ROCKDALE COUNTY'S INNOVATIVE APPROACH TO REHABILITATING AN AGING DAM

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REFERENCE: *Proceedings of the 2007 Georgia Water Resources Conference*, held March 27–29, 2007, at the University of Georgia.

Abstract. Rockdale County, located just east of metro Atlanta, faced a potential problem with a privately owned farm pond in the middle of a commercial corridor when the State's Safe Dams Program classified the earthen embankment as a high hazard structure and required upgrades to meet current safety standards. However, rather than burying its head in the sand and allowing the property owners to face the problems alone, Rockdale County responded with an innovative solution in the form of Regional Storm Water Detention.

The approximate thirty-foot high dam was constructed in the 1950's. The lake formed by the dam encompasses about five acres and the surrounding highly-developed, urban watershed is roughly 140 acres. The lake is situated between a State highway and a major urban arterial road with heavy commercial development to the north, east, and west. Residential communities have become established south of the dam leading to the State's classification of the dam as a high hazard structure.

Rather than facing a liability, Rockdale County seized an opportunity to improve the quality of life for the neighboring community. By acquiring the property and embarking on an effort to create a Regional Storm Water Detention Pond, the County found a way to rehabilitate the dam, improve water quality, reduce traffic congestion, potentially improve air quality, create an aesthetic recreational park for community gathering and educational opportunities, and also promote further development. In addition, Rockdale County found funding in the form of a U.S. Environmental Protection Agency Grant to help achieve these goals.

This paper describes Rockdale County's multifaceted solution to the problems presented by the aging dam. It highlights aspects of the Regional Storm Water Detention Project, including funding mechanisms, the investigation and rehabilitation of the dam, overall strategies for improving water quality, and other related aspects of the project.

Figure 1. The Lakefield Impoundment

PROJECT HISTORY

Federal Congressional Appropriations from 1999 through 2002 provided funding to Rockdale County and neighboring counties through the U.S. Environmental Protection Agency (US EPA) for the Big Haynes Creek Regional Project. The counties were unable to settle on a common project and in 2002 requested that the funding be split equally between Rockdale and Gwinnett County.

In 1997 the Georgia's Safe Dams Program (GASDP) had classified the dam of an old farm pond in the county as a Category I High Hazard Dam. The area draining to the pond consisted of about 140 acres of the most commercialized area in Rockdale County but the old farm pond had remained. Rockdale recognized that this farm pond in the Lakefield Watershed was the perfect site for implementing regional detention using the available funding left over from the Big Haynes Regional Project.

Rockdale County began negotiating with the private land owners and meeting with GASDP personnel to review the condition of the dam. Rockdale had already been considering the construction of a four-lane urban collector across the dam to connect two state roadways and relieve congestion at a busy nearby intersection.

In the end, Rockdale County determined that the Lakefield Watershed presented a tremendous opportunity to utilize the available funding, address critical water quality issues, provide a mechanism for realizing the completion of their roadway project, and construct amenities for the community. The project was presented to the US EPA and Rockdale issued a Request for Proposals to begin detailed studies and implementation of the project.

Dam History

The earthen embankment dam forming the Lakefield Impoundment was reported to have been constructed in the 1950s. The structure was not designed or constructed according to modern engineering standards and failed to meet many of the GASDP's requirements. The earthen embankment reaches a maximum height of about 30 feet and the surface area of the impoundment at normal pool is nearly 5 acres. The outlet works for the dam consist of a principal spillway with twin, 36-inch diameter corrugated metal pipe culverts and an earthen trapezoidal channel serving as an auxiliary spillway along the left abutment. Inspections by the GASDP indicated that the dam, although not in danger of imminent failure, was in need of repairs.

Water Quality Issues

Heavy development in the Lakefield Watershed during the 1980s and early 1990s drastically changed the landscape. Stormwater Best Management Practices (BMPs) were strewn across the watershed but were in poor condition and were not designed to meet the water quality standards that have been widely implemented since their construction.

The Lakefield Watershed is in the Snapping Shoals Creek Basin and discharges to a tributary of the South River. The South River discharges into the Upper Ocmulgee Basin and eventually drains to Lake Jackson. Snapping Shoals Creek, the South River, and Lake Jackson are listed on the GA Environmental Protection Division's 303(d) List of Impaired Waters as "Not Supporting" or "Partially Supporting".

Furthermore, previous water and biological assessments performed by Rockdale County of the streams within the Snapping Shoals Creek watershed have indicated a degraded and degrading system, likely caused by non-point source pollution and urban runoff.

PHASE I – STUDY DESIGN

In 2005 Rockdale County initiated the current project – The Lakefield Urban Watershed Restoration Project – with a team of consultants including Golder Associates, CH2M Hill, and Ecos Environmental Design. In accordance with the stipulations of the U.S. E.P.A.'s Special Purpose Projects Grant, only the initial phase of the project was originally authorized. This phase involved a detailed study of the watershed and dam, along with the development and analysis of alternatives for the project. Phase I culminated in the development of an Environmental Information Document to satisfy the requirements of the National Environmental Policy Act of 1969 (NEPA).

Dam Rehabilitation

The Lakefield Dam is shown in Figure 1 above. The rehabilitation of this structure was critical to the success of the project since the loss of the dam would result in a significant reduction of existing water quality benefits and the loss of a valuable resource for improving the water quality and channel protection downstream of the watershed. Phase I of the project involved the study and field reconnaissance/investigation of the dam, as well as an options analysis for rehabilitating the structure.

Previous Inspections/Supplemental Investigation. Geotechnical investigations had been previously performed on the Lakefield Dam and the GASDP had prepared a Visual Inspection Report following their reclassification of the structure as a Category I Dam. Some of the noted deficiencies in the dam included: very steep upstream and downstream slopes, large trees on the downstream face of the dam, uncontrolled seepage at the toe, no wave protection, insufficient capacity of the principal and auxiliary spillways, no low-level outlet structure, and minor sloughing and severe bank erosion along the downstream slope. As part of this review, a dam breach analysis was performed to confirm the Category I status of the dam.

Once the condition of the structure was assessed, a supplemental geotechnical investigation, including soil borings along the crest and downstream toe of the dam, was performed. Undisturbed samples were collected for laboratory analysis and piezometers were installed to allow monitoring of the phreatic surface through the dam. Laboratory testing included consolidation, strength, and permeability testing, on the various strata identified through the dam.

Conceptual Options Study. Three methods were identified for rehabilitating the dam, including: (1) Downstream Retrofitting; (2) Removal and Replacement; and (3) Roller Compacted Concrete (RCC) Retrofit. Option 1 – Downstream Retrofitting involved the construction of an engineered earthen dam on the downstream face of the existing structure while keeping the majority of the existing embankment in place. Option 2 – Removal and Replacement entailed removing the entire structure and re-

constructing the dam. Option 3 – RCC Retrofit was similar to Option 1 except that RCC would be used in lieu of an earthen dam on the downstream face. Option 1 was selected as the preferred method for rehabilitating the dam based on the results of a cost-benefits analysis.

Watershed Study

Phase I of the project involved three primary tasks associated with the study of the Lakefield Watershed: (1) Field Reconnaissance; (2) Watershed Modeling; and (3) Development and Analysis of Alternatives. The watershed is depicted in Figure 2.

Field Reconnaissance. The field reconnaissance was conducted to inventory and evaluate existing conditions within the Lakefield Watershed. The major items of interest included wildlife habitat and plant species, wetlands, stream conditions, and watershed BMPs.

The lakeshore and surrounding areas and the area downstream of the dam were found to have limited wildlife habitat and were dominated by invasive exotic plant species. Three types of wetlands were observed along the lakeshore and immediately below the dam.

Stream segments above and below the dam were surveyed and evaluated for Rosgen stream classification, bank erosion, physical habitat, potential pollution sources and maintenance issues, buffers, and potential stream restoration projects. The upstream segment was not significantly eroded but contained significant sediment deposition, reducing the water quality and habitat value. The stream segments below the dam exhibited bank erosion and incision with the severity of the bank erosion and incision decreasing with distance from the dam.

Watershed BMPs were initially identified through a desktop study using aerial photography and county GIS topographic data. Field crews then visited the site to verify those findings and refine BMP characteristics such as catchment areas, types, conditions, dimensions, and outlet structures. Of the 16 BMPs identified within the watershed, most were classified as vegetated swales or dry detention ponds. In general, the BMPs were undersized and under-designed with many providing very little or no benefit.

Watershed Modeling. Two tools were used to model the watershed so that existing conditions could be established and the alternatives analysis conducted. ICPR (Inter-Connected Pond Routing) software was used to hydraulically analyze the watershed and assess channel protection performance. The LIFE model (Low-Impact Feasibility Evaluation), a CH2M Hill proprietary software, was used to perform a dynamic simulation of runoff and infiltration in the watershed and analyze sediment loadings. Water quality goals and benefits were expressed

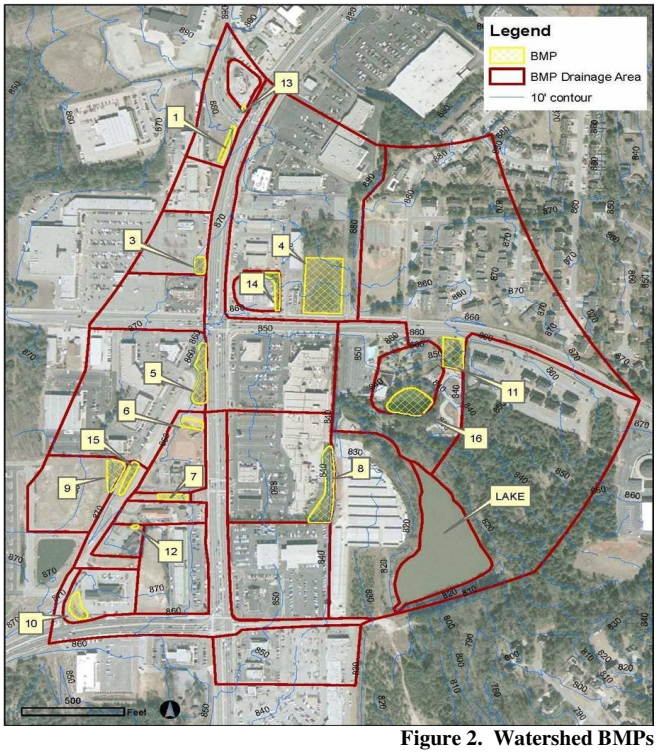

Figure 2. Watershed BMPs

through removal efficiencies obtained using the LIFE model. In order to enhance the accuracy of the watershed models, site-specific rainfall and flow data was captured for a period of approximately 6 months and was used to calibrate the models.

Evaluation criteria were established from the "Minimum Stormwater Management Standards" in the Georgia Stormwater Management Manual. To evaluate water quality benefits, Minimum Standard No. 2 was used. This standard requires that a system be designed to remove 80 percent of the total suspended solids (TSS). To evaluate stream channel protection benefits, our analysis relied upon one of the requirements of Minimum Standard No. 3, which calls for providing 24-hour extended detention of the 1-year, 24-hour storm event.

Alternatives Analysis. Four alternatives were developed for improvement of the Lakefield Watershed from a water quality and channel protection standpoint. The alternatives included: (1) No Action; (2) Lake Retrofit; (3) BMP Retrofit; and (4) Combined Lake and BMP Retrofit. The 'No-Action' alternative assumed that the existing dam would be rehabilitated but that no additional actions would be taken. The 'Lake Retrofit' alternative assumed that sediment forebays would be constructed at the two locations where concentrated flow enters the lake. Alternative 3 involved retrofitting only upland BMPs within the watershed and Alternative 4 consisted of Alternative 2 plus limited retrofitting of upland BMPs. The four alternatives

were modeled and compared to the evaluation criteria for channel protection and water quality goals. Cost-benefit analyses of the alternatives were also performed. Only Alternatives 2 and 4 were found to meet both goals with Alternative 4 providing slightly enhanced benefits at a slightly higher cost. Alternative 4 also contained added benefits in terms of maintaining the quality of the water within the Lakefield Impoundment. Results of the analysis are included in Table 1 below.

Table 1. Alternative Analysis Results

Alternative/ Description	Cost (million $)	TSS Removal Efficiency	Peak Flow Requirements
1/ No Action	$2.42	YES	NO
2/ Lake Retrofit	$2.49	YES	YES
3/ BMP Retrofit	$2.77	YES	NO
4/ Lake & BMP Retrofit	$2.61	YES	YES

NEPA Document

The results of the Phase I studies were combined with additional information gathered relative to the environmental impacts of the project to create the NEPA or Environmental Information Document (EID). Additional information gathered for the EID included the presence of rare or endangered species, the presence of historical structures or sites, environmental justice considerations, etc. The primary impact of the project on the environment was found to be wetland impacts which will be mitigated through the purchase of credits from a local wetlands mitigation credits bank. Overall the project was determined to have an overall net benefit to the environment.

PHASES II & III – DESIGN & IMPLEMENTATION

The U.S. E.P.A. approved the design and implementation phases of the project in September 2006. The dam rehabilitation design has gone through conceptual and preliminary phases and the 100 percent design is nearing completion at the time of this writing. Implementation of the project will include long-term monitoring for 5 years to assess the results in terms of improvement to water quality.

ADDITIONAL PROJECT BENEFITS

The Lakefield Urban Watershed Restoration Project is a multi-faceted project. In addition to the dam rehabilitation and water quality benefits, Rockdale County expanded the overall scope of the project to include amenities for the community and to improve traffic conditions.

Recreation Plan/Beautification

A Recreational Plan is being developed as part of the project to create a park-like setting around the Lakefield Impoundment. Features of the plan include a ½-mile walking trail, overlooks, native plantings, and educational kiosks. The Conceptual Recreation Plan is included as Figure 3 below.

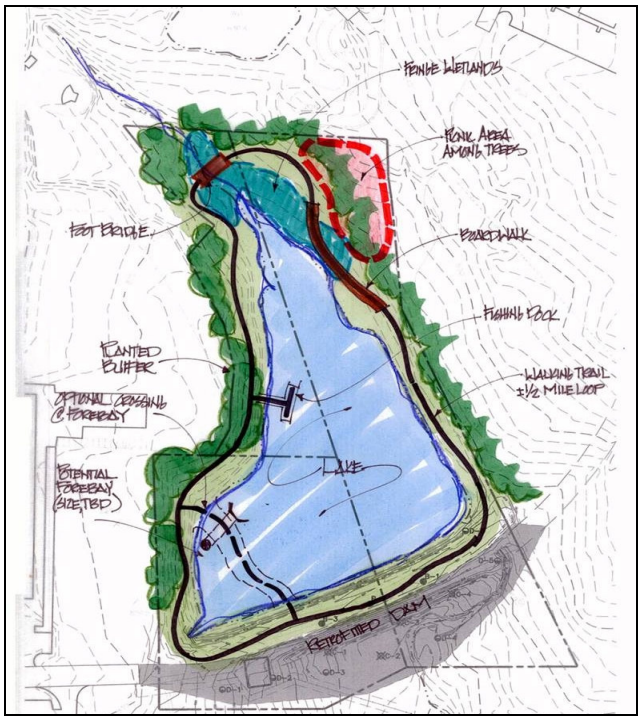

Figure 3. Conceptual Recreation Plan

Lakefield Drive Extension

With the rehabilitation of the dam, the opportunity was presented for Rockdale County to pursue its plan to reduce traffic congestion and improve air quality by constructing a roadway across the top of the dam. The Lakefield Drive Extension will connect two State Roads and create an alternate route to bypass a congested intersection. Although the roadway design and construction is ineligible for funding through the U.S. E.P.A. Special Purpose Grant, it is directly benefiting from the work being performed and will work synergistically with the other aspects of the project to improve the overall quality of life in the area. The planned roadway is approximately one-third of a mile long, and will consist of two lanes divided by a landscaped median.

CONCLUSION

The Lakefield Urban Watershed Restoration Project is a prime example of one county's ingenuity in turning a potentially serious problem into solutions for many others. The project also demonstrates that Regional Detention is a viable alternative to the construction of many independent on-site BMPs and can address other community needs.

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