7. WILLINGNESS-TO-PAY FOR REMEDIATION

Contingent Valuation Method

This method is based upon the simple idea that if you want to know the maximum amount of money that someone would be willing to pay for WBSR remediation, you simply ask them. We used a mail survey to ask such a question of 2,000 households inside and outside the WBSR watershed.

WTP is used to measure the monetary benefits from AMD remediation in the WBSR watershed among the affected general public. People have positive WTP for AMD remediation because of the various improvements associated with property values, recreation, and drinking water quality that were discussed in the previous sections of this report. Other non-use values such as aesthetics also contribute to people's WTP.

To calculate WTP estimates for remediation of AMD damage in the watershed, data were collected from a mail survey of households inside and outside the watershed. From this survey, the total WTP among Pennsylvania residents was calculated. Total WTP helps compare the benefits from AMD remediation with the costs.

The objectives of this mail survey were threefold. First, the survey provides a database from which to derive household-level WTP estimates for cleaning up AMD in the WBSR watershed such that these estimates can be aggregated to the affected population. Second, the survey determines whether in-watershed and out-of-watershed populations have different WTP values. Finally, in addition to WTP questions, this survey included questions to gauge the importance of AMD remediation, attitudes and opinions about water quality, recreational use of water resources, and basic demographic information.

The approach used to estimate WTP was contingent valuation method (CVM). CVM is based upon the simple idea that if an analyst wants to know the maximum amount of money that someone would be willing to pay for an environmental good or service—like watershed restoration—you simply ask them via a constructed or hypothetical market. WTP is estimated as the highest price that a respondent would pay to obtain the environmental good or service. This method is called "contingent" because the dollar values obtained from the survey are contingent upon creation of a market for stream restoration.

The goal of CVM is to construct a question that presents each respondent with a believable market that encourages realistic responses to a WTP question. With AMD pollution, attempting to place a WTP on watershed remediation was complicated by a fairness question: Why should respondents pay to clean up a problem that someone else created (Collins and Rosenberger, 2007)? Thus, the analysis of responses to CVM questions must minimize and/or account for responses that do not reflect respondents' true values (i.e., protest responses).

7.1 Mail survey

A mail survey was used in this study because mail surveys are less expensive than telephone and personal interview contacts. Also, mail surveys can address complex information of watershed restoration. Previous survey instruments utilized in CVM studies for restoration on the Cheat

River (Collins and Rosenberger, 2007) and Opequon Creek (Benson, 2006) watersheds in West Virginia were used as starting points. A draft survey instrument was then reviewed by members of the WBSR Task Force.

Very similar surveys were sent to residents inside and outside the watershed (See Appendices C and D). Section A of the survey included questions on respondents' attitudes, knowledge, and recreational activities related to water resources. Section B included questions about respondents' use and familiarity with the WBSR watershed and its problems. This section also included watershed restoration information, the CVM questions, and follow-up questions. Finally, Section C contained questions about demographic characteristics of the respondents and their households.

The CVM employed in this survey was a referendum question with a modified payment card approach to elicit maximum WTP. CVM included two questions: (1) a referendum question that was patterned after an actual ballot question on the 2006 Pennsylvania statewide election; and (2) a maximum, one-time tax increase question answered by those that did not oppose the referendum. Those who opposed the referendum were referred to a follow-up question that was used to distinguish between actual zero values and protest responses. Protest responses were designated as: "I support clean-up, but I think someone else other than the state should pay for the clean up" and "I support clean-up, but don't support any new taxes." These three questions are presented in Figure 11.

Two populations were identified as potentially affected by restoration in the WBSR watershed. The first population included residents within the watershed. Inside the watershed, the sample population was stratified in order to adequately represent the rural populations in the sample. This stratification included 75% of selected households in less populated zip codes and 25% in more populated zip codes.

The second population consists of all Pennsylvania households with recreational and/or environmental concerns about the WBSR watershed who reside outside the watershed. This population was determined based on recreational visitation rates to the Pennsylvania Wilds region (Sechoka, 2007), which overlaps considerably with the WBSR watershed (See Figure 6). Sixty percent of the outside-the-watershed surveys were sent to the targeted metropolitan areas of Johnstown-Altoona, Pittsburgh, and Philadelphia based on these areas having the highest visitation rates. The remaining 40% of surveys were sent to households throughout the rest of the state.

To create samples from both populations, mailing lists of randomly selected households for each population were purchased from Survey Sampling, Inc. With a target goal of 800 responses (400 per population), 2,000 surveys were mailed to these randomly selected households. Mail surveys were sent in three waves. In early June 2007, 1,000 surveys were sent to each sample population. A week or two later, reminder postcards were sent out. A second mail survey was sent to non-respondents in early July.

Figure 11: Contingent valuation method questions in West Branch Susquehanna River mail survey

B5. One way to provide money for AMD clean up is for the state of Pennsylvania to create a fund through a statewide referendum. Suppose that the following referendum was placed on the next ballot in the state of Pennsylvania:

"Do you favor creation of a fund by the Commonwealth that contains sufficient funds to clean up acid mine drainage in the West Branch Susquehanna River and its stream tributaries?"

How would you vote on this referendum? (Please check one)

____ Yes, I would support a referendum on an AMD clean up fund (Please answer question **B6**)
____ I am unsure how I would vote (Please answer question **B6**)
____ No, I would oppose an AMD clean up fund (Please skip to question **B7**)

B6. In order to pay for the clean-up fund described in question **B5**, funding would be needed. What is the **maximum, one time** tax increase that you would be willing to pay to clean up acid mine drainage in the West Branch Susquehanna River and its stream tributaries? (Please circle the highest amount that you would be willing to pay remembering your household budget)

$0	$5	$10	$15	$20
$30	$40	$50	$75	$100
$125	$150	$200	$300	$500

$1,000 Other (please specify) $_____

B7. If your answer is **NO** to question **B5**, which statement best reflects why you would oppose the referendum to create a fund to clean up acid mine drainage in the West Branch Susquehanna River and its stream tributaries? (Please check one)

____ I support AMD clean-up, but I can't afford to pay any more taxes.
____ I support clean-up, but I think someone else other than the state should pay for the clean up.
____ I support clean-up, but don't support any new taxes.
____ I don't support a clean-up fund because there are higher priorities for spending state money.
____ I don't think acid mine drainage is a problem in the West Branch region.
____ Other, please explain _____

Survey data were entered into Microsoft Excel for tabulation and analysis. Thirty-two surveys were randomly selected to verify that survey coding was correct. These included 12 out-of-watershed and 20 within-watershed surveys. Only three minor coding errors were found.[14] This level of mistakes was deemed small enough to not check all surveys. Coding of all survey responses also was checked for minimum and maximum values on each question, to make sure

[14] A zip code digit was left off one survey. On Question A4 of one survey, the coding was "polluted" when the response was "very polluted." The wrong category was coded for the second part of B3 ("Lack of fish or aquatic life" was coded when the response was "Trash in the river…".

that responses were not coded outside the bounds of the survey responses. Four coding changes were made to address inconsistent responses by survey respondents.[15]

7.2 Survey results

Table 19 contains the statistics on the survey response rates. The return rates were below expectations both inside- and outside-the-watershed. There probably were several factors involved in this low response rate: surveys were sent during the summer; the outside envelope used bulk postage from a non-profit organization rather than a stamp (although the outside envelope was clearly labeled as not being a fund raising letter); and no rewards were included in the mailings. Overall, 271 surveys were returned.

Table 19: Survey response statistics

Watershed area	Surveys sent out	Undeliverables	Net surveys sent out	Surveys returned	Response rate
Inside	1,000	62	938	149	15.88%
Outside	1,000	32	968	122	12.60%
Total	2,000	94	1,906	271	14.22%

7.2.1 Awareness of streams, rivers, and pollution

The survey included questions about people's knowledge of Pennsylvania rivers and streams. This self-reported knowledge was higher among respondents who lived inside the WBSR watershed. A total of 65% of watershed residents report high or medium knowledge, compared with 49% of out-of-watershed residents.

More specifically, the survey asked about respondents' familiarity with the eastern and western portions of the WBSR watershed. Fewer than one-half of in-watershed respondents were familiar with the streams in either portion of the watershed, and only 30% of out-of-watershed respondents were familiar with any streams in the watershed.

Awareness of environmental problems with the WBSR and its stream tributaries can be improved: 31% of in-watershed respondents and 70% of out-of-watershed respondents did not know if environmental problems existed. Most respondents reported they were not aware of how much AMD pollution existed in the WBSR and its stream tributaries prior to receiving this survey (50% in-watershed and 86% out-of-watershed).

[15] Coding for Question B6 was changed from a missing value to zero when the respondent said yes to Question B5 but indicated that s/he supported AMD clean-up but could not afford any more taxes. Changes were made on six surveys. Coding for Question B1 was changed when a respondent indicated they were familiar with one portion yet checked "I am not familiar…". The coding on the "I am not familiar…" response was changed to zero indicating that four such respondents were familiar with some part of the watershed. Coding for Question B3 was changed from a missing value to "Yes" when the respondent indicated problems on the West Branch in the second part of B3, yet did not answer Question B3 itself. This change was made on four surveys. Coding for Question B5 was changed from a missing value to "I am unsure how I would vote" when the respondent skipped Question B5 but responded with a positive value for Question B6. This change was made on three surveys.

Picture 7: Huling Branch Kill Zone in the Kettle Creek watershed

Photo credit: Amy Wolfe.

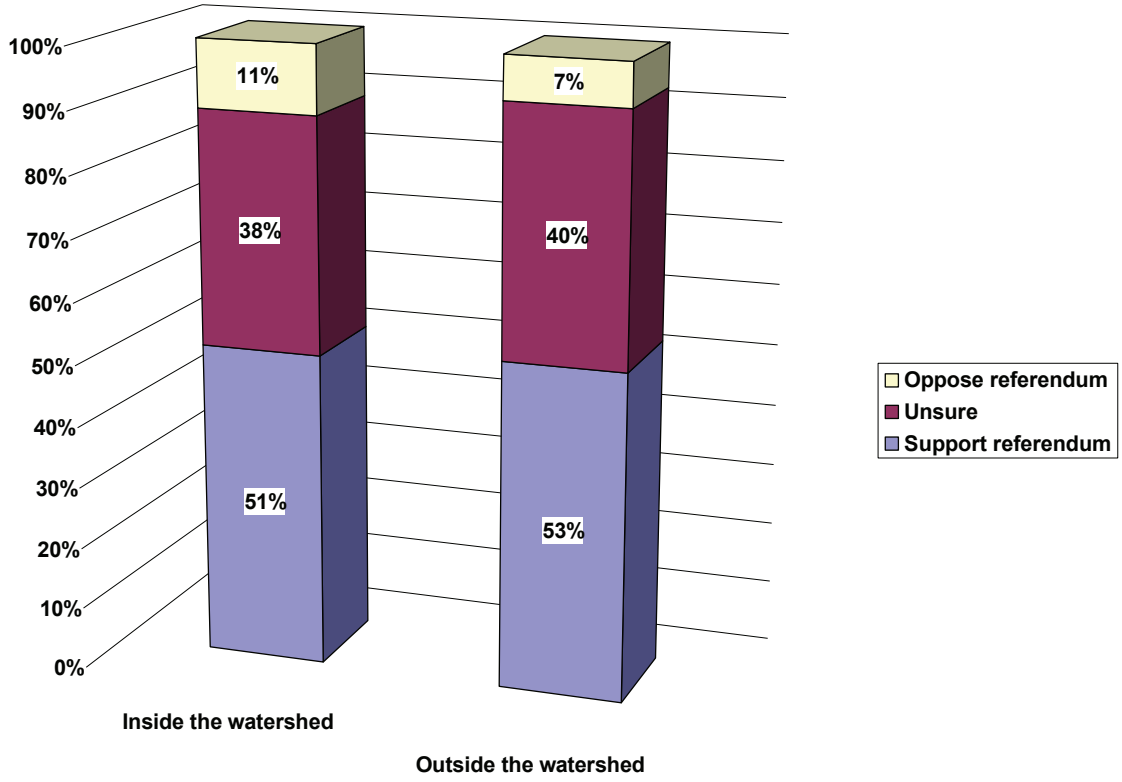
7.2.2 Use of Growing Greener funds

Pennsylvania's Growing Greener program is used for numerous efforts that improve the environment and quality of life, including, among other things, preserving farmland, protecting open space, maintaining state parks, cleaning up abandoned mines, restoring watersheds, and upgrading water and sewer systems. The survey asked specifically about respondents' priorities for spending Growing Greener funds. Cleaning up polluted rivers and streams was the most common choice: 84% in-watershed and 93% out-of-watershed.

7.2.3 Willingness-to-pay to clean up abandoned mine drainage in the watershed

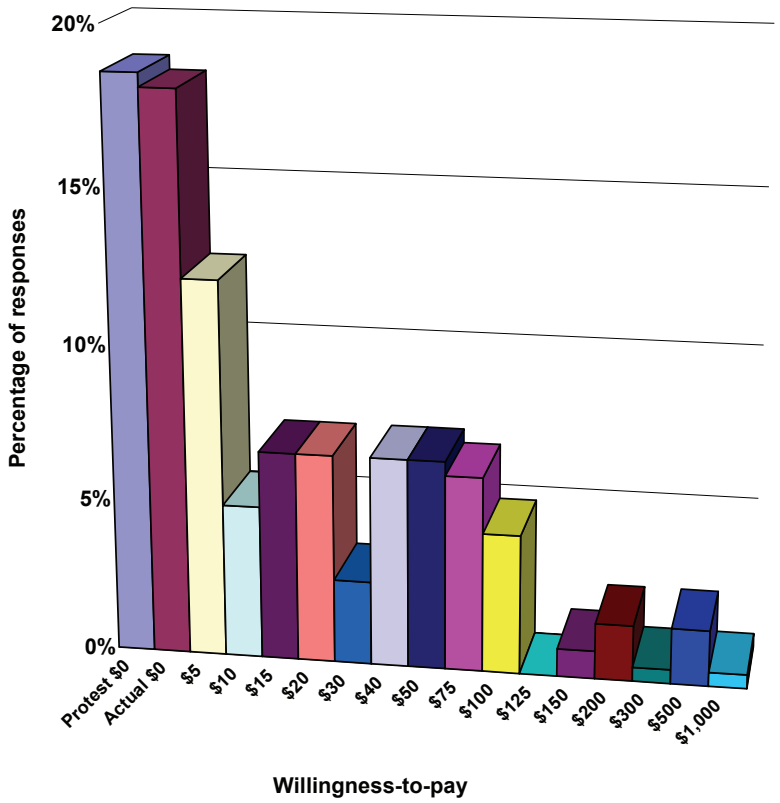
As described above, a series of three questions was used to quantify respondents' WTP to clean up AMD in the WBSR watershed. As shown in Figure 12, just over one-half of respondents were willing to support a referendum to provide funding to clean up AMD in the WBSR and its stream tributaries. Most of the remaining respondents were unsure about whether they would support or oppose such a referendum.

Figure 12: Responses to referendum question



Those who supported or were unsure about a referendum were directed to answer the CVM question. Of the 221 responses to the CVM question, the most common response was $0 (Figure 13). In fact, 37% of CVM responses were $0 responses (when including the "No" responses from Question B5 as a $0 response). Slightly over one-half of all $0 responses were classified as protest responses, as described above.

Figure 13: Distribution of responses to contingent valuation method question



Including the actual $0 responses, the average willingness-to-pay was similar between groups ($42 for in-watershed and $44 for out-of-watershed respondents). This amount reflects the maximum, one-time tax increase a respondent would be willing to pay to clean up AMD.

Most respondents were confident that they would have picked the same answer if the referendum were actually on the ballot (about 75% for both groups). In-watershed respondents agreed more (62% vs. 50%) that they had enough information to decide whether or not to clean up AMD and would more likely use a cleaned-up WBSR compared with today (40% vs. 24%).

7.3 Sample WTP estimates

From the survey sample obtained, there were two deficiencies to applying the CVM responses as WTP estimates for the affected population:

1. the low response rate makes the survey sample suspect in representing the affected population; and
2. the majority of zero responses were protest responses, and therefore did not reflect true respondent WTP values.

The lack of population representation can be noted by the differences in respondent education attainment compared with the general population.[16] Thus, a WTP model was needed to apply WTP estimates to the general population and to account for protest responses. For these purposes, a Tobit model was selected (See Appendix E). This model calculates separate WTP estimates for respondents inside and outside the watershed, as shown in Table 20.

Table 20: Willingness-to-pay estimates for respondents

Watershed area	Mean	Median
Inside	$25 +/- 3.25	$22
Outside	$34 +/- 5.43	$36

These WTP estimates were on a per-household basis and represent a maximum one-time payment for remediation of damage caused by AMD in the WBSR watershed. The mean WTP for WBSR restoration was about one-third higher among respondents outside the watershed. This result can be explained by several factors. Higher education levels among outside-the-watershed respondents would likely increase their willingness to spend money on remediation. Also, familiarity with the watershed increased WTP among respondents outside the watershed but decreased WTP for inside respondents, perhaps due to a greater acceptance of the AMD problem by people living in the watershed.

The WTP estimates found in this study can be considered conservative compared with estimates found elsewhere in the literature. They are higher than the $16 per household found by Collins and Rosenberger (2007) for AMD remediation in the Cheat River in north-central West Virginia. However, the WTP estimates in the WBSR watershed are substantially lower than those found for restoration of bacteria and sediment pollution in the Opequon Creek of Virginia and West Virginia (from $32 to $62 per household annually) as reported by Borisova et al. (forthcoming). They are much lower than other WTP estimates for watershed-wide improvements found in other water quality studies throughout the United States and Canada. Seven studies are summarized by Benson (2006), where household WTP estimates ranged from $60 to $400 annually.

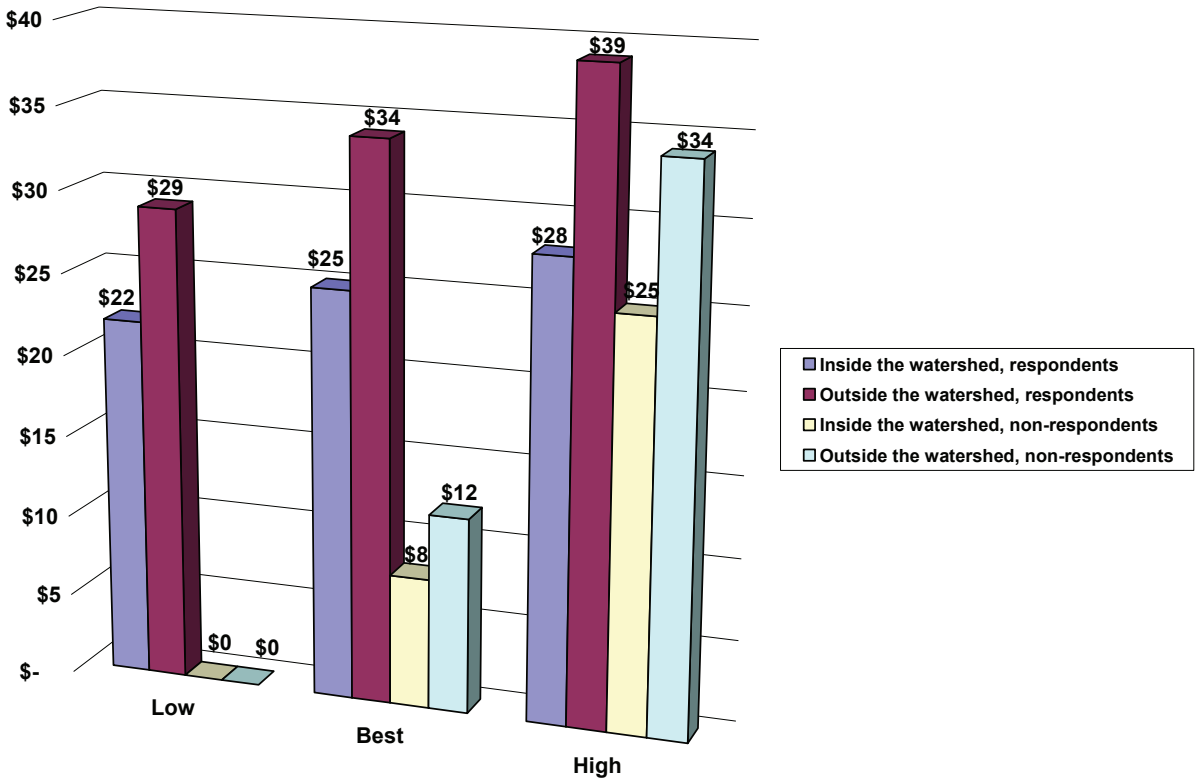
7.4 Affected population WTP estimates

In order to aggregate the sample WTP estimates into total WTP for remediation among the entire affected population, WTP for non-respondents is also required. As described in Appendix E, non-respondent WTP is calculated by assigning variable values for non-respondents in the Tobit model based on assumptions about non-respondents, survey data, and census information. The mean, non-respondent WTP is $8 inside the watershed and $12 outside the watershed.

[16] The survey sample was much more educated than the general population. Compared with census data estimates, college graduates were more prevalent in the sample both outside (49% vs. 26%) and inside (40% vs. 18%) the watershed.

Total WTP for the affected population inside and outside the watershed is computed as weighted averages of respondent and non-respondent WTP estimates. Three levels of total WTP were estimated: low, best, and high.[17] The WTP estimates are summarized in Figure 14.

Figure 14: Household low, best, and high willingness-to-pay estimates

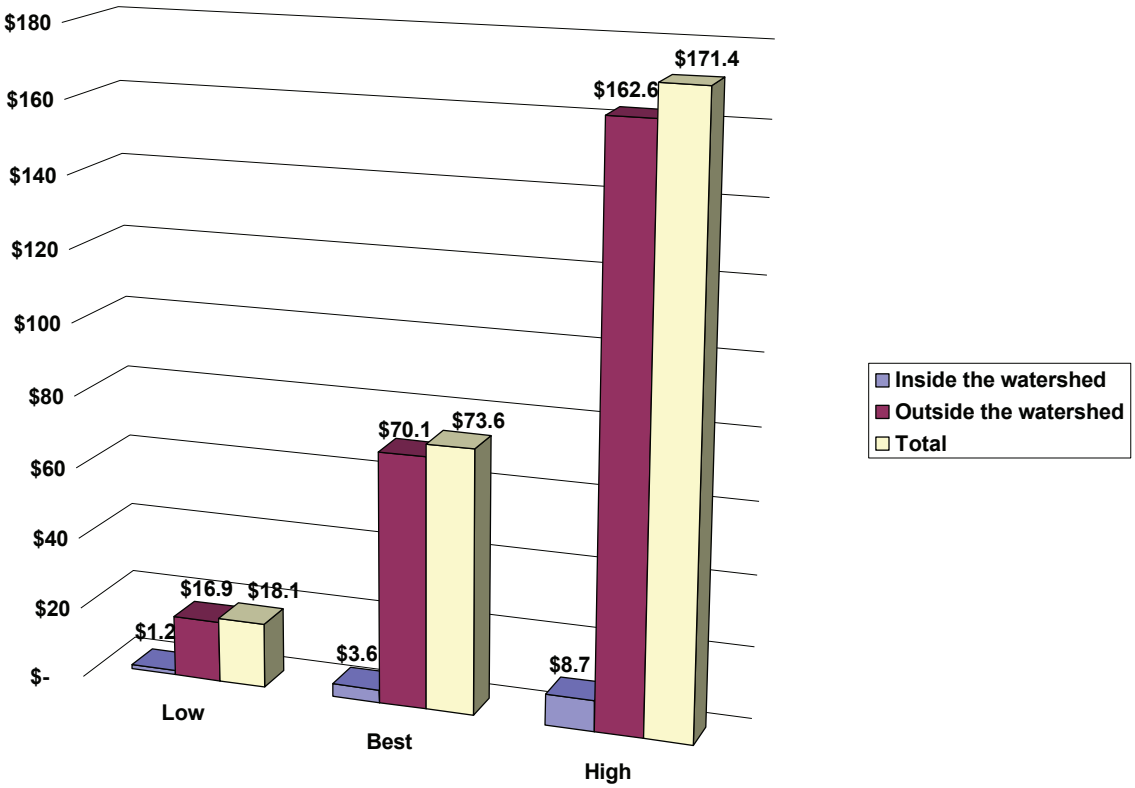


Total WTP estimates from the WTP portion of this study are presented in Figure 15. These estimates were based on 343,000 households inside and 4.7 million households outside the watershed in Pennsylvania from census population estimates in 2006.

In each of the three levels estimated, about 95% of the monetary value in total WTP comes from Pennsylvanians residing outside the watershed. The low estimate was just over $18 million and the high estimate was over $171 million. The best estimate of total WTP was $73.6 million.

[17] The best estimate utilized average WTP for respondents and non-respondents. Low total WTP utilized the lower bound of the 90% confidence interval for the respondent group WTP estimate and assumed a zero WTP for non-respondents. High total WTP utilized the upper bound of the 90% confidence interval for the respondent group WTP estimate and assumed that non-respondents had the average WTP estimate for respondents.

Figure 15: Total willingness-to-pay estimates for remediation (million $)



7.5 Comparisons with other components of this study

The WTP study asks how much money people would be willing to pay to clean up the WBSR and its stream tributaries. Different respondents are likely to base their answers on different perceived benefits. For example, one respondent might be willing to pay in order to improve fishing opportunities. Another respondent might focus in on cleaner drinking water. A third might be thinking about the economic activity that would be generated by funding large-scale remediation projects. And a fourth might be concerned solely about non-use values such as aesthetics. In short, the WTP study provides a broad estimate that mixes different people's values and concerns.

In contrast, Sections 3 through 6 present more specific analyses of particular components of people's WTP, and care must be taken when reporting the results from the different sections.

For example, the local benefits generated by spending remediation dollars are in addition to increased recreational spending, new and cleaner drinking water options, and increased property values. Without asking WTP respondents, it is not known whether WTP estimates include some accounting of people's WTP for remediation in expectation of those remediation projects then benefiting the local community through the purchase of local goods and services.

The local economic benefits of increased recreational spending, discussed in Section 4, likely overlap more completely with the WTP estimates in this section. When people provide WTP figures, these figures include a range of benefits that respondents may attribute to cleaner streams, including recreational benefits. The $22.3 million in expected benefits from increased fishing revenues due to AMD remediation could be expected to be included in the total WTP estimate calculated in this section.

7.6 Summary

Based on a mail survey of Pennsylvanians living both within and outside of the WBSR watershed, the best estimate of total WTP for remediation of the AMD in the watershed was calculated as $73.6 million. Low and high estimates of $18 and $171 million provide a broader range.