

Reservoir Project Joins Disparate Entities

Project unites public, water industry, and fish population.

By Michael R. May and Ray Tenney

The Elkhead Reservoir Expansion Project in the Yampa River area of Craig, CO, required the cooperation of an array of entities whose interests rarely complement one another. It entailed unlikely partnerships between a state wildlife agency and a coal-fired power plant, between water developers and endangered fish, and among federal, state, and local governments. All parties shared an interest in the successful completion of the project.

Its beneficiaries also were diverse. The project effectively stores and manages water to support the needs of people, industry, and wildlife while balancing environmental, economic, and social issues. Elkhead Reservoir has served Northwest Colorado including the city of Craig, since 1974. The enlargement project, which doubles the reservoir's water storage capacity, warrants that it

flow needs of the endangered fish early in the process of screening alternatives. While water supply is traditionally the motivation for reservoir construction, the project serves a unique combination of needs. The project was fashioned principally to provide flow augmentation for four species of fish native to the Colorado River system listed as endangered by both the federal government and the state: the Colorado Pikeminnow, the Razorback Sucker, the Bonytail, and the Humpback Chub. To protect the fish, it is necessary to assure minimum base flows in the Yampa River. An effective alternative was the enlargement of the Elkhead Reservoir.

The project was no small undertaking. It required about 20 years and a number of studies, planning sessions, analyses, negotiations, partnering endeavors, design procedures, and construction

efforts to bring it to completion at an overall construction cost of \$31 million. URS Corporation (www.urscorp.com) provided comprehensive water resource services through the duration of the project, including studies, permitting support, field investigations, technical analyses, alternatives analysis, final design, as well as construction engineering services for the

Colorado River Water Conservation District.

Enlarging the reservoir entailed:

- Raising the existing dam 25 ft and water surface 20 ft.

- Doubling reservoir storage capacity to about 25,000 acre-ft.
- Constructing a new spillway and outlet works.
- Building new Colorado State Park facilities.
- Developing new wetlands.

Balancing the interests of the various stakeholders and dealing with project constraints introduced some unusual design and construction concerns. Among them were maintaining a minimum reservoir pool, creating deep excavations, developing a cathodic protection system, working on a high-altitude site with a limited construction season, and compressing what would normally be three years of work into a two-year time frame.

One of the most innovative applications was designing the outlet works to include an intake tower in the partially full reservoir with multiple gates at various levels that include unique screens for the protection of the fish. Excessive corrosion on the metal gates was prevented by cathodic protection.

The intake is connected to the control house by a 505-ft long tunnel in bedrock, containing 72-in. and 24-in. conduits. The intake tower has two 48-in. inlets at upper reservoir elevations and a large diameter removable fish screen on the bottom primary outlet.

Variations of multiple gates have been constructed before, but they have not included fish screens. Knife gates on the inside of the tower openings were incorporated into the design to allow the fish screens to be installed on the outside of



A 505-ft long tunnel in bedrock, which contains 72-in and 24-in conduits, connects the intake to the control house.

will continue to provide a sustainable resource for future generations.

The enlargement of Elkhead Reservoir was identified as a solution to the water supply needs of Craig and the

the tower. Intake tower inlets are screened with 1/4-in. stainless steel wedge wire screens (round drum screens) to prevent passage of non-native game fish, such as bass, northern pike, and blue gill, downstream to the

slightly more than 80 percent of the height of the weir walls. The spillway was designed to allow for possible future increase of the active storage pool by raising the spillway walls should design flood values be reduced.



The intake tower features multiple gates that include unique screens for the protection of the fish.

Yampa River. To address regulatory concerns, the 84-in. diameter fish screen on the low-level outlet was designed to be removable to assure release capability for dam safety.

The Elkhead spillway is required to pass the probable maximum flood and was the most expensive feature of the project. The cost-effective design was a labyrinth spillway that was selected to minimize the spillway footprint as well

completed while maintaining a reservoir pool of about 60 ft to preserve fish in the reservoir and allow use of the modified existing spillway for spring snowmelt. To stabilize the original embankment, the excavation was phased in approximately 100-ft wide “panels” to minimize the extent of the excavation that was open at any given time.

The project was designed around foundation coal, fractured bedrock, and soft material. Over excavation was required to remove major coal seams in the foundation, making it difficult to connect the existing embankment. Excavation and foundation treatments were modified to over-excavate soft material and use machines in steep, potentially unstable excavation areas. For



Tower with forms after first lift.

as the construction cost. A continued refinement of accepted labyrinth spillway technology, it consists of a steep (about 80-degree) angled weir configuration and a design flow surcharge of

the intake tower, 60-ft rock excavation was conducted adjacent to the existing reservoir pool.

Timing was critical to the project. URS and the contractor developed a

Dealing with Complexities

The physical characteristics of the Elkhead Reservoir introduced a number of complexities that required imaginative responses. URS designed a phased new core and toe construction in a 30-ft deep excavation at the dam toe. The new core and toe construction was

detailed construction sequence that matched various procedures to the rhythm of the seasons. The intake tower approach channel, which was 150 ft long, more than 35 ft deep in bedrock, and under water, was completed after spring runoff subsided. A variety of construction methods were used, including long-reach excavators and temporary sheetpile to complete the approach channel excavation.

Although the Elkhead Reservoir expansion was a project that offered benefits to multiple interests, it was mostly about the endangered fish. It was one of the first instances in the Rocky Mountain region of a fish recovery entity participating with financial support in a new storage project. While the spring peak flow of the Yampa River remains relatively natural in magnitude and duration, base flows often are diverted for irrigation to levels that are detrimental to fish.

The enlarged reservoir provides critical water in low-flow years to supplement low flows in the Yampa River and support protection of endangered native fish. It also provides water for various parties, including Craig and the Craig power plant, with water available for drought and future needs. To meet regulatory requirements, four wetland mitigation areas were developed around the periphery of the enlarged reservoir, planted with 27,000 wetland plants to mitigate wetlands impacts.

The expanded reservoir provides an updated facility with double the storage capacity, which will become even more important as time passes and the demand for water storage in the Yampa River increases. In addition to its environmental and ecological value, the Elkhead Reservoir has become a popular recreation site in the Colorado State Park system. The site contains new spaces that will be developed as campgrounds, along with new access facilities such as boat ramps and roads. Day-use areas will include beaches and picnic grounds.



Mr. May, P.E., is a project manager with URS Corporation, Denver, CO, and Mr. Tenney, P.E., is a Senior Water Resources Engineer, Colorado River Water Conservation District.