MANAGEMENT PLAN
FOR
LAKE WHITNEY WATER TREATMENT PLANT

Revised April 2, 2012

The purpose of this management plan is to provide a set of operating and monitoring guidelines for the Regional Water Authority to protect the environmental quality of Lake Whitney and the downstream corridor, and to avoid unacceptable adverse impacts on the ecology and aesthetics of the area. Periodic updates to the management plan as warranted by additional information, or by changes in environmental goals for these resources, will be done in consultation with the City of New Haven and the Town of Hamden.

Recommended Performance Standard (from *Lake Whitney Water Treatment Plant Environmental Evaluation, January, 1999)*	**Mitigating/Monitoring Measure**
1) Minimum Spillway Flow - Maintain Flow over the Spillway to help protect downstream environment - Goal of at least +0.1 foot lake level when operationally feasible	1) Employ General Operating Guidelines a) Operate proposed Whitney WTP to work in concert with environmental goals and objectives as specified in the *Lake Whitney Water Treatment Plant Environmental Evaluation, January, 1999*, as supplemented by Performance Standards here established. Maintain flow over spillway as described below in accordance with minimum flow performance standards established through the results of the November 2003 RWA study of dissolved oxygen concentrations in the "critical reach" of the Mill River from the Whitney Dam to the Orange Street Bridge ("The dissolved oxygen study"). b) When lake level of Whitney is +0.2 feet or greater, operate plant as needed (in 3 to 15 mgd range). A lake level of +0.2 feet represents a spillway flow of approximately 40 MGD. c) When lake level is between +0.2 feet and +0.1 feet, minimize plant flow (3 to 5 MGD *except as needed operationally as noted below*) whenever Total System Storage **equals or exceeds** the current monthly long-term average, i.e., the monthly normal Total System Storage as noted in the Authority's Water Supply Plan. This will mitigate the impact on bass spawning in Lake Whitney during late May and June, and spring spawning runs of anadromous fish in the lower Mill River. d) When Total System Storage **is less than** the current monthly long-term average, operate plant as needed (in 3 to 15 MGD range) provided lake level of Whitney is greater than +0.1 foot. A lake level of +0.1 feet represents a spillway flow of approximately 13 MGD. e) When lake level is +0.1 feet or less, minimize plant flow (3-5 MGD) except as needed operationally, such as for: i) Days when total system demand is expected to exceed 130 percent

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	of annual average day demand. This will endeavor to maintain an equitable balance of the Authority's other water system environments, and balance the load placed on other treatment facilities, thereby improving water quality to the distribution system. ii) Fire protection. iii) Drought, as defined by the Authority's Drought Response Plan, included in the Water Supply Plan. iv) Water system emergencies, such as critical component failures as listed in the RWA Water Supply Plan. v) Provision of supplemental supply when other supplies or facilities are temporarily out of service. vi) During Whitney dam maintenance activities, when surplus inflow is available. f) When lake level is at spillway elevation, prepare to follow minimum flow release procedures in Mitigation/Monitoring Measure No. 2 below.
2) Minimum Flow Releases - Release median August flow of 0.2 CFS per square mile or 4.5 MGD in Mill River below the dam. - In winter release 9 MGD - During fish spawning season (April – mid-May) release 36 MGD. - To ensure channel scouring and spring inundation of the high marsh along the Mill River, the "mean March inflow" for Lake Whitney should be released for at least 2 days between February 15 and March 15. Release should be equivalent to 101 MGD, but in years when the natural inflow for the period drops below this level, the flood release would be reduced accordingly.	2) Minimum Release Procedures (subject to the results of the 11/30/03 oxygenation study in Section 3). The following schedule of releases takes into account a balance between the downstream and upstream environments and may be adjusted subject to new information. Flow releases listed below are in addition to the estimated 0.3 MGD flow from dam leakage. a) When lake level falls below spillway level, flows to be released from lake Whitney storage are as follows: i. Lake level from spillway elevation to ≤1ft below spillway = 4.2 MGD ii. Lake level >1 ft and ≤2 ft below spillway = 3.2 MGD iii. Lake Whitney >2 ft and ≤3 ft below spillway = 2.2 MGD iv. Lake Whitney >3 ft and ≤4 ft below spillway = 1.2 MGD v. Lake Whitney >4 feet below spillway = 0 MGD b) Releases from storage will be metered. c) Releases will be either surface water released downstream via an "artificial waterfall" over the dam and/or water from the current intake depth. The intake is above the thermocline and thus in either case releases will not be anoxic hypolimnetic water. d) Recommended flows for winter and spring are normally far exceeded naturally. If this does not occur, maintain flows in accordance with the minimum release procedures in item 2a above. This is because years

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	when winter and spring flows of 9 and 36 MGD are not met would likely be during severe droughts, whereby releases of this magnitude would be detrimental to ensuring adequate water for both water supply and the environment. e) For meeting the "mean March inflow" open the Whitney blow-off as necessary for 2 days between February 15 and March 15. Flow when the blow-off is fully open equals approximately 100 MGD. During years when flood flows are met naturally by spillway overflow between February 15 and March 15, use of the blow-off will not be necessary. During years when natural inflow is less than 100 MGD for this period, reduce the release accordingly.
3) Dissolved Oxygen - Maintain adequate aquatic habitat and prevent fish kills during low-flow conditions. Dissolved oxygen concentrations in plunge pool below dam should be at least 5 mg/l at all times.	3) Dissolved Oxygen Procedure Maintain at least 5 mg/l dissolved oxygen (DO) at all times in the plunge pool below the dam. The target DO for downstream releases when the lake level is below spillway elevation, as established in the November 2003 DO study, is 7 mg/L. It is expected under most circumstances that this will result in a surface water DO concentration above 5 mg/L at the Orange Street Bridge during dry weather conditions, although surface water DO concentrations less than this have been occasionally observed absent of water withdrawals. It may be necessary to make allowances to this target value when the DO in Lake Whitney is below 7 mg/L, since RWA has no control over low DO events in Lake Whitney. Over the study period that began in 1998, the EST has gradually narrowed its monitoring efforts to focus on the stretch of river between Lake Whitney dam and the East Rock Park footbridge, where potential impacts from water withdrawals are more likely to be detected. Further downstream, other factors, including tidal influence and stormwater quality, increase in relative importance in comparison to freshwater flows from Lake Whitney. Monitoring has shown that minimum DO concentrations within the dam to the Orange Street bridge reach of the river generally occur in the vicinity of the footbridge station, likely due to its wider and shallower channel configuration. a) Maintaining DO in the plunge pool will help maintain DO downstream. DO concentrations at the Orange Street Bridge should be maintained to a level equal or better than existing conditions provided that the City of New Haven maintains the water quality, e.g., biochemical oxygen demand and total suspended solids, of Combined Sewer Overflows and stormwater discharges at a level equal to or better than existing conditions.

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	b) Use of the artificial waterfall for all or a portion of minimum flow releases (as noted in Mitigating Measure No. 2 above) will aid in aerating water from Lake Whitney. Bypass waterfall – when not feasible (such as in freezing weather conditions or equipment failure). c) During rare extreme drought conditions alternative means of aerating the plunge pool, such as direct injection of air, will be considered as warranted to maintain acceptable DO concentrations. d) Conduct early-morning monitoring of river dissolved oxygen (DO) at the spillway, plunge pool and the East Rock Park footbridge when there is no natural flow going over the spillway, at least weekly from May through October and monthly for all other months, except when the lack of spillway flow is due to excess flow being released downstream through the blow-off to facilitate lake drawdown for dam maintenance, construction projects, or other reasons. e) DO monitoring conducted from 1998-2011 determined that the vast majority of surface DO concentrations at the East Rock Park footbridge station are > 5 mg/L when spillway flows equal or exceed 40 MGD, except during certain infrequent natural summer peak flow patterns unrelated to water withdrawals. For purposes of this section, a spillway flow rate of 40 MGD equates to a lake level of 0.20 feet above spillway elevation. Beginning in 2012, weekly early- morning monitoring of DO during July and August will be conducted at the Whitney spillway, plunge pool and East Rock Park footbridge only when the prior 14 day median flow, as determined weekly, is less than 40 MGD. No weekly measurement will be required when the 14 day median flow described above is greater than or equal to 40 MGD.
<u>4) Vegetation Monitoring</u> - Quantitative sampling of the fresh water tidal marsh community should be conducted on an annual or biennial basis prior to construction of the plant and continue after the plant is in operation.	<u>4) Vegetation Monitoring Program</u> a) Vegetation in two freshwater tidal marsh transects were quantitatively surveyed once in 1998 and annually from 2000-2011, in addition to various field evaluations of the marsh dating back to the 1980s. No trends attributable to water withdrawals in the patterns of vegetation coverage at the two downstream Mill River freshwater tidal marsh transects were evident. Given the magnitude of natural river flows and potential RWA water withdrawals as restricted by state law and the RWA's Management Plan, there is no evidence or indication that the RWA operation will

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	measurably impact the hydrology, chemistry, and biology of the marsh system. Based on these conclusions, annual vegetation surveys will be discontinued beginning in 2012. b) Soil water salinities were monitored in the freshwater tidal marsh transects identified in the 1999 Study team report from 2000-2011. Groundwater salinities monitored under a wide range of flow conditions occurred in a fairly narrow range and are indicative of salinities favorable for maintaining a freshwater tidal marsh. The EST concluded from the data that the timing and magnitude of water withdrawals under the Management Plan are not likely to measurably impact soil salinity, nor are they likely to impact the marshes' ability to sustain vegetation typical of a freshwater tidal marsh. Based on these conclusions, soil salinity monitoring will be discontinued beginning in 2012.
5) Aquatic Habitat Monitoring - Monitoring of aquatic organisms and habitat conditions including dissolved oxygen, flow and water levels, should be repeated at least biennially before and after plant operation begins. - Adequate flow should be maintained to allow fish passage between the plunge pool and downstream areas. - Monitoring should include evaluating whether alewife are actually spawning in the plunge pool, and specific measures such as channel modifications to permit movement of fish in and out of the plunge pool should be implemented if necessary. -	5) Aquatic Habitat Monitoring Program a) Aquatic habitat conditions and benthic aquatic invertebrates in the Mill River were surveyed in 1998 and either semiannually or annually from 2000-2011, The macroinvertebrate population in the lower Mill River, while thriving and fairly diverse, is typical of an urban river and is not particularly sensitive to water quality perturbations. To date, no relationships have been found in the monitoring data between macroinvertebrate metrics and river flow. Given the Management Plan measures designed to minimize prolonged periods of low stream flow, there is no evidence or indication that the RWA's future water withdrawals from Lake Whitney will cause detectable changes to the macroinvertebrate population outside of natural variability. Beginning in 2012, aquatic habitat and macroinvertebrate monitoring will only be conducted in August of the calendar year following the occurrence of a significant summer low flow event that occurred while the WTP was in a generally continuous operational mode. This is intended to enhance our current body of knowledge which thus far suggests that the macroinvertebrate community present is resilient enough to recover from such events. The occurrence of a significant low flow event will be determined by the EST based on data and observations that suggest the aquatic community was under atypical stress, including but not limited to unusually low summer stream flows due to cutbacks in downstream releases, and/or unusually low summer dissolved oxygen concentrations. b) Fisheries biologists from the Connecticut Department of Energy and Environmental Protection (DEEP) have confirmed that anadromous alewife migrate to the plunge pool during the spawning season. The DEEP

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	continues to monitor this migration as part of their coastal river herring monitoring program. It is expected that the natural hydrology of the Mill River system coupled with the flow performance standards above will allow adequate access to the plunge pool for anadromous fish during the spring spawning season. DEEP fisheries biologists have also determined that the morphology of the stream channel is adequate for alewife to move between the plunge pool and downstream areas, Should these conditions in the vicinity of the plunge pool change and alewife movement becomes impeded, channel modifications will be considered at this location and, if warranted, implemented in consultation with the DEEP subject to any required state, local, or federal agency approvals. Another species that migrates to the base of the Lake Whitney dam is the catadromous American eel. In consultation with DEEP fisheries biologists, the RWA constructed a permanent facility, referred to as an eel pass, near the base of the dam in 2005. The eel pass attracts and collects immature eels, which were spawned in the Sargasso Sea and transported to coastal streams. These eels are then manually released into the Mill River system above the dam, where they live until they emigrate and return to the Sargasso Sea to spawn. The DEEP is responsible for the operation, monitoring and minor maintenance of the eel pass. The DEEP and the RWA will periodically review the need for major repairs or major corrective actions to ensure the continued effectiveness of the eel pass. Such major repairs or major corrective actions will be the responsibility of the RWA, provided both parties agree that they are necessary and prudent.
6) Aesthetics - Preserve waterfall aesthetics to the extent feasible. - Consideration should be to providing a scenic flow through artificial means such as making downstream releases through a perforated pipe concealed under the lip of the dam.	6) Artificial Waterfall a) Operate an artificial waterfall to be used when lake level falls below spillway level that will improve the enjoyment of the area downstream of the dam by sight and sound. b) By-pass artificial waterfall during freezing conditions, such that minimum releases go directly into plunge pool below dam.
7) Lake Whitney Draw Down Management - Draw downs during May and June should be limited to one foot below spillway.	7) Draw Down Plan a) Draw down will generally be limited to one foot or less during May and June, given the General Operating Guidelines discussed under item no. 1.

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8) Lake Whitney Water Quality - Study the environmental consequences to overall habitat conditions from dredging the upper basin of Lake Whitney. - Avoid the use of copper sulfate in Lake Whitney.	8) Lake Whitney Water Quality Plan a) The Authority commissioned a comprehensive management study of the upper basin (report dated January 2002) that recommended watershed management as the preferred alternative for controlling sedimentation. It was concluded that dredging would not significantly benefit water quality and would adversely impact unique shallow water bird habitat. The Authority is proceeding with design and implementation of measures to control sediment inputs from the Lake Whitney watershed. Existing source water protection programs, e.g., site plan review, watershed inspections, spill response, etc., are continuing. The following action items recommended by the report are hereby incorporated into this Management Plan: i) implement watershed management measures to control sediment inputs to Lake Whitney; ii) use Lake Whitney and the Northern Service Area Pump Stations to reduce groundwater withdrawals from the Mill River aquifer. b) It is the Authority's intent not to apply copper sulfate and to rely on the treatment plant to remove algae. c) The Authority will evaluate the need for in-lake management measures, such as aeration, throughout the operation of the new treatment plant.

Note: The recommended performance standards and mitigating/monitoring measures may change depending upon the future status of the New Haven tide gates.

Long-Term and Regional Considerations	**Regional Water Conservation Initiatives**
The ecological and human values of the lower Mill River corridor are of significant regional value, and warrant protection. During critical periods, the Authority should consider requesting voluntary restrictions on water use as an alternative to reducing downstream flows below the recommended minimums. This will provide additional mitigation of downstream impacts by maintaining minimum flows as long as possible. The Authority should continue to expand and improve water conservation education programs. Large industrial water users should be encouraged to explore alternative sources of industrial process water that need not	The Authority modified its Drought Response Plan in its 2009 Water Supply Plan submittal to the Connecticut Department of Public Health to take into consideration reactivation of Lake Whitney for public water supply use and the protection of resources in the downstream Mill River corridor**.** The Drought Response Plan accounts for voluntary and mandatory conservation corresponding to various stages related to remaining system storage volumes of the Authority's entire water supply system. The Authority will continue to expand and improve its water conservation and education programs, such as:

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meet drinking water standards.	- The Whitney Water Center Education Programs for children and adults. - Industrial Water Audits - Consumer education on voluntary water conservation through on-going publications, and through the Authority's website at www.rwater.com. - Using technology to make distribution system leak detection efforts as effective as possible, and to continue to reduce unaccounted-for water. - Identify and contact high consumption by water users, and seek ways to eliminate wasted water. - Continue to improve the water conservation efforts outlined in the Authority's Water Conservation Plan within the Water Supply Plan. - Explore options of serving large industrial users with alternative sources of process water in lieu of potable water.