

Osage City Lake Restored with Mechanical Dredging

Sending a living person to the moon was once regarded to be science fiction. We went there, more than once, so we know it can be done. It's no longer fiction. But if we wanted to do it again, the purpose and the costs would require rock-solid, widely accepted justification. Dredging water supply reservoirs is not nearly as technical as aiming a rocket to an object 238,855 miles away, orbiting the earth at a speed of 2,287 miles per hour, relative to the earth. (Think how complicated it would be if the moon was also spinning, relative to the earth!) To recover the lost storage volume behind the dams of water supply reservoirs of all sizes, the need to dredge reservoirs must be communicated and the costs to dredge very well-understood. In 2010, a pilot project to dredge Mission Lake at Horton, Kansas, was accomplished. The most recent reservoir to be dredged and restored is the Osage City Lake.



The dam impounding Osage City Lake was built in 1910. Over 100 years later in 2014, the dam has been reconstructed to protect its integrity and to slow the flow of water exiting the spillway, minimizing erosion of the streambanks downstream.

According to William G. Cutler's *History of the State of Kansas* published in 1883, Osage City was surveyed and platted in 1869, after the route of the Atchison, Topeka and Santa Fe Railroad was established. Building the railroad to Osage County was the first priority of the Santa Fe's founders and investors, for it offered a local source of coal. On May 14, 1870, rail cars arrived in the new community of Osage City, according to the *Kansas Historical Quarterly* (Summer, 1968 edition). With the opening of at least 28 coal mine shafts in the area, the population of the town quickly exceeded 3,000 people. The last coal mine closed in Osage County over 50 years ago, but the population of Osage City is not significantly less than the peak experienced in the early years. US Census Bureau estimates show a population of 2,899 persons in Osage City in July, 2013.

The city's water system was started in 1910, according to the initial application to claim the vested municipal use water right, with the construction of a dam and reservoir.

The lake is located on approximately 75 acres of land owned by the city. The dam was raised in 1923 and 1939, likely because of increased demand and reduced storage capacity. In 1954, during a significant drought, the city dredged a portion of the lake when the water level was low. Sediment was piled on the north side of the reservoir close enough that some of the sediment likely washed back into the lake. Besides being a source of drinking water, the reservoir is a recreation facility – no motorized watercraft allowed – and the land adjacent to most of the shoreline is used by the Osage City Country Club. Unlike some municipally-owned lakes, there have been no lots sold or homes built in close proximity, preventing some unwanted water quality impacts caused by septic systems, etc.

Because of the modifications to the dam, its age, and tightening dam safety regulations, the dam and spillway needed significant modification before a dredging project could be approved. Engineering plans were drawn, approved and funded. This repair work was completed in 2014.

The lake has a capacity of 405 acre-feet. Before the dredging started, it was estimated that 143 acre-feet of sediment had settled into the lake, a reduction of storage capacity of 35 percent. The average thickness of the sediment was approximately 2.9 feet, and ranged from as little as 0.9 feet close to the dam, to as much as 5.7 feet in the middle to upper part of the lake, where the inflow experiences a significant decrease in flow velocity and allows the sediment to settle. The lake's drainage area is approximately 3,030 acres, which has contributed an average of approximately 2.5 acre-feet of sediment per year since 1954.

The city's water rights authorize the use of 190 million gallons per year from Osage City Lake. Another 382.926 million gallons per year is authorized from Melvern Lake. The city is authorized to store 105 million gallons per year (322.23 acre-feet) per calendar year in the Osage City Lake for use in subsequent years when there is little to no inflow. The total quantity authorized for use in the city is 382.926 million gallons. The city is a wholesale water supplier to Rural Water District No. 6, Osage County; Rural Water District No. 7, Osage County; the city of Burlingame and the City of Reading.

According to Hakim Saadi, P.E., Water Supply Restoration Program Manager, the Division of Conservation (DOC), Kansas Department of Agriculture administers a state cost-share program to assist small communities with the restoration of public water supply sources. This includes watershed district lakes, etc. With the dredging of Mission Lake at Horton and a dam and spillway project completed at Augusta Lake at Augusta, Kansas, completed, funding was available to do a new project.

Osage City chosen

Osage City was successful in having their lake chosen for the latest dredging project over other applicants because of a number of factors. Agreeing to upgrade their dam to meet regulatory requirements without using dredging

funds was a significant item. Their role as a wholesale water supplier to much of northwest Osage County was another factor. A significant break of the pipeline from Melvern Reservoir would likely cause a long period of water service interruption and severe hardship to individuals and businesses. The Osage City Lake is an important back-up supply to the Melvern Lake supply. Another significant item was a suitable, economically viable site to dispose of the dredged sediment.

To excavate the sediment from the lake, it was necessary to drain the lake as much as possible. While most people would have preferred more precipitation in 2014, the dry summer in the Osage City area was beneficial to this project. The closest Community Collaborative Rain, Hail and Snowfall (CoCoRaHS) volunteer recorded 7.28 inches of rainfall in June of 2014, when the 30-year average is 5.41 inches. However, in July, the same observer only recorded 0.84 inches when 4.24 inches is average. August precipitation was only 2.74 inches. With dry soils and warm temperatures, there was no runoff during those months. With the

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lake already low from the previous years' drought, there were no problems lowering the lake level to an acceptable level. Mechanical dredging commenced in August of 2014.

In case there was any runoff from areas upstream, a small cofferdam was built on the upstream side of the lake to help keep the areas of the lake further downstream where excavation was occurring, as dry as possible. It was fortunately never needed, or worse, washed out by a large runoff event. This dam will be removed at the end of the project.

The process that was found to work best was to use two excavators on the lake bed to scoop out the sediment. The



This aerial view of the Osage City Lake from Google Earth shows the nearly empty condition of the lake in March of 2014. The red boundary shows the approximate extent of the City of Osage City property. Much of the exposed lake bed shown in this photograph was dredged.



Sediment scraped from the lake bed is loaded onto trucks for transport to the staging area located immediately west of the Osage City Lake.

buckets that were used were not like typical buckets with teeth that one might find on backhoes. The digging edge of the buckets was gently curved, like the edge of a person's hand scooping sand on a beach. This design allowed the buckets to glide over the original rock of the lake bed, and remove only the deposited sediment, without ripping out any extra rock.

Two or three large dump trucks to haul the excavated material would first drive under a sprinkler system to wet the dumping bed of the truck. It was

found early in the project that some of the excavated sediment was very sticky, especially on hot, dry, smooth metal. Wetting it first helped more of the loaded material slide out of the dumping truckbed. After being wetted, the trucks would drive down to the active excavation area on the lake bed and be loaded. Once loaded, the trucks drove out of the lake to a staging area west of the lake where the excavated sediment was unloaded. The trucks would return to the sprinkler and repeat the process.

At the staging area, a loader turns the dumped sediment to accelerate evaporation of any water, until one of the 8 to 10 trucks in the "highway group" would arrive for loading. These trucks are loaded with partially dried sediment and hauled it to the disposal area located 5 miles south and 2 miles east of the Osage City Lake, adjacent to US Army Corps of Engineers land at Melvern Lake. The disposal site is in an abandoned quarry that was purchased by the Kansas Department of Wildlife, Parks and Tourism in 2008. This site is currently used for walk-in hunting and fishing. The sediment is stacked on rock, and not in the deepest part of the quarry where fishing occurs. The dredged material will be contained in such a way that it will not be allowed to erode and enter any streams, ditches, the quarry lake, or Melvern Lake. The dredged material is expected to allow the growth of vegetation suitable for wildlife habitat.

The contractor chosen to do the dredging work was Skillman Construction, LLC, of New Strawn, Kansas. The company has a great deal of dirt moving experience in pond rehabilitation projects, road construction, etc. They have previously completed lake sediment removal in Lebo and Gridley. They have taken great care to avoid spilling any sediment on the public roads and highways, and have taken measures to control dust from blowing off the gravel roads near rural homes. Skillman Construction is a 2014 American Business Magazine Company of the Year Finalist.

Other equipment was used in this project. A loader at the disposal site worked the dumped sediment to place it in the appropriate area with the proper slope, etc. Back at the lake, another earthmover shaped the banks of the lake to minimize erosion from

An advertisement for COBANK. The background is a blurred blue image of a field. The text "QUICK & EASY FINANCING SOLUTIONS" is written in large, bold, yellow capital letters. Below this, the COBANK logo is shown, consisting of a stylized 'C' and the word "COBANK" in white, with the tagline "COOPERATIVE. CONNECTED. COMMITTED." underneath. At the bottom, the website "www.cobank.com/h2oloan" and the phone number "844-846-3135" are listed in green. At the very bottom, it says "Proud Member of the Farm Credit System" with a small green logo.



wave action. Previously, underwater check dams were placed on tributaries to the lake to attempt to keep any new sediment from reaching the middle portions of the lake. These structures will provide habitat for fish, and keep sediment close to the shoreline where it might be easier to remove without draining the lake.

The total cost of the project was estimated to be \$3.30 million. The City of Osage City is responsible for \$2.17 million, which includes the dam repairs. State cost-share funds provided were \$1.13 million or 34% of the total cost, whichever was less, to excavate 100,000 cubic yards (61 acre-feet) of sediment. When the project is completed, the lake will be restored to approximately 80 percent of its original capacity.

Through this project and the previous hydraulic dredging project, the Division of Conservation has gained valuable information to help them promote, coordinate and manage future dredging projects. These projects can require permits from, and cooperation with, many different agencies, such as the Division of Water Resources - Kansas Department of Agriculture, the Kansas Department of Health and Environment, the Kansas Department of Wildlife, Parks and Tourism, the Kansas Department of Transportation, and the US Army Corps of Engineers. With their expanded expertise, the Division of

After the dredged material is dumped at the staging area, it is turned and allowed to partially dry. After completing the drying process, it is re-loaded onto trucks suitable for hauling on public roads.

Conservation can exercise better discernment to choose qualified projects and have these future projects completed quicker and more efficiently. The result of this project is a dependable water supply that will serve the city of Osage City and Northwest Osage County for many years to come.

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