SECTION 2.0:
ALTERNATIVES TO BE EXAMINED

In accordance with NEPA implementing regulations for USACE permitting actions (33 CFR Section 325.9b(5)) and guidance provided by the U.S. Environmental Protection Agency, this environmental document will evaluate four possible alternatives:

- Alternative 1: "no action", i.e. deny future permits, resulting in complete cessation of commercial river dredging within the study area.

- Alternative 2: "permit continued", extraction of sand and gravel from the rivers by dredging under existing permit conditions.

- Alternative 3: issue dredging permits using revised permit conditions and additional site-specific permit conditions formulated using an adaptive management process and mitigation.

- Alternative 4: using land-based operations within the region, importation of sand and gravel from other locations, and/or recycled materials to meet the need. This alternative includes an evaluation of secondary actions taken at regional land-based quarries producing sand and gravel products, as well as dredging on the Ohio River below river mile 40 beyond the Pennsylvania State line. A description of each alternative is presented below.

2.1 ALTERNATIVE 1: NO ACTION

Alternative 1 is the complete cessation of commercial river dredging within the study area following denial of permit requests, extensions, and expiration of existing permits held by the applicants. This alternative would essentially place a moratorium on future commercial dredging activities (other than for navigational purposes) on the entire navigable Allegheny River and between river miles 0 to 40 on the Ohio River. This alternative, which is considered the no action alternative, evaluates the effects of cessation of river dredging relative to baseline conditions (i.e., current conditions) within the study area.

Denial of permit requests will result in the immediate disruption of business operations and the inability of the applicants to satisfy the needs and contracts of customers who have routinely purchased sand and gravel materials from the applicants. Some of the applicants have limited integration of business markets (vertical integration potential) which may allow them to supply their own internal needs for sand and gravel material from privately held limited land-based operations. This may allow certain applicants with concrete or asphalt production capabilities to produce products from their own supply of sand and gravel. However, other secondary producers (i.e., concrete and asphalt production companies) throughout Pennsylvania, West Virginia, Maryland, and Ohio who currently purchase sand and gravel from the applicants, will be required to find other sources of material under this alternative. Alternative 4, discussed below, evaluates the effects associated with obtaining needed sand and gravel material from other sources within the region, such as land-based quarries.

2.2 ALTERNATIVE 2: CONTINUATION OF RIVER DREDGING UNDER CURRENT PERMIT CONDITIONS

Alternative 2 consists of obtaining sand and gravel from the Allegheny and Ohio rivers by a continuation of commercial dredging and the current permit conditions. Alternative 2 grants and extends DA Section 10 and Section 404 permits to commercial sand and gravel companies for the removal of sand and gravel between river miles 0 - 69.5 on the Allegheny River and between river miles 0 - 40 on the Ohio River (see Figure 1-1 for a map of the study area and Appendix A for detailed maps). The companies seek extension of their existing permits from USACE.

2.2.1 Current Permitting Process and Permit Conditions

Under Alternative 2, the applicants would conduct dredging activities in accordance with the current permitting process and permit conditions established by the permitting agencies (USACE, PADEP), as discussed below. The permit conditions include requirements that apply to all activities within the study area (referred to as universal permit conditions).

Figure 2-1 summarizes the current permitting process regarding commercial dredging. A dredging company must obtain a 404 certification from the USACE as well as a permit from the PADEP in order to dredge a particular location within the Pittsburgh District. The company applies to the PADEP requesting consent to dredge specific areas designated in tenths of a mile (500 linear feet) and in relation to the right or left bank of the river. Much of the river system except Pool 6 is theoretically available for dredging, given several permit restrictions as indicated below. PADEP placed a moratorium on dredging in Pool 6 in the early 1980s and that moratorium is still applied. In addition, dredging is not currently authorized in Pools 2, 9, and Emsworth on the Allegheny, and Emsworth and Dashields on the Ohio. Fairly heavy navigation traffic occurs around metropolitan Pittsburgh on Montgomery, Dashields and Emsworth pools on the Ohio River and Emsworth, 2, 3, and 4 pools on the Allegheny River. Dredging has not been allowed by PADEP in Pool 9 since the 1980 EIS was completed, because of concerns regarding the proximity of this pool to the upper free-flowing Allegheny River and the fauna there.

Currently, each applicant receives a Section 404 and Section 105 permit for broad reaches of the river. The applicants then determine what specific areas they desire for dredging and contract with a reputable mussel survey consultant, at the applicants expense, to conduct a mussel survey. The areas are typically less than one river mile in length. The mussel survey protocol indicates how mussels are to be sampled and under what river conditions, and how the data obtained from the survey is analyzed and interpreted. Decision criteria are included in the protocol, which explicitly indicates, based on the number of mussels and species collected during the survey, whether a location can be authorized for dredging. The mussel survey protocol has evolved substantially over the past 20 years as more information is obtained. The most recent PADEP/USACE protocol (September 2002) is based on the technical advice of a number of national experts in native mussel ecology and sampling, as

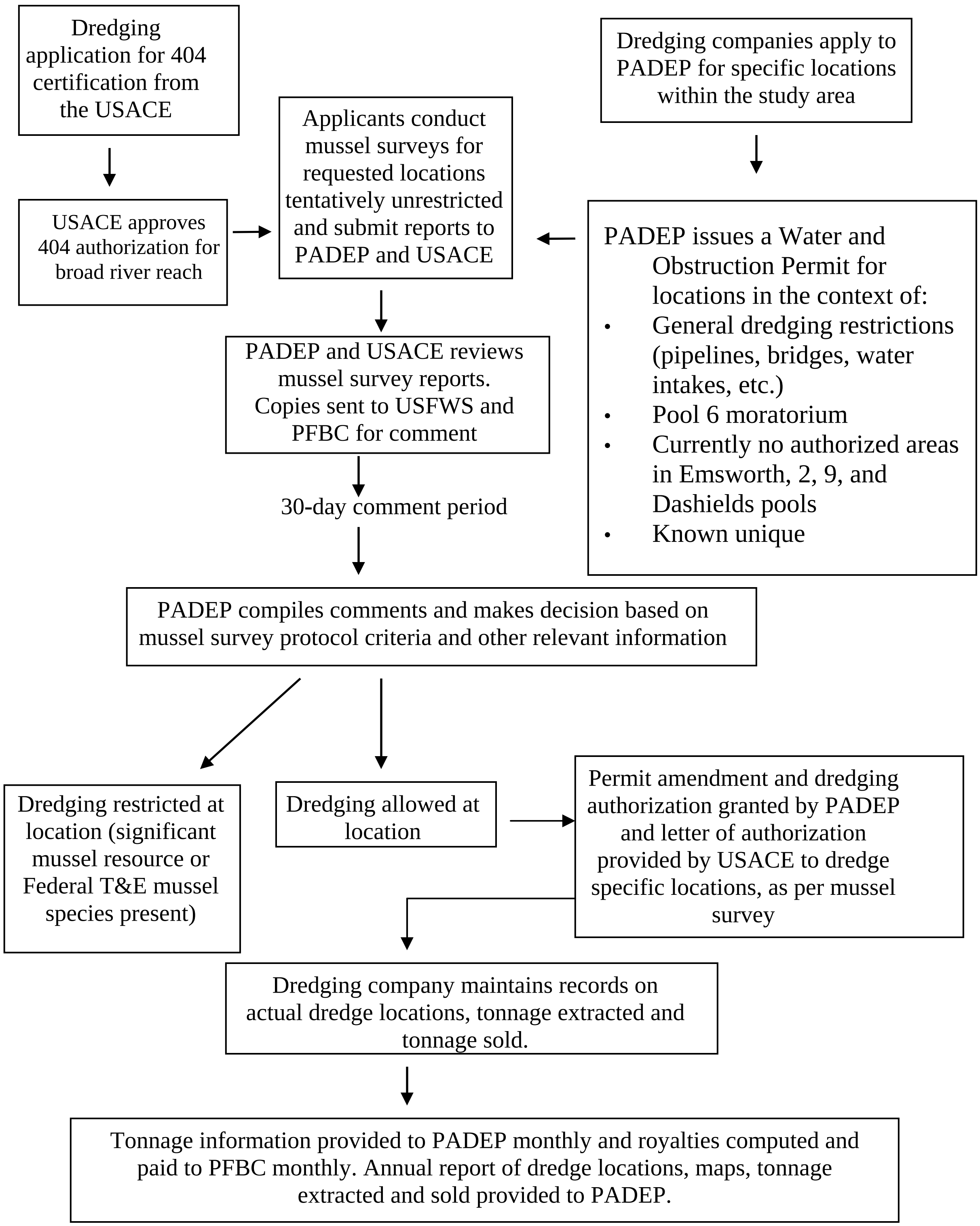


Figure 2-1. Summary of current permitting process for commercial sand and gravel dredging in the Pittsburgh District, USACE.

well as information collected during this EIS. By letters dated May 3, 2004, the three dredging companies were notified that the PADEP/USACE protocol (September 2002) should be utilized in all areas except Pool 8 of the Allegheny River, and in that pool and above the latest version of the Ohio River protocol should be implemented for conducting mussel surveys, pending completion of the consultation process with the U. S. Fish and Wildlife Service. Results of mussel surveys are submitted to PADEP and USACE for review. Copies of each survey report are provided to Pennsylvania Fish and Boat Commission (PFBC, Bellefonte, PA office), and to U.S. Fish and Wildlife Service (USFWS, State College, PA office), for review with a 30-day comment period. Based on comments received, PADEP and the USACE make a decision to either: (1) allow dredging to proceed (authorized) or (2) deny dredging in the area.

Once a specific location has been approved for dredging by PADEP, a dredging company obtains a revised "Attachment" to the Water Obstruction and Encroachment Permit (via a permit amendment) from PADEP that specifies the "authorized areas" in spreadsheet form. The USACE provides a letter stating that it approves commercial dredging in that area. Dredging companies are required to keep accurate daily records of the tonnage of material excavated and sold, as well as the spatial boundaries of the dredged area (river mile location, river gage, distances left and right to 6 feet depth contour, location on a map, and water depth at start and end of dredging). Buoys or other markers are required to mark the 6 foot river depth contour in the area and a laser rangefinder or other device is required to maintain the proper set-backs (see below). Annually, these records and maps of dredge locations are submitted to PADEP. Monthly, the applicants also compute the tons extracted, tons sold, compute the royalty and pay the royalty to the PFBC.

As noted above, dredging permits identify several permit conditions under which the applicants must operate at any location. A summary of these general permit conditions is presented below:

- *Islands and Shores.* No dredging is allowed within 150' of the 6' river depth contours, as measured at normal pool water elevation, or closer to the 6' river depth contour than twice the dredging depth (on average, this represents a 225' off-set from all shorelines). Buoys marking the 6' contour must be placed in the field adjacent to the dredging operation. No dredging is allowed on the backchannel side of any island, or within 1000' upstream and 300' downstream of any island.

- *Dams.* No dredging is allowed within 1000' of the upstream or downstream face of any navigable dam or lock.

- *Bridges and Piers.* No dredging is allowed within 500' of any bridge, pier, or abutment.

- *Navigation Channels.* No dredging is allowed within 150' of the centerline of the navigable channel unless authorized by USACE. There will be no unreasonable interference with the free discharge of the river or stream or navigation during dredging. If it is determined that water obstruction or encroachment causes unreasonable obstruction to the free passage of floodwaters or navigation, the licensee, upon notification, will remove or alter the water obstruction or encroachment at their own expense.

- *Public Water Supply Intakes.* No dredging is allowed within 1000' upstream, downstream, or laterally of any public water supply intake. Permitting agencies may impose additional set-backs from public water supply intakes, if in the opinion of the permitting agency, it is necessary to protect the intake from impacts created by the nearby dredging operation. PADEP further reserves the right to establish a setback laterally or upstream of any industrial, commercial, or public surface water intake.

- *Public Water Supply Well.* No dredging within the capture zone of any public water supply well or well field is allowed.

- *Underwater Structures.* No dredging within 300' of submerged pipelines and/or submarine cables, and within 300' of active commercial or industrial docks, or public launching areas.

- *Water Quality*. Weekly or bi-weekly sampling and analysis for total suspended solids, as per PADEP Water Quality Management Permits will be conducted. For on-board processing, USACE and PADEP require that discharge be delivered through a deep-water diffuser and conveyed to the dredge trench. Cranes must be positioned downstream and the wastewater diffuser positioned upstream. PADEP requires total suspended solids (TSS) water sampling at the river surface, at one-half the river depth and one foot from the bottom, at 100' upstream of the dredge; at 100', 500' and 1000' downstream of the dredge (at the same depths) and directly behind the dredge; and at 100' to the right and left (at the same depths), resulting in 30 water samples per sampling event (these locations may vary slightly for individual site-specific permits). PADEP requires that total suspended solids (TSS) levels at any sampling point 1000' downstream of the dredging unit cannot exceed 25 mg/l above TSS levels measured 100' upstream of the dredging unit. Bilge, ballast, or wash water pumped from barges will not be discharged into the river without removal of oil or toxic compounds. No refuse, sludge, oils, or petroleum products shall be discharged to the river. Use of non-toxic flocculants is required by PADEP for dredges with on-board processing.

X *River Bottom Substrate.* PADEP requires that all construction debris and excavated refuse incidental to the activity shall be removed from the stream and placed on shore above water influence, or at such dumping grounds as may be approved by PADEP (excluding incidental fall back). As specified by PADEP, dredged rock material that is larger than that which Licensee’s equipment can process may be returned to the river at the bottom of the trench from which it was dredged. Additionally, to preserve habitat, a minimum of five feet of sand and gravel substrate must be preserved on the bottom of all dredge holes, above any limiting rock layers.

- *Threatened and Endangered Species and Habitat.* All dredging must cease and regulatory authorities notified, if fauna or flora on the Federal or State registers of listed species, or habitat critical to their survival are encountered. In accordance with the

Endangered Species Act (ESA), formal consultation with the USFWS will be required if dredging activities have the potential to harm either Federally-listed species or critical habitat.

- *Mussel Beds.* Prior to issuing site-specific permit authorization for dredging, the applicants must conduct mussel surveys in accordance with the approved mussel sampling protocol developed and maintained by PADEP and USACE. Dredging will be prohibited (e.g., will not be authorized) if Federally listed mussel species and/or significant mussel resources are found, based on the decision criteria established in the mussel sampling protocol. If Federally listed mussel species and/or significant mussel resources are found, appropriate buffer restrictions are placed around the mussel resource. If Federally listed mussel species and/or significant mussel resources are not found, the dredging company obtains a revised "Attachment" to the Water Obstruction and Encroachment Permit (via a permit amendment) from PADEP that specifies the "authorized areas" in spreadsheet form. The USACE will provide a letter stating that the USACE approves commercial dredging in that area. It must be noted that the USFWS has not defined critical habitat and that significant mussel resources are not defined in Federal regulations. Such areas are considered for Federal protection under the Fish and Wildlife Coordination Act, but are not afforded the same protection provided under the ESA.

- *Cultural Resources.* All dredging must cease and the Pennsylvania Bureau for Historic Preservation must be notified in the event that previously unidentified historical or archaeological sites are encountered.

2.2.2 Remaining Mineable Reserves under Alternative 2

Using the current permit conditions discussed above, a Geographic Information System (GIS) analysis was conducted to identify areas to consider for future site-specific dredging permits under Alternative 2. The first step in this analysis was to identify areas where dredging was restricted based on currently available resource data. Next, permit restriction data and bathymetry data collected by resource agencies and the applicants were compiled to estimate the volume of mineable sand and gravel in each pool. The mineable reserves estimate for each pool was then used to estimate the potential life cycle of the industry.

The theoretical maximum tonnage of sand and gravel material in all pools of the Allegheny and Ohio rivers is 200 million (assuming a uniform depth of dredging to 50 feet and excluding areas with known permit restrictions) (see Table 2-1). Historical dredging information (e.g., probability that any given area may produce needed material, probability that an applicant may obtain a permit for a particular area) and further GIS analyses were evaluated to estimate the tonnage of material that may be recovered given the application of site-specific permit conditions, and PADEP policies previously discussed. Based on this analysis it was determined that only 16 to 22 percent of the river bottom within the study area might be available for dredging permits in the future, ultimately yielding 88 to 118 million tons of sand and gravel. It should be noted that nearly all dredging takes place in areas that were previously dredged in the past. There are very few, if any, virgin areas left within

Table 2-1
Mineable Reserves Under Current Permit Conditions (Alternative 2)

Pool	Total Acres in Pool (acres)	Total Sand and Gravel in Place (mtons)[1]	Total Mineable Reserves (mtons)[2]	River bottom with Mineable Reserves (%)[3]
Ohio New Cumberland	1,226.4	24	13.6 to 18.2	28 to 38
Ohio Montgomery	2,804.9	60	33.9 to 45.20	31 to 41
Ohio Dashields	1,198.2	17	9.3 to 12.4	209 to 26
Ohio Emsworth	1,117.0	16	0	0
Allegheny Emsworth	727.3	6	0	0
Allegheny Pool #2	1,067.1	13	7.1 to 9.4	17 to 23
Allegheny Pool #3	1,169.6	16	9.2 to 12.3	20 to 27
Allegheny Pool #4	708.8	9	5.2 to 7.0	19 to 25
Allegheny Pool #5	617.4	3	1.3 to 1.7	6 to 8
Allegheny Pool #6	1,136.2	7	0	0
Allegheny Pool #7	742.1	7	3.8 to 5	20 to 26
Allegheny Pool #8	936.5	13	4.9 to 6.5	14 to 18
Allegheny Pool #9	707.8	9	0	0
Total	14,159.4	200	88 to 118	16 to 22

1 Million tons (mtons) of sand and gravel material in place to a depth of 50' excluding areas with known permit restrictions (e.g., 150' from the 6' depth contour; offsets from dams, bridges and piers, potable water intakes, underwater structures, known mussel beds and buffer areas). Tonnage based on volumetric calculation of material from current river bottom depths down to a uniform depth of 50'.

2 Million tons of mineable resources based on physical/operating limitations and additional permit restrictions (including permit conditions noted in footnote 1). Physical and operating limitations include: poor quality material, hitting hardpan, poor dredging yields (e.g., thin and/or inconsistent layer of material in deep water or previously dredged out areas), aesthetic/noise restrictions near urban areas, and navigation restrictions. Additional permit restrictions may include: noise issues near residential areas, significant mussel resources discovered, threatened or endangered species discovered (including extended buffer areas), and State-listed fish species present.

3 Percent of total river bottom with mineable reserves below. Analysis was based on a volumetric calculation of the average tonnage found below an acre of river bottom across for each pool. On average, dredging 26 acres would yield 1 mtons of sand and gravel.

unrestricted areas of the river under current permit restrictions. Therefore, the majority of current dredging occurs in previously disturbed areas.

Given current permit conditions, production rates and estimated mineable reserves, commercial dredging could conceivably continue over the next 20 to 25 years. Over the next 10 years, it is estimated that dredging would disturb approximately 8 percent of the river bottom. In any one-year commercial sand and gravel dredging would occur over a much smaller area of less than 0.3 to 3 percent of the river bottom annually (on average, approximately 100 acres or 0.8 percent of the river bottom, annually).

2.2.3 Dredging Techniques

The basic technology for extracting and processing sand and gravel material in the Study Area (and further downstream on the Ohio River) has changed little over the past several decades. Dredging units utilize either a bucket-type conveyer system (ladder bucket) or clamshell-type dredgers to extract sand and gravel from the river bottom. At this time, dredging units can feasibly dredge to a depth of 50-60 feet from the water surface. Other types of river mineral extraction equipment, such as some large hydraulically-driven dredges can feasibly mine to a depth of 75 feet (Meador and Layher, 1998). The equipment now in use by the dredging companies produces products that meet specifications for the particular uses intended for the sand and gravel. The equipment varies in age and condition but, in general, produces the required product quality for the market the companies are serving. The nature of the raw material requires that the processing equipment be subject to relatively frequent renovation. Thus, in order for a dredge to continue efficient production, the mechanical equipment must be relatively new even though the basic hull and tankage of the dredge may be as old as 50 years. No change in the two basic methods of withdrawal (i.e., bucket-type or clamshell-type) of the river bottom material is anticipated by any of the permit holders. Descriptions of the dredging units and basic dredging techniques are summarized below.

Hoist Boats No. 4, No. 6 and No. 7 (Hanson). Hoist Boat 6 typically operates in Pool 7, Hoist Boat 7 typically operates in Pool 3, 4 or 5, of the Allegheny River, and Hoist Boat 4 is a spare that may operate in any of the pools listed. These hoist boats are very similar in nature. All are clamshell type dredges without any on-board processing. They contain diesel generators producing electricity to power the dredging and hoisting operation, along with normal electrical lighting, receptacles, heat, etc. They contain no self-propulsion systems, and are moved by the use of towboats. They anchor themselves into the river bottom by use of spuds. As with the other clamshell dredges, maximum dredging depth is approximately 50 feet.

Hoist Boat 6 produces approximately 300,000 to 350,000 tons of material per year while Hoist Boat 7 produces approximately 650,000 to 750,000 tons of material per year, based on market demand and weather conditions. Hoist Boat 4 has served as an extra hoist boat in the past during periods when Hoist Boats 6 or 7 were shut down for maintenance. The hoist boats do not utilize water from the river and do not discharge any water to the river.

However, water quality is monitored under existing Water Quality Management Permits issued by PADEP.

Unsized and unprocessed material is taken from the river bottom and placed directly into a barge tied along side of the hoist boat. A towboat then transfers the barge to a land based processing plant. In Pool 3, the land based processing plant is the Lower Burrell Plant (at river mile 18, City of Lower Burrell, Westmoreland County). In Pool 7, the plant is the Tarrtown Plant (at M.P. 49.3, East Franklin Township, Armstrong County). Final processed material is distributed from the two land plants either by truck or barge, depending upon the location and needs of the customers.

Thaddus Carr (Hanson). The Thaddus Carr is a three-story dredge and processing plant used for removing high quality sand and gravel from the bed of the Ohio River. The Thaddus Carr dredge operates by extracting raw material from the riverbed using a clamshell bucket and placing it on-board, where it is sorted into various sizes and types of construction aggregate. The processed material is conveyed to barges tied alongside the Thaddus Carr, and is then transported to dockside customers. Maximum dredging depth is approximately 50 feet below the water surface.

The Thaddus Carr is a 245 ft x 54 ft, 7-ft draft, all steel, diesel powered vessel which moves among dredge sites assisted by a towboat. It has no self-propulsion system and is moved by the use of towboats. The clamshell dredge has a 6-yd^3 capacity. The clamshell bucket is lowered to the streambed, where it grabs bed materials upon closing. The bucket is then raised and is released into an input hopper on the deck of the dredge. A grizzly screen removes oversized material. The screened large rocks are returned to the river while metal and certain woody debris are retained on board for later transport to land disposal sites. Gravel which passes through the grizzly screen is crushed and separated into various sizes and is moved to waiting barges. Smaller material reports to a classification system which is used to make various grades of natural sand. The Thaddus Carr dredge uses computerized aggregate classification technology and an on-board laboratory for strict quality control of the sand and gravel products.

The Thaddus Carr has several features that Hanson uses to decrease any possible negative effects on water quality. The dredge is equipped with a deep-water diffuser for discharge of process water directly into the excavation trench. The dredge is initially anchored so that the clamshell end is downstream and the deep-water diffuser is upstream to assure that wastewater is diffused in the direction of excavation. Thus, as the dredge works the area from downstream to upstream, fine sediments are replaced into the deeper dredged area and turbidity downstream is minimized. This initial position is not changed until sufficient excavation has developed a trench to contain the deep diffused wastewater. The deep-water diffuser is equipped with a flocculent system to rapidly settle solids in the river. The flocculent used is non-toxic and has been approved for this use under NPDES discharge permits in Pennsylvania.

Big Elmer (Glacial Sand & Gravel). Big Elmer is a large diesel-powered clamshell dredge equipped with a 7-yd^3 bucket. This dredge currently works in Allegheny River Pools 7 and 8 as weather conditions permit in order to satisfy market demand. Approximately 3,000 tons of material per day are removed by Big Elmer, transported by barge to Glacial's Bridgeburg plant, and processed for distribution. An average of two barges per day are filled by Big Elmer.

As with other clamshell dredges, Big Elmer removes bottom material and places it in barges without any sizing or washing. The clamshell dredge is mounted on a non-powered spud barge and towboats must move it from site to site. Bottom material is dug 20 to 60 ft below the water level.

The Bridgeburg plant processes all material mined by Big Elmer. Large (over 5-in) rocks are screened initially and broken by a hydraulic ram. Usable gravel is screened and crushed to appropriate marketable sizes and loaded into trucks for transport and/or stockpiling. At this plant, particular attention is devoted to controlling wastewater turbidity, conserving dredged materials, and eliminating disposal of any dredged or washwater wastes from material washing. The used washwater is pumped uphill into a series of settling basins and allowed to stand until particles of fine sand and silt settle out. The uppermost, or overflow, layer of water is either pumped back to the plant for reuse, as in the case of the ten-acre pond, or pumped back to the secondary settling pond for further silt removal, as in the case of the two five-acre ponds, and subsequently recycled to the plant for reuse. River water is used for make-up water. No wastewater or solids from the dredging process are returned to the river. About 4,000-gallons per minute (gpm) of water are pumped from the river for nine hours per week to keep the ponds full. About 3,800-gpm of pond water are used in washing the dredged material. As the settling ponds fill with sediment, their use is discontinued and new ponds are established and used. At least one ten-acre pond has been filled and abandoned at the Bridgeburg facility.

Hoist Boat 'Lima 2400' and Hoist Boat 'Conan' (Under Contract with Tri-State River Products, Inc.). Both of the Hoist Boats Lima 2400 and Conan are owned and operated by C & C Marine Maintenance Company, under contract with and operating under permits held by Tri-State River Products. Typically, the Lima 2400 is in operation and the Conan is utilized as a spare. This operation dredges in the New Cumberland Pool and Montgomery Pool of the Ohio River. Typical dredging depth is up to 50 to 60 feet.

Both hoist boats are clamshell dredges, without any self-propulsion. As with other hoist boats, they do not contain any onboard processing. The hoist boats do not utilize water from the river and do not discharge any water to the river. Unsized and unprocessed material is taken from the river bottom and placed directly into a barge tied alongside of the hoist boat. A towboat then transfers the barge to a land based processing plant. In the New Cumberland Pool, the land based processing plant is the Georgetown Sand and Gravel Plant, located at river mile 39.5, Greene Township, Beaver County.

William L. Price Dredge #16 (Tri-State River Products, Inc.). The William L. Price #16 Dredge (WLP #16) is a continuous bucket ladder dredge with a maximum digging rate of 660 tons per hour and an estimated average production rate of 500 tons per hour. These capacities will increase by up to 20% with the installation of the new jaw crusher system discussed later. The dredging buckets are 7 cubic foot capacity cast austenitic manganese steel, weighing 1400 pounds each. The bucket elevator is at a 56° angle with 49-foot vertical centers, 7 cubic foot capacity, and 100 hp adjustable speed. WLP #16 can dig to a depth of 60 feet with a continuous bucket elevator. The WLP #16 operates only in the Ohio River (Montgomery and New Cumberland pools).

WLP #16 can load four 500-ton deck barges or three 1500-ton jumbo barges or a combination of up to four deck barges/jumbo barges. It can separate the deposit into size components and re-blend back together in controlled proportions. Normal sizes of aggregate to be loaded simultaneously as finished product include: 1-1/2 to 3/8 inch gravel, 3/4 to 3/8 inch gravel, 3/8 to 1/8 inch "shot" gravel, and minus 3/8 inch sand (concrete/asphalt). Special products include: 2-1/2 to 1 inch gravel, minus 1/8 inch sand (masonry), and 3 to 1-1/2 inch gravel (US Engineers).

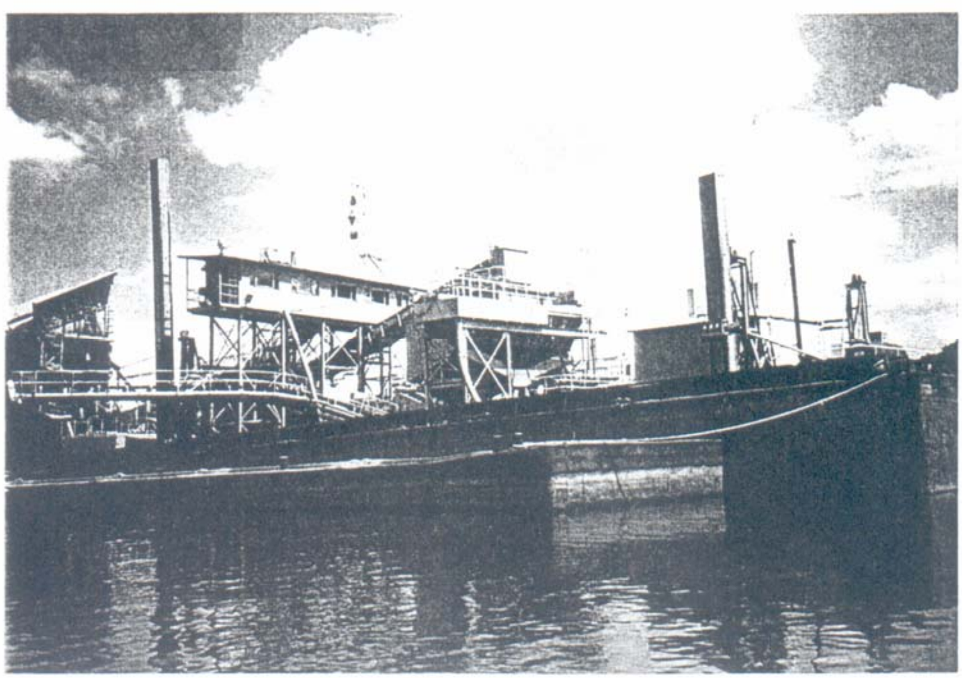
Grizzly screens scalp off deposit at 5-inch square size, processing the minus 5-inch material. The scalping size will be increased to 10 inch with the addition of the new jaw crusher. A heavy media (magnetite) system is used to further beneficiate the coarse aggregate by removing unwanted coal, lignite and wood present in the deposit. A grizzly screen provides separation and waste of 5" plus material; this will be modified to 10" with the installation of the jaw crusher. Triple deck roughing screens provide initial separation of material into specific sizes. Double deck sand screens separate sand (minus 3/8") from "shot" gravel and #8 gravel. The triple deck crushed gravel screens separate crushed gravel coming from the cone crusher into specific sizes. Triple deck screens allow for the final washing of the gravel prior to load-out into barges.

A Nordberg HP200 gyratory cone crusher handles the crushing of material in the deposit that is between 5" and 1-1/2". The finish size of the crushed material is 1". A Gator 1251 jaw crusher will be installed to handle the primary crushing of feed between 10" and 3 ½". Material from this crusher will feed into the Nordberg cone crusher. This will allow the Nordberg cone crusher to more efficiently crush material and will allow the processable feed size to increase to 10 inches.

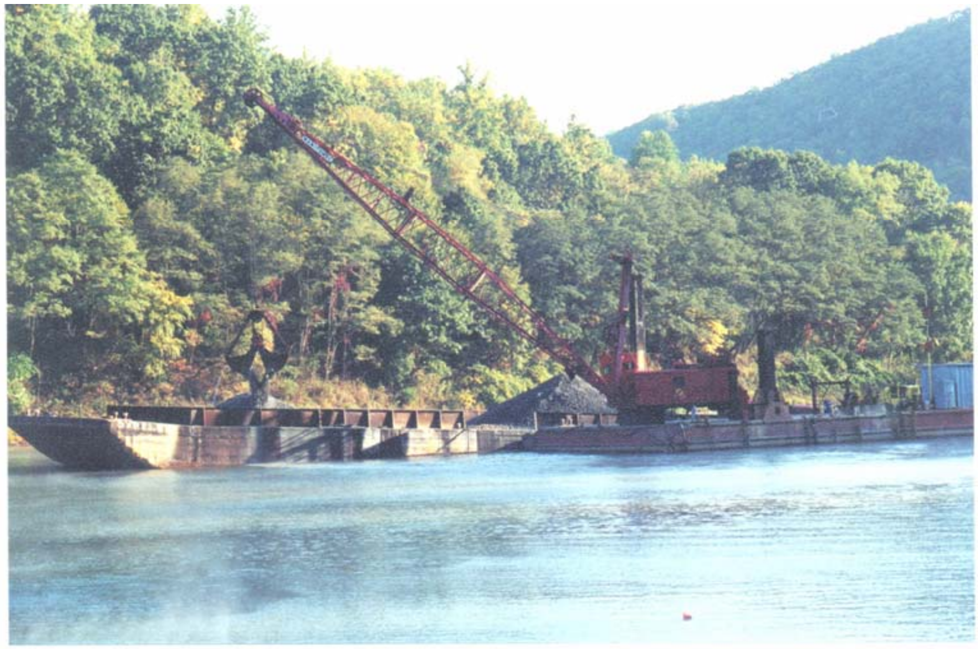
The dredge handles the crushed gravel separately until the final load-out screens to allow the controlled blending of crushed and natural sizes of gravel. Additionally, all gravel larger than "shot" gravel passes through the heavy media system for floating out light coal, lignite, porous gravel, wood, etc. This system is unique to river dredges in this part of the country. The magnetite is recycled through the use of an electro-magnetic separation system, which effectively removes the magnetite particles from the wash water and reintroduces the magnetite into the HMS system.

Sand is processed and sized using a classifying tank, dewatering screws, a variable speed slurry pump and a series of cyclone classifiers. The sized particles are control-fed into dewatering screws for load-out into the waiting barge. The slurry pump and cyclone classifiers allow for the removal of additional fine particles (generally less than 30 mesh and greater than 150 mesh) from the process water and from the classifying tank overflow. A

Hanson Aggregates Co. Hoist Boat Dredge



Hanson Aggregates Co. “Thaddus Carr” Dredge



Glacial Sand and Gravel Co. “Big Elmer” clamshell dredge.

Tri State Co. William L. Price Dredge #16 flume diffuser is located at the stern of the dredge to deposit slurry water at the bottom of the river to minimize the turbulent effects in the natural water flow.

There are four vertical turbine water pumps taking up to 4000 gallons/minute from the on-board sea wells. This water is used for washing and transmission of material. Warping engines allow the load-out men to move the barges being loaded independently of one another through the use of cables. Additionally, there are two vertical capstans used to assist when necessary in barge handling.

2.3 ALTERNATIVE 3: DREDGING WITH ADDITIONAL RESTRICTIONS

Under this alternative, the basic dredging equipment available is assumed to be the same as that evaluated under Alternative 2. Currently required permit conditions are also still in effect and are clarified under Alternative 3. However, several additional site-specific restrictions are evaluated under this alternative including:

- ***Limiting dredging to certain areas.*** Through consultation with the USFWS regarding the protection of federally endangered mussel species, it may be determined that dredging needs to be restricted in portions and/or entire pools of the Allegheny River.
- ***Additional site-specific analyses or surveys prior to dredging.*** Through consultation with USFWS regarding the protection of endangered mussel species and/or sensitive habitat, it may be necessary to develop enhanced protocols and/or site-specific analyses to ensure protection of listed species through an adaptive management process.
- ***Altering the bathymetry or configuration of dredged areas.*** As discussed further in Section 4, altering the 3 dimensional configuration of a dredged area can significantly change the flushing rate and circulation within the hole, thereby, altering the dissolved oxygen (DO) levels. Due to the nature of the permitting process, dredged areas can resemble deep isolated pockets with abrupt changes in river bottom contours that can reduce flushing rates within the hole. As a result of added cumulative effects (e.g., nearby thermal discharges, drought conditions, or other site-specific conditions), future dredging may create additional holes that experience periodic levels of DO below state standards. In areas where deep isolated pockets already exist, approving additional dredging in these areas may increase the size of the dredged hole (i.e., creating a channel, rather than isolated deep pockets), thereby increasing flushing rates and DO levels. In addition, modifying the slope of the dredged hole can also enhance flushing.
- ***Restricting dredging in certain habitat conditions.*** Through an interagency adaptive management process, it may be appropriate to restrict dredging in certain habitats deemed important to the propagation of aquatic life and/or conservation of listed species, although these habitats have not yet been defined.
- ***Restricting initial dredging to certain minimum depths.*** Restricting initial dredging in shallow areas (e.g., less than 9 feet deep) at the point of excavation, may conserve habitat important for certain aquatic life.

- ***Additional measures to mitigate noise conflicts/complaints.*** Under certain conditions, noise levels from dredging units may cause conflicts with nearby land use, particularly in cases where sensitive dwellings (e.g., residents, schools, churches, medical facilities, nursing homes) are in close proximity to the river. Noise monitoring at nearby residential homes and/or other dwellings may be necessary to ensure that excessive noise levels do not occur. In the event of noise complaints, several site-specific mitigation measures can be applied including: moving the dredging unit, reorienting the dredging unit so that the "quieter side" is facing the sensitive area, limiting night-time operations, enhanced dredge sound proofing and engineering controls, and/or noise monitoring.
- ***Additional compensatory mitigation and/or restoration measures.*** Dependent on individual and cumulative project impacts, mitigation and/or restoration measures may be required to minimize or offset adverse environmental impacts. Such measures may be designed and developed through the adaptive management process and include such things as channel restoration, embayments, riparian improvements, wetland creation, etc.

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 scientifically supported restrictions as needed to avoid or minimize potential impacts in a given location requested for dredging. The process for requiring such additional restrictions, and the particular restrictions applied, are assumed to be dynamic over time: as more monitoring information is obtained, changes in restrictions or permit conditions could evolve as necessary to avoid or minimize potential impacts. Conversely, if it is determined that existing restrictions are not scientifically supported, such conditions could and should be removed. Under the adaptive management process, for conditions to be acceptable they must balance the overall benefits against the reasonably foreseeable detriments.

It is noted that the adaptive management conditions can be established and would become effective with the issuance of new Department of the Army Permits. Compliance with the new and revised conditions would require adjustments to the dredgers' operational standards and methodologies. This would include adjusted mussel survey requirements. Since mussel surveys are subject to seasonal and flow restrictions, it is likely that new surveys would take 3-6 months to be completed. This could result in the loss of a dredging season, which would be a significant adverse impact on the industry. USACE believes it is reasonable to allow continued dredging operations in certain previously surveyed areas for a limited time period to allow for implementation of the new survey requirements. All other conditions identified in Alternative 3 and through the adaptive management process would still be required within these areas. Specific permit areas where dredging could continue under the previous surveys, or with minimal supplemental data would be established through the adaptive management process in coordination with PADEP, USFWS and the PFBC.

A key aspect of this alternative is evaluation of both environmental and socioeconomic ramifications of a given additional restriction. This is critical because a restriction that effectively reduces an applicant's ability to compete is functionally equivalent to denial of the permit or Alternative 1. Extensive GIS analyses were used to estimate reserves based on different types of additional restrictions and thereby, evaluate the likely socioeconomic consequences. Based on current knowledge of the industry, commercial dredging generally extracts a certain tonnage of aggregate material each year to maintain a backlog of needed supply. Therefore, additional restrictions that decrease the reserves available for dredging will likely result in a decrease in the industry's life cycle as opposed to a decrease in production in the short-term; i.e., the industry may extract the tonnage per year they do currently but reserves will not last as long. Once reserves are depleted, dredging will not be viable in its current state and a situation similar to Alternative 1 will result. Under Alternative 3, the life cycle of the industry may be expected to last 10 to 15 years depending on how adaptive management is applied.

2.4 ALTERNATIVE 4: SOURCES OTHER THAN DREDGING IN THE STUDY AREA

This alternative evaluates the short-term and long-term, direct and indirect, effects associated with obtaining sand and gravel from land-based operations within the region, importation of sand and gravel from other locations, and recycled materials. Implicit in this alternative is the practicality of relying on sources other than dredging within the study area, and the degree to which these other sources can satisfy the demand for sand and gravel. It is important to recognize that the determination of sand and gravel sources in the region (or anywhere else) is market-driven; i.e., those sources that consistently provide the necessary volume of appropriate quality material at the least cost will have the majority of the market share. Because aggregate material such as sand and gravel is heavy and bulky, most of the cost is in transporting the material to the job site or distributor. Aggregate will reach the Pittsburgh region from a variety of sources if the price is worth the extraction and shipment costs.

Alternative 4 is effectively the result of selecting the No-Action alternative (Alternative 1). This alternative is not the Federal Action being evaluated but is rather an outcome of a decision regarding commercial dredging permits, and is not within the regulatory authority of the USACE to select or implement such an alternative. It is the market forces that occur as a result of denying or restricting permits under Alternatives 1 or 3, respectively, that will define what other sources, or blend of sources, will provide aggregate material to the Pittsburgh region. Therefore, this document does not analyze specific combinations of sources. Instead, we estimate the tonnage of various aggregate types produced by other existing sources and their approximate cost, and analyze the extent to which such sources could increase their production in the future.

In the short term, it was assumed that only existing sources of sand and gravel would be utilized to meet the shortfall in current river based production. There is a high degree of uncertainty associated with evaluating the direct and indirect effects of the secondary actions taken at existing land-based quarries. Since the quarries are operated by companies other than the applicants, it is difficult to predict specifically which quarries have the capability (i.e., sufficient resources, quality material, capital expenditures, and permitting ability) and/or desire to increase operations in order to meet the short fall in river-based production, or even how quarries will actually increase operations. Therefore, it is not possible to quantitatively evaluate environmental impacts associated with actions that existing land-based quarry companies may or may not take in the future.

In the long-term, it is likely that market forces would lead to the development of new land-based quarries within western Pennsylvania. It should be noted that there is an even higher degree of uncertainty and speculation associated with evaluating environmental impacts associated with permitting new quarries to mine glacial deposits within western Pennsylvania. Currently, there is difficulty in and public opposition to, obtaining new permits for land-based operations. It is not known to what extent new quarries may be able to offset production short falls in river-based production in the long-term. Therefore, impacts under long-term conditions (e.g., over the next 10 years) were evaluated qualitatively. To support this analysis, other areas of Pennsylvania that utilize land-based sources (rather than river-based sources) were evaluated.

In support of this document, a detailed study was conducted to identify existing alternative sources of sand and gravel materials within the mid-Atlantic region. Several factors were considered in the source analysis, including: type of material, quality of the material (including customer preferences), quantity of material produced, location of customers (i.e., particularly asphalt and concrete companies who purchase sand and gravel and produce other final products), location of sources, current production output, ability to increase production, product price, and transportation costs. Sources up to 400 miles from the Pittsburgh area were evaluated in the study, including sources from across Pennsylvania, New York, New Jersey, Maryland, West Virginia, Virginia, Ohio, and Kentucky. Both land-based sources and dredging sources were evaluated in the study, including dredging sources from as far south as Kentucky on the Ohio River and to the north along Lake Erie. An overview of key factors in the source analysis is presented below.

Type and Quality of Material. Materials produced by the applicants and utilized within the region were categorized into three types: high quality fine aggregate (i.e., Type A sand); SRL coarse aggregate with an "E" rating (referred to as SRL E aggregate); and other aggregate material. Descriptions of these materials are discussed in further detail in Section 3.2. One of the primary buyers for this material is PennDOT (and contractors performing PennDOT projects). PennDOT has published specification manuals for the types of material needed in road construction. The highest quality aggregate materials utilized in road construction are Type A sand and SRL E aggregates, the latter providing the highest rating for skid resistance. Because of their physical properties, glacial deposits of natural sand and gravel occurring in the beds of the Allegheny and Ohio Rivers are commercially valuable as they exceed the material specifications set by PennDOT. PennDOT published a bulletin (Bulletin 14), which lists aggregate producers demonstrating their capability (through laboratory testing) to produce material meeting the Department's specification requirements for the type listed (PennDOT, 2001). Bulletin 14 was used to identify alternative sources of material meeting the specifications set by PennDOT. According to PennDOT (Basso, personal communication, 1997), the main factors in selecting a supplier for a particular type of aggregate are proximity to the work site and volume of material available, which affects the purchase price, so long as the material meets the rigorous specifications established by

PennDOT.   However, economics does play a major role, especially with low unit value and high transportation value commodities such as sand and gravel. Within the multi-county area, where most of the river-based material is purchased, there are very few land-based operations. Therefore, the quantity of local material is reduced and the distance to obtain enough quantity of material is increased, thus increasing the delivered price (e.g., supply/ demand relationship and increased transportation costs).

Quantity of Material and Source Locations. Based on the results of an extensive statistical analysis and uncertainty modeling effort (discussed in detail in Section 4.1.9), it was possible to determine the number of quarries that would be necessary to make up for the short fall in production by the applicants. It was estimated that quarries within 200 miles in radius from the City of Pittsburgh (average distance traveled was approximately 80 miles one-way) may need to increase production operations and transport their material to the region in order to make up for the loss in SRL E aggregate currently produced through dredging operations. For Type A sand, the distance was estimated to be within 250 miles (average distance traveled was approximately 80 miles one-way), and for other lower quality aggregates within 50 miles (average distance traveled was approximately 30 miles one-way). Figures 2-2, 2-3, and 2-4 identify alternative sources of Type A sand, SRL E coarse aggregate, and other coarse aggregate material, within the region, as identified by PennDOT. As listed in PennDOT Bulletin 14, within the multi-county area (Allegheny, Armstrong, Beaver, Butler, Fayette, Washington and Westmoreland Counties) where most of the river-based material is purchased, there are only four land-based quarries producing SRL-E aggregate and four land-based quarries producing Type A sand. All the Type A sand that is produced is natural sand and gravel; no crushed stone meets the Type A sand specifications.

With respect to other dredging sources, a search was conducted to identify other sources of Type A sand and SRL E aggregate that may be imported into the Pittsburgh metropolitan area. Other sources were identified that may barge material to Erie, Pennsylvania (then trucked to Pittsburgh) or barge material to Pittsburgh from the lower portions of the Ohio River (as far away as Kentucky). A market analysis was performed to determine what types of aggregate products could be barged cost-effectively into Pittsburgh. Importation of dredged material will also be subject to similar environmental impacts as dredging within the study area.

Recycled aggregate materials were also evaluated as a potential substitute for 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.

Customer Locations. As previously discussed, the material currently produced by the applicants through dredging is shipped throughout Pennsylvania, Ohio, Maryland, and West

Virginia, with over 75 percent of the material shipped within 30 miles of the center of Pittsburgh. Figure 1-2 presents the aerial extent of usage of river-based sand and gravel products generated by the applicants. Maps depicting the aerial extent of usage by aggregate type are presented in Figures 2-5, 2-6, and 2-7 for Type A sand, SRL E aggregate, and other aggregate, respectively.

Transportation and Pricing. Once possible alternative sources were identified, a market analysis was conducted to determine the increased costs associated with transporting material within the region primarily served by the applicants. It was estimated that the increased production capacities of quarries within 50 miles of current customers would be saturated for all 3 types of materials. Beyond that distance only Type A sand or SRL E aggregate would be purchased from quarries. Quarries beyond 250 miles in radius from the Pittsburgh metropolitan area would not likely be affected by cessation of river dredging. Transportation distances and increased costs were estimated based on the results of the market analysis (as presented in Section 4.1.9).

2.5 METHODOLOGY FOR IDENTIFYING IMPACTS TO ENVIRONMENTAL RESOURCES

Several agencies and organizations collect environmental data in the study area, particularly pertaining to aquatic life and water quality in the Allegheny and Ohio Rivers. Much relevant data have been collected since the last EIS documents were prepared (USACE, 1980, 1981), however, with the exception of an interagency study conducted in the early 1990s (PFBC, 1997), few studies or programs specifically examined effects of commercial dredging operations. In order to adequately address potential dredging impacts on environmental resources, a phased approach was used. In the first phase, available data and information collected since 1981 were compiled, with the assistance of several agencies including USFWS, PFBC, and PADEP. Following data compilation, a Gap Analysis was conducted to determine where existing information was either limited or ambiguous. An ecological risk assessment framework (USEPA, 1998) was used to help: (1) identify management goals for the river system, (2) select appropriate indicators that express those management goals, and (3) determine the factors that should be characterized or measured in order to evaluate dredging impacts.

Results of initial data compilation, gap analysis, and the ecological risk assessment framework were presented in a report that was distributed to stakeholder agencies for review and comment (Tetra Tech, 1998; Exhibit A). Through this review process, additional sources of relevant data were identified and potential impacts were refined. In addition, this process identified several important data gaps, for which additional sampling and analyses were necessary. These included dredging impacts on: (1) macroinvertebrates, (2) dissolved oxygen, (3) native mussels, (4) sediment particle size, (5) bathymetry, (6) toxicity, and (7) noise. In addition, this phase of the EIS determined that it was necessary to examine several different types of dredged areas including: both older and more recently dredged areas, areas that used different dredging equipment (clamshell or ladder bucket), areas dredged in different navigation pools and in different parts of a pool (i.e., head-end, middle, tail-end), and areas dredged to different depths.

Recommended sampling and analyses for this EIS were described in a Phase 2 Sampling and Analysis Plan (Tetra Tech, 1998; Exhibit B) that included specific dredged locations for each type of analysis and field sampling and analysis methods. This document was distributed to stakeholder agencies for review. Table 2-2 summarizes locations sampled and the navigation pools in which sampling took place for each type of analysis. A total of 18 locations in four Ohio River pools and 36 locations in nine Allegheny River pools in the study area were sampled. Locations represented the range of dredged conditions present including extent of depth, and time since the area was dredged.

Several specific dredged locations were targeted in this Plan to evaluate potentially challenging situations such as: (a) sites known to be especially deep; (b) sites reported to be impaired in terms of water quality, biota, or both, or (c) sites located in areas that were believed to have relatively productive habitats, based on previously collected information.

The sampling described in Exhibit B was conducted during the summer and fall of 1998 and the results presented in a Phase 2 Report (Tetra Tech, 1999; Exhibit B) that was reviewed by stakeholder agencies. These results were used, along with other information, to evaluate potential impacts of Alternative 2 on aquatic resources in this document.

Follow-up discussions with stakeholder agencies resulted in additional sampling of both dredged and undredged transects in three different pools (see Table 2-3). Stakeholder agencies worked with the USACE to design the sampling project and select transect locations (see Exhibit C). Results of this sampling (conducted in October, 1999) were described in a report (Tetra Tech, 2000; Exhibit C) that was distributed for stakeholder agency review. Results of these additional analyses were also used to evaluate potential impacts of Alternative 2.

It was not possible to comprehensively address all data gaps or uncertainties that arose during preparation of this EIS, nor is such effort required under NEPA. However, through the phased approach just described, a reasonable effort was made to address some of the important data gaps and provide sufficient information upon which to compare alternatives. In addition to the studies presented in Exhibits A-C, other agencies conducted studies during this effort that provided useful information. These included: a PADEP dissolved oxygen study of several dredged locations in Pools 7 and 8 on the Allegheny River and Montgomery and New Cumberland pools on the Ohio River during the summer of 1999; a dissolved oxygen study of several locations in Pools 5-8 in the Allegheny River by McLaren Hart, Inc. in 1999; a hydrogeological study of the Springdale groundwater supplies conducted by Harding Lawson, Inc.; a hydrogeological study of the Templeton water supply conducted by Moody and Associates; a USFWS-U. S. Geological Service mussel survey in certain areas of Pool 8; PADEP mussel survey protocol comparisons in Pool 5 and subsequent refinements in mussel sampling methods that were used in later studies during preparation of this EIS; and mussel surveys contracted by the applicants in many locations within the study area. Results of these studies were also used in evaluating Alternatives 2 and 3 in this EIS.

The evaluation of environmental consequences of Alternative 4 did not involve new data collection or analyses. Instead, potential impacts of this alternative were evaluated based on available information in the region and in the literature.

Table 2-2. Summary of Phase 2 field activities, 1998.

River/Pool	River Mile	Dissolved Oxygen Profiles	Sediment Fill Characteristics	Sampling Site Bathymetry	Sediment Toxicity Testing	Ambient Water Toxicity Testing	Mussel Sampling	Benthic Macroinvertebrate Sampling	Noise Monitoring
Ohio River									
New Cumberland Pool	49.2	ŏ	ŏ					ŏ	
	44.4	ŏ	NS					NS	
	40.3	ŏ	ŏ					ŏ	
	37.1	ŏ	ŏ					ŏ	
	36.6	ŏ							
	34.3	ŏ	ŏ					ŏ	
	32.4	ŏ				ŏ			ŏ
	32.3	ŏ	ŏ		ŏ	ŏ		ŏ	
	32.25	ŏ			ŏ	ŏ			
	32.2			ŏ			ŏ		
Montgomery Pool	31.3	ŏ	ŏ					ŏ	
	28.1	ŏ	ŏ					ŏ	
	18.5	ŏ	ŏ					ŏ	
Dashields Pool	12.5	ŏ							
	10.8	ŏ							
	7.1	ŏ							
Emsworth Pool	6.0	ŏ							
	5.0	ŏ							
	2.9	ŏ							
	1.0	ŏ							

Table 2-2. Continued

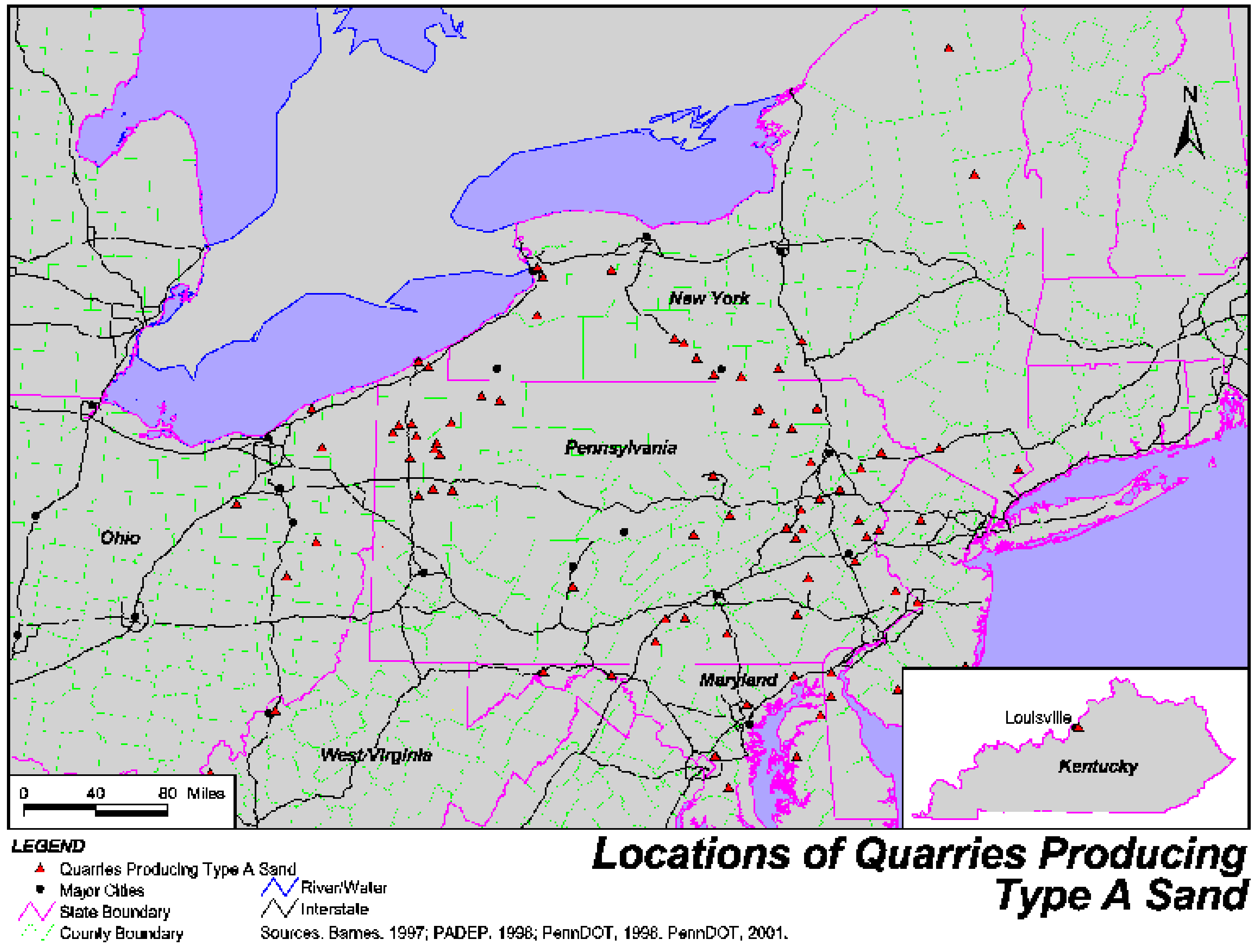
River/Pool	River Mile	Dissolved Oxygen Profiles	Sediment Fill Characteristics	Sampling Site Bathymetry	Sediment Toxicity Testing	Ambient Water Toxicity Testing	Mussel Sampling	Benthic Macroinvertebrate Sampling	Noise Monitoring
Allegheny River									
Emsworth Pool	0.8	ŏ							
	1.5	ŏ							
	3.2	ŏ							
Pool 2	9.5	ŏ							
	12.8	ŏ							
Pool 3	14.7	ŏ							
	17.0	ŏ							
	20.6	ŏ							
Pool 4	25.8	ŏ	ŏ	ŏ			ŏ	ŏ	
	27.4	ŏ	ŏ					ŏ	
	28.2	ŏ	ŏ					ŏ	
Pool 5	31.1	ŏ	ŏ					ŏ	
	31.7	ŏ				ŏ			
	31.8	ŏ			ŏ	ŏ			
	31.85	ŏ			ŏ	ŏ			ŏ
	32.2	ŏ	ŏ	ŏ			ŏ	ŏ	
	32.7	ŏ							
	34.6	ŏ	ŏ	ŏ			ŏ	ŏ	
Pool 6	36.5	ŏ	ŏ					ŏ	
	38.3	ŏ						ŏ	
	39.4						ŏ		
	40.4	ŏ	ŏ					ŏ	
	43.1						ŏ		

Table 2-2. Continued

River/Pool	River Mile	Dissolved Oxygen Profiles	Sediment Fill Characteristics	Sampling Site Bathymetry	Sediment Toxicity Testing	Ambient Water Toxicity Testing	Mussel Sampling	Benthic Macroinvertebrate Sampling	Noise Monitoring
Pool 7	47.3	ŏ							
	49.8	ŏ							
	51.5	ŏ							
Pool 8	53.7	ŏ	ŏ					ŏ	
	54.1	ŏ	ŏ					ŏ	
	54.2			ŏ			ŏ		
	55.2	ŏ	ŏ					ŏ	
	58.2	ŏ	NS					ŏ	
	58.55			ŏ			ŏ		
	58.6	ŏ	ŏ					ŏ	
Pool 9	62.4	ŏ							
	65.5	ŏ							
	66.8	ŏ							

Table 2-3. Location and description of transects sampled during additional Phase 2 field data collection. At each transect, native mussels, macroinvertebrates, dissolved oxygen, and sediment particle size were sampled.

Location	Description
Pool 4	
RM 26.3	150 feet downstream of old submerged pipeline (installed 1961)
RM 26.2	relatively undredged area approximately 400 feet downstream of the pipeline
RM 26.1	dredged area, approximately 600 feet downstream of the pipeline
Pool 7	
RM 47.2	150 feet downstream of old submerged pipeline (installed 1908)
RM 47.0	relatively undredged area approximately 900 feet downstream of the pipeline
RM 46.9	dredged area, approximately 1500 feet downstream of the pipeline
Pool 8	
RM 54.7	150 feet downstream of old submerged pipeline (installed 1899)
RM 54.7	relatively undredged area approximately 300 feet downstream of the pipeline
RM 54.3	dredged area, approximately 2000 feet downstream of the pipeline



New York
Pennsylvania
Ohio
Maryland
West Virginia
Louisville
Kentucky
N
0 40 80 Miles
LEGEND
Quarries Producing Type A Sand
Major Cities
State Boundary
County Boundary
River/Water
Interstate
Sources. Barnes. 1997; PADEP. 1998; PennDOT, 1998. PennDOT, 2001.
Locations of Quarries Producing Type A Sand

Figure 2-2

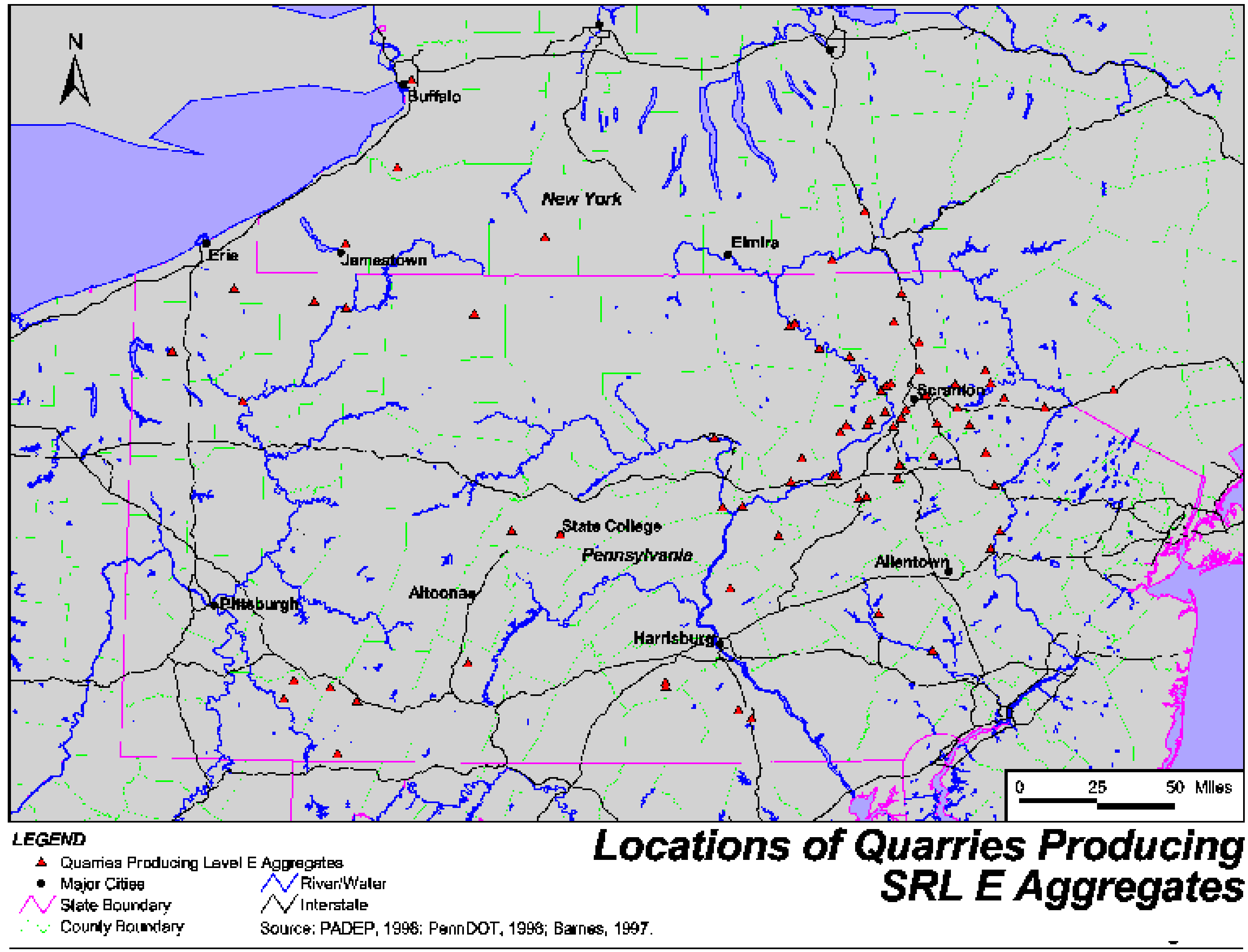

N
Buffalo
New York
Elmira
Erie
Jamestown
Scranton
State College
Pennsylvania
Allentown
Altoona
Pittsburgh
Harrisburg
0 25 50 Miles
LEGEND
Quarries Producing Level E Aggregates
Major Cities
State Boundary
County Boundary
River/Water
Interstate
Source: PADEP, 1996; PennDOT, 1996; Barnes, 1997.
Locations of Quarries Producing
SRL E Aggregates

Figure 2-3

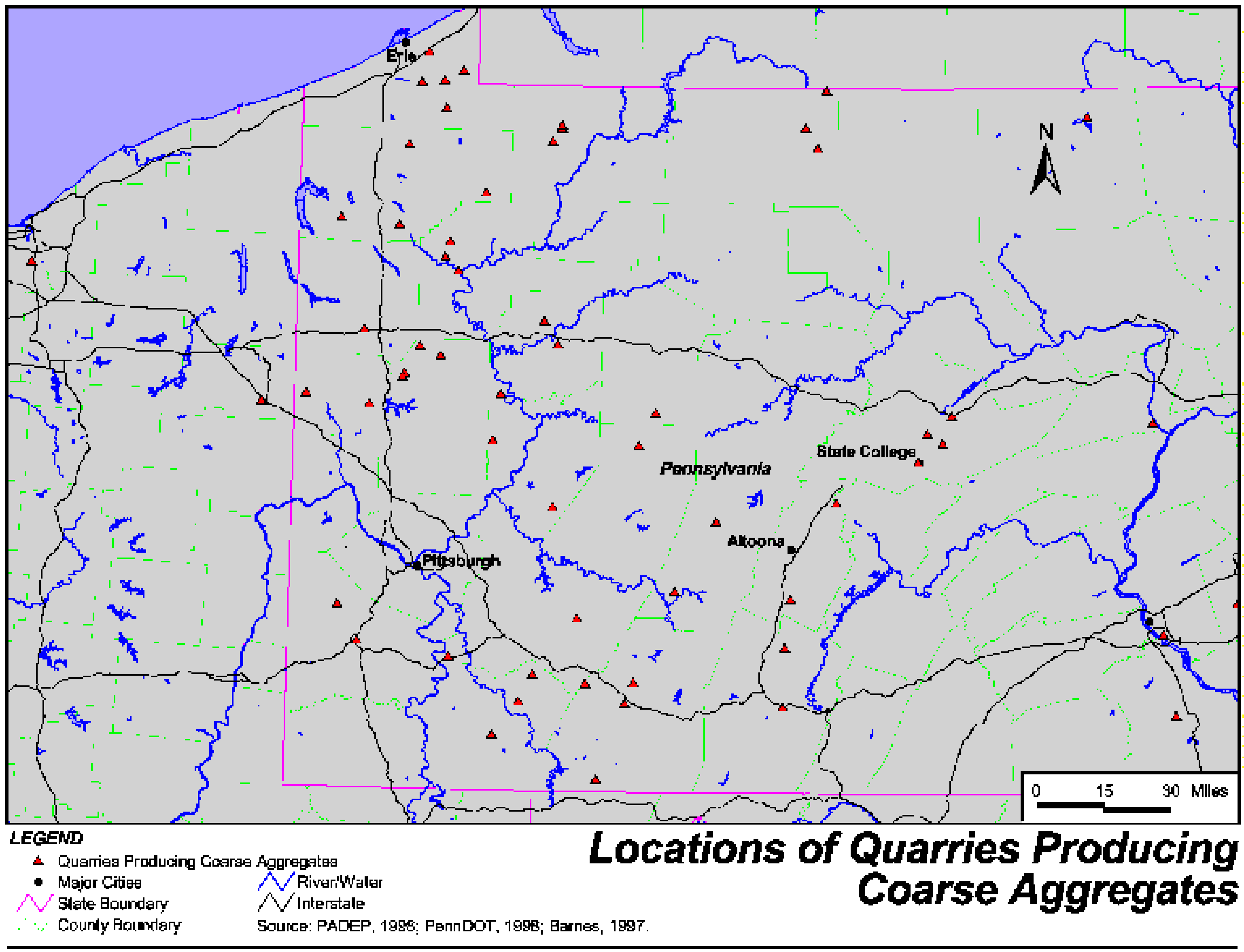

Erie
N
State College
Pennsylvania
Altoona
Pittsburgh
0 15 30 Miles
LEGEND
Quarries Producing Coarse Aggregates
Major Cities
River/Water
State Boundary
Interstate
County Boundary
Source: PADEP, 1998; PennDOT, 1998; Barnes, 1997.
Locations of Quarries Producing Coarse Aggregates

Figure 2-4

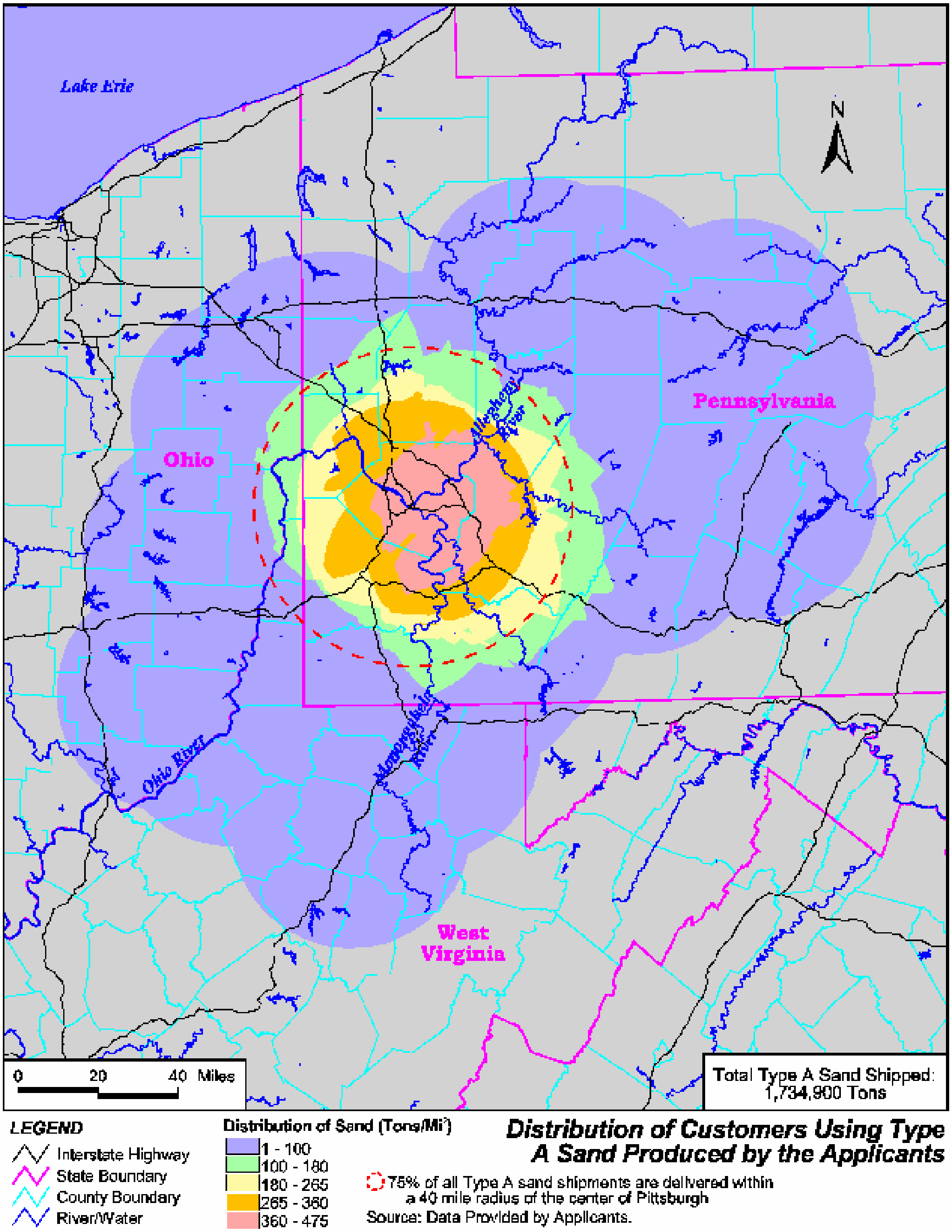

Lake Erie
N
Ohio
Pennsylvania
West Virginia
Allegheny River
Ohio River
Monongahela River
0 20 40 Miles
Total Type A Sand Shipped: 1,734,900 Tons
LEGEND
Interstate Highway
State Boundary
County Boundary
River/Water
Distribution of Sand (Tons/Mi²)
1 - 100
100 - 180
180 - 265
265 - 360
360 - 475
Distribution of Customers Using Type A Sand Produced by the Applicants
75% of all Type A sand shipments are delivered within a 40 mile radius of the center of Pittsburgh
Source: Data Provided by Applicants.

Figure 2-5

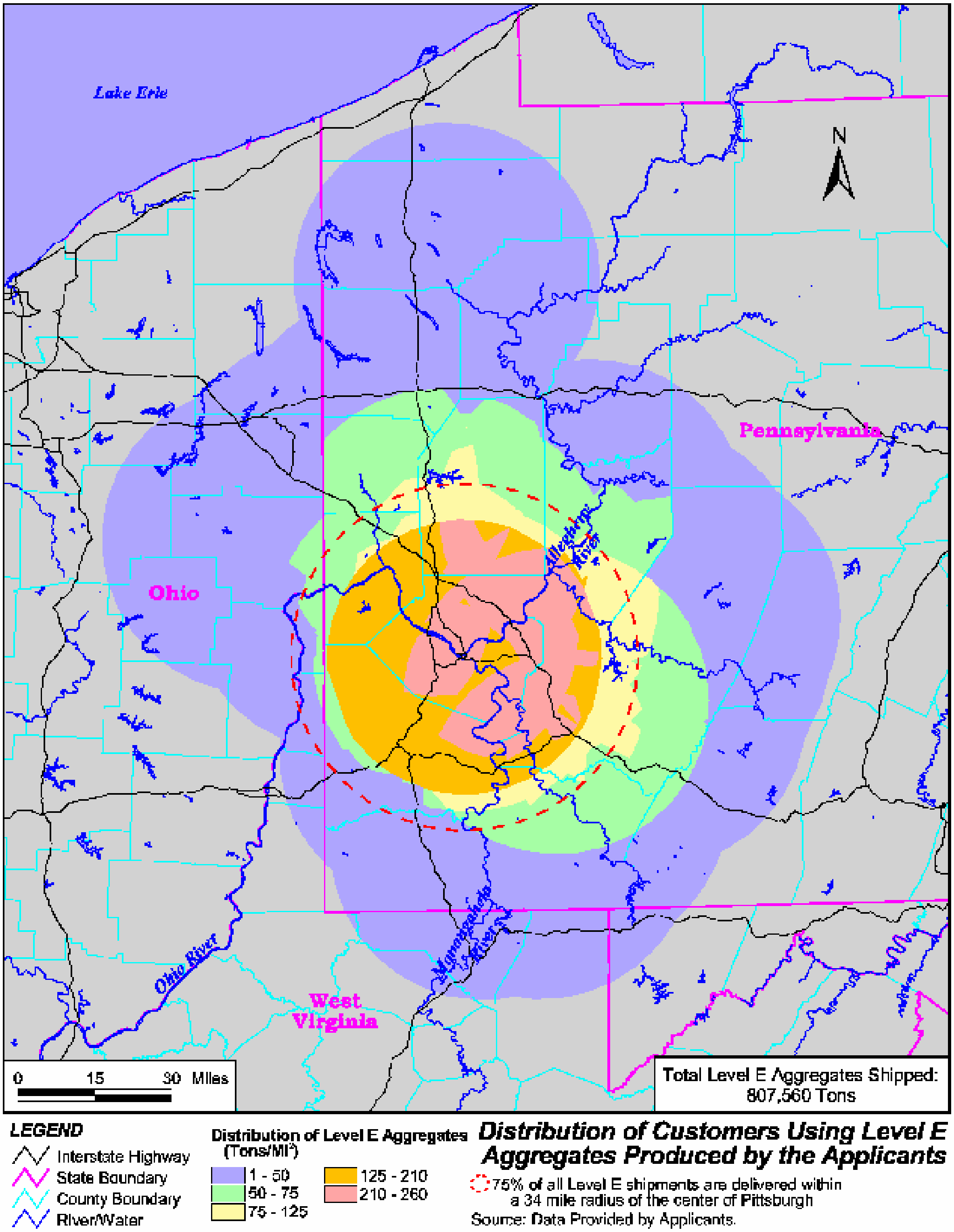

Lake Erie
N
Pennsylvania
Ohio
Allegheny River
Ohio River
Monongahela River
West Virginia
0 15 30 Miles
Total Level E Aggregates Shipped: 807,560 Tons
LEGEND
Interstate Highway
State Boundary
County Boundary
River/Water
Distribution of Level E Aggregates (Tons/MI²)
1 - 50
50 - 75
75 - 125
125 - 210
210 - 260
Distribution of Customers Using Level E Aggregates Produced by the Applicants
75% of all Level E shipments are delivered within a 34 mile radius of the center of Pittsburgh
Source: Data Provided by Applicants.

Figure 2-6

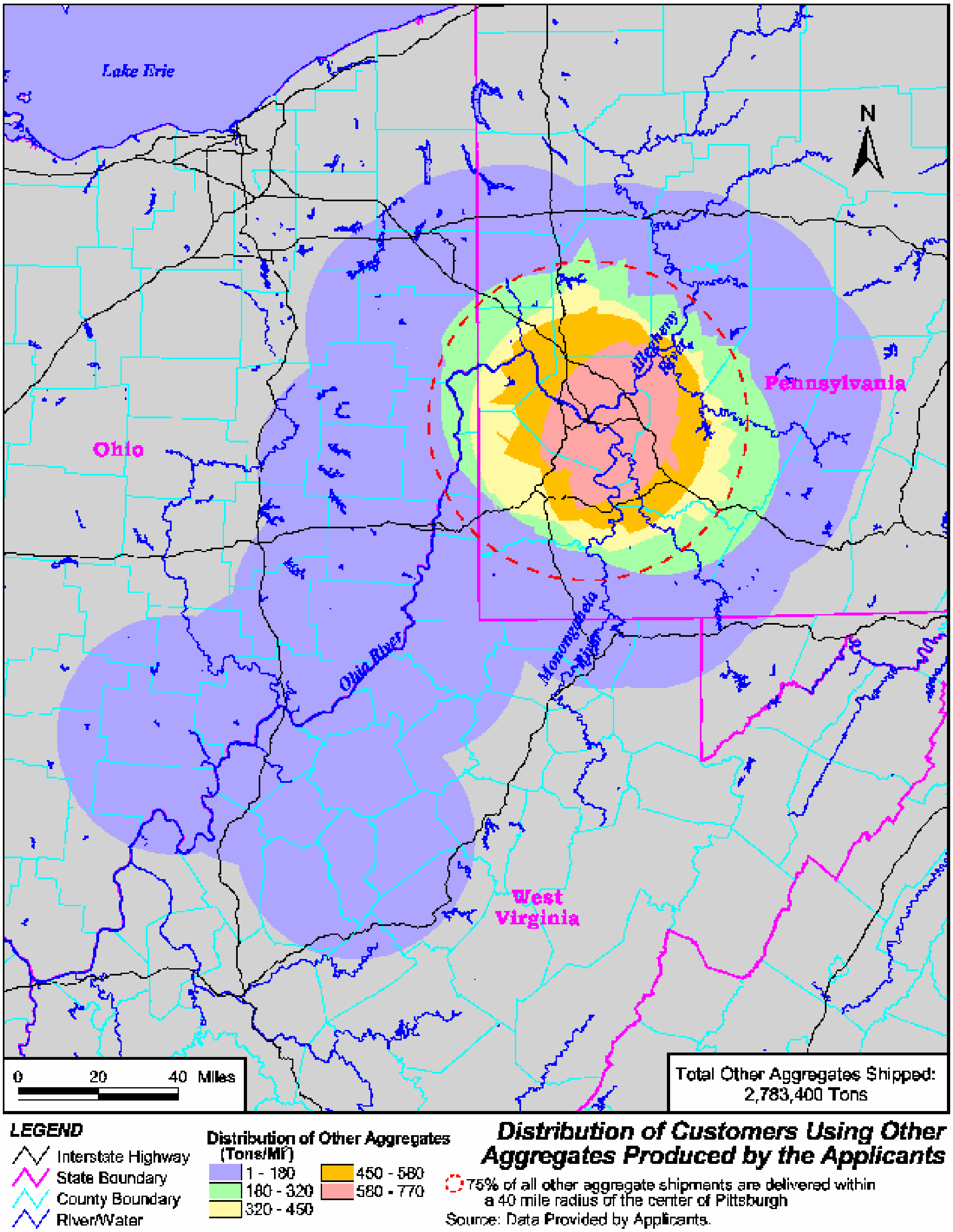

Lake Erie
N
Ohio
Pennsylvania
Allegheny River
Ohio River
Monongahela River
West Virginia
0 20 40 Miles
Total Other Aggregates Shipped:
2,783,400 Tons
LEGEND
Interstate Highway
State Boundary
County Boundary
River/Water
Distribution of Other Aggregates
(Tons/Mi²)
1 - 180
180 - 320
320 - 450
450 - 580
580 - 770
Distribution of Customers Using Other Aggregates Produced by the Applicants
75% of all other aggregate shipments are delivered within a 40 mile radius of the center of Pittsburgh
Source: Data Provided by Applicants.

Figure 2-7