



Utilities
electric · stormwater · wastewater · water
700 Wood Street
PO Box 580
Fort Collins, CO 80522
970.221.6700
970.221.6619 – fax
970.224.6003 – TDD
utilities@fcgov.com
fcgov.com/utilities

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**City of Fort Collins Comments on Black & Veatch NISP EIS Support Memo on
Total Organic Carbon Issues (memo dated 12/23/2008)**

Introduction

The Northern Colorado Water Conservancy District and other NISP participants engaged the services of technical experts (Black & Veatch) to review and analyze NISP DEIS comments prepared by the City of Fort Collins on the potential impacts of increased total organic carbon (TOC) in Horsetooth Reservoir water as a result of the transfer of water from Glade Reservoir to Horsetooth Reservoir. Black & Veatch conducted their analysis by assuming three possible schemes to strategically operate NISP in order to minimize and control TOC impacts to Horsetooth Reservoir. The details of these operational scenarios were not included in the DEIS or made available to the City during its review of the DEIS. As a result, although the additional operational information is helpful, the City has not yet had an opportunity to independently assess the relationship of the described scenarios to the TOC issues of concern to the City. In general, such operational schemes have the potential to serve as appropriate mitigation measures to minimize the TOC impacts to Horsetooth Reservoir. The analysis conducted by Black & Veatch represents an initial evaluation of possible mitigation. Further analysis will be required to more fully understand the range of potential water quality impacts to Horsetooth Reservoir and to evaluate potential avoidance or mitigation scenarios.

Summary of City of Fort Collins Comments on Black & Veatch

- B&V outlined three possible schemes to strategically operate NISP in order to minimize and control TOC impacts to Horsetooth Reservoir. Protection of the City's municipal drinking water supply from potential impacts of NISP is of the utmost importance to the City.
- Based on its preliminary review of the three operational schemes presented by B&V, along with the associated diversion and exchange values, there may be some opportunities for avoiding or mitigating impacts that had not previously been detailed and warrant further review and analysis as additional data is developed regarding potential water quality impacts.

- If the strategic operation of NISP to minimize and control TOC concentrations can be successfully implemented, added costs to the Fort Collins Water Treatment Facility (FCWTF) for TOC removal due to NISP could be limited to the additional expense for higher chemical doses with the existing treatment processes.
- If an optimal operational scheme can be selected to control TOC concentrations and agreed upon by the interested parties, written assurances of a long-term commitment by the District to implement and fund the agreed-upon scenario will be required, including considerations for the required infrastructure.
- Regardless of the NISP operational scheme, a sufficient analysis of impacts will require: 1) a better understanding of the worse-case TOC concentrations that will be encountered at the FCWTF with NISP (not long-term average conditions), 2) a better understanding of the potential for short-circuiting in Horsetooth Reservoir between the Glade-to-Horsetooth pipeline and the Horsetooth Reservoir outlet at Soldier Canyon Dam, and 3) an analysis of the impact on water quality in Horsetooth Reservoir due to decreased C-BT inflows (including impacts from potentially longer hydraulic detention times of water in Horsetooth Reservoir).

Detailed Comments

Comments on Section 2.0: Strategic Operation of NISP to Control TOC Concentrations.

The analysis conducted by Black & Veatch (B&V) evaluated the impact of three NISP operational schemes on total organic carbon (TOC) concentrations in Horsetooth Reservoir. Details of these three operational schemes were not presented in the DEIS and the associated diversion and exchange values were not previously made available to the City of Fort Collins. The DEIS indicated that an average of 2,600 acre-ft/year of Glade Reservoir water would be transferred to Horsetooth Reservoir, with a maximum transfer of about 7,000 acre-ft/year. The three operational schemes presented in the B&V memo include the transfer of an average of 0 to 267 acre-ft/year of Glade Reservoir water to Horsetooth Reservoir (depending on the scheme as shown in Table TOC-1) along with the transfer of an average of 0 to 480 acre-ft/year of water directly from the Poudre River to Horsetooth Reservoir (depending on the scheme as shown in Table TOC-1). Note that the 50-yr average transfer values shown in Table TOC-1 seem too small when compared to the yearly values graphed on Figures TOC-5, TOC-7, and TOC-8. If it can be assured that significantly less Glade Reservoir water is directly introduced into Horsetooth Reservoir (as outlined in the B&V memo), and only low TOC Poudre River water is transferred to Horsetooth Reservoir, the City agrees that the potential for water quality impacts could be reduced.

Comments prepared by the City of Fort Collins on the mitigation section of the DEIS state that TOC mitigation measures that must be considered include the implementation of operational scenarios that minimize the delivery of the highest TOC water to Horsetooth Reservoir (page 53 of the City's comments). The analysis conducted by

B&V focuses on the strategic operation of NISP to control TOC concentrations. The City of Fort Collins believes that this is an important and appropriate –and essential -- method to protect the City’s municipal drinking water supply from the potential impacts of NISP. However, additional information and analyses as well as detailed discussions between parties will be required to select the most appropriate operational scenario(s). Additional information would be required on such items as how the delivery volumes and exchanges were calculated, their underlying assumptions, and their ability to be sustained into the future. The City also must review a table of monthly diversion and exchange values for the different scenarios in order to gain a better understanding of how the schemes are expected to operate through the year.

Once an optimal operational scenario has been selected by the parties of concern, written assurances by the District of a long-term commitment to implement and fund the agreed-upon scenario will be required. The long-term commitment would need to specifically address what times of the year transfers to Horsetooth Reservoir would be permitted, volumes of transfers and exchanges, water sources to be transferred, and the water quality conditions that would limit those transfers (i.e., no transfers to Horsetooth Reservoir of any water that has a TOC concentration above some threshold value).

Comments on Section 2.3: Reservoir TOC Mass Balances

Effective drinking water treatment design and operation require the careful evaluation of worst case scenarios for water quality. The City needs to have a good understanding of the full range of water quality conditions that will be encountered at its water treatment plant so it can be prepared to treat it; and it needs to know far enough in advance so it can effectively plan, design and build any process modifications. The analysis conducted by B&V is summarized using long-term average TOC concentrations. Long-term average concentrations do not provide information on the range of conditions that could be potentially encountered at the treatment plant influent.

In the mass balance calculations, it is not clear if the impact of reduced C-BT flows into Horsetooth Reservoir from the Hansen Feeder Canal was considered. It is also not clear how much water will be entering Horsetooth Reservoir from all sources combined. The hydraulic detention times should be calculated for Horsetooth Reservoir for the different operating schemes since a significantly longer hydraulic detention time (compared to existing conditions) may result in the degradation of water quality.

Comments on Section 3.2.4: TOC Introduced to Horsetooth Reservoir

The B&V memo states that transfers from Glade Reservoir to Horsetooth Reservoir would only occur during the winter. Because of this, B&V assumed that substantial mixing due to seasonal overturn and internal circulation would limit the opportunity for short-circuiting. Therefore, they assumed that any water transferred to Horsetooth

Reservoir will be completely mixed with the entire volume of the reservoir. However, the hydraulics of Horsetooth Reservoir will likely limit the potential mixing of Glade Reservoir water to the volume of water available in the Soldier Canyon pool. Furthermore, it is not known the degree to which short-circuiting would be limited. Such factors as the Glade-to-Horsetooth pipeline outlet location, differences in water temperature between Horsetooth Reservoir water and water in the pipeline, flow rates, and the long, narrow geometry of Horsetooth Reservoir and the presence of three pools will all influence mixing, flow paths, and short-circuiting even in the winter. The Horsetooth Reservoir Soldier Canyon outlet provides a continuous (year round) supply of water to the Fort Collins Water Treatment Facility and the Tri-Districts Soldier Canyon Filter Plant. The Glade-to Horsetooth pipeline would deliver water to the north end of Horsetooth Reservoir relatively close to the Soldier Canyon outlet. With water continuously leaving Horsetooth Reservoir at Soldier Canyon dam, some portion of the water from the pipeline will likely take a flow path directly to the Soldier Canyon outlet. The impact of this short-circuiting may be significant, resulting in increased TOC levels at the City's intake. In order for the City of Fort Collins to understand how its raw water supply at the Soldier Canyon outlet is being impacted, a more rigorous assessment of mixing and the potential for short-circuiting should be made.

Comments on Section 4.2: TOC Removal at Fort Collins Water Treatment Facility

The City of Fort Collins Water Treatment Facility developed a process to treat 100% Poudre River water during the high TOC, low alkalinity snowmelt runoff period. This process was successfully demonstrated at full-scale in 2005. However, staff found the process to be extremely labor intensive and subject to upsets. The process also has higher costs associated with high chemical dosages and increased solids handling. Blending high TOC Poudre River water with Horsetooth Reservoir water eliminates these issues and ensures the highest quality of finished water for the City's customers. For these reasons, the current operational preference is to blend high TOC Poudre River water with Horsetooth Reservoir water during the snowmelt runoff period.

Comments on Section 4.2.1: Characterization and Treatability of TOC in the Poudre River

TOC removal and DBP formation both depend on the size, composition, structure, and reactivity of the various organic compounds that make up the TOC in the raw water. The City of Fort Collins has had a long interest in characterizing the TOC present in its source waters. Routine analysis of water samples for TOC concentrations has been conducted by the City of Fort Collins since the early 1990's. A study to characterize the properties of the TOC in raw Horsetooth Reservoir and Poudre River waters was first conducted by the City in 1994 (Carlson, et al, 1994) in order to obtain information to plan for the then upcoming Disinfectants-Disinfection Byproducts Rule. Detailed TOC characterization work was conducted in 2004 (Sharp et al, 2005) on raw Poudre River water samples collected at the FCWTF during the 2004 snowmelt runoff. Note that 2004 was a drought year with a below average snowpack and a peak TOC

concentration of only 7.7 mg/L. It is not known if the hydrophobic fraction of Poudre River snowmelt runoff water changes from year to year with changes in the snowpack and peak TOC concentration. A more comprehensive TOC characterization study of treatment plant influent and effluent and raw waters from the Poudre River, Horsetooth Reservoir, and components of the C-BT system upstream of Horsetooth Reservoir is currently being conducted by researchers at UCLA. The City of Fort Collins, Northern Water, the Tri-Districts, and the City of Greeley are all collaborating on this project. The goal of the project is to establish a baseline database of information that can be used into the future to help optimize water treatment and to consider the impacts of changing water sources and blends. Water samples were collected from November 2007 to November 2008 and lab analysis, data analysis and report preparation is currently being completed. A new study that builds on the 2008 UCLA study is currently being proposed by the City of Fort Collins and the University of Colorado (Boulder) as a Water Research Foundation Tailored Collaboration Project. It is expected that together, the results of both of these studies will provide a significant body of information on TOC sources and fate in our local watersheds and reservoirs, and the potential for this TOC to form disinfection byproducts – all information that can be applied to an improved understanding of the potential impacts of NISP on TOC concentrations and disinfection byproducts at the Fort Collins Water Treatment Facility.

Comments on Section 4.3: Potential Need for Additional TOC Removal at FCWTF Related to NISP

The information presented by the City of Fort Collins in its comments on the DEIS was based on a different set of NISP operational assumptions than that used by B&V in their analysis. The conventional treatment processes used at the FCWTF can remove TOC (at current concentrations and characteristics) to meet the City's regulatory requirements, adopted treatment goals, and customer expectations for both TOC removal and disinfection byproduct (DBP) formation. If the strategic operation of NISP to minimize and control TOC concentrations is successfully implemented, the City recognizes that the added costs to the FCWTF due to NISP may be limited to the additional expenses for higher chemical doses (alum, polymers, carbon dioxide, and lime) plus the cost for increased solids handling due to the corresponding higher solids production. Due to the uncertainties in the DEIS regarding both NISP operational parameters and the evaluation of NISP impacts, the City presented a worse-case scenario in their comments: advanced water treatment (costing up to \$56.3 million in capital costs and \$1.9 million in annual O&M costs) if increased TOC levels in Horsetooth Reservoir due to NISP reached levels where the City's existing conventional treatment processes could not meet existing or future Federal and State safe drinking water regulatory requirements for both TOC removal and DBP Maximum Contaminant Levels (MCLs). It was noted in the City's comments on the DEIS (page 50) that there was not sufficient operational data or modeling information provided in the DEIS to establish the likelihood that advanced treatment would be required.

Conclusion

The above comments are limited to the issues presented in the B&V report and are not intended to express the views of the City of Fort Collins on any other issue raised by the NISP DEIS or the City's comments thereon. The City reserves the right to make additional comments on all issues, including TOC treatment and Glade operation, as additional information becomes available.

References

Carlson, K.H., Elmund, G.K., and Gertig, K.R., 1994. *Getting a Jump on the Information Collection Rule: Plant Scale Characterization of NOM and the relationship to DBP Formation*, Presented at the 1994 AWWA WQTC, San Francisco.

Sharp, E.L., J. Banks, J.A. Billica, K.R. Gertig, R. Henderson, S.A. Parsons, D. Wilson, and B. Jefferson, 2005. *The application of zeta potential measurements for coagulation control: Pilot plant experiences from UK and US waters with elevated organics*. **Water Sci. Technol.: Water Supply**, 5(5):49-56.