

ATHOS/DELAWARE RIVER LOST USE VALUATION REPORT

March 29, 2007*

Prepared by the

Athos/Delaware River Lost Use Technical Working Group

For the

Athos/Delaware River Trustee Council

*This report was modified in September 2008 to include a discount factor and to account for inflation to July 2008 dollars

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EXECUTIVE SUMMARY

An important component of the value of natural resources derives from their use in outdoor recreation. The assessment of natural resource damages following an oil spill often includes a determination of recreational losses due to spill-related impacts. For the assessment of the Athos I oil spill, the Trustees examined a variety of potential recreational losses, and determined that damages would be evaluated for the following activities: recreational fishing and crabbing, waterfowl hunting, and pleasure boating. Recreational fishing includes both shore fishing and boat-based fishing.

The assessment of losses in these categories was based on techniques commonly applied in the economic analysis of recreation. The primary source of information was surveys of recreational users. A sample of people who use the Delaware River for recreation were contacted through telephone and in-person surveys. Hunters were reached by telephone based on a list of people who purchased a hunting license. Boaters, anglers and crabbers were contacted in onsite surveys because no license is required for these activities (a fishing license is not required on saltwater portions of the river). In all of the surveys, respondents were asked to estimate the number of trips they took to the Delaware River during the season following the spill, and whether the spill affected their hunting, fishing, crabbing or boating activities.

Affected trips were estimated in three categories. The term “lost” trips refers to a decline in trips to the Delaware River due to the spill. For example, an angler might take fewer trips because of the spill than he would have under normal conditions. The term “substitute” trips refers to a change in the location of trips to the Delaware River. A common response to localized impacts on a large river like the Delaware is to relocate to other areas of the river. The term “degraded” trips refers to a decline in the quality of recreation trips. In some cases trips that are not lost or substituted to other locations are nonetheless perceived as having lower value because of the presence or perception of oil.

Affected trips reported by survey respondents were extrapolated to account for the total number of trips potentially affected by the spill. In the case of recreational fishing and crabbing, information on the total number of trips was estimated based on comprehensive surveys conducted for management purposes. The extrapolation included adjustments to correct for a potential problem in onsite surveys, namely, that people who lost trips due to the spill are less likely to be contacted. The survey could not account for recreators who may have stopped using the river entirely, leading to a potential underestimate of affected trips.

For hunting, extrapolation to total trips used surveys conducted annually by the Fish and Wildlife Service. Extrapolation from the telephone survey did not require adjustments because hunters were contacted using a random sample of license holders. For boating, extrapolation relied on estimates of total use derived from the number of boats moored at area marinas. The typical rate of boating use for moored boats was multiplied by the number of pleasure boats moored in the spill impact area. Estimated losses for pleasure boating did not account for trips departing from several boat ramps in the area, leading to a potential underestimate of boating losses. It was determined that the potential underestimation of affected trips for both fishing and boating was likely to be modest.

The value of a recreational activity refers to the public's willingness to pay to participate in the activity net of any actual monetary expenses. This type of "surplus value" (also known as "consumer surplus") is the correct measure of compensable losses under natural resource damage assessment regulations. For the Athos I spill, the lost value associated with affected trips was estimated using benefit transfer methods. Benefit transfer involves the selection of appropriate per-trip values from previous studies of recreation in the economics literature. A report by the U.S. Department of Agriculture analyzes numerous such studies and presents values for a variety of recreational activities in specific regions of the United States. Values for the Northeast region were available for recreational fishing and waterfowl hunting and were applied to the estimates of affected trips. Crabbing values were not available but were assumed to be the same as values for recreational fishing, an assumption that has minimal impact on damage

estimates because the estimated number of affected crabbing trips was small. A nationwide value for motor boating was used in the assessment of pleasure boating. While original data collection and site-specific studies of recreational value are preferred, it was determined in this case that losses were not significant enough to warrant the expense of an original valuation study.

A summary of affected trips and lost value is presented in table 1. Affected trips include lost, substituted and degraded trips. Lost value is calculated by multiplying affected trips by benefit-transfer values. A discount factor has also been applied to account for the time between when damages occurred and when compensation is expected.¹ The number of recreational fishing/crabbing trips affected by the spill was estimated to be 20,652 leading to a loss in value of \$771,264. The number of waterfowl hunting trips affected was 15,559 leading to a loss of \$455,455. The number of pleasure boating trips affected was 5,498 causing a loss of \$107,081. The estimate of the total number of affected trips was 41,709 and the estimate of total recreational use losses was \$1,333,801.

Table 1. Summary of recreational use losses (July 2008 dollars)

Measure of loss	Recreational Fishing	Waterfowl Hunting	Pleasure Boating	Total
Affected trips	20,652	15,559	5,498	41,709
Raw lost value	\$698,841	\$412,687	\$97,026	\$1,208,554
Discount factor	1.104	1.104	1.104	
Total lost value	\$771,264	\$455,455	\$107,081	\$1,333,801

Source: Tables 2, 3 and 4.

*Note that numbers in table might not sum or multiply exactly due to rounding

The results in table 1 are derived for the purpose of recovering funds in the amount of the total lost value. The funds will be used to implement projects that enhance recreational opportunities on the Delaware River, thus compensating lost value with future recreation benefits. This approach to damage assessment and restoration is known as “value to cost”, because restoration projects are selected so that the cost of projects equals the value of losses. This approach is less preferred than the “value to value” approach, whereby the value of restoration projects is determined and projects are selected so that

¹ The discount factor of 1.104 was used for this analysis to account for the passage of time between the losses from the spill and the date compensation is received. The assumed date for compensation is November 1, 2008, and the midpoint of 2005 is used as the date for recreational losses.

restored value is equivalent to lost value. Valuing restoration projects is more difficult than valuing recreational losses due to the limited availability of previous research on the topic, and it was determined that the expense of a restoration valuation exercise was not warranted in this case. The trustees believe that the monetary valuation obtained in the recreational use assessment will provide sufficient guidance to determine the appropriate compensatory restoration.

DESCRIPTION OF THE SPILL INCIDENT

The spill occurred November 26, 2004 when the Athos I tanker struck two submerged objects while preparing to dock at a refinery in Paulsboro, NJ. The objects punctured two holes in the ship's hull, causing the release of approximately 265,000 gallons of heavy crude oil into the Delaware River. Initially, the spill formed a thick film and was transported up and down the river and from shore to shore by the wind and tidal currents. The oil ultimately spread from just above the Tacony-Palmyra Bridge in north Philadelphia south to the mouth of the river near Woodland Beach, Delaware. The extent of oiling is shown on the map in Figure 1. Weathering effects lead to the formation of tar balls that persisted in some places for many months, and may persist for several years. Patchy oiling on the shoreline and sheen on the water could still be observed in some place throughout the following summer. Additional details regarding the extent of oiling are available in the Preassessment Data Report (*Athos I* Natural Resource Trustees, 2006).

Many types of recreation are popular along the Delaware River in the areas affected by the spill. The river and its tributaries support numerous estuary marshes that are popular for waterfowl hunting. The waterfowl hunting season had begun prior to the spill in Delaware and the hunting season in New Jersey opened soon after the spill. However, hunting advisories were issued in both states following the spill closing certain areas to hunting and asking hunters to avoid any areas potentially affected by the oil. In Delaware, state lands were closed to hunting as far south as Cedar Swamp Wildlife Area. In New Jersey, the hunting advisory included most areas within five miles of the river from the

Tacony-Palmyra Bridge to the nuclear power facility in Salem, New Jersey. The advisories were in effect for about two weeks.

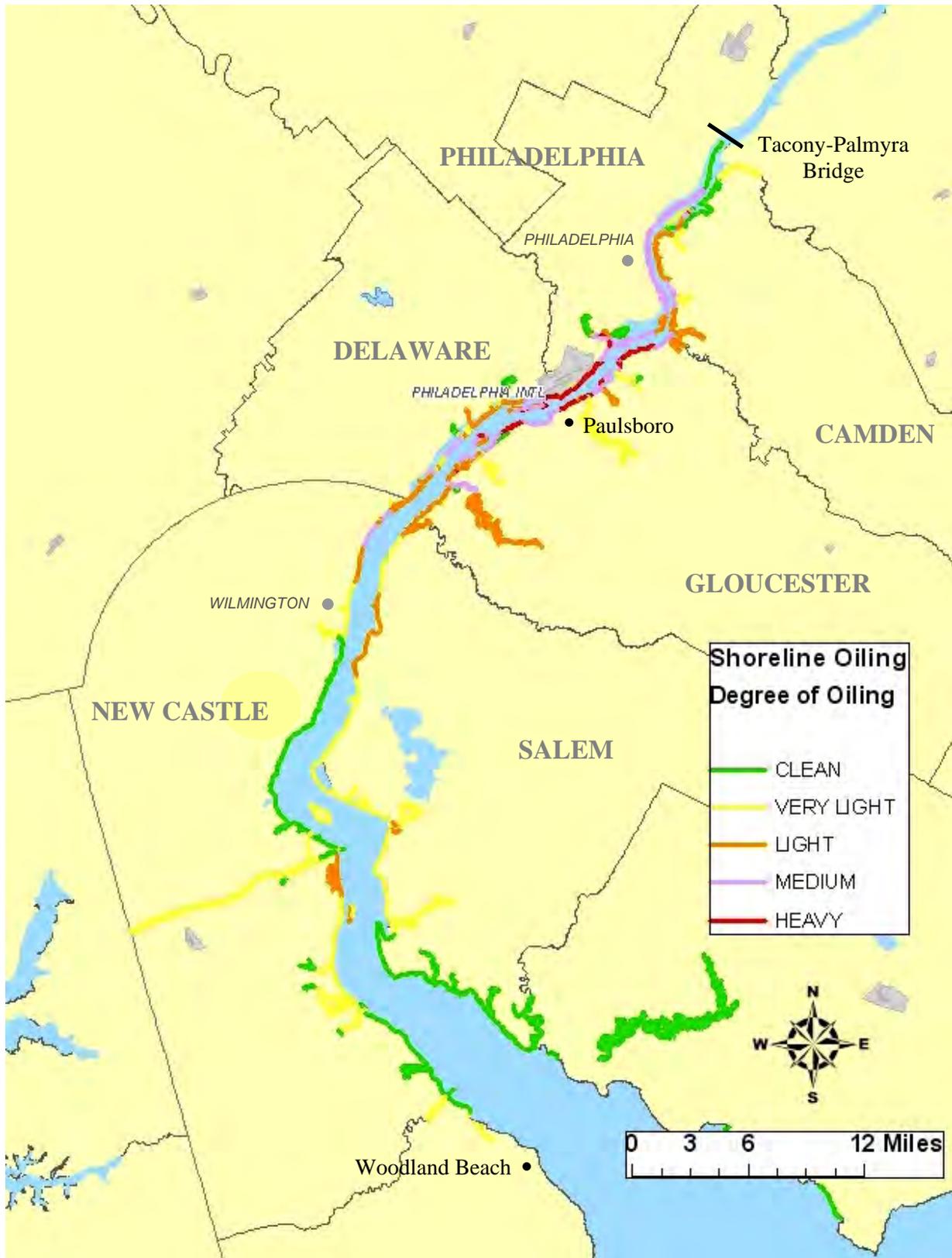


Figure 1. Degree of oiling from the Athos I oil spill on the Delaware River.

The same areas were also subject to a boating advisory. The level of recreational boating at the time of the spill was low, though some boat-based fishing continues throughout the year dependent on weather. Sporadic problems with oil were also reported at marinas in the area as late as August of the following summer. Other recreational activities such as fishing and crabbing were not specifically subject to an advisory. However, reports of oil and the presence of visible oil in some locations had the potential to affect any type of outdoor activity that takes place in water or shoreline areas of the Delaware River.

The oiling primarily affected six counties in three states. In Pennsylvania, Philadelphia County is largely urban, with boat ramps and shore access available at several locations in north Philadelphia and two large marinas in central Philadelphia. Delaware County is mostly urban, with a cluster of marinas in the town of Essington and a large boat ramp and shore fishing site in Chester. In New Jersey, the shoreline is a mixture of urban waterfront in much of Camden County and suburban or rural areas throughout most of Gloucester and Salem counties. Many areas of the New Jersey shoreline are suitable for fishing or hunting and access for boats is also available. New Castle County in Delaware is characterized by urban waterfront areas near Wilmington and the city of New Castle where fishing and boating is the primary form of river recreation. Further south, the shoreline becomes increasingly rural, and many areas are popular for waterfowl hunting and crabbing in addition to fishing and boating.

Shortly after being notified of the spill, representatives from natural resource trustee agencies cooperatively initiated preliminary assessment activities. Trustees overseeing the case include the National Oceanic and Atmospheric Administration, the U.S. Fish and Wildlife Service, the Pennsylvania Department of Conservation and Natural Resources, the Pennsylvania Department of Environmental Protection, the Pennsylvania Game Commission, the Pennsylvania Fish and Boat Commission, the New Jersey Department of Environmental Protection, and the Delaware Department of Natural Resources and Environmental Control. The trustees determined that sufficient evidence of injury existed to proceed with the natural resource damage assessment, including the evaluation of losses related to recreational use of the river.

DAMAGE ASSESSMENT METHODS AND RESULTS

Losses were assessed for four recreational activities affected by the spill: fishing and crabbing, waterfowl hunting, and boating. Potential losses were also considered for muskrat trapping, swimming, shellfishing, picnicking, and bird watching, but losses to these activities were not determined to be significant enough to warrant the expense of a claim for additional damages. For the selected activities, the loss of value due to the spill was determined using methods commonly applied in the economic analysis of recreation. While advisories were issued to restrict boating and hunting in the period immediately following the spill, the assessment of losses did not rely on this or other information of a regulatory nature. Instead, the analysis examined changes in behavior by those engaging in recreation on the Delaware River. The extent to which anglers, hunters, boaters and crabbers changed their activities in response to the spill is a measure of the severity of spill impacts. The results of economic valuation models were then applied to determine the lost value associated with these behavioral changes.

The primary focus of the assessment involved data collection through recreation surveys. Surveys of participants are the most common method to value recreational use (Haab and McConnell, 2003; Champ, Boyle and Brown, 2003). A combination of telephone surveys and onsite interviews collected information on the number of recreation trips that were affected by the spill. Affected trips included a decline in trips to the Delaware River called “lost” trips, a change in the location of trips to the Delaware River called “substitute” trips, and a reduction in the quality of fishing resulting in “degraded” trips. A value was ascribed to affected trips using a technique called “benefit transfer”. The benefit-transfer method relies on the results of previous studies that used economic models to determine a per-trip value for recreational trips (Garrod and Willis, 1999; Rosenberger and Loomis, 2001).

The sections that follow describe the methods and results leading to an estimate of recreational-use losses. The main body of this report provides an overview of the recreational-use assessment. Details are presented in the appendices, including additional

description of the methods, survey instruments used for the collection of data, maps showing the locations of survey activities and the extent of spill impacts, and spreadsheets showing mathematical calculations.

Recreational Fishing and Crabbing

Losses to recreational fishing and crabbing were estimated based on an intercept survey of anglers and crabbers using the Delaware River. Intercept surveys involve visiting sites where fishing takes place and approaching recreators for brief interviews. A total of 250 respondents were contacted in surveys conducted in June 2005, August 2005 and May 2006. The surveys were conducted by federal and state trustees with the cooperation of the company involved in the spill incident. Recreators were asked about their Delaware River fishing and crabbing, including the number of trips they typically take. They were also asked to estimate the number of their trips, if any, affected by the oil spill. Affected trips could include lost, substituted and degraded trips. Only a small number of recreational crabbers were intercepted, so the calculation of losses to crabbing was combined with the fishing assessment. The number of baseline crabbing trips to which the survey results were applied also represented a small portion of total baseline fishing and crabbing trips.

Results of the intercept surveys were used to estimate the number of affected trips as a percent of total trips taken by survey respondents. Effects were estimated separately for low, medium and high-impact areas. During the spring and early summer, the percentage of lost trips ranged from 4.3 percent in low-impact areas to 24.4 percent in high impact areas. The percentage of substitute trips was generally lower, ranging from 4.1 percent to 6.8 percent. The number of substitute trips was slightly higher in low-impact areas than other affected areas, possibly due to the nearby availability of substitute sites outside of the spill-impact area. While the analysis found no degraded trips in low impact areas, the percentage of degraded trips was 34.2 percent in high-impact areas. Effects in middle and late summer were determined to be approximately half those of the early part of the season.

In addition to the severity of effects, the surveys were used to establish the geographic extent of spill impacts. Anglers and crabbers were surveyed as far south as Port Mahon in Kent County, Delaware and as far north as the Frankford Arsenal access point north of Philadelphia. Physical oiling of the shoreline occurred entirely within the geographic coverage of the survey. Based on the responses of fishers intercepted in the various locations, the downstream boundary of the impact area was determined to be the southern border of New Castle County in Delaware and the southern border of Salem County in New Jersey. The upstream boundary of the impact area was determined to be the Linden Avenue boat ramp in north Philadelphia and the northern border of Camden County in New Jersey. Interviews with crabbers occurred only in the southern portion of the spill impact area below Wilmington, Delaware.

The intercept surveys were also used to determine the length of time when impacts to recreational fishing and crabbing occurred. Surveys in each of the three survey waves included questions regarding the presence of ongoing spill effects. Responses indicated that perceptions of the spill were relatively constant through mid-summer and up to the time of the August 2005 survey. For this reason, spill effects were assumed to continue throughout the remainder of the 2005 fishing season. It was determined that any effects beyond 2005 were likely to be small, and did not warrant the expense of additional assessment efforts.

One potential drawback to the use of intercept surveys in estimating effects of an environmental incident like an oil spill is that those who take fewer trips in response to the spill are less likely to be intercepted. This problem was addressed in the analysis by the use of weights that were applied to survey responses. The weights were inversely proportional to the number of trips taken by each respondent, so the responses of those taking fewer trips are adjusted to count more in the data analysis. Those who stopped fishing the Delaware River altogether due to the spill were not counted in the survey, potentially leading to an underestimate of damages. A random sample of fishers conducted by mail or telephone could avoid this potential bias, but would be considerably

more expensive than an onsite survey. A random survey would require an a high level effort to reach respondents, because fishing on the saltwater portions of the Delaware River (below the Commodore Barry Bridge) does not require a license and an extensive survey of the general population would be required.

Information from the intercept surveys was supplemented with estimates of the total number of anglers and crabbers in the impacted area obtained from comprehensive management surveys. The 2002 Delaware River Creel Survey conducted by state agencies in Pennsylvania, Delaware and New Jersey included estimates of angler activity from the northern edge of the impact area south to Wilmington, Delaware (Volstad, *et al.*, 2003). Trips south of Wilmington were available from the Marine Recreational Fishing Statistics Survey conducted by the National Marine Fisheries Service (NOAA, 2004). Estimates of total crabbing trips in Salem County, New Jersey were available from a 2005 survey of recreational crabbing (NJDEP, 2005). An estimate of crabbing trips in Delaware was not available, so potential losses associated with Delaware crabbing trips were not included in this assessment. These estimates of activity were used to estimate the number of baseline trips that would have been taken in 2005 had the spill not occurred. The estimate of baseline fishing and crabbing activity throughout the impact area from April to October was 136,862 trips, of which 128,354 were fishing trips and 8,507 were crabbing trips.

The percentage effects estimated from responses to the intercept survey were applied to the total number of baseline trips that would have been taken during the damage period throughout the area of impact. As noted, the severity of impacts varied across geographic areas and declined over time. It was estimated that a total of 10,278 trips were lost, 4,746 trips were substituted to other locations on the Delaware River, and 5,627 trips were degraded in quality due to effects of the spill.

The most commonly applied method to value impacts to recreational trips is called benefit transfer. The technique of benefit transfer involves obtaining an estimate of the value of recreational trips from studies published in the economics literature. A valid

transfer requires identifying previous studies that provide value estimates appropriate for the site of interest. No previous study of recreational fishing on the Delaware River was available. The appropriateness of transferred studies was therefore be evaluated based on similarities between sites previously studied and the Delaware River regarding the type of recreation involved, the characteristics of the resource, and the characteristics of the population of recreational users. The validity of the transfer also depends on the quality and methodology of the previous studies.

According to information from the onsite interviews, recreational fishing on the Delaware River consists of a mixture of shore fishing and boat-based fishing. According to data from the 2002 Creel survey, the target species include a mixture of highly valued migratory species such as striped bass as well as popular but less valued species such as white perch and channel catfish. Most shore angling in the assessment area occurs at developed access points. There are many studies in the economics literature addressing fishing activity with similar characteristics.

Regarding resource and population characteristics, the assessment area of the Delaware River is a large tidal river with a mixture of urban and suburban areas in New Jersey, southern Pennsylvania and northern Delaware. Areas in southern New Castle County, Delaware and Salem County, New Jersey are somewhat less developed. There are a limited number of other fishing locations with reasonably similar characteristics, including tidally influenced areas upstream of the assessment area on the Delaware River, as well as portions of the Hudson River and Chesapeake Bay. Angler populations in urban and suburban areas along these water bodies could be expected to have characteristics similar to those of anglers in the assessment area. However, no appropriate studies of the value of recreational fishing could be identified for these locations.

To determine the value of recreational fishing losses this assessment relied on benefit-transfer values reported in a study by the U.S. Department of Agriculture (Rosenberger and Loomis, 2001). Recreational values from numerous studies are analyzed in the USDA report, and average values by type of recreation and region of the country are

presented. Seventeen studies were selected in the report specifically for calculating an average per-trip value for fishing in the Northeast Region, including Delaware. The studies include a mixture of boat-based and shore-based fishing and address a variety of target fish species. Compared to studies conducted in other regions of the U.S., studies from the Northeast Region may address angler populations similar to those fishing on the Delaware River. An examination of the studies was conducted to determine whether a subset of the 17 studies would provide an average value specifically suited to Delaware River fishing. However, no valid basis could be identified for excluding any particular studies based on characteristics of the resource or angler population. Also, the values presented in the USDA report were specifically intended to assist with valid benefit transfers conducted by government agencies. The average value of recreational fishing in the Northeast region was \$31.16 in fourth-quarter 1996 dollars, according to the USDA report. This figure would be \$43.27 after adjustment for inflation to July 2008 dollars.

There are several reasons why the Delaware River could be considered more valuable for fishing than other resources in the Northeast. These might include the large size of the river, its suitability for boat-based as well as shore fishing, and the presence of popular ocean species like striped bass. However, the urban surroundings and longstanding contamination present in the spill impact area may reduce the quality and value of fishing. The regional average value of \$43.27 was determined to be reasonable for the purpose of this assessment. This figure was also applied to crabbing trips, because no value was available specifically for crabbing in the USDA report or elsewhere. Of the 20,652 affected trips in the fishing and crabbing assessment, only 1,286 were crabbing trips. It was determined that additional effort to identify a more appropriate value for crabbing trips was not warranted given the modest potential effect on the total estimate of losses.

The total value of recreational fishing and crabbing losses was obtained by multiplying the number of affected trips by the appropriate per-trip value. Lost trips as well as substitute trips both represent a decline in activity in the spill-impact area. It is common to value losses to recreation by multiplying substitute and lost trips by the average value

of a trip from previous studies. This is appropriate because per-trip values are generally derived based on the loss of access to a site, which includes both lost trips and trips diverted to substitute locations. There is less consistency in the treatment of degraded trips. Because degraded trips also involve lost value, losses associated with degraded trips were included in this assessment. In keeping with methods developed in past oil spill assessments (Chapman and Hanemann, 2001; Byrd et al., 2001) the value applied to degraded trips was 20 percent of the value applied to lost and substitute trips (or 0.2 multiplied by the full per-trip value).

Total losses are reported in table 2 in July 2008 dollars. The largest losses are attributable to a reduction in trips to the Delaware River in response to the spill. For the total of 10,278 lost trips the value was \$490,849. For 4,746 substitute trips the loss was \$226,669. There were also 5,627 degraded trips causing a loss of \$53,747. The estimate of total losses to recreational fishing is \$771,264. About 5.9 percent of the total losses are attributable to recreational crabbing, or \$45,842.

Table 2. Total recreational fishing/crabbing losses (July 2008 dollars)

Measure of loss	Lost Trips	Substitute Trips	Degraded Trips	Total
Affected trips	10,278	4,746	5,627	20,652
Raw lost value	\$444,757	\$205,384	\$48,700	\$698,841
Discount factor	1.104	1.104	1.104	
Total lost value	\$490,849	\$226,669	\$53,747	\$771,264

Source: Appendix A, tables A9-A11.

*Note that numbers in table might not sum or multiply exactly due to rounding

Waterfowl Hunting

The assessment of waterfowl hunting relied on a telephone survey of licensed hunters. The survey was conducted in October 2005 and obtained interviews with 302 respondents. Hunters were asked if they had hunted for waterfowl on the Delaware River and associated tidal marshes in the previous three years. Those who had hunted the

Delaware River were asked how many trips they took during the 2004/2005 season and whether the oil spill affected their hunting trips. Those affected by the spill were asked to estimate the number of lost and substitute trips. Degraded trips were estimated as the number of trips taken by those affected by the spill, with substitute trips netted out.

Hunters contacted in the telephone survey represented a random sample of hunters in four counties: New Castle County in Delaware and Salem, Gloucester and Camden counties in New Jersey. Hunters in Pennsylvania were not included in the survey because the areas of Pennsylvania affected by the spill have only a limited amount of hunting activity. Due to the small probability of contacting affected hunters a survey of Pennsylvania license-holders would not be cost-effective. Affected trips by Pennsylvania hunters, as well as by Delaware and New Jersey hunters living outside the four targeted counties, were accounted for using supplemental adjustments described below.

Because the hunter survey was based on a random sample, the results could be directly extrapolated to the total population of license holders in the four surveyed counties. Unlike the intercept angler surveys, hunters affected by the spill were equally likely to be contacted as hunters who were not affected. Affected trips were thus averaged over respondents in the survey, and the averages were then multiplied by the total number license holders in the four counties. The result is an estimate of affected trips for license holders living in the four surveyed counties.

To address losses outside the four-county coverage area of the survey, two additional steps were taken. First, the spill-impact area was defined. It was determined that the four counties included in the survey plus the two Pennsylvania counties where oiling occurred (Delaware and Philadelphia) represented the extent of the impact area. This determination was based on the extent of shoreline oiling and the results of the angler survey, which indicated that concern about the effects of oil extended throughout this area of the river. Second, additional data was obtained from the Harvest Information Program (HIP) survey conducted by the U.S. Fish and Wildlife Service (FWS, 2005). The HIP survey includes information on a random sample of all waterfowl hunting trips in the region.

Specifically, the data describe for each trip the county of residence of the hunter and the county of destination for the trip. From this information an adjustment ratio was calculated: Total trips to the six-county impact area were divided by the number of trips to the impact area taken by residents of the four surveyed counties. This ratio was used to adjust the estimates of affected trips calculated from the surveys, based on the assumption that affected trips are a constant proportion of total trips.

As with recreational fishing, affected trips were valued using estimates from the USDA study of recreational values. Support for the selected value is presented in the appendix, which describes a site-specific study of waterfowl hunting on the Delaware River that obtained values similar to the one contained in the USDA report. The site-specific study is an unpublished manuscript obtained from the University of Delaware, and the USDA report was determined to be a more valid source for the purpose of this assessment. The per-trip value for the report’s Northeast region in July 2008 dollars is \$44.56. This value was applied to both lost and substitute trips. As described above, the value of diminished trips was assumed to be 20 percent of the value of lost and substitute trips, or \$8.91.

Total losses to waterfowl hunting are presented in table 3 in July 2008 dollars. Approximately 15,559 trips were affected including 4,700 lost trips, 2,986 substitute trips and 7,872 degraded trips. The values associated with lost, substitute and degraded trips were \$231,152, \$146,872 and \$77,431, respectively. The estimate of total lost value was \$455,455.

Table 3. Total waterfowl hunting losses (July 2008 dollars)

Measure of loss	Lost Trips	Substitute Trips	Degraded Trips	Total
Affected trips	4,700	2,986	7,872	15,559
Raw lost value	\$209,446	\$133,081	\$70,160	\$412,687
Discount factor	1.104	1.104	1.104	
Total lost value	\$231,152	\$146,872	\$77,431	\$455,455

Source: Appendix B, tables B5 and B7.

*Note that numbers in table might not sum or multiply exactly due to rounding

Pleasure Boating

The assessment of losses to pleasure boating was based on an intercept survey of boaters at marinas in the impacted area. The survey focused on pleasure boaters, because boat-based fishing was included in the assessment of recreational fishing. The survey focused on marinas because boaters are relatively accessible at marinas and a significant number of interviews can be conducted in a reasonably short period of time. Intercepting boaters departing or returning at boat ramps is considerably more time-intensive, and obtaining an estimate of total pleasure boating trips including trips from boat ramps would be difficult. For these reasons this assessment includes only trips taken from marinas, and therefore is likely to understate actual losses.

The survey of boaters was similar to the angler survey and obtained information on lost and substitute trips based on 35 interviews. As before, degraded trips were calculated for those affected by the spill by subtracting substitute trips from actual trips taken to the Delaware River. The sample of intercepted boaters was treated as a random sample, because there was no direct relationship between their trip-taking behavior and the probability of selection for the survey. Effects were calculated as a percentage of baseline activity by dividing affected trips in each category by the sum of respondents' lost and actual trips.

Total baseline activity for pleasure boating on the Delaware River was calculated using an estimate of all boats moored at marinas in the impact area under baseline conditions. Total moored boats were multiplied by the rate of use of moored boats. The estimate of total moored boats was based on a combination of onsite counts and interviews with marina operators. The estimate of the rate of use, that is, the number of boats going out each day as a percent of moored boats, was based on a count obtained over a 12-hour period of weekend use in early September. The rate of use was found to be similar to figures obtained in previous assessments. Boating activity was expanded to weekdays and other months in the season using relative levels of boating activity obtained from previous assessments.

The rate of effects for survey respondents was multiplied by the total number of baseline trips to estimate total affected trips. The number of affected trips was multiplied by a per-trip value from the economics literature. As before, the values were taken from the USDA study, and degraded trips were valued at 20 percent of lost and substitute trips. Because the boating value for the Northeast region was estimated from only one study using data from 1965, the national average value was determined to be a more reliable estimate for use in benefit transfer. An appropriate site-specific study involving population and resource characteristics similar to those of the assessment area could not be identified. The per-trip values in July 2008 dollars were \$48.26 and \$9.65 for lost/substitute trips and degraded trips, respectively. As presented in table 4, a total of 5,498 trips were affected, and the associated loss in value was \$107,081.

Table 4. Total recreational boating losses (July 2008 dollars)

Measure of loss	Lost Trips	Substitute Trips	Degraded Trips	Total Trips
Affected trips	866	273	4,359	5,498
Raw lost value	\$41,782	\$13,173	\$42,071	\$97,026
Discount factor	1.104	1.104	1.104	
Total lost value	\$46,112	\$14,538	\$46,430	\$107,081

Source: Appendix C2, table C2-3.

*Note that numbers in table might not sum or multiply exactly due to rounding

Conclusions

In the evaluation of lost recreational use, the trustees have attempted to balance the need for accuracy in assessment methods with the objective of limiting the cost of the assessment. As a result certain aspects of the assessment involve a degree of uncertainty. For example, the intercept and telephone surveys relied on a relatively modest number of contacts to determine the number of affected trips. Data on baseline levels of recreational activity were in many cases intended for use on a statewide level, and the precision of the

county-level estimates used in this study is modest. In some cases data is known to be incomplete. For example, the creel data used to estimate total fishing in Pennsylvania and New Jersey counties did not include counts from certain low-use fishing sites, and as noted above the assessment of pleasure boating excluded trips taken from boat launches. These uncertainties and limitations in the data, along with other details of assessment methods, are considered further in the appendices. The trustees that undertook this study believe the estimate of damages presented herein results from a reasonable data collection effort and a valid analytical approach. The results of this report are intended to assist the Trustees in obtaining compensation for recreational-use losses and in undertaking appropriate restoration actions.

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APPENDIX A: Recreational Fishing/Crabbing Assessment

What follows is a detailed description of the data and methods used to calculate losses to recreational fishing from the Athos I oil spill. Fishing will refer to both finfishing and crabbing. The first section describes onsite surveys conducted for this assessment by state, federal and industry representatives. The surveys asked fishers to report any effects of the spill on their use of the Delaware River for recreational fishing. The second section describes how the onsite surveys were analyzed, resulting in estimates of the severity of spill impacts on total fishing use. The impacts are summarized in terms of the portion of total fishing trips affected, including “lost” trips, “substitute” trips and “degraded” trips. The third section describes the estimation of total baseline fishing trips, which refers to the total number of fishing trips that would have been taken in the absence of the spill. Estimation of baseline trips relied on data from the 2002 Delaware River creel survey and the annual Marine Recreational Fishing Statistical Survey. The fourth section presents a benefit-transfer estimate of the lost value associated with affected trips based on published studies of the value of recreational fishing. The final section calculates total recreation fishing losses by multiplying of affected trips by their respective per-trip values.

Onsite Intercept Surveys

The trustees conducted onsite surveys of recreational fishers at fishing sites along the Delaware River. The surveys were developed and conducted with the participation of federal and state officials as well as industry representatives. The geographic coverage of the surveys was designed to reach most areas potentially impacted by the spill. The surveys were conducted in three waves. The first wave was conducted June 11-12, 2005 and obtained data from 117 fishers. The second survey was conducted August 6, 2005 and obtained data from 82 fishers. The third survey was intended to gather supplemental information on impacts in New Castle County, Delaware, and only intercepted fishers at sites in that area. The supplemental survey was conducted May 13, 2006 and contacted

51 fishers. The wave 3 survey was intended to provide additional precision of estimated losses in Delaware, where a large proportion of baseline fishing trips occurred.

The fishing interviews were sometimes conducted with groups, so the total number of interviews was lower than the total number of fishers. There were 57 interviews conducted during wave 1, 40 interviews conducted during wave 2, and 17 interviews conducted during wave 3. The surveys were conducted in a “roving” fashion in the sense that interviewers proceeded from one site to another, moving to the next site once interviews were completed rather than waiting at a site for any prescribed period of time. Copies of the survey instruments are included in appendix A1. A map showing the locations where interviews were conducted is included in appendix A2. The interview sites extended from the Frankford Arsenal access area in north Philadelphia to the fishing piers in Port Mahon east of Dover, Delaware. There were 18 interview sites in all, including three in Pennsylvania, four in New Jersey and 11 in Delaware. The large number of sites in Delaware reflects the high availability of access points in New Castle County, the area of Delaware where oiling occurred.

The surveys included a variety of questions about each respondent’s current and previous fishing trips to the Delaware River and inquired about any possible effects of the oil spill on the respondent’s fishing. Specifically, fishers or groups of fishers were approached by the survey administrators. The number of people addressed in each interview was recorded. For fisher groups, participants in the group were asked to choose a spokesman. During the course of the interview, other members of the group were also asked whether they agreed in general with the responses given. In many groups, fishers indicated that they fished together regularly and had similar opinions about the effect of the spill. When fishing habits or opinions appeared to differ, separate interviews were conducted to the extent possible and each interview was recorded separately.

In addition to group size, the survey administrators recorded whether the group was fishing, crabbing, or engaging in both activities. This applied only to the wave 2 survey, since the wave 1 and wave 3 surveys were conducted when crabbing activity was low.

Next the length of the respondent's current trip was recorded. The respondent was asked to estimate the total length of the trip based on the time of arrival and the expected time of departure. The respondent was then asked generally about the quality of fishing in the current year compared to previous years. The next questions involved the number of trips taken previously to the Delaware River. In the wave 1 survey, the trip history was taken back to December 2004, up to a few days following the spill (the date of the spill was November 27, 2004). In the wave 2 survey, the trip history was recorded only as far back as April 2005 to reduce respondent burden and minimize recall bias. In the wave 3 survey requesting a trip history for the year of the spill (the previous year) would have been burdensome for the respondent. Instead, the wave 3 survey asked fishers to report their typical level of weekly fishing at the time of the survey, which could be applied to the previous year's spring fishing season. The respondent was then asked whether the number of trips taken in the current year was more, fewer or the same as the number of trips typically taken in previous years.

The several questions regarding changes in the quality or amount of fishing compared to previous years were designed to encourage the respondent to begin thinking about their recent fishing experience and the issues of fishing quality that could be important in the course of the survey. They were also meant to help identify any significant factors that might have affected fishing in the year of the assessment compared to previous years. Controlling for such factors was potentially important since data on baseline fishing activity would be drawn from surveys conducted in previous years. However, apart from the spill, no significant factors affecting fishing in 2005 were identified. It should be noted that a relatively small number of people identified the spill in response these initial questions, while subsequent questions identified a greater number of affected fishers. This may have been due to the tendency of respondents to interpret questions regarding fishing quality primarily in the context of the number and types of fish they were catching. Many respondents did not appear to interpret the question in terms of other factors such as environmental quality. Also, questions regarding a comparison to the previous year's fishing trips were subject to recall difficulties. For these reasons, the initial questions were not relied upon to specifically evaluate spill impacts.

The remaining questions in the survey involved the impacts of the oil spill. Respondents who had not already discussed the spill were asked if they were aware the spill had occurred. In all three surveys combined, 197 out of 250 respondents were aware of the spill. Respondents were next asked if the spill affected their fishing in any way, and 89 out of 250 respondents said that it had. As described in the next section, these numbers will be adjusted to control for potential differences in the level of survey effort in heavily and lightly affected areas respectively. The numbers will also be weighted to account for the lower likelihood of intercepting fishers who took fewer trips due to the spill.

Fishers who indicated that the spill had affected their fishing were asked whether they had taken fewer trips to the Delaware River in response to the spill, or whether they had changed the location of their trips to the Delaware River to avoid areas impacted by the spill. These two effects are the most common behavioral responses to adverse resource changes as analyzed in the literature. Finally, respondents affected by the spill were asked whether the effects of the spill had subsided and the quality of fishing on the Delaware River had returned to normal. This question was included to examine any decline in spill impacts throughout the season and to determine the end of the impact period.

Analysis of Spill Impacts

Data collected in the fisher surveys was used to estimate the extent and severity of impacts to recreational fishing from the oil spill. Tables in appendix A3 present the calculations and will be referenced in the text. The description of the analysis that follows is divided into four steps. First, observations from the survey were weighted to generate a representative sample of Delaware River fishers. Each observation consists of data collected in a single interview. Because the interviews were conducted with fishers intercepted on site rather than contacted in a random selection process, the weighting of observations is required in order to extrapolate to the total fisher population. Second, a method of spatial stratification was developed to correctly quantify effects in high, medium, and low impact areas. Because the intercept interviews were not conducted

according to a random selection of fishing locations, spatial stratification in the analysis stage of the assessment is used to correct for the possibility of over or under-sampling high or low-impact areas. Third, the analysis was stratified temporally to correctly combine information from the two survey waves and to account for the possibility of declining spill effects throughout the impact period. Finally, spill impacts were estimated in terms of affected trips. Potential effects include a reduction in trips taken to the Delaware River, a change in the location of trips to the Delaware River, and a decline in the value of trips due to degraded conditions caused by the oil spill.

Weighting of Observations

The objective of the survey analysis was to estimate the number of affected trips for a random sample of Delaware River fishers. If a random sample of fishers collectively lost 100 trips due to the spill from a total of 1,000 trips they would normally take, then lost trips occurred at a rate of 10 percent. This percentage loss can then be applied to the total number of Delaware River trips that would have been taken had the spill not occurred. To convert observations from the survey into figures representing a random sample of fishers, weights were applied to adjust for the effects of onsite sampling. Weights are multiplicative factors applied to the survey observations. Weights are applied to all information obtained in each interview and so that results of the analysis replicate those of a random sample.

Two types of weights were applied in the survey. First, each observation was multiplied by the inverse of the number of trips per month taken by the respondent during the month when the survey was conducted. This adjusts for sample selection effects due to the increased probability of sampling frequent fishers. Importantly, since trip frequency was recorded during the spill impact period, this also adjusts upward the responses of fishers who took fewer trips because of the spill. Fishers who stopped taking trips during the spill could not be contacted in an intercept survey and losses associated with this group are not included in this assessment. Second, observations were weighted by the inverse of trip length for each respondent. This adjusts for the increased probability of intercepting

fishers who take longer trips. Trip length refers to the number of hours a respondent spent fishing on the Delaware River on the day of the interview.

When proportions are calculated, the weighted observations are treated in the same way that randomly sampled observations would be. For example, the number of lost trips as a percentage of total trips (see table A3-4) would be:

$$\% \text{ Lost} = \frac{\sum_i w_i \text{Lost}_i}{\sum_i w_i \text{Actual}_i + \sum_i w_i \text{Lost}_i}. \quad (1)$$

The term Lost_i refers to lost trips reported by individual i , Actual_i refers to trips taken to the Delaware River by individual i , and w_i are the weights, composed of the product of the inverse of trip frequency and trip length.

When absolute numbers are calculated rather than proportions, the effect of the weights on the scale of the original figures is divided out. For example the total number of actual trips reported in wave 2 (see table A3-2) would be:

$$\text{Total Actual Trips} = \frac{\sum_i w_i \text{Actual}_i}{\sum_i w_i} \times I. \quad (2)$$

The total number of individuals i is I , which would equal the 82 observations in wave 2.

Because data was collected in survey waves occurring at different times, combining data from the two waves might require adjustment of the weights to avoid bias in the combined sample. For example, if fishers typically take trips more frequently during mid-summer (wave 2) compared to late spring (wave 1 or wave 3), a simple weighing of observations by the inverse of trip frequency would inappropriately underweight the wave 2 observations. However, prior surveys of total angler activity throughout the

season indicate that the peak fishing season on this part of the Delaware River extends from May through September (see the results of the Delaware Creel survey in table A3-6). All three surveys were conducted during this peak period, when the level of fishing activity is roughly comparable. In particular, the bulk of the survey effort took place in waves 1 and wave 2. These survey waves took place during June and August, two months which appear to have very similar levels of fishing activity. For these reasons no additional adjustments were made to the trip-frequency weights calculated for the different survey waves. The prior estimates of total angler activity obtained through the Delaware River Creel Survey are discussed further below and are presented in tables A3-5 and A3-6.

Spatial Stratification

The study area was divided into distinct geographic areas for the purpose of analyzing impacts of the spill. This type of spatial stratification was necessary to reduce any bias that may have resulted from the collection of data through onsite intercept surveys. In particular, the onsite surveys were not conducted according to a rigorous sampling plan involving the random selection of sites and times for the implementation of fisher interviews. Such an approach was not undertaken due to the high cost of implementation. Instead, interviews were conducted on limited occasions, to some extent emphasizing high-use sites over low-use sites, and may have focused effort unevenly between high-impact and low-impact areas. By grouping observations geographically into high, medium, and low-impact areas, any effects of uneven spatial sampling would be mitigated to a large extent. For example, the potential for over-sampling in high-impact areas would not affect the estimate of impacts in medium or low-impact areas, and would only serve to refine the estimate of losses in high-impact areas.

The division of sites according to high, medium, and low impact is illustrated in table A3-1. Designations were made based on three factors. First, the percentage of respondents reporting effects from the spill is considered. Because sample size can be quite small for many of the sites, the site-specific figures can only give a general

indication of the level of effects. The reported effects are presented in both weighted and unweighted form for this portion of the analysis because the weights could create misleading effects when averaged over small samples. A small number of anglers indicated that the site where they were fishing at the time they were interviewed was not a site where they normally fish, but instead represented a change in location due to the spill. These respondents were included in the spatial strata appropriate for their typical destination. Second, the level of reported effects at nearby sites is considered. By considering sites together with nearby locations the effects of the small sample size at each site can be ameliorated. Third, the degree of physical oiling at sites was evaluated. (The degree of oiling can be examined using the map in appendix A2. The map was prepared based on observed oiling, and therefore does not include some interpolation of data reflected in Figure 1 of the main report.) The severity of oiling does not directly correspond to behavioral responses by fishers, but a general correspondence between oiling and impacts on fishers would be expected. Sites in table A3-1 are listed roughly in order from upstream to downstream locations, with adjacent sites on either side of the river grouped together. The county of each site is also identified.

Sites designated as high impact were located in close proximity to one another and near the site of spill where the heaviest oiling occurred. Over 80 percent of respondents (unweighted) at three of the high-impact sites indicated that the spill had affected their fishing. Respondents at the “Floodgates” site did not report any effects. This may be a result of the small sample size. The site was included among the high-impact sites because it is located between National Park and Bridgeport, where more severe effects were reported. Fort Mifflin had a larger sample size with only 18 percent of respondents reporting effects. This effect appears even smaller when the weighting of observations is accounted for. However, Fort Mifflin was included with the high-impact sites because of its close proximity to the site of the spill and the heavy oiling that occurred there. The data for Fort Mifflin demonstrate that different fishers are affected differently by the presence or perception of oil.

Sites adjacent to the high-impact sites in both the upstream and downstream directions were identified as medium impact. The reported effects at medium-impact sites ranged from no reported effects to a high of 67 percent of individuals affected, according to the unweighted observations. Oiling at these locations was generally less severe than at the high-impact sites. The weighted observations suggest considerable spill effects as far south as the C&D canal. Some light and very light oiling occurred just south of the C&D canal. These factors indicate that this location should be grouped with the medium-impact sites. Augustine Beach and areas where fishers were interviewed south of Augustine Beach were designated as low-impact, with the portion of affected individuals ranging from 9 percent to 23 percent according to the unweighted observations, or 4 percent to 7 percent using the weighted observations. The sites Woodland Beach and Port Mahon included observations from several people who reported spill effects. However, all affected trips involved a change in location of Delaware River trips. The information collected for these observations did not specify whether the substituted trips involved the avoidance of perceived impacts at the intercept sites, or whether respondents had relocated trips to the intercept sites from locations that were more severely affected. Due to this uncertainty, and due to the fact that both sites are below the southern extent of oiling and considerably south of the heavily oiled areas, the effects at Woodland Beach and Port Mahon were assumed to be zero.

The objective of the designations in table A3-1 is to delineate the level of impact by geographic region so that results of the onsite surveys can be applied to information on baseline trips. Effects are ultimately divided by area rather than site because information on baseline trips corresponds to a group of sites that is not identical to those sampled in the onsite survey.

The map in appendix A2 shows the geographic extent of the high, medium and low impact areas. The lower limit of the spill impact area was determined to be the New Castle county boundary. The county boundary lies south of Augustine Beach, where spill effects were determined to be low, and north of Woodland Beach, where it was determined that no spill effects occurred. The upstream limit of the spill impact area is

determined to be the Linden Avenue boat ramp in Philadelphia. The Linden Avenue site is midway between the Frankford Arsenal site, where medium-level effects were measured, and Neshaminy State Park. In the boating portion of this assessment, intercept surveys at Neshaminy State Park indicated no spill effects. Unfortunately no surveys were conducted at the Linden Avenue site. However, since it is only a few miles north of the Frankford Arsenal, it is reasonable to believe that low-level impacts occurred there. No oiling was reported at either the Linden Avenue or Frankford Arsenal sites, though moderate oiling occurred throughout most of the Philadelphia shoreline up to a point just south of the Frankford Arsenal site.

On the New Jersey side of the Delaware River, the southern and northern boundaries of the spill impact area are delineated according to data obtained on the opposite shoreline in Delaware and Pennsylvania. In both of these areas the New Jersey shoreline has limited river access for fishing. The absence of significant fishing activity in these areas (described further in the next section) suggests that the precise delineation of the boundaries of the spill impact area on the New Jersey side of the river will not significantly affect the results of the assessment.

Information on the severity of impact at survey-intercept sites was used to divide the spill-impact zone into low, medium and high impact areas. The outlying low-impact areas extend from the boundaries of the spill impact area up to the areas designated as medium impact. From the south, the medium-impact area begins at the C&D Canal on the Delaware side of the river, and extends to the Philadelphia International Airport. It also includes areas north of the airport on the Pennsylvania side of the river up to Pennypack Park. On the New Jersey side of the river, the medium impact area begins south of Pennsville across the river from the C&D Canal entrance. It extends to the southern border of Gloucester County. It also includes areas above the northern border of Gloucester County. The medium-impact areas are characterized by moderate to light oiling in most places and include the medium-impact sites as designated using the intercept surveys.

The high-impact areas include the entire shoreline of Gloucester County in New Jersey and the Fort Mifflin site in Pennsylvania, located adjacent to the Philadelphia International Airport. These areas include all the high-impact sites and most of the areas were heavily oiled. Heavy oiling also occurred in several areas of the Pennsylvania shoreline north of Fort Mifflin in Philadelphia, but access for fishing is extremely limited apart from the Fort Mifflin site. Heading north from Fort Mifflin, the medium-impact Frankford Arsenal site is the next major fishing location.

Temporal Stratification

In addition to divisions by geographic area, the spill effects were also divided into three time periods. The first time period includes December 2004 through June 12 2005, that is, the period following the spill through the date of the wave 1 survey. The second time period runs from June 13 2005 through August 6 2005, the period following the wave 1 survey through the date of the wave 2 survey. The third period accounts for losses that occurred following the wave 2 survey through the end of the 2005 fishing season.

The primary reason for temporal stratification is to allow for the possibility that spill effects declined throughout the assessment period. If a high rate of affected trips measured early in the season were applied to fishing activity throughout the summer, the total effects of the spill could be overstated. Conversely, the spring fishing season should not be evaluated based on spill effects measured in late summer. The result of the temporal analysis is an estimate of the relative severity of effects occurring in the different time periods.

The analysis to determine the appropriate temporal stratification was applied only to lost trips, that is, trips not taken to the Delaware River due to the spill. The results of the lost-trips analysis were then applied to substitute and diminished trips. This approach was selected primarily because lost trips are likely to be the most reliable indicator of the severity of spill effects. Substitute trips involve only a change in location on the Delaware River. It is possible that people would return to the Delaware River as effects

of the spill decline, while at the same time choosing alternative Delaware River sites less impacted by oil. This could lead to an increase in substitute trips even as total effects of the spill decline. The same difficulty applies to degraded trips. It should also be noted that limitations of the data prevent the comparison of substitute trips during the first and second period, because due to an oversight respondents in the wave 1 survey were not asked to report the quantity of their substitute trips. However, all respondents were asked whether they engaged in substitution, and the number of people reporting substitute trips did increase by 13 percent in the wave 2 survey. This suggests that lost trips may indeed be the best indication of spill effects over time.

The temporal analysis of lost trips proceeded in several steps which are presented in table A3-2. The notes to table A3-2 present details of the calculations. Generally, the approach relies on the assumption that the rate at which trips were lost in period 1 is the same for both wave 1 and wave 2 respondents. Recall that the wave 2 data includes a record of actual trips that overlaps with data from the wave 1 survey. This permits the calculation of period 1 lost trips for wave 2 respondents based on the rate of loss in wave 1. The remaining wave 2 lost trips can then be allocated to period 2. Period 2 lost trips can then be divided by period 2 baseline trips (actual trips plus lost trips) to obtain the rate of lost trips in period 2. Rates of the loss of trips can thus be determined for both period 1 and period 2 in a way that is consistent with data from both wave 1 and wave 2. The rate of lost trips was determined to be 20.5 percent for period 1, and 10.4 percent for period 2. This suggests that effects of the spill declined between April and August.

It should be noted that the approach to temporal stratification just described would ideally be performed simultaneously with the spatial stratification described in the previous section. Without spatial stratification, it is possible that differences in the selection of interview locations between wave 1 and wave 2 are partly responsible for the estimated 50-percent decline in spill effects. However, examining temporal issues in each of the three spatial groups would be difficult given the limited amount of data. Because the selection of sites used in the intercept surveys did not change significantly between the

two waves, the analysis just described is viewed to be a reasonable approximation of temporal changes in spill impacts.

The assessment of losses includes an estimate of affected trips occurring after the completion of the wave 2 survey. Specifically, the period 2 rate of loss is assumed to remain the same in period 3. This determination was made based in part on information in table A3-3, which shows respondent opinions regarding spill conditions on the Delaware River. Respondents who reported that the spill affected their fishing were asked whether fishing on the river had returned to normal at the time of the interview. In the wave 1 survey conducted June 2005, an estimated 71 percent of those affected by the spill felt the effects of the spill were still ongoing. In the wave 2 survey conducted August 2005, the percentage was 81 percent. This indicates that perceptions of the spill were steady during the mid-summer period up to time of the August survey. The steady trend is assumed to continue throughout the remainder of the 2005 fishing season.

By the time of wave 3 survey in May 2006, the estimate of ongoing effects declined to 32 percent. While this provides some indication that effects continued beyond 2005, it is important to note that none of the respondents in the 2006 survey indicated that they continued to take fewer trips or to change the location of their trips in response to the spill. It is these types of behavioral responses that form the basis of the valuation of spill effects on recreation. It was therefore determined that losses would not be estimated for 2006, because any continuing losses would not be large enough to warrant additional assessment efforts.

Affected Trips

The severity of spill impacts are measured by affected trips as a percentage of baseline trips. These percentages are reported in table A3-4. As noted previously, there are three types of effects analyzed in this assessment. Lost trips represent the decline in the number of trips taken to the Delaware River due to the spill. Substitute trips represent the number of Delaware River trips involving a change in location to avoid spill impacts. Degraded

trips were taken to impacted areas and are characterized by diminished value due to the presence or perception of impacts from oil. Degraded trips were estimated for respondents who reported that their fishing was affected by the spill. The intercept surveys asked respondents to quantify their actual as well as lost and substitute trips. The number of degraded trips was calculated as the difference between a respondent's actual trips and those identified as substitute trips. For those fishers who reported spill effects but did not indicate that effects were ongoing at the time of the survey, the number of degraded trips could not be accurately estimated. To avoid potentially overstating losses, no loss was estimated for the degraded trips of these respondents.

A complication in the analysis of affected trips involves allocating wave 2 lost trips into period 1 and period 2. While this was done previously for total lost trips in the analysis of temporal stratification, the allocation must be applied to individual observations. This allows period 1 and period 2 effects to be calculated separately for low, medium and high impact areas based on individual observations in each of those areas. Recall that respondents reported total lost trips for the season, and due to issues of respondent burden they were not asked to divide their lost trips into pre-June 12 and post-June 12 periods. Considering this, the analysis of affected trips proceeded as follows. Observations for both survey waves were grouped by high, medium and low impacts according to the spatial allocation described previously. The analysis focused on period 1 effects, while retaining the assumption that period 2 effects are half as severe as period 1 effects (determined previously based on all observations combined). Period 1 effects were estimated using wave 1 data combined with wave 2 data allocated to period 1. Lost and substitute trips reported by wave 2 respondents were allocated to period 1 based on the estimated overall decline in effects from 20.5 percent to 10.4 percent. The percentage allocation of lost and substitute trips to period 1 that is consistent with both total reported trips for a given wave 2 respondent and the estimated decline in overall spill effects is:

$$\%Lost_{Period\ 1} = \frac{(20.5/10.4) \times Actual_{Period\ 1} / (1 - 0.205)}{\left[Actual_{Period\ 2} / (1 - 0.104) + (20.5/10.4) \times Actual_{Period\ 1} / (1 - 0.205) \right]} \quad (3)$$

The variable *Actual* is the actual number of trips taken by wave 2 respondents in either period 1 or period 2. Actual trips are increased by the estimated percentage of lost trips [$1 / (1 - 0.205)$ or $1 / (1 - 0.104)$] to obtain rough estimates of the respondent's baseline trips in both periods. The baseline estimates are not precise, because the 20.5 and 10.4-percent figures apply only on average to all respondents. Lost and substitute trips are allocated to the two periods according to these estimates of baseline activity in the two periods, but not in direct proportion to baseline trips. Rather, the higher rate of loss in period 1 is accounted for by weighting the period 1 baseline figures by 20.5/10.4 in both the numerator and the denominator of the above equation.

The above calculations represent an approximation. Unfortunately, there is no completely precise method for allocating trips to the two periods given the absence of precise information from respondents. It is important to note that the total number of affected trips and the total number of baseline trips in the two periods combined is determined by the data and is not altered when allocating between periods. The net effect of the allocation decision primarily affects losses in period 3, to which the period 2 rate of loss is applied. Several other methods of allocating between periods 1 and 2 were tested, and the results did not differ significantly.

The percentage obtained from the above equation was multiplied by total lost and substitute trips reported by each wave 2 respondent to allocate a portion of these trips to period 1. The number of period 1 baseline trips for survey respondents was calculated as the sum of actual and lost trips for period 1. By dividing lost and substitute trips by the number of baseline trips, the percentage of lost and substitute trips was determined. The percentage effects for period 2 and period 3 are then calculated by multiplying the period 1 effects by 0.5, in accordance with the decline in effects that was estimated initially.

It is worth noting that degraded trips are treated somewhat differently in period 1 and period 2. In the first period, degraded trips represent the balance of trips taken by affected fishers once substitute trips are netted out. The same calculation could be applied in period 2, which would lead to a slight increase in the percentage of degraded trips given the declining percentage of substitute trips. Instead the percentage of degraded trips is assumed also to fall by half, in keeping with the declining effects for lost and substitute trips. In some studies, the number of degraded trips has been allowed to increase as impacts become less severe while the per-trip loss associated with degraded trips has declined. The result is a decline in the total value associated with degraded trips. This analysis will combine the estimated decline in the number of degraded trips with a constant per-trip loss for degraded trips. The result is a decline throughout the season in the degree of losses from degraded trips, in keeping with past assessments but providing a better fit with information specifically available in this case.

Treatment of Wave 3 Observations

As noted previously, the third wave of intercept surveys was conducted in May 2006 in order to supplement data on spill effects in New Castle County, Delaware. It was determined that the additional surveys effort was warranted in order to improve the precision of impact estimates for New Castle County, in part because of the large number of baseline trips occurring in this area. Another reason involved the desire to survey sites that were not included in the first two survey waves but which were part of the NMFS calculation of baseline trips. Some of these additional sites were located inland from the Delaware River (for example, Newport Industrial Park), or were located in areas of the Delaware River that were not directly impacted by oil (for example, Fort DuPont State Park). In order to appropriately extrapolate results of the intercept surveys to the estimate of baseline trips obtained from the NMFS data, a more representative selection of intercept locations was desirable.

Most aspects of the wave 3 surveys and results were described in earlier sections together with information about the wave 1 and wave 2 surveys. The wave 3 observations were used to refine the estimate of spill impacts in period 1, while maintaining the previous estimate of a 50-percent decline in effects following period 1. To obtain estimates of period 1 activity, fishers were asked to report their typical level of fishing activity at the time of the survey (May 13, 2006) rather than their actual trips in the spring of 2005. Fishers' estimates of typical activity were reported as trips per week or month. The estimates of weekly or monthly activity were expanded into estimates of fishing activity from May 1 to June 12. This was based on the assumption that the typical level of activity at the time of the May 13 survey could be viewed as an average level of activity for the May 1 to June 12 period. These estimates were further developed into estimates of each fisher's activity during the period 1 portion of the assessment. This was based on the assumption that the proportion of period 1 fishing occurring prior to May 1 was the same for wave 3 respondents as for wave 1 respondents. In wave 1, about half as many trips were taken prior to May 1 as were taken in the remainder of period 1, and this proportion was applied to the wave 3 observations.

Lost and substitute trips were allocated to period 1 using the method described in equation (3). The wave 3 figures for actual and affected trips in period 1 were then combined with observations from wave 1 and wave 2 to generate the percentage-impact estimates presented in table A3-4.

Determining Baseline Fishing Activity

The total number of fishing trips to the spill impact area under baseline conditions was estimated using comprehensive surveys conducted for resource management purposes. An estimate of baseline trips is required for the assessment so that the number of affected trips can be estimated based on the spill-impact calculations in the previous section. The estimated percentage-loss figures will be multiplied by baseline trips to determine total lost trips. The three surveys used to estimate baseline activity were the 2002 Delaware River Creel Study conducted jointly by Pennsylvania, Delaware and New Jersey, the

Marine Recreational Fisheries Statistical Survey (MRFSS) which is conducted annually by the National Marine Fisheries Service, and the New Jersey Blue Crab Recreational Fishery Survey of 2005. The creel and MRFSS studies address finfishing and the New Jersey study is for crabbing only.

The 2002 Delaware River Creel survey reports angler activity from Wilmington, Delaware northward on the west side of the river and northward from Penn's Grove in Salem County, New Jersey the east side of the river. Unfortunately the publicly available creel report analyzes angler trips for three large stretches of the Delaware River, and does not provide sufficient detail to specifically estimate angler trips in the spill-impact area. However, supporting data for the creel study were provided to the trustees by the state of Pennsylvania. The data were used to estimate total trips to creel survey sites located within the spill area. The trip estimates from the 2002 creel survey will be used as an estimate of baseline activity in 2005.

To derive the estimate of angler trips from the Creel data, statistical analysis was used to predict angler activity at the relevant sites based on information contained in the survey. The available data consisted of angler counts conducted during one of two daily sampling periods: a morning period from 7 am to 1 pm and an afternoon period from 1 pm to 7 pm (or as late as 9 pm during the summer). Angler counts were conducted at a variety of sites on selected weekdays and weekends throughout the fishing season, from April 15 through October 31. To perform the statistical analysis, the anglers counts were fit to dummy variables for time of day (a.m. or p.m.), month (April through October), site (each of the 10 sites in the assessment area), and weekend versus weekday. These were considered to be the major factors affecting the total number of trips recorded for each observation. Total trips included both shore and boat trips for each site. The use of this kind of model to predict trips throughout the season eliminates the need to adjust the results to specifically account for the sampling design of the original survey. For example, the correct number of weekends and weekdays are included in the final results because the model predicts trips specifically for each site and day. The predictions over

all sites and all days can then be added together for an unbiased estimate of total angler trips during the season.

The regression was performed using the exponential form $\lambda = e^{\beta x}$ for the expected number of trips. The term λ represents the average number of trips to given site at a given time. The x vector included the independent (dummy) variables described above. The β parameters were estimated by fitting λ to observed counts using a Poisson regression. Maximum likelihood routines in the programming package GAUSS were used to obtain the parameter estimates. Predictions of trips throughout the season could then be obtained using $\lambda = e^{\beta x}$ and the appropriate seasonal, time and site variables. Total trips were summed across days and months for each site.

The results of the analysis are presented in table A3-5. The Christina River boat ramp was included to assist in the statistical analysis. However, because trips at the Christina River boat ramp are included in the MRFSS figures for New Castle County, the Creel figures for the Christina River boat ramp will not be used in estimation of losses. The total number of trips for all sites was estimated at 31,339 for the 2002 season. Trips for Pennsylvania and New Jersey sites (without the Christina River boat ramp) are estimated to total 25,804.

Table A3-6 reports the same figures broken out by month instead of by site. This allows the baseline level of activity to be allocated to assessment periods 1, 2 and 3 as required for the temporal stratification of spill effects. As illustrated in the table, approximately 36 percent of total baseline trips occur during period 1, 36 percent of trips occur during period 2, and the remaining 29 percent occur in period 3. These percentages will be used in the final calculation of damages presented at the end of this appendix.

Information from the MRFSS survey was provided for this assessment by the National Marine Fisheries Service of NOAA. The survey examines saltwater fishing and primarily covers coastal areas but extends as far inland as New Castle County in Delaware and Salem County in New Jersey. Data for both of these counties is reported in table A3-7.

The MRFSS survey does not report any trips for Salem County. In low-use areas, the MRFSS survey may record no use at all due to the modest sample size. The MRFSS estimate for Salem County will not be used in this assessment. Instead the calculations will rely on information available from the Creel survey for the Penn's Grove site, which is the only creel site located in Salem County. The average total number of trips for the 2000 to 2004 period in New Castle County is 105,651, and this figure will be used as an estimate of 2005 baseline activity.

The total number of trips in New Castle County was broken out into two regions based on the designation of low-impact and medium impact areas, as discussed previously. The C&D canal identifies the boundary between the two regions. Though the MRFSS survey reports results primarily on a county level, the National Marine Fisheries Service provided site-level data for this assessment that could be used to divide trips into the specified regions. This supplemental data is presented in table A3-7a. Information on angling "pressure" as estimated by NMFS represents an index of angling activity. Angling pressure was provided for weekdays and weekends for each month throughout the year. The monthly figures were averaged, and combined to form weekly figures (weekday figures were multiplied by 5, weekend figures were multiplied by 2). Average weekly pressure at each site was divided by total weekly angling pressure at all sites to determine the percent of total activity occurring at each site. As shown in table A3-7a, the sum of activity at sites north of the C&D canal (including the C&D canal) was 57.2 percent. Sites within the impact area below C&D canal totaled 39.9 percent. Multiplying by the total of 105,651 angler trips for New Castle County, the estimate of activity above the C&D canal the total is 60,404 trips, and below the C&D canal the total is 42,147 trips.

The baseline number of crabbing trips was calculated using information provided by the New Jersey Department of Environmental Protection from a 2005 survey of recreational crabbing. The crabbing survey determined that 65,183 crabbing trips were taken by residents of Salem, Cumberland and Cape May County from May through October of 2005. Combined with results specific to the telephone component of the survey, these

trips were divided by county of destination and time period. It was determined that there were 802 baseline trips to Salem County during period 1, 3,660 baseline trips during period 2 and 4,044 baseline trips during period 3. These figures account for the fact that the survey was undertaken during the year of the spill and include an upward adjustment based on the intercept-survey estimate of the percentage of baseline trips lost. Total baseline crabbing trips is estimated to be 8,507, as reported in table A3-8.

The estimate of baseline crabbing trips may be an underestimate for two reasons. First, trips to Salem County by people living outside of Salem, Cumberland or Cape May counties are excluded. Data regarding these trips were not available from the NJ DEP survey. Second, in adjusting survey totals to account for the presence of spill effects, the potential substitution of trips from Salem County to other areas outside the county was ignored. In other words, the estimated number of actual trips in 2005 was adjusted upwards to estimate baseline trips, but the upward adjustment accounted only for lost trips that were not taken to any Delaware River sites.

The Value of Affected Trips

The value of recreational fishing has been estimated in numerous economic studies. A site-specific study to estimate the value of fishing trips to the Delaware River was not undertaken for this assessment. It was determined that extent of losses to recreational fishing, though significant, did not justify the expense of such a study. Instead, previous studies were used to estimate a reasonable per-trip value that could be applied to the Delaware River.

A report prepared for the U.S. Department of Agriculture presents a wide array of trip values for outdoor recreation (Rosenberger and Loomis, 2001). Values for recreational fishing are averaged for four areas of the country. Mean and median values for the Northeast region are presented in the first column. The mean per-trip value for fishing, based on a total of 43 values from 17 studies, is \$31.16 in 1996 dollars. Updated to July 2008 dollars using the Consumer Price Index, the average value of a fishing trip at the

time of spill would be \$43.27. This value will also be applied to recreational crabbing, since no value for crabbing was available for this assessment. Crabbing trips represent a small percentage of total fishing trips, so the effect of this assumption is expected to be modest.

The value of \$43.27 was determined to be appropriate for application to fishing on the Delaware River. Some of the reasons for this determination were described in the main body of the report. First, a site-specific study of fishing on the Delaware River could not be identified for use in this assessment. Second, values from individual studies can exhibit considerable variation due to researcher assumptions used in the analysis. The use of a fishing value that is averaged over many studies has the advantage of reflecting a consensus-based estimate incorporating a range of possible assumptions and approaches. Third, it is reasonable to believe that the Delaware River offers a fishing experience of average value compared to other Northeast fishing sites. On the one hand, some characteristics of the Delaware River suggest it would be valued higher than other sites. The Delaware River is a large estuary that contains ocean going species such as striped bass and shad. This kind of fishery is unique to a small number of large rivers on the east coast and would be highly valued compared to many of the lakes and streams throughout the region. Also, the large stretches of open water are suitable for boat-based fishing, and many of the fishing trips recorded in the Creel Survey were boat-based trips. The prevalence of boat-based fishing is likely to be greater on the Delaware River than the average Northeast site, and boat-based fishing tends to be more highly valued than shore-based fishing. On the other hand, some characteristics would suggest a lower-than-average value might be appropriate. Much of the area impacted by the spill is urban, which generally leads to lower fishing values on a per-trip basis. Also, the presence of fish consumption advisories covering the entire spill-impact area is likely to reduce the quality of fishing on the Delaware River. While the net effect of these various characteristics is not known with certainty, the use of an average per-trip value based on Northeast fishing sites was determined to be appropriate for this assessment. It is worth noting that a previous assessment of environmental impacts from an oil spill on the

Delaware River near Paulsboro, New Jersey used a per-trip fishing value of \$47 for boat-based recreational fishing.²

Values must be determined for each of the types of affected trips analyzed in this assessment, namely lost trips, substitute trips, and degraded trips. Lost trips and substitute trips were distinguished in the surveys because they represent two common responses to impacts such as an oil spill. In the valuation literature, values typically represent the combined effect of these two types of responses. For example, a fishing study would estimate the loss associated with a decline in trips to a particular area, such as the spill impact area. The decline in trips would include decisions by fishers to take fewer fishing trips, as well as decisions to relocate fishing trips to other areas. Furthermore, trips lost to the Delaware River include the effects of substitution to other fishing resources. For these reasons, the average per-trip value of \$43.27 can appropriately be applied to both lost and substitute trips as measured in this assessment.

Degraded trips are typically assessed at a lower value than lost or substitute trips. A figure of 20 percent of the value of lost trips has been used in past oil spill assessments, including the American Trader and Chalk Point assessments. Reports from both of these assessments are available on the website of the NOAA Damage Assessment and Restoration Program. The 20-percent factor will also be applied to per-trip values in this assessment, resulting in a value for degraded trips of \$8.65. From an intuitive perspective, the loss associated with degraded trips may not be as severe as the loss associated with trips diverted from the site. After all, fishers who choose to fish under degraded conditions must obtain more value from their degraded trips than they would from alternative activities. More rigorously, the addition of a modest value applied to degraded trips compensates for the way per-trip values are measured in the literature. Per-trip values generally apply to the loss of all trips to a site during a complete closure. They do not fully capture the value of losses when applied to a smaller number of lost trips,

² Hartle, M. (2006), Pennsylvania Fish and Boat Commission, personal communication by email 15 Jan 2006. The value of \$46.91 (2005 dollars) was applied to boat-based fishing trips in determining losses from the M/T Kentucky oil spill in 1994.

such as the 10 or 20 percent decline in fishing activity associated with the Delaware River oil spill.

Total Recreational Fishing Damages

To calculate total damages, the three previous calculations are combined. The severity of impacts as determined by the onsite interviews is multiplied by the total number of baseline trips estimated from the creel, MRFSS and crabbing surveys. This results in an estimate of affected trips including lost, substitute and degraded trips. The affected trips in each category are multiplied by their respective values based on the average of results from previous studies in the Northeast region of the U.S. The results are presented in tables A3-8 through A3-11.

Table A3-8 summarizes the degree of impact for the sites identified in the analysis of baseline activity. Impact levels are applied to sites based on geographic location as illustrated in the impact-area map presented earlier. Impacts for periods 2 and 3 are half of those estimated for period 1. The Cristina River Boat Ramp has been omitted from these tables because it is included in the MRFSS data for New Castle County.

Tables A3-9 through A3-11 show the number of affected trips and lost value by site for periods 1, 2 and 3, respectively. First, trips are allocated to the three periods based on the figures in table A3-6, indicating that 36 percent of trips occurred in each of the first two periods and 29 percent occurred in period 3. Next, the total trips in each period are multiplied by the degree of impact reported in table A3-8. This provides estimates of the number of lost, substitute and degraded trips. Lost value of affected trips is the product of the number of trips in each category and the per-trip values identified in the previous section. These per-trip values are also reported in the first line of tables A3-9 through A3-11.

Before presenting final results, it is worth assessing the degree of uncertainty in the analysis that has been presented. An examination of factors leading to uncertainty assists

in understanding whether the combined effect of the data limitations appear to balance out, or may lead to bias. The calculation of affected trips relies on a limited number of observations. This could lead to uncertainty in the estimate of affected trips, but should not lead to bias in the assessment results. Another important factor is the omission of some fishing sites in the estimation of baseline fishing trips. Several sites visited during the intercept surveys, such as sites in National Park and areas south of Bridgeport in New Jersey, were not included in the 2002 Creel study. Also, no losses were estimated for 2006, although some fishers reported that spill effects were ongoing in the May, 2006 survey. These factors would lead to an underestimate of damages. The lack of survey data for late summer fishing following August 6 is also a limitation, and the assumption that losses after August 6 continue at the same rate as the prior period (June 12 through August 6) may overstate damages. Finally, the lack of a site specific study to value fishing trips on the Delaware River leads to additional uncertainty. While a precise analysis of any resulting bias is not possible without further data collection and analysis, it is assumed for this assessment that the net effect of these factors leads to a reasonable midpoint estimate of losses.

Table A3-12 presents the final summation of the total raw losses (without discount factor adjustment) over all sites and time periods. Losses in Pennsylvania and New Jersey amount to \$197,386, and losses in Delaware amount to \$501,455. The more severe impacts in Pennsylvania and New Jersey close to site of the spill generated greater proportions of affected trips, but this was offset in the calculation of lost value by the lower level of baseline fishing activity in those areas. Losses in period 1 (April to mid-June) were greater than losses in periods 2 and 3 (mid-June to the end of October). This is consistent with the declining severity of spill effects throughout the fishing season. Total estimated losses (without discount factor adjustment) for recreational fishing due to impacts of the oil spill are estimated to be \$698,841.

APPENDIX B: Waterfowl Hunting Assessment

The assessment of losses to waterfowl hunting was conducted using a telephone survey of licensed hunters. Respondents were asked to report the number of their hunting trips impacted by the spill, and the results were extrapolated to the full population of license holders. Impacted trips included lost, substituted and degraded trips. To limit the expense of the survey, hunters were targeted in only four of the six counties likely to be impacted by the spill. The results were further extrapolated to the remaining two counties using data collected by the Harvest Information Program of the U.S. Fish and Wildlife Service. Monetary values were applied to affected trips based on previous studies reported in the economics literature.

Telephone Survey of Waterfowl Hunters

A telephone survey of Delaware River waterfowl hunters was conducted in October 2005. Lists of licensed hunters were provided to the trustees by state officials in Delaware and New Jersey. Because only limited waterfowl hunting takes place in the Pennsylvania counties affected by the spill, it was determined that the survey should focus on Delaware and New Jersey hunting with extrapolation of the results to Pennsylvania. The sampling frame of the survey included all 3,381 license holders in New Castle County, Delaware and all 2,324 license holders in Camden, Gloucester and Salem Counties in New Jersey. A random sample of license holders was drawn for the purpose of the survey. Telephone contacts continued until 151 interviews with Delaware River waterfowl hunters were completed in both Delaware and New Jersey. The total number of completed interviews was 302.

The telephone survey instrument is contained in appendix B1. The survey began with a series of questions designed to screen out hunters who did not normally hunt waterfowl on the Delaware River and thus were not likely to be affected by the oil spill. Specifically, the survey targeted license holders who had hunted waterfowl on the Delaware River or associated tidal marshes sometime in the previous three years.

Delaware River waterfowl hunters were then asked how many trips they typically take to the Delaware River to hunt waterfowl. Also, they were also asked to identify anything that affected their waterfowl hunting on the Delaware River in the 2004/2005 season. This last question was intended to help estimate the baseline level of use for respondents, and to help identify any effects on 2004/2005 baseline hunting that were unrelated to the spill. Ultimately the assessment methods adopted for this study did not require the use of this baseline information.

Respondents were next asked whether the Delaware River oil spill had affected their hunting in any way. Those who indicated their hunting was affected were asked to identify the types of effects. Specifically there were asked to identify any lost trips, involving the decision to take fewer trips to the Delaware River as a result of the spill. They were also asked to identify any substitute trips, involving the decision to change the location of their Delaware River trips in order to avoid effects of the oil spill. For hunters indicated the spill affected their hunting, the number of Delaware trips less any reported lost or substitute trips were counted as degraded trips.

The final survey questions involved the demographic characteristics of age, sex and the suburban/urban nature of the respondent's residential location. These questions can potentially be useful in further refining survey results in some circumstances, but were not relied upon in the oil spill assessment.

Because the survey involved a random sample of license holders, compilation of the data did not require weighting or other statistical adjustments. The responses in each of the relevant categories were simply added over the 151 observations collected in each state. The observations were pooled by state to allow for differing levels of impact in the two areas. In particular, New Jersey counties included many heavily oiled areas while there was no shoreline oiling in many areas of New Castle County. The only additional calculation performed to arrive at estimates of affected trips for survey respondents involved adjustments to correct for potential contradictions. Specifically, in 17 of the 302 observations the total number of lost and substitute trips exceeded the number of trips

typically taken to the Delaware River by the respondent. In these cases, lost and substitute trips were reduced by the ratio of “typical” trips to the sum of reported lost and substitute trips. In this way the relative proportion of lost and substitute trips was maintained as reported by the respondent while the total number of affected trips was reduced to a level equal to the typical number of trips.

Affected trips for respondents were then extrapolated to the population of license holders from which the sample was drawn, namely, the original license lists for the selected Delaware and New Jersey counties. To extrapolate, the number of affected trips for the sample was multiplied by the ratio of total license holders to the number of license holders contacted in the survey. Those contacted included both respondents interviewed for the survey and all those who were determined to be ineligible because they did not typically hunt for waterfowl on the Delaware River. The extrapolations were performed separately for New Castle County, Delaware and for the three New Jersey counties combined. As noted previously, the total number license holders was 3,381 in Delaware and 2,324 in New Jersey. The number of contacts in each group, including respondents and ineligible contacts, were 333 and 309 in each group. An overview of the disposition of the survey, including the number of completed interviews, the number of ineligible contacts, and the number and types of attempted contacts, is presented in table B2-1.

Estimates of total affected trips for the counties surveyed are presented in table B2-2, and affected trips as a percent of baseline trips are reported in table B2-3. The reported number of lost trips is 3,741, the reported number of substitute trips is 2,377, and the number of diminished trips is estimated to be 6,265. The figure for total affected trips is 12,383. In the next section, these figures will be adjusted to account for losses in counties not included in the telephone survey.

Overall effects are somewhat higher in Delaware, but this is partly due to the greater number of hunters in New Castle County. The percentage losses indicate a mixed pattern. While the percentage of trips lost was higher in New Jersey (15.0 percent compared to 11.6 percent), the rate of substitution was higher in Delaware (9.9 percent compared to

6.2 percent). This makes sense, because the New Jersey counties included a significantly larger area of oiled shoreline. Many hunters living near the oiled areas of the shoreline in New Jersey would have to travel a considerable distance to reach non-oiled areas of the river. Most residents in New Castle County, Delaware could reach non-oiled areas comparatively easily. Thus substitution is easier for Delaware hunters, while New Jersey hunters might be more likely to forego trips rather than find alternative locations.

Out-of-Sample Adjustment Using the HIP Survey

The telephone survey targeted four counties in the area potentially impact by the oil spill. The estimate of affected trips obtained from the survey accounts for losses to all hunters living in those four counties. Hunters living adjacent to impacted areas of the river in Pennsylvania (i.e., Delaware and Philadelphia Counties) may have been affected by the oil spill but were not included in the survey. Furthermore hunters in other surrounding counties may have also been affected, especially in inland counties without significant alternative access to waterfowl hunting. This section describes an adjustment to the results of the telephone survey that accounts for these potential additional effects.

Information for the out-of-sample adjustment was obtained from a survey of hunters conducted annually by the Harvest Information Program (HIP) of the U.S. Fish and Wildlife Service. The HIP survey contacts a sample of hunters nationwide to collect data on the recreational harvest of migratory birds. The HIP data include information on the residential location of hunters as well as the locations where they hunted. Data obtained for this assessment include records for each waterfowl hunting trip taken by HIP survey respondents to the six Delaware River counties most likely to be impacted by the spill. The six counties include the four from the telephone survey along with Delaware and Philadelphia counties in Pennsylvania. Because oiling in the two Pennsylvania counties was comparable to the average level of oiling in the other four counties, it is assumed that spill effects extended throughout the six-county area.

The HIP data was used to calculate the proportion of baseline hunting trips to the six-county spill-impact area originating from outside the four counties included in the telephone survey. The average proportion was calculated for the years 1999 to 2003, the five years prior to the spill (i.e., 2003 refers to the 2003/2004 hunting season). The impacts measured in the telephone survey were then increased in proportion to the additional baseline trips. It is a common assumption in the analysis of recreation demand that resource changes affect recreational value in proportion to baseline trip demand.

Table B2-4 illustrates the extrapolation of results of the telephone survey to total baseline trips. For respondents in the HIP survey, baseline activity from within the four-county coverage area of the telephone survey was 2,086 trips for the period 1999-2003.

Additional trips from other areas to the six-county impact area totaled 535 trips. This represents an increase of 25.6 percent for all six counties combined, which will be used to inflate the estimates of affected trips. The increases are also reported individually by county for comparison with the overall adjustment. The New Castle County adjustment involves a 30 percent increase in trips. Increases are somewhat lower in the New Jersey counties, but the adjustments in Pennsylvania are higher, in the sense that all Pennsylvania trips were excluded from the initial telephone survey. Because the increase appears to occur fairly evenly across areas and to help mitigate potential limitations in the precision of the HIP estimates at the level of a single county, the 25.6-percent figure was determined to be a reasonable adjustment for the entire impact area. Table B2-5 shows revised estimates of affected trips based on figures in table B2-2 and the 25.6 percent increase.

Data from the HIP survey also provide an estimate of trips lost due to the spill and it is worth comparing the HIP data to the above calculations. Table B2-6 shows the HIP survey estimates of trips in the six-county assessment area from 1999 to 2004. The number of trips in the spill year can be compared to the average number of trips in previous years to obtain an estimate of the decline in trips due to the spill. The estimated decline is 6,180 trips. This figure should be greater than the total number of lost trips because it could include substitute trips taken to locations out of the six-county area.

Conversely it should be less than the combined number of lost and substitute trips, because many substitute trips are likely to involve a change of location within the six-county area. Indeed table B2-5 indicates that 4,700 trips were lost and that 7,686 trips were either lost or substituted, and the HIP estimate of 6,180 falls between these two figures. The percentage decline in the HIP numbers cannot be compared to the percentage declines from the telephone survey because baseline trips reported by respondents in the telephone survey would include many trips to areas of the Delaware River outside the six-county assessment area.

The Value of Affected Trips

The value of recreational hunting has been estimated in numerous studies. A site-specific study to estimate the value of hunting trips to the Delaware River was not undertaken for this assessment. Such a study would be costly, and the expense is unlikely to be warranted given the relatively modest extent of the losses to recreational hunting. Instead, previous studies were used to estimate a reasonable per-trip value that could be applied to hunting on the Delaware River.

In keeping with the fishing assessment, a per-trip hunting value was drawn from a study by the U.S. Department of Agriculture (Rosenberger and Loomis, 2001). For the Northeast region, the mean per-trip value for waterfowl hunting is \$32.09. This is based on a total of 23 studies. Updated to July 2008 dollars using the Consumer Price Index, the average value of a hunting trip at the time of spill would be \$44.56. As described in appendix A, the value of both lost and substitute trips can be approximated by this average per-trip value. In keeping with previous assessments, degraded trips will be valued at 20 percent of the value of lost and substitute trips, or \$8.91.

The mean value of \$44.56 is considered to be appropriate for this assessment for several reasons. First, a site-specific study of waterfowl hunting on the Delaware River obtained

from the University of Delaware provided similar estimates of value.³ Because the study is contained in an unpublished manuscript, the USDA report was considered to be a more reliable source for this benefit transfer. Second, values from individual studies can exhibit considerable variation due to researcher assumptions used in the analysis and random statistical variation. The use of a hunting value that is averaged over many studies has the advantage of reducing uncertainties associated with these factors. Third, it is reasonable to believe that the Delaware River offers a hunting experience at least as valuable as the average Northeast waterfowl site. Many marsh areas of the Delaware River suitable for hunting are easily accessible by boat, and boat launches are widely available throughout many of the impacted areas. While waterfowl may be more abundant along the shores of Delaware Bay to the south, the bird population throughout the Delaware River is quite significant and waterfowl are more abundant there than in many other hunting areas of the Northeast. It is worth noting that the Delaware River is a focus area of the North American Waterfowl Management Plan, a conservation initiative implemented cooperatively between Canada, the U.S. and Mexico. While some hunters may be concerned about the effects of Delaware River pollution on waterfowl captured there, the birds' migratory habits may mitigate these concerns for other hunters. While the net effect of these various characteristics is not known with certainty, the use of an average per-trip value based on Northeast hunting sites was determined to be appropriate for this assessment.

³ The University of Delaware study is a master's thesis from 2005 titled "A Random Utility Model of Waterfowl Hunting in Delaware" by Georgi Spiridonov. The study used a logit model to examine hunting trips to 13 sites along the Delaware River and Delaware Bay, including the C&D Canal and Cedar Swamp. The travel cost coefficient for the hunting model is -0.028. For logit models, Haab and McConnell (2002, page 229) discuss the lost value per trip taken to a group of sites in a region given the loss of access to a particular site within the region. This value can be calculated as $\ln(1-P)/\beta$, where P is an individual's probability for choosing the site of interest on a given trip to the region and β is the travel cost coefficient. Multiplying this expression by an individual's trips to the region T and dividing by the individual's trips to the site TP one obtains the access value per trip to the site: $\ln(1-P)/\beta P$. This site-specific access value is the per-trip value used in benefit transfers. The relevant site for the purpose of this assessment consists of areas affected by the oil spill, and the relevant region consists of all hunting sites that serve as reasonable substitutes for the affected sites. Since the oil spill affected a considerable area of the Delaware River, it is reasonable to assume that those who lost trips due to the spill had at least a 1 percent to 25 percent probability of visiting the affected sites if not for the spill. Entering the values $P = 0.01$, $P = 0.25$ and $\beta = -0.028$ into the formula for per-trip value gives a range of \$35.90 to \$41.10. For those who typically took 50 percent of their trips to the affected sites, the value would be \$49.51. The USDA average value for the Northeast region falls within this range, providing reasonable support for use of the USDA estimate.

Total Waterfowl Hunting Damages

Total raw losses (without discount factor adjustment) to recreational hunting in Delaware, Pennsylvania and New Jersey are presented in table B2-7. Comparing effects in the three areas, the greatest loss was \$239,267 in New Castle County, Delaware, due to the high number of hunting trips in that area. Losses to hunting in Pennsylvania were low due to limited access for hunting. In New Jersey, the value of hunting declined due to the spill by an estimated \$166,020. Lost and substitute trips accounted for the large majority of losses. Total losses to recreational hunting due to the spill were \$412,687, without discount factor adjustment.

APPENDIX C: Recreational Boating Assessment

The assessment of losses to recreational boating was conducted using an onsite intercept survey of recreation boaters conducted at marinas in areas potentially impacted by the spill. The boating assessment focuses on pleasure boating, and nets out any boat-based fishing trips that would have been included in the assessment of recreational fishing. It should also be noted that pleasure boaters departing from boat ramps in the impacted area were not included in this assessment of losses. Intercepting boaters at boat ramps is expensive because the interviewer must wait for long periods of time for departing or arriving boaters. Also, the heaviest use of boat ramps occurs during the peak fishing periods, and boat-based fishing is already included in the fishing assessment. The exclusion of pleasure boat trips originating from boat ramps leads to an underestimate of total losses.

The next section describes the boating survey, which asked boaters to report any effects of the spill on their use of the Delaware River for recreational boating. The second section describes how the onsite surveys were analyzed, resulting in estimates of the severity of spill impacts on total boating use. The impacts are summarized in terms of the portion of total boating trips affected, including “lost” trips, “substitute” trips and “degraded” trips. The third section describes the estimation of total baseline boating trips using the number of moored boats in the impact area multiplied by the typical rate of use of the moored boats. The final section presents a benefit-transfer estimate of the lost value associated with affected trips based on published studies of the value of recreational boating.

Onsite Recreational Boating Survey

The trustees conducted onsite surveys of recreational boaters at marinas along the Delaware River. The surveys were developed and implemented with the participation of federal and state officials as well as industry representatives. The geographic coverage of the survey was designed to reach most areas potentially impacted by the spill. The

surveys were conducted September 3-4, 2005 and obtained interviews with 35 boating parties at marinas in Essington, Pennsylvania and Camden, New Jersey. Interviews were attempted at marinas in Philadelphia, but no boaters were observed at one marina and access was restricted at another. Interviews were also conducted at marinas in Bear, Delaware on the C&D canal (18 interviews), at two marinas in or near Neshaminy State Park north of Philadelphia (20 interviews). These areas were determined to be outside the impact area. No respondents in Bear, Delaware indicated they were affected. One out of the 20 respondents in Neshaminy State Park indicated he was affected, but this was not considered to be significant enough to justify assessing damages for this area, which was a considerable distance north from the nearest oiling. Copies of the survey instruments are included in appendix C1.

All boaters observed at the marinas were approached for an interview. Some boaters were leaving on trips, others were returning, and others were maintaining or using their boats while moored at the marina. The surveys included a variety of questions about each respondent's boating trips to the Delaware River and inquired about any possible effects of the oil spill on the respondent's boating activities. First, respondents were asked about their current trip. Those not departing or returning at the time of the survey were asked about their most recent trip. Information included the number of people participating on the boat trip and the length of the trip. Next respondents were asked to estimate number of boating trips they had taken during the course of the 2005 season. They were also asked to estimate the portion of trips devoted at least in part to fishing, so that fishing trips could be netted out of this portion of the assessment. The survey then identified factors other than the spill that might effect boating in 2005 by asking respondents to compare their boating in the current year to their boating activity in past years. High gasoline prices were identified as a significant factor discouraging trips at the time of the survey.

The remaining questions in the intercept survey involved the impacts of the oil spill. Respondents who had not already discussed the spill were asked if they were aware the spill had occurred. All 35 respondents in the impacted area had heard of the spill.

Respondents were next asked if the spill affected their boating in any way, and 11 out of 35 respondents said that it had. Boaters who indicated that the spill had affected their activity were asked whether they had taken fewer trips to the Delaware River in response to the spill, or whether they had changed the location of their trips on the Delaware River to avoid areas impacted by the spill. As noted previously, these two effects are the most common behavioral responses to adverse resource changes as analyzed in the literature. Finally, respondents affected by the spill were asked whether the effects of the spill had subsided and the quality of fishing on the Delaware River had returned to normal. This question was included to examine any decline in spill impacts throughout the season and to determine the end of the impact period.

Analysis of Spill Impacts

Total trips and affected trips reported in the marina survey were summed across respondents. The results are summarized in table C2-1. The observations were not weighted by number of trips or trip length, because most interviews occurred while boaters were present at the marina but not engaged in a trip. The probability of selecting each respondent for an interview was therefore not directly related to the number or length of the respondent's trips. However, responses were weighted by the number of people in the respondent's boating party on the last trip. If a respondent typically goes boating with the same people, the respondent's affected trips would be a rough indication of the affected trips of those who accompany him.

In all, the survey indicated a total of 102 lost trips, 32 substitute trips and 1,484 actual trips. Baseline trips were calculated as lost trips plus actual trips, for a total of 1,585. Lost trips were found to occur at a rate of 6.4 percent of baseline trips. Substitute and degraded trips were found to be 2.0 and 32.2 percent of baseline trips, respectively. The low level of substitution makes sense for marina trips. While boaters have some choice of destination once on board, the point of entry is in any case fixed. The high rate of degraded trips compared to lost trips also makes sense, because boaters who have undertaken the expense of purchasing a boat and renting a marina slip tend to be

committed to an expected level of boating activity. Because the survey was conducted near the end of the boating season, and because only one of the respondents affected by the spill indicated that conditions had returned to normal at the time of the survey, the rate of losses reported in table C2-1 are assumed to continue through the end of the boating season.

Determining Total Baseline Boating Activity

The number of boating trips that would have been taken but for the spill was estimated using information from the marina intercept survey, information from marina operators regarding total boats typically moored in the impact area, and a limited amount of additional information about typical patterns of boating use obtained from previous assessments. The steps of the analysis are outlined in table C2-2.

The rate at which boats moored at a marina are taken out for boating trips was estimated using information from the marina survey conducted September 3-4, 2005. A survey interviewer was stationed at one of the marinas during a 12-hour period of peak weekend use, from noon to 6 pm Saturday and from 6 am to noon the following Sunday. Of the 125 boats moored at the marina, 14 boats went out during the observation period, for a rate of 11.2 percent. This estimate was assumed to reflect the late summer rate of use under baseline conditions. While it could have been adjusted upward to account for the effects of high gasoline prices or any continuing spill effects, no adjustment was made for three reasons. First, this figure is similar to the baseline rate of use observed in previous recreational boating studies. Second, the reduction in total use estimated in the boater interviews was small, so any adjustment to the observed rate of use based on spill effects would be modest. Finally, because spill effects may have declined throughout the season, it would be difficult to estimate the correct adjustment for early September based on survey questions that pertained to the whole season.

Marina operators indicated that fewer boats than usual were moored at marinas in the areas impacted by oil. Marina operators were contacted by telephone and asked to

provide an estimate of the number of boats that would be moored at their marinas in early September under normal conditions. In some cases marina operators could not be contacted, and estimates were made using onsite counts. The onsite counts were adjusted upward based on information from other marinas regarding the impact of the spill on the number of moored boats. The total number of boats under baseline conditions was estimated to be 600. This figure accounts for five marinas in Essington, Pennsylvania, one marina in Camden, New Jersey, and two marinas in Philadelphia, Pennsylvania. Beyond these locations, the next marinas of significant size were beyond the area of impact in Bear, Delaware and Neshaminy State Park, Pennsylvania.

Typical use on a weekend day was estimates as the product of 600 moored boats and 11.2 trips per moored boat. Weekday use was assumed to be 25 percent of weekend use based on data collected for a previous assessment (see “Recreational Use Valuation Report” for the Chalk Point oil spill at www.darrp.noaa.gov). Monthly use was approximated as total use on eight weekend days plus 22 weekdays, for an estimate of 907 trips per month in the impact area. Again based on data collected for the Chalk Point assessment, the ratio of monthly trips typical for late summer to trips during the entire season was determined to be 5.5. The figure of 907 trips was multiplied by the 5.5 ratio. Assuming three people per boat and netting out the 9 percent of trips devoted to fishing (both estimated using the 2005 boater survey) the total number of pleasure boating trips under baseline conditions was estimated to be 13,521.

Total Recreational Boating Losses

The per-trip value for lost and substitute boating trips was again taken from the USDA study of recreation values. The boats moored in the impact area were primarily motor boats, and the USDA study offers specific figures for motor boating. However, the estimate for motor boating for the Northeast Region includes only one study, conducted in New York State in 1965. It was determined that average nationwide figures would provide a more reasonable basis for valuing Delaware River trips. The average per-trip value in 1996 dollars was 34.75, based on 9 studies (Rosenberger and Loomis, 2001,

page 4). Adjusted to July 2008 dollars using the Consumer Price Index, the figure applied in this assessment was \$48.26 for lost and substitute trips. Degraded trips were valued at \$9.65, or 20 percent of the value of lost and substitute trips.

Table C2-3 summarizes the calculation of damages for recreational boating. Affected trips are the product of percentages given in table C2-1 and the total number of baseline trips from table C2-2. The raw value of lost trips (without discount factor adjustment) is \$41,782, the value of substitute trips is \$13,173 and the value of degraded trips is \$42,071. The estimate of total damages, without discount factor adjustment, for recreational boating is \$97,026.

APPENDIX A1

ANGLER INTERCEPT SURVEY INSTRUMENTS

**Delaware River Intercept Survey
Assessment of Recreational Fishing Use - Wave 1**

Time:
Location of Interview:
Number of Anglers at Location:

Interviewer Initials:
Date:

SECTION I

Hello. I'm (name) and I'm working with a team that is conducting a survey to find out about recreational fishing in the area. It will only take a couple of minutes. Shall we begin?

1. How long do you expect to spend fishing today? (Total length of trip in hours)
2. Would you say the quality of fishing on the Delaware River so far this year has been about average, better than average, or worse than average?
3. Including today, how many trips have you taken to the Delaware River in the past six weeks, through the beginning of May?
4. Could you estimate how many trips you took in April? March? February? January? December?
5. Compared to your "typical use" in past years, would you say you've taken more trips than usual since December 2004, fewer trips than usual, or about the same?
If fewer:
6. What was the reason for taking fewer trips?

Inter view No.	1. Length of trip today	2. Quality this year (avg, better, worse)	3. Trips past six weeks	4. Trips since December 2004	5. More, fewer, same	6. If fewer, reason
1				Apr__Mar__Feb__Jan__Dec__		
2				Apr__Mar__Feb__Jan__Dec__		
3				Apr__Mar__Feb__Jan__Dec__		
4				Apr__Mar__Feb__Jan__Dec__		
5				Apr__Mar__Feb__Jan__Dec__		
6				Apr__Mar__Feb__Jan__Dec__		
7				Apr__Mar__Feb__Jan__Dec__		
8				Apr__Mar__Feb__Jan__Dec__		
9				Apr__Mar__Feb__Jan__Dec__		
10				Apr__Mar__Feb__Jan__Dec__		

**Delaware River Intercept Survey
Assessment of Recreational Fishing Use - Wave 1**

SECTION II

If the respondent mentioned the oil spill in the answers to SECTION I, skip to Question 3a.

As you may know, there was an oil spill in the Delaware River that occurred in late November 2004.

1. *Were you aware of the spill before now?*
2. *Did the spill have any effects on your use of the Delaware River for fishing?*
If yes:
3. *Did you take fewer fishing trips to the Delaware River as a result of the spill?*
If no, report "0" in 3/3a. If yes:
3a. *How many fewer trips did you take as a result of the spill?*
4. *Did you change the sites where you fish as a result of the spill?*
5. *Do you think the quality of fishing in the areas affected by the spill has returned to normal?*
If yes:
6. *When did the quality of fishing on the Delaware River return to normal, in your opinion?*

Interview No.	1. Aware of spill? (Y/N)	2. Spill affect fishing? (Y/N)	3/3a How many fewer trips?	4. Change site? (Y/N)	5. Returned to normal? (Y/N)	6. When return to normal?
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						

Delaware River Intercept Survey
Assessment of Recreational Fishing/Crabbing Use - Wave 2

Time:
Location of Interview:
Number of Anglers at Location:

Interviewer Initials:
Date:

SECTION I

Hello. I'm (name) and I'm working with a team that is conducting a survey to find out about recreational fishing in the area. It will only take a couple of minutes. Shall we begin?

1. How long do you expect to spend fishing today? (Total length of trip in hours)
2. Would you say the quality of fishing on the Delaware River so far this year has been about average, better than average, or worse than average?
3. How often do you fish this time of year?
4. Could you estimate how many trips you took in July? June? May? April?
5. Compared to your "typical use" in past years, would you say you've taken more trips than usual since December 2004, fewer trips than usual, or about the same?
If fewer:
6. What was the reason for taking fewer trips?

Inter view No.	# in party	F/C	1. Length of trip today	2. Quality this year (avg, better, worse)	3. How often do you fish this time of year?	4. Trips	5. More, fewer, same	6. If fewer, reason
1						Jul__Jun__May__Apr__		
2						Jul__Jun__May__Apr__		
3						Jul__Jun__May__Apr__		
4						Jul__Jun__May__Apr__		
5						Jul__Jun__May__Apr__		
6						Jul__Jun__May__Apr__		
7						Jul__Jun__May__Apr__		
8						Jul__Jun__May__Apr__		
9						Jul__Jun__May__Apr__		
10						Jul__Jun__May__Apr__		

**Delaware River Intercept Survey
Assessment of Recreational Fishing/Crabbing Use - Wave 2**

SECTION II

If the respondent mentioned the oil spill in the answers to SECTION I, skip to Question 3a.

As you may know, there was an oil spill in the Delaware River that occurred in late November 2004.

1. *Were you aware of the spill before now?*
2. *Did the spill have any effects on your use of the Delaware River for fishing?*
If yes:
3. *Did you take fewer fishing trips to the Delaware River as a result of the spill?*
If no, report "0" in 3/3a. If yes:
 - 3a. *How many fewer trips did you take as a result of the spill?*
4. *Did you change the sites where you fish as a result of the spill?*
5. *On how many occasions did you change the location of a trip because of the spill?*
6. *Do you think the quality of fishing in the areas affected by the spill has returned to normal?*
If yes:
7. *When did the quality of fishing on the Delaware River return to normal, in your opinion?*

Inter- view No.	1. Aware of spill? (Y/N)	2. Spill affect fishing? (Y/N)	3/3a How many fewer trips?	4. Change site? (Y/N)	5. On how many occasions?	6. Returned to normal? (Y/N)	7. When return to normal?
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							

Delaware River Intercept Survey
Assessment of Recreational Fishing/Crabbing Use - Wave 3

Time:
Location of Interview:
Number of Anglers at Location:

Interviewer Initials:
Date:

SECTION I

Hello. I'm (name) and I'm working with a team that is conducting a survey to find out about recreational fishing in the area. It will only take a couple of minutes. Shall we begin?

1. How long do you expect to spend fishing today? (Total length of trip in hours)
2. Would you say the quality of fishing on the Delaware River so far this year has been about average, better than average, or worse than average?
3. How often do you fish this time of year?
4. Could you estimate how many trips you've taken since the beginning of the season (since January 2006)?
5. Compared to the same time last year, would you say you've taken more trips so far this year, fewer trips, or about the same number of trips?
If difference:
6. What was the reason for the difference?

Inter view No.	# in party	1. Length of trip today	2. Quality this year (avg, better, worse)	3. How often do you fish this time of year?	4. Trips so far this year	5. More, fewer, same	6. If difference, reason
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							

**Delaware River Intercept Survey
Assessment of Recreational Fishing/Crabbing Use - Wave 3**

SECTION II

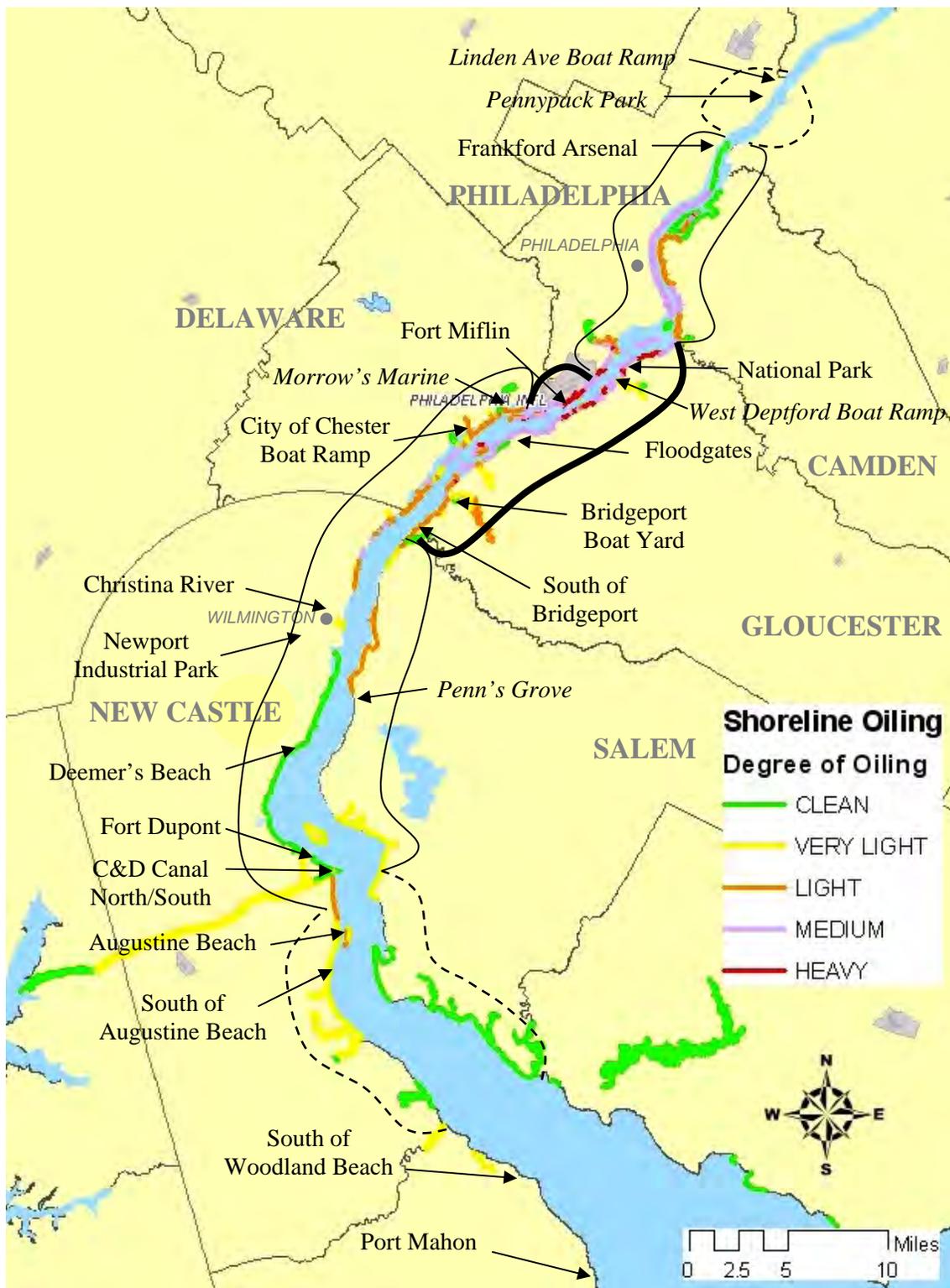
As you may know, there was an oil spill in the Delaware River that occurred in November 2004, or about one and a half years ago. This was prior to last year's fishing season. A ship accidentally released the oil while docking just south of Philadelphia.

1. Were you aware of the spill before now? (*If necessary, distinguish the 2004 spill incident from the more recent Delaware Bay oil spill, and note any indication of confusion by respondent*)
2. Do you recall if the spill had any effects on your use of the Delaware River for fishing? **Record NR if recall is an issue; Record "Y" or "N" for effects.**
If yes:
3. Did you take fewer fishing trips to the Delaware River as a result of the spill?
If no, report "0" in 3/3a. If yes:
3a. How many fewer trips did you take as a result of the spill?
4. Did you change the sites where you fished as a result of the spill?
If no, report "0" in 4/4a. If yes:
4a. On how many occasions did you change the location of a trip because of the spill?
5. Do you think the quality of fishing in the areas affected by the spill has returned to normal?
If yes:
6. When did the quality of fishing on the Delaware River return to normal, in your opinion?

Inter- view No.	1. Aware of spill? (Y/N)	2. Spill affect fishing? (Y/N)	3/3a How many fewer trips?	4/4a. Number of times changed location	5. Returned to normal? (Y/N)	6. When return to normal?
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						

APPENDIX A2

**MAP OF ANGLER SURVEY SITES
AND SPILL IMPACT AREAS**



Angler Intercept Sites – Creel sites in italic font

----- Low impact area

———— Medium impact area

———— High impact area

APPENDIX A: Recreational Fishing Assessment

APPENDIX A3

SUPPORTING TABLES - FISHING ASSESSMENT

APPENDIX A: Recreational Fishing Assessment

Table A3-1. Designation of high, medium and low-impact areas

Survey intercept site	County	State	Spill		Weighted		Effect
			Effect = Y	n =	% Spill Effect = Y	% Spill Effect = Y	
Frankford Arsenal	Philadelphia	PA	19	46	41%	31%	medium
National Park	Gloucester	NJ	11	13	85%	36%	high
Floodgates	Gloucester	NJ	0	5	0%	0%	high
Bridgeport Boat Yard	Gloucester	NJ	2	2	100%	100%	high
South of Bridgeport	Gloucester	NJ	15	17	88%	29%	high
Fort Miflin	Delaware	PA	4	22	18%	5%	high
City of Chester Boat Ramp	Delaware	PA	1	3	33%	23%	medium
Christina River - East 7th Street	New Castle	DE	2	3	67%	59%	medium
Newport Industrial Park	New Castle	DE	0	4	0%	0%	medium
Deemer's Beach	New Castle	DE	12	19	63%	63%	medium
Fort Dupont	New Castle	DE	4	12	29%	22%	medium
C&D Canal - Rt. 13 Bridge	New Castle	DE	0	10	0%	0%	medium
C&D Canal North	New Castle	DE	0	8	0%	0%	medium
C&D Canal South	New Castle	DE	6	26	23%	63%	medium
Augustine Beach	New Castle	DE	2	22	9%	7%	low
Rt 9 S of Augustine Beach	New Castle	DE	5	22	23%	4%	low
Route 9 south of Woodland Beach*	New Castle	DE	5	8	63%	36%	none
Port Mahon*	New Castle	DE	1	7	14%	2%	none
Total			89	250			

* Respondents affected by the spill reported a change in location only.

Source: Delaware River intercept survey.

APPENDIX A: Recreational Fishing Assessment

Table A3-2. The change in spill impacts for period 2 compared to period 1

(1) Actual trips reported in Wave 2	237.7
(2) Estimated period 1 trips prior to May 1	53.8 [1]
(3) Estimated period 1 Trips May 1 - June 12	107.6 [2]
(4) Total estimated period 1 trips	161.4
(5) Estimated period 2 trips	130.1 [3]
(6) Lost trips reported in wave 2	56.8
(7) Expected lost trips percentage in period 1	20.5% [4]
(8) Estimated Lost Trips Occuring Period 1	41.7 [5]
(9) Estimated Lost Trips Occuring Period 2	15.1 [6]
(10) Estimated lost trips percentage in period 2	10.4% [7]

Source: Delaware River intercept survey.

[1] Trips prior to May 1 are estimated by multiplying trips reported following May 1 by the ratio from wave 1 of pre-May 1 trips to post-May 1 trips.

[2] Total trips reported for May 1 to August 6 is allocated to the May 1 to June 12 period by pro-rating by week. Smoothing across weeks is required to allocate lost trips.

[3] Total trips reported for May 1 to August 6 is allocated to the June 12 to August 6 period by pro-rating by week. Smoothing across weeks is required to allocate lost trips.

[4] The rate of loss of trips is calculated using wave 1 data and applied here to wave 2, period 1.

[5] [Line (4) / (1 - line (7))] - line (4). Actual trips in period 1 are inflated to account for lost trips, giving an estimate of baseline trips. Actual trips are subtracted from baseline trips.

[6] Line (6) - line (8).

[7] Line (9) / [line (9) + line (5)].

APPENDIX A: Recreational Fishing Assessment

Table A3-3. Return to normal conditions [1]

Survey	Spill Effects = "Yes"	Return to Normal = "No"	Percent Return to Normal = "No"	Weighted Percent Return to Normal = "No"
Wave 1	38	23	61%	71%
Wave 2	33	16	48%	81%
Wave 3	16	5	31%	32%

Source: Delaware River intercept survey.

[1] Respondents whose fishing was affected by the spill were asked whether conditions had returned to normal at the time of the survey. The first two columns report the number of respondents answering as indicated. The raw percentage are given, then the percentage based on the weighted observations.

Table A3-4. Spill effects by area of impact

Impact area	Affected trips as percent of baseline		
	Lost	Substitute	Degraded
Period 1			
Low	4.3%	6.8%	0.0%
Medium	14.5%	4.1%	8.6%
High	24.4%	6.1%	27.6%
Period 2			
Low	2.2%	3.5%	0.0%
Medium	7.4%	2.1%	4.4%
High	12.4%	3.1%	14.0%

Source: Delaware River intercept survey.

APPENDIX A: Recreational Fishing Assessment

Table A3-5. Angler trips by site, Delaware River creel study

Intercept Site	County	State	Fishing Mode		Total
			Shore	Boat	
Linden Ave	Philadelphia	PA	1,518	1,168	2,686
Pennypack Park	Philadelphia	PA	3,782	100	3,882
Frankford Arsenal	Philadelphia	PA	3,863	3,761	7,624
West Deptford Boat Ramp	Gloucester	NJ	0	932	932
Hog Island Rd (Ft Mifflin)	Delaware	PA	2,107	0	2,107
Morrow's Marine, Ridley Park	Delaware	PA	88	2,021	2,109
City of Chester Boat Ramp	Delaware	PA	4,688	521	5,209
Bridgeport Boat Yard	Gloucester	NJ	0	975	975
Christina River Boat Ramp	New Castle	DE	5,389	146	5,535
Penn's Grove	Salem	NJ	280	0	280
Total			21,716	9,623	31,339

Source: 2002 Delaware River Creel Study. Data on angler counts at specific sites was derived from data provided by the state of Pennsylvania.

APPENDIX A: Recreational Fishing Assessment

Table A3-6. Angler trips by month, Delaware River Creel Study

Month	Angler Trips	Trips Period 1	Trips Period 2	Trips Period 3
April	2,092	2,092		
May	7,198	7,198		
June	4,630	1,852	2,778	
July	7,614		7,614	
August	3,885		752	3,133
September	3,964			3,964
October	1,956			1,956
Total	31,339	11,142	11,144	9,054
Percentage	100%	35.6%	35.6%	28.9%

Source: 2002 Delaware River Creel Study. Data on angler counts for specific months were derived from supplemental creel data provided by the state of Pennsylvania. For the three assessment periods, trips are divided at June 12 and August 6, with trips pro-rated by day within months.

Table A3-7. Angler trips by year, MRFSS study

Year	New Castle Co, DE		Salem Co, New Jersey	Total
	C&D Canal and Above	Below C&D Canal		
2000	35,354	24,668	0	61,837
2001	58,041	40,498	0	101,518
2002	61,568	42,958	0	107,686
2003	82,571	57,614	0	144,423
2004	64,487	44,996	0	112,793
Average	60,404	42,147	0	105,651

Source: Total angler trips for each year were provided by the National Marine Fisheries Service (NMFS) (see Appendix A4). The allocation of trips above and below the C&D canal was calculated using data provided by NMFS as presented in Table A3-7a.

APPENDIX A: Recreational Fishing Assessment

Table A3-7a. Percentage of MRFSS New Castle County trips above and below C&D canal

	Spill Effect	Average Pressure Rating		Average Weekly Pressure	Weekly	Percentage Above C&D Canal	Percentage Bellow C&D Canal
		Weekend	Weekday		Pressure As Percent Of Total		
C&D Canal North	med	6.08	3.08	27.58	4.7%	4.7%	0.0%
Augustine Beach	low	18.38	11.17	92.58	15.7%	0.0%	15.7%
C&D Canal South	med	9.25	5.75	47.25	8.0%	8.0%	0.0%
Delaware City Marina	med	0.00	0.00	0.00	0.0%	0.0%	0.0%
Christina River - E 7th Street	med	5.50	4.83	35.17	6.0%	6.0%	0.0%
Collin Beach Public Ramps	low	5.79	4.25	32.83	5.6%	0.0%	5.6%
Churchman's Road Boat Ramps	med	6.88	3.13	29.38	5.0%	5.0%	0.0%
Delaware City Public Ramp	med	0.00	0.00	0.00	0.0%	0.0%	0.0%
C&D Canal North	med	3.75	2.08	17.92	3.0%	3.0%	0.0%
Port Penn Fishing Area	low	9.83	4.67	43.00	7.3%	0.0%	7.3%
Fort Dupont Boat Ramp	med	6.42	5.42	39.92	6.8%	6.8%	0.0%
Newport Industrial Park	med	8.83	7.83	56.83	9.7%	9.7%	0.0%
Old Airport Road Bridge	med	5.42	3.42	27.92	4.7%	4.7%	0.0%
Augustine Marsh	low	5.33	3.21	26.71	4.5%	0.0%	4.5%
Deemer's Beach	med	6.33	2.88	27.04	4.6%	4.6%	0.0%
Twin Bridges, Odessa	low	3.13	1.67	14.58	2.5%	0.0%	2.5%
Silver Run Bridge	low	5.21	2.88	24.79	4.2%	0.0%	4.2%
Fort DuPont State Park	med	6.88	2.67	27.08	4.6%	4.6%	0.0%
Taylor's Bridge, Blackbird Creek	none*	3.42	2.08	17.25	2.9%	0.0%	0.0%
Total				587.83	100.0%	57.2%	39.9%

*Taylor's Bridge was not part of the assessment area and is excluded from the totals.

Source: Data provided by NMFS (see Appendix A4). Average weekday and weekend pressure is calculated using the midpoint of each pressure range provided by NMFS. Pressure ratings are averaged throughout the year. Ratings are to be interpreted as relative pressure and should not be interpreted as a count of total trips at each site.

APPENDIX A: Recreational Fishing Assessment

Table A3-8. Degree of impact by site and period

Location	Baseline		Period 1			Period 2/Period 3		
	Trips	Effect	Lost	Substitute	Degraded	Lost	Substitute	Degraded
Pennsylvania and New Jersey								
Linden Avenue boat ramp	2,686	Low	4.3%	6.8%	0.0%	2.2%	3.5%	0.0%
Pennypack Park	3,882	Low	4.3%	6.8%	0.0%	2.2%	3.5%	0.0%
Frankford Arsenal	7,624	Medium	14.5%	4.1%	8.6%	7.4%	2.1%	4.4%
West Deptford boat ramp	932	High	24.4%	6.1%	27.6%	12.4%	3.1%	14.0%
Hog Island Rd (Ft. Miflin)	2,107	High	24.4%	6.1%	27.6%	12.4%	3.1%	14.0%
Morrow's Marine, Ridley Park	2,109	Medium	14.5%	4.1%	8.6%	7.4%	2.1%	4.4%
City of Chester Boat Ram	5,209	Medium	14.5%	4.1%	8.6%	7.4%	2.1%	4.4%
Bridgeport Boat Yard	975	High	24.4%	6.1%	27.6%	12.4%	3.1%	14.0%
Penn's Grove	280	Medium	14.5%	4.1%	8.6%	7.4%	2.1%	4.4%
Salem County Crabbing	8,507	Medium	14.5%	4.1%	8.6%	7.4%	2.1%	4.4%
New Castle County, Delaware								
Above C&D	60,404	Medium	14.5%	4.1%	8.6%	7.4%	2.1%	4.4%
Below C&D	42,147	Low	4.3%	6.8%	0.0%	2.2%	3.5%	0.0%

Note: The sum of the figures in the first column is 128,355 baseline trips

Source: Tables A4, A5, and A7. Sites were designated as high, medium or low impact based on the map in Figure 1. Crabbing data was provided by NJDEP.

APPENDIX A: Recreational Fishing Assessment

Table A3-9. Lost raw (no discount factor adjustment) value in period 1

	Trips			Value			Total
	Lost	Substitute	Degraded	Lost	Substitute	Degraded	
Per-trip value				\$43.27	\$43.27	\$8.65	
<u>Pennsylvania and New Jersey</u>							
Linden Avenue boat ramp	41	65	0	\$1,762	\$2,819	\$0	\$4,581
Pennypack Park	59	94	0	\$2,546	\$4,074	\$0	\$6,620
Frankford Arsenal	394	111	234	\$17,057	\$4,813	\$2,029	\$23,899
West Deptford boat ramp	81	20	91	\$3,504	\$873	\$792	\$5,169
Hog Island Rd (Ft. Miflin)	183	46	207	\$7,925	\$1,975	\$1,791	\$11,691
Morrow's Marine, Ridley Park	109	31	65	\$4,718	\$1,331	\$561	\$6,610
City of Chester Boat Ram	269	76	160	\$11,654	\$3,289	\$1,386	\$16,328
Bridgeport Boat Yard	85	21	96	\$3,666	\$914	\$828	\$5,408
Penn's Grove	14	4	9	\$627	\$177	\$75	\$879
Salem County Crabbing	117	33	69	\$5,048	\$1,425	\$600	\$7,073
Total	1,352	501	931	\$58,507	\$21,690	\$8,061	\$88,259
<u>New Castle County, Delaware</u>							
Above C&D	3,123	881	1,857	\$135,140	\$38,136	\$16,072	\$189,347
Below C&D	639	1,022	0	\$27,644	\$44,231	\$0	\$71,876
Total	3,762	1,904	1,857	\$162,784	\$82,367	\$16,072	\$261,223

Source: Tables A6 and A8. Per-trip values obtained from Rosenberger and Loomis (2002). Crabbing data for Salem County was provided by NJDEP and was multiplied by percentage impacts in table A3-4 to arrive at estimates of affected trips.

Note: Per-trip values are multiplied by trips in each category to calculate losses in each category.

APPENDIX A: Recreational Fishing Assessment

Table A3-10. Lost raw (no discount factor adjustment) value in period 2

	Trips			Value			Total
	Lost	Substitute	Degraded	Lost	Substitute	Degraded	
Per-trip value				\$43.27	\$43.27	\$8.65	
<u>Pennsylvania and New Jersey</u>							
Linden Avenue boat ramp	21	33	0	\$894	\$1,430	\$0	\$2,324
Pennypack Park	30	48	0	\$1,292	\$2,067	\$0	\$3,359
Frankford Arsenal	200	56	119	\$8,655	\$2,442	\$1,029	\$12,127
West Deptford boat ramp	41	10	46	\$1,778	\$443	\$402	\$2,623
Hog Island Rd (Ft. Miflin)	93	23	105	\$4,021	\$1,002	\$909	\$5,932
Morrow's Marine, Ridley Park	55	16	33	\$2,394	\$676	\$285	\$3,354
City of Chester Boat Ram	137	39	81	\$5,913	\$1,669	\$703	\$8,285
Bridgeport Boat Yard	43	11	49	\$1,860	\$464	\$420	\$2,744
Penn's Grove	7	2	4	\$318	\$90	\$38	\$446
Salem County Crabbing	270	76	161	\$11,686	\$3,298	\$1,390	\$16,373
Total	897	314	598	\$38,811	\$13,581	\$5,175	\$57,567
<u>New Castle County, Delaware</u>							
Above C&D	1,585	447	942	\$68,571	\$19,350	\$8,155	\$96,076
Below C&D	324	519	0	\$14,027	\$22,443	\$0	\$36,470
Total	1,909	966	942	\$82,598	\$41,793	\$8,155	\$132,546

Source: Tables A6 and A8. Per-trip values obtained from Rosenberger and Loomis (2002). Crabbing data for Salem County was provided by NJDEP and was multiplied by percentage impacts in table A3-4 to arrive at estimates of affected trips.

Note: Per-trip values are multiplied by trips in each category to calculate losses in each category.

APPENDIX A: Recreational Fishing Assessment

Table A3-11. Lost raw (no discount factor adjustment) value in period 3

	Trips			Value			Total
	Lost	Substitute	Degraded	Lost	Substitute	Degraded	
Per-trip value				\$43.27	\$43.27	\$8.65	
<u>Pennsylvania and New Jersey</u>							
Linden Avenue boat ramp	17	27	0	\$726	\$1,162	\$0	\$1,888
Pennypack Park	24	39	0	\$1,050	\$1,679	\$0	\$2,729
Frankford Arsenal	163	46	97	\$7,032	\$1,984	\$836	\$9,852
West Deptford boat ramp	33	8	38	\$1,445	\$360	\$326	\$2,131
Hog Island Rd (Ft. Mifflin)	76	19	85	\$3,267	\$814	\$738	\$4,819
Morrow's Marine, Ridley Park	45	13	27	\$1,945	\$549	\$231	\$2,725
City of Chester Boat Ram	111	31	66	\$4,804	\$1,356	\$571	\$6,731
Bridgeport Boat Yard	35	9	39	\$1,511	\$377	\$341	\$2,230
Penn's Grove	6	2	4	\$259	\$73	\$31	\$362
Salem County Crabbing	298	84	177	\$12,912	\$3,644	\$1,536	\$18,091
Total	808	277	533	\$34,950	\$11,998	\$4,611	\$51,559
<u>New Castle County, Delaware</u>							
Above C&D	1,287	363	766	\$55,710	\$15,721	\$6,625	\$78,056
Below C&D	263	421	0	\$11,396	\$18,234	\$0	\$29,630
Total	1,551	785	766	\$67,106	\$33,955	\$6,625	\$107,686

Source: Tables A6 and A8. Per-trip values obtained from Rosenberger and Loomis (2002). Crabbing data for Salem County was provided by NJDEP and was multiplied by percentage impacts in table A3-4 to arrive at estimates of affected trips.

Note: Per-trip values are multiplied by trips in each category to calculate losses in each category.

APPENDIX A: Recreational Fishing Assessment

Table A3-12. Total raw (no discount factor adjustment) recreational fishing losses

Impact Area	Period 1	Period 2	Period 3	Total
Pennsylvania and New Jersey	\$88,259	\$57,567	\$51,559	\$197,386
New Castle County, Delaware	\$261,223	\$132,546	\$107,686	\$501,455
Total	\$349,482	\$190,114	\$159,246	\$698,841

Source: Tables A9-A11.

APPENDIX A4

SUPPLEMENTAL RECREATIONAL FISHING DATA (NMFS)

MARINE RECREATIONAL FISHERIES STATISTICS SURVEY - POST-STRATIFIED EFFORT
 DELAWARE RIVVER - SALEM COUNTY, NJ & NEW CASTLE COUNTY, DE

08:17 Thursday, October 27, 2005

		FISHING AREA									
		OCEAN, STS		OCEAN, EEZ		OTHER INLAND		DELAWARE ESTUARY		DEL. RIVER, TWO COUNTIES	
YEAR	STATE	NUMBER OF ANGLER TRIPS	PSE	NUMBER OF ANGLER TRIPS	PSE	NUMBER OF ANGLER TRIPS	PSE	NUMBER OF ANGLER TRIPS	PSE	NUMBER OF ANGLER TRIPS	PSE
2000	DE	114,969	10.8	71,026	11.8	359,262	9.2	488,547	8.4	61,837	17.3
	NJ	2,839,601	6.2	763,433	6.8	2,468,123	7.5	397,709	8.8	.	.
	NJ+DE	2,954,569	6.0	834,459	6.3	2,827,385	6.6	886,256	6.1	61,837	17.3
2001	DE	112,233	10.3	104,696	10.5	357,559	7.8	503,606	6.8	101,518	12.4
	NJ	2,596,970	4.5	691,230	5.0	3,315,316	4.2	880,686	4.9	.	.
	NJ+DE	2,709,203	4.4	795,926	4.5	3,672,875	3.9	1,384,292	4.0	101,518	12.4
2002	DE	104,709	9.3	113,452	9.1	264,624	7.3	437,472	5.9	107,686	8.6
	NJ	2,217,843	4.9	568,254	5.4	2,260,060	4.6	362,447	8.0	.	.
	NJ+DE	2,322,553	4.7	681,706	4.8	2,524,684	4.2	799,919	4.9	107,686	8.6
2003	DE	113,505	9.1	95,248	10.1	281,219	7.4	469,867	5.8	144,423	8.2
	NJ	2,542,817	4.9	615,943	5.6	2,966,902	4.7	653,625	6.0	.	.
	NJ+DE	2,656,322	4.7	711,191	5.0	3,248,121	4.3	1,123,492	4.3	144,423	8.2
2004	DE	151,452	9.9	82,954	10.9	358,617	7.9	457,172	7.1	112,793	10.7
	NJ	2,952,963	5.6	666,938	7.3	2,345,969	6.3	614,505	7.4	.	.
	NJ+DE	3,104,416	5.3	749,891	6.6	2,704,586	5.5	1,071,677	5.2	112,793	10.7

Pressure Information: 4 = 20-29 7 = 80+
 0 = 1-4 2 = 9-12 5 = 30-49 8 = Cannot determine activity
 1 = 5-8 3 = 13-19 6 = 50-79 9 = Mode not present at site

Pressure Data Format:
 Weekend SH PC PR CH
 Weekday SH PC PR CH

COUNTY=NEW CASTLE		Site Descriptions:	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
COUNTY=003	0099	PORT PENN FISHING AREA DELAWARE CITY ROUTE 9-CONGRESS STREET TO END (BEHIND C&D CANAL FISH&WILDLIFE HEADQUARTERS) LL= 393124 753424 SH PHONE=N/A CONTACT=N/A	WE 9999	9999	0999	1999	3999	4999	4999	4999	2999	1999	0999	9999
COUNTY=003	1598	FORT DUPONT BOAT RAMP DELAWARE CITY RTE 1 13-896E-9N TO NE SIDE OF C&D BRIDGE ON GOV. BAC 19706 LL= 393430 753516 NA PHONE=N/A CONTACT=N/A	WE 9999	9999	9919	9929	9929	9929	9929	9929	9919	9919	9909	9909
COUNTY=003	1859	NEWPORT INDUSTRIAL PARK RAMP- JAMES S NEWPORT I95 TO 141N TO NEWPORT EXIT LFT & LFT TO WATER ST. R LL= 394234 753549 SH PHONE=N/A CONTACT=N/A	WE 9999	9999	0909	0909	0919	1929	1929	1929	1919	1919	0909	0909
COUNTY=003	1860	OLD AIRPORT ROAD BRIDGE NEWPORT WATER ST., AT ENTRANCE TO NEWPORT INDUST. PARK NEAR BRIDGE- JUST OFF WATER ST. LL= 394240 753631 SH PHONE=N/A CONTACT=N/A	WE 9999	9999	0999	1999	2999	2999	2999	2999	1999	0999	0999	0999
COUNTY=003	1913	AUGUSTINE MARSH PORT PENN RT. 9 2 MILES BELOW AUGUSTINE BEACH, GATE UNDER RT.9 BETWN DE RIV. & AUGUSTINE BEACH LL= 392944 753518 SH PHONE=N/A CONTACT=N/A	WE 9999	9999	9999	1999	2999	2999	2999	2999	1999	1999	0999	9999
COUNTY=003	1914	DEEMER'S BEACH (THE CURVE @ DEEMERS) NEW CASTLE RT.9 1 MILE SOUTH OF 273 ALONG SIDE OF ROAD, DOBINSVI LL= 393911 753500 BB PHONE=N/A CONTACT=N/A	WE 9999	9999	0999	1999	3999	2999	1999	1999	2999	2999	1999	9999
COUNTY=003	1915	TWIN BRIDGES (OVER APPOQUINIMINK RIV) RT. 9, TWIN BRIDGES OVER APPOQUINIMINK RIVER, RT. 9 E ODESSA (BTWN ODESSA & BAYVIEW) LL= 393911 753501 MM PHONE=N/A CONTACT=N/A	WE 9999	9999	9999	0999	1999	1999	1999	1999	1999	0999	9999	9999
COUNTY=003	1916	SILVER RUN BRIDGE ODESSA RT.9 BRIDGE OVER SILVER RUN (TIDAL TRIBUTARY) TO LOWE DELAWARE RIVER (SOUTH OF BAYVIEW LL= 392833 753611 MM PHONE=N/A CONTACT=N/A	WE 9999	9999	0999	1999	1999	2999	2999	2999	1999	1999	0999	9999
COUNTY=003	3050	FORT DUPONT STATE PARK DELAWARE CITY NEW CASTLE AVE. / RT. 9 ON GOVERNON BACON GROUNDS OFF SH MODE LL= 393427 753449 SH PHONE=N/A CONTACT=N/A	WE 9999	9999	2999	2999	2999	2999	2999	2999	1999	1999	1999	9999

APPENDIX B1

HUNTER TELEPHONE SURVEY INSTRUMENT

Delaware River Waterfowl Hunting Survey

1. PRESS RETURN WHEN INTERVIEW BEGINS

START

TIMER STARTS AFTER THIS SCREEN

2. Time when program was opened.

TIME1 1:1-5

|__|__|__|__|__|

3. SURVEY NAME

SNAME 1:6

(CHECK ONLY ONE ANSWER)

|__| 1. DERIVER

4. Hello, my name is _____, may I speak with _____?
I am calling on behalf of the National Oceanic and Atmospheric
Administration. We are conducting a study of people's opinions
about waterfowl hunting in your area. Do you have a couple of
minutes to answer a few questions?

(IMPORTANT: ALL NE'S MUST BE SAVED! ONLY ENTER NE ON THIS
SCREEN IF RESPONDENT IS NOT A HUNTER. IT IS NOT NECESSARY
THAT THE RESPONDENT HUNTS WATERFOWL OR THAT THE RESPONDENT
HAS PURCHASED A HUNTING LICENSE THIS YEAR.)

CONPER1 1:7-8

(CHECK ONLY ONE ANSWER)

|__| 1. Correct person, good time to do survey (GO TO QUESTION 5)

|__| 2. Bad time/schedule recall (CB - do not save) (GO TO QUESTION

6)

|__| 3. AM, NA, BZ (do not save)

|__| 4. TM (GO TO QUESTION 20)

|__| 5. RF

|__| 6. NE (GO TO QUESTION 52)

|__| 7. DS

|__| 8. BG

|__| 9. DL

|__| 10. Bad Number (missing digit, begins with zero, etc.)

SKIP TO QUESTION 55

=====

5. Time when interview began.

TIME2 1:9-13

|__|__|__|__|__|

SKIP TO QUESTION 7

=====

6. When would be a more convenient time to call you back?
Thank you for your time.

WHENCALL

ENTER DAY AND TIME ON CALLSHEET (CB)

SKIP TO QUESTION 55

=====

7. ENTER STATE FROM CALL SHEET.

STATE 1:14

(CHECK ONLY ONE ANSWER)

|__| 1. Invalid answer. Select another. (GO TO QUESTION 7)
|__| 2. Delaware (GO TO QUESTION 9)
|__| 3. New Jersey

SKIP TO QUESTION 12

=====

8. YOU DID NOT USE SPACE BAR.

NOSPAC99

PRESS ENTER TO CONTINUE.

9. Have you purchased a Delaware hunting license for the 2005-2006 hunting season?
 (IF YES: A Delaware resident license, a Delaware non-resident license, or a Delaware non-resident three-day small game license?)
 (CHECK ALL THAT APPLY)

DELIC 1:15-20

(CHECK ALL THAT APPLY)

2006

- 1. No - have not purchased a Delaware hunting license for 2005-
- 2. Delaware Resident
- 3. Delaware Non-Resident
- 4. Delaware Non-Resident Three-Day Small Game
- 5. DNR: Other (GO TO QUESTION 10)
- 6. DNR: Don't know

IF (#9 = 0) GO TO #8

SKIP TO QUESTION 14

=====

10. ENTER OTHER LICENSE TYPE.

DELICST 2:1-240

SKIP TO QUESTION 14

=====

11. YOU DID NOT USE SPACE BAR.

NOSPAC98

PRESS ENTER TO CONTINUE.

12. Have you purchased a New Jersey hunting license for the 2005 hunting season?

(IF YES: What New Jersey hunting licenses have you purchased?)

(READ LIST AS NECESSARY; CHECK ALL THAT APPLY)

NJLIC 3:1-13

(CHECK ALL THAT APPLY)

2005

- 1. No - have not purchased a New Jersey hunting license for
- 2. Resident Firearm Hunting
- 3. Resident Bow & Arrow Hunting
- 4. Senior Resident Firearm (65 yrs & older)
- 5. Senior Resident Bow & Arrow Hunting (65 yrs & older)
- 6. Non-Resident Firearm Hunting
- 7. Non-Resident Two-Day Small Game Firearm Hunting
- 8. Non-Resident Bow & Arrow Hunting
- 9. Special One-Day Hunting (on commercial preserves only)
- 10. All-Around Sportsman
- 11. Youth License
- 12. Other (GO TO QUESTION 13)
- 13. Don't know

IF (#12 = 0) GO TO #11

SKIP TO QUESTION 14

=====

13. ENTER OTHER LICENSE TYPE.

NJLICST 4:1-240

14. How many days do you typically go waterfowl hunting each year?

(PORTIONS OF A DAY COUNT AS A WHOLE DAY; MULTIPLE OUTINGS WITHIN ONE DAY COUNT AS A SINGLE DAY)

(ENTER ? FOR TYPICALLY HUNTS WATERFOWL, BUT CANNOT ESTIMATE DAYS)

(ENTER 0 IF RESPONDENT DOES NOT TYPICALLY HUNT WATERFOWL)

DAYSHUNT 4:241-243

|_|_|_| days

LOWEST VALUE = 0

HIGHEST VALUE = 365

15. Time check.

TIME3 4:244-248

|__|__|__|__|__|

IF (#14 = 0) GO TO #16

IF (#14 > 9) GO TO #17

SKIP TO QUESTION 18

=====

16. DID YOU MEAN TO ENTER ZERO?

ZERODAYS 4:249

(CHECK ONLY ONE ANSWER)

|__| 1. Invalid answer. Select another. (GO TO QUESTION 16)

|__| 2. Yes

|__| 3. No (GO TO QUESTION 14)

SKIP TO QUESTION 19

=====

17. DID YOU MEAN TO ENTER #14?

HIDAYS 4:250

(CHECK ONLY ONE ANSWER)

|__| 1. Invalid answer. Select another. (GO TO QUESTION 17)

|__| 2. Yes

|__| 3. No (GO TO QUESTION 14)

18. Have you gone waterfowl hunting on the Delaware River or associated tidal marshes in the past three years?

(IF ASKED: The Delaware River or associated tidal marshes refers to any tidal area of the Delaware River and bay tidal area and areas within one mile of the confluence with the Delaware River when upstream or in non-tidal areas.)

PAST3 5:1

(CHECK ONLY ONE ANSWER)

|__| 1. Invalid answer. Select another. (GO TO QUESTION 18)

|__| 2. Yes (GO TO QUESTION 21)

|__| 3. No

|__| 4. DNR: Don't know

19. Have you purchased a Federal Migratory Bird Hunting Stamp in the past three years?

STAMP 5:2

(CHECK ONLY ONE ANSWER)

- 1. Invalid answer. Select another. (GO TO QUESTION 19)
- 2. Yes
- 3. No
- 4. Don't know

20. That's all we need to know. Thank you for your time. (IMPORTANT: ALL NE'S MUST BE SAVED!)

NESTATE

PRESS ENTER TO CONTINUE.

SKIP TO QUESTION 52

=====

21. How many days do you typically go waterfowl hunting on the Delaware River or associated tidal marshes each year?

(PORTIONS OF A DAY COUNT AS A WHOLE DAY; MULTIPLE OUTINGS WITHIN ONE DAY COUNT AS A SINGLE DAY)

(ENTER ? FOR DON'T KNOW)

(NUMBER CANNOT BE HIGHER THAN TOTAL NUMBER OF DAYS WATERFOWL HUNING.)

(IF ASKED: The Delaware River or associated tidal marshes refers to any tidal area of the Delaware River and bay tidal area and areas within one mile of the confluence with the Delaware River when upstream or in non-tidal areas.)

DAYSDETV 5:3-5

|_|_|_| days

LOWEST VALUE = 0

HIGHEST VALUE = #14

IF (#21 = 0) GO TO #22

IF (#21 > 9) GO TO #23

SKIP TO QUESTION 24

=====

22. DID YOU MEAN TO ENTER ZERO?

ZERODERV 5:6

(CHECK ONLY ONE ANSWER)

- 1. Invalid answer. Select another. (GO TO QUESTION 22)
- 2. Yes
- 3. No (GO TO QUESTION 21)

SKIP TO QUESTION 24

=====

23. DID YOU MEAN TO ENTER #21?

HIDERV 5:7

(CHECK ONLY ONE ANSWER)

- 1. Invalid answer. Select another. (GO TO QUESTION 23)
- 2. Yes
- 3. No (GO TO QUESTION 21)

24. Did you go waterfowl hunting on the Delaware River or associated tidal marshes last season, that is, the 2004/2005 season?
 (IF ASKED: The Delaware River or associated tidal marshes refers to any tidal area of the Delaware River and bay tidal area and areas within one mile of the confluence with the Delaware River when upstream or in non-tidal areas.)

LASTSEAS 5:8

(CHECK ONLY ONE ANSWER)

- 1. Invalid answer. Select another. (GO TO QUESTION 24)
- 2. Yes
- 3. No
- 4. DNR: Don't know

SKIP TO QUESTION 26

=====

25. YOU DID NOT USE SPACE BAR.

NOSPAC1

PRESS ENTER TO CONTINUE.

26. Is there anything that reduced the quality of your waterfowl hunting experiences in #7 or prevented you from going waterfowl hunting as much as you would have liked or where you would have liked during the 2004/2005 season? (DO NOT READ LIST; CHECK ALL THAT APPLY)

PREVNT 5:9-24

(CHECK ALL THAT APPLY)

- 1. No, nothing
- 2. Oil Spill
- 3. Lack of access to places to hunt
- 4. Not enough places to hunt
- 5. No time (including work, family obligations)
- 6. Cost/Too expensive
- 7. Too crowded/too many hunters in the field
- 8. Poor behavior of other hunters
- 9. Safety concerns/fear of injury from another hunter
- 10. Season does not fit schedule/season length
- 11. Bag limits
- 12. Not enough game
- 13. Quality of game (e.g., not enough large-antlered bucks)
- 14. Age/health
- 15. Other
- 16. Don't know

IF (#26 = 0) GO TO #25

IF (#26 @ 15) GO TO #27

IF (#26 @ 2) GO TO #30

SKIP TO QUESTION 28

=====

27. ENTER OTHER RESPONSE.

PREVNTST 6:1-240

IF (#26 @ 2) GO TO #30

28. As you may know, there was an oil spill on the Delaware River near Philadelphia last November. Did the Delaware River oil spill affect your waterfowl hunting in any way?

OILAFFCT 6:241

(CHECK ONLY ONE ANSWER)

- 1. Invalid answer. Select another. (GO TO QUESTION 28)
- 2. Yes (GO TO QUESTION 30)
- 3. No (GO TO QUESTION 38)
- 4. Don't know

SKIP TO QUESTION 32

=====

29. YOU DID NOT USE SPACE BAR.

NOSPAC2

PRESS ENTER TO CONTINUE.

30. Please describe how the oil spill affected your waterfowl hunting.

(DO NOT READ LIST; CHECK ALL THAT APPLY)

HWAFF 6:242-248

(CHECK ALL THAT APPLY)

- 1. Reduced enjoyment of hunting trips
- 2. Reduced waterfowl population
- 3. Reduced quality of waterfowl
- 4. Took fewer hunting trips
- 5. Changed location of hunting trips
- 6. Other
- 7. Don't know

IF (#30 = 0) GO TO #29

IF (#30 @ 6) GO TO #31

IF (#30 @ 4) GO TO #33

SKIP TO QUESTION 32

=====

31. ENTER OTHER RESPONSE.

HWAFFST 7:1-240

IF (#30 @ 4) GO TO #33

32. Did the Delaware River oil spill cause you to take fewer waterfowl hunting trips?

OILFEWER 7:241

(CHECK ONLY ONE ANSWER)

- 1. Invalid answer. Select another. (GO TO QUESTION 32)
- 2. Yes
- 3. No
- 4. Don't know

IF (#32 = 2) GO TO #33

IF (#30 @ 5) GO TO #36

SKIP TO QUESTION 35

=====

33. You said you spent fewer days waterfowl hunting due to the Delaware River oil spill, could you estimate how many fewer days?

(PORTIONS OF A DAY COUNT AS A WHOLE DAY; MULTIPLE

OUTINGS WITHIN ONE DAY COUNT AS A SINGLE DAY)

(ENTER ? FOR DON'T KNOW)

HOWMANY 7:242-244

|__|__|__| days

LOWEST VALUE = 1

HIGHEST VALUE = 365

IF (#33 > 9) GO TO #34

IF (#30 @ 5) GO TO #36

SKIP TO QUESTION 35

=====

34. DID YOU MEAN TO ENTER #33?

HIFEWR 7:245

(CHECK ONLY ONE ANSWER)

- 1. Invalid answer. Select another. (GO TO QUESTION 34)
- 2. Yes
- 3. No

IF (#34 = 3) GO TO #33

IF (#30 @ 5) GO TO #36

35. Did the Delaware River oil spill cause you to change the location where you hunt waterfowl?

OILLOC 7:246

(CHECK ONLY ONE ANSWER)

- 1. Invalid answer. Select another. (GO TO QUESTION 35)
- 2. Yes (GO TO QUESTION 36)
- 3. No
- 4. Don't know

SKIP TO QUESTION 38

=====

36. You said you changed the location where you went waterfowl hunting due to the Delaware River oil spill, could you estimate how many days you changed location?

(PORTIONS OF A DAY COUNT AS A WHOLE DAY; MULTIPLE OUTINGS WITHIN ONE DAY COUNT AS A SINGLE DAY)
(ENTER ? FOR DON'T KNOW)

DAYSLOC 7:247-249

|__|__|__| days

LOWEST VALUE = 1
HIGHEST VALUE = 365

IF (#36 > 9) GO TO #37

SKIP TO QUESTION 38

=====

37. DID YOU MEAN TO ENTER #36?

HILOC 7:250

(CHECK ONLY ONE ANSWER)

- 1. Invalid answer. Select another. (GO TO QUESTION 37)
- 2. Yes
- 3. No (GO TO QUESTION 36)

38. Great! We're just about through. The final few questions are for background information and help us analyze the results.

DEMO

PRESS ENTER TO CONTINUE.

39. Do you consider your place of residence to be a large city or urban area, a suburban area, a small city or town, a rural area on a farm or ranch, or a rural area not on a farm or ranch?
(READ LIST) (CHECK ONLY ONE ANSWER)

RESIDE 8:1

(CHECK ONLY ONE ANSWER)

- 1. Invalid answer. Select another. (GO TO QUESTION 39)
- 2. Large city or urban area
- 3. Suburban area
- 4. Small city or town
- 5. Rural area on a farm or ranch
- 6. Rural area not on a farm or ranch
- 7. Don't know
- 8. Refused

40. May I ask your age?
(ENTER 888 FOR REFUSED; ENTER ? FOR DON'T KNOW)

AGE 8:2-4

|_|_|_| years

LOWEST VALUE = 1

41. That's the end of the survey. Thanks for your time and cooperation. If you have any additional comments, I can record them here.
(ENTER ANY ADDITIONAL COMMENTS; IN FIRST PERSON; 240 CHARACTERS)

END 8:5-244

42. OBSERVE AND RECORD RESPONDENT'S GENDER.

GENDER 8:245

(CHECK ONLY ONE ANSWER)

- 1. Invalid answer. Select another. (GO TO QUESTION 42)
- 2. Male
- 3. Female
- 4. Don't know

43. TIME INTERVIEW WAS COMPLETED

ENDTIME 8:246-250

|_|_|_|_|

44. Please enter your initials in LOWERCASE ONLY!

INTVRINT 9:1-3

|_|_|_|_|

45. Enter the area code and telephone number of number dialed.

TELEPHON 9:4-13

|_|_|_|_|-|_|_|_|_|-|_|_|_|_|_|

LOWEST VALUE = 1

46. ENTER RM CASE NUMBER.

CASENO 9:14-19

|_|_|_|_|_|_|_|

LOWEST VALUE = 1

47. SAVE OR ERASE INTERVIEW.

ONLY ERASE IF THIS IS A PRACTICE INTERVIEW!

FINISH1 9:20

(CHECK ONLY ONE ANSWER)

- |_| 1. Invalid answer. Select another. (GO TO QUESTION 47)
- |_| 2. Save answers
- |_| 3. Erase answers (GO TO QUESTION 54)
- |_| 4. Terminate (TM) (GO TO QUESTION 51)
- |_| 5. Person was not eligible (NE) (GO TO QUESTION 52)
- |_| 6. Review answers (GO TO QUESTION 4)
- |_| 7. Invalid answer. Select another. (GO TO QUESTION 47)

48. Check the time of the interview.

TIMECHEK 9:21

(CHECK ONLY ONE ANSWER)

- |_| 1. Check Time (GO TO QUESTION 49)
- |_| 2. Real

COMPUTE IF ((#4 = 1) AND (#43 - #15) < 300) 1
 COMPUTE IF ((#4 = 1) AND (#43 - #5) > 1500) 1
 COMPUTE 2

SKIP TO QUESTION 53

=====

49. Is this a real completed interview?

PRACTICE 9:22

(CHECK ONLY ONE ANSWER)

- 1. Invalid answer. Select another. (GO TO QUESTION 49)
 - 2. Real completed interview
 - 3. Practice interview (Select erase answers on next screen)
- (GO TO QUESTION 47)
- 4. Terminate (TM) (GO TO QUESTION 51)
 - 5. Person was not eligible (NE) (GO TO QUESTION 52)
 - 6. Review answers (GO TO QUESTION 4)

IF ((#4 = 1) AND (#43 - #5) > 1500) AND #49 = 2) GO TO #50

SKIP TO QUESTION 53

=====

50. Was this interview completed in one phone call or two phone calls?

STAGES 9:23

(CHECK ONLY ONE ANSWER)

- 1. One call
- 2. Two calls

SKIP TO QUESTION 53

=====

51. SAVE AS TERMINATE OR REVIEW ANSWERS.

SURETM 9:24

(CHECK ONLY ONE ANSWER)

- 1. Invalid answer. Select another. (GO TO QUESTION 51)
- 2. Save as TM
- 3. Review answers (GO TO QUESTION 4)

SKIP TO QUESTION 53

=====

52. SAVE AS "NOT ELIGIBLE" OR REVIEW ANSWERS.

SURENE 9:25

(CHECK ONLY ONE ANSWER)

- 1. Invalid answer. Select another. (GO TO QUESTION 52)
- 2. Save as NE
- 3. Review answers (GO TO QUESTION 4)

53. Determines final call status.

CONPER 9:26-27

(CHECK ONLY ONE ANSWER)

- 1. Correct person, good time to do survey
- 2. Bad time/schedule recall
- 3. AM, NA, BZ
- 4. TM
- 5. RF
- 6. NE
- 7. DS
- 8. BG
- 9. DL
- 10. Bad Number (missing digit, begins with zero, etc.)

```

COMPUTE IF (#51 = 2) 4
COMPUTE IF (#52 = 2) 6
COMPUTE IF (#4 = 1) 1
COMPUTE IF (#4 = 2) 2
COMPUTE IF (#4 = 3) 3
COMPUTE IF (#4 = 4) 4
COMPUTE IF (#4 = 5) 5
COMPUTE IF (#4 = 6) 6
COMPUTE IF (#4 = 7) 7
COMPUTE IF (#4 = 8) 8
COMPUTE IF (#4 = 9) 9
COMPUTE IF (#4 = 10) 10

```

SKIP TO QUESTION 55

=====

54. ARE YOU SURE YOU WANT TO ERASE THIS INTERVIEW?
ONLY ERASE IF THIS IS A PRACTICE INTERVIEW.

MAKESURE 9:28

(CHECK ONLY ONE ANSWER)

- 1. No, do not erase the answers (GO TO QUESTION 47)
- 2. Yes, erase this interview

55. Save or erase interview.

FINISH 9:29

(CHECK ONLY ONE ANSWER)

- 1. Save
- 2. Erase

```

COMPUTE IF (#54 = 2) 2
COMPUTE IF (#4 = 2) 2
COMPUTE IF (#4 = 3) 2
COMPUTE 1

```


56. Date call was made

INTVDAT 9:30-37

|_|_|_|_|_|_|_|-|_|_|_|_|_|_|_|-|_|_|_|_|_|_|_|
Year Month Day

SAVE IF (#55 = 1)

APPENDIX B2

SUPPORTING TABLES - HUNTING ASSESSMENT

APPENDIX B: Recreational Hunting Assessment

Table B2-1. Disposition of telephone survey

State	Goal	Outcome [1]											Total
		CM	TM	RF	NE	DS	BG	DL	AM	BZ	NA	CB	
Delaware	150	151	-	12	182	83	28	1	86	2	77	122	744
New Jersey	150	151	-	2	158	72	5	1	91	3	69	96	648
Grand Total	300	302	-	14	340	155	33	2	177	5	146	218	1,392

Source: Responsive Management, Inc., which undertook the survey on behalf of trustees.

[1] Outcome codes are as follows:

- Goal (Target completes)
- CM (Completes)
- TM (Terminates)
- RF (Refusals)
- NE (Not Eligible)
- DS (Disconnects)
- BG (Business/Government)
- DL (Deaf/Language)
- AM (Answering Machine)
- BZ (Busy)
- NA (No Answer)
- CB (Call Back)

APPENDIX B: Recreational Hunting Assessment

Table B2-2. Estimated affected trips, surveyed counties

Survey area	Lost	Substitute	Degraded	Total
Delaware	1,883	1,609	3,889	7,381
New Jersey	1,857	768	2,377	5,001
Total	3,741	2,377	6,265	12,383

Source: 2005 telephone survey of Delaware River waterfowl hunters.

APPENDIX B: Recreational Hunting Assessment

Table B2-3. Affected trips as percent of baseline trips [1]

Survey area	Lost	Substitute	Degraded
Delaware	11.6%	9.9%	24.0%
New Jersey	15.0%	6.2%	19.2%

Source: 2005 telephone survey of Delaware River waterfowl hunters.

[1] Baseline trips are estimated as the total "typical" number of trips respondents take to the Delaware River for waterfowl hunting.

APPENDIX B: Recreational Hunting Assessment

Table B2-4. Extrapolation of telephone survey results to baseline trips from outside survey area

	State and County							Total
	Delaware		New Jersey		Pennsylvania			
	New Castle	Camden	Gloucester	Salem	Philadelphia	Delaware		
Included in coverage area of telephone survey	1038	63	284	701	0	0	2086	
Trips from outside coverage area of telephone survey	311	18	29	130	16	31	535	
Percent increase in baseline trips	30.0%	28.6%	10.2%	18.5%	na	na	25.6%	
Allocation of increase to DE, NJ, PA	58.1%			33.1%		8.8%	100.0%	

Source: Harvest Information Program (HIP) survey of hunters.

APPENDIX B: Recreational Hunting Assessment

Table B2-5. Estimated affected trips, with coverage-area adjustment

Survey area	Lost	Substitute	Degraded	Total
Delaware	2,441	1,964	4,823	9,227
New Jersey	2,175	969	2,908	6,052
Pennsylvania	84	54	141	279
Total	4,700	2,986	7,872	15,559

Source: Tables B2 and B4.

APPENDIX B: Recreational Hunting Assessment

Table B2-6. Assessment area trips during the spill period compared to previous years, HIP survey data

County	State	1999	2000	2001	2002	2003	1999-2003	
							Average	2004
Philadelphia	PA	0	500	300	1,400	0	440	500
Delaware	PA	600	900	700	1,700	500	880	0
New Castle	DE	9,800	7,800	8,600	9,800	8,000	8,800	8,400
Camden	NJ	400	900	800	900	400	680	600
Gloucester	NJ	2,400	1,600	2,800	2,400	3,100	2,460	1,100
Salem	NJ	5,200	7,000	5,800	7,400	7,700	6,620	3,100
Total		18,400	18,700	19,000	23,600	19,700	19,880	13,700
Average trips (1999-2003) less 2004 trips								6,180

Source: Harvest Information Program (HIP) survey.

APPENDIX B: Recreational Hunting Assessment

Table B2-7. Total raw (with no discount factor adjustment) recreational hunting losses

	Lost	Substitute	Degraded	Total
Per-trip value	\$44.56	\$44.56	\$8.91	
<u>Survey area</u>				
Delaware	\$108,781	\$87,504	\$42,982	\$239,267
New Jersey	\$96,909	\$43,191	\$25,920	\$166,020
Pennsylvania	\$3,756	\$2,386	\$1,258	\$7,400
Total	\$209,446	\$133,081	\$70,160	\$412,687

Source: Table B5. Per-trip values obtained from Rosenberger and Loomis (2002).

Note: Per-trip values are multiplied by trips in each category to calculate losses in each category.

APPENDIX C1

BOATER INTERCEPT SURVEY INSTRUMENT

**Delaware River Intercept Survey
Assessment of Recreational Boating Use**

Time:
Location of Interview:

Interviewer Initials:
Date:

SECTION I

Hello. I'm (name) and I'm working with a team that is conducting a survey to find out about recreational boating in the area. It will only take a couple of minutes. Shall we begin?

1. How long did you spend boating today? (*Total length of trip in hours*)
2. Could you estimate how many boating trips you've taken on the Delaware River so far this year?
3. About how many of your trips were for fishing versus boating for pleasure only?
4. Compared to your "typical use" in past years, would you say you've taken more trips to the Delaware River than usual this year, fewer trips than usual, or about the same?
If fewer:
5. What was the reason for taking fewer trips?

Inter view No.	# in party	1. Length of trip today	3. Trips This Year	2. Portion fishing trips	5. More, fewer, same	6. If fewer, reason
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						

**Delaware River Intercept Survey
Assessment of Recreational Boating Use**

SECTION II

If the respondent mentioned the oil spill in the answers to SECTION I, skip to Question 3a.

As you may know, there was an oil spill in the Delaware River that occurred in late November 2004.

1. *Had you heard about the spill before now?*
2. *Did the spill have any effects on your use of the Delaware River for boating?*
If yes:
3. *Did you take fewer boating trips to the Delaware River as a result of the spill?*
If no, report "0" in 3/3a. If yes:
3a. *How many fewer trips did you take as a result of the spill?*
4. *Did you change locations where you go boating on the Delaware River as a result of the spill?*
5. *(If yes on 4) On how many occasions did you change the location of a trip because of the spill?*
6. *(If yes on 3 or 4) Have your activities returned to normal?*
If yes:
7. *When did the quality of boating on the Delaware River return to normal, in your opinion?*

Inter- view No.	1. Aware of spill? (Y/N)	2. Spill affect boating? (Y/N)	3/3a How many fewer trips?	4. Change location? (Y/N)	5. On how many occasions?	6. Returned to normal? (Y/N)	7. When return to normal?
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							

APPENDIX C2

SUPPORTING TABLES - BOATING ASSESSMENT

APPENDIX C: Recreational Boating Assessment

Table C2-1. Affected trips as percent of baseline trips

	Lost	Substitute	Degraded	Total Affected	Actual Trips	Baseline Trips
Affected trips	102	32	511	645	1,484	1,585
Percent of baseline trips	6.4%	2.0%	32.2%	40.7%	93.6%	100.0%

Source: 2005 marina intercept survey.

APPENDIX C: Recreational Boating Assessment

Table C2-2. Calculation of total baseline trips

(1) Boats departing from Anchorage Marina Sept 3-4, 2005	14 [1]
(2) Total boats moored at Anchorage Marina Sept 3-4, 2005	125 [2]
(3) Boat trips as percent of boats moored	11.2% [3]
(4) Boats moored at impact area marinas, baseline conditions	600 [4]
(5) Estimated daily late summer weekend boat trips	67 [5]
(6) Ratio, weekday to weekend day trips	0.25 [6]
(7) Total monthly boat trips, late summer	907 [7]
(8) Ratio, August/September monthly trips to total season	5.5 [8]
(9) Estimated total season trips, impact area	4,990 [9]
(10) People per boat trip	3.0 [10]
(11) Estimated total season people trips, all purposes	14,969 [11]
(12) Percent fishing trips	9.7% [12]
(13) <u>Estimated total pleasure trips</u>	<u>13,521 [13]</u>

Source: 2005 marina intercept survey, previous recreational boating assessments

[1] Boat departures during a 12-hour period, September 3-4, 2005.

[2] Onsite count, September 3, 2005.

[3] Line (1) / line (2).

[4] Based on counts and interviews with marina operators.

[5] Line (3) x line (4).

[6] Based on daily counts for the full season at a boat ramp in Golden Beach, MD. Details available in the "Lost Use Valuation Report" for the Chalk Point oil spill, www.darp.noaa.gov.

[7] Line (5) x 8 weekend days + line (5) x line (6) x 22 weekdays.

[8] Based on daily counts for the full season at a boat ramp in Golden Beach, MD. Details available in the "Lost Use Valuation Report" for the Chalk Point oil spill, www.darp.noaa.gov.

[9] Line (7) x line (8).

[10] 2005 marina intercept survey.

[11] Line (9) x line (10).

[12] 2005 marine intercept survey

[13] Line (11) x (1 - line (12)).

APPENDIX C: Recreational Boating Assessment

Table C2-3. Total raw (with no discount factor adjustment) recreational boating losses

	Lost	Substitute	Degraded	Total
Per-trip value	48.26	48.26	9.65	
Affected trips	866	273	4,359	5,498
Lost value	\$41,782	\$13,173	\$42,071	\$97,026

Tables C1 and C2. Per-trip value obtained from Rosenberger and Loomis (2002).