City of Austin
WATERSHED PROTECTION

M E M O R A N D U M

TO: Austin Water Resources Planning Task Force

FROM: Chris Herrington, P.E., Manager
Water Resource Evaluation Section
City of Austin Watershed Protection Department

DATE: June 10, 2014

SUBJECT: Some Environmental Implications of Proposed Alternative Water Supply Augmentation Options

Staff of the City of Austin Watershed Protection Department (WPD) reviewed the proposed alternative water supply augmentation options presented to the Austin Water Resources Planning Task Force ("Task Force") on May 19, 2014. This memorandum qualitatively summarizes some potential environmental impacts of the proposed options pertinent to the water quality protection mission of WPD for consideration by the Task Force.

WPD recognizes the absolute need for Austin to provide adequate water supply security, but consideration of potential environmental impacts of supply augmentation options is necessary for comprehensive future planning. WPD similarly recognizes that in times of extreme drought, reliance on some strategies that may be less preferred relative to the mission of WPD may be necessary to provide adequate water security for Austin. Additionally, some strategies that are preferential relative to the mission of WPD may not meet short-term emergency needs.

Some important facts about the existing conditions of regional water resources that were considered by WPD in evaluating the supply options are presented for the benefit of the Task Force. Supply options for which WPD could reasonably predict potential environmental implications are ranked qualitatively as being most preferred, preferred, neutral, less preferred, or not preferred solely relative to the water quality protection mission of the WPD.

Given the planning level of detail for the supply augmentation options, there is a high degree of uncertainty in predicting the potential environmental impacts of some options. Estimates of the implications of the supply options are derived from City of Austin Watershed Protection Department publications, available via the web at http://www.austintexas.gov/watershed_protection/publications/default.cfm, in combination with scientific literature and the decades of professional local experience of WPD biologists, geologists and engineers. Because of the uncertainty associated with this planning level of detail, additional studies in some cases are necessary to evaluate the feasibility and full range of potential environmental impacts of some options.

Overall, water supply augmentation strategies relying on the various forms of conservation and strategies involving improved stormwater and land use management are completely consistent with the mission of the WPD. These strategies would have many positive environmental benefits in addition to further implementing multiple priority programs of the Imagine Austin Comprehensive Plan.

WPD staff remain available to provide additional information relative to our water quality protection mission as needed. Please contact me at (512) 974-2840 or via email at Chris.Herrington@AustinTexas.Gov.

Background Considerations:

1. The frequency and severity of planktonic (floating) blue-green algae blooms in Lady Bird Lake and Lake Austin are increasing over time (figure 1). The frequency and severity of depressed dissolved oxygen harmful to aquatic life in the downstream portions of Lady Bird Lake (known as the Basin) are increasing over time. Increases in algae blooms and shifts in planktonic algae community composition towards an increase in blue-green algae indicate eutrophication of these reservoirs as a result of excessive nutrient addition. The reduction of releases from the Highland Lakes during summer months as a result of emergency orders issued by the Texas Commission on Environmental Quality modifying the Lower Colorado River Authority (LCRA) Water Management Plan contributes to the increased observation of these effects. Despite these degrading temporal trends, Lotic Ecosystem Trophic Status Index values derived from Matlock Periphytometers indicate that Lady Bird Lake is not yet at maximum productivity, such that additional nutrients input to the lake would continue to increase phytoplankton growth.

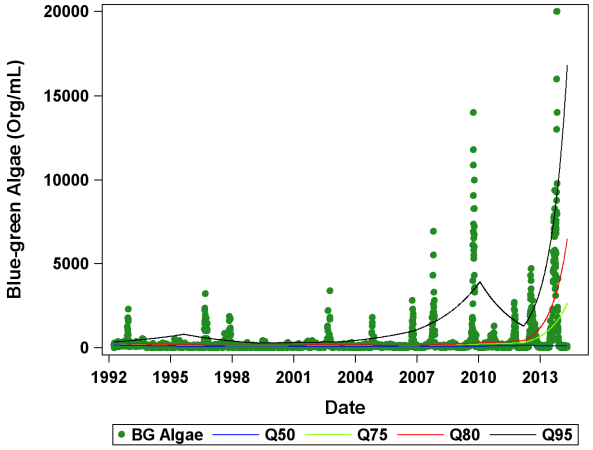

Figure 1: Blue-green algae counts from the Davis Water Treatment Plant on Lake Austin with the median (Q50), 75th percentile (Q75), 80th percentile (Q80), and 95th percentile (Q95) piecewise regressions using six breakpoints.

2. Reclaimed water has significantly higher concentrations of nutrients than ambient streams and reservoirs in Austin (figure 2). WPD fully supports the recycling use of reclaimed water and graywater to offset demand on freshwater supply. WPD supports outdoor irrigation with recycled wastewater as long as sufficient buffers from surface waters and groundwater recharge features are used. Discharge of reclaimed water to Austin's reservoirs or small streams will have significant negative impacts on algal and aquatic plant growth.

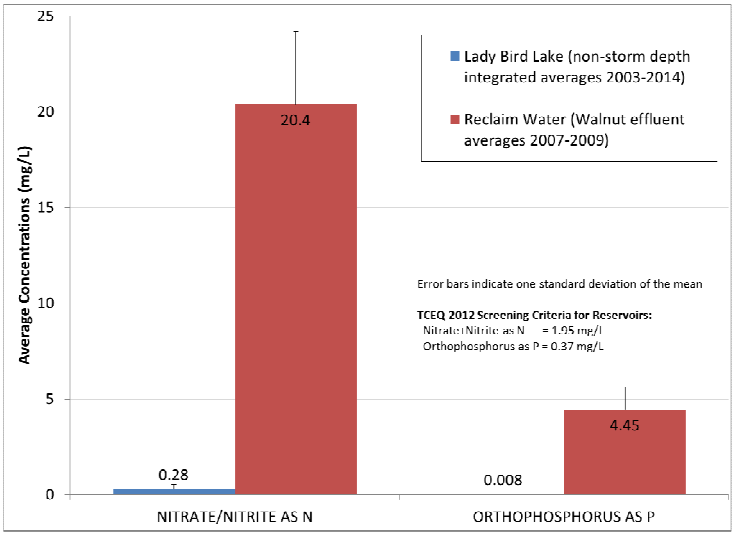

Figure 2: Lady Bird Lake average nutrient concentrations versus Austin reclaimed water for nitrate plus nitrate as nitrogen and orthophosphorus as phosphorus.

3. Invasive exotic aquatic plants like *Hydrilla* negatively impact recreational use and aquatic ecosystem integrity of Lake Austin and Lady Bird Lake currently. Excessive growth of both native (e.g., *Cabomba*) and invasive aquatic plants increases with reduced flows through these reservoirs and corresponding increased water temperature.

4. Levels of dissolved oxygen in the Colorado River downstream of Austin do not meet the Texas Commission on Environmental Quality aquatic life use standards at some locations based on City of Austin data. Reduction in flow in the river during warm summer months would exacerbate these impairments.

5. As a result of the current release practice of water from Lake Austin into Lady Bird Lake and then release to the Colorado River, water surface elevations in the river downstream of Longhorn Dam fluctuate on average 2.5 feet daily. These large daily fluctuations in wetted area have negative impacts on aquatic ecosystems, especially freshwater mussels (*Unionidae*), sediment resuspension, and communication with alluvial aquifers.

6. The Barton Springs Edwards Aquifer Conservation District (BSEACD) manages the groundwater resources via regulation of groundwater withdrawal within its jurisdiction including the Edwards Aquifer. The Edwards Aquifer and its primary discharge point, the Barton Springs Complex, are the source of habitat for the federally endangered Barton Springs (*Eurycea sosorum*) and Austin Blind (*Eurycea waterlooensis*) salamander species. During a recurrence of the drought of record, the current Desired Future Conditions (DFC) of the aquifer established by BSEACD is predicted to maintain discharge at Barton Springs of 6.5 ft^3/s. Barton Springs discharge as low as 6.5 ft^3/s would have severe negative consequences for the protected salamander species. Total authorized withdrawals from the aquifer under these conditions would be 5.2 ft^3/s on an average annual basis.

Evaluation of Water Supply Options:

Options with beneficial or limited adverse water quality impacts

1. **Stormwater Management and Land Use Incentives/Programs (MOST PREFERRED):** Incentivizing or requiring "green" stormwater management provides a wide variety of beneficial enhancements to water supply augmentation, water quality improvement, flood reduction, and erosion prevention. These strategies directly align with the missions of the WPD and multiple

Priority Programs of the Imagine Austin Comprehensive Plan. For more information, see written response from Matt Hollon, WPD Policy and Planning Division.

2. **Leak Detection (MOST PREFERRED):** Chlorinated potable water has multiple adverse and toxic impacts on freshwater aquatic ecosystems. Leak detection and correction improves water quality and conserves potable water supplies.
3. **Conservation, also including Direct Reuse, Gray Water Use, Smart Meter implementation, Code modifications, Decentralization, Entering into Drought Stages Earlier, Public Education (MOST PREFERRED):** Conservation strategies reduce water demand maintaining freshwater reservoirs longer, reducing wastewater volumes to be treated and discharged, and maintaining environmental flows. Gray water (not including outdoor irrigation) and direct reuse may increase the strength of wastewater to be treated and subsequent concentration of dissolved solids in the eventual wastewater discharge, although these impacts are anticipated to be minimal relative to other benefits. Decentralized and gray water strategies additionally could reduce energy demands for pumping, and reduce leakage of wastewater to Austin creeks. Widespread use of reclaim water would reduce environmental instream flows in the Colorado River as a result of reduced wastewater discharge. Outdoor irrigation via a decentralized management approach or gray water use would be beneficial as long as appropriate buffers were used to keep high nutrient wastewater away from riparian areas and sensitive groundwater recharge features. Entering into drought stages earlier with associated curtailments on outdoor irrigation could have negative impacts on the long-term maintenance of urban canopy although the resiliency of urban landscapes to drought can be improved with enhanced "green" stormwater management, more regionally appropriate landscape design and more sustainable land use planning.
4. **Barton Springs Flow Augmentation (MOST PREFERRED):** Retirement of pumping rights to the Edwards Aquifer would provide significant benefits to endangered species that rely on spring flows during critical drought periods. This strategy would help to address the gap between the current desired future conditions for the aquifer and the current pumping permitted by the Barton Springs Edwards Aquifer Conservation District. This strategy directly aligns with a goal of the WPD to maintain or enhance the quality and quantity of water in the Edwards Aquifer. This strategy is unlikely to generate a large volume of water as the total amount of pumping of the Edwards authorized during a recurrence of the drought of record is only 5.2 ft^3/s. Benefits to the Edwards Aquifer and the endangered salamanders, though substantial, would come at the cost of impacts to freshwater ecosystems via reduced instream flow in the Colorado River. This strategy could enhance growth in Hays County, although this growth could be directed along the IH-35 corridor and off of the Barton Springs Edwards Aquifer recharge zone.
5. **Rainwater Harvesting (MOST PREFERRED):** Promotion of rainwater harvesting is a specific management measure included in the 2005 Barton Springs Zone Regional Water Quality Protection Plan. Widespread use of rainwater harvesting would reduce storm water runoff and non-point source pollution consistent with the mission of the WPD without adverse impacts to stream baseflow. Rainwater is of a chemical composition that is better than potable water for outdoor irrigation, and because it is captured locally requires substantially less energy to move or treat. Rainwater harvesting has been used with success on a large scale in Australia under highly variable climatic conditions. The Texas Water Development Board (TWDB) reports that in the Austin area assuming an average annual rainfall of 33 inches and 80% efficiency of the harvesting system, approximately 33,000 gallons of rainwater annually could be collected from every 2,000 ft^2 of roof area. From a water supply perspective, this strategy would realistically need to be implemented over a mid- to long-range planning period to yield substantial supply augmentation.
6. **Longhorn Dam modifications and automation (PREFERRED)**: The proposed improvements to Longhorn Dam would stabilize the daily fluctuations of water surface elevations in the Colorado River, lessening current adverse impacts to aquatic life including freshwater mussels as well as littoral and riparian zone habitats. Depending on the variable timing of releases from Tom Miller Dam and subsequent flow-dependent lag in travel time through Lady Bird Lake, the impact of the Longhorn Dam improvements on dissolved oxygen in the river is difficult to predict but is not anticipated to exacerbate existing depressed dissolved oxygen conditions in the

river. Additionally, dam operation improvements would improve floodwater management functions.

7. **Lake level fluctuations (Walter E. Long Lake Off Channel Storage, Lake Austin Varying Operating Level) (PREFERRED):** Assuming that drawdown of lakes occur over a slow period of time, allowing area lake levels to vary seasonally would more closely mimic natural riverine conditions. Having lakes drawdown during drought might increase public awareness of the severity of climatic conditions and promote conservation. Lakes are drawdown under some winter conditions currently to kill invasive aquatic plants (e.g., *Hydrilla*). This slow fluctuation is very different from the large daily fluctuations that occur in the Colorado River downstream of Austin as a result of current release practices through Longhorn Dam. This strategy would maintain environmental flows during critical low flow periods by shifting some volume of releases away from flood events to baseflow periods. Although there likely would be some negative impacts in the lakes from this strategy to littoral nursery habitats, water temperatures, and freshwater mussel (*Unionidae*), these negative impacts would be minimized by slow drawdown of lakes. There would be adverse impacts to recreation as a result of this strategy.
8. **Capture Local Inflows to Lady Bird Lake (NEUTRAL):** The full range of impacts of this strategy are somewhat uncertain. Some loss of environmental flows in the Colorado River during storm events would occur, although estimating the degree of impact on the Colorado River or the estuaries and bay would require further analysis.
9. **SAR discharge relocation above the Austin gauge (NEUTRAL):** Oxygenated wastewater effluent could improve depressed dissolved oxygen concentrations in the river downstream of Longhorn Dam and upstream of the Walnut Creek Wastewater Treatment Plant discharge outfall. Wastewater effluent contains excess nutrients that increase the growth of algae as well as human personal care and pharmaceutical products that adversely impact aquatic life. Although this strategy would increase the spatial extent of Austin's wastewater impact on the Colorado River, the magnitude of the spatial increase is relatively limited. Water quality improvements as a result of this strategy would need to be balanced against additional power required for pumping.
10. **Reclaimed water bank infiltration (NEUTRAL, potentially beneficial):** The full impacts of this strategy are not immediately evident, although this strategy could further enhance treatment and nutrient removal of wastewater. Underground storage could reduce evaporative losses. Locations would have to carefully selected to avoid intercepting alluvial aquifer areas that are currently very high in nitrate in excess of drinking water standards or altering groundwater flow gradients to the extent that the flux of this high nitrate to the Colorado River or to local wells of concern is not adversely impacted..
11. **Lake Long Enhanced Storage (NEUTRAL, potentially beneficial):** Generally, this strategy would increase nutrient addition to Lake Long as effluent would no longer be diluted by Colorado River water before entering the lake. Lake Long is currently eutrophic and potentially near maximum primary productivity growth rates (Lotic Ecosystem Trophic Status Index near 1 based on limited Matlock Periphytometer data), so the negative impact on phytoplankton could be limited if algae are growing at maximum rates currently. Additional phytoplankton growth bioassays would be needed to evaluate the potential impacts on Lake Long algae. This strategy could benefit environmental flows in the Colorado River.
12. **Colorado River Bed and Banks (NEUTRAL):** This strategy could maintain environmental flows in the Colorado River downstream of Austin. Recirculation could increase dissolved solids in the eventual discharge although the degree of concentration and thus potential environmental impact is not known.

<u>Options with Potential Negative Water Quality Impacts:</u>

1. **Indirect Potable Reuse-SAR to Lady Bird Lake (NOT PREFERRED):** Additional nutrient impacts to Lady Bird Lake would significantly exacerbate current eutrophication trends, nuisance aquatic macrophyte blooms and depressed dissolved oxygen conditions. This would be contrary to extensive and long-term efforts by the WPD to reduce nutrient loading to this reservoir. Human personal care and pharmaceutical product adverse impacts to aquatic organisms from extended exposure to treated wastewater are well-documented, even locally. Although Lady Bird

Lake is not included in the Highland Lakes wastewater discharge ban (Title 30 Texas Administrative Code Chapter 311), City of Austin wastewater discharge to Lady Bird Lake could be construed as being contrary to continued City of Austin support of this important water quality protection.

2. **Aquifer Storage and Recovery-Northern Edwards (NOT PREFERRED):** This strategy directly conflicts with the goal of the WPD to maintain or enhance the quality of water recharging the aquifer. Nutrient content in reclaim water is significantly higher than current ambient conditions in the aquifer. There is a strong potential for negative impacts to local wells as a result of large-scale pumping. Environmental impacts associated with this strategy would largely be imposed outside of Austin's jurisdiction. This strategy has significant energy costs.
3. **Reduced Lake Evaporation (LESS PREFERRED):** Existing reviews of evaporation suppression identify multiple water quality concerns including increased water temperature that can reduce oxygen solubility and increase phytoplankton growth, environmental impacts of the breakdown constituents of the applied product, and increases in the carbon dioxide and reductions in dissolved oxygen as a result of reduce gas exchange across the air-water interface. Some studies documenting the effectiveness of monolayer products without adverse environmental impacts were conducted over short time periods (e.g., 3 weeks). Increased water temperatures similarly increase water evaporation as aquatic systems seek a new equilibrium in response to changes in the balance of energy inputs and losses. Longer term studies are necessary to more fully evaluate the benefits and impacts of evaporation suppression by chemical methods.
4. **Blue Water Systems, Forestar, Vista Ridge (LESS PREFERRED):** The pumping limits allowed by groundwater conservation districts (GCD) can be largely political decisions dependent on the preferences of the district board members. Although some GCD like the Barton Springs Edwards Aquifer Conservation District do strongly emphasize environmental endpoint protection in the establishment and management of the Desired Future Conditions (DFC) for aquifers, some GCD may not consider these environmental impacts adequately and permit withdrawal in excess of the modeled available groundwater. Excess withdrawals from the Carrizo-Wilcox and Simsboro aquifers would have severe negative impacts to local wells and creeks in eastern Texas counties. These contracts are generally long-term and very expensive, but only needed for short-term drought periods. Additionally, this would establish a new paradigm of private ownership for Austin's public water supply sources.
5. **Hays-Caldwell PUA (UNCERTAIN)**: Although WPD has strong reservations about the importation of groundwater (see below), this strategy could create supply redundancy and add infrastructure along the IH-35 corridor that could be used to help reduce reliance on the freshwater Barton Springs Segment of the Edwards Aquifer as a water supply.
6. **Trinity Aquifer pumping (NEUTRAL, potentially less preferred):** The extent and mechanisms of hydraulic connectivity between the Edwards Aquifer and the Trinity Aquifer continues to studied by hydrogeologists. Additional pumping of the Trinity Aquifer would have negative impacts to local supply wells and creeks with Trinity springs. Withdrawal from the Trinity would negatively impact transient water in the Trinity potentially reducing Trinity water inputs to the freshwater Edwards Aquifer, although the extent and timing of the impact is uncertain.
7. **Brackish Edwards Desalinization (NEUTURAL, potentially less preferred):** Interest in this strategy should be explored further by cooperating with the pilot studies being implemented by the Barton Springs Edwards Aquifer Conservation District. Large-scale withdrawal from the saline Edwards could result in pressure head changes that could adversely impact the freshwater Edwards Aquifer. This negative impact would occur under critical drought conditions when endangered salamander species are most in jeopardy. Although there are strong correlations between pumping and spring discharge in the freshwater Edwards, head loss patterns in response to pumping in the saline zone are not well understood. Waste brine disposal is an addition environmental consideration. Desalinization of other more remote aquifers would be less preferred (see #4).