SECTION 4.0:
ENVIRONMENTAL CONSEQUENCES

This section presents the environmental and socioeconomic consequences of implementing the four alternatives described in Section 2:

- Alternative 1 - the "no action" alternative which is not obtaining sand and gravel from the rivers (i.e., denial of permit extensions and cessation of all commercial sand and gravel river dredging within the study area);
- Alternative 2 - extraction of sand and gravel from the rivers by dredging with current permit restrictions (i.e., extension of dredging permits);
- Alternative 3 – river dredged with adaptive management; and
- Alternative 4 - obtaining sand and gravel only from land based operations or importation of material from other locations.

The environmental consequences section addresses the following resource areas for each of the four alternatives: hydrology, geology/hydrogeology, water quality, aquatic life, terrestrial life, threatened and endangered species, air, noise, socioeconomics, quality of life, environmental justice and protection of children, and cultural resources.

Key Assumptions

Baseline Conditions. Section 4 presents the estimated environmental and socioeconomic impacts associated with implementing the four alternatives relative to baseline conditions. Since commercial river dredging is not the responsibility of the Federal government to initiate or manage (other than permitting activities), it is assumed that baseline conditions would not include continuation of river dredging. Thus, baseline conditions, described in Section 3, reflect the current environmental condition of the river systems (which includes past dredging activities) without presupposing the continuation of future river dredging. Therefore, under Alternative 1, cessation of future commercial sand and gravel dredging would leave the rivers generally unchanged relative to current baseline conditions (with the exception that some natural recovery processes will continue to occur over time for certain resources). Under Alternative 2 (continuation of river dredging), if river dredging causes an adverse effect to a particular environmental resource (e.g., noise), then implementing this alternative would be characterized as having a negative adverse effect on that resource relative to baseline conditions. However, with respect to socioeconomics, it was assumed that baseline conditions included the temporal socioeconomic effects of recent dredging activities (e.g., certain applicant business activities would continue [e.g., employment, truck traffic] until all sand and gravel stockpiles were exhausted).

Implementation and Enforcement of Current Permit Conditions. It is important to note that Alternative 2 includes a wide array of permit conditions that are imposed to reduce the environmental consequences associated with dredging activities, as discussed in

Section 2.2.1. The environmental consequences discussion presented below assumes that these permit conditions and adequate monitoring and enforcement measures will be put in place to ensure that dredging operations abide by the site-specific permits. Furthermore, it was assumed that permitting agencies will continue to exercise their regulatory authority to develop and/or enforce site-specific permit conditions that will ensure that Federal, state, and local regulations are not violated and significant concerns of local residents are addressed, as already specified in current permit conditions.

Annual Dredging Rates. As discussed in Section 2, it was assumed that under Alternative 2 the applicants would continue to extract sand and gravel from the rivers at the current rate (current annual production is approximately 4 million tons of sand and gravel). This is an important assumption because if annual dredging production were reduced under Alternative 2, then land-based quarry operations would increase production to meet regional demand. This increase in land-based production will generate additional and unique environmental and socioeconomic impacts, which are assumed not to occur under Alternative 2 (i.e., since production of 4 million tons per year is expected to remain achievable under Alternative 2 at least for the next few decades). However, it is likely that implementation of additional permit conditions, or more restrictive site-specific permit conditions, will reduce the overall life cycle of river dredging on the Allegheny and Ohio Rivers due to fewer areas available for dredging.

Definitions. Throughout this section, reference will be made to various geographical areas where environmental and socioeconomic impacts are evaluated. To clarify the use of these terms, definitions of each geographical area are presented below:

Region - A multi-state area including the entire state of Pennsylvania, eastern parts of Ohio, the northern half of West Virginia, western Maryland, and portions of southwestern New York. The "region" includes all areas that would be directly, indirectly, or secondarily impacted by the decisions addressed in this document. This area includes the land-based quarry operations which are located primarily in Pennsylvania. The location of the existing land-based quarries within the region are presented in Figures 2-1, 2-2, and 2-3.

Region of Influence (ROI) - A multi-county area in southwestern Pennsylvania consisting of Allegheny, Armstrong, and Westmoreland counties comprising the primary economic region of influence (ROI). The criteria typically used to determine the ROI are the residency distribution of affected industry employees, commuting distances and times, and the location of businesses providing goods and services to the affected companies, their personnel, and their dependents. Thus, the ROI is defined primarily to evaluate local socioeconomic impacts associated with the alternatives considered in this document.

Study Area - The Allegheny River, between river miles 0 to 69.5, and the Ohio River, between river miles 0 to 40 (109.5 miles total length), including adjacent terrestrial habitat that may be influenced by activities on these rivers (e.g., noise). The document focuses on

the environmental impacts within the study area given the nature of the proposed action (i.e., river dredging).

4.1 ENVIRONMENTAL CONSEQUENCES OF ALTERNATIVE 1

This sub-section presents the environmental consequences associated with the "no action" alternative, which is not obtaining sand and gravel from the rivers. Essentially, this alternative involves the denial of permit extensions and cessation of all commercial sand and gravel river dredging within the study area. Under Alternative 1, cessation of future commercial sand and gravel dredging would leave the rivers generally unchanged relative to current baseline conditions (with the exception that some natural recovery processes will continue to occur over time for certain resources). Therefore, there will be no direct or indirect effect to many of the resource areas within the Allegheny and Ohio River study area relative to current baseline conditions from implementing Alternative 1. In such cases, the condition of these resources will not be repeated in Section 4.1, as they were discussed previously in Section 3.

With respect to resources within the entire region, implementation of Alternative 1 will result in induced secondary effects as a result of increases in production at existing land-based quarries within the region, as well as creation of new land-based quarries near the Pittsburgh area. Utilizing other sources of sand and gravel products is the essence of Alternative 4, which is discussed in Section 4.4. For most resource areas, the reader is referred to Section 4.3 for a discussion of secondary effects (both short-term and long-term) associated with implementing Alternative 1. Therefore, the total effect associated with implementing Alternative 1 includes the effects presented below in Sections 4.1.1 through 4.1.12, as well as the induced effects detailed for Alternative 4, as presented in Sections 4.4.1 through 4.4.12.

4.1.1 Impacts to Hydrology

Impacts to Hydrology in the Study Area. With respect to the natural flow of the river, no adverse effects would be expected relative to baseline conditions because no further dredging would occur. Thus, natural river flow conditions would remain unchanged. Under Alternative 1, dredging would be permitted only for navigational and other maintenance purposes (e.g., maintenance of navigational channels and docks).

No adverse impacts to navigational traffic are expected to occur under Alternative 1. It should be noted, however, that virtually all of the barge traffic in the upper pools consists of sand and gravel shipments by the applicants (98% in Pools 8 and 9, and 57% in Pool 7). In the long term, a decrease in operational revenues supporting the lock and dam system may have an adverse impact on the services provided to commercial river traffic, particularly in the upper-most pools where dredging-related traffic makes up a higher percentage of the river traffic volume. Under this alternative, the U.S. Army Corps of Engineers (USACE) may determine that it is not economically viable to keep the lock and dam system open in the

upper pools of the Allegheny River (especially from Lock and Dam 5 through Lock and Dam 9). Closure of these locks would have a significant detrimental effect on pleasure boaters and fisherman who lock through between these pools. Also, the Pittsburgh Wind Symphony (traveling to Kittanning Riverfront Park) and Gateway Clipper Fleet could not access the upper pools unless specific advance lockage arrangements are made.

Impacts to Hydrology in the Region. Refer to Section 4.4.1 for the presentation of secondary effects associated with implementation of Alternative 1 on stream/riverine hydrology in the region.

4.1.2 Impacts to Geology and Hydrogeology

Impacts to Geology/Hydrogeology in the Study Area. No adverse effects would be expected under Alternative 1 within the study area relative to baseline conditions. Under Alternative 1, commercial extraction of sand and gravel would not be permitted and thus geologic and hydrogeologic resources of the rivers would remain unchanged. Therefore, there would be no impact to the geologic or hydrogeologic resources within the Ohio and Allegheny Rivers relative to baseline conditions.

Impacts to Geology/Hydrogeology in the Region. Refer to Section 4.4.2 for the presentation of secondary effects associated with implementation of Alternative 1 on geology and hydrogeology in the region.

4.1.3 Impacts to Water Quality

Impacts to Water Quality in the Study Area. Under Alternative 1 no further actions would occur in the river systems related to commercial dredging activities; therefore, water quality conditions would be largely the same as they are today in areas of the river where no active dredging is occurring. Because the hydrodynamics of the rivers would remain unchanged over time, areas that may have been anoxic during very warm, dry conditions in the past (such as in certain areas of Pool 8 or Pool 7 in the summer of 1999) are likely to continue to be anoxic in the absence of dredging into the future, with little potential for recovery. Thus, dissolved oxygen (DO) levels and anoxic conditions are likely to remain unchanged relative to baseline conditions, as a result of implementing Alternative 1. This includes some locations that have occasionally been anoxic but were probably not associated with dredging activities (e.g., certain locations in the tail end of Pool 6). Also, discontinuation of dredging would eliminate associated barge traffic. Dredging currently supports most of the barge traffic in the upper Allegheny pools. The apparently fewer sub-standard DO measurements in the lower Allegheny and Ohio River pools as compared to the upper Allegheny pools (Pools 6-9), may be a function of increased barge traffic and better mixing of the water column. If this is true, Alternative 1 may result in an increase in the frequency of substandard DO measurements. Under long-term conditions of Alternative 1, if the upper lock and dam systems (Pools 6 and higher) are closed due to lack of boat traffic, then one

source of water oxygenation would be virtually eliminated. However, DO conditions may be better relative to current baseline in those areas not currently restricted and that are otherwise "vulnerable" to anoxia if dredged to a certain depth and/or configuration.

Turbidity in the study area is also expected to remain unchanged for much of the river and at most times as a result of implementing Alternative 1. Historic data (STORET database) indicates maximum turbidities during summer conditions of 140 FTU in New Cumberland Pool and 20-30 FTU in other pools within the study area. During rain events and other seasons, turbidity levels can be fairly high throughout the study area (80 - 110 FTU). Given the temporary and spatially limited nature of dredging activities, cessation of dredging (including barge-related traffic) is not likely to result in observable changes in river turbidity overall. Ohio Environmental Protection Agency (Ohio EPA) (1994) and ORSANCO (1998) report relatively high turbidity levels throughout the Allegheny and Ohio Rivers due to natural and agricultural sources. For example, several major tributaries to the Allegheny and Ohio Rivers are on Pennsylvania Department of Environmental Protection's (PADEP) 303(d) list of impaired waters due to sedimentation from nonpoint sources (PADEP, 2001). These sources are independent of dredging activity. Removal of dredging-caused turbidity and suspended solids would result in minimal change in river water quality because: (1) turbidity increases caused by dredging and associated barges are spatially limited to the very few areas being actively dredged at any given time in the study area; (2) there would still be barge traffic within the study area, albeit at a lower level, in Pool 5 and areas downstream; and (3) primary sources of suspended sediments and turbidity (agricultural and urban runoff, combined sewer overflows) would still be present, even in the upper pools, without dredging.

Impacts to Water Quality in the Region. Refer to Section 4.4.3 for the presentation of secondary effects associated with implementation of Alternative 1 on water quality in the region.

4.1.4 Impacts to Aquatic Life

Impacts to Aquatic Life in the Study Area. No impacts would be expected to the phytoplankton assemblage, periphyton, or aquatic plants, under Alternative 1 relative to baseline conditions. As explained above, water quality characteristics that might affect aquatic plants and algae (TSS, DO, turbidity) are not expected to change appreciably in the absence of dredging due to nonpoint and point source effects in the study area. Shallow nearshore areas, in which aquatic plants potentially occur are already restricted to dredging, so the absence of dredging should not change the density or distribution of this flora.

Implementation of Alternative 1 may have a beneficial effect on mussels, macro-invertebrates, and fish relative to baseline to the extent that those habitats not currently restricted might be suitable for future colonization of these fauna. However, as much of the permitted dredge areas are at least 200 feet from shore and near mid-channel, it is not clear to what extent these habitats would be colonized in the absence of dredging. Biological

sampling for this Environmental Impact Statement (EIS) indicated similar mussel and macroinvertebrate densities and species in dredged and undredged mid-channel transects.

To the extent that mussels recolonize dredged areas, such recolonization has been occurring under baseline conditions and therefore is not expected to change relative to baseline conditions. It is generally thought that many dredged areas may not be recolonized by mussels to an appreciable extent, despite the predominance of sand and gravel and apparently satisfactory water quality in those areas, because the natural habitat heterogeneity was disturbed.

Impacts to Aquatic Life in the Region. Refer to Section 4.4.4 for the presentation of secondary effects associated with implementation of Alternative 1 on plankton, periphyton, aquatic plants, macroinvertebrates, mussels, and fishes in the region.

4.1.5 Impacts to Wetlands and Terrestrial Life

Impacts to Wetlands and Terrestrial Life in the Study Area. Under Alternative 1 no further actions would occur in the river systems related to commercial dredging activities; therefore, the conditions of terrestrial habitat and wildlife would be unchanged relative to baseline conditions. Any areas that may have been adversely impacted by recent dredging activities (e.g., impacts from siltation) would undergo a natural recovery process which is considered an aspect of natural baseline conditions.

Impacts to Wetlands and Terrestrial Life in the Region. Refer to Section 4.4.5 for the presentation of secondary effects associated with implementation of Alternative 1 on terrestrial resources in the region.

4.1.6 Impacts to State- and Federally-Listed Threatened and Endangered Species

Impacts to State- and Federally-Listed Species within the Study Area. Under Alternative 1, federally-listed aquatic species might increase in abundance relative to baseline in those habitats not currently restricted and which might be suitable for colonization. However, critical habitat has not been identified by U.S. Fish & Wildlife Service (USFWS) for the federally listed mussel species. Current information suggests that neither the Clubshell or the Northern riffleshell species are likely to be found in most areas permitted for dredging. Thus far, out of a total of over 80 recent dive surveys in the study area, the Northern riffleshell has been found only in a small area at RM 58.85 in Pool 8 in < 10 feet of water, and one individual Clubshell mussel has been collected at RM 58.3. Previous sampling at the East Brady Bridge and at the West Hickory Bridge, in the free-flowing part of the Allegheny River, also indicate a preference for relatively shallow water with moderate current velocity for both federally-listed mussel species (Smith et al., 2001). In general, these are not the types of areas currently permitted for dredging. The habitats potentially utilized by state- and/or Federally-listed species would therefore likely remain unchanged relative to baseline

conditions. If, however, the distribution of the listed mussel species has been constrained up to now by water quality factors, it is then possible that these species could increase in the future as water quality continues to improve in the study area.

Impacts to Listed Species in the Region. Refer to Section 4.4.6 for the presentation of secondary effects associated with implementation of Alternative 1 on listed species in the region.

4.1.7 Impacts to Air Quality

Impacts to Air Quality in the Study Area. No adverse effects would be expected under Alternative 1 within the study area. Under Alternative 1, no further actions would occur in the river systems related to commercial dredging activities; therefore, air quality will remain unchanged relative to baseline conditions.

Impacts to Air Quality in the Region. Refer to Section 4.4.7 for the presentation of secondary effects associated with implementation of Alternative 1 on air quality in the region.

4.1.8 Impacts to Noise

Impacts to Noise in the Study Area. No adverse effects would be expected under Alternative 1 within the study area. Under Alternative 1, no further actions would occur in the river systems related to commercial dredging activities; therefore, noise levels will remain unchanged relative to baseline conditions.

Impacts to Noise in the Region. Refer to Section 4.4.8 for the presentation of secondary effects associated with implementation of Alternative 1 on noise levels in the region.

4.1.9 Impacts to Socioeconomic Conditions

4.1.9.1 Overview of Socioeconomic Impacts

Under Alternative 1, the permits held by four companies to commercially dredge the Allegheny and Ohio Rivers in the state of Pennsylvania for sand and gravel would not be renewed.[1] Alternative 1, which would prohibit these companies from conducting their core business functions, would adversely affect the ROI and state economy in two general ways:

[1] At the time the economic analysis was conducted, four companies comprised the consortium of dredgers that are the subject of this EIS. Recently, the smallest of the four companies (Lane Industries) ceased operations, leaving only three active dredgers on the Allegheny and Ohio Rivers in Pennsylvania. This resulted in < 15% change in overall production of the industry. As the conclusions did not change, the original analysis remains valid.

- Reduce employment and income due to the downsizing or closing of businesses associated with river-based sand and gravel production; and
- Increase the cost of commercial and public infrastructure projects that currently use river-based sand and gravel primarily in concrete and asphalt.

The potential adverse economic impacts of Alternative 1 would be both short-term and long-term and direct and indirect. Furthermore, secondary actions taken by other companies to supply the shortfall in sand and gravel material would create regional economic impacts. However, as will be described in later sections, the magnitude of these adverse impacts would be small compared to the overall size of the regional economy.

Direct employment and income losses would result from the closure or significant downsizing of those regional firms that produce river-based sand and gravel products. Specifically, river-dredging firms that do not currently own and operate land quarries would likely be forced to terminate business operations and lay off their workers. Although these firms might be able to shift their operations to another river location outside the state of Pennsylvania to obtain certain types of aggregates (e.g., Type A sand), such a move would require new permits and likely involve a protracted review process with an uncertain outcome. In either case, the ROI would experience a direct loss in employment and income as those workers associated with river dredging activities would no longer be employed in the ROI. Furthermore, river dredging companies would no longer purchase supplies and services (e.g., fuel, equipment, and repair services) from other firms located within the ROI, thus reducing the revenue and income generated through inter-industry trade. Other adverse indirect economic impacts would result from diminished spending by households that would have smaller incomes because of reduced employment. Hence, the initial economic impacts of terminating river dredging activities would ripple throughout the ROI economy leading to losses of output, income, and employment in other industrial and service sectors.

Termination of commercial dredging could also adversely affect the ROI and state economy as a result of shortfalls in supply of sand and gravel materials produced within the ROI. Although reserves elsewhere in Pennsylvania, West Virginia, Ohio, and New York could potentially makeup for any shortfall, there would likely be additional costs associated with these alternative sources. Under the best-case scenario, alternative existing land-base sources would be able to compensate for the loss of river-based production, however, these materials would likely be extracted at higher costs and transported over larger distances than under current conditions. It should be noted, however, that there is uncertainty as to whether existing land-based operations could indeed increase production as assumed, or that new quarries could be constructed near the Pittsburgh area given economic constraints, environmental rules and regulations, land use ordinances, zoning laws, and probable public opposition to new quarry development.

Increased aggregate material costs would be translated into higher costs for highway and building construction and adversely affect both the regional and state economy, because the

higher costs would be borne by both ROI consumers and state taxpayers. Nonetheless, these adverse affects would be small compared to the overall level of economic activity conducted at both the regional and state levels. Furthermore, total cost impacts on planned construction projects would be relatively small because for most building projects, aggregate materials account for only a small portion of the total cost.

Implementation of Alternative 1 would also generate secondary socioeconomic impacts within the region and the state. These secondary impacts would be associated with the increased production of aggregates at existing land-based quarries within the region, importation of sand and gravel from sources outside the region, and from potential development of new quarries in or near the ROI in the long-term. These secondary impacts of Alternative 1 represent the economic impacts associated with implementing Alternative 4. Given the linkage between Alternatives 1 and 4 with respect to socioeconomic impacts, the methods, analysis, and results for both are presented below.

4.1.9.2 Overview of Methodologies

Methodologies for Quantifying Economic Impacts. Quantifying the magnitude and extent of these economic impacts was accomplished through a multi-step process:

- Collection and analysis of regional economic and industry-specific data.
- Statistical analysis of data to estimate alternative land-based production of sand and gravel and cost impacts (Monte Carlo Simulation).
- Application of Economic Input-Output Model to estimate changes to economic indicators in the ROI and state of Pennsylvania.

Data Collection and Sources. Economic data obtained from various government agencies including the Census Bureau, the Bureau of Economic Analysis, and Bureau of Labor Statistics were used to characterize the regional economy and the sand and gravel industry. Regional socioeconomic data, including information on labor force size, historical unemployment rates, personal income, and population were used primarily for descriptive purposes and to provide context to estimated changes in the river dredging industry and other economic indicators. Industry-specific data on employment, output, wages and salaries were used as inputs into the economic model.[2] Data were collected on sand and gravel end-use to determine size and geographic extent of the river dredgers' market.

[2] The economic input-output model contains detailed regional economic information on employment, income, output, and trade flows for all industry and service sectors located within the ROI. This information is used by the model to develop the economic impact multipliers.

Information was also obtained on production and expansion capacity of existing land-based sources of Type A sand, SRL E aggregate, and other coarse aggregates to estimate the potential to replace the lost river-based production. Data were collected on historical aggregate production levels as well as information on the potential for the existing quarries located within a 150-mile radius of the Pittsburgh Area to expand production capacity.[3] The primary sources for this information were the Pennsylvania Department of Transportation (PennDOT), PADEP, and aggregate producers.

Monte Carlo Simulation of Data. Alternative land-based production and expansion data, together with cost information for different modes of transportation were then used in Monte Carlo simulations to develop estimates of alternative production output and price impacts. Monte Carlo simulation is an efficient technique for calculating the probability distributions of possible outcomes for a defined set of scenarios. This technique is particularly useful when analyzing problems with elements of uncertainty that are too complex to be solved by strict analytical methods.

For this analysis, the information collected on existing alternative production sources and on the potential for capacity expansion, was entered into the Monte Carlo simulation model to develop forecasts of additional sand and gravel output by product type by existing quarries in the absence of river-dredging. As described in detail in the technical appendix, probability distributions and confidence intervals were derived for each of the input parameters (current annual production, expansion capacity, cost per ton, shipping cost) for which data were collected, and forecasts were generated to estimate how many quarries would be required to expand output to compensate for the elimination of river-based material from the regional market.[4] This information was then used to estimate the average distance of these alternative land-based sources to the Pittsburgh Metropolitan Area. Monte Carlo simulations were also used on transportation and expansion cost data to estimate probable average transportation costs (ton/mile), and production costs for each of the three products. Production and transport costs were then combined with estimates of average distance transport requirements for each of the three products to estimate incremental price increases on a per ton basis for each of the three commodities. These estimated price levels were then entered into the economic impact model to estimate impacts to the ROI economy and the state of Pennsylvania.

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[3] Aggregate materials are typically extracted and used within an 80-mile radius. However, depending on particular market conditions (e.g., absence of local reserves) and the type of transportation mode used, such as river barges or trucks, aggregate material can be transported significantly greater distances than 80 miles. The per ton cost of the product, however, would increase substantially; i.e., every additional mile traveled significantly increases material cost.

[4] The number of land-based quarries required to fill the production loss is based on the estimated average expansion capacity for all land-based quarries certified to produce Type A, Level E Aggregates, and other coarse aggregates for use in Pennsylvania State Highway construction. In reality, expansion levels would vary from quarry to quarry.

Economic Input-Output Analysis. Projections of economic impacts to the ROI and the state of Pennsylvania resulting from changes to the river-based sand and gravel industry and from product price increases have been developed using the Impact Analysis for Planning Model (IMPLAN). IMPLAN is an economic Input-Output Model, originally developed by the U.S. Forest Service for natural resource planning, but later updated and adapted by many other government agencies and private sector analysts for use in economic impact analysis. The IMPLAN system has been in use since 1979 and has evolved from a mainframe non-interactive application to a menu-driven microcomputer program that is completely interactive.

The IMPLAN model is a regional input-output model that is derived by using local data combined with national input-output accounts. The model uses the most currently available data obtained from the U.S. Department of Commerce, Bureau of Labor Statistics, and other federal and state agencies. The model uses trade flow characteristics to trace economic changes in a regional economy arising from changes in the level of activity in one or more identified sectors. The model uses county-level data to adjust the national income accounts to fit the trade flow characteristics of the sub national ROI for the study. The analyst develops an ROI based on various factors, including residential distribution of the directly affected workforce, and trading and commuting patterns. ROIs are typically an aggregation of one or more counties, since the county is the smallest jurisdiction for which most economic data are collected. IMPLAN estimates economic changes for the defined ROI and quantifies changes to the following economic indicators:[5]

- Sector Output
- Employment
- Personal Income
- Total Value Added
- Employee Compensation
- Proprietors Income
- Other Property Income
- Indirect Business Taxes

Changes in these indicators provide a detailed picture of how a change in a specific sector affects businesses, households, and the public sector in the whole region.

Major Assumptions used in Economic Input-Output Analysis. The predicted economic impacts from Alternative 1 were derived using the methodologies described above. The analytical results of the modeling efforts, however, are affected by several factors including the quality of the data used and the types of assumptions made. Although Monte Carlo simulations were performed to address the uncertainties associated with the aggregate production capacity and expansion data, and unit costs, numerous other assumptions were

[5] Appendix M provides definitions for each of these economic indicators.

made regarding market conditions and production and transportation costs, which would also affect the outcome of the model results. In general, however, the analysis used conservative assumptions to help ensure that projected impacts would not be overstated. The major assumptions used in the statistical and economical modeling are:

Under Alternative 1, the river-dredging firms would cease operations and all workers directly associated with dredging operations become unemployed.

- Land-based quarry operations within the region would increase production output to 100 percent of existing production capacity or expand production capacity to satisfy the demand for sand and gravel material.

Imported aggregate material would be hauled from land-based quarries to the Pittsburgh Metropolitan area using trucks, and there would be sufficient truck capacity to meet the additional demand.

Projected price increases for all three products would be solely attributable to increases in transportation and production costs regardless of supply/demand cost increases.

All cost increases for aggregate materials would be passed on to households either through tax increases or through price increases.

The first assumption derives from the fact that all but one of the affected businesses are entirely dependent on river-based sand and gravel. Under Alternative 1, the affected companies would likely terminate all business functions and layoff workers directly associated with dredging activities. Although two of the affected firms also operate concrete and asphalt plants dependent on river-dredged material, it is assumed these plants would continue to operate but use alternative sand and gravel sources at higher costs. Hence, the initial economic impacts to the ROI projected in this analysis are based only on the elimination of dredging activities and the loss of income and employment directly associated with those functions.

The second assumption was developed using industry and state data on mineral resources, that indicated much of the river-based sand and gravel could be made up through expansion of existing land-based quarries in the region. It is assumed that existing land-based quarries within the region would increase production output to supply needed sand and gravel materials in the event that commercial river dredging ceases. This assumption does not take into account that quarry owners could face numerous obstacles to increasing their production output for an extended period of time. Significant constraints on production expansion may include permitting issues, age and physical condition of quarry, and labor and capital requirements for increased output. For example, many quarry operations are small businesses and may not have the requisite capital to invest in additional equipment that would be needed to sustain production increases. There are also physical constraints such as

streams, wetlands, roads, railroads, utilities, and dwellings, which frequently impede the siting or expansion of land quarries. Legal constraints including local ordinances and permit limitations could also prevent quarry expansion or increased operational hours. Competition for aggregates from markets located closer to the alternative sources could also limit the quantity of available replacement supply that could enter the Pittsburgh market.

The analysis does not quantify the potential for new land-based quarries to compensate for any supply shortfall that would result from termination of river-based dredging. While the area's geological resources could be developed as alternative sources of aggregate, the existing regulatory environment creates significant barriers to entry into the regional market. For example, opening a new quarry requires that numerous environmental permits be issued and local land use approvals obtained. Depending on the location and the degree of local opposition to the quarry (which is a common occurrence), the permit process can be protracted, sometimes taking years to complete with an uncertain outcome (see Appendix N for further discussion). Thus, while the geological potential exists to open new land-based operations, the level of uncertainty associated with the timing of quarry development and location of the facilities can pose significant obstacles to conducting a quantitative analysis of this option. Therefore, the opening of new land-based quarries is addressed only qualitatively in this analysis.

It should also be noted that the analysis evaluated the potential for other source materials to substitute for the river dredged aggregate material. Specifically, recycled glass (RG) and recycled Portland Cement Concrete (RPCC) were assessed for their potential use in highway and building construction. Information provided by PennDOT (PennDOT, 2003) suggested that these materials would not meet their specifications and could not be used in highway construction. The quality of the recycled material may also not be suitable for most building construction products. Furthermore, there are no major recyclers in the Pittsburgh area, hence, the materials would have to be transported over long distances, rendering this option uneconomical, even if specifications could be met.

Limited truck capacity could also impede the flow of aggregates into the ROI from other markets. These materials are typically transported in three-axle trucks (e.g., dump trucks), or tractor-trailers, which have capacities of only 22-25 tons. Information provided by producers at the time the economic analysis was performed indicated that there was insufficient truck capacity to transport 4 million tons of sand and gravel annually across the region. The ability of trucking companies to accommodate such an increase in demand, however, would largely depend on the state of the regional economy at the time dredging ceased operations. Under robust economic conditions, the demand for vehicles used for transporting bulk materials such as aggregates and coal would likely leave existing trucking companies with inadequate excess capacity to meet the significant additional regional demand created by the need to transport substitute aggregates by land transportation modes. Conversely, during periods of sluggish economic conditions, the demand for trucking capacity would be weak, increasing

the likelihood that trucking companies would have sufficient excess capacity to meet the additional demands to transport aggregate materials across the region.

Because of the uncertainty of future demand, and the difficulty of projecting truck capacity into the future, this analysis conservatively assumes that companies would be able to reallocate or expand existing trucking capacity to meet the additional demand. This assumption (i.e., sufficient truck capacity is available to ship materials) is critical to the study results, because without sufficient transportation capacity, there would be no way to deliver the sand and gravel to the Pittsburgh area. Of the three potential modes of transport (barges, railroads, trucks), trucking would be the mostly likely mode used to transport sand and gravel from the alternative land-based quarries to Pittsburgh. Barges are the least expensive transport mode on a ton/mile basis, but because the alternative sources of sand and gravel are located away from the major navigable rivers, barging would not be practical. Furthermore, dredging operations further downstream on the Ohio River are located far enough away from Pennsylvania that land-based operations can deliver products to Pittsburgh at a lower price even though trucking is more costly than barging on a per mile basis. In addition, river-based materials downstream of the study area generally do not meet PennDOT specifications for Level E aggregates and Type A sand. Although rail transport is commonly used in the area for transporting bulk commodities, rail transport is typically used for higher valued products (on a $/ton basis) such as petroleum and coal rather than aggregates. Competition from these commodities for the limited railroad capacity would render rail transport economically infeasible.

The economic analysis also conservatively assumes that price changes for sand and gravel would be affected only by increases in transport distances and production expansion costs. Specifically, the predicted price increases do not take into account potential market related impacts on trucking costs and sand and gravel prices, i.e., supply/demand relationships. For example, short-term trucking prices could significantly increase as aggregate suppliers shift from barge to land transport and attempt to purchase the available truck capacity. Unit prices (cost/ton/mile) could increase sharply until the trucking sector is able to adapt to the new market conditions. Similarly, sand and gravel prices could also increase considerably in the short run as demand would outstrip supply until the market reached equilibrium (i.e., new land-based production increases supply). However, because of the lack of data on price elasticity for either trucking services or sand and gravel products, it was not possible to accurately estimate the impact of these market factors on total cost. Furthermore, because the sand and gravel industry is a highly competitive sector, producers often have difficulty raising prices beyond their own cost increases. Hence, for purposes of this analysis, no cost increases were estimated for these market factors.

The analysis does take into account potential cost increases associated with expansion of existing quarries. Using information provided by producers, the analysis conservatively assumes that per unit costs of production would rise 50 percent. The analysis used a range of

cost increases and included those estimates in Monte Carlo simulations to account for the large degree of uncertainty associated with those figures.

Finally, the economic analysis assumes that the increase in price of sand and gravel would be ultimately passed on to consumers. Increased sand and gravel prices would raise the cost of public transportation projects, whose costs are borne by taxpayers. Private sector construction project costs would also rise and be passed on to consumers in the form of higher prices (e.g., building purchase or lease prices). Because it is not possible to identify the universe of end users of river-based sand and aggregate materials, although the majority of the aggregate materials are used in state highway construction (which are paid for by all Pennsylvania taxpayers), the analysis does not differentiate between public and private sector consumption. The analysis assumes the aggregate cost increases are borne equally by all Pennsylvania households even though the ROI would be disproportionately affected through increases in local construction costs. This approach would likely capture the overall impact of sand and gravel price increases for transportation construction but would underestimate ROI economic impacts from price increases to private construction projects.

4.1.9.3 Impacts to Socioeconomic Conditions

Impacts within the ROI. Under Alternative 1, minor adverse short-term and long-term economic impacts would be expected within the ROI. Table 4-1 presents changes to the major economic indicators resulting from termination of commercial river dredging on the Ohio and Allegheny Rivers. Approximately 214 jobs directly associated with river dredging activities would be permanently eliminated. An additional 200 jobs in the ROI would be lost due to reduced spending by the sand and gravel industry and by affected ROI households. Thus, the direct and indirect impact associated with Alternative 1 would be the loss of 414 jobs. As a result of secondary actions by land-based quarry operations within the ROI (i.e., Alternative 4), some new jobs would be created by land quarries expanding their output to meet ROI demand for sand and gravel products. However, most of the replacement sand and gravel would originate from existing quarries located outside the ROI. In fact, only supplies of coarse aggregate could be significantly replaced by existing land quarries located within the ROI. Expansion of these quarries is estimated to generate a total of 24 jobs in the ROI. Hence, the total net employment loss in the ROI attributable to elimination of river dredging activities would be approximately 390 jobs. As noted earlier, it is possible that over time, new quarries would be developed in the region to compensate for the loss of river dredged material. Under such a scenario, the number of jobs lost would be smaller.

As seen in Table 4-1, there would be decreases in all other economic indicators evaluated by the IMPLAN model. Personal income would decrease by more than $11.5 million, industry output by $46.5 million, and total value added by $19.3 million. These changes, while not inconsequential, are small compared to the overall large urban economy comprising the ROI. All decreases in economic activity would be a small percentage of the ROI baseline and therefore would not be considered significant. For example, because total ROI employment

exceeds 1.2 million jobs, the projected percentage change in ROI employment attributable to the cessation of river dredging activities would be negligible.

Table 4-1
Economic Impacts of Terminating Commercial River Dredging

Indicator	Direct Impacts	Indirect and Secondary Impacts	Total
Employment	-214	-176	-390
Employment Compensation	-$4,923,993	-$5,548,914	-$10,461,908
Personal Income	-$5,080158	-$6,417.898	-$11,498,055
Output	-$28,533,162	-$18,062,027	-$46,486,171
Total Value Added	-$8,153,781	-$11,155,653	-$19,309,434
Indirect Business Taxes	-$166,721	-$1,126,171	-$1,292,891
Proprietors Income	-$167,164	-$873,343	-$1,040,508
Other Property Income	-$2,906,904	-$3,607,223	-$6,514,126

Note: These estimates combine losses from river-dredging and potential gains from expansion of existing land quarries. They do not include the effects of potential development of new quarries.
All impact estimates have been updated to 2002 dollars.

Changes in these gross/macroeconomic indicators would be too small to affect other socioeconomic indicators including the housing market, public education, or other public services such as fire protection and law enforcement. While it is possible that some of the unemployed workers would migrate out of the ROI, the numbers would be too small to affect the public services or the public finances of the communities in which they currently reside.

Impacts to the State Economy. The price of sand and gravel products would increase due to increases in transportation and production costs. Currently, river-based sand and gravel fill almost all of the regional demand for these products. As a result of secondary actions under Alternative 1 (i.e., Alternative 4), Type A Sand and Level E Aggregates would be supplied by producers primarily located outside the ROI. Based on analysis of the distribution of existing land quarries, the analysis estimated that fine aggregate Type A Sand and Level E Aggregates would be transported from sites averaging 78 and 80 miles, respectively, from Pittsburgh. Because coarse aggregates resources are more plentiful in the ROI, the average distance from suppliers to Pittsburgh would be only about 28 miles.

Expanding quarry output could increase production costs by up to 50 percent or more due to increased capital costs and other factors such as limited market demand for byproducts. For example, quarries capable of increasing Level E Aggregates for the ROI market would also

generate additional coarse aggregates of lower quality. However, because the ROI demand would be filled by land quarries located closer to Pittsburgh at a lower cost, these producers could be compelled to stockpile the coarse aggregate until sufficient demand is created (increasing inventory costs). Taking both transportation costs and production cost increases into account, the modeling results indicate that on average coarse aggregate prices would increase price by approximately 43 percent, while prices for Level E and Type A Sand would increase approximately 121 percent and 226 percent, respectively. The total dollar increase for all three products based on existing demand would be approximately $37.8 million dollars per year.

The substantial increases in the price of sand and gravel would affect the price of concrete and asphalt and ultimately the cost of construction projects in which these materials are used. The actual effect on the price of end use products, whether they be highways or buildings, will depend on the percentage of total costs attributable to aggregate material costs. For new highway construction projects, for example, aggregate material costs may account for as little as two percent of the total construction costs (including land acquisition, highway design, and so forth). Hence, a doubling of the cost of aggregate material would result in only a small percent increase in the cost of constructing a new highway. However, for repaving projects, the costs of raw materials would comprise a much higher percentage of the total project. The typical cubic yard of concrete or ton of asphalt contains approximately 95 percent aggregate. For example, if the estimated price for concrete is $70 per cubic yard, it would increase to $160 per cubic yard; for asphalt, if the estimated price is $30 per ton, it would increase to approximately $60 per ton.

While Level E Aggregate is used almost exclusively in state highway projects, Type A Sand and Coarse Aggregates are employed in both commercial and public sector construction projects and Level E would still be required. Because data are not available to identify the universe of end users, the analysis assumes that these material cost increases get passed on to all residents in the state of Pennsylvania (state highways are paid for by all residents of the state, not just ROI residents). As noted earlier, this assumption understates the economic impacts that would be disproportionately borne by the ROI residents, but would provide a reasonable estimate of how these forecasted price increases would affect the state economy. In particular, much of the coarse aggregate is consumed by local users and for private sector construction. The impact of price increases for these aggregates would be mostly confined to the ROI economy since these projects would not be paid for by the state taxpayers.

Table 4-2 presents estimates of the impacts to the state economy as a result of price increases for sand and gravel. Price increases would generate a loss of 595 jobs and a reduction in personal income by almost $17.3 million, state output would diminish by $45.7 million. Combined with ROI losses from termination of dredging activities (390 jobs as shown in Table 4-1), total job losses to the state economy would exceed 1,000 and personal income would decrease by about $28.8 million. Compared to the overall size of the State economy, these losses would be considered minor. For example, total employment in Pennsylvania

during 2000 approached 7 million and total personal income exceeded $365 billion. The economic losses from cessation of river dredging would be small for each measurable indicator.

Table 4-2
Economic Impacts of Price Increases for Type A Sand, Level E Aggregates, and Coarse Aggregates

Indicator	Direct Impacts	Indirect and Secondary Impacts	Total
Employment	-350	-245	-595
Employment Compensation	-$8,984,463	-$6,872,558	-$14,897,894
Personal Income	-$9,794,641	-$7,492,294	-$17,286,935
Output	-$25,471,158	-$20,249,528	-$45,720,686
Total Value Added	-$16,040,834	-$11,956,947	-$27,997,781
Indirect Business Taxes	-$1,488,316	-$1,032,779	$2,521,095
Proprietors Income	-$1,245,457	-$1,143,584	-$2,389,041
Other Property Income	-$4,757,875	-$3,431,876	-$8,189,753

As noted earlier, in order to make up for the short fall in production of aggregate materials that would result from termination of dredging permits, land based quarries would have to expand their output. Such an expansion would lead to an increase in economic activity associated with these quarries including increases in employment. Based on current output, it is estimated that approximately 75 percent of the total aggregate material supply lost due to the termination of river dredging could be potentially replaced by in-state mining operations. Assuming land-based quarrying and river dredging operations have similar employment to production ratios, approximately 165 new jobs would be created as a direct result of expansion of land-based quarries. Using IMPLAN to assess the impact on state employment, a total of 280 new jobs would be created within the state of Pennsylvania due to direct, indirect, and induced effects of expanding land-based sand and gravel production. Therefore, the net effect on employment for the state of Pennsylvania as a result of shutting down the river dredging would be a loss of about 700 jobs. The other negative economic impacts as noted in the preceding section would also be reduced due to the indirect economic activity generated by land-based quarry expansion. For example, because these new sources of aggregate would be located further away from Pittsburgh (and away from major navigable waterways) than the existing sources, there would likely be a larger demand for trucking services that would extend to Pennsylvania's borders.

If new land quarries were developed and if these quarries were located closer to Pittsburgh than the existing quarries, the direct and secondary impacts of cessation of river dredging would be further diminished since the operations would have lower transportation costs than existing quarries. The ability of new quarries to affect the ROI market price would depend on their production output and location.

Other Potential Economic Impacts to the State, ROI, and Study Area. The termination of the commercial river dredging could engender other adverse economic impacts not captured by the modeling efforts. Insufficient information precluded modeling these impacts so they are described qualitatively.

Loss of Royalties: During 1998, the commercial river dredgers paid more than $335,000 in Inland Waterway Royalties to the Pennsylvania Fish and Boat Commission (PFBC). These royalty payments are specifically tied to river-based aggregates; in the past, the payments have accounted for almost one percent of the commission's budget. Specifically, royalty rates that were set at 25 cents per ton were raised to 30¢/ton plus/minus an amount equal to the change in producer price index (PPI) from the base year (2002), but not less than 25 cents. This revenue would not be reinstated if the aggregate materials were to be replaced by land-based sources.

Reduction in Cost Effectiveness of Lock and Dam System: The loss of river-based aggregates could reduce the cost effectiveness of the lock and dam system maintained by the Army Corps of Engineers, because of lower traffic volume. Aggregates comprise a significant portion of the total volume of transported goods (barges carrying sand and gravel accounted for 7 percent of all river traffic in the study area, third after petroleum and coal). The elimination of this industry would reduce traffic and increase the cost of the Army Corps maintenance per unit volume of traffic. A secondary effect of reduced river traffic would be losses in revenue to firms servicing barges including fuel service and repair companies and dock businesses.

It should be noted that virtually all of the barge traffic in the upper pools of the Allegheny River consists of sand and gravel shipments by the applicants (98% in Pools 8 and 9, and 57% in Pool 7). In the long term, a decrease in operational revenues supporting the lock and dam system may have an adverse impact on the services provided to commercial river traffic, particularly in the upper-most pools where dredging-related traffic makes up a higher percentage of the river traffic volume. Under this alternative, the USACE may determine that it is not economically viable to keep the lock and dam system open in the upper pools of the Allegheny River (especially from Lock and Dam 5 through Lock and Dam 9). Closure of these locks would have a detrimental effect on pleasure boaters and fishermen who lock through between these pools. Also, the Pittsburgh Wind Symphony (docking at Kittanning Riverfront Park) and Gateway Clipper Fleet could not access the upper pools unless specific advance lockage arrangements are made.

Delays in Major Development Projects: Termination of river dredging activities could lead to short-term shortages once existing stockpiles are diminished since alternative aggregate sources would not be able to quickly compensate for the supply reduction. Expansion of output would require new resource allocation, including additional capital investment. In some cases, land quarries would have to obtain additional permits. Available truck capacity might be inadequate depending on other demands at the time. Together, these factors could lead to disruptions in ongoing construction projects and delays in new projects. Such impacts could adversely affect the economic viability of some projects and lead to additional financial losses to the ROI economy

Demographic, Housing, Public Service Impacts to the ROI. Under Alternative 1, which includes secondary actions, no adverse short-term or long-term impacts would be expected. Small employment losses could potentially result in out-migration of unemployed workers and their families from the ROI. However, even if a large percentage of the newly unemployed left the ROI, the impact would be small on ROI demographics or on the housing market. For example, if all former commercial dredging workers left the ROI, the population loss would total approximately 1000, or less than 0.1 percent of the current ROI population. Such a reduction would have little effect on the demand for housing or public services within the ROI.

Summary of Socioeconomic Impacts. The following bullets summarize projected impacts to socioeconomic resources from implementation of Alternative 1, as well as secondary actions at regional land-based quarry operations (i.e., Alternative 4).

- Minor adverse short-term and long-term effects to employment, income, and business activity at both the ROI and state level.

- Minor reduction in tax revenues.

- Elimination of royalty fees paid to PFBC due to the cessation of river-based operations.

- Major increase in the unit cost (up to 200 percent or more) of aggregate products, asphalt, and concrete in the ROI (as a result of importation of land-based aggregate within the region).

- Reduction in the cost effectiveness in the operation of lock and dams on the Allegheny River due to decrease in barge traffic.

- Potential for lock and dam closures, especially for Pools 5 and higher on the Allegheny River.

- Potential delays in completion of near-term economic development projects requiring large quantities of aggregate materials.

4.1.10 Impacts to Quality of Life

Recreation. Under Alternative 1, no effects would be expected to the recreational fishing resources within the study area relative to baseline conditions. However, possible minor adverse effects on fishing and boating may occur in the upper pools if lock service is curtailed or eliminated due to loss of barge traffic. In lower pools, minor beneficial impacts may occur to recreational boating due to removal of dredging units from the rivers and reduced barge traffic.

Within the region, minor adverse effects to recreation would be expected from increased land-based quarry operations as a result of potential impacts to fisheries. See Section 4.4.10 for further discussion of induced impacts associated with increases in land-based quarry operations.

Aesthetics. Under Alternative 1, localized minor aesthetic benefits to the study area would be expected. Termination of dredging operations would lead to the complete removal of idle dredging units from the river, including cranes, barges, towboats, and other large pieces of machinery that do not blend with the natural river scenery. It should be noted, however, that the dredging operations cover an extremely small portion of the river at any given time, thus aesthetic benefits would be very small and localized.

In localized areas within the region, adverse effects to aesthetics (e.g., landscape disturbance, increased truck traffic, noise) would be expected from increased land-based quarry operations. See Section 4.4.10 for further discussion of induced impacts associated with increases in land-based quarry operations.

Traffic. Minor to moderate (localized near quarry operations) adverse effects to traffic are expected from implementation of Alternative 1 as a result of an increase in truck traffic within the region. Although traffic around existing ports along the Ohio and Allegheny Rivers would be reduced by 0.3 million truck-miles per year, the region will experience a net increase of 6 million truck miles per year as a result of importation of sand and gravel from increased land-based quarry operations. This increase would be minor compared to the current level of traffic serviced by interstates in the region, and moderate for areas near existing or new quarry operations. See Section 4.4.10 for further discussion of induced impacts associated with increases in land-based quarry operations.

Safety. Significant adverse effects to public safety within the region are expected under Alternative 1 as a result of increases in land-based quarry operations. Elimination of river dredging would result in the immediate increase in land-based quarry activities to fill the demand for sand and gravel in the Pittsburgh area. Increases in regional trucking and quarry

operations would result in increased traffic hazards, worker hazards, and other public concerns (e.g., long-term creation of new quarries that pose safety hazards to children). Within the next 10 years, implementation of Alternative 1 would most likely result in 3 traffic fatalities, 80 injuries, and 200 property loss accidents (current baseline risks are approximately half of those estimated for Alternative 1, see Section 4.4.10 for further discussion). Furthermore, there would be an increase in worker-related accidents at land-based quarries (50 additional injuries at quarries in the next 10 years expected). In addition, there have been several incidences of fatal accidents that have occurred as a result of trespassing on quarries in the region. Implementation of Alternative 1 would likely result in an increased public safety risk, particularly to children, from cliff falls, diving and swimming accidents, falling rocks and banks, and other high risk accidents. See Section 4.4.10 for further information on public safety risks from land-based quarry operations.

4.1.11 Impacts to Environmental Justice and Protection of Children

No effects on environmental justice issues would be expected under Alternative 1. As noted in Section 3.8.6, environmental justice analyses are performed to identify potential disproportionately high and adverse impacts from proposed actions to minority communities or low-income communities. Alternative 1 would result in only minor changes to economic indicators, including personal income and employment. These economic changes are not expected to disproportionately affect either minority communities or low-income communities. For example, the average income of the directly affected commercial river dredging employees exceeds that of the ROI and is significantly above the poverty level. Similarly, changes to demographics, housing, and public services are also expected to be minor and not disproportionate to these vulnerable populations.

Significant adverse effects on children safety would likely occur as a result of increases in land-based quarry operations within the region. Within the region, a number of fatalities and injuries have occurred as a result of children trespassing at quarries (as a result of falling from cliffs, diving accidents, and other high risk activities). Refer to Section 4.4.11 for the presentation of secondary effects associated with implementation of Alternative 1 on child safety in the region.

4.1.12 Impacts to Cultural Resources

Impacts to Cultural Resources in the Study Area. No adverse effects would be expected under Alternative 1 within the study area. Under Alternative 1, commercial extraction of sand and gravel would not be permitted and thus cultural resources of the rivers would remain unchanged relative to baseline conditions.
Impacts to Cultural Resources in the Region. Refer to Section 4.4.12 for the presentation of secondary effects associated with implementation of Alternative 1 on cultural resources in the region.

4.2 ENVIRONMENTAL CONSEQUENCES OF ALTERNATIVE 2

This section presents the environmental consequences associated with continuation of river dredging under the current permit conditions required by both the USACE and PADEP, as presented in Section 2.2.1.

4.2.1. Impacts to Hydrology

Moderate adverse impacts to hydrology would be expected from implementing Alternative 2. Continued dredging activities will cause additional relatively permanent changes to the morphology of the river bottom. These changes generally consist of deeper trenches as depicted in Appendix B, Figures B-1 and B-2. These figures present bathymetry photos of representative dredged areas as compared to undredged areas (see Exhibit B for further bathymetry photos and Appendix D for representative bathymetric cross sections where dredging has taken place). Dredged areas are generally about 15- to 35-feet deeper than the pre-dredging surface or adjacent undredged areas, depending on equipment limitations and beginning river depths at the dredge sites. As indicated in Chapter 2, clam shell dredges are potentially able to extract deeper material than ladder bucket type dredges.

Under Alternative 2, approximately 0.8 percent (~ 100 acres) of additional river bottom will be disturbed each year, producing effects similar to those shown in Appendix B. In the next decade, approximately 8 percent (~ 1,100 acres) of river bottom will be disturbed under Alternative 2, however, much or all of that dredging activity will occur in previously dredged areas. The impact of dredging an additional 0.8 percent of the river bottom annually is likely to have a minor adverse impact on the natural flow of the river systems and navigation (see Section 4.4 for a characterization of cumulative impacts). Current permit conditions impose immediate corrective actions if dredging activities interrupt localized free discharge of the river or navigation. Specifically, current permit conditions call for no unreasonable interference with the free discharge of the river or stream or navigation during dredging, with immediate removal of obstruction or encroachment should any occur. To date, there has been no significant problems reported with the interference of the free discharge of the river or navigation as a result of dredging operations. Removal of sand and gravel material has been used to enhance navigation within the study area. For example, the applicant's dredging operations have been utilized to enhance navigation for local recreational activities (e.g., Kittanning Park in Pool 6 of the Allegheny River) and for boat access to the new baseball stadium in downtown Pittsburgh.

Results of diving studies conducted in support of this document, indicated that the morphology of the trenches has changed little over time. This was indicated by diver-recorded descriptions of several different dredged areas in four different pools during mussel sampling in the summer of 1998 and in three different pools in the fall of 1999. Video tapes recorded by divers showed that most dredged areas (even those dredged 20+ years ago) still had fairly steep side slopes, indicating little if any head cutting or other morphological

changes over time. Side-scan sonar images from the same dredged area at RM 32.2 in Pool 5 (~50 ft deep) taken 2 years apart, indicated little change in bottom morphology (Figure 4-1). The two images indicate that this particular dredged area has perhaps shrunk in size slightly in a two-year period. It seems likely that deeper dredged trenches would change more slowly over time than more shallow dredged areas.

USACE (1980) reported that sediment input and bedload movement in the study area is relatively limited due to the lock and dam structures. The generally low percentage of very fine silts observed throughout most of study area based on data collected in support of this document, and in previous work (USACE, 1997), also indicates relatively low sediment deposition rates in the study area. The preponderance of sand and gravel in the study area also reduces the likelihood of headcutting and downcutting because these sediments are relatively stable in deeper rivers such as the navigable Allegheny and upper Ohio Rivers. Videotapes of dredged areas 150 ft from the 6 ft depth contour show little evidence of downcutting. In addition, riverbanks, and the area extending at least 100 ft from the riverbank, appeared to be stable and normal in most cases. A recent bathymetry survey in Pools 4 and 5 also indicated that shorelines are not subsiding and that there is no evidence of downcutting (see Appendix D).

Headcutting and downcutting have been observed in relation to instream mining in other rivers (especially in southeastern U.S.) (Hartfield, 1993; Peterson et al., 1998; Brown et al., 1998), and in the West (Kondolf, 1997; Heede and Rinne, 1990). Many of these studies also reported other hydrological changes due to instream mining, such as lengthened pools, increased bank-full channel widths, channel straightening, shallower pools (due to increased siltation), and decreased riffles (Patrick et al., 1990; Kondolf, 1997; Brown et al., 1998). Furthermore, several of these studies examined effects of streambank or point bar sediment extraction and channel modifications (Patrick et al., 1990; Hartfield, 1993; Kondolf, 1997). As noted above, under Alternative 2 and present permit conditions, dredging is restricted in such areas. However, all of these cases involved unregulated rivers, and in most cases, relatively shallow, non-navigable rivers. Effects of instream mining in these types of systems have questionable relevance to conditions in the Allegheny and Ohio Rivers examined in this EIS. Much of the permitted dredgeable area is in water > 15 ft deep (i.e., current permit conditions explicitly restrict dredging in shoreline areas or stream banks) and “riffle” areas do not generally occur in the study area (due to the locks and dams). In addition, current velocity is much less in the study area than that reported in the above referenced reports due to the presence of locks and dams. As a result, many of the effects of dredging cited in those studies, such as lengthening pools, decreased riffles, and shallower pools, are not observed in the study area, nor are they expected to occur.

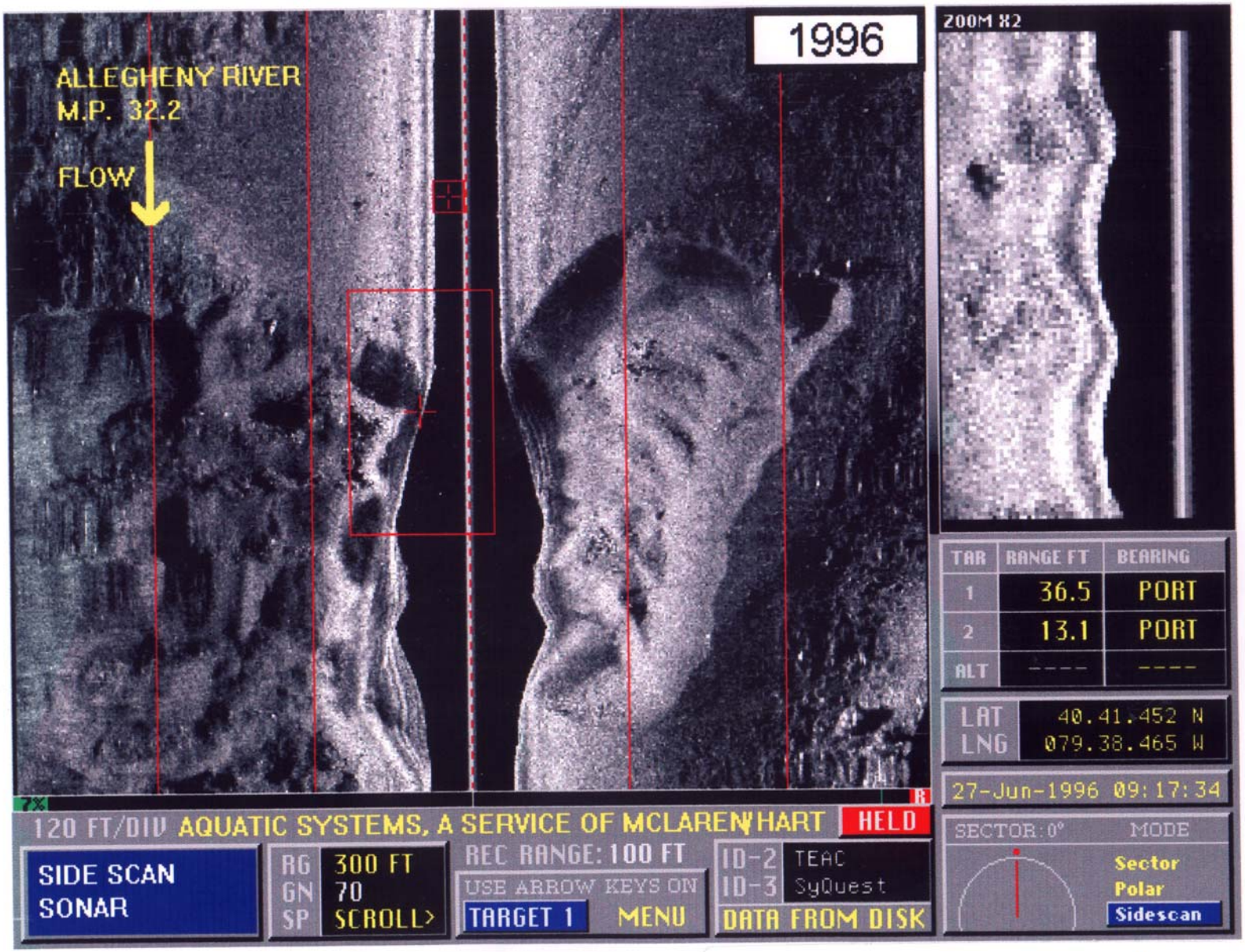


Figure 4-1. Dredged area in Pool 5, 1996 and 1998

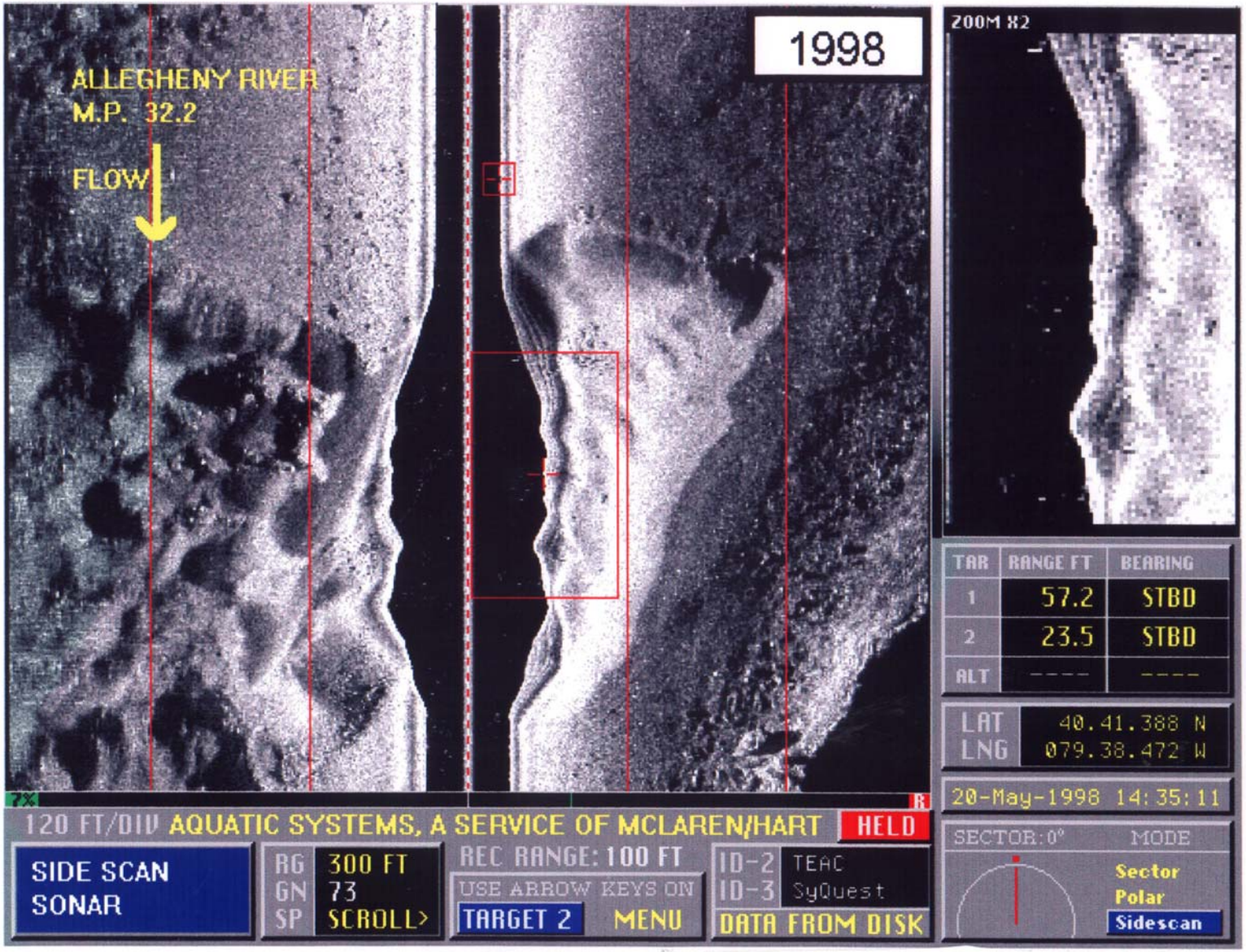


Figure 4-1. Continued.

Stream bank stability may or may not be adversely affected under Alternative 2, depending on site-specific factors. Historically (pre-1980), dredging sometimes occurred very close to or on the river shoreline in some pools of the study area. Some property owners on the river have reported stream bank subsidence as a result of historic dredging operations. At these locations, river depth increases rapidly with distance from shore such that the 6 ft. depth contour may be very close to or at the shoreline. These cases represent significant impacts to the property owners and to the geomorphology of the river. As was mentioned in Section 3.1.2.3 (baseline channel morphology), permit restrictions were instituted to protect shorelines (i.e., 150 ft. from the 6 ft. depth contour; see permit conditions, Section 2.2.1) based on the results of the previous EIS conducted for this study area (USACE, 1980, 1981). Based on information to date, it appears that current permit conditions regarding river bank set backs (150 ft riverward of the 6 ft depth contour, or a distance of 225 feet from the river bank on average) minimize the probability of downcutting along river banks. However, there may be isolated cases where the 6 ft depth contour is close to shore, and channel morphology and current velocity are such that the 150 ft set-back might result inincreased bank subsidence. In these isolated cases, Alternative 2 as currently permitted, could result in adverse impacts on property owners on the river.

4.2.2 Impacts to Geology and Hydrogeology

Geology. Minor adverse effects to geologic resources would be expected as a result of implementing Alternative 2. The unavoidable effect of any extraction operation is the depletion of the geologic deposits. Over time, the nonrenewable glacial deposits of the Allegheny and Ohio Rivers are being permanently removed. Since the construction of the lock and dam system on the rivers, the natural dynamics of the waterways have been altered, and the influx of new coarse material is limited to that carried by large tributaries of the Allegheny and Ohio Rivers. As with any nonrenewable resource, this commitment of mineral resources for current use naturally precludes any benefit that could be gained by holding the resource for future use.

Approximately, 4 million tons of sand and gravel material are produced annually from river bottom substrate. Production of this quantity of material requires the disturbance of approximately 0.8 percent (~ 100 acres) of the river bottom annually. At this rate, the geologic resources of the Allegheny and Ohio Rivers may provide up to 35 years of aggregate material at current demand levels and under current permit restrictions.

The removal of sand and gravel will permanently change the contours of the river bottom. Dredging also may result in accumulations of silt and debris under certain as yet undefined conditions. Data collected for this environmental document suggested that dredged areas generally are not associated with major shifts in particle size distribution. All samples in that study were dominated by sand and gravel fraction; silts comprised a very small minority of these samples (Table 4-3). A subsequent study of particle size distribution was conducted

in October 1999 on pools 4, 7, and 8 of the Allegheny River using diver-assisted Ponar sampling. This study found that there was no significant difference in percent gravel, sand, silt, or fines among dredged and non-dredged transects in Pools 4 and 7 (Table 4-3). In Pool 8, significantly less gravel was found along the undredged transect near a pipeline, compared to the other two transects (Table 4-3). These studies suggest that significant changes in particle size distribution are not expected to occur in the near future, but over a longer period of time (decades). It should be noted, however, that this sampling effort represents a small subset of the entire river and may not reflect all conditions throughout the river (e.g., dredged areas that may receive more silt near the thalweg). Observations by USFWS divers indicated that certain dredged areas have accumulated deep layers of silty material and debris (e.g., in Pool 6). Therefore, changes in particle size distribution between dredged and undredged areas may occur in the long-term. Site-specific conditions, such as proximity to the thalweg, orientation with respect to dams, or the physical configuration of the dredged area (see Section 4.2.3), may be important in explaining whether a given dredged area will have silt accumulations. The type of dredge itself does not appear to be a factor except to the extent that dredging depth is affected.

There have been several reports that dredging causes increased accumulation of fine material (silt) and reduced substrate heterogeneity (Hartfield, 1993; Kondolf, 1997; Brown et al., 1998; Meador and Layher, 1998). As noted under Section 4.2.1, many of these studies examined relatively shallow, non-regulated stream systems with generally greater current velocities and greater sediment transport of fine material than that observed in the study area. It is not clear that the hydrodynamics of such systems are appropriate for assessing effects of dredging in the navigable Allegheny and Ohio Rivers. As noted above, limited sediment sampling suggested relatively greater substrate heterogeneity in dredged areas as compared to deeper undredged areas. However, there may be differences in substrate heterogeneity and/or particle size between dredged and more shallow, undredged areas.

Current permit conditions require that 5 feet of sand and gravel must be left on top of the bedrock so the river bed will not be scoured and the sand and gravel resources exhausted. Little quantitative information is available concerning sediment depth in the study area. Limited data from borings in preparation for bridge or pipeline crossings suggest sediment bedload depths of at least 80 feet in the Allegheny River. Undoubtedly, there is variation in sediment depth within a given pool as well as the study area as a whole. Dredging depth is currently constrained to approximately 50-60 ft depth from the surface by the dredging equipment and current operating procedures.

***Hydrogeology*.** No or minor adverse effects would be expected under Alternative 2. Dredging and land based mining operations would continue as presently conducted, and there would be little change expected to groundwater conditions.

Table 4-3. Summary of benthic substrate particle size analysis from samples collected in October 1999 by diver- assisted Ponar sampling. Control transects were relatively undredged areas.

	Transect	% Gravel	% Sand	% Silt	% Fine
4 / 26.1	Dredged	83.2	9.8	2.8	4.2
4 / 26.1	Dredged	60.4	17.5	11.6	10.5
4 / 26.1	Dredged	96.9	2.2	0.5	0.4
4 / 26.2	Control	83.6	9.5	5.1	1.8
4 / 26.2	Control	20.5	49.8	25.7	4.0
4 / 26.2	Control	89.7	7.8	2.0	0.5
4 / 26.3	Pipeline	98.7	0.2	0.1	1.0
4 / 26.3	Pipeline	81.6	13.1	4.5	0.8
4 / 26.3	Pipeline	92.2	5.6	1.7	0.5
7 / 46.7	Dredged	99.9	0.04	0.04	0.02
7 / 46.7	Dredged	90.7	4.6	1.5	3.2
7 / 46.7	Dredged	93.8	3.7	1.2	1.3
7 / 46.8	Control	98.3	1.1	0.6	0.0
7/ 46.8	Control	54.0	39.9	5.1	1.0
7 / 46.8	Control	93.7	5.5	0.7	0.1
7 / 47.1	Pipeline	98.9	0.7	0.3	0.1
7 / 47.1	Pipeline	93.7	3.6	2.1	0.6
7 / 47.1	Pipeline	95.5	3.7	0.6	0.2
8 / 54.4	Dredged	19.6	42.7	21.7	16.0
8 / 54.4	Dredged	58.3	37.4	3.0	1.3
8 / 54.4	Dredged	54.0	41.5	3.3	2.2
8/ 54.6	Control	99.7	0.2	0.1	0.0
8 / 54.6	Control	55.0	42.6	1.2	1.2
8 / 54.6	Control	0.2	87.0	9.7	3.1
8 / 54.7	Pipeline	0.8	90.2	5.5	3.5
8 / 54.7	Pipeline	0.4	76.7	16.9	6.0
8 / 54.7	Pipeline	11.5	57.1	26.5	4.9

Effects have been reported on the hydrodynamics of the water intake structure at the Allegheny Energy Supply power plant in Pool 8, purportedly due to a relatively deep adjacent dredged area. Dive sampling and visual observations of this area indicated predominately silts and some detritus in the deepest part of the dredged area implying slower water velocities there. Other parts of the dredged area had reportedly coarse particle sizes (gravel, cobble, boulder) and little if any detritus similar to other undredged areas nearby. It was not clear from these data to what degree dredging has interfered with the water intake at this plant. No other situations similar to this one have been reported in the study area.

Another hydrogeological impact purported to be related to dredging is degradation of groundwater quality. As discussed in Section 3.1.3, a number of public and industrial water supplies are located along the Allegheny and Ohio Rivers. Some of these intakes utilize wells whose zones of influence extend beneath the river or are located within the riverbed. In 1995 and 1999, PPG, located near river mile 16.2 on the Allegheny River, reported an increase in groundwater temperature at their two industrial water supply wells. As a result, the Borough of Springdale, Pennsylvania, expressed concerns that water quality and quantity obtained from their public water supply well field (located near the PPG facility), might be impacted by dredging activities through disruption of the riverbed. No changes were noted at the Springdale well field during this time period. A hydrogeological study of this area (Harding ESE, 2000; Appendix O), indicated that dredging did not cause a groundwater quality problem in this case. PADEP sponsored a hydrogeological study to determine appropriate set-backs from well fields near the river, given various hydrogeological characteristics of the particular area, which is still in development (Moody and Associates, 2002). Another study by Moody and Associates (2001), evaluating the Templeton water supply system in Pine Township (Armstrong County, Pennsylvania), reported that the wellhead protection area is not likely to extend beneath the Allegheny River, which would limit the size and extent of the zone of contribution beneath the river to the Templeton water supply.

As far as it is known, there have been no reports of water contamination due to dredging at any time for at least the past 20 years, when permit conditions regarding protection of well capture zones were instituted (Moody and Associates, 2002; see also Section 2.2.1). Public water supplies in parts of the Allegheny and Ohio Rivers have been reported by PADEP as impaired for contact recreational uses and oral consumption due to pathogen contamination. The source of these pathogens is believed to be nonpoint sources, such as urban and agricultural runoff (PADEP, 2001), not dredging.

Given the type of sediment in the rivers, contaminants are not likely to accumulate and/or be released via dredging. This is because sand and gravel, the dominant sediment particle sizes found in the study area, are too large to adsorb or accumulate pollutants. Sediment contamination is more prevalent in much finer sediments (silts and clays), such as those found in much of the Great Lakes or the lower Mississippi River. To the extent that unknown pockets of contaminated sediment exist in other pools, and these are dredged and

contaminants released to downstream capture zones of wells, significant impacts on human health might occur. This scenario would also require that the water treatment system does not remove the contaminants.

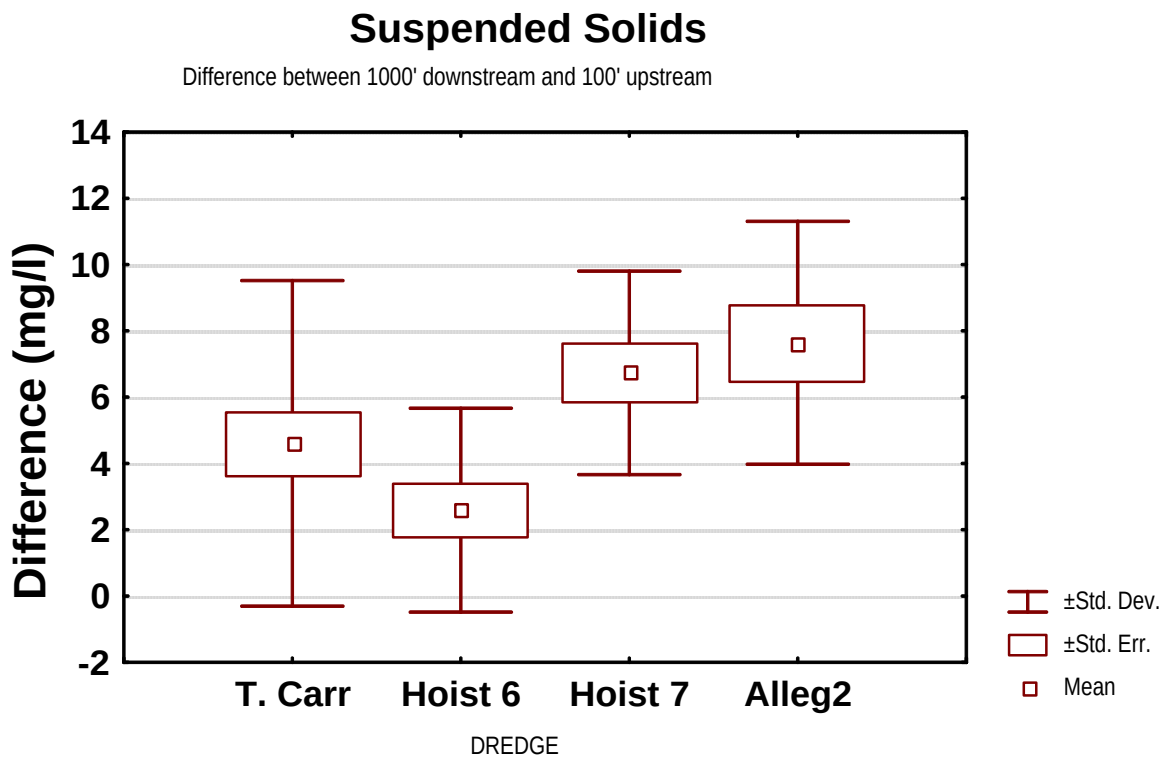
4.2.3 Impacts on Water Quality

Dredging activities appear to have minor adverse impacts on overall water quality. Historic and current data on water temperature, pollutants such as metals, sediment contaminants, and water and sediment toxicity, generally indicate increasingly improved conditions over time and few problems arising from dredging activities as currently permitted. Two parameters appear to be susceptible to adverse impacts as a result of dredging activities: turbidity and dissolved oxygen. However, neither the Allegheny or Ohio River in the study area are considered impaired by PADEP because of either parameter. Current impairments are attributed largely to metals from acid mine drainage and nutrients and sediment from urban and agricultural sources.

Turbidity and Suspended Solids. Available data suggests that dredging and particularly on-board processing dredging, has an adverse effect on turbidity as much as 1,000 – 1,500 ft. downstream of dredging. Weekly discharge monitoring data for the Hanson on-board processing dredge, Thaddus Carr, between 1996 and 1998 indicated that total suspended solids (TSS) 1000 ft downstream of dredging were statistically similar to TSS levels recorded upstream (Figure 4-2; t-test, $p > 0.3$).

Turbidity data were collected by PADEP above and below an active dredging operation in the lower part of Pool 8 and in several locations in the upper part of Pool 7 related to previous dredging activity (Appendix H). PADEP recorded turbidity levels significantly above background at 320 – 362 yards downstream of dredging in certain water depths depending on the horizontal location of the sampling point. A sampling location in direct line downstream of the dredge had the highest turbidity concentration recorded in this survey (297 NTU), which occurred within the top 3 feet of the water. Water collected from deeper strata had turbidity values similar to undredged areas. Sampling locations somewhat to the side of the dredge, had lower turbidities (60 – 100 NTU) but still higher than background, and these levels occurred within the top 6-10 feet of water only. These locations were all within 1,000 feet of the dam at Pool 8. Background (upstream) levels were between 2 and 35.9 NTU at the same time.

To further evaluate TSS effects from dredging, dredging-related TSS were compared with undredged sources of TSS to the Allegheny and Ohio Rivers. Flow and TSS data were obtained from USGS records on two tributaries, between 1980 and 1995. These tributaries represent drainages at opposite edges of the study area. Higher turbidity and TSS were associated with higher tributary flows as expected. Comparison of TSS data between these



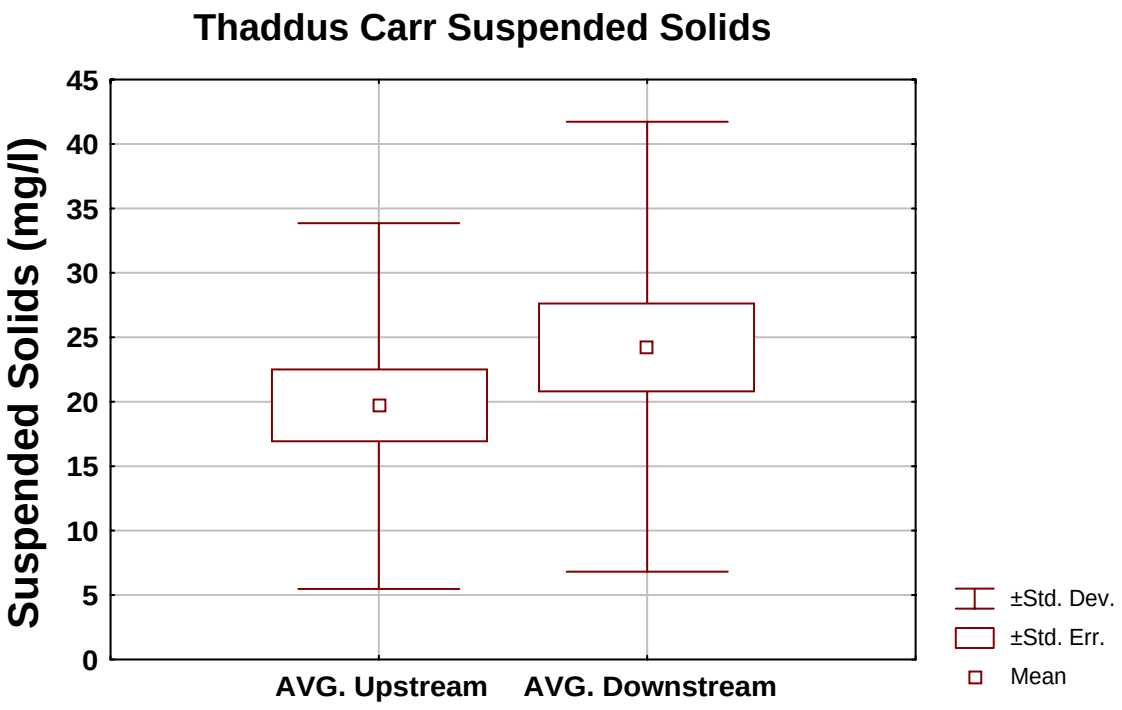


Figure 4-2. Summary of dredge discharge suspended solids monitoring data.

tributaries and on-board processing dredge activity indicated that the level found downstream of dredging is similar to ambient conditions during higher flows ($p>0.05$), and is similar to ambient low-flow conditions 25 percent of the time. Thus, except under low flow conditions, suspended solids 1000 ft downstream of dredging is similar in concentration to ambient river water unaffected by dredging.

Barge traffic, in association with dredging operations and other commercial traffic, is another source of turbidity in the study area. Turbidity plumes downstream of towboats have been reported through aerial photography (PFBC, personal communication) particularly in shallow areas of the river. Under Alternative 2, indirect adverse effects of dredging on turbidity, through associated barge traffic would be expected.

Dissolved Oxygen. Available data, summarized in Section 3.3.3, suggest that dredging may have an overall adverse impact on dissolved oxygen levels; within deeper areas, significant adverse impacts may occur during particularly warm, dry summer conditions. PADEP observed DO levels below the state standard in ≥ 20 ft of water, in several dredged areas of Pools 7 and 8 in July 1999, during a particularly warm, dry period (Appendix H). However, not all dredged areas impact oxygen, even some of those greater than 40 ft deep. For example, the same PADEP study mentioned above, measured satisfactory DO levels at the same time in several dredged areas in Montgomery Pool, Ohio River. In a separate study, oxygen monitoring of a relatively deep dredged area in Pool 8 (RM 55.3) in July 2000 indicated well oxygenated conditions throughout the area. Thus, impact on oxygen is apparently localized, and not exclusively related to depth. Although not explicitly tested, divers noted differences in current velocity among sites during the 1998 sampling for this EIS. Such differences, which may arise from site-specific factors such as location in the pool, proximity to the navigation channel, and bathymetric features of the surrounding area, as well as depth, could determine whether DO will be below the state standard in a given dredged area. Additionally, activities such as barge traffic are likely to mix the water column and help re-aerate the water. Barge traffic in the upper Ohio River and lower Allegheny pools (Emsworth - Pool 4) is greater than in the upper Allegheny pools which could explain, in part, the oxygen impairments observed by PADEP in certain dredged areas of Pools 7 and 8 as compared to sites in Montgomery Pool in the Ohio River in their July 1999 survey.

The cause of the low DO levels in some dredged areas in the summer of 1999 (and during similar conditions in the past) is not known. Sediment oxygen demand is believed to be low in general because the sand-gravel sediment does not readily accumulate fine organic matter and associated biological activity. However, particulate organic matter and decaying algal blooms might be present during these times and these would be expected to accumulate in deeper areas of the river. Although the ultimate source of the oxygen demand may come from non-dredging sources (e.g., urban and agricultural runoff according to PADEP 303(d) listings for the study area), dredging provides deeper areas in which anaerobic conditions can develop, given sufficient time, prolonged hot, dry conditions, and no mechanism for re-aeration. Under Alternative 2, current permit conditions do not directly address DO issues.

Therefore, this alternative can not ensure that DO levels below the state standard will not occur in some locations.

Metals and Other Contaminants. Available data, summarized in Section 3.3, suggest that dredging may have an overall minor adverse effect on water quality with respect to concentrations of metals and other contaminants. Most water column copper and zinc values were below PADEP water quality standards (9.9 **µg/l** for copper; 109 **µg/l** for zinc at the prevailing hardness), with periodic exceedences. Ambient metal values have generally not been excessive, and higher concentrations apparently result from widespread acid mine drainage around the basin, particularly near Pool 4 of the Allegheny River (RM 24) downstream of the Kiskiminetas River confluence. It is possible that metals residing in the substrate could be liberated to the water column if dredging occurred, resulting in potential direct effects on water quality. If substrate areas exposed to greater contaminant loads are dredged, increases in suspended contaminants and toxicity might occur. Very limited chronic and acute toxicity test results generated for this EIS suggested no toxicity from resuspended contaminants in actively dredged areas. In one site in New Cumberland Pool, zinc and Polycyclic Aromatic Hydrocarbons (PAH) sediment concentrations exceeded National Oceanic and Atmospheric Administration ER-L (Effect Range Low or chronic toxicity) values, yet neither the sediment, nor the resuspended water samples were chronically toxic to the United States EPA (USEPA) indicator freshwater test species. Thus, at least for that sample, the metals and PAHs did not appear to be bioavailable. However, dredging areas that have much higher contaminant concentrations than tested thus far, may pose a local adverse effect on water quality. Dredging would tend to liberate contaminants in affected areas, resulting in resuspension of contaminated fine sediments downstream. This type of situation is more likely in the vicinity of Pittsburgh, where industrial activities and contaminant inputs have been greatest. This would include the lower part of Pools 3 and downstream on the Allegheny River and Emsworth and Dashields Pools in the Ohio River. Accidental resuspension of these contaminants could be detrimental to aquatic life and perhaps human health. This situation is not directly addressed in current permit conditions under Alternative 2.

While resuspension of toxics may be an unlikely scenario for much of the study area, there is one example of a recent incident in which a dredge, during normal permitted operations, dug into oil-laden sediments in New Cumberland Pool that were not known to be there by either the dredging company, the PADEP, or the USACE. The result was a resuspension of a small quantity of oil downstream. The oil was quickly contained, the area cleaned, and the dredge vacated the area. This type of situation, though quickly resolved with little or no environmental damage, illustrates the potential for minor adverse impacts from dredging contaminated sediments.

4.2.4 Impacts on Aquatic Life

Plankton. Implementation of Alternative 2 is expected to have a minor adverse effect on phytoplankton. The phytoplankton consist of the assemblage of small plants that have no, or very limited, powers of locomotion, and are more or less subject to disruption by water movements. Ambient environmental factors, such as light, nutrients, and turbidity, interact to regulate the spatial and temporal distribution of phytoplankton. In addition to the important basic physiological requirements of temperature and light, the means of remaining in the photic zone long enough to complete growth and reproduction, and the influences of predation, a number of organic and inorganic factors play critical roles in the condition of the phytoplankton population. Considering these environmental factors, the chance for dredging activity to affect phytoplankton productivity would rest primarily upon a link between dredging and nutrient levels, light attenuation, and metals/toxics presence or availability.

Dredging typically does not affect nutrient levels of the Allegheny and Ohio Rivers, and affects light attenuation locally. The current USACE and PADEP discharge requirement of a deep-water diffuser within the dredge trench for on-board processing dredges, helps to reduce turbidity downstream (Section 4.2.3). Considering that 0.8 percent of the river bottom within the study area would be disturbed annually, and most of this area has been previously dredged, the effect of dredging on phytoplankton is expected to be short-term and localized.

Periphyton. Implementation of Alternative 2 is expected to have a minor adverse effect on periphyton. Within sand, light is attenuated very rapidly, and may be reduced to zero within 0.5 cm (Wetzel, 1975). Round (1991) found that the general seasonal biomass of periphyton in the photosynthetically illuminated zone followed the curve of incident light and temperature. In the study area, limited data suggest that population numbers were relatively constant on sediments at depths of 1-6 m; below 6 m, numbers decreased dramatically to nearly zero by a depth of 8 m. This information suggests that dredging under Alternative 2 should have little impact on the periphyton assemblage because dredging is restricted to 150 ft off the 6 ft depth contour and hence, occurs in deeper water. Secchi disk measurements during a drought period in October 1999, when water clarity was exceptionally good, indicated that the photic zone was approximately five feet (Exhibit C). Thus, dredging within current permitted areas should not directly affect the shallow, photosynthetically illuminated zone. Indirect effects of dredging on periphyton will be localized (i.e., dislodgement or removal in the immediate vicinity of an active dredge, and sedimentation or sediment toxics resuspension immediately downstream from the dredge), and temporary (pending recolonization). Given that 0.8 percent of the river bottom would be disturbed annually at current rates under Alternative 2, impacts to the baseline periphyton assemblage for the study area as a whole are expected to be minor.

Submergent and Emergent Aquatic Plants. Implementing Alternative 2 is expected to have a minor effect on aquatic plants given current permit restrictions. Baseline surveys indicate that aquatic plant (in particular submergent aquatic plants) coverages are generally sparse within the study area (Appendix I, Figures I-1 to I-7); however, the relatively stable flows tend to promote long-term stability of the macrophyte beds where they occur (e.g., certain areas of Pool 6).

Emergent and submergent vegetation in the study area is typically associated with shorezone, tributary confluence, and island margin areas (Appendix I, Figures I-1 to I-7). These conditions are generally restricted under current permits. Using Allegheny Pools 5 and 6 as examples (Appendix I), spatial analysis indicates that 0% of the Pool 5 macrophyte bed coverage falls within the area currently permitted for dredging. If those same permit conditions/restrictions were applied to Pool 6 (currently under a dredging moratorium imposed by the State), 0.1% of the macrophyte coverage area could be disturbed by future dredging under Alternative 2. Given the areas typically suitable for macrophyte growth, the current dredging permit conditions, and the many other dredging restrictions already in place (i.e., water intakes, tributary confluences, and shallow depths), minor adverse impacts to macrophytes would be expected from implementing Alternative 2.

Benthic Macroinvertebrates. Implementation of Alternative 2 is expected to have a minor adverse effect on macroinvertebrates. Sand and gravel dredging operations have the potential to negatively affect aquatic invertebrates by direct removal of organisms, removal of productive substrates, and/or degradation of downstream habitat through sedimentation (Nelson, 1973). Literature accounts are varied, indicating that: dredging results in permanent loss of productive macroinvertebrate habitats (Lee, 1973); benthic macroinvertebrates are impacted far downstream from product processing operations and recolonization of the benthic invertebrate fauna is rapid following dredging (Newport and Moyer, 1974). Kondolf (1997) reported reduced populations of benthic invertebrates or changes in species composition in California streams subject to instream gravel mining. Cross et al. (1982) reported fewer macroinvertebrate taxa in disturbed habitats in a study evaluating commercial dredging effects in the lower Kansas River. Both of these cases, however, involved dredging in relatively shallow, fast current areas as compared to those permitted in the Allegheny and Ohio Rivers.

Previous sampling conducted by USACE in Pools 5 and 6 (PFBC, 1997a) indicated fewer individuals, fewer species, and lower average dry weight in samples > 21 ft deep. At a given depth range, there was no significant difference in abundance, diversity, or average dry weight of macroinvertebrates between Pools 5 and 6 (PFBC, 1997a). However, Pool 5 has proportionally more deeper areas than Pool 6.

In order to characterize the benthic macroinvertebrate assemblage of the study area and to evaluate dredging effects, contemporary sources of Allegheny and Ohio River macroinvertebrate data (Tetra Tech, 1998) were tabulated (Section 3.4.2.2) and samples from

dredged and non-dredged areas were compared (Exhibits B and C). Samples were categorized as:

- restricted — collected from non-dredged areas or areas restricted from dredging under current permit conditions

- dredged — collected from previously dredged areas

- unknown — collected from locations not restricted from dredging; however, no specific report of dredging activity was indicated/available, therefore dredge status is unknown.

Benthic macroinvertebrate assemblage measures or metrics were calculated and plotted to allow comparisons of median metric values (Figures Q-1 to Q-4, Appendix Q). The data set was not amenable to comparisons of taxa richness measures, because data sources varied in level of taxonomy for the oligochaetes (worms); however, comparisons of composition and functional feeding group metrics were possible. Restricted and unknown site categories were similar for all metrics. Metric statistics indicated similarities and differences between restricted and dredged categories. Similarities included the number of Ephemeroptera, Plecoptera, Trichoptera (EPT) (sensitive mayfly, stonefly and caddisfly) taxa, the percent abundance of the most dominant taxon, the Shannon-Wiener diversity index, and the proportion of the assemblage known to be filter feeders. The proportion of collector feeders decreased somewhat and percent predators increased with increasing probability of dredging, possibly due to a decrease in relative dominance of worms. Hilsenhoff's Biotic Index (HBI, a measure of assemblage tolerance of organic enrichment) decreased with increasing probability of past dredging. The HBI is expected to increase with increasing impairment, and the reduced (i.e., favorable) HBI scores in dredged areas is driven primarily by the decrease in percent worms. Samples collected in deep dredged locations (Exhibit B) yielded a low percentage of worms, a high percentage of the burrowing mayfly *Hexagenia* at many of the Allegheny River sites, and a high percentage of dipteran predators (primarily *Chaoborus, Coelotanypus* and *Procladius*) at several Ohio River sites. These results are in direct contrast to those reported by Cross et al. (1982), regarding dredging effects in the lower Kansas River. In that study, they observed more worms and fewer mayflies, probably due to greater inputs of fine sediment material, and the fact that dredging activities took place in very shallow areas. Variability in macroinvertebrate species abundance and distribution within dredged areas in the study area is likely to be, at least in part, a function of recruitment of benthic macroinvertebrates from tributaries that enter the navigation pools.

Field investigations, designed specifically to compare the benthic macroinvertebrates of dredged sites to non-dredged sites, were conducted during 1999 (Exhibit C). Samples were collected from three different transects (each in Allegheny River Pools 4, 7, and 8):

- a historically undredged area near a submerged pipeline

- a relatively undredged area in a location that could be dredged under existing permit conditions, and
- an extensively dredged area.

Results indicated that most samples were dominated by oligochaetes and/or *Hexagenia* (Appendix Q, Table Q-1). Taxa richness was similar among the three transect types; however, differences in the proportion of individuals as worms and as *Hexagenia* typically differed between dredged and undredged transects (i.e., worms were common in undredged areas and *Hexagenia* was common in dredged areas).

The foregoing information suggests that dredging may have an impact on the benthic macroinvertebrate assemblage, in that it may result in a shift in the dominant macroinvertebrate taxon (dredged areas compared to protected areas). Furthermore, shallow (< 9 ft) undisturbed areas are likely to have greater species diversity and more individuals than dredged areas. However, for most areas currently permitted for dredging, structural and functional attributes of the macroinvertebrate assemblage is not significantly related to depth (e.g., taxa richness, functional feeding groups, and tolerance ratings were similar in samples from dredged or undredged areas of varying depths; Exhibit C). Therefore, impacts of continued dredging to the baseline macroinvertebrate assemblage under Alternative 2 would be localized (i.e., dislodgement or removal in the immediate vicinity of an active dredge, and sedimentation or sediment toxics resuspension immediately downstream from the dredge) and temporary (i.e., recolonization and recruitment are rapid for this fauna.). Adverse impacts would be expected in mid-channel shallow areas (i.e., offshore of the 150 foot set-back from the 6 foot depth contour). Considering that on average 0.8 percent of the river bottom would be disturbed annually at current rates under Alternative 2, recruitment potential is expected to be high and impacts to baseline benthic macroinvertebrate conditions are expected to be minor.

Freshwater Mussels[A1]**.** Localized adverse impacts to freshwater mussels in the study area would be expected from implementing Alternative 2 in most areas currently permitted for dredging. To the extent that mussels are capable of colonizing certain habitats, but do not occur there now, significant adverse impacts may occur, particularly in shallower, undredged areas (≤ 10-15 ft deep) where the types and arrangement of bottom substrate more closely matches natural unimpounded conditions. Dredging operations have the potential to impact mussels in several ways. First, dredging removes mussels as well as substrate. Substrate surrounding a dredged area could displace, crush, or bury mussels that are present (Strayer and Ralley, 1991; Hartfield, 1993). Sedimentation is detrimental to mussels, and has been implicated in the decline and extinction of numerous species (Stansbery, 1971; Ahlstedt, 1991). Silt can clog gills and filtration systems, preventing respiration and causing nutritive stress. Ellis (1933) showed that most unionids died when covered by as little as 13 to 50 mm of silt. In addition, increased turbulence and resuspended silt, which could occur during dredging, can reduce growth (Yokley and Gooch, 1976), feeding rates, oxygen consumption, and nitrogen excretion of mussels (Aldridge et al., 1987). However, the increase in

suspended solids concentration as measured by ongoing clamshell and hoist boat operations is not intense enough to cause direct mortality in organisms outside of the direct excavation area. Laboratory studies show that frequent exposure to high-suspended solids concentrations (600 - 750 mg/l) decreased the efficiency of physiological functioning in mussels (Aldridge et al., 1987). These levels are many times higher than the mean and maximum levels (24 and 83 mg/l, respectively) recorded 1000 feet downstream of typical dredging operations in the Ohio River (Tetra Tech, 1997) or in the PADEP DO monitoring study in 1999 (mean = 61 mg/l, max = 279 mg/l). However, as dredging operations typically occur within a fixed location for an extended time period (weeks perhaps), chronic effects of suspended solids might occur within 1000 feet downstream of a dredge, if a significant mussel resource occurred in this area and was not identified using the current mussel sampling protocol.

Data collected in preparation of this EIS suggested little difference in the mussel assemblage between dredged and adjacent undredged locations in areas currently permitted for dredging. Diving data collected in 1998 (Exhibit B), indicated that mussels were more abundant in one shallow area (restricted from dredging) of Pool 6 as compared to the adjacent deeper, dredged area; however, the other seven areas examined in that survey (including a second area in Pool 6) indicated no difference in mussel density, and little if any difference in species richness or mussel size between dredged and adjacent (offshore) undredged areas (Appendix Q, Figure Q-5 to Q-7). In addition, species richness was similar between areas sampled in Pool 5, which has been dredged for many years, and offshore areas in Pool 6, which has received little dredging activity (Tetra Tech, 1999). Few differences in mussel fauna were also observed between mussel habitat sites in these two pools in an interagency study conducted in 1991 (PFBC, 1997a), and in data collected from undredged, submerged pipeline areas and dredged areas (Table Q-2, Appendix Q). Furthermore, most unionids appear to prefer some current velocity and a clean mixture of gravel, sand, and cobble substrate. These habitats are generally found in shallow water, near the river margins, and around islands within the study area. These habitats are restricted from dredging under current permit conditions.

Potential impacts of dredging on mussel resources have been mitigated up to now through the implementation of mussel surveys, required by PADEP and the USACE as part of the permit prior to dredging a new area (see Section 2.2.1). This sampling protocol has undergone several revisions prior to and during preparation of this EIS and received modifications following recommendations from a multi-agency expert panel workshop held on October 31, 2000 by PADEP staff. The consensus from that workshop was that a rigorous mussel survey is able to identify populations of mussels needing protection. The efficiency of the revised diver sampling approach developed during this EIS was evidenced by the collection of the federally endangered Northern riffleshell mussel (*Epioblasma torulosa rangiana*) in Pool 8. Prior to this sampling protocol, this species had not been collected in this location, or in the study area as a whole. Similarly, several state species of concern have been collected in several locations using this protocol and recent data suggest that some of these species

(e.g., fragile papershell [*Leptodea fragilis*], the salamander mussel [*Simpsonaias ambigua*], and the Wabash pigtoe [*Fusconaia flava*]) may be more widely distributed in the study area than previously thought.

Current permit conditions in Alternative 2 avoid direct dredging impacts on mussels but it is not clear whether these conditions guard against indirect effects (e.g., sedimentation, turbidity) directly downstream of the dredge, or in adjacent undredged areas (from side slope cave-in of the dredged area). Furthermore, there is some debate as to whether certain habitats might not harbor mussels now (due perhaps to past water quality constraints) but may be suitable for mussel colonization in the future. Under the current permitting process, if a significant mussel resource is not observed in a location, it is assumed to be unsuitable for mussels. Several mussel experts present at PADEP's October 31, 2000 meeting expressed this viewpoint based on work in many other systems. Furthermore, most of the areas currently permitted for dredging have been dredged some time in the past and are therefore disturbed. Several mussel experts indicated that mussel recruitment in these habitats is marginal. However, not all experts agree on this issue. To the extent that productive habitats (presently undefined) exist, in which mussels do not currently occur (and therefore are recorded as having no significant mussel resource present), and these locations meet other current permit conditions, Alternative 2 could have an adverse impact on mussels by diminishing the amount of future usable habitat.

Fishes. Implementation of Alternative 2 is expected to have a minor adverse effect on most fish species in the study area. Dredging operations have the potential to negatively affect the fish assemblage by altering the river channel, modifying water quality, reducing spawning and nursery habitats, altering the food web, and changing assemblage structure. Effects of dredging on fish communities varies among and within waterbodies (Meador and Layher, 1998). Literature accounts indicate that: dredging has a negative impact on fish communities and fish habitat (Lee, 1973); gravel-dredging operations were associated with habitat changes and reduced abundance of sport fishes (Forshage and Carter, 1973; Heede and Rinne, 1990; Kondolf, 1997; Brown et al., 1998); dredged and non-dredged area comparisons indicate no major differences in fish species composition, diversity, relative abundance, or biomass (Nelson, 1973); and fish densities were unaffected by dredging activities whereas fish species composition at dredged and non-dredged sites indicated little similarity (Meador and Layher, 1998). Many of the studies reporting changes in fish species composition, or reduction in game species in relation to dredging, often examined streams that were much shallower and had more riffles than the Allegheny and Ohio Rivers in the study area.

Within the study area, Lee (1973) reported a 50% reduction in the number of species (and a difference in species composition) in a dredged pool compared to a "natural" pool in the Allegheny River. The dredged pool reportedly contained more "rough fish" and fewer game and forage species. The changes were attributed to habitat modification resulting from dredging. Riffle areas contained a greater diversity of fishes (particularly forage species) in

comparison to the dredged pool. Consequently, Lee (1973) concluded that the conversion of riffles to dredged pools could result in a significant decline in the forage base of the river. This example may be applicable to the extreme upstream reach of the study area (i.e., the upper part of Pool 9), however, it is unlikely to apply to most of the Allegheny and Ohio River study area, in which the river has been converted into cannalized pools, or navigable waters. As noted above, very little riffle habitat exists in the study area.

In order to characterize the baseline ichthyofaunal resources of the Allegheny and Ohio River study area, contemporary sources of fish assemblage data were tabulated (Section 3.4.2.4). The contemporary survey information indicated the presence of 112 fish species representing 21 families. The majority of the species were in the carp and minnow, sucker, bullhead catfish, sunfish, and perch families. The cumulative catch in the Allegheny River study reach was dominated by emerald shiners, bluntnose minnows, and common carp, collectively comprising 49% of the fish collected. In the Ohio River, gizzard shad, emerald shiners, and channel catfish predominated, accounting for 76% of the total catch. An examination of the spatial distribution of fishes generally demonstrated increasing species richness with increasing drainage area. Total species ranged from 26 (upstream) in Allegheny Pool 8, to 86 (downstream) at New Cumberland Pool on the Ohio River. A notable exception to the gradient in species richness was Emsworth Pool, located in the greater Pittsburgh area. Emsworth Pool proved to be an anomalous location with respect to all measures of assemblage structure and function examined (Section 3.4.2.4), ranking lowest for species richness, composition, and trophic measures. These observations tend to reflect cumulative stressor effects in the greater Pittsburgh area, i.e., the effects of urbanization.

Following the characterization of contemporary fisheries resources of the study area, Aquatic Resources Geographic Information System (ARCS-GIS) data (Normandeau Associates, 1997) and species-habitat association models were employed in an effort to evaluate the effects of dredging operations on the baseline fish assemblage. This ARCS-GIS and species-habitat association information was developed as part of an aquatic resource characterization study of the Allegheny, Monongahela and Ohio Rivers for the PADEP, PFBC, and Ohio River Valley Water Sanitation Commission (Normandeau Associates 1998). The ARCS-GIS provided a basemap, descriptions of habitat features, and species-habitat association/preference information for most of the study area (i.e., through Pool 6). Multivariate statistical analyses (e.g., canonical correspondence analysis) were used to associate aquatic area types to the general habitat requirements/preferences of Allegheny and Ohio River fishes (Section 3.4.2.4). Results indicated nine groups of species or species-habitat associations (Appendix Q, Table Q-3), classified as:

- margin-lacustrine species
- margin-generalists
- margin-riverine species
- general-riverine species
- channel-riverine species

- channel-generalists
- channel-lacustrine species
- general-lacustrine species
- generalist-opportunists.

Based on these classifications, those fishes expected to be protected by current dredging restrictions would be the “margin” species and “generalists/opportunists”, and those potentially impacted by dredging would include the “channel” species. To test those assumptions, species-habitat association models (linking information on fish habitat requirements/preferences with physical habitat data for the study area, georeferenced in the GIS) were run for spawning and adult life stages of a random sample of at least one species from each of the groups listed above. In addition, models were run for the representative important game fishes (both spawning and adult lifestages), smallmouth bass, largemouth bass, and channel catfish (note that the recreationally-important walleye was captured in the random selection of species).

The ARCS-GIS and ArcInfo tools were used to map Allegheny River Pools 5 and 6, and to delineate “permitted” areas versus “protected” areas (based on current permit conditions). These tools, together with species-habitat association modeling, allowed spatial analysis of fish habitat requirements/preferences. Pools 5 and 6 were selected as examples due to their differing dredging histories, i.e., the persistent dredging activity in Pool 5 through to the present, and the limited dredging history (and no dredging currently) in Pool 6, and because bathymetry and other fish habitat information were most comprehensive for these two pools. For this alternative, permitted and protected areas were determined for both pools based on current permit conditions. The permitted/protected overlay for Pool 6 is presented as a hypothetical example of the potential consequences of current permit conditions on suitable fish habitat. Spatial analyses applied to Pool 5 evaluates prevailing or baseline conditions under current permit restrictions in a pool that is actively dredged. Fish species-habitat association model results for each of these scenarios described habitat-related fish distributional patterns, and spatial analysis linked those patterns with the percentage of total pool area within (“permitted”) and outside (“protected”) of the permitted area.

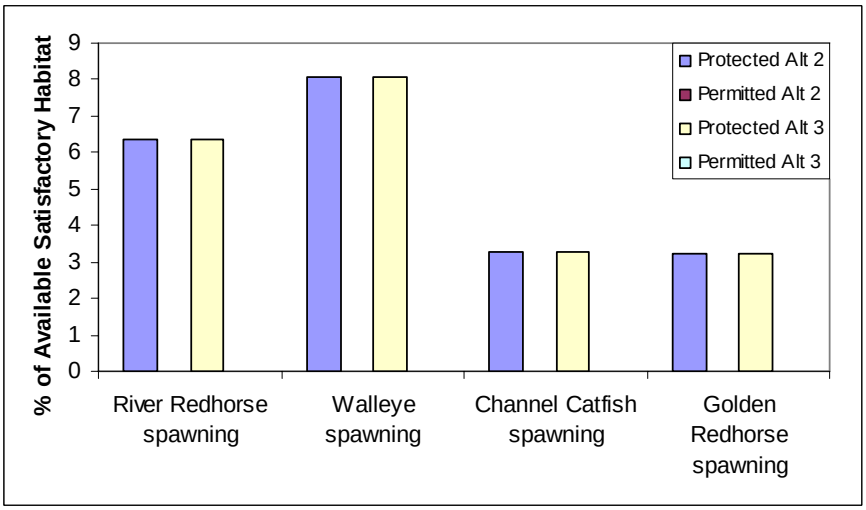
Model results and associated spatial analyses present the gradient of habitat suitability or quality divided into six categories ranging from unsuitable to high quality. The top three categories (average, above average, and high quality) denote areas of notable quality, and the bottom three (below average, poor, and unsuitable) denote low quality to unsuitable areas. Spatial analyses verified the assumptions mentioned previously, i.e., that in general, those fishes protected by current dredging restrictions are the “margin” species and “generalists/ opportunists,” and those potentially impacted by dredging would include the “channel” species. Example graphics of two species (walleye and central stoneroller), representing the extremes in the range of potential effects from dredging, are presented as Figures Q-8 through Q-11. Central stoneroller is a margin-generalist and spatial analysis indicates that no suitable habitat is found within the permitted area of Pool 5 (Figure Q-8) or the hypothetical

permitted area of Pool 6 (Figure Q-9). In contrast, walleye is a channel-lacustrine species, and suitable habitat can be found for adults within the permitted area of Pool 5 (Figure Q-10) and the hypothetical permitted area of Pool 6 (Figure Q-11).

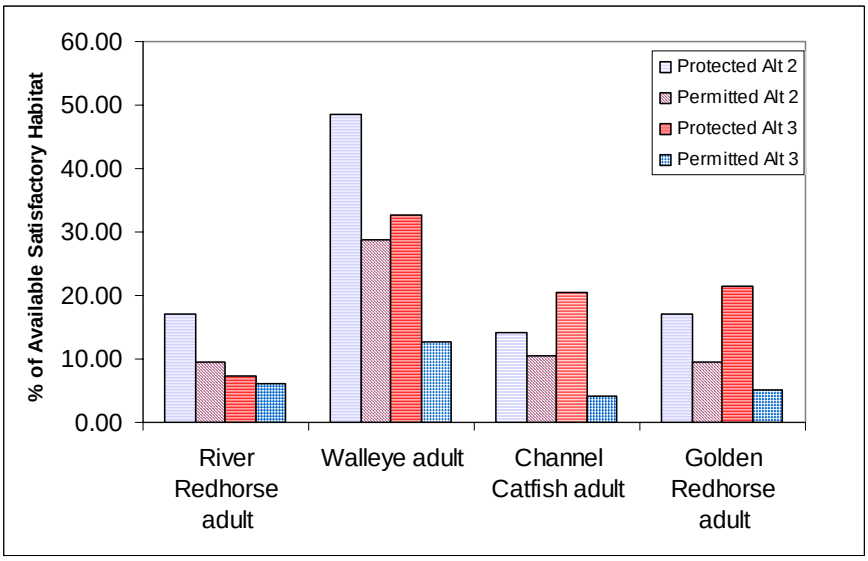
Model results for a number of fishes (both spawning and adult life stages) are summarized in Table Q-4, Appendix Q. Overall, most of the suitable habitat (for both spawning and adult fish) is found within the "protected" portions of Pools 5 and 6 (i.e., outside of the permitted area in Pool 5 and the hypothetical permitted area of Pool 6). For fishes of the margin-lacustrine, margin-generalist, margin-riverine, general-riverine, channel-riverine, and generalist-opportunist groups, the amount of suitable habitat found inside the permitted zone is less than 1% of the total pool area. Conversely, fishes that could find suitable habitat within the permitted zone, and therefore are potentially most susceptible to impact from dredging are members of the channel-generalist, channel-lacustrine, and general-lacustrine groups. Examples of these in Table Q-4 include river redhorse (adults), walleye (adults), channel catfish (adults), and golden redhorse (adults). For these species, the amount of suitable habitat found inside the permitted zone under Alternative 2 ranges from nearly 10% to 28% of the total satisfactory habitat area in Pool 6 (Figure 4-3). Overall, most habitats in the "high quality" or "satisfactory" rating class for margin species were found within the zone that is currently protected by permit conditions (e.g., largemouth spawning or adult stages, Figure 4-3c). The only high quality habitats (for species in Table Q-4) found within the "potentially permitted" zone under Alternative 2 were channel species habitats (e.g., adult river redhorse and adult walleye, Figure 4-3b).

The model results indicate that habitat for fishes in most of the species-habitat association groups would be protected by current permit restrictions. The question of dredging effects, therefore, focuses on those fishes (i.e., channel-generalists, channel-lacustrine, and general-lacustrine species) that could occupy suitable habitats present in the permitted zone of the study area. For those species, dredging activity could potentially have a localized, short-term influence on fish presence and/or movements in the immediate vicinity of the active dredge, and could increase levels of suspended solids. The effect of suspended solids and sediment on fish varies with the stages of the reproductive cycle. The level of lethality for suspended solids is determined by the interaction between biotic factors (e.g., age-specific and species-specific differences) and abiotic factors such as particle size, shape, concentration, and amount of turbulence. Some relevant mechanisms of stress include decreased light penetration/visual interference and loss of suitable spawning habitats (e.g., siltation of formerly clean substrates). Very few fishes of the area rely on the channel areas or the permitted area for spawning (Tables Q-3 and Q-4, appendix Q), i.e., spawning habitats for most species are protected under current dredging restrictions. Increases in suspended solids within the permitted area appear to be localized (Section 4.2.3), i.e., generally within the area ≤ 1000 ft downstream from active dredging operations. Within that area, turbidity levels were similar to ambient high flow conditions, and were similar to low-flow conditions 25 percent of the time. Fishes vary in their ability to tolerate suspended sediments; however,

A



B



C

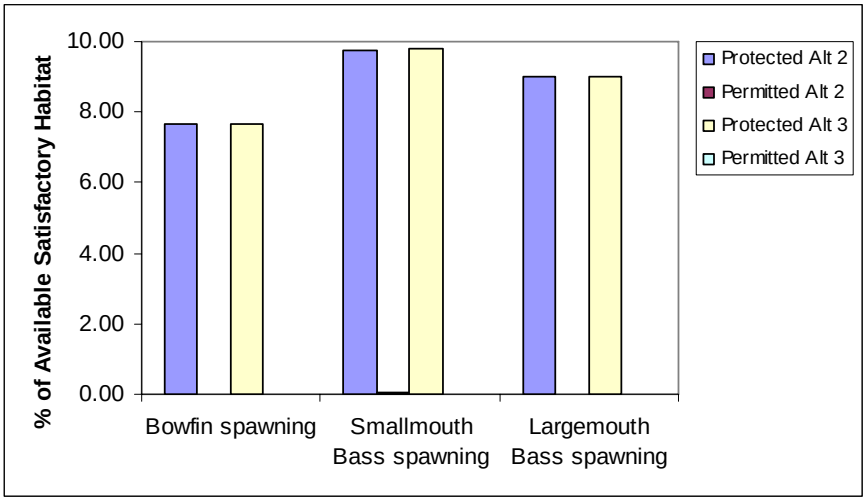


Figure 4-3. Percent of satisfactory fish habitat currently available that could theoretically be permitted for dredging in Pool 6 under Alternatives 2 or 3 for representative channel species (A and B above) and margin species (C above) and different life stages. Pool 6 is used as an example in this analysis due to the diverse habitats present in that pool.

most species can survive short-term exposure to very high levels, i.e., ≤ 1,000 ppm (Newport and Moyer, 1974). Levels noted downstream from active, on-board processing dredges have ranged from 30-90 ppm (Section 4.2.3), representing levels that are not harmful to fisheries (Newport and Moyer, 1974). The foregoing information suggests that dredging may have an impact on certain channel, lacustrine, or opportunistic fish species, but probably not margin species under Alternative 2.

4.2.5 Impacts to Wetlands and Terrestrial Life

Overall, minor adverse effects to wetlands associated with implementation of Alternative 2 would be expected. Short and long term minor adverse effects to emergent wetlands occurring within the river channel would be expected as a result of increased sedimentation and turbidity in the habitats. Existing permit conditions for dredging require a minimum 150 ft offset from the 6 ft river depth, as measured at normal pool water elevation. This permit condition would require an average 225 ft offset (minimum of 150 ft) from wetlands occurring adjacent to the riverbanks. Permit conditions also require a minimum setback of 1,000 ft upstream or 500 ft downstream of any island; and therefore any wetlands associated with the shoreline of an island would be protected. Dredging is also restricted from back channels associated with islands.

Under certain rare conditions, moderate adverse effects to wetlands could occur in cases where emergent wetlands are located in the river channel, but are not in association with the shoreline or islands. Dredging activities could occur within 150 ft upstream of emergent wetlands under these conditions. For example, emergent wetlands located in Pool 6 in association with the Cogley Island complex extend well beyond the shoreline of the islands (although dredging could not occur in this area due to current permit conditions; this example provides an incident where emergent wetlands can be found beyond existing permit buffers). Wetlands associated with the islands, at some locations, extend as much as 1,000 ft upstream of the shoreline of the islands. Under existing buffer restrictions, dredging could potentially occur within 150 ft upstream of emergent wetlands. Increased sediment loads downstream of dredging operations could adversely impact in-channel emergent wetlands as a result of the deposition of sediments in the habitats. Modification of the existing substrate of wetlands as a result of sedimentation and stressors to vegetation resulting from increased turbidity could result in changes to, or elimination of, affected wetland vegetative communities and their associated functions over time.

Provisions established in Pennsylvania Code Title 25 (Environmental Resources), Chapter 105 (Dam Safety and Waterway Management) reduce the potential for adverse effects occurring to wetlands as a result of dredging operations. Chapter 105 requires that an assessment of potential impacts to wetlands be conducted prior to the issuance of permits for in stream activities that could affect the habitats. Provisions established at §105.13 (Permit Applications), §105.14 (Review of Applications), §105.15 (Environmental Assessment), §105.17 (Wetlands), and §105.18a (Permitting of Structures and Activities in Wetlands)

require an assessment of potential impacts to wetland functions. Avoidance of significant impacts to wetlands is required as part of the permitting process. Potential adverse impacts to wetlands occurring adjacent to or downstream of dredging operations should be minimized as a result of implementing site-specific permit requirements that would be imposed to comply with Title 25.

Short-term minor adverse effects to fauna and terrestrial habitats from noise associated with dredging operations would be expected. Noise could adversely affect terrestrial fauna when dredging operations occur in close proximity to ecologically important habitat, such as wetlands. As discussed in Section 4.2.8 below, peak sustained noise levels fall between 94 and 82 decibels (dB) on board for two different types of dredging units. The corresponding noise levels on-shore in the vicinity of dredging ranged from 70 to 50 dB, as compared with an expected background value of approximately 45 dB. In some cases, noise could preclude certain species from using the habitats or cause species currently using the habitats to move out. Effects of dredging noise on fauna in areas where shorelines are currently developed would be expected to be minimal because of pre-existing anthropogenic noise levels.

4.2.6 Impacts to State and Federally-Listed Threatened and Endangered Species

Aquatic Species. Within the potential range of Federally-listed mussel species, significant adverse effects may occur. As part of this effort, letters of inquiry were submitted to the PFBC, USFWS, and the Pennsylvania Department of Conservation and National Resources (PDCNR) as to whether or not listed species and their habitat may be present within the study area. Response letters from these agencies are presented in Appendix J. Further coordination with the USFWS has resulted in USACE preparation of a Biological Assessment on the impact of the proposed dredging on Endangered and Threatened species and a December 16, 2005 response letter from the USFWS (see Appendix S). The USFWS letter identifies eight endangered mussels, two mussels that are candidates for listing, the bald eagle (Haliaeetus leucocephalus), and Indiana bat (Myotis sodalis) as known or possible inhabitants of the study area. The mussels (see Appendix T) are considered to be at highest risk of impact from the proposed dredging.

Implementation of Alternative 2 may have a significant adverse impact on the listed and candidate mussels if they occupy habitat in close proximity to and downstream of the dredging activity. The area immediately surrounding the proposed dredging site would be exposed to levels of suspended solids and sedimentation that are higher than ambient levels under low flow conditions. Higher suspended solids may reduce the ability of mussels to filter water, thereby impeding food absorption and respiration (see Section 3.4.2.3). Other adverse effects from increased sediment exposure include reduced growth, reduced oxygen consumption, and reduced nitrogen excretion. These responses have been generally noted among mussels, and the endangered and candidate mussels are expected to react similarly, possibly with even greater sensitivity. These impacts would likely be significant given the endangered and candidate status of these species.

Some less common state-listed mussel species have been collected either in, or adjacent to, dredged areas including: the fragile papershell *(Leptodea fragilis*), the Salamander mussel (*Simpsonaias ambigua*), and the Wabash pigtoe (*Fusconaia flava*). These state-listed Species of Concern (Appendix J, Table J-1) may be given special consideration for protection because of their limited distribution and abundance. To the extent that mussel species of concern rely on host fish species with limited distributions, those mussel species are likely to remain relatively rare. Habitats are not well described for these species. Diving data suggest that many of these species appear to prefer the types of benthic habitat that now occur primarily in shallower parts of the study area. As these species are relatively rare, dredging under Alternative 2 could result in significant adverse impacts.

As noted in Section 2.2.1 and in Section 4.2.4, mussel surveys are required prior to dredging to reduce the likelihood of impacting threatened or endangered mussels. The extent or possibility of impact to threatened or endangered mussels depends on the accuracy with which pre-dredging surveys indicate such mussels or their habitat are present. If the endangered or candidate mussels are present at sites released for dredging, then dredging would have a significant adverse impact, since the removal of even small numbers of individuals may lead to significant declines in populations that are already dangerously low.

The sampling technique utilized at the start of preparation of this environmental document was a brailing technique. This technique has been found to collect only limited species and has been determined to be inadequate for locating endangered species.

In consultation with various mussel experts, the USACE and PADEP developed "Working Draft, Sept. 02, A Protocol to Evaluate Mussel Resources in Selected Reaches of the Ohio and Allegheny Rivers" (Appendix V). This protocol has been utilized by the industry since its development, and the USACE formally directed its use by letters to the dredgers dated May 3, 2004. The USFWS has never concurred with this protocol as an adequate sampling technique for determining absence of endangered mussels.

To address the USFWS's concerns, the USACE entered into informal consultation and submitted a Final Biological Assessment dated February 15, 2005. This assessment deferred to utilizing the "Draft Protocol for Mussel Surveys in the Ohio River Where Dredging/Disposal/Development Activity is Proposed", Ohio River Valley Ecosystem Mollusk Subgroup (clarified April 2004). The USFWS responded to the Biological Assessment by letter dated December 16, 2005.

A second concern with respect to threatened and endangered species is indirect effects of dredging due to alteration of the bottom and potential reduction of suitable habitat for species recolonization in the future. Since critical habitat requirements for the endangered mussels have not been determined thus far, it is difficult to evaluate the relative importance of this

concern. However, it is generally recognized, and addressed in this report, that deeper water habitats are not as suitable for mussel colonization.

In addition to the state-listed mussel species, several fish species are listed by PFBC as threatened, endangered, or species of concern in the study area (see Section 3.4.3). Habitat requirements for many of these fish species are fairly well described and in some cases, may overlap at certain points in their life cycle with areas or habitats that could be permitted for dredging under Alternative 2. While direct impacts of dredging on these fish species is unlikely because they are mobile and can avoid active dredging, long-term adverse impacts may occur if dredging is permitted in their preferred habitats, or if turbidity generated by dredging impacts spawning areas downstream.

Terrestrial Species. Lists of Federally- and state-listed threatened and endangered terrestrial species were provided by the USFWS (1997, 1999, see also Appendix J), PFBC (1997b, 1999), PDCNR, and PNDI. The bald eagle is not currently known to be nesting in the vicinity of any dredging operations. If a nest would be identified, appropriate coordination would be undertaken. The Indiana bat and bald eagle may occur within the counties bordering the study area. In addition, a Federally-listed candidate species, the Massasauga rattlesnake may utilize habitat in the Butler County area, although preferred habitat is not known to occur along the rivers (the species prefers relic prairie terrain). It is possible that the study area may be used as foraging or nesting habitat by the Indiana bat and bald eagle. However, given the limited number of dredging units on these rivers and the nature of the action, Alternative 2 is not expected to have any effect on these species.

Based on correspondence with PFBC, USFWS, and PDCNR, including searches of PNDI, seven terrestrial state-listed species (including proposed listed species) may utilize areas within the study area, as presented in Table J-2, Appendix J. Given the nature of the activities conducted under this alternative (i.e., dredging on average 225 ft from shore), no adverse effects to marginal adverse effects would be expected to state-listed terrestrial species. Noise from dredging units may cause a marginal adverse effect on nesting state-listed birds (e.g., prothonotary warbler) that may frequent areas near dredging operations.

4.2.7 Impacts to Air Quality

Overall there would be no effect to air quality related to Alternative 2 on either a short-term or long-term basis within the study area. Estimated dredge emissions are not large enough to affect the air quality in the study area. Dredger emission levels are extremely small compared to other regional sources (e.g., NO_x and SO_2 produced by electric generators in the Ohio Valley) or existing local sources (private and commercial vehicular traffic). Table 4-4 indicates estimated dredge emissions relative to emissions recently reported for all permitted point sources in the air quality control region that overlaps the study area. Table 4-5 presents a summary of regional air quality effects from Alternative 2.

Table 4-4
Annual Emissions for Point Sources for Select Counties in the Study Area (tons/yr)

Location/Source Area	PM-10[a]	VOCs (Ozone precursor)	SO_2	NO_x	CO
Beaver County	1,230	1,416	31,824	33,343	35,956
Allegheny County	3,414	2,254	49,001	21,735	8,239
Estimated Dredge Emissions[b]	15	NA	66	381	125

[a] Inhalable particulate matter (PM), 10μm in size or less.
[b] Based on the assumption that eight dredge/processing operations will operate concurrently. Each dredge/processor combination was assumed to emit at levels equal to the average of estimated emission rates provided in two current dredger permit applications: OP-03-00207 and OP-4-00698; and estimates provided by the applicants.
Source: USEPA, 1999b.
NA = Data unavailable

Table 4-5
Regional Air Quality Effects from Alternative 1

Pollutant[1]	Net Change in Emissions	Relative Significance for NAAQS
CO	Small decrease	No measurable change in air conformity. Combustion pollutants generated by dredging are much less than 1 percent of regional emission totals.
PM-10[a]	No change	By nature, dredging produces negligible levels of PM-10
SO_2 and Ozone	Small decrease	Combustion products generated by dredging much less than 1 percent of regional totals

[1] Considering only nonattainment or non-classified pollutants in the ROI.
[a] Inhalable particulate matter (PM), 10μm in size or less.

4.2.8 Impacts to Noise

Alternative 2 will not have a long-term effect on noise levels, although it could have a short-term direct adverse effect under certain circumstances. While historically there have been few reported noise complaints over many years of dredge operations, some residents reported noise problems related to dredging during the comment period prior to completing this EIS. Alternative 2 may produce noise levels above those recommended for sensitive land uses (e.g., hospitals, churches, residential areas). Based on dredge noise levels measured in preparation of this EIS, and noise propagation models (documented in Appendix R), current dredging activities can have a short-term noise effect where dredging occurs "near" a sensitive land use (generally at a distance less than 300 to 600 feet). Under current permit conditions, the applicants may be required to implement noise abatement measures in the event of noise complaints, most commonly involving moving the dredge from the affected area.

The key parameters to consider in assessing noise impacts are the extent and condition of dredger soundproofing, geography of the shoreline, period of day, and distance between the dredge and sensitive land area. From an assessment of two dredge types (bucket and clam shell, both with on-board processing), it appears the peak sustained noise levels fall between 94 and 82 dB, varying mainly with the monitoring position on the dredge. The corresponding noise levels on-shore in the vicinity of dredging ranged from 70 to 50 dB, as compared with an expected background value between 45 dB (undeveloped wooded areas) and 65 dB (active urban areas). Based on the noise dispersion model developed from monitoring data, it is evident that the potential for noise conflicts exists because a dredge typically stays in one area for an extended time period, and, during summer months, can operate for up to a 16-hour period during week days. However, most dredging currently occurs in either areas removed from sensitive land uses or at a sufficient offset distance to keep noise levels below recommended levels.

4.2.9 Impacts to Socioeconomic Conditions

No short-term or long-term economic effects would be expected from implementing Alternative 2 relative to baseline conditions. Under this alternative, the existing dredging permits would be renewed and current operations would continue at baseline levels. Employment, revenues, and income directly and indirectly generated by the applicants would remain unaffected by the implementation of Alternative 2. Secondary economic activity generated by the river dredging sector would also remain unchanged. Accordingly, there would be no change to economic activity in either the ROI or the State economy.

4.2.10 Impacts to the Quality of Life

Recreation. Overall, minor adverse effects to recreational opportunities would be expected under Alternative 2. Under Alternative 2, dredging operations could pose minor aesthetic or navigational inconveniences to recreational boaters; however, deeper water created by dredging is generally favored by recreational boaters. With respect to recreational angling, minor adverse effects could occur as a result of impacts of dredging on fish populations (as discussed in Section 4.2.4).

Aesthetics. Overall, minor adverse effects to the aesthetics of the river would occur as a result of Alternative 2. The dredging units may disrupt the aesthetic viewshed of the river, thereby causing minor adverse effects. As these dredging units occupy a single area of the river for the majority of the year, these impacts are expected to be very localized and short-term, given the small area taken up by the dredges verses the study area.

Traffic. No adverse effects would be expected to traffic under Alternative 2, relative to current baseline conditions (which includes current local truck traffic levels of 6 million truck-miles annually). Currently, the applicants use a combination of barges and trucks to deliver sand and gravel products to their customers who produce concrete and asphalt within the region. Given the relatively low cost of barge transportation, the applicants, when feasible, use barge transportation to the maximum extent practical to ship river-based products to their customers. Once the barge has reached its destination, sand and gravel products are off loaded at river terminals and are either consumed there or transported by truck. Using barges to transport sand and gravel has an additional benefit by reducing the need for trucks, thereby increasing road safety. Trucks delivering sand and gravel produced by the applicants within the region are estimated to travel approximately 6 million truck-miles annually.

Safety. No adverse effects would be expected to traffic safety under Alternative 2, relative to current baseline conditions (which includes current truck traffic levels). Using the U.S. Department of Transportation (USDOT) truck accident data, it was estimated that truck traffic accidents may result in less than 2 expected fatalities and 40 expected injuries in the next 10 years as a result of transporting river-based sand and gravel to customers in the region. With respect to barge traffic accidents, expected fatalities and injuries are estimated to both be less than one in the next
10 years.

4.2.11 Impacts to Environmental Justice and Protection of Children

No effects to environmental justice issues would be expected under Alternative 2. No changes in demographics, employment, housing, or public services would be expected relative to baseline conditions. Therefore, no environmental justice issues would result from implementation of Alternative 2. With respect to protection of children, the principal child

safety issue is truck traffic accidents, which are discussed in Section 4.2.10. Overall, these risks are expected to remain unchanged relative to baseline conditions. The degree to which these risks are borne disproportionately by children is unknown.

4.2.12 Impacts to Cultural Resources

No effects upon cultural resources would be expected under Alternative 2. According to the Pennsylvania State Historic Preservation Officer (SHPO), there are no National Register of Historic Places-eligible resources within the rivers, nor have there been any cultural resources identified within the rivers (see Appendix M). The Pennsylvania SHPO has stated that the proposed project will have no effect on any archaeological resources, and that no archaeological investigations are necessary in the project area (Carr, personal communication, 1999). Current permit conditions specify that dredging operations are not permitted in areas with known or suspected cultural resources sites. PADEP requires that dredging cease and the Pennsylvania Bureau for Historic Preservation be notified in the event that previously unidentified historical or archaeological sites are encountered. Dredging is usually conducted only within Pleistocene gravels. Human occupation in the New World post-dates the Pleistocene Era, so it is anticipated that no archaeological resources will exist in the dredged soil layers.

4.3 ENVIRONMENTAL CONSEQUENCES OF ALTERNATIVE 3

This section discusses potential consequences of continued dredging but with further site-specific restrictions, in addition to those contained in current permit conditions. Several different categories of additional restrictions are considered in this alternative including:

- ***Limiting dredging to certain areas.***
- ***Additional site-specific analyses or surveys prior to dredging.***
- ***Altering the bathymetry or configuration of dredged areas.***
- ***Restricting dredging in certain habitat conditions.***
- ***Restricting dredging to certain depths.***
- ***Additional measures to mitigate noise conflicts/complaints.***
- ***Additional compensatory mitigation and/or restoration measures***

The above additional restrictions are evaluated within the context of an adaptive management process in which a particular restriction is not necessarily formulated as a “universal” permit condition to be carried out at all locations in the study area. Rather, regulatory agencies, with input from other resource organizations, would require additional restrictions as needed to avoid or minimize potential impacts in a given location requested for dredging. In addition, under this alternative, additional or modified restrictions can be implemented as more information becomes available.

In considering further restrictions for this alternative, certain types of restrictions, previously thought worthy of evaluation, were found to be either impractical, ineffective in terms of mitigating impacts, or result in restricting the industry to the point that dredging would cease (i.e., the No Action Alternative). The latter consequence needs to be considered for any combination of further restrictions to make sure that the result does not immediately lead to the No Action Alternative, as that alternative is already considered in this EIS. The adaptive management process will continue to evaluate specifications which may result in either greater or lesser restrictions. Restrictions considered but not further evaluated were: (1) restricting dredging/processing techniques and (2) dredging only distinct aggregate types; and (3) limiting dredging to previously dredged areas. The following briefly summarizes why each of these additional restrictions is not further considered in this document.

- *Restricting dredging/processing techniques*. Applicants use different mechanical techniques for obtaining sand and gravel (e.g., clam shell dredging units versus bucket-type conveyer units, discussed in Section 2.2.3) and for processing sand and gravel (e.g., on-board processing versus processing on land, also discussed in Section 2.2.3). Current information, summarized under Alternative 2 (Section 4.2), indicated that there was little difference in environmental impacts between these two techniques. Both clam shell and bucket-type dredges result in similar turbidity conditions downstream and both have nearly the same depth of dredging. On-board processing results in higher noise levels on the river than land-based processing in general, but the difference is not great enough to warrant restriction to utilize land-based processing only. Furthermore, over the past several decades the applicants have made significant financial investments in equipment employing specific types of dredging and processing technique. Therefore, restricting dredging and/or processing techniques was considered an ineffective and infeasible way to reduce adverse environmental effects associated with dredging.

- *Limiting dredging for only distinct aggregate types*. This issue is already addressed under current permit conditions in Alternative 2. The applicants were previously required to provide notices to their customers encouraging conservation of the material. In the current Water Obstruction and Encroachment Permits issued by PADEP, this requirement was eliminated, due to the difficulty it creates for the regulators, the companies and the consumers of aggregate. The applicants cannot control the final use of the aggregate sold to their customers. Likewise, the applicants cannot discriminate against customers who utilize the aggregate for numerous purposes.

- *Limiting dredging to areas dredged in the past*. As previously discussed, the Allegheny and Ohio rivers have been dredged for over a century. To reduce the impact of dredging virgin areas on the rivers, it has been suggested that applicants should only be allowed to dredge areas that have been previously dredged. The current permit restrictions are effectively already doing this. Most of the river area that meets current permit restrictions (under Alternative 2) has been dredged in the past. Therefore, this alternative is effectively incorporated into Alternatives 2 and 3 and does not need to be addressed

separately. It should also be noted that no extent of previous disturbance from dredging is defined as to determine what constitutes a previously dredged area.

4.3.1 Impacts to Hydrology

As discussed under Alternative 2 (Section 4.2.1), current permit conditions restrict dredging to 150 feet from the point where the 6 ft depth contour occurs. Normally, this occurs at about 50 feet from the shoreline. In some cases, it may be closer, such as at barge docking areas, and in other cases it may be larger, especially at inside bends of the river. However, the current bank setback appears to be effective in preventing shoreline erosion. Since this restriction was implemented over 20 years ago, there have been no documented cases where dredging has caused shoreline erosion. A recent situation involving bank subsidence at a private boat dock in Pool 5 revealed that dredging was not the cause and that there was no evidence of downcutting or bank instability (see transect bathymetry maps, Appendix D).

Currently, the applicants are required to set buoys 100 feet apart at the location of the 6 feet depth contour. Maintaining these buoys in the river has been difficult, considering the current and elevation changes of the river. An alternative could be to determine the 6 feet depth contour and its distance from the shoreline, and add this distance to 150 feet to determine the offset from the shoreline. This would eliminate the need to install and maintain the buoys, while providing the same offset distance.

A key to the adaptive management process for protection of hydrology in the project area is prior bathymetric measurements taken along transects perpendicular to the river flow between the shoreline and the area proposed for dredging. Such measurements could be especially useful in identifying locations where river depth exceeds 6 feet at the shoreline and river currents are such that shoreline erosion and downcutting of the river bank is possible (for example, outside river bends). With this information, permitting agencies and the applicants could identify the need for somewhat larger set-back distances from the 6 foot depth contour on a site-specific basis. Restricting dredging in areas of less than 9 feet of water will also help reduce impacts to shore-line hydrology. Implementation of other restrictions suggested at the beginning of this chapter are unlikely to mitigate adverse impacts on hydrology.

4.3.2 Impacts to Geology and Hydrogeology

Current dredging practices under Alternative 2 appear to have a minor, if any, adverse impact on geology in the study area. Measurements of particle size were identical in dredged versus undredged areas. However, there have been reports of silt accumulations in certain dredged

areas. Although the cause of silt accumulations in these areas and not others is not known, a likely possibility is some combination of depth, physical configuration of the dredged area, and placement in the navigation pool. Silt and other fine material will accumulate where

current velocity is lowest: deep areas in which flushing is minimal, such as away from the thalweg, directly downstream of islands, and in the tail end of pools.

Hydrodynamic modeling conducted for this EIS indicated that small, deep pockets or holes in the river bottom have lower flushing rates than more tapered configurations, even if they are similarly deep (see Appendix P). Thus, one further restriction that would help mitigate this impact is to require a particular dredge area configuration to maximize the flushing rate in areas that are likely to have low current velocities. A key to this form of adaptive management is to have prior measurements of current velocity near the river bottom at proposed dredging locations in which the permitting agency suspects the potential for siltation. Side-scan sonar photography can be used to document the configuration following dredging and bathymetric data of the dredged area can be used to determine predicted flushing rates given actual site-specific conditions. This information can be used to predict if an area has the potential to have lower flushing rates.

4.3.3 Impacts to Water Quality

Two water quality parameters are potentially impacted by current dredging practices: turbidity and dissolved oxygen. A third category, sediment contaminants, may consist of different chemical parameters, and might be a cause for concern in certain parts of the study area. The cause of impacts on each parameter is different and therefore, the additional site-specific restrictions that may be needed are different as discussed below.

Turbidity. Increased turbidity and suspended solids downstream is a predictable outcome of dredging activity, regardless of the technique used, for at least some distance downstream (1000-1500 ft given available information compiled in this EIS). Available information indicates that dredging operations are unlikely to impact water quality supplying aquatic resources or water intakes if they occur at least 1000 feet downstream because the suspended solids and turbidity recorded at those distances is the same as in undredged locations. Dredging operations over the past 20 years, with this set-back distance enforced in permits, have resulted in no known complaints from water intakes concerning turbidity or suspended solids from dredging.

If an operator desires to dredge closer than 1000 feet from an intake or a unique habitat as determined by the types of biota present (e.g., wetlands), the use of dredge screens, directly downstream of active dredging, may be used to trap suspended sediments and decrease transport downstream. Dredge screens are commonly employed where dredging is used to

remove unwanted sediments in certain riverine hazardous waste sites and in habitat restoration. If implemented properly, flow conditions are amenable, and the screen does not impede river navigation, dredge screens may be able to reduce turbidity and suspended solids levels to tolerable ambient concentrations within a relatively short distance downstream.

Dissolved Oxygen. Although not completely understood at this time, DO may be adversely impacted in some deep dredged locations under relatively extreme hot and dry conditions when oxygen saturation, river velocities and re-aeration are likely to be lowest. Extensive data collected for this EIS demonstrate that depth is one factor influencing observed oxygen levels but not the only factor. Several similarly deep locations measured during the same hot, dry conditions did not exhibit adverse impacts on oxygen levels. One potential explanation is that decreased boat traffic in the uppermost pools on the Allegheny (Pools 7 and 8, where PADEP observed impacted DO levels below 30 feet deep in some dredged areas), results in less mixing or reaeration and more stagnant hydrodynamic conditions in deeper areas. However, the depth of vertical mixing resulting from boat traffic and prop wash is not accurately known. Other potential explanations include: the placement of the dredged area relative to the thalweg and/or the head or tail end of the pool; and/or the bathymetric configuration of the dredged area.

To address many of these potential hypotheses, predicted DO levels were evaluated using the Environmental Fluid Dynamics Model (EFDC), which is a 3-dimensional hydrodynamic fate and transport model used extensively by USEPA and other agencies to model complex hydrological and water quality situations (see Appendix P for more information about the model and how it was parameterized and validated). The impact of different dredged trench configurations on flushing rates and associated dissolved oxygen levels was examined, using PADEP temperature and dissolved oxygen data, collected in the summer drought, July 1999 (Appendix H), as a “worst-case” modeling scenario. The EFDC model was used to evaluate predicted dissolved oxygen levels in several different dredge configurations at two different starting water depths: 4.3 m and 6.3 m, which approximates initial river depths at relatively shallow and more typical areas, respectively. Effect of depth of dredging was examined using three different depths: 1, 3, and 6 m. The deepest dredge depth (6 m), combined with the deepest initial water depth level (6.3 m), approximates the deepest dredged locations currently in the project area (40 feet). Effects of three lengths of dredging (20 m, 100 m, and 200 m), and two dredge configurations (v-shaped, and sloping side walls), were also examined in relation to depth of dredging. A total of 24 dredge scenarios (including baseline simulations with no dredging) were examined in this exercise (see Appendix P).

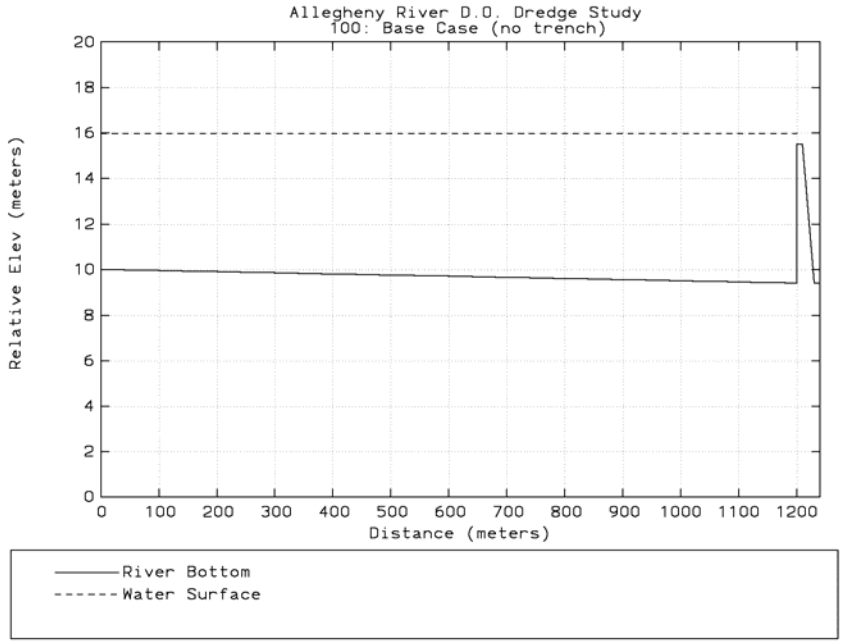
Results of modeling indicated that at a depth of 6.3 m, DO at the bottom would be at or slightly above the State standard of 5 mg/l under the July 1999 river conditions in Pools 7 and 8, without any further dredging taking place (Figure 4-4). This result is supported by PADEP’s actual data in which several locations 20-25 feet deep had DOs at or less than 5.0 mg/l, indicating relatively strong temperature and oxygen stratification in the river at that

time. At an initial water depth of 4.3 m, both shallow and deeper dredging (6 m deep) had relatively little effect on DO and compliance with the DO standard was observed, particularly if trenches were longer (e.g., 100 m) and v-shaped side walls were used (Figure 4-5). This is consistent with EFDC hydrodynamic modeling indicating higher flushing rates using such dredge configurations (Appendix P). In deeper areas initially (6.3 m deep), v-shaped configurations also yielded less change in DO concentration from baseline (without dredging) than sloped side walls, however, most scenarios (even shallow dredging at 1 m deep) resulted in possible bottom DO values < 5 mg/l under July, 1999 river conditions (Appendix P). Again, this is due to the fact that DOs recorded by PADEP at approximately 6 m deep at this time were very close to the state standard of 5 mg/l.

Modeling analyses indicate that improvement in bottom DO conditions over Alternative 2 can be achieved by configuring the dredged area to maximize flushing and reaeration. Longer v-shaped areas are preferable in terms of resulting DO levels as compared to small, steep "holes". Other factors that may naturally increase reaeration, such as increased currents in outside bends and proximity to the thalweg, are expected to further mitigate DO effects. Conversely, factors that may reduce reaeration rates, such as proximity to the upstream face of a dam or reduced surface wind stress (due to stream bank obstructions such as hills and forest), will reduce the effectiveness of different dredge configurations in mitigating worst-case DO levels.

We note that many states recognize difficulties in meeting the 5.0 mg/l DO standard at all times in deeper water bodies under natural conditions (where no dredging or similar activity occurs) and have modified their standards accordingly. For example, South Carolina's DO standard applies to the photic zone only (the upper strata of water where most planktonic biological activity occurs) in deeper water bodies.

To mitigate the impact of dredging on areas that have the potential to yield low DO levels, sand and gravel should be extracted in the pattern of elongated trenches (preferably in areas with the greatest flow rates), as opposed to deep isolated pockets. To restore favorable flow conditions that may eliminate intermittent low DO conditions, it may be advisable to modify the morphology of small deep trenches and create trench conditions that will enhance flushing. In some river locations, current barriers may make it difficult to achieve the desired dredge trench configurations. In these cases, the current permit restrictions (off-set distances) may need to be modified in order to accommodate the required dredge trench configuration to promote flushing.



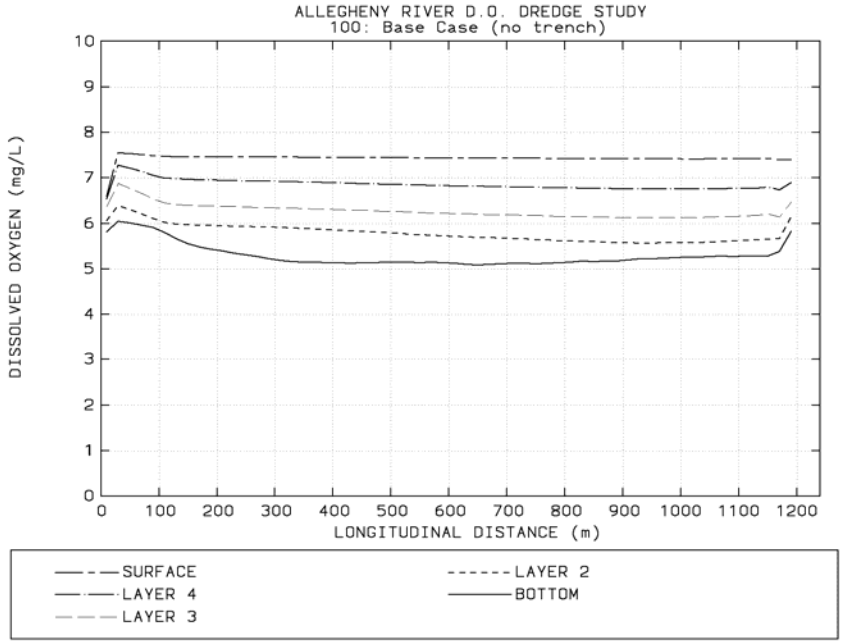
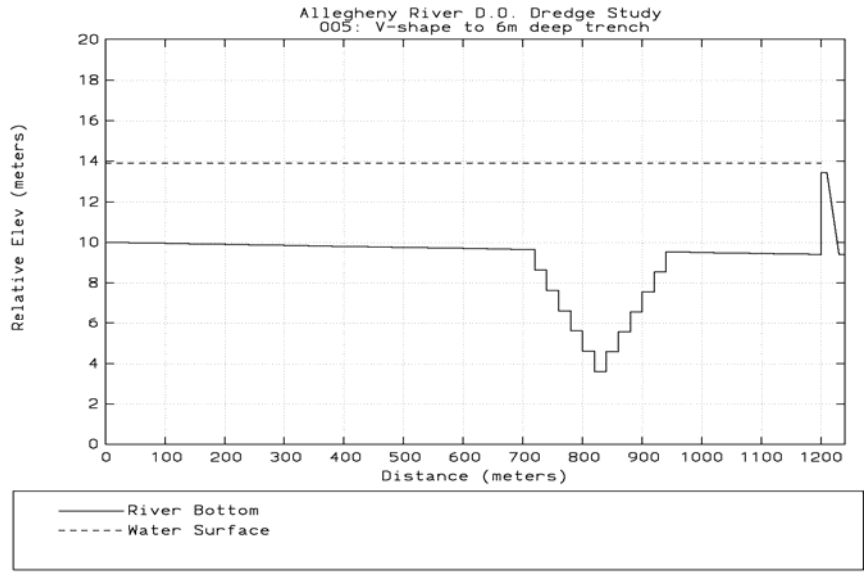


Figure 4-4. Results of dissolved oxygen modeling using the EFDC model for a baseline scenario in which the initial water depth is 6.3 meters and no dredging has occurred. Temperature and other model input parameters used were those recorded by PADEP in their water quality survey of dredged areas in Pools 7 and 8 in the Allegheny River, July, 1999. The model predicts an oxygen level of approximately 5 mg/l (state minimum standard) at the river bottom under these conditions.



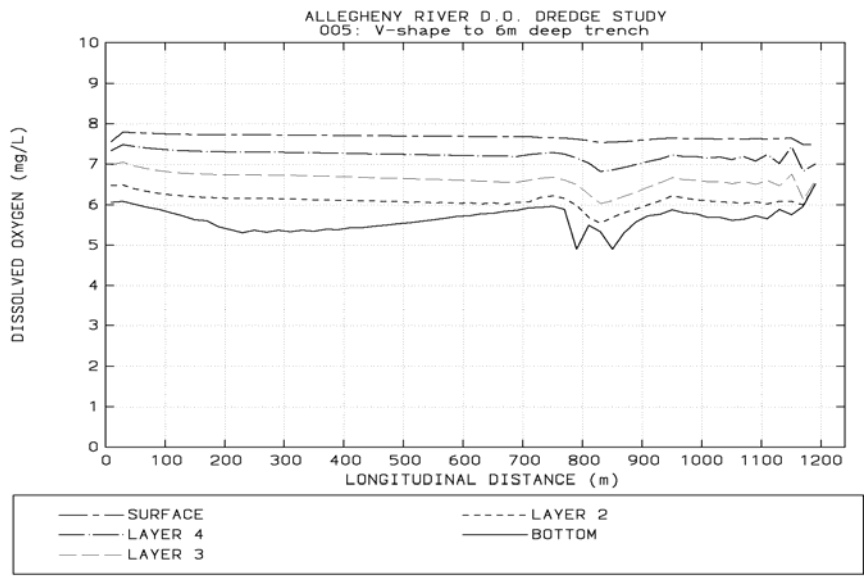


Figure 4-5. Results of dissolved oxygen modeling using the EFDC model for a scenario in which dredging occurs to a depth of approximately 40 feet and sloping side walls are maintained. Temperature and other model input parameters used were those recorded by PADEP in their water quality survey of dredged areas in Pools 7 and 8 in the Allegheny River, July, 1999. The model predicts oxygen levels of at least 5 mg/l (state minimum standard) at all depths under these dredged conditions.

Sediment Contaminants. For most of the study area, resuspension of sediment contaminants is likely to be a very minor issue because contamination is low and contaminant sources to the river have decreased markedly over the past 20 years. This is evidenced by improved water quality conditions within the study area, increased quality of the fishery, and reports of excellent drinking water quality from utilities that rely on river water as their raw source water.

However, certain parts of the study area, particularly adjacent to Pittsburgh, are known to have potentially harmful sediment contaminant levels as a result of historic industrial and urban practices. The City of Pittsburgh has requested no dredging in Pool 2, where the intake for the City of Pittsburgh water treatment plant is located. The City raised concerns that dredging might resuspend sediment contaminants that are otherwise buried and harmless. If permitting agencies suspect contaminated sediments in locations that are being considered for dredging, it may be prudent to require sediment contaminant analyses similar to those conducted during this EIS. As more data are collected on this issue, modifications to current monitoring practices may need to be re-considered on a site-specific basis.

4.3.4 Impacts to Aquatic Life

Information collected for this EIS indicates the potential for significant adverse impacts on native mussels, some other macroinvertebrates, and some fish species under the current permitting process (Alternative 2). In very few areas, aquatic macrophytes (submerged and emergent vegetation) may also be adversely impacted given current permit restrictions. These impacts have been mitigated up to now by restricting certain pools (i.e., Pool 6) considered unique in terms of aquatic life resources. The following evaluates additional restrictions for mitigating adverse impacts on aquatic life in the study area. A key to this issue is identifying and protecting productive habitats that may or may not be used by aquatic life resources presently.

The mussel survey protocol developed by the USFWS (see Appendix T) is now the primary means by which aquatic life resources are directly protected. Based on abundant ecological literature, native mussels are good sentinel organisms of long-term water quality and the welfare of many other types of aquatic life, including other benthic invertebrates and fish. Measures that are protective of freshwater mussels are likely to be protective of many other forms of aquatic life.

In comparing the unrestricted area for dredging between Alternatives 2 and 3, current adaptive management restrictions result in approximately 25% less dredgeable area as compared to that theoretically available under Alternative 2. Thus, a significant additional portion of the study area is restricted from dredging using Alternative 3 as currently practiced, largely based on protecting aquatic life resources.

A concern raised with the mussel survey approach is that it indicates whether mussels are presently in a given location but not necessarily what could be present in the future, given continued water quality improvements in the study area. Again, the central issue is determining productive or high quality aquatic life habitat, independent of the fauna or flora there currently. There is currently no consensus on the definition of high quality habitat in the study area. Several nationally-known mussel experts who participated at the October 31, 2000 mussel protocol workshop sponsored by PADEP, indicated that productive mussel habitat is best indicated by their presence. Under this paradigm, the water quality conditions in the study area over at least the past 10-15 years have been satisfactory for mussel recruitment and their fish hosts and so mussels should be present wherever they were capable of colonizing and growing. Therefore, locations where mussels are not currently found are unlikely to harbor mussel populations in the future due to habitat constraints. Another viewpoint expressed by some experts is that past water quality degradation has limited mussel distribution today and that some habitats, not currently colonized by mussels, could do so in the future.

Nearly all mussel experts appear to agree that dredged or disturbed areas are not likely to harbor significant mussel populations. Data collected for this EIS also indicated that undredged areas > 15-20 ft deep (e.g., areas with submerged pipelines that have been restricted to dredging) do not harbor significant mussel populations. In contrast, mussel data collected from relatively shallow (< 9 ft) undisturbed areas in the study area (e.g., near islands or river shorelines) often have the highest density and diversity of mussels observed anywhere in the study area. Although experts disagree as to whether depth itself is a causative factor in this regard, there is little doubt that depth, as well as the degree of prior disturbance, are at least proximate factors indicative of not only preferred mussel habitat but also general benthic invertebrate and fish habitat as well. This conclusion is further supported by the fact that the relatively shallow, undisturbed portion of the Allegheny River, just upstream of the study area (e.g., just upstream of East Brady Bridge in Pool 9), has mussel densities at least an order of magnitude higher than any similar survey conducted anywhere within the study area. Although still considered to be part of Pool 9, the East Brady Bridge area is at the upriver end of the navigation pool and has free flowing river characteristics, thus providing better mussel habitat.

Based on the above discussion, the following set of adaptive management processes would become part of Alternative 3 to mitigate adverse impacts on aquatic life resources:

1) Limit dredging to areas > 9 ft depth initially;
2) Continue to conduct mussel surveys prior to dredging, revisiting the methodology and decision criteria as necessary as more information is compiled;
3) Consider other adaptive management restrictions, as necessary, on a site-specific basis, that are warranted to avoid adverse impacts on aquatic life, such as avoidance of high quality habitats when identified; and

4) Consider policy changes to utilize the existing fees paid by the applicants for aquatic life projects along the Allegheny and Ohio Rivers.

The 9 foot depth restriction was derived from several pieces of information including: (1) the navigation channel is required to have a minimum depth of 9 feet, (2) previous data relating mussel data (via diving) with river depth showed significantly more mussels and more mussel species at depths < 9 feet, and (3) current navigation maps for the project area indicate the 9 foot depth contour (as opposed to other depth contours), making it feasible to identify and enforce this depth restriction.

While the above adaptive management processes should help to avoid or minimize impacts on aquatic life, some compensatory mitigation may be required to offset the possible loss of potential future habitat for aquatic life, pending agency input. Currently, the applicants pay a fee ("royalty") to the PFBC for extraction of river resources. These fees are a form of compensatory mitigation because they may be used, in part, to support healthier fish populations through PFBC programs. Consideration should be given to utilize these fees specifically for aquatic life enhancement projects in the study area.

The adaptive management processes described above for mussels would also minimize occasional impacts to fish. Using the same GIS analysis described in Section 4.2.4 under Alternative 2, a wide variety of species and their habitats would be protected under Alternative 3. Figure 4-3 demonstrates the type of improvement in potential protection for certain fish species under Alternative 3. Although very little optimal habitat occurs in currently permitted dredge areas in either Pools 5 or 6, for many fish species and life stages, habitat that is at least satisfactory is more likely to be protected rather than permitted under Alternative 3, particularly for the channel-riverine and channel-lacustrine species such as river redhorse and largemouth bass (see Appendix Q). This includes spawning and early life-stage rearing habitat for these species.

Margin species, such as bowfin and smallmouth bass (as well as most of the state-listed fish species occurring in the study area), are protected as well due to current shoreline setbacks and adaptive management in Alternative 3. The Pennsylvania Fisheries Advisory workgroup developed a sampling technique and standards to further protect the fisheries resource. The sampling targets benthic lithophils due to their utilization of the substrates impacted by dredging. Sampling results may lead to further restrictions on dredging as part of the adaptive management process. These sampling requirements may be required as part of the State permits.

By limiting dredging to areas > 9 feet deep initially, more shallow areas are protected in each pool, which would help maintain spawning and feeding areas for many fish species, including several that are state-listed, as well as benthic macroinvertebrates and other biota upon which fish rely. Table 4-6 summarizes the number of acres of river habitat < 9 feet deep (at normal pool stage) in each pool that would be theoretically available for dredging

Table 4-6
Total Number and Dredgeable (theoretically permitted) Acres of Shallow Habitat (< 9 feet deep) in each Navigation Pool in the Study Area (as computed using the Project GIS and Available Bathymetry Data) under Either Alternative 2 or Alternative 3 Permit Restrictions

		Dredgeable Acres (and Percent) of Shallow Habitat	
Pool	**Current Total Acres of Shallow Habitat***	**Alternative 2**	**Alternative 3****
Allegheny River			
Emsworth	237	1.5 (0.6)	0 (0)
2	1,388	0.6 (0.04)	0 (0)
3	384	49.1 (12.8)	10 (2.6)
4	287	67.8 (23.6)	4 (1.4)
5	302	52.5 (17.3)	0 (0)
6	960	237 (24.7)	12 (1.2)
7	226	40.1 (17.7)	6 (2.6)
8	508	157 (31.0)	23 (4.5)
Ohio River			
Emsworth	188	9.1 (4.8)	5 (2.6)
Dashields	348	17.9 (5.2)	8 (2.3)
New Cumberland	242	21.3 (8.8)	9 (3.7)
Montgomery	566	66.0 (11.7)	13 (2.3)
Total	5,636	719.8 (12.8)	89 (1.6)

* Shallow habitat defined as areas < 9 feet deep at normal pool stage

** Estimate based on minimum implementation of adaptive management restrictions and current known locations of significant mussel resources and state-listed fish species. Actual dredgeable shallow acres could be less (not more) under this alternative than estimated depending on results of mussel surveys and quality of material present.

under Alternatives 2 and 3. Less than 10% of the shallow habitat theoretically available under Alternative 2 would be considered for dredging under Alternative 3 on average. Out of a total of more than 5,600 acres of riverine habitat < 9 feet deep in the project area, 89 acres (1.6%) would be theoretically available for dredging under Alternative 3. Significant mussel resources in these remaining shallow areas, as determined through required mussel surveys, would further diminish the amount of shallow area that is dredgeable.

4.3.5 Impacts to Wetlands and Terrestrial Life

Minor adverse impacts to wetlands and associated plant and wildlife are expected with implementation of Alternative 3, similar to Alternative 2. However, under this alternative, permitting agencies may elect to deny site-specific permits at specific river miles that are considered to have the potential to impact unique or rare habitats such as emergent wetlands. This will further reduce the potential for adverse impacts to wetland habitat.

4.3.6 Impacts to State and Federally-listed Threatened and Endangered Species

Aquatic Species. Many of the adaptive management processes listed under Section 4.3.4 for aquatic life would apply to the state and federally-listed aquatic species as well, with the additional requirement that the mussel sampling protocol must be capable of finding rare species with some specified confidence level. As noted under Section 4.3.4, and in other places in this document, the mussel survey protocol used by the USACE and PADEP in their permitting program has continued to be developed with input from a number of experts. In the Biological Assessment, the USACE deferred to the use of the Ohio River Protocol (Draft Protocol for Mussel Surveys in the Ohio River Where Dredging/Disposal/Development Activity is Proposed, clarified April 2004) (Appendix U). The USFWS responded to the Biological Assessment by letter dated December 16, 2005. The response concurred that the proposed permit actions are not likely to adversely affect Federally listed species, contingent upon implementing Alternative 3 with inclusion of the following measures: (1) bald eagle screening and avoidance language, as detailed below; (2) adoption and implementation of the *Guidelines for Mussel Surveys in the Navigable Ohio and Allegheny Rivers* (Appendix T) as specified in permit conditions 11 and 14 in the Biological Assessment (Appendix S); (3) implementation of permit conditions 10, 11, 13, 14, 16, 17 and 19 in the Biological Assessment (Appendix S); (4) implementation of a mitigation plan, including the designation of additional reserve areas to offset the indirect and cumulative effects of dredging; and (5) issuance of dredging permits or authorizations that are fully consistent with the above measures. Such surveys should avoid or minimize direct impacts on state and federally-listed species. Indirect impacts on these species should be avoided through the types of adaptive management processes summarized in Section 4.3.4 for aquatic life. As critical habitat has not been defined by USFWS for the federally-listed mussel species, mussel surveys are an important tool for protecting this resource.

Potential impacts to state-listed fish species will be minimized through adaptive management restrictions discussed above as well as recent practices to avoid certain locations at which the PFBC indicates state-listed species occur.

Terrestrial Species. Give the nature of the activities conducted under Alternative 3 (restrictions from all shallow areas < 9 feet deep, bank set-backs, and noise controls), no adverse effects are expected on federally or state-listed terrestrial species in the project area.

As the project is within the range of the bald eagle (Haliaeetus leucocephalus) and the Indiana bat (Myotis sodalis), the Service has concurred that no impacts will occur to Indiana bats since no potential habitat will be affected. Since bald eagles are known to nest near the rivers, the following special condition will be required:

To avoid potential adverse effects to bald eagles, projects will be screened for the presence of this species using the Pennsylvania Natural Heritage Program's online environmental review database (http://www.naturalheritage.state.pa.us) or by contacting the Fish and Wildlife Service. If a bald eagle nest occurs in the vicinity of a proposed dredging area, no dredging will occur within 0.5 mile of the nest during the nesting season (January 1 to July 31).

4.3.7 Impacts to Air Quality

No adverse impacts on air quality are expected due to implementation of Alternative 3. As noted under Section 4.2.7, no impacts are observed under current permitting conditions (Table 4-4).

4.3.8 Impacts to Noise

As noted under Alternative 2 (Section 4.2.8), under certain conditions, noise levels from dredging may cause conflicts with river-side dwellings and other sensitive land uses nearby. Under Alternative 3, such occasional impacts (i.e., noise complaints) would be mitigated on a site-specific basis using perhaps several measures including: moving the dredge unit such that noise levels are < 55 dB at the complaint site (median noise level between expected background and active urban areas), reorienting the unit so that the quieter side is facing the sensitive area, limiting night-time operations, enhanced dredge sound proofing, and/or engineering controls. Noise monitoring at nearby residential homes and/or other dwellings could be used, if necessary, to ensure that excessive noise levels do not occur.

4.3.9 Impacts to Socioeconomic Conditions

Under Alternative 3, adaptive management procedures would be implemented. This Alternative would impose restrictions as to where dredging could be conducted. The primary effect of these restrictions is that some aggregate material would not be available for extracting. In short, the remaining reserves would be somewhat diminished and the life cycle of the dredging operations would be shortened. These restrictions would not affect the level of activities carried out by the dredgers on a daily basis. Hence, annual production and workforce and income levels would be the same as for Alternative 2 over the next 10 years. Accordingly, the economic impacts from both Alternatives would be identical.

4.3.10 Impacts to Quality of Life

Recreation. Under Alternative 3, minor adverse effects may be expected, similar to Alternative 2. However, Alternative 3 is expected to have less impact on recreational resources than Alternative 2 because shallow areas and unique habitats would be explicitly avoided.

Aesthetics. No change in aesthetics is expected as a result of implementing Alternative 3. Dredging would continue to occupy an extremely small percentage of the river at any given time.

Traffic. No adverse impacts are expected under Alternative 3.

Safety. None to minor effects on public safety would be expected, similar to that discussed under Alternative 2.

Traffic Safety. None to minor effects on public safety would be expected, similar to that discussed under Alternative 2.

4.3.11 *Environmental Justice and Protection of Children*

No adverse effects on environmental justice or children are expected under Alternative 3.

4.3.12 Impacts to Cultural Resources

No adverse effects on cultural resources are expected, similar to Alternative 2.

4.4 ENVIRONMENTAL CONSEQUENCES OF ALTERNATIVE 4

In addition to land-based sources, other sources within the region for supplying aggregate material to the Pittsburgh metropolitan area were considered, including importation of aggregate and recycled materials, as discussed below:

Recycled Materials. As discussed in Section 2, recycled materials do not meet PennDOT specifications set forth for Type A sand and SRL E aggregate. With respect to lower quality course aggregates, the costs of utilizing recycled materials relative to the close proximity of cheaper coarse aggregate materials from land-based quarries in the Pittsburgh metropolitan area, would indicate that land-based quarry operations that produce such material (i.e., the lower quality aggregates) would be utilized more readily. Although they may be used to some extent and may become more competitive in the future, their inability to meet Type A sand and SRL E aggregate requirements, renders them unviable. Thus, use of recycled materials would not contribute significantly as a source to supply any regional shortfalls due to the denial of river dredging permits in Pennsylvania on the Ohio and Allegheny Rivers.

Importation of Sand and Gravel. As discussed in Section 4.1.9, a market analysis was conducted to assess alternative sources of sand and gravel materials in the region and beyond. Several viable alternative sources were found throughout the states of Pennsylvania, Ohio, West Virginia, Kentucky, and New York. The majority of these sources consisted of land-based quarries that would transport their products using trucks to the region currently served by the applicants. These are evaluated in detail as discussed below.

Other sources were evaluated including dredged materials barged from sources located downstream of river-mile 40 on the Ohio River and northern sources barged into Erie, PA. Sources that currently barge materials into Erie, PA would then have to truck the materials to Pittsburgh. Although extensive resources exist to the north around Erie, PA, they would not be cost competitive, relative to closer land-based and river-based sources, due to the high costs associated with transportation. Therefore, the only viable alternative sources of sand and gravel were determined to be existing and future land-based quarries located in the region and importation of material from river-based sources below river-mile 40 on the Ohio River. It was further determined that by far the principal alternative source of sand and gravel materials is land-based quarry operations located within the region. The environmental consequences of utilizing land-based quarry operations are presented in the sections to follow.

With respect to importation of river-based products, companies dredging sources below river-mile 40 are currently serving customers within their respective regions (e.g., city of Parkersburg, Huntington, and Wheeling WV); however, if market forces allowed for the importation of materials to the Pittsburgh metropolitan area, then it is likely that this sector would respond to the potential for increasing their business and market share. It was determined, that dredging operations that are currently centered in the Parkersburg, West Virginia area and further downstream on the Ohio River may provide some material to Pittsburgh, but generally could not compete with existing land-based quarry operations in western Pennsylvania due to the increased cost of transporting materials a farther distance. However, importation of dredged materials from just below river mile 40 and areas north of Parkersburg, West Virginia on the Ohio River, may provide a viable alternative source of aggregate.

In this area of the river, the principal product obtained would be Type A sand, as course aggregates, particularly Level E materials are generally not found in this portion of the river. Other large land-based sources of Type A sand exist in western Pennsylvania and eastern Ohio in close proximity to Pittsburgh; therefore, it is uncertain to what extent river-based sources would serve to offset demand for sand relative to land-based sources. It should be further noted that the customers of Type A sand are located throughout western Pennsylvania and barging sand up the Ohio would not eliminate the need to also truck material to its final destination. Given the added transportation costs, it is likely that many land-based sources in

closer proximity to the final customer would be able to out compete the imported materials from below river-mile 40.

To the extent that importation of sand from river-based sources below river-mile 40 would be utilized to satisfy the demand caused by cessation of commercial sand and gravel dredging in Pennsylvania, adverse impacts to the Ohio River and aquatic ecosystem may occur. Thus, selection of Alternative 4 may result in a "shift" of some environmental impacts from above river-mile 40, to below river-mile 40. Thus, similar environmental effects described for Alternative 2 may also occur under Alternative 4. However, the overall cumulative effect to the river system would be reduced because a much smaller portion of the sand and gravel material would likely come from the Ohio River, perhaps less than 15 percent, relative to current dredging practices. Given the high degree of uncertainty associated with the extent of dredging that may occur below river-mile 40 and the relatively small portion that may likely come from this source, the environmental consequences section for Alternative 4 focuses on the secondary impacts that may occur as a result of land-based quarry operations. Nevertheless, it should be noted that to some extent similar environmental consequences associated with Alternative 2 (i.e., river-based dredging) would occur below river-mile 40 to the extent that this source is utilized to off-set demand, particularly for Type A sand, in the event of the complete cessation of commercial sand and gravel dredging under Alternative 4.

Land-based sources. As discussed in Section 2 of this document, there are several areas within Pennsylvania (e.g., central and northeastern portions of the state) where river-based aggregate are not readily available and the area must rely on land-based sources for their primary source of sand and gravel materials. Overall, the cost of material at land-based quarry sites is not significantly different from the cost of river-based material at the river terminal. As long as the quality of the material meets all specified requirements, the principal factor to be used by the customer in the selection of material is the price delivered to the job site, the asphalt plant or the concrete plant. As with any bulk commodity that has a low unit value but high transportation value like aggregate, the transportation costs contribute significantly to the overall final delivered cost of the commodity. Therefore, the proximity of the material to the customer is the significant portion of the final cost.

The northwestern and northeastern corners of Pennsylvania both contain significant glacial deposit resources, similar to that found in the riverbeds of the Ohio and Allegheny, which have the potential to supply the needs of western Pennsylvania currently served by the applicants. In the short-term, land-based quarry operations within the region have the potential capacity to supply the needs of western Pennsylvania. It is estimated that approximately 50 existing quarries would need to significantly increase production in order to make up for the immediate needs of the applicants' customers. In the long-term, it appears that the significant glacial sand and gravel resources of northwestern Pennsylvania could be developed to supply the needs of western Pennsylvania, so long as environmental permits and local land use approvals are issued for the expansion and/or creation of new quarries in this region. In the long-term, it is estimated that 20 new quarries would be needed to off-set

demand for sand and gravel products in the market currently supplied by the applicants. It should be noted that it is uncertain whether quarries in the region will increase production as assumed, or whether new quarries will be permitted near the Pittsburgh metropolitan area.

At this point, it is very speculative to identify specific locations that may be impacted by the selection of Alternative 4. As such, a detailed quantitative analysis for this alternative could not be performed. Rather, a qualitative analysis of existing land-based quarry operations in the state, where river-based sources are not utilized, was conducted, along with an assessment of the potential regional effect associated with increasing existing land-based quarry operations. Based on the results of a market analysis, it appears that sufficient land-based quarry production capacity was found within the region to supply the needs of the Pittsburgh metropolitan area in the short-term. The short-term analysis focuses on the impact associated with increasing production capacity at existing permitted facilities, assuming that the quarries are able and willing to increase production. In the long-term, economic forces would favor the creation of new quarries in western Pennsylvania to supply local needs, assuming that new quarries are able to be created. Newly created local quarries would certainly capture market share from existing quarries that may be significantly farther away from the customer, assuming similar product quality, yet the product would be sold at a much lower cost. Therefore, the long-term analysis focuses on the impact associated with the creation and/or expansion of new quarry sites in western Pennsylvania.

It should be noted that this alternative is based on the assumption that existing quarries will be able to and are willing to increase production, and that additional land-based operations will be added. As detailed in Appendix N, there have been a number of incidences where permits were denied or delayed, due in large part to localized public opposition to expansion and creation of land-based quarries.

4.4.1 Impacts to Hydrology

Minor adverse effects would be expected to the hydrology of streams within the watersheds of land-based quarry operations under Alternative 4. Evidence of potential impacts to Pennsylvania streams near quarry operations has been obtained from literature searches which are summarized in Appendix N. The types of impacts that may occur as a result of increased land-based quarry operations within the region are discussed below:

Sedimentation. Increases in production at existing quarries (under short- and long-term conditions) and/or opening of new quarries (under long-term conditions) may result in increased land erosion and sediment run-off into tributaries and into main river channels within the region, if adequate sediment controls are not practiced. Moderate or significant impacts would likely be avoided as land-based quarry operations must operate under PADEP and USEPA permits for the control of sediment discharges and runoff. Minor impacts could result directly from quarrying operations or indirectly from associated increases in road-building and/or transportation activities. Increases in stream bed load could adversely affect

the stream channel as excess load is deposited, and stream channel hydraulics could become altered by the build-up of bed material. PADEP permits for land-based quarries within the region were reviewed to determine if there had been any recorded permit violations with respect to excess particulate loads to receiving streams. In recent years (since 1997), no permit violations were issued as a result of particulate loads from existing quarrying operations. However, violations have been issued for exceeding suspended solids effluent limitations from sedimentation ponds. Although quarries must operate under state and Federal permits, concerns related to sedimentation have been raised at a number of quarry operations as presented in Appendix N.

Water Discharges. Another concern related to land-based quarry operations is the practice of pumping out quarry pits (due to groundwater recharge) and discharging large quantities of water into small nearby streams and rivers. Under certain conditions, the increased flows from these water discharges can cause increased bank erosion, sedimentation, and flooding of wetlands. Again, these discharges would be regulated by existing state and Federal permits thereby preventing significant adverse impacts. Nonetheless, some minor adverse effects have been noted at existing quarry operations.

Dewatering. It is also possible that massive pumping operations can lower the groundwater table in the area and dewater streams and wetlands that are normally fed by groundwater recharge. Although evidence suggests that these impacts have occurred at existing quarry operations, excessive pumping that would result in significant impacts to wetlands or streams would be prevented and/or mitigated as required by state and Federal agencies. It should be noted, however, that anecdotal evidence suggests that such impacts have occurred at existing land-based quarries and restitution has been sought through enforcement actions.

Physical Disturbance. Other hydrology concerns relate to expanding quarries and new quarry operations in the long-term that may directly impact the hydrologic conditions and morphology of streams due to direct alteration and/or mining activities. Such activities have been necessary in the past for creating quarry operations and the actions have been regulated and monitored by state and Federal agencies, requiring appropriate mitigation.

As a result of denying dredging permits, an increase in land-based operations within the region would be expected in order to supply the growing demands for sand and gravel products, particularly Type A sand and SRL E aggregates. It is estimated that in the short-term, production capacity of existing quarries would need to increase operations by 30 percent at over 50 quarry operations, primarily in Pennsylvania, in order to offset the shortfall in available sand and gravel in the region. Therefore, there would be the potential for minor adverse effects to occur in streams near these quarries across the region.

Under long-term conditions, new quarries and/or quarry expansions may be permitted which will likely have some impact on receiving streams within the watershed, both from mining operations and clearing land, as well as from increases in road-building and transportation

activities. It is estimated that 20 new local quarries would be needed to off-set demand for sand and gravel products in the customer area. Thus, as many as 20 or more streams currently unaffected by quarrying operations may be adversely impacted by the creation of these quarries in the future, if in fact permits are granted. To some extent, these effects would be expected to be mitigated in part due to natural scouring during high-flow events. In addition, these quarries would be required to meet permitting requirements set by PADEP and the U.S. Office of Surface Mining Reclamation and Enforcement (OSM).

4.4.2 Impacts to Geology and Hydrogeology

Geology. Negligible to minor adverse effects to geologic resources would be expected as a result of increases in land-based operations under Alternative 4. The applicants currently produce 4.1 million tons of material annually for customers within the region. Under Alternative 4, the need for this material will remain and would only be offset by significant increases in production output of land-based operations within the region. Under the short-term, it is estimated that approximately 50 quarries would need to significantly increase production output in order to make up for the ever increasing demand for sand and gravel products (particularly Type A sand and SRL E aggregate). Given that finite resources exist within these quarries, the lifecycle of these quarries will be reduced because of the increased demand on their products. As a result, it will be necessary for existing quarry operations to obtain permits to expand operations and/or open new quarry operations. Between March of 1997 and August 1999 there were 41 permits issued by the PADEP for large (10,000 tons/year or greater) surface mines for industrial minerals. However, of those 41 permits, it is not known which mines will become suppliers to PennDOT or meet PennDOT specifications for Type A and SRL E material, when the mines will begin operating, or how many tons of material per year the mines will produce. Since 1998, only 2 additional new quarries producing Type A sand have been listed as a potential supplier to PennDOT in the ROI. Overall, 5 additional Type A sand suppliers have been listed that were not previously listed since 1998 in the western half of Pennsylvania. With respect to SRL E aggregate sources, no additional quarries have been listed as potential suppliers to PennDOT within the ROI. Overall, 6 new suppliers were listed within western Pennsylvania since 1998. It should be noted, however, that these additional suppliers are not necessarily new permitted quarries. An additional quarry may be listed as a PennDOT supplier when a certain stockpile of material passed the PennDOT specifications. Even though a location may be listed with PennDOT, each material stockpile needs to be sampled, analyzed, and the results must meet the specifications for PennDOT to be considered as PennDOT specification aggregate. Not all material at a given quarry site will meet PennDOT specifications.

Hydrogeology. Long term minor or potentially moderate adverse effects would be expected to groundwater within the vicinity of land-based quarry operations. Any land-based mining operation has the potential to affect groundwater flow. When mining below the water table, pumps are used to keep groundwater out and the mine pit dry (this is referred to as "dewatering"). This procedure diverts water from its natural ground flow directly to a

surface water body and prevents recharging of the groundwater aquifer. This can potentially lower the groundwater table, and dry up wells that are used by nearby residents who are not connected to a public water supply (see Appendix N, under the subheading Hydrologic Conditions). Wells are still an important supply of potable water to homes in the region. The expected increase in mining could increase the rate of mine dewatering, and therefore the potential risk of lowering the water table further in the immediate vicinity of the quarry. It is not known, however, whether such an increase in quarrying activity could dewater nearby wells or not.

Currently, there is no regulation by PADEP on the amount of water used or dewatered by mining operations. In 1995, the mining industry was the largest daily consumer of water in western Pennsylvania[6] at 48.7 million gallons per day (Ludlow, PADEP, personal communication, 1999). Water was used in quarrying, milling, washing of equipment, and dust control. This amount does not include dewatering. Dewatering discharges an estimated 88.3 million gallons of water a day in western Pennsylvania. This number is calculated from average gallons per day dewatered as reported by industrial mineral mining facility owners or managers in Pennsylvania between the years of 1985 and 1995. With a 30 percent increase in mining activity, the increase in dewatering would be an additional 26.5 million gallons per day for western Pennsylvania. Compared to a four-person household, which uses 732 gallons of water per day on average (average statistic used in USEPA's Drinking Water Program), an average single mine could withdraw 2,000 times as much groundwater from the aquifer for dewatering activities. Removal of such a large volume of water could reduce the groundwater table enough to impact nearby residential wells under certain hydrogeologic conditions. Evidence suggests that within Pennsylvania, adverse impacts to private wells and groundwater resources have been an issue at certain quarry sites. However, permitting activities conducted by regulators would likely prevent loss of residential water supplies, either through avoidance, enforced corrective measures, or restitution, thereby lessening significant adverse impacts.

4.4.3 Impacts to Water Quality

Implementation of Alternative 4 may result in minor adverse effects on water quality in the region. Land-based quarry operations are a source of suspended solids, turbidity, and, in some cases, metals and other contaminants. Since many of the land-based facilities are located on or near several tributaries of the Allegheny and Ohio Rivers, there is the potential for minor adverse impacts to water quality resulting from increased land-based production. Several quarries in the region, and elsewhere in Pennsylvania, have had problems complying with state and USEPA permit conditions for turbidity and suspended solids in their discharges to stream systems. For example, a previous study conducted by Tetra Tech in Monocacy Creek (a tributary to the Lehigh River in eastern Pennsylvania and a native trout

[6] Pennsylvania counties included in this number are Allegheny, Armstrong, Beaver, Butler, Cambria, Clarion, Clearfield, Elk, Fayette, Forest, Greene, Indiana, Jefferson, Lawrence, Mercer, Somerset, Venango, Washington, and Westmoreland.

stream) demonstrated elevated turbidity and suspended solids originating from a Keystone Mining limestone quarry. Retention ponds on the site, which typically settle out the solids before discharge, overflowed due to increased production, prolonged rainfall, and apparent inadequate management of the holding ponds. In this particular case, much of the solids were kiln dust material that was colloidal (very fine) in nature. It is questionable whether conventional retention ponds would have settled out such material under most circumstances due to the generally short hydraulic residence times at these facilities.

Another limestone land quarry, Con-Stone Mining, located in Penns Valley, Pennsylvania, has been the target of heated controversy, in part, because two well-known, productive trout streams (Pine and Elk Creeks) would be potentially affected by elevated suspended solids and turbidity. PADEP did permit the new quarry to operate, however, one of the 19 special conditions of the permit is that the facility must have zero discharge (i.e., no water flow) to either stream. All process water (i.e., wash down water, etc.) is to be land disposed on-site. Thus, the PADEP recognized in this case that land-based quarries have the potential to degrade water quality through discharge of elevated turbidity and suspended solids and made efforts to minimize such effects. Land application treatment such as required by PADEP for the Con-Stone Quarry, is a more expensive and complicated alternative as compared to the usual retention pond system and requires a large, open, vegetated land area to be feasible. It is unclear that such a water treatment system will be feasible for many quarries in the region of influence. A similar issue was raised concerning a proposed 290-acre quarry in Berks County by Haines & Kibblehouse, Inc., which would discharge treated wastewater into Hay Creek, a productive trout stream with high-quality water and low summer temperatures. Opposition groups cited a problem with other quarries resulting from sedimentation and storm-water runoff. In this particular case, Haines & Kibblehouse sought permission to mine within 100 feet of smaller streams and to mine through several tributaries that now drain into Hay Creek and nearby wetlands to extract diabase, a hard rock commonly used for railroad ballast and roadbed (*Philadelphia Inquirer*, February 8, 1998, page C17). Likewise, under proposed PADEP antidegradation policies, there would be no new NPDES discharges from existing or new quarries that discharge into high quality or exceptional value streams. This would significantly limit the ability of applicants to expand or construct new quarries within these watersheds.

The on-going impacts of land-based mining on water quality have been well documented by Ohio EPA in their 305(b) reports to USEPA and in other state agency reports. The Ohio EPA has found that quarries (primarily crushed limestone) are a source of suspended solids in tributaries to the Ohio River (Ohio EPA, 1998). Several of these quarries were closely monitored and given more stringent permit conditions in order to better protect water quality.

Another relevant factor related to land-based sources of aggregate material is that many quarries are located on small streams in the Ohio River basin, many of which historically were important habitats for indigenous fish and mussel fauna (Watters, 1994). Some of these streams were degraded in the past by multiple activities such as agriculture, urban

development, and point-source wastewater discharges. Although there have been significant improvements in overall water quality in many of these streams, and in the Ohio and Allegheny Rivers in general, increased land-based quarry activity could impede those improvements. For example, in opposition to a proposed limestone quarry in Westmoreland County proposed by New Enterprise Stone & Lime Co., Inc., the Mountain Watershed Association cited that the quarry will remove limestone, greatly reducing the stream's buffering capacity, or its ability to fight acidic pollution, such as acid mine drainage pollution. In addition, the association expressed fears that the proposed sedimentation control ponds will fail over time and thus release sediment into the stream. A major issue was "... the cumulative impacts of additional mining activity in a watershed that has already been heavily impacted and degraded" (Connellsville *Daily Courier*, November 23, 1998) by as many as 110 mining discharges that have released aluminum, iron and magnesium into the stream.

PADEP reported that surface mining (which includes crushed stone and sand quarries) was one of the top 20 causes of stream water quality impairment in their 1998 305(b) report statewide. The category surface mining itself, was responsible for 36 impaired river miles according to the PADEP 1998 report, however, there were another 134 impaired river miles due to construction activities and 114 impaired river miles due to industrial point sources, both of which include, in part, concrete production and material facilities and related land-based crushed stone and sand activities. It is not known, however, to what extent sand and gravel surface mining has specifically contributed to these impairments. Furthermore, it is not known whether these impacts were primarily associated with abandoned mines or mines that are currently in operation. Overall, the available data suggests that increased land-based quarry production, due to cessation of dredging, may increase the extent of surface water quality impacts from suspended sediment and turbidity inputs. It should be noted, however, that such operations must comply with permits established and reviewed by PADEP. This regulatory oversight should help to mitigate significant adverse impacts to water quality.

PADEP listed siltation (which includes suspended sediments and turbidity) as the second most important (i.e., most river miles affected) cause of water quality impairment in Pennsylvania (PADEP, 2000). A total of 1,232 river miles in the state are impaired due to siltation effects. A portion of that siltation is due to land-based surface mining and concrete production, as well as agricultural activities. The incremental impact of current sand and gravel quarry operations on the statewide impairment is not known, although it is reasonable to assume that they contribute to such impacts.

4.4.4 Impacts to Aquatic Life

Plankton. Short-term and long-term consequences of Alternative 4 would likely have minor adverse effects on plankton in receiving streams within the region. Potential effects on western Pennsylvania streams near the quarry operations include sedimentation (e.g., erosion and sediment run-off), water discharges (e.g., the purging of quarry pits), dewatering (e.g.,

lowering of groundwater table thereby dewatering streams and wetlands), and physical disturbance (e.g., changing stream morphology/hydrology) (Appendix N). These impacts, either singly or collectively, would have at least minor adverse effects on the phytoplankton assemblage. Increases in erosion or sediment runoff would negatively affect phytoplankton growth/succession factors of light and possibly nutrients. Water discharges could affect growth factors of temperature and water turbulence, and dewatering of streams or wetlands would be detrimental to phytoplankton.

Periphyton. Short-term and long-term consequences of Alternative 4 would likely have minor to moderate adverse effects on periphyton in receiving streams within the region. Impact potential to streams near new (or increased production capacity) quarry operations would increase via increased sedimentation, water discharges, dewatering, and physical disturbance (Appendix N). These impacts, either singly or collectively, would have minor (e.g., physical disturbance) to moderate (e.g., dewatering) effects on the periphyton assemblage. Land-based quarry operations are a source of suspended solids, turbidity and, in some cases, metals and other contaminants. Increased solids, erosion, or sediment runoff would risk light attenuation and possible total deprivation of light to stream periphyton, thereby negatively affecting the assemblage, at least in the vicinity of quarry discharges. The seasonal biomass of periphyton often follows the general curve of incident light and temperature. Even in cases where solids are controlled, quarry discharges could impact periphyton productivity and survival in downstream areas through modification of thermal regimes and stream flow patterns.

Aquatic Plants. Short-term and long-term consequences of Alternative 4 would likely have minor effects on aquatic plants in receiving streams within the region. Potential effects to streams near the quarry operations include sedimentation, water discharges, dewatering, and physical disturbance. Each of these stressors, either singly or collectively, could affect the aquatic vegetation of streams near quarry operations. Concerns for these potential effects have been raised during permit application discussions associated with Pennsylvania quarry expansion or construction plans (Appendix N). Opposition to proposed limestone quarry construction in Centre County focused on the quarry discharge into Pine and Elk Creeks, and the associated deposition of limestone sediment (*Philadelphia Inquirer*, October 8, 1995). Deposition of this type can fill interstitial spaces in stream substrata in the area immediately downstream from the discharge, and in extreme cases can nearly cement the substrata, impeding plant growth (Tetra Tech 1996). Opposition to an application proposing a quarry discharge to Saucony Creek in Mazatawny Township focused on impacts to the stream and adjacent wetlands (The Allentown *Morning Call*, January 3, 1995). Eastern Industries, Inc. of Center Valley applied to PADEP to pump water from the quarry into the stream at a rate of 5,000 gallons per minute. Local residents claimed that "discharges to the Saucony during dry months would increase the streams' flow by 10 times its normal flow, causing erosion of stream banks and destruction of vegetation." In extreme cases, massive pumping operations can lower the groundwater table in the area and dewater streams and wetlands. Testimony of an aquatic ecologist at a hearing for a proposed limestone quarry in Fayette County included

the allegation that “That section of stream will dry up...” and that “...habitat will be lost” (Connellsville *Daily Courier*, December 22, 1998). Considering the potential consequences of the above-mentioned stressors identified in Appendix N, minor adverse effects on aquatic plant resources might be expected as a result of increases in land-based operations under Alternative 4.

Macroinvertebrates. Consequences of Alternative 4, both long-term (new quarry construction) and short-term (increased quarry production capacity) would likely have a minor adverse effect on macroinvertebrates in receiving streams within the region. Potential impacts to streams in proximity to the quarry operations include sedimentation, water discharges, dewatering, and physical disturbance. Each of these stressors has the potential to affect the benthic macroinvertebrate assemblage of streams near quarry operations. Concerns regarding these potential effects have been raised during permit application discussions associated with Pennsylvania quarry expansion or construction plans (Appendix N). Considering the potential consequences of these stressors, minor adverse effects on the benthic macroinvertebrate assemblage might be expected in the vicinity of land-based operations under Alternative 4.

Mussels. Minor adverse effects may occur to freshwater mussels in the region under short-term conditions, but are more likely to occur under long-term conditions, from implementing Alternative 4. Mussels are prevalent in certain tributaries of the Allegheny and upper Ohio Rivers (e.g., French Creek). Ohio EPA has found that quarries are a source of suspended solids in Ohio River tributaries (Ohio EPA, 1996). Groups opposing quarry construction in Berks (*Philadelphia Inquirer*, February 8, 1998) and Westmoreland (Connellsville *Daily Courier*, November 23, 1998) counties cited stream sedimentation and stormwater runoff problems at existing quarries as cause for concern, and valid reasons for halting the construction of new land-based facilities. To the extent that present quarries are located on or near streams with mussel populations, increased production of those quarries (or permitting of new quarries) may result in suboptimal conditions for mussels, due to increased probability of siltation and instream suspended solids. However, discharges from quarries would be regulated by Federal and state agencies, thereby reducing the potential for adverse effects on mussels. In the event that sensitive mussel populations are found in certain streams, regulators may require the performance of mussel surveys and monitoring to ensure that significant mussel resources are not adversely affected by the construction of new quarries or increased activities at existing quarries.

Fishes. Short- and long-term consequences of Alternative 4 would likely have minor adverse effects on fish in receiving streams within the region, as well as potential intermittent moderate adverse impacts. Potential impacts to streams near the quarry operations include sedimentation, water discharges, dewatering, and physical disturbance. Each of these stressors, either singularly or collectively, could affect the fish assemblage of streams near quarry operations. Given that quarries must operate under regulatory constraints set in state and Federal permits, significant adverse effects on fish would likely be averted. However,

violation of permits, particularly during severe weather conditions, may cause intermittent moderate effects that can not be ruled out. Public concerns related to these types of impacts have been raised during permit application discussions associated with Pennsylvania quarry expansion or construction plans (Appendix N). For example, in at least one case concerning a proposed new limestone quarry and a quarry discharge stream, the PFBC asked PADEP to delay a permit until further studies of the fish assemblage were completed (Appendix N). Trout Unlimited and others have also opposed proposed quarry discharges, claiming that trout habitat may be destroyed, either via dewatering of streams, erosion, and/or changes in pH or temperature (see Appendix N). Concerns have also been raised over the steady build-up of limestone "fines" in stream beds downstream from quarry operations. This limestone "siltation" can fill interstitial spaces in the substrate, thereby impacting the invertebrate food-source of fishes, and such imbeddedness can ruin spawning habitats for stream fishes that require clean substrates (and interstitial spaces) for a successful spawn (e.g., trout) (Appendix N). Considering the potential consequences of these stressors, minor long-term adverse effects to the fish assemblage might be expected as a result of increases in land-based operations under Alternative 4.

4.4.5 Impacts to Wetlands and Terrestrial Life

Marginal effects on terrestrial fauna and habitat would be expected in the short-term from the potential increase in production at existing land-based quarries from implementation of Alternative 4. In the long-term, expansion of quarries and/or creation of new quarries may have a minor to moderate adverse effect on fauna and terrestrial habitat. With respect to wetlands habitat, minor to moderate adverse effects may occur under both short-term and long-term conditions. Adverse impacts to terrestrial life will occur primarily as a result of habitat loss (e.g., indirect impacts to wetlands, clearing habitat during quarry construction), and to some degree, noise impacts.

Development of a land-based quarry results in the direct removal of terrestrial habitat in order to access subsurface minerals. The aerial extent of habitat removal varies from quarry to quarry, but typically the foot print of an average sized quarry is approximately 100 acres, with some quarries being significantly larger. Once the quarry is developed and the minerals have been extracted (within two to three decades of operation on average), a large open pit remains which typically is left as a lake surrounded by steep slopes or cliffs. Typically, terrestrial habitat that once occupied the foot print can not be reclaimed. In addition, noise associated with the development and operation of new quarries could adversely affect fauna associated with the habitats. Increased noise levels could preclude certain species from using nearby habitat or cause species currently using nearby habitat to move out. For example, at one quarry, it was reported that truck traffic may have adversely impacted a heron rookery (see Appendix N).

Implementation of Alternative 4 would likely result in the increased expansion of existing quarries and the potential creation of new quarries within the region. As previously

discussed, it was estimated that 50 quarries within the region would need to increase operations by 30 percent in order to meet demands for sand and gravel products. This increase in operation will reduce the typical life cycle of existing quarries, resulting in the creation of new quarries and/or expansion of existing quarries. It is estimated that approximately 60 acres of terrestrial habitat would be lost each year as a result of the reduced life cycle of land-based quarries. If all new quarries are permitted within the region to meet the increased demand for sand and gravel, then it is estimated that approximately 2,000 acres of terrestrial habitat would be lost. Several environmental concerns that have been raised with respect to habitat loss at proposed or existing land-based quarries, including loss of sensitive habitat (e.g., old growth forest and wetlands habitat), impacts to state-listed species, and habitat fragmentation.

With respect to wetlands, Alternative 4 would likely result in minor adverse effects to wetland habitat either through direct disturbance or indirectly through modification of local hydrology. However, existing permitting requirements to avoid, minimize, or mitigate wetland effects would reduce the potential for direct impacts in the form of acreage loss associated with dredging, draining, or filling. Long and short term indirect effects to wetlands located adjacent to new or expanding quarries could occur as a result of sedimentation in the habitats if proper erosion and sediment controls were not implemented both during the development and operation of the quarry. In addition, wetlands along the banks of streams may be adversely impacted by increased water discharges from quarry dewatering operations. Overall, these impacts would be reduced through permitting actions and enforcement activities, thereby avoiding significant adverse effects.

4.4.6 Impacts to State and Federally-Listed Threatened and Endangered Species

Aquatic Species. Minor adverse effects may occur to state or Federally-listed aquatic species in the region under both short-term and long-term conditions from implementing Alternative 4. In particular, listed mussel species are prevalent in certain tributaries of the Allegheny and upper Ohio Rivers (e.g., French Creek). Both the clubshell and the northern riffleshell mussels are present in the upper Allegheny River and some tributaries in Venango, Warren, and Crawford Counties in Pennsylvania, well upstream of the study area. Several Type A sand quarries and some SRL E aggregate quarries are present in these same counties (Figs. 1-1 and 1-2).

To the extent that present quarries are located on or near streams with listed mussel populations, increased production at those quarries (or permitting of new quarries) may result in suboptimal conditions for these mussels, due to increased probability of siltation and instream suspended solids. However, regulatory agencies have permitting authority over the operation, creation, and/or expansion of quarries and must evaluate these impacts relative to listed species. For example, if Federally-listed species are likely to be within the vicinity of a quarry, then an intensive survey and Section 7 consultation would be required with USFWS. If Federally-listed species are found, then formal consultation with USFWS would be

required to ensure compliance with the Endangered Species Act. Therefore, it is unlikely that significant impacts to Federally-listed aquatic species would occur.

Terrestrial Species. Minor adverse effects would be expected to state and Federally-listed terrestrial species from Alternative 4. Creation and/or expansion of an existing land-based quarry results in the direct removal of terrestrial habitat in order to access subsurface minerals. The extent of habitat removal varies from quarry to quarry, but typically the footprint of a quarry is approximately 100 acres or more. In the long-term, if new quarries were developed within the area to supply the demand for sand and gravel, then as many as 2,000 acres of terrestrial habitat would be disturbed. In addition, the operation of a quarry can create noise impacts that may disturb species nearby. Therefore, operation, creation, and/or expansion of land-based quarries can potentially adversely affect listed species, if they are present nearby. In particular, the Massasauga rattlesnake is listed as a Federal Candidate species, as well as a state-listed endangered species. Available records on the Massasauga rattlesnake indicate that it may be found in several locations in northwestern Pennsylvania where creation of new quarries would be most favorable economically. Creation of 20 quarries in this region of Pennsylvania may have an impact on the snake. Furthermore, the Indiana bat, which is listed as endangered in the state and Federally, may also utilize terrestrial habitat in this area. Given the occurrence of these species, USFWS would likely require site-specific surveys for these species, and formal consultation as necessary, to ensure that significant adverse effects would be avoided.

With respect to state-listed species, there is the potential for state-listed flora and fauna to occur within or nearby quarries depending on the location. Land clearing activities and noise could affect state-listed species that may reside within or in the immediate vicinity of the footprint of a quarry operation. Permitting actions with state regulators would likely mitigate significant impacts to state-listed species. Thus, only minor to moderate adverse effects to state-listed species would be expected overall.

4.4.7 Impacts to Air Quality

With respect to regional air quality, there will be no appreciable effect on air quality from Alternative 4. It is expected that there will be a net increase in total emissions from the use of land-based sources, principally due to increased quarrying and aggregate transportation. However, as summarized in Table 4-7 the net emission contribution of surface mining and stone/quarrying processing are reported to be very small contributors relative to other sources identified in USEPA's regular national inventory of air emission sources. Based on available information, it is likely that regional influences of Alternative 4 would be very minor.

The influence of Alternative 4 on air quality would be noteworthy for some very small areas, specifically areas along the access roads used by trucks traveling to and from quarries. Newspapers reported that some communities adjacent to quarries have complained about dust caused by blasting and dust caused by transportation trucks. Of forty-seven quarries

identified in newsprint articles reporting on land quarrying, seven quarries reported negative impacts on local air quality related to fugitive dust (Appendix N). It is expected that changing to land-based quarries will produce more PM-10 due to materials extraction and processing. This is because the majority of quarried material is relatively dry and extraction generally includes activities such as blasting and dry-sizing; inherently dusty operations. However, only the immediate vicinity around the quarry would be affected, and effects will decrease rapidly with distance from the quarry.

The net increase in combustion emissions from alternative sources is also due to trucks transporting replacement materials into the ROI. As discussed in Section 3, the majority of the transportation increase will be outside of the ROI. Overall, it is estimated that the major interstates within the ROI would convey an additional 1,400 trucks per day, hauling land-based sand and gravel products, the bulk of which would be on routes I-80, I-70, I-79, SR-22, SR-30, and the Pennsylvania Turnpike. However, the net increase in truck traffic and truck-related emissions is small when compared to current levels. The projected increase in trucks on the Interstate highways into the ROI (interstates with annual average daily traffic levels up to 100,000) should not affect the level of service/congestion levels. In addition, based on a reasonable estimate of 10 percent commercial vehicle traffic, it is estimated that two regional highways in the vicinity of Pittsburgh (I-376 and I-279) alone daily convey a total of 10,000 trucks (PennDOT, 1999). It has been concluded that the chance is small that congestion levels will cause a rise in local CO levels. In addition, the increase in trucks operating means that there is likely to be a minor increase in other combustion pollutants over current levels.

4.4.8 Impacts to Noise

Alternative 4 will result in minor adverse effects associated with noise as a result of increased land-based quarry operations in the region. First, noise levels will increase in the vicinity of existing quarries, and wherever new quarries are created. Land-based extraction will have to increase significantly to replace current dredge-based extraction: e.g., to match the current dredge production would require approximately 50 quarries in the region to increase their production an average of 30 percent each. Greater extraction (e.g., blasting) and processing of extracted materials will increase local noise levels in the vicinity of the quarries. A second source of additional noise will be trucks transporting land-based aggregate. It has been estimated for this study that the annual increase in truck trips into the study area from the surrounding region will be approximately 1,400 trucks per day.

Currently employed noise management methods can mitigate but not eliminate impacts from land based quarrying. A recent survey of newsprint articles (Appendix N) documented complaints of excessive noise near land-based quarries. Approximately 10 percent of these articles within the last 7 years contained references to noise complaints/concerns of local citizens.

Table 4-7
1997 Annual Emission Loads (Percentages of Total)

Pollutant	PM-10[a]	PM-2.5[b]	VOCs (Ozone precursor)	SO_2	NO_x	CO
Surface Mining	0.05%	0.08%	NV	NV	NV	NV
Stone quarrying/processing	0.18%	0.32%	NV	NV	NV	NV
Marine Vessels	0.09%	0.26%	0.26%	NV	1.00%	0.10%
On-road Diesel Vehicles	0.49%	1.64%	1.24%	0.41%	8.19%	1.72%
Natural Sources	15.83%	9.59%	0.07%	NV	NV	NV
Fugitive Dust	57.86%	41.64%	0.01%	NV	0.00%	0.00%
Totals in terms of short tons	33,581	8,311	19,214	20,369	23,582	87,451

[a] Inhalable particulate matter (PM), ≤ 10μm in size.
[b] Inhalable particulate matter (PM), ≤ 2.5 μm in size.
Source: USEPA, 1998b.
NV = no value given by USEPA for this pollutant

4.4.9 Impacts to Socioeconomic Conditions

Under Alternative 4, aggregate materials would be supplied by either land-based sources or imported from other river locations, including river dredging operations on the Ohio River, but outside the State of Pennsylvania. As discussed in Sections 2 and 4.1.9, a market analysis was conducted to identify other likely sources of sand and gravel materials, including Type A sand and SRL E aggregate. From this analysis, it was estimated that there is sufficient land-based production capacity within an approximately 150-mile radius of the Pittsburgh Metropolitan Area to supply the existing demand for sand and gravel materials in western Pennsylvania. In addition, other areas were identified in central and northeastern Pennsylvania, that must rely principally on land-based sources for sand and gravel material. These areas were found to have similar prices and sufficient supplies of Type A sand and SRL E aggregate materials for their area of the state. While locations on the Ohio River outside the State of Pennsylvania could potentially supply Type A sand, new permits would have to be obtained prior to dredging at specific sites. The ability to obtain these permits, the length of time to receive approval, as well as the willingness of Pittsburgh dredgers to relocate to these areas is uncertain.

The socioeconomic impacts of Alternative 4 are inextricably tied to the no action alternative (i.e., Alternative 1). Essentially, Alternative 4 represents the secondary actions taken by independent land-based quarry owners in response to the denial of dredging permit extensions (i.e., Alternative 1). The socioeconomic effects associated with Alternative 4 were presented previously in Section 4.1.9 (Alternative 1) and are summarized below.

As discussed in Section 4.1.9, termination of river dredging would lead to a significant reduction in the amount of locally available aggregate materials for transportation and other construction projects. In the short-term, increasing capacity at existing land-based quarries within the region could fill these shortfalls. Overall, production would need to increase by 30 percent at approximately 50 land-based quarry operations within the region. In the long-term, market forces would favor the creation of new land-based quarries near the Pittsburgh metropolitan area. Approximately, 20 land-based quarries would be needed to offset the loss in river dredging. Due to the high degree of uncertainty associated with development of new quarries, the socioeconomic analysis quantifies only the impacts of expanding existing quarries. Creation of new quarries is addressed qualitatively.

The primary socioeconomic impacts of land-based dredging would be to reduce the adverse effects of terminating commercial river dredging activities. Because not all of the shortfall would likely be made up by existing quarries located within the ROI, the number of jobs created by these expanding quarries would not fully compensate for the loss in jobs from the river-dredging sector. Accordingly, there would still be a net loss in employment in the ROI, although that loss would be too small to have any significant impacts on the region. Similarly, if new dredging were to commence on the Ohio River outside the borders of Pennsylvania, most of the economic benefits, in terms of job creation would likely be generated outside the economic region of influence evaluated for this study. It is expected that unit costs for aggregate materials would substantially increase in the ROI, because most of the material would be brought in from considerable distances. Overall, the price of aggregate would increase approximately 200 percent or more above the current price in the short-term. This price change would result in an increase in construction costs in the region. The actual effect on the cost of large construction projects, such as highways or buildings, would depend on the percentage of total costs attributable to aggregate material costs. For most new highway construction projects, for example, aggregate material costs may account for as little as 2 percent of the total construction project costs. Hence, a doubling of the cost of aggregate material would result in a small percent increase in the total cost of constructing a new highway. However, for repaving projects, which account for the majority of highway construction projects in the Pittsburgh region, the percent of aggregate costs relative to the entire project would be much higher.

At the state-level, the economic benefits associated with increases in land-based operations would not offset the economic losses associated with the elimination of the commercial dredging industry. As discussed in Section 4.1.9, based on the results of IMPLAN socioeconomic modeling, there would be a net loss of approximately 700 jobs in the state and

economic output for the state would decrease by over $45.7 million annually in the short-term. Compared to the overall size of the state economy, these losses would be considered minor. For example, total employment in Pennsylvania exceeds 7 million and total personal income approaches $365 billion. Thus, the economic losses from Alternative 4 would result in minor adverse effects at the state level for each measurable indicator.

As noted in the previous section, shortfalls in aggregate material supplies could be potentially filled by new land-based quarries in the long-term. However, environmental regulations, including local zoning laws, in addition to often-strong public opposition to land quarries, would pose barriers to new quarry development near the ROI. If new quarries were to be developed within or near the ROI, the likely impact would be to further diminish the adverse economic impacts attributable to Alternative 4. Specifically, these quarries would increase the supply of locally available aggregate materials at lower costs and would generate both direct and indirect employment in the ROI and other areas in western Pennsylvania.

4.4.10 Impacts to Quality of Life

Recreation. Under Alternative 4 minor short-term and long-term adverse effects may be expected to the recreational resources within the region. Public concern has been expressed in recent years throughout the state of Pennsylvania regarding the effect quarries can have on small streams and other water bodies that support recreational fishing opportunities. As summarized in Appendix N (under the subheadings *Aquatic Life* and *Water Quality)*, some anglers, conservationists, and wildlife organizations have argued against the opening of new quarries. The concern is that wastewater discharge and storm water runoff from quarries can affect the water quality of the receiving water body by changing the water temperature, pH level, water level, and the amount of suspended solids. These changes could possibly alter habitat to the extent that sport fish populations are adversely impacted, resulting in long-term adverse impacts to recreational opportunities. Although this has been raised as a concern, potential significant impacts to fisheries and streams are not expected to occur because wastewater discharges and storm water runoff will be regulated under the authority of the state. Thus, permitting actions will likely mitigate serious impacts to fisheries.

Aesthetics. Under Alternative 4, localized minor and moderate adverse effects to aesthetics would be expected from the creation of new quarries within the region, in the long-term. Quarries cause unavoidable alteration in the natural landscape, leveling off mountaintops or creating large pits in the ground. These land areas cannot be restored to their original state. Whether the adjacent property is residential, recreational, (e.g., a ski resort, or a camping and hiking area), or a business, neighboring properties are left with an unappealing view, an increase in noise and dust created by quarry activities, and a possible decrease in property value. Appendix N (under the subheading *Aesthetics*) contains information on effects of new or expanding quarries on adjacent property owners within the region.

Traffic. Minor adverse effects on traffic in localized areas within the region would occur under Alternative 4. It is estimated that in the short-term, production capacity of existing quarries would need to increase by 30 percent at over 50 quarry operations, primarily in Pennsylvania, in order to offset the shortfall in available sand and gravel in the region. Under Alternative 4, approximately 260 trucks would collectively travel 12 million truck-miles annually within the region to deliver sand and gravel from quarries to cement and asphalt producers currently served by river dredging companies. Roads near land-based quarries would likely experience a 30 percent increase in truck traffic flow. In addition, there would be an estimated increase of 1,400 truck trips per day on roads into the Pittsburgh metropolitan area, the bulk of which would be routes I-80, I-70, I-79, I-376, I-279, I-579, SR22, SR30, and the Pennsylvania Turnpike. However, the net increase in truck traffic is small when compared to current levels. Based on a reasonable estimate of 10 percent commercial vehicle traffic, I-376 and I-279 alone daily convey a total of 10,000 trucks in the vicinity of Pittsburgh (PennDOT,1999). The projected increase of several hundred trucks per day at most on one interstate highway into the Pittsburgh metropolitan area (interstates with annual average daily traffic levels of up to 100,000) would likely have a minor adverse effect on the level of service/congestion levels in the area.

Safety. Significant adverse effects on public safety within the region will occur under Alternative 4. As presented in Appendix N, several references were found that identified several public safety concerns relative to land-based quarry operations, including: truck related accidents, worker safety, deteriorating road conditions, and risks to trespassers. To address these concerns, an accident risk analysis was conducted to evaluate the impact of implementing Alternative 4 as compared to baseline conditions. Overall, it is estimated that implementation of Alternative 4 will result in an increase in fatalities and injuries in the State of Pennsylvania, primarily as a result of increased traffic accidents and to a minor extent work related accidents. In addition, it is possible that increased land-based quarry operations may pose other public safety hazards to trespassers under long-term conditions. Results of the safety analysis are presented below.

Traffic Safety. Under Alternative 4, it was estimated that approximately 260 trucks would collectively travel 12 million truck-miles annually (as compared to 6 million truck-miles under baseline conditions) within the region to deliver sand and gravel from quarries to cement and asphalt producers currently served by river dredging companies. Using traffic accident statistics compiled by the USDOT for trucks, the expected annual increase in fatalities, injuries, and property-loss accidents was calculated for Alternative 4.

Within 10 years, increases in regional truck travel are expected to result in an increase in fatalities, injuries, and property damage. Individuals at risk include: occupants of vehicles struck by large trucks, truck drivers, and pedestrians. Based on the results of the Monte Carlo simulation and truck accident data, the most-likely outcome of implementing Alternative 4 within the next 10 years would be 3.4 fatalities (as compared to 1.7 fatalities under baseline conditions), 80 injuries (as compared to 40 injuries under baseline conditions),

and 200 property loss accidents (as compared to 100 property loss accidents under baseline conditions). Thus, injuries, property loss, and fatalities specifically related to Alternative 4 would be expected to double over the next 10 years.

The largest source of uncertainty associated with the traffic accident estimates is associated with the underlying survey and analysis that was used to predict the distance that trucks would need to travel annually to deliver sand and gravel to asphalt and cement producers in the Pittsburgh metropolitan area under Alternative 4. The distances traveled may vary depending on how many quarries elect to sell products in the Pittsburgh area and the degree to which these quarries can increase annual production above current levels. If quarries elect to not supply products in the Pittsburgh metropolitan area and/or they are unable to increase production by 30 percent on average, then additional quarries located beyond the current region will be needed to supply local demand.

Under long-term conditions, the risks from traffic accidents would likely decline, and may be smaller relative to baseline conditions, if new land-based quarries are allowed to be constructed near the Pittsburgh metropolitan area, particularly if they are located near existing producers of cement and asphalt. However, other public safety concerns and public opposition will increase when quarries are located near populated areas.

Worker Safety. Increases in land-based operations would also involve increased labor hours for quarry workers. Based on the results of a Monte Carlo simulation, it was estimated that quarry output would increase by approximately 30 percent on average at approximately 50 quarries in the region. Utilizing mining operator safety statistics provided by the U.S. Department of Labor, Mine Safety and Health Administration (1999), it was possible to estimate the increased incidence of fatalities and injuries that would occur within the region due to increased land-based quarry operations. It was estimated that in the next 10 years, expected fatalities would be less than one (0.3, one fatality expected in over 30 years) and work-related injuries would most likely exceed 50 incidences (30 requiring days off and 20 requiring no time off).

Other Public Safety Concerns. In addition to truck and worker safety concerns, there have been several incidences of fatal accidents that have occurred as a result of trespassing on active and abandoned quarries within the region. Increases in land-based quarry operations may result in the opening of new quarries, increased frequency in the expansion of existing quarries, and increased frequency in the closing of existing quarries (due to accelerated use of resources in existing quarries). Public safety hazards associated with active and/or abandoned quarries identified by the Mine Safety and Health Administration include: off-road vehicle accidents (e.g., motor bikes and ATVs trespassing on quarry property); falling rocks and banks; cliff falls due to bank failures; blasting debris; and swimming/diving accidents due to subsurface terrain, sharp changes in water depth, and extremely cold water temperatures. Given that the quarries represent a permanent change to the terrain, the public safety hazards would likely remain indefinitely.

In the past several years, there have been records of a number of fatal accidents in the State of Pennsylvania associated with abandoned quarry operations (see Appendix N). Therefore, Alternative 4 would likely result in increased long-term public safety hazards in localized areas within the state as more quarry resources are exhausted and the sites permanently abandoned. These public safety risks could be reduced by requiring quarry operators to modify the morphology of the pits to eliminate steep cliffs and formation of lakes, which attract trespassers.

4.4.11 Environmental Justice and Protection of Children

No adverse effects to environmental justice issues would be expected under Alternative 4. As noted in Section 3.8.6, environmental justice analyses are performed to identify potential disproportionately high and adverse impacts from proposed actions to minority communities or low-income communities. Alternative 4 would result in only minor changes to economic indicators, including personal income and employment. These economic changes are not expected to disproportionately affect either minority communities or low-income communities.

Alternative 4 may have a direct adverse impact on public safety. First of all, Alternative 4 would likely result in an increase in truck-related accidents resulting in additional injuries and fatalities to passengers and potentially pedestrians, including children. However, the adverse effects would likely be borne equally by all populations residing in the region. The majority of mileage that would be traveled by trucks carrying aggregate products would be on state and interstate highways that are used by the general population. Accordingly, these routes linking the land-based quarries with the Pittsburgh area are not used disproportionately by low-income or minority populations, and thus these groups would not experience high and disproportionate adverse impacts. Thus, none of the estimated environmental consequences from implementing Alternative 4 would meet the general threshold for raising environmental justice concerns. The degree to which traffic accident risks are borne disproportionately by children is unknown, but could be a concern (e.g., children playing near quarry access roads has been raised as a public concern).

Significant adverse effects to child safety would occur from implementing Alternative 4. Long-term increases in land-based quarry operations under Alternative 4 would pose an increased risk to children who may trespass on these sites. As noted in Section 4.3.10, a number of accidental deaths and injuries have occurred at a number of quarries in the region in the past several years. These sites attract children and teenage trespassers as they appear to offer secluded sites for climbing, cliff diving, swimming and/or other high-risk activities.

4.4.12 Impacts to Cultural Resources

Minor adverse effects on cultural resources would be expected as a result of increases in land-based operations under Alternative 4. Existing quarries, especially limestone quarries, can contain flint, the stone that was preferred by prehistoric peoples for use as tools such as projectile points (arrows). These quarries are often the site of prehistoric archaeological remains, sometimes including burials, and may be the site of remains of prehistoric quarries, stone tool-making locations, hunting blinds or villages. Historic sites and cemeteries may also be located within such quarries.

As one example, excavations at a proposed surface coal mine tract in Fayette County, Pennsylvania, near the Monongahela River, uncovered archaeological remains of an Early Woodland prehistoric occupation. In Maryland, archaeological sites have been identified in Prince Georges and Anne Arundel Counties along the Patuxent River, near sand and gravel quarries; in many cases it is probable that prehistoric sites were destroyed by quarrying. In Carroll County, Maryland, an historic farmstead with a probable family cemetery is located on the site of a proposed limestone quarry. Furthermore, a 19th-century historic cemetery was found in a gravel quarry on the eastern shore of Maryland (Shaffer, personal communication).

4.5 CUMULATIVE IMPACTS

Cumulative effects are the impacts on the environment that result from the incremental impact of an action when added to other past, present, and reasonably foreseeable future actions regardless of what agency or entity (Federal or non-Federal) or person undertakes such other actions (40 CFR 1508.7). Historically, there has been little specific guidance on how to treat cumulative effects analysis in the NEPA process. The Council on Environmental Quality, reacting to the current state of environmental science and requests from practitioners for better guidance, prepared a handbook entitled *Considering Cumulative Effects Under the National Environmental Policy Act* (1997).

The effects of individual minor disturbances and other changes to the environment by humans will accumulate when the frequency of disturbances is so high that the ecosystem has not fully rebounded before another stressful event is introduced. The spatial and temporal crowding of such disturbances can result in cumulative effects.

- ***Past Actions.*** "Past Actions" are defined as actions within the region of influence for a particular resource that occurred before the decision to develop this EIS. Unless otherwise indicated, the characteristics and results of these past actions are described in Section 3.0, Affected Environment.

- ***Present Actions.*** "Present Actions" include: (1) current dredging operations; and (2) current resource management programs, land use activities and development projects

that are being implemented by other governmental agencies and the private sector (where they can be identified) within the region. There are potentially several different types of human activities that could affect resources in the study area. These activities include dams and resulting pools; dredging; nonpoint source inputs of contaminants and sediments from urban, mining, and agricultural areas; and point source inputs of contaminants and Biochemical Oxygen Demand (BOD) from industrial and municipal facilities. A list of these activities, accompanying potential stressors, and potential for cumulative impacts is summarized in Table 4-8.

- ***Reasonably Foreseeable Future Actions.*** To avoid undue speculation, "Reasonably Foreseeable Future Actions" are those that have been approved for implementation by appropriate authority and that can be identified and defined with respect to time frame and location.

Future actions, such as modifications to dam structures, substantial changes in outflow regimes from reservoirs within the ROI or further upstream (e.g., Kinzua Dam and Allegheny Reservoir), or installation or modification of large power plants within the study area, could result in different cumulative impacts to certain resource areas. For purposes of this analysis, we considered those activities likely to occur within the next 10 years for illustration purposes. Activities proposed include:

- Installation of flash boards to the dam of Pool 6 to increase the head for hydroelectric power.

- Potential flood control projects within the ROI administered by the USACE.

Based on the analyses discussed in Section 4, the environmentally important areas to be included in this cumulative impacts analysis are: (1) hydrology modification from permanent loss of sand and gravel substrate, (2) turbidity and dissolved oxygen, (3) native mussels including the two Federally threatened and endangered species and state species of concern, and (4) certain native fish species including several state listed species, all of which indicated the potential for impacts due to the proposed dredging activity (Alternative 2). Impacts to other resource areas due to Alternative 2 were judged to be minor and are therefore not considered further in this section (e.g., permanent loss of riverbed sand and gravel resources is considered to have a relatively minor impact on regional sand and gravel resources given the vast land-based reserves located in northeast Pennsylvania). Alternative 3 relies on the use of several additional restrictions, using adaptive management, to avoid or minimize impacts identified under Alternative 2. Significant impacts were not identified for Alternative 4. Therefore, the following discusses potential cumulative impacts to the above resource areas based on Alternatives 2 and 3. Areas of uncertainty are also pointed out. Extensive environmental data were collected prior to and during preparation of this EIS in the study area, which have increased the knowledge base on many of the important

Table 4-8. Summary of relative ranking of specific sources and stressors (based on information to date) and their effect on the overall goal of maintaining and restoring, to the extent feasible, ecological integrity in the study area. H = relatively high or large; M = moderate; L = low or small. Numbers in parentheses represent qualitative judgements of uncertainty: 1 = uncertain; 2 = moderate certainty; 3 = certain.

Human Activity	Potential Stressors	Context to Region	Relative Magnitude	Level of Irreversibility	Probability of Cumulative Impacts - Interactions
Dams	hydrologic modification	H(3)	H(3)	H(3)	H(3)
	sedimentation	H(3)	H(2)	H(3)	M(2)
	anoxia	M(2)	L(2)	M(1)	L(1)
Dredging	substrate modification	M(1)	L(1)	M(1)	M(2)
	sedimentation	L(1)	L(1)	M(1)	M(1)
	hydrologic modification	M(1)	L(1)	M(1)	M(1)
	resuspension of sediment toxics	L(1)	L(1)	L(3)	L(1)
	anoxia direct mortality	L(2)	L(3)	L(3)	L(2)
Industrial and Municipal Facilities	BOD	M(2)	M(1)	M(2)	M(2)
	toxics	L(1)	L(2)	L(2)	M(1)
	nutrients	L(2)	L(2)	L(2)	M(1)
	pathogens	L(2)	L(1)	M(2)	L(1)
Agricultural and Urban Runoff	sedimentation	M(2)	M(1)	M(2)	M(2)
	toxics	M(1)	L(1)	M(1)	M(1)
	BOD	M(2)	M(2)	M(1)	M(2)
	pathogens	L(2)	M(1)	M(2)	M(1)

Over the next 10-year period, we are unaware of any other future activities that may affect the cumulative impacts analysis.

ecological relationships present. However, as with any complex environmental system where multiple human activities potentially affect resources, there is always some uncertainty in terms of cause-effect relationships, particularly when forecasting into the future. Present and future dredging actions under Alternatives 2 and 3 in this analysis are considered within the context of available data at the time of this writing, current dredging permit conditions, and a 10-year future time frame.

4.5.1 Hydrology

Potentially significant cumulative impacts to hydrology under Alternative 2 are possible. Dredged areas are generally about 15 to 35 feet deeper than the pre-dredging surface or adjacent undredged areas, depending on equipment limitations and beginning river depths at the dredge sites. Results of diving studies conducted in support of this environmental document indicated that the morphology of the trenches has changed little over time. Videotapes recorded by divers showed that most dredged areas (even those dredged ≥ 20 years ago) still had distinct side slopes, indicating little if any head cutting or other morphological changes over time. Although these changes have not had a significant impact on navigation, water flow, or river bottom substrate composition, the trenches left by dredging are relatively permanent modifications to the river bottom. Although uncertain, much (> 75%) of the currently dredgeable area has been dredged in the past. Over the next 10 years, the percentage of total river bottom disturbed by dredging (i.e., in terms of trenches) is estimated to be an average of 0.8% per year or 8% of the river bottom, most of it previously dredged.

Under Alternative 3, greater restrictions of shallow, undisturbed areas and other increased set-backs are likely to result in an even greater percentage of dredging activity in previously dredged areas rather than new areas. This would result in a reduced percentage of virgin river bottom disturbed from that predicted under Alternative 2.

Under the current permit restrictions (Alternative 2), dredging could potentially continue at its current pace for the next 20 to 25 years. The maximum extent of currently shallow (relatively undredged) river bottom that could be potentially dredged under this alternative is approximately 5% of the total shallow area remaining. Depending on results of mussel surveys, an even lower amount of shallow or virgin areas may be permitted for dredging. Under Alternative 3, adaptive management would be employed, potentially reducing the amount of dredgeable area by as much as 25%. Assuming that the annual rate of dredging (i.e., dredging production) remains unchanged, Alternative 3 would reduce the life cycle of the industry to between 10 and 15 years. Under this alternative, the maximum extent of shallow river bottom potentially dredged is < 1% of the shallow area currently present in the project area. Actual dredgeable shallow area is likely to be less due to the presence of significant mussel resources.

4.5.2 Dissolved Oxygen

Potentially significant cumulative DO impacts of dredging under Alternative 2 are possible under extreme river and weather conditions within deep dredged areas. Under particularly warm, dry summer conditions, areas of deeper water can exacerbate the already lowered oxygen saturation point and relatively low current velocities, potentially yielding DO levels below the state standard. The low oxygen levels reported by PADEP in certain dredged areas of Pools 7 and 8 in their July 1999 sampling, were indicative of the prolonged drought condition occurring at that time and concurrent warm water temperatures. DO monitoring in dredged areas in support of this EIS indicated compliance with state standards at most locations even in relatively deep (> 40 ft) areas, under other summer conditions. Follow-up DO monitoring four weeks after PADEP sampled in the summer of 1999, indicated no violations of the state standard in water ≤ 40 ft. This improvement in oxygen conditions was coincident with cooler water temperatures and greater oxygen saturation.

It is not clear whether infrequent DO depletion in deeper areas affects mussels or other invertebrates in the study area. Benthic macroinvertebrate data from deeper, dredged areas collected for this EIS suggested similar macroinvertebrate assemblage characteristics as compared to deep undredged areas. However, these data are limited in scope. There are many examples from the literature indicating that some mussels and benthic insects are sensitive to low oxygen stress.

A second factor affecting cumulative impacts of dredging on oxygen levels is fossil fuel power plant discharges which tend to increase water temperature, particularly during low flow summer conditions, resulting in less oxygen saturation capacity. Major power plant discharges occur in Pools 9, 8, 6, and 5. Historically, STORET data indicated infrequent DO levels below the state standard in Pools 8 and 6 but not other pools in general. Locations of lower DO coincided with areas downstream of power generating facilities. The low DO levels observed by PADEP in Pool 8 at > 30 ft of water in 1999 also coincided with an area directly downstream of an electric power plant thermal discharge. Thus, during lower flows and warm water temperatures, electric power facilities may contribute to localized cumulative impacts in DO levels in deeper dredged areas.

Under Alternative 3, DO impacts will be minimized by altering the bathymetric configuration of dredged areas based on the location of the area (e.g., distance from the thalweg or a dam) and certain design factors that affect oxygen saturation (e.g., summer drought water temperature, reaeration rates, and river velocity). The adaptive management process inherent in this alternative will also help minimize impacts as more of this information and monitoring results are evaluated.

4.5.3 Mussels

Continued dredging under Alternative 2 is likely to have generally a minor cumulative effect on mussels in areas that already have suboptimal habitat, which includes the majority of the areas currently available for dredging. However, continuation of river dredging over the life-cycle of the industry under Alternative 2 (20 to 25 years) may pose a significant adverse effect on uncommon/rare, state-listed, and Federally-listed mussel species, when considering all past, present, and future anthropogenic activities in the rivers. This effect may occur as a result of either reducing host fish populations or dredging high quality habitat currently not utilized by mussels. Both effects may adversely impact mussel populations given their generally low recruitment rate and patchy distribution. Furthermore, significant adverse impacts to Federally-listed mussel species could occur if the sampling protocol would fail to identify the location of such species and dredging commences in areas where they occur.

As indicated in the discussions in Sections 3.4 and 4.2.4, native mussels, and especially Federally-listed species and state species of concern in the study area, are potentially affected by several different types of human activities (Table 4-7). Dams have had clear effects on native mussel species distribution and abundance in many riverine systems (Ahstedt 1991; Watters, 1995). This is best evidenced in the Allegheny River by the generally higher density of mussels, greater species richness, and greater abundance of threatened and endangered mussels in the free-flowing portion of the Allegheny River than in apparently undredged portions of the study area. Previous mussel sampling in the free-flowing Allegheny River has frequently yielded as many as 48 mussels/m^2 (e.g., near Kennerdell Bridge, Venango Co.) and as many as 10 species in a 200 x 10 ft transect (Appendix I, Table I-9). Undredged portions of Pool 6, for example, have yielded 3.2 mussels/m^2) and 6 species in a 200 x 10 ft transect. Recent (1999) mussel sampling by PADEP in relatively shallow, undredged areas near submerged pipelines in Pools 4, 7, and 8 (Exhibit C) and around Murphy's Island in Pool 5 indicated lower mussel densities and fewer species than observed upstream of the navigable part of Pool 9. Thus, dams and impoundments are likely to already have had a significant effect on native mussel populations within the study area.

Available data suggests that there can be higher densities and greater diversity of mussels in relatively undredged areas that are already restricted from dredging. For example, greater numbers of mussels and mussel species have been reported in the upper part of Pool 8 and near islands such as Murphys Island in Pool 5. Recent dive sampling by USFWS and by PADEP has confirmed relatively high mussel abundance and diversity in these locations. Furthermore, in each of these instances, divers observed suitable habitat features. Relatively deeper areas, in which dredging often occurs, are already disturbed and are marginal habitats for native mussels, especially as compared to most currently restricted areas. However, while many high quality habitat sites are within currently restricted areas (i.e., within 150 ft of the 6 ft depth contour) some high quality habitat areas may be located in areas otherwise considered for dredging under Alternative 2.

A meeting of mussel experts, held by PADEP in October 2000, concluded that preferred mussel habitat can be identified using a dive sampling protocol and experienced divers. Furthermore, these experts suggested that preferred mussel habitat is generally associated with greater mussel abundance, diversity, and the presence of rare species. However, future colonization of high quality habitat, which is currently not being utilized by mussels, cannot be ruled out. As such, continuation of river dredging in the long-term may have a significant impact on rare, state-listed, and Federally-listed species.

Use of a mussel sampling protocol prior to dredging has been required by PADEP and USACE, and is expected to mitigate most of these impacts by more accurately identifying the presence of Federal and state-listed mussel species, as well as concentrations of mussels. The PADEP transect dive sampling protocol already demonstrated improved results over previous sampling protocols as evidenced by:

- New locations of the Federally listed Northern Riffleshell in Pool 8.
- New locations of state species of concern including Fragile Papershell, Salamander Mussel, and Pink Heelsplitter.
- More information on the distribution of native mussel species in the study area.

Mussel sampling conducted by the dredging industry since 1996 has greatly increased the body of knowledge about freshwater mussels within the Allegheny and Ohio Rivers. Prior to this, limited data existed on mussel populations and current species distributions in the study area.

Implementation of Alternative 3 is expected to have a minor cumulative effect on mussels, including rare and state or federally-listed species. In addition to current set-backs of shorelines, islands, and other potentially suitable habitats, Alternative 3 explicitly recognizes the importance of protecting high quality aquatic life habitats within the study area. To this end, shallow areas are restricted from dredging, regardless of where they occur. Larger set-backs from potentially productive areas downstream or laterally are also used as appropriate to further protect those areas from potential effects of dredge-related turbidity. The mussel sampling protocol, refined considerably during this EIS, will continue to be updated periodically, using the best available science and interagency participation to ensure that effects on rare, state-listed, and Federally-listed species are avoided and/or minimized. Subsequent changes to the sampling protocols and protection criteria will be evaluated and implemented through the adaptive management process. Finally, under Alternative 3, compensatory mitigation may be appropriate in the form of restoring certain habitats in select locations on a site-specific basis.

4.5.4 Fishes

Moderate cumulative effects on fishes are possible under Alternative 2. Spatial analysis (Section 4.2.4) suggested that habitat for most fishes would be protected from dredging effects under current permit restrictions. However, selected species (e.g., channel/lacustrine species) could occupy suitable habitats present in the permitted zone. The cumulative impacts of point source discharges, nonpoint source stressors (e.g., urbanization effects), the presence of dams, severe summer drought conditions (i.e., as related to dissolved oxygen), and dredging activity have the potential to affect those species in particular.

Trautman (1981) recounts that cannalization of the Allegheny and Ohio Rivers had a pronounced effect on the fish assemblage, since it almost or entirely eliminated riffles. As a group, those species requiring riffles and/or flowing waters were the most adversely affected. Conversely, species preferring turbid, quiet waters benefited, and some of these tolerant fishes are now among the most numerous species of the area. Cannalization decreases peak flows and prevents water from inundating floodplains, which in turn reduces the recruitment of spawning gravel from the floodplain, and decreases prime habitat for productive foraging and refuge. Reductions in floodplain inundation often result in decreased species diversity and standing crop of fish (Finger and Stewart, 1987; Pollard et al., 1983; Welcomme and Hagborg, 1977; Wharton et al., 1982; Zalumi, 1970). Compilation of recent information (Section 3.4.2.4) indicates that the Allegheny River study reach is dominated by emerald shiners, bluntnose minnows, and common carp and that gizzard shad, emerald shiners, and channel catfish are predominant in the Ohio River. All of these species are either channel-lacustrine, general-lacustrine, or generalist-opportunist fishes.

With the presence of multiple dams, riffle or “shallow-water” species (i.e., those dependent upon shallows or increased flow for at least a part of their life history) that remain rely on tributaries and river margins for suitable habitat, and channel/lacustrine species are predominant in the slackwater pools. Spatial analysis in Section 4.2.4 indicated that preferred habitats for most “margin” species are found within the areas restricted from dredging under Alternative 2. Conversely, some of the common channel or lacustrine species could find suitable habitat inside the zone permitted under Alternative 2. For these species, dredging activity could potentially have a localized, short-term influence on their presence and/or movements, and episodic reductions in dissolved oxygen as described in Section 4.2.3 could represent at least an ephemeral loss of suitable habitat. However, spatial analysis indicated that “high quality” habitat is available for selected channel/lacustrine species (e.g., adult walleye, adult river redhorse) in Allegheny Pool 6. Habitats such as the “high quality” portions of Pool 6 and the shallows of Pool 9 (upstream of the navigable portion of the pool) may warrant special protection from dredging.

Under Alternative 3, potential effects on “margin” fish species that might otherwise occupy areas permitted for dredging, would be mitigated by restricting high quality habitats, on a site-specific basis, as previously mentioned for mussels. By protecting high quality mussel

habitats, margin fish species should also be protected. The dissolved oxygen mitigation, mentioned previously, involving altering the configuration of the dredged area, depending on location and modeling analyses, should address these concerns as well. Finally, under Alternative 3, compensatory mitigation such as restoring or creating "reefs" in certain locations (apart from the navigation channel) on a site-specific basis, may help to mitigate potential impacts on fishery resources.

4.6 UNAVOIDABLE ADVERSE ENVIRONMENTAL IMPACTS

The following section identifies the major adverse environmental effects that cannot be avoided in connection with each of the three Alternatives evaluated in this document.

Alternative 2. Continuation of river dredging could result in several unavoidable adverse environmental effects over the next 10 years including: significant morphological changes to the river bottom (approximately 8 percent of the river bottom [1,100 acres] deepened an additional 15 to 35 feet); occasional failure to achieve the state water quality dissolved oxygen standard of 5 mg/l in certain deep locations of the study area during dry, hot summer conditions; and the unintended "take" of endangered, threatened, and rare species of mussels.

Alternative 3. Under Alternative 3, a more scientifically appropriate mussel sampling protocol, site-specific habitat and/or depth restrictions, and alterations of the dredged area configuration to minimize dissolved oxygen impacts, should ensure that water quality and mussel and fish populations, including species of concern identified by state and federal agencies and Federally-listed mussels, are not significantly impacted by dredging activities. However, similar to Alternative 2, this alternative will result in adverse effects on river bottom morphology, but to a lesser extent. With the implementation of revised mussel sampling protocols, modified permit conditions, and applying adaptive management, unintended "take" of listed species is not expected to occur. Any potential adverse impacts to listed species would have to be addressed through separate authorization and subsequent formal consultation.

Alternative 1 (No Action) and Alternative 4. Cessation of river dredging, under the no action alternative (i.e., Alternative 1), will result in reasonably foreseeable and unavoidable adverse environmental effects to various locations throughout the region due to the inevitable increase in land-based quarry activities (i.e., Alternative 4). In the short-term, these effects would result in increases in activity levels and/or expansions in operations at existing operations. In the long-term, market forces will favor the establishment of new land-based quarries within western Pennsylvania to provide the sand and gravel products generated annually by river dredging companies. Although it is difficult to predict the extent and specific location of these secondary actions taken by land-based quarry operators, it is reasonable to conclude that certain adverse environmental effects may occur, including: minor to potentially moderate adverse effects to aquatic life (including mussels and fish) in streams near land-based quarry operations; adverse effects to wetlands and terrestrial habitat

(loss of up to 2,000 acres with the creation of permanent deep pits); increased truck traffic resulting in increased noise, decreased air quality, and increased potential for accidents, injuries, and fatalities.

It is clear that all of the alternatives evaluated would result in some level of adverse environmental impact. As long as there is a need for such sand and gravel resources, the selected Alternative 3 represents the least environmentally damaging practicable alternative.

4.7 IRREVERSIBLE OR IRRETRIEVABLE COMMITMENTS OF RESOURCES

Irreversible and irretrievable resource commitments are related to the use of nonrenewable resources and the effects that use of these resources will have on future generations. Irreversible effects primarily result from use or destruction of a specific resource (e.g., energy and minerals) that cannot be replaced within a reasonable time frame. Irretrievable resource commitments involve the loss in value of an affected resource that cannot be restored as a result of the action (e.g., extinction of a threatened or endangered species).

Alternative 2 would result in an irreversible and irretrievable commitment of resources. Dredging activities will result in a relatively permanent significant alteration in the morphology of the river bottom. Over the next 10 years, additional trenches would be created in approximately 8 percent of the river bottom, thereby deepening the river by 15 to 35 feet relative to the pre-dredged surface. Furthermore, the loss of glacially-derived sand and gravel resources of the river systems is irreversible. At current production levels, the applicants could extract over 40 million tons of sand and gravel material over the next 10 years. Potentially, 720 acres of relatively shallow virgin river bottom might be dredged, representing 12% of the total shallow area in the study area. Without habitat restoration, this loss would be permanent.

Alternative 3 would also result in an irreversible and irretrievable commitment of resources but at a somewhat lower level than Alternative 2. Under this alternative, the applicants will extract the same tonnage of sand and gravel over the next 10 years, however, >90% of this aggregate is likely to come from previously dredged areas, as roughly defined by depth. Potentially, 89 acres of shallow virgin river bottom (1.6% of the total shallow area) is dredgeable in the study area. Under the adaptive management process, this loss could be offset through mitigative actions, such as habitat restoration.

Alternatives 1 and 4 (i.e., the secondary actions that will occur as a result of implementing Alternative 1) would also result in an irreversible commitment of resources. To satisfy current demand for sand and gravel products, approximately 100 acres of terrestrial habitat would be eliminated annually. However, if all new quarries are constructed within western Pennsylvania to make up for existing river-based dredging production, then approximately 2,000 acres of terrestrial habitat would be eliminated (every 20 years, approximately), including the creation of permanent large open pits. If new quarries are not developed, but

rather existing quarries expanded, then approximately 1,000 acres would be permanently altered (every 10 years), including the creation of large open pits within the next 10 years. Furthermore, a similar quantity of sand and gravel resources (i.e., over 40 million tons) would be extracted and irreversibly lost from quarries within the region.

It is clear that any commercial use of such sand and gravel resources will have some level of adverse impact and a decline in availability of such resources. The selected Alternative 3 results in the least impact to such resources.

4.8 SUMMARY OF ENVIRONMENTAL AND SOCIOECONOMIC EFFECTS

A summary of the environmental and socioeconomic effects of Alternatives 1, 2, 3, and 4 are presented in Table 4-9. Overall, significant adverse effects to hydrology, water quality, and mussels, particularly Federally-listed species, were identified for Alternative 2. Several mitigation measures, identified under Alternative 3, reduce these effects. Significant adverse effects on public safety and children were identified for Alternative 1 (as a result of induced effects associated with increased land-based quarry operations) and Alternative 4. Negligible, minor, or moderate effects were identified for the remaining resource areas for each of the alternatives. In addition to these effects, several cumulative adverse effects have been identified, including adverse impacts to hydrology (approximately 8 percent of the river bottom will be irreversibly disturbed in the next 10 years through the creation of trenches), and potential impacts to dissolved oxygen levels, mussels, and fish due to past, present, and foreseeable future actions within the watersheds of these river systems. Other actions which have also had major impacts to the river systems include the lock and dam system and other man-made modifications to the river (e.g., navigation dredging, other civil works projects) which have contributed to further hydrologic modifications, sedimentation, and anoxia; industrial and municipal facilities which have contributed to BOD, toxics, nutrient loadings, and pathogens; acid mine drainage; and agricultural and urban runoff which have contributed to BOD, toxics, sedimentation, and pathogen levels.

Alternative 3 has been identified as the preferred alternative as described in this Final EIS. This alternative serves to minimize the overall adverse impacts while allowing for continued commercial sand and gravel dredging operations.

Table 4-9. Summary of Environmental and Socioeconomic Effects

Resource Areas	Alternatives			
	Alternative 1 **No Action**	**Alternative 2** **River Dredging with Current Permit Restrictions**	**Alternative 3** River Dredging with Adaptive Management	**Alternative 4** **Land-Based Quarries and Importation (assumes 50 quarries expand and/or 20 new quarries permitted)**
Hydrology	***Study Area Effects*** • No change in effects relative to current baseline conditions. • Sand and gravel barge traffic makes up 98% of commercial navigation in Pools 8 and 9, 57% in Pool 7, 50% on Pools 2-5, and approximately 13% in Ohio River Pools. Potential for long-term adverse effects to navigational services in upper pools. ***Induced Regional Effects*** • Minor adverse effects to streams in localized areas within the region due to increases in land-based quarry operations (see Alternative 4).	• Moderate adverse effects to hydrology as a result of permanent changes to the river bottom morphology in the form of trenches. In the next 10 years, 8% of river bottom would be dropped by 15' to 35' ft. • Significant cumulative adverse effects from past, present, and future dredging activities. Potentially 720 acres of relatively shallow virgin river bottom might be dredged, representing 12% of the total shallow area in the study area. • Morphology of trenches has changed little over time due to the substrate (sand and gravel) and lock and dam system. • Minor adverse effects to navigation. Permit conditions already require immediate corrective actions if dredging activities interrupt free discharge of the river or navigation.	• Moderate adverse effects to hydrology as a result of permanent changes to the river bottom morphology in the form of trenches. In the next 10 years, 8% of river bottom would be dropped by 15' to 35' ft. • Significant cumulative adverse effects from past, present, and future dredging activities. Potentially 89 acres of shallow virgin river bottom (1.6% of the total shallow area) is dredgeable in the study area. • Morphology of trenches has changed little over time due to the substrate (sand and gravel) and lock and dam system. • Minor adverse effects to navigation. Permit conditions already require immediate corrective actions if dredging activities interrupt free discharge of the river or navigation.	***Land Based*** • Minor adverse effects to streams near quarries in the region, including sedimentation, increased stream flow, bank erosion, dewatering, and direct alteration of stream bed channels. ***Importation from Dredging*** • Morphology of trenches has changed little over time due to the substrate (sand and gravel) and lock and dam system.

Table 4-9. Summary of Environmental and Socioeconomic Effects

Resource Areas	Alternatives			
	Alternative 1 **No Action**	**Alternative 2** **River Dredging with Current Permit Restrictions**	**Alternative 3** River Dredging with Adaptive Management	**Alternative 4** **Land-Based Quarries and Importation (assumes 50 quarries expand and/or 20 new quarries permitted)**
Geology/ Hydrogeology	***Study Area Effects*** • No change in effects relative to current baseline conditions. ***Induced Regional Effects*** • Negligible to minor adverse effects to geologic resources and moderate adverse effects to groundwater resources in localized areas within the region due to increases in land-based quarry operations (see Alternative 4).	• Minor adverse effects to geologic resources as a result of changes to particle size distribution, as well as depletion of nonrenewable resources. Anecdotal accounts of siltation and debris in certain dredged trenches. Field studies did not find any significant differences in particle size distribution between dredged and non-dredged areas. • No adverse effects to groundwater from dredging. Intensive hydrogeological study at Springdale indicated no effect to groundwater from dredging.	• Minor adverse effects to geologic resources as a result of changes to particle size distribution, as well as depletion of nonrenewable resources. Anecdotal accounts of siltation and debris in certain dredged trenches. Field studies did not find any significant differences in particle size distribution between dredged and non-dredged areas. • Adaptive management used to ensure no effects on well fields or industrial water supplies on a site-specific basis.	• Negligible to minor adverse effects to geologic resources due to depletion of nonrenewable resources. • Moderate adverse effects to groundwater near land-based quarries due to dewatering activities may occur, resulting in adverse effects to nearby private wells.
Water Quality	***Study Area Effects*** • No change in effects relative to current baseline conditions. • ***Induced Regional Effects*** Minor adverse effects to water quality in localized areas within the region due to increases in land-based quarry operations (see Alternative 4).	• Moderate adverse effects on water column turbidity, dissolved oxygen, and resuspended sediment contaminants. Significant cumulative adverse effects to DO under extreme conditions (low flow, high temperature, and certain hydrologic conditions).	• Minor adverse effects to water column turbidity, dissolved oxygen, and suspended sediment contaminants. Minor cumulative adverse effects on dissolved oxygen (D.O.) or other water quality parameters. • Mitigation measures include: creating elongated dredged trenches, as opposed to small deep pockets to enhance flushing; DO monitoring; and use of screens to trap suspended solids during dredging, if within 1000 feet of a resource of concern.	**Land Based** • Minor adverse effects to stream turbidity and suspended solids near land-based quarries due to material processing, non-point run-off, and overflow of settling ponds/lagoons. • Minor adverse effects to sediment contaminants and sediment embeddedness near land-based quarries due to inputs of very fine sediments and trace contaminants (metals) from quarries and material processing.

Table 4-9. Summary of Environmental and Socioeconomic Effects

Resource Areas	Alternatives			
	Alternative 1 **No Action**	**Alternative 2** **River Dredging with Current Permit Restrictions**	**Alternative 3** River Dredging with Adaptive Management	**Alternative 4** **Land-Based Quarries and Importation (assumes 50 quarries expand and/or 20 new quarries permitted)**
Water Quality (cont'd)		• Moderate adverse effects on turbidity levels. Turbidity levels within 1000 ft downstream of dredging may be 2-3 times low flow background levels but within normal ranges observed under other flow conditions. Turbidity and suspended solids ≥ 1000 ft downstream of dredging are similar to upstream levels. No adverse effects on public or industrial water supply intakes observed due to turbidity during dredging activities. • Moderate adverse effects on dissolved oxygen, with significant cumulative effects. Dissolved oxygen in some locations of Pools 7 and 8 were anoxic below 30 ft under summer drought conditions. Montgomery Pool locations at similar depths and flows were unaffected. Anoxic conditions were not generally observed under low baseflow conditions in summer field studies.	• Minor adverse effects on turbidity levels. If dredging within 1000 feet upstream of an area of ecological importance (e.g., unique habitat), dredge screens may be required to trap suspended solids and turbidity. • Minor adverse effects on dissolved oxygen. 3-dimensional D.O. modeling used to optimize dredge configuration to promote flushing and maintain D.O. above state standard. • Hydrogeological studies and modeling on-going to confirm the current 1000 foot set-back from well-fields and other water supplies obtained from the sub-river aquifer. • Adaptive management could be used to sample sediment contaminants prior to dredging if a particular site is located in a potentially contaminated area.	**Importation from Dredging** • Increased barge and vehicular traffic.

Table 4-9. Summary of Environmental and Socioeconomic Effects

Resource Areas	Alternatives			
	Alternative 1 **No Action**	**Alternative 2** **River Dredging with Current Permit Restrictions**	**Alternative 3** River Dredging with Adaptive Management	**Alternative 4** **Land-Based Quarries and Importation (assumes 50 quarries expand and/or 20 new quarries permitted)**
Water Quality (cont'd)		Factors impacting DO include depth, flow rate, water temperature, dredge trench configuration, and perhaps other river activities. No evidence of abiotic conditions was found from infrequent anoxic conditions in dredged areas of Pools 7 and 8. • Minor adverse effects to sediments. Sediment contaminants could possibly be resuspended in the water column during dredging although no toxicity or water quality standards violations were observed in field studies. For much of the upper Allegheny River (Pool 4 and upstream) the likelihood of dredging contaminated sediments appears remote due to few potential sources.		
Aquatic Life: Plankton, Periphyton, Flora	***Study Area Effects*** • No change in effects relative to current baseline conditions. ***Induced Regional Effects*** • Minor adverse effects to plankton, periphyton, and macrophytes in localized areas within the region due to increases in land-based quarry operations (see Alternative 4).	• Minor adverse effects on plankton, periphyton, and macrophytes within the turbidity plume downstream of dredging due to excessive light attenuation. Effects are likely to be within 1000 ft of dredging, temporary and intermittent. • Current permit conditions mitigate most adverse effects on macrophytes that occur in the river margins, around islands, and tributary confluences all of which are restricted under current permit conditions.	• Minor adverse effects on plankton, periphyton, and macrophytes within the turbidity plume downstream of dredging due to excessive light attenuation. Effects are likely to be within 1000 ft of dredging, temporary and intermittent. • Submerged and emergent macrophytes protected through minimum 9 foot initial depth restriction and site-specific offsets from unique habitats.	• Minor to moderate (in the short-term) adverse effects on plankton, periphyton, and aquatic plants in streams near land-based quarries due to siltation and turbidity from material processing and run-off.

Table 4-9. Summary of Environmental and Socioeconomic Effects

Resource Areas	Alternatives			
	Alternative 1 **No Action**	**Alternative 2** **River Dredging with Current Permit Restrictions**	**Alternative 3** River Dredging with Adaptive Management	**Alternative 4** **Land-Based Quarries and Importation (assumes 50 quarries expand and/or 20 new quarries permitted)**
Aquatic Life: Macro-invertebrates	***Study Area Effects*** • Minor beneficial effect relative to current baseline conditions to the extent that preferred habitat, not currently restricted, are suitable for future colonization. ***Induced Regional Effects*** • Minor adverse effects to benthic macroinvertebrates in localized areas within the region due to increases in land-based quarry operations (see Alternative 4).	• Minor adverse effects on benthic invertebrates located within or directly downstream of dredging activity due to dislodgement, removal, or sedimentation. However, field studies indicated that recruitment is high and effects relative to baseline may be temporary. • 0.8% of the river is dredged per year on average, indicating that most of the invertebrate recruitment pool is intact. Invertebrate dispersal and recolonization is often rapid suggesting high resilience to temporary dredging effects.	• Minor adverse effects on benthic invertebrates located within or directly downstream of dredging activity due to dislodgement, removal, or sedimentation. • Preferred macroinvertebrate habitats protected through minimum 9 foot initial depth restriction and site-specific adaptive management protection of unique habitats.	• Minor adverse effects on benthic invertebrate in streams near land-based quarries due to physical disturbance of temperature and flow regimes, and siltation effects and turbidity from quarry operations and run-off.
Aquatic Life: Mussels	***Study Area Effects*** • Minor beneficial effect relative to current baseline conditions to the extent that preferred habitats not currently restricted, are suitable for future colonization. ***Induced Regional Effects*** • Minor adverse effects to mussels in localized areas within the region due to increases in land-based quarry operations (see Alternative 4).	• Minor adverse effects to common species of mussels and in areas with marginal habitat. Over the long-term (25 to 35 years), potentially significant cumulative adverse effects to uncommon/rare mussel species may occur, when effects are combined with other past, present, and future anthropogenic activities. These impacts are primarily associated with dredging high quality habitat, currently not used by mussels.	• Rigorous sampling protocol, which is modified through adaptive management, will substantially mitigate effects on mussels. Use of a revised protocol identified T&E mussels, resulting in the area being restricted from dredging. Minimum 9 foot initial depth restriction also protects high quality habitat. Other mitigation measures to reduce effects which may be applied on a site-specific basis include: protection of unique habitats and habitat enhancement measures.	• Minor adverse effects to mussels that may be present in streams downstream of land-based quarries due to increased siltation and sedimentation. These effects may occur in the event that these species are undetected in the stream and not sufficiently protected. • Formal consultation with regulatory agencies would mitigate any moderate or significant adverse impacts.

Table 4-9. Summary of Environmental and Socioeconomic Effects

Resource Areas	Alternatives			
	Alternative 1 **No Action**	**Alternative 2** **River Dredging with Current Permit Restrictions**	**Alternative 3** River Dredging with Adaptive Management	**Alternative 4** **Land-Based Quarries and Importation (assumes 50 quarries expand and/or 20 new quarries permitted)**
Aquatic Life: Fish	***Study Area Effects*** • Minor beneficial effect relative to current baseline conditions on certain channel species to the extent that preferred habitats, not currently restricted, are suitable for future colonization. ***Induced Regional Effects*** • Overall, minor adverse effects to fish in localized areas within the region due to increases in land-based quarry operations (see Alternative 4).	• Minor adverse effects to fish due to disturbance in the vicinity of active dredging. Moderate cumulative adverse effects from past, present, and future dredging activities, when combined with other anthropogenic activities in the rivers. In small portion of the study area, dredging may result in a reduction in habitat suitability for selected channel-specialist species (e.g., walleye).	• GIS-habitat modeling indicated that habitat for most species and life stages are protected using adaptive management procedures. Minor adverse effects on adult habitat for channel and lacustrine species (e.g., walleye) but no adverse effects on spawning or early life-stage habitat. Minimum 9 foot initial depth restriction further ensures protection of state-listed fish species in the study area. • Mitigation measures include site-specific protection of unique habitat that provides important spawning or feeding habitat, and habitat enhancement measures (e.g., artificial reefs). • The PADEP and PA Fish and Boat Commission have developed sampling techniques and standards to further protect the fishery resource.	• Overall, minor adverse effects on fish in streams near land-based quarries due to physical disturbance of temperature and flow regimes, and siltation effects and turbidity from run-off and quarry operations. Short-term moderate impacts to fish may occur during certain conditions.

Table 4-9. Summary of Environmental and Socioeconomic Effects

Resource Areas	Alternatives			
	Alternative 1 **No Action**	**Alternative 2** **River Dredging with Current Permit Restrictions**	**Alternative 3** River Dredging with Adaptive Management	**Alternative 4** **Land-Based Quarries and Importation (assumes 50 quarries expand and/or 20 new quarries permitted)**
Wetlands and Terrestrial Life	***Study Area Effects*** • No change in effects relative to current baseline conditions. ***Induced Regional Effects*** • Minor adverse effects on wetlands and fauna in localized areas within the region due to increases in land-based quarry operations (see Alternative 4).	• Minor adverse effects on wetlands (due to sedimentation, disturbance). Impacts to wetlands would be mitigated by site-specific permits in compliance with Title 25. • See effects to terrestrial fauna from operational noise.	• None to minor adverse effects on wetlands. Minimum 9 foot initial depth restriction will further protect wetlands and marsh habitat. Other adaptive management measures, which may be applied on a site-specific basis, include protection of unique and high quality habitats.	• Minor to moderate adverse effects to fauna (from habitat loss and noise) and terrestrial habitat (including wetlands) would be expected. Approximately 100 acres of terrestrial habitat would be lost per year (2,000 acres if all new quarries are constructed). Impacts may include: loss of sensitive habitat, impacts to State-listed species, nesting disturbance, wetland loss, and habitat fragmentation.

Table 4-9. Summary of Environmental and Socioeconomic Effects

Resource Areas	Alternatives			
	Alternative 1 **No Action**	**Alternative 2** **River Dredging with Current Permit Restrictions**	**Alternative 3** River Dredging with Adaptive Management	**Alternative 4** **Land-Based Quarries and Importation (assumes 50 quarries expand and/or 20 new quarries permitted)**
Threatened & Endangered Species: Aquatic Life	***Study Area Effects*** • Minor beneficial effect relative to current baseline conditions to the extent that preferred habitats, not currently restricted, are suitable for future colonization. • ***Induced Regional Effects*** No adverse effects to minor adverse effects to State- and Federally-listed aquatic species in localized areas within the region due to increases in land-based quarry operations (see Alternative 4).	• Potentially significant adverse effects (such as incidental taking an individual or its habitat) to Federally-listed mussels (i.e., clubshell mussel, northern riffleshell mussel) may occur within their range. Including significant cumulative adverse effects when considering past, present, and future dredging activities combined with all other anthropogenic activities. Federally-listed mussels have been found in Pools 8 and 9. Significant effects could occur if the sampling protocol would fail to identify their location and dredging commences in areas where they occur. Furthermore, unidentified habitat that could possibly be important to Federally-listed species may be disturbed through dredging. Implementation of formal consultation with regulatory agencies will likely reduce significant adverse impacts.	• Potentially significant adverse effects (incidental taking on individual or its habitat) to federally-listed mussels may occur within their range. However, current development of more rigorous sampling protocol with USFWS, along with 9 foot minimum initial depth restriction, should mitigate these effects. Under this alternative, nearly all dredging would occur in previously dredged areas that are unlikely to be preferred habitat for these species. Adaptive management will be used to further decrease risks to listed species through refinements in the sampling protocol, and potential recognition and avoidance of preferred habitats when they are defined. • Adverse impacts to state-listed fish species should be reduced through the 9 foot minimum initial depth restriction, which further restricts shallow habitats important for spawning, early life-stages, and feeding for many of these species. Sampling protocols and adaptive management will be used to further protect known populations or their habitat.	• Minor adverse effects to State- and Federally-listed aquatic species. • Formal consultation with regulatory agencies would likely mitigate any significant adverse impacts.

Table 4-9. Summary of Environmental and Socioeconomic Effects

Resource Areas	Alternatives			
	Alternative 1 **No Action**	**Alternative 2** **River Dredging with Current Permit Restrictions**	**Alternative 3** River Dredging with Adaptive Management	**Alternative 4** **Land-Based Quarries and Importation (assumes 50 quarries expand and/or 20 new quarries permitted)**
Threatened & Endangered Species: Aquatic Life (cont'd)		• In the long-term (20-25 years), potentially significant cumulative adverse effects to rare and state-listed mussel species may occur, when effects are combined with other past, present, and future anthropogenic activities. These impacts are primarily associated with dredging high quality habitat, currently not used by mussels.	• Royalties paid by the applicants will be used for habitat enhancement projects in the study area.	
Threatened & Endangered Species: Terrestrial Life	***Study Area Effects*** • No change in effects relative to current baseline conditions. ***Induced Regional Effects*** • No adverse effects to minor adverse effects to State- and Federally-listed terrestrial species due to increases in regional land-based quarry operations (see Alternative 4).	• No adverse effects to marginal adverse effects to terrestrial species are expected. No terrestrial Federally-listed species were identified by regulatory agencies in their correspondence letters. Searches of databases revealed 2 species that may be in or near the study area (Bald Eagle and Indiana bat). Furthermore, seven state-listed species were identified within the study area.	• In response to the Biological Assessment, the Service identified standard conditions that must be implemented to avoid impacting Bald Eagles.	• Minor adverse effects would be expected to State- and Federally-listed terrestrial species from habitat loss and noise if a listed species was in the vicinity of an active quarry. Federally-listed and candidate species that may be affected by land-based quarry operations include the Bald Eagle (threatened), Indiana bat (endangered) and the Massasauga rattlesnake (candidate). • Formal consultation with regulatory agencies would likely mitigate any significant adverse impacts. • Controversies related to quarries impacting listed terrestrial species were identified.

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	Alternative 1 **No Action**	**Alternative 2** **River Dredging with Current Permit Restrictions**	**Alternative 3** River Dredging with Adaptive Management	**Alternative 4** **Land-Based Quarries and Importation (assumes 50 quarries expand and/or 20 new quarries permitted)**
Air Quality	***Study Area Effects*** • No change in effects relative to current baseline conditions. ***Induced Regional Effects*** • Marginal adverse effects to air quality in the region, and localized adverse effects near quarries, due to increases in land-based quarry operations (see Alternative 4).	• No adverse effects to air quality from operation of dredging units. Emissions are extremely small compared to other regional sources.	• Same as those listed for Alternative 2.	• Marginal adverse effects to overall air quality within the region due to increases in regional truck traffic. • Localized adverse effects due to fugitive dust emissions from land-based quarries operations (including increased truck traffic, and crushing and sorting operations).
Noise	***Study Area Effects*** • No change in effects relative to current baseline conditions. ***Induced Regional Effects*** • Minor adverse effects from noise in localized areas within the region due to increases in land-based quarry operations (see Alternative 4).	• Minor-moderate short-term adverse effects will occur near dredging units. Adverse effects would be localized, with no long-term adverse effects. At certain locations, noise complaints have been made. Noise modeling and monitoring shows that bank noise levels may range from 50 to 70 db depending on site-specific conditions. These results indicate the potential for noise conflicts under certain site conditions.	• Minor adverse short-term effects will occur near dredging units. Noise abatement options include moving locations, reorienting dredging unit, limiting night-time operations, and enhancing sound-proofing through engineering controls, thereby avoiding significant adverse effects.	• Minor short-term adverse effects. Land-based quarry operations generate noise from blasting, earthmoving, crushing, and truck transport. Noise complaint issues have been raised against some land-based quarry operations in the region. Typically, these noise issues can be mitigated as they arise; thereby, avoiding persistent significant noise problems.

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	Alternative 1 **No Action**	**Alternative 2** **River Dredging with Current Permit Restrictions**	**Alternative 3** River Dredging with Adaptive Management	**Alternative 4** **Land-Based Quarries and Importation (assumes 50 quarries expand and/or 20 new quarries permitted)**
Socioeconomics (ROI and State Impacts)	• Minor adverse impacts to the economy of the Region of Influence (ROI) and State of Pennsylvania would be expected. • 400 Jobs would be lost in the ROI, 700 jobs in the entire State of Pennsylvania. • Economic output would be reduced by $40 million in the State, personal income loss by $10 million and total value added loss of $17 million. • Major increase in aggregate prices (up to 200 percent or more) borne primarily by government and taxpayer. • Increases in cost for highway construction and repaving projects. • Short-term immediate shortfalls in aggregate materials resulting in potential delays in certain economic development projects and public infrastructure projects that require large quantities of aggregates.	• No change in effects relative to current baseline conditions.	• Minor-moderate adverse effect relative to baseline conditions. The amount of future dredgeable area will be reduced by about 25% resulting in a decrease in the industry life cycle from 20-25 years to 10-15 years.	o Same as listed under Alternative 1.

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Socioeconomics (ROI and State Impacts) (Cont'd)	• Minor reduction in tax revenues • Elimination of royalty fees paid to PFBC (currently $1 million each year). • Possible closure of locks and dams, especially for Pools 5 and higher. • Reduction in the cost effectiveness of the lock and dam system in the upper pools.			
Quality of Life	***Study Area Effects*** • No change in effects on recreational fishing would be expected relative to current baseline conditions. • Minor beneficial effects on aesthetics (removal of dredging units), traffic (reduced near river terminals), recreational boating (removal of dredging units and reduced barge traffic), and safety (reduced truck traffic near terminals and reduced barge traffic) would be expected from cessation of river dredging within the study area. • Potential for long-term adverse effects on recreational boating in upper pools due to possible curtailment of lock usage	• Minor adverse effects on recreation due to dredging effects on fish and navigation. • No change in effects on traffic or safety relative to current baseline conditions.	• Same as those listed in Alternative 2.	• Minor to potentially moderate adverse effects to recreation, aesthetics, and traffic from increased land-based quarry operations relative to the quality of life in the region as a whole. Adverse effects may include: impairment of recreational sport fishing; landscape disturbance; increase in truck traffic. • Significant adverse effects to public safety as a result of trucking and land based quarry activities: ➢ Trucks will travel 12 million miles/year resulting in an increase in truck-related fatalities, accidents, and injuries. Mitigation to reduce traffic risks would include creation of new land-based quarries near producers in the Pittsburgh area.

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Quality of Life (Cont'd)	***Induced Regional Effects*** • Minor adverse effects on recreation, aesthetics, and traffic in localized areas due to increases in land-based quarry operations (see Alternative 4). • Significant adverse effects on public safety including increases in traffic fatalities and injuries, worker accidents, and trespasser accidents due to increases in land-based quarry operations (see Alternative 4).			➢ Expected increase in quarry work-related accidents and potential fatalities. ➢ Potential for fatal accidents or serious injuries resulting from children trespassing on quarry property (swimming/diving accidents, off-road vehicle accidents, falling rocks, bank failures, blasting debris). Mitigation would include requiring restoration of quarries to eliminate steep cliffs and lake formation.
Environmental Justice & Protection of Children	• No disproportionate effects to minority communities, low-income communities, or children. • Significant adverse effects to children safety as a result of increased land-based quarry operations, as documented by a number of trespassing accidents and fatalities within the region (see Alternative 4, Quality of Life).	• No disproportionate effects to minority communities, low-income communities, or children.	• Same as those listed in Alternative 2.	• No disproportionate effects to minority communities or low-income communities are expected from implementation of Alternative 3. Minor changes in regional economic indices should result in a measurable disproportionate effect to minority communities or low-income communities. • Significant adverse effects to children safety as a result of increased land-based quarry operations, as documented by a number of trespassing accidents and fatalities within the region (see Alternative 3, Quality of Life).

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	Alternative 1 **No Action**	**Alternative 2** **River Dredging with Current Permit Restrictions**	**Alternative 3** River Dredging with Adaptive Management	**Alternative 4** **Land-Based Quarries and Importation (assumes 50 quarries expand and/or 20 new quarries permitted)**
Cultural Resources	***Study Area Effects*** • No change in effects relative to current baseline conditions. ***Induced Regional Effects*** • Potential adverse effects to cultural resources in localized areas within the region due to increases in land-based quarry operations (see Alternative 4).	• No adverse effects to cultural resources would be expected. The Pennsylvania SHPO has stated that the proposed project will have no effect on any archaeological resources, and that no archaeological investigations are necessary in the project area.	• Same as those listed in Alternative 2.	• Potential adverse effects to cultural resources would be expected as new quarries are opened and existing quarries are expanded. Some quarry sites (particularly limestone quarries) have been known to contain prehistoric archaeological remains, burials, prehistoric quarry operations, stone tool-making locations, hunting blinds or villages, historic sites, and cemeteries. Significant adverse effects should be mitigated through performance of field studies and consultation with the SHPO.