Overview of Machado Lake Ecosystem Restoration Project: Dredge & Cap Approach to Restoration

John Hull, P.E., John Collins (AquaBlok, Ltd., Toledo, Ohio)

Battelle
The Business of Innovation

AquaBlok® Composite Particle System

INTRODUCTION

Machado Lake is located in the Ken Malloy Harbor Regional Park near Harbor City, CA. The park is approximately 290 acres and contains the 45-acre Machado Lake. The primary goal of the project was to improve the water quality in Machado Lake, while enhancing the surrounding natural habitat and the recreational features of the park. The project and this presentation describe some of the in-lake improvements, such as dredging approximately 239,000 cubic yards of lake sediment and capping the lake bottom with AquaBlok, as well as use of a sediment trap system to address storm water inputs and rehabilitating the dam structure at the south end of the lake. The vegetation, habitat, and park improvements include invasive plant removal and replanting of native species, such as fishing piers, fencing, and walkways.

The lake has been identified as an impaired water body as a result of pollution in storm water and urban runoff flowing from its 15,553-acre watershed. The Wilmington Drain feeds more than half of the water that flows into Machado Lake, so its water quality is of great importance. The City of Los Angeles Department of Public Works project team is managing the project with the prime contractor being OHL, Inc.

This poster will provide an overview of the project from the perspective of the materials used and application.

PROJECT OVERVIEW

Project Location and Key Objectives:

Machado Lake Recommended Plan Performance Measure Results

Project Goal	Performance Measure	Result
Satisfy water quality objectives	-Reduce sediment load to Machado Lake -Reduce wet weather metals load to Los Angeles Harbor from storm water BMPs -Reduce mean summer phosphorus -Reduce mean summer nitrogen -Reduce mean summer chlorophyll-a	-510 tons removed per year -222 pounds removed per year -63% reduction from baseline -53% reduction from baseline -71% reduction from baseline
Enhance recreational opportunities	-Provision of amenities -Length of new trails	-Medium -2,370 feet
Provide a sustainable project	-Probability of meeting TMDL -Supplemental water requirement -Recycled water use -Reuse of dredged material	-5 (rated from low [1] to high [5]) -115 acre feet per year -100% -10% of total excavation
Enhance habitat	-New wetland habitat -New upland habitat -Invasive plant removal - primrose -Invasive plant removal - Cal-IPC non-natives and other non-native threats	-7 acres -5.4 acres -5.9 acres removed -11.5 acres removed
Achieve cost efficiency	-Estimated capital cost -Estimated annual operation and maintenance cost	-$70.2 million -$400,000
Minimize short-term construction impacts	-Dredged material removal requirement	-11,250 bins of dredged material

PROJECT OVERVIEW – (CONT.)

The broad goal of the project is "To improve the water quality conditions, visual aesthetics, and biological diversity of the ecosystem to attain and sustain its desired uses and characteristics (i.e., recreational fishing, wildlife habitat, environmental education), and to meet Total Maximum Daily Load (TMDL) requirements and other water quality targets."

The effort will be accomplished through integrated ecological and engineering strategies and solutions involving watershed-based management approaches, in-lake rehabilitation and streambed assessment techniques, riparian system enhancements, and storm water best management practices (BMPs) at strategic areas in the park.

Diminishing of coastal wetlands ecosystems and impacts to native wildlife: Machado Lake and the Wilmington Drain contain one of the largest remaining coastal wetlands ecosystems in Southern California. The unlined portions of Wilmington Drain are dominated by exotic plant species that have displaced native plants that formerly provided habitat and food sources for wildlife. Biological communities at Machado Lake are also diminished due to hydrologic constraints, past and present recreational needs, and water quality degradation.

Water Quality & Regulatory Requirements:
Machado Lake is listed for trash, algae, ammonia, odor, and legacy pollutants from historical use of pesticides and discharge of lubricants. Improvements to the water quality of the Wilmington Drain and Machado Lake will benefit the Harbor in addition to the lake itself.

Project design must target pollutants of concern (POCs)

Lake Options
Lake rehabilitation options include lake dredging, capping and lake augmentation with supplemental water. Dredging the lake will remove sediment that holds excessive historic contamination and excessive internal nutrient loading. An offline-treatment wetland, an aeration system, and alum injection (as necessary) will also help satisfy the water quality objectives by removing nutrients from the water and increasing dissolved oxygen. In-lake sediment basins will be constructed in the northern portion of the lake just south of the riparian forest and near the Project 77 storm drain outfall to promote localized sediment deposition. The dam at the southern end of the lake will also be modified so that the lake level can be adjusted as desired. A final decision with regard to floating versus terrestrial islands will be made during the design phase.

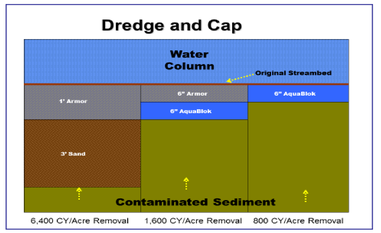
DREDGE & CAP APPROACH

The Dredge & Cap approach is intended to focus dredging activity only on the highest levels of contaminant concentrations within a site. Removal should not be driven by achieving a low target residual concentration level because remaining contaminants in the sediment can be effectively sequestered or isolated with either a low-permeability cap (AquaBlok) or a permeable in-situ amendment layer (AquaGate).

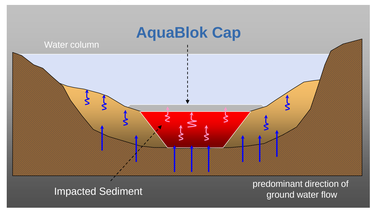
Key advantages:

1. **Minimize removal volumes (with all associated costs).**
2. **Provides 100% clean surface for restoration – Eliminates risks associated with residual.**
3. **Reduces risk of recontamination from other sources, such as upland seep zones.**

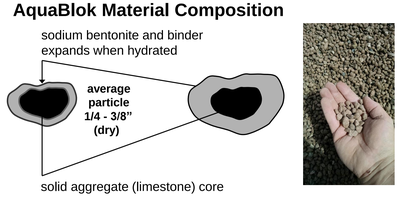
AquaBlok 1 min post hydration → time → **AquaBlok** 24 hr post hydration



The above graphic illustrates the concept and shows the reduction in removal volume that can be achieved assuming different assumptions regarding cap type and cap thickness.



AquaBlok Material Composition



CAP MATERIAL PRODUCTION & INSTALLATION

Production Overview:

Since the primary weight and volume of AquaBlok is stone, the manufacturing facility for AquaBlok materials in Southern California is located at a stone quarry south of Corona, CA (see photo to the **right**). Production is carried out in conventional ready mix concrete mixers. Material is off-loaded into bins and material is transferred to bulk dump trucks for transport to the Machado Lake site, which is an approximate one hour drive from the production facility. Early in the project, it was expected that AquaBlok would be produced on-site at Machado, but it was determined to be more cost effective to deliver the finished material rather than stone to the project site.

To the **right** is a photo of the AquaBlok stockpiled at the project site. After off-loading from the trucks, stacking conveyors were used to create large piles that could be covered with a high density plastic cover to protect the material from rain. In spite of these measures, it was estimated that from 1%-3% handling losses would take place due to material handling and water damage to the material

Installation / Quality Control:

Installation was performed with a hopper/barge system that was able to place a thin-uniform layer in a 20-foot wide 'lane' across the lake bottom. The material to keep the placement barge productive was provided by a separate supply barge, which was loaded with AquaBlok from the lake shore. The photo to the **top left** shows the placement barge and hopper during application of AquaBlok. The photo to the **bottom left** shows the material stock on the placement barge and the mini-excavator that was used to load the hopper.

Quality control was performed on AquaBlok material in advance of shipment, after shipment and after placement. Testing prior to placement consisted of hydraulic conductivity tests in both columns and by independent geotechnical laboratories (see photo to the **right**). Meeting the project specification was demonstrated using both methods.

Post-placement confirmation consisted of core samples to verify the minimum placement thickness of 6-inches (hydrated). To accomplish this, the contractor placed two lifts of approximately 20lb/SF (2.5-3 inch dry thickness) and allowed for hydration between lifts.

CONCLUSIONS

The project demonstrates that it is possible to both improve water quality, while enhancing the surrounding natural habitat and the recreational features of the area. This presentation describes some of the in-lake improvements, such as dredging approximately 239,000 cubic yards of lake sediment and capping the lake bottom with AquaBlok to address residual contaminants in the underlying sediments. The habitat and improvements include measures to help maintain water quality after completion or the project to minimize impacts of ongoing nutrient additions. Invasive plant removal and replanting of native species, such as fishing piers, fencing, and walkways also provide important features which improve the ability for the public to enjoy the restored waterbody.

AquaBlok, Ltd. | 175 Woodland Ave. | Swanton, OH | (419) 825-1325 | www.aquablok.com