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open WATERS

Restoring and Improving the Red River Valley's Waterways

The distinctively flat Red River Valley is known for its rich agricultural land as well as its regular floods—the most notable of which occurred in 1997. Formed by the ancient glacial Lake Agassiz, the Red River Basin covers approximately 40,000 square miles of northwestern Minnesota, eastern North Dakota, and extreme northeastern South Dakota as well as roughly 5,000 square miles in Manitoba, Canada. Attention to this river basin has been growing—particularly since the 1997 flood—and interest continues to be directed toward water management solutions which enhance the natural ecology of the river basin and reconnect hundreds of miles of waterways.

The Red River Valley has a long history of man-made modifications. It is estimated that 500 dams and other barriers have been constructed on the Red River of the North and its tributaries in Minnesota, North Dakota, and Manitoba. The dams were constructed for several reasons—to power mills, generate electricity, provide communities with water, or to otherwise control water flow. With the dams, however, came significant impacts on geography, life safety, and wildlife and fish habitat.

When water is contained behind a dam, "potential energy" is stored in the elevated upstream pool. If this energy is not dissipated as the water passes over a dam's spillway or through a power dam's turbines, it is converted into faster water flow downstream. Additionally, much of the river's sediment is deposited in the upstream reservoir, making the water which leaves it "sediment hungry." The increased water velocity as well as its "sediment hungry" nature contribute to down-cutting the channel, which may lead to severe erosion, undercutting of the banks, and slumping. Not only does such erosion degrade the riverbank's stability, it also poses a threat to nearby commercial, agricultural, and residential developments. The hydraulic rollers—or undertows—created by dams have also proven deadly, resulting in several fatalities throughout the Red River Valley over the years.

The introduction of dams into a river system often reduces or eliminates fish species in areas made unreachable by the man-made barriers. For example, the Campbell Beach Ridge area—formed by the shoreline of Lake Agassiz—has been identified as one of the best spawning sites in the Red River Basin for walleye, lake sturgeon, and other species. Prior to the removal of the Otter Tail Power dam on the Red Lake River in Crookston (see "Dam Busters," p. 2), fish were prevented from moving upstream to these historic spawning sites, except during significant floods when water levels allowed passage over or around the dam.

The Minnesota Department of Natural Resources—with cooperation and funding from various sources including DNR Fisheries, U.S. Fish and Wildlife Service, U.S. Army Corps of Engineers, local watershed districts, DNR dam safety program, and the State of North Dakota—has made significant strides in its sweeping plan to remove or transform several dams into passable rapids in the Red River Valley, reconnecting hundreds of river miles and restoring the valley's waterways to a more natural state. To date, four dams on the Red River and its tributaries have been removed, 17 dams have been modified, and three road crossings have been revamped to restore fish passage.

The primary challenge in replacing or altering a dam is to transform a submerged concrete wall into a passable structure while maintaining upstream water levels. Huge boulders are strategically placed in the river, creating curved weirs that are higher toward the sides to keep the water flow in

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dam BUSTERS

OPENING UP THE RED LAKE RIVER

The former Otter Tail Power dam on the Red Lake River in Crookston, Minnesota, was one of the most disruptive structures in the Red River Basin. Originally built near the turn of the 20th century and rebuilt in 1942, the dam was recognized as the cause of deteriorating riverbanks, excessive erosion, and degraded fish habitat, as well as a significant life safety threat.

Erosion had significantly widened the channel, and a remediation project downstream would not have been economically feasible. By completely removing the dam and constructing rapids in its place, the project area was more manageable, upstream water levels preserved, energy dissipated, safety enhanced, and riverbanks stabilized—all while creating a more natural and inviting recreational area.

In this pre-construction photo, the reverse swirling flow caused by excess energy is apparent. The slight hydraulic jump in the spillway did not fully dissipate the energy created by the nine-foot drop from upstream to downstream, and the eroded riverbanks are double the normal channel width—400 feet versus 200 feet.

The original dam was constructed of a timber crib with timber piling and cross bracing, capped with 12 inches of reinforced concrete. The contractor built a platform to gain access to the west dam abutment to complete excavation. All exposed reinforcing steel was carefully removed to eliminate potential hazards near the completed project.

Ten boulder weirs replaced the old dam. The slope of the rapids varies from 2 percent at the crest where the energy is greatest, to 5 percent near the tailwater, where the lowest weir is submerged.

Each of the ten successive weirs is curved and higher toward the sides to keep the flow in the center of the channel. Plunge pools between weirs dissipate energy and serve as resting places for fish migrating upstream to traditional spawning areas.

The upstream water surface has been maintained at the same pool elevation that existed with the former dam. The river depth upstream from the rock rapids crest is 17 feet.

ask the EXPERT

Q I am planning on purchasing property soon. Do I need a land survey?

A A specific answer to your question depends upon many factors. In general, however, it is a good idea—and in some cases a requirement—to have property surveyed when the following conditions exist:

- It is going to be divided into parcels for sale or development
- It is going to be sold, purchased, or mortgaged
- Improvements are planned or are being developed
- The location of boundaries or corners is uncertain or disputed
- Trespass or encroachment is suspected or evident
- Government regulations require a survey and map of the property

A property survey describes, maps, and locates land ownership boundaries, easements, and corners; features; and improvements. Property is a major financial investment, and a land survey can help you manage and secure such an asset.■

Chad Conner, LS, is a land surveyor with Widseth Smith Nolting.

Q How do geothermal heating and cooling systems work?

A Just a few feet below the surface, the earth's temperature remains relatively constant. In our region, it is approximately 50 degrees Fahrenheit. In a geothermal system, a water solution circulates through a closed-loop system of pipes which are buried underground and heat pumps which are located within the facility. During the heating season, the solution is heated by the earth's thermal energy. The solution returns to the heat pumps which concentrate this thermal energy and transfer it to the building's heating system—such as hot air circulated through ductwork. In the summer, the process is reversed. The system extracts heat from the building, transfers it to the closed-loop system, and the water solution carries the excess heat to the earth.

Geothermal systems are reliable, simple to operate, and have low annual maintenance and operating costs. These systems are also environmentally friendly, using renewable energy and producing no harmful "greenhouse gases." Geothermal systems are used in an array of building types—from residential to commercial, from schools to churches. While initial installation costs are significantly higher than "traditional" heating and cooling systems, a geothermal system will pay for itself within roughly five to ten years and has a life expectancy of up to 50 years.■

Nate Kirkeby, PE, is a mechanical engineer with Widseth Smith Nolting.

outside the LINES

North Dakota Communities Take Advantage of New Law

Several of North Dakota's smaller communities are experiencing a building boom. A new state law—passed during the 2005 session—allows communities with populations of less than 5,000 to form housing authorities and to publicly construct low- or moderate-income housing.

The city must first make the determination that there is a need for an authority. This determination is either made directly by the city or must be made if the city is presented with a petition signed by a minimum of 25 residents.

The city must adopt a resolution when it is found that "unsanitary or unsafe inhabited dwelling accommodations exist . . . or that there is a shortage of safe or sanitary dwelling accommodations . . . available to persons of low or moderate income at rentals they can afford to pay" (North Dakota Housing Authorities Law 23-11-03.1). Once the mayor is notified of the adoption of the resolution, he or she appoints five commissioners for terms of one, two, three, four, and five years, respectively. Thereafter, appointments are for a period of five years. The mayor also determines which commissioner among the initial appointees shall serve as chair, while the commissioners select subsequent chairs.

Developers have been working with Minnesota's and South Dakota's smaller cities for the past several years to develop housing alternatives but, until the legislation took effect August 1st, were unable to work with North Dakota's small cities. Now the state's rural municipalities can offer appropriate housing for their existing residents as well as those wishing to relocate. With the ability to form housing authorities and develop alternatives, the state's rural communities are able to keep the resources their long-time residents represent—history, experience, investments, and purchases—while also freeing-up housing for new families. ■

Roger Helland, AIA, is an architect and vice president with Widseth Smith Nolting.

public SIGHTINGS

Governor **Tim Pawlenty** appointed eight citizen conservationists to the newly created Environment and Natural Resource Trust Fund Advisory Task Force. Among the members are **Wayne Enger**, Otter Tail County Director of the Farm Service Agency, and **Pam Landers**, formerly the environmental education project manager for the Minnesota DNR and the Blandin Foundation.

MCEA's 2006 officers include president **Dave Enblom, PE**, Cass County; vice president **Don Theisen, PE**, Washington County; secretary **Dave Robley, PE**, Douglas County; and treasurer **Dave Olsonawski, PE**, Hubbard County.

Tim Schoonhoven, PE, of Widseth Smith Nolting, was appointed to the West Central Minnesota (District 4) Area Transportation Partnership (ATP).

David Bovee, city manager for Dawson, received a Leadership Award from the League of Minnesota Cities for appointed officials who work in cities with a population of less than 10,000.

The City Engineers Association of Minnesota (CEAM) recognized **Alexandria's Second Avenue/Third Avenue Corridor Street Reconstruction Project** with an Honor Award in its 2005 Project of the Year competition.

The **Crookston–Red Lake River Dam Removal and Rock Rapids Construction Project** was recognized with an Honor Award at the American Consulting Engineers Council–Minnesota's 39th Annual Engineering Excellence Awards banquet.

The reconstruction of **Aitkin's Minnesota Avenue** (CSAH 1) received a 2005 Merit Award from the Minnesota Asphalt Pavement Association, the Minnesota Association of Asphalt Paving Technologists, and the Minnesota Department of Transportation.

Crookston Mayor **Don Osborne**, University of Minnesota Chancellor **Charles Casey**, and State Representative **Bernie Lieder** were in attendance at the ribbon-cutting ceremony for the new $500,000 highway lighting project in Crookston. ■

If you have a "public SIGHTING," please contact Liesa Thill, Widseth Smith Nolting, 218.829.5117, lthill@wsn-mn.com.

(continued from cover)

the center of the channel and to control the rate at which it flows downstream. Smaller riffles are built downstream to prevent further bed degradation. The number of weirs designed for and constructed at a particular site depends on the water levels that must be maintained and the drop in elevation from the upstream to the downstream sides of the dam. As the water cascades over the rapids, friction and turbulence release the energy that was stored in the elevated pool. Between the weirs, plunge pools not only dissipate the water's energy but also provide resting places for fish. Weirs may either act as "steps" to allow passage of a dam that is left in place, or the dam may be completely removed leaving the rapids to naturally control water levels.

The needs of the communities as well as the regions that surround dam sites are complex; life safety issues, riverbank stability, maintenance of water or reservoir levels, and flood control are among the many challenges. Construction of rock rapids is an elegant solution that reconnects portions of the river, amends the negative social and economic impacts created by dams, improves fish habitat, provides canoeists, kayakers, and anglers a safe and attractive recreational area, and requires little—if any—future intervention or maintenance.■

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quick LINKS

For more information, check out these websites and follow their links to learn more about the Red River Basin, dams, and water management . . .

crunch.tec.army.mil/nid/webpages/nid.cfm National Inventory of Dams

dnr.state.mn.us Minnesota Department of Natural Resources

www.ijc.org International Joint Commission, Canada & United States

www.internationalwaterinstitute.org International Water Institute

www.mvp.usace.army.mil St. Paul District U.S. Army Corps of Engineers

www.rrbdin.org Red River Basin Decision Information Network

www.swc.state.nd.us North Dakota State Water Commission

hind SIGHTS

139 years ago . . . A patent for reinforced concrete was issued to Frenchman Joseph Monier. While concrete had been used as a building material since antiquity, its brittleness made it unsuitable for use on large structures. A gardener, Monier used iron mesh to reinforce concrete flowerpots and discovered that doing so dramatically changed the nature of concrete, making it much more flexible. Reinforced concrete has become a critical component of modern construction.

76 years ago . . . Construction began on the Hoover Dam. Contrary to popular belief, there are no bodies encased in the concrete of the dam. Even if such an accident had occurred, the body would have been recovered to avoid compromising the dam's structural integrity. There were, however, more than 100 fatal accidents during construction.

9 years ago . . . Spring flooding of the upper Minnesota River and the Red River of the North broke most existing flood records. Total flood damages and associated economic impacts were estimated to be as high as $2 billion.■

RED LAKE RIVER ROCK RAPIDS–CROOKSTON, MN

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