Attachment A

CITY OF BOULDER
WATER RESOURCES ADVISORY BOARD INFORMATION ITEM
MEETING DATE: October 17, 2005

AGENDA TITLE: Update on the Boulder Reservoir Source Water Protection and Facility Improvements for the Boulder Reservoir Water Treatment Plant

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FISCAL IMPACT: The 2006-2011 CIP includes $250,000 in 2005 and 2006 and $500,000 in 2007 and 2008 for source water protection. As a place holder, $20 million (bond proceeds) is shown in 2009 for construction of a pipeline from Carter Lake to the Boulder Reservoir Water Treatment Plant (BRWTP).

Also included in the six-year CIP is $400,000 in 2008 for design of the next phase of improvements at the BRWTP, with $3 million for construction in 2009. In addition, $500,000 was included for the design of long-term improvements at the treatment plant in 2011. Funding has not yet been included in the CIP for construction of the long-term improvements.

PURPOSE: This memorandum provides information to the Water Resources Advisory Board on the status of source water protection and facility improvements for the BRWTP.

EXECUTIVE SUMMARY:
Source water protection has become a critical component of providing safe and reliable drinking water due to a greater understanding of the limits of treatment processes in removing contaminants. Most water utilities institute a multiple barrier approach which includes preventing contaminants from entering the water supply, in addition to providing multiple water treatment processes. Increased loading of contaminants in source waters causes a greater potential for contaminants to pass through the treatment facility. Over the past decade, water utilities have increased reliance on source water protection to provide a complete overall prevention and treatment barrier for public health safety.

A Source Water Quality Planning Study – Phase I (Phase I Study) was completed by Black & Veatch Consulting Engineers (B&V) in April 2003 to provide the city with an overview of alternative approaches available to improve and protect the source water quality for the Boulder Reservoir Water Treatment Plant (BRWTP.) Attachment A is the Executive Summary from that study. Recommendations from the Phase I Study included further consideration of the management of Boulder Reservoir and the construction of a pipeline from Carter Lake to the BRWTP. The Phase I study provided an overview of the range of source water alternatives available to the city and evaluated the relative merits of each.

At the same time that the Phase I Study was being developed, a BRWTP Facility Plan was completed by MWH Engineers as part of the Predesign Report for Near-term Improvements. This plan presented near-term, mid-term and long-term improvements for the BRWTP based on upcoming regulatory requirements as well as internal city-established goals. Near-term improvements at the water treatment plant were completed in July 2005.

A second phase of the Source Water Quality study (Phase II Study) will consider the source water protection alternatives proposed for evaluation in the Phase I Study in conjunction with options for enhancing treatment processes in order to meet regulatory requirements and internal city goals.

BACKGROUND:

Source Water

Raw water is primarily delivered to the BRWTP through the Colorado-Big Thompson (CBT) project, which is operated by the Northern Colorado Water Conservancy District (NCWCD). The CBT project diverts water from the Colorado River (western slope) and the Big Thompson River (eastern slope) to be stored and delivered for irrigation and water supplies on the eastern slope of Colorado. The city of Boulder's portion of the CBT project water is delivered from Carter Lake in a 21-mile-long open channel known as the Boulder Feeder Canal (BFC). The BRWTP can either receive water directly from the canal, or canal water can be delivered into Boulder Reservoir and then pumped into the treatment plant. Water is typically delivered in the canal only during the irrigation season, which is usually April through October. Historically, the BRWTP has often operated using water from the BFC in the summer and the Boulder Reservoir in the winter.

Both the canal and the reservoir sources of water have unique challenges. Boulder Reservoir is a low volume, shallow, multi-purpose reservoir. During the summer, the reservoir stratifies, causing a low dissolved oxygen layer near the bottom. This results in the release of soluble manganese from the sediment in the reservoir causing taste, odor and other treatment issues. The water in the reservoir is also high in total dissolved solids including sodium, sulfate and hardness. The turbidity of the water in the reservoir is generally low, but high winds can cause the turbidity to increase significantly over short periods of time. Reservoir water quality is also impacted by recreational uses including swimming and boating. High flows into the reservoir from the BFC help improve the quality of the water by keeping it mixed; however, the city has limited control over the amount of water entering or leaving the reservoir. The reservoir provides dilution, settling and natural processes that break down contaminants before entering the treatment plant.

The BFC is a 21-mile-long open canal. While the quality of water in Carter Lake, where the canal originates, is high, a significant degradation of water quality generally occurs along the length of the canal as a result of surface runoff into the canal. Copper sulfate and herbicides are routinely applied to the canal to control algae and native vegetation. There are 51 outfalls emptying into the canal that drain a variety of adjacent land uses. There are 11 street crossings that provide potential for release of contaminants into the canal.

BRWTP

The BRWTP was built in 1969 with a nominal treatment capacity of 8 million gallons a day. The current treatment process at the BRWTP includes: rapid mix, flocculation, solids removal, filtration and disinfection. Until 1994, the plant had primarily been used as a peaking plant to meet summer water demands. During 1994 it became necessary to operate the facility on a year-round basis to eliminate staffing and maintenance problems, and to maximize use of the city's raw water resources. During 1993 a masonry building was constructed to cover the existing flocculator-clarifier, and a cover was installed over the backwash recovery basin to facilitate winter operations.

In 1995 the existing filter building was modified to house new chemical feed and storage equipment, and two new filters were installed. The new chemical feed and storage equipment was designed for system redundancy and increased storage capacity. The existing chemical building was converted to administrative and laboratory space. During 2001, the existing chlorine gas disinfection system was converted to a Mixed Oxidant System (MIOX) in order to eliminate the use of chlorine gas. The most recent improvements to the facility were completed in July 2005 and addressed “pretreatment” and residuals handling and are described below under BRWTP Facility Plan as “near-term” improvements.

Regulatory Requirements

The Safe Drinking Water Act addresses a wide range of water quality issues including microbial contamination, disinfection byproducts, metals, arsenic, radionuclides as well as biological and chemical contaminants. The United States Environmental Protection Agency (EPA) has focused special attention on reducing the potential for the occurrence of certain microbial pathogens, most importantly Cryptosporidium, because they are resistant to traditional disinfection methods. In recent years, the EPA has issued the Interim Enhanced Surface Treatment Rule (IESWTR) and proposed a new regulation called the Long-term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR)**.** This regulation would require certain public water systems to provide additional treatment for Cryptosporidium by implementing one or more source water protection or treatment options.

The proposed LT2ESWTR requirements for each system are based on the vulnerability of the source water to contamination, as measured by the occurrence of Cryptosporidium. This strategy stems from recognition that only some systems may need to provide additional protection from Cryptosporidium and that such decisions should be made on a system-specific basis. The

regulations specify categories (bins) based on the quality of the source water and corresponding additional source water protection or treatment from a "toolbox" of options. Based on current source water quality data, it appears that the Boulder Reservoir WTP source water falls into a Bin 1 category when pumped directly from Boulder Reservoir, indicating that no further treatment is required from a regulatory perspective. However, water delivered from the BFC exceeds the threshold for Cryptosporidium; therefore, additional source water protection or treatment will be required once the regulation is enacted.

Another important aspect of the proposed LT2ESWTR is promoting a multi-barrier approach for treating drinking water. A multi-barrier treatment process provides a number of protective "layers" against contamination by using more than one method of prevention and treatment to remove/inactivate pathogens and minimize disinfection byproducts (DBPs).

ANALYSIS:

Source Water Quality Phase I Study Results

The Phase I Study evaluated five source water protection alternatives:

- Boulder Reservoir as a year-round terminal reservoir
- Pipeline from Carter Lake to the BRWTP
- Pipeline from Nelson Road to the BRWTP
- New terminal reservoir
- Forebay upstream of the Boulder Reservoir

These alternatives were evaluated based on their predicted water quality, treatability issues, capital cost, operational impacts, water rights impacts, community impacts, impacts on meeting the city's goals and the implementation timeframe. The Phase I Study recommends further evaluation of two alternatives: management of water quality in Boulder Reservoir and full containment of the BFC in a pipeline. The Phase I Study suggests the full time use of Boulder Reservoir as a terminal reservoir and eliminating direct use of water from the canal in order to reduce microbial pathogen risk and gain compliance with the LT2ESWTR. Management strategies were suggested to enhance the source water quality of the reservoir along with physical improvements to reduce the uptake of manganese. Additional studies were also performed by Dr. Bill Lewis that evaluated travel time in the feeder canal, as well as mixing, short circuiting and optimal withdrawal depth from Boulder Reservoir.

In an effort to improve the quality of the water coming from Boulder Reservoir, the city decided to move forward with modifications to the Boulder Reservoir Water Treatment Plant intake structure as recommended by B&V and Dr. Lewis. In order to reduce the turbidity and concentration of manganese in the plant influent, the elevation of the intake structure was raised ten feet from the bottom of the reservoir. This work was completed in March 2005 and cost $235,000. While these improvements reduced the turbidity and concentrations of manganese entering the treatment plant, treating water from the reservoir continues to present challenges to the treatment plant. Fine clay silt sediment, high hardness and alkalinity, and low dissolved oxygen do not allow for optimal coagulation. This has resulted in finished water particle counts

exceeding internal city goals; poor total organic carbon removal which can cause disinfection byproducts; and problems with dirty taste. These problems were exacerbated by warm temperatures typical of the reservoir in the summer. Sodium levels also continue to be high.

BRWTP Facility Plan

The Predesign Report for Near-Term Improvements for the Boulder Reservoir Water Treatment Plant prepared by MWH Engineers in July 2003 included a Facility Plan for the BRWTP. The Facility Plan evaluated improvements to address deficiencies that were identified in the Treated Water Master Plan (Integra Engineering, 2000) as well as in a follow-up study conducted by McGuire Environmental Consultants, Inc. (Assessment of the Boulder Reservoir Water Treatment Plant, 2001). Improvements were categorized into near-term, mid-term and long-term based on upcoming regulatory requirements as well as internal city goals. In addition to addressing treatment deficiencies, it became apparent that the capacity of the facility needed to increase.

The importance of the BRWTP was emphasized during the summer of 2002 when drought conditions restricted raw water availability to the Betasso Water Treatment Plant (WTP). During that period, the BRWTP was treating 12 million gallons per day (MGD) although the facility was designed to treat 8 MGD. Also, in September 2002, an industrial wastewater discharge permit was issued to the BRWTP restricting the daily maximum iron level allowed to be discharged into the sanitary sewer resulting in limits on the capacity and operational flexibility of the facility. The BRWTP Facility Plan recommended that the plant capacity be increased to 16 MGD to be capable of independently meeting the city's winter water demand. The plan also recommended facilities be constructed for on-site handling of the BRWTP treatment residuals so that the water plant could operate without negative effect on the wastewater treatment plant.

The BRWTP Facility Plan recommended the following near-term improvements to the treatment plant:

- replacing the existing flocculator/clarifier with two Dissolved Air Flotation (DAF) thickeners
- installing baffling in the clearwell
- providing increased pumping capacity from the treatment plant
- providing on site treatment residual lagoons

These improvements were completed in July 2005. In addition to enhancing the performance of the treatment plant, the maximum effective capacity of the BRWTP increased from 8.5 million gallons per day (MGD) to 16 MGD. Previous pretreatment processes (rapid mix, flocculation and sedimentation) limited the plant capacity at which treatment standards could reliably be met to 8.5 MGD. Compliance with the Interim Surface Water Treatment Rule for Giardia inactivation was achieved through baffling the clearwell. The residual lagoons were designed to handle a 10 MGD annual average flow. By constructing on-site handling of the water treatment residuals, impacts to the wastewater treatment plant were eliminated and operational flexibility of the BRWTP increased.

Future Source Water Protection Efforts

Staff continues to evaluate source water protection for both the canal and reservoir water sources, as

well as improvements to the treatment plant. The 2006-2011 CIP for Source Water Protection includes the following:

2005	2006	2007	2008	2009
$250,000	$250,000	$500,000	$500,000	$20,000,000

A place holder of $2 million (from bond proceeds) is shown in 2009 for potential construction of a pipeline from Carter Lake to the BRWTP. The $250,000 budgeted in 2005 is anticipated to be spent as follows:

- $100,000-$120,000 for a Carter Lake pipeline feasibility study to be completed by Northern Colorado Water Conservancy District
- $5,000 for buoys around the Boulder Reservoir intake structure
- $65,000-$75,000 for toilet facilities for recreational users north of Boulder Reservoir
- $50,000 for monitoring and rerouting outfalls into the BFC

Status of the Carter Lake Pipeline Project

Several water providers, including the city of Boulder, the town of Erie and the Left Hand Water District, have requested that the NCWCD investigate the possibility of constructing a second water supply pipeline running from Carter Lake to the southern portions of the district. Boulder might participate in the pipeline project to gain a flow capacity of 25 cubic feet per second (cfs) out of what may be up to a 96 cfs pipeline running from Carter Lake through Boulder County.

The pipeline project was initiated in late 2004 with the official request by the water providers that NCWCD take the management lead in developing the project. A consultant has been hired to do a project feasibility study with each project participant paying its pro-rata share of the project costs. The city of Boulder has paid its portion of the feasibility study costs in 2005. The study is expected to be completed by early 2006. The project schedule calls for obtaining any necessary county or federal permits in 2006, obtaining rights-of-way in 2007 and 2008, and constructing the pipeline in 2009 and 2010. Achieving this schedule depends on many variables and the cooperation of several different entities, this schedule may or may not prove to be optimistic.

If Boulder elects to continue participation in the Carter Lake Pipeline project, Boulder will seek sufficient pipeline capacity (25 cfs) to carry the portion of its CBT and Windy Gap Projects water that is delivered directly for treatment at the BRWTP. The remainder of Boulder's CBT and Windy Gap water that is used to drive the exchange of water into Barker Reservoir and the Silver Lake Watershed reservoirs will continue to be carried in the Boulder Feeder Canal. If Boulder continues to participate, it is estimated that Boulder's share of the pipeline project costs following the feasibility study stage could be in the range of $20 million to $30 million.

Future Water Treatment Facility Improvements

In addition to the near-term improvements at the BRWTP, the BRWTP Facility Plan recommends the following mid-term improvements:

- addition of chlorine dioxide
- improved instrumentation
- new raw water pump
- treatment of discharged washwater
- pre-sedimentation
- pH adjustment

These improvements continue to strengthen the reliability of the treatment process in meeting regulatory requirements, as well as internal water quality and quantity goals. Chlorine dioxide will help oxidize organics, thereby reducing disinfection byproducts and reducing taste and odor issues in the treated water. It will also help oxidize manganese and reduce the burden on the mixed oxidant (MIOX) disinfection system which at times has problems meeting chlorine demands. Providing pretreatment of the discharged washwater will help reduce the recycling of contaminants removed in the filtration process. Pre-sedimentation will help remove fine particles and reduce the load to the DAF units. Better pH adjustment will allow improve coagulation.

The 2006-2011 BRWTP CIP includes:

2007	2008	2009	2010	2011
0	$400,000	$3,000,000	0	$500,000

The CIP includes $400,000 for design of the mid-term improvements in 2008, with $3 million for construction in 2009. It also includes $500,000 for the design of long-term improvements in 2011. Funding has not yet been included in the CIP for construction of the long-term improvements to the BRWTP.

The recommended long-term improvements are projected to include:

- New treated water storage tank
- Third DAF unit
- Emergency power
- Granular activated carbon
- UV or membranes

The long-term improvements at the BRWTP are not firmly established at this time. The final combination of long-term improvements will be determined by future regulatory requirements for Cryptosporidium removal/inactivation, the city's internal goals and the feasibility of source water protection improvements. The installation of a third DAF unit and a new treated water storage tank will be driven by a need to increase the capacity of the BRWTP.

Some of the long-term improvements are mutually exclusive. For example, construction of a new UV disinfection system would make a new reservoir for Giardia inactivation unnecessary. The need for ozone, UV or membranes will be driven by the need for additional

Cryptosporidium removal/inactivation required by the LT2ESWTR.

Future Analysis

In order to maintain a multiple barrier approach to drinking water protection and treatment, the city plans to complete a Phase II Water Source Protection study in which the potential long-term improvements to the treatment process can be evaluated in conjunction with the recommendations for source water protection. This approach will identify the most cost-effective means of meeting regulatory requirements and achieving the city's water quality goals prior to large investments in either treatment facilities or the Carter Lake Pipeline.

PUBLIC COMMENT AND PROCESS:

The public process has not been initiated. It is anticipated the pipeline from Carter Lake will be subject to County 1041J review.

ATTACHMENTS:

Attachment A: Source Water Planning Study Phase I Executive Summary (Phase I Study)