

## Bear Creek Watershed Association



**Approved:** November 13, 2013; Revised October 3, 2016

### BCWA Policy 20 – Preferred Management Strategies EGL and BCR

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#### Statement of Basis and Purpose

The Bear Creek Watershed Association (BCWA) maintains a set of preferred management strategies and options to maintain existing water and environmental quality, and protect or enhance water quality in Bear Creek Reservoir and Evergreen Lake.

The Bear Creek Control Regulation (5 CCR 1002-74) requires the Association to develop and maintain a watershed management plan with a stated goal of improving water quality in Bear Creek Watershed. The Control regulation further states:

*The Association shall ensure that water quality monitoring is conducted on Turkey Creek, Bear Creek, and in Bear Creek Reservoir to measure the phosphorus loadings reaching the reservoir and other factors which affect the watershed water quality, as well as the attainment of beneficial uses for the reservoir and watershed.*

If any beneficial uses, standards and classification are **not** being met (as determined by the Association monitoring program) in the watershed, then the Association management process will recommend “fixes” for the problem(s). The Control Regulation has an implied expectation that the Association will determine appropriate strategies and options as part of a long-term management program, and implement such program to assure beneficial uses, standards and classification are met in all surface waters within the defined watershed.

#### BEAR CREEK RESERVOIR

Bear Creek Dam was the last of three dams built to protect the Denver region from floods. This flood-control structure is located on the southwest edge of suburban Lakewood at the confluence of Bear Creek and Turkey Creek. Construction of the dam was authorized in 1968 and was completed in 1982. The reservoir drains an area of approximately 236 square miles. The normal multi-purpose pool measures 110-surface-acres and has a storage capacity of 2,000 acre-feet. The maximum storage capacity is 78,000 ac-ft with maximum surface acres (max. pool) of 718 acres. The authorized purposes of the Bear Creek Dam and Lake Project are flood control, recreation, and fish and wildlife enhancement. The percentages of benefits assigned to the authorized purposes are 92.2 percent for flood control and 7.8 percent for recreation and fish and wildlife enhancement. The Association has a long-term water quality monitoring water program for the reservoir.

#### EVERGREEN LAKE

Evergreen Lake (Segment 1d) is a small reservoir constructed in 1927 and serves as a major direct use water supply for the Evergreen community. The lake is an important year-round recreational facility with fishing and winter ice activities. In recent years, the Association has increased monitoring efforts to better characterize the reservoir and help protect the quality. In last few years, the dissolved oxygen concentrations (DO) in the lake were becoming very low with periodic bottom waters having less than 5 mg/l DO. The Evergreen Metropolitan District in cooperation with the recreation district installed an aeration system near the dam outlet area to help maintain elevated DO levels throughout the lake. The districts in cooperation with the Colorado Department of Parks and Wildlife introduced Grass Carp into the reservoir with the first release of about 100 fish at 20 inches length. This program reduces some of the excess Elodea algal (introduced invasive species) growth that contributes to the depressed DO problem. The combination of the aeration system and grass carp

program resulted in DO compliance in 2012 monitoring program. The Association monitoring program data supports the designation of Evergreen Lake as a direct use water supply.

The Association has some existing operational management strategies for Evergreen Lake and Bear Creek Reservoir. The Association has also identified a set of preferred strategies and options for these waterbodies that have the greatest potential to protect or enhance water quality. The Association is actively considering the preferred options for future implementation.

## **General Management Strategies and Options for Bear Creek Reservoir and Evergreen Lake**

### **EXISTING OPERATIONAL STRATEGIES AND OPTIONS**

1. **Bear Creek Reservoir Control Regulation.** Implementation of Control Regulation (*5 CCR 1002-74*) directed at improving water quality, including standards, classifications, load reductions, wasteload allocations, management strategies, watershed monitoring, nonpoint management. Periodically, review and update as appropriate components of control regulation as an adaptive management process.
2. **Bear Creek Reservoir Flood Control and Water Rights Management.** Pool Level and release controlled by Colorado Department of Natural Resources and the U.S. Army Corps of Engineers.
3. **Bear Creek Reservoir and Evergreen Lake Adaptive Management Plans.** Maintain active adaptive management strategies and process for these waterbodies
4. **Bear Creek Reservoir Master Planning.** Modification to the Army Corps Master Plan (Design Memorandum No. PB – 10, July 2012) and /or Lakewood Park plan to include features such as flood diffusion structures, channelization, shoreline or flood area vegetation reduction, armoring in-flow streams, sediment basins, hypolimnetic withdrawal, and modified outlet structure.
5. **Bear Creek Reservoir Sediment Deposition/ Quality.** Continues sediment analysis program. Expand program to track (annually or bi-annually) sediment deposition and sediment characterization, e.g., total phosphorus content. The U.S. Army Corps of Engineers maintains fixed cross-sections to characterize pool size.
6. **Bear Creek Reservoir and Evergreen Lake Aeration or Oxygen Addition.** Mechanical maintenance of oxygen levels. The Association has a policy on aeration, update modify or expand.
7. **Evergreen Lake Harvesting, Pulling, and Cutting** – Including hydroraking or rotoation that disturbs plants, often with removal of roots to disrupt growth and reduce plants by mechanical means.
8. **Evergreen Lake Biomanipulation** – Facilitation of biological interactions to alter ecosystem processes, such as the introduction of Grass Carp.
9. **Shoreline Management** – The City of Lakewood Bear Creek Regional Parks maintains a park management plan that includes such management options as prescribed burns, invasive species removal and vegetation management. The Evergreen Park & Recreation District maintains recreational uses and includes shoreline and trail management.
10. **Bear Creek Reservoir and Evergreen Lake Rules and Regulations** – Restrictions on human actions directed at minimizing impacts (e.g., boat motor size, trail use, fishing line collection, pet waste removal, controlled stream crossings, etc.)

11. **Bear Creek Reservoir and Evergreen Lake Aquatic Nuisance Species Protection** - Bear Creek Lake Park is involved in Colorado efforts to stop the spread of Aquatic Nuisance Species in Colorado waters. A Watercraft Inspection and Decontamination station is located in the Whitetail parking lot. The Evergreen Park & Recreation District requires a permit for all personal watercraft to be on Evergreen Lake. This is an opportunity to do the zebra mussel or other invasive species inspection at the Lake House prior to launch.

#### **ADDITIONAL STRATEGIES OR OPTIONS FOR FUTURE IMPLEMENTATION**

1. **Reservoir and Lake Aeration System Upgrades.** Maintain enhanced or upgraded artificial aeration systems to support dissolved oxygen standards. Changes to aerations systems to improve efficiency.
2. **Reservoir and Lake Sediment Deposition.** Establish expanded programs to track (annually or bi-annually) sediment deposition and sediment characterization, e.g., total phosphorus content. Establish fixed cross-sections and sample points.
3. **Evergreen Lake Direct Use Water Supply Regulation** – Modify standards, classifications, load reductions, WLA, management strategies and implementation of sub-basin source water protection programs.
4. **Reservoir and Lake Nutrient Inactivation** – chemical addition and precipitation of nutrients, mainly Phosphorus, but can also target nitrogen. Includes PhosLock concept, alum treatment and Bio-domes.
5. **Reservoir and Lake Biomanipulation** – Facilitation of biological interactions to alter ecosystem processes. Physical obstruction of rooted plant growth.
6. **Reservoir and Lake Artificial Circulation.** Water movement to enhance mixing and/or prevent stratification.
7. **Bear Creek Reservoir Partitioning for Pollutant Capture.** Creation of in-lake or in-Park areas, such as forebays and wetlands, to capture incoming pollutants.
8. **Reservoir and Lake Dredging.** Removal of sediment under water or dry conditions.
9. **Reservoir Bottom Sealing.** Reduced nutrient exchange at the sediment water interface. Evaluate sealant processes or nutrient reduction operations, this includes SePRO PhosLock process, Alum treatment and or Bio-Domes.
10. **Reservoir and Lake Chemical Sediment Treatment** – Addition of compounds that alter sediment features to limit growth or control chemical exchange reactions.
11. **Reservoir and Lake Education Program** – The Association has several educational programs designed to increase awareness on reservoir quality and factors that impair the quality.
12. **Climate Modeling and Implementation Strategies.** Additional climate modeling to predict reservoir and lake alterations.

#### **Policy Positions**

The BCWA supports as a long-term and necessary water quality management practice a set of operational and preferred management strategies and options to maintain existing water and environmental quality, and protect or enhance water quality in Bear Creek Reservoir and Evergreen Lake.

***Bear Creek Watershed Association  
35-years of Watershed Management***

1. The Association will periodically review all operational reservoir strategies and options for necessary updates based on results from the ongoing water quality monitoring program as an adaptive management process.
2. The Association will continue ongoing evaluation of the preferred strategies and options for future implementation. Water quality studies and data characterizations will be used in this evaluation process.
3. Since nutrient loading from reservoir sediments has been determined to be a significant concern, the Association will determine appropriate strategies or options to address this problem by January 2018.