



❖ *Original or Innovative Application of New or Existing Techniques*

Two innovative applications to standard techniques stand out in this project. The first relates to the holistic approach applied to stormwater management. The second relates to the use of soil cement for the Shadow Lake Dam auxiliary spillway.

**Comprehensive Stormwater Management Plan.**

The Papio-Missouri River NRD (P-MNRD) identified the need for peak stormwater runoff restrictions at Highway 370 north of the site and long-term flooding concerns downstream of Highway 370. In addition to the P-MNRD concerns for the site, the Natural Resources Conservation Service (NRCS) had long-term plans to construct a grade stabilization structure on Midland Creek.

The result of addressing these concerns led to the design and construction of two rolled earth dams and their associated wet reservoirs, Shadow Lake Dam and Midland Lake Dam. From its inception, comprehensive stormwater management was integral to the planning and design of Shadow Lake dam system. In addition to flood control, the two dams and reservoirs were designed to accommodate 25 years of sediment accumulation while still having a clear zone of approximately 8 to 10 feet. An undulating lake bottom, a wide range of depths within the lake and along the shoreline, and varying shoreline vegetation combine to provide favorable conditions to aquatic wildlife. The lakes were built to create clear, viable pools above the sedimentation volume. The lakes can maintain a fish population and provide flood control and sedimentation for water quality by making them deeper than required.

Several features were provided to help protect the water quality in the lake. Fringe wetlands were strategically placed near storm sewer discharge points to take in nutrients, control erosion and filter silt and debris. A 30-foot zone of native grasses provides a buffer along the shoreline as well as similar benefits to those provided by the fringe wetlands. Additional buffer space exists between the adjacent residential lots and the shoreline. Over 2000 trees were planted, primarily in these buffer zones.

Waterways were designed to allow for low flow stream meander and include drops, pools, wetlands and trees surrounded by native grass buffers to protect water quality. These stream corridors have been connected by other green space corridors to provide connectivity within and to adjacent sites.

**Auxiliary Spillway.** The auxiliary spillway for Midland Lake Dam is typical for rolled earth dams in that it is cut into natural soils and graded so that velocities are rarely a problem. On the Shadow Lake Dam, site constraints did not permit the construction of the typical auxiliary spillway. The auxiliary spillway for Shadow Lake Dam needed to be constructed in an embankment section and the slopes on the downstream side of the spillway control section were 5H:1V. Hydraulics and a breach analysis determined that armoring was needed to protect this critical section of the dam. While different options were investigated, the final design included constructing a soil-cement auxiliary spillway section. This option was unique in that a soil-cement auxiliary spillway had not been constructed in Nebraska.

The soil-cement method combines very fine sand with a cement mixture to form a solid, durable surface. Layers, typically 6 inches thick and 8 to 11 feet wide, run the length of the 400 foot long spillway section. The layers overlap each in a series of steps to provide a thickened soil-cement section typically 2 feet thick. The layers were formed into a bowl section at the base of the downstream side of the spillway to induce a hydraulic jump and help dissipate energy before crossing the future Schramm Road into a downstream channel section. A Portland cement concrete sill 4 feet wide and 7 feet deep was poured along the length of the control section to reduce the potential for breach.