-of-oil-spills.aspx

This article notes the different ways that the environment is impacted by oil spills, both in long term and in short term.

The Daily Beast. (2010, May 11). 11 Extreme Oil Spill Solutions. *The Daily Beast*. Retrieved from http://www.thedailybeast.com/articles/2010/05/12/11-extreme-oil-spill-solutions.html

Dasic International Ltd. (2013). *Slickgone NS*. Retrieved from http://www.dasicinter.com/oil-dispersant/products/range/oil-dispersant-product-range/show/slickgone-ns

This is the company website for the manufacturer of Slickgone NS, the dispersant used on the Rayong Oil Spill. The site details the optimal ratio of dispersant to oil as well as the various methods for use. This is a helpful site to determine the actual amount of oil that was spilled in Rayong and for assessing possible environmental damage caused by the dispersant.

Dow, D. K., Lord, F., Tuler, D. S., & Webler, D. T. (2010). *Report on databases and tools available to assess the vulnerabilities of human communities to oil spills.* Social and Environmental Research Institute. Retrieved from http://www.seri-us.org/sites/default/files/Database%20Report.pdf

This project defines the different areas of human life that are affected by oil spills. Categories for the impacts are listed including economic, health, cultural, social, and governance. Vulnerability is defined as exposure, sensitivity, and resilience to the oil spill.

Resources for determining the level of vulnerability for areas of interest are defined for each impact category. Areas with fewer resources to assess vulnerability are designated and include cultural impacts and social impacts as these are defined by a relatively small geographic region compared to the national data that can be used for the health and governance impact assessments.

The identified lack of resources for assessing the social and cultural vulnerability will be a point of research for this project. The resources identified to assess vulnerabilities are relevant towards our development of oil spill response methods and awareness of human impacts. The responses to the Exxon Valdez and Deepwater Horizon oil spills could be analyzed to assess their level of consideration of these vulnerabilities. Any gaps discovered will lead to development of objectives for this project.

Eastern Province Office of Strategy Management. (2013, August 28*). PTT and the governor of Rayong Province work to compensate those affected by the oil spill*. Retrieved from http://www.eastosm.com/%E0%B8%AB%E0%B8%99%E0%B8%B2%E0%B9%81%E0%B8%A3%E0%B8%81/tabid/1004/ctl/Details/mid/2093/ItemID/2743/language/th-TH/Default.aspx

EPA. (2013). *Exxon Valdez*. Retrieved from http://www.epa.gov/oem/content/learning/exxon.htm

This website defines the actions used during the Exxon Valdez oil spill and clearly lays out the methods used to clean the spill, as well as how effective they were.

Erasmus University Medical Center. (n.d.). *Risk questionnaire*. Retrieved from http://www.socialpartnershipforum.org/SiteCollectionDocuments/Sefton%20Questionnaire.pdf

This is an example of a questionnaire that can be used to evaluate risk.

Fernquest, J. (2013, July 29). Oil spill hits beach at Koh Samet island. *Bangkok Post.* Retrieved from www.bangkokpost.com/learning/learning-from-news/362033/oil-spill-hits-beach-at-koh-samet-island-update-2

Fiocco, R. J., & Lewis, A. (1999). Oil spill dispersants. *Pure Applied Chemistry.* 71 (1), 27-42. Great Britain: IUPAC. Retrieved from http://pac.iupac.org.ezproxy.wpi.edu/publications/pac/pdf/1999/pdf/7101x0027.pdf

This article outlines the effects and chemistry of dispersants used in oil spills. This is important to understand because of the many major impacts that oil spills cause. For the better understanding of our group this article displays the chemical reactions that take place between dispersants and the oil itself.

This is an important article for our group in particular because we will be working to best decide which dispersant(s) are best for the environment and its inhabitants (people and animals). From the information we find, we will be able to better recommend different types of dispersants.

Fuller, T. (2013, August 23). Thai Officials Play Down Effects of Oil Spill. *The New York Times*. Retrieved from http://www.nytimes.com/2013/08/24/world/asia/thai-officials-play-down-effects-of-oil-spill.html?pagewanted=1&_r=1&smid=fb-share&

Global Health Workforce Alliance. (n.d.). *Thammasat University --Faculty of Public Health, Pathumthani, Thailand*. Retrieved from http://www.who.int/workforcealliance/members_partners/member_list/thammasat/en/index.html

Gore, A. (2010, May 21). The crisis comes ashore. *New Republic.* Retrieved from http://www.newrepublic.com/article/politics/the-crisis-comes-ashore

This is an article by Al Gore published after the Deepwater Horizon Oil Spill. He discusses the long term impacts of oil spills --particularly economic and health.

Gundlach, E. R., Hayes, M. O. (1978). Vulnerability of coastal environments to oil spill impacts. *Marine Technology Society Journal.* South Carolina: Marine Technology Society. Retrieved from http://www.oil-spill-info.com/Publications/1978_MTS_Vulnerability_ESI.pdf.

Important concepts of oil spill dispersants are described in this article. Covered topics include the physics of dispersant use, factors affecting the performance of dispersants, and methods to test the level of oil dispersion. It describes the complications of using dispersants such as harmful environmental effects like toxicity of some dispersant chemicals and the ironic concept of making the oil mix with the water it is affecting rather than removing the oil from the surface.

This reference is useful because it shows the importance and uses of the dispersants when dealing with the oil spill, this is relevant and can be used as background information to understand the response methods described in other sources. Specifically, this will define the uses of dispersants and can be combined with the information provided in the US National Contingency Plan about decisions related to choosing dispersants during oil spill response. Written in 1978, the controversies have likely evolved with new technologies. We must be careful to apply it to current times by researching the technologies present now and their effects on the environment. The information presented in this article will be helpful background information and can be compared to more updated sources to find recurring issues that need to be addressed.

Greenpeace East Asia. (2012). *Mission & values.* Retrieved from http://www.greenpeace.org/eastasia/about/mission/

Greenpeace International. (2013a). *Oil spill clean up. Rayong Province, Thailand.* Retrieved from http://www.greenpeace.org/international/en/multimedia/slideshows/Oil-Spill-Thailand/

Greenpeace International. (2013b). "*Petition to save our paradise, no more oil spill.*" Retrieved October 27, 2013, from http://www.greenpeace.org/international/en/getinvolved/Thailand-Oil-Spill/.

Greenpeace New Zealand. (2011, April 21). "*Moving beyond oil."* Retrieved from http://www.greenpeace.org/new-zealand/en/campaigns/climate-change/Oil-drilling-not-a-solution/Moving-beyond-oil/

Hassarungsee, R., & Kiatiprajuk, S. (2010). Time to rethink industrial development. *Social Watch*.Thailand: Chulalongkorn Social Research Institute. Retrieved from http://www.socialwatch.org/node/12114

Hoff, R. National Oceanic and Atmospheric Administration, Office of Response and Restoration. (2010). *Oil spills in mangroves: planning & response considerations*. Retrieved from U.S. Department of Commerce website: http://archive.orr.noaa.gov/book_shelf/34_mangrove_complete.pdf

This publication describes the relationship between coral reefs and mangroves. It describes the harmful effects of oil spills on mangroves and gives suggestions for response decisions to minimize the harm to mangroves. This can be used in our project with the World Resources book to illustrate the long term effects of oil spills on coastal ecosystems.

International Spill Control Organizations. (n.d.). *Oil spill solutions.* Retrieved from http://www.oilspillsolutions.org/evaluation.htm

ITOPF. (2010). *Thailand country profile.* Retrieved from http://www.itopf.com/_assets/country/thailand.pdf

This describes the response procedure currently used in Thailand. This is helpful to assess if there are human dimension considerations and to know who is involved in making these decisions. It can be used with the source from the Thailand Ministry of Transportation that describes the official contingency plan in place.

ITOPF (2011). *Use of dispersants to treat oil spills: Technical information paper.* International Tanker Owners Pollution Federation Limited: London, United Kingdom. Retrieved from http://www.itopf.com/information-services/publications/documents/TIP4UseofDispersantstoTreatOilSpills.pdf

ITOPF. (2013). *Spill response --dispersants.* Retrieved from http://www.itopf.com/spill-response/clean-up-and-response/dispersants/

This website describes the role of dispersants in spill response techniques. It also describes the factors that should be considered when determining the type and amount of dispersant to use. This will be helpful to us to understand the implications involved when choosing a dispersant to use. It will also help us understand the harmful effects of choosing the wrong dispersant in hasty, disorganized decisions. Reasons to protect the shoreline by using

dispersants include: shoreline oil leads to large environmental and economic impacts and “It also determines to a large extent the political and public perception of the scale of the incident, as well as the costs” (Shoreline Cleanup, para. 1).

Kingston, P. F. (2002). Long-term environmental impact of oil spills. *Spill Science & Technology Bulletin, 7*(1–2), 53-61.

This article details the lasting environmental effects that result from an oil spill in a particular region. It first defines key terminology as it is referenced in the article and classifies the various states of water and oil mixtures. Environmental impacts are sorted by category and characteristics indicative of a full recovery are identified.

This will be an effective source when researching the general environmental impact based on the particular characteristics of Rayong Province. The detailed impacts on the food chain will be particularly helpful in tracking health problems resulting from contaminated seafood. This article can be used with the Piatt article about the effects of the oil spill on wildlife.

Kingtong, Sutin, (2014). *Environmental impacts from the oil spill* [PowerPoint slides], From Golden city PTTGC conference

Kirby, M. F., & Law, R. J. (2010). Accidental spills at sea – Risk, impact, mitigation and the need for coordinated post-incident monitoring. *Marine Pollution Bulletin, 60*(6), 797-803.

This source details the importance of proper post-spill monitoring and assessment and discusses mitigation option to minimize some of the negative results. The report is based on the PREMIAM (Pollution Response in Emergencies: Marine Impact Assessment and Monitoring) project, which improved previous post-incident monitoring. The article sites many external sources, indicating extensive and diverse research. The article describes the interacting factors which determine the nature and extent of the biological consequences of oil spills including the type of oil, oil dosage, physical environmental factors, prevailing weather conditions, nature of the biota, seasonal factors, prior exposure of the area to oil, presence of other pollutants and type of remedial action.

Newspaper articles describing the Rayong Oil Spill have suggested that the response to the spill was not optimal for the region. We can use this source to understand the methods that could have been used in decision making. We will need to build from this analysis to create suggestions for future response decision methods. The article suggests the importance of monitoring the current state of post-spill effects, and these suggestions can provide guidance in our methods section.

Lefevre, A. (2013, July 30). *Thai oil spill having "extreme" impact on tourism --minister*. Reuters. Retrieved from http://www.reuters.com/article/2013/07/30/us-thailand-oil-spill-idUSBRE96T0AP20130730

Loya, Y., & Rinkevich, B. (1980). Effects of oil pollution on coral reef communities. *Marine Ecology Progress Series*. Vol. 3, pp. 167-180). Tel-Aviv University, Israel: Department of Zoology. Retrieved from

http://www.tau.ac.il.ezproxy.wpi.edu/lifesci/departments/zoology/members/loya/027.pdf.pdf

This paper is a useful tool to understand the effects that were seen from oil spill pollutions in 1980, although this article is relatively old, the information should not have

changed. This article outlines the effects of only crude oil spills on octocorals, scleractinian corals and the other various types of reef flora.

This article will be useful for us to find out what has changed since this time. This research is roughly 33 years old, but is still extremely useful since coral reefs continue to be an important ecosystem. One notion to keep in mind is the fact that we now have different and more potent dispersants at our disposal, and those dispersants may also have negative effects on the coral reefs.

McDowell, Ian, & Newell, Claire. (1996). *Measuring health: A guide to rating scales and questionnaires.* New York: Oxford University Press.

The Affect Balance Scale test is found in this book as well as many other health measurement methods. The updated edition of this book is available online, but we are citing the 1996 version (second edition).

Mendonea, G. (2013, October 8). *ONGC oil leak hits Uran coast, heavy pollution feared along 10-km stretch*. Retrieved from http://articles.timesofindia.indiatimes.com/2013-10-08/mumbai/42827902_1_oil-seeps-uran-plant-water-pollution

This article outlines the plan that was used by the ONGC oil company after one of their pipelines burst and caused around 50,000 liters of oil to spill out into the ocean.

Ministry of Natural Resources and Environment. (2013). *Rehabilitation plan for the recovery of natural resources and environment at Ao Phrao, Koh Samet, and affected areas in the Rayong Province.* Manuscript submitted for publication.

We were given this article by the Ministry of Natural Resources on our second trip to Rayong.

National Oceanic and Atmospheric Administration. (2013 a). *How oil spills affect fish and whales*. Retrieved from http://response.restoration.noaa.gov/oil-and-chemical-spills/oil-spills/how-oil-spills-affect-fish-and-whales.html

This article describes the harmful effects of oil spills on fish and whales. It describes factors that affect the extent of damage including the depth of the oil spilled and the way the animals feed. Shellfish are most impacted because they have limited mobility and are filter feeders.

National Oceanic and Atmospheric Administration. (2013b). *Response tools*. Retrieved from http://response.restoration.noaa.gov/taxonomy/term/33/all

This source lists helpful tools for planning oil spill response. It is a good source of tools that are currently available and it will be especially helpful to use when combined with some of our older sources like analyses from the Exxon Valdez spill in order to ensure that our considerations are applicable to current technology and concerns.

NGL Supply Co. (2012, October 11). *Material safety data sheet light sour crude oil* (pp. 7). Retrieved from http://www.nglsupply.com/MSDS/Crude%20Oil-LightSour/Light%20Sour%20Crude%20Oil%20English.pdf

This source officially describes the hazards of the crude oil that spilled including short term and long term effects caused by inhalation, contact with skin, and ingestion. It also

describes hazards the chemical presents such as flammability and slip hazards. This is important to analyze the health impact of the oil spill and to extrapolate what the long term impacts of contact with oil may be.

Nigeria wants oil spill plan. (2002). Oil Daily, 1. Retrieved from http://ezproxy.wpi.edu/login?url=http://search.proquest.com/docview/199155328?accountid=29120

This article describes the problems Nigeria had before it created an oil spill contingency plan. Note: The contingency plan was completed and put in place in 2011.

NRC. (2011). *Oil spill response.* Retrieved from http://www.nrcc.com/Services/pages/OilSpillResponse.aspx

NY Daily News. (2013, July 29). Oil spill in Thailand's sea reaches tourist island. *NY Daily News*. Retrieved from http://www.nydailynews.com/news/world/oil-spill-thailand-sea-reaches-tourist-island-article-1.1412136

O'Hanlon, L. (2014). How crude oil can harm you. *Discovery News*. Retrieved from http://news.discovery.com/human/health/crude-oil-harms-humans.htm

This article describes the health effects of crude oil. It is very informative for how humans will be impacted including the most important aspect --that there are many types of toxins present.

Piatt, J. F., Lensink, C. J., Butler, W., Kendziorek, M., & Nysewander, D. R. (1990). Immediate Impact of the 'Exxon Valdez' Oil Spill on Marine Birds. *The Auk*, 107(2), 387-397.

This study estimates the number of birds killed as a result of the Exxon Valdez oil spill to be between 100,000 and 300,000 birds. The oil spread through the Gulf of Alaska and onto shore. Received data from aerial and boat-based surveys, as well as OCSEAP data for natural bird densities and historical data. They concluded that the oil had a lower lethal effect over time. This was apparent in the type and number of birds killed. Most birds killed at sea do not reach shore. Bird deaths could have been greater if the spill had happened at a different time of year.

This study covers much information that we do not yet know about the Rayong Oil Spill concerning the environmental impact on animals. A key element of environmental effects involves wildlife populations affected by spilled oil, and our project will require extrapolation of these environmental effects to understand their impact on humans. Combination of this study with the Seri studies on human impacts can lead us to an assessment of human impacts-especially as a result to hardships in the fishing industry and wildlife-dependents in communities.

Pirom, Ply. (2013). *Rayong oil spill* [PDF document].

This report was given to us by the author, Mr. Ply Pirom. He is the Head of Small Fisheries and is a contact for Greenpeace's analysis of the Rayong Oil Spill.

Post Publishing Co. (2007). *Arrivals*. Retrieved from http://www.bangkokpost.com/tourismreview2007/10.html\

This article describes the state of the tourism industry in Thailand in 2007. It gives background on how the Thailand economy depends on the tourism industry. We need to acknowledge that this was written before the 2008 global economic recession, but can use the predictions made here as a basis for the potential for tourism in Thailand rather than what actually happened following the recession and unstable economy that followed.

Provincial Health Organization. (2014). *Health data for Rayong Province.*

PTT Global Chemical. (n.d.). *PTT Global Chemical*. Retrieved from http://www.pttgc-oilspill.com/

PTT Global Chemical. (2013a, August 2). *Summary of PTTGC oil spill incident and execution*. Retrieved from http://www.pttgc-oilspill.com/Uploads/Document/20130802-PTTGC-PROGRESS-EN.pdf

This is a publication from PTTGC that details the response procedure and teams in place after the oil spill. It is a good source to use to find further sources of information about public outreach and also shows the long term plans for improvement by PTTGC. One notable aspect is that it doesn't mention economic, health, or social impacts (any human impacts).

PTT Global Chemical. (2013b). *Rayong oil spill incident: Preliminary incident summary.* Manuscript submitted for publication.

This is a publication from PTTGC that is due to be published in late March/early April. It is a complete review of the incident.

PTTEP Australia. (n.d.). *PTTEP AA oil spill contingency plan*. Retrieved from http://www.au.pttep.com/about-us/safety,-security,-health-and-environment

Rigg, J (ed.). (1995). *Counting the Costs: economic growth and environmental change in Thailand*. Singapore: Institute of Southeast Asian Studies.

Thailand has been rapidly changing in the last several decades. This book details the rise and fall of Thailand's economy and environment up to 1995, and correlates the changes between the two categories. The book touches on various dimensions of Thailand's economy, and often ties social factors into explanations, such as the influence of Buddhism.

Because Thailand is unfamiliar to us, this book gives a great introduction to the economic, environmental, and social factors that we will encounter throughout this project. This book is relevant to our topic because rather than detail the effects of oil spills, it details the connection between the various components of Thai culture. These ties will interlace each of our intended areas of study into a cohesive and comprehensive analysis, giving the "big picture" rather than a disjointed breakdown. Using this article with the Seri project will help us to understand the human impacts of the oil spill. The article defining resources to plan for vulnerabilities of humans resulting from oil spills defined cultural and social vulnerability as areas lacking in guidance. The social and cultural information in this book may be helpful for us to improve human dimension planning.

Ritchie, B. W., Crotts, J. C., Zehrer, A., & Volsky, G. T. (2013). Understanding the effects of a tourism crisis: The impact of the BP Oil Spill on regional lodging demand. *Journal of Travel Research*. 53(1), 12-25.

This article provides detailed data for tourism in the Gulf after the major BP oil spill in 2010. BP paid over $13 billion in business owners in the Gulf as a result of lost business. The spill occurred right before peak tourism months. Media coverage created a very poor image of

the area, even though most of the spill remained offshore. The areas that had the most oil and the areas that saw the largest decline in tourism did not correlate. This indicates that tourism was lost, in part, by a creation of poor public perception of the situation.

This analysis suggests that we look at tourism by specific location, rather than as a blanket industry. We will have to study the impact of the media on public perception of the Rayong Oil Spill.

Saithong, S. (2014). *Report to address and recover the natural resources of Ao Phrao Koh Samet and affected areas at the Rayong Province* [Word document]. Manuscript submitted for publication.

Saiyasombut, S., & Siam Voices (2013). After the Thai oil spill clean-up, questions remain for PTTGC. *Asian Correspondent.* Retrieved February 18, 2014, from http://asiancorrespondent.com/111441/after-the-thai-oil-spill-clean-up-questions-remain/

This source has extremely pertinent information to the actual outcome of our project; this can be seen in the information and reliable links that are associated with it.

Sarnsamak, P. (2013a, August 3). Gulf of Thailand Oil Spill: Toxic matter 'may enter food chain in 3 months'. *The Nation*. Retrieved from http://www.asianewsnet.net/GULF-OF-THAILAND-OIL-SPILL-Toxic-matter-may-enter--49852.html

This news article describes the health effects associated with the Rayong Oil Spill. It may take 3 months for the toxic chemicals to make an appearance in fish. This article is relevant to our project in order to assess the health impacts of the oil spill and to track the methods used by the Thai Health agencies to inform the public of health risks. The article also describes some of the response methods that were performed.

Sarnsamak, P. (2013b, August 16). PCD delays disclosure of results on Samet water. *The Nation*. Retrieved from http://www.nationmultimedia.com/national/PCD-delays-disclosure-of-results-on-Samet-water-30212748.html

Sarnsamak, P. (2013c, September 9). Rayong oil spill dangers remain despite clean-up, say US experts. *The Nation*. Retrieved from http://www.nationmultimedia.com/national/Rayong-oil-spill-dangers-remain-despite-clean-up-s-30214440.html

This article includes the opinions of Geosyntec Consultants expert David Krause on the Rayong Oil Spill, particularly the impacts on the ocean's ecosystem. He explains that it takes seasons for contaminants (oil and dispersants) to not be harmful to seafood and those that consume it.

Scarlett, A., Galloway, T. S., Canty, M., Smith, E. L., Nilsson, J., & Rowland, S.J. (2005). Comparative toxicity of two oil dispersants Superdispersant-25 and Corexit 9527 to a range of coastal species. *Environmental Technology and Chemistry, 24(5).* Retrieved from https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=2&cad=rja&ved=0CDIQFjAB&url=http%3A%2F%2Fwww.rikiott.com%2Fpdf%2FToxicity%2520of%2520Superdispersant-25%2520and%2520Corexit%25209527.pdf&ei=obkFU4_UDYg0rAeAo4HgDQ&usg=AFQjCNEBBvtcrd7n09a9-SjvYrALojNroQ&sig2=594fmVPsXLdqzwgdxWOwkQ&bvm=bv.61725948,d.bmk

Schmit, J. (2010, May 13). Shrimpers, fishermen, hotels feel oil spill's trickledown effect. *USA Today*. Retrieved from http://usatoday30.usatoday.com/money/economy/2010-05-13-gulfecon13_CV_N.htm

This news article describes the effect of the BP oil spill on fishermen.

SERI. (2010). Cultural Impacts. *Human Dimensions Impacts of Oil Spills*. Amherst, MA: Social and Environmental Research Institute. Retrieved from http://www.seri-us.org/sites/default/files/Brief_Culture.pdf

This PDF defines cultural from a research standpoint and addresses some of the more frequent impacts that oil spills have on culture. It also outlines the cultural effects that resulted from the Exxon Valdez spill and the subsequent environmental destruction. This spill had significant impacts on the community because of the heavy reliance the local people have on the environment.

SERI. (2010) *SERI Memo to Unified Command.* Social and Environmental Research Institute: Greenfield, MA. Retrieved from http://www.seri-us.org/sites/default/files/SERI_HD_oil_memo_REV_3May10b_0.pdf

This document is a memo sent by SERI to organizations organizing the response to the Deepwater Horizon Oil Spill. It outlines their recommendations for reducing oil spill impact caused by the spill itself and spill response.

Shafir, S., Van Rijn, J., & Rinkevich, B. (2007). Short and long term toxicity of crude oil and oil dispersants to two representative coral species. *Environmental Science & Technology,* 41(15), 5571-5574.

This article describes the results of a study of six commercial dispersants (including Slickgone, the dispersant used by the Rayong response teams). The results showed that all of the dispersants led to significantly more damage to coral reefs than crude oil contact alone. The researchers concluded that dispersants should be ruled out of response methods in the vicinity of coral reefs. The dispersants studied were ranked from least harmful to most harmful with Slickgone as the least harmful. This information is helpful to our project because the coral reefs in the Gulf of Thailand are a tourist destination and a protected landmark (through the Ministry of Natural Resources and Environment).

Small Fisheries. (2013). Photos of Oil Spill clean-up [Digital photos].

Sky, N. (2013, July 31). Thailand oil spill: Koh Samet slick spreads. *Sky News.* Retrieved from http://news.sky.com/story/1122533/thailand-oil-spill-koh-samet-slick-spreads

This is a news article that outlines what Sky found out during the first few days at the Ko Samet Island where the oil spill impacted the most.

Social Partnership Forum. (n.d). *Trust questionnaire* [PDF document]. Retrieved from http://www.socialpartnershipforum.org/SiteCollectionDocuments/Sefton%20Questionnaire.pdf

This is an example of a questionnaire that can be used to evaluate trust.

Tan, S. (2010, May 26). *Collision between MT Bunga Kelana 3 and MV Waily in the Singapore Strait – MPA update*. Retrieved from http://www.pulauhantu.org/collision-between-mt-bunga-kelana-3-and-mv-waily-in-the-singapore-strait-mpa-update/

This article outlines how the oil spill occurred as well as how the clean-up procedure occurred. It showed that if you react quickly enough, then the oil spill can be contained and handled in a very short amount of time.

Thailand Ministry of Transport. (1995). *National oil spill response plan*. Retrieved from Marine Department of Thailand website http://www.md.go.th/asean-ospar_files/national_plan_new.pdf

This article describes the process of responding to an oil spill in Thailand. It describes the role of the government and the private company as well as organizes specific response aspects based on the size of oil spills. Use with the more current article from ITOPF (2010) which describes the oil spill response procedures in Thailand.

Thai Post. (2013, October 27). Waves caused pipe leak. *Thai Post.* Retrieved October 27, 2013, from http://www.thaipost.net/news/150813/77834).

Thammasat University. (2013a). *Current public health projects.* Thammasat University School of Global Studies Webpage. Retrieved November 10, 2013, from https://sites.google.com/a/sgs.tu.ac.th/sgs/faculty.

This provides background information about our sponsor.

Thammasat University. (2013b). *Faculty*. Thammasat University School of Global Studies Webpage. Retrieved from https://sites.google.com/a/sgs.tu.ac.th/sgs/faculty.

This describes the faculty at Thammasat University's School of Global Studies. We can use it in our description of our sponsor's organization.

Thammasat University. *Our mission.* (2013c). Thammasat University School of Global Studies Webpage. Retrieved from https://sites.google.com/a/sgs.tu.ac.th/sgs/

Thammasat University. *School of Global Studies* (2013d). Thammasat University Website. Retrieved from http://www.sgs.tu.ac.th/.

This is the official website of the School of Global Studies through Thammasat University. A welcome message from Dr. Nuntavarn Vichit-Vadakan details the goals of the School of Global Studies and its characteristics.

Thammasat University. *School of global studies' experience*. (2013e).Thammasat University Linked In Profile. Retrieved November 10, 2013, from http://www.linkedin.com/in/sgstu

This gives background information about our sponsor.

Tourism Authority of Thailand. (2003). *Tourism Statistics.* Retrieved from http://www2.tat.or.th/stat/web/static_tts.php

Tourism Thailand. (n.d.). Rayong. *Where to go.* Retrieved March 5, 2014 from http://www.tourismthailand.org/Where-to-Go/Rayong

Tuler, S., Webler, T., Seager, T., & Kay, R. (2007, March 30). *Defining and selecting objectives and performance metrics for oil spill response assessment: A process design integrating analysis and deliberation.* Amherst, MA: Social and Environmental Research Institute. Retrieved from http://www.crrc.unh.edu/sites/crrc.unh.edu/files/media/docs/Publications/seri_process_design_report.updated092007.pdf

This is the report for SERI's decision-making tool for oil spill responses. It will be useful to identify gaps in efficiency in the Rayong spill response by comparing the existing decision-making process with an ideal response situation, based on their research.

United Nations Development Programme, United Nations Environment Programme, World Bank, & World Resources Institute. (2000). *World Resources 2000-2001: People and Ecosystems: The Fraying Web of Life.* Washington, D.C.: World Resources Institute.

This book describes the level of contamination of water globally as well as coastal ecosystems. Impacts on biodiversity, economics, and tourism are described. This global perspective is helpful in establishing a basis for the overall level of contamination. When we look at case studies, we will be able to look at each case relative to the global contamination to get an idea of the extent of damage. This book also describes the depletion of mangrove trees which play a role in protecting coastal ecosystems (page 74: 84% depleted in Thailand).

United States. Congress. Office of Technology Assessment. (1990). *Coping with an oiled sea: an analysis of oil spill response technologies.* Retrieved from http://www.fas.org/ota/reports/9011.pdf

This article was written in response to the Exxon Valdez oil spill that occurred in Alaska in March, 1989. Practical considerations for oil spill responses are described including factors influencing which cleaning method to use, how to train responders, and a review of European oil spill procedures. While technological advancements have been made since the article was written, many of the methods are still used. The article makes a point of stating that the physical remediation technologies cannot be optimized without sufficiently training personnel and engineers to make well-informed and timely decisions.

Some of the technology described in this article is likely out of date, but the information about the improvements that were needed after the Exxon Valdez oil spill can be compared to the EPA's recommendations after the Deepwater Horizon oil spill. This will be helpful to use in the background section to describe the recurring issues.

United States Department of Transportation. (2013). *Pipeline & Hazardous Materials Safety Administration*. Retrieved from http://primis.phmsa.dot.gov/comm/Index.htm?nocache=5137

This website describes pipelines in the United States, safety precautions around pipelines, and tips to avoid oil spills for a range of bodies including members of the general public, construction workers, state officials, and federal agencies.

These tips and descriptions will be helpful in the background section of our project to understand the varied roles of people in oil spills. We will also benefit from background information about the logistics of oil transportation and knowledge of the cause of oil spills in order to provide meaningful recommendations for better organization of oil spill response in Thailand.

United States Environmental Protection Agency. (2011). *Revisions needed to national contingency plan based on Deepwater Horizon Oil Spill.* Retrieved from

http://www.epa.gov/oig/reports/2011/20110825-11-P-0534.pdf

This article was written by the United States EPA in response to the Deepwater Horizon Oil Spill that occurred in the Gulf of Mexico. Topics covered are directly responding to issues that arose from the role of the EPA in advising the response to the Deepwater Horizon Oil Spill. Several issues are covered, including use of non-ideal dispersant chemicals, an imperfect testing procedure for dispersant evaluation, and lack of preparedness and clarity for Oil Spills of National Significance.

Findings presented in this article due to the spill in the United States can be applied to potential shortcomings in the Rayong Oil Spill response by the Thai Pollution Control Department. The United States National Contingency Plan is used as another source for this project and directly responds to this article.

United States Environmental Protection Agency. (2012). *National oil and hazardous substances pollution contingency plan*. Retrieved from http://www.epa.gov/oem/content/lawsregs/ncpover.htm#key

This is the formal documentation of the plans and guidelines the US EPA has created for response to oil spills. The sections include the establishment of national priorities in the event of an oil spill, a description of the required reports to be filed to document response actions, and the establishment of a central officer to make decisions based on current status of the spill. Guidelines for decision-making process in response to a spill include considerations of the size of the oil spill and the density and proximity of surrounding populations.

Decision-making guidelines are vital to optimally responding to oil spills, and this formal documentation can be applied to the decision-making process in response to the Rayong Oil Spill. Comparison to the Thai Pollution Control contingency plan could lead us to make recommendations for the decision making process in Thailand.

University of Florida. (2002). *Material safety data sheet crude oil.* Retrieved from http://oilspill.fsu.edu/images/pdfs/msds-crude-oil.pdf.

This source officially describes the hazards of crude oil including short term and long term effects caused by inhalation, contact with skin, and ingestion. It also describes hazards the chemical presents such as flammability and slip hazards. This is important to analyze the health impact of the oil spill and to extrapolate what the long term impacts of contact with oil may be.

Vichit-Vadakan, D. N. *Welcome: Message from the Dean, Associate Professor Nuntavarn Vichit-Vadakan, Dr.PH.* (2013). Thammasat University School of Global Studies Webpage. Retrieved from https://sites.google.com/a/sgs.tu.ac.th/sgs/about-global-studies-1.

Wangkiat, P. (2013, July 31). Oil spill clean-up chemicals: What are they? *Bangkok Post*. Retrieved from http://www.bangkokpost.com/learning/learning-from-news/362349/oil-spill-clean-up-chemicals-what-are-they

This article discusses some of the concerns that have surfaced regarding the use of dispersants to clean up the oil spilled in Rayong. Hazards of dispersant chemicals are described and an environmental engineering professor from Chula University describes implications of a common dispersant chemical. He links the Rayong Oil Spill to the BP Oil Spill. A future interview with this professor could be possible and this link will be helpful to remember in the analysis of the Deepwater Horizon oil spill.

Wattayakorn, G., King, B., Wolanski, E., & Suthanaruk, P. (1998). Seasonal dispersion of petroleum contaminants in the Gulf of Thailand. *Continental Shelf Research, 18*(6), 641-659.

This article focuses on the characteristics of the Gulf of Thailand in 1993 and 1994. It details the currents, chemical composition of the water, and the levels of petroleum pollutants in various areas of the Gulf of Thailand. This source provides baseline oceanographic data of the Gulf prior to the oil spill, which can be compared to recorded petroleum pollutant levels both after the spill and after the response.

This article can be useful in providing a reference to the physical state of the Gulf of Thailand, especially regarding its petroleum contamination before the oil spill. The currents during the summer season can be analyzed to determine the spread of the oil spill against the spread of a spill in the winter or fall seasons. This is a technical source published by the Department of Marine Science at Chulalongkorn University, which is our partner university. This will enable us to access related documents if needed.

Webler, D. T., Tuler, D. S., & Lord, F. (2010). *Guidance for incorporating human impacts and vulnerabilities in marine oil spill contingency planning.* Amherst, MA: Social and Environmental Research Institute. Retrieved from http://www.seri-us.org/sites/default/files/Guidance%20Final%20ver1.3.pdf

This project describes the importance of planning for the human dimension impacts of oil spills and oil spill response decisions. It ultimately presents a method to incorporate the human impacts of the oil spill in contingency plans which are developed for areas potentially affected by oil spills.

This project provides an outlook on the existing work that has been done to consider the human impact of oil spills. We can use the information in our background to establish the human dimension and also to expose gaps in research that came up. Reviewing the issues considered in the two articles in response to the major oil spills could help verify that the human impact considerations are valuable additions to response teams' procedures. Ultimately, an assessment of the Thailand contingency plan, the Rayong Oil Spill decision process, and the human impacts of the spill apparent so far can lead to exposed gaps between the existing research presented in this article and the reality of spill response impacts.

West, L. (2013). *Oil Spills and the Environment --How do oil spills damage the environment?* Retrieved October 27, 2013, from http://environment.about.com/od/petroleum/a/oil_spills_and_environment.htm)

Wipatayotin, A. (2013, August 14). Tests find mercury in Ao Phrao sea water. *Bangkok Post*. Retrieved from http://www.bangkokpost.com/lite/topstories/364487/dangerous-mercury-levels-found-at-ao-phrao

Wikipedia. (n.d.-a). *Consumer confidence index.* Retrieved March 3, 2014 from http://en.wikipedia.org/wiki/Consumer_confidence_index

Wikipedia. (n.d.-b). *Ko Samet* Retrieved December 18, 2013, from http://en.wikipedia.org/wiki/Ko_Samet

Wikepedia. (n.d.-c). *List of crude oil products.* Retrieved 19 February, 2014, from http://en.wikipedia.org/wiki/List_of_crude_oil_products

Wikipedia. (n.d.-d). *Map Ta Phut Industrial Estate.* Retrieved December 19, 2013, from http://en.wikipedia.org/wiki/Map_Ta_Phut_Industrial_Estate

Wikipedia. (n.d.-e). *Mueang, Rayong.* Retrieved March 5, 2014 from

Wikipedia. (n.d.-f) *Rayong Province.* Retrieved December 19, 2013, from http://en.wikipedia.org/wiki/Rayong_Province

World Health Organization. (2013). *WHO Definition of Health*. Retrieved from http://www.who.int/about/definition/en/print.html

This webpage defines health as “a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity.” We will use this to define health in our background section.

Wunderground. (2013). *Weather history for Rayong, Thailand.* Retrieved from http://www.wunderground.com/history/airport/VTBU/2013/7/27/DailyHistory.html?req_city=NA&req_state=NA&req_statename=NA

Appendices

Appendix A: Sponsor Description

Our project sponsor is the School of Global Studies at Thammasat University. The school was founded in 2009 and is located in Rangsit, Pathum Thani, Thailand (Thammasat University, 2013d). The school works under the mission statement: "The Thammasat University School of Global Studies positions the university as a regional and global academic focal point by fostering trans-disciplinary initiatives in higher education, research and academic services, leading to enhanced international visibility through our focus on social innovation for human security and well-being" (Thammasat University, 2013c, para. 1).

Thammasat University is comprised of several education units (Thammasat University, 2013e). The Thammasat School of Global Studies is one of these accredited units and answers to direction from the greater University. It focuses on global health and human well-being. Our impact assessment of the oil spill in Rayong will communicate health effects on the community which can be applied not only to oil spills in Thailand, but to oil spills worldwide. This universal application makes our project appropriate for the School of Global Studies. Understanding the wide focus of the School of Global Studies can ensure that we complete this project with the proper final goal in mind.

The School of Global Studies is comprised of ten faculty members including professors and lecturers (Thammasat University, 2013b). Associate Professor Dr. Nuntavarn Vichit-Vadakan, our sponsor liaison, serves as the School's Dean. The faculty focus on health and safety in their research and teaching. Since the sponsoring organization is an academic institution, their greatest asset is knowledge --our team will benefit from their years of research and teaching experience.

Under the direction of Thammasat University, the School of Global Studies receives funding along with the other Schools in the Thammasat University as well as collaborating with external organizations (Thammasat University, 2013a). Its current projects include work with the World Health Organization, Thailand's Office of Higher Education, the University of Magway in Myanmar, and the National Aids Management Center. Our project is unique in regards to the projects the school is currently working on since it deals with the energy industry, environmental aspects, and the citizens of Thailand.

Other groups in Thailand concerned with the Rayong Oil Spill include companies in the energy and petroleum industry, the government, groups working on cleaning the spill, and community members in the Rayong area. However, the School of Global Studies is not partnering with any external organization in the sponsorship of this project.

Appendix B: Summative Team Assessment

From the beginning, our team has had a great personal relationship and group chemistry. We genuinely appreciate each other's company, which made long workdays and trips to Rayong more enjoyable. Having members from wide range of fields of chemical engineering, mechanical engineering and chemistry allowed us to work analytically throughout the duration.

Our first task as a group, in addition to unifying our proposal, was unifying our team -- taking into account the fact that we came from different backgrounds and had spent the previous term working solely with the students from our own university. We were aware of cultural differences and tried to find a balance between American and Thai norms, so that we all learned from and taught each other. Moreover, all members' opinions were heard and ideas were fully supported by all. We worked as a team and respected each other by understanding and accepting the weaknesses. Team members were always supportive and challenged by one another in order to prepare one another for real world issues and working scenario ahead.

Like any team process, we encountered issues that, left unresolved, would have been barriers to our success. We have encountered hard times in which we have to discuss issues as a team. Sometimes it was emotional but everyone acted professionally. Discussions were most of the time intense and full of debating factors, however it brought out the best of the topic and contributed everyone's opinion into it. The more vocal members learned to hold back more throughout the project. This resulted in the highest standard of work since all opinion and important aspects were heard and are included in this report. We were very supportive of each other as a team!

"The way a team plays as a whole determines its success. You may have the greatest bunch of individual stars in the world, but if they don't play together, the club won't be worth a dime."

- Babe Ruth

Appendix C: Consent Form for Interviews (English and Thai)

i. English

Informed Consent Agreement for Participation in a Research Study

Investigators and Contact Information:

Amy Kampa	Email: alkampa@wpi.edu
Athena Casarotto	Email: amcasarotto@wpi.edu
Cody Woodard-Wallace	Email: cgwoodardwallace@wpi.edu
James Whyte	Email: jswhyte@wpi.edu
Wongsathorn Jiraphanvanich	Email: wongsathorn.j@gmail.com
Waranya Limpiwattakee	Email: waranyalim.92@gmail.com
Pimchaya Luangaramvej	Email: pimchaya.l@hotmail.com

Title of Research Study: Assessing the Human Dimension Impacts of the Rayong Oil Spill

Sponsor: Dr. Nuntavarn Vichit-Vadakan, Dean of School of Global Studies at Thammasat University

You are being asked to participate in a research study. Before you agree, however, you must be fully informed about the purpose of the study, the procedures to be followed, and any benefits, risks or discomfort that you may experience as a result of your participation. This form presents information about the study so that you may make a fully informed decision regarding your participation.

Purpose of the study: We are university students conducting research on the impacts of the Rayong Oil Spill as a project we are completing for Thammasat University. Local fishermen and tourism industries are impacted by less business. Members of the community may feel sad, have suffered from health problems caused by the oil spill, or may have less trust of the government and oil companies. We will use the information gathered in this study to help response planners consider the human dimension impacts after an oil spill in the future.

Procedures to be followed:

-Interview: We will ask you a series of questions for you to answer to your best ability. The interview should take about 20 minutes.

Risks to study participants: No risks are anticipated in this study, but discomfort may occur in describing the negative impacts of the oil spill.

Benefits to research participants and others: By participating in this study, you will be helping us understand the negative impacts of oil spills so that we can help minimize negative impacts in your area if an oil spill occurs in the future.

Record keeping and confidentiality: Records of responses to questionnaires and interview questions will be kept securely in a password protected file accessible only to researchers and their faculty advisors. Paper questionnaires will be kept in a safe or other locked location provided by Chulalongkorn University. Records of your participation in this study will be held confidential so far as permitted by law. However, the study investigators, the sponsor or it's designee and, under certain circumstances, the Worcester Polytechnic Institute Institutional Review Board (WPI IRB) will be able to inspect and have access to confidential data that identify you by name. Any publication or presentation of the data will not identify you.

Compensation or treatment in the event of injury: There is no risk of injury perceived in this study. You do not give up any of your legal rights by signing this statement.

For more information about this research or about the rights of research participants, or in case of research-related injury, contact:

--Researchers listed above

--WPI IRB Chair: Professor Kent Rissmiller, Tel. 508-831-5019, Email: kjr@wpi.edu)

--University Compliance Officer: Michael J. Curley, Tel. 508-831-6919, email: mjcurley@wpi.edu

Your participation in this research is voluntary. Your refusal to participate will not result in any penalty to you or any loss of benefits to which you may otherwise be entitled. You may decide to stop participating in the research at any time without penalty or loss of other benefits. The project investigators retain the right to cancel or postpone the experimental procedures at any time they see fit.

By signing below, you acknowledge that you have been informed about and consent to be a participant in the study described above. Make sure that your questions are answered to your satisfaction before signing. You are entitled to retain a copy of this consent agreement.

_____ Date: _____

Study Participant Signature

_____

Study Participant Name (Please print)

_____ Date: _____

Signature of Person who explained this study

ii. Thai

ภาคผนวกค .ระเบียบการการสัมภาษณ์มัคคุเทศน์

1. แบบฟอร์มแสดงความยินยอมในการสัมภาษณ์:

ข้อตกลงสำหรับการเข้าร่วมการสัมภาษณ์เพื่องานวิจัยคณะผู้ดำเนินการสัมภาษณ์

Amy Kampa Email: alkampa@wpi.edu
Athena Casarotto Email: amcasarotto@wpi.edu
Cody Woodard-Wallace Email: cgwoodardwallace@wpi.edu
James Whyte Email: jswhyte@wpi.edu
พิมพ์ชญา เหลืองอร่ามเวช Email: pimchaya.l@hotmail.com
วรัญญา ลิมปิวัฒกี Email: waranyalim.92@gmail.com
วงศธร จิระพันธุ์วานิช Email: wongsathorn.j@gmail.com

หัวข้อวิจัย :การประเมินค่าของผลกระทบต่อมนุษย์จากเหตุการณ์น้ำมันดิบรั่วที่ระยอง

ผู้สนับสนุน:รองศาสตราจารย์ดร .นันทวรรณวิจิตรวาทการคณบดีคณะสาธารณสุขศาสตร์มหาวิทยาลัยธรรมศาสตร์

ขอเชิญเข้าร่วมการประเมินผลกระทบต่อมนุษย์จากเหตุการณ์น้ำมันดิบรั่วที่ระยอง

ก่อนที่คุณจะเข้าร่วมการประเมินครั้งนี้ผู้ดำเนินการสัมภาษณ์ขอชี้แจงวัตถุประสงค์เบื้องต้นและระเบียบแบบแผนของการลงพื้นที่เพื่อวิเคราะห์ผลกระทบจากน้ำมันดิบรั่วในครั้งนี้

วัตถุประสงค์ :

เพื่อค้นคว้าและประเมินค่าผลกระทบต่างๆอันเนื่องมาจากเหตุการณ์น้ำมันดิบรั่วที่ระยองจากการสัมภาษณ์โดยกลุ่มนิสิตนักศึกษา เหตุการณ์น้ำมันดิบรั่วที่ระยองได้สร้างผลกระทบในเชิงลบต่อธุรกิจของชาวประมงและอุตสาหกรรมการท่องเที่ยวรวมถึงสุขภาพและความเป็นอยู่ของผู้คนในระยองซึ่งส่งผลกระทบต่อความเชื่อมั่นและความไว้วางใจต่อรัฐบาลและบริษัทผู้ผลิตน้ำมัน

หน้าที่หลักของโครงการคือการรวบรวมข้อมูลที่ได้รับเพื่อนำเสนอผลกระทบของเหตุการณ์น้ำมันดิบรั่วที่ระยองและเปิดโอกาสให้ผู้สนับสนุนโครงการนำข้อมูลไปใช้ให้เกิดประโยชน์สูงสุดต่อสังคม

ขั้นตอนการปฏิบัติ:

• การสัมภาษณ์ :ประกอบด้วยคำถามต่างๆและจะมีการอัดเสียงเพื่อให้ข้อมูลสมบูรณ์มากที่สุด
โดยจะใช้เวลาประมาณ20 นาที

• แบบสอบถาม :โปรดตอบคำถามโดยการวงกลมหรือกรอกรายละเอียดลงในช่องว่างโดยจะใช้เวลาประมาณ10 นาที

ผลประโยชน์ที่ได้รับ :

ข้อมูลที่ได้จากการสัมภาษณ์จะช่วยให้คณะผู้ดำเนินการสัมภาษณ์เข้าใจถึงผลกระทบในเชิงลบของการรั่วไหลของน้ำมันดิบซึ่งสามารถนำไปใช้ประโยชน์ในการช่วยลดผลกระทบเชิงลบในพื้นที่หากเกิดเหตุการณ์การรั่วไหลของน้ำมันดิบอีกในอนาคต

การจัดเก็บข้อมูล :

ประวัติข้อมูลของแบบสอบถามและความเห็นต่างๆจากการสัมภาษณ์จะเก็บไว้เป็นความลับโดยจะจัดเก็บข้อมูลด้วยรหัสป้องกันไฟล์ซึ่งมีเพียงผู้ได้รับอนุญาตเท่านั้นที่จะสามารถเข้าถึงได้อีกทั้งจะเก็บเอกสารต่างๆไว้ในสถานที่ที่ปลอดภัยที่ทางจุฬาลงกรณ์มหาวิทยาลัยได้จัดเตรียมขึ้นซึ่งผู้ที่สามารถเข้าถึงข้อมูลได้คือคณะดำเนินการผู้สัมภาษณ์ได้แก่คณะนิสิตจากจุฬาลงกรณ์มหาวิทยาลัยและนักศึกษาจากสถาบันWorcester Polytechnic Institute(WPI) WPI Institutional Review Board (WPI)

รวมถึงผู้สนับสนุนและอาจารย์ที่ปรึกษาอีกทั้งการตีพิมพ์รายงานหรือการนำเสนอข้อมูลใดๆที่ถูกเปิดเผยจะไม่มีการระบุชื่อของผู้ให้สัมภาษณ์เว้นแต่กรณีที่ยินยอมเท่านั้น

ค่าชดเชยในกรณีที่ได้รับบาดเจ็บ :

ในการสัมภาษณ์ครั้งนี้ผู้ให้สัมภาษณ์จะไม่มีความเสี่ยงในการได้รับบาดเจ็บและสิทธิส่วนบุคคลของผู้ให้สัมภาษณ์จะไม่ถูกละเมิดจากการเซ็นเอกสารครั้งนี้

ข้อมูลเพิ่มเติมเกี่ยวกับการวิเคราะห์หรือเกี่ยวกับสิทธิส่วนบุคคลของผู้ให้สัมภาษณ์

หรือในกรณีที่ได้รับบาดเจ็บจากการร่วมให้ข้อมูลกับการศึกษาครั้งนี้สามารถติดต่อ:

- คณะผู้สัมภาษณ์ดังกล่าวไว้ข้างต้น

- ประธานของWPI IRB: Professor Kent Rissmiller, Tel. 508-831-5019, Email: kjr@wpi.edu
- เจ้าหน้าที่ของWPI IRB: Michael J. Curley, Tel. 508-831-6919, Email: mjcurley@wpi.edu

การมีส่วนร่วมในการวิจัยครั้งนี้เป็นความสมัครใจการปฏิเสธที่จะมีส่วนร่วมในการศึกษาค้นคว้าครั้งนี้จะไม่มผลเสียใดๆทั้งสิ้นโดยผู้ให้สัมภาษณ์สามารถตัดสินใจที่จะหยุดการให้สัมภาษณ์ได้ตลอดเวลาคณะผู้ดำเนินการสัมภาษณ์ขอสงวนสิทธิในการยกเลิกเลื่อนหรือเปลี่ยนแปลงขั้นตอนการสัมภาษณ์โดยไม่แจ้งให้ทราบล่วงหน้าการลงนามด้านล่างนี้หมายถึงผู้ให้สัมภาษณ์ได้ทราบถึงโครงการนี้และยินยอมที่จะมีส่วนร่วมในการศึกษาวิจัยที่ได้อธิบายไว้ข้างต้น โดยคุณมีสิทธิที่จะเก็บสำเนาของข้อตกลงนี้ไว้

_____ วันที่: _____

ผู้ให้สัมภาษณ์ลงนาม

_____

ชื่อ-นามสกุล (ตัวพิมพ์ใหญ่ภาษาอังกฤษ)

_____ วันที่: _____

ผู้ดำเนินการสัมภาษณ์ลงนาม

iii. Consent Letter for Interview (Thai)

สาขาเคมีประยุกต์ หลักสูตรนานาชาติ
ภาควิชาเคมี คณะวิทยาศาสตร์
จุฬาลงกรณ์มหาวิทยาลัย
วันที่.....เดือน.....2557
เรื่อง ขออนุญาตเข้าสัมภาษณ์เจ้าหน้าที่.....
เรียน .....

เนื่องด้วยทางนิสิตระดับปริญญาตรี ชั้นปีที่ 4 ของจุฬาลงกรณ์มหาวิทยาลัยจากหลักสูตรนานาชาติ สาขาเคมีประยุกต์ ภาควิชาเคมี คณะวิทยาศาสตร์ กำลังทำงานวิจัยร่วมกับ นักศึกษาชาวสหรัฐอเมริกันจากสถาบัน Worcester Polytechnic Institute (WPI) ถึงเรื่องผลกระทบทางด้านสุขภาพ เศรษฐกิจ และสังคมจากเหตุการณ์น้ำมันดิบรั่วที่จังหวัดระยองที่เกิดขึ้นเมื่อวันที่ 27 กรกฎาคม 2556

การทำงานวิจัยในครั้งนี้นิสิตและนักศึกษาต่างชาติต้องทำการสัมภาษณ์กลุ่มผู้ได้รับผลกระทบต่างๆ จากเหตุการณ์น้ำมันดิบรั่ว เช่น นักท่องเที่ยว มัคคุเทศน์ เจ้าของกิจการโรงแรมและร้านอาหาร ชาวประมง และชาวบ้าน เป็นต้น

ดังนั้นพวกเรากลุ่มนิสิตนักศึกษาผู้ดำเนินการสัมภาษณ์จึงใคร่ขอความอนุเคราะห์ทาง……..……..
ในการ…….. ณ ช่วงเวลา.....วันที่ 2557
เกี่ยวกับผลกระทบทางด้าน…….. ในช่วงเกิดเหตุการณ์น้ำมันดิบรั่ว

จึงเรียนมาเพื่อทราบและโปรดพิจารณา
ขอแสดงความนับถือ

……

อาจารย์ ดร. ปาริฉัตร วนลาภพัฒนา

อาจารย์ที่ปรึกษาโครงการ

Appendix D: Interview Strategy

We interviewed a range of people for our project. In order to respect the different backgrounds and comfort levels of the people we interviewed, we used teams of 2-3 people made up of both Thai and American interviewers. The interviews were carried out in the business location of the interviewee. We audial recorded some of our interviews (after asking permission). We contacted the interviewees before visiting the site as much as possible. The chart below shows the interviews conducted and which interview protocols were followed:

Interviews Overview									
Interviewee:	**Appendix**								
	E	**F**	**G**	**H**	**I**	**J**	**K**	**L**	**M**
	Trip 1 Health and Economic Impact	Trip 1 Tour Guide	Trip 1 Diving Instructor	Trip 1 Government Officials Economic Impact	Trip 2 Economic Impact	Trip 2 Tourism Focused	Environmental Damage	Trip 2 Fishing Related	Trip 2 Government Officials
Local Business Owners	X				X				
Fishermen					X			X	
Tour Guides		X							
Scuba diving Instructors			X						
Mr. Pongpakorn -Vice President of the Ban Phe subdistrict [PP]				X		X			X
Mr. Bamroonsak Chatananthawej [BC] Director of Marine and Coastal Resources Research and Development Center the Eastern Gulf of Thailand									X

Head of Small Fisheries and Greenpeace contact [GP]							X		
Director of Marine and Coastal Resources Conservation Center [DMC]							X		X
Mr. Chairat Trirattanajarasporn [CT] Owner of Tamnanpar Restaurant President of Rayong Tourism Association					X	X			
Head of Thong Gra Cher Fisheries [TGC]--								X	
Head of the Pak Nam Baan Rao Fisheries and Marine Coastal Patroller interviewed together [PNB&MCP]							X	X	
Member of Department of Marine Coastal Resources [MCR]									X
Fisherman Village Leader of Par Kun & Hin Dum[PK&HD]					X			X	
President of Eastern Coastal Fisheries [ECF]							X	X	X

Appendix E: Trip 1 Health and Economic Impact Interview Protocol

Interviewees:
business owners

1. Consent form (see Appendix C)
2. Questions:

Note-taker records: location of interview, gender, age group (Youth, Adult, Senior)

i. English

1. Was your business affected by the oil spill?

2. Did the oil spill cause a decrease in your revenue? If so, by how much? And why?

3. IF YES: In your opinion, what has been the major cause of your decreased revenue?

4. Did the local/national government aid you in any way? If so, how?

5. What have you done to make up the difference in income?

6. Do you know who is responsible for the oil spill?

7. Do you trust the company that cleaned up the oil spill?

8. Did you have any health issues related to the oil spill?

9. Did anyone you know have health issues related to the oil spill?

10. IF YES TO HEALTH ISSUES: Did [your, their] health affect your trust in the company that cleaned up the oil spill?

11. IF NO TO HEALTH ISSUES: Do health impacts affect your trust in the company that cleaned up the oil spill?

12. Do you trust the company that spilled the oil to do their best to clean the oil?

13. Do you think this will happen again?

14. If another oil spill occurred, do you think they will do a better job cleaning it up?

15. How would this affect you? (choose one)
a. I will not be affected.
b. I will be more affected.
c. I will be less affected
d. I will be affected the same.

ii. Thai

1. ธุรกิจของคุณได้รับผลกระทบโดยเหตุการณ์น้ำมันดิบรั่วหรือไม่

2. ธุรกิจของคุณได้รับรายได้ลดลงหรือไม่จากเหตุการณ์น้ำมันรั่ว
ถ้าใช่โดยจำนวนประมาณเท่าไหร่และทำไม

3.อะไรคือปัจจัยหลักที่ทำให้รายได้ของธุรกิจของคุณลดลง?

4. ทางหน่วยเทศบาลหรือหน่วยงานรัฐได้ยื่นมือเข้ามาช่วยคุณในด้านใดหรือไม่
ถ้าใช่อย่างไร

5. คุณทำอย่างไรในการหารายได้เพิ่มเติมในรายได้ที่ขาดหายไปจากผลกระทบนี้

6. คุณทราบหรือไม่ว่าผู้ใดเป็นต้นเหตุของเหตุการณ์น้ำมันดิบรั่วในครั้งนี้?

7. คุณให้ความไว้วางใจกับองค์กรผู้เกี่ยวข้องมากน้อยเพียงใด?

8. คุณมีปัญหาสุขภาพจากเหตุการณ์น้ำมันดิบรั่วหรือไม่?

9. คุณมีคนรู้จักที่มีปัญหาสุขภาพเพราะเหตุการณ์น้ำมันดิบรั่วหรือไม่?

10. ถ้ามี ผลกระทบทางด้านสุขภาพมีอิทธิพลกับความเชื่อมั่นของคุณต่อบริษัทที่รับผิดชอบต่อการกำจัดคราบน้ำมันหรือไม่

11. ถ้าไม่มี ผลกระทบทางด้านสุขภาพมีอิทธิพลกับความเชื่อมั่นของคุณต่อบริษัทที่รับผิดชอบต่อการกำจัดคราบน้ำมันหรือไม่

12. คุณไว้วางใจในการกำจัดคราบน้ำมันของบริษัทดังกล่าวหรือไม่

13. คุณคิดว่าเหตุการณ์น้ำมันดิบรั่วจะเกิดขึ้นอีกหรือไม่ในอนาคต?

14. หากเหตุการณ์น้ำมันดิบรั่วเกิดขึ้นอีก คุณคิดว่าแผนรับมือจะมีประสิทธิภาพมากกว่านี้หรือไม่?

15. อธิบายผลกระทบต่อคุณหากเกิดเหตุน้ำมันรั่วขึ้นอีกในอนาคต
ไม่กระทบเลย, มีผลกระทบมากขึ้น, มีผลกระทบน้อยลง, มีผลกระทบเหมือนเดิม

Appendix F: Trip 1 Tour Guide Interview Protocol

1. Confidentiality form (see Appendix C)
2. Questions

Note-taker records: location of interview, gender, age group (Youth, Adult, Senior)

i. English

A. Tour Route Questions and Customers' Reaction:

1. Have you altered your tour route since the Rayong Oil Spill?

2. If yes, why and how?

3. Has your route been altered by a supervisor?

4. When giving tours, have any of your customers been upset or concerned with what they've seen of environmental impacts from the spill? What upset them?

5. YES TO PREVIOUS: What location were they talking about?

6. NO (or unsure) TO PREVIOUS: Is there a location that is still in particularly bad condition due to the spill? What location was in the worst condition following the oil spill?

7. How do people on your tours feel about the oil spill? Is there a particular aspect mentioned frequently?

B. Tour Business Questions:

8. How did the oil spill affect your business as a tour guide? How was your business affected?

9. Before the first tours you gave after the oil spill, did you need to preview or test your intended tour route alone to be sure that there was no damage to the area?

10. How is your business doing now? Do you think it is still affected by the oil spill aftermath?

11. If you can, please try to estimate the number of tours you gave per day before the oil spill and the number of tours you gave per day in each month following the oil spill: August, September, November, and December.

ii. Thai

คำถามเกี่ยวกับการท่องเที่ยวและปฏิกิริยาของลูกค้า :

เพื่อที่จะสะท้อนให้เห็นถึงทัศนคติของนักท่องเที่ยวและผู้ที่ทำงานในอุตสาหกรรมการท่องเที่ยวที่มีต่อเหตุการณ์รั่วไหลของน้ำมันดิบ

1.หลังจากเกิดเหตุน้ำมันดิบรั่วที่ระยองเคยเปลี่ยนเส้นทางหรือสถานที่ท่องเที่ยวบ้างไหม?

2.ถ้าเคยทำไมถึงเปลี่ยนและเปลี่ยนอย่างไร?

3.เคยต้องเปลี่ยนเส้นทางหรือสถานที่ท่องเที่ยวไหม?

4.ในขณะนำเที่ยวลูกค้าของคุณแสดงความไม่พอใจ หรือเป็นห่วงกับผลกระทบต่อสิ่งแวดล้อมจากเหตุการณ์น้ำมันรั่วที่พวกเขาเห็นหรือไม่ อะไรทำให้พวกเขาไม่พอใจหรือเป็นห่วง

5.ถ้าลูกค้าของคุณแสดงความไม่พอใจสถานที่นั้นคือบริเวณใด?

6.ถ้าลูกค้าของคุณไม่เคยแสดงความไม่พอใจสำหรับคำตอบของข้อที่แล้ว
มีสถานที่ใดยังคงอยู่ในสภาพที่ไม่ดีโดยเฉพาะอย่างยิ่งเนื่องจากการรั่วไหลของน้ำมัน
และสถานที่ใดอยู่ในสภาพที่เลวร้ายที่สุด?

7.คนในกลุ่มทัวร์ของคุณรู้สึกอย่างไรต่อเหตุการณ์น้ำมันดิบรั่วมุมมองใดที่ถูกกล่าวถึงบ่อยที่สุด?

คำถามเกี่ยวกับธุรกิจการท่องเที่ยว: เพื่อแสดงให้เห็นถึงผลกระทบต่ออุตสาหกรรมการท่องเที่ยวโดยเฉพาะทางด้านเศรษฐกิจ

8.เหตุการณ์น้ำมันรั่วส่งผลกระทบต่อธุรกิจการท่องเที่ยวของคุณอย่างไร?
และส่งผลกระทบต่อการเป็นมัคคุเทศก์นำเที่ยวอย่างไรบ้าง?

9.ก่อนการนำทัวร์ครั้งแรกหลังจากเหตุการณ์น้ำมันรั่ว
คุณได้ไปสำรวจพื้นที่หรือเส้นทางการเดินทางเพื่อที่จะแน่ใจว่าสถานที่หรือเส้นทางนั้นไม่ได้รับผลกระทบหรือไม่มีความเสียหายหรือไม่?

10.ปัจจุบันนี้ธุรกิจการท่องเที่ยวเป็นอย่างไร? คุณคิดว่ายังได้รับผลกระทบจากการรั่วไหลของน้ำมันอยู่หรือไม่?

11.ถ้าเป็นไปได้กรุณาประมาณจำนวนรอบทัวร์ (ครั้งต่อวัน) ก่อนเกิดเหตุการณ์น้ำมันรั่ว และประมาณจำนวนรอบทัวร์ (ครั้งต่อวัน) หลังเกิดเหตุการณ์น้ำมันรั่วในเดือนสิงหาคม กันยายน พฤศจิกายน และธันวาคม

Appendix G: Trip 1 Diving Instructor Interview Protocol

1. Confidentiality form (see Appendix C)
2. Questions

Note-taker records location of expertise (geographical area locally, National Park, or province)

i. English

A. Diving Locations

1. During the time of the Oil Spill, was there any location you preferred to not show to students or tourists?

2. If yes, Where? Are there still areas where you notice damage to the reef and prefer to not visit them? If yes, Where?

B. Business Impacts

3. How has your business been affected by the oil spill? Have you seen a change in the number of students/tourists recently? If so, by how many?

4. Do you know of any SCUBA or snorkeling schools that have been affected by the Oil Spill? If yes, how many, where are they located?

ii. Thai

1. แบบฟอร์มแสดงความยินยอมในการสัมภาษณ์ (.ดูเพิ่มเติมจากภาคผนวก ค)

2. แบบสอบถามกรุณาระบุสถานที่ทำงาน : เมือง จังหวัด

ตำแหน่งของการดำน้ำ

1 ระหว่างระยะเวลาการเกิดเหตุการณ์น้ำมันดิบรั่ว มีตำแหน่งหรือสถานที่ดำน้ำใดหรือไม่ ที่คุณเลือกที่จะไม่พานักเรียนหรือนักท่องเที่ยวไป
ถ้ามี ที่ไหน

2. ยังมีพื้นที่ใดบ้างหรือไม่ที่คุณสังเกตเห็นการถูกทำลายของแนวประการัง ซึ่งเป็นเหตุให้คุณเลือกที่จะไม่ไปแถวนั้น
ถ้ามี ที่ไหน

ผลกระทบทางธุรกิจ

3. ธุรกิจของคุณถูกกระทบอย่างไรโดยเหตุการณ์น้ำมันดิบรั่ว
คุณสังเกตเห็นการเปลี่ยนแปลงในจำนวนของนักเรียนหรือนักท่องเที่ยวเมื่อเร็วๆนี้บ้างหรือไม่
ถ้ามี จำนวนประมาณเท่าไหร่

4. คุณรู้จักโรงเรียนดำน้ำที่ถูกผลกระทบจากเหตุการณ์น้ำมันดิบรั่วบ้างหรือไม่
ถ้ามี เป็นจำนวนประมาณเท่าไหร่ เยอะหรือไม่ แล้วสถานที่เหล่านั้นตั้งอยู่ที่ใด

Appendix H: Trip 1 Government Officials Economic Impact Interview Protocol

1. Consent form (see Appendix B)
2. Questions

i. English

Please briefly describe your role in the government as __(title of official)_____?

Describe your role in the response process after the oil spill.

Did the local government compensate the fisheries or other industries in the affected areas?

What were the economic effects that occurred as a result of the oil spill?

Did you feel pressured to react in certain ways when making decisions related to the oil spill? If so, please describe. If not, why not?

ii. Thai

1. แบบฟอร์มแสดงความยินยอมในการให้สัมภาษณ์ กรุณาดูเพิ่มเติมจากภาคผนวก ค.

2. แบบสอบถามกรุณาระบุบทบาทหน้าที่ของคุณ :

กรุณาอธิบายบทบาทของคุณในปฏิกิริยาตอบสนองต่อสถานการณ์หลังเหตุการณ์น้ำมันดิบรั่ว

ทางรัฐบาลได้ชดเชยเงินให้ชาวประมงหรืออาชีพอื่นๆในพื้นที่ประสบภัยหรือไม่

อะไรคือผลกระทบทางเศรษฐกิจจากเหตุการณ์น้ำมันดิบรั่ว

คุณรู้สึกกดดันเวลาที่ต้องตัดสินใจทำอะไรเกี่ยวข้องกับเหตุการณ์น้ำมันดิบรั่วหรือไม่ ถ้าใช่ อย่างไร ถ้าไม่ เพราะอะไร

Appendix I: Trip 2 Economic Impact Protocol

Community Member Economic Interview Protocol:

1. Consent form (see Appendix C)
2. Recorder notes: Location --Market and location in Mueang Rayong District; Gender; Age group (youth, adult, senior)

i. English

We will ask you some questions about your business and the Rayong Oil Spill.

1. Was your business affected by the oil spill?

2. Did the oil spill cause a decrease in revenue? If so, by how much?

3. IF YES: In your opinion, what has been the major cause of your decreased revenue?
   For fish/seafood merchants:
   3a. Where is your source of fish/seafood?
   3b. Have you had difficulty selling your products after the oil spill?

4. What have you done to make up the difference in income?

Now we will ask some questions about the oil spill recovery process and your business.

5. Did the local/national government, PTTGC, or a Non-Government Organization aid you in any way? If so, how?

6. Where did you get information about the oil spill response process/plans?

7. Are you satisfied with the response actions?

8. What concerned you most after the oil spill?

9. How do you think the response could have been better?

10. Do you trust the company that cleaned up the oil spill?

Now we will ask you about your feelings about your business and the future.

11. Do you think an oil spill will happen again here?

12. If another oil spill occurred, do you think they will do a better job cleaning it?

13. How would this affect you?
    I will be less affected
    I will not be affected.
    I will be affected the same
    I will be affected more

ii. Thai

1. ธุรกิจคุณได้รับผลกระทบจากเหตุการณ์น้ำมันดิบรั่วหรือไม่?

2. เหตุการณ์น้ำมันรั่ว มีผลกระทบต่อรายได้คุณหรือไม่ ถ้ามีเป็นจำนวนเงินประมาณเท่าไหร่?

3. ปัจจัยใดทำให้รายได้คุณลดลง?

สำหรับผู้ขายอาหารทะเล:

3.1 คุณจำหน่ายอาหารทะเลที่มาจากแหล่งใด?

3.2 คุณประสบปัญหาในการขายอาหารทะเลหรือไม่ หลังจากเหตุการณ์น้ำมันดิบรั่ว?

4. คุณชดเชยรายได้ที่หายไปอย่างไร?

ต่อไปคณะผู้ดำเนินการสัมภาษณ์จะขอถามคำถามเกี่ยวกับขั้นตอนการเยียวยาเหตุการณ์น้ำมันรั่วและธุรกิจของคุณ

5. ทางภาครัฐ พีทีที โกลบอล เคมิคอล หรือ กลุ่มองค์กรพัฒนาเอกชน ได้ให้ความช่วยเหลือเยียวยาหรือไม่? ถ้าให้ ได้รับการช่วยเหลืออย่างไร?

6. คุณได้รับข้อมูลการให้ความช่วยเหลือเยียวยาเกี่ยวกับน้ำมันรั่วหรือไม่ ถ้าได้รับ เป็นข้อมูลด้านเงินช่วยเหลือ หรือด้านการเก็บกวาดคราบน้ำมัน?

7. คุณมีความพึงพอใจต่อการให้ความช่วยเหลือเยียวยาจากภาครัฐ พีทีที โกลบอล เคมิคอล หรือกลุ่มองค์กรพัฒนาเอกชน หรือไม่?

8. อะไรทำให้คุณกังวลใจมากที่สุดหลังจากเหตุการณ์น้ำมันรั่ว

9. คุณคิดว่าการให้ความช่วยเหลือเยียวยาควรที่จะดีกว่านี้อย่างไร?

10. คุณมีความเชื่อมั่นต่อหน่วยงานที่เก็บกวาดคราบน้ำมันในพื้นที่เกิดเหตุหรือไม่?

ตอนนี้เราจะถามคุณเกี่ยวกับความรู้สึกต่อธุรกิจของคุณในอนาคต

11. คุณคิดว่าเหตุการณ์น้ำมันดิบรั่วจะเกิดขึ้นอีกหรือไม่ในอนาคต?

12. หากเกิดเหตุการณ์น้ำมันดิบรั่วขึ้นอีก คุณคิดว่าแผนรับมือจะมีประสิทธิภาพมากกว่าเดิมหรือไม่?

13. โปรดอธิบายผลกระทบของคุณ

ได้รับผลกระทบลดลง, ไม่ได้รับผลกระทบเลย, ได้รับผลกระทบเหมือนเดิม, ได้รับผลกระทบมากขึ้น

Appendix J: Trip 2 Tourism Focused Interview Protocol

Interviewees:
Owner of Tam Narn Phar Restaurant, President of Rayong Tourism Industry
Mr. Pongpakorn --Vice President of the BanPhe Subdistrict
Khun (Mr.) Sumet- official of the National Reserve Lam Yah Koh Samet Island
Any others (by snowball sampling)

1. Consent form (see Appendix C)
2. Questions:

i. English

First we will ask questions about tourism immediately following the oil spill. Then we will ask about the current tourism activity and expectations for the future.

1. How was the tourism industry impacted by the oil spill?

2. How did the oil spill affect European tourists? American tourists? Thai tourists?

3. When did the tourists start to return to the area --if you know, what country/region did they come from?

4. What is the current level of tourism compared to the past “normal” level?

5. Has Rayong experienced an event (such as a chemical spill) in the past that caused a decrease in tourism?

6. What do you think will happen if oil re-emerges from the bottom of the ocean when the seasons change?

7. What has been done to help tourists gain trust in the area? What could be done to help or what is lacking?

8. Do you have any data that we could use that reports the level of tourism in the area before the oil spill and following the oil spill?

9. Is there anyone else you know of to contact who would be helpful to us?

ii. Thai

ขออนุญาตเรียนถามถึงผลกระทบของการท่องเที่ยวหลังจากเหตุการณ์น้ำมันรั่ว รวมถึงการท่องเที่ยวในปัจจุบัน และแผนฟื้นฟูการท่องเที่ยวในอนาคต

1. การท่องเที่ยวของระยองโดนผลกระทบอย่างไรบ้างจากเหตุการณ์น้ำมันดิบรั่ว?

2. เหตุการณ์น้ำมันดิบรั่วได้ส่งผลกระทบกับจำนวนนักท่องเที่ยวต่างชาติ อย่างไร (ชาวยุโรป ชาวอเมริกัน ชาวไทย ฯลฯ)?

3. ช่วงไหนที่นักท่องเที่ยวเริ่มกลับไปเที่ยวระยอง แล้วนักท่องเที่ยวเหล่านั้นมาจากที่ใด?

4. จำนวนนักท่องเที่ยวตอนนี้เปรียบเทียบกับเมื่อก่อนตอนเหตุการณ์ปกติเป็นอย่างไร?

5. จังหวัดระยองเคยเจอเหตุการณ์ อย่างเช่นการรั่วไหลของสารเคมี ที่ทำให้จำนวนนักท่องเที่ยวลดลงมาก่อนหรือไม่

6. จะเกิดอะไรขึ้นหากน้ำมันที่อยู่ใต้ทะเลโดนพัดขึ้นมาเมื่อฤดูเปลี่ยน?

7. มีมาตราการใดที่ภาครัฐหรือผู้เกี่ยวข้องได้ทำเพื่อสร้างความมั่นใจให้กับนักท่องเที่ยวบ้าง? มีอะไรที่ควรทำเพื่อเพิ่มความมั่นใจหรือไม่?

8. คุณมีข้อมูลเกี่ยวกับการเปลี่ยนแปลงของจำนวนนักท่องเที่ยวในระยองหรือไม่?

9. มีใครที่คุณจะแนะนำให้ไปสอบถามข้อมูล เพิ่มเติมหรือไม่?

Appendix K: Environmental Damage Interview Protocol

Interviewees:
Khun (Mr.) Sumet- official of the National Reserve Lam Yah Koh Samet Island
President of Eastern Marine Fisheries Research and Development
Center
Other experts (snowball)

1. Consent form (see Appendix C)
2. Interview

i. English

First we will ask about the environmental effects of the oil spill and then we will ask about the long term environmental outlook.

1. Are you able to answer some questions about the environmental damage from the oil spill?

2. How did the environmental damage from the oil spill affect fish? Seafood?

3. Is there still evidence of the environmental damage from the oil spill?

4. What do you think about the dispersant chemicals used? ask if [Was the amount of dispersant used safe or harmful to the environment?]

5. When the seasons change and the ocean water rotates, do you think oil will re-surface?

6. Is there anyone else you think we could contact that would be helpful?

ii. Thai

คณะผู้ดำเนินการสัมภาษณ์จะเริ่มจากการถามคำถามเกี่ยวกับผลกระทบทางสิ่งแวดล้อมจากเหตุการณ์น้ำมันรั่ว
รวมถึงทัศนคติต่อผลกระทบต่อสิ่งแวดล้อมระยะยาว

1. คุณสามารถตอบคำถามเกี่ยวกับผลกระทบทางสภาพแวดล้อมหลังเกิดเหตุการณ์น้ำมันรั่วหรือไม่

2. ผลกระทบทางสิ่งแวดล้อมส่งผลต่อปลาและอาหารทะเลอย่างไร?

3. ยังมีร่องรอยความเสียหายทางด้านสิ่งแวดล้อมหลงเหลืออยู่หรือไม่?

4. คุณคิดอย่างไรกับการใช้สารเคมีในการกำจัดคราบน้ำมันดิบ? จำนวนสารเคมีที่ใช้ปลอดภัยหรืออันตรายต่อสิ่งแวดล้อมหรือไม่?
(ควรใช้จำนวนเท่าไหร่เพื่อที่จะไม่ส่งผลกระทบกับสิ่งแวดล้อม?)

5. เมื่อฤดูเปลี่ยนคุณคิดว่าน้ำมันจะโดนพัดและตีขึ้นจากใต้ทะเลมาบนผิวน้ำหรือบนบกหรือไม่?

6. มีใครที่คุณจะแนะนำให้ไปสอบถามข้อมูล เพิ่มเติมหรือไม่?

Appendix L: Trip 2 Fishing Related Interview Protocol

Interviewees:
Authority positions of fisheries
Fishing boat owners/managers
Others (by snowball sampling)

1. Consent form
2. Questions:
Economic Impact Protocol (see Appendix H)

i. English

We would like to ask you some questions about how the oil spill affected fishing.
If they didn't cover the following yet:
1. Do you think the oil spill negatively impacted the amount of fish in your fishing area?

2. When did you resume fishing? How did you know when it was safe to fish again?

3. Is there anyone else you think we could contact that would be helpful?

4. Did you believe that 50,000 liters of crude oil discharged into the sea?
If yes, why did you believe that it is true?
If no, why did you not believe and what sources of information did you receive an alternate amount?

ii. Thai

1.คุณคิดว่าเหตุการณ์น้ำมันรั่วมีผลกระทบเชิงลบต่อจำนวนปลาและสัตว์ทะเลในพื้นที่หาปลาของคุณหรือไม่

2.คุณได้หยุดหาปลาหรือไม่
ถ้าใช่ คุณกลับไปหาปลาอีกทีเมื่อไหร่ และคุณรู้ได้อย่างไรว่าเมื่อปลอดภัยที่จะกลับไปหาปลาอีกครั้ง

3.มีผู้ใดที่คุณสามารถแนะนำให้ผู้สัมภาษณ์ไปติดต่อหาข้อมูลเพิ่มเติมหรือไม่

4.คุณคิดว่าน้ำมันรั่ว 50,000 ลิตรตามข่าวที่บอกหรือไม่
ถ้าใช่ ทำไมถึงเชื่อ
ถ้าไม่ ทำไมคุณจึงไม่เชื่อ และ ได้ทราบจำนวนน้ำมันรั่วที่แตกต่างมาจากที่ใด

Appendix M: Trip 2 Government Officials Interview Protocol

Interviewees:
Mr. Pongpakorn --Vice President of the BanPhe Subdistrict
Village Leaders (accessed by snowball)

1. Consent form (see Appendix C)
2. Questions:

i. English

We would like to ask you some questions about the role of the local government in responding to the Rayong Oil Spill.

1. Please describe your role in the government.

2. What was your role in the response process after the oil spill?

3. What were the economic effects that occurred as a result of the oil spill?

4. Did you distribute information about the oil spill response to community members (business owners)?

5. What information did you distribute? Where was the source of this information?

6. Please describe the oil spill cleanup plan.

ii. Thai

คณะผู้ดำเนินสัมภาษณ์จะขอถามท่านเกี่ยวกับบทบาทของหน่วยงานภาครัฐในการจัดการกับเหตุการณ์น้ำมันดิบรั่ว

1. โปรดอธิบายบทบาทของท่านในงานราชการ

2. ท่านมีบทบาทอะไรในการจัดการหลังจากเหตุการณ์น้ำมันดิบรั่ว?

3. ปัญหาเศรษฐกิจปัจจัยใดที่เกิดขึ้นอันเนื่องมาจากเหตุการณ์น้ำมันดิบรั่ว?

4. ท่านได้เผยแพร่ข้อมูลการแก้ไขเยียวยาเหตุการณ์น้ำมันดิบรั่วให้คนในชุมชนและผู้ประกอบการหรือไม่?

5. ท่านได้เผยแพร่ข้อมูลใดสู่ชุมชนบ้าง และข้อมูลนั้นๆได้รับทราบมาจากที่ใด?

6. กรุณาอธิบายแผนการทำความสะอาดกำจัดคราบน้ำมัน

Appendix N: Trip 2 Interviews

Interviewees:

- Mr. Bamroonsak Chatananthawej [BC]
- Director of Marine and Coastal Resources Research and Development Center The Eastern Gulf of Thailand
- Head of Small Fisheries and Greenpeace contact [GP]
- Director of Marine and Coastal Resources Conservation Center [DMC]
- Mr. Chairat Trirattanajarasporn [CT], Owner of Tamnanpar Restaurant and President of Rayong Tourism Association
- Head of Thong Gra Cher Fisheries [TGC]
- Head of the Pak Nam Baan Rao Fisheries and Marine Coastal Patroller interviewed together [PNB&MCP]
- Member of Department of Marine Coastal Resources.[MCR]
- Mr. Pongpakorn --Vice President of the Ban Phe subdistrict [PP]
- Fisherman Village Leader of Par Kun & Hin Dum [PK&HD]
- President of Eastern Coastal Fisheries [ECF]

i. Government Officials Interviews

1. Please describe your role in the government.

[BC] Director of Department of Marine and Coastal Resources Research and Development Center, The Eastern Gulf of Thailand, under the Ministry of Natural Resources and Environment

[MCR]He watches and looks over the coastlines and fisheries.

[PP]To solve the problems and satisfy the people here in Ban Phe.

[PK&HD]His role is to ask the village what is wrong and then relay that information to the community. He also takes information from meetings and relays that back to the villages.

[ECF]to study the fisheries and quality of water and fish.

[DMC]His 3 duties:

1) To protect and prevent existing natural resources from being damaged.
2) To conserve and redeem existing natural resources.
3) To encourage all environmental activities of locals.

2. What was your role in the response process after the oil spill?

[BC] The impacts are split into 3 stages: early stage, middle stage, and final stage

Early Stages:

- Monitor the impacts to the resources
- Operate the urgent plans
- Explore the well-being of the coral reefs

Middle Stages:

- Continue monitoring
- Restore things back: environment, marine lives, etc.

Final Stage: NOT YET THERE

Evaluate, follow up, and study the environment, coral reefs, and other rare sea creatures. ex. Dolphins, sea turtles, etc.

Analyze coral, rare marine animals, sea environment, change in nature and environment

Covers area from Chonburi to Trat

TPH: Total Petroleum Hydrocarbons, analyze water sample

[MCR] Environmental conservation -- He tried to go into the governmental aspect of conservation, but they won't hire him because he would rather tell the truth about these different disasters and they don't want that.

[DMC]The role was to watch closely to follow up situation, work duty is to revitalize the coral reed at Ao Phratom.

3. What were the economic effects that occurred as a result of the oil spill?

[BC]

- From his point of view, locals' ways of living were affected; tourism, business' owners, merchants, local fishermen.
- 40+ occupations were affected
- Affect locals in large area; tourism mainly affected

[ECF]The physiological effects in regards to fear and anxiety but people were afraid to eat the fish. Some people stated that they were selling fish from other areas but locals were too scared to eat the seafood.

[DMC]Can classify economic impacts into two groups; 1) fishermen and 2) tourism

industries. These two groups were mostly affected because they concerned about chemical contamination in the ocean and seafood.

4. Did you distribute information about the oil spill response to community members (business owners)?

[BC] No, not directly

[MCR] The government is very corrupt here, the staff in PTT were supposed to give out 30,000 baht but told people they were only getting 15,000 Baht and kept the other half for themselves. But he cannot say this to anyone, he has tried before and he has since stopped because his life has been threatened.
He has tried to go to news stations about this information, and they already know it, but they won't distribute this information because it would cause uproar in the community.

[PP]The president made up the staff. They have documents which they provided to the people and were already sent back to the company.

[ECF]They distributed that it was clean and able to be eaten. They got this information from their laboratory.

[DMC]Responsible for distributing information to provincial community members-held conference and big group meetings.

5. What information did you distribute? Where was the source of this information?

[BC]

- Didn't distribute any information to the public but distributed to another development center
- TPH (total petroleum hydrocarbon) was measured; normal since December
- Heavy metals were measured by Pollution Control Department
- Media was main source of information for locals

[PP]The information was given by PTT to the News sources and to us daily, but I believe that the company is hiding the information because they didn't clear up a lot of the issues that people had.

[PK&HD]He receives his information from NGO's like Greenpeace, and this is what he relays to the villagers

[DMC]Just talked overall about the situation and recovery process>>sources were many local and provincial organizations. Oil leaked 20 km from Map Ta Phut the night of July 27th, PTT used booms to surround the oil, then used ships to spray dispersants and

then reported to news that oil leaked under control. But on 28th, oil leaked from booms and then PTT used a c130 airplanes to release dispersants to the ocean, reported that they used 20,000 L dispersants then the oil spill vanished --that area is only 10 m deep, but actually plan for using dispersant is more efficient when ocean is 15+ m deep.

6. Please describe the oil spill cleanup plan.

[BC]

1. Spray down the dispersants from the ship in order to dissolve the spilled oil
2. Scoop and soak up

The oil was collected since the first two days. After a week, there was a 'big cleaning' activity where people from different places come and clean the shore.

[MCR] He is unsure about the cleanup plan, the PTT company is rich and they could very well do a better job, but they wanted to erase it quickly, so they just dropped dispersants.

[PP]First the company used barriers and the oil overflowed these barriers, then they scooped up the oil manually, then they used dispersants and that's what everyone is worried about, because they used too much.

[ECF] They used booms and dispersants but Sickgone needs to be dispersed by plane and they used boats at first. The 200 meter boom that was used was not enough to cover the area. They used removal of sand and newspaper to pick it up off the beach; they used pressurized water to clean off the residue off the rocks. They collected water from the area where water has passed. The PH and TH were high but this place in particular doesn't gather this information, it's done in another area. The mercury level however is normal. The 9 times higher than normal mercury levels came from Ao Phrao they day of the spill.

ii. Economic Impact Interview Protocol

1. **Was your business affected by the oil spill?**
   [MSR] There has been over a 95% decrease in the Ban Phe area. Koh Samet is safe and less impacted.
   [CT]Yes, immediately, Nothing in the first week, but the media caused the impact after the first week. The impact hit a big area.
   The effect from the oil spill incident started since the oil leaked into the ocean. The impact on the first week was not very serious. After the first week, the news about the oil spill widely spread causing the impact to increase massively.

2. **Did the oil spill cause a decrease in revenue? if so, By how much?**

   [CT]Keep on decreasing. Normally, there will be 20-30% decrease in the income during the low season. After the oil spill, which was also in the low season, there was 50-60% decrease. Currently (mid of Feb), it is high season now but there is still decrease in the income for about 20-30%, not because of the oil spill but because of the politics too.

3. **IF YES: In your opinion, what has been the major cause of your decreased revenue?**

   [PP]Chain reactions have caused this decrease. The tourists are the main cause, tourists need to buy the items to get the economy to increase.

   [CT]
   1. Oil Spill
   2. Rainy season (during the oil spill)
   3. Political issue

   Oil spill is the priority, and the politics is the second concern.

   [PNB&MCP] Slickgone is a dangerous chemical used. Fish are moving to other places. Loss of shrimp products that were dependent on the area. Fishermen can't fish here anymore because of the spill. Who is responsible for the fish in the area? PTTGC isn't stepping up to address this issue: government officials are trying to take it on. There is a chain effect: when fishermen can't fish, they can't sell products to merchants in the area, and then the merchants don't have goods to sell to people. In addition, there is lower demand for the goods because of the contamination concern. High oil prices mean that going out to fish sometimes costs more to fishermen than the amount of profit they would make from the fish they do bring in. Normally a fishermen would make 6,000-10,000 THB per day. Their monthly gross earnings dropped from 200,000 THB per month to 60,000 THB per month following the oil spill.

4. **What have you done to make up the difference in income?**

   [PK&HD]Most of the villagers stopped fishing and began doing other work just so that they could live.

   [CT]He demanded and complained. The company should be more responsible. There is not much that a private sector can do, but he has asked for compensation.

   [PNB&MCP]Several boats were sold. These ships are the size that 3-4 fishermen would fish from and would bring in around 40,000-70,000 THB per month. Merchants were impacted because their source of fish was lost. Some fish merchants dropped income from 1000 THB per day to 100 THB per month. Some switched from selling fish to just processing squid. These people now make 100 THB revenue per day. One woman they knew is 66 years old and cuts up 100 kilograms of squid per day and makes 3 THB per kilogram.

5. **Did the local/national government, PTT, or a Non-Government Organization aid you in any way? If so, how?**

   [CT]During the first period, they gave lots of help. They gave money on Koh Samet, do advertising, and precipitate the oil. However, PTT helped Tamnanpar by giving out promotion: buy 1 get free 1. The company should do more advertising and promoting instead of giving out money. The company shouldn't focus only at Koh Samet, but Rayong too.

   The government and PTT did help a lot by offering compensation to the people in Koh Samet and also trying to precipitate the oil as quickly as possible. PTT offered help only at the first period. There are over 1,000 people waiting to be helped by PTTGC.

   [PNB&MCP]The compensation process from PTTGC was not well organized. Some community members were not fishermen or business owners but they still were given compensation. This is causing a breakdown between villagers. People are fighting about it. If the compensation was well-organized and regulated, the problem would be avoided.

6. **Where did you get information about the oil spill response process/plans?**

   [CT] Mr. Chairat went and helped them clean up. He was the one who gave information to news reporter too.

   [PNB&MCP]There was no publicity of the response plan. They heard divers had encountered oil under the sea because the Slickgone had pushed it down to the bottom of the ocean. This effect was not publicized by PTTGC.

   For compensation, the plan wasn't publicized either. Merchants were supposedly

allocated 6,000 THB, but if they didn't fill out a form to ask for it, they didn't receive it. There is a lot of evidence of environmental damage from the oil spill (dead dolphins, dead turtles) but PTTGC is not taking action. If comparing PTTGC and the fishermen in Rayong, Rayong is like an elephant, and the fishermen are like ants; but ants bite!

Now, the total compensation of PTTGC is 500 million THB. The company has claimed an insurance amount of 1000 million THB. The fishermen want to know where the rest of the money was/will be spent.

7. **Are you satisfied with the response actions?**

[CT]Only at certain level but not that much.

[PNB&MCP]No, the environmental damage to the fish and the oil on the bottom of the ocean are major issues that haven't been addressed. This information should be publicized so that everyone will know about the contamination that is still present and needing attention.
The amount of oil reported to be spilled would have called for 5,000 liters of dispersants. Since there were 32,000 liters of dispersants used, there couldn't have been just 50,000 liters of oil spilled. An internal source from PTTGC has said that 100,000 - 200,000 liters of oil were spilled.

8. **What concerned you most after the oil spill?**

[CT] Concerned about how they'll protect the spill in the future because he doesn't want the oil to spill again. This was not the first time that the oil spilled.

[PNB&MCP]The marine life and environment and how long it will take them to recover concerned them the most. Tourism and finance also made them scared because they didn't know how they would sell their products or make money to live. Also very concerned when they did go fishing and couldn't catch many fish. Some were forced to sell their ships (described in question 4).

9. **How do you think the response could have been better?**

[CT] The response should have been better. They didn't solve and focus at the correct problem. They should do more advertising and arranging more events.

[PNB&MCP]The compensation process should have been better organized (described in question 5). The aesthetics in the area were fixed efficiently, but the real environmental issues still exist and need to be addressed. The company should have publicized their recovery plan more.

10. **Do you trust the company that cleaned up the oil spill?**

[PK&HD]No, he doesn't trust them, he isn't educated but deep down he doesn't trust them. He believes that it is bad, the things he sees are all negating what PTT says such as dead fish and oil.

[CT]PTTGC did a very rough job on the clean-up process. A national company like PTTGC should have done a better job. The company isn't professional.

[PNB&MCP]No, the company hasn't taken full responsibility for its actions especially regarding the environmental damage.

11. **Do you think an oil spill will happen again here?**

[CT]Another oil spill is definitely going to happen as there has been a number of oil leakage accidents happened in the past, but the amount of oil spilled was not as high as this time.
[PNB&MCP]It is very likely to occur again. They inspected the pipe that was broken and repaired but the pipe is still old and in bad shape. It is rusted and has barnacles growing on it. PTTGC doesn't seem to have changed their pipe setup to prevent future issues. The pipe needs to be updated and/or replaced. The pipe burst because of a miscommunication between operators connecting the pipe between the rig and the storage. They failed to open a valve for the oil to go through, and the pressure difference caused the pipe to burst. The pipe has an outdated flow rate capacity of 4,000 liters per minute when compared to the new ship flow rate capacity of 5,000 liters per minute.

12. **If another oil spill occurred, do you think they will do a better job cleaning it?**

[CT]The previous spill, PTT has too much confident and thought that they can handle the spill. They shouldn't have that much of confident. If PTTGC was less careless, the impact would not have been this bad.

13. **How would this affect you?**

[CT]Will be affected worse.

iii.Tourism Focused Interview Protocol

1. **How was the tourism industry impacted by the oil spill?**
[PP] There has been over a 95% decrease in the Ban Phe area. Koh Samet is safe and less impacted.

[CT]The tourism industry was impacted by the oil spill a lot because at Koh Samet, there

were lots of foreign tourists. The tourists cancelled their plan to Koh Samet because they know a lot about the danger of chemicals.

2. **How did the oil spill affect European tourists? American tourists? Thai tourists?**
   [PP] Foreigners are more reasonable and come back to Ban Phe, but Thai people are stubborn and won't come back.

   [CT]First period, decrease in 80% of all of the tourists. Most foreign tourists were from Russia and China. They change their destination to Koh Chang, Pattaya, etc.

3. **When did the tourists start to return to the area --if you know, what country/region did they come from?**
   [PP] The Thai tourists generally come from the northern side of Thailand. Before the oil spill, the most common tourists were Europeans, but now it's a mix of Russians and Chinese. Where they come from is just a trend, not due to the oil spill.

   [CT]
   1. mostly from Russia and China
   2. Scandinavian → Swiss, etc.
   3. Retired people

   After the low season, normally tourists will come back at around October. However, because of the oil spill, the tourists came back during December.

4. **What is the current level of tourism compared to the past "normal" level?**
   [PP]The first three months of the oil spill Ban Phe and Koh Samet lost 90% of its income. But now Ban Phe is at 80% loss and Koh Samet is only losing about 10% is normal amount of income.

   [CT]Decreased at least 30%

5. **Has Rayong experienced an event (such as a chemical spill) in the past that caused a decrease in tourism?**

   [PP] There hasn't been an oil spill in the past.

   [CT]Never, Rayong haven't been this bad.

6. **What do you think will happen if oil re-emerges from the bottom of the ocean when the seasons change?**

   [PP] If this were to happen again, Rayong wouldn't really be affected. Ban Phe has already lost so many tourists.

   [CT]Maybe the oil won't re-emerges when the season changes. Heavy chemicals will be

settle in the bottom of the ocean and will affect sea creatures. Once in a while, it will re-emerge up a little.

7. **What has been done to help tourists gain trust in the area? What could be done to help or what is lacking?**

   [
   PP] Lots of people came to help, there were campaigns and promotions to get people to come. A T.V. Show came and videotaped the mayor eating seafood. (I suggest that they pay people to come down to eat the food, because having only one person eat it, no matter if he's a mayor or not.)

   [CT]Nothing has been done to gain trust back. The company should clarify things before anything.

8. **Do you have any data that we could use that reports the level of tourism in the area before the oil spill and following the oil spill?**

   [CT]Normally, the income should increase at least 12% every year.

   In 2012:
   - 5.2 million people visited Rayong (including Koh Samet because Koh Samet is in Rayong Province too)
   - 20,000 million baht (income)

   In 2013:
   - Before the oil spilled, there was an increase in income by 20%.
   - After the oil spilled, the income decreased

   Therefore, the assumption was that they cancel each other out. Nothing was concluded yet.

9. **Is there anyone else you know of to contact who would be helpful to us?**

   [CT]Local police that are in charge of tourists information about environment
   Tourism Department
   Careful of the biases.

iv. Environmental Damage Interview Protocol

1. **Are you able to answer some questions about the environmental damage from the oil spill?**

   [MSR] Yes, see the drawing.

   [ECF]Yes, this place does the study of environment and contamination of water and marine life.

   [GP]Yes.

   [DMC]Yes I am.

2. **How did the environmental damage from the oil spill affect fish? Seafood?**

   [MSR] The 50,000 Liters that spilled is only some of it, 1 oil truck can carry 50,000 liters, there were 5 trucks on Ao Phrao, and that was only one area.

   [ECF]Laboratory Research shows that they did not see any contamination in the fish, but that doesn't mean it didn't have any impacts on the wildlife. The PH is the main issue.

   [GP]Some of the fishes are gone --squid (certain type written in Thai) were worst impacted. Seafood was affected because it left the area. Lots of squid died and washed up on the shore. This was maybe because of the dispersant, Slickgone.

   [PNB&MCP]They saw a decrease in fish, shrimp, crab, and krill. Krill especially are gone in the area now.

   [DMC]Right now there is still no contamination in fish and seafood from lab tests. Short term effects are still unseen and unnoticeable. However, we cannot say whether in the next 2 or 3 years the effects will become more obvious or not. We cannot judge that fish died due to the consequences of the oil spill because fish dies normally by many natural causes. The numbers of dead fish before and after the oil spill are not different. Thus it is hard to say that fish dies because of the oil spill.

   [BC]

   - Quality of water: high concentration of oil in the impacted area
   - Shells (oyster for example) died
   - Other sea creatures that live in the shore (small crabs for example) died because they don't have enough time to migrate
   - Lots of marine creatures which lived in the seashore died

- Coral reef:
    - 2-3 days after, 70-80% of them bleached because of the stress and tension they have. This is only temporary.
    - Last week (3-9 Feb) was the middle stage of the recovery time, the coral reefs were starting to get brown.
- Dispersant was used to dissolve the oil and is still remaining in the sea bottom. According to the fishermen, there are fewer sea animals because they migrated. According to the company that produced the dispersant, the dispersant used have no effect on coral reef, seagrass, living things, and human.

- There was no obvious and distinct amount of the deaths of marine lives; areas which were near to the spill, the amount of marine lives decrease significantly.

- According to the Ministry of Public Health, seafood is safe to consume because the level of contamination, for instance heavy metals, was no over the limit. However, people don't trust and believe in that.

- According to the Pollution Control Department, during the first period of time, mercury level was 10 or 20 times more than usual. However, the level of mercury dramatically decreased after few days/weeks and now it gradually decreases.

- Seafood is safe and the sea water is safe to swim too.

- TPH (Total Petroleum Hydrocarbons) were very high after the spill, but have been normal since December

- Fish, dolphins, and turtles died from plastic bags and broken bones

- Water quality affects shells and immobile species: they died, some in the sand also died due to lack of oxygen

- Diving at Ao Phrao shows that 70-80% of coral was bleached, but coming back better in the area of the spill

3. Is there still evidence of the environmental damage from the oil spill?

[MSR] Yes, Yesterday there were a huge amount of dead creatures from the spill on the shoreline of Rayong Bay, the people near Rayong Bay are who is affected, because there are no more fish to catch.

[ECF]They only test water from the fisheries, but there are no contaminants. The coral and seafood have significant impacts in terms of impact from bleaching. Fishermen don't understand if fish movement is from nature or from the oil spill itself. There are no dead fish from the oil spill directly. The shelled fish or non-mobile ones won't be as affected. The ones on Ao Phrao will be most affected.

[GP]Oil came up again last week at Thalo Pinwai at Bach Nao. Unknown whether oil that came up was from July or from last week (pipes normally leak a little bit each day). The pipe that leaked was considered to be repaired in this picture (showed us picture)

Picture: Credit to Small Fisheries

[DMC] No, there is no evidence of damage left. We can prove by using the coral reef that has become as beautiful as before as the criterion.

[BC] Dispersant in the sea

Organisms moved away (seen in fish numbers decreasing for fishing), affect only area of spill, catching less fish (amount of fish available to catch has decreased)

Ministry of Health took fish samples: not dangerous; mercury levels have decreased significantly

Small organisms started to come back

4. What do you think about the dispersant chemicals used? Was the amount of dispersant used safe or harmful to the environment?

[MSR] The chemical used is not good for the environment or humans, the company just wanted to erase the problem, but by using this dispersant and as much as they did, they just put all of the oil on the bottom of the ocean.

[ECF] They don't know about the slick gone dispersant. They believe it is biodegradable.

[GP] The dispersant was improperly used. According to the proper procedure for using the product from the supplier, the dispersant should be used in depths of over 10 meters. However, the depth it was used to clean up the oil spill here was shallower. This hurts the environment even more. Large tar balls were deposited.

The proper preparation of Slickgone involves dilution with 20 liters of water per liter of Slickgone, but (he believes --not sure exactly) the chemical was diluted with only 10 liters of water per liter of Slickgone. Also, based on the amount of dispersant that was used, the amount of oil that precipitated to the bottom was more than 50,000 liters. The company used 32,000 liters of Slickgone. Each liter of Slickgone will disperse 20 liters of oil. This means that the amount of oil that deposited on the bottom of the ocean was at least 640,000 liters.

There is an international protocol for responding to oil spills that involves five steps. They are (translated from Thai):

1. Immediate response to stop the source of leakage.
2. Monitor the movement of the oil in the sea.
3. Respond to create boundaries to prevent oil from spreading using booms. Then prepare the removal of oil using a skimmer.
4. Prevent oil from reaching large economic and environmentally diverse areas.
5. Use dispersants to disperse oil.
6. Clean oil on beaches using labor or specialized instruments.

The dispersant was added prematurely. Instead of surrounding the oil, using a skimmer, and then adding the dispersant to the remaining thinner layer of oil, the dispersant was added to the oil after only surrounding it (and the boom used was not reliable --showed a picture of boom quality). During cleanup, the waves were 50 centimeters high and this was a normal wave amount. The oil should have been surrounded and then skimmed before the dispersant was added. Twenty percent of the oil spilled hit Ao Phrao and eighty percent of the oil was dispersed and deposited in the ocean.

The toxic effects from the dispersant used on the Mexico oil spill [Deepwater Horizon] caused health problems on the fish and seafood. Some shrimp developed tumors, fish were blinded and had infections. Deformed fish were also being born. The dispersant and oil is toxic to coral reefs. It causes them to bleach and die. The amount of dispersant internationally recognized to have an acceptable coral survival rate was not followed. The amount that was used correlates to a zero percent survival rate (but the dilution amount is still unknown exactly, he noted).

Long term human health issues are concerning. One year after the Mexico oil spill, 10,000 people were sick (died??). They had better personal protective equipment than the people that responded to the Rayong Oil Spill. Thailand will have to wait for a while to see if cancer and other diseases will emerge from the chemicals spilled and used to clean up the spill. Benzene is the worst chemical that people are exposed to. Everywhere, not just Rayong, has issues with contaminated water and food caused by industries. Heavy metals get into all of the food from the sea even if the amount of heavy metals doesn't exceed the safety limit. Rayong in particular has a lot of contamination issues because it is an industrial area. Rayong has six times more cancer than the rest of the world.

In general, it is difficult to trust the cleanup process because the facts about it were not shared outright. The government should have made the company share more of the facts about what was actually done in the cleanup process.

[BC] Dispersant is the synthetic chemical which is known to be foreign to nature; therefore, they will surely affect the environment but not that critical.

5. When the seasons change and the ocean water rotates, do you think oil will re-surface?

[MSR] Within the next three years the oil will continue to float up to the surface from this oil spill.

[ECF] The oil will resurface when the current brings it up. If a tar ball gets stuck on the coral it will resurface at a later date.

[PNB&MCP] Yes, this is currently happening and they believe it will get worse. They are going to look at more beaches soon. They will let us know if they find anything.

[BC]Some are dissolved in water, some(benzene) evaporate into air

If it can't be removed it will form tar balls

iv. Fishing Related Interview Protocol:

1. **Did any related stakeholders or PTT provide any monetary aid or assistance?**

   [PK&HD]30,000 Baht per boat

   [ECF]In this order, Fisherman, Hotel and Tourism, Restaurants and hotels, community members and health areas, then others.

2. **Did you receive any monetary compensation?**

   [PK&HD]They didn't get the money they were supposed to get, 2000 baht per day for two months and only ended up getting 1000 baht per day for one month. They are not happy with the money they received, they tried to talk with them, but they were never able to contact them.

   [ECF]The Primary Response for fisherman was 1,000 Baht per day for 30 days (those with boats). Smalls boats and shoreline fisherman received this kind of help generally. PTT and committee have been the ones to decide on this amount. Normal people send in a form statin why they were impacted and then they send an official document for the ship they own and the committee decides if they get the compensation or not. If 30,000 baht was not enough, they could send in another application and maybe get more money.

3. **Did you believe that 50,000 liters of crude oil discharged into the sea?**

   [PP]Yes absolutely more than 50,000 liters.

   [PK&HD]He cannot judge from the site or from the news, but the oil was like the size of Koh Samet. And from what he knows the dispersant they used is worse than the oil itself, causing a lot of dead fish.

   [ECF]They believe that 50,000 liters of oil is true, this is calculated from the pipe and the flow rate.

   [DMC]**PTTGC lied about the amount of oil that leaked. The amount was as high as 100,000L calculated from my past experiences.

4. **Do you think the oil spill negatively impacted the amount of fish in your fishing area?**

[PK&HD]They have lost 130,000 baht from the past two months compared to the last four years, they have lost 60-70% of the fish they normally caught. A lot of fish are seemingly extinct.

[ECF]The area near Samet and Fishing areas were most impacted.

Appendix O: Timeframe of PTTGC Involvement with Community

27- July	Oil leaked from PTTGC fractured pipeline – 54,340 liters of Oman Blend
28- July	Emergency Oil spill response unit executed at Ao Phrao
	Oil witnessed on the beach by locals on Ao Phrao
	Official document approved by Pollution Control Department for the use of 32,000 liters of Slickgone NS dispersant
	Closure of Ao Phrao for cleaning
29- July	Shoreline clean-up by volunteers and related group
30- July	Rocks and cleanup of sand
31- July	Water cleaning
2-Aug.	Eastern fisheries start studies regarding to marine lives
3- Aug.	PCD found that mercury level is very high and removal of oil big bag from beach
4- Aug.	All big bags removed

5- Aug.	All machineries used in cleaning cleaned and removed from beach
10- Aug.	PTTGC hosted Big Cleaning Day
13- Aug.	PCD's 3rd Aug water testing news issued through media causing concerns
14-Aug	Mr. Plodprasop, Vice prime minister swims at Ao Phrao to regain confidence
20-Aug	PTTGC starts giving out compensation 932 cases 22.9 million baht at Koh Samet
21-Aug	PTTGC gives out compensation for 1152 cases 30.7 million at Pha monastery
22-Aug	PTTGC gives out compensation for 1715 cases 47.59 million at Ban Phe
23-Aug	PTTGC gives out compensation for Ao Phrao at Le Vimarn Hotel
29-Aug	PTTGC gives out compensation for Laem Ya Moo Koh Samet national park and Ao Phrao at Le Vimarn Hotel for 2154 Cases 85.52 million
31-Aug	PTTGC hosted seafood fair to promote seafood eating at Suan Son Baan Phe and give compensation for 2439 cases 93.2 million
1-Sept.	PTTGC conduct further analysis on situation
2-Sept.	Ministry of Agriculture and PTTGC let breeding fish into the sea
5-Sept.	PTTGC gives out compensation for Kao Laem Ya Moo Koh Samet national park
6-Sept.	PTTGC gives out compensation to Ta Pong area and Kao Laem Ya

	Moo Koh Samet national park so far 3568 cases 141.09 million
13-Sept.	PTTGC gives out compensation to Kao Laem Ya Moo Koh Samet National Park so far 4153 cases 162.64 million
18-Sept.	PTTGC asks volunteer to clean-up Ao Phrao
14-17 Oct.	Further compensation to people in affected area
1-Nov.	Ministry of Natural Resources and Environment declared Ao Phrao opened for tourists and is now safe
16-Nov.	PTTGC hosted 'Samet Smart Smile' fair to regain tourist's confidence
20-Nov.	Koh Samet Aquathlon international championship
22-23-Nov.	PTTGC hosted advertisement and public hearing to promote tourism at Sai Kaew Beach Resort
8-Dec.	PTTGC hosted an PTTGC-UBE Rayong Marathon 2013 to promote that the water is safe
12-Dec.	PTTGC hosted an event to let breeding fish into the Ao Phrao area to increase fish population in the future
21-Dec.	PTTGC hosted Seafood festival to promote tourists to eat prawns crabs produced caught in Rayong
27-Jan.	Conference at Golden City hosted by PTTGC major revitalization plan
6-Feb.	Tar ball discovered

7-Feb.	Tar ball discovered near Jae Waan Restaurant
8-Feb.	Tar ball discovered on the Baan Loong Lee Beach
11-Feb.	Conference at Star Hotel – Filing lawsuit against PTTGC by local fisheries

Appendix P: Recovery Plan Assessments and Projects

From the natural resources and environment recovery plan (Saithong, 2014)

Activities	Main Agency	Auxiliary Agency
Recovery of impacts on the ecology	TC	OS
Recover of impacts on coastal and marine lives	TC	OS, KPM
Recovery of impacts on ecological service	TC	OS, KPM
Follow-up of possible future impacts	TC	KP, SS
Environmental revitalization recovery plan for enduring tourism industry of Koh Samet	OS	N/A
Follow-up and assessment of marine factors	TC	KP
Follow-up and assessment of coral reefs	TC	AS
Follow-up and assessment of sea grasses	TC	N/A
Follow-up and assessment of beach ecology	AS	N/A
Follow-up and assessment of mangrove ecology	TC	N/A
Follow-up and assessment of rare marine animals	TC	N/A
Follow-up and assessment of pollution	KP	N/A

Key:
TC denotes Marine and Coastal Agency
KP denotes Pollution Control Department
AS denotes Department of National park, wildlife, and plant conservation
SS denotes Department of Environmental Quality Promotion
KPM denotes department of fisheries
Other participants:
Institutes such as Chulalongkorn University, Kasetsart University, Burapha University, Ramkamhaeng University, King Mongkut's Institute of Technology Ladkrabang, and Mahidol University