# *Water Treatment Plant*

*City of Celina, OH, USA*

The Celina Water Treatment Plant is located on the west bank of Grand Lake in Celina, Ohio. The raw water source for the water treatment plant is Grand Lake, a raw water source high in dissolved organic matter conducive to the formation of regulated disinfection byproducts (DBPs).

The treatment process employed by the water treatment plant is ineffective in removing dissolved organic matter from the raw water. During disinfection of the finished water, the combination of free chlorine and dissolved organic carbon creates regulated disinfection byproducts. In the case of Celina, the concentration of these byproducts consistently and continuously exceeds the regulatory limits. As a result, the Ohio Environmental Protection Agency (OEPA) has issued Final Findings and Orders requiring the City to upgrade the water plant to achieve compliance with the Disinfection / Disinfection Byproduct Rule (DBPR).

The City hired the team of Floyd Browne Group and Metcalf & Eddy to conduct a thorough evaluation of the alternatives available for upgrading the water treatment plant with a new treatment process that will produce a finished water quality meeting or exceeding existing and potential future regulations in a cost-effective and reliable manner.

As part of the Evaluation, both interim and long-term compliance alternatives were evaluated. The purpose of the interim compliance evaluation was to identify and evaluate alternatives available to the City that could be implemented on a short-term, temporary basis until long-term and permanent improvements could be implemented. Under the long-term compliance evaluation, the project team identified and evaluated alternatives available to the City of a permanent nature that provide long-term regulatory compliance.

Three interim treatment alternatives were identified to achieve interim compliance including the following:

***Remove DBP Precursors:***

1) **Activated Carbon**

2) **Membrane treatment (reverse osmosis)**

*-or-*

***Change Disinfectants:***

3) **Monochloramines**

Under the activated carbon alternative, granular activated carbon (GAC) contactors would be installed downstream of the existing filtration process to remove DBP precursors.

Under the reverse osmosis (RO) alternative, an RO system would be installed downstream of the existing filtration process to remove DBP precursors. Both of these alternatives would allow the City to continue using free chlorine as a primary disinfectant.

Under the monochloramine alternative, DBP precursors are not removed and chloramination still forms byproducts. However, the byproducts formed by chloramines are not currently regulated and therefore this approach is currently acceptable to regulating agencies.

Further evaluation of the three interim treatment alternatives includes:

Chloramination has the lowest initial capital and long-term operating costs. However chloramination may degrade finished water quality which is already a sensitive issue with the administrators and residents of Celina. Chloramination forms unregulated DBPs that may be regulated in the future, at which time other full-scale improvements will be required. While interim DBP compliance may be feasible at existing system demands, expansion to greater flows requires additional storage or disinfection contact tanks.

Granular Activated Carbon (GAC) has a lower installed cost than RO, but the annual operation and maintenance (O&M) costs are higher than that of an RO system and has fewer advantages. A GAC approach has much greater uncertainty with respect to frequency of media replacement and regulatory compliance than the RO approach. True O&M costs are unknown and could be greater than those assumed in this report.

The Reverse Osmosis (RO) membrane system has the highest installed cost of the three alternatives, but produces a finished water quality superior to all other forms of treatment. RO removes DBP precursors, synthetic organic compounds (SOCs), volatile organic compounds (VOCs), hardness and taste and odor causing compounds, thus it is a universal treatment process. RO has a lower annual operating cost than GAC, thus the long-term cost of RO is lower than GAC. Furthermore, if RO is implemented as an interim solution, the RO equipment can be incorporated into the upgraded water plant and is central to any long-term solution for the CWTP.

Eight separate process alternatives were evaluated to upgrade the existing water treatment plant to achieve regulatory compliance and improve finished water quality. Each alternative was evaluated based on its ability **to accomplish the following goals**:

- Operate reliably and consistently considering the Grand Lake raw water quality characteristics
- Operate efficiently considering the Grand Lake capacity constraints
- Fit within the existing site constraints
- Operate cost-effectively without a high degree of complex operation and maintenance
- Consistently produce finished water meeting the established water quality goals
- Provide the flexibility to cost-effectively meet growth, development and future demands
- Provide an affordable solution in terms of initial capital cost and long-term operating and maintenance costs
- Provide a proven track record of successful operation in similar situations
- Maximize use of existing infrastructure to minimize capital expenditure

Eight separate alternatives were evaluated and are summarized below by Table 1.3

**Summary of Treatment Alternatives**
**Table 1.3**

| Alternative No. | Description |
|---|---|
| 1 | Existing WTP retrofit including MIEX®, dissolved air flotation (DAF) retrofit of the existing Walker clarifiers, intermediate ozonation, sand filtration expansion / upgrade, and RO |
| 2 | Existing WTP retrofit including DAF retrofit of the existing Walker clarifiers, intermediate ozonation, sand filtration expansion / upgrade, and RO |
| 3 | New treatment process in existing power plant including MIEX®, ultrafiltration (UF), RO |
| 4 | New treatment process in existing power plant including UF and RO |
| 5 | New treatment process in existing power plant including MIEX®, DAF, intermediate ozonation, cluster filters, and RO |
| 6 | New treatment process in existing power plant including DAF, intermediate ozonation, cluster filters, and RO |
| 7 | New treatment process in existing power plant including MIEX®, Actifloc®, and RO |
| 8 | New treatment process in existing power plant including Actifloc® and RO |

Capital and O&M costs were developed for each alternative to form a basis of comparison. All costs are in current year US dollars. Present worth costs were development for a 20-year period.

*For more information regarding water master planning, contact Floyd Browne Group at 740-363-6792.*