US Army Corps
of Engineers ®
Huntington District

MUSKINGUM BASIN INFRASTRUCTURE STUDY

OCTOBER 2005

~ *Foreword* ~

Please note the purpose of this study is to serve as an initial, comprehensive listing of all identified project deficiencies and potential improvements among the sixteen USACE projects within the Muskingum River Basin. It is not the intent for this study to provide emphasis or prioritization of these needs. Deficiency prioritization is planned to be a future effort to optimize funding with the needs of the Muskingum projects.

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BACKGROUND TO THE MUSKINGUM PROJECTS

The Huntington District of the U.S. Army Corps of Engineers (USACE) originally constructed and currently operates sixteen projects in the Muskingum River Basin. Of these sixteen projects, fourteen were constructed in the 1930's and have approached the end of their design and economic lives. The Dillon and North Branch of the Kokosing projects were completed in 1961 and 1972, respectively. These projects have served the Nation well through flood reduction benefits, recreation opportunities both in the lake and downstream, environmental enhancements, water quality improvements, and water supply.

Routine operation and maintenance activities were executed at the projects until the advent of the July 1969 flood event. During this same timeframe, USACE implemented a new engineering regulation, ER 1110-2-100, establishing a Periodic Inspections (PI) program for completed civil works projects. Both events (the 1969 flood and the initiation of the PI program) brought attention to major deficiencies in embankments, foundations, hydrologic capacities, operating machinery and appurtenant works. Many significant rehabilitation, Dam Safety Assurance (DSA), and performance monitoring efforts have been implemented over the years to address these deficiencies. Examples of these remedial measures include construction of filter blankets, relief well systems, embankment stability berms, and new instrumentation systems. These instrumentation systems (associated with embankment/foundation geotechnical investigations) have provided essential data used in preparing Embankment Reanalysis Reports (ERR) for the fourteen original 1930 projects. These ERRs forecast vital performance information for critical loading conditions. These are just a few remedial actions, of several, that have been instrumental in preventing major a dam safety related incident (including catastrophic failure of potentially at least one project).

Implemented remedial measures cataloged in PI program records represent a total investment of in the magnitude of $75 million dollars in the 1968 through 2005 period. However, much needed rehabilitation and modernization work remains unresolved. The recent winter storm of January 2005 brought eleven projects to a new pool of record, with water passing through the spillway at Wills Creek. That storm event served as a strong reminder of the years of flood control these projects have provided to the Muskingum Basin, however, it also revealed further deficiencies amplifying the need to refurbish these projects that are at the end of their design and economic life. These deficiencies are presented in this comprehensive study and will require several hundred million dollars in remedial costs. Correction of these deficiencies is crucial in order to continue safe, successful project and system operation over the next 50 years.

INTRODUCTION

The Huntington District was tasked to review infrastructure deficiencies of the sixteen projects operated by the U.S. Army Corps of Engineers (USACE) in eastern Ohio's Muskingum River Basin. This study is to serve as an initial, comprehensive listing to identify and characterize all infrastructure deficiencies. These needs require major reinvestment; some are critical in nature and require immediate attention. Preliminary remedial measures presented with each deficiency are initial design options that are expected to be refined once properly studied (some may be proven wholly inadequate).

DEFICIENCY

For the purpose of this report, deficiency items have been categorized as "Major" or "Minor". This initial categorization is intended to simplify the presentation of the data. Prioritization of these project deficiencies is beyond the scope of this study, yet is a necessary future effort. Ultimately, public safety and economic benefits will establish the ranking (investment prioritization) criteria for correction of all identified deficiencies. The "Minor" category includes such items as new maintenance equipment, improvements to public recreation facilities, and resurfacing for access roads and parking lots. This report only presents the "Major" category items in detail while the "Minor" items are grouped into a lump sum total shown in the cost summaries.

In the subsequent pages, brief descriptions of the sixteen USACE projects are given along with their respective "Major" deficiencies. Preliminary cost estimates for all deficiencies by project (including "Minor" items) are summarized in Appendix A.

DEFICIENCY TAG

Unique identification tags were developed for each deficiency to more easily cross-reference the item description and costs shown in Appendix A. Figure 1 illustrates the tagging system.

Figure 1. Deficiency Tag coding.

DESCRIPTION OF "NEED TYPE" CATEGORIES

Deficiencies are categorized by "Need Type". Need categories include dam safety issue, efficiency, erosion control, facility safety, recreation/maintenance, sustainability, and performance monitoring. Category descriptions follow:

Dam Safety Issue

To simplify this report, major rehab issues and dam safety issues have been combined under the heading "Dam Safety". Deficiencies related to "Dam Safety Issues" incorporate various studies and investigations, rehabilitation of existing structures, and new construction to correct existing or potential Dam Safety issues. These issues include hydrologic deficiencies, underseepage concerns, seismic safety reviews, stability against overturning, sliding, etc.

Sustainability

The items related to "Sustainability" incorporate changes that would sustain the project for the next 50 years. Examples include upgrading/rehabilitating operating equipment, rehabilitating existing structures, and repair of hydrogen sulfide corrosion problems.

Erosion Control

The needs related to "Erosion Control" address existing problems with erosion specifically within the project areas. Recommendations include performing erodibility studies and implementing solutions, lining channels with stone slope protection, etc.

Performance Monitoring

The items related to "Performance Monitoring" would enable the project facilities to monitor conditions at the site more effectively. These include instrumentation systems, piezometers, project personnel observation, other inspections, etc.

Efficiency

The needs related to "Efficiency" provide more efficient operation of the Muskingum projects. Human resources at these projects continue to be limited; therefore, it is essential for these facilities to operate efficiently to ensure human efforts are as effective as possible. Items range from improvements to existing operating equipment to automating piezometric data collection.

Facility Safety

The items related to "Facility Safety" are necessary to improve/maintain safe operation and access for project personnel and the public. Examples of these items include, providing improved security lighting, and updating the Water Control Manuals based on revised hydraulic modeling.

Recreation/Maintenance

The needs related to “Recreation/Maintenance” would maintain or enhance current conditions by providing or updating facilities used by the public to keep them safe and up-to-date. Examples include rehabilitating restrooms, repaving parking lots, and access roads, providing new maintenance equipment, conduct cleaning and painting, etc.

DEFICIENCY IDENTIFICATION

Project deficiencies listed in this Muskingum Infrastructure Study were compiled from several sources. Most of these sources were provided from Huntington District Dam Safety Periodic Inspection (PI) Program documentation. Other sources include the Portfolio Risk Assessment (PRA) study, Operations Division Maintenance Backlogs, and interviews with project personnel and District office staff.

Portfolio Risk Assessment

The Portfolio Risk Assessment (PRA) was a study conducted by the Huntington District (August 2003) for the purpose of identifying dam structural or operational deficiencies, analyzing risks and consequences for these deficiencies, prioritizing fixes, and developing a recommended plan of action. Corrections to remediate the deficiencies identified in the PRA require significant capital investments such as raising top-of-dam heights, widening spillways, correcting gate reliability, remediation of known defects in embankment dams and their foundations (and/or concrete dams and structures), and preventing spillway blockages.

Maintenance Backlog (developed and maintained by LRH Operations Division)

Project operations personnel submit needs to the District Office where they are reviewed, prioritized, and added to the Operations Division Maintenance Backlog (named Backlog due to 45 million dollars of unfunded Muskingum items). This database is utilized to document necessary facility improvements along with recommended plans of action. These needs range from small site improvements such as replacing a sidewalk or repaving a parking lot to larger construction work such as repairing concrete outlet structures or replacing intake structure gates.

Periodic Inspection Reports

Periodic Inspections (PI's) are performed regularly by multi-disciplinary Huntington District dam safety inspection teams. The inspections are performed to document conditions of key structural and operating components such as the embankment, stone slope protection, spillway concrete, electrical systems, gate machinery, tunnel and conduits, and outlet channel. Periodic Inspection Reports are prepared once these inspection findings have been compiled to formally document project deficiencies and recommended plans of action.

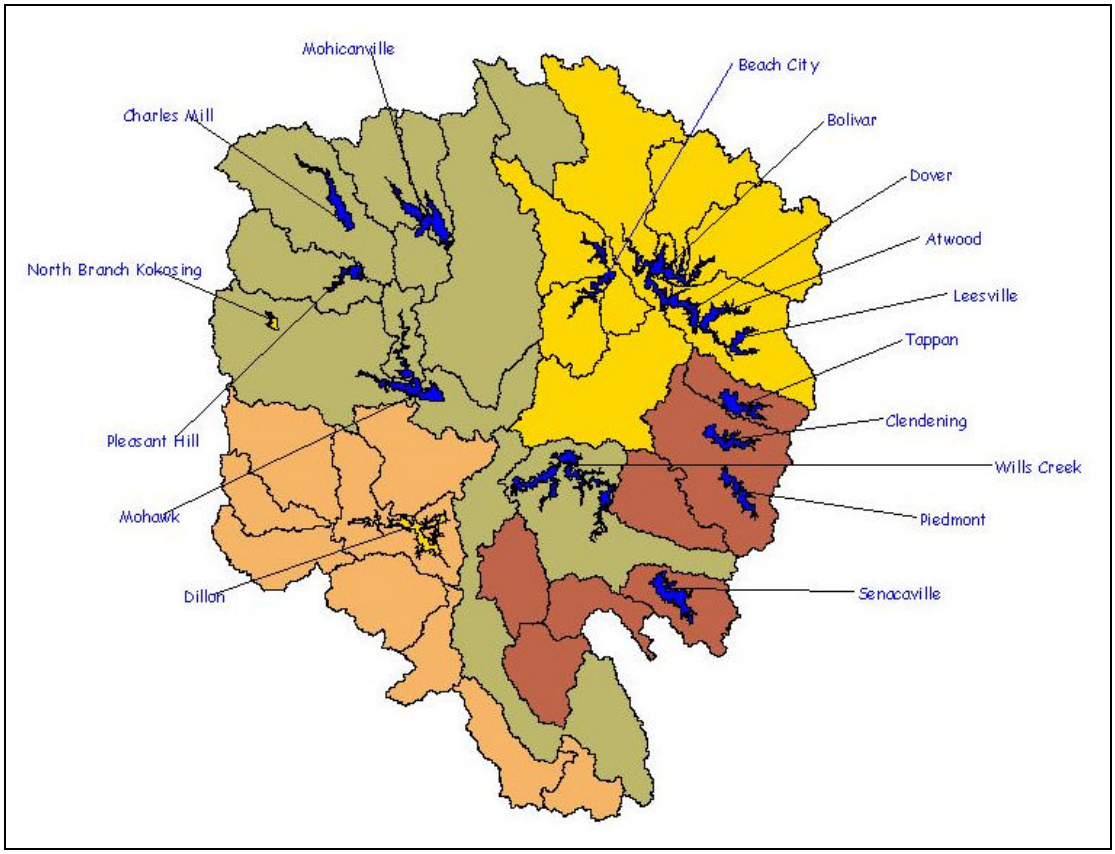


Figure 1. Overview of USACE Projects within the Muskingum River Basin.

REQUISITE FOR AN ASSET MANAGEMENT PLAN

Updated digital mapping and project surveys for the entire basin are very important foundations for engineering design, planning, and analysis. Obtaining up-to-date basin information would also provide significant benefits to asset management of the Muskingum River Basin that would extend well into the future. Currently many of the hydraulic and hydrologic analyses, study, and design efforts are performed with out-of-date topographical mapping. New design and study efforts must reference this same outdated information. The purpose of an Asset Management Plan is to provide this much needed updated digital mapping, project features, boundary surveys, and hydrographic surveys. The development of a comprehensive basin-wide geospatial information system (GIS) for collecting, storing, and accessing this data would also provide significant benefits.

Projects Include:

- **Atwood Lake**
- **Beach City Lake**
- **Bolivar Dam**
- **Charles Mill Lake**
- **Clendening Lake**
- **Dillon Lake**
- **Dover Dam**
- **Leesville Lake**
- **Mohawk Dam**
- **Mohicanville Dam**
- **North Branch of Kokosing Lake**
- **Piedmont Lake**
- **Pleasant Hill Lake**
- **Senecaville Lake**
- **Tappan Lake**
- **Wills Creek Lake**

SCOPE

The scope of the Asset Management Plan would include obtaining and development of the following:

1. Updated digital mapping for the Muskingum Basin.
2. Lake hydrographic surveys, project feature surveys, monument and property boundary marker surveys, river depth and geometry surveys, selected highway bridge surveys, and flowage easement surveys for use with encroachment investigations.
3. Geospatial information system (GIS) development and management. A GIS would require the acquisition of computer hardware and software, data entry and management efforts, coordination with users and data providers, and development of a comprehensive GIS system plan.
4. A comprehensive basin wide geo-referenced hydraulic model, which can be readily accessed and updated to produce visual images of inundation with profiles to accurately explore, analyze and develop solutions for any hydraulic problem or issue relating to water quantity.
5. Repair and modernize gage instrumentation to more accurately and consistently monitor real-time lake level and stream flow conditions.

BENEFITS

There are many benefits from obtaining updated digital mapping, updated surveying, and development and management of a GIS database for the basin and include the following:

1. **Updated Digital Mapping:** (8051 square miles, 1" = 100' with 2' contour intervals) will serve as the foundation and springboard for many repairs and upgraded engineering designs and analysis. Updated survey markers will be required to supplement the updated mapping for future surveying needs. The updated mapping will allow designers to develop digital terrain models for existing ground conditions and facilitate the design of repairs and upgrades.

2. **Hydraulics & Hydrology:** This data will include existing bridge geometry, stream depths, flood inundation mapping, sedimentation/erosion data, and land use/cover. H&H engineering analysis would benefit in a number of ways including the development of surface hydrology, river hydraulics and sediment transport, hydrologic statistics and risk analysis, reservoir system analysis, planning analysis, real-time water control management and the development of flood warning systems. Current flood frequency data was compiled 20 years ago, and requires updating. Most stream profile data is historic and very few detailed studies have been completed in the past 30 years. The accuracy of nearly all hydraulic models is dependent on mapping and cross sectional data. In order to obtain accurate engineering solutions through modeling, it is necessary to utilize current and accurate mapping.

3. **Hydraulic Modeling:** A hydraulic model of the basin would allow quick and accurate assessments of the negative/positive impacts of new projects. An updated hydraulic model would be a foundation for use with: Federal Emergency Management Agency (FEMA) insurance, Dam Break Analysis as part of Dam Safety Assurance Program, real-time reservoir regulation, Local Protection Projects, lake studies, sedimentation studies, water supply regulation, water quality monitoring, stream restoration projects, flow predictions during a flood event, Flood Warning Systems, and Basin Utilization Studies.

4. **Real Estate:** Real estate management will benefit from the identification of existing encroachments, flowage easements, fee boundaries, rights-of-ways, and ownership tracts entered within the updated digital mapping.

5. **Emergency Management:** This will improve in the areas of transportation, evacuation plans, first aid, accident management, and hazard area identification.

6. **Water Quality:** Water quality management will improve as sampling data points and locations, sampling analysis, and monitoring criteria can be managed centrally in the GIS database.

7. **Regulatory & Environmental:** Critical environmental documentation may be maintained and made readily available. Examples of such documents include NPDES permits, NEPA permits, environmental impact statements (EIS's), Environmental Assessments (EA's), abandoned mine lands (AML's), mitigation plans, and others.

8. **Data Management:** Data management will be improved by centralizing all data in a GIS system maintained by the LRH GIS/CADD section. Maintenance of data, hardware, and coordination of data entry/storage/access will be required and ensure data availability for USACE, the Muskingum Watershed Conservancy District, and other local, state, and federal stakeholders. Additionally, this system will assist in making decisions for future maintenance and expenditure of funds.

9. **Public Access to Information:** Much of the information contained within the GIS system could be made readily available for public use via the Internet. Examples of such data may include a list of identified recreational opportunities within the Basin, survey data, stream gage information, etc. It is expected that some data maintained within the GIS system will be more appropriate for internal use only and restricted from public use.

SCHEDULE

Updated digital mapping, surveying, and GIS database planning and development are scheduled to be obtained in the first five fiscal years (FY06 thru FY10) pending approval and funding. Management of the GIS database will continue indefinitely into the future to keep information up-to-date, organized, and accessible.

REMOTE OPERATION CAPABILITY STUDY

The purpose of conducting a Remote Operation Capability Study is to determine the benefits and limitations of remote operations. The study could look toward optimizing equipment operation from the standpoint of safety, efficiency, implementation cost, and operation and maintenance cost. Finally, the study should conclude by evaluating the economic feasibility of the identified operational improvements and providing a recommended future-plan of action.

The Huntington District recognizes the potential for remote operation capability at some or all of the Muskingum Basin projects. Studying remote capability could help better manage flood conditions and to more efficiently and effectively operate projects through modern technology. Remote operation capability could range from a basin-wide, fully automated system operated from a central control center to remote monitoring with improvements to the local operational interfaces between the equipment and field personnel. Components of a truly remote operated system could include programmable logic controllers (PLCs) incorporated into the control system for each project to provide remote operation capability. Existing network connections could be used for communication that would enable each project to be operated from a nearby project or from the District Office. Gate position indication could also be provided along with cameras to allow an operator at a remote location to verify proper and intended gate operation.

ATWOOD LAKE

DESCRIPTION OF PROJECT

Valley (Main) Embankment

The construction of Atwood Dam was completed in September 1936 on Indian Fork of Conotton Creek, 188.4 miles upstream of the mouth of the Muskingum River. The valley embankment is a rolled earth embankment with impervious core structure that extends across the valley from a terrace on the left to the abrupt hillside adjacent to the channel on the right. The upstream valley face is protected by dumped stone below elevation 933 and by sod above. A rock fill drain is located at the downstream toe. The crest of the valley embankment is 30 feet wide and the length is approximately 900 feet. The top of the embankment is at elevation 955.0, which is 65 feet above the streambed.

Figure 2. General view of upstream face of main embankment looking toward the left abutment at Atwood Lake, OH.

Terrace (Dike) Embankment

The upstream and downstream terrace embankment slopes are 1V to 2H. The crest width of the embankment is 25 feet and is approximately 2600 feet long. Both the valley and terrace embankments have an impervious core.

Figure 3. General view of the terrace embankment looking in the direction of the left abutment.

The outlet works are located near the south abutment and consist of an approach channel, intake structure, tri-channeled conduit, stilling basin, and outlet channel. Access to the intake structure is provided by a service bridge that is six feet wide.

The spillway is located approximately 350 feet beyond the left abutment. It is a partially lined, uncontrolled trapezoidal open-cut chute type that has an approximate crest length of 1500 feet and a crest elevation of 941 feet. A highway bridge crosses the spillway about 100 feet downstream of the crest. The bridge is a two-span concrete structure with both the center pier and abutments founded on rock.

Atwood

PLAN OF ACTION TO CORRECT IDENTIFIED DEFICIENCIES

Dam Safety Issue

ATI-H01I **Widen spillway, build parapet wall, and grout abutment.**
The spillway needs to be widened (or possibly a parapet wall constructed) and the abutment grouted. As the spillway is widened, it will reduce the plugging issues. The spillway should also be evaluated for erosion potential.

ATI-H08E **Perform structural evaluation on tunnel to resolve hydrogen sulfide problems.**
The tunnel is expected to require relining. During the summer months, lower depths of the lake form high levels of hydrogen sulfide. The service gates release water from these depths causing the tunnel concrete to be exposed to the hydrogen sulfide. A structural evaluation needs to be performed to determine the severity of tunnel erosion, the exact plan of action, and if a liner is truly needed.

ATI-H09E **Remediate tunnel according to study (re-lining).**
Hydrogen sulfide has increased the rate of deterioration in the concrete tunnel and consequently the tunnel will require relining. Trial patches of tunnel coatings were examined in March 1994 at various locations and appeared to hold up well. Relining the tunnels will be required to prevent further damage.

ATI-S21E **Perform Seismic Safety Review (SSR) in accordance with ER 1110-2-1806.**
A Seismic Safety Review (SSR) in accordance with ER1110-2-1806 is required. Depending on the results of the SSR, a Dynamic Analysis may also be required.

Efficiency

ATI-A20N **Install ADAS (Automated Data Acquisition System).**
An ADAS (Automated Data Acquisition System) is needed to improve the monitoring of piezometric levels (internal pore water pressures) in the dam.

Facility Safety

ATI-O17E **Revise and update Water Control Manual.**
The District recognizes the need to revise the Water Control Manuals for a more detailed procedure outlining water management operations for all events.

Atwood

PLAN OF ACTION TO CORRECT IDENTIFIED DEFICIENCIES

Performance Monitoring

ATI-L18N Install additional piezometers.
As a part of the Periodic Inspection Program, the Geotechnical evaluation has recommended the installation of six additional piezometers to monitor water levels with the embankment, abutment, and downstream areas.

ATI-O14E Replace outlet control weir.
The outlet weir is deteriorated and needs to be replaced. Installation would require a large crane, sheet-pile, and stone slope protection placed around the weir.

Recreation/Maintenance

ATI-C05A Patch deteriorated concrete spillway.
The surface is heavily deteriorated, but the concrete is 1½ feet thick or more. The deterioration is attributed to lack of an Air Entrainment Admixture (AEA) in the mix design and an alkali-silica reaction that has developed within the concrete, both are accentuated by age. A couple of deeper spalls were found underneath the bridge. The length of the spillway is 1500 feet and the width is approximately 60 feet. The deteriorated concrete will be patched as needed.

Sustainability

ATI-B23E Replace backup generator.
The backup generator needs to be replaced to ensure continued reliable operation over the next 50 years.

ATI-C16E Replace emergency gate guides.
The emergency gate guides (made from railroad rail) have deteriorated due to corrosion and need to be replaced.

ATI-E25E Rehabilitate electrical service systems.
Electrical service systems require updating in order to ensure sustainability over the next 50 years.

ATI-M07O Modify intake structure for selective withdrawal.
Lake water at the current intake elevation contains a high concentration of hydrogen sulfide that causes safety and environmental hazards as well as structural damage to the outlet structure. The plan of action is to modify the current intake with a selective withdrawal system designed to reduce the hydrogen sulfide in the outflow and improve water quality downstream.

Atwood

PLAN OF ACTION TO CORRECT IDENTIFIED DEFICIENCIES
Sustainability

ATI-M22E **Replace motor operated floor stands with hydraulic cylinders.**
Motor operating stands require replacement to ensure sustainability. A new hydraulic actuated system would more effectively integrate with a new selective withdrawal system.

ATI-O24E **Rehabilitate overhead crane and trolley systems.**
Overhead crane and trolley system requires rehabilitation to ensure sustainability over the next 50 years.

ATI-S12E **Replace existing service bridge.**
The service bridge is currently six feet wide curb to curb and is 120 feet long. The narrow width of the existing bridge prohibits vehicular traffic and the concrete on the abutments, intermediate pier, and decking is deteriorating. The recommendation is to replace the bridge with a wider service bridge (possibly an additional five to six foot expansion).

ATI-S13O **Clean, paint, and repair sluice gates.**
The intake structure contains three 3’-6’’ x 7’-0’’ slide type control gates. The sluice gates need to be cleaned, painted, and critical structural members repaired.

ATI-T10E **Replace trash racks.**
The trash racks are deteriorated due to hydrogen sulfide and need to be replaced. There are six trash racks whose dimensions are 6'-3” x 13’-6”.

BEACH CITY LAKE

DESCRIPTION OF PROJECT

Dam

The construction of Beach City Dam was completed in 1937 on Sugar Creek of the Tuscarawas River, 179.8 miles upstream of the mouth of the Muskingum River. The embankment is rolled earth with an impervious core, having a maximum height of 64 feet. The crest length of the dam is 5,600 feet with a crest height 65 feet above streambed at elevation 995. Under the dam safety assurance program, the embankment was raised, relief wells and seepage blankets were rehabilitated, and a parapet wall added to the upstream side of the crest in 2001. The top of the parapet wall is at elevation 999.7.

Figure 4. General view of intake structure and service bridge at Beach City Lake, OH. 08 December 2003

The outlet works are adjacent to the right abutment and consist of an approach channel, control weir, intake structure, operating house, twin conduits, stilling basin, and outlet channel. Access to the intake structure is provided by a service bridge that is 12 feet wide (curb-curb).

The spillway is located approximately 600 feet upstream from the right abutment. It is a partially lined, uncontrolled saddle type that has an approximate crest length of 500 feet and a crest elevation of 976.5 feet.

Brewster Levee

Brewster Levee is located 5.5 miles upstream of Beach City Dam and protects a portion of the Town of Brewster, Ohio. This levee has a crest elevation of 988 feet and is divided into three separate sections with a total length of 10,496 feet. The levee, a pump station, and the appurtenances need raised and revamped, respectively, as a result of the flood of 1969.

U.S. Silica Sand Industrial Levee

Additionally, a small industrial levee is located in Dundee, Ohio, which is approximately 4 miles southwest of Beach City Dam. This levee protects the sand plant U.S. Silica from flooding.

Beach City

PLAN OF ACTION TO CORRECT IDENTIFIED DEFICIENCIES

Dam Safety Issue

BCS-C07R Dredge channel 600 feet long to clear culvert at U.S. Silica Industrial Levee.

The storm water in the interior of the U.S. Silica Industrial Levee drains through a culvert and flap valve. The outlet is partially blocked by silt reducing flow capacity. A channel approximately 600 feet long needs to be dredged to remove the obstruction (estimated volume is 14,400 cubic yards) and to improve hydraulic efficiency of the channel.

BCS-F08O Construct new gate closure at Brewster Levee.

The eighteen-track railroad opening in the Brewster Levee will require considerable time and resources in a closure event. At this time, 6,000 sandbags would need to be located, purchased, delivered, filled and placed. Manpower will be a problem during a flooding event (currently, 24 people 36 hours to install), therefore a quick closing device (swing gate, stoplogs, etc) needs to be constructed.

BCS-F12U Build levee section in opening at Silica Sand Industrial Levee.

The construction of a levee section in the opening at the U.S. Silica Sand Industrial Levee is recommended to alleviate time and resource concerns regarding the placement of sandbags during a closure event. The top would be 8 feet wide, 18 feet tall, 1V to 3H slopes, 116 foot base, and 80 feet in length.

BCS-L28M Improve access to areas downstream of the dam, including clearing and grubbing of the downstream area.

Limited access to areas downstream of the dam causes difficulty performing dam monitoring and maintenance. A road needs to be established in order to transport materials to the downstream area. This is a significant concern in the event emergency maintenance is required on the dam.

Beach City

PLAN OF ACTION TO CORRECT IDENTIFIED DEFICIENCIES

Dam Safety Issue

BCS-P32E Perform underseepage study on dam and remediate concerns according to the study results.

Beach City Dam has a history of foundation underseepage that has been noted and measured in the field and documented as part of the 1978 Embankment Reanalysis Report (ERR). As a result of this earlier study, a system of ten relief wells and a small seepage blanket were placed adjacent to the downstream embankment toe. During the winter storm event of 2005, Beach City Dam exhibited piping downstream from these remedial measures at pools nearing spillway crest (El. 976.5 frequency of 140 years). Because of this event, it is believed that several areas of the foundation and/or embankment could become unstable due to piping at pools below the spillway crest and would threaten the integrity of the dam. Studies could point to a variety of combinations for safely passing underseepage through the dam's foundation. One plausible scenario for addressing the foundation underseepage problem would be to supplement the existing relief well system with an additional line of relief wells and to augment the existing seepage blanket with additional granular material both in the vertical and horizontal directions. The downstream instrumentation would also require modification as well as installation of addition instrumentation.

BCS-S10E New emergency gate closure system at the end of dam.

The stop log closure at Beach City Dam utilizes 117 aluminum logs that are placed 20.4 feet high and 34 feet wide. This method requires a significant amount of manpower and introduces many safety concerns. The effort required to place these logs using a crane takes 12 people 16 hours to install. A 34 feet wide by 20 feet high swing gate closure is recommended to alleviate time and resource concerns. In order to implement a swing gate the existing concrete walls will need to be replaced.

BCS-S20E Perform Seismic Safety Review (SSR) in accordance with ER 1110-2-1806.

A Seismic Safety Review (SSR) in accordance with ER1110-2-1806 is required. Depending on the results of the SSR, a Dynamic Analysis may also be required.

Beach City

PLAN OF ACTION TO CORRECT IDENTIFIED DEFICIENCIES

Dam Safety Issue

BCS-S29U **Purchase and stockpile sandbags and filter material for emergency use at the project.**
Sandbags and stockpiles of filter material are not readily available for building seepage blankets or to remediate other dam safety deficiencies in emergency conditions.

Efficiency

BCS-A19N **Install ADAS (Automated Data Acquisition System).**
An ADAS (Automated Data Acquisition System) is needed to improve the monitoring of piezometric levels (internal pore water pressures) in the dam.

Erosion Control

BCS-L11D **Add stone slope protection (SSP) to downstream wing walls.**
Approximately 1000 cubic yards of SSP needs to be replaced to prevent further bank erosion at the downstream wing wall area.

Facility Safety

BCS-O01E **Revise and update Water Control Manual.**
The District recognizes the need to revise the Water Control Manuals for a more detailed procedure outlining water management operations for all events.

Performance Monitoring

BCS-I18N **Install piezometers.**
As a part of the Periodic Inspection Program, the Geotechnical evaluation has recommended the installation of twelve additional piezometers to monitor water levels at Brewster Levee.

Sustainability

BCS-C15A **Sandblast/paint tractor gates.**
The service gates show moderate rusting and blistering. Sandblasting and painting is required to prevent deterioration due to corrosion. There are six sluice gates each measuring 9 feet by 15.5 feet and one foot thick.

BCS-C27A **Sandblast/paint gatewell gates and guides.**
Corrosion preventative maintenance is required for gatewell gates and guides to ensure sustainability over the next 50 years.

BCS-D17P **Upgrade relief well collection system.**
The existing relief collection system is overloaded. The plan of action is to expand the collection system including instrumentation for monitoring.

Beach City

PLAN OF ACTION TO CORRECT IDENTIFIED DEFICIENCIES

Sustainability

BCS-E25P **Rehabilitate electrical service systems.**
Electrical service systems require updating in order to ensure sustainability over the next 50 years.

BCS-G26E **Replace all gatewell stems and guides.**
Gatewell stems and guides are deteriorated and require replacement to ensure sustainability.

BCS-O24E **Rehabilitate overhead crane and trolley systems.**
Overhead crane and trolley system requires rehabilitation to ensure sustainability over the next 50 years.

BCS-P21E **Replace pumps and motors at Brewster Levee pump station.**
Pumps and motors at Brewster Levee pump station need replaced to ensure sustainability over the next 50 years.

BCS-T06N **Initiate preventative maintenance on relief wells.**
As recommended by USACE regulation, preventative maintenance is required on Beach City's 10 relief wells that have been in operation since 1979.

BCS-W23E **Refurbish gate hoist machinery and replace wire ropes.**
Wire rope for gate hoist needs to be replaced. Hoist equipment and components (sheaves, brakes, motors, etc) require rehabilitation to ensure sustainability over the next 50 years.

BOLIVAR DAM

DESCRIPTION OF PROJECT

Dam

The construction of Bolivar Dam was completed in 1938 on Sandy Creek of the Tuscarawas River, 183.4 miles upstream of the mouth of the Muskingum River. The embankment is rolled earth with an impervious core, having a maximum height of 87 feet. The crest length of the dam is 6300 feet with a crest elevation of 982 feet. A 3.5-foot concrete parapet wall is located on the upstream side of the crest.

Figure 5. Downstream face of the main embankment at Bolivar Dam, OH. 16 September 2003

The outlet works are located within the left abutment and consist of an approach channel, intake structure, two horseshoe-shaped tunnels, stilling basin, and outlet channel. Access to the intake structure is provided by a single span service bridge that is 12 feet wide (curb-curb).

The spillway is located just beyond the left abutment. It is an uncontrolled, saddle type that has a crest length of 540 feet, crest width of 25 feet, and a crest elevation of 962 feet.

Magnolia Levee

Magnolia Levee is located 6.5 miles east of Bolivar Dam and protects the Town of Magnolia, Ohio. This levee spans 4,877 feet at a crest elevation of 976 feet. Two small industrial levees are located in East Sparta, Ohio, which is approximately 10 miles east of Bolivar Dam. These levees are relatively low and protect the Sparta Ceramic Company and the U.S. Quarry Tile Company from high reservoir pools.

Bolivar

PLAN OF ACTION TO CORRECT IDENTIFIED DEFICIENCIES

Dam Safety Issue

BOS-L24M **Improve access to areas downstream of the dam, including clearing and grubbing of the downstream area.**

Limited access to areas downstream of the dam causes difficulty performing dam monitoring and maintenance. A road needs to be established in order to transport materials to the downstream area. This is a significant concern in the event emergency maintenance is required on the dam.

BOS-S16E **Perform Seismic Safety Review (SSR) in accordance with ER 1110-2-1806.**

A Seismic Safety Review (SSR) in accordance with ER1110-2-1806 is required. Depending on the results of the SSR, a Dynamic Analysis may also be required.

BOS-S25U **Purchase and stockpile sandbags and filter material for emergency use.**

Sandbags and stockpiles of filter material are needed to be immediately available for constructing seepage blankets or to remediate other dam safety deficiencies in emergency conditions. These items had to be used for emergency repairs during the January 2005 flood event.

Bolivar

PLAN OF ACTION TO CORRECT IDENTIFIED DEFICIENCIES

Dam Safety Issue

BOS-T02O Perform underseepage study on dam and remediate concerns according to the study results. One possible solution is to construct a segmental concrete panel cutoff wall to remediate the underseepage concerns at terrace areas.

Bolivar Dam has a history of excessive downstream seepage and a potential of underseepage instability at design pools. The Embankment Reanalysis Report (ERR) provided an evaluation of the slope and underseepage stability of the dam and served as the vehicle to justify the downstream seepage blanket, relief wells, and upstream stability berm. During preparation of the 2001 Periodic Inspection report, all existing subsurface and instrumentation data was reviewed and an assessment made by the District concerning the seepage stability of the dam. The January 2005 flood event set a new pool record and showed numerous areas of seepage through the terrace embankment and foundation. Conducting a seepage study on Bolivar Dam is a high priority work item and there are several alternatives for eliminating the seepage. First, an upstream impervious blanket could be tied into an impervious section of the dam. Second, enhanced drainage features could be used but will be ineffective in areas where the dam's foundation deposits contain highly pervious glacial outwash and open work gravel. However, these two alternatives only partially reduce underseepage. To get a complete correction to underseepage, a cutoff or partial cutoff wall (slurry trench or concrete panel) should be considered. In this case a segmental concrete cut off wall has been recommended to control underseepage. The wall panels average 25-foot in length and are constructed by slurry methods; the wall could possibly be located through the embankment and keyed into bedrock, which would provide an effective seepage barrier through the full foundation depth as well as the full random fill embankment height. This segmental concrete cut-off wall is the most positive solution of any of the solutions listed above and provides the least amount of future operational efforts.

Efficiency

BOS-A15N Install ADAS (Automated Data Acquisition System).

An ADAS (Automated Data Acquisition System) is needed to improve the monitoring of piezometric levels (internal pore water pressures) in the dam.

Bolivar

PLAN OF ACTION TO CORRECT IDENTIFIED DEFICIENCIES

Facility Safety

BOS-O17E Revise and update Water Control Manual.
The District recognizes the need to revise the Water Control Manuals for a more detailed procedure outlining water management operations for all events.

Recreation/Maintenance

BOS-B09O Bolivar Service Bridge - Clean and paint steel members.
As part of the bridge inspection program, corrosion was noted as being present on the steel members due to failure of the paint system. Steel members need to be cleaned and repainted to prevent further corrosion.

BOS-M10A Magnolia Service Bridge - Clean and paint steel members.
As part of the bridge inspection program, the structural steel on the service bridge to the gatewell structure was noted as being corroded. Steel members need to be cleaned and painted to prevent further corrosion.

Sustainability

BOS-304N Initiate preventative maintenance on relief wells.
As recommended by USACE regulation, preventative maintenance is required on Bolivar's 35 relief wells that have been in operation since 1982.

BOS-B11E Replace backup generator at the intake structure.
The backup generator needs to be replaced to ensure continued reliable operation over the next 50 years.

BOS-C19A Sandblast and paint Mill Race, Magnolia Levee, and East Sparta Levee gates.
Corrosion preventative maintenance for the gates at Mill Race, Magnolia Levee, and East Sparta Levee Pump stations.

BOS-E13P Rehabilitate electrical service system for Magnolia Levee pump station.
Electrical service systems at Magnolia Levee pump station require updating in order to ensure sustainability.

BOS-E22P Rehabilitate electrical service systems.
Electrical service systems require updating in order to ensure sustainability over the next 50 years.

Bolivar

PLAN OF ACTION TO CORRECT IDENTIFIED DEFICIENCIES

Sustainability

BOS-G20E **Replace all Magnolia Levee, East Sparta Levee, and Mill Race gatewell stems and stem guides.**
As the gatewell stems and guides age and deteriorate, they will require replacement to ensure continued reliable operation over the next 50 years.

BOS-M14E **Repair bottom two feet of Magnolia gate closure.**
The bottom of the swing gate road closure at the Magnolia Levee is beginning to deteriorate. The bottom two feet of both gates will be repaired on the gates.

BOS-O23E **Rehabilitate overhead crane and trolley systems.**
Overhead crane and trolley system requires rehabilitation to ensure sustainability over the next 50 years.

BOS-P03E **Replace service (tractor) gates at the intake structure.**
Project personnel confirmed that the sluice gates were in fair condition during a site visit on 08 December 2003. The 2001 Periodic Inspection report stated that the vertical members of the gates were severely corroded and had significant section loss. Damage and corrosion of the skin plates were also mentioned in the report. Project Operations staff initiated a five-part memo to EC to request recommendations and cost estimates in order to begin the repair process. However, no repairs have been made at this time. Considering the condition of the gates, it may be beneficial to make a replacement rather than a repair. Overall, the intake structure houses six 7-foot by 15’-foot sluice gates.

BOS-P18E **Replace pumps and motors at Magnolia Levee pump station.**
Pumps and motors at Magnolia Levee pump station need replaced to ensure sustainability.

BOS-T07E **Reline discharge line of small pump at Magnolia Levee pump station.**
Relining the discharge pipe of the small pump at the Magnolia Levee pump station is deteriorated and requires replacement or re-lining. The discharge pipes of the two larger pumps were recently relined. The discharge pipe of the small pump spans approximately 130 feet, one is 16 inches in diameter, while the other two are 20 inches in diameter.

BOS-W21E **Refurbish gate hoist machinery and replace wire ropes.**
Wire rope for gate hoist needs to be replaced. Hoist equipment and components (sheaves, brakes, motors, etc) require rehabilitation to ensure sustainability over the next 50 years.

CHARLES MILL LAKE

DESCRIPTION OF PROJECT

The construction of Charles Mill Dam was completed in 1936 on the Black Fork of the Mohican River, 181.8 miles upstream of the mouth of the Muskingum River. The embankment is rolled earth with an impervious core, having a maximum height of 48 feet. The crest length of the dam is 1390 feet at elevation 1035. In 1984, a concrete parapet wall was constructed on the upstream side of the crest, raising the elevation of the dam to 1039.4.

Figure 6. Parapet wall at Charles Mill Lake, OH. 10 July 2002

The outlet works are located between the embankment and the west abutment and consist of an approach channel, control weir, intake structure, discharge conduits, stilling basin, and outlet channel. Access to the intake structure is provided by a service bridge that is 12 feet wide.

The combined primary and secondary spillways are located in the right abutment with the outlet works. The primary spillway is an uncontrolled ogee section with a crest length of 58 feet and a crest elevation of 1020 feet. The ogee section houses the sluices and control gates in the base. The primary spillway empties into the stilling basin and is topped by a reinforced concrete service bridge resting on the retaining wall and two concrete piers.

The secondary spillway is also an uncontrolled ogee section that is positioned between the primary spillway and the right abutment. This spillway has a crest length of 96.5 feet and a crest elevation of 1022 feet. It is also important to note that three small saddles that are located near Dike Number 2 serve as emergency spillways.

Pavonia Levee is located 6.5 miles northwest of Charles Mill Dam and protects the Pavonia Station of the Ohio Fuel Gas Station. This levee spans 980 feet at a crest elevation of 1023 feet.

Charles Mill

PLAN OF ACTION TO CORRECT IDENTIFIED DEFICIENCIES

Dam Safety Issue

CMB-S11E Perform Seismic Safety Review (SSR) in accordance with ER 1110-2-1806.

A Seismic Safety Review (SSR) in accordance with ER1110-2-1806 is required. Depending on the results of the SSR, a Dynamic Analysis may also be required.

Efficiency

CMB-A10N Install ADAS (Automated Data Acquisition System).

An ADAS (Automated Data Acquisition System) is needed to improve the monitoring of piezometric levels (internal pore water pressures) in the dam.

Facility Safety

CMB-O12E Revise and update Water Control Manual.

The District recognizes the need to revise the Water Control Manuals for a more detailed procedure outlining water management operations for all events.

Performance Monitoring

CMB-O04E Replace outlet control weir.

The outlet weir needs to be replaced. Installation would require a large crane, sheet-pile, and stone slope protection placed around the weir.

Recreation/Maintenance

CMB-S09E Repair concrete at spillway.

The uncontrolled secondary spillway, located at the right abutment adjacent to the outlet structure, discharges flow onto a deteriorated concrete terrace and then into the stilling basin. The length of the secondary spillway is 96.5 feet. Concrete repairs are required to the spalls in the spillway and restore spillway foundation drains on the lower two tiers.

Sustainability

CMB-C08E Repair parabolic transition into Sluice Gate #1.

The concrete upstream of Sluice Gate #1 has a spalled section missing overhead. The spalls in the concrete parabolic transition require repair.

CMB-E14P Rehabilitate electrical service systems.

Electrical service systems require updating in order to ensure sustainability over the next 50 years.

Charles Mill

PLAN OF ACTION TO CORRECT IDENTIFIED DEFICIENCIES

Sustainability

CMB-O15E **Replace motor operating stands for sluice gates with ones.**
The operating stands require replacement to ensure continued reliable operation over the next 50 years.

CMB-O20E **Rehabilitate overhead crane and trolley systems.**
Overhead crane and trolley system requires rehabilitation to ensure sustainability over the next 50 years.

CMB-P22E **Rehabilitation of sluice gates and operators.**
There is considerable leakage around sluice gates 2, 3, and 4 requiring repair; it appears to be emanating from the bottom of the gates. Corrosion preventative maintenance for all gates (both at the project and at Pavonia Levee) is needed to ensure continued reliability for the next 50 years. Service gate stems and guides are also deteriorated and require replacement.

CMB-R16E **Replace flap gate at Pavonia Levee.**
Replace 2-foot diameter flap gate to ensure continued reliable operation for the next 50 years.

CLENDENING LAKE

DESCRIPTION OF PROJECT

The construction of Clendening Dam was completed in June 1936 on the Brushy Fork of Stillwater Creek, 184.4 miles upstream from the mouth of the Muskingum River. The embankment is rolled earth with an impervious core, having a maximum height of 64 feet. The crest length of the dam is 950 feet at elevation 925.5.

Figure 7. General view of intake structure and service bridge at Clendening Lake, OH 08 December 2003

The outlet works are located near the right abutment and consist of an approach channel, intake structure, horseshoe-shaped tunnel, stilling basin, and outlet channel. Access to the intake structure is provided by a 10-foot service bridge.

The spillway is located approximately 230 feet northwest of the right abutment. It is an unlined, uncontrolled saddle type that has an approximate crest length of 128 feet and a crest elevation of 910.5 feet. A two-lane, 18-foot wide bridge that spans the spillway allows access to the operating house.

Clendening

PLAN OF ACTION TO CORRECT IDENTIFIED DEFICIENCIES

Dam Safety Issue

CLB-H01A Raise dam and parapet wall.

Dam embankment is below original height due to settlement. The dam is below the as constructed height by 1.0 to 1.8 feet. At this elevation, the project can only pass 80.5% of the Probable Maximum Flood (PMF) without overtopping. LRD has recommended that the district program O & M funds to raise the dam to its original height. However, at that elevation the project can only pass 91% of the PMF without overtopping. The dam needs to be raised to the appropriate height to pass the PMF.

CLB-H04E Perform structural evaluation on tunnel to resolve hydrogen sulfide problems.

The tunnel is expected to require relining. During the summer months, lower depths of the lake form high levels of hydrogen sulfide. The service gates release water from these depths causing the tunnel concrete to be exposed to the hydrogen sulfide. A structural evaluation needs to be performed to determine the severity of tunnel erosion, the exact plan of action, and if a liner is truly needed.

CLB-H05E Remediate tunnel according to study (re-lining).

Hydrogen sulfide has increased the rate of deterioration in the concrete tunnel and consequently the tunnel will require relining. Trial patches of tunnel coatings were examined in March 1994 at various locations and appeared to hold up well. Relining the tunnels will be required to prevent further damage.

CLB-P02E Widen spillway to reduce plugging issues.

The uncontrolled saddle-type spillway at the right (west) abutment has a crest width of 128 feet at elevation 910.5. The spillway is unlined and narrows to 60 feet wide at a distance 200 feet downstream of the crest. The spillway needs to be widened to reduce plugging issues.

CLB-S15E Perform Seismic Safety Review (SSR) in accordance with ER 1110-2-1806.

A Seismic Safety Review (SSR) in accordance with ER1110-2-1806 is required. Depending on the results of the SSR, a Dynamic Analysis may also be required.

Clendening

PLAN OF ACTION TO CORRECT IDENTIFIED DEFICIENCIES

Efficiency

CLB-A14N Install ADAS (Automated Data Acquisition System).
An ADAS (Automated Data Acquisition System) is needed to improve the monitoring of piezometric levels (internal pore water pressures) in the dam.

Erosion Control

CLB-E08T Study and remediate erodibility issues.
Potential problems result from an unlined spillway (except for sill) and erodible rock in these unlined portions. An erodibility study is required to determine the extent of problem and appropriate remedial action.

CLB-S06L Place stone on downstream face.
The stone on the downstream slope face was noted to be weathering in various locations and in particular in the middle portion of the embankment face. Approximately 1000 cubic yards of additional stone should be placed on the downstream face.

Facility Safety

CLB-O16E Revise and update Water Control Manual.
The District recognizes the need to revise the Water Control Manuals for a more detailed procedure outlining water management operations for all events.

Sustainability

CLB-C19A Sandblast/paint sluice gates.
Corrosion preventative maintenance for the sluice gates is needed to ensure continued reliable operation over the next 50 years.

CLB-E17P Rehabilitate electrical service systems.
Electrical service systems require updating in order to ensure sustainability over the next 50 years.

Clendening

PLAN OF ACTION TO CORRECT IDENTIFIED DEFICIENCIES

Sustainability

CLB-M03O Modify intake structure for selective withdrawal.
Lake water at the current intake elevation contains a high concentration of hydrogen sulfide that causes safety and environmental hazards as well as structural damage to the outlet structure. The plan of action is to modify the current intake with a selective withdrawal system designed to reduce the hydrogen sulfide in the outflow and improve water quality downstream.

CLB-M18E Replace motor operated floor stands with hydraulic cylinders.
Motor operating stands require replacement to ensure sustainability. A new hydraulic actuated system would more effectively integrate with remote control capability.

CLB-O13E Replace out-dated emergency generator.
The current 30kW generator needs to be replaced as it is nearing the end of its design life.

CLB-O20E Rehabilitate overhead crane and trolley systems.
Overhead crane and trolley system requires rehabilitation to ensure sustainability over the next 50 years.

CLB-T07N Initiate preventive maintenance on relief wells.
Preventative maintenance is required on Clendening's twelve (12) relief wells in operation since 1979.

CLB-T09E Replace trash racks.
The trash racks are deteriorated due to hydrogen sulfide and will require replacement. There are nine racks whose dimensions are 6.25-feet by 13-feet.

DILLON LAKE

DESCRIPTION OF PROJECT

The construction of Dillon Dam was completed in September 1961 on the Licking River, 83.4 miles upstream of the mouth of the Muskingum River. The embankment is rolled earth with an impervious core, having a maximum height of 118 feet. The crest length of the dam is 1400 feet at elevation 818.

Figure 8. General view of the intake structure and part of the u/s face of the embankment. 2003 August 01

The outlet works consist of an intake structure, stilling basin, and outlet channel. Access to the intake structure is provided by a three span service bridge that is 13'-11" feet wide (curb-curb).

The spillway is located near the left abutment. It is a partially lined, uncontrolled broad-crested chute type that has an approximate crest length of 292 feet and a crest elevation of 790 feet. Three reinforced concrete piers support a concrete bridge over the spillway to provide access to the top of the dam and the control tower from the left abutment.

Two earth fill dikes associated with the project are located north of the dam. The Nashport Dike, which is located about 8.5 miles northwest of the dam, is 48 feet high and 1,500 feet long. The Pleasant Valley Dike, located about 3.5 miles north of the dam, is 38 feet high and 1,404 feet long.

Dillon

PLAN OF ACTION TO CORRECT IDENTIFIED DEFICIENCIES

Dam Safety Issue

DIL-I03U **Purchase real estate and build two dikes to correct saddled depressions under spillway crest elevation.**

As noted in the Water Control Manual, natural saddled depressions are under the spillway crest elevation. Two dikes are needed including the real estate where they will be constructed.

DIL-R01A **Raise dam and add parapet wall along dam and dikes.**

The dam embankment is below original height and may not be capable of passing the Probable Maximum Flood (PMF) with adequate freeboard. The dam needs to be raised and a parapet wall constructed along the dam and dikes.

DIL-S02E **Remediate spillway to reduce plugging issues.**

There is potential for the spillway to become plugged, therefore the spillway needs widened to reduce plugging concerns. The concrete sill and floor slabs have some scattered cracking and spalling at the joints; the walls exhibit some spalling, especially at the joints, and some efflorescence is visible on the walls. The unlined portions of the spillway also contain some minor sloughing of rock and loose debris. Concrete repairs are required as well as rehabilitation of unlined portions of the spillway.

DIL-S29E **Perform Seismic Safety Review (SSR) in accordance with ER 1110-2-1806.**

A Seismic Safety Review (SSR) in accordance with ER1110-2-1806 is required. Depending on the results of the SSR, a Dynamic Analysis may also be required.

Efficiency

DIL-D16N **Install drift boom to help with debris issues.**

Due to high-water, drift and debris collects at the intake structure and needs to be removed. A drift boom needs to be installed to help with this problem.

DIL-P26E **Redesign maintenance bulkhead for easier installation and replacement.**

The maintenance bulkheads are difficult to install. A new system needs to be designed and implemented.

Dillon

PLAN OF ACTION TO CORRECT IDENTIFIED DEFICIENCIES

Efficiency

DIL-S21M Install ADAS (Automated Data Acquisition System).
An ADAS (Automated Data Acquisition System) is needed to improve the monitoring of piezometric levels (internal pore water pressures) in the dam.

Erosion Control

DIL-R06L Place stone slope protection (SSP) along several areas of the
Approximately 2,000 cubic yards of SSP on the upstream right side of the approach channel, at the Pleasant Valley dike inlet, and on the downstream left side of the outlet channel embankment is required to reduce erosion concerns.

Facility Safety

DIL-C04H Change stoplog closure to swing gate and make embankment repairs.
A swing gate is needed at the railroad closure to alleviate resource and time concerns associated with installing the existing stoplog system during a high water event. Embankment repairs will also have to be made adjacent to the railroad closure.

DIL-O30E Revise and update Water Control Manual.
The District recognizes the need to revise the Water Control Manuals for a more detailed procedure outlining water management operations for all events.

Recreation/Maintenance

DIL-P05A Pave access roads & parking lots.
Pavement is needed for the fisherman's access road, parking lot, and pond parking lot. This is an estimated area of approximately 72,000 square feet. The blacktop on the access road needs to be resurfaced from the spillway, across the dam and railroad, and to the parking lots above the dam. The parking lots above the dam also needs to be resurfaced. This is an estimated area of 60,000 square feet.

DIL-R18E Replace bridge over spillway and service bridge to intake
The decking and beams on the spillway bridge and service bridges need to be replaced. The spillway bridge is approximately 327 feet long and 24 feet wide, while the service bridge is about 265 feet long and 16 feet wide.

Dillon

PLAN OF ACTION TO CORRECT IDENTIFIED DEFICIENCIES

Sustainability

DIL-B32E **Replace low flow gate valves for sustainability.**
Both pair of 42" butterfly and 42" low flow gate valves need to be replaced for sustainability.

DIL-C09A **Sandblast and paint three sluice gates, emergency gate, gate guides, tunnel liner, and hoist machinery.**
The outlet works consist of an intake structure with three 8-foot by 16-foot gated sluices discharging through a 20-foot diameter conduit in the right abutment into the stilling basin. Sandblast and paint the three sluice gates, emergency gate, gate guides, tunnel liner, hoist machinery, and crane to ensure continued reliability.

DIL-D17E **Repair slide in downstream outflow channel.**
The downstream stilling basin wall is partially blocked due to rip-rap and embankment material collecting on the training wall and channel, restricting outflow. The recommendation is to repair the slide of earth and embankment in the downstream outflow channel.

DIL-E31P **Rehabilitate electrical service systems.**
Electrical service systems require updating in order to ensure sustainability over the next 50 years.

DIL-O27E **Rehabilitate overhead crane and trolley systems.**
Overhead crane and trolley system requires rehabilitation to ensure sustainability over the next 50 years.

DIL-P33E **Replace Pleasant Valley Dike gate stems and stem guides.**
Pleasant Valley Dike gate stems and guides are deteriorated and require replacement to ensure sustainability.

DIL-T20N **Initiate preventative maintenance on relief wells.**
As recommended by USACE regulation, preventative maintenance is required on Dillon's seven relief wells in operation since 1959.

DIL-W08E **Replace wire rope for service gates.**
Replacement of deteriorated wire rope at the service gates is required. The wire rope is approximately 1750 feet long, and 1.5 inches in diameter.

DIL-W34E **Refurbish gate hoist machinery.**
Hoist equipment and components (sheaves, brakes, motors, etc) require rehabilitation to ensure sustainability over the next 50 years.

DOVER DAM

DESCRIPTION OF PROJECT

Dover Dam

The construction of Dover Dam was completed in 1938 on the Tuscarawas River, 173.6 miles upstream of the mouth of the Muskingum River. Dover Dam is a concrete gravity structure, having a maximum height of 83 feet. The crest length of the dam is 824 feet at elevation 931.

Figure 9. General view of ogee spillway at Dover Dam, OH.

The outlet works are located at the base of the spillway and consist of a stilling basin and 18 gate-controlled conduits. The spillway is situated in the central portion of the concrete structure. It is an uncontrolled ogee spillway that has a crest length of 338 feet and a crest elevation of 916 feet. Dover Dam has operated as a dry dam since 1941.

Zoar Levee

Zoar Levee is located 4 miles north of Dover Dam and protects the historic town of Zoar, Ohio. This levee spans 3,893 feet at a crest elevation of 928.5 feet. Appurtenant structures include a gated concrete culvert, pump station, and Zoar Diversion dam.

Figure 10. Zoar Levee.

Zoar Diversion Dam

The Zoar Diversion Dam is approximately 500 feet long and 35 feet high. This small dam impounded Goose Run Lake, but was drained in 1992. A lake was never authorized to be impounded by this dam.

Figure 11. Zoar Diversion Dam.

Somerdale Levee

Somerdale Levee is located 3 miles east of the dam and protects the town of Somerdale, Ohio. It consists of a 4,070 feet long railroad embankment constructed of impervious material to form a levee. Design crest elevation of the levee is 919.0. Three gated culverts and two flap gate drains are part of this levee

Three small industrial levees were built to provide protection to El. 919.0 for the Corundite Refractories at Zoar (now defunct), the Fairfield Brick Company at Zoarville (now defunct), and the U.S. Brick Company (formerly Norton Chemical) at Mineral City.

Dover

PLAN OF ACTION TO CORRECT IDENTIFIED DEFICIENCIES

Dam Safety Issue

DOT-P08E **Perform hydrologic deficiency and underseepage study at Zoar Levee; remediate concerns according to the study results.**
Underseepage and hydrologic deficiency studies are needed to define the extent of these issues along with alternatives for remediation. Prepare final design and implement action based on study results.

DOT-P09E **Perform hydrologic deficiency & underseepage study at Zoar Diversion Dam.**
Underseepage and hydrologic deficiency studies are needed to define the extent of these issues along with alternatives for remediation.

DOT-P10E **Remediate Zoar Diversion Dam according to study results.**
Prepare final design and implement action to remediate underseepage and hydrologic concerns based on study results.

DOT-P15R **Prepare Emergency Action Plan for Zoar Diversion Dam.**
An Emergency Action Plan (EAP) should be prepared for the Zoar Diversion Dam.

DOT-P30M **Perform structural reanalysis and hydrologic deficiency studies on Dover Dam; implement remedial measures based on the studies results.**
Structural reanalysis is required due to weak foundation rock below the concrete gravity dam structure. The structure is thought to be unstable at pools slightly above spillway elevation 916 (elevation equivalent to a 180-year flood event). Hydrologic studies are required to assess concerns of overtopping; currently, the probable maximum flood overtops the project by nine feet. Potential remedial actions include anchoring the dam to bedrock with high capacity rock anchors, raising the dam, lowering the spillway, creating an auxiliary spillway, or some combination thereof.

DOT-S16E **Perform underseepage and instability study for Somerdale Levee.**
Perform study to identify the extent of underseepage and instability concerns and potential remedial measures.

DOT-S17M **Implement underseepage and instability fix for Somerdale Levee.**
Design and implement remedial action based on study results to alleviate underseepage and instability concerns.

Dover

PLAN OF ACTION TO CORRECT IDENTIFIED DEFICIENCIES

Dam Safety Issue

DOT-S19E **Perform Seismic Safety Review (SSR) in accordance with ER 1110-2-1806.**

A Seismic Safety Review (SSR) in accordance with ER1110-2-1806 is required. Depending on the results of the SSR, a Dynamic Analysis may also be required.

Efficiency

DOT-A18N **Install ADAS (Automated Data Acquisition System).**

An ADAS (Automated Data Acquisition System) is needed to improve the monitoring of piezometric levels (internal pore water pressures) in the dam.

DOT-P27E **Design and install an additional pump for the Zoar Levee pump station.**

An additional pump is needed in the pump station in order to evacuate additional internal drainage due to inadequacies with the Zoar Diversion Dam.

Facility Safety

DOT-M13E **Design and construct small to mid size pump station at Somerdale Levee (approx. 8000 GPM).**

A study is needed to size a pump station for Somerdale Levee. The next step would be to install the pump station based on the results of the study.

DOT-O20E **Revise and update Water Control Manual.**

The District recognizes the need to revise the Water Control Manuals for a more detailed procedure outlining water management operations for all events.

Sustainability

DOT-C23A **Sandblast and paint service gates and levee gates.**

Corrosion preventative maintenance is required for the service gates and levee gates to ensure continued reliable operation over the next 50 years.

DOT-D12N **Analyze and repair concrete deterioration problems throughout the project.**

Repair deteriorated concrete in the division walls, splash walls, ogee, training walls, and the longitudinal crack in the gallery ceiling.

DOT-E04M **Emergency generator for control structure.**

The 50kW emergency generator for the control structure needs to be replaced due to age and unavailability of repair parts.

Dover

PLAN OF ACTION TO CORRECT IDENTIFIED DEFICIENCIES

Sustainability

DOT-E21P **Rehabilitate electrical service systems.**
Electrical service systems require updating in order to ensure sustainability over the next 50 years.

DOT-P25E **Replace pumps and motors at Zoar Levee pump station.**
Pumps and motors at Zoar Levee pump station need replaced to ensure sustainability over the next 50 years.

DOT-R11E **Perform maintenance on Zoar Levee relief wells.**
Preventative maintenance is required on the relief wells.

DOT-S26E **Replace flap gates at Somerdale Levee.**
Somerdale Levee flap gates (approximately 18" diameter) need to be replaced to ensure continued reliable operation over the next 50 years.

DOT-T22E **Rehabilitate the hydraulic cylinders for the slide gates throughout the dam structure.**
The eighteen hydraulic cylinders that actuate the slide gates in the dam structure need a detailed inspection and overhaul to ensure sustainability.

DOT-T24E **Replace gate stems and guides for gatewells at Zoar Levee, Zoar Diversion Dam, and Somerdale Levee.**
The gate stems and guides at Zoar, Somerdale, and Zoar Diversion Dam gatewells are deteriorated and require replacement to ensure sustainability.

DOT-Z03U **Purchase emergency generator for Zoar pump station.**
Purchase emergency generator for Zoar pump station to ensure continued reliable operation over the next 50 years.

LEESVILLE LAKE

DESCRIPTION OF PROJECT

The construction of Leesville Dam was completed in October 1936 on McGuire Creek, which is a tributary of Conotton Creek of the Tuscarawas River, 196.4 miles upstream of the mouth of the Muskingum River. The embankment is rolled earth with an impervious core, having a maximum height of 75 feet. The crest length of the dam is 1695 feet at elevation 990. In 1984, a concrete parapet wall was placed on the upstream crest of the dam to elevation 995.1 NGVD (National Geodetic Vertical Datum).

Figure 12. General view of intake structure and service bridge at Leesville Lake, OH. 29 April 2003.

The outlet works are located in the right abutment and consist of an approach channel, intake structure, horseshoe-shaped tunnel, open-cut conduit section, stilling basin, and outlet channel. Access to the intake structure is provided by a service bridge that is 12 feet wide (curb-curb).

The spillway is located approximately 750 feet from the left abutment. It is a concrete lined, uncontrolled saddle type that has an approximate crest width of 150 feet and a crest elevation of 977.5 feet.

Leesville

PLAN OF ACTION TO CORRECT IDENTIFIED DEFICIENCIES

Dam Safety Issue

LEM -H02E Perform structural evaluation on tunnel to resolve hydrogen sulfide problems.

The tunnel is expected to require relining. During the summer months, lower depths of the lake form high levels of hydrogen sulfide. The service gates release water from these depths causing the tunnel concrete to be exposed to the hydrogen sulfide. A structural evaluation needs to be performed to determine the severity of tunnel erosion, the exact plan of action, and if a liner is truly needed.

LEM -H03E Remediate tunnel according to study (re-lining).

Hydrogen sulfide has increased the rate of deterioration in the concrete tunnel and consequently the tunnel will require relining. Trial patches of tunnel coatings were examined in March 1994 at various locations and appeared to hold up well. Relining the tunnels will be required to prevent further damage.

LEM -S12E Perform Seismic Safety Review (SSR) in accordance with ER 1110-2-1806.

A Seismic Safety Review (SSR) in accordance with ER1110-2-1806 is required. Depending on the results of the SSR, a Dynamic Analysis may also be required.

Efficiency

LEM -A11N Install ADAS (Automated Data Acquisition System).

An ADAS (Automated Data Acquisition System) is needed to improve the monitoring of piezometric levels (internal pore water pressures) in the dam.

Erosion Control

LEM -S08L Place stone on downstream bank of outlet channel.

Significant erosion was noted on the left descending bank, downstream of the outlet channel, under the gage house. Some of the stone slope protection (SSP) has migrated down slope towards the channel, leaving some areas of the left descending bank without stone protection. Additional SSP is also needed downstream of the outlet channel and under the gage house. The recommendation is to replace approximately 1000 cubic yards of stone on the channel bank.

Facility Safety

LEM -O13E Revise and update Water Control Manual.

The District recognizes the need to revise the Water Control Manuals for a more detailed procedure outlining water management operations for all events.

Leesville

PLAN OF ACTION TO CORRECT IDENTIFIED DEFICIENCIES

Recreation/Maintenance

LEM -C06E Remove old clay drain and re-grade benches on dam.
The clay tile drainage system continues to deteriorate and is wholly inadequate. The recommended plan of action is to remove the old clay tile and re-grade the benches on the dam to achieve positive drainage.

LEM -S04O Concrete repairs to stilling basin wall.
Crane hook within the operating house does not employ a lockable safety latch. By safety regulation, crane hooks are required to have a lockable safety latch.

LEM -V07E Replace outlet control weir.
The V-notch weir in the outlet channel is in danger of collapsing and requires replacement.

Sustainability

LEM -C16A Sandblast and paint service gates.
Corrosion preventative maintenance for the service gates is needed to ensure continued reliable operation over the next 50 years.

LEM -E15E Rehabilitate electrical service systems.
Electrical service systems require updating in order to ensure sustainability over the next 50 years.

LEM -M01O Modify intake structure for selective withdrawal.
Lake water at the current intake elevation contains a high concentration of hydrogen sulfide that causes safety and environmental hazards as well as structural damage to the outlet structure. The plan of action is to modify the current intake with a selective withdrawal system designed to reduce the hydrogen sulfide in the outflow and improve water quality downstream.

LEM -M14E Replace motor operated floor stands with hydraulic cylinders.
Motor operating stands require replacement to ensure sustainability. A new hydraulic actuated system would more effectively integrate with remote control capability.

LEM -O17E Rehabilitate overhead crane and trolley systems.
Overhead crane and trolley system requires rehabilitation to ensure sustainability over the next 50 years.

LEM -T06N Initiate preventive maintenance on relief wells.
Preventative maintenance is required on Leesville's twelve (12) relief wells that have been in operation since 1977.

Leesville

PLAN OF ACTION TO CORRECT IDENTIFIED DEFICIENCIES

Sustainability

LEM -T09E Replace trash racks.

The trash racks are deteriorated due to hydrogen sulfide and require replacement. There are six trash racks whose dimensions are 6-feet 3-inches wide and 11-feet 7.5-inches tall.

MOHAWK DAM

DESCRIPTION OF PROJECT

The construction of Mohawk Dam was completed in 1937 on the Walhonding River, 129.8 miles upstream of the mouth of the Muskingum River. The embankment is rolled earth with an impervious core, having a maximum height of 115.5 feet. The crest length of the dam is 2300 feet at elevation 914.5. A 3-foot concrete parapet wall was installed at the dam to provide freeboard protection.

Figure 13. General view of intake structure at Mohawk Dam, OH. September 2003.

The outlet works are located in the left abutment and consist of an approach channel, intake structure, horseshoe-shaped tunnel and conduit, stilling basin, and outlet channel. Access to the intake structure is provided by a service bridge that is 12 feet wide (curb-curb).

The spillway is located just beyond the left abutment. It is an uncontrolled saddle type that has an approximate crest length 657 feet and a crest elevation of 890 feet.

Mohawk

PLAN OF ACTION TO CORRECT IDENTIFIED DEFICIENCIES

Dam Safety Issue

MKW-R01E Remediate seepage concerns at terrace areas and along the old stream channel.

There are several alternatives for eliminating seepage. First, an upstream impervious blanket could be tied into an impervious section of the dam. Second, enhanced drainage features could be used but will be ineffective in areas where the dam's foundation deposits contain highly pervious glacial outwash and open work gravel. However, these two alternatives only partially reduce underseepage. To get a complete correction to underseepage, a cutoff or partial cutoff wall (slurry trench or concrete panel) should be considered. In this case a segmental concrete cut off wall has been recommended to control underseepage. The wall panels average 25-foot in length and are constructed by slurry methods. The wall could possibly be located through the embankment and keyed into bedrock, which would provide an effective seepage barrier through the full foundation depth as well as the full random fill embankment height. This segmental concrete cut-off wall is the most positive solution from any of the solutions listed above and also provides the least amount of future operational efforts.

MKW-S14E Perform Seismic Safety Review (SSR) in accordance with ER 1110-2-1806.

A Seismic Safety Review (SSR) in accordance with ER1110-2-1806 is required. Depending on the results of the SSR, a Dynamic Analysis may also be required.

MKW-S18U Purchase and stockpile sandbags and filter material for emergency use.

Sandbags and stockpiles of filter material are not readily available for building seepage blankets or to remediate other dam safety deficiencies in emergency conditions.

Efficiency

MKW-A13N Install ADAS (Automated Data Acquisition System).

An ADAS (Automated Data Acquisition System) is needed to improve the monitoring of piezometric levels (internal pore water pressures) in the dam.

Facility Safety

MKW-O15E Revise and update Water Control Manual.

The District recognizes the need to revise the Water Control Manuals for a more detailed procedure outlining water management operations for all events.

Mohawk

PLAN OF ACTION TO CORRECT IDENTIFIED DEFICIENCIES

Recreation/Maintenance

MKW-D06E Replace the deck of the service bridge.

The deck of the service bridge requires repair due to deterioration. The dimensions of the deck are approximately 15-feet 4-inches by 95-feet.

Sustainability

MKW-A02D Add additional 2 feet of fill to the filter blanket material & raise relief wells and piezometers.

An additional 2 feet of filter blanket material was noted to be necessary: To provide sufficient relief against excessive uplift pressure, an additional 2 feet of fill material is needed on the filter blanket. The area of the filter blanket is approximately 520,000 square feet; therefore this would require about 38,500 cubic yards of fill material.

MKW-B08A Sandblast and paint beams and crane rails in the operating house at the intake structure.

Sandblasting and painting of the beams and crane rails within the operating house at the intake structure are needed to remediate corrosion problems. It is noted that the beams within the operating house contain lead paint that will require appropriate containment.

MKW-E16P Rehabilitate electrical service systems.

Electrical service systems require updating in order to ensure sustainability over the next 50 years.

MKW-M04E Repair concrete within the stilling basin walls, center pier, and intake bridge.

Concrete within the stilling basin walls, center pier, and intake bridge has become deteriorated and requires repair.

MKW-O17E Rehabilitate overhead crane and trolley systems.

Overhead crane and trolley system requires rehabilitation to ensure sustainability over the next 50 years.

MKW-T05N Initiate preventative maintenance on relief wells.

As recommended by USACE regulation, preventative maintenance is required on Mohawk's 21 relief wells in operation since 1975.

MKW-W07E Refurbish gate hoist machinery and replace wire ropes.

Wire rope for gate hoist needs to be replaced. Hoist equipment and components (sheaves, brakes, motors, etc) require rehabilitation to ensure sustainability over the next 50 years.

MOHICANVILLE DAM

DESCRIPTION OF PROJECT

The construction of Mohicanville Dam was completed in 1936 on Lake Fork of the Mohican River, 171.2 miles upstream of the mouth of the Muskingum River. The embankment is rolled earth with an impervious core, having a maximum height of 46 feet. The crest length of the dam is 1220 feet at elevation 978.8. Atop the dam is a parapet wall that extends to elevation 982.

Figure 14. General view of intake structure & service bridge at Mohicanville Dam 24 September 2003

The outlet works are located in the left abutment and consist of an approach channel, intake structure, concrete-lined channel, stilling basin, and outlet channel. Access to the intake structure is provided by means of a roadway on top of the earthen embankment.

The spillway is located at the left abutment adjacent to the intake structure. It is an uncontrolled concrete structure that consists of an ogee weir gravity section that is 90 feet wide with a crest elevation of 963 feet.

Two earth fill dikes associated with the project are located southeast of the dam. Dike Number 1, which is located about four miles from the dam, is 11 feet high and 925 feet long. Dike Number 2, which is located about five miles from the dam, is 25 feet high and 2177 feet long.

Mohicanville

PLAN OF ACTION TO CORRECT IDENTIFIED DEFICIENCIES

Dam Safety Issue

MOL-S05E Perform Seismic Safety Review (SSR) in accordance with ER 1110-2-1806.

A Seismic Safety Review (SSR) in accordance with ER1110-2-1806 is required. Depending on the results of the SSR, a Dynamic Analysis may also be required.

Efficiency

MOL-A04N Install ADAS (Automated Data Acquisition System).

An ADAS (Automated Data Acquisition System) is needed to improve the monitoring of piezometric levels (internal pore water pressures) in the dam.

Facility Safety

MOL-O06E Revise and update Water Control Manual.

The District recognizes the need to revise the Water Control Manuals for a more detailed procedure outlining water management operations for all events.

Recreation/Maintenance

MOL-I02E Remove and replace catwalk on u/s side of intake structure.

Currently, there is limited access to the spillway due to the condition of the catwalk on the upstream side of the intake structure. In order to provide adequate access to the spillway for maintenance purposes, approximately 65 feet of catwalk on the on the upstream side of the intake structure needs to be replaced. This will provide adequate access to the spillway for maintenance purposes.

Sustainability

MOL-B08E Replace backup generator.

The backup generator needs to be replaced to ensure continued reliable operation over the next 50 years.

MOL-D07E Replace three 7' x 12' tractor gates.

Due to the level of deterioration of three 7' x 12' tractor gates, replacement is required to ensure continued reliable operation over the next 50 years.

MOL-E11P Rehabilitate electrical service systems.

Electrical service systems require updating in order to ensure sustainability over the next 50 years.

Mohicanville

PLAN OF ACTION TO CORRECT IDENTIFIED DEFICIENCIES

Sustainability

MOL-O10E **Rehabilitate overhead crane and trolley systems.**
Overhead crane and trolley system requires rehabilitation to ensure sustainability over the next 50 years.

MOL-W09E **Refurbish gate hoist machinery and replace wire ropes.**
Wire rope for gate hoist needs to be replaced. Hoist equipment and components (sheaves, brakes, motors, etc) require rehabilitation to ensure sustainability over the next 50 years.

NORTH BRANCH OF KOKOSING LAKE

DESCRIPTION OF PROJECT

The construction of North Branch of Kokosing Dam was completed in May 1972 on the North Branch of Kokosing River, 2.2 miles northwest of Fredericktown. The embankment is rolled earth with an impervious core, having a maximum height of 70.5 feet. The crest length of the dam is 1400 feet at elevation 1169.

Figure 15. General view of the embankment at North Branch of Kokosing Lake, OH. 19 August 2003.

The outlet works are located in the right abutment and consist of an intake structure, open-cut conduit, stilling basin, and outlet channel. Access to the intake structure is by project maintenance boat only. The spillway is located just beyond the right abutment. It is a concrete-lined, uncontrolled broad-crested type that has a crest width of 60 feet and a crest elevation of 1146 feet. In addition, a dike, approximately 5 feet high and 580 feet long was constructed across a low area beyond the left abutment contact.

North Branch of Kokosing

PLAN OF ACTION TO CORRECT IDENTIFIED DEFICIENCIES

Dam Safety Issue

NBN-S02E **Perform Seismic Safety Review (SSR) in accordance with ER 1110-2-1806.**

A Seismic Safety Review (SSR) in accordance with ER1110-2-1806 is required. Depending on the results of the SSR, a Dynamic Analysis may also be required.

Efficiency

NBN-A01N **Install ADAS (Automated Data Acquisition System).**

An ADAS (Automated Data Acquisition System) is needed to improve the monitoring of piezometric levels (internal pore water pressures) in the dam.

Facility Safety

NBN-O03E **Revise and update Water Control Manual.**

The District recognizes the need to revise the Water Control Manuals for a more detailed procedure outlining water management operations for all events.

Sustainability

NBN-C04A **Sandblast and paint service gate.**

Corrosion preventative maintenance for the service gate is needed to ensure continued reliable operation over the next 50 years.

NBN-P05N **Initiate preventative maintenance on relief wells.**

As recommended by USACE regulation, preventative maintenance is required on North Branch of Kokosing's sixteen (16) relief wells.

PIEDMONT LAKE

DESCRIPTION OF PROJECT

The construction of Piedmont Dam was completed in 1937 on Stillwater Creek of the Tuscarawas River, 198 miles upstream of the mouth of the Muskingum River. The embankment is rolled earth with an impervious core, having a maximum height of 56 feet. The crest length of the dam is 1750 feet at elevation 937.6.

Figure 16. Intake structure at Piedmont Lake.

The outlet works are located in the left (north) abutment and consist of an approach channel, intake structure, horseshoe-shaped tunnel, stilling basin, and outlet channel. Access to the intake structure is provided by a service bridge that is 12 feet wide (curb-curb). The spillway is located west of the left abutment. It is a partially lined, uncontrolled saddle type that has an approximate crest width of 130 feet and a crest elevation of 924.6 feet.

Piedmont

PLAN OF ACTION TO CORRECT IDENTIFIED DEFICIENCIES

Dam Safety Issue

PES-H01A Raise embankment, spillway key, and relocate road.
Necessary work includes raising the dam embankment, constructing a concrete spillway key to resist erosion, and relocating the road across the dam.

PES-H04E Perform structural evaluation on tunnel to resolve hydrogen sulfide problems.
The tunnel is expected to require relining. During the summer months, lower depths of the lake form high levels of hydrogen sulfide. The service gates release water from these depths causing the tunnel concrete to be exposed to the hydrogen sulfide. A structural evaluation needs to be performed to determine the severity of tunnel erosion, the exact plan of action, and if a liner is truly needed.

PES-H05E Remediate tunnel according to study (re-lining).
Hydrogen sulfide has increased the rate of deterioration in the concrete tunnel and consequently the tunnel will require relining. Trial patches of tunnel coatings were examined in March 1994 at various locations and appeared to hold up well. Relining the tunnels will be required to prevent further damage.

PES-S12E Perform Seismic Safety Review (SSR) in accordance with ER 1110-2-1806.
A Seismic Safety Review (SSR) in accordance with ER1110-2-1806 is required. Depending on the results of the SSR, a Dynamic Analysis may also be required.

Efficiency

PES-A11N Install ADAS (Automated Data Acquisition System).
An ADAS (Automated Data Acquisition System) is needed to improve the monitoring of piezometric levels (internal pore water pressures) in the dam.

Facility Safety

PES-O13E Revise and update Water Control Manual.
The District recognizes the need to revise the Water Control Manuals for a more detailed procedure outlining water management operations for all events.

Piedmont

PLAN OF ACTION TO CORRECT IDENTIFIED DEFICIENCIES

Recreation/Maintenance

PES-D10E Repair concrete on stilling basin wall.
Spalling at the joints and scour at the base of the stilling basin steps requires repair.

PES-S09E Replace deck of Service Bridge.
Crane hook within the operating house does not employ a lockable safety latch. By safety regulation, crane hooks are required to have a lockable safety latch.

Sustainability

PES-B16E Replace backup generator.
The backup generator needs to be replaced to ensure continued reliable operation over the next 50 years.

PES-C15A Sandblast and paint service gates.
Corrosion preventative maintenance for the service gates is needed to ensure continued reliable operation over the next 50 years.

PES-E14P Rehabilitate electrical service systems.
Electrical service systems require updating in order to ensure sustainability over the next 50 years.

PES-M03O Modify intake structure for selective withdrawal.
Lake water at the current intake elevation contains a high concentration of hydrogen sulfide that causes safety and environmental hazards as well as structural damage to the outlet structure. The plan of action is to modify the current intake with a selective withdrawal system designed to reduce the hydrogen sulfide in the outflow and improve water quality downstream.

PES-M18E Replace motor operated floor stands with hydraulic cylinders.
Motor operating stands require replacement to ensure sustainability. A new hydraulic actuated system would more effectively integrate with remote control capability.

PES-O17E Rehabilitate overhead crane and trolley systems.
Overhead crane and trolley system requires rehabilitation to ensure sustainability over the next 50 years.

PES-S08A Sandblast and paint beams on the service bridge.
Extensive corrosion is present on the steel members of the service bridge. Sandblasting and painting of the beams is required to prevent further corrosion.

Piedmont

PLAN OF ACTION TO CORRECT IDENTIFIED DEFICIENCIES

Sustainability

PES-T06N **Initiate preventative maintenance on relief wells.**
As recommended by USACE regulation, preventative maintenance is required on Piedmont's eight (8) relief wells in operation since 1997.

PES-T07E **Replace trash racks.**
The trash racks are deteriorated due to hydrogen sulfide and require replacement. There are twelve (12) trash racks whose dimensions are 11-feet 2-inches by 6-feet 3-inches wide.

PLEASANT HILL LAKE

DESCRIPTION OF PROJECT

The construction of Pleasant Hill Dam was completed in 1937 on Clear Fork of the Mohican River, 169 miles upstream of the mouth of the Muskingum River. The embankment is rolled earth and rock fill with an impervious core having a maximum height of 113 feet. The crest length of the dam is 775 feet at elevation 1085.

Figure 17. Aerial view of Pleasant Hill dam.

The outlet works are located near the right abutment and consist of an intake structure, tunnel, stilling basin, and outlet channel. Flow is controlled by two 3.5 feet x 7.5 feet gated sluices, which discharge into a 14.25-foot diameter tunnel. Access to the intake structure is provided by a service bridge that is 6 feet wide.

An identifying feature of Pleasant Hill Lake is its morning glory (shaft) spillway, the only one of its type in the Huntington District. The morning glory spillway is located between the intake structure and the right abutment. It is an uncontrolled spillway with a 76-foot diameter entrance that transitions to a 19-foot diameter tunnel. The spillway crest is at an elevation of 1065 feet. The spillway transitions to the tunnel and then exits into a stilling basin at the beginning of the outlet channel. Pleasant Hill also has an auxiliary saddle spillway located approximately 1.5 miles north of the embankment. The auxiliary spillway has a crest length of 390 feet and a crest elevation of 1075 feet. In 2002, a fuse plug was constructed at the entrance of this spillway in order to add to the level of protection against the possibility of a breach caused by the erodability of the soils located there. The top of dike elevation is 1080.

Pleasant Hill

PLAN OF ACTION TO CORRECT IDENTIFIED DEFICIENCIES

Dam Safety Issue

PHC-A02R Prepare study and design for repairing spillway deficiency.
The morning glory spillway and auxiliary spillway are not capable of passing a PMF (Probable Maximum Flood). Perform hydrologic deficiency studies, review alternatives, prepare final design, and implement action to remediate these concerns based on study results.

PHC-P01L Plug low areas on reservoir rim.
Plug low areas on reservoir rim. Two dikes are required to be constructed, along with the required real estate purchase.

PHC-S10E Perform Seismic Safety Review (SSR) in accordance with ER 1110-2-1806.
A Seismic Safety Review (SSR) in accordance with ER1110-2-1806 is required. Depending on the results of the SSR, a Dynamic Analysis may also be required.

Efficiency

PHC-A09N Install ADAS (Automated Data Acquisition System).
An ADAS (Automated Data Acquisition System) is needed to improve the monitoring of piezometric levels (internal pore water pressures) in the dam.

Facility Safety

PHC-O11E Revise and update Water Control Manual.
The District recognizes the need to revise the Water Control Manuals for a more detailed procedure outlining water management operations for all events.

Recreation/Maintenance

PHC-C06O Morning glory spillway concrete repair.
The concrete surface of the morning glory spillway is deteriorated and requires repair.

PHC-S03A Patch spalls in tunnel.
The morning glory spillway transitions to a 19-foot diameter tunnel, which is also the controlled outlet tunnel. This tunnel is about 700 feet long and exits into a stilling basin at the beginning of the outlet channel. Areas of spalled concrete and minor leakage along the monolith joints exist, as well as other minor cracking and efflorescence around the periphery of both tunnels. The progression of the spalls in the concrete is a gradual phenomena associated with freeze-thaw cycles. Large spalls of leakage exist at monolith joints 2, 20, and 21.

Pleasant Hill

PLAN OF ACTION TO CORRECT IDENTIFIED DEFICIENCIES

Recreation/Maintenance

PHC-S05E **Remove stones from the stilling basin and outlet channel, repair stilling basin wall deterioration, and construct improved rock slope adjacent to stilling basin.**

Rocks and soil from the right hillside continually fall into the stilling basin. A significant amount of debris exists in the stilling basin as seen during dewatering of the basin in 2005. The baffles that dissipate the energy of the water coming out of the tunnel are also completely covered with debris. As a result, high discharge flows could cause excessive erosion of the banks and possibly the toe of the dam. Work is required to remove stones from the stilling basin and outlet channel, and repair the stilling basin wall deterioration. Design and construction of an improved rock slope is also needed to remediate erosion concerns.

Sustainability

PHC-B15E **Replace backup generator.**

The backup generator needs to be replaced to ensure continued reliable operation over the next 50 years.

PHC-C16A **Sandblast and paint service gates.**

Corrosion preventative maintenance for the service gates is needed to ensure continued reliable operation over the next 50 years.

PHC-E12P **Rehabilitate electrical service systems.**

Electrical service systems require updating in order to ensure sustainability over the next 50 years.

PHC-O13E **Replace motor operating stands for sluice gates with ones.**

The operating stands require replacement to ensure continued reliable operation over the next 50 years.

PHC-O14E **Rehabilitate overhead crane and trolley systems.**

Overhead crane and trolley system requires rehabilitation to ensure sustainability over the next 50 years.

PHC-T07L **Cleaning and painting of trash racks.**

The existing trash racks are corroded and require sandblasting and painting. There are two sets of trash racks. There are eighteen upper trash racks that are 6-feet 7-inches by 7.5-feet, and eight lower trash racks that are 7-feet 2.5-inches” by 12-feet 7.25 inches.

PHC-T17E **Replace service gate stems and guides.**

The service gate stems are deteriorated and require replacement to ensure sustainability.

SENECAVILLE LAKE

DESCRIPTION OF PROJECT

The construction of Senecaville Dam was completed in 1936 on Seneca Fork of Wills Creek, 188 miles upstream of the mouth of the Muskingum River. The embankment is separated into two sections by a low, rock knoll. Both embankments are rolled impervious fill with a downstream rock shell, having a maximum height of 49 feet. The crest length of the dam is 2350 feet at elevation 857. In 1991 under the Dam Safety Assurance Program (DSA), the embankments were raised to an elevation of 861.1 feet. A parapet wall, which has a top elevation of 863.8 feet, provides 4.6 feet of freeboard above the maximum pool elevation of 859.2 feet.

Figure 18. Aerial view of Senacaville Lake. The north and south embankments are separated by the intake structure and spillway.

The combined outlet works and spillway structure are located on the rock knoll near the center of the embankment and consist of an intake structure, concrete lined discharge channel, stilling basin, and outlet channel. Normal flow is controlled by two 3.5 feet x 7.5 feet gated sluices. The intake structure is flanked by two control weirs, which are controlled by tainter gates. The tainter gates, in the closed position, form a portion of the spillway crest length. The remaining portion of the spillway consists of two uncontrolled overflow ogee weir sections, situated at the outer ends. The spillway has a total crest length of 73 feet and a crest elevation of 842.5 feet. Access to the intake structure is provided by a two-lane highway bridge that spans the overflow section.

In 1982, a 75-foot filter blanket was constructed downstream of the north embankment, and a 300-foot filter blanket was constructed downstream of the south embankment. Seven relief wells (three below the north embankment and four below the south embankment) were added in 1985.

Senecaville

PLAN OF ACTION TO CORRECT IDENTIFIED DEFICIENCIES

Dam Safety Issue

SES-S15E **Perform Seismic Safety Review (SSR) in accordance with ER 1110-2-1806.**

A Seismic Safety Review (SSR) in accordance with ER1110-2-1806 is required. Depending on the results of the SSR, a Dynamic Analysis may also be required.

Efficiency

SES-A14N **Install ADAS (Automated Data Acquisition System).**

An ADAS (Automated Data Acquisition System) is needed to improve the monitoring of piezometric levels (internal pore water pressures) in the dam.

SES-P09E **Remote gage readings to the office.**

Remoted gage readings would provide real-time monitoring of water levels improving water control capabilities. This would consist of a control system for the intake structure.

SES-P18E **Redesign maintenance bulkhead for easier installation.**

The maintenance bulkhead is difficult to install and will not seat under flowing conditions. A new system needs to be designed and implemented.

Erosion Control

SES-A02L **Place stone slope protection (SSP) in the upstream side of dam on the north and south embankments.**

About 200 -300 feet of the shore line along the north embankment needs SSP. There are also areas along the south embankment to be lined. The total SSP required is approximately 700 cubic yards.

Senecaville

PLAN OF ACTION TO CORRECT IDENTIFIED DEFICIENCIES

Facility Safety

SES-I06E Replace the stoplog closure with an aluminum bulkhead closure system.

The maintenance bulkheads (stop logs) for the spillway gates are creosoted, heavy, have to be floated into place, and require several employees from other projects to assist. The recommendation is to add an aluminum panel (6-foot high) bulkhead closure system to replace the stoplog system. A small section of concrete upstream of the existing gate slots would need to be removed to allow installation of the bulkhead. This bulkhead could be suspended near the top of one of the slots for storage and could be used in either gate bay. The bulkhead would be placed with a small crane or boom truck. Some minor electrical adjustments will take place as a result of installing this beam.

SES-O16E Revise and update Water Control Manual.

The District recognizes the need to revise the Water Control Manuals for a more detailed procedure outlining water management operations for all events.

SES-P11D Add parking spot near the intake structure.

Project personnel have to park along highway when going to the intake structure. A small parking area is needed for improved facility safety, however this may be difficult due to the land constraints.

Recreation/Maintenance

SES-C10E Repair concrete on stilling basin wall.

The tops of some of the walls for the spillway basin/channel are deteriorated due to weathering and freeze damage and require repair. The deterioration is attributed to lack of an Air Entrainment Admixture (AEA) in the mix design and an alkali silica reaction that has developed within the concrete, both are accentuated by age. Some of the deterioration is cosmetic, however, some deep deterioration is beginning to occur and noticeable bulging of the left wall has occurred.

Sustainability

SES-C03A Sandblast and paint sluice gates and liners.

The combined outlet works and spillway structure consists of an intake tower with two 3’-6’’ x 7’ gated sluices. The sluice gates and liners need to be sandblasted and painted.

Senecaville

PLAN OF ACTION TO CORRECT IDENTIFIED DEFICIENCIES

Sustainability

SES-D01E **Replace emergency gate guides at intake structure.**
The emergency gate guides at the intake structure need to be replaced.

SES-E21P **Rehabilitate electrical service systems.**
Electrical service systems require updating in order to ensure sustainability over the next 50 years.

SES-O19E **Rehabilitate overhead crane and trolley systems.**
Overhead crane and trolley system requires rehabilitation to ensure sustainability over the next 50 years.

SES-O20E **Replace motor operating stands for sluice gates with ones.**
The operating stands require replacement to ensure continued reliable operation over the next 50 years.

SES-S17E **Replace service gate's stems and guide stems.**
Service gate stems and guides are deteriorated and require replacement to ensure sustainability.

SES-T05E **Replace trash racks.**
The trash racks are deteriorated due to hydrogen sulfide and need to be replaced. There are four trash racks whose dimensions are 6’-3” by 11’-7.5”.

TAPPAN LAKE

DESCRIPTION OF PROJECT

The construction of Tappan Dam was completed in October 1936 on Little Stillwater Creek, 174 miles upstream of the mouth of the Muskingum River. The embankment is rolled earth fill having a maximum height of 52 feet. The crest length of the dam is 1550 feet. A concrete parapet wall was constructed in 1982 raising the top of the dam to an elevation of 922 feet under the DSA program.

Figure 19. Aerial view of intake structure at Tappan Lake. Date unknown.

The outlet works are located in the south abutment and consist of an approach channel, intake structure, horseshoe-shaped tunnel, stilling basin, and outlet channel. Access to the intake structure is provided by a single span service bridge that is 11'-8" wide. Normal flow is controlled by three 3.5 feet x 7 feet gated sluices, discharging into a 7.5 feet x 8 feet horseshoe tunnel.

Tappan

PLAN OF ACTION TO CORRECT IDENTIFIED DEFICIENCIES

Dam Safety Issue

TAL-H03E Perform structural evaluation on tunnel to resolve hydrogen sulfide problems.

The tunnel is expected to require relining. During the summer months, lower depths of the lake form high levels of hydrogen sulfide. The service gates release water from these depths causing the tunnel concrete to be exposed to the hydrogen sulfide. A structural evaluation needs to be performed to determine the severity of tunnel erosion, the exact plan of action, and if a liner is truly needed.

TAL-H04E Remediate tunnel according to study (re-lining).

Hydrogen sulfide has increased the rate of deterioration in the concrete tunnel and consequently the tunnel will require relining. Trial patches of tunnel coatings were examined in March 1994 at various locations and appeared to hold up well. Relining the tunnels will be required to prevent further damage.

TAL-S14E Perform Seismic Safety Review (SSR) in accordance with ER 1110-2-1806.

A Seismic Safety Review (SSR) in accordance with ER1110-2-1806 is required. Depending on the results of the SSR, a Dynamic Analysis may also be required.

Efficiency

TAL-A13N Install ADAS (Automated Data Acquisition System).

An ADAS (Automated Data Acquisition System) is needed to improve the monitoring of piezometric levels (internal pore water pressures) in the dam.

Erosion Control

TAL-S05E Replace stone slope protection on sections of the upstream face.

In some areas the stone slope protection has weathered to gravel. Placement of new stone on upstream slope is difficult because access is hindered by the parapet wall. Approximately 1000 cubic yards of stone is required on sections of the upstream face.

TAL-S06P Spillway erodibility study for unlined portion.

Potential problems associated with the Tappan spillway were an unlined spillway (except for sill) and potentially erodible rock in these unlined portions. An erodibility study is needed to determine the scope of the problem. The spillway is located 800 feet south of the dam and consists of an uncontrolled saddle having a crest width of 250 feet at elevation 909.0. The spillway is cut through firm clay stone, shale, and sandstone.

Tappan

PLAN OF ACTION TO CORRECT IDENTIFIED DEFICIENCIES

Facility Safety

TAL-O15E Revise and update Water Control Manual.
The District recognizes the need to revise the Water Control Manuals for a more detailed procedure outlining water management operations for all events.

Sustainability

TAL-E19P Rehabilitate electrical service systems.
Electrical service systems require updating in order to ensure sustainability over the next 50 years.

TAL-M02O Modify intake structure for selective withdrawal.
Lake water at the current intake elevation contains a high concentration of hydrogen sulfide that causes safety and environmental hazards as well as structural damage to the outlet structure. The plan of action is to modify the current intake with a selective withdrawal system designed to reduce the hydrogen sulfide in the outflow and improve water quality downstream.

TAL-O18E Rehabilitate overhead crane and trolley systems.
Overhead crane and trolley system requires rehabilitation to ensure sustainability over the next 50 years.

TAL-S08E Replace trash racks.
The trash racks are deteriorated due to hydrogen sulfide and need to be replaced. There are nine (9) trash racks whose dimensions are 6’-3” by 10’-11”.

TAL-S09A Sandblast and paint beams on the service bridge.
Results from a bridge inspection in August 1999, it was noted that corrosion with loss was present on the steel members. Therefore, the beams need to be cleaned and repainted to prevent further corrosion. The bridge has a max span length of 28 feet and a total structure length of 29 feet. The beams were noted to contain red lead paint and will require appropriate containment.

TAL-S10A Sandblast and paint 3 sluice liners.
The outlet works consist of an intake structure with three 3’-6” x 7’ sluice gates. The three sluice liners are corroded, requiring them to be sandblasted and painted.

TAL-T01N Initiate preventative maintenance on relief wells.
As recommended by USACE regulation, preventative maintenance is required on Tappan's sixteen (16) relief wells in operation since 1978.

WILLS CREEK LAKE

DESCRIPTION OF PROJECT

The construction of Wills Creek Dam was completed in 1936 on Wills Creek, 108 miles upstream of the mouth of the Muskingum River. The embankment is rolled earth fill with an impervious core, having a maximum height of 87 feet. The crest length of the dam is 1950 feet at elevation 799.

Figure 20. A typical view of the upstream side of the embankment looking towards the right abutment. Wills Creek Lake, OH.

The outlet works are located at the left abutment and consist of an approach channel, intake structure, twin arch conduits, stilling basin, and outlet channel. Access to the intake structure is provided by a service bridge that is 12 feet wide (curb-curb).

The spillway is located approximately 150 feet to the right of the right abutment. It is a partially lined, uncontrolled trapezoidal open-cut chute type that has a crest width of 204.5 feet and a crest elevation of 779 feet.

Wills Creek

PLAN OF ACTION TO CORRECT IDENTIFIED DEFICIENCIES

Dam Safety Issue

WCW-S13E Perform Seismic Safety Review (SSR) in accordance with ER 1110-2-1806.

A Seismic Safety Review (SSR) in accordance with ER1110-2-1806 is required. Depending on the results of the SSR, a Dynamic Analysis may also be required.

Efficiency

WCW-A12N Install ADAS (Automated Data Acquisition System).

An ADAS (Automated Data Acquisition System) is needed to improve the monitoring of piezometric levels (internal pore water pressures) in the dam.

Erosion Control

WCW-S02D Add additional stone to the upstream face.

The stone on the upstream slope face continues to show some degradation. Approximately 1000 CY of stone is needed to remediate erosion concerns.

Facility Safety

WCW-O14E Revise and update Water Control Manual.

The District recognizes the need to revise the Water Control Manuals for a more detailed procedure outlining water management operations for all events.

Recreation/Maintenance

WCW-C03E Repair concrete on the right training wall of the stilling basin.

The concrete on the right downstream training wall of the stilling basin has deteriorated and must be repaired. .

WCW-S11L Clean and paint service bridge.

The deck shows signs of significant weathering including spalls on both outside edges of the deck, scaling of the deck surface, and cracking with exposed rebar on the underside of the deck. Some minor corrosion is also present on the steel girders. Therefore, the corroded areas and steel members need to be cleaned and repainted to prevent further corrosion. The bridge has a max span length of 28 feet and a structure length of 29 feet. Also, it has a bridge roadway width (curb-curb) of 12 feet and a deck width (out-out) of 14 feet.

Wills Creek

PLAN OF ACTION TO CORRECT IDENTIFIED DEFICIENCIES

Sustainability

WCW-204N Initiate preventative maintenance on relief wells.
As recommended by USACE regulation, preventative maintenance is required on Wills Creek's 21 relief wells in operation since 1975.

WCW-B08E Replace backup generator.
The backup generator needs to be replaced to ensure continued reliable operation over the next 50 years.

WCW-C15A Sandblast and paint service gates.
Corrosion preventative maintenance for the service gates is needed to ensure continued reliable operation over the next 50 years.

WCW-E17P Rehabilitate electrical service systems.
Electrical service systems require updating in order to ensure sustainability over the next 50 years.

WCW-H06A Sandblast and paint hoist motor assembly and frames once service gate cables are installed.
Sandblasting and painting of the hoist motor assembly and frames along with the replacement of the service gate cables is required to ensure sustainability over the next 50 years.

WCW-O16E Rehabilitate overhead crane and trolley systems.
Overhead crane and trolley system requires rehabilitation to ensure sustainability over the next 50 years.

WCW-W05E Refurbish gate hoist machinery and replace wire ropes.
Wire rope for gate hoist needs to be replaced. Hoist equipment and components (sheaves, brakes, motors, etc) require rehabilitation to ensure sustainability over the next 50 years.

APPENDIX A: COST DEVELOPMENT AND SUMMARIES

COST METHODOLOGY

Preliminary Cost Estimates for the Muskingum Infrastructure Study were prepared to an equivalent price level of 1 October 2003. The estimate has been updated to an equivalent price level of 1 October 2005 using CWCCIS (non-federal labor and construction) and OMB (federal) escalation factors. Estimate preparation was in accordance with guidelines and policies included in ER 1110-1-1300 Cost Engineering and General Requirements and ER 1110-2-1302 Civil Works Cost Engineering. MCACES Second Generation (MII) Version 1.1 cost estimating software was used to prepare and compile the estimate.

Preliminary costs and pricing were developed from MEANS® Cost Books, similar projects within USACE, vender quotes, and from the experience of project personnel.

The indirect cost for field office overhead is included as a percentage of the direct costs. For the prime contractor, field office overhead is 20% based on the cost engineer's judgment. It represents the anticipated prime contractor field office overhead costs for such items as project supervision, contractor quality control, contractor field office supplies, personal protective equipment, field engineering, and other incidental field overhead costs.

The estimate includes an allowance applied as a percentage of direct cost plus field overhead for home office overhead expense. A value of 6% was used for the prime contractor's home office overhead based on the cost engineer's judgment. Home office overhead includes such items as office rental/ownership costs, utilities, office equipment ownership and maintenance, office staff (managers, accountants, clerical, etc.), insurance and miscellaneous. The home office overhead generally depends largely on a contractor's annual volume of work and the type of work that is generally performed by the contractor.

Profit for the prime contractor was established as 9.1%, based on the Profit Weighted Guideline Method. Bond was estimated at 0.5% based on the estimator's experience.

Costs for Engineering and Design are estimated to be 25% of construction costs. Engineering and design costs are included for project management, preliminary and final design, geotechnical and HTRW investigations, hydraulic modeling, quality management, preparation of plans and specifications, engineering during construction, advertisement, opening of bids, and contract award.

Costs for Supervision and Administration are estimated at 7.5% of total project construction cost. Supervision and administration costs are included for contract supervision, contract administration, construction management, technical management activities, and District Office supervision and administration costs.

A 25% contingency was applied to direct cost based on the cost engineer's judgment for the amount of risk and/or uncertainty.

The detailed construction schedule for the Muskingum Infrastructure Study was not available pending a priority study to be performed in the near future. At that time, each deficiency within the Muskingum Basin will be prioritized based on public safety and economic benefits (investment prioritization). For the purpose of this report, construction is anticipated to occur over a ten year period from FY07 through FY16. The estimate has been fully funded by escalating the project costs to the midpoint of construction (FY11). Costs were escalated by applying OMB factors to both construction and labor accounts at 12.10% and 17.90% respectively.

SUMMARY OF PRELIMINARY COSTS

The estimated cost to perform all recommendations of the Muskingum Infrastructure Study is $519,682,000 based on the 1 October 2005 price level. Including escalation over the assumed implementation period the fully funded project cost is $594,973,000. Project costs by facility are summarized in Table A-1. Project costs by need type are summarized in Table A-2. Costs for each project facility are summarized in the following section of this appendix.

Table A-1. Summary of preliminary costs by project.

Project	Estimated Cost	Contingency	Project Cost (FY06)	Fully Funded Cost*
Asset Management Plan	$53,620,000	$13,405,000	$67,025,000	$79,022,000
Atwood	$11,029,000	$2,759,000	$13,788,000	$15,660,000
Beach City	$18,892,000	$4,722,000	$23,614,000	$26,786,000
Bolivar	$77,289,000	$19,324,000	$96,613,000	$109,637,000
Charles Mill	$3,260,000	$816,000	$4,076,000	$4,635,000
Clendening	$15,002,000	$3,752,000	$18,754,000	$21,426,000
Dillon	$25,586,000	$6,397,000	$31,983,000	$36,300,000
Dover	$87,616,000	$21,904,000	$109,520,000	$124,349,000
Leesville	$5,986,000	$1,499,000	$7,485,000	$8,495,000
Mohawk	$44,145,000	$11,039,000	$55,184,000	$62,636,000
Mohicanville	$3,599,000	$900,000	$4,499,000	$5,108,000
North Branch of Kokosing	$657,000	$164,000	$821,000	$943,000
Piedmont	$11,765,000	$2,942,000	$14,707,000	$16,700,000
Pleasant Hill	$41,960,000	$10,490,000	$52,450,000	$61,356,000
Remote Operation Plan	$205,000	$51,000	$256,000	$301,000
Senecaville	$2,978,000	$744,000	$3,722,000	$4,229,000
Tappan	$8,692,000	$2,174,000	$10,866,000	$12,508,000
Wills Creek	$3,454,000	$865,000	$4,319,000	$4,882,000
Grand Total	**$415,735,000**	**$103,947,000**	**$519,682,000**	**$594,973,000**

*Fully Funded costs were developed by escalating FY06 dollars to FY11 dollars (mid-point of an assumed 10-year implementation period)

Table A-2. Summary of preliminary costs by need type.

Project Cost (FY06)

Project	Dam Safety Issue	Efficiency	Erosion Control	Facility Safety	Performance Monitoring	Recreation & Maintenance	Sustainability	Project Cost (FY06)
Asset Management Plan							$67,025,000	**$67,025,000**
Atwood	$8,967,000	$384,000	$59,000	$84,000	$238,000	$427,000	$3,629,000	**$13,788,000**
Beach City	$19,657,000	$390,000	$82,000	$131,000	$36,000	$71,000	$3,247,000	**$23,614,000**
Bolivar	$86,802,000	$384,000		$84,000		$715,000	$8,628,000	**$96,613,000**
Charles Mill	$204,000	$384,000		$76,000	$211,000	$1,240,000	$1,961,000	**$4,076,000**
Clendening	$5,516,000	$384,000	$8,568,000	$84,000		$80,000	$4,122,000	**$18,754,000**
Dillon	$19,469,000	$1,218,000	$250,000	$4,691,000		$4,197,000	$2,158,000	**$31,983,000**
Dover	$98,353,000	$1,172,000		$3,674,000		$243,000	$6,078,000	**$109,520,000**
Leesville	$2,197,000	$384,000	$101,000	$84,000		$664,000	$4,055,000	**$7,485,000**
Mohawk	$51,514,000	$384,000	$55,000	$76,000		$425,000	$2,730,000	**$55,184,000**
Mohicanville	$204,000	$384,000		$76,000		$328,000	$3,507,000	**$4,499,000**
North Branch of Kokosing	$204,000	$384,000		$76,000			$157,000	**$821,000**
Piedmont	$8,573,000	$384,000		$84,000		$615,000	$5,051,000	**$14,707,000**
Pleasant Hill	$48,574,000	$384,000		$126,000		$2,819,000	$547,000	**$52,450,000**
Senecaville	$204,000	$1,341,000	$171,000	$389,000		$428,000	$1,189,000	**$3,722,000**
Tappan	$2,807,000	$384,000	$3,913,000	$107,000		$65,000	$3,590,000	**$10,866,000**
Wills Creek	$204,000	$384,000	$311,000	$84,000		$1,072,000	$2,264,000	**$4,319,000**
Remote Operation Plan		$256,000						**$256,000**
Project Cost (FY06)	**$353,449,000**	**$8,985,000**	**$13,510,000**	**$9,926,000**	**$485,000**	**$13,389,000**	**$119,938,000**	**$519,682,000**

Project	Issues Major/Minor	Need Category	Tag #	Recommendation	Type	Current Price Level (PL 1-Oct-06) Construction	E&D	S&A	Estimated Cost	Contingency	Project Cost (FY06)	Mid-point (FY11**) Fully Funded Cost
Asset Management Plan												
	Major					$0	$53,619,559	$0	$53,620,000	$13,405,000	$67,025,000	$79,022,000
		Sustainability										
			AMP-S01E	Perform a comprehensive study to update mapping & GIS*.	Engineering	$0	$53,619,559	$0	$53,620,000	$13,405,000	$67,025,000	$79,022,000
Asset Management Plan Total						**$0**	**$53,619,559**	**$0**	**$53,620,000**	**$13,405,000**	**$67,025,000**	**$79,022,000**

Project	Issues Major/Minor	Need Category	Tag #	Recommendation	Type	Current Price Level (PL 1-Oct-06) Construction	E&D	S&A	Estimated Cost	Contingency	Project Cost (FY06)	Mid-point (FY11**) Fully Funded Cost
Atwood												
	Major					$8,134,967	$2,181,602	$610,123	$10,926,000	$2,732,000	$13,658,000	$15,514,000
		Dam Safety Issue										
			ATI-H01I	Widen spillway, build parapet wall, and grout abutment.	Construction	$4,420,593	$1,105,148	$331,544	$5,857,000	$1,464,000	$7,321,000	$8,312,000
			ATI-H08E	Perform structural evaluation on tunnel to resolve hydrogen sulfide problems.	Engineering	$0	$40,905	$0	$41,000	$10,000	$51,000	$60,000
			ATI-H09E	Remediate tunnel according to study (re-lining).	Construction	$840,007	$210,002	$63,001	$1,113,000	$278,000	$1,391,000	$1,579,000
			ATI-S21E	Perform Seismic Safety Review (SSR) in accordance with ER 1110-2-1806.	Engineering	$0	$162,582	$0	$163,000	$41,000	$204,000	$240,000
		Efficiency										
			ATI-A20N	Install ADAS (Automated Data Acquisition System).	Construction	$232,052	$58,013	$17,404	$307,000	$77,000	$384,000	$436,000
		Facility Safety										
			ATI-O17E	Revise and update Water Control Manual.	Engineering	$0	$60,697	$0	$61,000	$15,000	$76,000	$89,000
		Performance Monitoring										
			ATI-L18N	Install additional piezometers.	Construction	$16,258	$4,065	$1,219	$22,000	$5,000	$27,000	$31,000
			ATI-O14E	Replace outlet control weir.	O & M	$127,629	$31,907	$9,572	$169,000	$42,000	$211,000	$240,000
		Recreation/Maintenance										
			ATI-C05A	Patch deteriorated concrete spillway.	O & M	$270,970	$0	$20,323	$291,000	$73,000	$364,000	$410,000
		Sustainability										
			ATI-B23E	Replace backup generator.	O & M	$34,808	$0	$2,611	$37,000	$9,000	$46,000	$53,000
			ATI-C16E	Replace emergency gate guides.	O & M	$29,007	$7,252	$2,175	$38,000	$10,000	$48,000	$55,000
			ATI-E25E	Rehabilitate electrical service systems.	O & M	$184,072	$46,018	$13,805	$244,000	$61,000	$305,000	$346,000
			ATI-M07O	Modify intake structure for selective withdrawal.	Construction	$1,231,288	$307,822	$92,347	$1,631,000	$408,000	$2,039,000	$2,315,000
			ATI-M22E	Replace motor operated floor stands with hydraulic cylinders.	O & M	$71,536	$17,884	$5,365	$95,000	$24,000	$119,000	$135,000
			ATI-O24E	Rehabilitate overhead crane and trolley systems.	O & M	$51,131	$0	$3,835	$55,000	$14,000	$69,000	$77,000
			ATI-S12E	Replace existing service bridge.	O & M	$270,970	$67,743	$20,323	$359,000	$90,000	$449,000	$509,000
			ATI-S13O	Clean, paint and repair sluice gates.	O & M	$108,388	$0	$8,129	$117,000	$29,000	$146,000	$164,000
			ATI-T10E	Replace trash racks.	O & M	$246,258	$61,564	$18,469	$326,000	$82,000	$408,000	$463,000
	Minor					$89,308	$7,252	$6,698	$103,000	$27,000	$130,000	$146,000
Atwood Total						**$8,224,275**	**$2,188,853**	**$616,821**	**$11,029,000**	**$2,759,000**	**$13,788,000**	**$15,660,000**

Project	Issues Major/Minor	Need Category	Tag #	Recommendation	Type	Current Price Level (PL 1-Oct-06) Construction	E&D	S&A	Estimated Cost	Contingency	Project Cost (FY06)	Mid-point (FY11**) Fully Funded Cost
Beach City												
	Major					$14,378,521	$3,224,648	$1,078,389	$18,683,000	$4,669,000	$23,352,000	$26,490,000
		Dam Safety Issue										
			BCS-C07R	Dredge channel 600 feet long to clear culvert at U.S. Silica Industrial Levee.	O & M	$276,335	$0	$20,725	$297,000	$74,000	$371,000	$418,000
			BCS-F08O	Construct new gate closure at Brewster Levee.	Construction	$3,930,362	$982,591	$294,777	$5,208,000	$1,302,000	$6,510,000	$7,390,000
			BCS-F12U	Build levee section in opening at Silica Sand Industrial Levee.	Construction	$385,040	$96,260	$28,878	$510,000	$128,000	$638,000	$724,000
			BCS-L28M	Improve access to areas downstream of the dam, including clearing and grubbing of the downstream area.	Construction	$409,049	$102,262	$30,679	$542,000	$135,000	$677,000	$769,000
			BCS-P32E	Perform underseepage study on dam and remediate concerns	Construction	$3,441,509	$860,377	$258,113	$4,560,000	$1,140,000	$5,700,000	$6,471,000
			BCS-S10E	New emergency gate closure system at the end of dam.	Construction	$3,023,356	$755,839	$226,752	$4,006,000	$1,001,000	$5,007,000	$5,685,000
			BCS-S20E	Perform Seismic Safety Review (SSR) in accordance with ER 1110-2-1806.	Engineering	$0	$162,582	$0	$163,000	$41,000	$204,000	$240,000
			BCS-S29U	Purchase and stockpile sandbags and filter material for emergency use at the project.	O & M	$409,049	$0	$30,679	$440,000	$110,000	$550,000	$618,000
		Efficiency										
			BCS-A19N	Install ADAS (Automated Data Acquisition System).	Construction	$232,052	$58,013	$17,404	$307,000	$77,000	$384,000	$436,000
		Erosion Control										
			BCS-L11D	Add stone slope protection (SSP) to downstream wing walls.	O & M	$6,962	$1,740	$522	$9,000	$2,000	$11,000	$13,000
		Facility Safety										
			BCS-O01E	Revise and update Water Control Manual.	Engineering	$0	$60,697	$0	$61,000	$15,000	$76,000	$89,000
		Performance Monitoring										
			BCS-I18N	Install piezometers.	Construction	$21,678	$5,419	$1,626	$29,000	$7,000	$36,000	$41,000
		Sustainability										
			BCS-C15A	Sandblast/paint tractor gates.	O & M	$221,328	$0	$16,600	$238,000	$59,000	$297,000	$335,000
			BCS-C27A	Sandblast/paint gatewell gates and guides.	O & M	$15,339	$0	$1,150	$16,000	$4,000	$20,000	$23,000
			BCS-D17P	Upgrade relief well collection system.	Construction	$238,454	$59,613	$17,884	$316,000	$79,000	$395,000	$448,000
			BCS-E25P	Rehabilitate electrical service systems.	O & M	$255,656	$63,914	$19,174	$339,000	$85,000	$424,000	$481,000
			BCS-G26E	Replace all gatewell stems and guides.	O & M	$61,357	$15,339	$4,602	$81,000	$20,000	$101,000	$115,000
			BCS-O24E	Rehabilitate overhead crane and trolley systems.	O & M	$51,131	$0	$3,835	$55,000	$14,000	$69,000	$77,000
			BCS-P21E	Replace pumps and motors at Brewster Levee pump station.	O & M	$715,836	$0	$53,688	$770,000	$192,000	$962,000	$1,082,000
			BCS-T06N	Initiate preventative maintenance on relief wells.	O & M	$70,452	$0	$5,284	$76,000	$19,000	$95,000	$107,000
			BCS-W23E	Refurbish gate hoist machinery and replace wire ropes.	O & M	$613,574	$0	$46,018	$660,000	$165,000	$825,000	$928,000
	Minor					$183,838	$11,659	$13,788	$209,000	$53,000	$262,000	$296,000
Beach City Total						**$14,562,359**	**$3,236,307**	**$1,092,177**	**$18,892,000**	**$4,722,000**	**$23,614,000**	**$26,786,000**

Project	Issues Major/Minor	Need Category	Tag #	Recommendation	Type	Current Price Level (PL 1-Oct-06) Construction	E&D	S&A	Estimated Cost	Contingency	Project Cost (FY06)	Mid-point (FY11**) Fully Funded Cost
Bolivar												
	Major					$58,812,530	$13,967,293	$4,410,940	$77,190,000	$19,298,000	$96,488,000	$109,497,000
		Dam Safety Issue										
			BOS-L24M	Improve access to areas downstream of the dam, including clearing and grubbing of the downstream area.	Construction	$818,099	$0	$61,357	$879,000	$220,000	$1,099,000	$1,237,000
			BOS-S16E	Perform Seismic Safety Review (SSR) in accordance with ER 1110-2-1806.	Engineering	$0	$162,582	$0	$163,000	$41,000	$204,000	$240,000
			BOS-S25U	Purchase and stockpile sandbags and filter material for emergency use.	O & M	$818,099	$0	$61,357	$879,000	$220,000	$1,099,000	$1,237,000
			BOS-T02O	Perform underseepage study on dam and remediate concerns	Construction	$50,958,491	$12,739,623	$3,821,887	$67,520,000	$16,880,000	$84,400,000	$95,813,000
		Efficiency										
			BOS-A15N	Install ADAS (Automated Data Acquisition System).	Construction	$232,052	$58,013	$17,404	$307,000	$77,000	$384,000	$436,000
		Facility Safety										
			BOS-O17E	Revise and update Water Control Manual.	Engineering	$0	$60,697	$0	$61,000	$15,000	$76,000	$89,000
		Recreation/Maintenance										
			BOS-B09O	Bolivar Service Bridge - Clean and paint steel members.	O & M	$222,195	$0	$16,665	$239,000	$60,000	$299,000	$336,000
			BOS-M10A	Magnolia Service Bridge - Clean and paint steel members.	O & M	$222,195	$0	$16,665	$239,000	$60,000	$299,000	$336,000
		Sustainability										
			BOS-304N	Initiate preventative maintenance on relief wells.	O & M	$247,125	$0	$18,534	$266,000	$66,000	$332,000	$374,000
			BOS-B11E	Replace backup generator at the intake structure.	O & M	$34,808	$0	$2,611	$37,000	$9,000	$46,000	$53,000
			BOS-C19A	Sandblast and paint Mill Race, Magnolia Levee, and East Sparta Levee gates.	O & M	$81,810	$0	$6,136	$88,000	$22,000	$110,000	$124,000
			BOS-E13P	Rehabilitate electrical service system for Magnolia Levee pump station.	O & M	$35,792	$8,948	$2,684	$47,000	$12,000	$59,000	$67,000
			BOS-E22P	Rehabilitate electrical service systems.	O & M	$173,846	$43,461	$13,038	$230,000	$58,000	$288,000	$327,000
			BOS-G20E	Replace all Magnolia Levee, East Sparta Levee, and Mill Race gatewell stems and stem guides.	O & M	$92,036	$23,009	$6,903	$122,000	$30,000	$152,000	$173,000
			BOS-M14E	Repair bottom two feet of Magnolia gate closure.	O & M	$69,616	$17,404	$5,221	$92,000	$23,000	$115,000	$131,000
			BOS-O23E	Rehabilitate overhead crane and trolley systems.	O & M	$51,131	$0	$3,835	$55,000	$14,000	$69,000	$77,000
			BOS-P03E	Replace service (tractor) gates at the intake structure.	O & M	$3,414,223	$853,556	$256,067	$4,524,000	$1,131,000	$5,655,000	$6,419,000
			BOS-P18E	Replace pumps and motors at Magnolia Levee pump station.	O & M	$715,836	$0	$53,688	$770,000	$192,000	$962,000	$1,082,000
			BOS-T07E	Reline discharge line of small pump at Magnolia Levee pump station.	O & M	$11,603	$0	$870	$12,000	$3,000	$15,000	$18,000
			BOS-W21E	Refurbish gate hoist machinery and replace wire ropes.	O & M	$613,574	$0	$46,018	$660,000	$165,000	$825,000	$928,000
	Minor					$83,787	$8,702	$6,284	$99,000	$26,000	$125,000	$140,000
Bolivar Total						**$58,896,317**	**$13,975,995**	**$4,417,224**	**$77,289,000**	**$19,324,000**	**$96,613,000**	**$109,637,000**

Project	Issues Major/Minor	Need Category	Tag #	Recommendation	Type	Current Price Level (PL 1-Oct-06) Construction	E&D	S&A	Estimated Cost	Contingency	Project Cost (FY06)	Mid-point (FY11**) Fully Funded Cost
Charles Mill												
	Major					$2,133,037	$743,756	$159,978	$3,037,000	$760,000	$3,797,000	$4,321,000
		Dam Safety Issue										
			CMB-S11E	Perform Seismic Safety Review (SSR) in accordance with ER 1110-2-1806.	Engineering	$0	$162,582	$0	$163,000	$41,000	$204,000	$240,000
		Efficiency										
			CMB-A10N	Install ADAS (Automated Data Acquisition System).	Construction	$232,052	$58,013	$17,404	$307,000	$77,000	$384,000	$436,000
		Facility Safety										
			CMB-O12E	Revise and update Water Control Manual.	Engineering	$0	$60,697	$0	$61,000	$15,000	$76,000	$89,000
		Performance Monitoring										
			CMB-O04E	Replace outlet control weir.	O & M	$127,629	$31,907	$9,572	$169,000	$42,000	$211,000	$240,000
		Recreation/Maintenance										
			CMB-S09E	Repair concrete at spillway.	O & M	$580,130	$145,033	$43,510	$769,000	$192,000	$961,000	$1,091,000
		Sustainability										
			CMB-C08E	Repair parabolic transition into Sluice Gate #1.	O & M	$11,603	$2,901	$870	$15,000	$4,000	$19,000	$22,000
			CMB-E14P	Rehabilitate electrical service systems.	O & M	$255,656	$63,914	$19,174	$339,000	$85,000	$424,000	$481,000
			CMB-O15E	Replace motor operating stands for sluice gates with ones.	O & M	$189,679	$47,420	$14,226	$251,000	$63,000	$314,000	$357,000
			CMB-O20E	Rehabilitate overhead crane and trolley systems.	O & M	$51,131	$0	$3,835	$55,000	$14,000	$69,000	$77,000
			CMB-P22E	Rehabilitation of sluice gates and operators.	O & M	$664,705	$166,176	$49,853	$881,000	$220,000	$1,101,000	$1,250,000
			CMB-R16E	Replace flap gate at Pavonia Levee.	O & M	$20,452	$5,113	$1,534	$27,000	$7,000	$34,000	$38,000
	Minor					$187,851	$20,305	$14,089	$223,000	$56,000	$279,000	$314,000
Charles Mill Total						**$2,320,888**	**$764,060**	**$174,067**	**$3,260,000**	**$816,000**	**$4,076,000**	**$4,635,000**

Project	Issues Major/Minor	Need Category	Tag #	Recommendation	Type	Current Price Level (PL 1-Oct-06) Construction	E&D	S&A	Estimated Cost	Contingency	Project Cost (FY06)	Mid-point (FY11**) Fully Funded Cost
Clendening												
	Major					$9,394,356	$4,834,311	$704,577	$14,932,000	$3,734,000	$18,666,000	$21,326,000
		Dam Safety Issue										
			CLB-H01A	Raise dam and parapet wall.	Construction	$1,355,184	$338,796	$101,639	$1,796,000	$449,000	$2,245,000	$2,548,000
			CLB-H04E	Perform structural evaluation on tunnel to resolve hydrogen sulfide problems.	Engineering	$0	$43,355	$0	$43,000	$11,000	$54,000	$64,000
			CLB-H05E	Remediate tunnel according to study (re-lining).	Construction	$1,354,850	$338,713	$101,614	$1,795,000	$449,000	$2,244,000	$2,547,000
			CLB-P02E	Widen spillway to reduce plugging issues.	Construction	$464,104	$116,026	$34,808	$615,000	$154,000	$769,000	$873,000
			CLB-S15E	Perform Seismic Safety Review (SSR) in accordance with ER 1110-2-1806.	Engineering	$0	$162,582	$0	$163,000	$41,000	$204,000	$240,000
		Efficiency										
			CLB-A14N	Install ADAS (Automated Data Acquisition System).	Construction	$232,052	$58,013	$17,404	$307,000	$77,000	$384,000	$436,000
		Erosion Control										
			CLB-E08T	Study and remediate erodibility issues.	Construction	$3,264,509	$3,264,509	$244,838	$6,774,000	$1,693,000	$8,467,000	$9,746,000
			CLB-S06L	Place stone on downstream face.	O & M	$75,584	$0	$5,669	$81,000	$20,000	$101,000	$114,000
		Facility Safety										
			CLB-O16E	Revise and update Water Control Manual.	Engineering	$0	$60,697	$0	$61,000	$15,000	$76,000	$89,000
		Sustainability										
			CLB-C19A	Sandblast/paint sluice gates.	O & M	$51,131	$0	$3,835	$55,000	$14,000	$69,000	$77,000
			CLB-E17P	Rehabilitate electrical service systems.	O & M	$184,072	$46,018	$13,805	$244,000	$61,000	$305,000	$346,000
			CLB-M03O	Modify intake structure for selective withdrawal.	Construction	$1,231,288	$307,822	$92,347	$1,631,000	$408,000	$2,039,000	$2,315,000
			CLB-M18E	Replace motor operated floor stands with hydraulic cylinders.	O & M	$71,536	$17,884	$5,365	$95,000	$24,000	$119,000	$135,000
			CLB-O13E	Replace out-dated emergency generator.	O & M	$34,808	$0	$2,611	$37,000	$9,000	$46,000	$53,000
			CLB-O20E	Rehabilitate overhead crane and trolley systems.	O & M	$51,131	$0	$3,835	$55,000	$14,000	$69,000	$77,000
			CLB-T07N	Initiate preventive maintenance on relief wells.	O & M	$704,522	$0	$52,839	$757,000	$189,000	$946,000	$1,065,000
			CLB-T09E	Replace trash racks.	O & M	$319,583	$79,896	$23,969	$423,000	$106,000	$529,000	$601,000
	Minor					$65,361	$0	$4,902	$70,000	$18,000	$88,000	$100,000
Clendening Total						**$9,459,717**	**$4,834,311**	**$709,479**	**$15,002,000**	**$3,752,000**	**$18,754,000**	**$21,426,000**

Project	Issues Major/Minor	Need Category	Tag #	Recommendation	Type	Current Price Level (PL 1-Oct-06) Construction	E&D	S&A	Estimated Cost	Contingency	Project Cost (FY06)	Mid-point (FY11**) Fully Funded Cost
Dillon												
	Major					$18,590,359	$4,630,188	$1,394,277	$24,617,000	$6,154,000	$30,771,000	$34,929,000
		Dam Safety Issue										
			DIL-I03U	Purchase real estate and build two dikes to correct saddled depressions under spillway crest elevation.	Construction	$6,503,282	$1,625,820	$487,746	$8,617,000	$2,154,000	$10,771,000	$12,228,000
			DIL-R01A	Raise dam and add parapet wall along dam and dikes.	Construction	$4,664,248	$1,166,062	$349,819	$6,180,000	$1,545,000	$7,725,000	$8,770,000
			DIL-S02E	Remediate spillway to reduce plugging issues.	Construction	$464,104	$116,026	$34,808	$615,000	$154,000	$769,000	$873,000
			DIL-S29E	Perform Seismic Safety Review (SSR) in accordance with ER 1110-2-1806.	Engineering	$0	$162,582	$0	$163,000	$41,000	$204,000	$240,000
		Efficiency										
			DIL-D16N	Install drift boom to help with debris issues.	O & M	$21,678	$5,419	$1,626	$29,000	$7,000	$36,000	$41,000
			DIL-P26E	Redesign maintenance bulkhead for easier installation and replacement.	Construction	$421,037	$105,259	$31,578	$558,000	$139,000	$697,000	$792,000
			DIL-S21M	Install ADAS (Automated Data Acquisition System).	Construction	$270,970	$67,743	$20,323	$359,000	$90,000	$449,000	$509,000
		Erosion Control										
			DIL-R06L	Place stone slope protection (SSP) along several areas of the channel.	O & M	$151,167	$37,792	$11,338	$200,000	$50,000	$250,000	$284,000
		Facility Safety										
			DIL-C04H	Change stoplog closure to swing gate and make embankment repairs.	Construction	$2,741,518	$685,380	$205,614	$3,633,000	$908,000	$4,541,000	$5,155,000
			DIL-O30E	Revise and update Water Control Manual.	Engineering	$0	$60,697	$0	$61,000	$15,000	$76,000	$89,000
		Recreation/Maintenance										
			DIL-P05A	Pave access roads & parking lots.	O & M	$284,264	$71,066	$21,320	$377,000	$94,000	$471,000	$534,000
			DIL-R18E	Replace bridge over spillway and service bridge to intake struc	O & M	$1,625,820	$406,455	$121,937	$2,154,000	$539,000	$2,693,000	$3,057,000
		Sustainability										
			DIL-B32E	Replace low flow gate valves for sustainability.	O & M	$204,525	$51,131	$15,339	$271,000	$68,000	$339,000	$385,000
			DIL-C09A	Sandblast and paint three sluice gates, emergency gate, gate guides, tunnel liner, and hoist machinery.	O & M	$541,940	$0	$40,646	$583,000	$146,000	$729,000	$819,000
			DIL-D17E	Repair slide in downstream outflow channel.	O & M	$80,724	$20,181	$6,054	$107,000	$27,000	$134,000	$152,000
			DIL-E31P	Rehabilitate electrical service systems.	O & M	$184,072	$46,018	$13,805	$244,000	$61,000	$305,000	$346,000
			DIL-O27E	Rehabilitate overhead crane and trolley systems.	O & M	$51,131	$0	$3,835	$55,000	$14,000	$69,000	$77,000
			DIL-P33E	Replace Pleasant Valley Dike gate stems and stem guides.	O & M	$10,226	$2,557	$767	$14,000	$3,000	$17,000	$19,000
			DIL-T20N	Initiate preventative maintenance on relief wells.	O & M	$54,194	$0	$4,065	$58,000	$15,000	$73,000	$82,000
			DIL-W08E	Replace wire rope for service gates.	O & M	$8,671	$0	$650	$9,000	$2,000	$11,000	$13,000
			DIL-W34E	Refurbish gate hoist machinery.	O & M	$306,787	$0	$23,009	$330,000	$82,000	$412,000	$464,000
	Minor					$767,476	$142,018	$57,561	$969,000	$243,000	$1,212,000	$1,371,000
Dillon Total						**$19,357,834**	**$4,772,206**	**$1,451,838**	**$25,586,000**	**$6,397,000**	**$31,983,000**	**$36,300,000**

Project	Issues Major/Minor	Need Category	Tag #	Recommendation	Type	Current Price Level (PL 1-Oct-06) Construction	E&D	S&A	Estimated Cost	Contingency	Project Cost (FY06)	Mid-point (FY11**) Fully Funded Cost
Dover												
	Major					$65,677,154	$16,812,294	$4,925,787	$87,416,000	$21,853,000	$109,269,000	$124,068,000
		Dam Safety Issue										
			DOT-P08E	Perform hydrologic deficiency and underseepage study at Zoar	Construction	$3,441,509	$860,377	$258,113	$4,560,000	$1,140,000	$5,700,000	$6,471,000
			DOT-P09E	Perform hydrologic deficiency & underseepage study at Zoar Diversion Dam.	Engineering	$0	$541,940	$0	$542,000	$135,000	$677,000	$799,000
			DOT-P10E	Remediate Zoar Diversion Dam according to study results.	Construction	$6,503,282	$1,625,820	$487,746	$8,617,000	$2,154,000	$10,771,000	$12,228,000
			DOT-P15R	Prepare Emergency Action Plan for Zoar Diversion Dam.	Engineering	$0	$16,258	$0	$16,000	$4,000	$20,000	$24,000
			DOT-P30M	Perform structural reanalysis and hydrologic deficiency studies	Construction	$43,018,868	$10,754,717	$3,226,415	$57,000,000	$14,250,000	$71,250,000	$80,885,000
			DOT-S16E	Perform underseepage and instability study for Somerdale Levee.	Engineering	$0	$244,523	$0	$245,000	$61,000	$306,000	$360,000
			DOT-S17M	Implement underseepage and instability fix for Somerdale Levee.	Construction	$5,690,372	$1,422,593	$426,778	$7,540,000	$1,885,000	$9,425,000	$10,699,000
			DOT-S19E	Perform Seismic Safety Review (SSR) in accordance with ER 1110-2-1806.	Engineering	$0	$162,582	$0	$163,000	$41,000	$204,000	$240,000
		Efficiency										
			DOT-A18N	Install ADAS (Automated Data Acquisition System).	Construction	$232,052	$58,013	$17,404	$307,000	$77,000	$384,000	$436,000
			DOT-P27E	Design and install an additional pump for the Zoar Levee pump station.	Construction	$475,520	$118,880	$35,664	$630,000	$158,000	$788,000	$894,000
		Facility Safety										
			DOT-M13E	Design and construct small to mid size pump station at Somerdale Levee (approx. 8000 GPM).	Construction	$2,167,761	$541,940	$162,582	$2,872,000	$718,000	$3,590,000	$4,076,000
			DOT-O20E	Revise and update Water Control Manual.	Engineering	$0	$60,697	$0	$61,000	$15,000	$76,000	$89,000
		Sustainability										
			DOT-C23A	Sandblast and paint service gates and levee gates.	O & M	$613,574	$0	$46,018	$660,000	$165,000	$825,000	$928,000
			DOT-D12N	Analyze and repair concrete deterioration problems throughout the project.	Construction	$1,160,261	$290,065	$87,020	$1,537,000	$384,000	$1,921,000	$2,182,000
			DOT-E04M	Emergency generator for control structure.	O & M	$34,808	$0	$2,611	$37,000	$9,000	$46,000	$53,000
			DOT-E21P	Rehabilitate electrical service systems.	O & M	$255,656	$63,914	$19,174	$339,000	$85,000	$424,000	$481,000
			DOT-P25E	Replace pumps and motors at Zoar Levee pump station.	O & M	$715,836	$0	$53,688	$770,000	$192,000	$962,000	$1,082,000
			DOT-R11E	Perform maintenance on Zoar Levee relief wells.	O & M	$758,716	$0	$56,904	$816,000	$204,000	$1,020,000	$1,147,000
			DOT-S26E	Replace flap gates at Somerdale Levee.	O & M	$15,339	$3,835	$1,150	$20,000	$5,000	$25,000	$29,000
			DOT-T22E	Rehabilitate the hydraulic cylinders for the slide gates throughout the dam structure.	O & M	$409,049	$0	$30,679	$440,000	$110,000	$550,000	$618,000
			DOT-T24E	Replace gate stems and guides for gatewells at Zoar Levee, Zoar Diversion Dam, and Somerdale Levee.	O & M	$61,357	$15,339	$4,602	$81,000	$20,000	$101,000	$115,000
			DOT-Z03U	Purchase emergency generator for Zoar pump station.	O & M	$123,194	$30,798	$9,240	$163,000	$41,000	$204,000	$232,000
	Minor					$185,610	$0	$13,921	$200,000	$51,000	$251,000	$281,000
Dover Total						**$65,862,764**	**$16,812,294**	**$4,939,707**	**$87,616,000**	**$21,904,000**	**$109,520,000**	**$124,349,000**

Project	Issues Major/Minor	Need Category	Tag #	Recommendation	Type	Current Price Level (PL 1-Oct-06) Construction	E&D	S&A	Estimated Cost	Contingency	Project Cost (FY06)	Mid-point (FY11**) Fully Funded Cost
Leesville												
	Major					$4,530,619	$1,110,955	$339,796	$5,980,000	$1,497,000	$7,477,000	$8,486,000
		Dam Safety Issue										
			LEM -H02E	Perform structural evaluation on tunnel to resolve hydrogen sulfide problems.	Engineering	$0	$43,355	$0	$43,000	$11,000	$54,000	$64,000
			LEM -H03E	Remediate tunnel according to study (re-lining).	Construction	$1,170,591	$292,648	$87,794	$1,551,000	$388,000	$1,939,000	$2,201,000
			LEM -S12E	Perform Seismic Safety Review (SSR) in accordance with ER 1110-2-1806.	Engineering	$0	$162,582	$0	$163,000	$41,000	$204,000	$240,000
		Efficiency										
			LEM -A11N	Install ADAS (Automated Data Acquisition System).	Construction	$232,052	$58,013	$17,404	$307,000	$77,000	$384,000	$436,000
		Erosion Control										
			LEM -S08L	Place stone on downstream bank of outlet channel.	O & M	$75,584	$0	$5,669	$81,000	$20,000	$101,000	$114,000
		Facility Safety										
			LEM -O13E	Revise and update Water Control Manual.	Engineering	$0	$60,697	$0	$61,000	$15,000	$76,000	$89,000
		Recreation/Maintenance										
			LEM -C06E	Remove old clay drain and re-grade benches on dam.	O & M	$59,414	$14,853	$4,456	$79,000	$20,000	$99,000	$112,000
			LEM -S04O	Concrete repairs to stilling basin wall.	O & M	$270,970	$0	$20,323	$291,000	$73,000	$364,000	$410,000
			LEM -V07E	Replace outlet control weir.	O & M	$121,731	$30,433	$9,130	$161,000	$40,000	$201,000	$229,000
		Sustainability										
			LEM -C16A	Sandblast and paint service gates.	O & M	$51,131	$0	$3,835	$55,000	$14,000	$69,000	$77,000
			LEM -E15E	Rehabilitate electrical service systems.	O & M	$184,072	$46,018	$13,805	$244,000	$61,000	$305,000	$346,000
			LEM -M01O	Modify intake structure for selective withdrawal.	Construction	$1,231,288	$307,822	$92,347	$1,631,000	$408,000	$2,039,000	$2,315,000
			LEM -M14E	Replace motor operated floor stands with hydraulic cylinders.	O & M	$71,536	$17,884	$5,365	$95,000	$24,000	$119,000	$135,000
			LEM -O17E	Rehabilitate overhead crane and trolley systems.	O & M	$51,131	$0	$3,835	$55,000	$14,000	$69,000	$77,000
			LEM -T06N	Initiate preventive maintenance on relief wells.	O & M	$704,522	$0	$52,839	$757,000	$189,000	$946,000	$1,065,000
			LEM -T09E	Replace trash racks.	O & M	$306,598	$76,649	$22,995	$406,000	$102,000	$508,000	$576,000
	Minor					$5,624	$0	$422	$6,000	$2,000	$8,000	$9,000
Leesville Total						**$4,536,244**	**$1,110,955**	**$340,218**	**$5,986,000**	**$1,499,000**	**$7,485,000**	**$8,495,000**

Project	Issues Major/Minor	Need Category	Tag #	Recommendation	Type	Current Price Level (PL 1-Oct-06) Construction	E&D	S&A	Estimated Cost	Contingency	Project Cost (FY06)	Mid-point (FY11**) Fully Funded Cost
Mohawk												
	Major					$33,268,988	$8,228,387	$2,495,174	$43,993,000	$11,000,000	$54,993,000	$62,421,000
		Dam Safety Issue										
			MKW-R01E	Remediate seepage concerns at terrace areas and along the o	Construction	$30,913,208	$7,728,302	$2,318,491	$40,960,000	$10,240,000	$51,200,000	$58,124,000
			MKW-S14E	Perform Seismic Safety Review (SSR) in accordance with ER 1110-2-1806.	Engineering	$0	$162,582	$0	$163,000	$41,000	$204,000	$240,000
			MKW-S18U	Purchase and stockpile sandbags and filter material for emergency use.	O & M	$81,810	$0	$6,136	$88,000	$22,000	$110,000	$124,000
		Efficiency										
			MKW-A13N	Install ADAS (Automated Data Acquisition System).	Construction	$232,052	$58,013	$17,404	$307,000	$77,000	$384,000	$436,000
		Facility Safety										
			MKW-O15E	Revise and update Water Control Manual.	Engineering	$0	$60,697	$0	$61,000	$15,000	$76,000	$89,000
		Recreation/Maintenance										
			MKW-D06E	Replace the deck of the service bridge.	O & M	$174,505	$43,626	$13,088	$231,000	$58,000	$289,000	$328,000
		Sustainability										
			MKW-A02D	Add additional 2 feet of fill to the filter blanket material & raise relief wells and piezometers.	Construction	$174,039	$43,510	$13,053	$231,000	$58,000	$289,000	$327,000
			MKW-B08A	Sandblast and paint beams and crane rails in the operating house at the intake structure.	O & M	$270,970	$0	$20,323	$291,000	$73,000	$364,000	$410,000
			MKW-E16P	Rehabilitate electrical service systems.	O & M	$255,656	$63,914	$19,174	$339,000	$85,000	$424,000	$481,000
			MKW-M04E	Repair concrete within the stilling basin walls, center pier, and intake bridge.	O & M	$270,970	$67,743	$20,323	$359,000	$90,000	$449,000	$509,000
			MKW-O17E	Rehabilitate overhead crane and trolley systems.	O & M	$51,131	$0	$3,835	$55,000	$14,000	$69,000	$77,000
			MKW-T05N	Initiate preventative maintenance on relief wells.	O & M	$148,492	$0	$11,137	$160,000	$40,000	$200,000	$224,000
			MKW-W07E	Refurbish gate hoist machinery and replace wire ropes.	O & M	$696,156	$0	$52,212	$748,000	$187,000	$935,000	$1,052,000
	Minor					$136,046	$5,801	$10,203	$152,000	$39,000	$191,000	$215,000
Mohawk Total						**$33,405,035**	**$8,234,188**	**$2,505,378**	**$44,145,000**	**$11,039,000**	**$55,184,000**	**$62,636,000**

Project	Issues Major/Minor	Need Category	Tag #	Recommendation	Type	Current Price Level (PL 1-Oct-06) Construction	E&D	S&A	Estimated Cost	Contingency	Project Cost (FY06)	Mid-point (FY11**) Fully Funded Cost
Mohicanville												
	Major					$2,643,908	$709,378	$198,293	$3,552,000	$888,000	$4,440,000	$5,043,000
		Dam Safety Issue										
			MOL-S05E	Perform Seismic Safety Review (SSR) in accordance with ER 1110-2-1806.	Engineering	$0	$162,582	$0	$163,000	$41,000	$204,000	$240,000
		Efficiency										
			MOL-A04N	Install ADAS (Automated Data Acquisition System).	Construction	$232,052	$58,013	$17,404	$307,000	$77,000	$384,000	$436,000
		Facility Safety										
			MOL-O06E	Revise and update Water Control Manual.	Engineering	$0	$60,697	$0	$61,000	$15,000	$76,000	$89,000
		Recreation/Maintenance										
			MOL-I02E	Remove and replace catwalk on u/s side of intake structure.	O & M	$162,582	$40,646	$12,194	$215,000	$54,000	$269,000	$306,000
		Sustainability										
			MOL-B08E	Replace backup generator.	O & M	$34,808	$0	$2,611	$37,000	$9,000	$46,000	$53,000
			MOL-D07E	Replace three 7' x 12' tractor gates.	O & M	$1,365,689	$341,422	$102,427	$1,810,000	$452,000	$2,262,000	$2,568,000
			MOL-E11P	Rehabilitate electrical service systems.	O & M	$184,072	$46,018	$13,805	$244,000	$61,000	$305,000	$346,000
			MOL-O10E	Rehabilitate overhead crane and trolley systems.	O & M	$51,131	$0	$3,835	$55,000	$14,000	$69,000	$77,000
			MOL-W09E	Refurbish gate hoist machinery and replace wire ropes.	O & M	$613,574	$0	$46,018	$660,000	$165,000	$825,000	$928,000
	Minor					$43,160	$0	$3,237	$47,000	$12,000	$59,000	$65,000
Mohicanville Total						**$2,687,068**	**$709,378**	**$201,530**	**$3,599,000**	**$900,000**	**$4,499,000**	**$5,108,000**

Project	Issues Major/Minor	Need Category	Tag #	Recommendation	Type	Current Price Level (PL 1-Oct-06) Construction	E&D	S&A	Estimated Cost	Contingency	Project Cost (FY06)	Mid-point (FY11**) Fully Funded Cost
North Branch of Kokosing												
	Major					$349,889	$281,292	$26,242	$657,000	$164,000	$821,000	$943,000
		Dam Safety Issue										
			NBN-S02E	Perform Seismic Safety Review (SSR) in accordance with ER 1110-2-1806.	Engineering	$0	$162,582	$0	$163,000	$41,000	$204,000	$240,000
		Efficiency										
			NBN-A01N	Install ADAS (Automated Data Acquisition System).	Construction	$232,052	$58,013	$17,404	$307,000	$77,000	$384,000	$436,000
		Facility Safety										
			NBN-O03E	Revise and update Water Control Manual.	Engineering	$0	$60,697	$0	$61,000	$15,000	$76,000	$89,000
		Sustainability										
			NBN-C04A	Sandblast and paint service gate.	O & M	$5,113	$0	$383	$5,000	$1,000	$6,000	$8,000
			NBN-P05N	Initiate preventative maintenance on relief wells.	O & M	$112,724	$0	$8,454	$121,000	$30,000	$151,000	$170,000
North Branch of Kokosing Total						**$349,889**	**$281,292**	**$26,242**	**$657,000**	**$164,000**	**$821,000**	**$943,000**

Project	Issues Major/Minor	Need Category	Tag #	Recommendation	Type	Current Price Level (PL 1-Oct-06) Construction	E&D	S&A	Estimated Cost	Contingency	Project Cost (FY06)	Mid-point (FY11**) Fully Funded Cost
Piedmont												
	Major					$8,803,967	$2,294,775	$660,298	$11,759,000	$2,940,000	$14,699,000	$16,691,000
		Dam Safety Issue										
			PES-H01A	Raise embankment, spillway key, and relocate road.	Construction	$3,264,509	$816,127	$244,838	$4,325,000	$1,081,000	$5,406,000	$6,138,000
			PES-H04E	Perform structural evaluation on tunnel to resolve hydrogen sulfide problems.	Engineering	$0	$43,355	$0	$43,000	$11,000	$54,000	$64,000
			PES-H05E	Remediate tunnel according to study (re-lining).	Construction	$1,755,886	$438,972	$131,691	$2,327,000	$582,000	$2,909,000	$3,301,000
			PES-S12E	Perform Seismic Safety Review (SSR) in accordance with ER 1110-2-1806.	Engineering	$0	$162,582	$0	$163,000	$41,000	$204,000	$240,000
		Efficiency										
			PES-A11N	Install ADAS (Automated Data Acquisition System).	Construction	$232,052	$58,013	$17,404	$307,000	$77,000	$384,000	$436,000
		Facility Safety										
			PES-O13E	Revise and update Water Control Manual.	Engineering	$0	$60,697	$0	$61,000	$15,000	$76,000	$89,000
		Recreation/Maintenance										
			PES-D10E	Repair concrete on stilling basin wall.	O & M	$270,970	$0	$20,323	$291,000	$73,000	$364,000	$410,000
			PES-S09E	Replace deck of Service Bridge.	O & M	$151,743	$37,936	$11,381	$201,000	$50,000	$251,000	$285,000
		Sustainability										
			PES-B16E	Replace backup generator.	O & M	$34,808	$0	$2,611	$37,000	$9,000	$46,000	$53,000
			PES-C15A	Sandblast and paint service gates.	O & M	$61,357	$0	$4,602	$66,000	$16,000	$82,000	$93,000
			PES-E14P	Rehabilitate electrical service systems.	O & M	$255,656	$63,914	$19,174	$339,000	$85,000	$424,000	$481,000
			PES-M03O	Modify intake structure for selective withdrawal.	Construction	$2,051,785	$512,946	$153,884	$2,719,000	$680,000	$3,399,000	$3,858,000
			PES-M18E	Replace motor operated floor stands with hydraulic cylinders.	O & M	$95,381	$23,845	$7,154	$126,000	$32,000	$158,000	$179,000
			PES-O17E	Rehabilitate overhead crane and trolley systems.	O & M	$51,131	$0	$3,835	$55,000	$14,000	$69,000	$77,000
			PES-S08A	Sandblast and paint beams on the service bridge.	O & M	$216,776	$0	$16,258	$233,000	$58,000	$291,000	$328,000
			PES-T06N	Initiate preventative maintenance on relief wells.	O & M	$56,362	$0	$4,227	$61,000	$15,000	$76,000	$85,000
			PES-T07E	Replace trash racks.	O & M	$305,549	$76,387	$22,916	$405,000	$101,000	$506,000	$574,000
	Minor					$5,624	$0	$422	$6,000	$2,000	$8,000	$9,000
Piedmont Total						**$8,809,592**	**$2,294,775**	**$660,719**	**$11,765,000**	**$2,942,000**	**$14,707,000**	**$16,700,000**

Project	Issues Major/Minor	Need Category	Tag #	Recommendation	Type	Current Price Level (PL 1-Oct-06) Construction	E&D	S&A	Estimated Cost	Contingency	Project Cost (FY06)	Mid-point (FY11**) Fully Funded Cost
Pleasant Hill												
	Major					$6,637,190	$34,785,380	$497,789	$41,920,000	$10,480,000	$52,400,000	$61,299,000
		Dam Safety Issue										
			PHC-A02R	Prepare study and design for repairing spillway deficiency.	Engineering	$0	$32,951,402	$0	$32,951,000	$8,238,000	$41,189,000	$48,562,000
			PHC-P01L	Plug low areas on reservoir rim.	Construction	$4,335,521	$1,083,880	$325,164	$5,745,000	$1,436,000	$7,181,000	$8,152,000
			PHC-S10E	Perform Seismic Safety Review (SSR) in accordance with ER 1110-2-1806.	Engineering	$0	$162,582	$0	$163,000	$41,000	$204,000	$240,000
		Efficiency										
			PHC-A09N	Install ADAS (Automated Data Acquisition System).	Construction	$232,052	$58,013	$17,404	$307,000	$77,000	$384,000	$436,000
		Facility Safety										
			PHC-O11E	Revise and update Water Control Manual.	Engineering	$0	$60,697	$0	$61,000	$15,000	$76,000	$89,000
		Recreation/Maintenance										
			PHC-C06O	Morning glory spillway concrete repair.	O & M	$270,970	$67,743	$20,323	$359,000	$90,000	$449,000	$509,000
			PHC-S03A	Patch spalls in tunnel.	O & M	$270,970	$67,743	$20,323	$359,000	$90,000	$449,000	$509,000
			PHC-S05E	Remove stones from the stilling basin and outlet channel, repai	O & M	$1,160,261	$290,065	$87,020	$1,537,000	$384,000	$1,921,000	$2,182,000
		Sustainability										
			PHC-B15E	Replace backup generator.	O & M	$34,808	$0	$2,611	$37,000	$9,000	$46,000	$53,000
			PHC-C16A	Sandblast and paint service gates.	O & M	$35,792	$0	$2,684	$38,000	$10,000	$48,000	$54,000
			PHC-E12P	Rehabilitate electrical service systems.	O & M	$97,149	$24,287	$7,286	$129,000	$32,000	$161,000	$183,000
			PHC-O13E	Replace motor operating stands for sluice gates with ones.	O & M	$75,872	$18,968	$5,690	$101,000	$25,000	$126,000	$143,000
			PHC-O14E	Rehabilitate overhead crane and trolley systems.	O & M	$51,131	$0	$3,835	$55,000	$14,000	$69,000	$77,000
			PHC-T07L	Cleaning and painting of trash racks.	O & M	$52,212	$0	$3,916	$56,000	$14,000	$70,000	$79,000
			PHC-T17E	Replace service gate stems and guides.	O & M	$20,452	$0	$1,534	$22,000	$5,000	$27,000	$31,000
	Minor					$30,536	$7,634	$2,290	$40,000	$10,000	$50,000	$57,000
Pleasant Hill Total						**$6,667,726**	**$34,793,014**	**$500,079**	**$41,960,000**	**$10,490,000**	**$52,450,000**	**$61,356,000**

Project	Issues Major/Minor	Need Category	Tag #	Recommendation	Type	Current Price Level (PL 1-Oct-06) Construction	E&D	S&A	Estimated Cost	Contingency	Project Cost (FY06)	Mid-point (FY11**) Fully Funded Cost
Remote Operation Plan												
	Major					$0	$204,525	$0	$205,000	$51,000	$256,000	$301,000
		Efficiency										
			REM-T01R	Perform study to evaluate the capabilities for remote operations	Engineering	$0	$204,525	$0	$205,000	$51,000	$256,000	$301,000
Remote Operation Plan Total						**$0**	**$204,525**	**$0**	**$205,000**	**$51,000**	**$256,000**	**$301,000**

Project	Issues Major/Minor	Need Category	Tag #	Recommendation	Type	Current Price Level (PL 1-Oct-06) Construction	E&D	S&A	Estimated Cost	Contingency	Project Cost (FY06)	Mid-point (FY11**) Fully Funded Cost
Senecaville												
	Major					$1,991,432	$601,453	$149,357	$2,742,000	$685,000	$3,427,000	$3,898,000
		Dam Safety Issue										
			SES-S15E	Perform Seismic Safety Review (SSR) in accordance with ER 1110-2-1806.	Engineering	$0	$162,582	$0	$163,000	$41,000	$204,000	$240,000
		Efficiency										
			SES-A14N	Install ADAS (Automated Data Acquisition System).	Construction	$232,052	$58,013	$17,404	$307,000	$77,000	$384,000	$436,000
			SES-P09E	Remote gage readings to the office.	Construction	$157,163	$39,291	$11,787	$208,000	$52,000	$260,000	$296,000
			SES-P18E	Redesign maintenance bulkhead for easier installation.	Construction	$421,037	$105,259	$31,578	$558,000	$139,000	$697,000	$792,000
		Erosion Control										
			SES-A02L	Place stone slope protection (SSP) in the upstream side of dam on the north and south embankments.	O & M	$127,629	$0	$9,572	$137,000	$34,000	$171,000	$193,000
		Facility Safety										
			SES-I06E	Replace the stoplog closure with an aluminum bulkhead closure system.	Construction	$46,410	$11,603	$3,481	$61,000	$15,000	$76,000	$87,000
			SES-O16E	Revise and update Water Control Manual.	Engineering	$0	$60,697	$0	$61,000	$15,000	$76,000	$89,000
			SES-P11D	Add parking spot near the intake structure.	O & M	$138,032	$34,508	$10,352	$183,000	$46,000	$229,000	$260,000
		Recreation/Maintenance										
			SES-C10E	Repair concrete on stilling basin wall.	O & M	$270,970	$0	$20,323	$291,000	$73,000	$364,000	$410,000
		Sustainability										
			SES-C03A	Sandblast and paint sluice gates and liners.	O & M	$29,007	$0	$2,175	$31,000	$8,000	$39,000	$44,000
			SES-D01E	Replace emergency gate guides at intake structure.	Construction	$58,013	$14,503	$4,351	$77,000	$19,000	$96,000	$109,000
			SES-E21P	Rehabilitate electrical service systems.	O & M	$184,072	$46,018	$13,805	$244,000	$61,000	$305,000	$346,000
			SES-O19E	Rehabilitate overhead crane and trolley systems.	O & M	$51,131	$0	$3,835	$55,000	$14,000	$69,000	$77,000
			SES-O20E	Replace motor operating stands for sluice gates with ones.	O & M	$75,872	$18,968	$5,690	$101,000	$25,000	$126,000	$143,000
			SES-S17E	Replace service gate's stems and guide stems.	O & M	$58,013	$14,503	$4,351	$77,000	$19,000	$96,000	$109,000
			SES-T05E	Replace trash racks.	O & M	$142,032	$35,508	$10,652	$188,000	$47,000	$235,000	$267,000
	Minor					$213,322	$6,102	$15,999	$236,000	$59,000	$295,000	$331,000
Senecaville Total						**$2,204,754**	**$607,556**	**$165,357**	**$2,978,000**	**$744,000**	**$3,722,000**	**$4,229,000**

Project	Issues Major/Minor	Need Category	Tag #	Recommendation	Type	Current Price Level (PL 1-Oct-06) Construction	E&D	S&A	Estimated Cost	Contingency	Project Cost (FY06)	Mid-point (FY11**) Fully Funded Cost
Tappan												
	Major					$3,999,818	$4,173,135	$299,986	$8,472,000	$2,118,000	$10,590,000	$12,195,000
		Dam Safety Issue										
			TAL-H03E	Perform structural evaluation on tunnel to resolve hydrogen sulfide problems.	Engineering	$0	$43,355	$0	$43,000	$11,000	$54,000	$64,000
			TAL-H04E	Remediate tunnel according to study (re-lining).	Construction	$1,539,110	$384,778	$115,433	$2,039,000	$510,000	$2,549,000	$2,894,000
			TAL-S14E	Perform Seismic Safety Review (SSR) in accordance with ER 1110-2-1806.	Engineering	$0	$162,582	$0	$163,000	$41,000	$204,000	$240,000
		Efficiency										
			TAL-A13N	Install ADAS (Automated Data Acquisition System).	Construction	$232,052	$58,013	$17,404	$307,000	$77,000	$384,000	$436,000
		Erosion Control										
			TAL-S05E	Replace stone slope protection on sections of the upstream fac	O & M	$75,584	$0	$5,669	$81,000	$20,000	$101,000	$114,000
			TAL-S06P	Spillway erodibility study for unlined portion.	Engineering	$0	$3,049,606	$0	$3,050,000	$762,000	$3,812,000	$4,494,000
		Facility Safety										
			TAL-O15E	Revise and update Water Control Manual.	Engineering	$0	$60,697	$0	$61,000	$15,000	$76,000	$89,000
		Sustainability										
			TAL-E19P	Rehabilitate electrical service systems.	O & M	$184,072	$46,018	$13,805	$244,000	$61,000	$305,000	$346,000
			TAL-M02O	Modify intake structure for selective withdrawal.	Construction	$1,231,288	$307,822	$92,347	$1,631,000	$408,000	$2,039,000	$2,315,000
			TAL-O18E	Rehabilitate overhead crane and trolley systems.	O & M	$51,131	$0	$3,835	$55,000	$14,000	$69,000	$77,000
			TAL-S08E	Replace trash racks.	O & M	$241,055	$60,264	$18,079	$319,000	$80,000	$399,000	$453,000
			TAL-S09A	Sandblast and paint beams on the service bridge.	O & M	$216,776	$0	$16,258	$233,000	$58,000	$291,000	$328,000
			TAL-S10A	Sandblast and paint 3 sluice liners.	O & M	$116,026	$0	$8,702	$125,000	$31,000	$156,000	$175,000
			TAL-T01N	Initiate preventative maintenance on relief wells.	O & M	$112,724	$0	$8,454	$121,000	$30,000	$151,000	$170,000
	Minor					$176,121	$31,120	$13,209	$220,000	$56,000	$276,000	$313,000
Tappan Total						**$4,175,939**	**$4,204,254**	**$313,195**	**$8,692,000**	**$2,174,000**	**$10,866,000**	**$12,508,000**

Project	Issues Major/Minor	Need Category	Tag #	Recommendation	Type	Current Price Level (PL 1-Oct-06) Construction	E&D	S&A	Estimated Cost	Contingency	Project Cost (FY06)	Mid-point (FY11**) Fully Funded Cost
Wills Creek												
	Major					$2,672,505	$345,206	$200,438	$3,219,000	$805,000	$4,024,000	$4,550,000
		Dam Safety Issue										
			WCW-S13E	Perform Seismic Safety Review (SSR) in accordance with ER 1110-2-1806.	Engineering	$0	$162,582	$0	$163,000	$41,000	$204,000	$240,000
		Efficiency										
			WCW-A12N	Install ADAS (Automated Data Acquisition System).	Construction	$232,052	$58,013	$17,404	$307,000	$77,000	$384,000	$436,000
		Erosion Control										
			WCW-S02D	Add additional stone to the upstream face.	O & M	$232,052	$0	$17,404	$249,000	$62,000	$311,000	$351,000
		Facility Safety										
			WCW-O14E	Revise and update Water Control Manual.	Engineering	$0	$60,697	$0	$61,000	$15,000	$76,000	$89,000
		Recreation/Maintenance										
			WCW-C03E	Repair concrete on the right training wall of the stilling basin.	O & M	$270,970	$0	$20,323	$291,000	$73,000	$364,000	$410,000
			WCW-S11L	Clean and paint service bridge.	O & M	$313,270	$0	$23,495	$337,000	$84,000	$421,000	$474,000
		Sustainability										
			WCW-204N	Initiate preventative maintenance on relief wells.	O & M	$148,492	$0	$11,137	$160,000	$40,000	$200,000	$224,000
			WCW-B08E	Replace backup generator.	O & M	$34,808	$0	$2,611	$37,000	$9,000	$46,000	$53,000
			WCW-C15A	Sandblast and paint service gates.	O & M	$357,918	$0	$26,844	$385,000	$96,000	$481,000	$541,000
			WCW-E17P	Rehabilitate electrical service systems.	O & M	$255,656	$63,914	$19,174	$339,000	$85,000	$424,000	$481,000
			WCW-H06A	Sandblast and paint hoist motor assembly and frames once service gate cables are installed.	O & M	$162,582	$0	$12,194	$175,000	$44,000	$219,000	$246,000
			WCW-O16E	Rehabilitate overhead crane and trolley systems.	O & M	$51,131	$0	$3,835	$55,000	$14,000	$69,000	$77,000
			WCW-W05E	Refurbish gate hoist machinery and replace wire ropes.	O & M	$613,574	$0	$46,018	$660,000	$165,000	$825,000	$928,000
	Minor					$219,058	$0	$16,429	$235,000	$60,000	$295,000	$332,000
Wills Creek Total						**$2,891,563**	**$345,206**	**$216,867**	**$3,454,000**	**$865,000**	**$4,319,000**	**$4,882,000**

APPENDIX B: SCREENING PORTFOLIO RISK ANALYSIS (SPRA)

In June 2005, the USACE began evaluating reservoir and lock and dam projects with known dam safety concerns to develop relative ratings for human and economic risk; this document, called the Screening Portfolio Risk Analysis (SPRA), will be used as a tool to help shape USACE budget decisions on the national level. Over 60 projects nation-wide were evaluated in the SPRA and five of them were located in the Muskingum Basin. The relative risk rankings for these projects are summarized in Table 1 below. In FY06, a second series of projects will be evaluated by the SPRA; the Huntington District will offer Atwood, Pleasant Hill, and Zoar Levee.

Table 1. Project ranking results from SPRA.

Project	National SPRA Ranking
Mohawk	7
Dover	9
Bolivar	11
Beach City	18
Piedmont	No Ranking

Current on-going projects within the Huntington District Dam Safety Program include DSA (Dam Safety Assurance) studies at Dover Dam and Major Rehabilitation Program studies at Mohawk and Bolivar Dams. DSA studies address hydrologic and seismic deficiencies while the Major Rehabilitation Program focuses on seepage corrections. Summaries of the major project deficiencies identified by the SPRA are listed below; a complete list of Dam Safety deficiencies can be found in other sections of this report.

- **Mohawk Dam Seepage Correction Major Rehabilitation Program.** Mohawk Dam Seepage Correction Study is ranked No. 7 nationally by the SPRA. Funding was allocated for FY 05 to initiate a study and geotechnical subsurface explorations.
- **Dover Dam Hydrologic Deficiency DSA Program.** The Dover Dam Hydrological Deficiency Study is ranked No. 9 nationally by the SPRA. Dover Dam is hydrologically deficient with a potential stability problem and abutment erodibility problem. Geotechnical subsurface explorations began in FY 04 in order to better identify the lithology along the abutments.
- **Bolivar Dam Seepage Correction Major Rehabilitation Program.** Bolivar Dam Seepage Correction Study is ranked No. 11 nationally by the SPRA. Geotechnical subsurface explorations and inspection began in February 2004 as a part of a study for the Seepage Correction at Bolivar Dam. Additional explorations and studies are needed to better define the severity of seepage instability and implement remedial measures.
- **Beach City Dam and Zoar Levee Seepage Corrections.** Geotechnical investigations need to be conducted on Beach City and Zoar Levee to better define the extents of the underseepage problems.

- **Piedmont Lake Dam Safety Assurance Program (DSA).** The Piedmont Lake DSA Evaluation Report was approved in October 2000. Currently, plans and specifications to construct a parapet wall across the top of the dam, place a concrete erosion block on the spillway crest, and relocate roadways are 100% complete.

The following pages show proposed Huntington District Dam Safety Program schedules assuming complete funding is available.

Figure 21. Mohawk Dam Seepage Correction Major Rehabilitation Program.

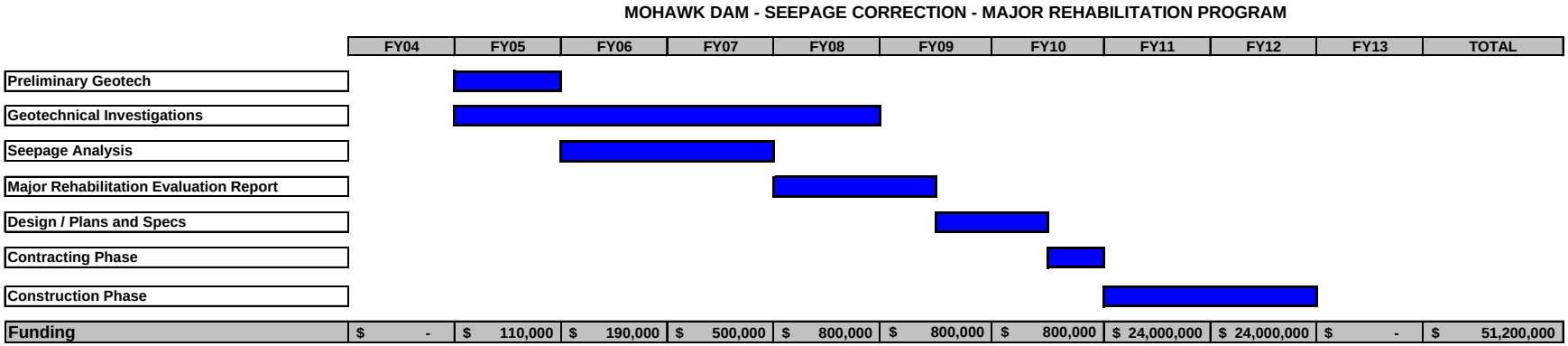


Figure 22. Dover Dam DSA Program.

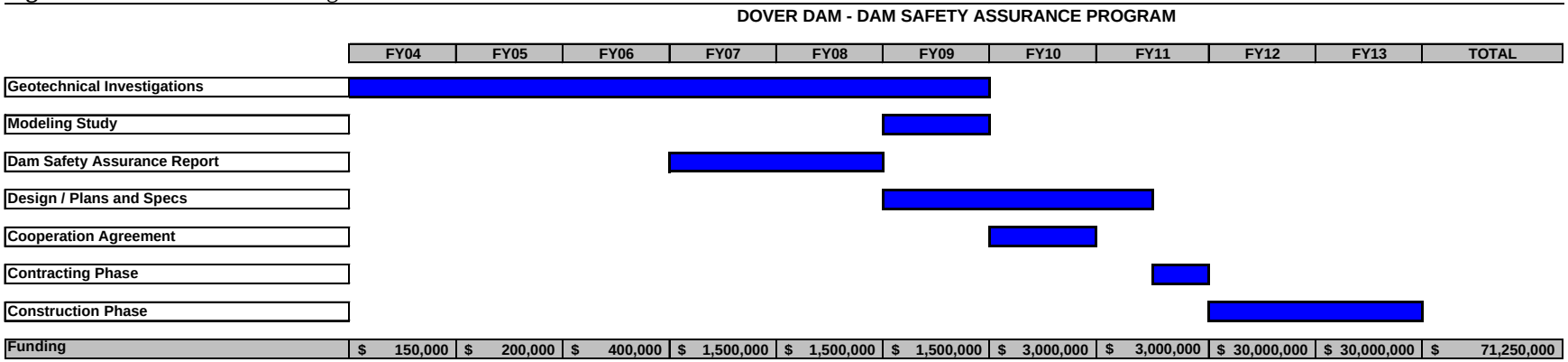


Figure 23. Bolivar Dam Seepage Correction Major Rehabilitation Program

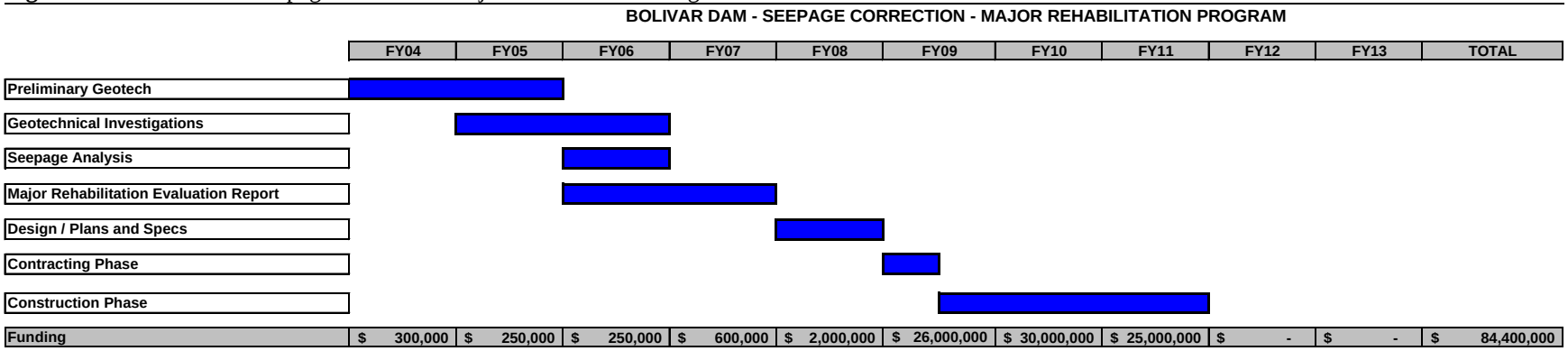


Figure 24. Beach City Dam Seepage Correction

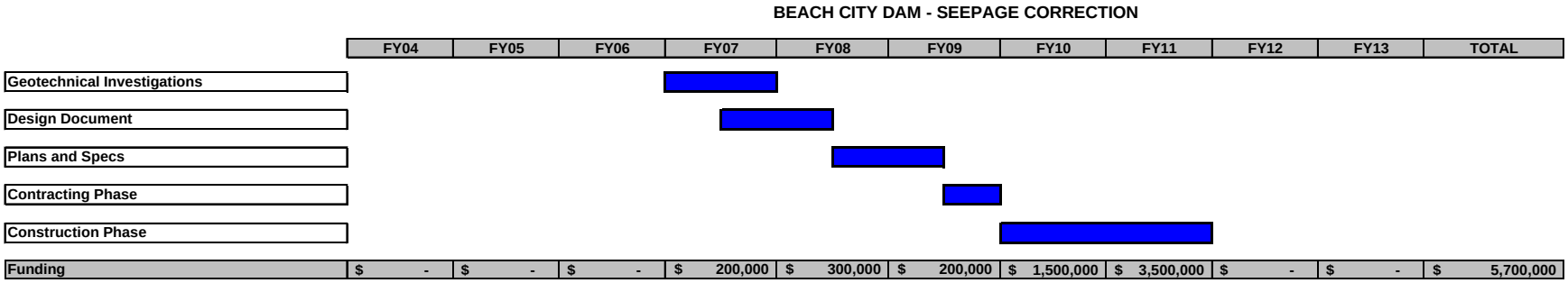
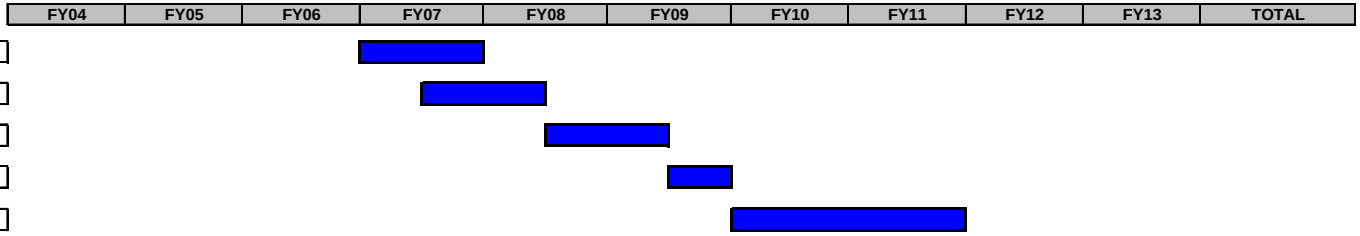


Figure 25. Zoar Levee Seepage Correction

ZOAR LEVEE - SEEPAGE CORRECTION



	FY04	FY05	FY06	FY07	FY08	FY09	FY10	FY11	FY12	FY13	TOTAL
Geotechnical Investigations											
Design Document											
Plans and Specs											
Contracting Phase											
Construction Phase											
Funding	$ -	$ -	$ -	$ 200,000	$ 300,000	$ 200,000	$ 1,500,000	$ 3,500,000	$ -	$ -	$ 5,700,000

Figure 26. Projects Combined.

COMBINED PROJECT COST

	FY04	FY05	FY06	FY07	FY08	FY09	FY10	FY11	FY12	FY13	TOTAL
Mohawk	$ -	$ 110,000	$ 190,000	$ 500,000	$ 800,000	$ 800,000	$ 800,000	$ 24,000,000	$ 24,000,000	$ -	$ 51,200,000
Dover	$ 150,000	$ 200,000	$ 400,000	$ 1,500,000	$ 1,500,000	$ 1,500,000	$ 3,000,000	$ 3,000,000	$ 30,000,000	$ 30,000,000	$ 71,250,000
Bolivar	$ 300,000	$ 250,000	$ 250,000	$ 600,000	$ 2,000,000	$ 26,000,000	$ 30,000,000	$ 25,000,000	$ -	$ -	$ 84,400,000
Beach City	$ -	$ -	$ -	$ 200,000	$ 300,000	$ 200,000	$ 1,500,000	$ 3,500,000	$ -	$ -	$ 5,700,000
Zoar Levee	$ -	$ -	$ -	$ 200,000	$ 300,000	$ 200,000	$ 1,500,000	$ 3,500,000	$ -	$ -	$ 5,700,000
Funding	$ 450,000	$ 560,000	$ 840,000	$ 3,000,000	$ 4,900,000	$ 28,700,000	$ 36,800,000	$ 59,000,000	$ 54,000,000	$ 30,000,000	$ 218,250,000