Operation and Maintenance of Water Infrastructure

Although most people do not typically give much thought to the components of our water systems, even less thought is given to the operation and maintenance of those systems. However, proper operation and maintenance of water infrastructure is essential in order to provide the clean water that comes out of the tap each day when we turn on the faucet to take a drink, wash our hands, or brush our teeth. While much of the Alternative Water Source Program is related to the significant capital improvements required to bring Lake Michigan water to Joliet, consideration must also be given to the time, energy, and resources that will be required to operate and maintain the new system. Not only can the operation and maintenance (O&M) costs have a significant impact on the life cycle cost of the system, it is also important to plan appropriately so that the new system is operated and maintained in a way that protects the City's investment for years to come.

Operation and maintenance of several main components need to be considered while developing the future water infrastructure as part of the Alternative Water Source Program, including:

- New Lake Michigan Intake (New Indiana Intake Alternative only)
- Pump Stations
- Water Treatment Plant (New Indiana Intake Alternative only)
- Water Transmission Mains
- Storage Facilities

The intake facilities for the New Indiana Intake alternative will include a submerged intake structure located approximately 7,000 feet out in Lake Michigan, along with raw water pumps and screens located at the Raw Water Pump Station near the shoreline. Operation of these facilities will require labor to operate, maintain, and monitor the raw water pumps, screens, and chemical feed systems. The chemical feed system at the Raw Water Pump Station will protect the water system by feeding chemicals to the intake for control of mussels. If not controlled, mussels can accumulate inside of the intake structure and piping reducing the capacity of the intake or clogging the pipe entirely, jeopardizing the raw water supply to Joliet. Also included with the intake facilities are screens that are located before the raw water pumps to remove vegetation or large debris from the water in order to protect the pumps. Operation and maintenance of these components will be critical for providing water to Joliet, if the New Indiana Intake alternative is selected.

Transmission of raw and/or finished water via pumping will be required for either of the two alternatives being evaluated. For the Chicago Department of Water Management (CDWM) alternative, pump stations at the Chicago connection point and at an intermediate point between Chicago and Joliet will be required. For the New Indiana Intake alternative, a raw water pump station at the intake near the shoreline of Lake Michigan (as described above) and an intermediate pump station will be required to transfer raw water from Lake Michigan to the new water treatment plant (WTP), and pumps will be required to convey finished water from the WTP to the City's distribution system. As with the intake facilities, these pump stations must have adequate operations staff to operate and monitor the pump stations. Maintenance of these pumps, much like our cars, is required to ensure the pumps and motors are maintained and functioning properly. The pumping stations are also a major consumer of power/electricity. As a point of comparison, the average

home in Illinois uses approximately 775 kWh per month.[1] while the intermediate pump station will use over 500,000 kWh per month[2] on average to convey water to Joliet. Therefore, adequate operator attention and routine maintenance of the pump stations is necessary to maximize performance and keep the pump stations operating efficiently.

The water treatment plant (WTP) that will be required if the New Indiana Intake alternative is selected, will treat raw water from Lake Michigan so that reliable, clean water is provided to the residents of Joliet. Labor for operation and maintenance of the WTP will be more substantial as compared to the previous components given the many treatment processes which require regular monitoring, inspection, maintenance, and routine repairs. Appropriately trained and licensed WTP operations staff will have the important role of monitoring and managing the various treatment processes to confirm that the City's objectives for water quality are met under all operating conditions. In addition, there are numerous pieces of equipment, such as pumps, motors, valves, pipes, etc., in a WTP that require routine maintenance. Chemicals required by the various treatment processes are also part of the O&M associated with a WTP. The chemicals include coagulants used to improve settling/filtration of the water, ozone to address taste & odor as well as emerging contaminants, chlorine for disinfection, and fluoride for dental health. Lastly, energy for operations of the treatment equipment will contribute to the operational cost of the WTP. Proper operations of the WTP will be essential to optimize both the chemical and power usage by the treatment processes.

Large diameter (48-inch to 60-inch) transmission mains will convey water approximately 30 miles from Chicago or approximately 48 miles from northwest Indiana to Joliet. A transmission main is generally considered passive infrastructure as it does not continuously require energy or moving parts to operate. Nonetheless, it is a critical component that must function reliably to continuously convey water to Joliet. Operation and Maintenance procedures will help ensure this reliability. Monitoring of conditions such as pressure and flow at key points along the transmission main will ensure the pipe is within design pressures. Sudden change in pressure can indicate a leak that needs to be addressed. Monitoring of transmission main right-of-way can identify activities or conditions that could pose a threat to the pipeline. Appurtenances along the transmission main line such as isolation valves, pressure relief valves and air release valves are rarely used but must operate properly when needed. Periodic inspections and exercising of these devices will ensure they can operate when needed. An inspection and monitoring plan can include internal visual inspection or use of electronic inspection technologies to inspect for leaks, pipe deterioration or accumulation of sediment. External visual inspections can also be performed checking for deterioration or corrosion of the pipe.

Storage facilities are also considered passive infrastructure with few moving parts, similar to transmission mains. While the transmission main has the primary task to convey water, the storage tank is needed to provide a volume of water to support pump operations, accommodate fluctuations in flow, and provide reserve capacity in the event of an emergency outage. Storage facilities must also be kept in good operating condition. Typical daily operations will require monitoring of levels for proper operation and regular turnover of water in summer to prevent loss of disinfectant residual, if water is stagnant, and in winter to minimize the potential for freezing. Routine inspections will check for overflows, leaks, corrosion and unauthorized access. Annual inspections will more closely check for deterioration of coatings, foundations, screens and components of the storage tank. The American Water Works Association (AWWA) recommends draining storage tanks to allow for a more comprehensive inspection about every 3 years.

Proper O&M after construction of the new system will be critically important to the reliable and efficient delivery of Lake Michigan water to Joliet. Scheduled maintenance will keep equipment running, and minimize the cost, stress, and inconvenience of unexpected breakdowns. Joliet's ongoing efforts include a focus on identifying O&M needs in preparation for the transition to a Lake Michigan water source.

[1] https://www.electricchoice.com/blog/electricity-on-average-do-homes/#:~:text=According%20to%20the%20U.S.%20Energy,around%2010%2C909%20kWh%20per%20year

[2] Assuming an average flow rate of 21 mgd at a pressure of 100 psi