Appendix G – Civil Engineering

Mitchell Lake, San Antonio, TX

General Investigations Feasibility Study
Integrated Draft Feasibility Report and Environmental Impact Assessment

September 2019

US Army Corps
of Engineers®
Fort Worth District

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EXISTING CONDTIONS OF THE MITCHELL LAKE COMPLEX:

Mitchell Dam and Lake

Mitchell Lake has a surface area covering approximately 600 acres with an average water depth of less than 8 feet. It is located in southern Bexar County and is currently operated and managed by San Antonio Water System (SAWS). Mitchell Lake Dam was constructed in 1901 by the San Antonio Irrigation Company. In the 1970's, an eighty-seven acre polder complex was constructed at the northern end of the lake to accept waste activated sludge from the Rilling Road Wastewater Treatment Plant. This practice continued until 1987, when the Dos Rios Wastewater Treatment Plant came on line into operations. The upper complex currently consists of five decant basins (constructed in the 1980s) designated 1 through 5, and two polders (East and West). The polder complex area is protected by dikes and does not receive storm water runoff.

Mitchell Lake Dam consists of an earthen embankment that varies from 2 to 10-feet in height and is approximately 3,200 feet long. The embankment crest is 15 feet wide and its elevation varies from 525.5 to 528.9 feet above mean sea level. The upstream slope is 2 feet horizontal to 1 feet vertical and the downstream slope is 2.5-ft horizontal to 1-foot vertical. Concrete rubble used for erosion protection is located at various locations along the upstream face of the dam. The dam is vegetated and there are large trees present at various points adjacent to the toe of the dam. A 55 feet wide concrete spillway is located along the eastern abutment and the normal water surface varies between 520 ft-msl and 523 ft-msl. The dam's spillway consists of eight (8), 36-inch diameter gate valves with invert elevations at 520.7 ft-msl. The gates are rusted open and inoperable. A 250-foot stone and mortar outfall channel proceeds from the spillway into a heavily eroded plunge pool. The pool discharges into Cottonmouth Creek which flows into the Medina River. Treated effluent (recycled water) is piped to the lake from the Leon Creek Water Recycling Center - it enters the lake within the polder complex and is used to maintain lake levels during dry periods.

The Polders complex has two pumping stations at the southern end of the basins 5 and 4 to allow for water circulation flows. There are three pumps at the southwest corner of basin 5 that allow for water to be pumped from the Mitchell Lake to the Polders complex. The water is pumped into Basin 5 then flows into basin 1 which then flows into the West Polder. From there water will circulate to the East Polder, then to basin 3 and finally into basin 4. There is a single pump at the pump station on the southeast corner of basin 4 allows for the water to be discharged back into Mitchell Lake.

FUTURE CONDITIONS WITH PROJECT:

Area 1 Option - Adjacent to Bird Pond

Bird Pond contains an existing perimeter approximately 3.17 acres that can restored to a wetland feature. To increase the perimeter to a larger wetland area then the perimeter can be expanded to 6.42 acres. Water Supply would be pumped through a pipeline system from the southwest pump station (or new/modified pump) to the north edge of Birds Pond Wetland. The pipeline would need to cross existing petrochemical pipeline right-of-way but the petrochemical pipeline would not have to be relocated. The outfall from the Bird Pond Wetland should be designed with a drainage ditch to merge into the existing creek below Bird Pond. A culvert would be needed to cross the road between Bird Pond wetland and the Bird Pond creek. See Figure 1.

Wetland excavation criteria and limits

Wetlands perimeter area should be excavated to establish average depth grading of 6" to 2' throughout. In addition to the bottom grading of the wetlands there should be deeper pockets four feet in depth with an approximate bottom radius of 4', sloped to meet back up with a 2' depth. The deeper pockets should be located 65 feet from the shoreline and no closer than 65 feet from each other around the perimeter of each wetland. All the excavated material can be disposed onsite if the options for Area 6 – Polders and Area – Island Habitat are implemented.

Construction of a water control structure

Stop log type water control structure should be place such that allows water levels to be controlled to maintain 6" to 4' depths with appropriate freeboard. The wetland shall be allowed to be drained to 2' so that the deeper holes retain water to maintain maximum depths during spring and fall months, allowed to draw down up to 1' foot during the summer, and drain during the winter months to control and promote diverse vegetation.

Area 1A - Adjacent to Bird Pond Existing	Unit	Est Qty
Wetland Cell Excavation	CY	772

Area 1B - Adjacent to Bird Pond Expanded Limits	Unit	Est Qty
Wetland Cell Excavation	CY	1,570

Area 2 Option - Central Wetlands

The Central Wetland area contains an existing perimeter approximately 10.46 acres that can restored to a wetland feature. To increase the perimeter to a larger wetland area then the perimeter can be expanded to 18.37 acres. Water supply to this wetland can provided from two sources depending on the restoration features upstream. If Bird Pond is included in the restoration project then the flows from the drainage ditch and existing creek will provide the water supply. If nothing is restored upstream then water supply would be pumped through a pipeline system from the southwest pump station (or new/modified pump) to the north edge of the Central Wetland. The pipeline would need to cross existing petrochemical pipeline right-of-way but the petrochemical pipeline would not have to be relocated. The outfall from the Central

Wetland would be a drainage ditch along an existing creek to drain into the next wetland cell at Skips Pond. See Figure 1.

Wetland excavation criteria and limits
Wetlands perimeter area should be excavated to establish average depth grading of 6" to 2' throughout. In addition to the bottom grading of the wetlands there should be deeper pockets four feet in depth with an approximate bottom radius of 4', sloped to meet back up with a 2' depth. The deeper pockets should be located 65 feet from the shoreline and no closer than 65 feet from each other around the perimeter of each wetland. All the excavated material can be disposed onsite if the options for Area 6 – Polders and Area – Island Habitat are implemented.

Construction of a water control structure
Stop log type water control structure should be place such that allows water levels to be controlled to maintain 6" to 4' depths with appropriate freeboard. The wetland shall be allowed to be drained to 2' so that the deeper holes retain water to maintain maximum depths during spring and fall months, allowed to draw down up to 1' foot during the summer, and drain during the winter months to control and promote diverse vegetation.

Area 2A - Central Wetlands Existing	Unit	Est Qty
Wetland Cell Excavation	CY	2,747

Area 2b - Central Wetlands Expanded Limits	Unit	Est Qty
Wetland Cell Excavation	CY	4,826

Area 3 Option - Skip's Pond
The Skip's Pond perimeter area to be part of the restored wetland feature is 2.18 acres. The water supply would be from the discharge ditch coming out of the Central Wetland cells. See Figure 1.

Excavation at Skip's Wetland would be limited to 30% of the perimeter area for the feature to the same criteria and limits as described above for the Central Wetlands and would only include one 4' deep pocket with the dimensions describe above.

Modification of one existing water control structure or construction of a new one if needed to maintain water levels as described above.

Area 3 - Skip's Pond	Unit	Est Qty
Wetland Cell Excavation	CY	432

Area 4 Option - Edward's Tank
The perimeter area around this wetland cell is 1.15 acres.
No excavation or grading of existing area will be done as a structural measure of improvement to meet the planting of diverse tree, shrub and/or herbaceous species. See Figure 1.

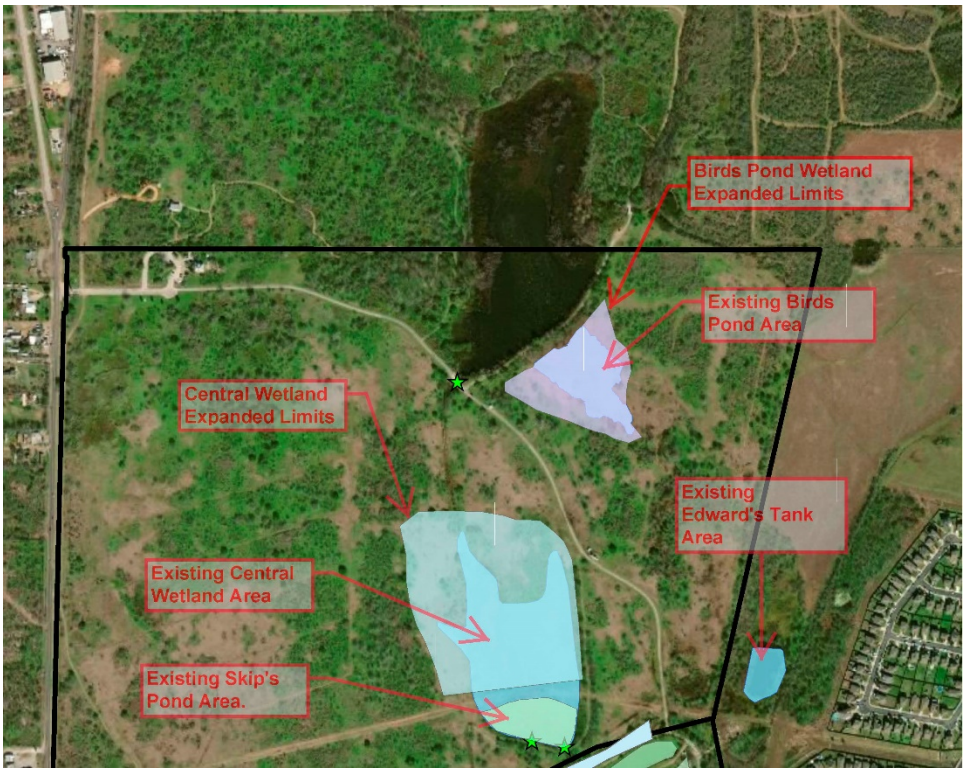


Figure 1 – Bird Pond and Central Wetlands

Area 5 Option - Linear Wetland
The perimeter area around this wetland cell is 4.43 acres.
No excavation or grading of existing area will be done as a structural measure of improvement to meet the planting of diverse tree, shrub and/or herbaceous species. See Figure 2.

Area 6 Option - Polders
The perimeter area for the Polders area consists of 49.52 acres. The Polders complex consists of two long cells divided as East and West and five basin cells. All the cells are divided by perimeter berms that have a top of berm elevation at approximately 527. In order to facilitate an operation to lower the water levels at different stages and times additional berms would be added to the following Polder cells from excavated materials of the constructed wetland cells
Construction of two berms at the south end of the West Polder
Construction of one berm at the south end of the East Polder
Construction of one berm at the southwest corner of Basin 1
See Figure 2.

Water Control Structures
Modification/replacement of existing water control structures to drop the invert to a level that would allow the draining of the polder cells.
Installation of new water control structures to facilitate transfer of water across the new berms in the West Polder, East Polder, and Basin 1

Other Potential Option would be the construction of a controlled outfall structure on the west side of Basin 1 to facilitate releasing water to filter through the northwest end of Mitchell Lake if the Mitchell Lake emergent wetland Area 7 Option would be implemented.

Area 6 - Polders	Unit	Est Qty
Berms Fill Material	CY	3,309

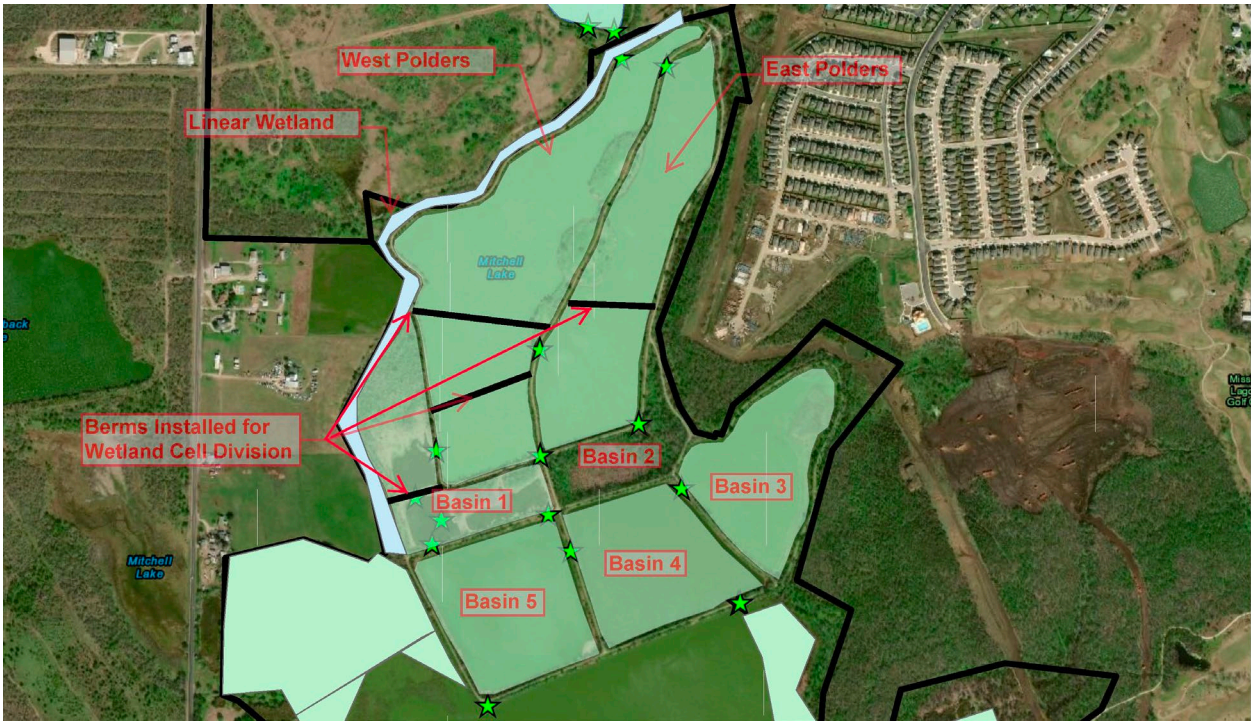


Figure 2 – Linear Wetlands and Polder Area

Area 7 Option - Fringe Wetlands
The perimeter area around the entirety of lake's edge is a total of 143.72 acres.
No excavation or grading of existing area will be done as a structural measure of improvement to meet the planting of diverse tree, shrub and/or herbaceous species. See Figure 3.

Area 8 Option - Island Habitat
This option would allow for development of new habitat areas within Mitchell Lake. A total of three islands can be built from excavated materials of the constructed wetlands. Island 1 would consist of 8.37 acres, Island 2 would consist of 14.70 acres and Island 3 would consist of 12.24 for a total of all islands to be 35.31 acres. Excavated material from the constructed wetlands in other options may be used to create islands in Mitchell Lake instead of hauling and disposing the material. This option would require transport using heavy equipment (haulers, barges, etc.) to move and place. The island area will be planted with diverse native emergent and aquatic vegetation. See Figure 3.

Area 8 - Island Habitat	Unit	Est Qty
Fill Material	CY	69,230

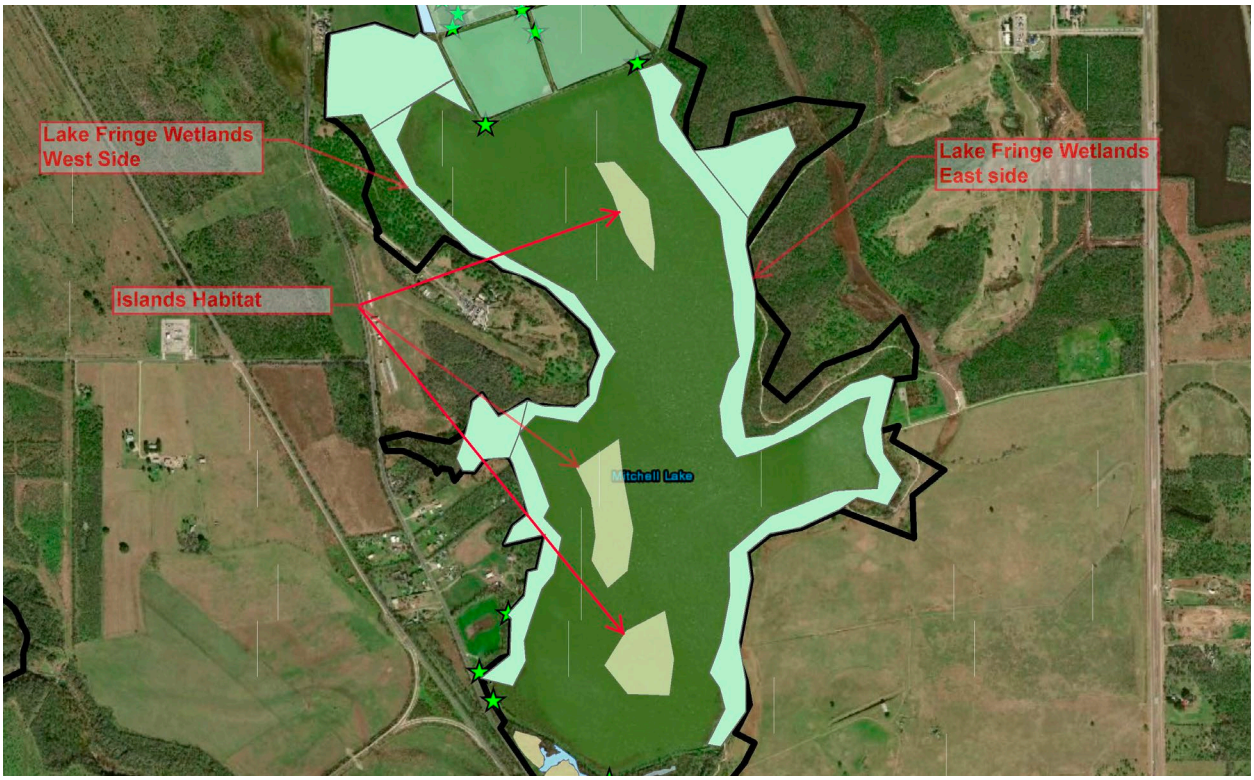


Figure 3 – Fringe Wetlands and Island for Habitat

Area 9 Option - Dam Forested Wetland

Just downstream of the dam along the middle area of the dam length is an existing drainage area that consists of 2.55 acres which can be enhanced to a wetland area. Adjacent to this existing drainage area a new wetland can be created consisting of 3.86 Acres. The wetland perimeter would be the limits of the required plantings and removal of invasive species. Within this perimeter excavation would done on 20% of the existing wetland and 30% on the created wetland. Excavation should provide 6" – 1' average depths and no deep holes are needed. This is part of a natural drainage area so not water control structures would be required. See Figure 4.

Area 9 - Dam Forested Wetland	Unit	Est Qty
Existing Wetland Excavation	CY	52
New Wetland Excavation	CY	111

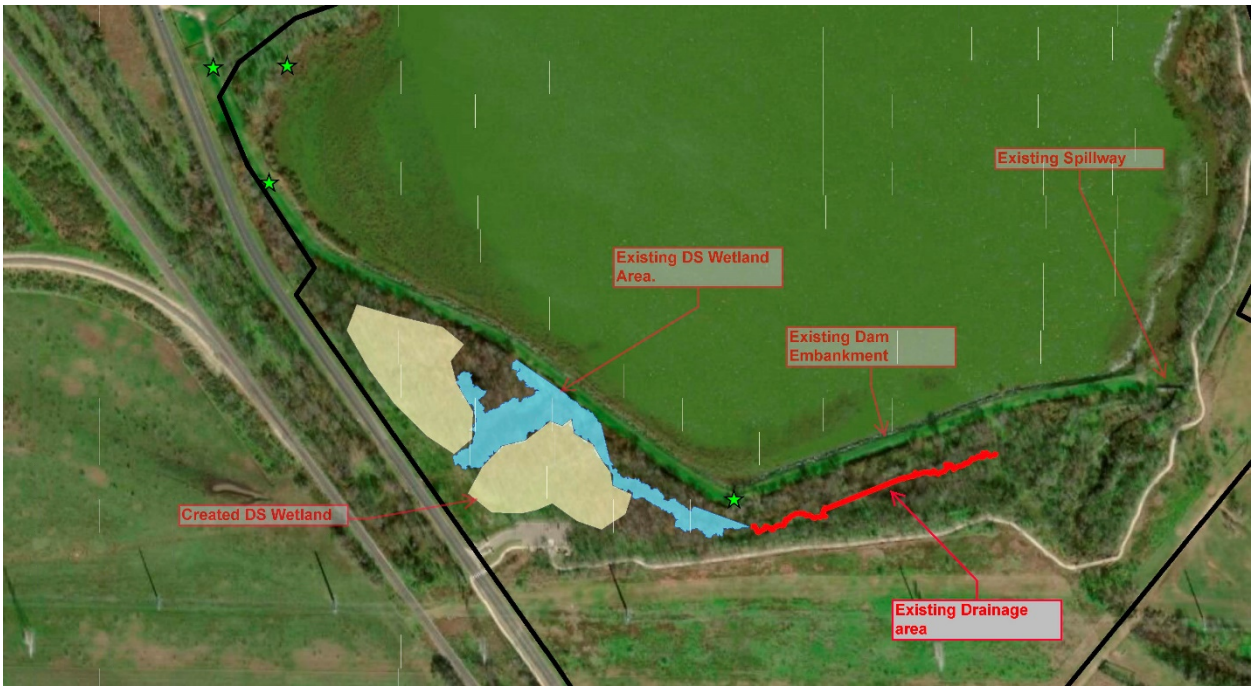


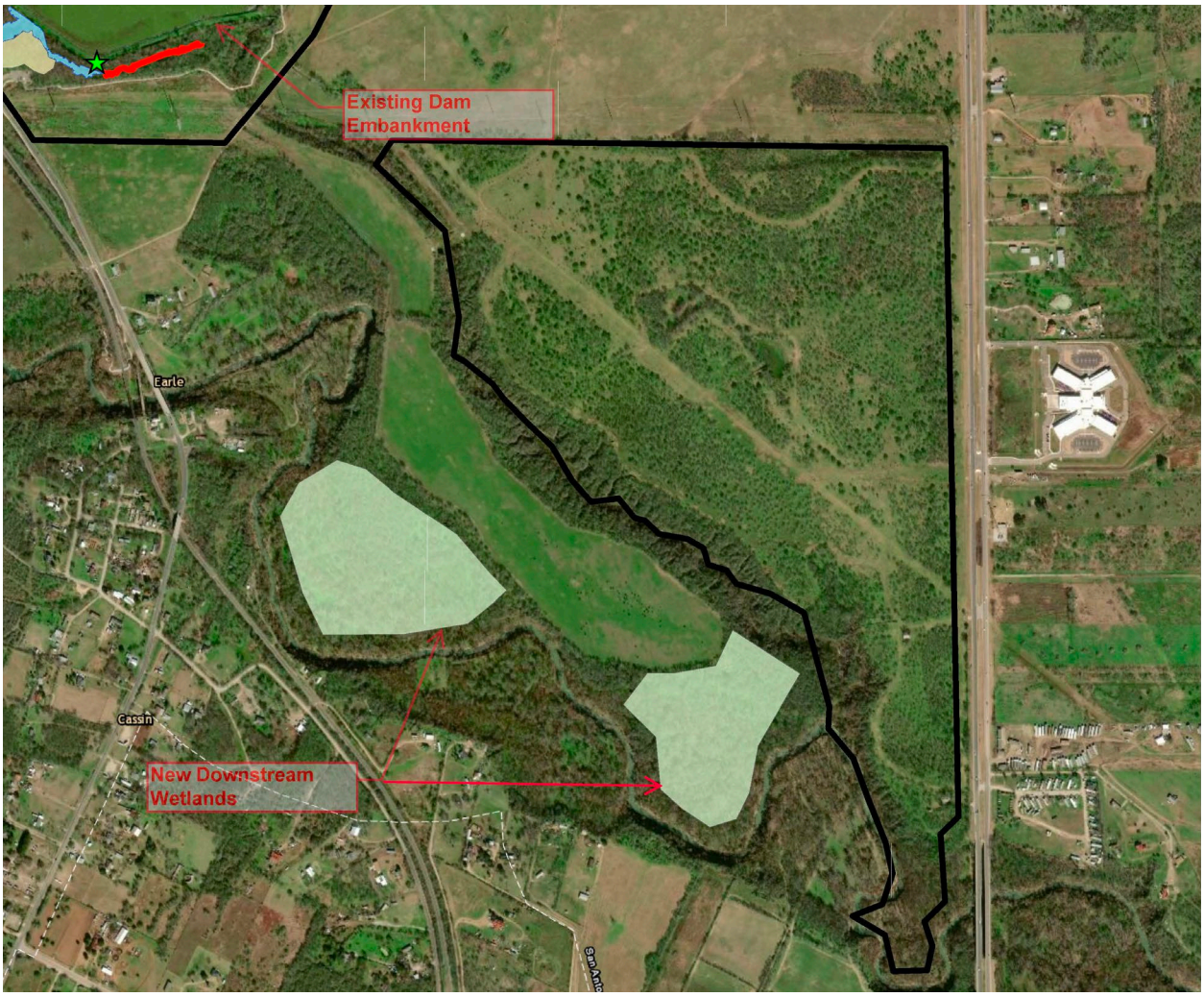
Figure 4 – Dam Forested Wetlands

Area 10 Option - Downstream Wetland
Approximately 3000 feet down stream of the existing dam along Cottonmouth Creek two new wetlands can be created totaling an area of 51.32 acres. Adjacent to these wetland cells the non-federal sponsor will construct two wetland cells with a water supply of treatment water from the lake. From water control structures at the non-federal sponsor wetland cells water can be supplied the new created wetlands with the excavation of drainage ditches. See Figure 4.

Wetland excavation criteria and limits
Wetlands perimeter area should be excavated to establish average depth grading of 6" to 2' throughout. In addition to the bottom grading of the wetlands there should be deeper pockets four feet in depth with an approximate bottom radius of 4', sloped to meet back up with a 2' depth. The deeper pockets should be located 65 feet from the shoreline and no closer than 65 feet from each other around the perimeter of each wetland. All the excavated material can be disposed onsite if the options for Area 6 – Polders and Area – Island Habitat are implemented.

Construction of a water control structure
Stop log type water control structure should be place such that allows water levels to be controlled to maintain 6" to 4' depths with appropriate freeboard. The wetland shall be allowed to be drained to 2' so that the deeper holes retain water to maintain maximum depths during spring and fall months, allowed to draw down up to 1' foot during the summer, and drain during the winter months to control and promote diverse vegetation.

Area 10 - Downstream Wetland	Unit	Est Qty
Wetland Cell Excavation	CY	7,907



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References

EM	1110-2-38	Environmental Quality in Design of Civil Works Projects	3-May-79
EM	1110-2-1205	Environmental Engineering and Local Flood Control Channels	15-Nov-89

OPERATION AND MAINTENANCE MANUAL

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GENERAL INFORMATION

This Operation and Maintenance (O&M) Manual defines responsibilities and provides guidance for the safe operation, maintenance and overall performance of the Mitchell Lake Dam and its appurtenances. Adequate inspection and maintenance are critical for ensuring safe operation of the flood control dam. The dam owner is to implement this manual and evaluate the effectiveness of each activity and revise/update this manual as necessary.

Location of the Dam

Mitchell Lake is located in southern Bexar County, Texas currently operated and managed by San Antonio Water System (SAWS).

Description of the Dam and Appurtenances

Dam properties

Construction Material (Type): Earth
Height (Maximum): 10 feet
Crest Width of Top of Dam: 15 feet
Crest Elevation: 528 feet
Crest Length: 3,200 feet
Upstream Slope (H:V): 2:1; Downstream Slope (H:V): 2.5:1

Reservoir

Drainage Area: 9.76 square miles
Normal Water Level Elevation: 520.4 feet
Normal Water Level Surface Area: 670 acres
Normal Water Level Storage: 2,640 acre-feet
Maximum Storage: 5,000 acre-feet
Primary Service Spillway Construction Material: Concrete
Primary Service Spillway Location: Southeastern
Primary Service Spillway Wide: 55 feet and has eight 36-inch gate valves
Primary Service Spillway Crest: 520.73

Emergency Spillway

Type: Earth
Location: Western side of dam
Crest Elevation: 527 feet
Crest Length: 1,000 feet

Responsibilities

The San Antonio Water System (SAWS) is the owner of the dam and is responsible for its operation, inspection, maintenance and repair.

INSPECTIONS

A representative of San Antonio Water System (SAWS) shall perform routine inspections to ensure timely identification of potential problems. Inspections will be performed annually during the non-flood season, which allows needed work to be completed before summer thunderstorms. Three types of inspections are required to ensure that the flood control structure functions as designed.

1. **Special** inspections will be conducted immediately following severe storms, earthquakes, initial filling of the reservoir, vandalism, and other significant events.
2. **Annual** inspections will be accomplished during the non-flood season by trained personnel of the SAWS.
3. **Formal** inspections shall be conducted at least once every 5 years. These inspections are to be accomplished under the direction of a registered professional engineer licensed in the State of Texas and qualified in the design and construction of dams. The purpose of the inspection is to perform a detailed inspection and engineering evaluation of the dam and appurtenances.

The individual conducting any inspection must record all pertinent observations and data. A photographic record of inspections, with locations and dates of photos, can assist in diagnosing and solving problems that may arise. The inspection report and photos shall be placed in the Operating Log and made available to other parties as deemed appropriate by the dam owners.

Preparing an inspection route in advance helps assure that every part of the structure will be observed. The following is a recommended sequence for an annual inspection of the main earthen embankment structure.

- **Crest** - Walk along the crest from abutment to abutment.
- **Downstream Toe** - Walk the entire length of the downstream toe.
- **Upstream/Downstream Slope** - Walk across the slope from abutment to abutment in a pattern such that the entire slope is inspected.
- **Principal Spillway and Outlet Conduit** - Observe all accessible features of the principal spillway.
- **Auxiliary (Emergency) Spillway** - Walk along the entire length of the spillway in a back and forth manner.
- **Embankment-Abutment Contacts** - Walk the entire length of the embankment-abutment contacts (groins).
- **Abutments** - Traverse abutments in a practical manner so as to gain a general feel for the conditions that exist along the valley sidewalls.
- **Downstream Channel** - Travel the route of the stream below the dam to maintain familiarity with locations of residences and property that can be affected by dam failure.
- **Reservoir Slopes** - Scout the reservoir perimeter in an effort to develop an overall familiarity with its conditions.

Table 1 provides specific items and locations to be inspected during annual and special inspections.

Table 1: Inspection Plan

Special Inspections
1. Record reservoir level in the Operating Log. 2. Check and record outlet flow in the Operating Log. 3. Visually examine condition of: a. Embankment crests b. Upstream and downstream slopes (faces) c. Principal spillway inlet and outlet d. Riser e. Auxiliary (emergency) spillway f. Fence and gates 4. Record observations of visual inspection in the Operating Log. 5. Check floodwater diversion, outlet channel, pool area, and inlet area for erosion, sediment and debris. 6. Make note of any other pertinent observations in the Operating Log.
Annual Inspections
1. Inspect earthen embankments for erosion, rills, cracks and rodent burrows. 2. Inspect earthen embankments, outlet channels, and all concrete structures for woody vegetation, tree seedlings, trees and large shrubs. 3. Inspect all concrete elements, including interior of riser for cracks, spalling, loss of joint filler or sealer, and other signs of deterioration. 4. Check fences, gates, and related appurtenances for signs of disrepair. 5. Check for corrosion on all exposed metalwork. 6. Inspect reservoir pool, outlet channels, inlet structures, and any other area that may result in debris blockage or debris being transported to or through the floodwater retarding structures or outlet channels.

MAINTENANCE

Preventive maintenance will be performed on Mitchell Lake Dam and its appurtenances to ensure the safe function of the dam. Representatives of SAWS will execute routine maintenance tasks. Table 2 outlines maintenance tasks and the frequency with which they must be performed.

Table 2: Maintenance Schedule

Element	Frequency	Description
Dam Embankment		
Vegetation Control	Annually	Inspect and remove weeds and mow native grasses as needed to allow visual surveillance of the embankment surface.
Control of Burrowing Animals	Annually	Eliminate or relocate the burrowing animals to alleviate the problem long term. Repair animal burrows by compacting fill into the excavated areas.
Maintain Crest Design Elevation	Annually	Inspect the dam crest for signs of ruts, minor depressions, or erosion. Fill any ruts or minor depressions with similar soil and compact it to surrounding grade.
Erosion Control on Upstream & Downstream Slopes	Annually	Inspect the slopes for signs of rill and gully erosion. Repair by installing appropriate erosion control measures such as wattles, net wire diversions or gravel fill. Fill large rills and gullies with compacted soil.
Emergency Spillway		
Inspect and/or Repair Earth Spillway	Annually and After Large Storm Events	Repair erosion gullies by removing loose material and replacing it with compacted fill. Gravel and properly sized riprap should be added to the damaged area as appropriate to prevent future erosion. Control unwanted vegetation in spillway area.
Inspect and/or Repair Concrete Spillway	Annually and After Large Storm Events	Keep concrete joints and surfaces free of vegetation. Make repairs to concrete surfaces and joints.
Maintain Emergency Spillway Channel	Annually and After Large Storm Events	Remove any obstructions or debris from the spillway channel, using NMOSE *Vegetation Management on Dams*. These guidelines are dated August 15, 2011 and are found in Appendix B-1.
Outlet Works (Principal Spillway)		
Clean Trash Rack	Annually and After Large Storm Events	Remove debris from trash rack and spillway (port and weir) openings.

Inspect and Repair Concrete	Annually	Keep concrete joints and surfaces free of vegetation.
Maintain Metal Features	Annually	Remove mineral deposits and paint or galvanize metal features as needed. Restore corroded metal to original condition by replacing or welding on new metal and painting to prevent corrosion.
Inlet Structure	5 Years	Inspect inside of riser either manually or via a remote control camera, depending on accessibility.
Inlet Conduit	Annually	Visually inspect conduit from downstream end for corrosion, leakage, or other significant problems. Repair as needed.
Inlet Conduit	5 Years	Inspect entire conduit interior either manually or via remote control camera, depending on accessibility. Repair as needed.
Principal Spillway Outlet Structure	Annually and After Large Storm Events	Remove visible and accessible obstructions to flow (e.g. debris, vegetation, etc.) Repair concrete as necessary. Replace missing riprap with adequately sized riprap to prevent movement or removal by flow events. Reshape channel as necessary to maintain channel geometry shown on the as-built drawings.
Principal Spillway Outlet Channel	Annually	Repair erosion gullies by removing loose material and replacing it with compacted fill. Remove any obstructions, including small trees and bushes that could affect flow now or in the future.
Other		
Polder	Annually	Inspect pumping stations. Make repairs to pump as needed.
Reservoir Area	Based on need	Keep reservoir area clear of debris and vegetation that could clog intake of principal spillway.