APPENDIX M. Wetland Management Guidelines

Steigerwald Lake National Wildlife Refuge

Historically, Gibbons Creek emptied into the Steigerwald Lake basin, then flowed to the west, where it emptied into the Columbia River. A dike along the Columbia River was constructed in 1966 to protect adjacent landowners from floodwaters. After dike construction, water was removed from the enclosed basin by a combination of tidegates and pumps. In 1992, an elevated channel was constructed to transport the waters of Gibbons Creek from its inflow into the refuge at State Route 14, over Steigerwald Lake, then southeast into the Columbia River. This creek modification facilitated passage for anadromous fish between the Gibbons Creek and the Columbia River. At the same time, however, the elevated channel and perimeter dike have isolated Steigerwald Lake from its tributary and from Columbia River floods. Currently the wetland receives water from springs, seeps, precipitation, and Gibbons Creek flows when they infrequently exceed elevated channel capacity. When the elevated channel was built, two culverts with water control structures were installed through the realigned channel dike. These structures, plus two additional dikes with water control structures provide three managed wetland impoundments within Steigerwald Lake: (1) the Port Unit impoundment located west of the elevated channel, (2) the Stevenson Unit impoundment located east of the elevated channel and west of the Straub Dike, and (3) the Straub Unit impoundment located at the east end of the refuge. Scaup Pond was excavated and contoured as fill material was removed to construct the elevated channel. Redtail Lake, located south of Scaup Pond between the cottonwood-lined Gibbons Creek and the Columbia River dike, is also isolated from the Columbia River floodplain and has hydrological limitations imposed by the perimeter dike.

The following elevations are guidelines for annual operation of these impoundments and wetlands. Periodic annual adjustments are anticipated for management activities. Impoundments may be drawn-down rapidly to low elevations to accommodate management actions such as suppressing invasive plant species and promoting native communities. However, it is encouraged that adjoining wetlands or impoundments be maintained to compensate the aquatic habitat temporarily lost during localized draw downs and subsequent management activities.

Port Unit Impoundment

Description

The Port Unit impoundment is situated between the elevated channel and the Port of Camas/Washougal Industrial Park. Water levels within the impoundment are maintained behind a cross dike between the southwest corner of the Washougal sewage treatment plant and the northeast corner of the Port of Camas/Washougal Industrial Park. Maximum levels in this impoundment are imposed by the elevations of both the cross dike and perimeter dike of the sewage plant. Both dikes could be overtopped at wetland levels exceeding 16 feet mean sea

level (msl). Water levels are regulated within this impoundment by water control structures installed through the cross dike between the sewage plant and Industrial Park. Water passing through this water control structure flows to the west through the Refuge. Water levels to the west are regulated by tidegates and pumps operated by the Port of Camas/Washougal and are typically maintained low to increase capacity for floodwater retention.

The source of water within the Port Unit is primarily from precipitation and excess waters flowing from the Straub and Stevenson Units to the east. Additionally, the Port Unit Impoundment receives excess Gibbons Creek waters flowing over the concrete weir at the Gibbons Creek diversion structure. The elevated channel is designed to carry flows up to 70 cubic feet per second (cfs), with flows exceeding 70 cfs being diverted into the original Gibbons Creek channel west of the diversion structure, then south into the Port Unit. When constructed this flow diversion was predicted to be an infrequent occurrence, however, reduced capacity within the elevated channel and diversion structure has increased the frequency of these events.

Management Recommendations

Water level gauges have been set at the water control structure for the Port Unit based on benchmarks at the sewage plant. Therefore, gauge readings of this impoundment should be at or near mean sea level. Table WMG-1 portrays the approximate wetland surface area of the Port Unit relative to the depth of water impounded. Water control boards should be set at 10.0 feet msl by October 15. It is anticipated that water elevations within the Port Impoundment will often exceed this level due to the constriction imposed by the water control structures. This level should be maintained through late winter when reed canarygrass shows evidence of growth, often late February through March. No later than the April 1, add boards to the structure to elevate the wetland to 14.0 feet msl for reed canarygrass suppression. Starting June 15 remove one or two boards a week from the water control structure until 12.0 feet msl is achieved. Retention of this initial base elevation will benefit brooding waterfowl, nesting species and developing amphibians. As summer progresses, it is assumed levels will gradually drop below 12.0 feet msl with evaporation. A beaver deceiver should be installed at this water control structure at first opportunity during the late summer (August through September).

Table WMG-1. Port Unit Impoundment of Steigerwald Lake Refuge; Approximate Potential Surface Areas.

Water Elevation (feet above msl)	Max. Water Depth (feet)	Surface Area (acres)	Comments
9	0	0	Approximate bottom
10	1	2.5	
12	3	17	
14	5	66.8	
16	7	84	Maximum elevation - top of sewage pond dike

Stevenson Unit Impoundment

Description

The Stevenson Unit is situated between the elevated channel and the Straub Dike. Water levels within the impoundment are regulated by two water control structures installed through the elevated channel. Water passing through these water control structures flow to the west into the Port Unit. The floodplain and uplands adjoining the Stevenson Unit are within Service ownership, allowing some flexibility in management of wetland area and depth. However, management options are still limited as the Straub Unit Impoundment drains westerly into the Stevenson Unit Impoundment. Water elevations within the Straub Unit are regulated to prevent inundation of private pastures along the eastern Refuge boundary. Therefore, water elevations within the Stevenson Unit Impoundment must be maintained to accommodate drainage of the Straub Unit Impoundment. Without gravity flow into the Stevenson Unit Impoundment, water accumulating in the Straub Unit Impoundment from seeps, springs, and winter rains could eventually flood adjoining private pastures.

Management Recommendations

Water control boards should be set between 15.3 feet and 15.5 feet msl by October 15. Lacking a secure water source, annual fill rate this basin will vary with rainfall. This level should be maintained into late winter until reed canarygrass shows evidence of growth. No later than April 1, add boards to the structure to elevate the wetland to 15.7 feet to 16.0 feet msl for reed canarygrass suppression. Starting June 1 remove on or two boards weekly from the water control structure until 14.0 feet msl is achieved. As summer progresses, it is assumed levels will gradually drop below 14.0 feet msl with evaporation. Table WMG-2 portrays the approximate surface area of the Stevenson Unit relative to the depth of water impounded. A beaver deceiver should be installed at this water control structure during the late summer (August through September).

Table WMG-2. Stevenson Unit Impoundment of Steigerwald Lake Refuge; Approximate Potential Surface Areas.

Water Elevation (feet above msl)	Max. Water Depth (feet)	Surface Area (acres)	Comments
9	0	0	Approximate bottom
10	1	2	
12	3	22	
14	5	65	
16	7	92	
18	9	115	
20	11	145	20.0' top elevation water control structure
22	13	202	

Straub Unit Impoundment

Description

The Straub Unit is situated to the east of the Straub Dike. Water levels within the impoundment are regulated by a water control structure installed through the Straub Dike. Water passing through this water control structure flows to the west into the Stevenson Unit Impoundment and then on to the Port Unit. Elevations within the Straub Unit Impoundment are regulated to prevent inundation of private pastures along the eastern Refuge boundary. Therefore, elevations within Stevenson Unit Impoundment are maintained to accommodate drainage of the Straub Unit Impoundment.

Management Recommendations

Placement and size of the water control structure maintaining the Straub Unit Impoundment imposes several limitations to water management. The water control structure and associated culvert bisecting the Straub Dike are set too high to fully drain the Unit. Additionally, the structure size is inadequate to efficiently remove water during periods of heavy precipitation. Therefore the structure needs to be replaced at the proper elevation with a larger structure. Water level gauges should also be reset at the Straub Dike, as gauge elevations once thought to be mean sea level have proven to be erroneous. Water management at the Straub Dike will retain one board in the water structure at all times to establish a minimum pool elevation and prevent debris accumulation below the bottom board. Occasionally, boards may be added at the Straub Dike to maintain independent control of seasonal water depths. However, water within the Straub Unit Impoundment will generally be managed from the structures at the elevated channel (Stevenson Unit). Water levels of 16.0 feet msl, as read at the Straub Dike, are known to saturate private property to the east of the Refuge boundary. Table WMG-4 correlates surface area within the Straub Unit relative to maximum depth and gauge reading. Frequent comparative gauge readings between the Straub Dike and elevated channel coupled with periodic

confirmation of water levels near the eastern Refuge boundary, will further refine target water levels at the elevated channel.

Table WMG-3. Straub Unit Impoundment of Steigerwald Lake Refuge; Approximate Potential Surface Areas.

Gage Reading (feet*)	Max. Water Depth (feet)	Surface Area (acres)	Comments
10	0	0	Approximate bottom
12	2	7	
14	4	62	
16	6	89	water impounded on private property
18	8	127	
20	10	156	
22	12	230	

*Gauge readings are inaccurate relative to mean sea level. They are included as a reference to the present gauge at Straub Dike, however, do not correspond exactly to the gage at the elevated channel.

Scaup Pond

Description

The U.S. Army Corps of Engineers (COE) constructed an elevated channel to transport the waters of Gibbons Creek from its inflow onto the refuge, over Steigerwald Lake, and out into the Columbia River. Excavation of fill material for the elevated channel resulted in the creation of Scaup Pond, where formerly there were perched wetlands. Scaup Pond measures approximately 300 feet across and is approximately 13 acres when full. Several islands and the shorelines were contoured at 1-unit vertical to 3-units horizontal. Islands within the pond are 19.5 feet to 25.0 feet msl in height; the bottom of the pond is at approximately 16 feet msl. Bordering Scaup Lake to the east is a drainage ditch which was formerly used to dewater Redtail Lake, a slough, and several perched wetlands into the Steigerwald Lake. A water control structure was installed at the southern end of the drainage ditch at Scaup Pond. This structure and the ditch are elevated and do not facilitate drainage of Scaup Pond.

Management Recommendations

Management of this basin would be improved if the ditch elevation was lowered and the water control structure reset to accommodate periodic water manipulations within Scaup Pond. Gauges should also be installed to monitor water elevations coupled with monitoring of emergent plant response to hydrological regime. Assuming engineering designs are correct and the bottom of the wetland is 16 feet msl, place water control boards to maintain water levels between 18.0 feet and 18.5 feet msl by October 15. By April 1, add boards to elevate water to

19.0 feet msl. Precipitation will dictate the rate of fill for the pond. Until drainage is improved, the wetland will dissipate with evaporation. When management is improved, drawdown should occur slowly (one or two boards at a time) starting June 1. The wetland will be drawn down to 17.0 feet msl allowing evaporation to continue to reduce the wetland during the summer. Periodically, the wetland should be drawn down entirely to eliminate bullfrog tadpoles from the basin and to access the islands for weed control.

Redtail Lake

Description

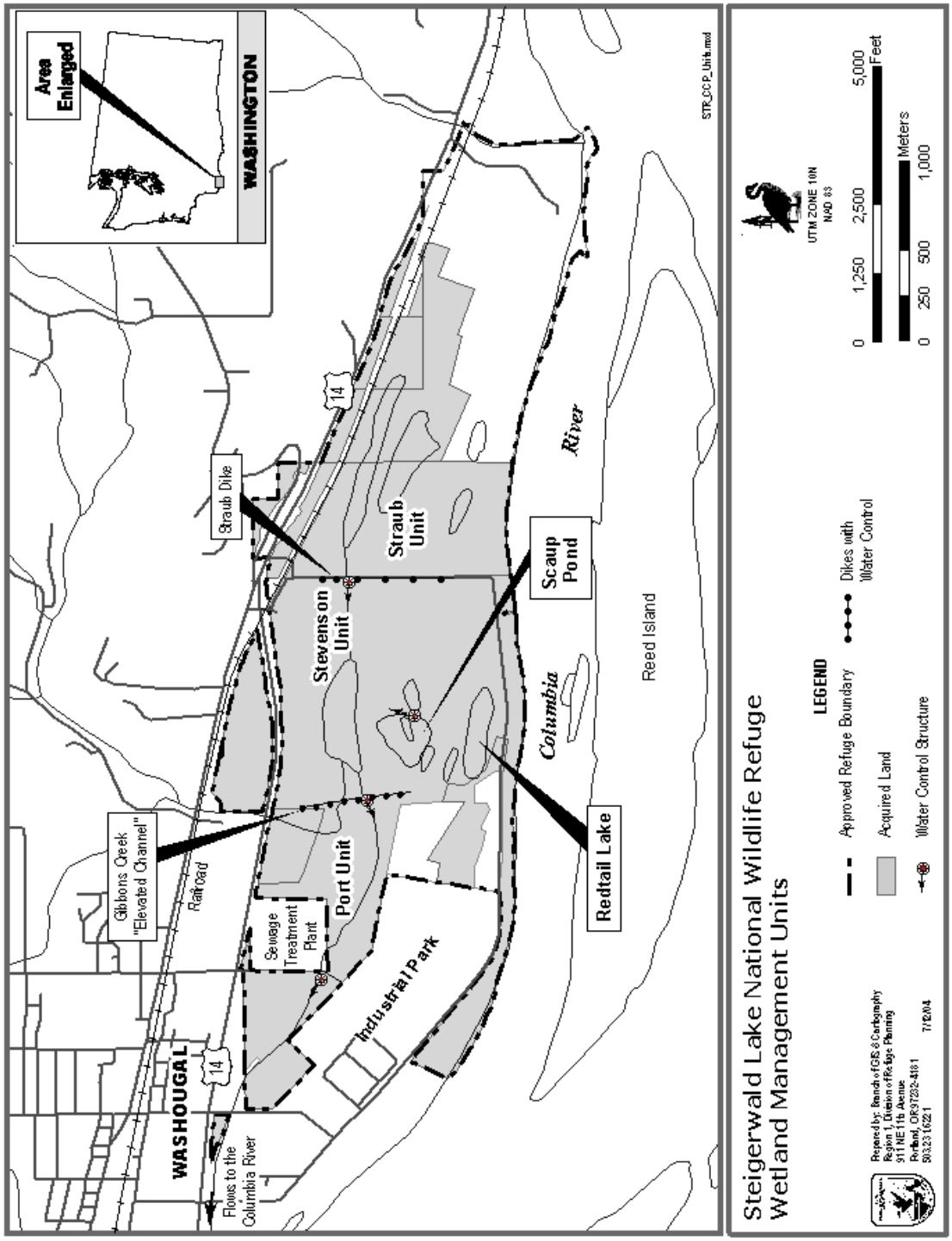
The realignment of Gibbons Creek from the elevated channel to a newly constructed fish ladder, routed the creek through a forested slough north of Redtail Lake. A drainage ditch connecting Redtail Lake to the slough was plugged at that time to prevent the loss of Gibbons Creek water into Redtail Lake. Redtail Lake is maintained by precipitation and possibly by ground water from the slough containing lower Gibbons Creek. Water in the basin is typically perennial, however, during the summer months the lake may retreat to a very small pool (less than an acre). When recharged with precipitation, Redtail Lake may approach 20 acres. Table WMG-4 depicts the elevation, maximum water depth, and surface area of Redtail Lake.

Management Recommendations

Lacking water control infrastructure and a water source, the existing semi-permanent hydrology will be maintained. Periodic herbicide applications to reed canarygrass and soil disturbance may encourage native wetland communities.

Table WMG-4. Redtail Lake on Steigerwald Lake Refuge; Approximate Potential Surface Areas.

Elevation (feet above msl)	Max. Water Depth (feet)	Surface Area (acres)	Comments
21	0	0	Approximate bottom
22	1	8.5	
24	3	16.2	May periodically exceed this area/depth


Area Enlarged
WASHINGTON
Straub Dike
Straub Unit
Stevenson Unit
Scaup Pond
Columbia River
Reed Island
Redtail Lake
Port Unit
Industrial Park
Sewage Treatment Plant
Railroad
Gibbons Creek "Elevated Channel"
WASHOUGAL
14
Flows to the Columbia River
STR_CCP_Units.mxd
Steigerwald Lake National Wildlife Refuge
Wetland Management Units
LEGEND
Approved Refuge Boundary
Acquired Land
Water Control Structure
Dikes with Water Control
UTM ZONE 10N
NAD 83
0 1,250 2,500 5,000 Feet
0 250 500 1,000 Meters
Prepared by: Branch of GIS & Cartography
Region 1, Division of Refuge Planning
911 NE 11th Avenue
Portland, OR 97232-4181
503/231-6221
7/12/04

Pierce National Wildlife Refuge

At Pierce Refuge changes in agricultural practices, refuge activities, and diversions from road and railroad construction have improved several basins capable of maintaining emergent wetland vegetation. Pierce Lake was formed by diking the Grenia Creek outflow, just upstream of Hardy Creek. Both Domestic Springs Pond and Lena's Lake are manmade impoundments fed by spring water. Before human intervention, these locations would have functioned as riverine wetlands influenced largely by localized precipitation and the hydrology imposed by the Columbia River. Despite recent improvements made to the water control features at Domestic Springs Pond and Lena's Lake, little native aquatic vegetation grows in either impoundment, apparently due to excessive water depths. Pierce Lake is relatively shallow and supports a diversity of native emergent vegetation on its shallower benches, and submergent vegetation within the deeper portions of the wetland basin. Improved management strategies within these basins should produce a better emergent community, with benefits to a number of native wildlife species that currently inhabit the refuge. Northwestern salamanders (*Ambystoma gracile*) and western toads (*Bufo boreas*), State candidate species for listing, breed on the refuge in low numbers. These are considered to be some of the last remaining populations of these species still breeding successfully within the Columbia River floodplain. Western pond turtles (*Clemmys marmorata*) are a State-listed endangered species that was introduced to the refuge in 2000, as part of a State-sponsored program to recover its beleaguered population. Productive emergent marshes will provide essential cover and food for these species.

Pierce Lake

Description

Pierce Lake was created when a dike and water control structure were built across Grenia Creek in 1994 to replace an earlier structure that had washed out prior to establishment of the refuge. Grenia Creek, springs, and precipitation feed the lake, which is managed as a semi-permanent wetland. Periodically, the lake is drawn down in summer to remove invasive species, including carp, bullheads, and bullfrog tadpoles. Most of the lakebed when drawn down consisted of mudflats with very little submergent vegetation, however submergent vegetation apears to have recovered since carp removal was initiated. At full pool, the surface acreage of the lake is about 11 acres. Table WMG-5 depicts additional wetland surface areas relative to the depth of Pierce Lake.

Management Recommendations

Throughout the year, maintain screens on the water control structure to prevent undesired warm water fish species from entering the lake during backwater flood events. Screens will require frequent inspection and cleaning to prevent debris from building up. Install boards at 4.5 feet on the gauge by October 15. Between April 1 and July 1, maintain boards at 5.0 feet to 5.5 feet. After June 20, commence a slow draw-down to 2.8 feet to 3.0 feet. Maintain this level through the summer unless management actions necessitate additional draw-down. Water levels in excess of 5.5 feet will flood most traditional painted turtle nesting sites based on 2002 nesting

data. Currently, the wetland is on an odd year drawdown cycle for control of invasive fish and amphibians; draw downs have occurred in 1999, 2001, and 2003. These draw-downs may be an opportune time to spot treat reed canarygrass with herbicide and disking.

Table WMG-5. Pierce Lake on Pierce Refuge; Approximate Potential Surface Areas.

Gauge Reading (feet*)	Surface Area (acres)	Comments
0	0	Approximate bottom
1	2.0	
2	5.1	Elevation less than 2.5feet exposes island to north
3	8.6	
4	9.8	
5	10.9	

* Gauge readings are set to the approximate bottom of Pierce Lake and not relative to sea level or other standardized datum.

South Pierce Pond

Description

South Pierce Pond appears to have been a high-flow side channel of Grenia Creek which coursed through Oregon ash gallery forest, before emptying back into Grenia Creek (now Pierce Lake). This side channel was subsequently cut-off due to construction of a gravel road along the east side of the refuge. Currently, when Grenia Creek reaches approximately 40 feet above msl, excess water enters an open culvert under this road and drains to the southwest into a wetland basin (now called South Pierce Pond) with a bottom elevation of approximately 20 feet msl. South Pierce Pond is filled with accumulated precipitation, localized run-off, overflow from Grenia Creek, and backflows from Pierce Lake. Water levels exceeding 4.5 feet in Pierce Lake start to fill South Pierce Pond through a connecting channel. In June 2000 a water control structure was installed between Pierce Lake and South Pierce Pond for improved water management capability. Water levels during the winter have been held in South Pierce Pond at approximately 5.5 feet. Table WMG-6 depicts additional wetland surface areas relative to the depth of South Pierce Pond.

Management Recommendations

South Pierce Pond should be managed at elevations above that of Pierce Lake, as operational levels of Pierce Lake are insufficient to maintain adequate water in the pond. Pierce Lake is subject to erratic fluctuations from clogged screens and backwater flood events that loosen boards. For these reasons, it is advisable to isolate South Pierce Pond from Pierce Lake for

much of the season. Back flow from Pierce Lake should be allowed to fill the pond when appropriate water conditions exist. Pierce Lake may occasionally overtop the boards but the pond will retreat to 5.5 feet when the Pierce Lake drops. Allow South Pierce Pond to elevate to 5.5 feet in the spring with Pierce Lake. No active draw down is advised for South Pierce Pond. Allow South Pierce Pond to slowly dissipate through summer. This prolonged hydroperiod will facilitate development of western toads known to breed within the basin.

Table WMG-6. South Pierce Pond on Pierce Refuge; Approximate Potential Surface Areas.

Gauge Reading (feet*)	Max. Water Depth (feet)	Surface Area (acres)	Comments
4.48	0	0	Approximate bottom
5.48	1	1.3	1.7 feet of water needed to connect upper and lower pools
6.48	2	3.7	

* Gauge readings are set to the approximate bottom of Pierce Lake and not relative to sea level or other standardized datum.

Domestic Springs Pond

Description

In 1999, a dike and water control structure were installed at the outlet of a small pond fed by year-round flows from Domestic Springs. This structure replaced a small berm and water control structure that were destroyed during the floods of 1996 to 1997. This spring previously flowed downstream into Hardy Creek. The resulting dike created a small semi-permanent wetland, now called Domestic Springs Pond. Water levels during winter 2001 (October through June) were targeted for 8.0 feet to 8.5 feet, however, ranged 7.10 feet to over 10 feet. The upper benches of this wetland are dominated by reed canarygrass, and have been mowed on several occasions in past years during summer draw downs, both to provide weed control and provide winter goose browse. This wetland is relatively deep and does not support emergent vegetation except along the shoreline. At managed pool levels, this wetland encompasses about 3 acres. Table WMG-7 depicts additional wetland surface areas relative to the depth of Domestic Springs Pond.

Management Recommendations

The target water elevation range for Domestic Springs Pond from October to April 1 is 7.0 feet to 7.5 feet. After April 1 levels should be elevated from 8.0 feet to 8.5 feet into June. This depth inundates a significant portion of the upper benches for emergent vegetation. After June 20 levels should be slowly (one or two boards removed weekly) reduced between 5.0 feet to 5.5 feet. With a perennial water source this wetland will maintain depths at the board elevation throughout the summer months.

Table WMG-7. Domestic Springs Pond on Pierce Refuge; Approximate Potential Surface Areas.

Gauge Reading (feet)	Max. Water Depth (feet)	Surface Area (acres)	Comments
0	~ 0	0	Approximate bottom
1.5	~1.5	0.2	
3.5	~3.5	0.6	
5.5	~5.5	1.5	
7.5	~7.5	2.9	Areas not surveyed beyond 7.5 feet

* Gauge readings are set to the approximate bottom of Domestic Springs Pond and not relative to sea level or other standardized datum.

Lena's Lake

Description

Lena's Lake was created prior to the refuge's establishment by the damming of a small unnamed stream that enters the refuge through a culvert under the railroad. When the original dam washed out, the dike was rebuilt and a new water control structure was installed in 1999. The integrity of the dike is questionable, as sinkholes have developed within the dike since its construction. As installed, the water control structure that drains the wetland is approximately 3.2 feet above the lake bottom. This limits options for wetland management and does not allow the complete draw down of the lake. The basin cannot be dried up for control of invasive species such as carp and bullfrog tadpoles. Currently, the 1.6-acre basin is managed as a semi-permanent wetland, however excessive water depths, carp, and heavy sediment loads may impose limitations to emergent and submergent vegetation growth. Table WMG-8 depicts additional wetland surface areas relative to the depth of Lena's Lake.

Management Recommendations

Utilizing the maps recently generated by the COE of Lena's Lake, the water gauge should be reset to either mean sea level or to the bottom of the basin. The current gauge is not set to any relevant reference point. The interim management strategy is to maintain a permanent wetland pool while seasonally flooding the upper benches for emergent vegetation. To attain inundation of the higher perched wetlands, a significant amount of water may be periodically impounded. During the winter and spring when water is impounded and soil saturation is high, monitoring of water levels, water control structure function, and dike condition will be required to ensure dike integrity. Target gauge elevation from October to April 1 is 4.50 feet to 4.70 feet. This level needs to be monitored to ensure that it covers the bench on the southeast side of the wetland by greater than six inches. Water levels should be elevated after April 1 to between 5.0 feet and 5.2 feet or to achieve twelve to sixteen inches of water depth on the southeast bench. After June 20 slowly draw wetland down to a gauge reading of between 2.00 feet and 2.50 feet.

During future planning, it is recommended that refuge staff review options for decreasing the depth of Lena's Lake. Due to its current target water depths and the depth of fine silts, the lake is incapable of supporting aquatic vegetation or a diversity of wildlife. Reducing water depths and increasing the overall structural diversity of the lake would significantly improve the productivity of the wetland.

Table WMG-7. Domestic Springs Pond on Pierce Refuge; Approximate Potential Surface Areas.

Gauge Reading (feet*)	Max. Water Depth (feet)	Surface Area (acres)	Comments
na	0	0	below gauge below bottom of water control structure
na	1	0.1	below gauge below bottom of water control structure
na	2	0.3	below gauge below bottom of water control structure
na	3	0.7	below gauge below bottom of water control structure
1.32	4	0.8	gauge reading of 0.52 is bottom of water control structure
2.32	5	1.0	
3.32	6	1.1	

* Gauge is set to approximate bottom of water control structure. Bottom of structure is actually a gauge reading of 0.52 feet. Bottom of wetland is ~3.2 feet below the bottom of water control structure. This would be a gauge reading of -2.68 if the gauge extended to the wetland bottom.