



10/14/2016



Some Dam – Hydro News™ And Other Stuff



Quote of Note: *“Nothing great was achieved by copying” - Aby*

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“Good wine is a necessity of life.” - -Thomas Jefferson

Ron’s wine pick of the week: 2013 Accornero Italian (Piedmont) Red “CampoMoro Barbera”

“No nation was ever drunk when wine was cheap.” - - Thomas Jefferson



Dams:

(Wonder what PMP they’re using?)

Meadville leaders move forward with design phase to rehab dam that protects city from flooding

By Mike Crowley Meadville Tribune, Sep 28, 2016, meadvilletribune.com

Meadville’s Rainbow Lake dam, PA is aging gracefully, but there’s no getting around the fact that it is old — old for a dam, at least. The dam had a projected 50-year service life when constructed at Shady Brook Park in 1964. Since then, it has provided key flood control protection for much of downtown Meadville along with the two dams that form Tamarack Lake. The three dams were constructed simultaneously in an effort to control the flooding of Mill Run that had afflicted downtown



Meadville for years and that had been especially devastating in 1959. The dams that form Tamarack Lake did not make it to the end of their expected 50-year service life. An emergency drawdown of the lake took place in 2012 after a hole was found in the south dam. In contrast, Rainbow Dam is in no immediate danger. "Currently, there are no known safety issues with the structure," said Kevin Shamburg, director of engineering for KLA Environmental Services. "As far as we can tell, the dam is operating exactly as intended." KLA was hired by the U.S. Department of Agriculture Natural Resources Conservation Service to assess the dam and to lay out the city's options for the dam's future — everything from decommissioning and removing it to aggressively rehabilitating it.

While Rainbow Dam is functioning properly, the state's Division of Dam Safety has notified the city each of the past several years of potential problems. "With the current estimations for runoff, your dam does not store and pass without overtopping the probable maximum precipitation," said Hosea Latshaw, NRCS conservation engineer. In other words, in the event of a hurricane-level amount of rain, Rainbow Dam would overflow, causing flooding in much of downtown Meadville. "They are watching that," Latshaw said. Presented with a half dozen possible courses of action at its most recent meeting, Meadville City Council selected the least expensive of the six alternatives while observing that the least expensive option was also the one recommended by the KLA and NRCS. The four members of council who were present all voted in favor of the recommended option. Councilmember John Battaglia was absent from the meeting.

The approved plan calls for extending the auxiliary spillway alongside Rainbow Lake by 120 feet and constructing a new retaining wall between the earthen embankment and the spillway. In addition, the earthen embankment — what most people think of as the dam itself — would be reinforced and extended at a grade of 3 feet to 1 foot. The current grade is 2 feet to 1 foot. As a result, the earthen embankment would be longer with a more gradual slope. Lengthening the slope of the embankment would require the principal spillway conduit underneath the embankment to be lengthened as well.

These changes would also lower the maximum surface level of the dam so that it would not overflow in the case of a hurricane-level event, according to Shamburg. Selecting this plan only allows NRCS to complete its preliminary study of rehabilitating the dam, City Manager Andy Walker said. "We're not committing to a rehabilitation of the dam yet. There's lots of phases in terms of design that would have to happen first," he said. The two main goals of the rehabilitation would be to bring the dam into compliance with current dam safety criteria and to extend the service life of the dam by at least another 50 years. Rainbow Dam is classified as a high hazard class dam, Shamburg said. The high hazard level signifies a potential loss of life in the unlikely event of a dam failure. "That's really what changed since the dam was originally constructed," Shamburg said. "We have much more restrictive criteria for high hazard class dams." If the rehabilitation plan goes forward, Shamburg predicted that Rainbow Dam would be around for a long time. "We were able to project a service life of 100 years," he said. Another century of service from Rainbow Dam is still a long way off, however.

"We've been working with you for two years and we're not done yet," said Latshaw. He estimated that designing the rehabilitation work would take another two years. "The timeframe for completion is probably another three to four years at best," Latshaw said of the proposed rehabilitation project. In the meantime, Meadville officials have the opportunity to search for funds to pay for the rehabilitation work. The NRCS rehabilitation study that will now be completed has been paid entirely by the federal government. Construction costs associated with any plan that results from the study would also be paid in large part by federal funds, but Meadville would be responsible for 35 percent of those costs. With the cost of construction currently estimated to be approximately \$2.2 million that means Meadville would be responsible for about \$780,000. "The final cost is not known yet," Latshaw cautioned the council. Nor is it known where the city would come up with its share of the cost. Determining potential sources of funds is the city's next step, said Walker. "I think we're confident about aggressively going after state grant funding to match the federal funds," he said. "We'll begin to lay the groundwork with state legislators and local funding agencies to make them aware of the need over the next few months."

(Fix the dam dam. Any dam built over 100 years ago has a good chance of having a spillway that doesn't meet modern criteria, especially one flooded over already. It will happen again.)

State official says Bonita dam is unsafe, nearby residents in jeopardy

The dam was built in 1888 and flooded over in 1916

By Joe Little, September 30, 2016, 10news.com

The Sweetwater Dam in Bonita, CA is unsafe and people living downstream are in jeopardy. That's according to the Director of California's Division of Safety of Dams who flew down to San Diego Wednesday from Sacramento to address the Sweetwater Authority Board of Directors, which recently voted to not fund repairs to the dam. "The problem is the spillway, which actually safely passes the flow, is not big enough," said David Gutierrez, director of the division.



The dam was built in 1888 and flooded over in 1916. Eight people were killed. Gutierrez told 10News the design of the dam is flawed and the spillway needs to be focused more towards the center of the dam. He traveled from his Sacramento office Wednesday to address the board directly. "The only reason I'm here today is I received a letter a few months ago actually that said the Sweetwater Authority is not going to fund the project at this time," he said. "I'm here to make sure that the board members understand the importance of this dam safety issue." The Sweetwater Dam holds back the Sweetwater Reservoir, which provides water to customers in Chula Vista, Bonita, and National City. "I'm concerned about the people that live downstream from this dam. That's my job," said Gutierrez. "The consequence of a failure is extreme. We can't allow that. We will not allow that.

Gutierrez made a presentation during Wednesday's Sweetwater Authority Board meeting to emphasize the dangers. He stressed the dam is fine on a sunny day but it will not withstand a flood like the one that hit San Diego County in 1916. That was his biggest concern. "We need to safely get the water over the dam without obviously eroding it and causing some damage," he said. During the meeting, a couple of the Sweetwater Authority board members said they were unaware of the dam's unsafe status. However, documents obtained by 10News reveal the board was notified of the problem as early as 2013. Gutierrez said they first broached the subject with the Sweetwater Authority staff even earlier in 2003. The board still voted nonetheless to not fund the repairs, which would have cost roughly \$7 million. That decision was made this summer and triggered Gutierrez's visit. The state wants the dam to be repaired by 2018. Gutierrez's visit might have worked. The board said they would find the funding to repair that dam. Gutierrez warned the board that failure to fix the dam could result in the state restricting how much water Sweetwater could store in the reservoir.

(Too much rain for small dams.)

As flood waters rise, NC dams threaten to give way

By CBS North Carolina, September 29, 2016, wncn.com

SPRING LAKE, N.C. (WNCN) – One dam has already given way and three more are in danger after drenching rains soaked the area, federal officials say. The Long Valley Farm Lake Dam at Carvers Creek State Park has a partial breach, and a full beach of the dam appears imminent, according to the National Oceanic and



Atmospheric Administration. Officials report the neighborhood at greatest risk from the dam has already been evacuated.

The Rhodes Pond Dam near Godwin was already being overtopped, according to NOAA. A CBS North Carolina reporter on the scene reports that a breach has occurred in the earthen levee just where it meets the concrete dam. Workers are trying to plug the breach with rocks. A construction crew was already on site for ongoing dam repairs, which were scheduled to conclude in late November or early December. And in east central Hoke County a dam on a small lake has failed. That lake drains into McLaughlin Lake. The water is going over the top of the McLaughlin Lake dam, which is worrying officials.

(A little dam history.)

Tracing the origins of the Wyoming Dam

By KELLY SULLIVAN, 9/30/16, ricentral.com

RICHMOND, RI – In centuries past, a mill owner's livelihood depended on his ability to harness water. When John Brown came to Richmond in 1780 and purchased land along the Wood River, the deed listed a mill and dam on the premises. Six years later, Samuel Brand arrived and bought from John Foster two acres on the east side of the river which included the grist mill, situated between two bridges. Brown built the first house in the village, standing not far down the road from where Wood River Inn is now located. He began his iron foundry on the Hopkinton side of the river and saw the industrialized little nook become known as Brand's Iron Works. Around the turn of the century, Brand's son-in-law Francis Brown built a tavern along that stretch of river. The 26-room inn and large livery stable proved to be a popular stop when the turnpike went through and Brand's Iron Works became one of the most bustling areas of town.



In 1809, Ezekiel Tefft built a mill to be called Brothers Cotton Manufacturing Company on the property, not far from an already existing carding mill. In 1833 it was leased to John Olney. Two years later, Olney bought the lot of Nathan Lillibridge. However, tragedy in the form of flood and fire had a severe effect on the village. In 1843, rising waters washed away the gristmill. The Wood River Company mill burned down and Olney quickly had to rebuild, using white oak, pitch pine and heavy iron bolts. The mill was leased to Nathan and Abel Fenner until 1866 when it was sold to John Sheldon. Across from the iron works, the Niles Brothers Carriage Shop operated out of a sawmill before it too burned down. The village had its own post office and a store at the Richmond end of the bridge. After Sheldon's death, his mill was sold to the Tyler Batting and Warp Manufacturing Company. The old Olney mill was later sold to the American Mica Company and burned in 1898. In later years, Elisha Bitgood ran a box factory there in Wyoming.

The last mill left standing in the village was the Lower Batting Mill. At that time Edward Tillinghast owned the main Wyoming Water Privilege and agreed that, should the water levels fall low, he would adjust his gates to allow enough through to power the mill for ten hours each day. Through the years, the water rushing over Wyoming Dam made all of these mills successful. It provided business opportunities for entrepreneurs and a paycheck for residents. The old wooden bridge that stretched over the dam has been replaced by a sturdier version. The livery stable has been torn down but the tavern still stands, as does the old store building at the end of the bridge. The old water wheels are gone but, beyond the grasses and wildflowers, one can still look down and see the wheel pits, turbines and tailraces of yesterday. Although the dam no longer powers industry, it is the centerpiece of Wyoming.

Without its presence, without its sound, the village would be forever altered. The 26-acre pond created by the dam is a magnet for fisherman in the summer. It's the view of dozens of homes-

owners. It's the destination of kayakers and canoers. But, really, it's even more than all of that. It's a testimony to those here before us; those who built our foundations and settled our villages. Those who chose that very spot by the Wood River to take a chance on their dreams...powered by nothing more than a strong will and a rushing dam. Those founders would have been proud to see those who came after them, recently standing together at a town meeting with their own strong wills, determined to save the very essence of Wyoming. *Kelly Sullivan is a freelance history and features writer for the Chariho Times.*

(They're winning.)

Feds Open Public Comment on Hydropower Alternatives; Dam Opponents Say 'Free the Snake Now'

By George Prentice, 10/2/16, boiseweekly.com



In what environmentalists are calling "a once-in-a-generation opportunity to speak with one voice on behalf of free-flowing rivers and abundant salmon," the U.S. government opened public comment Sept. 30 on how, or even if, the region should continue the operation of hydroelectric dams on the Snake and Columbia Rivers. Earlier this summer, Boise Weekly chronicled the long and often contentious debate over the Northwest's network of hydropower. "Living without those dams in order to save the salmon is not an insurmountable problem. We can do this," said Todd True, managing attorney of Earthjustice's Northwest regional office. "We still have time to find alternative solutions. One study says if hydro would go away, customer bills would actually go down. Another study says that customer bills might go up, but less than \$1 a month."

The federal government now has little choice but to look at a wide range of alternatives to the Snake and Columbia river dams, including possible dam removal: This past May, U.S. District Court Judge Michael Simon tossed the government's desire to keep the dams operational while trying to find other ways of protecting threatened and endangered salmon and steelhead.

"For more than 20 years, the federal agencies have ignored the admonishments and continued to focus essentially on the same approach," wrote Simon.

"These efforts have already cost billions of dollars, yet they are failing. Many populations of the listed species continue to be in a perilous state." As part of the new public comment period, federal agencies are scheduled to hold as many as 15 public meetings around the region, including four in Idaho:

Wednesday, Oct. 26, in Priest River; Thursday, Oct. 27, in Bonners Ferry; Wednesday, Nov. 16, in Lewiston; and Wednesday, Nov. 29, in Boise. "We're

less than thrilled that the agencies in charge of this process have scheduled it on top of a presidential election cycle and the holiday season, but we're confident Idahoans will be heard loud and clear in the weeks and months ahead," said Tom Stuart, Idaho Rivers United board member. "Five more years of salmon slaughter because of unnecessary dams is unconscionable. We need to free the Snake now."



A floatilla of more than 300 protested the Snake River Dam System in Oct. 2015.

(Sometimes judges rule the world.)

Ruling forces discussions on breaching dams to save salmon

By BECKY KRAMER The Spokesman-Review, OCTOBER 2, 2016, thenewstribune.com

SPOKANE, Wash. - A federal judge is forcing discussion of a radical step to save endangered salmon: taking out four dams on the Lower Snake River. The public will get a chance to weigh in at meetings throughout the Northwest starting next month. "Scientists tell us that removing the four Lower Snake dams is the single most important action we could take to restore salmon in the entire Columbia-Snake river basin," said Sam Mace of Save Our Wild Salmon.

The four dams produce about 5 percent of the Northwest's hydroelectric power. They allow barges to ship goods between Lewiston and Portland. But they also hamper salmon migration to some of the best remaining fish habitat. Commercial interests have long opposed removing the Lower Snake dams. "We think those dams need to stay in place because of the multiple benefits they provide," said Terry Flores, executive director of Northwest River Partners, which represents public utilities, port districts and farm groups. "They provide clean, carbon-free energy. We think they're an important part of the Northwest economy and the environment," she said. Three federal agencies will hold public hearings across the region this fall to discuss the creation of a new salmon plan.

Back in May, U.S. District Court Judge Michael H. Simon sided with fishing groups, environmentalists, the state of Oregon and the Nez Perce Tribe, finding that the latest of five federal plans for protecting the fish wasn't adequate. He ordered the agencies to prepare a new one by early 2018. Simon said federal agencies had "done their utmost" to avoid considering breaching the Snake River dams, ignoring strong suggestions to do so by a previous federal judge. While Simon said he wouldn't dictate what options agencies should consider, he said a proper analysis under federal law "may well require" considering breaching, bypassing or removing one or more of the four Lower Snake River dams. Salmon advocates said the ruling is the closest the region has come to dam breaching since 2000, when the Army Corps of Engineers did a study of taking out the Lower Snake dams. The four dams produce about 1,000 megawatts of electricity on average, which is enough to meet the needs of about 800,000 households each year. But despite millions of dollars spent on fish passage improvements, adult salmon still die in the reservoirs behind the dams. "The four dams on the Lower Snake River have had a devastating impact on salmon, steelhead and Pacific lamprey, and in turn on the Nez Perce people," said McCoy Oatman, vice chairman of the tribe, which is also advocating dam removal. The Snake River is the gateway to millions of acres of pristine, high-elevation habitat in central Idaho, southwest Washington and northeast Oregon, which could help salmon survive in a warming climate. "We have the healthy rivers, but the salmon aren't making it back," Mace said. In a typical year, only about 40 percent of the Idaho sockeye counted on the Lower Columbia River make it back to their Idaho spawning grounds. During last year's drought, mortality was in the 99 percent range. Warm water in the four Lower Snake reservoirs is a contributor.

The economic argument for the dams isn't as strong as it once was, Mace said. The Lower Snake dams were built from the 1950s to the 1970s, with navigation as a primary goal. But that barge traffic has dropped in recent years as the region has invested in rail capacity, Mace said. "These dams weren't built for flood control. They're not big water storage dams and their power benefits are replaceable," she said. "It's time to call the question on them." Salmon advocates "downplay the value of the dams," said Flores, of Northwest River Partners. Dams provide more operating flexibility than other renewable energy sources, such as wind and solar, Flores said. Electricity generated from wind turbines and solar panels can't be stored easily. But dams can store water, releasing it during periods of high demand for electricity. Breaching the four Lower Snake dams would require the Northwest to build a natural-gas-fired plant, the Bonneville Power Administration said this spring. Even a highly efficient gas-fired plant would increase the region's carbon dioxide emissions by 2 million to 2.6 million metric tons annually, which is like adding 421,000 passenger cars to the road, according to the BPA. The agency sells the electricity produced by 31 federal dams. Replacing the Lower Snake dams' electric production with natural gas would cost between \$274 million and \$372 million each year, the agency said. The estimates include the capacity to keep the Northwest power grid running smoothly. Another study found that dam removal would have a minor impact on electricity costs. A 2015 study done by the Northwest Energy Coalition said residential customers of public power companies would pay about \$1 more

per month. John Harrison, a spokesman for the Northwest Power and Conservation Council, said he's not aware of an "objective, independent, bipartisan" analysis of the economic impact of dam removal. The information available at this time either comes from agencies or interest groups, he said.

(The long arm of the government. You thought there were going to see a photo of the dam, huh? Couldn't find one.)

Judge OKs deal for man, EPA in dispute over dam

By Emily Walkenhorst, 10/03/2016, arkansasonline.com

A Van Buren County, Ark. man must pay \$200,000 and get the dam he had built on his property certified for safety as part of a consent decree with the U.S. Environmental Protection Agency, approved in federal court last week. Dan Eoff, the operator of the Chuckwagon Races, hired a contractor to build a dam on his property several years ago without seeking a permit under the federal Clean Water Act, according to court records. The EPA determined that Eoff's dam violated the Clean Water Act and issued a compliance order in the case on June 10, 2013, asking Eoff to remove the dam and assessing



penalties of \$37,500 for each day after deadline that the dam had not been removed, court documents said. Eoff filed a federal lawsuit against the EPA on June 21, 2013, arguing that his property was not subject to the Clean Water Act and that the demands of the compliance order posed an "immense financial expense," according to court documents. The EPA filed an answer and counterclaim against Eoff, saying the stream on his property -- Branch Hollow -- was subject to the Clean Water Act. The stream has an effect on the South Fork of the Little Red River, the EPA argued. In the counterclaim, the EPA requested restoration of any environmental damages and civil penalties against Eoff for discharging "pollutants into waters of the United States" without a permit authorized by the Clean Water Act. After 34 months of back-and-forth in court, the EPA and Eoff filed a proposed settlement in April that went out for public comment in August.

Under the consent decree approved Thursday by U.S. District Judge D. Price Marshall Jr., Eoff must pay a \$75,250 civil penalty, spend \$124,750 worth of stream mitigation credits and have a professional engineer certify the dam's safety. The Arkansas Natural Resources Commission opposed the consent decree in a public comment filed Aug. 25, arguing that it did not address the requirement that a person constructing a dam get a permit from the commission. "While an engineer must oversee Mr. Eoff's work to bring this dam into compliance with Arkansas law and rules, determination of compliance rests with ANRC," the commission wrote in a letter signed by Executive Director Bruce Holland. In his order filed Thursday, Marshall said no public comments raised "serious" objections to the consent decree. "The necessity of a state permit is, as EPA suggests, beyond the federal issues joined in this case," Marshall wrote. "It's a matter between Eoff and the Arkansas Natural Resources Commission. The Court has presided over the twists and turns in this case for more than three years." Commission attorneys had argued that Eoff should have sought a permit for the dam because of its size, and noted that the dam is located on a stream that falls under the commission's jurisdiction and that the dam is in a floodway designated by the National Flood Insurance Program run by the Federal Emergency Management Agency. Only two other people filed comments on the consent decree, neither on behalf of any organizations. Joel R. Ward argued that federal authorities went too far and did not do a complete review of the issues on Eoff's property. Don Richardson, who serves on the Natural Resources Commission board but who submitted his comment as a Clinton resident, asked that the penalties against Eoff be used to clean up sediment in the Little Red River allegedly caused by the dam and for other cleanup efforts.

(50 and 75 isn't that old, for a dam.)

Littleville and Knightville dams turn 50 and 75; ceremony set for Saturday

By Mary Serreze | Special to The Republican, October 05, 2016, masslive.com

HUNTINGTON, MA — The U.S. Army Corps of Engineers and the communities of Huntington and Chester will celebrate the 50th anniversary of Littleville Lake and the 75th anniversary of the Knightville Dam on Saturday, and the public is invited to a ceremony and open house. Knightville Dam was completed in 1941 on the east branch of the Westfield River as a flood control project. The 1,200-foot dam can impound nearly 16 billion gallons of water. More than 2,400 acres at Knightville are available for picnicking, hiking, fishing, mountain biking, hunting, horseback riding, cross country skiing and snowmobiling.



Littleville Dam at Littleville Lake on the Middle Branch of the Westfield River in Huntington and Chester was completed in 1965. (U.S. Army Corps of Engineers photo)

Littleville Dam, on the middle branch of the Westfield, took three years to build and was finished in 1965. The 1,360-foot dam, 164 feet high, stores up to 7.5 billion gallons of floodwater in Littleville Lake. Its nearly 1,600-

acre property is also available for recreation, including boating and fishing. Littleville Lake also serves as a backup drinking water supply for the city of Springfield. "These projects are great examples of applied engineering and science successfully mitigating flood risk and damage, and adding immeasurable value to the region," said District Engineer Col. Christopher Barron, commander of the U.S. Army Corps of Engineers, New England District. Barron said the dams have successfully protected downstream citizens, together preventing around \$490 million in flood damages since their construction.

(A fixer upper.)

Beaver Park rehab recognized with national award

5 October 2016, waterpowermagazine.com

AECOM has announced that the Beaver Park Dam Rehabilitation Project in Colorado, US, has been named the "National Rehabilitation Project of the Year" by the Association of State Dam Safety Officials (ASDSO). The AECOM project was selected over three other highly qualified nominations and acknowledged the client, Colorado Parks and Wildlife (CPW), for the innovative design components of this significant dam rehabilitation.

Beaver Park Dam is a large, high hazard dam owned and operated by CPW and located near South Fork, Colorado. After an initial evaluation, the Colorado State Engineer's Office (SEO) restricted storage in the reservoir to 20ft below the spillway crest. The AECOM team facilitated the risk analyses to estimate failure probabilities and risks for three scenarios – the existing facility under normal operation; the existing facility under restricted operation; and risk reduction alternatives. The results helped provide the SEO with a sound basis for the magnitude of the reservoir restriction. The investigations and analyses to support selected repairs and improvements made to the dam included site investigation, left abutment stabilization, outlet works conduit replacement and control gates/valves reconfiguration (including a new downstream valve house and energy dissipation structure), spillway crest modifications (three feet higher to increase storage), and design of electrical, instrumentation and controls. AECOM completed the final design and prepared detailed engineering drawings and technical specifications for two construction bid packages that were submitted to, and approved by, the SEO. The team also provided construction phase services which included full-time construction observation, review of

submittals and RFIs, design change orders, final walk-through and punch list, construction completion report and record drawings.

(Another youngster.)

Beaver Lake Dam celebrates 50 years of service

By [Joshua Cole](#), Oct 06, 2016, 4029tv.com

BENTON COUNTY, Ark. — **The Beaver Lake Dam celebrates 50 years in service to Northwest Arkansas residents** as local leaders and the Army Corps of Engineers are coming together for a special commemorative ceremony. "We going to talk a little bit about obviously some of the great things the dam has done for the area over the past 50 years. But we're going to mark we're looking forward to another 50 years of service and the dam continuing to provide these important services to the area," said Sean Harper, operations project manager for the Corp's Beaver Lake Project Office.



Officials at the Army Corps of Engineers Beaver Project Office are hosting a 50th anniversary celebration at Beaver Lake, 2 p.m. Thursday, Oct. 6. The celebration will be held at Dam Site Park at the north side of Beaver Dam and immediately adjacent to State Highway 187. **"You've got Beaver Lake that impounded and that provides obviously water supply to 500 thousand people that stretches from Harrison to south of Fayetteville.** And it is a major resource for the area. And we get visitors from all over the country that come to Beaver Lake to enjoy the recreational opportunity," said Harper. Colonel Robert Dixon, Little Rock District commander will be the keynote speaker. Scheduled speakers include: Honorable John Boozman, U.S. Senator, Honorable Steve Womack, Third Congressional District; Gene Bland, Carroll-Boone Water District; Alan Fortenberry, Beaver Water District; Marshall Boyken, Southwestern Power Administration; Audrey Klug, essay contest winner; and Sean Harper. Tours of the powerhouse will be offered at the conclusion of the official ceremony.

(Imagine being a century old.)

Museum celebrates Elephant Butte Dam centennial; exhibit opening set for Thursday, Oct. 13

Oct 5, 2016, [lascrucesbulletin.com](#), by Mike Cook, Las Cruces Bulletin

At the time of its construction, Elephant Butte Dam was the largest U.S. Bureau of Reclamation project in the world. It brought "important change to southern New Mexico," as the dam began storing water from the Rio Grande for irrigation, and eventually would produce hydroelectricity and become part of New Mexico's most popular state park. The New Mexico Farm & Ranch Heritage Museum (NMFRHM) is celebrating the dam's centennial with a special exhibit entitled "Elephant Butte Dam: Building a Future for Agriculture."



The exhibit opening will be from 6 to 8 p.m. on Thursday, Oct. 13 at the museum, 4100 Dripping Springs Road. Admission is free and refreshments will be served.

Construction on the dam, located south of Truth or Consequences, began in 1911 and was completed in 1916, although it began filling the year before. The dam is 301 feet high and 228 feet wide at its base, according to the Bureau of Reclamation. It contains 629,500 cubic yards of

concrete. Its total storage is more than 2.1 million acre feet of water. When completed, the big dam will be 1,200 feet long on top at an elevation of 4,414 feet, which is 200 feet above the elevation of the original river surface,” according to an article published in “Popular Mechanics” magazine in 1915. “The exhibit tells the story of what brought about the dam, how it was built, and what it provided to southern New Mexico,” according to the news release. “Dozens of historical photographs are part of the exhibit, as well as maps and information panels.

“The museum also has moved three early components of the dam to be displayed in front of the main building,” the news release continued. “The valve cylinder, top cap and bonnet were used to raise and lower the sluice gate at the dam. The sluice gate was used to flush rocks, gravel and debris from the dam. In the 1980s, these pieces of equipment were removed from the dam to make way for a more modern hydraulic operation. They were loaned to the Museum by the Bureau of Reclamation in 1996. Also on Oct. 13, “Ben Craske, a recent graduate of New Mexico State University’s history masters program, will give a talk about the dam’s creation and how it fit into the country’s Progressive Era,” according to a NMFRHM news release. The presentation will begin at 7 p.m. in the museum’s theatre and will have free admission. Craske “did months of archival research for his postgraduate studies on the subject of the dam,” NMFRHM said. The exhibit will be on display through Sept. 24, 2017, the museum said. **“The exhibit is part of a celebration of the dam’s centennial,”** the museum said. A number of events and activities are planned from Oct. 8 to 23 in the area around the dam. For more information, visit <http://buttedamcentennial.wixsite.com/buttedamcentennial>.



Hydro:

(We'll take what we can get.)

New Hydroelectric Plant Proposed for Kittanning Borough

From the KP NewsDesk, kittanningpaper.com, 9/28/16

Local officials and citizens were informed of a new hydroelectric power generating plant that may be built in Kittanning, PA. **The plant would be built on the Lock 7 dam along the shoreline of the Allegheny River in Kittanning Borough.** The project is being proposed by Rye Development, with primary offices in Portland, Oregon.



Rye Development Vice-President Erik Steimle led the discussion and listened to concerns raised by citizens at Tuesday’s public meeting at the Kittanning Township Fire Hall. Rye Vice-President Erik Steimle and Environmental Vice-President Kelli Doherty explained the company’s project to approximately 12 people in an afternoon session who consisted of government officials, business leaders, and residents who could be displaced when the new plant is constructed. Steimle said the proposal includes a 16.5 megawatt power house that could potentially provide electricity for as many as 8,000 residents. The power “house” would be located on the opposite side of Lock 7. Steimle said that although Rye is applying to build plants all over the United States, they do not actually have any of them up and running yet. “Right now, we are beginning the feasibility and permitting process for a new hydro power project here. The earliest the project construction could begin would be sometime in 2020,” Steimle told the Kittanning Paper. He said the construction of the plant could employ anywhere from 50 to 200 workers. However, once completed, only a staff of three persons will be

needed to actually work in the facility. Access to the facility and a parking lot could be built through the purchase of property off of Maple Street. Steimle said homeowners have not yet been contacted as the project is still in the preliminary stages.

Jeff Miller from Snyder Associated Companies discussed dredging operations and participated personally in the discussion. Jeff Miller with Snyder Associated Companies brought up concerns about the dredging moratorium current in effect for this part of the Allegheny River. Steimle said that construction is a permitted activity in the water and therefore does not come under the same rules as business activity that was previously conducted by Snyder company, Glacial Sand and Gravel. "It's not any different; it's just a different industry," Miller told Doherty. He also questioned if Rye could financially support the Allegheny River Development Corporation, who fund-raises to keep the locks operational for recreational boating each year. Steimle was not able to discuss any agreements at this point since the planning is exploratory.

Kittanning First Ward Council persons Betsy Wilt and David Croyle expressed concerns with running power lines down Water Street and crossing Market. "We've spent millions of dollars on Market Street. We've done a complete revitalization project that buried all of those (utility) lines. I would like to see how you are going to go from that location without going over Market Street to carry those lines with the capacity you are talking about," Croyle said. Croyle also said he would like to see an agreement between Rye and the borough to provide funding that would make it advantageous for the community to support the project. Steimle encouraged the public to file comments with the Federal Energy Regulatory Commission by writing to them at 888 First Street NE, Washington, DC 20426 and reference docket P-14522. Comments may be filed electronically by visiting: www.ferc.gov/docs-filing/efiling.asp.

(Even though you lose flood control and a third of the power, the state's going to require what they already said.)

Town balks at safety study for Green River dam

By Andrew Martin | News & Citizen, Sep 29, 2016, stowetoday.com

The dam at Green River Reservoir seems to be safe and sound, for now. Federal officials want to know if that will still be the case under new water-flow recommendations, but the dam's owner isn't springing for the study. Instead, Morrisville Water and Light has put aside any concerns about safety issues until its appeal is heard on those new state-requested regulations.



The Vermont Agency of Natural Resources wants Morrisville to lower wintertime drawdowns out of the reservoir from 10 feet to 18 inches in order to protect aquatic habitats. Morrisville argues it would lose about a third of the electricity it produces at the hydropower dam, making it a big-time money loser instead of a profit center. Earlier this month, the Federal Energy Regulatory Commission asked the utility — which owns four dams in three towns — to begin studying how the dam would hold up to this new practice and lack of space for spring runoff. The commission classifies the Green River dam as "high hazard," meaning that if it were to fail, there is a potential for loss of life or significant property damage. Craig Myotte, the utility's general manager, said he and his staff still hope the appeal they've filed in state environmental court will relax those drawdown restrictions. Until then, no studies. "Until we know what the final water quality certificate is, we aren't going to study what could be a fictitious option," Myotte said. Morrisville's appeal could take years. Until then, the utility will continue operating the dam as it has in the past. According to Jeff Crocker, a river ecologist with the Agency of Natural Resources, federal officials inspected the Green River dam was inspected in 2014 and found no major concerns.

Life below the dam

Charlie McArther owns a house below the dam, just off Garfield Road in Morristown. He's never had any safety worries about the dam but isn't sure what would happen if water started spilling over it during a severe flood. McArther and his wife live on a hill fairly high above the Green River, but they could be stranded there if water levels got really high. "If anything did happen, it might be a while before we got out," he said. Morristown officials have held practice drills on how to handle the worst-case scenario: the failure of the Green River dam. "There is a plan in place and we will keep updating that," said Dan Lindley, town administrator for Morristown. That plan would include evacuating anyone who could be stranded by high waters. Flow data shows that a failure of the dam would take out most of the bridges over the river. "We have a map to highlight what areas to get people out of and would concentrate on that," Lindley said. The other focus would be keeping drivers away from the roads that could be washed out and posting emergency first responders on both sides of the river to ensure they can cover any calls.

Thwarting spring floods

Myotte said a 10-foot drawdown not only helps make electricity, but also provides more room in the reservoir for snow runoff in the spring, a benefit that would be lost under the practices requested by the agency. "Given the time, effort and cost involved in doing the studies, it would be reasonable to delay that effort until it is known what drawdown requirement will actually be included in the final water quality certificate," Myotte said in a letter to the Federal Energy Regulatory Commission last week. The ability to hold back runoff and snowmelt at the dam came in handy last winter, when the utility was able to hold back millions of gallons of water during severe flooding along the Lamoille River, which the Green River flows into. Severe February storms caused icepack flooding along the river in Hardwick, while downstream in Morrisville the icepack got bad enough to threaten that town's Bridge Street sewage-treatment plant. Morrisville was able to hold back a lot more of the runoff for a longer period than would have been possible if water drawdown levels had been only 18 inches. Myotte said that drawdown allowed 25 million cubic feet of water to be captured and held back during that 24-hour storm.

(Trying to restore history.)

Big Otter Mill group continuing to raise funds to preserve historic landmark

By Christina Craig - September 30, 2016, wsls.com

BEDFORD COUNTY (WSLS10), VA – A group in Bedford County is trying to preserve what some call a historic staple. "There's no turning back," said Big Otter Mill's Board President Kristy Milton. Holding back tears, Milton said she made a promise to restore the old mill that dates back to the 1780s and she's not about to break her word. "When we lost our board president in March of this year, a three-time cancer survivor, our board made a commitment to finish this project and we're going to," said Milton. The end goal is to fully restore the mill by 2017; however, that may cost \$400,000. Area leaders said it's important to preserve the county's heritage. "It will give children a way to go back, to look and see what people did in the old days and how people used to get flour," commented the county's Public Works Director Shelton Cash. Milton explained the mill's board, Friends of Big Otter Mill, have already spent \$150,000 on repairs like repainting the exterior and hooking up to electricity to get the water wheel moving. But, the work is nowhere near complete in order for the mill to be safe to the public. "We've got water that's pushing into the south side of the foundation and we need to work on that," added Milton. Lighting, new machinery parts and window repairs are still needed in order to preserve the historic mill. Milton hopes the community will rally behind this restoration. If you would like to help, the Big Otter Mill's fall festival will kick off this Saturday at 10 a.m. and the fun will run until 4 p.m. Money raise from this event will go towards mill renovations.





Water:

(Somehow, this doesn't sound like a good denial.)

Minnesota DNR Denies Permit for Red River Diversion Plan

October 03, 2016, The Associated Press



The Minnesota Department of Natural Resources has denied a permit for a Red River diversion channel around the Fargo area, but backers say it should not halt the project. The permit to build a dam to hold back water during serious flooding was considered to be the final hurdle for construction of the \$2.1 billion project. Fargo Mayor Tim Mahoney says he's surprised by the decision, but believes the Army Corps of Engineers still has authority to move forward with it. Minnesota DNR Commissioner Tom Landwehr says the permit was rejected because there are better options for flood control and there is a "lack of consistency" with state and local plans. He says it doesn't contain proper remedies for upstream impacts. Landwehr says the project should not proceed as proposed.



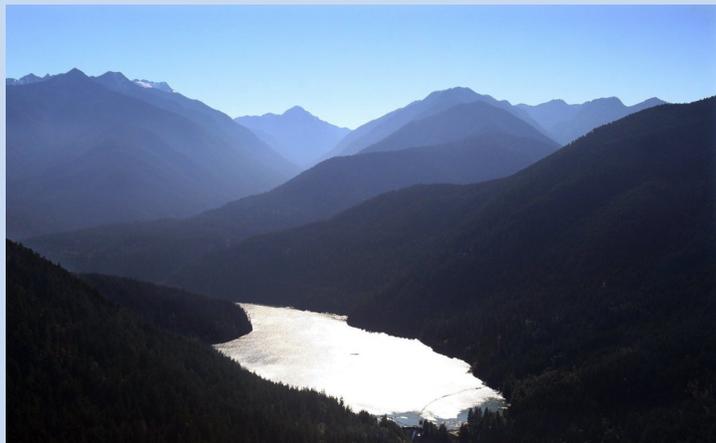
Environment:

(They keep trying to sink hydro. Even though it's miniscule, the enviros will have a field day with this.)

Hydropower isn't carbon neutral after all, WSU researchers say

September 28, 2016, By Lynda V. Mapes, Seattle Times environment reporter, seattletimes.com

Think hydropower is carbon neutral? You have another think coming, Washington State University researchers have learned. In their paper to be published next week in BioScience, the researchers reported that reservoirs of all sorts are important sources of the potent greenhouse-gas methane. The gas is produced by decomposing organic material underwater. While much attention has been paid to the effects of dams on fisheries and the natural form and function of rivers, little notice has been taken of the emissions they cause. Usually thought of as carbon-neutral sources of energy, hydropower dams, while far cleaner than fossil fuel for generating power, nonetheless are sources of carbon pollution. Reservoirs not only produce methane, but they generate more greenhouse gases than natural lakes, found research associate



Bridget Deemer and John Harrison, associate professor of biogeochemistry at WSU Vancouver. That is for two reasons: Dams on rivers trap organic materials from a large catchment area continually delivered by the free-flowing river upstream. Secondly, dams tend to be located closer to human presence, where nutrient loading from fertilizers used in agriculture, manure from farm animals, and septic and sewer systems boosts production of algae and other organic life in the water. That means more for microbes to eat — and more methane produced by the microbes. In their synthesis review of 100 research papers published on the topic since 2000, the researchers and their collaborators also established that methane emissions were about 25 percent higher per acre than previously understood on a given reservoir, said Deemer, lead author on the paper. That was because the researchers looked not only at methane diffused from the surface of lakes, but at gas in bubbles rising to the surface.

“I was excited about what we found,” Deemer said. Collectively, reservoirs created by dams produce about 1.3 percent of total annual global human-caused emissions. That’s as much greenhouse gas as other significant human sources, such as rice cultivation and biomass burning, the researchers found. The findings are expected to shift the way the Intergovernmental Panel on Climate Change tallies greenhouse-gas production by human activities to include flooded lands in those calculations, Harrison said. Previously — unlike rice cultivation and biomass burning — emissions from flooded lands were not counted. More than 1 million dams constructed globally have provided a variety of services important to people. But their environmental effects are profound, from blocked migration of fish, to impoundment of woody debris and other organic materials carried by rivers. Add to the list the generation of potent greenhouse gases, so called because they block the radiation of heat from the Earth and reradiate it to the atmosphere, raising the global average temperature of the planet.

Per molecule, methane is far more efficient at trapping and reradiating heat to the atmosphere than carbon dioxide, also adding to the importance of the findings. Researchers are continuing their work to investigate the degree to which management of reservoirs also contributes to greenhouse-gas production, Harrison said. Lower reservoir levels reduce water pressure in the lake, which releases more gas, in the same way that taking the cap off a soda bottle releases bubbles of carbon dioxide for that soda-pop tang. The synthesis paper is the largest of its kind to date, pulling together findings not only from hydropower reservoirs, but any sort, such as reservoirs for flood control, navigation or irrigation. The study also is the first to examine the flow of all three major greenhouse gases — carbon dioxide, methane and nitrous oxide — from reservoirs to the atmosphere.

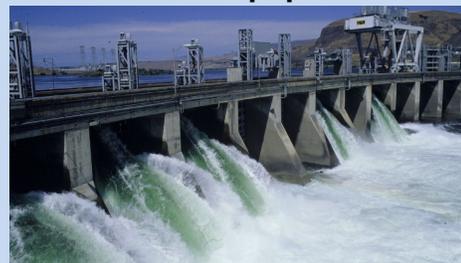
The contribution of greenhouse gases from reservoirs is sure to increase. While Washington state leads the world in dam removal — most notably on the Elwha River — globally, a boom in dam construction is under way. At least 3,700 major hydropower dams are either planned or under construction, primarily in countries with emerging economies, according to a paper published in Aquatic Sciences in 2015 by Christiane Zarfl and A.E. Lumsdon at the Leibniz-Institute of Freshwater Ecology and Inland Fisheries in Berlin. Dam construction on such a grand scale, primarily in Southeast Asia, Africa and South America, is predicted to reduce the planet’s remaining free-flowing large rivers by 21 percent, those authors found.

(A good rebuttal.)

National Hydropower Association responds to WSU research paper on reservoir green house gas emissions

NCWLIFE Staff Report, Sep 30, 2016, ncwlife.com

Washington, D.C. - The following is a statement on recent news articles on a soon-to-be published research paper on reservoir emissions by Washington State University in BioScience. These articles give the false impression that hydropower is a major source of greenhouse-gas emissions. "Hydropower, America's



single largest source of renewable energy, is helping the nation reduce its carbon footprint. It is also experiencing a renaissance because of its clean energy attributes. To be sure, hydropower is needed to meet federal and state clean energy goals. "It appears that the paper by Washington State University (WSU) is not based on new research on the issue, but is a review of 100 research papers published on the reservoir emissions since 2000." It should be clearly noted that conclusions from the existing research on reservoir emissions is mixed. In fact, the U.S. Department of Energy's Hydropower Vision Report released this July states that studies surrounding GHG reservoir emissions are filled with large uncertainties. Additionally, some of the existing data is for reservoirs in regions with characteristics not comparable to U.S. reservoirs. "If methane emissions are an issue, it is one for freshwater systems in general, not centered on hydropower generation itself. Determining the net emissions differential between natural rivers and reservoirs and man-made reservoirs, is a complex calculation dependent on many factors for which more investigation is needed and for which the scientific community has yet to reach consensus.

"Without question, the science on reservoir emissions is far from settled as the recent set of news articles appear to imply. In fact, some of the research has found that reservoirs may also act as carbon sinks, absorbing and removing carbon dioxide from the atmosphere. "Most importantly, ascribing all methane emissions, if any, solely to hydropower generation would be inaccurate. Particularly when hydropower generation - water flowing through a turbine - is a renewable form of producing electricity and reservoirs, in general, are built for many different purposes including: municipal water supply; irrigation; flood control; and navigation. In fact, only 3 percent of U.S. dams even have hydropower plants associated with them. "Hydropower provides many benefits in the fight to address climate change and for cleaner air. The DOE Report estimates that increasing hydropower's capacity by 50 gigawatts by 2050 reduces greenhouse gas emissions by 5.6 billion metric tons and saves \$209 billion in avoided global damages from GHG emissions, including \$185 billion in savings from the existing hydropower fleet being operated through 2050. "The Report also finds that the cumulative reduction in other air pollutants such as sulfur dioxide, nitrous oxides, and particulate matter due to the existing hydro fleet results in nearly 5 million fewer cases of acute respiratory symptoms and 750,000 fewer cases of childhood asthma. "Let's not lose sight of what we know for certain about hydropower - it has greatly contributed to a healthier environment and can sustainably grow to do more."

Reservoir GHG Emissions Talking Points:

- A newly released study from the Washington State University gives the false impression that clean and renewable hydropower generation is a major source of greenhouse gas emissions (GHG).
- This is a complex issue, one in which continued study and research is needed. However, the science on reservoir emissions is far from settled.
- The Energy Department's Hydropower Vision Report states that studies surrounding GHG reservoir emissions are filled with large uncertainties.
- If methane emissions are an issue, the focus should be on freshwater systems in general, not centered on hydropower generation itself.
- The scientific community should be focused on determining the net differential, a complex calculation that is dependent on many factors and for which the community has yet to come to agreement on.
- Ascribing all methane emissions, if any, solely to hydropower generation would be inaccurate. Particularly when hydropower generation - water flowing through a turbine - is a renewable form of producing electricity.
- According to the DOE Hydropower Vision Report, many of the studies and research currently available focus only on new reservoir construction, particularly in tropical regions with "low to negligible emissions in cold and temperate climates".
- Equally important, some reservoirs have been found to be carbon sinks, absorbing and removing carbon dioxide from the atmosphere.
- Freshwater reservoirs, whether natural or manmade, emit biogenic GHG emissions as a result of bacterial processes in waters and soils.

New Development/Reducing Carbon Footprint:

- According to the DOE Hydropower Vision Report, increasing hydropower's capacity by 50 gigawatts by 2050 reduces greenhouse gas emissions by 5.6 billion metric tons and saves \$209 billion in avoided global damages from GHG emissions, including \$185 billion in savings from the existing hydropower fleet being operated through 2050.
 - The report also makes clear that adding hydropower at existing non-power dams is "unlikely to lead to changes in biogenic GHG emissions."
 - In addition, the report finds \$58 billion in savings as a result of the existing hydropower fleet in avoided damages from the cumulative reduction in emissions from other air pollutants such as sulfur dioxide, nitrous oxides, and particulate matter. Doing so would result in nearly 5 million fewer cases of acute respiratory symptoms and 750,000 fewer cases of childhood asthma.
- A Distraction from Hydropower's Growth:
- Hydropower is helping the nation reduce its carbon footprint. And is doing so when only 3 percent of the nation's dams even have hydropower plants associated with them.
 - Let's not lose sight of what we know for certain about hydropower - it has greatly contributed to a healthier environment and economic prosperity and can sustainably grow to do more.
 - It would be unfortunate if this issue leads us to forego the significant opportunities to increase the clean air benefits derived from increased hydropower deployment, such as through upgrades at existing facilities and adding generation to non-powered dams.

(Yuk!)

Violation issued for contamination caused by American Fork dam project

By Sara Weber,, September 28th 2016, kutv.com

(KUTV) The group behind a dam rehabilitation project in American Fork that contaminated a nearby creek and killed local fish a little over a month ago is being issued a violation and compliance order by the state. The Utah Department of Environmental Quality's Division of Water Quality (DWQ) issued the North Utah County Water Conservancy District a violation notice for the project, which cost \$7.3 million and turned the water black. By altering the 50-year-old Tibble Fork Dam, DWQ said the group sent metal-laden pollutants into the water that brought the quality below state standards. They also said Water Conservancy District failed to meet federal and state permit conditions before they began construction. "The release had a significant effect on a popular fishing area and an important water source for local irrigation companies," said DWQ Director Walt Baker. "We still don't know what the long-term impacts to aquatic life and other uses of the river will be from the deposition of a significant quantity of sediment in and along the river." DWQ is now requiring that the Water Conservancy District take "all actions necessary" to bring the water quality back to state standards, explain why the contamination occurred and submit a plan for cleanup. For more photos and a copy of the violation issued, visit tibble.utah.gov.



(Oh, oh.)

Power plant resumes operations after Youghiogheny River fish kill

By Don Hopey / Pittsburgh Post-Gazette, October 5, 2016, post-gazette.com

A small hydroelectric power operation at the Youghiogheny River Dam in Confluence, Somerset County, PA resumed operation Tuesday morning, a week after it was shut down and blamed for killing about 230 brown and rainbow trout held in nursery pens below the dam. It was at least the third time the power plant has played a role in the death of fish in the Yough Cage Nursery, a co-operative trout rearing project of Chestnut Ridge Trout Unlimited and the Pennsylvania Fish and Boat Commission, that has operated at the base of the dam since the late 1990s. The U.S. Army Corps of Engineers, which owns the flood control dam and ordered the power plant to temporarily stop operations, said its preliminary investigation determined the fish died when the power plant's water discharges became "supersaturated" with nitrogen. But Gregory Brant, project operator for D/R Hydro Co. of the 12 megawatt power plant owned by the Youghiogheny Hydropower Authority, said its gauges showed nitrogen concentrations were in the safe range, and instead attributed the kill to high water temperatures that "stressed the fish," and poor water circulation due to the algae-caked rearing pens. "We have a difference of opinion about the readings on the water quality gauges," Mr. Brant said. "This has happened at other times in similar conditions in late summer, and there are procedures in place to reduce the risk. But truthfully, there shouldn't be fish in those pens at this time of year. That just invites disaster."



The high nitrogen concentrations usually occur in late summer when the hydroelectric power plant draws water low in oxygen from the bottom of the dam's lake. Releasing that water below the dam would kill fish, so the power plant must add oxygen before it's released into the river below the dam.

It does that by either injecting liquid oxygen into the water — an expensive process — or using blowers. But the atmospheric air blown into the water contains about 20 percent oxygen and 80 percent nitrogen, Mr. Brant said. He said the power plant was using a combination of liquid oxygen and blowers when the Corps ordered it to shut down last week. "We didn't think anything was wrong until we got the order from the Corps," Mr. Brant said. "We've been in communication with the Corps and will need to sit down and work out procedures on how to handle this situation in the future."

Dale Kotowski, president of Chestnut Ridge Trout Unlimited, said the nursery gets about 10,000 fish a year from the state, raises them and stocks them in the Youghiogheny river and other lakes and streams in the region. After the fish kill last week, chapter members emptied the nursery cages, removing about 600 live trout and releasing them in the river. "The nursery functions as the canary in the coal mine to tell us when things are going wrong with water quality in the river," Mr. Kotowski said. "This happened because gauges monitoring water quality didn't catch the high [nitrogen] gas levels quickly enough." Investigations of the incident by both the state Fish and Boat Commission and the Army Corps of Engineers are continuing. A meeting to discuss findings of the investigations and solutions to the nitrogen problem is scheduled for next week. Youghiogheny Hydroelectric Authority holds a Federal Energy Regulatory Commission license for the hydroelectric plant, operated by D/R Hydro Co. since 1989. The plant has the capacity to generate up to 12 megawatts of electricity per hour, enough to service approximately 8,000 homes for a year.



Other Stuff:
(All too cold.)

10 Best-Run US Cities

You'll find most of them in Middle America

By Jenn Gidman, Newser Staff, Oct 3, 2016, newser.com

(NEWSER) – Running a city is no small feat, and with nearly 63% of the US population living in urban centers, per the US Census Bureau. WalletHub decided to see which ones are managed the best. The site looked at 150 of the biggest cities in the country, combining the results of six different indicators—financial stability, education, health, safety, economy, and infrastructure and pollution—into one "Overall City Services" ranking; it then figured out how well each city handles its budgeting. From there, an overall ranking was determined, and in the top spot: Boise, Idaho. Rounding out the top 10, most of which lie in the American heartland:

1. Boise, Idaho
2. Nampa, Idaho
3. Provo, Utah
4. Missoula, Mont.
5. Fort Wayne, Ind.
6. Lexington-Fayette, Ky.
7. Billings, Mont.
8. Bismarck, ND
9. Sioux Falls, SD
10. Nashua, NH

See WalletHub's complete list for more well-managed cities

<https://wallethub.com/edu/best-run-cities/22869/>

(Meanwhile, here are the most affordable US cities to live in.

<http://www.newser.com/story/231375/the-6-best-affordable-big-american-cities.html>



Boise, Idaho



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