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TRIP REPORT
FIELD EVALUATION
AND
RECOMMENDATIONS

ALLAN LAKE WETLAND RESTORATION
USDA Coconino National Forest

Prepared for:
Arizona Department of Game and Fish
February 2004

Allan Lake lies in the Coconino National Forest just south of Mormon Lake in northern Arizona (Figure 1). The lake is located at an elevation of approximately 7,450 feet within an extensive Ponderosa pine forest. The area was not a lake in the traditional sense but instead a broad, shallow, depressional ephemeral wetland or wet meadow supporting native wetland vegetation within a small closed basin of approximately 1.5 square miles. The wetland was excavated using explosives to create nesting islands. However, the excavated channels failed to hold water and subsequently lowered the ground water table. As a result, the wetland has evolved back to upland grasses. Later efforts to seal the excavations using bentonite were unsuccessful.

The Arizona Department of Game and Fish (AZGF) wishes to restore the seasonal wetland system including the native wetland vegetation. As part of the alternative assessment the AZGF prefers to keep the existing pond. A field survey of the site was conducted on November 4, 2003 by Stephanie Yard of Natural Channel Design, Inc. (NCD) and Rick Miller of the AZGF. Three cross-sections were surveyed along with the elevations of several random points. Aerial photographs were taken of the site in October 2003. This information was used to augment historical information in an evaluation of the existing condition of the site. This document describes the initial evaluation and preliminary recommendations for meeting AZGF goals.

Numerous wet meadow/depressional wetlands throughout the Anderson Mesa were dynamited and have similar lack of function. The AZGF hopes to demonstrate successful restoration practices on Allan Lake and the opportunity exists to restore many others. This restoration approach may be pertinent to the current USFS Anderson Mesa Landscape Scale Assessment and other studies underway.

BACKGROUND

Ephemeral (seasonal) wetlands or wet meadows are relatively common within the Coconino National Forest north of the Mogollon Rim. These wetlands formed when volcanic silts and clays sealed the bottoms of small open and closed basins. Due to the impervious soils, ground water levels remain relatively high in these systems throughout the year. During and immediately following the wet seasons of spring snowmelt and late summer/fall monsoonal rains the basins would often contain shallow surface waters. Over the following months, evapotranspiration slowly reduce water levels. Much of the year no open water may be present but soil moisture levels remain high sustaining a vigorous community of native wetland plants. These species have adapted to flourish in a wide range of soil moisture conditions from inundation to extended periods of drought.

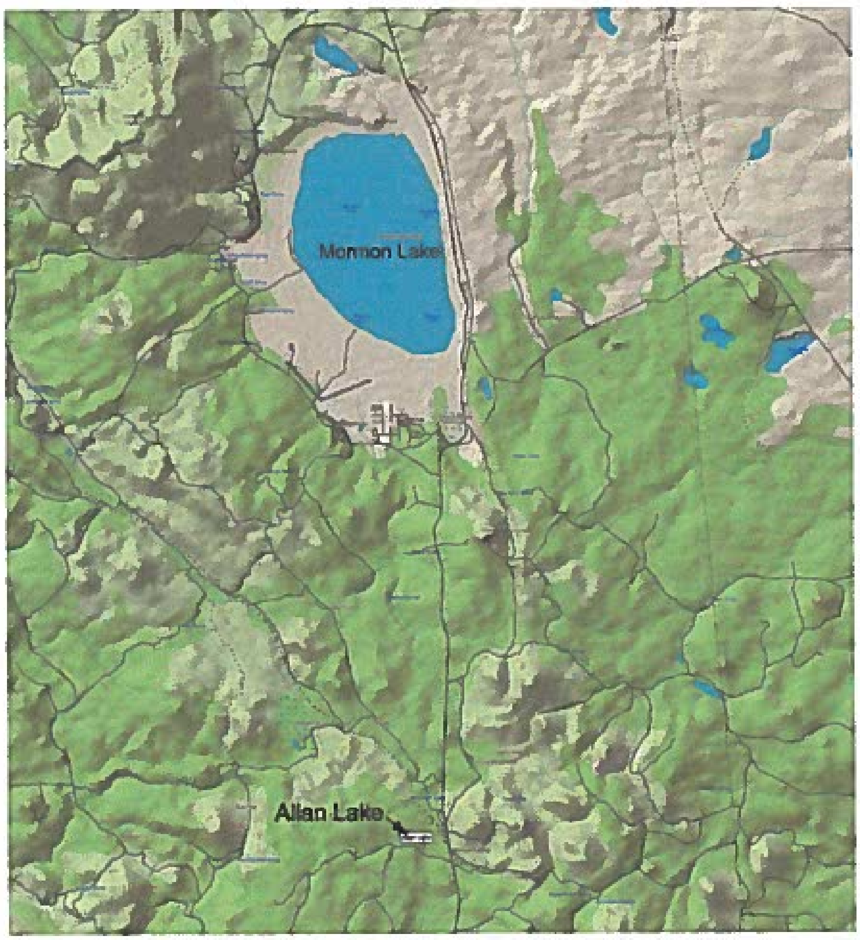

Figure 1. Location Map – Allan Lake.

Mormon Lake, Lake Mary, Rogers Lake, and Dry Lake are larger and better-known examples of these wetlands (Figure 2). A significant ephemeral wetland complex can be found on Anderson Mesa to the east of Allan Lake.

Figure 2. Lake Mary wet meadow. Photo taken in May 2003 (NCD).

Plant production is very high with biomass production as much as twenty-five times that of adjacent lands (Zeedyk 1995). Due to the regional hydrologic cycle, production of the wetland plants was most vigorous in the late spring and the late fall. The fact that these times coincide with the migration cycle of many birds lead some experts to believe these areas provided critical food and energy during migrations. Depressional wetlands of the arid and semi-arid southwest provide important habitat for wintering and migrating wetland birds and some amphibians, and they can provide for the replenishment of soil and ground water (USDA-NRCS 1997).

However, water has been an equally important resource for humans in the area. Because of their natural ability to collect water, many of these wetlands have been altered by the construction of cattle tanks and other structures designed to create greater volumes of open surface water and nesting islands. In many cases, this resulted in the creation of deeper excavations thereby concentrating the water in a smaller area of the basin and reducing the extent and vegetation composition of the original wetland.

EXISTING CONDITION

Allan Lake was originally an ephemeral wetland within a small closed basin. During the late1800's a logging camp was established adjacent to the Lake and a pond was dug to provide water. In 1986 explosives were used to excavate a series of canals in the rough shape of a wagon wheel (Figure 3). The figure is nearly 600 to 800 feet in diameter. Individual channels are approximately 30 feet wide and 5 to 6 feet deep (Figure 4).

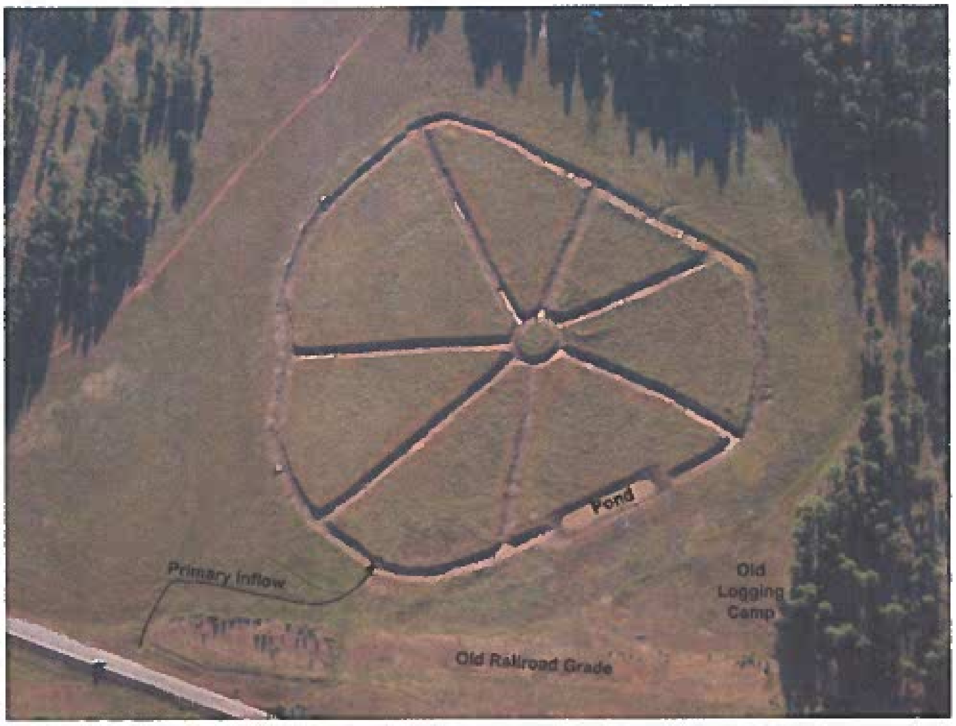

Figure 3. Allan Lake aerial view. Original logging camp pond is in the lower right part of the "wheel". Photo taken in October 2003 (NCD).

Figure 4. Allan Lake excavated channel.
Note the lack of moisture and vegetation in the channel sides & bottom.
Photo taken in November 2004 (NCD).

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The logic of the shape of the excavation is not known but the feature was almost certainly excavated to create nesting islands and increase open surface water. In that objective it failed, as the excavated channels no longer hold water for any appreciable time. As a result, the ground water table is commonly 5 to 6 feet or more below the basin/meadow floor. Lateral moisture movement by capillary action is restricted by the channel network. Wetland vegetation can no longer reach the common ground water depth and upland grass species have replaced them.

CONCLUSIONS

Two mechanisms have been put forward to explain the failure of the impervious soils.

1) Excavations may have penetrated the thin clays that sealed the basin. Once broken, the basin floor can no longer hold water. An attempt to reseal the channels using bentonite was unsuccessful.
2) Explosives used to blast/excavate the channels may have fractured the impervious bottom allowing water to soak through. The fact that the original pond, dug by hand over a century ago still holds water despite its greater depth lends credence to this possibility.

To achieve the project objectives of restoring the wetland and increasing wetland vegetation, a means must be found to successfully maintain higher water levels.

Critical components for restoration of Allan Lake ephemeral wetland include:

- Restore Natural Water Depths: The ground water table needs to be elevated to the historic condition for wetland vegetation to be re-established. This requires filling the excavated channels to a higher elevation.

- Reduce Seepage Loss: Plans for reducing seepage losses by sealing the basin bottom should be part of the design components. The problem of reducing seepage losses is one of reducing the permeability of the soils to a point where the losses become tolerable. The failure of previous efforts using bentonite makes a simple sealing of the existing channels difficult. Filling the excavated channels in compacted layers and using chemical additives for sealing may be used to decrease seepage.

- Restore Native Wetland Plants: Typical vegetation expected in a wet meadow habitat is wetland obligate and facultative grasses, grass-like plants and forbs, and scattered upland plants. Typical vegetation in a playa habitat is submergent and emergent wetland obligates (cattail, rushes, bulrush, pondweeds). It is assumed that the wetland seed bank exists and that natural colonization will take place. A critical factor regarding vegetation is stable slopes. There is a direct relationship between slope gradient, slope stability, and plant species growth and survival. The existing sideslopes of the excavated channels have a sideslope of 3:1 and are too steep to maintain vegetation (see Table 1 for Slope Analysis). In addition the soils are loose and disturbed during freeze-thaw cycle.

Table 1. Slope Analysis.

Channel banks:	3:1	unvegetated
Pond banks	5:1	unvegetated
Railroad Grade:	10:1	vegetated (grasses)
Historic wetland:	100:1	vegetated (wetland plants)

ALTERNATIVES

1. Do Nothing: The old logging pond would continue to hold water and the excavated channels will continue to have excessive seepage losses. The vegetation in the basin would remain upland grass species. Existing channels are shown in Figure 5 Cross-Section and Figure 6 Estimated Water Table.

2. Completely fill existing channels: The old logging pond would remain. All channels would be filled back to the basin floor elevation. Total earthwork volume is about 16,000 cy. Because the explosives blew the channel material to powder (i.e. smithereens) there is not sufficient earthfill available to fill channels back historic elevation. (See historic wetland surface in Figure 5 Cross-Section.)

3. Partially fill existing channels: The old logging pond would remain. All channels would be filled and compacted in layers upto 2.5 to 3 feet above the existing channel elevation. This would create 100 feet wide shallow depressions (around 2 feet deep). Total earthwork volume is about 9,500 cy. Earthfill would be available from the widening of the channels. The post construction channels are shown Figure 5 and Figure 6. The water table should rise to within 2 feet of the original basin (see Figure 6.) By keeping the existing pond there may be additional seepage loss. A chemical additive (vegetable oil based resinous polymer emulsion) for sealing the shallow depressions may be used.
   ****RECOMMENDED ALTERNATIVE****

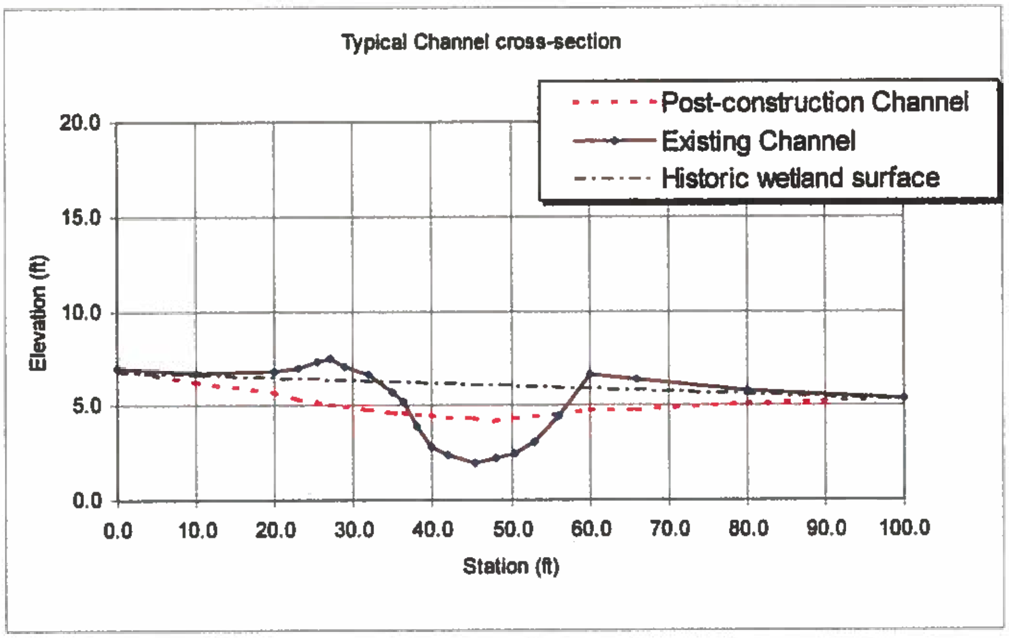

Figure 5. Cross-Section (Showing existing, historic wetland surface, and proposed partially filled channel)

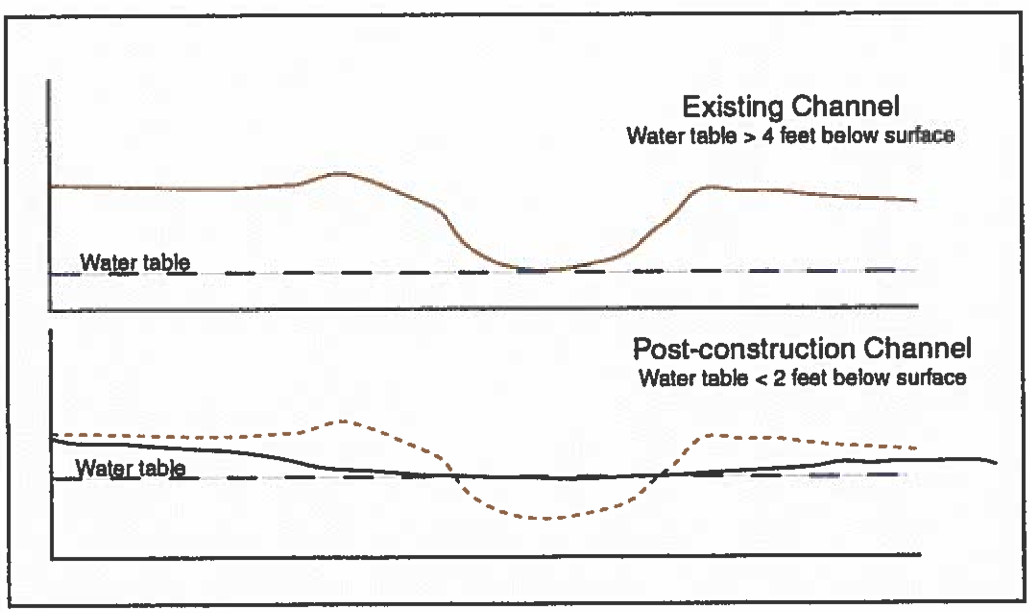

Figure 6. Estimated Water Table
(existing channel and post-construction channel)

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MONITORING

Understanding ground water elevations and movement is essential to the success of the project. Therefore a monitoring program should be developed and implemented to document and evaluate seasonal ground water elevations.

REFERENCES

U.S. Department of Agriculture, Natural Resources Conservation Service. 1997. Wetland Restoration, Enhancement, or Creation. Engineering Field Handbook – Chapter 13.

Zeedyk, William D. 1995. Managing Roads for wet meadow ecosystem recovery. USDA Forest Service FHWA-FLP-96-016.

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ALLAN LAKE WETLAND RESTORATION

DEMONSTRATION PROJECT

The success of any restoration is dependent on the ability to effectively restore pre-excavation hydrology. If the natural impermeability of the wetland cannot be restored, the area will continue to support grassland species rather than a wetland plant community. Therefore we suggest a pilot project be implemented to first to evaluate the restoration techniques.

It is recommended that several of the upslope channels adjacent the pond be filled. This would serve as a demonstration to the final success of restoring the entire wetland. Using these select channels will still allow inflow into the pond. See Figures 7 and 8 for the conceptual design of areas treated.

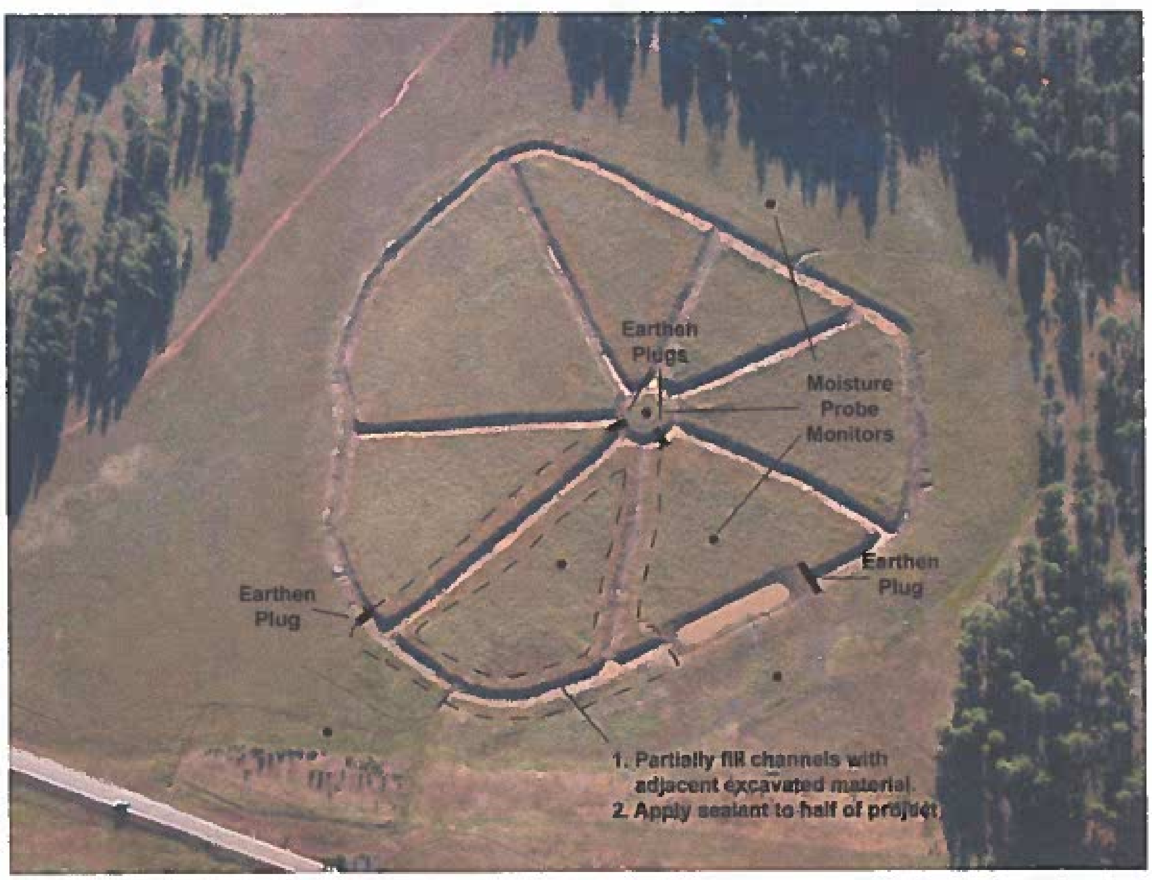

Figure 7. Plan View of Demonstration Project

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1. Isolate section by plugging channels as shown in Figure 7.

2. Partially fill designated channels as shown in Figures 7 and 8.

   The bottom of the channel shall be thoroughly scarified before placement of fill material. The surface shall have moisture added or it shall be compacted and bonded to the foundation. The fill material shall contain sufficient moisture such that a sample taken in the hand and squeezed shall remain intact when released. Material that is too dry shall have water added and mixed until the requirement is met.
   Fill should be brought up in horizontal layers not to exceed:
   - Six (6) inches of loose fill for wheel compaction or
   - Eight (8) inches of loose fill for sheepsfoot roller or
   - Three (3) inches of loose fill for dozer compaction

3. Apply sealant to half of the treatment area per manufacturer's recommendations (see Figure 7 and attached technical data). The soil shall be treated with the sealant material and compacted in lifts.

4. Revegetate with native wetland vegetation.

5. Install moisture probe monitors as shown in Figure 7 to determine change in the hydrologic system.

6. If the pilot project is successful in demonstrating success in restoring the wetland hydrology then the remaining excavated channels could be treated. At that time planting of native wetland obligates will accelerate the restoration.

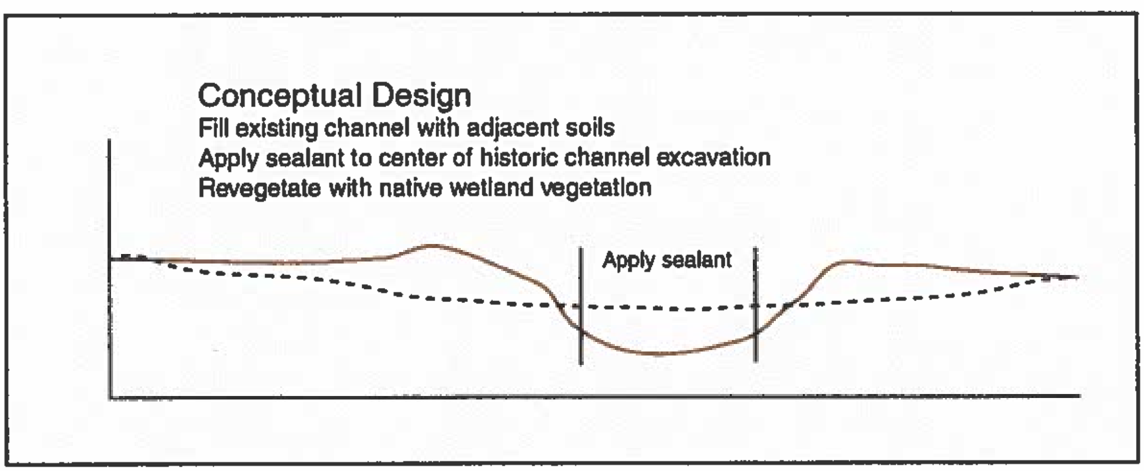

Figure 8. Cross-section of Demonstration Project

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TECHNICAL DESIGN DATA

Existing channel depth:	4.5 feet
Post-construction channel depth:	2.0 feet
Proposed channel treatment length:	1600 feet
Disturbed Treatment Area:	4.0 acres
Earthwork volumes:	2700 cubic yards
Sealant area:	0.5 acres

CONSTRUCTION COSTS

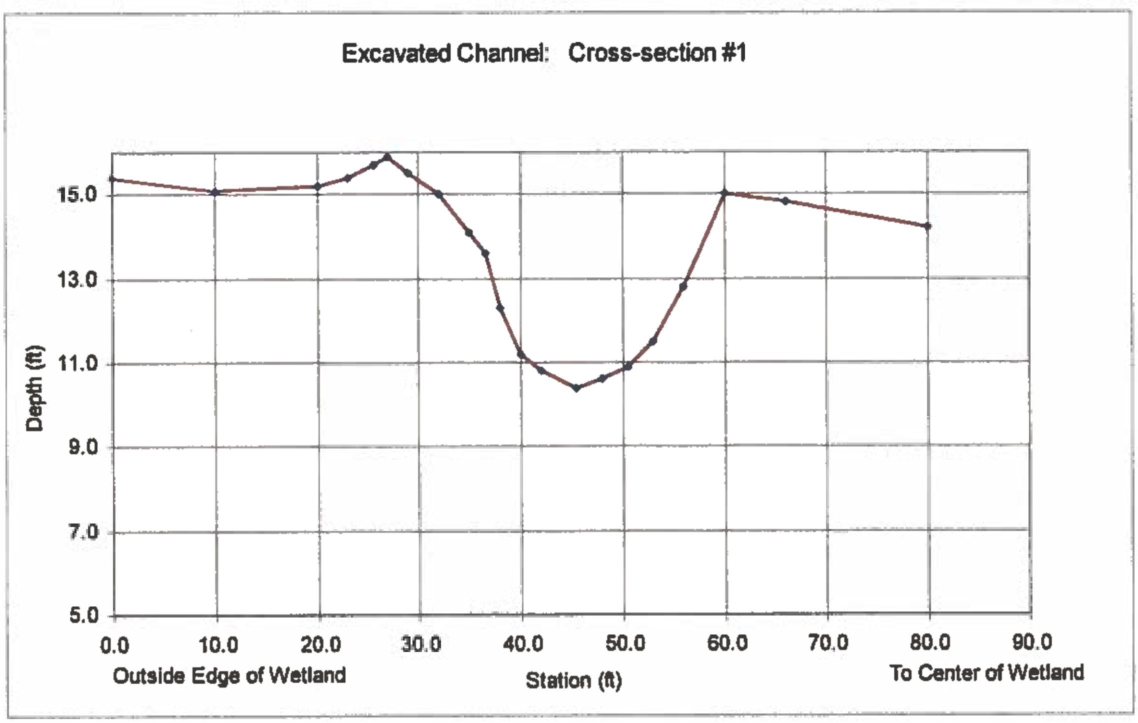
Earthwork:	$ 6,000
Sealant:	$ 3,500

Additional costs include permitting, construction supervision, and monitoring.

NOTES

- Estimated construction time is one week.
- This area may be a jurisdictional wetland under Section 404 of the Clean Water Act. If so permits must be obtained from the Army Corps of Engineers prior to any earthwork.

ATTACHMENTS (Survey Data)



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